Workshop Manual

Industriemotoren - Industrial Engines 2009 ►

Workshop Manual for Diesel Engine (2.0 l/ 36-75 kW_EA 189)

Edition 05.2015

Engine code	CJDA	CJDD	CPYA	CPYB	CPYC	CPYD	CPYE		

Repair Group overview for workshop manual
Industriemotoren - Industrial Engines 2009 ►

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When filing a Technical Bulletin, enter the bulletin number in the column adjacent to the Repair Group. When using the Maintenance Manual you can then see at a glance whether Technical Bulletins have been published which refer to the Repair Group you are looking for.

Repair Group	Technical Bulletins					
00 Technical data						
01 Vehicle self-diagnosis						
10 Removing and installing engine						
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Technical information should always be available to the foremen and mechanics, because their careful and constant adherence to the instructions is essential to ensure vehicle road-worthiness and safety. In addition, the normal basic safety precautions for working on motor vehicles must, as a matter of course, be observed.

Contents

00 - Technical data

1 Description of symbols

⚠ ***WARNING***

Sections with this symbol provide information concerning your safety as well as information on how to avoid the risk of severe and fatal injuries.

Sections with a "Warning" symbol are particularly critical. Make sure to "always" read these sections.

ⓘ ***Caution***

Sections with this symbol provide information on how to avoid damage to the engine.

If information with a "Caution" symbol is not adhered to, damage to the engine may result (e.g. "Make sure to switch off the ignition before connecting the battery, because otherwise the engine control unit may be damaged").

ⓘ ***Note***

- *Sections with this symbol contain additional, useful information.*
- *A "Notice" symbol refers to special additional details about the repair measure and information associated with it.*

2 Important notes for repair work on the engine

ⓘ ***Note***

- *The procedures described in this workshop manual must only be carried out by personnel which has undergone the appropriate training conducted by Volkswagen. If you have not undergone the appropriate training or if you are not sufficiently qualified, have a qualified workshop perform any repair work.*
- *Some of the repair work must be carried out in a Volkswagen dealership only. The relevant chapters are identified by a respective note. Always have these repairs performed by a Volkswagen dealership.*
- *If these instructions are not adhered to and damage results, Volkswagen is exempt from any liability and warranty claims.*
- *Before performing repair work on the engine that could well be covered by the comprehensive warranty, seek advice from a qualified workshop.*

Note

- *Incorrect parts or improperly performed repair work can cause serious damage to the engine and its systems. They can also bring about expensive repair measures to rectify the damage, and the warranty cover could be impaired as a result.*
- *Any structural modifications to engine and the related electric components is not permitted.*
- *Only use servicing materials and replacement parts which comply with the technical requirements specified by Volkswagen.*
- *Please note that when using replacement parts and accessories which were not supplied by Volkswagen, the specified characteristics of the machine und thus the safety may be impaired.*
- *Before performing repair work on a vehicle/machine, make sure that all necessary tools and replacement parts are ready to hand. Read all instructions and descriptions carefully and heed all “CAUTION” texts. Observe the repair instructions without omitting any steps. Always use the tools and equipment described in the manual that comply with Volkswagen specifications. The use of makeshift tools, wrong components as well as proceeding in the wrong way results in improper repair work.*
- *Part numbers stated in this manual serve purely as a reference. Always check these part numbers with the parts department of a qualified workshop to make sure that they reflect the latest information.*
- *Exercise due care and attention with regard to your environment. Before draining engine oil, for example, make sure that it can be collected and disposed of in the correct manner. Under no circumstances must service fluids be disposed of or allowed to seep in the ground, in the sewage/drainage system, in a river, stream, pond or lake. If there are any queries, contact the person responsible for environmental protection in your company or local or district council office.*
- *For technical reasons it is possible that several cross references are not directed to the correct chapter. In this case select the procedure manually in the information.*

2.1 General safety notes

⚠ ***WARNING***

Proceed with particular care when working on the vehicle/machine. Adhere to the general safety regulations as well as your good judgment. Never take the risk of being injured.

If you do not have the specialist skills required for the work described in this manual, we strongly recommend that you have the work performed exclusively in a qualified workshop. This recommendation also applies in cases where individuals and workshops are not equipped with the necessary tools and equipment.

Adhere to the safety regulation for workshops. Always wear safety goggles when using tools or working with acid. In addition, always wear safety goggles, protective gloves and suitable protective clothing when working with hazardous material.

Never perform any work on a vehicle/machine if you are not feeling well. If you are tired and exhausted, there is a higher risk to injure yourself or others. In addition, some medicine or pharmaceutical products may impair your concentration and reactivity.

Make sure to illuminate your work environment properly and safely. Use a portable safety lamp when working inside or below the vehicle/machine. Also make sure that the bulb is properly shielded. The hot filament of a damaged bulb may cause spilled fuel or oil to be ignited and thus cause fire and burns.

Never reuse any used securing and fastening elements. Most of the securing and fastening elements are designed for single use. If they are reused they are unreliable and may fail. Accidents and severe injuries may result. The following securing and fastening elements must not be reused:

- ***Self-locking nuts***
- ***Pins***
- ***Washers***
- ***Retaining clips***
- ***Cotter pins***

Follow the recommendations given in the respective workshop manual. Always replace these securing and fastening elements by new parts. Also renew any securing and fastening elements which seem to be due for renewal after a visual check.

⚠ ***WARNING***

During any repair work in the engine or engine compartment there is a risk of scalding, injuries, accidents and fire.

Never start the engine of the vehicle/machine in small or enclosed spaces, which are not sufficiently ventilated. Exhaust emissions contain carbon monoxide (CO) which is a transparent, odourless and lethal gas.

Never leave a vehicle/machine unattended while the engine is running. If a vehicle/machine is left unattended while the engine is running, there is a risk of injuries.

The engine compartment of each vehicle/machine is a hazardous area. Before checking the engine compartment, switch off the engine, pull the ignition key out of the ignition lock, and allow the engine to cool off. Hot engine components may cause burns, if they get in contact with your skin.

Do not open the coolant expansion tank as long as the engine is at operating temperature. The cooling system is pressurised.

⚠ ***WARNING***

When working on the electrical system or the fuel system of the vehicle/machine, always disconnect the negative battery cable from the battery of the vehicle/machine. Never smoke or perform any work near flames or heater units. Fluids in the engine compartment may catch fire. Therefore, keep a functional fire extinguisher at hand.

An fluids, e.g. fuel, oil, brake fluid etc., must always be collected in suitable containers which are identified accordingly. To avoid any risk of poisoning, never use food cans or beverage cans. Other persons may drink from the can.

Always store flammable fluids away from any source of fire to reduce the risk of fire. Always wipe up any spilled service fluids. Also, store and dispose of any used cloths accordingly.

Avoid any contact with servicing materials. If servicing materials got into the eyes, rinse your eyes with clear water and seek advice from a doctor immediately. Always bring the original container when consulting the doctor.

> ⚠ ***WARNING***
>
> ***When working in the engine compartment of a vehicle/ machine using tools or with the engine running, always tie back long hair. Never wear a neck tie, a scarf, a neck lace, loose-fitting clothing, or similar. Said risk factors may get into moving engine components such as the poly V-belt, the alternator and the radiator fan. Severe injuries may result.***
>
> ***Never wear any jewellery when working in the engine compartment using machines or tools. Short-circuits and electric shock may result. In addition, jewellery may cause severe crushing injuries when it gets into rotating parts or under heavy components.***

3 Technical data

Engine number/engine code ⇒ Page 5.

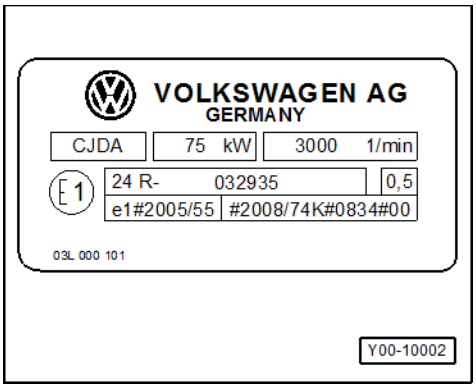
Engine data ⇒ Page 6.

In the event of any queries, claims/complaints and when ordering replacement parts, always indicate the engine designation, engine code and engine number. This helps to avoid any mistakes when dealing with the request.

> ⚠ ***WARNING***
>
> ***Before reading the engine data, switch off the engine, and allow it to cool off.***
>
> ***Read the safety instructions before starting any work on the engine or in the engine compartment. ⇒ Page 1***

3.1 Engine number/engine code

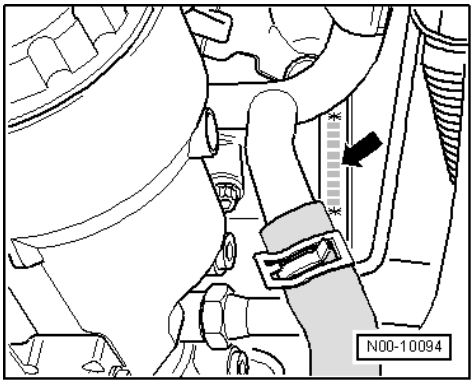
The engine code can be found on the type plate, which is located on the side of the toothed belt guard or on the valve timing housing.



The engine number (“engine code” and “serial number”) can be found at the joint -arrow-.

Additionally there is a sticker on the toothed belt guard with “engine code” and “serial number”.

The engine number consists of up to nine characters (alphanumeric). The first part (maximum 3 characters) makes up the “engine code”, and the second part (6 characters), the “serial number”. If more than 999999 engines with the same engine code are produced, the first of the six characters is replaced with a letter.



3.2 Engine data

Diesel engines in accordance with 97/68 EC, category 3b

Engine codes		CPYA	CPYB
Manufactured		12.11 ►	12.11 ►
Engine designation		TDI 2.0 - 455 MD/MC (CR)	TDI 2.0 - 444 MD/MC (CR)
Engine type		Diesel engine	Diesel engine
Displacement/cylinders	l / number	2.0 / 4	2.0 / 4
Output	kW at rpm	55/2700	44/2700
Torque	Nm at rpm	240/1750	200/1750
Bore	Diameter, mm	81.0	81.0
Stroke	mm	95.5	95.5
Weight (without attachments and diesel particulate filter)	kg	140	140
Compression ratio		16.5	16.5
Fuel	min.	Diesel in accordance with DIN EN 590 with min. 51 CN	Diesel in accordance with DIN EN 590 with min. 51 CN
Firing order		1-3-4-2	1-3-4-2
Injection system		Common rail	Common rail
Emissions fulfil		97/68 EC, category 3b	97/68 EC, category 3b
Particulate filter		yes	yes
Exhaust gas recirculation		yes	yes
Turbocharging/supercharging		yes	yes
Charge air cooler		yes	yes
Upper idling speed	rpm	3400	3400
Lower idling speed	rpm	830 +50/-25	830 +50/-25

Diesel engines in accordance with 97/68 EC, category 3a

Engine codes		CPYC	CPYD
Manufactured		07.09 ►	11.10 ►
Engine designation		TDI 2.0 - 436 MC (CR)	TDI 2.0 - 455 MC (CR)
Engine type		Diesel engine	Diesel engine
Displacement	l	2.0 / 4	2.0 / 4
Output	kW at rpm	36/2700	55/2700
Torque	Nm at rpm	197/1750	240/1750
Bore	Diameter, mm	81.0	81.0
Stroke	mm	95.5	95.5
Weight (without attachments and diesel particulate filter)	kg	140	140
Compression ratio		16.5	16.5
Fuel	min.	Diesel in accordance with DIN EN 590 with min. 51 CN	Diesel in accordance with DIN EN 590 with min. 51 CN
Firing order		1-3-4-2	1-3-4-2
Injection system		Common rail	Common rail
Emissions fulfil		97/68 EC, category 3a	97/68 EC, category 3a
Particulate filter		no	no
Exhaust gas recirculation		yes	yes
Turbocharging/supercharging		yes	yes
Charge air cooler		yes	yes
Upper idling speed	rpm	3400	3400
Lower idling speed	rpm	830 +50/-25	830 +50/-25

Diesel engines in accordance with 97/68 EC, category 3a

Engine codes		CPYE	CPYF
Manufactured		07.09 ►	08.14 ►
Engine designation		TDI 2.0 - 444 MC (CR)	TDI 2.0 - 444 MC (CR)
Engine type		Diesel engine	Diesel engine
Displacement	l	2.0 / 4	2.0 / 4
Output	kW at rpm	44/2700	44/2700
Torque	Nm at rpm	200/1750	200/1750
Bore	Diameter, mm	81.0	81.0
Stroke	mm	95.5	95.5
Weight (without attachments and diesel particulate filter)	kg	140	140

Engine codes		CPYE	CPYF
Compression ratio		16.5	16.5
Fuel	min.	Diesel in accordance with DIN EN 590 with min. 51 CN	Diesel in accordance with DIN EN 590 with min. 51 CN
Firing order		1-3-4-2	1-3-4-2
Injection system		Common rail	Common rail
Emissions fulfil		97/68 EC, category 3a	97/68 EC, category 3a
Particulate filter		no	no
Exhaust gas recirculation		yes	yes
Turbocharging/supercharging		yes	yes
Charge air cooler		yes	no
Upper idling speed	rpm	3400	3400
Lower idling speed	rpm	830 +50/-25	830 +50/-25

Diesel engines in accordance with 97/68 EC, category 3a

Engine codes		CPYG	
Manufactured		08.14 ►	
Engine designation		TDI 2.0 - 436 MC (CR)	
Engine type		Diesel engine	
Displacement	l	2.0 / 4	
Output	kW at rpm	36/2700	
Torque	Nm at rpm	200/1750	
Bore	Diameter, mm	81.0	
Stroke	mm	95.5	
Weight (without attachments and diesel particulate filter)	kg	140	
Compression ratio		16.5	
Fuel	min.	Diesel in accordance with DIN EN 590 with min. 51 CN	
Firing order		1-3-4-2	
Injection system		Common rail	
Emissions fulfil		97/68 EC, category 3a	
Particulate filter		no	
Exhaust gas recirculation		yes	
Turbocharging/supercharging		yes	
Charge air cooler		no	

Engine codes		CPYG	
Upper idling speed	rpm	3400	
Lower idling speed	rpm	830 +50/-25	

Euro 5 diesel engines

Engine codes		CJDA	CJDD
Manufactured		07.09 ►	11.10 ►
Engine designation		TDI 2.0 - 475* NE	TDI 2.0 - 475 NE
Engine type		Diesel engine	Diesel engine
Displacement	l	2.0 / 4	2.0 / 4
Output	kW at rpm	75/3000	75/3500
Torque	Nm at rpm	285/1750	255/1750
Bore	Diameter, mm	81.0	81.0
Stroke	mm	95.5	95.5
Weight (without attachments and diesel particulate filter)	kg	140 kg	140 kg
Compression ratio		16.5	16.5
Fuel	min.	Diesel in accordance with DIN EN 590 with min. 51 CN	Diesel in accordance with DIN EN 590 with min. 51 CN
Firing order		1-3-4-2	1-3-4-2
Injection system		Common rail	Common rail
Emissions fulfil		EC directive Euro 5	EC directive Euro 5
Particulate filter		yes	yes
Exhaust gas recirculation		yes	yes
Turbocharging/supercharging		yes	yes
Charge air cooler		yes	yes

Engine codes		CJDA	CJDD
Upper idling speed	rpm	3400	3900
Lower idling speed	rpm	830 +50/-25	830 +50/-25

4 Service work

WARNING

Adhere to the general safety regulations and the notes on repair work on the engine!⇒ Page 1

Always adhere to the following instructions.

- ***Only use servicing materials and replacement parts which comply with the technical requirements specified by Volkswagen.***
- ***Please note that when using replacement parts and accessories which were not supplied by Volkswagen, the specified characteristics of the machine und thus the safety may be impaired.***
- ***If these instructions are not adhered to and damage results, Volkswagen is exempt from any liability and warranty claims.***

Note

- *If you do not have the specialist skills required for the work described in this manual, we strongly recommend that you have the work performed exclusively in a qualified workshop. This recommendation also applies in cases where individuals and workshops are not equipped with the necessary tools and equipment.*
- *Incorrect parts or improperly performed repair work and settings can cause serious damage to the vehicle/machine and its systems. They can also bring about expensive repair measures to rectify the damage, and the warranty cover could be impaired as a result.*

⇒ "Entries in service history book" on page 10

⇒ "Service intervals" on page 11

⇒ "Scope of interval service" on page 14

4.1 Entries in service history book

If a component is changed which has a change interval prescribed by the manufacturer, e.g. the toothed belt, the new change interval starts after the component has been changed.

- Therefore, it is very important to record every change of such components in the service history book.
- This also applies to components which were changed before the regular change interval.

Note

- *When using “Genuine parts kits” it must be taken into account whether it is technically necessary to change all the components included in the genuine parts kits.*
- *If more components are renewed than is technically necessary, inform the customer before repair!*

4.2 Service intervals

⇒“Countries with high sulphur content in diesel fuel” on page 12

⇒“Severe operating conditions” on page 13

⇒“Extended service intervals” on page 13

The operating hours or time values in this chapter have been determined and specified by Volkswagen. Under normal operating conditions, achieving these service intervals is technically guaranteed.

Note

- *The following prevails if both the operating hours and the elapsed time since the last service are indicated: whichever occurs first.*
- *Depending on the conditions under which the vehicle is used, extra service work must be performed in addition to the interval service, inspection service or interval service inspection.*
- *It is also possible to have additional work done outside the service intervals, with account being taken of the entries in the service history book.*

Note

- *If the intended use of the Volkswagen industrial engine has not been evaluated by means of an engine parameter test, the operating conditions cannot be assessed properly by Volkswagen.*
- *If there is any doubt about the suitability for the respective operating conditions, Volkswagen recommends to double the frequency of service work, i.e. perform the respective service work every 300 operating hours instead of 600 operating hours, every 900 operating hours instead of 1.800 operating hours and so on.*
- *However, in some operating conditions, the frequency of service work must be more than doubled.*

Caution

Only applies to diesel engines:

- ***In some countries, diesel fuel has a high sulphur content.***
- ***The engines with engine codes CPYA and CPYB must not be operated with fuel containing sulphur.***
- ***The high sulphur content leads to excessive wear of cylinders and it considerably reduces the cleanliness of pistons.***
- ◆ ***Therefore, the frequency for service work (change engine oil and fuel filter) must be doubled in countries where diesel has a high sulphur content.***

The service interval is applicable for the engines listed in this chapter starting from the point of commissioning and delivery.

Service intervals / events: CJDA, CJDD, CPYA, CPYB, CPYC, CPYD, CPYE, CPYF, CPYG		
All engines		
Service type Engine code/PR No./ Remarks	**Service events**	**Intervals**
Diesel engines which are operated with fuel with a high sulphur content ● Countries with high sulphur content in fuel ⇒ Page 12	Change engine oil	Every 300 operating hours / 1 year: whichever occurs first
Engines operated under normal operating conditions ⇒ Page 14	Interval service	Every 600 operating hours / 1 year: whichever occurs first
Engines operated under severe operating conditions ⇒ Page 13	Interval service	< 600 hours / < 1 year depending on operating conditions, double the frequency as necessary.
Extended service intervals ⇒ Page 13	Interval service	Only upon written approval from your Volkswagen representative.

4.2.1 Countries with high sulphur content in diesel fuel

Note

The engines with engine codes CPYA and CPYB must not be operated with fuel containing sulphur.

Caution

In the markets listed below, TDI engines require an oil change service "every 300 operating hours".

Countries with high sulphur content in diesel fuel			
Egypt	Jamaica	Morocco	Saudi Arabia
Armenia	Jordan	Mauritius	Zimbabwe

Countries with high sulphur content in diesel fuel			
Bahrain	Serbia, Montenegro, Vojvodina, Kosovo	Macedonia	Sri Lanka
Bangladesh	Cambodia	Moldova	South Africa
Chile	Kazakhstan	Mozambique	Suriname
Dominican Republic	Kenya	Myanmar	Tajikistan
El Salvador	Columbia	New Caledonia	Tanzania
Ecuador	Cuba	Nigeria	Turkey
Ghana	Kuwait	Oman	Uruguay
Guatemala	Lebanon	Pakistan	Uzbekistan
Honduras	Madagascar	Panama	Venezuela
Indonesia	Malawi	Papua New Guinea	United Arab Emirates
Iraq	Malaysia	Peru	Vietnam
Iran	Mali	Russia (East and West)	

4.2.2 Severe operating conditions

If the vehicle is used under severe operating conditions some repair work will have to be performed before the next interval service due or at shorter service intervals.

This is applicable in particular for the air filter, toothed belt, fuel filter, diesel particulate filter and engine oil.

The following are severe operating conditions:

- Deviation from notes on operation
- Fuel containing sulphur ⇒Page 12
- Regular operation in areas with high levels of dust
- Use of engine in areas with extremely low temperatures over a long period
- Continuous operation of engine
- Frequent “stop-and-go” operation

4.2.3 Extended service intervals

The service intervals may be extended.

If you want to extend the service intervals, contact your Volkswagen representative.

Note

- *Extended service intervals allow for reducing the maintenance costs.*
- *To ensure a proper service life of the engine, several tests must be completed successfully by the machine manufacturer.*

4.3 Scope of interval service

⇒“General scopes of service” on page 14

⇒“Additional work” on page 16

⇒“Scopes of service for gas systems” on page 17

The following chapter contains the service tables with the service specifications of the Volkswagen brand.

4.3.1 General scopes of service

Note

- *Unless otherwise agreed, the general scopes of service apply.*
- *In this case, the engine oil must be changed every 600 operating hours or after 1 year ⇒Page 11.*
- *Volkswagen recommends to double the frequency of service work according to the operating conditions ⇒Page 11, i.e. perform the respective service work every 300 operating hours instead of 600 operating hours, every 900 operating hours instead of 1.800 operating hours and so on.*

Scopes of service

Service type Engine code/PR No./ Remarks	Scopes of service	Page
◆ Interval service ◆ Applicable for all engine codes Every 600 operating hours / 1 year whichever occurs first	◆ Vehicle self-diagnosis: read event memory of all systems	⇒ Page 26
	◆ Change engine oil, renew engine oil filter [1)]	⇒ Page 244
	◆ Perform visual check on engine and components in engine compartment for leaks and damage	⇒ Page 18
	◆ Check coolant level and anti-freeze protection, if necessary, replenish coolant or coolant additive	⇒ Page 280
	◆ Perform road test to test engine	⇒ Page 18
	◆ Check condition of poly V-belt, and renew as necessary	⇒ Page 143 ⇒ Page 141
	The add-on parts on the engine peripherals are subject to specific service intervals. Always adhere to the specifications of the respective manufacturer. Such peripheral add-on parts may include the following: ◆ Perform visual check on radiator, radiator fan and cooling fins for leaks and soiling on the outside ◆ Check exhaust system for leaks, damage and whether it is secured firmly ◆ Renew air filter ◆ Check hoses/clamps, and renew as necessary ◆ Check air lines for leaks, and renew as necessary	⇒ Refer to documentation of respective manufacturer ⇒ Page 19

1) Applicable for diesel engines only: in some countries the sulphur content in diesel fuel exceeds 2000 ppm. The high sulphur content leads to excessive wear of cylinders and it considerably reduces the cleanliness of pistons. Therefore, the frequency for service work (change engine oil and fuel filter) must be doubled in countries where diesel has a high sulphur content. Your importer will inform you about countries with elevated sulphur content in diesel fuel.

Note

- *The add-on parts on the engine peripherals are subject to specific service intervals.*
- *Perform any service work and interval services in accordance with the specifications of the respective manufacturer.*

4.3.2 Additional work

Depending on the conditions under which the vehicle is used ⇒Page 13, extra service work must be performed.

It is also possible to have additional work done outside the service intervals, with account being taken of the entries in the service history book.

As necessary

Additional work	Engine code	Page
– “Drain water” from fuel filter	CPYA CPYB CPYC CPYD CPYE CPYF CPYG	⇒Page 307

Every 600 operating hours

Additional work	Engine code	Page
– Renew fuel filter [1]: ◆ Diesel conforming to EN 590 ◆ Diesel not conforming to EN 590	CPYA CPYB CPYC CPYD CPYE CPYF CPYG CJDA CJDD	⇒Page 308
– Perform service work on diesel particulate filter	CPYA CPYB CPYC CPYD CPYE CPYF CPYG	⇒Page 454

[1] Applicable for diesel engines only: in some countries the sulphur content in diesel fuel exceeds 2000 ppm. The high sulphur content leads to excessive wear of cylinders and it considerably reduces the cleanliness of pistons. Therefore, the frequency for service work (change engine oil and fuel filter) must be doubled in countries where diesel has a high sulphur content. Your importer will inform you about countries with elevated sulphur content in diesel fuel.

Every 2,400 operating hours

Additional work	Engine code	Page
– Renew toothed belt	CJDA CJDD CPYA CPYB CPYC CPYD CPYE CPYF CPYG	⇒Page 210

Every 4,800 operating hours

Additional work	Engine code	Page
– Renew coolant – Renew coolant pump	CJDA CJDD CPYA CPYB CPYC CPYD CPYE CPYF CPYG	⇒Page 284⇒Page 287

Every 9,600 operating hours or depending on loading (500 ml)

Additional work	Engine code	Page
– Renew diesel oxidising catalytic converter (depending on ash deposit mass) – Renew diesel particulate filter (depending on ash deposit mass)	CPYA CPYB CPYC CPYD CPYE CPYF CPYG CJDA CJDD	⇒Page 430 ⇒Page 465

As necessary

Additional work	Engine code	Page
– Drain water from fuel filter	CPYA CPYB CPYC CPYD CPYE CPYF CPYG CJDA CJDD	⇒Page 307

Exhaust emissions test

Note

Adhere to the legal requirements.

4.3.3 Scopes of service for gas systems

WARNING

Adhere to the respective legal requirements when performing service work on the gas system. Service work on the gas system must only be performed by qualified personnel.

Note

The applicable service intervals for the gas system must be obtained from the manufacturer of the gas system.

4.4 Descriptions of work, engine, general

In this chapter you will find any scopes of service which cannot be assigned to one of the repair groups. Any other descriptions of work can be found in the relevant repair group. All descriptions of work are cross-referenced in the tables for service work ⇒Page 14 or additional work ⇒Page 16.

WARNING

Adhere to the general safety regulations and the notes on repair work on the engine! ⇒Page 1

4.4.1 Engine and add-on parts in engine compartment (from above and below): perform visual check for leaks and damage

Perform visual check as follows:

– Check engine and components for leaks, damage and whether they are secured firmly.

– Check lines, hoses and connections of:

- exhaust system
- fuel system
- cooling and heating system
- engine oil circuit
- air conditioning system
- intake system and air lines

for leaks, abrasions, porosity, brittleness and soiling.

Note

- *Arrange for defects to be rectified as repair measures.*
- *If the fluid loss is greater than can be expected through normal use, determine the sources, and rectify the defect (repair measure).*

4.4.2 Perform road test

Check the following during a road test:

– Engine: output, misfiring, idling speed, acceleration

– Clutch: pulling away, odours

– Air conditioner compressor: functional check (at low temperatures the operation of the air conditioner compressor must be checked in the workshop)

– Engine: hot start behaviour

– During the road test, accelerate with full throttle at least once to check the high-pressure section of the fuel system for leaks.
– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26.

4.4.3 Add-on parts on the engine peripherals

Note

- *Many of the add-on parts on the engine peripherals are not provided by Volkswagen. However, these components need to be serviced as well. For more information refer to the documentation of the respective manufacturer.*
- *Perform any service work and interval services in accordance with the specifications of the respective manufacturer.*

5 Warranty

Repair work - important information ⇒Page 19.

Warranty terms ⇒Page 19.

5.1 Repair work - important information

Any repair work is performed by a workshop which is certified for servicing your Volkswagen industrial engine. For less complex repair work which can be performed with the engine installed, drive the vehicle to the workshop. If this is not possible, you can request a mechanic to provide assistance.

For complex repair work, provide the removed and cleaned engine to the certified workshop.

The workshop is not obligated to remove and install the industrial engine or to perform any repair work on accessories which have not been provided by the Volkswagen Group.

Due to the high number of possible configurations, not all special components for the industrial motors can be kept in stock in any workshop which is certified for servicing industrial engines. However, all replacement parts are available on short notice in the distribution centres for Volkswagen industrial engines.

5.2 Warranty terms

The purchaser is permitted to transfer the warranty to the subpurchaser including the service history book for the Volkswagen industrial engine under the conditions described below. In this case, the warranty period starts after the engine has been delivered to the subpurchaser.

1 - The vendor warrants that the object of purchase is free of any faults. The state of the art of similar products which are of the same type as the object of purchase serves as a reference for the fault-free condition. The warranty period starts at the day of delivery. The warranty period is 24 months and is limited to 2,000 operating hours. If 2,000 operating hours have already been attained in the first 12 months, the warranty period is 12 months respectively.

2 - Within the warranty period, the purchaser is entitled to have any faults rectified (remediation). The warranty process is as follows:

- The purchaser may assert claims for Volkswagen industrial engines to the vendor or the workshop which is certified by the Volkswagen Group for servicing the object of purchase. The purchaser must report faults in writing to or have faults documented by the workshop to which the claim is to be asserted immediately after a fault has been discovered.
- Any required remedies must be taken immediately by renewing or repairing faulty components, and any efforts which are associated with the remediation are not subject to any charge. This applies in particular for labour and material costs. Any travel and transport costs are exempt from the warranty. Any parts which have been renewed become the property of the vendor. If the remedies require any additional service work prescribed by the Volkswagen Group, the vendor will bear any costs for said service work including the costs for any required material and lubricants.
- The warranty period for any components installed during the remediation ends with the warranty period of the object of purchase as agreed in the contract of purchase.

Note

If the fault cannot be rectified or any more attempts to rectify a fault would not be reasonable anymore from the purchaser's point of view, the purchaser shall be entitled to revoke the contract or to reduce the purchase price.

3 - No claims can be asserted, if:

- the purchaser has not reported a fault or did not have it documented by the workshop.
- the purchaser did not allow for taking remedies immediately although the purchaser has been asked to do so.
- the object of purchase has been handled improperly or has been overloaded, e.g. in a car race.
- the object of purchase has been improperly serviced in a workshop which was readily identifiable a non-certified by the Volkswagen Group for servicing the object of purchase.
- the object of purchase has been fitted with components which are not approved by the Volkswagen Group or the object of purchase has been modified in a way which has not been approved by the Volkswagen Group.

- the purchaser did not adhere to the regulations for handling, servicing and maintaining the object of purchase.

4 - Any regular wear and tear is exempt from the warranty.

5 - If the workshop to which the purchaser has asserted a claim is not able to take the remedies in due time, the purchaser shall be entitled to hold back any pending payments until the remediation has been completed appropriately.

6 - If any agreed features are missing, there is a claim for damages due to a breach of the agreement.

7 - The warranty claims mentioned above become invalid after the warranty period has elapsed in accordance with paragraph 1. If a warranty claim has been asserted within the warranty period but could not be rectified until the warranty period has elapsed, the warranty claim remains valid for the affected fault until it has been rectified. If clause 2 applies, the limitation period ends 3 months after the workshop to which the claim has been asserted has declared to have rectified the fault or that there is no fault.

01 - Vehicle self-diagnosis

1 Vehicle self-diagnosis

Note

The engine control unit -J623- must be coded when the engine is commissioned for the first time.

Features of vehicle self-diagnosis ⇒Page 22.

Technical data of vehicle self-diagnosis ⇒Page 22.

Connect vehicle diagnosis, testing and information system and select Engine control unit ⇒Page 23.

Connect test box to check lines ⇒Page 24.

1.1 Features of vehicle self-diagnosis

The engine control unit -J623- is equipped with a event memory.

If faults occur in the sensors and components being monitored, they will be stored in the event memory together with an indication of the type of fault.

After evaluating the information, the engine control unit decides between different fault codes (see "Fault table" ⇒Page 28) and stores the matching fault code until the event memory is cleared.

Faults which occur only temporarily (sporadically), are displayed with the addendum “sporadic fault” “/SP”. The cause of sporadic faults can be, for example, a loose contact or a brief open circuit. If a sporadic fault does not occur again within 50 engine starts, it will be cleared from the event memory.

If faults affecting the operation of the engine have been detected, the glow plug indicator lamp -K29- and/or the exhaust emissions warning lamp -K83- light up.

The faults stored can be read using the vehicle diagnosis, testing and information system -VAS 5051/B- ⇒Page 23.

The event memory must be cleared after the faults have been rectified.

Note

For general information on the vehicle self-diagnosis refer to the operating manual for the vehicle diagnosis, testing and information system -VAS 5051/B-.

1.2 Technical data of vehicle self-diagnosis

1.2.1 Read version of engine control unit

Connect the vehicle diagnosis, testing and information system -VAS 5051/B-, and select the vehicle system “001-Engine elec-

tronics" to display the control unit identification and the coding ⇒Page 23.

Note

Instead of the vehicle diagnosis, testing and information system other diagnosis systems, such as the DiagRA, may be used as well.

1.2.2 Available diagnosis functions when using the vehicle diagnosis, testing and information system

Note

The prerequisites for selecting the desired diagnosis functions can be determined from the following table.

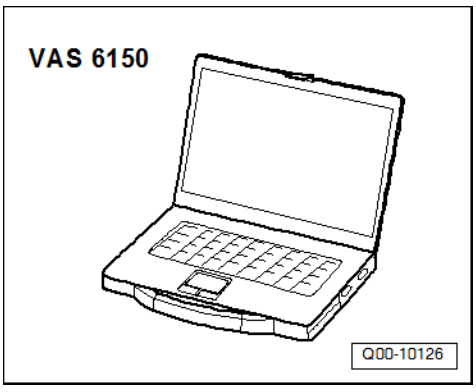
Diagnosis functions	Prerequisite		
	Engine stationary, ignition switched on	Engine running at idling speed	Engine under load
001-Identification (Read control unit version)	yes	yes	yes
004-Contents of event memory	yes *)	yes	yes
03 - Final control diagnosis	yes	yes	no
007-Coding	yes	no	no
011 - Measured values	yes	yes	yes
014-Long adaptation	yes	yes	no
015-Access permissions	yes	yes	no

*) Only carry out with ignition switched on and when engine does not start.

1.3 Connecting vehicle diagnostic tester and selecting engine control unit

Special tools and workshop equipment required

- Connect vehicle diagnosis, testing and information system -VAS 5051/B- using diagnostic cable -VAS 5051B/1- or diagnosis system -VAS 6150 A-.



Note

- *For a detailed description of the design, function and operation of the vehicle diagnosis, testing and information system -VAS 5051/B- refer to the ⇒ Operating manual of the vehicle diagnosis system.*
- *Instead of these vehicle diagnosis systems other diagnosis systems, such as the DiagRA, may be used as well.*

Prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.

- All electrical consumers must be switched off.
- Earth connections OK

Procedure

– Connect connector of diagnostic cable -VAS 5051B/1- or remote head to diagnostic connection.

– Depending on the function required, do the following:

◆ Switch on ignition, or

◆ start engine; available diagnosis functions.

Note

◆ *If the display remains blank, check the voltage supply for the diagnostic connector using the current flow diagram.*

◆ *If the display is not as shown in the procedure, refer to the ⇒ Operating manual for the vehicle diagnosis system.*

Select operating mode

– Press button on display for “Vehicle self-diagnosis”.

Select vehicle system

– Press “01 - Engine electronics” button on display.

The identification and coding of the engine control unit are shown on the display.

If the coding does not match:

– Check control unit coding.

Select diagnostic function

All the available diagnosis functions are shown on the display.

– Press key on display for the desired function.

Note

For the function “011-Measured values”, the display zones are listed from top to bottom.

Available functions when using the vehicle diagnosis, testing and information system.

1.4 Connecting test box to check lines

Note

◆ *The adapter cables -V.A.G 1598/39-1- and -V.A.G 1598/39-2- are used in conjunction with the test box -V.A.G 1598/42- to check the lines between the relevant components and the engine control unit.*

◆ *The contacts on the engine control unit are distributed over two different wiring harnesses.*

◆ *Depending on the component to be checked, the test is performed on the wiring harness with a 60-pin connector or with a 94-pin connector.*

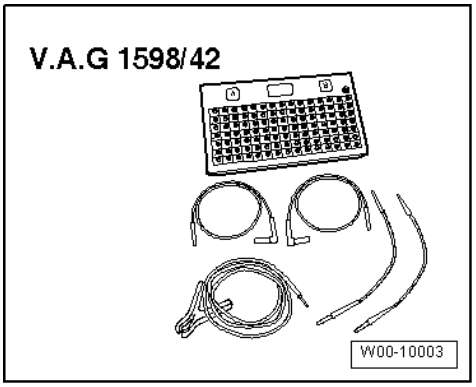
Connect test box -V.A.G 1598/42- using:

- adapter cable -V.A.G 1598/39-1- ⇒Page 25, or
- adapter cable -V.A.G 1598/39-2- ⇒Page 26.

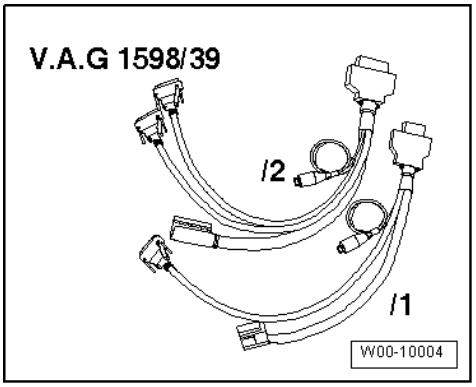
1.4.1 Connecting test box -V.A.G 1598/42- using adapter cable -V.A.G 1598/39-1-

Special tools and workshop equipment required

- Test box -V.A.G 1598/42-



- Adapter cable -V.A.G 1598/39-1-



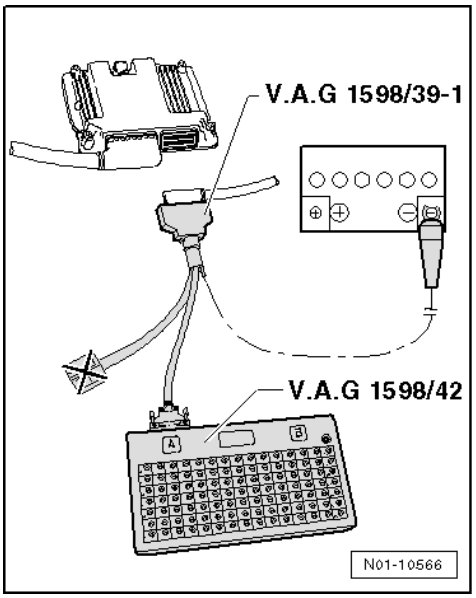
Prerequisites

- Ignition switched off.
- All electrical consumers must be switched off.

Procedure

– Pull 60-pin connector off engine control unit -J623-.

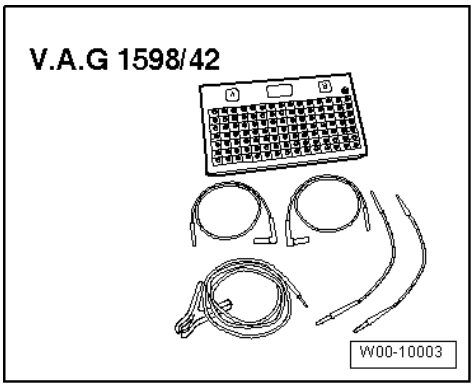
– Using adapter cable -V.A.G 1598/39-1-, connect test box -V.A.G 1598/42- to wiring harness of engine control unit and to -connection A- of test box. The engine control unit is not connected by this action.



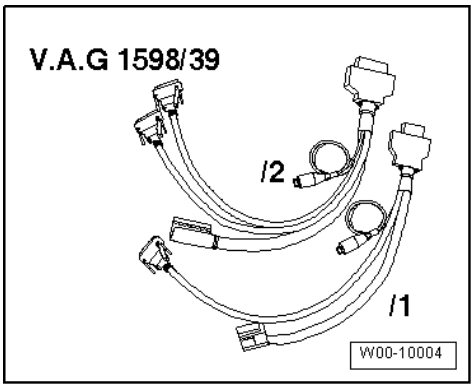
1.4.2 Connecting test box -V.A.G 1598/42- using adapter cable -V.A.G 1598/39-2-

Special tools and workshop equipment required

- Test box -V.A.G 1598/42-



- Adapter cable -V.A.G 1598/39-2-



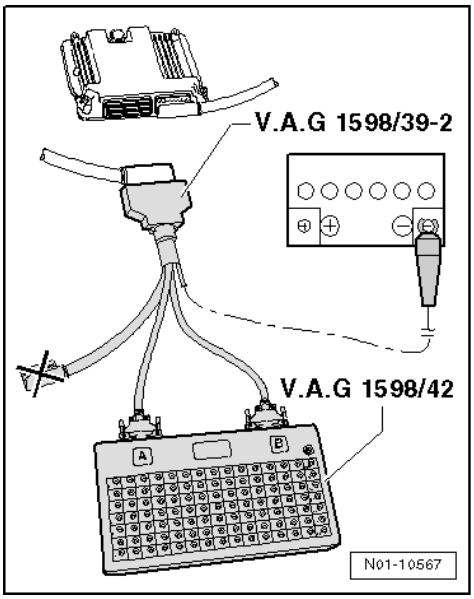
Prerequisites

- Ignition switched off.
- All electrical consumers must be switched off.

Procedure

– Pull 94-pin connector off engine control unit -J623-.

– Using adapter cable -V.A.G 1598/39-2-, connect test box -V.A.G 1598/42- to wiring harness of engine control unit and to -connections A and B- of test box. The engine control unit is not connected by this action.



2 Event memory

2.1 Reading event memory

Procedure for reading event memory

– Allow engine to idle.

– Connect vehicle diagnostic tester, and select engine control unit. ⇒Page 23
– Select diagnosis function “004-Contents of event memory”.
– Select diagnosis function “004.01-Read event memory”.

Only when engine does not start:

– Switch on ignition.
– If no fault is stored in engine control unit, “0 fault(s) detected” is displayed.
– If faults are stored in the engine control unit, these are shown one below the other on the display.
– Exit diagnosis function.
– Switch off ignition.
– Rectify any displayed faults using fault table (), and then clear event memory ⇒Page 26.

Note

If a fault cannot be cleared, seek advice from an authorised dealership or from an employee who has been trained accordingly by Volkswagen.

Static faults

If one or more static faults are stored in the event memory, it is recommended in agreement with the customer to rectify these faults using "Guided fault finding".

Sporadic faults

If only sporadic faults or notes are stored in the event memory and the customer has no complaints in conjunction with the electronic vehicle system, clear fault memory.

– Press “next” button [>] again, to go to the test plan.
– Exit "Guided fault finding" by pressing "GoTo" and "Exit" buttons.

After that, all event memories are read again.

Then, a screen is displayed to confirm that all sporadic faults have been cleared. The diagnosis log is sent automatically “online”.

The vehicle system test has been completed.

2.2 Clearing event memory

Procedure for clearing event memory

Prerequisite

- Fault eliminated

Procedure

Note

After eliminating faults the event memory must be read again as follows and then cleared.

– Start engine and run at idling speed.

– Connect vehicle diagnostic tester, and select engine control unit. ⇒Page 23

– Select diagnosis function “004-Read event memory”.

– Select diagnosis function “004.10-Clear event memory”.

Note

If the event memory will not erase there is a fault still in the system and this must be rectified.

– Exit diagnosis function.

– Switch off ignition.

3 List of fault codes

Note

- *The fault table is listed in ascending order according to the 5-digit V.A.G. fault code on the left.*
- *In addition, so-called P codes, e.g. P0118, are displayed as well.*
- *For additional information on the fault types (e.g. “Open circuit/Short to Earth")”) refer to the ⇒ Operating manual for vehicle diagnosis, testing and information system VAS 5051.*
- *If components are indicated as faulty: First check the wiring and connectors to these components as well as the system earth connections referring to current flow diagram. Only when no fault can be located here should the component be renewed. This is particularly relevant if faults are output as “sporadic” (SP).*
- *The event memory must be cleared after rectifying existing faults* ⇒Page 27*.*

Indicated on display:

00280/P0118 035

Coolant temperature sender -G62-

Signal too large

Sporadic fault

Note

- *00280 = Fault code*
- *P0118 = Additional fault code*
- *Coolant temperature sender -G62- = faulty current path or fault location*
- *Signal too high = Fault type as text*
- *Sporadic faults = Faults that are not always present e.g. loose contact*

Fault code:

- 00022/P0016...00146/P0092 ⇒Page 30
- 00256/P0100...01687/P0697 ⇒Page 34,
- 04110/P100E...05784/P1693 ⇒Page 64,
- 08194/P2002...09780/P2634 ⇒Page 70,
- 12256/P33C8...13093/P3325⇒Page 87.
- 49153/U0001...54282/U140A ⇒Page 88

3.1 Fault code: 00022/P0016...00146/P0092

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
00022/P0016 Bank 1, camshaft position sender-G40 /crankshaft position sender-G28 Wrong allocation	◆ Open circuit or line short-circuit ◆ -G28- defective ◆ -G40- defective ◆ Valve timing not OK ◆ Engine oil pressure too low ◆ Sender wheel of camshaft damaged	◆ Injectors are locked, engine is shut-off ◆ VW diesel synchronisation is prevented by means of a substitutional reaction, and all injectors are locked ◆ Reduced output possible ◆ Irregular idling up to “engine being shut-off”	– -G28- Check. ⇒ “Checking engine speed sender -G28-” on page 400 – -G40- Check. ⇒ “Checking Hall sender 2 -G40-” on page 403 – Use tester to check valve timing (camshaft position) – Check operation of camshaft adjuster (check control valves, shaft adjuster, oil pressure) – Check valve timing ⇒Page 210; Removing, installing and tensioning toothed belt – Checking oil pressure ⇒Page 260. – Check sender wheel of camshaft ⇒Page 146 – Check wiring of camshaft adjusters – Check sensor wiring
00069/P0045 Charge pressure control valve, bank 1/charger1 Open circuit	◆ Wiring open circuit ◆ -N75- defective	◆ Torque limiting	– Check electrical connection to actuator
00071/P0047 Charge pressure control valve, bank 1/charger1 Short to earth	◆ Wiring short to earth ◆ -N75- defective	◆ Torque limiting	– Check electrical connection to actuator

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
00072/P0048 Charge pressure control valve, bank 1/charger1 Short to positive	◆ Wire has short to positive ◆ -N75- defective	◆ Torque limiting	– Check electrical connection to actuator
00135/P0087 Pressure in fuel rail/fuel system Too low	◆ Fuel level too low ◆ Leak in fuel system ◆ Fault in low-pressure fuel system ◆ Fault in high-pressure fuel system ◆ Metering unit is defective	◆ Torque reduction or shutdown	– Checking fill level of fuel tank – Checking fuel system for leaks ⇒Page 384 – Check supplementary fuel pump -V393- ⇒Page 314 – Checking fuel pressure regulating valve -N276- ⇒Page 391. – Check return flow rate from fuel pressure regulating valve -N276- ⇒Page 377 – Checking fuel pressure sender -G247- ⇒Page 394. – Check fuel metering valve -N290- ⇒Page 388 – Check CR system for leaks – Check operation of low-pressure fuel system – Check operation of high-pressure pump – Check operation of metering unit and pressure regulating valve
00136/P0088 Pressure in fuel rail/fuel system			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Too high	◆ Fuel level too low ◆ Leak in fuel system ◆ Fault in low-pressure fuel system ◆ Fault in high-pressure fuel system ◆ Metering unit is defective	◆ Glow period warning lamp -K29- lights up ◆ Exhaust emissions warning lamp -K83- lights up ◆ Reduced performance ◆ Increased exhaust emissions ◆ Torque reduction or shutdown	– Checking fill level of fuel tank – Checking fuel system for leaks ⇒Page 384 – Check supplementary fuel pump -V393- ⇒Page 314 – Checking fuel pressure regulating valve -N276- ⇒Page 391. – Check return flow rate from fuel pressure regulating valve -N276- ⇒Page 377 – Checking fuel pressure sender -G247- ⇒Page 394. – Check fuel metering valve -N290- ⇒Page 388 – Check CR system for leaks – Check operation of low-pressure fuel system – Check operation of high-pressure pump – Check operation of metering unit and pressure regulating valve
00144/P0090 Fuel metering valve -N290-			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Electrical fault	◆ Open circuit or line short-circuit ◆ -N290- defective	◆ Failure of metering unit	– Check fuel metering valve -N290- ⇒Page 388 – Check electrical connection to metering unit – Check terminal 15 ON and +12V on actuator + (A2). No voltage ⇒ open circuit between Vbat and actuator – Pull connector off actuator, and check wiring between actuator/ ECU – Measure resistance on actuator. If no continuity ⇒ renew ECU
00145/P0091 Fuel metering valve -N290- Short to earth	◆ Wiring short to earth ◆ -N290- defective	◆ Failure of metering unit and engine	– Check fuel metering valve -N290- ⇒Page 388 – Pull connector off actuator, and read event memory again. If in addition MeUnOL ⇒ renew actuator - otherwise check wiring between actuator/ ECU - if OK ⇒ renew ECU
00146/P0092 Fuel metering valve -N290- Short to positive	◆ Wire has short to positive ◆ -N290- defective	◆ Failure of metering unit	– Check fuel metering valve -N290- ⇒Page 388 – Pull connector off actuator, and read event memory again. If in addition MeUnOL ⇒ renew actuator - otherwise check wiring between actuator/ ECU - if OK ⇒ renew ECU

3.2 Fault code: 00257/P0101...01687/P0697

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
00257/P0101 Air mass meter -G70- Implausible signal	◆ Open circuit or line short-circuit ◆ -G70- defective	◆ EGR is switched off. Diesel particulate filter regeneration suppressed ◆ Driving dynamics impaired ◆ Fumes generated ◆ No regeneration	– -G70- Check. ⇒Page 411 – Check whether there is an electrical fault in wire or wiring harness (short to positive or to earth, or open circuit). If not ⇒ renew sensor
00258/P0102 Air mass meter -G70- Signal too low	◆ Open circuit or line short-circuit ◆ -G70- defective	◆ EGR is switched off. Diesel particulate filter regeneration suppressed ◆ Driving dynamics not or barely impaired, because a good alternative value is used. Possible breakdown due to full DPF (consequential fault)	– -G70- Check. ⇒Page 411 – Check whether there is an electrical fault in wire or wiring harness (short to positive or to earth, or open circuit). If not ⇒ renew sensor – After road test fault in event memory ⇒ renew ECU (there is no other way to test the air mass meter, maybe with a frequency generator)
00259/P0103 Air mass meter -G70- Signal too large	◆ Open circuit or line short-circuit ◆ -G70- defective	◆ EGR is switched off. Diesel particulate filter regeneration suppressed ◆ Driving dynamics not or barely impaired, because a good alternative value is used. Possible breakdown due to full DPF (consequential fault)	– -G70- Check. ⇒Page 411 – Check whether there is an electrical fault in wire or wiring harness (short to positive or to earth, or open circuit). If not ⇒ renew sensor – After road test fault in event memory ⇒ renew ECU (there is no other way to test the air mass meter, maybe with a frequency generator)
00260/P0104 Air mass meter -G70-			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
No signal	◆ Open circuit or line short-circuit ◆ -G70- defective	◆ EGR is switched off. Diesel particulate filter regeneration suppressed ◆ Driving dynamics not or barely impaired, because a good alternative value is used. Possible breakdown due to full DPF (consequential fault)	– -G70- Check. ⇒Page 411 – Check whether there is an electrical fault in wire or wiring harness (short to positive or to earth, or open circuit). If not ⇒ renew sensor – After road test fault in event memory ⇒ renew ECU (there is no other way to test the air mass meter, maybe with a frequency generator)
00273/P0111 Intake air temperature sender -G42- Implausible signal	◆ Open circuit or line short-circuit ◆ -G42- defective	◆ No limitation	– Check intake air temperature sender -G42- ⇒Page 404 – Comparison of all temperatures with completely cooled down engine and terminal 15 ON / engine OFF – Electrical check of sensor wires. Possibly auxiliary heater coded incorrectly
00274/P0112 Intake air temperature sender -G42- Signal too low	◆ Wiring open circuit or wiring short to positive ◆ -G42- defective	◆ Torque limiting; diesel particulate filter is locked	– -G42- Check. ⇒Page 404 – Pull off temperature sensor ⇒ sensor raw voltage in measured value block "Air_uRawTCACDs" approx. reference voltage (3.3 V) ⇒ sensor defective, sensor raw voltage in measured value block approx. 0 V ⇒ check wire to ECU – Wire to ECU OK, ECU defective

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
00275/P0113 Intake air temperature sender -G42- Signal too large	◆ Wire open circuit or wire has short to earth ◆ -G42- defective	◆ Torque limiting; diesel particulate filter is locked	– -G42- Check. ⇒Page 404 – Pull off temperature sensor, and measure reference voltage (3.3 V) on signal line, measured value block "Air_uRawTCACDs" approx. reference voltage ⇒ connect signal line to earth. If sensor raw voltage in measured value block = 0 V ⇒ sensor defective ⇒ sensor raw voltage in measured value block = 0 V ⇒ check sensor wire to ECU – Wire to ECU OK, ECU defective
00278/P0116 Coolant temperature sender -G62-			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Implausible signal	◆ Open circuit or line short-circuit ◆ -G62- defective	◆ No limitation	– -G62- Check. ⇒ “Checking coolant temperature sender -G62-” on page 407 – Check thermostat ⇒Page 278, parts of cooling system - engine side – Comparison of all temperatures with completely cooled down engine and terminal 15 ON / engine OFF – Electrical check of sensor wires. Possibly auxiliary heater coded incorrectly – Sensor signal constant ⇒ check electrical connection to sensor – Pull off temperature sensor ⇒ sensor raw voltage
00279/P0117 Coolant temperature sender -G62- Signal too low	◆ Wiring open circuit or wiring short to positive ◆ -G62- defective	◆ Alternative values are used for coolant, alternative values are only used for temperature range ◆ Bad cold start behaviour possible	– Check coolant temperature sender -G62- ⇒Page 407 – Checking thermostat ⇒Page 278 – Pull off temperature sensor ⇒ sensor raw voltage in measured value block "CEngDsT_uRaw" approx. reference voltage (3.3 V) ⇒ sensor defective – Sensor raw voltage in measured value block approx. 0 V ⇒ check wire to ECU – Wire to ECU OK, ECU defective
00280/P0118 Coolant temperature sender -G62-			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Signal too large	◆ Wire open circuit or wire has short to earth ◆ -G62- defective	◆ Alternative values are used for coolant, alternative values are only used for temperature range ◆ Bad cold start behaviour possible	– -G62- Check. ⇒Page 407 – Check thermostat ⇒Page 278, parts of cooling system - engine side – Pull off temperature sensor, and measure reference voltage (3.3 V) on signal line, measured value block "DEngDst_uRaw" ⇒ connect signal line to earth, if sensor raw voltage in measured value block = 0 V ⇒ check sensor wire to ECU – Wire to ECU OK, ECU defective
00289/P0121 Throttle valve potentiometer -G69- Implausible signal	◆ Open circuit or line short-circuit ◆ Throttle valve potentiometer -G69- defective	◆ No limitations	– Check -J338- ⇒Page 89, final control diagnosis – -J338- Check. ⇒Page 414 – Check electrical connection to sensor
00290/P0122 Throttle valve potentiometer -G69- Signal too low	◆ Wiring open circuit or wiring short to positive ◆ Throttle valve potentiometer -G69- defective	◆ Regeneration is locked	– Check -J338- ⇒Page 89, final control diagnosis – -J338- Check. ⇒Page 414 – Check electrical connection to sensor
00291/P0123 Throttle valve potentiometer -G69-			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Signal too high	◆ Wire open circuit or wire has short to earth ◆ Throttle valve potentiometer -G69- defective	◆ Regeneration is locked	– Check -J338- ⇒ Page 89, final control diagnosis – -J338- Check. ⇒ Page 414 – Check electrical connection to sensor
00304/P0130 Bank 1 - probe 1 Electrical fault in current circuit	◆ Open circuit or line short-circuit ◆ Lambda probe -G39- defective	◆ Zero quantity calibration, calculation of diesel particulate filter load, exhaust gas temperature regulation, FMO locked ◆ Regeneration of NOx storage catalytic converter is locked	– -G39- Check. ⇒ Page 439 – Check electrical connection to sensor
00309/P0135 Bank 1 - probe 1, heating element circuit			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Electrical fault	◆ Wiring open circuit ◆ Lambda probe heater -Z19- defective	◆ If there is a definite fault, the output duty cycle is set to 0%. Zero quantity calibration, calculation of diesel particulate filter load, exhaust gas temperature regulation, FMO locked ◆ Regeneration of NOx storage catalytic converter is locked	– -Z19- Check. ⇒Page 441 – Check measuring resistor: disconnect universal lambda probe, and measure on contacts of coupling between "pump current (APE)" and "trimm resistor (Ri)", R=60-65 ohm; Warning!: terminal 15 Off for this ⇒ if measuring resistor is defective, renew lambda probe. Check voltage supply: disconnect universal lambda probe, and measure on contacts of coupling between "virtual earth (IPN)" and "body earth", V=2-3 V; Warning!: terminal 15 ON for this ⇒ if there is no voltage, check wire for open circuit and renew it as necessary. Check wires for "pump current (APE)", "virtual earth (IPN)", "trimm resistor (Ri)" and "Nernst voltage (RE+) for open circuits and short-circuits. ⇒ if there are open circuits or short-circuits, repair lines ⇒ if the fault persists, check ECU
00385/P0181 Fuel temperature sender -G81-			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Implausible signal	◆ Open circuit or line short-circuit ◆ -G81- defective	◆ No limitation	– -G81- Check. ⇒ “Checking fuel temperature sender -G81-” on page 409 – Comparison of all temperatures with completely cooled down engine and terminal 15 ON / engine OFF. Check electrical connection to sensor – Electrical check of sensor wires; maybe auxiliary heater coded incorrectly
00386/P0182 Fuel temperature sender -G81- Short to earth	◆ Wiring short to earth ◆ -G81- defective	◆ Changes to alternative value "RB_FuelT_TransStg. Dfl_C" ◆ Regeneration is locked	– -G81- Check. ⇒ “Checking fuel temperature sender -G81-” on page 409
00387/P0183 Fuel temperature sender -G81- Open circuit/short to positive	◆ Wiring open circuit or wiring short to positive ◆ -G81- defective	◆ Changes to alternative value "RB_FuelT_TransStg. Dfl_C" ◆ Regeneration is locked	– -G81- Check. ⇒ “Checking fuel temperature sender -G81-” on page 409
00401/P0191 Fuel pressure sender -G247- Implausible signal	◆ Open circuit or line short-circuit ◆ -G247- defective	◆ Limp mode ◆ If there is a fault before start of limp mode, the fuel rail pressure is controlled via open-loop control and not closed-loop control	– -G247- Check. ⇒ Page 394 – Before start or during coasting, check for offset drift of fuel pressure sender. Check pressure release, if necessary renew fuel pressure sender, note environmental conditions and engine operating status.

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
00402/P0192 Fuel pressure sender -G247- Short to earth	◆ Wire open circuit or wire has short to earth ◆ -G247- defective	◆ Torque reduction or shutdown	– -G247- Check. ⇒Page 394 – Perform electrical test on fuel pressure sender and wires
00403/P0193 Fuel pressure sender -G247- Short to positive	◆ Wiring open circuit or wiring short to positive ◆ -G247- defective	◆ Torque reduction or shutdown	– -G247- Check. ⇒Page 394 – Perform electrical test on fuel pressure sender and wires
00513/P0201 Injector for cyl. 1 -N30- Electr. fault in circuit	◆ Open circuit or line short-circuit ◆ -N30- defective	◆ Engine is switched off ◆ Engine fails	– -N30- Check. ⇒Page 398 – Check for short to positive on injector 1 (high- and low-wire). If OK, check injector. If OK, renew ECU.
00514/P0202 Injector for cyl. 2 -N31- Electr. fault in circuit	◆ Open circuit or line short-circuit ◆ -N31- defective	◆ Engine is switched off ◆ Engine fails	– -N31- Check. ⇒Page 398 – Check for short to positive on injector 2 (high- and low-wire). If OK, check injector. If OK, renew ECU.
00515/P0203 Injector for cyl. 3 -N32- Electr. fault in circuit	◆ Open circuit or line short-circuit ◆ -N32- defective	◆ Engine is switched off ◆ Engine fails	– -N32- Check. ⇒Page 398 – Check for short to positive on injector 3 (high- and low-wire). If OK, check injector. If OK, renew ECU.
00516/P0204 Injector for cyl. 4 -N33-			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Electr. fault in circuit	◆ Open circuit or line short-circuit ◆ -N33- defective	◆ Engine is switched off ◆ Engine fails	– -N33- Check. ⇒Page 398 – Check for short to positive on injector 4 (high- and low-wire). If OK, check injector. If OK, renew ECU.
00564/P0234 Charge pressure control Control limit exceeded	◆ Defective charge pressure control solenoid valve -N75- ◆ Hose connections interchanged, not connected ◆ Leak in charge air system	◆ Torque limiting; regeneration is locked	– Check -N75- ⇒Page 89, final control diagnosis – Checking charge pressure control ⇒Page 333. – Checking charge air system for leaks ⇒Page 331
00567/P0237 Charge pressure sender -G31- Signal too low	◆ Open circuit or line short-circuit ◆ -G31- defective	◆ Torque limiting; regeneration is locked	– -G31- Check. ⇒Page 343 – Checking charge pressure control ⇒Page 333. – Pull off pressure sensor, and apply a reference voltage (5 V) to the signal line => sensor raw voltage in measured value block "Air_uRawP-CACDs"=reference voltage => sensor defective => sensor raw voltage in measured value block=reference voltage => check sensor wire to ECU – Wire to ECU OK, ECU defective
00568/P0238 Charge pressure sender -G31-			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Signal too large	◆ Open circuit or line short-circuit ◆ -G31- defective	◆ Torque limiting; regeneration is locked	– -G31- Check. ⇒Page 343 – Checking charge pressure control ⇒Page 333. – Pull off pressure sensor ⇒ sensor raw voltage in measured value block "Air_uRawPCACDs" approx. 0 V ⇒ sensor defective => sensor raw voltage in measured value block > 0 V ⇒ check wire to ECU – Wire to ECU OK, ECU defective
00611/P0263 Incorrect injection quantity on cyl.1	◆ Adaption values do not match adaption value specified on injector	◆ Glow period warning lamp -K29- lights up ◆ Incorrect injection quantity.	– Check injector delivery calibration values/ injector voltage calibration values ⇒Page 421 – Adaption injector, if adaptation is not possible, try to enter code for injector delivery calibration/injector voltage calibration from other injectors, if adaptation still not possible, ECU defective. If an additional fault is stored, which indicates a defective EEProm --> renew ECU –

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
00614/P0266 Incorrect injection quantity on cyl.2	◆ Adaption values do not match adaption value specified on injector	◆ Glow period warning lamp -K29- lights up ◆ Incorrect injection quantity.	– Check injector delivery calibration values/ injector voltage calibration values ⇒ Page 421 – Adaption injector, if adaptation is not possible, try to enter code for injector delivery calibration/injector voltage calibration from other injectors, if adaptation still not possible, ECU defective. If an additional fault is stored, which indicates a defective EEProm --> renew ECU
00617/P0269 Incorrect injection quantity on cyl.3	◆ Adaption values do not match adaption value specified on injector	◆ Incorrect injection quantity.	– Check injector delivery calibration values/ injector voltage calibration values ⇒ Page 421 – Adaption injector, if adaptation is not possible, try to enter code for injector delivery calibration/injector voltage calibration from other injectors, if adaptation still not possible, ECU defective. If an additional fault is stored, which indicates a defective EEProm --> renew ECU

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
00626/P0272 Incorrect injection quantity on cyl.4	◆ Adaption values do not match adaption value specified on injector	◆ Incorrect injection quantity.	– Check injector delivery calibration values/ injector voltage calibration values ⇒Page 421 – Adaption injector, if adaptation is not possible, try to enter code for injector delivery calibration/injector voltage calibration from other injectors, if adaptation still not possible, ECU defective. If an additional fault is stored, which indicates a defective EEProm --> renew ECU
00665/P0299 Charge pressure control Control limit not reached	◆ Defective charge pressure control solenoid valve -N75- ◆ Turbocharger defective ◆ Leak in charge air system	◆ Torque limiting; regeneration is locked	– Check -N75- ⇒Page 89, final control diagnosis – Checking charge air system for leaks ⇒Page 331 – Checking charge pressure control ⇒Page 333.
00768/P0300 Misfiring detected	◆ Poor compression values ◆ Injectors for cyl.1...4 -N30...N33- defective ◆	◆ Irregular engine operation at idling speed	– Checking compression ⇒Page 218. – Check injectors for cyl.1...4 -N30...N33- ⇒Page 398 – Compare learnt values for zero quantity calibration (ZFC);
00769/P0301 Misfiring detected in cyl. 1	◆ Poor compression values for cylinder 1 ◆ Injector for cyl.1 -N30- defective	◆ Slightly irregular engine operation at idling speed	– Checking compression ⇒Page 218. – Check injector for cyl. 1 -N30- ⇒Page 398 – Compare learnt values for zero quantity calibration (ZFC);

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
00779/P0302 Misfiring detected in cyl. 2	◆ Poor compression values for cylinder 2 ◆ Injector for cyl.2 -N31- defective	◆ Slightly irregular engine operation at idling speed	– Checking compression ⇒Page 218. – Check injector for cyl. 2 -N31- ⇒Page 398 – Compare learnt values for zero quantity calibration (ZFC);
00771/P0303 Misfiring detected in cyl. 3	◆ Poor compression values for cylinder 3 ◆ Injector for cyl.3 -N32- defective	◆ Slightly irregular engine operation at idling speed	– Checking compression ⇒Page 218. – Check injector for cyl. 3 -N32- ⇒Page 398 – Compare learnt values for zero quantity calibration (ZFC);
00772/P0304 Misfiring detected in cyl. 4	◆ Poor compression values for cylinder 4 ◆ Injector for cyl.4 -N33- defective	◆ Slightly irregular engine operation at idling speed	– Checking compression ⇒Page 218. – Check injector for cyl. 4 -N33- ⇒Page 398 – Compare learnt values for zero quantity calibration (ZFC);
00801/P0321 Engine speed sender -G28- Implausible signal	◆ Wire open circuit or wire has short to earth ◆ -G28- defective or loose ◆ Metal shavings on sender wheel, or ◆ Too much clearance -G28-/sender wheel	◆ Limp mode via camshaft is activated, considerably decreased performance ◆ Exhaust gas recirculation switched off ◆ Torque limiting ◆ Governed speed ◆ Increased idling speed ◆ Camshaft diagnosis locked ◆ Smoothness regulator and jolt damper switched off ◆ Regeneration suppressed	– -G28- Check. ⇒ “Checking engine speed sender -G28-” on page 400 – Check whether sensor is installed correctly (clearance between sensor and sender wheel, firmly seated) – Check supply voltage of sensor (only if sensor is activated), – Check sensor signal with engine running (oscilloscope) – Check wiring – Check sender wheel
00802/P0322 Engine speed sender -G28-			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
No signal	◆ Open circuit or line short-circuit ◆ -G28- defective	◆ Limp mode via camshaft is activated, considerably decreased performance, regeneration suppressed ◆ Exhaust gas recirculation switched off ◆ Torque limiting ◆ Governed speed ◆ Increased idling speed ◆ Camshaft diagnosis locked, ◆ Smoothness regulator and jolt damper switched off ◆ Regeneration suppressed	– -G28- Check. ⇒Page 400 – Check supply voltage of sensor (only if sensor is activated) – Check sensor signal with engine running (oscilloscope). – Check wiring. – Check whether sensor is installed correctly (clearance between sensor and sender wheel, firmly seated) – Checking sender wheel . .
00833/P0341 Camshaft position sender => sender -G40- Implausible signal	◆ Wire open circuit or wire has short to earth ◆ Hall sender -G40- defective or loose ◆ Metal shavings on hub or Hall sender -G40- ◆ Too much clearance between Hall sender -G40-/hub ◆ Hub with sender wheel on camshaft is twisted or loose	◆ Engine is operated via crankshaft signal. ◆ EPC is activated, because detection of reverse rotation is not available (project-specific). ◆ VW diesel: engine is synchronised via test injections, otherwise no noticeable substitutional reactions. ◆ VW diesel: (no noticeable impairment) ◆ Crankshaft diagnosis is locked ◆ Camshaft adaptation and camshaft offset diagnosis are locked	– -G40- Check. ⇒Page 403 – Check camshaft and sender wheel positions ⇒Page 210; Removing, installing and tensioning toothed belt – Check whether sensor is installed correctly (clearance between sensor and sender wheel, firmly seated) – Check supply voltage of sensor (only if sensor is activated) – Check sensor signal with engine running (oscilloscope) – Check wiring – Checking sender wheel
00899/P0383 Activation of glow period control unit 1			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Short to earth	◆ Wire open circuit or wire has short to earth ◆ Automatic glow period control unit -J179- defective	◆ Glow plug control module is switched off ◆ Entire glow plug system does not work. ◆ Possible bad cold start behaviour of engine ◆ Possible smoke when starting engine	– Check -J179- ⇒Page 89, final control diagnosis – Electr. test of pilot line ECU<>glow period control unit, connector
01024/P0400 Exhaust gas recirculation system Malfunction	◆ Exhaust gas recirculation system defective	◆ No exhaust gas recirculation ◆ Reduced performance ◆ Increased exhaust emissions	– Check exhaust gas recirculation system ⇒Page 436
01025/P0401 Exhaust gas recirculation system Insufficient throughput	◆ Exhaust gas recirculation system clogged ◆ Leak in exhaust gas recirculation system	◆ EGR is switched off ◆ No regeneration	– Check exhaust gas recirculation system ⇒Page 436 – Check operation of exhaust gas recirculation valve – Check air duct system for leaks
01026/P0402 Exhaust gas recirculation system Excessive throughput	◆ Leak in exhaust gas recirculation system	◆ EGR is switched off ◆ No regeneration	– Check exhaust gas recirculation system ⇒Page 436 – Check operation of exhaust gas recirculation valve – Check air duct system for leaks
01027/P0403 Exhaust gas recirculation valve -N18-			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Malfunction	◆ -N18- defective	◆ Glow period warning lamp -K29- lights up ◆ Exhaust emissions warning lamp -K83- lights up ◆ Position controller de-activated ◆ Offset cannot be learnt anymore ◆ No particulate filter re-generation possible anymore	– Check -N18- ⇒Page 89, final control diagnosis – Check exhaust gas re-circulation system ⇒Page 436 – If difference between "EGRVlvR" and "EGRVlvRAct" is higher than +/-15%, renew valve. – If difference is smaller ⇒ check activation wiring (M+ and M-) for loose contacts. – Sensor voltage supply and signal line are to excluded
01029/P0405 Exhaust gas recirculation sender Signal too low	◆ Wiring open circuit or wiring short to positive ◆ -G212- defective	◆ Particulate filter re-generation locked	– Check -G212- ⇒Page 437, check exhaust gas recirculation valve -N18- – Check exhaust gas re-circulation system ⇒Page 436 – Check whether connector on exhaust gas recirculation valve is OK – On wiring harness: check feedback line for short-circuit to sensor earth and to body earth. – On exhaust gas recirculation valve: check for short-circuit between pins for sensor earth and feedback line on exhaust gas recirculation valve
01030/P0406 Exhaust gas recirculation sender			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Signal too large	◆ Wire open circuit or wire has short to earth ◆ -G212- defective	◆ Particulate filter regeneration locked	– Check -G212- ⇒Page 437, check exhaust gas recirculation valve -N18- – Check exhaust gas recirculation system ⇒Page 436 – Check whether connector on exhaust gas recirculation valve is OK – On wiring harness: check feedback line for short-circuit to battery voltage and to sensor +5V supply voltage. Check feedback line for open load. – On exhaust gas recirculation valve: check for short-circuit between sensor +5V supply voltage and feedback line on exhaust gas recirculation valve
01056/P0420 Catalytic converter system, bank 1			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Low performance	◆ Diesel oxidising catalytic converter clogged with sulphur	◆ Difference between exhaust gas temperature ahead of turbine and downstream from diesel oxidising catalytic converter too low during regeneration	– Check -G212- ⇒Page 437, check exhaust gas recirculation valve -N18- – Check exhaust gas recirculation system ⇒Page 436 ◆ On 1st occurrence, repeat service regeneration ◆ On repeated occurrence, note the following: – Check temperature sensors ahead of turbine and downstream from diesel oxidising catalytic converter for plausibility – If OK, check air mass meter for plausibility – If OK, check exhaust system for leaks – If OK, check injection system – If OK, check whether high-pressure exhaust gas recirculation valve is stuck on open position or whether throttle valve is jammed – If OK, renew oxidising catalytic converter
01132/P046C Exhaust gas recirculation potentiometer Implausible signal	● Open circuit or line short-circuit ● -G212- defective	◆ None	– Clean valve, renew as necessary
01281/P0501 Vehicle speed signal			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Implausible signal	◆ Open circuit or line short-circuit ◆ Switch or button for working speed control switch defective	◆ None	– Check components for working speed control ⇒Page 486, current flow diagram – Check electrical connection to sensor, if OK => sensor defective (electrical)
01283/P0503 Vehicle speed signal Signal too large	◆ Wire open circuit or wire has short to earth ◆ Switch or button for working speed control switch defective	◆ Torque reduction	– Check components for working speed control ⇒Page 486, current flow diagram – Check electrical connection to sensor, if OK => sensor defective (electrical), or read event memory of vehicle control unit.
01348/P0544 Exhaust gas temperature sender 1, bank 1 Electrical fault	◆ Short-circuit in wire ◆ -G235- defective		– -G235- Check. ⇒Page 347 – Rectify fault: check installation position of exhaust gas temperature sender 1 (ahead of turbine), correct it as necessary or renew exhaust gas temperature sender, check wires
01349/P0545 Exhaust gas temperature sender 1, bank 1			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Short to earth	◆ Wiring short to earth ◆ -G235- defective	◆ Torque limiting; diesel particulate filter regeneration is locked	– -G235- Check. ⇒Page 347 – Pull off temperature sensor => sensor raw voltage in measured value block "Exh_uRawTTrbnUS" approx. reference voltage (3.3 V) ⇒ sensor defective, sensor raw voltage in measured value block approx. 0 V ⇒ check wire to ECU – Wire to ECU OK, ECU defective
01378/P0562 Voltage supply Voltage too low			– Check voltage supply for engine control unit -J623- ⇒Page 417
01379P0563 Voltage supply			
Voltage too great			– Check voltage supply for engine control unit -J623- ⇒Page 417 – Possible open circuit on terminal 87
01538/P0602 Control unit coding Malfunction	◆ Invalid control unit coding for engine control unit -J623-	◆ Several effects possible, since ECU is coded incorrectly	– Recode/flash engine control unit -J623- (as specified by manufacturer), or renew it
01541/P0605 Control unit defective	◆ Internal defect in engine control unit -J623-	◆ Various running problems ◆ Engine stops	– -J623- Renew ⇒Page 418
01542/P0606 Control unit defective	◆ Internal defect in engine control unit -J623-	◆ Project-specific. Alternative function depends on which components are controlled via which output stage, project-specific. SPI output stages not functional / cannot be diagnosed	– -J623- Renew ⇒Page 418

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
01542/P0606 Control unit defective	◆ Internal defect in engine control unit -J623-	◆ None	
01542/P0606 Control unit defective	◆ Internal defect in engine control unit -J623-	◆ Hardware fault to filter EMI. If the fault is not detected another time, it can be assumed that it was just a sporadic fault.	– -J623- For static fault, renew engine control unit⇒ Page 418
01543/P0607 Control module not plausible	◆ Internal defect in engine control unit -J623-	◆ Correction value of O2 calibration = last valid value ◆ Zero quantity calibration locked ◆ Calculation of diesel particulate filter load ◆ Exhaust gas temperature regulation, FMO ◆ Regeneration of NOx storage catalytic converter is locked	– -J623- Renew ⇒ Page 418
01576/P0628 Electric fuel pump 1 relay Short to earth	◆ Wire open circuit or wire has short to earth ◆ Fuel pump relay -J49- defective ◆ Engine control unit -J623- defective	◆ On terminal 15 ON pressurisation pump runs continuously	– Pull off relay, and read event memory again – If in addition PSPOL--> renew relay – Otherwise, check wiring between relay and ECU – Check wires between -J49- and -J623-, ⇒ Page 486, current flow diagrams – If OK, renew control unit.
01577/P0629 Electric fuel pump 1 relay			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Short to positive	◆ Wiring open circuit or wiring short to positive ◆ Fuel pump relay -J49- defective ◆ Engine control unit -J623- defective	◆ Engine failure	– Pull off relay, and read event memory again – If in addition PSPOL--> renew relay – Otherwise, check wiring between relay and ECU – Check wires between -J49- and -J623-, ⇒Page 486, current flow diagrams – If OK, renew control unit.
01588/P0634 Control unit, temperature shut-off	◆ Overload on output stage(s) in -J623- ◆ Glow plug control module is switched off ◆ Very high ambient temperature ◆ Engine control unit not installed correctly ◆ Internal defect in engine control unit -J623-	◆ Possible smoke when starting engine ◆ Entire glow plug system does not work ◆ Possible bad cold start behaviour of engine	– -J623- Allow to cool off, and clear event memory ⇒Page 27 – If necessary, renew ECU -J623- ⇒Page 418
01601/P0641 Sender reference voltage “A”			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Open circuit	◆ Open circuit or line short-circuit ◆ -G28- defective ◆ -G31- defective ◆ Defective accelerator position sender -G79- ◆ Defective exhaust gas recirculation potentiometer -G212- ◆ Defective exhaust gas recirculation valve -N18- ◆ Position sender for charge pressure positioner -G581- defective	◆ Faults for sensors connected to this source are locked. ◆ Limp mode	– Check electrical connection or sensor: camshaft encoder; intake manifold flap; differential pressure diesel particulate filter; pedal encoder 1 – -G28- Check. ⇒ “Checking engine speed sender -G28-” on page 400 – -G31- Check. ⇒ “Checking charge pressure sender -G31-” on page 343 – -G79- Check. ⇒ “Checking accelerator pedal position sender -G79-, if fitted” on page 316 – Check -G212- ⇒ “Checking exhaust gas recirculation valve -N18-” on page 437, check exhaust gas recirculation valve -N18- – Check -N18- ⇒ “Final control diagnosis” on page 89, final control diagnosis – -G581- Check. ⇒ “Checking position sender for charge pressure positioner -G581-” on page 345

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
01612/P064C Glow period control unit	◆ Wire open circuit or wire has short to earth ◆ Wrong automatic glow period control unit -J179- installed	◆ Glow period warning lamp -K29- lights up ◆ Engine does not start or is difficult to start when cold ◆ Smoke is generated when engine is started	– Check -J179- ⇒Page 89, final control diagnosis – After a while, the fault should stored. Rectify fault: glow plug control unit does not match engine control unit. Has one of the control units been renewed, and did an error occur while doing so? – Check whether the correct -J179- is installed – Check COM line (DI line) between glow period control unit and ECU.
01617/P0651 Sender reference voltage “B”			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Open circuit	◆ Open circuit or line short-circuit ◆ -G28- defective ◆ Defective charge pressure sender -G31- ◆ Defective accelerator position sender -G79- ◆ Defective exhaust gas recirculation potentiometer -G212- ◆ Defective exhaust gas recirculation valve -N18- ◆ Defective fuel pressure sender -G247- ◆ Position sender for charge pressure positioner -G581- defective	◆ Limp mode	– Check electrical connection or sensor: fuel pressure sender; turbocharger travel sender; crankshaft encoder; EGR actuator; control flap; charge pressure probe; pedal encoder 2 – -G28- Check. ⇒ “Checking engine speed sender -G28-” on page 400 – -G31- Check. ⇒ “Checking charge pressure sender -G31-” on page 343 – -G79- Check. ⇒ “Checking accelerator pedal position sender -G79-, if fitted” on page 316 – Check -G212- ⇒ “Checking exhaust gas recirculation valve -N18-” on page 437, check exhaust gas recirculation valve -N18- – Check -N18- ⇒ “Final control diagnosis” on page 89, final control diagnosis – -G247- Check. ⇒ “Checking fuel pressure sender -G247-” on page 394 – -G581- Check. ⇒ “Checking position sender for charge pressure positioner -G581-” on page 345
01642/P066A Glow plug for cylinder 1			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Short to earth	◆ Wire open circuit or wire has short to earth Glow plug 1 -Q10- defective	◆ One of the glow plugs is not functional	– Check wiring to automatic glow period control unit -J179- ⇒Page 486, current flow diagrams – Electr. test of glow plug, connector – Pull off glow plug, and read entry in event memory – If entry is still stored in event memory, check wire and connector
01644/P066C Glow plug for cylinder 2 Short to earth	◆ Wire open circuit or wire has short to earth Glow plug 2 -Q11- defective	◆ One of the glow plugs is not functional	– Check wiring to automatic glow period control unit -J179- ⇒Page 486, current flow diagrams – Electr. test of glow plug, connector – Pull off glow plug, and read entry in event memory – If entry is still stored in event memory, check wire and connector
01646/P066E Glow plug for cylinder 3 Short to earth	◆ Wire open circuit or wire has short to earth Glow plug 3 -Q12- defective	◆ One of the glow plugs is not functional	– Check wiring to automatic glow period control unit -J179- ⇒Page 486, current flow diagrams – Electr. test of glow plug, connector – Pull off glow plug, and read entry in event memory – If entry is still stored in event memory, check wire and connector
01648/P0670 Glow period control unit 1			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Electrical fault in current circuit	◆ Open circuit or line short-circuit ◆ Automatic glow period control unit -J179- defective	◆ Glow plug control module is switched off ◆ Entire glow plug system does not work ◆ Possible bad cold start behaviour of engine ◆ Possible smoke when starting engine	– Check -J179- ⇒Page 89, final control diagnosis – Electr. test of pilot line ECU<>glow period control unit, connector.
01649/P0671 Glow plug for cylinder 1 -Q10- Electrical fault in current circuit	◆ Open circuit or line short-circuit ◆ Glow plug 1 -Q10- defective	◆ One of the glow plugs is not functional	– Check wiring to automatic glow period control unit -J179- ⇒Page 486, current flow diagrams – Electrical test of glow plug, connector, wire to glow plug control unit. – Pull off glow plug, and check resistance. – Check glow plug control unit – If resistance is not infinite, check wire and connector ⇒“Removing, installing and checking glow plugs” on page 536
01650/P0672 Glow plug for cylinder 2 -Q11- Electrical fault in current circuit	◆ Open circuit or line short-circuit ◆ Glow plug 2 -Q11- defective	◆ One of the glow plugs is not functional	– Electrical test of glow plug, connector, wire to glow plug control unit. – Pull off glow plug, and check resistance ⇒Page 536 – If resistance is not infinite, check wire and connector.
01651/P0673 Glow plug for cylinder 3 -Q12-			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Electrical fault in current circuit	◆ Open circuit or line short-circuit ◆ Glow plug 3 -Q12- defective	◆ One of the glow plugs is not functional	– Electrical test of glow plug, connector, wire to glow plug control unit. – Pull off glow plug, and check resistance ⇒Page 536 – If resistance is not infinite, check wire and connector.
01652/P0674 Glow plug for cylinder 4 -Q13- Electrical fault in current circuit	◆ Open circuit or line short-circuit ◆ Glow plug 4 -Q13- defective	◆ One of the glow plugs is not functional	– Electrical test of glow plug, connector, wire to glow plug control unit. – Pull off glow plug, and check resistance ⇒Page 536 – If resistance is not infinite, check wire and connector.
01658/P067A Glow plug for cylinder 4 Short to earth	◆ Wire open circuit or wire has short to earth Glow plug 4 -Q13- defective	◆ One of the glow plugs is not functional	– Electrical test of glow plug, connector, wire to glow plug control unit. – Check wiring to automatic glow period control unit -J179- ⇒Page 486, current flow diagrams – Pull off glow plug, and read entry in event memory ⇒“Removing, installing and checking glow plugs” on page 536 – If entry is still stored in event memory, check wire and connector
01668/P0684 Glow period control unit 1 -J179-			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Implausible signal	◆ Open circuit or line short-circuit ◆ Automatic glow period control unit -J179- defective	◆ Entire glow plug system does not work ◆ Engine does not start or is difficult to start when cold ◆ Possible smoke when starting engine	– Check -J179- ⇒Page 89, final control diagnosis – Check wiring to automatic glow period control unit -J179- ⇒Page 486, current flow diagrams – Check terminal 30 fuse for glow plug main circuit. – Disconnect glow period control unit, and measure voltage on pin – Check voltage on wire.
01674/P068A Main relay Opens too early	◆ Open circuit or line short-circuit ◆ Defective terminal 30 voltage supply relay -J317-	◆ Engine stops ◆ Engine control unit switched off	– Check wires to -J317- ⇒Page 486, current flow diagrams – Renew main relay, if necessary
01675/P068B Main relay Opens too late	◆ Open circuit or line short-circuit ◆ Defective terminal 30 voltage supply relay -J317-	◆ Battery may be discharged, because ECU is not switched off	– Check wires to -J317- ⇒Page 486, current flow diagrams – Renew main relay, if necessary
01687/P0697 Sender reference voltage “C” Open circuit	◆ Open circuit or line short-circuit	◆ Faults for sensors connected to this source are locked. ◆ Worst case - engine stops	– Renewing engine control unit -J623- ⇒Page 418

3.3 Fault code: 04110/P100E...05779/P1693

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
04110/P100E Torque reduction to protect turbocharger	◆ Charge pressure control defective ◆ Turbocharger defective	◆ No charge pressure control ◆ No exhaust gas recirculation ◆ Reduced performance ◆ Increased exhaust emissions	– -Ladedruckregelung- Check. ⇒Page 333
04197/P1065 Fuel pressure control Control difference	◆ Wire has short to positive ◆ Fuel pressure sender -G247- defective ◆ Fuel pressure regulating valve -N276- defective	◆ No noticeable effects	– -Kraftstoffdruckgeber G247- Check. ⇒Page 394 Check return flow rate from fuel pressure regulating valve -N276- ⇒Page 377. – -N276- Check. ⇒Page 391
04663/P1237 Injector for cyl. 1 -N30- Open circuit	◆ Open circuit or line short-circuit ◆ -N30- defective	◆ Irregular idling or engine stalls ◆ Cylinder is not activated anymore - limp mode	– Check wires on injector 1 (high and low) for open circuit – If OK, check -Einspritzventil N30- ⇒Page 398 – If OK, renew ECU
04664/P1238 Injector for cyl. 2 -N31- Open circuit	◆ Open circuit or line short-circuit ◆ -N31- defective	◆ Irregular idling or engine stalls ◆ Cylinder is not activated anymore - limp mode	– Check wires on injector 2 (high and low) for open circuit – If OK, check -Einspritzventil N31- ⇒Page 398 – If OK, renew ECU
04665/P1239 Injector for cyl. 3 -N32-			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Open circuit	◆ Open circuit or line short-circuit ◆ -N30- defective	◆ Irregular idling or engine stalls ◆ Cylinder is not activated anymore - limp mode	– Check wires on injector 3 (high and low) for open circuit – If OK, check -Einspritzventil N32- ⇒Page 398 – If OK, renew ECU
04672/P1240 Injector for cyl. 4 -N33- Open circuit	◆ Open circuit or line short-circuit ◆ -N33- defective	◆ Irregular idling or engine stalls ◆ Cylinder is not activated anymore - limp mode	– Check wires on injector 4 (high and low) for open circuit – If OK, check -Einspritzventil N33- ⇒Page 398 – If OK, renew ECU
04999/P1387 Control unit defective	◆ Engine control unit -J623- defective	◆ Reduced performance ◆ Increased exhaust emissions ◆ Replicate fault: fault is stored on ignition ON	– -Motorsteuergerät J623- Renew ⇒Page 418
05000/P1388 Control unit defective	◆ Engine control unit -J623- defective	◆ Reduced performance ◆ Increased exhaust emissions ◆ Replicate fault: fault is stored on ignition ON	– If the fault occurs once, a reset can be performed. – If the fault persists, the injection quantity is limited. (there is no injection above 1500 rpm) – Strong jolt when trying to set engine speed above 1500 rpm using pedal encoder. – -Motorsteuergerät J623- Renew ⇒Page 418
05120/P1400 Exhaust gas recirculation valve			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Electrical fault in current circuit	◆ Open circuit or line short-circuit ◆ -N18- defective	◆ No regeneration of diesel particulate filter ◆ H bridge deactivated - no EGR ◆ No limitation	– Check -N18- ⇒Page 89, final control diagnosis – Check wiring of DC motor/EGR valve (short-circuit between M+ and M-) – Disconnect EGR valve --> clear event memory, fault stored again == ECU defective --> no new fault == actuator defective
05121/P1401 Exhaust gas recirculation valve Short to earth	◆ Wire open circuit or wire has short to earth ◆ -N18- defective	◆ No exhaust gas recirculation ◆ H bridge deactivated ◆ No regeneration of diesel particulate filter ◆ No limitation	– Check -N18- ⇒Page 89, final control diagnosis – Check wiring of DC motor/EGR valve (short-circuit between M+ and M-) – Disconnect EGR valve --> clear event memory, fault stored again == ECU defective --> no new fault == actuator defective
05122/P1402 Exhaust gas recirculation valve Short to positive	◆ Open circuit or short to positive in wire ◆ -N18- defective	◆ No exhaust gas recirculation ◆ H bridge deactivated ◆ No regeneration of diesel particulate filter ◆ No limitation	– Check -N18- ⇒Page 89, final control diagnosis – Check wiring of DC motor/EGR valve (short-circuit between M+ and M-) – Disconnect EGR valve --> clear event memory, fault stored again == ECU defective --> no new fault == actuator defective
05184/P1440 Exhaust gas recirculation valve			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Open circuit	◆ Open circuit in wire ◆ -N18- defective		– Check -N18- ⇒Page 89, final control diagnosis – Check electrical connection to actuator, basic setting
05214/P145E Air throughput in regeneration mode Too low	◆ Leak in exhaust gas recirculation system ◆ -N18- defective	◆ The exhaust gas recirculation system is shut-off, and constant specified values are output. ◆ No limitation ◆ No limitation	– Check exhaust gas recirculation system for leaks ⇒Page 433 – Check operation of exhaust gas recirculation valve – Check -N18- ⇒Page 89, final control diagnosis
05215/P145F Air throughput in regeneration mode Too high	◆ Leak in exhaust gas recirculation system ◆ -N18- defective	◆ The exhaust gas recirculation system is shut-off, and constant specified values are output ◆ No limitation	– Check exhaust gas recirculation system for leaks ⇒Page 433 – Check -N18- ⇒Page 89, final control diagnosis
05455/P154F Charge pressure control Malfunction	◆ Charge pressure control defective ◆ Turbocharger defective ◆ Leak in charge air system		– Checking charge air system for leaks ⇒Page 331 – Checking charge pressure control ⇒Page 333.
05488/P1570 Engine control unit locked	◆ Ignition key defective ◆ Gateway control unit defective	◆ Fuel injection suppressed ◆ Engine does not start or stalls right after starting	– Gateway control unit possibly defective – Replicate fault: fault is stored when starting engine – Rectify fault: - problem with key: key (with remote control) broken off, key defective => try with replacement key

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
05522/P1592 Altitude sender/charge pressure sender signal Implausible ratio	◆ Defective charge pressure sender -G31- ◆ Altitude sender -F96- in engine control unit -J623- defective	◆ Torque limiting ◆ Regeneration locked ◆ EGR locked	– -G31- Check. ⇒Page 343 – If necessary, renew -J623- or check electrical connections ⇒Page 418 – With terminal 15 ON, compare measured values of sensors, and check plausibility using a barometer
05635/P1603 Control unit defective	◆ Internal defect in engine control unit -J623-	◆ Engine is switched off ◆ Vehicle cannot be driven anymore	– -J623- Renew ⇒Page 418
05636/P1604 Control unit defective	◆ Internal defect in engine control unit -J623-	◆ Engine is switched off ◆ Vehicle cannot be driven anymore	– Check electrical connection to actuator – -J623- Renew ⇒Page 418
05642/P160A Control unit defective	◆ Internal defect in engine control unit -J623-	◆ Engine does not start or is difficult to start	– -J623- Renew ⇒Page 418
05648/P1610 Control unit defective	◆ Internal defect in engine control unit -J623-	◆ Fuel injection suppressed ◆ Engine does not start or stalls right after starting	– -J623- Renew ⇒Page 418
05650/P1612 Engine control unit Incorrectly coded	◆ Invalid control unit coding for engine control unit -J623-	◆ Dateset 0 is chosen ◆ Various malfunctions possible	– -J623- is not coded or coded incorrectly. => recode ECU, or renew it as necessary
05654/P1616 Glow period warning lamp -K29- Short to positive	◆ Wire has short to positive ◆ -K29- defective	---	– Check -K29- ⇒Page 89, final control diagnosis – Electrical test of pilot line, connector or lamp

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
05655/P1617 Glow period warning lamp -K29- Open circuit/short to earth	◆ Wire open circuit or wire has short to earth ◆ -K29- defective	---	– Check -K29- ⇒ Page 89, final control diagnosis – Electrical test of pilot line, connector or lamp
05694/P163E Control unit defective	◆ Internal defect in engine control unit -J623-	---	– -J623- Renew ⇒ Page 418
05696/P1640 Control unit defective	◆ Internal defect in engine control unit -J623-	◆ ECU performs reset	– -J623- Renew ⇒ Page 418
05778/P1692 Self-diagnosis warning lamp -K83- Short to earth	◆ Wire open circuit or wire has short to earth	---	– Check -K83- ⇒ Page 89, final control diagnosis – Check electrical connection to lamp, if OK => lamp defective ⇒ Page 486, current flow diagrams
05779/P1693 Self-diagnosis warning lamp -K83- Short to positive	◆ Wiring open circuit or wiring short to positive	---	– Check -K83- ⇒ Page 89, final control diagnosis – Check electrical connection to lamp, if OK => lamp defective ⇒ Page 486, current flow diagrams

3.4 Fault code: 08320/P2080 ... 11179 ... P2BAB

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
08320/P2080 Exhaust gas temperature sender 1 Implausible signal	◆ Open circuit or line short-circuit ◆ -G235- defective	◆ The signal range monitoring for exhaust gas temperature sender 1 is stopped, and no plausibility check of other sensors is performed on cold start. ◆ Service regeneration of diesel particulate filter is deactivated.	– -G235- Check. ⇒Page 347 – Comparison of all temperatures with completely cooled down engine and terminal 15 ON / engine OFF. – Electr. test of sensor wires and sensor – Possibly auxiliary heater coded incorrectly
08448/P2100 Throttle valve control Open circuit	◆ Open circuit or line short-circuit ◆ -J388- defective	◆ No regeneration of diesel particulate filter	– Check -J338- ⇒Page 89, final control diagnosis – -J338- Check. ⇒Page 414 – Check electrical connection to actuator
08450/P2102 Throttle valve module, control motor activation Signal too low	◆ Open circuit or line short-circuit ◆ -J388- defective	◆ No regeneration of diesel particulate filter	– Check -J338- ⇒Page 89, final control diagnosis – -J338- Check. ⇒Page 414 – Check electrical connection to actuator
08451/P2103 Throttle valve module, control motor activation Signal too large	◆ Open circuit or line short-circuit ◆ -J388- defective	◆ No regeneration of diesel particulate filter	– Check -J338- ⇒Page 89, final control diagnosis – -J338- Check. ⇒Page 414 – Check electrical connection to actuator

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
08465/P2111 Throttle valve module Jammed in open position	◆ -J388- soiled ◆ -J388- defective	◆ The monitoring is deactivated, and the flap is deenergised. ◆ No regeneration of diesel particulate filter	– Check -J338- ⇒Page 89, final control diagnosis – -J338- Check. ⇒Page 414 – Clean -J338-, and renew as necessary – The sensor may be defective as well
08466/P2112 Throttle valve module Jammed in open position	◆ -J388- soiled ◆ -J388- defective	◆ The monitoring is deactivated, and the flap is deenergised ◆ No regeneration of diesel particulate filter	– Check -J338- ⇒Page 89, final control diagnosis – -J338- Check. ⇒Page 414 – Clean -J338-, and renew as necessary – The sensor may be defective as well
08482/P2122 Accelerator pedal position sender Signal too low	◆ Wiring open circuit or wiring short to positive ◆ -G79- defective	◆ Torque is considerably reduced above 3000 rpm	– -G79- Check. ⇒Page 316 – Electrical test: connectors, short to earth in cable
08483/P2123 Accelerator pedal position sender Signal too large	◆ Wire open circuit or wire has short to earth ◆ -G79- defective	◆ Torque is considerably reduced above 3000 rpm	– -G79- Check. ⇒Page 316 – Electrical test: connectors, short to positive in cable
08487/P2127 Accelerator pedal position sender 2 Signal too low	◆ Wiring open circuit or wiring short to positive ◆ -G185- defective	◆ Torque is considerably reduced above 3000 rpm	– Electrical test: connectors, short to earth in cable

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
08488/P2128 Accelerator pedal position sender 2 Signal too large	◆ Wire open circuit or wire has short to earth ◆ -G185- defective	◆ Torque is considerably reduced above 3000 rpm	– Electrical test: connectors, short to positive in cable
08504/P2138 Accelerator pedal position senders 1/2 -G79+G185- Implausible signal	◆ Open circuit or line short-circuit ◆ -G79/G185- defective	◆ Torque is considerably reduced above 3000 rpm	– -G79- Check. ⇒Page 316 – Electrical test: connectors, check cables for contact resistance between sensors 1 and 2. – The sensors may have to be renewed
08518/P2146 Voltage supply of injector(s) A Open circuit	◆ Open circuit or line short-circuit ◆ -N30...N33- defective	◆ Engine stalls	– -N30...N33- Check. ⇒Page 398 – Check wires (high and low) of injectors for short to positive/earth. – Check one high wire of bank A for short-circuit to another high wire of bank A. If OK, check injectors. If OK, renew ECU.
08521/P2149 Voltage supply of injector(s) B Open circuit	◆ Open circuit or line short-circuit ◆ -N30...N33- defective	◆ Engine stalls	– -N30...N33- Check. ⇒Page 398 – Check wires (high and low) of injectors for short to positive/earth. – Check one high wire of bank A for short-circuit to another high wire of bank A. If OK, check injectors. If OK, renew ECU.

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
08597/P2195 Lambda probe 1 - bank 1 Signal too lean	◆ Wiring open circuit ◆ Lambda probe -G39- defective	◆ Regeneration of NOx storage catalytic converter is locked	– -G39- Check. ⇒ Page 439 – Check electrical connection to lambda probe, or renew probe, possibly consequential fault of: - leak in intake air/exhaust gas duct - air mass meter defective, offset in fuel rail
08598/P2196 Lambda probe 1 - bank 1 Signal too rich	◆ Wiring open circuit ◆ Lambda probe -G39- defective	◆ Regeneration of NOx storage catalytic converter is locked	– -G39- Check. ⇒ Page 439 – Check electrical connection to lambda probe, or renew probe, possibly consequential fault of: - leak in intake air/exhaust gas duct - air mass meter defective, oil leak in turbocharger, offset in fuel rail
08759/P2237 Lambda probe 1 - bank 1, pump current			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Open circuit	◆ Wiring open circuit ◆ Lambda probe -G39- defective	◆ Zero quantity calibration locked ◆ Calculation of diesel particulate filter load locked ◆ No exhaust gas temperature regulation, FMO ◆ Regeneration of NOx storage catalytic converter is locked	– -G39- Check. ⇒Page 439 – Check measuring resistor: disconnect universal lambda probe, and measure on contacts of coupling between "pump current (APE)" and "trimm resistor (Ri)", R=60-65 ohm; Warning!: terminal 15 OFF for this --> if measuring resistor is defective, renew lambda probe. Check voltage supply: disconnect universal lambda probe, and measure on contacts of coupling between "virtual earth (IPN)" and "body earth", V=2-3 V; Warning!: terminal 15 ON for this --> if there is no voltage, check wire for open circuit and renew it as necessary. Check wires for "pump current (APE)", "virtual earth (IPN)", "trimm resistor (Ri)" and "Nernst voltage (RE+) for open circuits and short circuits --> if there are open circuits or short-circuits, repair lines --> if the fault persists, check ECU
08771/P2243 Lambda probe 1 - bank 1, reference voltage			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Open circuit	◆ Wiring open circuit ◆ Lambda probe -G39- defective	◆ Zero quantity calibration locked ◆ Calculation of diesel particulate filter load locked ◆ No exhaust gas temperature regulation, FMO ◆ Regeneration of NOx storage catalytic converter is locked	– -G39- Check. ⇒Page 439 – Check measuring resistor: disconnect universal lambda probe, and measure on contacts of coupling between "pump current (APE)" and "trimm resistor (Ri)", R=60-65 ohm; Warning!: terminal 15 OFF for this --> if measuring resistor is defective, renew lambda probe. Check voltage supply: disconnect universal lambda probe, and measure on contacts of coupling between "virtual earth (IPN)" and "body earth", V=2-3 V; Warning!: terminal 15 ON for this --> if there is no voltage, check wire for open circuit and renew it as necessary. Check wires for "pump current (APE)", "virtual earth (IPN)", "trimm resistor (Ri)" and "Nernst voltage (RE+) for open circuits and short circuits --> if there are open circuits or short-circuits, repair lines --> if the fault persists, check ECU
08785/P2251 Lambda probe 1 - bank 1, earth wire			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Open circuit	◆ Wiring open circuit ◆ Lambda probe -G39- defective	◆ Zero quantity calibration locked ◆ Calculation of diesel particulate filter load locked ◆ No exhaust gas temperature regulation, FMO ◆ Regeneration of NOx storage catalytic converter is locked	– -G39- Check. ⇒Page 439 – Check measuring resistor: disconnect universal lambda probe, and measure on contacts of coupling between "pump current (APE)" and "trimm resistor (Ri)", R=60-65 ohm; Warning!: terminal 15 OFF for this --> if measuring resistor is defective, renew lambda probe. Check voltage supply: disconnect universal lambda probe, and measure on contacts of coupling between "virtual earth (IPN)" and "body earth", V=2-3 V; Warning!: terminal 15 ON for this --> if there is no voltage, check wire for open circuit and renew it as necessary. Check wires for "pump current (APE)", "virtual earth (IPN)", "trimm resistor (Ri)" and "Nernst voltage (RE+) for open circuits and short circuits --> if there are open circuits or short-circuits, repair lines --> if the fault persists, check ECU
08825/P2279 Leaked air in intake system	◆ Leaks between turbocharger and engine (charge air system)	◆ Torque limiting (limp mode) ◆ Regeneration locked ◆ Exhaust gas recirculation switched off ◆ Charge pressure control switched off	– Checking charge air system for leaks ⇒Page 331 – Checking charge pressure control ⇒Page 333.
08852/P2294 Fuel pressure regulating valve			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Open circuit	◆ Open circuit in wire ◆ Fuel pressure regulating valve -N276- defective	◆ Failure of pressure regulating valve ◆ Engine stalls	– -N276- Check. ⇒Page 391 – Check electrical connection to pressure regulating valve. Check terminal 15 ON and +12V on actuator + (A2). No voltage -> open circuit between Vbat and actuator. Pull connector off actuator, and check wiring between actuator/ ECU. Measure resistance on actuator. If no continuity -> renew ECU
08853/P2295 Fuel pressure regulating valve Short to earth	◆ Wiring short to earth ◆ Fuel pressure regulating valve -N276- defective	◆ Failure of pressure regulating valve ◆ Engine stalls	– -N276- Check. ⇒Page 391 Pull connector off actuator, and read event memory again -- if in addition PCVOL--> renew actuator -- otherwise check wiring between actuator/ ECU -- if OK --> renew ECU
08854/P2296 Fuel pressure regulating valve Short to positive	◆ Wire has short to positive ◆ Fuel pressure regulating valve -N276- defective	◆ Failure of pressure regulating valve ◆ Engine stalls	– -N276- Check. ⇒Page 391 – Pull connector off actuator, and read event memory again -- if in addition PCVOL--> renew actuator -- otherwise check wiring between actuator/ECU -- if OK --> renew ECU
09258/P242A Exhaust gas temperature sender 3, bank 1			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Electrical fault	◆ Open circuit or line short-circuit ◆ -G495- defective	◆ Regeneration of diesel particulate filter locked	– -G495- Check. ⇒Page 442 – Pull off temperature sensor, and measure reference voltage (3.3 V) on signal line, measured value block "Exh_uRawTOxiCatDs" ⇒ connect signal line to earth, if sensor raw voltage in measured value block = 0 V => sensor defective, sensor raw voltage in measured value block approx.=0 V => check sensor wire to ECU – Wire to ECU OK, ECU defective
09259/P242B Exhaust gas temperature sender 3, bank 1 Implausible signal	◆ Open circuit or line short-circuit ◆ -G495- defective	◆ No limitation	– -G495- Check. ⇒Page 442 – Comparison of all temperatures with completely cooled down engine and terminal 15 ON / engine OFF. Electr. test of sensor wires
09260/P242C Exhaust gas temperature sender 3, bank 1			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Short to earth	◆ Wiring short to earth ◆ -G495- defective	◆ Regeneration of diesel particulate filter locked	– -G495- Check. ⇒Page 442 – Pull off temperature sensor => sensor raw voltage in measured value block "MWB,Exh_uRaw-TOxiCatDs" approx. reference voltage (3.3 V) ⇒ sensor defective, sensor raw voltage in measured value block approx. 0 V ⇒ check wire to ECU – Wire to ECU OK, ECU defective
09263P242F Diesel particulate filter Overloaded	◆ Wiring short to earth ◆ -G495- defective	◆ No service regeneration possible anymore	– Renew diesel particulate filter
09298/P2452 Diesel particulate filter, pressure differential sender Electrical fault	◆ Open circuit or line short-circuit ◆ -G450- defective	◆ Regeneration of diesel particulate filter locked	– -G450- Check. ⇒Page 446 – Pull off pressure sensor and connect signal wire to earth ⇒ sensor raw voltage in measured value block approx. 0 V => sensor defective => sensor raw voltage in measured value block > 0 V => check wire to ECU – Wire to ECU OK, ECU defective
09299/P2453 Diesel particulate filter, pressure differential sender			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Implausible signal	◆ Wire open circuit or wire has short to earth ◆ -G450- defective ◆ Control lines between -G450- and diesel particulate filter clogged or interchanged	◆ No limitation	– -G450- Check. ⇒Page 446 – Check control lines ⇒Page 427, Assembly overview - diesel particulate filter – Check diesel particulate filter, CJDA, CJDD ⇒Page 460, – Check diesel particulate filter, CPYA, CPYB, CPYC, CPYD, CPYE ⇒Page 454, – Check proper connection of hoses on pressure differential sender (leaks, clogged, etc.), perform electr. test on sensor wire: 1.) Pull off pressure sensor => sensor raw voltage in measured value block=reference voltage (5V) => sensor defective =>sensor raw voltage in measured value block=reference voltage => check sensor wire to ECU – Wire to ECU OK, ECU defective
09300/P2454 Diesel particulate filter, pressure differential sender			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Short to earth	◆ Wiring short to earth ◆ -G450- defective	◆ Regeneration of diesel particulate filter locked	– -G450- Check. ⇒Page 446 – Check control lines ⇒Page 427, Assembly overview - diesel particulate filter – Check diesel particulate filter, CJDA, CJDD ⇒Page 460, – Check diesel particulate filter, CPYA, CPYB, CPYC, CPYD, CPYE ⇒Page 454, – Pull off pressure sensor => sensor raw voltage in measured value block=reference voltage (5V) => sensor defective =>sensor raw voltage in measured value block=reference voltage => check sensor wire to ECU – Wire to ECU OK, ECU defective
09315/P2463 Diesel particulate filter			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Soot level too high	◆ Diesel particulate filter overloaded, e.g. due to excessive short-distance driving ◆ The load detection function reported a soot loading of > 30 g. The engine runs in limp mode, and torque is limited to 120 Nm.	◆ Torque limiting ◆ Regeneration of diesel particulate filter locked ◆ As of a soot loading of 35 g, the diesel particulate filter must be renewed. ◆ No exhaust gas recirculation ◆ After the fault has been rectified, the oil must be changed.	– Check diesel particulate filter ⇒“Checking diesel particulate filter, engine codes CJDA, CJDD” on page 460, – Check diesel particulate filter, and note engine code Emergency regeneration must be performed on diesel particulate filter – An emergency regeneration must be performed on diesel particulate filter, because the regeneration is locked. This may be caused by excessive short-distance driving, or it may be a consequential fault (EGR valve defective; air mass meter defective; leak in charge air system; pressure differential sender on diesel particulate filter defective). If no emergency regeneration can be performed on diesel particulate filter, it must be renewed
09326/P246E Exhaust gas temperature sender 4, bank 1			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Electrical fault	◆ Open circuit or line short-circuit ◆ -G648- defective	◆ Regeneration of diesel particulate filter locked	– -G648- Check. ⇒Page 444 – Pull off temperature sensor, and measure reference voltage (3.3 V) on signal line, measured value block => connect signal line to earth, if sensor raw voltage in measured value block = 0 V => sensor defective => sensor raw voltage in measured value block approx.=0 V => check sensor wire to ECU – Wire to ECU OK, ECU defective
09327/P246F Exhaust gas temperature sender 4, bank 1 Implausible signal	◆ Open circuit or line short-circuit ◆ -G648- defective	◆ No limitation	– -G648- Check. ⇒Page 444 – Comparison of all temperatures with completely cooled down engine and terminal 15 ON / engine OFF. Electr. test of sensor wires;
09328/P2470 Exhaust gas temperature sender 4, bank 1 Short to earth	◆ Wiring short to earth ◆ -G648- defective	◆ Regeneration of diesel particulate filter locked	– -G648- Check. ⇒Page 444 – Pull off temperature sensor => sensor raw voltage in measured value block "Exh_uRawTPFltDs" approx. reference voltage (3.3 V) => sensor defective, sensor raw voltage in measured value block approx. 0 V => check wire to ECU – Wire to ECU OK, ECU defective

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
0938/P247A Exhaust gas temperature sender 3, bank 1 Exhaust gas temperature out of permissible range		◆ The worst case is that the regeneration may not be completed successfully	– Primarily: electrical test/renewal of sensor wiring and exhaust gas temperature sender 1; secondarily: check proper operation of EGR, throttle valve, injector, air mass meter -> if OK, diesel oxidising catalytic converter may be defective
09571/P2563 Position sender for charge pressure positioner Implausible signal	◆ Open circuit or short-circuit in wire ◆ -G581- defective		– -G581- Check. ⇒Page 345 – Final control test (measure raw voltage in measured value block). (Specification must constantly change between 0.15 V - 4.85 V). If not OK: - check actuator mechanism - check vacuum hoses - clean actuator - sensor stuck
09572/P2564 Position sender for charge pressure positioner			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
Signal too low	◆ Open circuit or short-circuit in wire ◆ -G581- defective	◆ Limp mode ◆ Regeneration of diesel particulate filter locked (regular and emergency regeneration)	– -G581- Check. ⇒Page 345 – Check electr. connection to sender, check feedback line for open circuit, check for short-circuit between feedback line and sensor earth/body earth, check for short-circuit between pins for sensor earth and feedback voltage on charge pressure positioner, if check shows no results, renew charge pressure positioner.
09573/P2565 Position sender for charge pressure positioner Signal too high	◆ Open circuit or short-circuit in wire ◆ -G581- defective	◆ Limp mode ◆ Regeneration of diesel particulate filter locked (regular and emergency regeneration)	– -G581- Check. ⇒Page 345 – Terminal 15 ON, read event memory -> only MAX fault, terminal 15 OFF, pull off connector on turbocharger -> Terminal 15 ON, read event memory -> additional MIN fault == renew turbocharger (E-positioner), no additional MIN fault: check electr. connection to sender, check for short-circuit between feedback line and and battery voltage, sensor supply voltage and DC motor lines. Check for short-circuit on pins for sensor supply voltage and feedback line on charge pressure positioner
09742/P0260E Activation of diesel particulate filter warning lamp			

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
	◆ Open circuit or short-circuit in line ◆ Warning lamp defective		– Check warning lamp ⇒Page 89, final control diagnosis – Check electrical connection to lamp, if OK => lamp defective ⇒Page 486, current flow diagrams
09744/P2610 Control unit defective	◆ Internal defect in engine control unit -J623-	◆ ESI4, calculation limited and validation of temperature sensors on cold start locked	– -J623- Renew ⇒Page 418
09778/P2632 Electric fuel pump 2 relay -J49- Open circuit	◆ Open circuit in wire ◆ -J49- defective	◆ Supplementary fuel pump -V393- fails ◆ Pressure in low-pressure fuel system too low	– Check -J49- ⇒Page 89, final control diagnosis – Check wiring to -J49- ⇒Page 486, current flow diagrams – Check terminal 15 On and +12V on relay + (KL85). Pull off relay connector, and check wiring between relais/ECU. Measure resistance on relay. – If no continuity ⇒ renew -JJ623- ⇒Page 418
09779/P2633 Electric fuel pump 2 relay -J49- Short to earth	◆ Wiring short to earth ◆ -J49- defective	◆ Inline fuel pump -V393- runs continuously when terminal 15 ON	– Check -J49- ⇒Page 89, final control diagnosis – Pull off relay, and read event memory again -- if in addition PSPInlineOL--> renew relay – Check wiring to -J49- ⇒Page 486, current flow diagrams – If OK, renew -JJ623- ⇒Page 418

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
09780/P2634 Electric fuel pump 2 relay -J49- Short to positive	◆ Wire has short to positive ◆ -J49- defective	◆ Supplementary fuel pump -V393- fails ◆ Pressure in low-pressure fuel system too low	– Check -J49- ⇒ Page 89, final control diagnosis – Pull off relay, and read event memory again -- if in addition PSPInlineOL--> renew relay – Check wiring to -J49- ⇒ Page 486, current flow diagrams – If OK, renew -JJ623- ⇒ Page 418
11179/P2BAB Nox limit exceeded -J49- Fault in exhaust gas recirculation system		◆ Statutory long-term event memory entry; the entry only occurs in conjunction with another EGR fault. "Incorrect EGR throughput"	

3.5 Fault code: 13256/P33C8...13257/P33C9

Indicated on display	Possible cause of fault		Fault remedy
13256/P33C8 Soot loading of diesel particulate filter Soot threshold 1 exceeded	---	◆ This fault path is used for indicating an excessive soot loading of the diesel particulate filter. The counter in the diagnosis extract describes, how often there was a diesel particulate filter loading > 1st alarm threshold (soot loading of 22 g). No repair required, use only for statistics.	---

Indicated on display	Possible cause of fault		Fault remedy
13257/P33C9 Soot loading of diesel particulate filter Soot threshold 2 exceeded	◆ Diesel particulate filter overloaded, e.g. due to excessive short-distance driving ◆ The system was in thermal management mode for longer than for more than 100 operating hours, or the operating hour ratio between normal mode and thermal management mode is higher than 25% (as of 25 operating hours in thermal management mode after last service regeneration)	◆ This fault path is used for indicating an excessive soot loading of the diesel particulate filter. The counter in the diagnosis extract describes, how often there was a diesel particulate filter loading > 2nd alarm threshold (soot loading of 26 g). After the work day has been completed, a service regeneration must be performed on the diesel particulate filter.	◆ After the service regeneration, the engine oil must be changed. There may be a fault in the following components: EGR cooler, air mass meter, turbocharger/ charge pressure, injection quantities, injectors (IMA-code), air filter, leak in charge air system, pressure differential sender with hoses. Note and evaluate measured value blocks 100, 104, 108

3.6 Fault code: 49153/U0001...54282/U140A

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
49153/U0001 Data bus Powertrain defective	◆ Fault in data wires ◆ No communication	◆ Engine will not start ◆ Torque limiting ◆ Gearbox limp mode	– Check data bus/CAN wiring ⇒Page 424
53263/U100F Special vehicle control unit No communication		◆ No ACC increase	– Check powertrain CAN bus and vehicle control unit
53306/U103A Special vehicle control unit Implausible signal		◆ None ◆ No ACC increase	– Check powertrain CAN bus and vehicle control unit

Indicated on display	Possible cause of fault	Possible effects	Fault remedy
54282/U140A Terminal 30 Open circuit	◆ Voltage supply too small ◆ Defective terminal 30 voltage supply relay -J317-	◆ Engine will not start ◆ Various issues during operation including engine will not start	– Check voltage supply for engine control unit -J623- ⇒ Page 417

4 Final control diagnosis

Performing final control diagnosis ⇒ Page 89

4.1 Performing final control diagnosis

The final control diagnosis activates the following components in the stated sequence:

1 - Exhaust gas recirculation valve -N18-

2 - Charge pressure control solenoid valve -N75-

3 - Alternator shutdown device (if fitted)

4 - Throttle valve module -J338-

5 - Glow period warning lamp -K29- (if fitted)

6 - Exhaust emissions warning lamp -K83- (if fitted)

7 - Warning lamp for diesel particle filter -K231-

8 - Radiator fan control unit -J293-, radiator fan activation assembly 1 (if fitted)

9 - Automatic glow period control unit -J179-

10 - Electric fuel pump relay -J49-

11 - Supplementary fuel pump -V393-

Note

- *Activation of individual final controls is limited to 120 s but can be stopped at any time by pressing the → button.*
- *The ignition must be switched off before repeating the final control diagnosis.*

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK
- Coolant temperature must be at least 80°C, ⇒ display group 1, display zone 4.

Procedure

– Connect vehicle diagnostic tester, and select engine control unit. ⇒Page 23

– Select diagnosis function “03-Final control diagnosis”. Engine must be idling.

Activating exhaust gas recirculation valve -N18-

Note

After the diagnosis function “03-Final control diagnosis” has been selected, the first final control, here the exhaust gas recirculation valve -N18-, is activated.

The exhaust gas recirculation valve -N18- is activated.

The displays in display zones 3 and 4 must fluctuate within following control range:

- Specification in display zone 3: 180…470 mg/stroke
- Specification in display zone 4: 70…100%

Note

The activation of the valve can also be checked by touching it.

If the valve is not activated:

– Proceed with final control diagnosis until completed.

– Check exhaust gas recirculation ⇒Page 436.

Activating charge pressure control solenoid valve -N75-

– Press [→] button.

The charge pressure control solenoid valve -N75- is activated.

The displays in display zones 2, 3 and 4 must fluctuate within following control range:

Display zone 2 OFF:

- Specification in display zone 3: 900…1150 mbar
- Specification in display zone 4: 90…100%

Display zone 2 ON:

- Specification in display zone 3: 100 mbar higher than with display OFF
- Specification in display zone 4: 95%

Note

- *The activation of the valve can also be checked by touching it.*
- *During activation, the linkage of the charge pressure control vacuum unit on the turbocharger must move back and forth.*

If the valve is not activated:

– Proceed with final control diagnosis until completed.

– Check the charge pressure control ⇒Page 333.

Activating alternator shutdown function (if present)

– Press [→] button.

The alternator is activated.

- The alternator warning lamp must flash.

The display in display zone 4 must fluctuate within the following control range:

Alternator warning lamp OFF:

- Specification in display zone 4: battery voltage V

Alternator warning lamp ON:

- Specification in display zone 4: smaller than with display OFF

If the alternator is not activated:

– Proceed with final control diagnosis until completed.

– Check alternator according to current flow diagram ⇒ Page 486, current flow diagrams.

Activating throttle valve module -J338-

– Press [→] button.

The throttle valve module -J338- is activated.

- The engine must be switched off when the throttle valve module is activated.

If the engine is not switched off:

– Proceed with final control diagnosis until completed.

– Switch off ignition.

– Check throttle valve module ⇒ Page 414.

Activating glow period warning lamp -K29- (if fitted)

– Press [→] button.

The glow period warning lamp -K29- is activated.

- The warning lamp must flash.

Warning lamp does not flash:

– Check glow period warning lamp -K29- according to current flow diagram ⇒ Page 486, current flow diagrams.

Activating exhaust emissions warning lamp -K83- (if fitted)

– Press [→] button.

The exhaust emissions warning lamp -K83- is activated.

- The exhaust emissions warning lamp must flash.

Exhaust emissions warning lamp does not flash:

– Check exhaust emissions warning lamp -K83- according to current flow diagram ⇒ Page 486, current flow diagrams.

Activating diesel particulate filter warning lamp -K231-

– Press [→] button.

The diesel particulate filter warning lamp -K231- is activated.

- The warning lamp must flash.

Warning lamp does not flash:

– Check diesel particulate filter warning lamp -K231- according to current flow diagram ⇒Page 486, current flow diagrams.

Activating radiator fan activation assembly 1 (if fitted)

> ⚠ ***DANGER!***
>
> ***Risk of injury caused by rotating components. Makes sure that no objects, such as components and lines, are blocking the radiator fan.***

– Press [→] button.

The radiator fans are activated.

- The radiator fans must start running according to the status in display zone 2 (ON/OFF).

If the radiator fans do not start:

– Check radiator fan activation assembly 1 according to current flow diagram ⇒Page 486, current flow diagrams.

Activating automatic glow period control unit -J179-

– Press [→] button.

The automatic glow period control unit -J179- is activated.

- The control unit must click.

Note

The clicking of the control unit is difficult to hear and is therefore best checked by touching.

If the control unit does not click:

– Check automatic glow period control unit -J179- ⇒Page 486, current flow diagrams.

Activating electric fuel pump relay -J49-

– Press [→] button.

The supplementary fuel pump -V393- is activated intermittently.

Note

The activation of the supplementary fuel pump -V393- can be heard and felt.

If the activation of the supplementary fuel pump -V393- could not be heard or felt:

– Exit diagnosis function.

– Switch off ignition.

The final control diagnosis is complete.

– Check supplementary fuel pump -V393- and electric fuel pump relay -J49- ⇒Page 486, current flow diagram.

Activating fuel pump

– Press [→] button.

The supplementary fuel pump -V393- is activated.

Note

The activation of the supplementary fuel pump -V393- can be heard and felt.

If the activation of the supplementary fuel pump -V393- could not be heard or felt:

– Exit diagnosis function.

– Switch off ignition.

The final control diagnosis is complete.

– Check supplementary fuel pump -V393- and electric fuel pump relay -J49- ⇒Page 486, current flow diagram.

5 Measured value blocks, engine codes CJDA, CJDD

Observe safety precautions ⇒Page 93.

Read measured value block ⇒Page 94.

Evaluate measured value blocks:

- At idling speed ⇒Page 95,
- At full load ⇒Page 106.

5.1 Safety precautions

WARNING

When doing any repair work, pay attention to the following due to the cramped conditions:

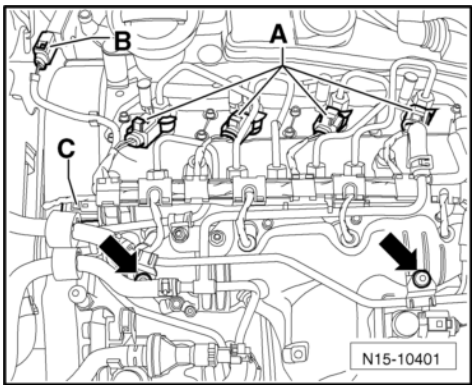
- ***Route all the various lines (e.g. for fuel, hydraulics, activated charcoal filter system, coolant, refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.***
- ***Ensure that there is sufficient clearance to all moving or hot components.***

To prevent injuries to persons and/or destruction of the injection and glow plug system, the following must be noted:

- Always switch off the ignition before connecting or disconnecting injection and glow plug system wiring or tester cables.
- If the engine is to be turned at starter speed without starting, e.g. to check compression, pull connector -A- off injectors.
- Disconnecting and connecting the battery must only be done with the ignition switched off, otherwise the engine control unit could be damaged.

Note the following if testers and measuring instruments have to be used during a road test:

- The test and measuring equipment must always be secured and operated by a 2nd person.



5.2 Reading measured value block

Note

The measured values in the diagnosis function “011-Read measured value block” are described in the sections for checking the individual components. This table serves only as an overview.

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- Earth connections OK
- All electrical consumers must be switched off.
- No faults must be stored in event memory ⇒Page 26, read event memory.
- Coolant temperature must be at least 80°C, ⇒ display group 1, display zone 4.

Test procedure

– Start engine and run at idling speed.

– Connect vehicle diagnostic tester, and select engine control unit. ⇒Page 23

– Select “011-Read measured value block”.

Note

The “Display group 1” is an example to illustrate the procedure.

– Select “Display group 1”.

Indicated on display: (1…4 = display zones)

```
Display group 1
        1         2         3         4
```

Note

The display zones may be shown one below the other or next to each other on the display of the vehicle diagnostic tester.

– To change to another display group proceed as follows:

Display group	Button
Higher	Press [↑] button
Lower	Press [↓] button
Skip	Press [←] button.

If the specifications are attained in all display zones:

– Exit diagnosis function.

– Switch off ignition.

5.3 Evaluating measured value blocks at idling speed

Always follow safety precautions ⇒ Page 93.

Read measured value block ⇒ Page 94.

Display group:

- 1 - Injected quantity ⇒ Page 95,
- 2 - Idling speed ⇒ Page 96,
- 3 - Exhaust gas recirculation ⇒ Page 97,
- 4 - Activation of injectors -N30...N33- ⇒ Page 97,
- 7 - Temperatures ⇒ Page 98,
- 10 - Air quantities ⇒ Page 98,
- 11 - Charge pressure control ⇒ Page 99,
- 12 - Status ⇒ Page 99,
- 13 - Smooth running control ⇒ Page 101,
- 20 - Fuel rail values 3 ⇒ Page 101,
- 30 - Pedal encoder ⇒ Page 102,
- 34 - Charge pressure positioner ⇒ Page 103,
- 99 - Exhaust gas temperature sender ⇒ Page 103,
- 100 - Diesel particulate filter, exhaust gas temperature, differential pressure ⇒ Page 104,
- 106 - Diesel particulate filter regeneration 6 ⇒ Page 105,
- 108 - Diesel particulate filter regeneration 8 ⇒ Page 105

5.3.1 Display group 1 - Injected quantity

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80°C.
- Intake air temperature < 40°C.

Display zone	Operating mode or component	Specification	Evaluation
1	Engine speed	760...940 rpm	---
2	Average injection quantity	3.0...9.0 mg/stroke	⇒Page 96
3	Pressure in high-pressure fuel system (actual)	170.0...350.0 bar	---
4	Coolant temperature	80.0...110.0°C	---

Evaluation: Display group 1, display zone 2 - quantity injected

Display shows	Possible cause of fault	Fault remedy
Below specification	◆ Injectors for cylinders 1…4 -N30...N33- defective	– -N30...N33- Check. ⇒Page 398
Above specification	◆ Engine too cold	– Run engine at increased speed to warm up, and repeat test
	◆ Shortage of fuel ◆ Air in fuel system	– Check fuel supply system ⇒Page 298, removing and installing parts of fuel supply system – Bleeding fuel system ⇒Page 383.
	◆ Injectors for cylinders 1…4 -N30...N33- defective	– -N30...N33- Check. ⇒Page 398

5.3.2 Display group 2 - Idling speed

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80°C.
- Intake air temperature < 40°C.

Display zone	Operating mode or component	Specification	Evaluation
1	Engine speed	760...940 rpm	---
2	Accelerator position ◆ If accelerator position sender -G79- is installed	0.0 %	⇒Page 96
3	Accelerator pedal switch positions	---	---
4	Coolant temperature	80.0...110.0°C	---

Evaluation: Display group 2, display zone 2 - accelerator position

Display shows	Possible cause of fault	Fault remedy
1.0...100.0%	◆ Defective accelerator position sender -G79- ◆ Open circuit in wiring to -G79-	– -G79- Check. ⇒Page 316

5.3.3 Display group 3 - Exhaust gas recirculation

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80°C.
- Intake air temperature < 40°C.

Display zone	Operating mode or component	Specification	Evaluation
1	Engine speed	760...940 rpm	---
2	Intaken air mass (specified):	280...460 mg/stroke	---
3	Intaken air mass (actual):	280...480 mg/stroke[1)]	⇒Page 97
4	Duty cycle of exhaust gas recirculation valve	70...100 %	---

1) The specification applies for deactivated exhaust gas recirculation system. (Duty cycle of exhaust gas recirculation valve in display zone 4 at 100 %.

Evaluation: display group 3, display zone 3 - intaken air mass (actual)

Display shows	Possible cause of fault	Fault remedy
Below specification	◆ Excessive exhaust gas recirculation	– Check exhaust gas recirculation system ⇒Page 436
	◆ Unmetered air	– Check intake system for leaks
Above specification	◆ Engine too cold	– Run engine at increased speed to warm up, and repeat test
	◆ Insufficient exhaust gas recirculation	– Engine running for a long time at idling speed, give burst on throttle
	◆ Defective air mass meter -G70-	– -G70- Check. ⇒Page 411

5.3.4 Display group 4 - Activation of injectors -N30...N33-

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80°C.
- Intake air temperature < 40°C.

Display zone	Operating mode or component	Specification	Evaluation
1	Engine speed	760...940 rpm	---
2	Start of main injection activation	-5...5°CrS	⇒Page 97
3	Duration of main injection activation	350...700 ms	---
4	Pressure in high-pressure fuel system (actual)	170...350 bar	---

Evaluation: display group 4, display zone 2 - start of main injection activation:

Display shows	Possible cause of fault	Fault remedy
Above specification	◆ Engine too cold	– Run engine at increased speed to warm up, and repeat test

5.3.5 Display group 7 - Temperatures

Test prerequisites

- Ignition switched on.
- Engine is off and cooled down.

Display zone	Operating mode or component	Specification	Evaluation
1	Fuel temperature	Approx. ambient temperature[1)]	⇒Page 98
2	Engine oil temperature	---	---
3	Intake air temperature	Approx. ambient temperature[1)]	⇒Page 98
4	Coolant temperature	Approx. ambient temperature[1)]	⇒Page 98

1) Details of temperature specifications are not possible. When the engine is cold the fuel, intake air and coolant temperatures must equate approximately to ambient temperature. If one of the temperature readings is noticeably different, test the relevant sender.

Evaluation: Display group 7, display zone 1 - fuel temperature

Display shows	Possible cause of fault	Fault remedy
Large deviation from ambient temperature	◆ Short circuit or fuel temperature sender -G81- defective	– -G81- Check. ⇒Page 409

Evaluation: display group 7, display zone 3 - Intake air temperature

Display shows	Possible cause of fault	Fault remedy
Large deviation from ambient temperature	◆ Short circuit or intake air temperature sender -G42- defective	– -G42- Check. ⇒Page 404

Evaluation: Display group 7, display zone 4 - coolant temperature

Display shows	Possible cause of fault	Fault remedy
Large deviation from ambient temperature	◆ Short circuit or defective coolant temperature sender -G62-	– -G62- Check. ⇒Page 407

5.3.6 Display group 10 - Air quantities

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80°C.

- Intake air temperature < 40°C.

Display zone	Operating mode or component	Specification	Evaluation
1	Intaken air mass (actual)	xxx mg/stroke 1)	---
2	Atmospheric pressure (ambient pressure)	900...1100 mbar	---
3	Charge pressure (actual)	xxx mbar 1)	---
4	Accelerator position ◆ If accelerator position sender -G79- is installed	0,0 %	⇒Page 99

1) The values displayed at “idling speed” are not relevant.

Evaluation: Display group 10, display zone 4 - accelerator position

Display shows	Possible cause of fault	Fault remedy
1.0...100.0%	◆ Defective accelerator position sender -G79- ◆ Open circuit in wiring to -G79-	– -G79- Check. ⇒Page 316

5.3.7 Display group 11 - Charge pressure control

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80°C.
- Intake air temperature < 40°C.

Display zone	Operating mode or component	Specification	Evaluation
1	Engine speed	760...940 rpm	---
2	Charge pressure (specified)	xxx mbar 1)	---
3	Charge pressure (actual)	xxx mbar 1)	---
4	Duty cycle of charge pressure control solenoid valve	xxx % 1)	---

1) The values displayed at “idling speed” are not relevant.

5.3.8 Display group 12 - Status

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80°C.
- Intake air temperature < 40°C.

Display zone	Operating mode or component	Specification	Evaluation
1	Glow plug system status	1111 1111	⇒Page 100
2	Glow period (in seconds)	xx,x s	---
3	Voltage supply from automatic glow period control unit	Approx. battery voltage	---
4	Coolant temperature	80.0...110.0°C	---

Evaluation: display group 12, display zone 1 - glow plug system status

Note

Meaning of figures in 8-digit number block for status of glow plug system:

Significance if display = 1	
Display shows	**Glow plug system status**
0000 0000	Waiting for coolant temperature
0001 0000	Pre-heating
1011 0000	Post-heating
1111 0000	Intermediate heating
0011 0000	Standby-heating
1011 0001	Waiting for post-heating
1111 0001	Waiting for intermediate heating
0000 0001	Waiting for ECO start request (Economy)
0101 0000	No glow period
1000 0000	No heating for start-up
1111 1111	No heating
0111 0000	Heating for start-up
1101 0000	No post-heating

5.3.9 Display group 13 - Smooth running control 1

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80°C.
- Intake air temperature < 40°C.

Display zone	Operating mode or component	Specification	Evaluation
1	Injection quantity for smooth running control through injector, cylinder 1 -N30-	-2.80...2.80 mg/stroke	⇒ Page 101
2	Injection quantity for smooth running control through injector, cylinder 2 -N31-	-2.80...2.80 mg/stroke	⇒ Page 101
3	Injection quantity for smooth running control through injector, cylinder 3 -N32-	-2.80...2.80 mg/stroke	⇒ Page 101
4	Injection quantity for smooth running control through injector, cylinder 4 -N33-	-2.80...2.80 mg/stroke	⇒ Page 101

Evaluation: display group 13, display zones 1…4 - idling speed smooth running control

- The injection system provides idling speed smooth running control. There may be differences in performance between the individual cylinders (component tolerances, jet flow rate, compressions, etc.) which are recognised and compensated for by selective injection quantities.
- Recognition at idling speed is via the signal from the engine speed sender. If the signals are delivered at the same rhythm then all cylinders work the same. If one cylinder is weaker then the crankshaft takes longer for the next half revolution. Conversely a more powerful cylinder will accelerate the crankshaft so that less time is needed for the half revolution.
- If the engine control unit recognises a difference, then the relevant cylinder is immediately given more or less fuel, until the engine runs “smoothly” again.
- +... mg/stroke: The respective cylinder is less powerful and is therefore supplied with more fuel.
- -... mg/stroke: The respective cylinder is more powerful and is therefore supplied with less fuel.

5.3.10 Display group 20 - Fuel rail values 3

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80°C.
- Intake air temperature < 40°C.

Display zone	Operating mode or component	Specification	Evaluation
1	Engine speed	760...940 rpm	---
2	Pressure in high-pressure fuel system (specified)	170...350 bar	---
3	Pressure in high-pressure fuel system (actual)	170...350 bar	⇒Page 102
4	Regulating valve for pressure in high-pressure fuel system	15...30 %	⇒Page 102

Evaluation: display group 20, display zone 3 - pressure in high-pressure fuel system

Display shows	Possible cause of fault	Fault remedy
Deviation from specification	◆ Defective fuel pressure sender -G247- ◆ Fuel pressure regulating valve -N276- defective ◆ Fuel metering valve -N290- defective ◆ Fuel pump defective	– -G247- Check. ⇒Page 394 – -N276- Check. ⇒Page 391 – -N290- Check. ⇒Page 388 – -V393- Check. ⇒Page 314

Evaluation: display group 20, display zone 4 - regulating valve for pressure in high-pressure fuel system

Display shows	Possible cause of fault	Fault remedy
Deviation from specification	◆ Fuel pressure regulating valve -N276- defective	– -N276- Check. ⇒Page 391

5.3.11 Display group 30 - Pedal encoder

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80°C.
- Intake air temperature < 40°C.

Display zone	Operating mode or component	Specification	Evaluation
1	Accelerator pedal, sender voltage 1	0.67...0.83 V	---
2	Accelerator pedal, sender voltage 2	0.25...0.5 V	---
3	Accelerator pedal, switch position	---	---
4	Accelerator position	0...100 %	⇒Page 102

Evaluation: Display group 30, display zone 4 - accelerator position

Display shows	Possible cause of fault	Fault remedy
1.0...100.0%	◆ Defective accelerator position sender -G79- ◆ Open circuit in wiring to -G79-	– -G79- Check. ⇒Page 316

5.3.12 Display group 34 - Charge pressure positioner

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80°C.
- Intake air temperature < 40°C.

Display zone	Operating mode or component	Specification	Evaluation
1	Engine speed	760...940 rpm	---
2	Charge pressure positioner (specified)	90...101 %	---
3	Charge pressure positioner (actual)	90...101 %	⇒ Page 103
4	Charge pressure positioner, activation	90...100 %	⇒ Page 103

Evaluation: display group 34, display zone 3 - charge pressure control

Display shows	Possible cause of fault	Fault remedy
Deviation from specification	◆ Position sender for charge pressure positioner -G581- defective ◆ Leaks between turbocharger and engine (charge air system) ◆ Charge pressure control defective	– Checking charge pressure control ⇒ Page 333. – -G581- Check. ⇒ Page 345

Evaluation: display group 34, display zone 4 - charge pressure control

Display shows	Possible cause of fault	Fault remedy
Deviation from specification	◆ Position sender for charge pressure positioner -G581- defective ◆ Leaks between turbocharger and engine (charge air system) ◆ Charge pressure control defective	– Checking charge pressure control ⇒ Page 333. – -G581- Check. ⇒ Page 345

5.3.13 Display group 99 - exhaust gas temperature sender

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80°C.
- Intake air temperature < 40°C.

Display zone	Operating mode or component	Specification	Evaluation
1	Engine speed	760...940 rpm	---
2	Exhaust gas temperature ahead of turbocharger	80...300 °C	⇒ Page 104

Display zone	Operating mode or component	Specification	Evaluation
3	---	---	---
4	Exhaust gas temperature ahead of diesel particulate filter	80...200 °C	---

Evaluation: display group 99, display zone 2 - exhaust gas temperature

Display shows	Possible cause of fault	Fault remedy
Deviation from specification	◆ Exhaust temperature sender 1 -G235- defective	– -G235- Check. ⇒Page 347

5.3.14 Display group 100 - diesel particulate filter, exhaust gas temperature sender, pressure differential sender

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80°C.
- Intake air temperature < 40°C.

Display zone	Operating mode or component	Specification	Evaluation
1	Exhaust gas temperature ahead of diesel particulate filter	100...200 °C	⇒Page 104
2	Exhaust gas temperature downstream of diesel particulate filter	100...250 °C	⇒Page 104
3	Diesel particulate filter, pressure differential sender (adapted)	0...20 mbar	⇒Page 104
4	Diesel particulate filter, pressure differential sender (current offset value)	0 mbar	---

Evaluation: display group 100, display zone 1 - exhaust gas temperature

Display shows	Possible cause of fault	Fault remedy
Deviation from specification	◆ Exhaust temperature sender 3 -G495- defective	– -G495- Check. ⇒Page 347

Evaluation: display group 100, display zone 2 - exhaust gas temperature

Display shows	Possible cause of fault	Fault remedy
Deviation from specification	◆ Exhaust temperature sender 4 -G648- defective	– -G648- Check. ⇒Page 444

Evaluation: display group 100, display zone 3 - differential pressure

Display shows	Possible cause of fault	Fault remedy
Deviation from specification	◆ Exhaust gas pressure sensor 1 -G450- defective	– -G450- Check. ⇒Page 446

5.3.15 Display group 106 - diesel particulate filter, regeneration 6

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80°C.
- Intake air temperature < 40°C.

Display zone	Operating mode or component	Specification	Evaluation
1	---	---	---
2	Diesel particulate filter, fuel consumption since last regeneration	---	---
3	Diesel particulate filter, mileage since last regeneration	---	---
4	Diesel particulate filter, time since last regeneration	---	---

5.3.16 Display group 108 - diesel particulate filter, regeneration 8

Test prerequisites

- Secure vehicle/machine
- Engine running at idling speed.
- Engine warm, coolant temperature not below 80°C.
- Intake air temperature < 40°C.

Display zone	Operating mode or component	Specification	Evaluation
1	Diesel particulate filter, ash deposit mass	0...175 ml	⇒Page 105
2	Diesel particulate filter, soot loading (calculated)	0...40 g	⇒Page 105
3	Diesel particulate filter, soot loading (measured)	0...40 g	⇒Page 106
4	---	---	---

Evaluation: display group 108, display zone 1 - diesel particulate filter, regeneration

Display shows	Possible cause of fault	Fault remedy
Higher than specification	◆ Soot level too high	– Renew diesel particulate filter ⇒Page 427

Evaluation: display group 108, display zone 2 - diesel particulate filter, regeneration

Display shows	Possible cause of fault	Fault remedy
Higher than specification	◆ Calculated soot level too high	– Renew diesel particulate filter ⇒Page 427

Evaluation: display group 108, display zone 3 - diesel particulate filter, regeneration

Display shows	Possible cause of fault	Fault remedy
Higher than specification	◆ Measured soot level too high	– Renew diesel particulate filter ⇒Page 427

5.4 Evaluating measured value blocks at full load

Note conditions for measurements at full load ⇒Page 106.

Display group:

- 1 - Injected quantity ⇒Page 106,
- 3 - Exhaust gas recirculation ⇒Page 107,
- 8 - Torque limit 1 ⇒Page 108,
- 11 - Charge pressure control ⇒Page 109,

5.4.1 Conditions for measurements at full load

Always follow safety precautions ⇒Page 93.

Read measured value block ⇒Page 94.

Note

Due to the various use cases of industrial engines, check whether the engine attains full load under the respective operating conditions before performing measurements at full load.

– At full load, increase engine speed from 1500 rpm to full throttle (accelerator pedal position sender at end stop).
– Have a second person read the measured values at approx. 3000 rpm.
– Exit diagnosis function.
– Switch off ignition.

5.4.2 Display group 1 - Injected quantity

Note

- *To perform the test increase engine speed from 1500 rpm to full throttle at full load. Note conditions for measurements at full load ⇒Page 106.*
- *The measured values must be read at an engine speed of 3000 rpm (2nd person required).*

Test prerequisites

- Engine warm, coolant temperature not below 80°C
- Engine speed 2800…3200 rpm
- Engine at full load

Display zone	Operating mode or component	Specification	Evaluation
1	Engine speed	2800...3200 rpm	---
2	Average injection quantity	40.0...60.0 mg/stroke	⇒Page 107
3	Pressure in high-pressure fuel system (actual)	1200.0...1700.0 bar	---
4	Coolant temperature	80.0...110.0°C	---

Evaluation: Display group 1, display zone 2 - quantity injected

Display shows	Possible cause of fault	Fault remedy
Below specification	◆ Injectors for cylinders 1…4 -N30...N33- defective	– -N30...N33- Check. ⇒Page 398
Above specification	◆ Engine too cold	– Run engine at increased speed to warm up, and repeat test
	◆ Shortage of fuel ◆ Air in fuel system	– Check fuel supply system ⇒Page 298, removing and installing parts of fuel supply system – Bleeding fuel system ⇒Page 383.
	◆ Injectors for cylinders 1…4 -N30...N33- defective	– -N30...N33- Check. ⇒Page 398

5.4.3 Display group 3 - Exhaust gas recirculation

Note

- *To perform the test increase engine speed from 1500 rpm to full throttle at full load. Note conditions for measurements at full load* ⇒Page 106.
- *The measured values must be read at an engine speed of 3000 rpm (2nd person required).*

Test prerequisites

- Engine warm, coolant temperature not below 80°C
- Engine speed 2800…3200 rpm
- Engine at full load

Display zone	Operating mode or component	Specification	Evaluation
1	Engine speed	2800...3200 rpm	---
2	Intaken air mass (specified):	450...950 mg/stroke	---

Display zone	Operating mode or component	Specification	Evaluation
3	Intaken air mass (actual):	Approx. intaken air mass (specified)	⇒Page 97
4	Duty cycle of exhaust gas recirculation valve	80...100 %	---

Evaluation: display group 3, display zone 3 - intaken air mass (actual)

Display shows	Possible cause of fault	Fault remedy
Below specification	◆ Excessive exhaust gas recirculation	– Check exhaust gas recirculation system ⇒Page 436
	◆ Unmetered air	– Check intake system for leaks
Above specification	◆ Engine too cold	– Warm up engine, and repeat test
	◆ Insufficient exhaust gas recirculation	– Give burst on throttle
	◆ Defective air mass meter -G70-	– -G70- Check. ⇒Page 411

Evaluation: display group 3, display zone 4 - duty cycle of exhaust gas recirculation valve

Display shows	Possible cause of fault	Fault remedy
Below specification	◆ Excessive exhaust gas recirculation	– Check exhaust gas recirculation system ⇒Page 436
	◆ Unmetered air	– Check intake system for leaks

5.4.4 Display group 8 - torque limit 1

Note

- *To perform the test increase engine speed from 1500 rpm to full throttle at full load. Note conditions for measurements at full load ⇒Page 106.*
- *The measured values must be read at an engine speed of 3000 rpm (2nd person required).*

Test prerequisites

- Engine warm, coolant temperature not below 80°C
- Engine speed 2800…3200 rpm
- Engine at full load

Display zone	Operating mode or component	Specification	Evaluation
1	Engine speed	2800...3200 rpm	---
2	Desired torque	xxx Nm	---
3	Torque limit	xxx Nm	---
4	Smoke limiting	xxx Nm	---

5.4.5 Display group 11 - Charge pressure control

Note

- *To perform the test increase engine speed from 1500 rpm to full throttle at full load. Note conditions for measurements at full load* ⇒ Page 106.
- *The measured values must be read at an engine speed of 3000 rpm (2nd person required).*

Test prerequisites

- Engine warm, coolant temperature not below 80°C
- Engine speed 2800…3200 rpm
- Engine at full load

Display zone	Operating mode or component	Specification	Evaluation
1	Engine speed	2800...3200 rpm	---
2	Charge pressure (specified)	2100..2300 mbar	---
3	Charge pressure (actual)	2100...2300 mbar	⇒ Page 109
4	Duty cycle of charge pressure control solenoid valve	20...60 %	---

Evaluation: display group 11, display zone 3 - charge pressure (actual)

Display shows	Possible cause of fault	Fault remedy
Below specification	◆ Leaks between turbocharger and engine (charge air system) ◆ Charge pressure control defective	– Checking charge air system for leaks ⇒ Page 331 – Checking charge pressure control ⇒ Page 333.
Above specification	◆ Charge pressure control defective ◆ Turbocharger defective	– Checking charge pressure control ⇒ Page 333.
	◆ Defective charge pressure sender -G31-	– -G31- Check. ⇒ Page 343

6 Measured value blocks, engine codes CPYA, CPYB, CPYC, CPYD, CPYE, CPYF, CPYG

Observe safety precautions ⇒ “Safety precautions” on page 110.

Read measured value block ⇒ “Reading measured value block” on page 110.

Evaluate measured value blocks:

- At idling speed ⇒ “Evaluating measured value blocks at idling speed” on page 111,
- At full load ⇒ “Evaluating measured value blocks at full load (engine code CPYA)” on page 125.

6.1 Safety precautions

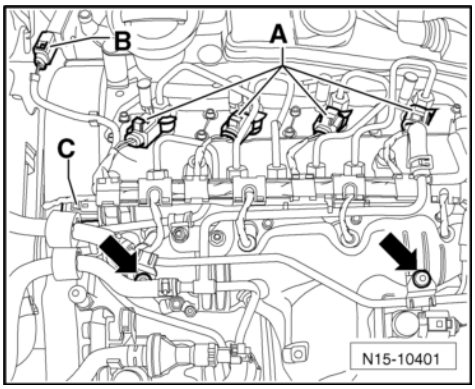
WARNING

When doing any repair work, pay attention to the following due to the cramped conditions:

- ***Route all the various lines (e.g. for fuel, hydraulics, activated charcoal filter system, coolant, refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.***
- ***Ensure that there is sufficient clearance to all moving or hot components.***

To prevent injuries to persons and/or destruction of the injection and glow plug system, the following must be noted:

- Always switch off the ignition before connecting or disconnecting injection and glow plug system wiring or tester cables.
- If the engine is to be turned at starter speed without starting, e.g. to check compression, pull connector -A- off injectors.
- Disconnecting and connecting the battery must only be done with the ignition switched off, otherwise the engine control unit could be damaged.



Note the following if testers and measuring instruments have to be used during a road test:

- The test and measuring equipment must always be secured and operated by a 2nd person.

6.2 Reading measured value block

Note

The measured values in the diagnosis function “011-Read measured value block” are described in the sections for checking the individual components. This table serves only as an overview.

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- Earth connections OK
- All electrical consumers must be switched off.
- Some measured values change as the engine temperature changes. Note the coolant temperature. The specifications

are applicable for an engine temperature of at least 80°C ⇒ display group 1, display zone 4.

Test procedure

– Start engine and run at idling speed.

– Connect vehicle diagnostic tester, and select engine control unit. ⇒Page 23

– Select diagnosis function “011-Read measured value block”.

Note

The “Display group 1” is an example to illustrate the procedure.

– Select “Display group 1”.

Indicated on display: (1…4 = display zones)

```
Display group 1
        1         2         3         4
```

Note

The display zones may be shown one below the other or next to each other on the display of the vehicle diagnostic tester.

– To change to another display group proceed as follows:

Display group	Button
Higher	Press [↑] button
Lower	Press [↓] button
Skip	Press [←] button.

If the specifications are attained in all display zones:

– Exit diagnosis function.

– Switch off ignition.

6.3 Evaluating measured value blocks at idling speed

Always follow safety precautions ⇒Page 110.

Read measured value block ⇒Page 110.

Display group:

- 1 - Injected quantity ⇒Page 112,
- 2 - Idling speed ⇒Page 112,
- 3 - Exhaust gas recirculation ⇒Page 113,
- 4 - Activation of injectors -N30...N33- ⇒Page 114,
- 7 - Temperatures ⇒Page 114,
- 10 - Air quantities ⇒Page 115,
- 11 - Charge pressure control ⇒Page 116,
- 12 - Status ⇒Page 116,
- 13 - Smooth running control ⇒Page 117,
- 20 - Fuel rail values 3 ⇒Page 118,
- 30 - Pedal encoder ⇒Page 119,

- 34 - Charge pressure positioner ⇒Page 119,
- 99 - Exhaust gas temperature sender ⇒Page 121,
- 100 - Diesel particulate filter, exhaust gas temperature, differential pressure ⇒Page 121,
- 108 - Diesel particulate filter regeneration 8 ⇒Page 123

6.3.1 Display group 1 - Injected quantity

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80°C.
- Intake air temperature < 40°C.

Display zone	Operating mode or component	Specification	Evaluation
1	Engine speed	880...1090 rpm	---
2	Average injection quantity	6.5...12.0 mg/stroke	⇒Page 112
3	Pressure in high-pressure fuel system (actual)	320.0...780.0 bar	---
4	Coolant temperature	80.0...110.0°C	---

Evaluation: Display group 1, display zone 2 - quantity injected

Display shows	Possible cause of fault	Fault remedy
Below specification	◆ Injectors for cylinders 1…4 -N30...N33- defective	– -N30...N33- Check. ⇒Page 398
Above specification	◆ Engine too cold	– Run engine at increased speed to warm up, and repeat test
	◆ Shortage of fuel ◆ Air in fuel system	– Check fuel supply system ⇒Page 298, removing and installing parts of fuel supply system – Bleeding fuel system ⇒Page 383.
	◆ Injectors for cylinders 1…4 -N30...N33- defective	– -N30...N33- Check. ⇒Page 398

6.3.2 Display group 2 - Idling speed

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80°C.
- Intake air temperature < 40°C.

Display zone	Operating mode or component	Specification	Evaluation
1	Engine speed	880...1090 rpm	---
2	Accelerator position ◆ If accelerator position sender -G79- is installed	0.0 %	⇒ Page 113
3	Accelerator pedal switch positions	---	---
4	Coolant temperature	80.0...110.0°C	---

Evaluation: Display group 2, display zone 2 - accelerator position

Display shows	Possible cause of fault	Fault remedy
1.0...100.0 %	◆ Defective accelerator position sender -G79- ◆ Open circuit in wiring to -G79-	– -G79- Check. ⇒ Page 316

6.3.3 Display group 3 - Exhaust gas recirculation

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80°C.
- Intake air temperature < 40°C.

Display zone	Operating mode or component	Specification	Evaluation
1	Engine speed	880...1090 rpm	---
2	Intaken air mass (specified):	190...320 mg/stroke	---
3	Intaken air mass (actual):	190...320 mg/stroke[1)]	⇒ Page 113
4	Duty cycle of exhaust gas recirculation valve	45...70 %	---

[1)] The specification applies for deactivated exhaust gas recirculation system. (Duty cycle of exhaust gas recirculation valve in display zone 4 at 100 %.

Evaluation: display group 3, display zone 3 - intaken air mass (actual)

Display shows	Possible cause of fault	Fault remedy
Below specification	◆ Excessive exhaust gas recirculation	– Check exhaust gas recirculation system ⇒ Page 436
	◆ Unmetered air	– Check intake system for leaks
Above specification	◆ Engine too cold	– Run engine at increased speed to warm up, and repeat test
	◆ Insufficient exhaust gas recirculation	– Engine running for a long time at idling speed, give burst on throttle
	◆ Defective air mass meter -G70-	– -G70- Check. ⇒ Page 411

6.3.4 Display group 4 - Activation of injectors -N30...N33-

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80°C.
- Intake air temperature < 40°C.

Display zone	Operating mode or component	Specification	Evaluation
1	Engine speed	880...1090 rpm	---
2	Start of main injection activation	-2.5...0.5°CrS	⇒Page 114
3	Duration of main injection activation	270...550 ms	---
4	Pressure in high-pressure fuel system (actual)	320...780 bar	---

Evaluation: display group 4, display zone 2 - start of main injection activation:

Display shows	Possible cause of fault	Fault remedy
Above specification	◆ Engine too cold	– Run engine at increased speed to warm up, and repeat test

6.3.5 Display group 5

Display zone	Operating mode or component	Value range	Evaluation
1	Engine speed	0...5865 rpm	---
2	Engine start, quantity on start-up	0...70 mg/stroke	---
3	Engine start, start syn.	0 .. 255 -	---
4	Coolant temperature	-90...139.5°C	---

6.3.6 Display group 7 - Temperatures

Test prerequisites

- Ignition switched on.
- Engine is off and cooled down.

Display zone	Operating mode or component	Specification	Evaluation
1	Fuel temperature	Approx. ambient temperature[1)]	⇒Page 115
2	Engine oil temperature	---	---
3	Intake air temperature	Approx. ambient temperature[1)]	⇒Page 115
4	Coolant temperature	Approx. ambient temperature[1)]	⇒Page 115

1) Details of temperature specifications are not possible. When the engine is cold the fuel, intake air and coolant temperatures must equate approximately to ambient temperature. If one of the temperature readings is noticeably different, test the relevant sender.

Evaluation: Display group 7, display zone 1 - fuel temperature

Display shows	Possible cause of fault	Fault remedy
Large deviation from ambient temperature	◆ Short circuit or fuel temperature sender -G81- defective	– -G81- Check. ⇒Page 409

Evaluation: display group 7, display zone 3 - Intake air temperature

Display shows	Possible cause of fault	Fault remedy
Large deviation from ambient temperature	◆ Short circuit or intake air temperature sender -G42- defective	– -G42- Check. ⇒Page 404

Evaluation: Display group 7, display zone 4 - coolant temperature

Display shows	Possible cause of fault	Fault remedy
Large deviation from ambient temperature	◆ Short circuit or defective coolant temperature sender -G62-	– -G62- Check. ⇒Page 407

6.3.7 Display group 10 - Air quantities

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80°C.
- Intake air temperature < 40°C.

Display zone	Operating mode or component	Specification	Evaluation
1	Intaken air mass (actual)	xxx mg/H 1)	---
2	Atmospheric pressure (ambient pressure)	900...1100 mbar	---
3	Charge pressure (actual)	xxx mbar 1)	---
4	Accelerator position ◆ If accelerator position sender -G79- is installed	0.0 %	⇒Page 115

1) The values displayed at “idling speed” are not relevant.

Evaluation: Display group 10, display zone 4 - accelerator position

Display shows	Possible cause of fault	Fault remedy
1.0...100.0%	◆ Defective accelerator position sender -G79- ◆ Open circuit in wiring to -G79-	– -G79- Check. ⇒Page 316

6.3.8 Display group 11 - Charge pressure control

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80°C.
- Intake air temperature < 40°C.

Display zone	Operating mode or component	Specification	Evaluation
1	Engine speed	880...1090 rpm	---
2	Charge pressure (specified)	xxx mbar 1)	---
3	Charge pressure (actual)	xxx mbar 1)	---
4	Duty cycle of charge pressure control solenoid valve	xxx % 1)	---

1) The values displayed at “idling speed” are not relevant.

6.3.9 Display group 12 - Status

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80°C.
- Intake air temperature < 40°C.

Display zone	Operating mode or component	Specification	Evaluation
1	Glow plug system status	1111 1111	⇒Page 116
2	Glow period (in seconds)	xx,x s	---
3	Voltage supply from automatic glow period control unit	Approx. battery voltage	---
4	Coolant temperature	80.0...110.0°C	---

Evaluation: display group 12, display zone 1 - glow plug system status

Note

Meaning of figures in 8-digit number block for status of glow plug system:

Significance if display = 1	
Display shows	**Glow plug system status**
0000 0000	Waiting for coolant temperature
0001 0000	Pre-heating

Significance if display = 1	
Display shows	**Glow plug system status**
1011 0000	Post-heating
1111 0000	Intermediate heating
0011 0000	Standby-heating
1011 0001	Waiting for post-heating
1111 0001	Waiting for intermediate heating
0000 0001	Waiting for ECO start request (Economy)
0101 0000	No glow period
1000 0000	No heating for start-up
1111 1111	No heating
0111 0000	Heating for start-up
1101 0000	No post-heating

6.3.10 Display group 13 - Smooth running control 1

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80°C.
- Intake air temperature < 40°C.

Display zone	Operating mode or component	Specification	Evaluation
1	Injection quantity for smooth running control through injector, cylinder 1 -N30-	-2.80...2.80 mg/H	⇒ Page 117
2	Injection quantity for smooth running control through injector, cylinder 2 -N31-	-2.80...2.80 mg/H	⇒ Page 117
3	Injection quantity for smooth running control through injector, cylinder 3 -N32-	-2.80...2.80 mg/H	⇒ Page 117
4	Injection quantity for smooth running control through injector, cylinder 4 -N33-	-2.80...2.80 mg/H	⇒ Page 117

Evaluation: display group 13, display zones 1…4 - idling speed smooth running control

- The injection system provides idling speed smooth running control. There may be differences in performance between the individual cylinders (component tolerances, jet flow rate, compressions, etc.) which are recognised and compensated for by selective injection quantities.
- Recognition at idling speed is via the signal from the engine speed sender. If the signals are delivered at the same rhythm then all cylinders work the same. If one cylinder is weaker then the crankshaft takes longer for the next half revolution. Conversely a more powerful cylinder will accelerate the crankshaft so that less time is needed for the half revolution.
- If the engine control unit recognises a difference, then the relevant cylinder is immediately given more or less fuel, until the engine runs “smoothly” again.
- +... mg/stroke: The respective cylinder is less powerful and is therefore supplied with more fuel.
- -... mg/stroke: The respective cylinder is more powerful and is therefore supplied with less fuel.

6.3.11 Display group 20 - Fuel rail values 3

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80°C.
- Intake air temperature < 40°C.

Display zone	Operating mode or component	Specification	Evaluation
1	Engine speed	880...1090 rpm	---
2	Pressure in high-pressure fuel system (specified)	320...780 bar	---
3	Pressure in high-pressure fuel system (actual)	320...780 bar	⇒Page 118
4	Regulating valve for pressure in high-pressure fuel system	25...42 %	⇒Page 118

Evaluation: display group 20, display zone 3 - pressure in high-pressure fuel system

Display shows	Possible cause of fault	Fault remedy
Deviation from specification	◆ Defective fuel pressure sender -G247- ◆ Fuel pressure regulating valve -N276- defective ◆ Fuel metering valve -N290- defective ◆ Fuel pump defective	– -G247- Check. ⇒Page 394 – -N276- Check. ⇒Page 391 – -N290- Check. ⇒Page 388 – -V393- Check. ⇒Page 314

Evaluation: display group 20, display zone 4 - regulating valve for pressure in high-pressure fuel system

Display shows	Possible cause of fault	Fault remedy
Deviation from specification	◆ Fuel pressure regulating valve -N276- defective	– -N276- Check. ⇒Page 391

6.3.12 Display group 30 - Pedal encoder

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80°C.
- Intake air temperature < 40°C.

Display zone	Operating mode or component	Specification	Evaluation
1	Accelerator pedal, sender voltage 1	0.67...0.83 V	---
2	Accelerator pedal, sender voltage 2	0.25...0.5 V	---
3	Accelerator pedal, switch position	---	---
4	Accelerator position	0...100 %	⇒Page 119

Evaluation: Display group 30, display zone 4 - accelerator position

Display shows	Possible cause of fault	Fault remedy
1.0...100.0%	◆ Defective accelerator position sender -G79- ◆ Open circuit in wiring to -G79-	– -G79- Check. ⇒Page 316

6.3.13 Display group 32

Display zone	Operating mode or component	Value range	Evaluation
1	Engine speed	0...5865 rpm	---
2	Charge pressure (specified)	0...2601 mbar	---
3	Charge pressure (actual)	0...2601 mbar	---
4	Charge pressure positioner, activation, output stage	-101 .. 100.2 %	---

6.3.14 Display group 34 - Charge pressure positioner

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80°C.
- Intake air temperature < 40°C.

Display zone	Operating mode or component	Specification	Evaluation
1	Engine speed	880...1090 rpm	---
2	Charge pressure positioner (specified)	90...101 %	---
3	Charge pressure positioner (actual)	90...101 %	⇒Page 120
4	Charge pressure positioner, activation	60...100 %	⇒Page 120

Evaluation: display group 34, display zone 3 - charge pressure control

Display shows	Possible cause of fault	Fault remedy
Deviation from specification	◆ Position sender for charge pressure positioner -G581- defective ◆ Leaks between turbocharger and engine (charge air system) ◆ Charge pressure control defective	– Checking charge pressure control ⇒Page 333. – -G581- Check. ⇒Page 345

Evaluation: display group 34, display zone 4 - charge pressure control

Display shows	Possible cause of fault	Fault remedy
Deviation from specification	◆ Position sender for charge pressure positioner -G581- defective ◆ Leaks between turbocharger and engine (charge air system) ◆ Charge pressure control defective	– Checking charge pressure control ⇒Page 333. – -G581- Check. ⇒Page 345

6.3.15 Display group 38

Display zone	Operating mode or component	Value range	Evaluation
1	Engine speed	0...5865 rpm	---
2	Exhaust gas recirculation system (specified)	0...100%	---
3	Exhaust gas recirculation valve (actual)	-101 .. 100.2%	---
4	Exhaust gas recirculation valve, activation	-101 .. 100.2%	---

6.3.16 Display group 39

Display zone	Operating mode or component	Value range	Evaluation
1	Engine speed	0...5865 rpm	---
2	Air mass (actual)	0...1275 mg/stroke	---
3	Intake air temperature	-90....139.5°C	---
4	Throttle valve, activation, output stage	-101 .. 100.2%	---

6.3.17 Display group 85

Display zone	Operating mode or component	Value range	Evaluation
1	---	0...2550 m	---
2	---	0...255	---
3	---	0....255	---
4	Engine start counter	0 - ?	---

6.3.18 Display group 97

Display zone	Operating mode or component	Value range	Evaluation
1	Diesel particulate filter, differential pressure offset (only CPYA and CPYB)	-328 .. 325 mbar	---
2	Diesel particulate filter, old differential pressure offset (only CPYA and CPYB)	-328 .. 325 mbar -	---
3	---	---	---
4	---	---	---

6.3.19 Display group 99 - exhaust gas temperature sender

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80°C.
- Intake air temperature < 40°C.

Display zone	Operating mode or component	Specification	Evaluation
1	Engine speed	880...1090 rpm	---
2	Exhaust gas temperature ahead of turbocharger	150...370 °C	⇒ Page 121
3	---	---	---
4	Exhaust gas temperature ahead of diesel particulate filter	130...310 °C	---

Evaluation: display group 99, display zone 2 - exhaust gas temperature

Display shows	Possible cause of fault	Fault remedy
Deviation from specification	◆ Exhaust temperature sender 1 -G235- defective	– -G235- Check. ⇒ Page 347

6.3.20 Display group 100 - diesel particulate filter, exhaust gas temperature sender, pressure differential sender

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80°C.
- Intake air temperature < 40°C.

Display zone	Operating mode or component	Specification	Evaluation
1	Exhaust gas temperature ahead of diesel particulate filter	130...310 °C	⇒Page 122
2	Exhaust gas temperature downstream of diesel particulate filter	100...270 °C	⇒Page 122
3	Diesel particulate filter, pressure differential sender (adapted)	0...20 mbar	⇒Page 122
4	Diesel particulate filter, pressure differential sender (current offset value)	-10...10 mbar	---

Evaluation: display group 100, display zone 1 - exhaust gas temperature

Display shows	Possible cause of fault	Fault remedy
Deviation from specification	◆ Exhaust temperature sender 3 -G495- defective	– -G495- Check. ⇒Page 347

Evaluation: display group 100, display zone 2 - exhaust gas temperature

Display shows	Possible cause of fault	Fault remedy
Deviation from specification	◆ Exhaust temperature sender 4 -G648- defective	– -G648- Check. ⇒Page 444

Evaluation: display group 100, display zone 3 - differential pressure

Display shows	Possible cause of fault	Fault remedy
Deviation from specification	◆ Exhaust gas pressure sensor 1 -G450- defective	– -G450- Check. ⇒Page 446

6.3.21 Display group 104

Display zone	Operating mode or component	Value range	Evaluation
1	Diesel particulate filter, exhaust gas treatment (only CPYA and CPYB)	FF00 .. FFFF	---
2	Diesel particulate filter, exhaust gas treatment, lower stage (only CPYA and CPYB)	FF00 .. FFFF	---
3	Diesel particulate filter, field regeneration, request status (only CPYA and CPYB)	00000000 .. 11111111	---
4	Diesel particulate filter, field regeneration, lock status (only CPYA and CPYB)	00000000 .. 11111111	---

6.3.22 Display group 108 - diesel particulate filter, regeneration 8

Test prerequisites

- Secure vehicle/machine
- Engine running at idling speed.
- Engine warm, coolant temperature not below 80°C.
- Intake air temperature < 40°C.

Display zone	Operating mode or component	Specification	Evaluation
1	Diesel particulate filter, ash deposit mass	500 ml	⇒ Page 123
2	Diesel particulate filter, soot loading (calculated)	35 g	⇒ Page 123
3	Diesel particulate filter, soot loading (measured)	35 g	⇒ Page 123
4	---	---	---

Evaluation: display group 108, display zone 1 - diesel particulate filter, regeneration

Display shows	Possible cause of fault	Fault remedy
Higher than specification	◆ Ash deposit mass too high	– Renew diesel particulate filter ⇒ Page 430

Evaluation: display group 108, display zone 2 - diesel particulate filter, regeneration

Display shows	Possible cause of fault	Fault remedy
Higher than specification	◆ Calculated soot level too high	– Renew diesel particulate filter ⇒ Page 430
0 - 35 g	---	– Regenerate diesel particulate filter ⇒ Page 454.

Evaluation: display group 108, display zone 3 - diesel particulate filter, regeneration

Display shows	Possible cause of fault	Fault remedy
Higher than specification	◆ Measured soot level too high	– Renew diesel particulate filter ⇒ Page 430
0 - 35 g	---	– Regenerate diesel particulate filter ⇒ Page 454.

6.3.23 Display group 245

Display zone	Operating mode or component	Value range	Evaluation
1	Thermal management timer since last successful regeneration and ash deposit mass adaptation, high byte (only CPYA and CPYB)	00000000 .. 11111111	---
2	Thermal management timer since last successful regeneration and ash deposit mass adaptation, low byte (only CPYA and CPYB)	00000000 .. 11111111	---
3	Engine operating hours since last successful regeneration and ash deposit mass adaptation, high byte (only CPYA and CPYB)	00000000 .. 11111111	---
4	Engine operating hours since last successful regeneration and ash deposit mass adaptation, low byte (only CPYA and CPYB)	00000000 .. 11111111	---

6.3.24 Display group 246

Display zone	Operating mode or component	Value range	Evaluation
1	Ratio between thermal management and regular engine operation (only CPYA and CPYB)	0...100%	---
2	Test status for diesel oxidising catalytic converter (only CPYA and CPYB)	00000000 .. 11111111	---
3	---	---	---
4	---	---	---

6.3.25 Display group 248

Display zone	Operating mode or component	Value range	Evaluation
1	ACC main sw. bit 0, safety sw. bit 1 (must be different)	00000000 .. 11111111	---
2	Working speed control switch ON	00000000 .. 11111111	---
3	ACC pins, bit 0=TipDown, 1=TipUp, 2=Fix1, 3=Fix2, 4=Fix3, 5=Akt. 6=WA	00000000 .. 11111111	---
4	Bit 0=diesel particulate filter warning lamp, 1=ACC warning lamp, 2=warning lamp, 3=OBD warning lamp	00000000 .. 11111111	---

6.3.26 Display group 250

Display zone	Operating mode or component	Value range	Evaluation
1	Working speed control switch, specified engine speed	0 .. 5865 rpm	---
2	Specified engine speed via buttons	0 .. 5865 rpm	---
3	CAN, specified engine speed	0 .. 5865 rpm	---
4	Accelerator pedal, specified engine speed	0 .. 5865 rpm	---

6.3.27 Display group 253

Display zone	Operating mode or component	Value range	Evaluation
1	Radiator fan 1, activation	-101 .. 100.2 %	---
2	Status: switch on alternator	00000000 .. 11111111	---
3	Clutch status	00000000 .. 11111111	---
4	Brake status	0 .. 255	---

6.3.28 Display group 254

Display zone	Operating mode or component	Value range	Evaluation
1	Engine speed	0 .. 5865 rpm	---
2	Status of regeneration and ash deposit mass adaptation (only CPYA and CPYB)	0 .. 255 -	CAN available = 1 in doc. for commissioning (coding) -> request message "Vehicle is secured" -> 255 = message not received (regeneration does not start)
3	---	---	---
4	---	---	---

6.4 Evaluating measured value blocks at full load (engine code CPYA)

Note conditions for measurements at full load ⇒Page 125.

Display group:

- 1 - Injected quantity ⇒Page 126,
- 3 - Exhaust gas recirculation ⇒Page 127,
- 8 - Torque limit 1 ⇒Page 128,
- 11 - Charge pressure control ⇒Page 128,

6.4.1 Conditions for measurements at full load

Always follow safety precautions ⇒Page 110.

Read measured value block ⇒ Page 110.

Note

Due to the various use cases of industrial engines, check whether the engine attains full load under the respective operating conditions before performing measurements at full load.

– At full load, increase engine speed from 1500 rpm to full throttle (accelerator pedal position sender at end stop).
– Have a second person read the measured values at approx. 2500 rpm.
– Exit diagnosis function.
– Switch off ignition.

6.4.2 Display group 1 - Injected quantity

Note

- *To perform the test increase engine speed from 1500 rpm to full throttle at full load. Note conditions for measurements at full load ⇒ Page 125.*
- *The measured values must be read at an engine speed of 2500 rpm (2nd person required).*

Test prerequisites

- Engine warm, coolant temperature not below 80°C
- Engine speed 2200…2800 rpm
- Engine at full load

Display zone	Operating mode or component	Specification	Evaluation
1	Engine speed	2200...2800 rpm	---
2	Average injection quantity	23.0...45.0 mg/H	⇒ Page 126
3	Pressure in high-pressure fuel system (actual)	1450...1900 bar	---
4	Coolant temperature	80.0...110.0°C	---

Evaluation: Display group 1, display zone 2 - quantity injected

Display shows	Possible cause of fault	Fault remedy
Below specification	◆ Injectors for cylinders 1…4 -N30...N33- defective	– -N30...N33- Check. ⇒ Page 398
Above specification	◆ Engine too cold	– Run engine at increased speed to warm up, and repeat test

Display shows	Possible cause of fault	Fault remedy
	◆ Shortage of fuel ◆ Air in fuel system	– Check fuel supply system ⇒Page 298, removing and installing parts of fuel supply system – Bleeding fuel system ⇒Page 383.
	◆ Injectors for cylinders 1…4 -N30...N33- defective	– -N30...N33- Check. ⇒Page 398

6.4.3 Display group 3 - Exhaust gas recirculation

Note

- *To perform the test increase engine speed from 1500 rpm to full throttle at full load. Note conditions for measurements at full load ⇒Page 125.*
- *The measured values must be read at an engine speed of 2500 rpm (2nd person required).*

Test prerequisites

- Engine warm, coolant temperature not below 80°C
- Engine speed 2200…2800 rpm
- Engine at full load

Display zone	Operating mode or component	Specification	Evaluation
1	Engine speed	2200...2800 rpm	---
2	Intaken air mass (specified):	620...830 mg/stroke	---
3	Intaken air mass (actual):	Approx. intaken air mass (specified)	⇒Page 113
4	Duty cycle of exhaust gas recirculation valve	65...80 %	---

Evaluation: display group 3, display zone 3 - intaken air mass (actual)

Display shows	Possible cause of fault	Fault remedy
Below specification	◆ Excessive exhaust gas recirculation	– Check exhaust gas recirculation system ⇒Page 436
	◆ Unmetered air	– Check intake system for leaks
Above specification	◆ Engine too cold	– Warm up engine, and repeat test
	◆ Insufficient exhaust gas recirculation	– Give burst on throttle
	◆ Defective air mass meter -G70-	– -G70- Check. ⇒Page 411

Evaluation: display group 3, display zone 4 - duty cycle of exhaust gas recirculation valve

Display shows	Possible cause of fault	Fault remedy
Below specification	◆ Excessive exhaust gas recirculation	– Check exhaust gas recirculation system ⇒Page 436
	◆ Unmetered air	– Check intake system for leaks

6.4.4 Display group 8 - torque limit 1

Note

- *To perform the test increase engine speed from 1500 rpm to full throttle at full load. Note conditions for measurements at full load ⇒Page 125.*
- *The measured values must be read at an engine speed of 2500 rpm (2nd person required).*

Test prerequisites

- Engine warm, coolant temperature not below 80°C
- Engine speed 2200…2800 rpm
- Engine at full load

Display zone	Operating mode or component	Specification	Evaluation
1	Engine speed	2200...2800 rpm	---
2	Desired torque	xxx Nm	---
3	Torque limit	xxx Nm	---
4	Smoke limiting	xxx Nm	---

6.4.5 Display group 11 - Charge pressure control

Note

- *To perform the test increase engine speed from 1500 rpm to full throttle at full load. Note conditions for measurements at full load ⇒Page 125.*
- *The measured values must be read at an engine speed of 2500 rpm (2nd person required).*

Test prerequisites

- Engine warm, coolant temperature not below 80°C
- Engine speed 2200…2800 rpm
- Engine at full load

Display zone	Operating mode or component	Specification	Evaluation
1	Engine speed	2200...2800 rpm	---
2	Charge pressure (specified)	1600...1820 mbar	---

Display zone	Operating mode or component	Specification	Evaluation
3	Charge pressure (actual)	1600...1900 mbar	⇒Page 129
4	Duty cycle of charge pressure control solenoid valve	35...70 %	---

Evaluation: display group 11, display zone 3 - charge pressure (actual)

Display shows	Possible cause of fault	Fault remedy
Below specification	◆ Leaks between turbocharger and engine (charge air system) ◆ Charge pressure control defective	– Checking charge air system for leaks ⇒Page 331 – Checking charge pressure control ⇒Page 333.
Above specification	◆ Charge pressure control defective ◆ Turbocharger defective	– Checking charge pressure control ⇒Page 333.
	◆ Defective charge pressure sender -G31-	– -G31- Check. ⇒Page 343

6.5 Evaluating measured value blocks at full load (engine code CPYB)

Note conditions for measurements at full load ⇒Page 129.

Display group:

- 1 - Injected quantity ⇒Page 130,
- 3 - Exhaust gas recirculation ⇒Page 130,
- 8 - Torque limit 1 ⇒Page 131,
- 11 - Charge pressure control ⇒Page 132,

6.5.1 Conditions for measurements at full load

Always follow safety precautions ⇒Page 110.

Read measured value block ⇒Page 110.

Note

Due to the various use cases of industrial engines, check whether the engine attains full load under the respective operating conditions before performing measurements at full load.

– At full load, increase engine speed from 1500 rpm to full throttle (accelerator pedal position sender at end stop).

– Have a second person read the measured values at approx. 2300 rpm.

– Exit diagnosis function.

– Switch off ignition.

6.5.2 Display group 1 - Injected quantity

Note

- *To perform the test increase engine speed from 1500 rpm to full throttle at full load. Note conditions for measurements at full load* ⇒ Page 129.
- *The measured values must be read at an engine speed of 2300 rpm (2nd person required).*

Test prerequisites

- Engine warm, coolant temperature not below 80°C
- Engine speed 2200…2450 rpm
- Engine at full load

Display zone	Operating mode or component	Specification	Evaluation
1	Engine speed	2200...2450 rpm	---
2	Average injection quantity	30.0...37.0 mg/H	⇒ Page 130
3	Pressure in high-pressure fuel system (actual)	1600.0...1900.0 bar	---
4	Coolant temperature	80.0...110.0°C	---

Evaluation: Display group 1, display zone 2 - quantity injected

Display shows	Possible cause of fault	Fault remedy
Below specification	◆ Injectors for cylinders 1…4 -N30...N33- defective	– -N30...N33- Check. ⇒ Page 398
Above specification	◆ Engine too cold	– Run engine at increased speed to warm up, and repeat test
	◆ Shortage of fuel ◆ Air in fuel system	– Check fuel supply system ⇒ Page 298, removing and installing parts of fuel supply system – Bleeding fuel system ⇒ Page 383.
	◆ Injectors for cylinders 1…4 -N30...N33- defective	– -N30...N33- Check. ⇒ Page 398

6.5.3 Display group 3 - Exhaust gas recirculation

Note

- *To perform the test increase engine speed from 1500 rpm to full throttle at full load. Note conditions for measurements at full load* ⇒ Page 129.
- *The measured values must be read at an engine speed of 2300 rpm (2nd person required).*

Test prerequisites

- Engine warm, coolant temperature not below 80°C
- Engine speed 2200…2450 rpm
- Engine at full load

Display zone	Operating mode or component	Specification	Evaluation
1	Engine speed	2200...2450 rpm	---
2	Intaken air mass (specified):	690...750 mg/stroke	---
3	Intaken air mass (actual):	Approx. intaken air mass (specified)	⇒Page 113
4	Duty cycle of exhaust gas recirculation valve	65...80 %	---

Evaluation: display group 3, display zone 3 - intaken air mass (actual)

Display shows	Possible cause of fault	Fault remedy
Below specification	◆ Excessive exhaust gas recirculation	– Check exhaust gas recirculation system ⇒Page 436
	◆ Unmetered air	– Check intake system for leaks
Above specification	◆ Engine too cold	– Warm up engine, and repeat test
	◆ Insufficient exhaust gas recirculation	– Give burst on throttle
	◆ Defective air mass meter -G70-	– -G70- Check. ⇒Page 411

Evaluation: display group 3, display zone 4 - duty cycle of exhaust gas recirculation valve

Display shows	Possible cause of fault	Fault remedy
Below specification	◆ Excessive exhaust gas recirculation	– Check exhaust gas recirculation system ⇒Page 436
	◆ Unmetered air	– Check intake system for leaks

6.5.4 Display group 8 - torque limit 1

Note

- *To perform the test increase engine speed from 1500 rpm to full throttle at full load. Note conditions for measurements at full load* ⇒Page 129*.*
- *The measured values must be read at an engine speed of 2300 rpm (2nd person required).*

Test prerequisites

- Engine warm, coolant temperature not below 80°C
- Engine speed 2200…2450 rpm
- Engine at full load

Display zone	Operating mode or component	Specification	Evaluation
1	Engine speed	2200...2450 rpm	---
2	Desired torque	xxx Nm	---
3	Torque limit	xxx Nm	---
4	Smoke limiting	xxx Nm	---

6.5.5 Display group 11 - Charge pressure control

Note

- *To perform the test increase engine speed from 1500 rpm to full throttle at full load. Note conditions for measurements at full load* ⇒ Page 129.
- *The measured values must be read at an engine speed of 2300 rpm (2nd person required).*

Test prerequisites

- Engine warm, coolant temperature not below 80°C
- Engine speed 2200…2450 rpm
- Engine at full load

Display zone	Operating mode or component	Specification	Evaluation
1	Engine speed	2200...2450 rpm	---
2	Charge pressure (specified)	1620...1750 mbar	---
3	Charge pressure (actual)	1620...1800 mbar	⇒ Page 132
4	Duty cycle of charge pressure control solenoid valve	40...70 %	---

Evaluation: display group 11, display zone 3 - charge pressure (actual)

Display shows	Possible cause of fault	Fault remedy
Below specification	◆ Leaks between turbocharger and engine (charge air system) ◆ Charge pressure control defective	– Checking charge air system for leaks ⇒ Page 331 – Checking charge pressure control ⇒ Page 333.
Above specification	◆ Charge pressure control defective ◆ Turbocharger defective	– Checking charge pressure control ⇒ Page 333.
	◆ Defective charge pressure sender -G31-	– -G31- Check. ⇒ Page 343

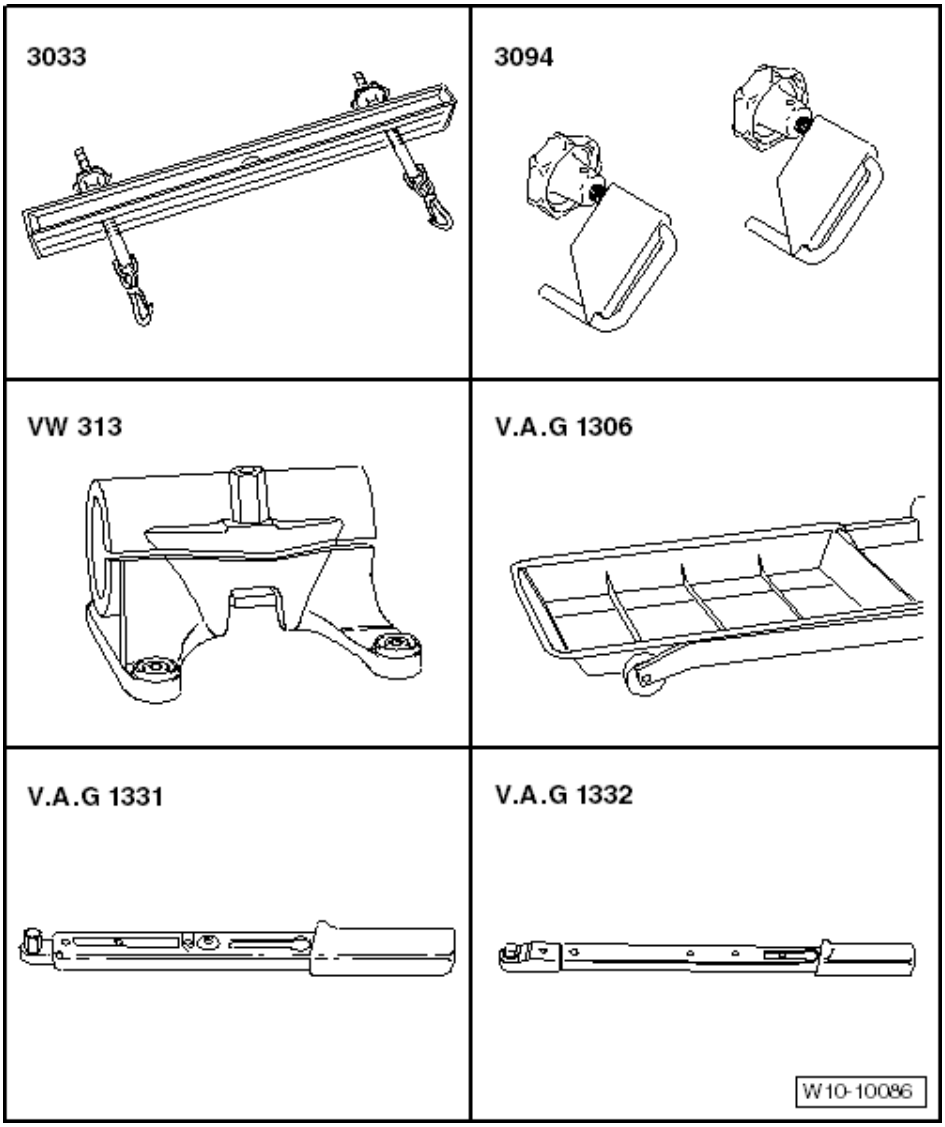
10 - Removing and installing engine

1 Removing and installing engine

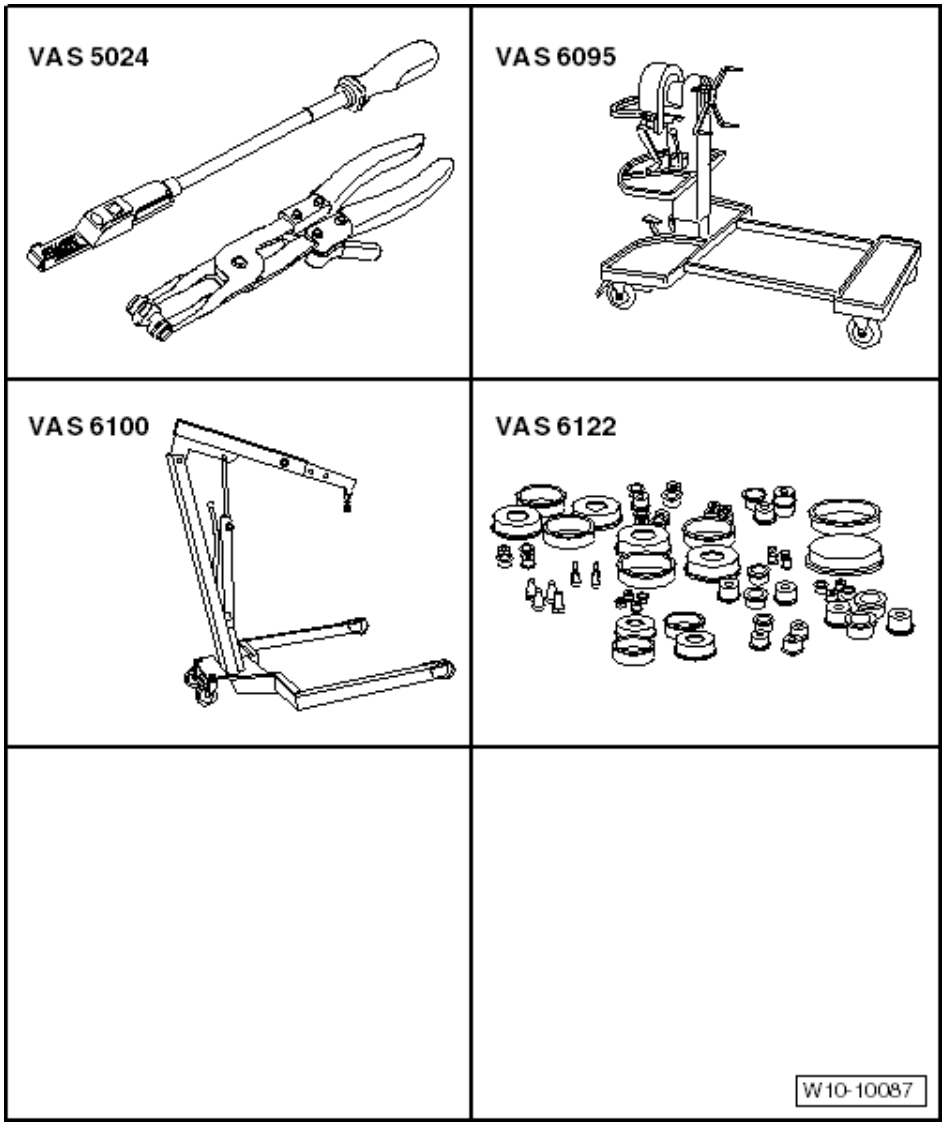
> ⚠ ***WARNING***
>
> ***Adhere to the general safety regulations and the notes on repair work on the engine!*** ⇒ **Page 1**

Special tools and workshop equipment required

- Lifting tackle -3033-
- Hose clamps up to 25 mm -3094-
- Support clamp -VW 313-
- Drip tray -V.A.G 1306- or drip tray -VAS 6208-
- Torque wrench (5…50 Nm) -V.A.G 1331-
- Torque wrench (40…200 Nm) -V.A.G 1332-



- Spring-type clip pliers -VAS 5024-
- Engine and gearbox support -VAS 6095-
- Workshop hoist -VAS 6100- or workshop hoist -V.A.G 1202 A-
- Engine bung set -VAS 6122-



Not illustrated:

- Container for removed parts -V.A.G 1698-
- Grease G 000 100
- Cable ties

Notes on removing ⇒Page 134.

Securing engine to assembly stand ⇒Page 136.

Notes on installing ⇒Page 136.

Specified torques ⇒Page 137.

Additional information and assembly work for power units with air conditioner ⇒Page 137.

1.1 Notes on removing

Note

The procedure described below provides only general instructions for removing and installing industrial engines, since due to

the various use cases it is not possible to specify a common procedure.

Procedure

> ⚠ ***WARNING***
>
> ***When doing any repair work, pay attention to the following due to the cramped conditions:***
>
> - ***Adhere to the general safety precautions, and never take any risk.***
> - ***The engine is a hazardous area and can cause serious injuries.***
> - ***Never leave any objects in the engine compartment, such as cleaning cloths or tools.***
> - ***Many engine components become hot during operation – risk of burns. If necessary, provide appropriate protective means.***
> - ***Servicing materials, such as fuel, engine oils or coolant additive, are harmful substances; adhere to the safety instructions from the manufacturer.***
> - ***There is a risk of injuries, if maintenance locations are difficult to access. This risk can be reduced, by installing the engine in an appropriate location and by avoiding sharp edges.***
> - ***Route all the various lines (e.g. for fuel, hydraulics, coolant and refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.***
> - ***Ensure that there is sufficient clearance to all moving or hot components.***
> - ***Tools are to be checked for damage and safety risks on a regular basis.***

Note

- *All cable ties which are opened or cut through when the engine is removed must be replaced in the same position when the engine is installed.*
- *To prevent damage to removed components, place them in the container for removed parts -V.A.G 1698-.*
- *Some components cannot be removed, or removed only with difficulty, with the engine installed. Therefore, you should determine all defective components before removing engine and renew them while engine is removed.*

– Before removing, read event memory of engine control unit as of ⇒Page 26, read event memory.

– With ignition switched off, disconnect earth strap from battery.

– Pull fuel supply hose and fuel return hose off engine.

– Seal lines so that fuel system is not contaminated by dirt.

– Observe rules for cleanliness ⇒Page 354.
– Drain coolant ⇒Page 284.
– Pull coolant hoses off radiator.
– Pull off all coolant hoses to engine using assembly tool for spring-type clips -VAS 5024-.
– Disconnect all electrical wiring from gearbox, alternator and starter and lay to side.
– Pull off or disconnect all other electrical connections as necessary from engine and lay to side.
– Pull off necessary vacuum and breather hoses from engine.
– Release clamp for front exhaust pipe/diesel particulate filter.

Power units with air conditioning system:

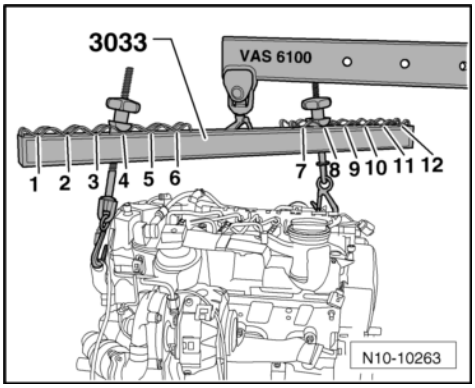
– Observe additional information and installation work ⇒Page 137.

1.2 Securing engine to assembly stand

Before carrying out repair work, secure engine on engine and gearbox support -VAS 6095/1- using universal mounting -VAS 6095-.

Procedure

– Attach lifting tackle -3033- as shown and raise engine using workshop hoist -V.A.G 1202 A- or workshop hoist -VAS 6100-.



Flywheel end:

- Position 4.

Vibration damper end:

- Position 8.

– Engine can now be moved using lifting tackle.
– Secure engine on engine and gearbox support -VAS 6095/1- using universal mounting -VAS 6095-.

1.3 Notes on installing

Installation is carried out in the reverse order. When installing, note the following:

Procedure

Note

The clutch and related components are not always in the scope of supply from Volkswagen. Adhere to the manufacturing specifications when performing any maintenance and repair work.

– Check whether dowel sleeves for centring engine/gearbox have been fitted in cylinder block, insert if necessary.
– Screw in all bolts on assembly mountings by hand approx. 5…6 turns.

– Align assembly mountings stress-free by rocking.
– Replenish coolant ⇒Page 284.
– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

1.4 Specified torques

Threaded connection		Specified torque
On cylinder block.	M6	10 Nm
	M7	15 Nm
	M8	20 Nm
	M10	40 Nm
	M12	65 Nm [1)]

1) Specified torque for M12 flange bolts: 75 Nm

1.5 Additional information and assembly work for power units with air conditioning system

WARNING

The air conditioner refrigerant circuit must not be opened.

Note

- *The opening of the refrigerant circuit can only be carried out in workshops, which have trained personnel and the necessary range of tools and workshop equipment.*
- *To prevent damage to condenser or to refrigerant lines/hoses, ensure that the lines and hoses are not stretched, kinked or bent.*

To facilitate removing and installing engine without opening refrigerant circuit:

– Remove retaining clamp(s) for refrigerant lines.
– Remove poly V-belt ⇒Page 138.
– Remove air conditioner compressor, and place it aside so that the refrigerant lines and hoses are relieved; Assembly overview - poly V-belt drive.

13 - Crankshaft group

1 Dismantling and assembling engine

⚠ *WARNING*

Adhere to the general safety regulations and the notes on repair work on the engine! ⇒ **Page 1**

⚠ *WARNING*

When doing any repair work, pay attention to the following due to the cramped conditions:

- ***Adhere to the general safety precautions, and never take any risk.***
- ***The engine is a hazardous area and can cause serious injuries.***
- ***Never leave any objects in the engine compartment, such as cleaning cloths or tools.***
- ***Many engine components become hot during operation – risk of burns. If necessary, provide appropriate protective means.***
- ***Servicing materials, such as fuel, engine oils or coolant additive, are harmful substances; adhere to the safety instructions from the manufacturer.***
- ***There is a risk of injuries, if maintenance locations are difficult to access. This risk can be reduced, by installing the engine in an appropriate location and by avoiding sharp edges.***
- ***Route all the various lines (e.g. for fuel, hydraulics, coolant and refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.***
- ***Ensure that there is sufficient clearance to all moving or hot components.***
- ***Tools are to be checked for damage and safety risks on a regular basis.***

Note

- *Before carrying out repair work, secure engine on engine and gearbox support -VAS 6095- using universal mounting -VAS 6095/1-.*
- *All bearing and running surfaces must be oiled before assembly.*

Caution

Finding metal shavings or a large quantity of small metal particles during engine repair could indicate that the crankshaft bearings or conrod bearings are damaged. To prevent this from causing further damage, perform the following on completion of repairs:

- ***Thoroughly clean oil passages,***
- ***Renew oil spray jets,***
- ***Renew oil cooler,***
- ***Renew oil filter element.***

Assembly overview - poly V-belt drive, with air conditioner compressor ⇒ Page 140.

Removing and installing poly V-belt ⇒ Page 141.

Assembly overview - poly V-belt drive, without air conditioner compressor ⇒ Page 141

Checking poly V-belt ⇒ Page 143.

Removing and installing poly V-belt tensioner, engines with air conditioner compressor only ⇒ Page 143.

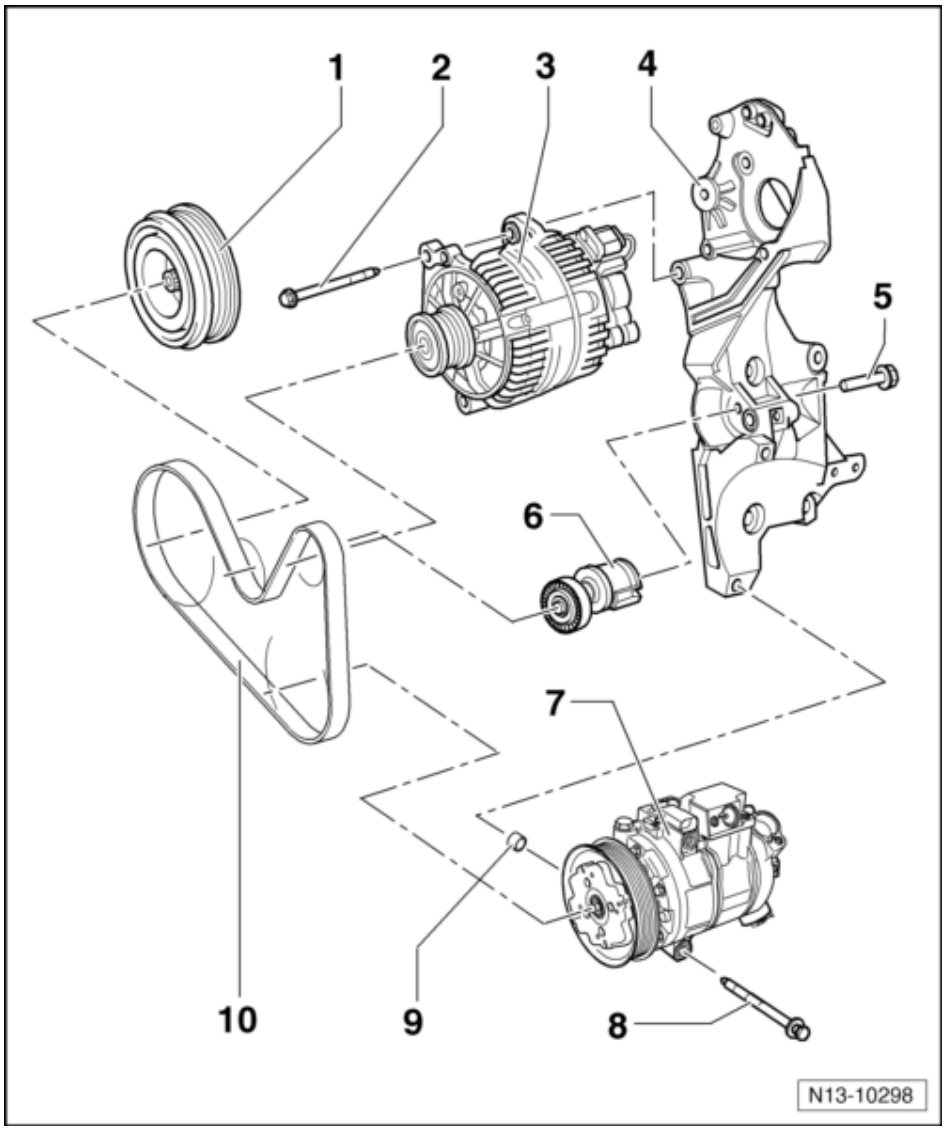
Removing and installing bracket for ancillary units ⇒ Page 144.

Assembly overview - toothed belt drive ⇒ Page 146.

Assembly overview - crankcase, engine codes CJDA, CJDD ⇒ Page 156.

Assembly overview - crankcase, engine codes CPYA, CPYB, CPYC, CPYD, CPYE ⇒ Page 157.

1.1 Assembly overview - poly V-belt drive, with air conditioner compressor



1 - Belt pulley and vibration damper
- ❑ Can only be installed in one position, holes are offset.

2 - 23 Nm

3 - Alternator -C-
- ❑ Assembly overview

4 - Ancillary bracket
- ❑ For alternator and air conditioner compressor
- ❑ Removing and installing.

5 - 20 Nm + 1/2 turn (180°) further
- ❑ Renew
- ❑ Do not additionally oil or grease the threads and shoulder.
- ❑ Turning further can be done in several stages.

6 - Poly V-belt tensioning element
- ❑ Swing to slacken poly V-belt
- ❑ Removing and installing tensioning element

7 - Air conditioner compressor

8 - 25 Nm

9 - Dowel sleeve

10 - Poly V-belt
- ❑ Mark direction of rotation before removing.
- ❑ Do not kink
- ❑ Removing and installing.
- ❑ Check for wear

1.2 Assembly overview - poly V-belt drive, without air conditioner compressor

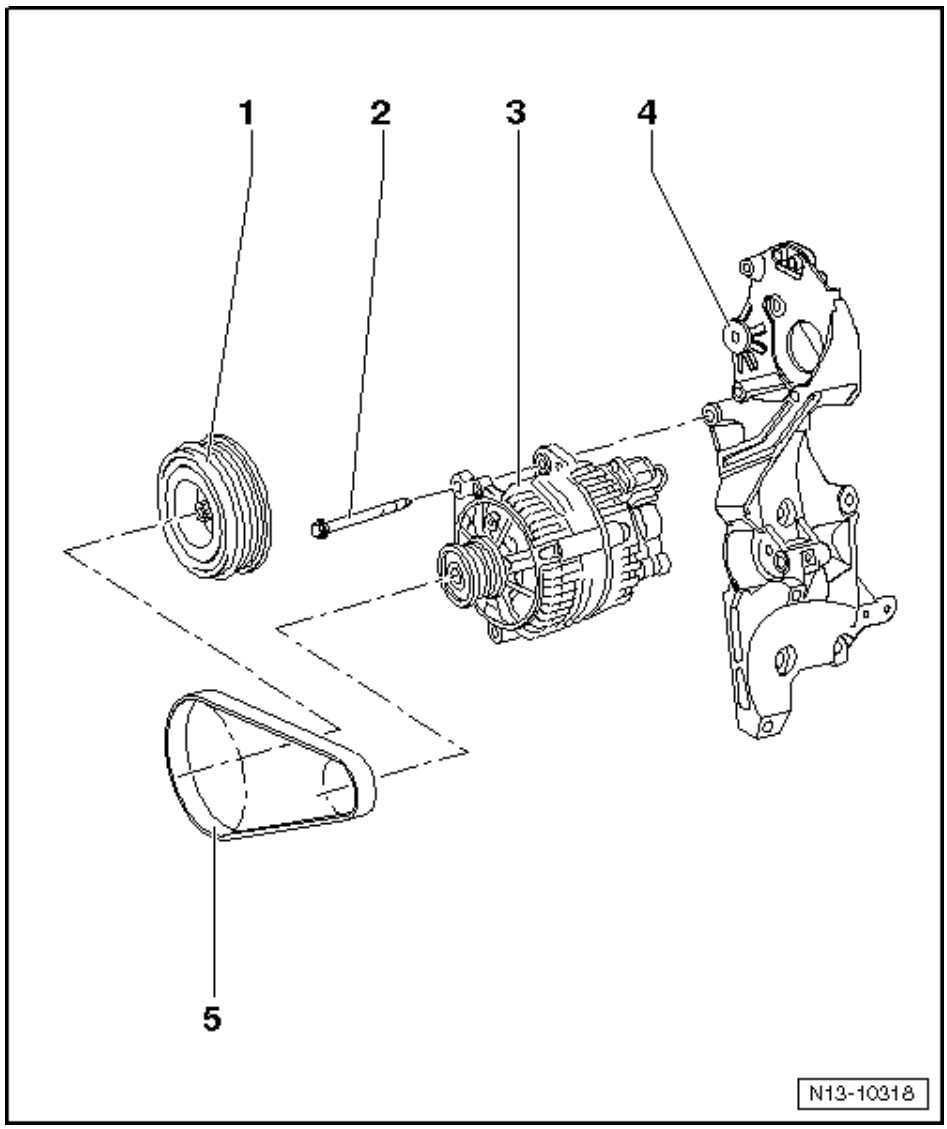
1 - Vibration damper
- ❑ Installation position: hole in vibration damper must align over protrusion on crankshaft pulley.

2 - 23 Nm

3 - Alternator

4 - Ancillary bracket

5 - Poly V-belt
- ❑ Check for wear ⇒Page 143
- ❑ Removing and installing ⇒Page 141

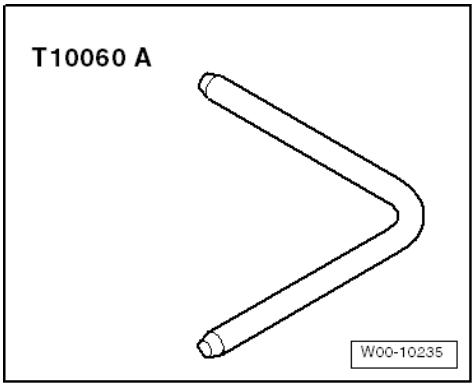


1.3 Removing and installing or renewing poly V-belt

Example with air conditioner compressor

Special tools and workshop equipment required

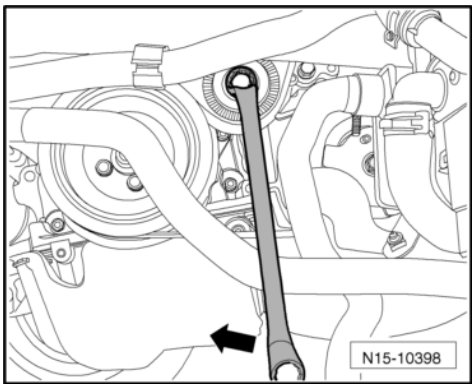
◆ Locking pin -T10060 A-



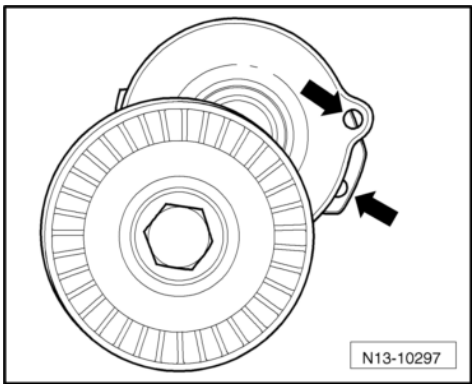
Removing

– Mark direction of rotation of poly V-belt.

– Swing tensioning element in -direction of arrow- to remove tension from poly V-belt.



– Align holes -arrows-, and lock tensioning element in position using locking pin -T10060 A-.
– Remove poly V-belt.



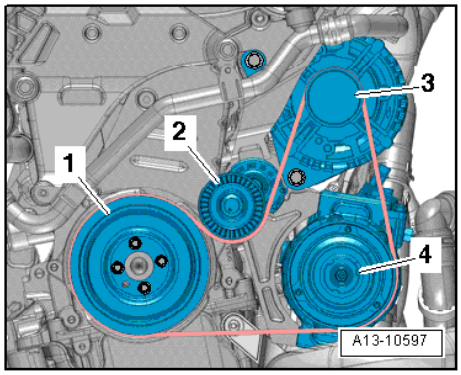
Installing

– Installation is carried out in the reverse order. When installing, note the following:

Note

- *Before installing poly V-belt, make sure that all ancillaries (alternator, air conditioner compressor) are secured firmly.*
- *When installing poly V-belt, check direction of belt rotation and proper seating of belt in pulleys.*

– Fit poly V-belt on pulleys.



1 - Crankshaft
2 - Tensioning element
3 - Alternator
4 - Air conditioner compressor

After completing repairs always:

– Make sure that the poly V-belt is routed as shown in illustration.
– Start engine and check belt running.

Example without air conditioner compressor

Special tools and workshop equipment required

- Poly V-belt repair kit with assembly tool ⇒ Electronic Parts Catalogue

Procedure

Note

The poly V-belt repair kit with tools contains tool -T10367- and illustrated instructions.

– Cut through the poly V-belt.

– Proceed as described in illustrated instructions.

After completing repairs always:

– Start engine and check belt running.

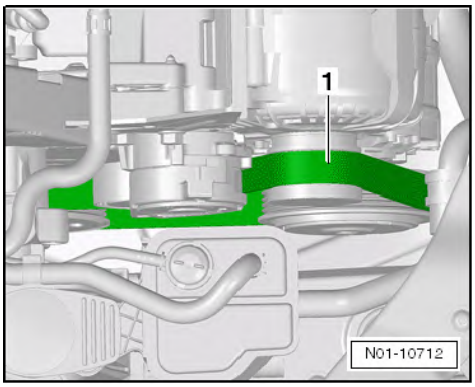
– Make sure that the poly V-belt is routed as shown in illustration ⇒Page 141.

1.4 Poly V-belt: Check condition

Carry out the following procedure:

– Crank engine at vibration damper on pulley using a socket.

Check poly V-belt -1- for the following:



- Substructure cracks (cracks, core ruptures, cross sectional breaks)
- Delamination (top cover, cord strands)
- Eruptions on bottom cover
- Fraying of cord strands
- Flank wear (material abrasion, frayed flanks, flank hardening -glass-like flanks-, surface cracks)
- Traces of oil and grease

Caution

- ***If faults are found it is absolutely necessary to renew the poly V-belt.***
- ***This can avoid breakdowns and malfunctions.***
- ***Renewing the poly V-belt is a repair measure.***

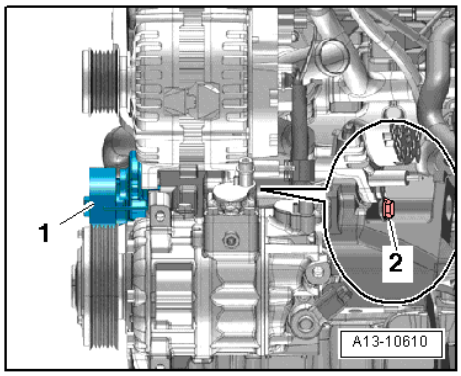
1.5 Removing and installing poly V-belt tensioner, engines with air conditioner compressor only

Removing

– Remove poly V-belt ⇒Page 141.

– Remove any relevant hoses and charge air pipes.

– Unscrew securing bolt -2- and remove poly V-belt tensioner -1-.



Installing

Install in reverse order. In the process, note the following:

- Renew bolt for tensioning element
- Specified torques ⇒Page 140.
- Install poly V-belt ⇒Page 141.

1.6 Removing and installing ancillary bracket

Removing

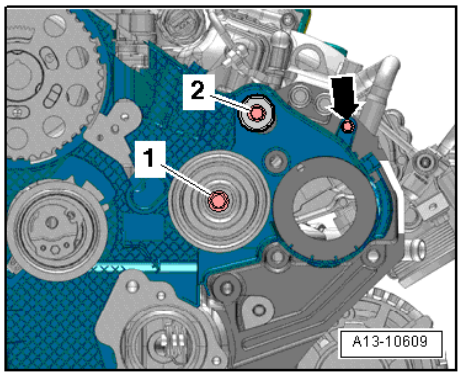
– Remove high-pressure pump ⇒Page 380.

– Remove alternator ⇒Page 471.

> ⚠ ***WARNING***
>
> ***The air conditioner refrigerant circuit must not be opened.***

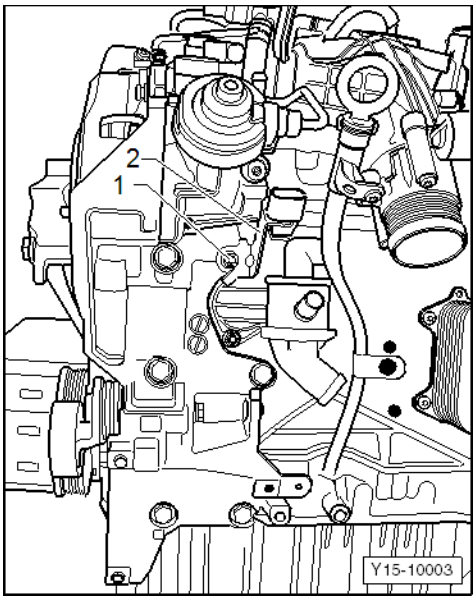
– If fitted, unbolt air conditioner compressor from ancillary bracket, and tie it up free of stress at a suitable location.

– Unbolt idler pulleys -1- and -2-, and remove bolt of toothed belt guard -arrow-.



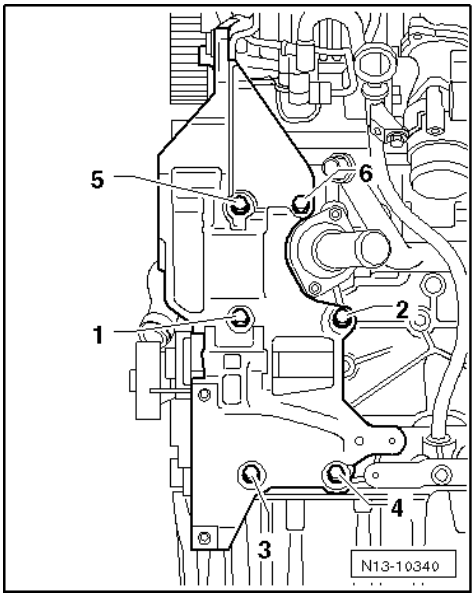
Engine codes CPYA, CPYB, CPYC, CPYD, CPYE

– Unscrew nut -1-, and remove retainer for connector of Hall sender —G40– -2-.



Continuation for all engine codes

– Unscrew bolts -6…1- and remove ancillaries bracket.



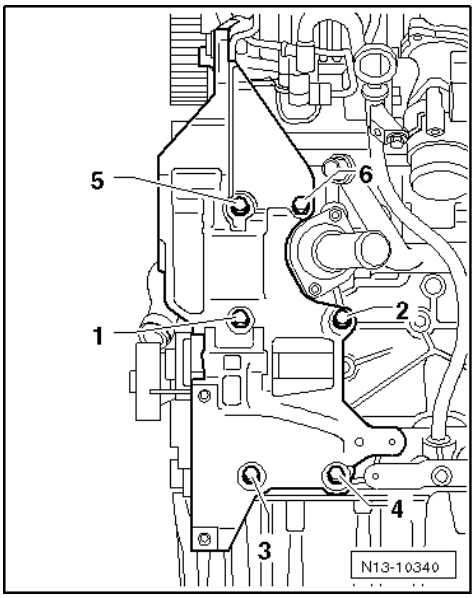
Installing

Install in reverse order. In the process, note the following:

- Take note of any dowel sleeves in ancillary bracket. Replace missing ones if necessary.
- Renew all bolts that must be tightened with specified tightening angle.

– Insert securing bolts for ancillary bracket as follows:

- Bolts -1- and -2-
- Bolts -3- and -4-
- Bolts -5- and -6-



– Tighten securing bolts for ancillary bracket in sequence -1 … 6- in 2 stages as follows:

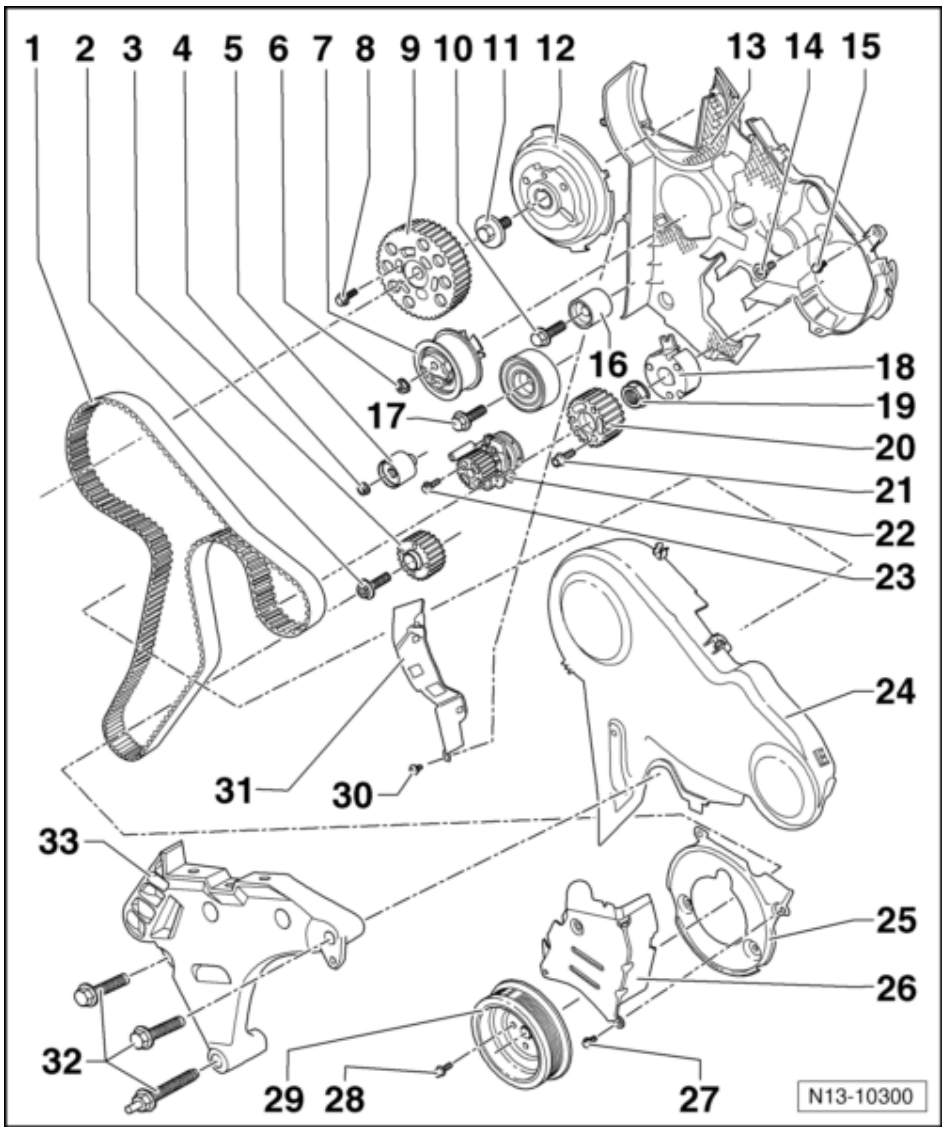
1. Screw all bolts in to stop by hand.
2. Tighten all bolts to 40 Nm.
3. Turn bolts -1, 2, 5 and 6- 90° further.
4. Turn bolts -3- and -4- 45° further.

– Install connector retainer at position -6-. Specified torque 20 Nm.

– Install high-pressure pump ⇒ Page 380.

– Install alternator.

1.7 Assembly overview - toothed belt drive, engine codes CJDA, CJDD, without crankshaft seal



1 - Toothed belt
- ❑ Mark direction of rotation before removing.
- ❑ Check for wear
- ❑ Do not kink
- ❑ Removing, installing and tensioning ⇒Page 210.

2 - 180 Nm + 3/8 turn (135°) further
- ❑ Renew
- ❑ Use counterhold tool -3415- to loosen and tighten.
- ❑ Do not additionally oil or grease the threads and shoulder.
- ❑ Turning further can be done in several stages.

3 - Crankshaft toothed belt pulley

4 - 20 Nm

5 - Idler pulley

6 - 20 Nm + 1/8 turn (45°) further
- ❑ Renew

7 - Tensioning roller
- ❑ If fitted, remove engine bracket to remove and install

8 - 20 Nm + 1/8 turn (45°) further
- ❑ Renew

9 - Camshaft pulley

10 - 25 Nm

11 - 100 Nm

12 - Hub
- ❑ Use counterhold tool -T10051- to loosen and tighten.
- ❑ To remove, use puller -T10052-.
- ❑ Removing and installing ⇒Page 138 Removing and installing camshafts.

13 - Rear toothed belt guard

14 - 20 Nm + 1/8 turn (45°) further

15 - 10 Nm

- ❑ Renew

16 - Idler pulley

17 - 50 Nm + 1/4 turn (90°) further

- ❑ Renew

18 - Hub

- ❑ Use counterhold tool -T10051- to loosen and tighten.
- ❑ To remove, use puller -T40064-.
- ❑ Removing and installing ⇒ Page 380

19 - 95 Nm

20 - Toothed belt pulley for fuel system high-pressure pump

21 - 23 Nm

- ❑ Renew

22 - Coolant pump

- ❑ Removing and installing ⇒ Page 287

23 - 15 Nm

24 - Toothed belt guard upper part

- ❑ Installing ⇒ Fig. on page 147.

25 - Toothed belt guard lower part

26 - Toothed belt guard centre part

27 - 10 Nm

- ❑ Renew

28 - 10 Nm + 1/4 turn (90°) further

- ❑ Renew

29 - Belt pulley and vibration damper

- ❑ Can only be installed in one position, holes are offset.

30 - 5 Nm

31 - Protective plate

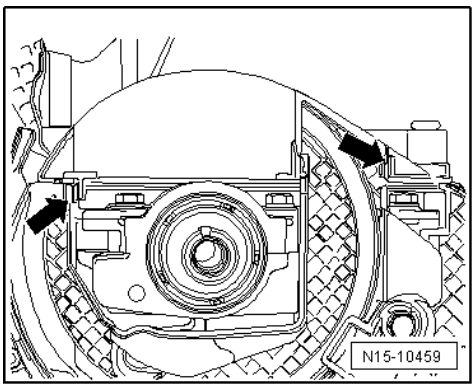
32 - 40 Nm + 1/2 turn (180°) further

- ❑ Renew
- ❑ Observe tightening sequence ⇒ Fig. on page 148.

33 - Engine bracket

Install toothed belt guard upper part.

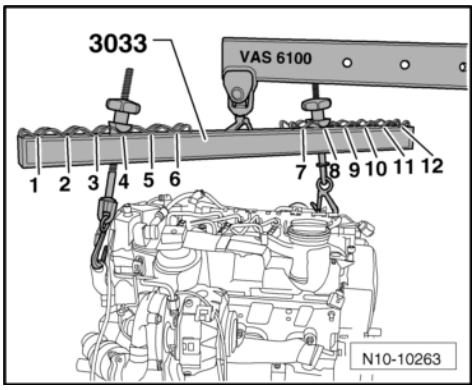
– Make sure that upper part of toothed belt guard is correctly clipped to cylinder head cover -arrows-.



1.8 Removing and installing engine bracket

Removing

– Attach lifting tackle -3033- as shown, and take up weight of engine using workshop hoist -V.A.G 1202 A- or workshop hoist -VAS 6100-.



Flywheel end:

- Position 4.

Vibration damper end:

- Position 8.

– Unscrew bolts of engine bracket, and remove engine bracket.

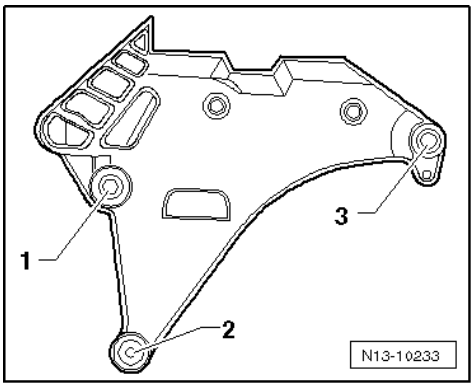
Note

Another suitable lifting and support device may be used as an alternative.

> ***WARNING***
>
> ***Secure the engine. There must be no hazards caused by the engine falling, tipping over, etc.***

Installing

Tightening sequence for securing engine bracket to cylinder block (if fitted)



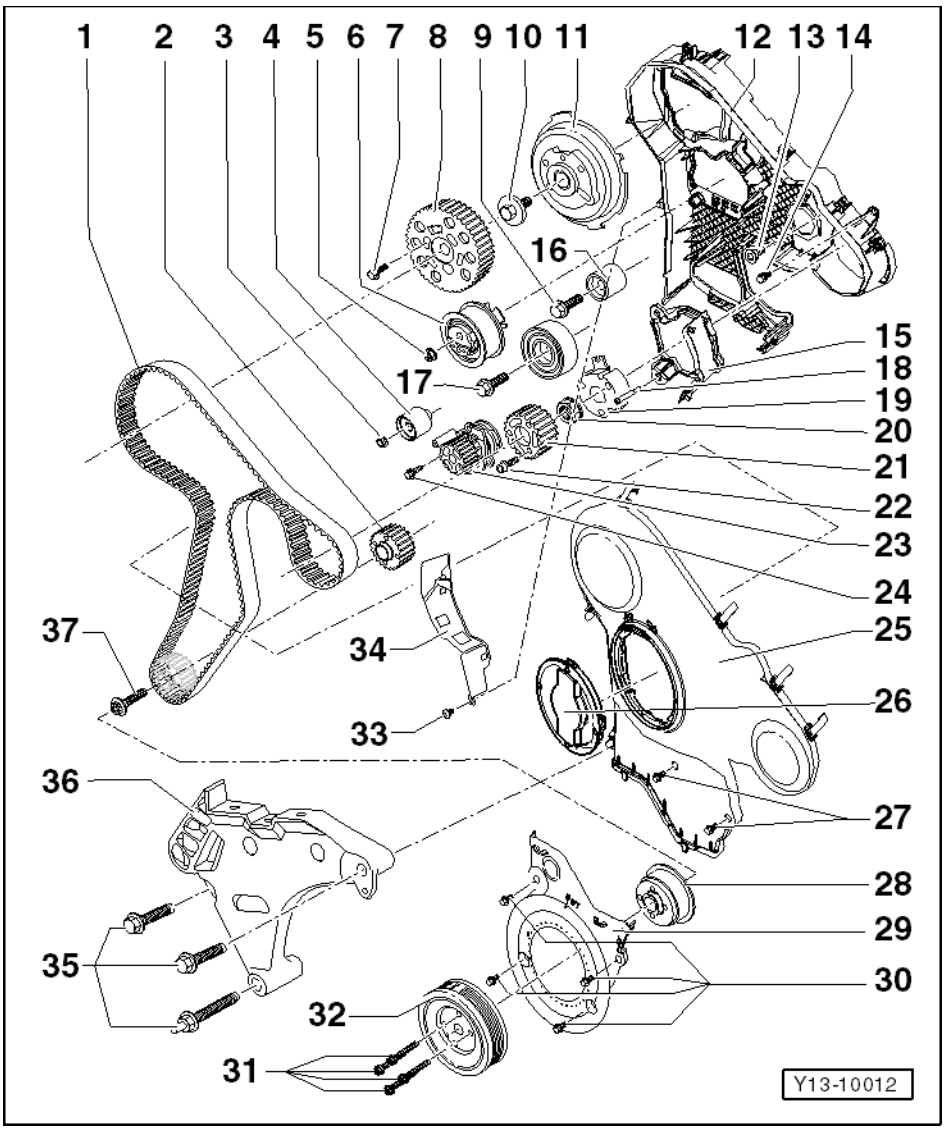
Caution

The tightening sequence and specified torques for the engine bracket securing bolts must always be followed. Otherwise the engine bracket can be stressed, causing it to break.

– First tighten new securing bolts hand-tight in sequence -1…3-.

– Retighten securing bolts in tightening sequence to specified torque ⇒ Item 32 on page 147 which is listed on page 128.

1.9 Assembly overview - toothed belt drive, engine codes CPYA, CPYB, CPYC, CPYE, with crankshaft seal



1 - Toothed belt
- ❑ Mark direction of rotation before removing.
- ❑ Check for wear
- ❑ Do not kink
- ❑ Removing, installing and tensioning ⇒Page 210.

2 - Crankshaft toothed belt pulley

3 - 20 Nm

4 - Idler pulley

5 - 20 Nm + 1/8 turn (45°) further
- ❑ Renew

6 - Tensioning roller
- ❑ If fitted, remove engine bracket to remove and install

7 - 20 Nm + 1/8 turn (45°) further
- ❑ Renew

8 - Camshaft pulley

9 - 25 Nm

10 - 100 Nm

11 - Hub
- ❑ Use counterhold tool -T10051- to loosen and tighten.
- ❑ To remove, use puller -T10052-.
- ❑ Removing and installing ⇒Page 138 Removing and installing camshafts.

12 - Rear toothed belt guard

13 - 20 Nm + 1/8 turn (45°) further

14 - 10 Nm
- ❑ Renew

15 - Toothed belt guard centre part

16 - Idler pulley

17 - 50 Nm + 1/4 turn (90°) further
- ❑ Renew

18 - Stud

19 - Hub
- ❑ Use counterhold tool -T10051- to loosen and tighten.
- ❑ To remove, use puller -T40064-.

❑ Removing and installing ⇒Page 380

20 - 95 Nm

21 - Toothed belt pulley for fuel system high-pressure pump

22 - 23 Nm

❑ Renew

23 - Coolant pump

❑ Removing and installing ⇒Page 287

24 - 15 Nm

25 - Toothed belt guard upper part

❑ Installing ⇒Fig. on page 147.

26 - Inspection cover for checking tension of toothed belt

27 - 10 Nm

28 - Guide

29 - Toothed belt guard lower part

30 - 10 Nm

31 - 20 Nm + $^{1}/_{2}$ turn (180°) further

❑ Renew

32 - Belt pulley and vibration damper

❑ Can only be installed in one position, holes are offset.

33 - 5 Nm

34 -

35 - Protective plate

36 - 40 Nm + $^{1}/_{2}$ turn (180°) further

❑ Renew

❑ Observe tightening sequence ⇒Fig. on page 148.

37 - Engine bracket

38 - 180 Nm + $^{3}/_{8}$ turn (135°) further

❑ Renew

❑ Use counterhold tool -3415- to loosen and tighten.

❑ Do not additionally oil or grease the threads and shoulder.

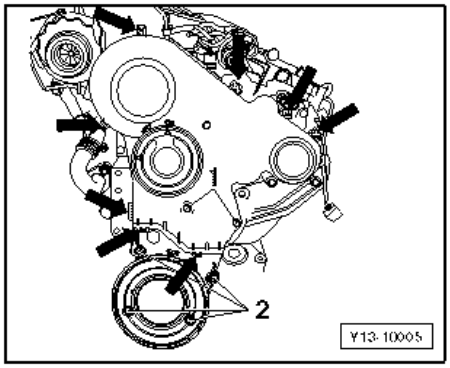
❑ Turning further can be done in several stages.

1.10 Removing and installing toothed belt guard with inspection cover for checking tension of toothed belt

Removing

– Release all retaining clips -arrows- on upper and lower part of toothed belt guard.

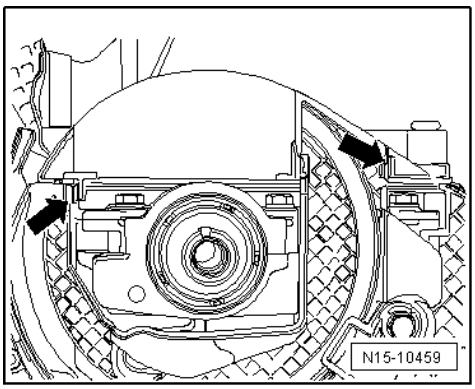
– Unscrew bolts -1- on upper part of toothed belt guard (qty. 2) as well as bolts -2- on lower part of toothed belt guard (qty. 4), and remove both parts of toothed belt guard.



Installing

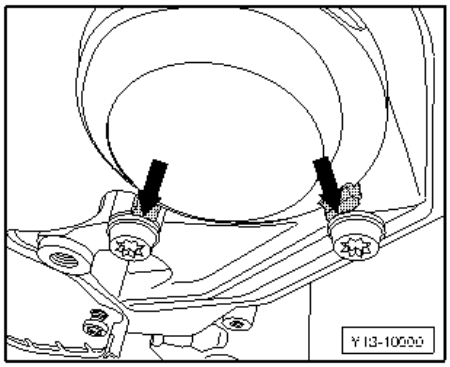
– Install in reverse order. In the process, note the following:

◆ Make sure that upper part of toothed belt guard is correctly clipped to cylinder head cover -arrows-.



◆ Retaining lugs of cover must engage in behind heads of bolts -arrows- ⇒ Page 150.

◆ After installing the toothed belt guard, make sure that the Hall sender wheel is free to move. There may be grinding noise. Slight grinding noises should disappear after the engine has been running for a while. If the clearance is too small, rework toothed belt guard as necessary (grind) before installing toothed belt.

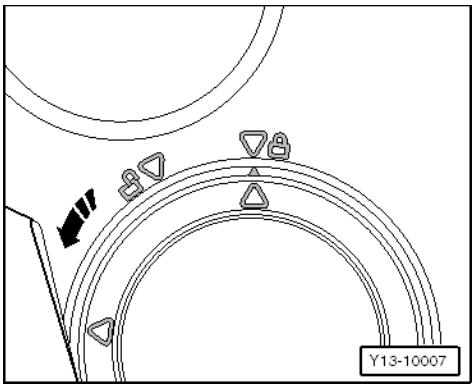


1.11 Performing visual check of toothed belt tension

– For the visual check turn inspection cover on upper part of toothed belt guard towards left to allow for removing inspection cover ⇒ see Service schedule 2.0 l_4 cyl._TDI_CR.

– Remove inspection cover, and perform visual check.

– Start the cold engine, and run it at idling speed.



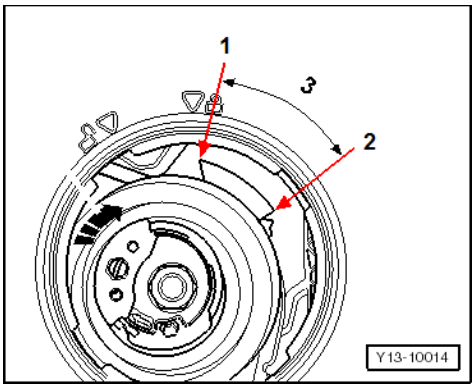
Note

After the visual check has been completed, make sure to turn the inspection cover towards right until the triangle marks are properly aligned. If the inspection cover is not fitted as specified, it may become detached during operation.

– -1- Worn

– -2- New

– -3- Operation time



Note

After the visual check has been completed, make sure to turn the inspection cover towards right until the triangle marks are properly aligned. If the inspection cover is not fitted as specified, it may become detached during operation.

1.12 Assessing wear on tensioning roller and belt pulleys

Toothed belt und pulleys

– -1- Worn

– -2- New

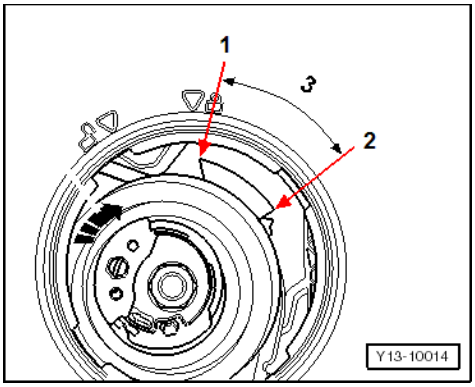
– -3- Operation time

– The toothed belt tension must be checked as part of maintenance work/every 600 operating hours. This is also applicable for extended service intervals.

– The toothed belt must not be retensioned.

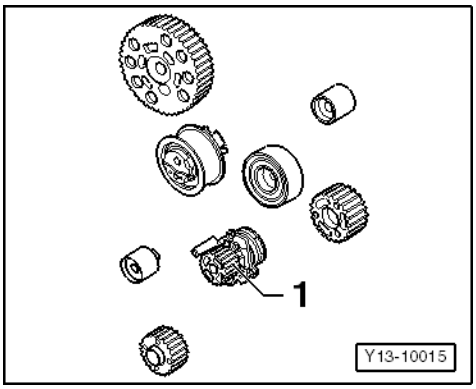
– The remaining service life must be determined, and if necessary the toothed belt must renewed earlier than specified.

– Each time the toothed belt is renewed, check wear on toothed belt pulleys.



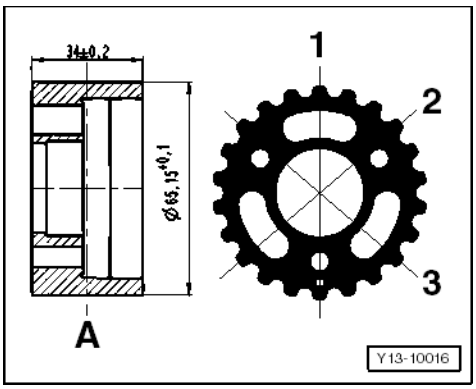
1.13 Wear of high-pressure pump pulley

– If wear of high-pressure pump pulley -1- exceeds 0.50 mm, renew all toothed belt pulleys and rollers. The diameter of a new high-pressure pump pulley is 65.15 mm (+0.1 mm).



– Determine wear of high-pressure pump pulley by measuring the tooth tip diameter.
– To do this, measure 3 tooth tip diameters -1-, -2- and -3- in the centre of track -A-, and calculate the average from these measurements.

– If the diameter is below 64.65 mm, renew toothed belt pulleys of toothed belt drive.



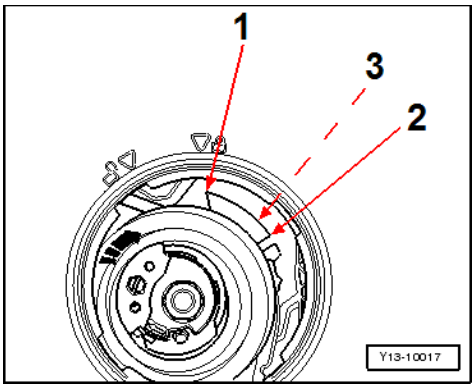
1.14 Assessing wear

– Remove toothed belt guard, or open inspection cover.
– Let the engine run at idling speed. Observe indicator position on tensioning roller.
– Assess whether the toothed belt will exceed the wear limit before the next service interval taking the operating hours into account.
– The toothed belt must not be retensioned.

Example 1 (inspection at 600 operating hours)

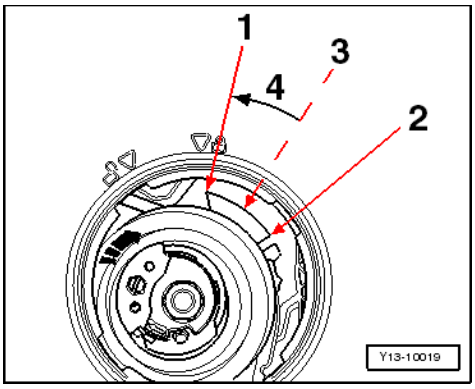
– -1- Worn (2400 operating hours)
– -2- New
– -3-.$^1/_4$ of measuring field
– If the dashed indicator -3- is positioned at $^1/_4$ -3- or less of the measuring field at the 600 operating hour inspection, the toothed belt wear is still within the specified range. I.e., the toothed belt will last until the next inspection is due and does not need to be renewed earlier than specified.

– If the toothed belt wear exceeds $^1/_4$ of the measuring field, the appropriate time for renewing the toothed belt must be specified for each individual scenario. The indicator should not be too close to the centre of the measuring field. If this is the case, the toothed belt is very likely to last until the next service interval is due.



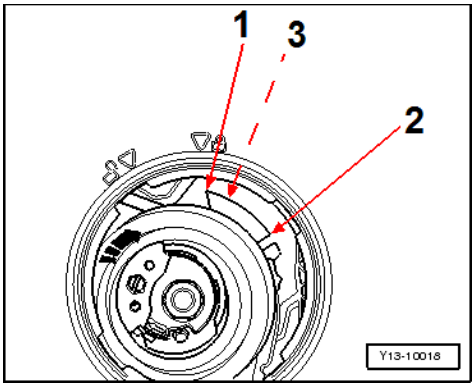
Example 2 (inspection at 1200 operating hours)

– -1- Worn (2400 operating hours)
– -2- New
– -3-.$^1/_2$ of measuring field
– -4- Range for toothed belt not OK
– If the dashed indicator is still ahead of the centre of the measuring field at the 1200 operating hour inspection, the toothed belt wear is linear. I.e., the toothed belt will last until the next inspection is due and does not need to be renewed.
– If the indicator exceeded $^1/_2$ of the measuring field, it is in the "Range for toothed belt not OK", and the toothed belt must be renewed. This must be assessed for each individual case.



Example 3 (inspection at 1800 operating hours)

– -1- Worn (2400 operating hours)
– -2- New
– -3-.$^3/_4$ of measuring field
– If the dashed indicator is still ahead $^3/_4$ of the measuring field at the 1800 operating hour inspection, the toothed belt wear is linear. I.e., the toothed belt will last until the next inspection is due and does not need to be renewed.
– If the indicator exceeded $^3/_4$ of the measuring field, renew toothed belt -immediately-.

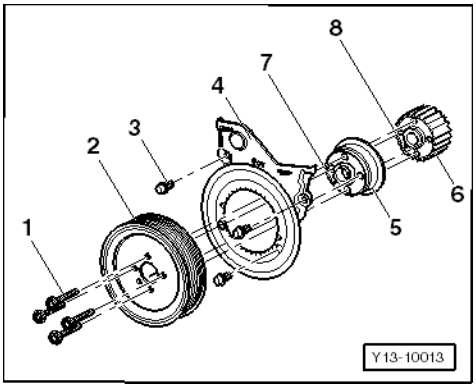


If the assessment showed that the toothed belt will not last until the next service interval is due, renew toothed belt.

After the toothed belt has been removed, check wear of toothed belt pulleys ⇒ "Wear of high-pressure pump pulley" on page 152.

If the wear on one of the toothed belt pulleys (especially on the high-pressure pump and coolant pump pulleys) exceeds 0.50 mm, renew all toothed belt pulleys and rollers.

1.15 Removing and installing crankshaft protective cover



Removing

– Loosen bolts -1- on vibration damper -2-, and remove vibration damper.

– Loosen bolts -3- on lower part of toothed belt guard -4-, and remove lower part of toothed belt guard.

– Remove hub (guide) -5- from protective cover.

Installing

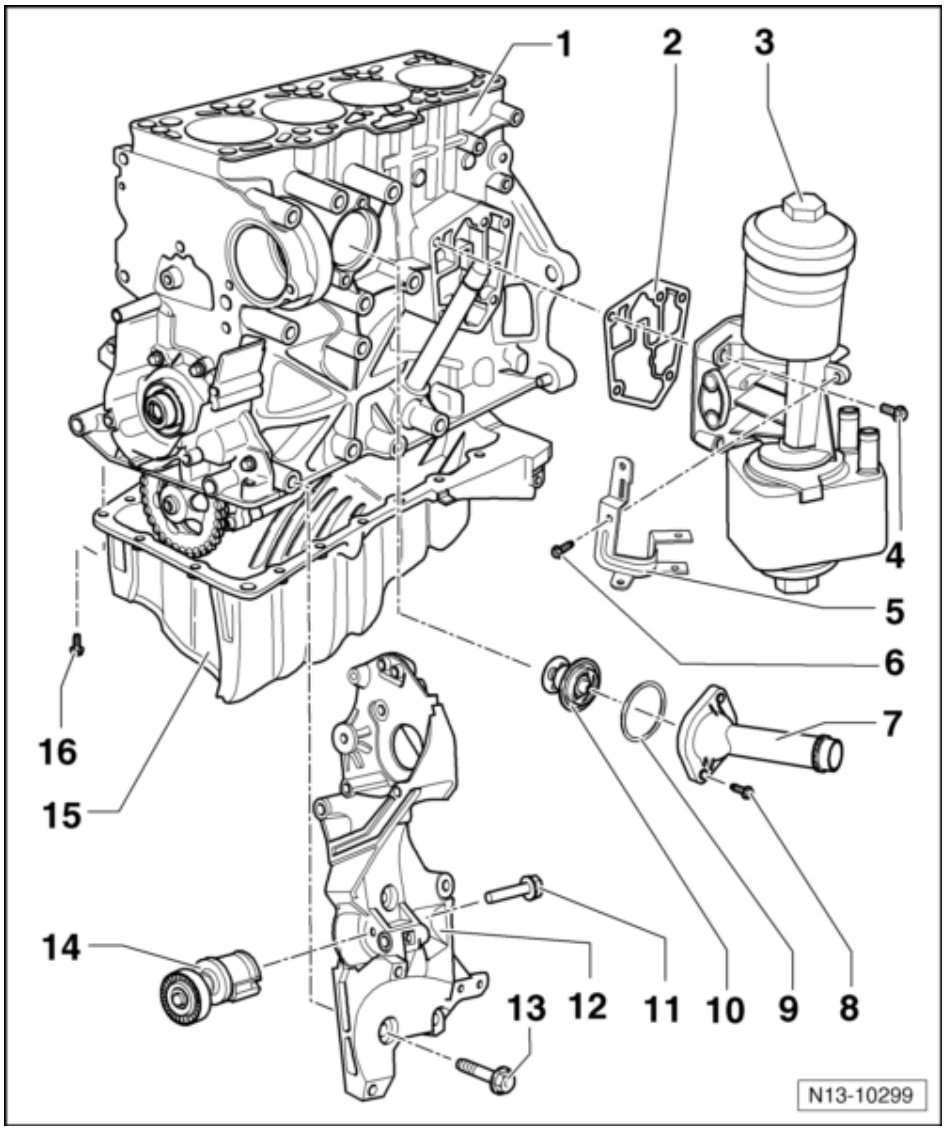
– Install in reverse order. In the process, note the following:

Note

The protective cover can only be installed in one position, holes are offset.

- Push locking lug -7- of guide -5- precisely onto respective locking peg -8- on toothed belt pulley -6-.
- Fit lower part of toothed belt guard -4-, and renew bolts -3-.
- Tighten bolts -3- to specified torque of 10 Nm.
- Fit vibration damper -2-, and renew bolts -1-.
- Counterhold on central bolt of crankshaft using a multi-point socket bit (standard tool), and tighten bolts -1- to 20 Nm + $^1/_2$ turn (180°) further.

1.16 Assembly overview - crankcase, engine codes CJDA, CJDD



1 - Cylinder block
- ❑ Removing and installing sealing flange and flywheel ⇒Page 158.
- ❑ Removing and installing crankshaft ⇒Page 138.
- ❑ Dismantling and assembling pistons and conrods ⇒Page 138.

2 - Gasket
- ❑ Renew

3 - Oil filter bracket
- ❑ Assembly overview - oil filter bracket and oil cooler ⇒Page 260.

4 - 15 Nm + 1/4 turn (90°) further
- ❑ Renew
- ❑ First fit upper left and lower right bolts and then tighten all four bolts diagonally.

5 - Bracket

6 - 10 Nm

7 - Connection
- ❑ For 4/2-way valve
- ❑ Removing and installing 4/2-way valve ⇒Page 290

8 - 15 Nm

9 - O-ring
- ❑ Renew

10 - 4/2-way valve
- ❑ Removing and installing 4/2-way valve ⇒Page 290

11 - 20 Nm + 1/2 turn (180°) further
- ❑ Renew

12 - Ancillary bracket
- ❑ For alternator and, if fitted, air conditioner compressor
- ❑ Removing and installing ⇒Page 144
- ❑ Removing and installing, adhere to tightening sequence ⇒Page 144

13 - Bolt
- ❑ Renew
- ❑ Observe different prescribed torques and tightening sequence ⇒Page 144

14 - Poly V-belt tensioner, if fitted

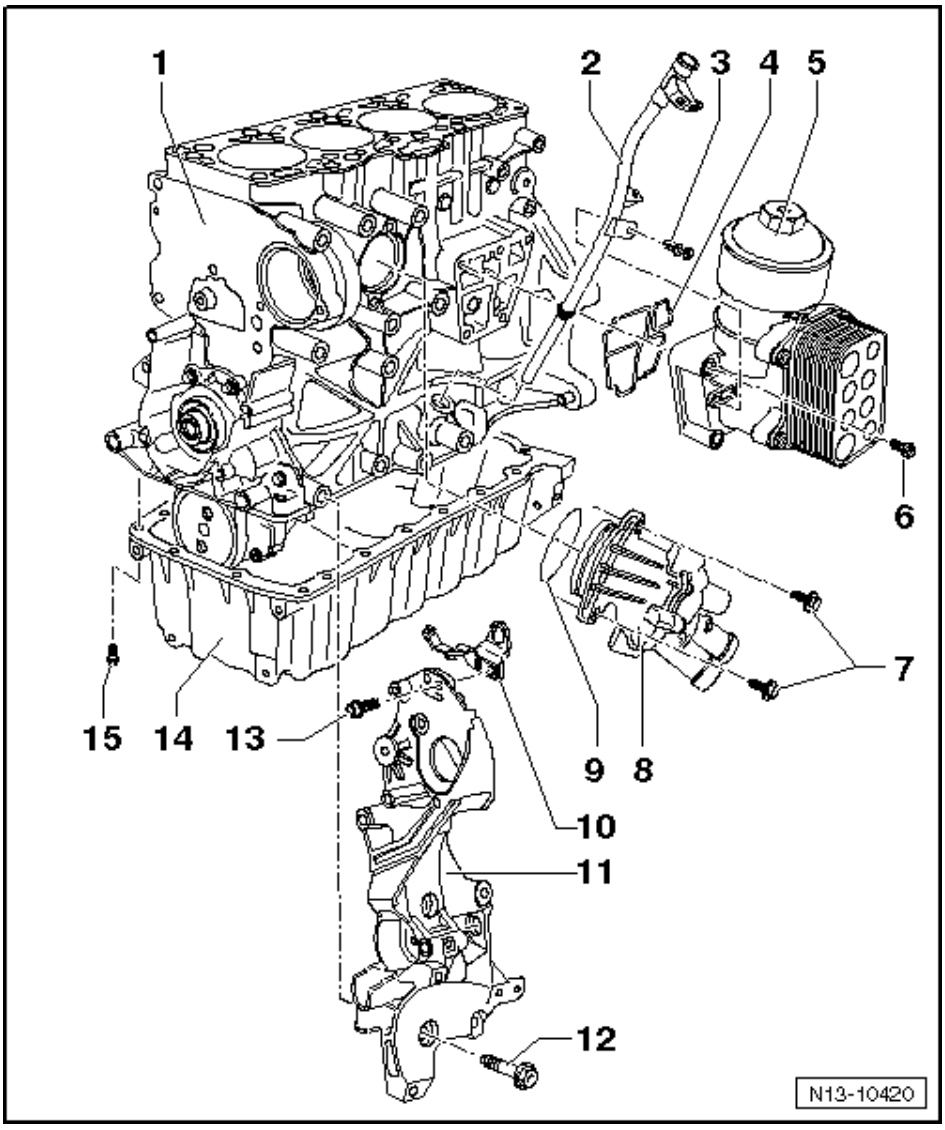
- ❑ Swing to slacken poly V-belt

15 - Sump

- ❑ Clean sealing surface before fitting.
- ❑ Install with silicone sealant D176404 A2
- ❑ Removing and installing ⇒Page 244

16 - 15 Nm

1.17 Assembly overview - crankcase, engine codes CPYA, CPYB, CPYC, CPYD, CPYE



1 - Cylinder block

- ❑ Removing and installing sealing flange and flywheel ⇒Page 158.
- ❑ Removing and installing crankshaft ⇒Page 138.
- ❑ Dismantling and assembling pistons and conrods ⇒Page 138

2 - Guide tube

- ❑ Renew O-ring.

3 - Spreader clip

4 - Gaskets

- ❑ Renew
- ❑ May not be lubricated with oil
- ❑ Fit into lugs on oil filter bracket.

5 - Oil filter bracket

- ❑ Oil filter bracket and engine oil cooler

6 - 14 Nm + $^1/_2$ turn (180°) further

- ❑ Renew
- ❑ First fit upper left and lower right bolts and then tighten all four bolts diagonally.

7 - 13 Nm

8 - 4/2-way valve

- ❑ Removing and installing ⇒Page 290

9 - O-ring

- ❑ Renew

10 - Lifting eye

11 - Ancillary bracket

- ❑ For alternator, air conditioner compressor, if fitted
- ❑ Removing and installing, adhere to tightening sequence ⇒Page 144

12 - Bolt

- ❑ Observe different prescribed torques and tightening sequence ⇒Page 144

13 - 25 Nm

14 - Sump

- ❑ Clean sealing surface before fitting.
- ❑ Install with silicone sealant D176404 A2
- ❑ Removing and installing ⇒Page 244

15 - 15 Nm

2 Removing and installing sealing flange and flywheel

Note

- *The repair work described in this chapter must be carried out in a Volkswagen dealership only. Go to a Volkswagen dealership.*
- *If these instructions are not adhered to and damage results, Volkswagen is exempt from any liability and warranty claims.*

> ***WARNING***
>
> ***Adhere to the general safety regulations and the notes on repair work on the engine! ⇒Page 1***

Note

Before carrying out repair work, secure engine on engine and gearbox support -VAS 6095/1- using universal mounting -VAS 6095-.

Assembly overview - sealing flange, belt pulley end ⇒Page 159.

Renewing crankshaft oil seal, belt pulley end ⇒Page 161.

Removing and installing crankshaft sealing flange, pulley end ⇒Page 164.

Assembly overview - sealing flange and flywheel ⇒Page 167.

Renewing crankshaft sealing flange, flywheel end ⇒Page 169.

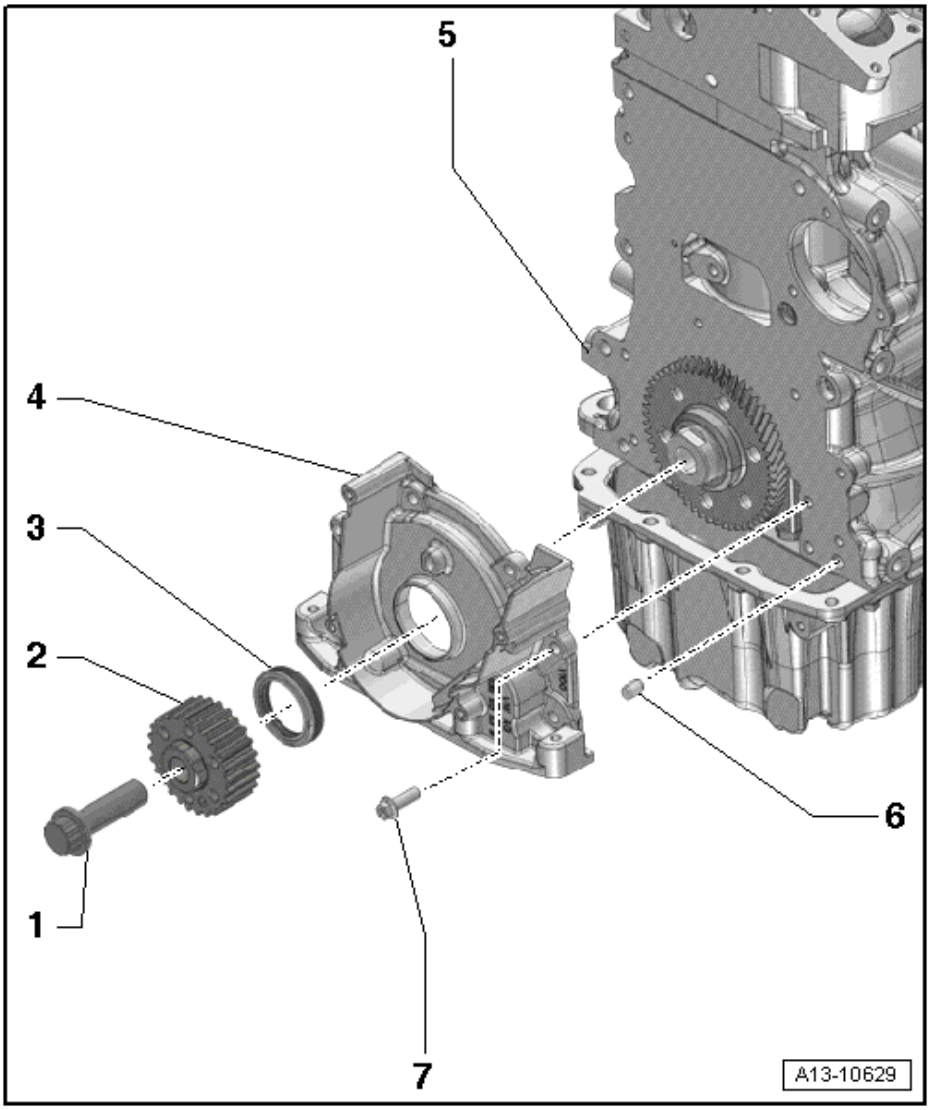
Removing and installing engine speed sender -G28- ⇒Page 178.

2.1 Assembly overview - Sealing flange, belt pulley end

⚠ ***WARNING***

Always adhere to the following instructions.

- ***The repair work described in this chapter must be carried out in a Volkswagen dealership only.***
- ***If these instructions are not adhered to and damage results, Volkswagen is exempt from any liability and warranty claims.***



1 - 180 Nm + $^{3}/_{8}$ turn (135°) further
- ❑ Renew
- ❑ Use counterhold -3415- to loosen and tighten.
- ❑ Do not additionally oil or grease thread and shoulder.
- ❑ Turning further can be done in several stages.

2 - Crankshaft pulley
- ❑ Contact surface between toothed belt pulley and crankshaft must be free from oil
- ❑ Fitting possible in one position only.

3 - Seal
- ❑ Do not additionally oil or grease the oil seal sealing lip.
- ❑ Before installing, remove oil residue from crankshaft journal using a clean cloth.
- ❑ Renewing crankshaft oil seal - belt pulley end ⇒Page 161.

4 - Sealing flange
- ❑ Must seat on dowel pins.
- ❑ Removing and installing ⇒Page 164
- ❑ Install with silicone sealant -D 176 404 A2- ⇒Page 164.

5 - Cylinder block
- ❑ Removing and installing crankshaft ⇒Page 138.
- ❑ Dismantling and assembling pistons and conrods ⇒Page 138.

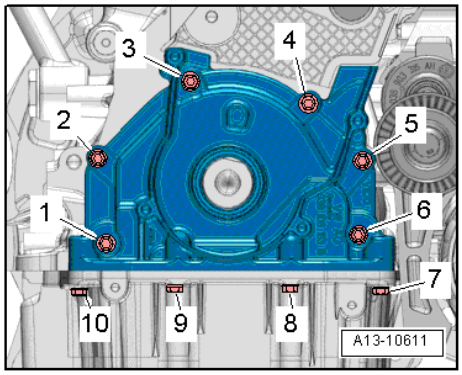
6 - Dowel pin
- ❑ Qty. 2

7 - Bolt
- ❑ Specified torque and tightening sequence ⇒Fig. on page 161.

Sealing flange at belt pulley end - Prescribed torque and tightening sequence

– Tighten bolts in 3 stages in the sequence shown:

Stage	Bolts	Specified torque
1.	-1 … 10-	Screw in to contact by hand
2.	-1 … 6-	Diagonally in stages; final torque 15 Nm
3.	-7 … 10-	15 Nm



2.2 Renewing crankshaft oil seal - pulley end

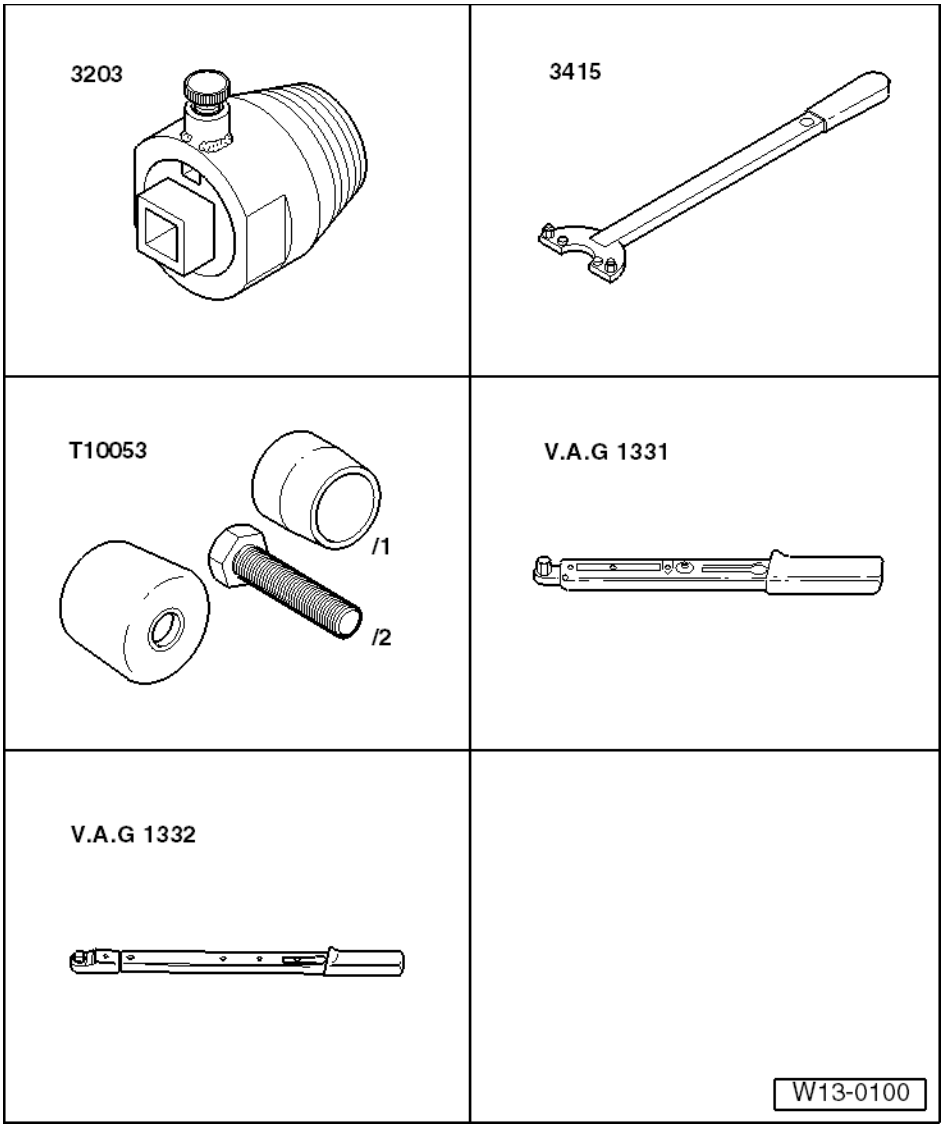
Note

- *The repair work described in this chapter must be carried out in a Volkswagen dealership only. Go to a Volkswagen dealership.*
- *If these instructions are not adhered to and damage results, Volkswagen is exempt from any liability and warranty claims.*

> ***WARNING***
>
> ***Adhere to the general safety regulations and the notes on repair work on the engine!*** ⇒Page 1

Special tools and workshop equipment required

- Oil seal extractor -3203-
- Counterhold -3415-
- Assembly tool -T10053-
- Torque wrench (5…50 Nm) -V.A.G 1331-
- Torque wrench (40…200 Nm) -V.A.G 1332-



Removing ⇒Page 162.

Installing ⇒Page 163.

2.2.1 Removing

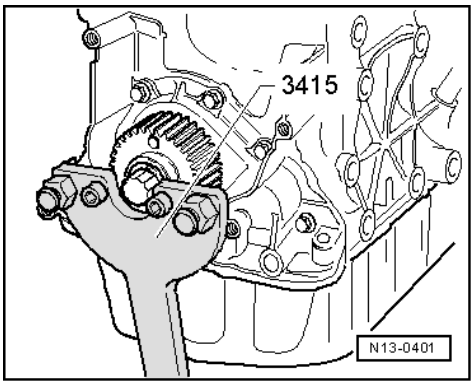
– Remove toothed belt ⇒Page 210.

– Remove crankshaft pulley. To do this, lock toothed belt pulley using counterhold -3415-.

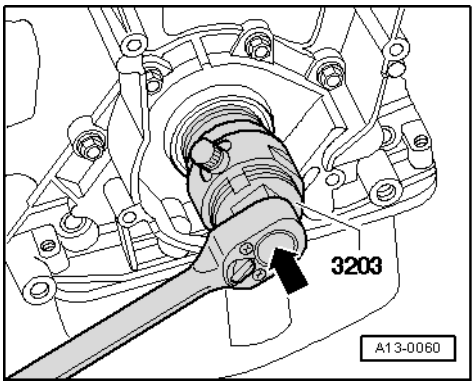
– To guide oil seal extractor -3203-, screw central bolt by hand to stop into crankshaft.

– Unscrew inner part of oil seal extractor by 20 mm from outer part making sure that it still remains screwed in by at least two turns. Lock oil seal extractor in position using knurled screw.

– Oil threaded head of oil seal extractor.



– Using great pressure, screw oil seal extractor as far as possible into oil seal.
– Loosen knurled screw and turn inner part against crankshaft until oil seal is pulled out.

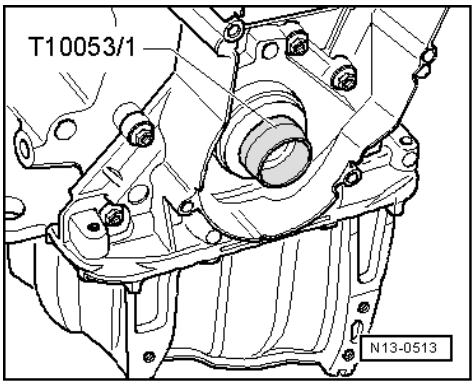


2.2.2 Installing

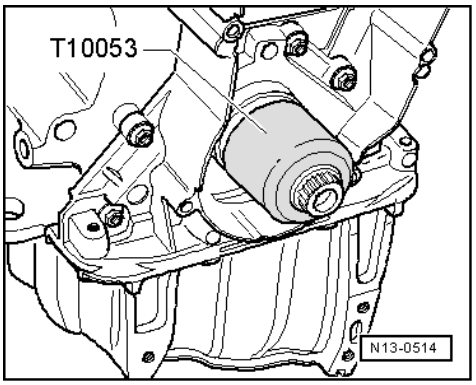
Note

The oil seal sealing lip must not be additionally oiled or greased.

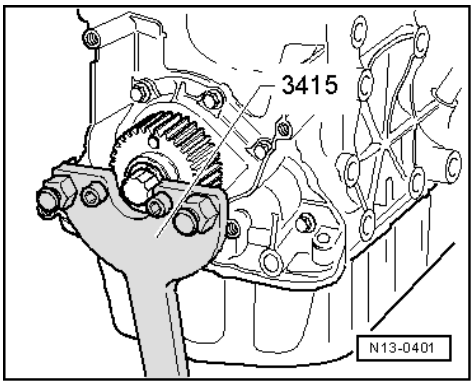
– Remove oil residue from crankshaft journal using clean cloth.
– Place guide sleeve -T10053/1- onto crankshaft journal.
– Slide oil seal over guide sleeve onto crankshaft journal.



– Press oil seal in to stop using assembly tool -T10053- and central bolt.



– Install crankshaft pulley. To do this, lock toothed belt pulley using counterhold -3415-.
– Tighten new central bolt to 120 Nm and $^1/_4$ turn (90°) further (turning further can be done in several stages).



Note

Thread and shoulder must be free of oil and grease.

– How to install and tension toothed belt ⇒ Page 210.

2.3 Removing and installing crankshaft sealing flange, pulley end

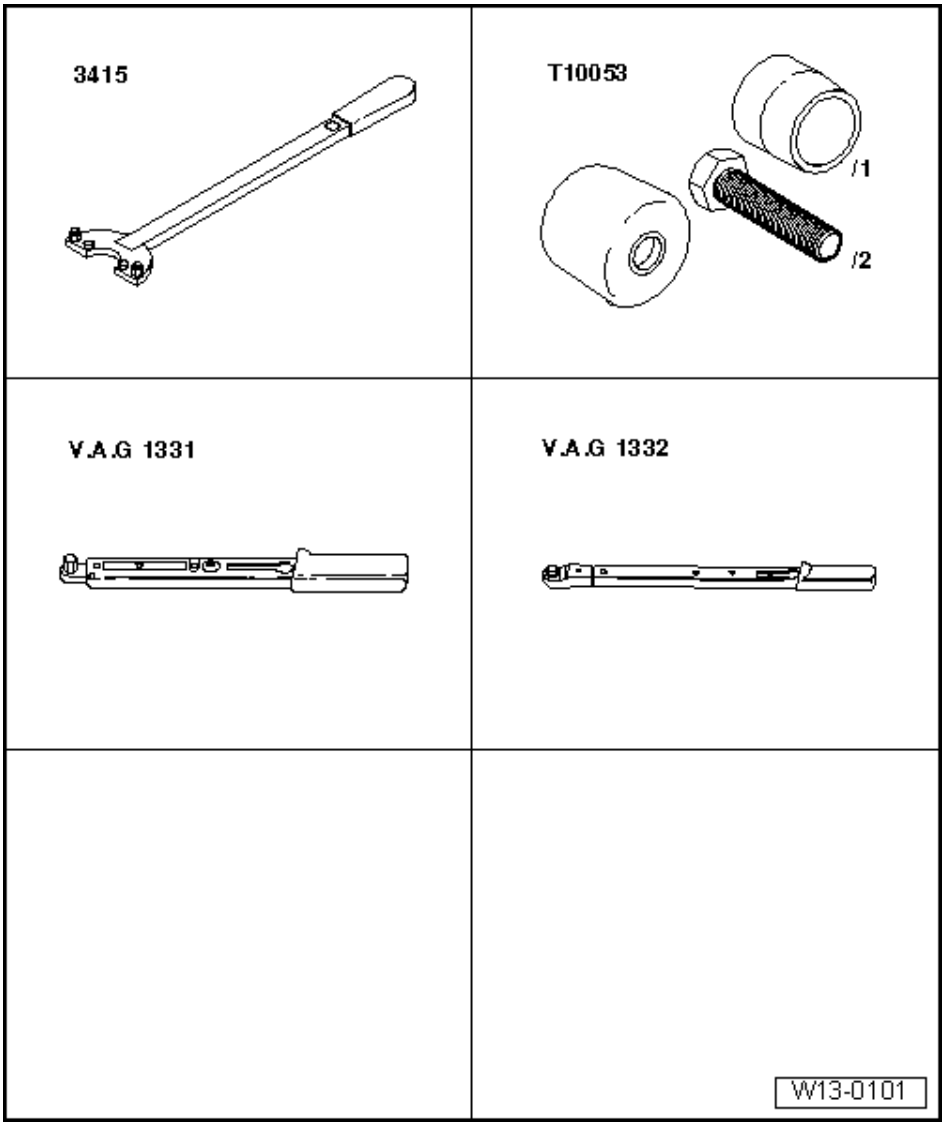
WARNING

Always adhere to the following instructions.

- ***The repair work described in this chapter must be carried out in a Volkswagen dealership only.***
- ***If these instructions are not adhered to and damage results, Volkswagen is exempt from any liability and warranty claims.***

Special tools and workshop equipment required

- Counterhold -3415-
- Assembly tool -T10053-
- Torque wrench (5…50 Nm) -V.A.G 1331-
- Torque wrench (40…200 Nm) -V.A.G 1332-



Not illustrated:

- Silicone sealant D176404 A
- Hand drill with plastic brush attachment
- Flat scraper
- Eye protection

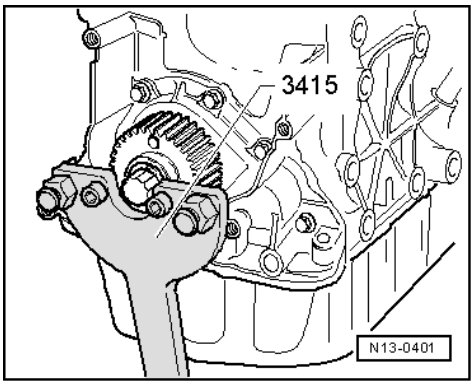
Removing ⇒Page 165.

Installing ⇒Page 166.

2.3.1 Removing

– Remove toothed belt ⇒Page 210.

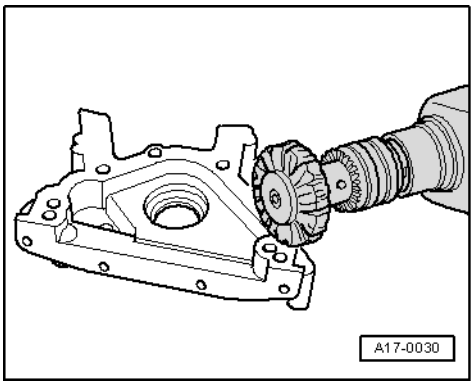
– Remove crankshaft pulley. To do this, lock toothed belt pulley using counterhold -3415-.
– Drain engine oil ⇒Page 245.



Note

Observe environmental regulations for disposal.

– Remove sump ⇒Page 244.
– Unscrew crankshaft sealing flange on belt pulley end.
– Remove sealing flange; if necessary, loosen by applying light blows with a rubber-headed hammer.
– Remove sealant residue from cylinder block with a flat scraper.
– Remove residual sealant from sealing flange using a plastic rotary brush (wear eye protection).
– Clean sealing surfaces. They must be free of oil and grease.

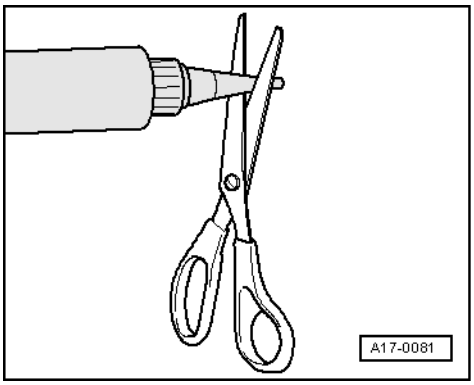


2.3.2 Installing

Note

- *Note the expiry date of the sealant.*
- *The sealing flange must be installed within 5 minutes of applying silicone sealant.*

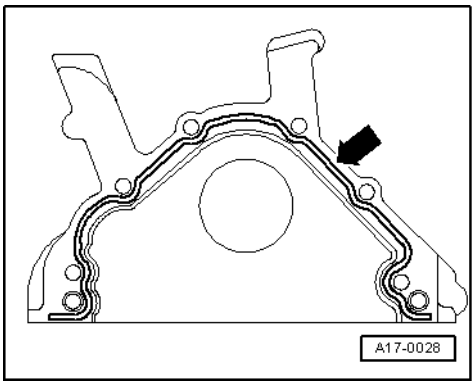
– Cut off tube nozzle at front marking (nozzle diameter approx. 3 mm).



Note

- *Sealant bead must not be thicker than 2…3 mm, because otherwise excess sealant can enter sump and clog strainer in oil pump suction pipe as well as drip onto crankshaft oil seal.*
- *Before applying sealant bead, cover sealing surface of oil seal with a clean cloth.*

– Apply silicone sealant bead as shown to the clean sealing surface of sealing flange.
– Install sealing flange immediately and tighten all bolts lightly.



Note

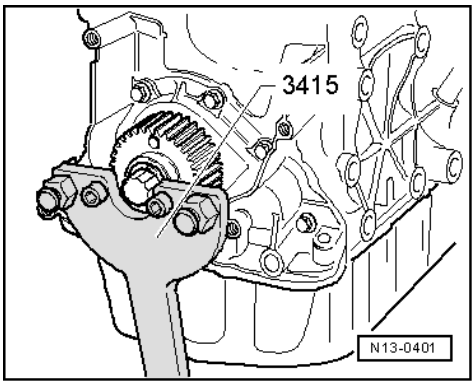
When fitting sealing flange with oil seal installed use guide sleeve -T10053/1-.

– Tighten securing bolts for sealing flange to 15 Nm using alternate and diagonal sequence.
– Remove excess sealant.
– Install sump ⇒ Page 244.

Note

Sealing compound must dry for approx. 30 minutes after installation. Only then fill with engine oil.

Install crankshaft pulley. To do this, lock toothed belt pulley using counterhold -3415-.



Tighten new central bolt to 120 Nm and $^{1}/_{4}$ turn (90°) further (turning further can be done in several stages).

Note

Thread and shoulder must be free of oil and grease.

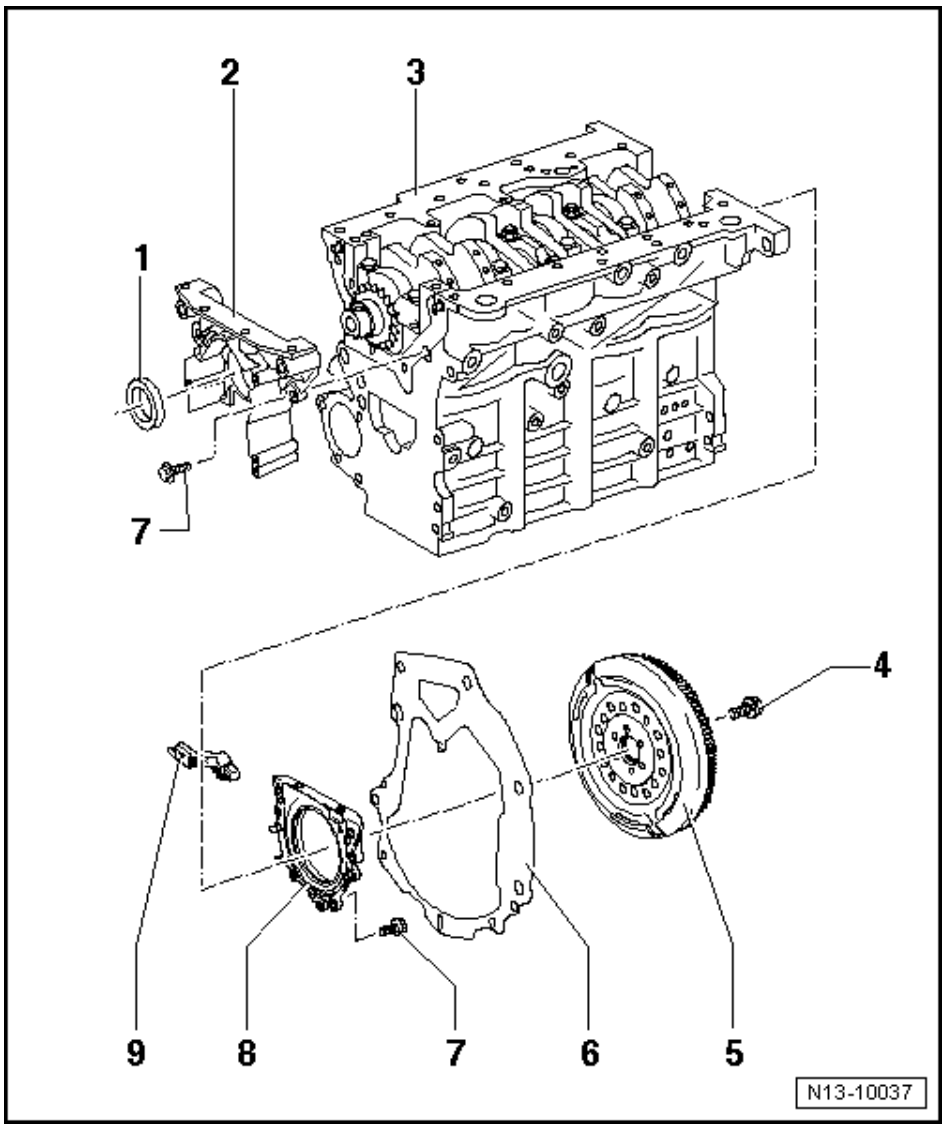
– How to install and tension toothed belt ⇒ Page 210.

2.4 Assembly overview - sealing flanges and flywheel

WARNING

Always adhere to the following instructions.

- ***The repair work described in this chapter must be carried out in a Volkswagen dealership only.***
- ***If these instructions are not adhered to and damage results, Volkswagen is exempt from any liability and warranty claims.***



1 - Crankshaft oil seal (belt pulley end)

- ❑ Do not additionally oil or grease the oil seal sealing lip.
- ❑ Before installing, remove oil residue from crankshaft journal using a clean cloth.
- ❑ Renew ⇒Page 161

2 - Crankshaft sealing flange, belt pulley end

- ❑ Must seat on dowel sleeves.
- ❑ Removing and installing ⇒Page 164

3 - Cylinder block

- ❑ Removing and installing crankshaft ⇒Page 138.
- ❑ Dismantling and assembling pistons and conrods ⇒Page 138.

4 - 60 Nm + 1/4 turn (90°) further

5 - Flywheel

- ❑ Lock flywheel or crankshaft in position when removing and installing flywheel
- ❑ The flywheel is not always in the scope of supply from Volkswagen. Adhere to the manufacturing specifications when performing any maintenance and repair work.

6 - Intermediate plate

- ❑ Must seat on dowel sleeves.
- ❑ Do not damage or bend when assembling.
- ❑ The intermediate plate is not always in the scope of supply from Volkswagen. Adhere to the manufacturing specifications when performing any maintenance and repair work.

7 - 15 Nm

- ❑ Renew

8 - Crankshaft sealing flange, flywheel end

- ❑ With seal.
- ❑ Do not additionally oil or grease the oil seal sealing lip.
- ❑ Before installing, remove oil residue from crankshaft journal using a clean cloth.
- ❑ Renew complete with oil seal and sender wheel only.
- ❑ Renew ⇒Page 169

9 - Engine speed sender -G28-, 5 Nm

- ❑ Check ⇒Page 400
- ❑ Loosen and tighten using commercially available ball-ended hexagon key socket
- ❑ Removing and installing ⇒Page 178

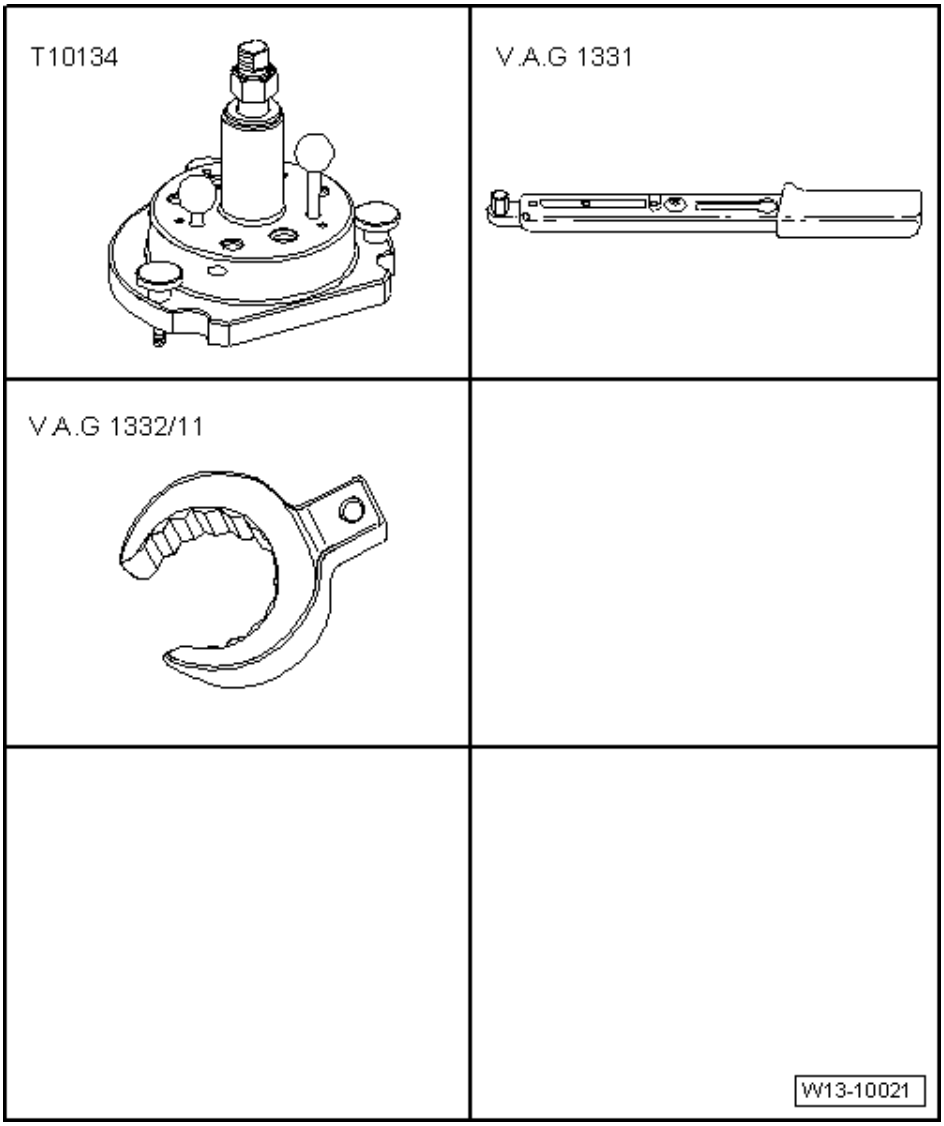
2.5 Renewing crankshaft sealing flange - flywheel end

> ⚠ ***WARNING***
>
> ***Adhere to the general safety regulations and the notes on repair work on the engine! ⇒Page 1***

> ⚠ ***WARNING***
>
> ***Always adhere to the following instructions.***
>
> - ***The repair work described in this chapter must be carried out in a Volkswagen dealership only.***
> - ***If these instructions are not adhered to and damage results, Volkswagen is exempt from any liability and warranty claims.***

Special tools and workshop equipment required

- Assembly tool -T10134-
- Torque wrench -V.A.G 1331-
- Tool insert 24 mm -V.A.G 1332/11-



Not illustrated

- Vernier gauge
- 3 hexagon bolts M6 x 35 mm
- 2 hexagon bolts M7 x 35 mm

Pressing out sealing flange with sender wheel ⇒Page 171.

Pressing in sealing flange with sender wheel ⇒Page 172.

A - Assembling seal with sender wheel on assembly tool -T10134- ⇒Page 172.

B - Installing assembly tool -T10134- with sealing flange to crankshaft flange ⇒Page 174.

C - Bolting assembly tool -T10134- to crankshaft flange ⇒Page 175.

D - Pressing sender wheel onto crankshaft flange using assembly tool -T10134- ⇒Page 176

E - Checking installation position of sender wheel on crankshaft ⇒Page 176.

F - Re-pressing sender wheel ⇒Page 177.

2.5.1 Pressing out sealing flange with sender wheel

Note

For the sake of clarity, the work is performed with the engine removed.

– Remove flywheel ⇒Page 167, Assembly overview - sealing flanges and flywheel.

– Remove intermediate plate.

– Set engine to TDC for no. 1 cylinder ⇒Page 210, Removing and installing toothed belt.

– Drain engine oil ⇒Page 245.

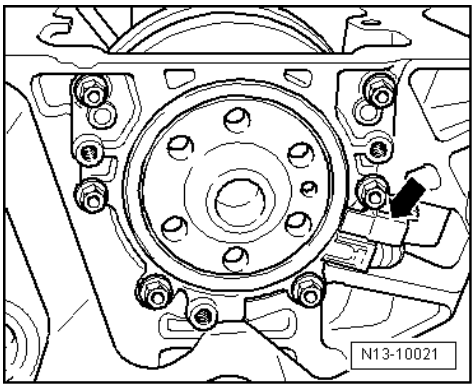
Note

Observe environmental regulations for disposal.

– Remove sump ⇒Page 244.

– Remove engine speed sender -G28- -arrow- using a commercially available ball-ended hex key socket.

– Unscrew sealing flange securing bolts.

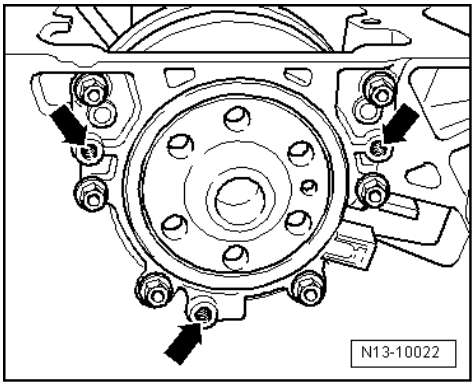


Note

Sealing flange and sender wheel are pressed off the crankshaft together using three M6 x 35 mm bolts.

– Screw three M6 x 35 mm bolts into threaded holes -arrows- of sealing flange.

– Screw bolts alternately (max. $^{1}/_{2}$ turn (180 °) for each bolt) into sealing flange and press sealing flange together with sender wheel off crankshaft.



2.5.2 Pressing in sealing flange with sender wheel

Note

- *The sealing flange with a PTFE seal is equipped with a sealing lip support ring. This support ring serves as a fitting sleeve and must not be removed prior to installation.*
- *Sealing flange and sender wheel must not be separated or turned after removal from packaging.*
- *The sender wheel is held in its installation position on the assembly device -T10134- by a locating pin.*
- *Sealing flange and oil seal form one unit and must only be renewed together with the sender wheel.*
- *The assembly device -T10134- is held in its position relative to the crankshaft by a guide pin inserted into a hole in the crankshaft.*

Assembly tool -T10134-

A - Clamping surface

B - Hexagon nut

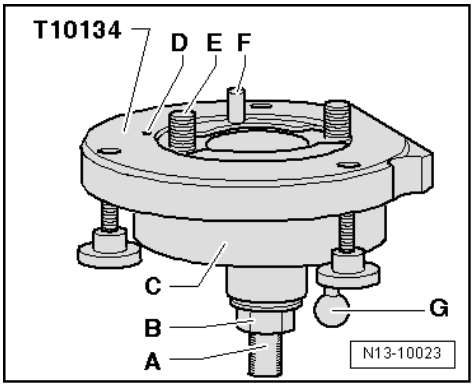
C - Assembly housing

D - Locating pin

E - Hexagon socket head bolt

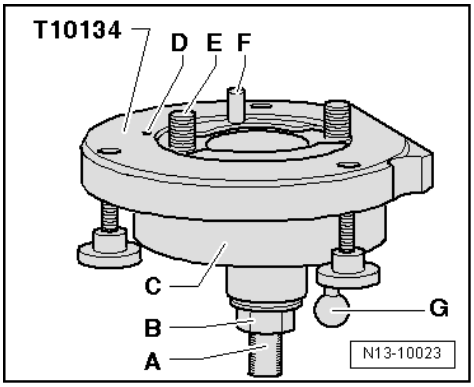
F - Guide pin for diesel engines (black knob)

G - Guide pin for petrol engines (red knob)

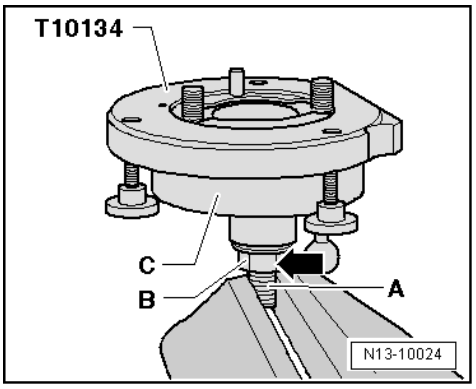


2.5.3 A - Assembling seal with sender wheel on assembly tool -T10134-

– Screw in hexagon nut -B- to just before clamping surface -A- of threaded spindle.



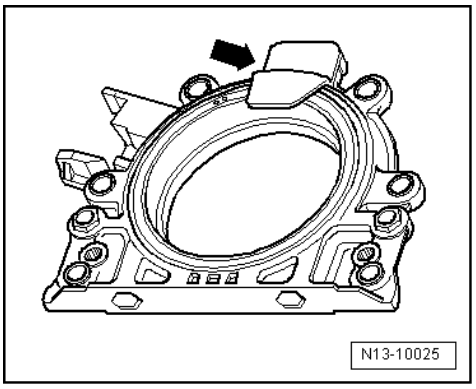
– Clamp assembly device -T10134- in a vice on clamping surface -A- of threaded spindle.
– Press assembly housing -C- downwards so that it lies on hexagon nut -B- -arrow-.



Note

Inner part of assembly tool and assembly housing must be at same height.

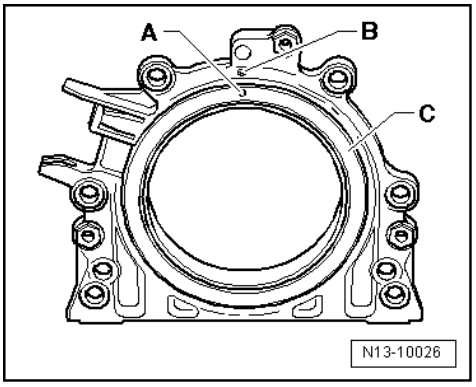
– Remove securing clip -arrow- from new sealing flange.



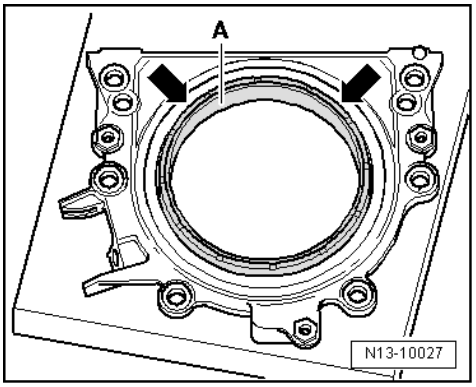
Note

The sender wheel must not be taken out of the sealing flange or twisted.

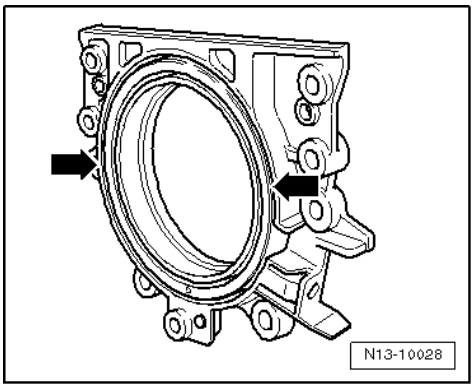
– Locating hole -A- on sender wheel -C- must align with marking -B- on sealing flange.
– Place sealing flange with front side downwards on a clean flat surface.



– Push sealing lip support ring -A- downwards in direction of arrow until it lies on flat surface.



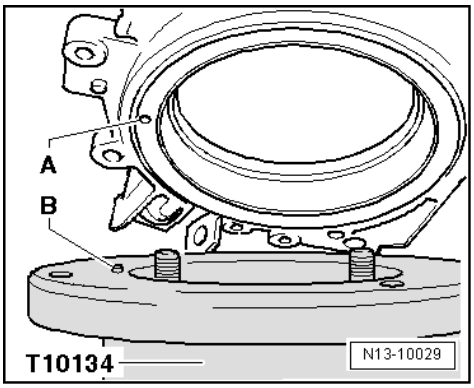
– Upper edge of sender wheel and front edge of sealing flange must align -arrows-.



– Place sealing flange with front side on assembly tool -T10134- so that locating pin -A- can be inserted in sender wheel hole -A-.

Note

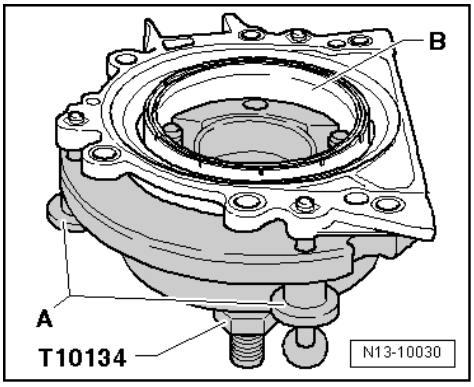
Ensure sealing flange lies flat on assembly tool.



– Push sealing flange and support ring for sealing lip -B- against surface of assembly tool -T10134- whilst tightening the three knurled screws -A- so that locating pin cannot slide out of sender wheel hole.

Note

When installing sealing flange, ensure that sender wheel remains fixed in assembly device.



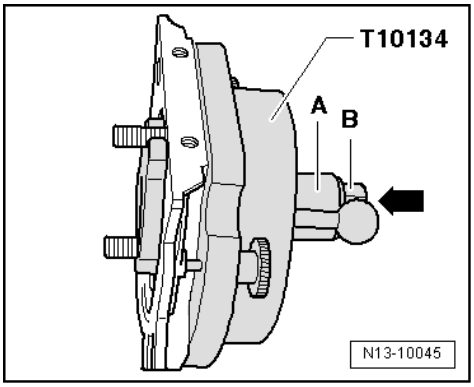
2.5.4 B - Installing assembly tool -T10134- with sealing flange to crankshaft flange

- Crankshaft flange must be free of oil and grease.
- Engine positioned at TDC No. 1 cylinder.

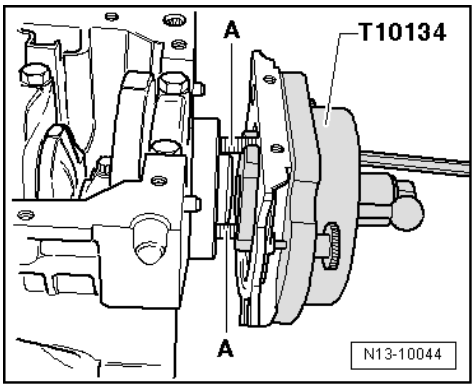
– Screw hexagon nut -B- to end of threaded spindle.

– Press threaded spindle of assembly tool -T10134- in -direction of arrow-, until hexagon nut -B- rests against assembly assembly housing -A-.

– Align flat side of assembly housing on sump side of crankcase sealing surface.



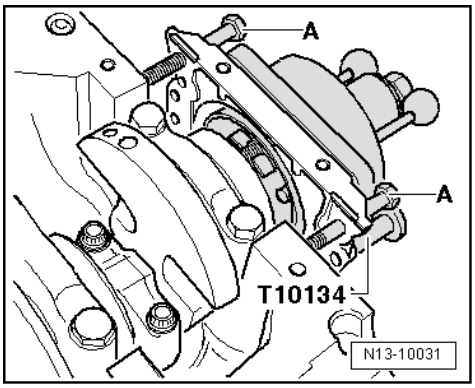
– Secure assembly tool -T10134- to crankshaft flange using hexagon socket head bolts -A-.



Note

Screw hexagon socket head bolts -A- into crankshaft flange (approx. 5 full turns).

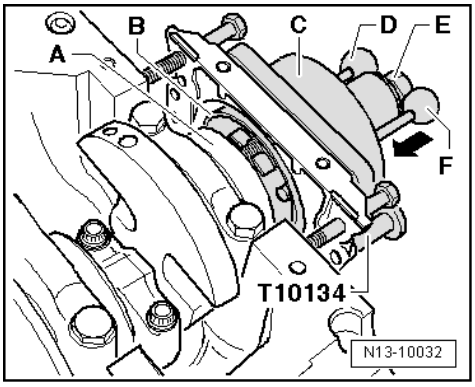
– To guide sealing flange, screw two M7 × 35 mm bolts -A- into cylinder block.



2.5.5 C - Bolting assembly tool -T10134- to crankshaft flange

– Push assembly hub -C- by hand in -direction of arrow- until sealing lip support ring -B- contacts crankshaft -A-.

– Push guide pin for diesel engines (black knob) -D- into hole in crankshaft. This ensures that the sender wheel reaches its final installation position.



Note

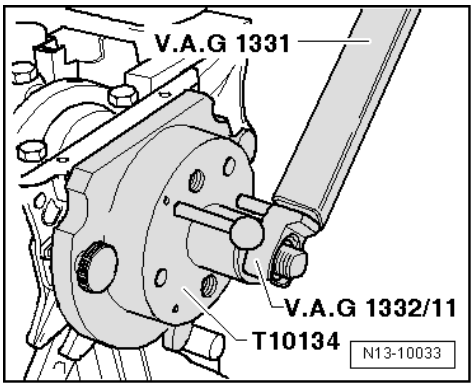
The guide pin for petrol engines (red knob) -F- must not be inserted in threaded hole of crankshaft.

– Hand-tighten both hexagon socket head bolts of assembly tool.

– Screw hexagon nut -E- onto threaded spindle by hand until it lies on assembly housing -C-.

2.5.6 D - Pressing sender wheel onto crankshaft flange using assembly tool -T10134-

– Tighten hexagon nut of assembly tool -T10134- to 35 Nm using torque wrench -V.A.G 1331- and tool insert, 24 mm -V.A.G 1332/11-.

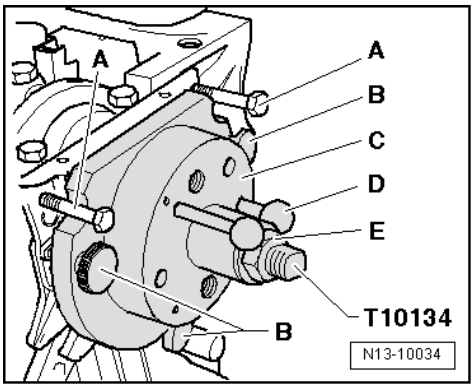


Note

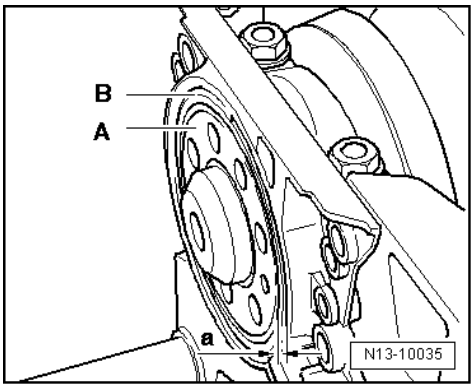
After the hexagon nut is tightened to 35 Nm, there must still be a small air gap between cylinder block and sealing flange.

2.5.7 E - Checking installation position of sender wheel on crankshaft

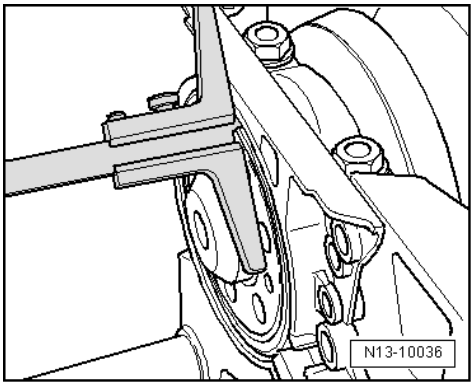
– Screw hexagon nut -E- to end of threaded spindle.
– Remove the two bolts -A- from cylinder block.
– Loosen the two hexagon socket head bolts.
– Screw the three knurled screws -B- out of sealing flange.
– Remove assembly tool -T10134-.
– Remove sealing lip support ring.



– The sender wheel is in the correct installation position on the crankshaft if a gap -a- = 0.5 mm exists between crankshaft flange -A- and sender wheel -B-.



– Set vernier gauge on crankshaft flange.
– Measure distance -a- between crankshaft flange and sender wheel.



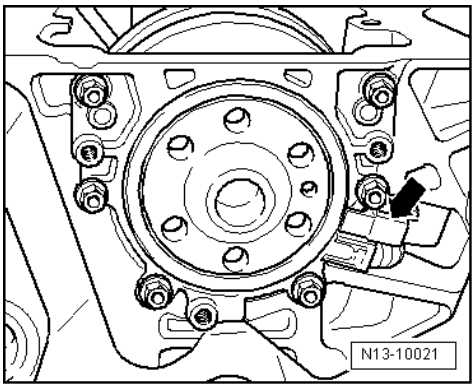
If measurement -a- is too small:

– Re-press sender wheel ⇒Page 177.

If dimension -a- is attained:

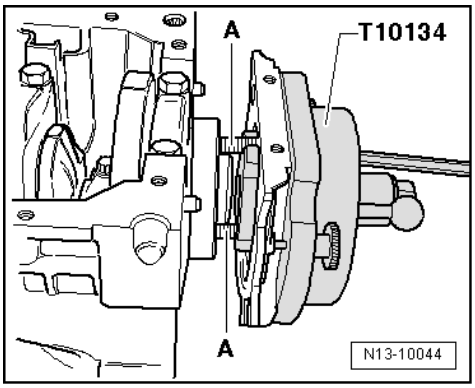
– Tighten new securing bolts for sealing flange to 15 Nm using alternate and diagonal sequence.

– Install engine speed sender -G28- -arrow-, and tighten securing bolt to 5 Nm.
– Install sump ⇒ Page 244.
– Install intermediate plate.
– Install flywheel using new bolts. Tighten securing bolts to 60 Nm +$^1/_4$ turn (90°).

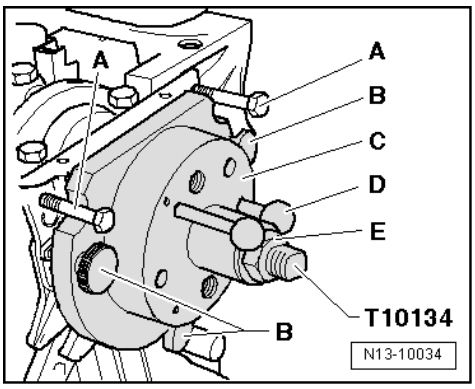


2.5.8 F - Re-pressing sender wheel

– Secure assembly tool -T10134- to crankshaft flange using hexagon socket head bolts -A-.
– Hand tighten both hexagon socket head bolts -A-.
– Push assembly tool -T10134- by hand to sealing flange.



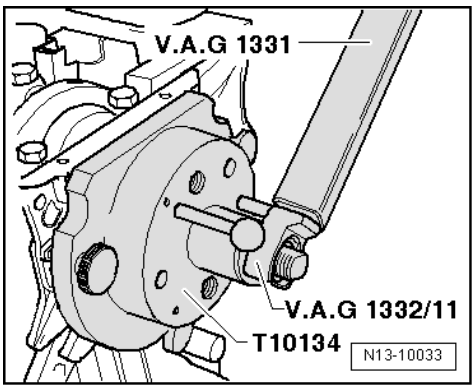
– Screw hexagon nut -E- onto threaded spindle by hand until it lies on assembly housing -C-.



– Tighten hexagon nut of assembly tool -T10134- to 40 Nm using torque wrench -V.A.G 1331- and tool insert, 24 mm -V.A.G 1332/11-.
– Check installation position of sender wheel on crankshaft again ⇒ Page 176.

If dimension -a- is too small again:

– Tighten hexagon nut for assembly tool -T10134- to 45 Nm.
– Check installation position of sender wheel on crankshaft again ⇒ Page 176.

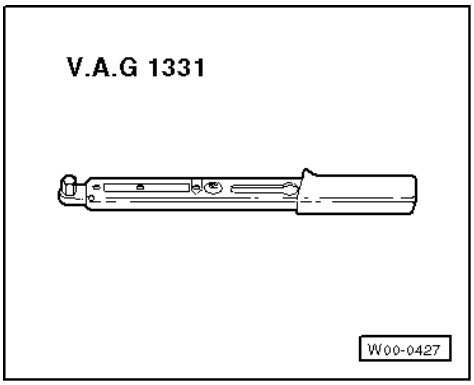


2.6 Removing and installing engine speed sender -G28-

> ⚠ ***WARNING***
>
> ***Adhere to the general safety regulations and the notes on repair work on the engine!*** ⇒ **Page 1**

Special tools and workshop equipment required

- Torque wrench (5…50 Nm) -V.A.G 1331-



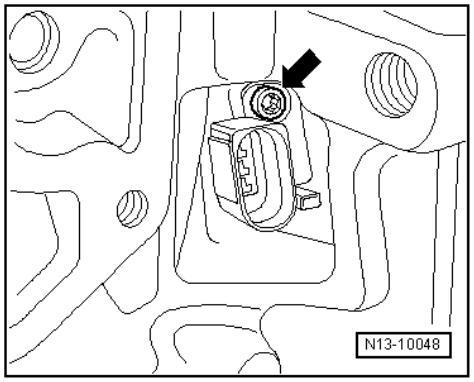
Removing ⇒ Page 178.

Installing ⇒ Page 178.

2.6.1 Removing

Depending on the installation space for the engine, the oil filter bracket and the engine oil cooler may have to be removed.

– Clamp off coolant hoses at oil cooler using hose clamp and pull off hoses.
– Remove oil filter bracket ⇒ Page 260, Assembly overview - oil filter bracket and engine oil cooler.
– Pull 3-pin connector off engine speed sender -G28-.
– Using a commercially available ball-ended hexagon key socket, loosen securing bolt -arrow- through opening in crankcase, and pull out engine speed sender -G28-.



2.6.2 Installing

Installation is carried out in the reverse order. When installing, note the following:

– Tighten securing bolt for engine speed sender -G28- to 5 Nm

3 Removing and installing crankshaft

Note

- *The repair work described in this chapter must be carried out in a Volkswagen dealership only. Go to a Volkswagen dealership.*
- *If these instructions are not adhered to and damage results, Volkswagen is exempt from any liability and warranty claims.*

> ***WARNING***
>
> ***Adhere to the general safety regulations and the notes on repair work on the engine!*** ⇒ **Page 1**

Note

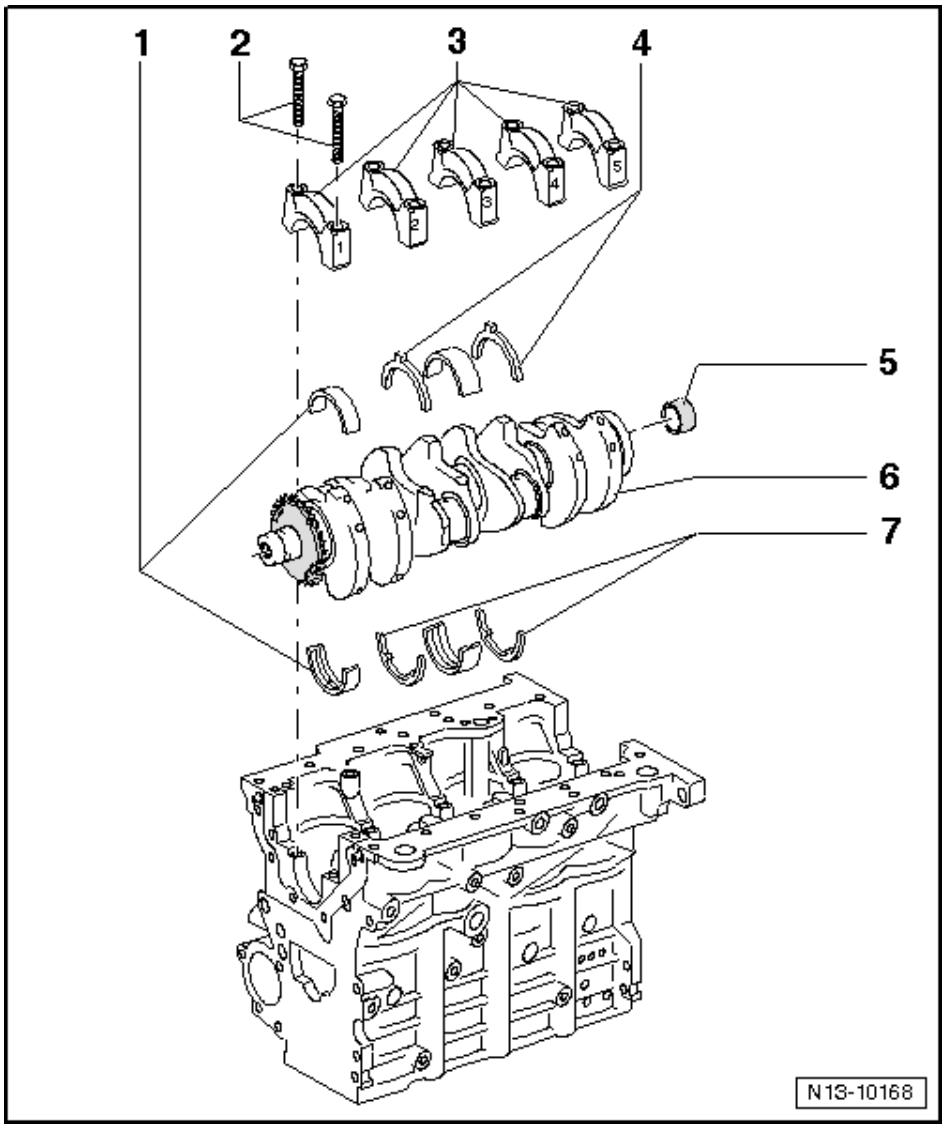
- *Before carrying out repair work, secure engine on engine and gearbox support -VAS 6095/1- using universal mounting -VAS 6095-.*
- *Finding metal shavings or a large quantity of small metal particles during engine repair could indicate that the crankshaft bearings or conrod bearings are damaged. To prevent this from causing further damage, perform the following repairs:*
- *Thoroughly clean oil channels.*
- *Renew oil spray jets*
- *Renew oil cooler*
- *Renew oil filter element*

Assembly overview - crankshaft ⇒ Page 180.

Crankshaft dimensions ⇒ Page 180.

Pulling needle bearing, if fitted, out of and driving into crankshaft ⇒ Page 181.

3.1 Assembly overview - crankshaft



1 - Bearing shells 1, 2, 4 and 5
- ❑ For bearing cap without oil groove.
- ❑ For cylinder block with oil groove.
- ❑ Do not interchange used bearing shells (mark).

2 - 65 Nm + 1/4 turn (90°) further
- ❑ Renew
- ❑ To measure radial clearance, tighten to 65 Nm but not further.

3 - Bearing cap
- ❑ Bearing cap 1: belt pulley end
- ❑ Bearing cap 3 with recesses for thrust washers.
- ❑ Bearing shell retaining lugs in cylinder block and bearing caps must align.

4 - Thrust washer
- ❑ For bearing cap 3.
- ❑ Note fixing arrangement.

5 - Needle bearing
- ❑ Not installed on all engines
- ❑ Pulling out and driving in ⇒ Page 181.

6 - Crankshaft
- ❑ Axial clearance new: 0.07…0.17 mm, wear limit: 0.37 mm
- ❑ Check radial clearance with Plastigage new: 0.03…0.08 mm, wear limit: 0.17 mm
- ❑ Do not rotate crankshaft when checking radial clearance.
- ❑ Crankshaft dimensions ⇒ Page 180.

7 - Thrust washer
- ❑ For cylinder block, bearing 3

3.2 Crankshaft dimensions

(Dimensions in mm)

Honing dimension	Crankshaft main journal diameter	Conrod journal diameter
Basic dimension	54.00 -0.022 -0.042	50.90 -0.022 -0.042

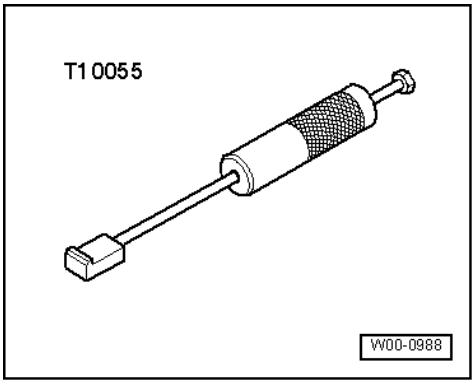
3.3 Pulling needle bearing, if fitted, out of and driving into crankshaft

Note

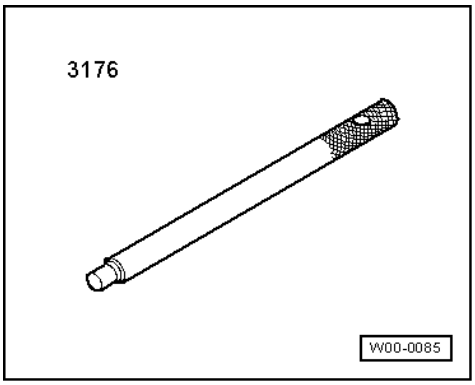
The needle bearing in the crankshaft is not installed on all engines.

Special tools and workshop equipment required

- Puller -T10055-
- With adapter -T10055/3-



- Centring mandrel -3176-
- or drift -VW 207 C-
- Puller, e.g. Kukko -21/2-

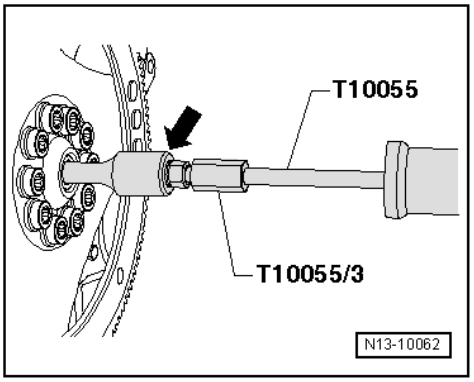


Pulling out ⇒Page 181.

Driving in ⇒Page 182.

3.3.1 Pulling out

– Using commercially available puller, e.g. Kukko -21/2- -arrow-, pull out adapter -T10055/3- and puller -T10055-.

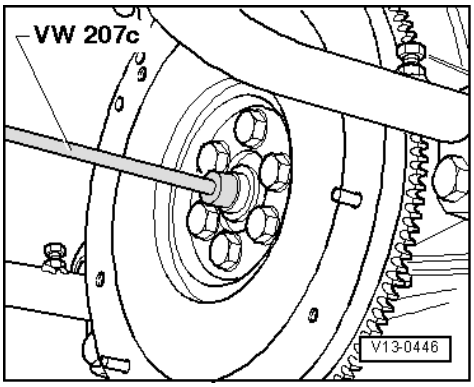


3.3.2 Driving in

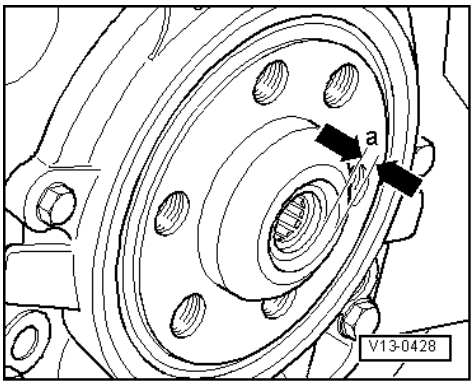
Note

The lettering on the needle bearing must be visible when installed.

– Drive in with drift -VW 207 C- or centring mandrel -3176-.



Installation depth: dimension -a- = 2 mm.



4 Dismantling and assembling pistons and conrods

Note

- *The repair work described in this chapter must be carried out in a Volkswagen dealership only. Go to a Volkswagen dealership.*
- *If these instructions are not adhered to and damage results, Volkswagen is exempt from any liability and warranty claims.*

WARNING

Adhere to the general safety regulations and the notes on repair work on the engine! ⇒ **Page 1**

Note

Before carrying out repair work, secure engine on engine and gearbox support -VAS 6095/1- using universal mounting -VAS 6095-.

Assembly overview - pistons and conrods ⇒ Page 183.

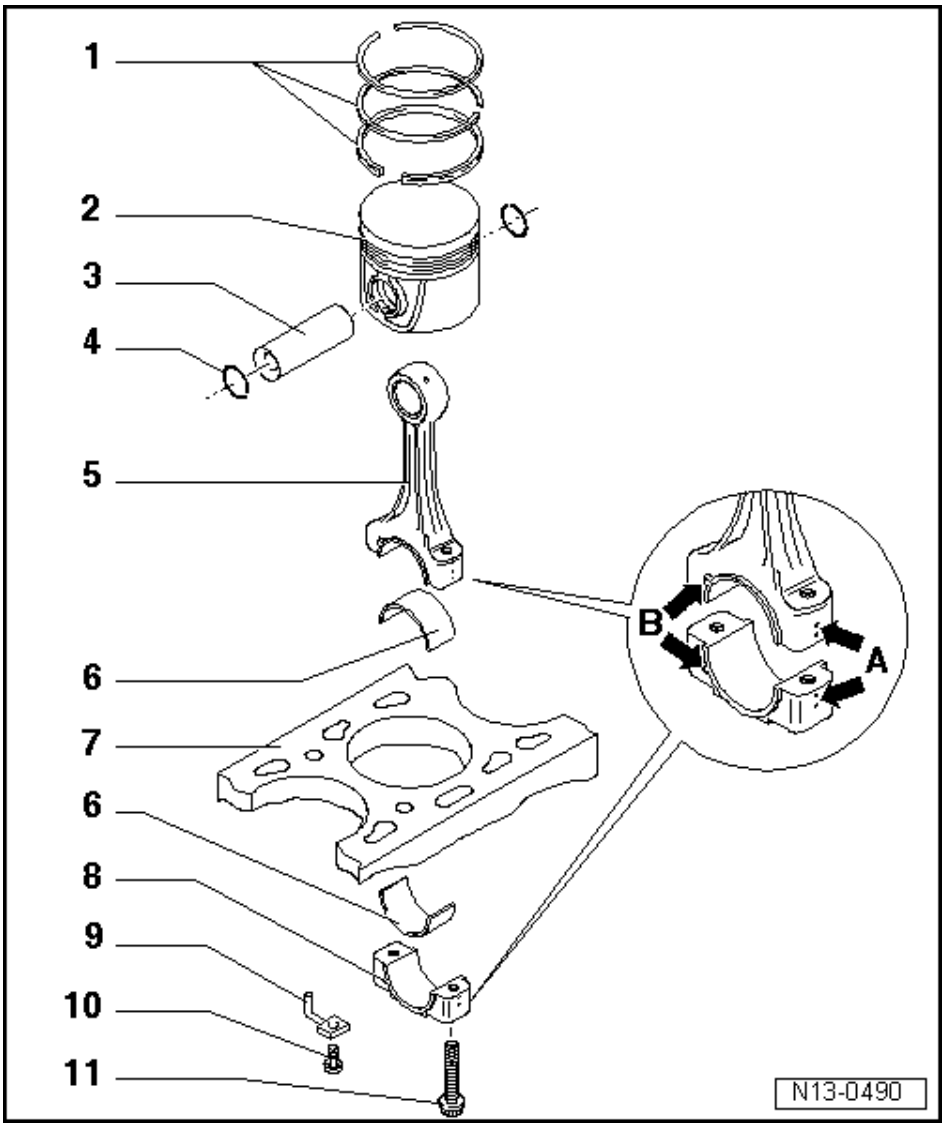
Separating new conrods ⇒ Page 185

Bearing shells - installation position ⇒Page 186.

Checking piston projection at TDC ⇒Page 187.

Piston and cylinder dimensions ⇒Page 188

4.1 Assembly overview - pistons and conrods



1 - Piston rings

- ❑ Offset gaps by 120°.
- ❑ Use piston ring pliers to remove and install.
- ❑ “TOP” faces towards piston crown.
- ❑ Checking ring gap ⇒Fig. on page 184.
- ❑ Checking ring-to-groove clearance ⇒Fig. on page 185.

2 - Piston

- ❑ Mark installation position and cylinder number.
- ❑ Installation position and allocation of piston to cylinder ⇒Fig. on page 185.
- ❑ Arrow on piston crown points to belt pulley end.
- ❑ Install using piston ring clamp.
- ❑ If piston skirt is cracked, renew piston.
- ❑ Checking piston projection at TDC ⇒Page 187.

3 - Piston pin

- ❑ If difficult to remove, heat piston to 60°C
- ❑ Remove and install using drift -VW 222 a-.

4 - Retaining ring

5 - Conrod

- ❑ Mark with cylinder number -A-.
- ❑ Installation position: Marking -B- faces towards pulley end.
- ❑ With industrially cracked conrod cap.
- ❑ Separate new conrod ⇒Page 185

6 - Bearing shell

- ❑ Note installation position ⇒Page 186
- ❑ Do not interchange used bearing shells.

- ❑ Insert bearing shells centrally.
- ❑ Make sure it is firmly seated
- ❑ Axial clearance, wear limit: 0.37 mm
- ❑ Check radial clearance with Plastigage; wear limit: 0.08 mm. Do not rotate crankshaft when checking radial clearance.

7 - Cylinder block

- ❑ Checking cylinder bores ⇒Fig. on page 185.
- ❑ Piston and cylinder dimensions ⇒Page 188.

8 - Conrod bearing cap

- ❑ Note installation position
- ❑ Due to the cracking method used to separate the bearing cap from the conrod in manufacture, the caps only fit in one position and only on the appropriate conrod.
- ❑ Separate new conrod ⇒Page 185

9 - Oil spray jet

- ❑ For piston cooling.

10 - 25 Nm

- ❑ Insert without sealant

11 - Conrod bolt, 30 Nm + $^{1}/_{4}$ turn (90°) further

- ❑ Renew
- ❑ Oil threads and contact surface.
- ❑ Use old bolts to measure radial clearance.

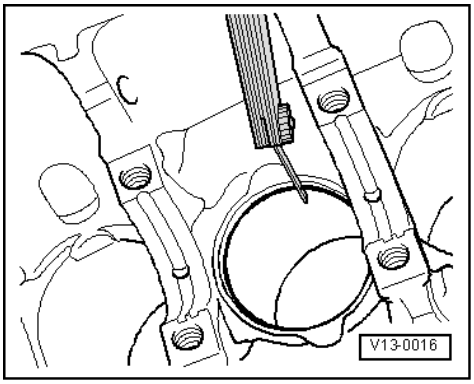
Checking piston ring gap

Special tools and workshop equipment required

◆ Feeler gauges

Test procedure

– Push piston ring at right angles from above down to approx. 15 mm from bottom end of cylinder.



Piston ring		Ring gap	
		New	Wear limit
1st compression ring	mm	0.20…0.40	1.00
2nd compression ring	mm	0.20…0.40	1.00
Oil scraper ring	mm	0.25…0.50	1.00

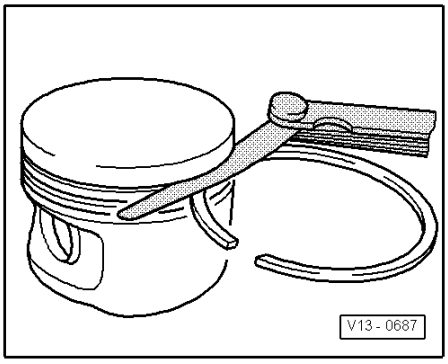
Checking ring-to-groove clearance

Special tools and workshop equipment required

- Feeler gauges

Test procedure

– Clean ring groove before checking.



Piston ring		Clearance	
		New	Wear limit
1st compression ring	mm	0.06…0.09	0.25
2nd compression ring	mm	0.05…0.08	0.25
Oil scraper ring	mm	0.03…0.06	0.15

Checking cylinder bores

Special tools and workshop equipment required

- Cylinder gauge 50…100 mm

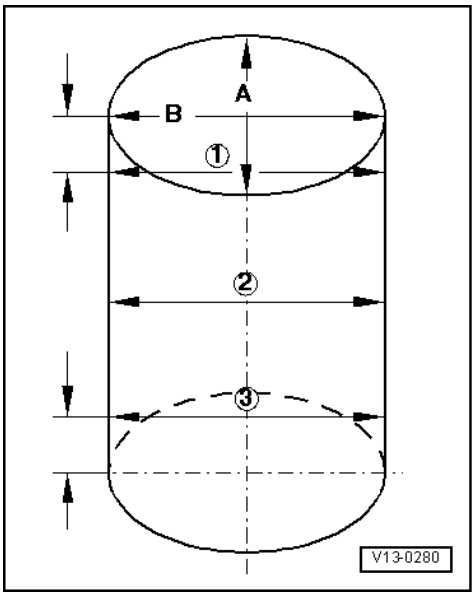
Test procedure

– Take measurements at 3 positions in both transverse -A- and longitudinal -B- directions, as illustrated.

Difference between actual and nominal diameter max. 0.10 mm.

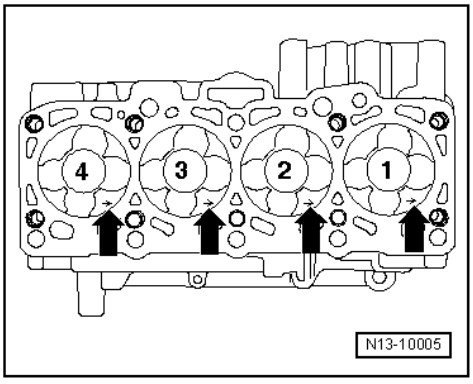
Note

The cylinder bores must not be measured when the cylinder block is mounted on a repair stand with engine and gearbox support -VAS 6095-, as measurements may then be incorrect.



Piston installation position and allocation of piston to cylinder

Arrow on piston crown -arrows- points in direction of cylinder 1.

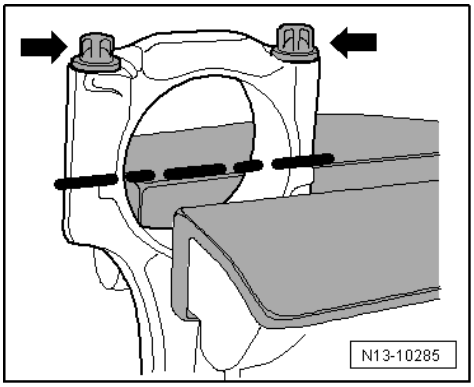


4.2 Separating new conrods

On new conrods it is possible that the breaking point is not fully separated. Proceed as follows, when the conrod bearing cap cannot be removed by hand:

– Mark cylinder allocation of conrod.

– Lightly clamp the conrod in a vice using aluminium vice clamps, as shown in the illustration.

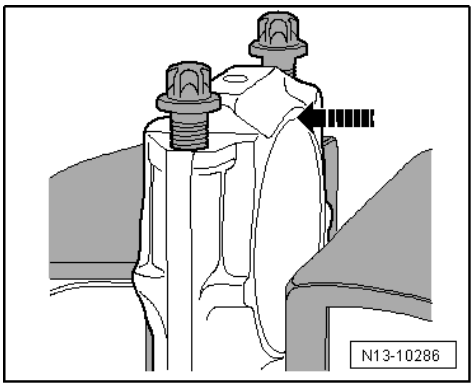


Note

- *To prevent damage to the conrod, only clamp conrod in lightly.*
- *Conrod is clamped below the dashed line.*

– Unscrew the two bolts -arrows- approx. 5 turns.

– Using a plastic hammer, carefully knock against conrod bearing cap in -direction of arrow- until it is loose.



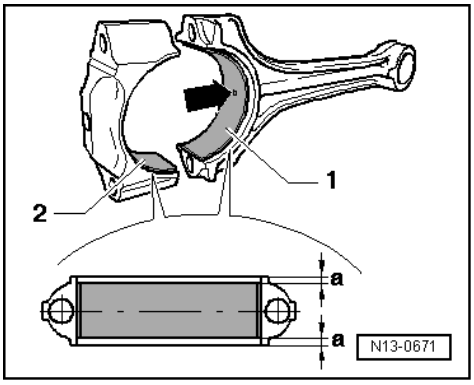
4.3 Bearing shells - installation position

Bearing shell -1- with oil hole -arrow- for conrod.

Bearing shell -2- without oil hole for conrod bearing cap.

– Position bearing shells in centre of conrod and conrod bearing cap when fitting.

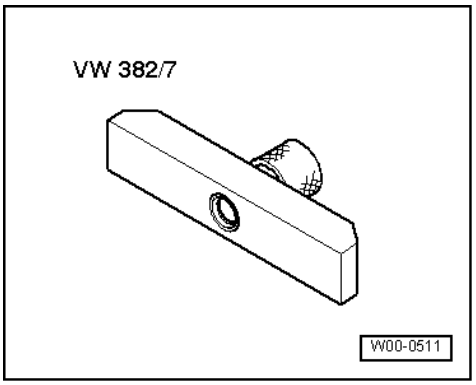
Dimension -a- must be identical on both sides.



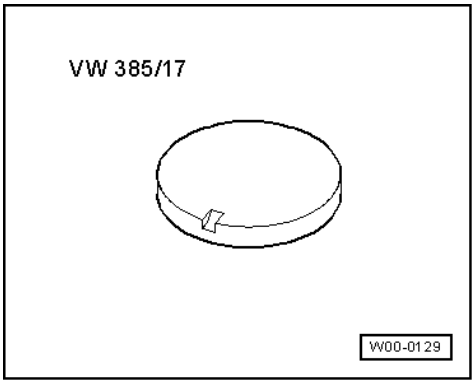
4.4 Checking piston projection at TDC

Special tools and workshop equipment required

- Measuring bridge -VW 382/7-



- End dimension plate -VW 385/17-

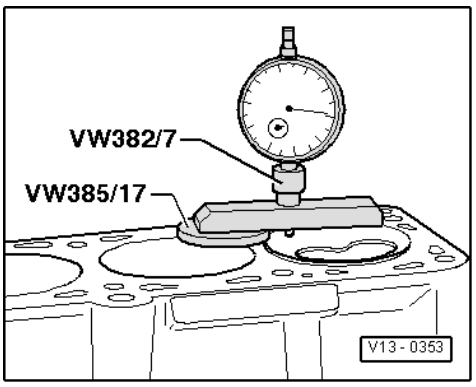


Not illustrated:

- Dial gauge

Test procedure

Piston projection at TDC must be measured when installing new pistons or a short engine. Install the appropriate cylinder head gasket depending upon piston projection, according to following table:



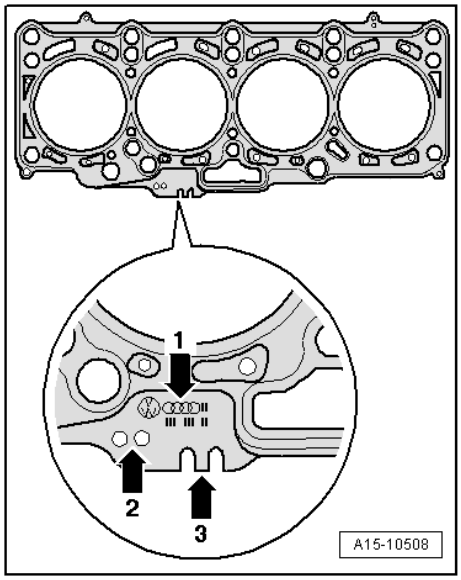
Note

- *Turn engine clockwise to measure piston projection at TDC.*
- *If different values are determined during the projection measurement, use the largest dimension for selecting the gasket.*

Piston projection	Identification Holes/notches
0.91 mm … 1.00 mm	1
1.01 mm … 1.10 mm	2
1.11 mm … 1.20 mm	3

Cylinder head gasket identification

- Part number = arrow 1
- Holes = arrow 2
- Production control code = arrow 3 (can be disregarded)



Note

- *Different thicknesses of cylinder head gasket are fitted depending on the piston projection. When the seal is renewed, ensure that the designation matches.*
- *Piston projection at TDC must be determined when installing new pistons or a short engine* ⇒ Page 187.

4.5 Piston and cylinder dimensions

Honing dimension		Piston diameter	Cylinder bore diameter
Basic dimension	mm	80.96	81.01

15 - Cylinder head, valve gear

1 Cylinder head

Note

- *The repair work described in this chapter must be carried out in a Volkswagen dealership only. Go to a Volkswagen dealership.*
- *If these instructions are not adhered to and damage results, Volkswagen is exempt from any liability and warranty claims.*

WARNING

Adhere to the general safety regulations and the notes on repair work on the engine! ⇒Page 1

WARNING

Adhere to the general safety regulations and the notes on repair work on the engine! ⇒Page 1

When doing any repair work, pay attention to the following due to the cramped conditions:

- ***Adhere to the general safety precautions, and never take any risk.***
- ***The engine is a hazardous area and can cause serious injuries.***
- ***Never leave any objects in the engine compartment, such as cleaning cloths or tools.***
- ***Many engine components become hot during operation – risk of burns. If necessary, provide appropriate protective means.***
- ***Servicing materials, such as fuel, engine oils or coolant additive, are harmful substances; adhere to the safety instructions from the manufacturer.***
- ***There is a risk of injuries, if maintenance locations are difficult to access. This risk can be reduced, by installing the engine in an appropriate location and by avoiding sharp edges.***
- ***Route all the various lines (e.g. for fuel, hydraulics, coolant and refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.***
- ***Ensure that there is sufficient clearance to all moving or hot components.***
- ***Tools are to be checked for damage and safety risks on a regular basis.***

Note

- *The plastic protectors fitted to protect the open valves must be removed only immediately before the cylinder head is fitted.*
- *If the cylinder head is replaced, all the coolant in the system must also be renewed.*

Observe safety precautions ⇒Page 354.

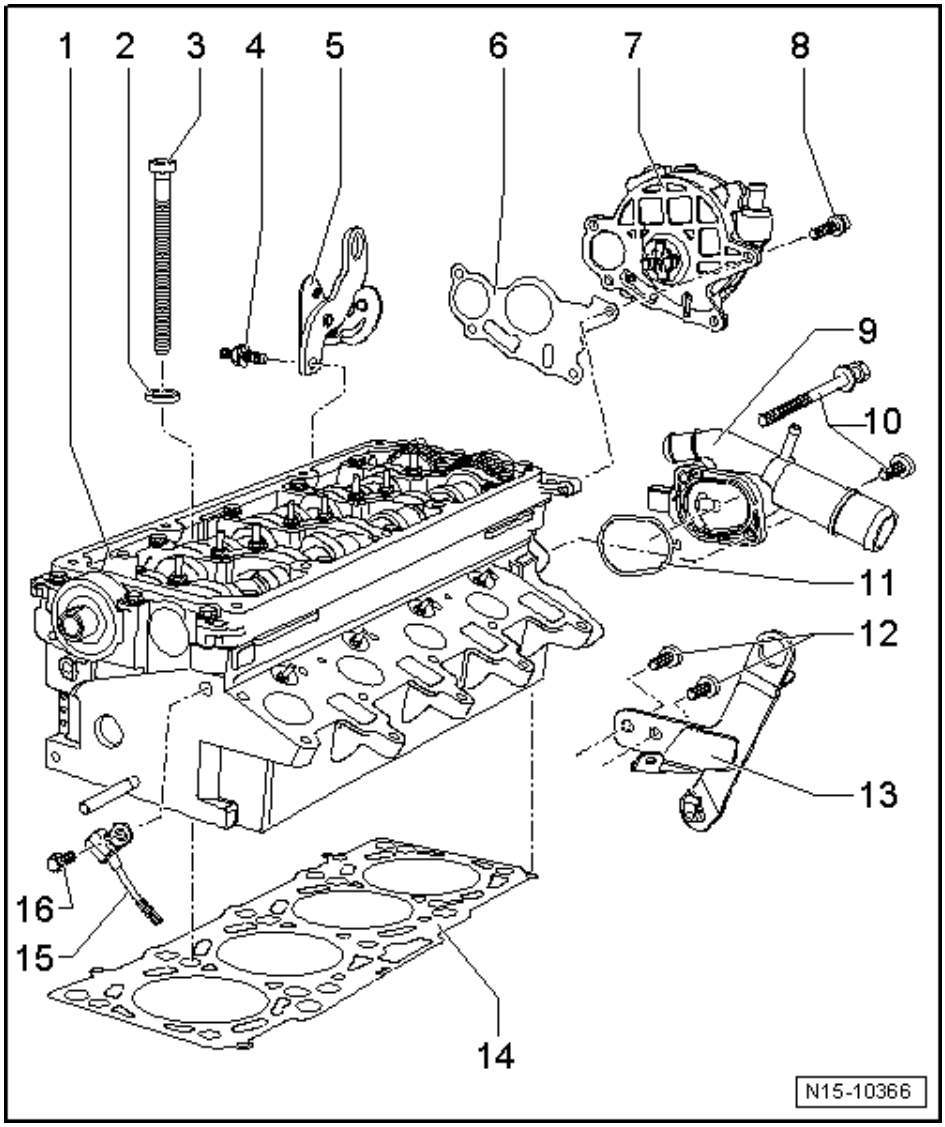
Observe rules for cleanliness ⇒Page 354.

Removing and installing Hall sender -G40- ⇒Page 191.

Removing, installing and tensioning toothed belts ⇒Page 210

Checking compression ⇒Page 218.

1.1 Assembly overview - cylinder head



1 - Cylinder head
- ❑ Check for distortion ⇒Fig. on page 191.
- ❑ Removing and installing ⇒Page 220
- ❑ After renewing, renew entire coolant.

2 - Washer
- ❑ For cylinder head bolt.

3 - Cylinder head bolt
- ❑ Renew
- ❑ Note sequence when loosening and tightening ⇒Page 220, Removing and installing cylinder head.
- ❑ Before installing, place washers in cylinder head ⇒Item 2.

4 - 25 Nm

5 - Lifting eye

6 - Gasket
- ❑ Renew

7 - Vacuum pump
- ❑ Removing and installing ⇒Page 226

8 - 10 Nm

9 - Coolant hose connection

10 - 10 Nm

11 - Gasket

- ❑ Renew

12 - 25 Nm

13 - Lifting eye

14 - Cylinder head gasket

- ❑ Renew
- ❑ Note marking ⇒Fig. on page 191.
- ❑ After renewing, renew entire coolant.

15 - Hall sender -G40-

- ❑ For camshaft position.
- ❑ Check ⇒Page 403
- ❑ Removing and installing ⇒Page 191

16 - 10 Nm

Checking cylinder head for distortion

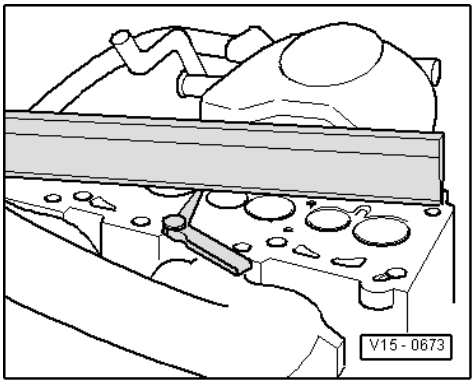
Special tools and workshop equipment required

- Straightedge 500 mm -VAS 6075-
- Feeler gauges

Max. permissible distortion: 0.1 mm.

Note

Reworking diesel cylinder heads is not permissible.

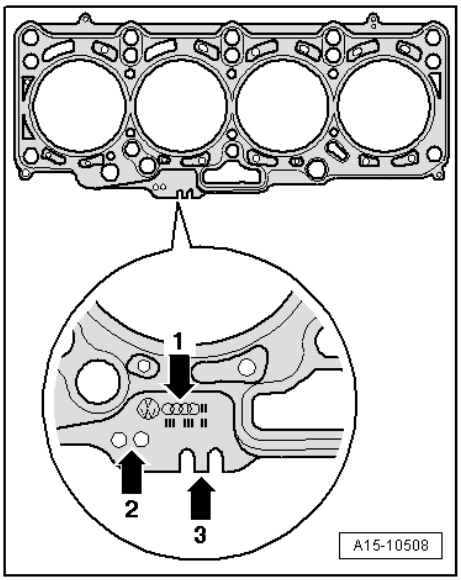


Cylinder head gasket identification

- Part number = arrow 1
- Holes = arrow 2
- Production control code = arrow 3 (can be disregarded)

Note

- *Different thicknesses of cylinder head gasket are fitted depending on the piston projection. When the seal is renewed, ensure that the designation matches.*
- *Piston projection at TDC must be determined when installing new pistons or a short engine.* ⇒Page 213.



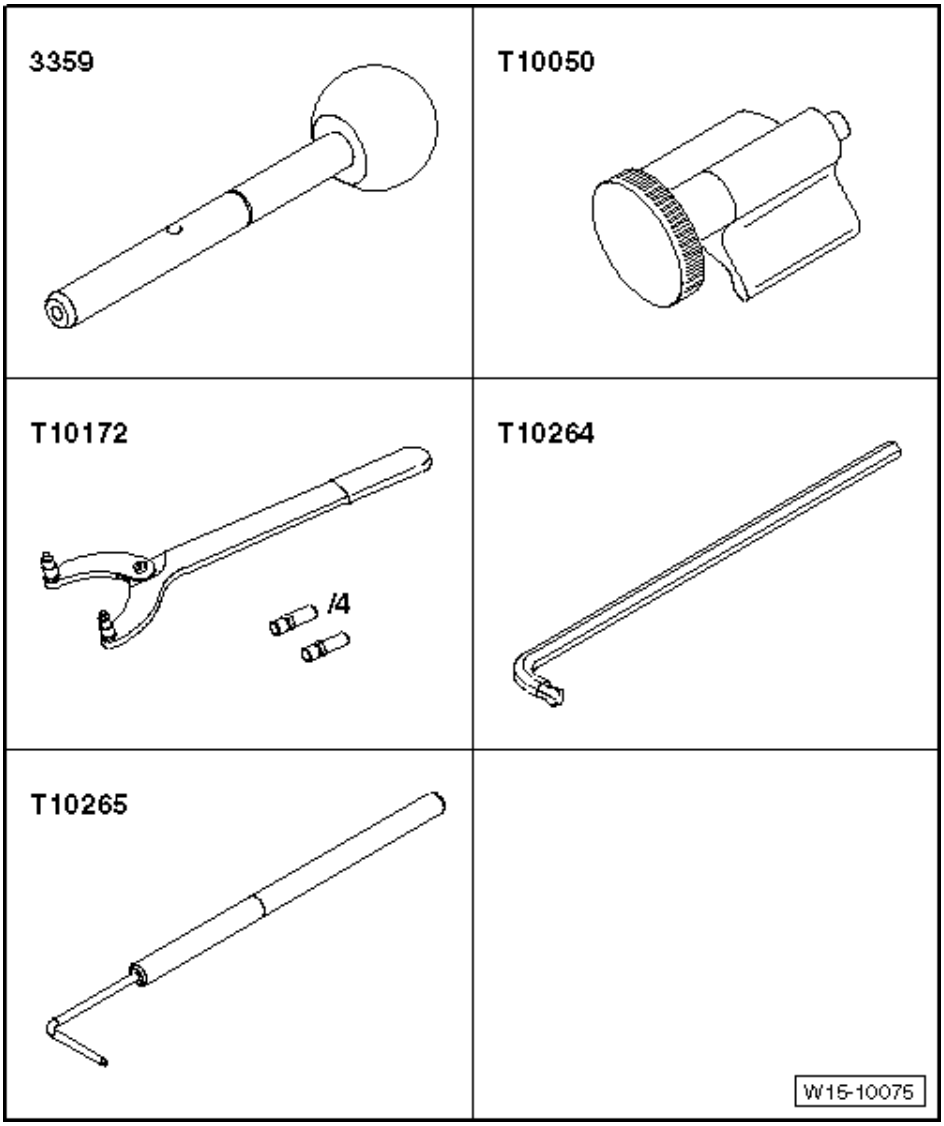
1.2 Removing and installing Hall sender -G40-

WARNING

Adhere to the general safety regulations and the notes on repair work on the engine! **⇒Page 1**

Special tools and workshop equipment required

- Locking pin -3359-
- Crankshaft stop -T10050-
- Counterhold -T10172-
- Angle driver -T10264- for tensioning roller
- Locking tool -T10265-



Removing

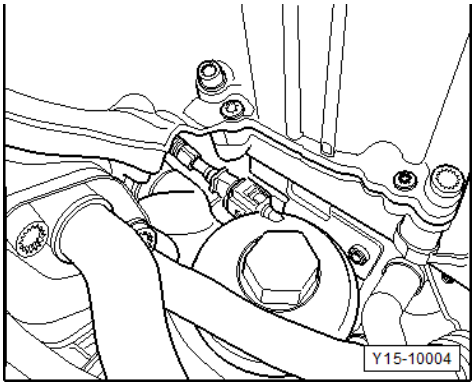
– Remove toothed belt from idler pulley high-pressure pump pulley. To do this, remove toothed belt ⇒ Page 212.

Engine codes CJDA, CJDD

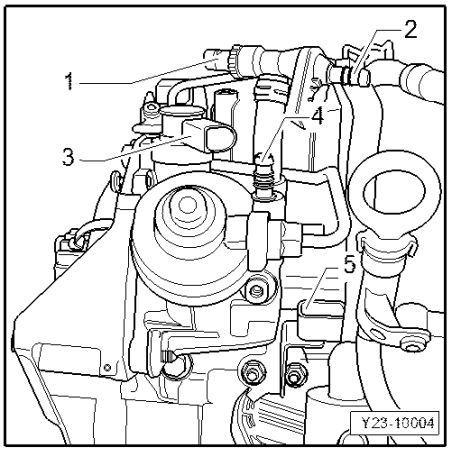
– Disconnect connector for Hall sender -G40- in -centre-.

– Detach plug from its retainer.

Engine codes CPYA, CPYB, CPYC, CPYD, CPYE



– Disconnect connector for Hall sender -G40- -5-.



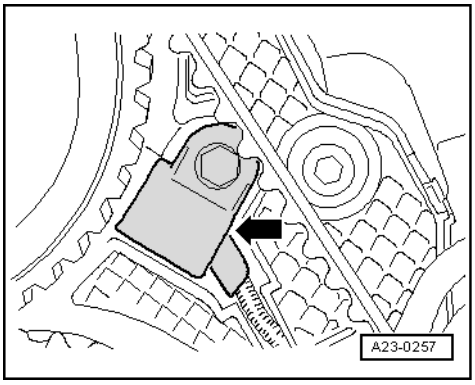
Continuation for all engine codes

– Detach plug from its retainer.

– Unscrew Hall sender -G40- -arrow-.

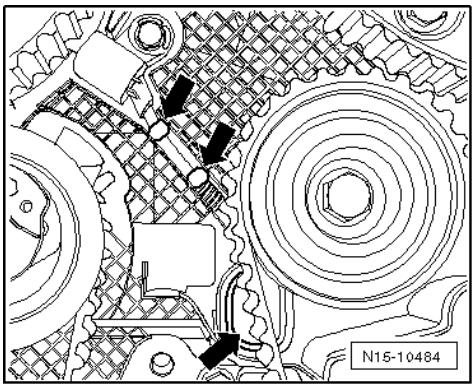
– Using a screwdriver, remove webs -arrows-, and remove repair aperture cover -arrows-.

– Remove idler pulley -right side-.



– Remove repair aperture cover -arrows-.

– Remove Hall sender -G40- from cylinder head and guide its plug through repair aperture in toothed belt guard.



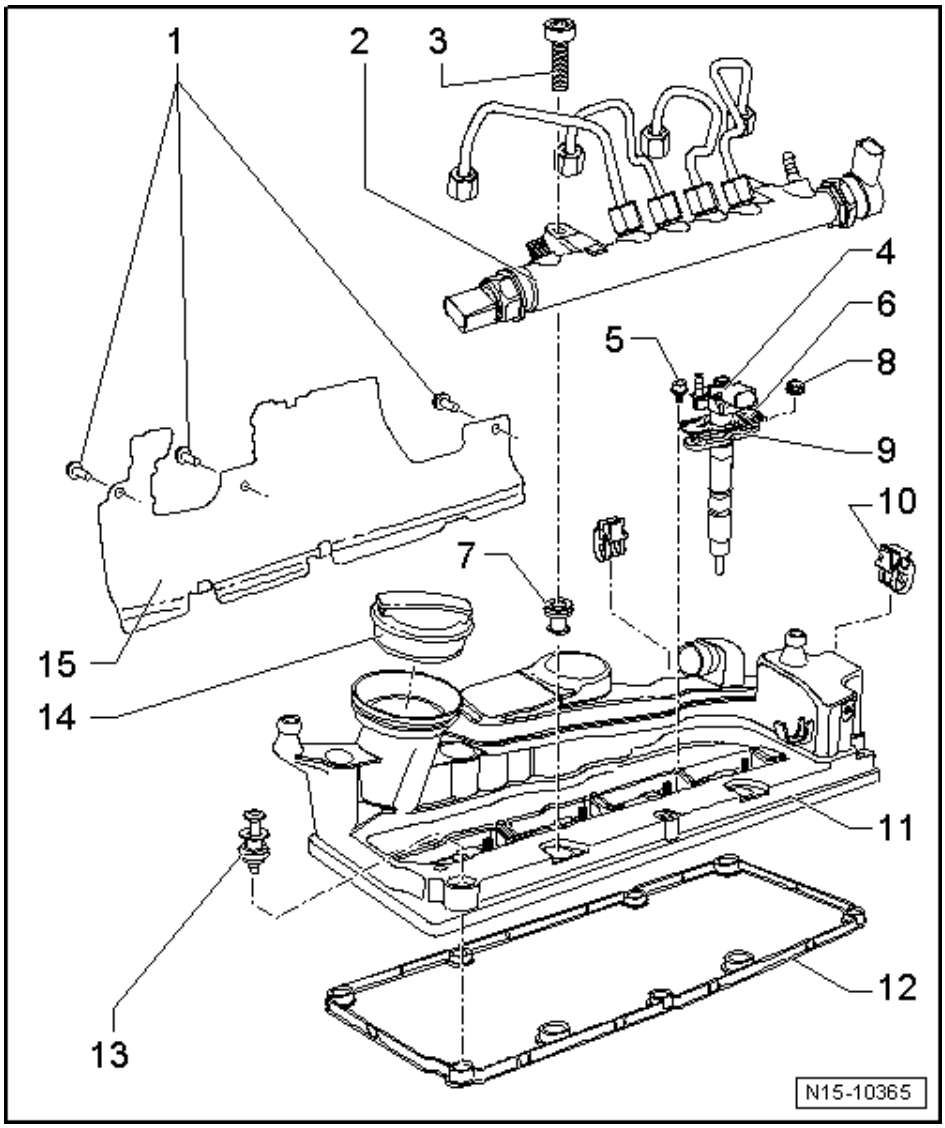
Installing

Install in reverse order. Observe the following:

- Seal repair aperture in toothed belt guard using the respective rubber plug. ⇒ ETKA (Electronic Parts Catalogue).
- Idler pulley, renew bolt, specified torque: 50 Nm + $^{1}/_{4}$ turn (90°) further

– Fit toothed belt, and adjust valve timing. Install toothed belt ⇒Page 214.

1.3 Assembly overview - cylinder head cover, engine codes CJDA, CJDD



1 - 5 Nm

2 - Fuel rail
- ❑ With injection pipes.
- ❑ Do not attempt to bend injector pipes to a different shape.

3 - 22 Nm

4 - Injector (piezo injectors)
- ❑ Removing and installing.
- ❑ With union for fuel return line
- ❑ The fuel return lines must not be dismantled.
- ❑ Removing ⇒Fig. on page 195
- ❑ Check fasteners ⇒Fig. on page 195
- ❑ Attach ⇒Fig. on page 195
- ❑ Lock ⇒Fig. on page 196

5 - 5 Nm

6 - Injector cover

7 - Bush
- ❑ For securing fuel rail
- ❑ Renew if damaged

8 - 10 Nm

9 - Clamping piece
- ❑ Note installation position

10 - Cable guide

11 - Cylinder head cover
- ❑ Tightening sequence ⇒Fig. on page 196.
- ❑ Removing and installing ⇒Page 196

12 - Gasket
- ❑ Renew if damaged or leaking

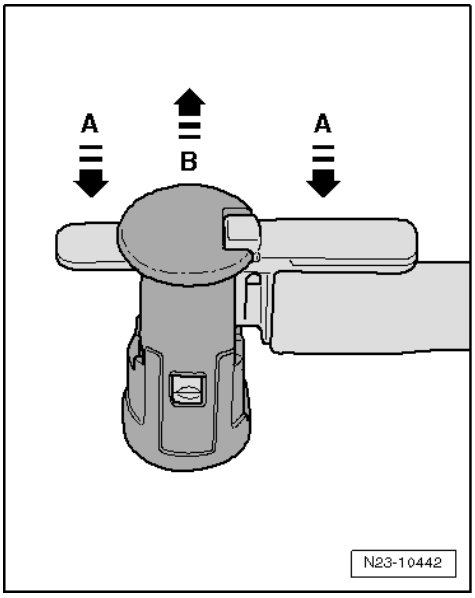
13 - 10 Nm
- ❑ Tightening sequence ⇒Fig. on page 196.

14 - Cap

15 - Heat shield

Disconnecting fuel return lines

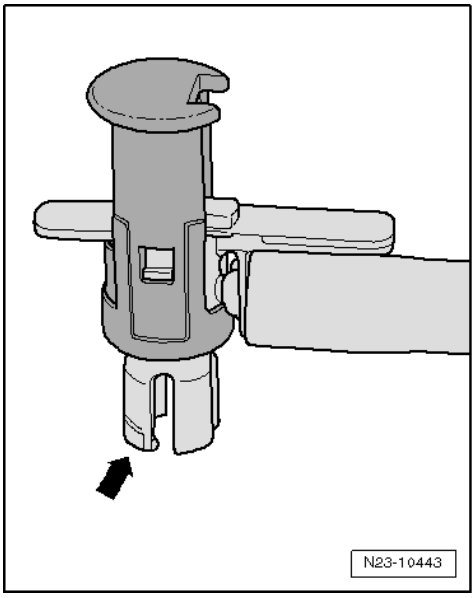
– With engine switched off, carefully pull return line connections off injectors. To do this, press both clips downwards -arrow A- and simultaneously pull release pin upwards -arrow B-.



Check catches

Caution

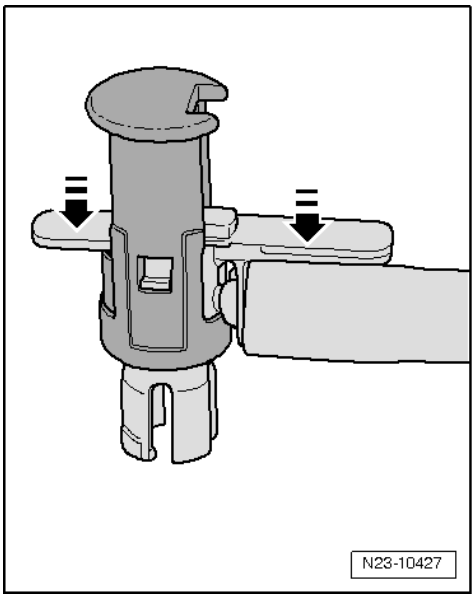
- ***Carefully pull fuel return lines upwards vertically when disconnecting, as the 4 catches -arrow- can fracture.***
- ***After disconnecting, check the 4 catches -arrow- to see whether they are fractured or have broken off.***
- ***Always replace damaged fuel return lines.***
- ***A damaged fuel return line that becomes loose when engine is running causes damage to injection valve (piezo injector). The injection valve (piezo injector) must then be replaced.***



Attach fuel return line

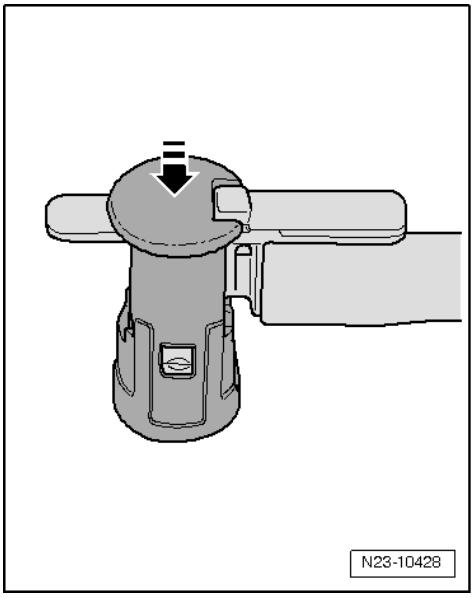
– Apply a thin coat of diesel fuel to new O-rings on return-line connections.

– Attach fuel return line and press the two clips downwards as far as they will go -arrows-.



Lock fuel return line

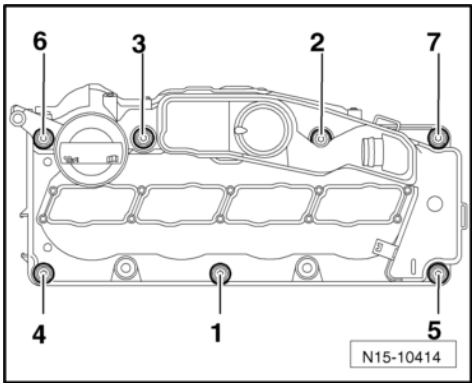
– After fuel return line has been pushed on completely, press locking pin downwards -arrow-.



Tightening sequence

– Screw on cylinder head cover hand-tight in the sequence -1 to 7.-

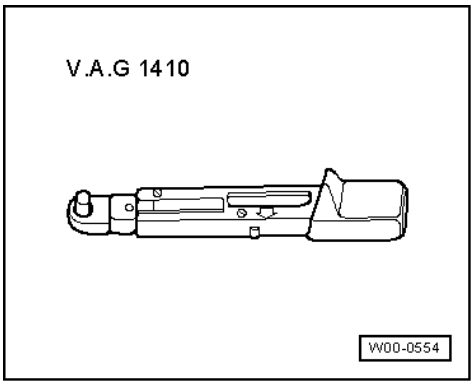
– Tighten bolts to 10 Nm in the sequence -1...7-.



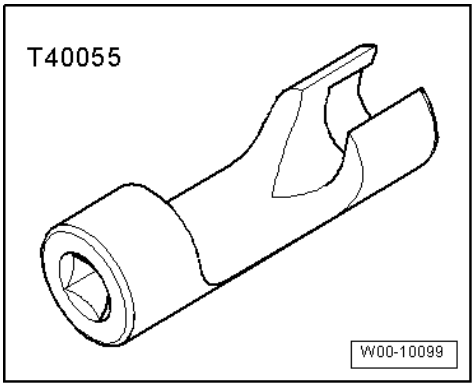
1.3.1 Removing and installing cylinder head cover

Special tools and workshop equipment required

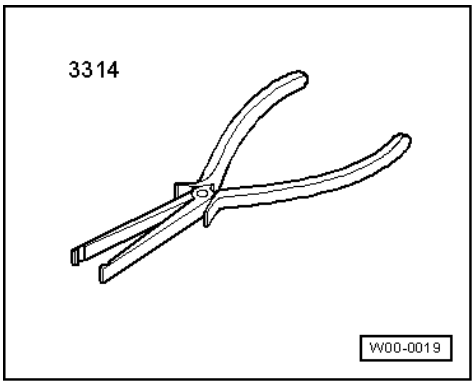
◆ Torque wrench -V.A.G 1410-



◆ Socket -T40055-



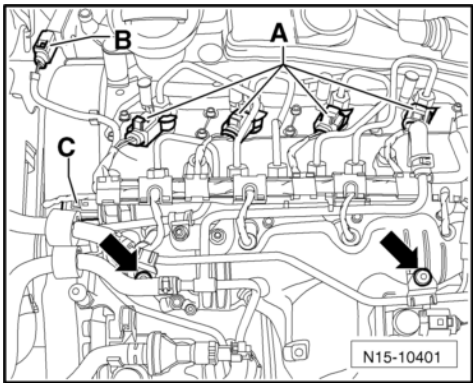
◆ Pliers -3314-



Removing

– Remove noise insulation from injectors.

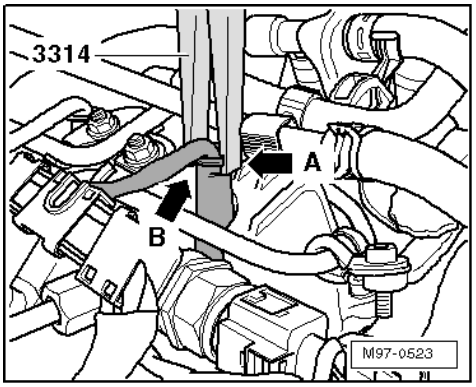
– Pull connectors off injectors -A-, exhaust gas pressure sensor 1 -G450- -B- and fuel rail pressure sensor -C-.



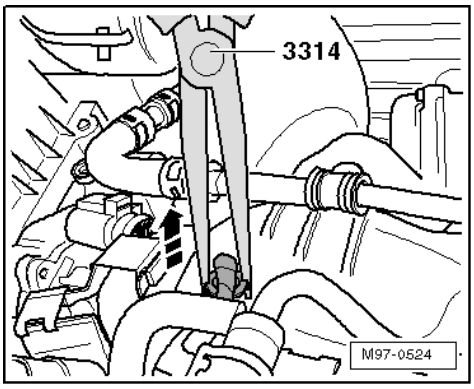
Caution

Make sure that no wiring connections are damaged when disconnecting the connectors. Otherwise the whole wiring harness will need to be renewed. Do not compress the pliers -3314- too firmly to separate the connectors, otherwise the support sleeve may be damaged.

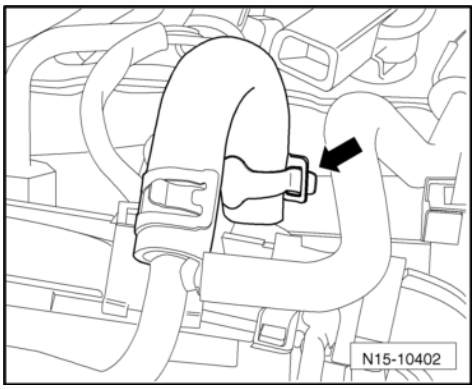
– Position pliers -3314- with groove -arrow A- on shoulder of support sleeve -arrow B- and pull connectors off glow plugs.



– Carefully pull connector in direction of -arrow- off glow plug.



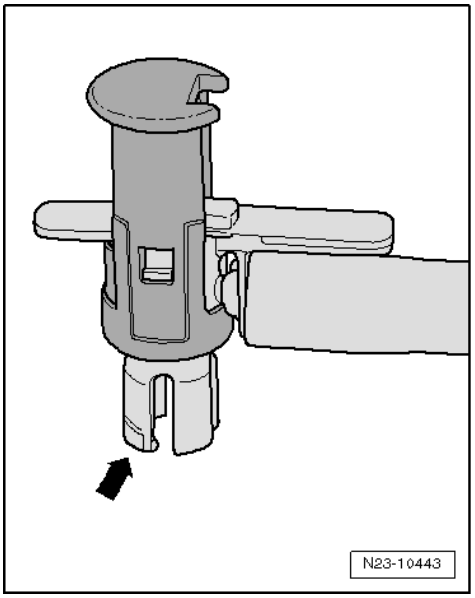
– Open clamp -arrow- and pull line off fuel rail.



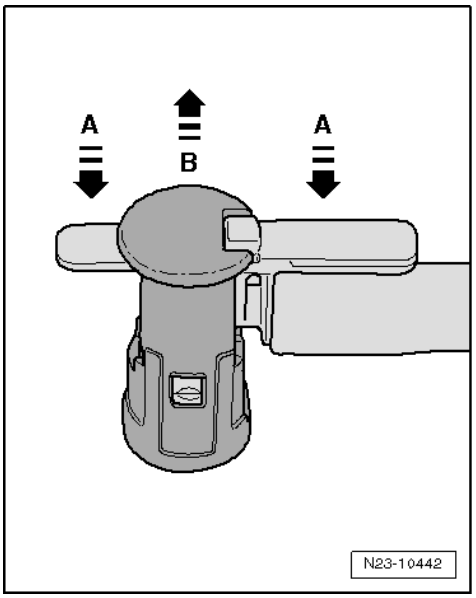
Disconnecting fuel return lines

Caution

- ***Carefully pull fuel return lines upwards vertically when disconnecting, as the 4 catches -arrow- can fracture.***
- ***After disconnecting, check the 4 catches -arrow- to see whether they are fractured or have broken off.***
- ***Always replace damaged fuel return lines.***
- ***A damaged fuel return line that becomes loose when engine is running causes damage to injection valve (piezo injector). The injection valve (piezo injector) must then be replaced.***



– With engine switched off, carefully pull return line connections off injectors. To do this, press both clips downwards -arrow A- and simultaneously pull release pin upwards -arrow B-.

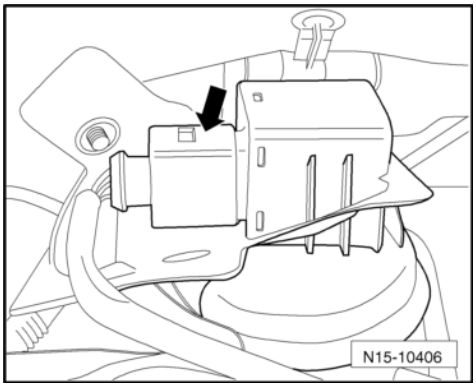


Note

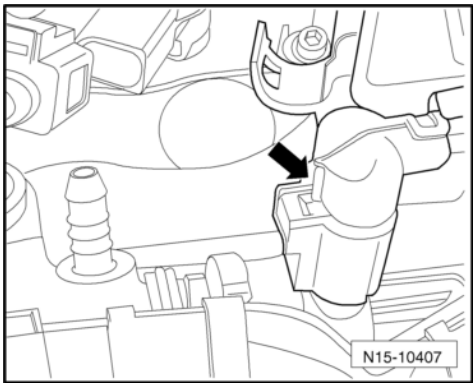
Adhere strictly to rules of cleanliness. No dirt must be allowed to get into the disconnected fuel return lines or the open connections on the injectors.

– Remove entire fuel return line and set it down in front of intake manifold.

– Pull connector of position sender for charge pressure positioner -G581- -arrow- off turbocharger and guide wiring out of retainers.

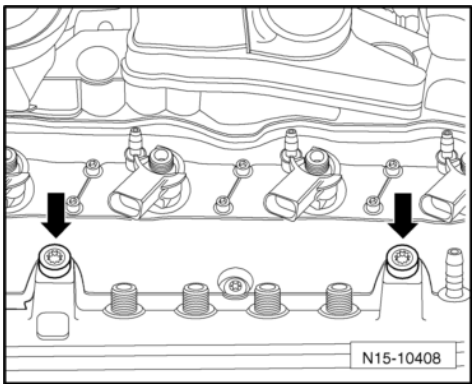


– Pull connector off fuel pressure regulating valve -N276- -arrow-.



– Remove wiring harness from rail and lay to one side.
– Pull off vacuum line at the cylinder head cover. Remove the other vacuum lines from the retainer on the cylinder head cover.
– Remove upper toothed belt guard.
– Remove breather line between cylinder head cover and intake hose. Press quick-release fasteners to do this.
– Remove high-pressure line between high-pressure pump and fuel rail.
– Remove high-pressure lines between fuel rail and injectors.

– Unscrew bolts -arrows- and remove fuel rail.
– Remove injectors.
– Remove securing bolts for cylinder head cover and take off cylinder head cover.



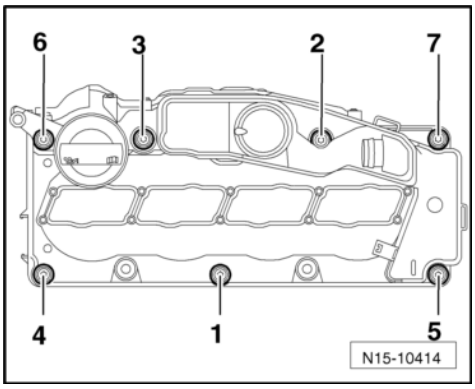
Installing

Install in reverse order. In the process, note the following:

Note

Renew seal for bolts if damaged.

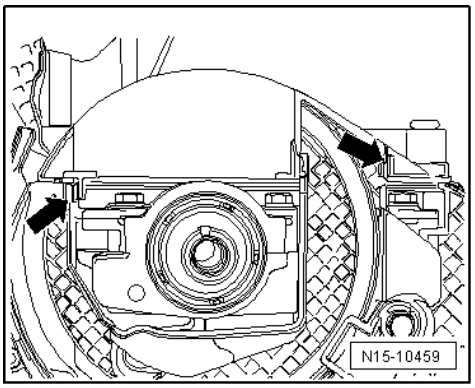
– Screw on cylinder head cover hand-tight in the sequence -1 to 7.-
– Tighten bolts to 10 Nm in the sequence -1...7-.
– Ensure that cylinder head cover is correctly clipped to toothed belt guard.



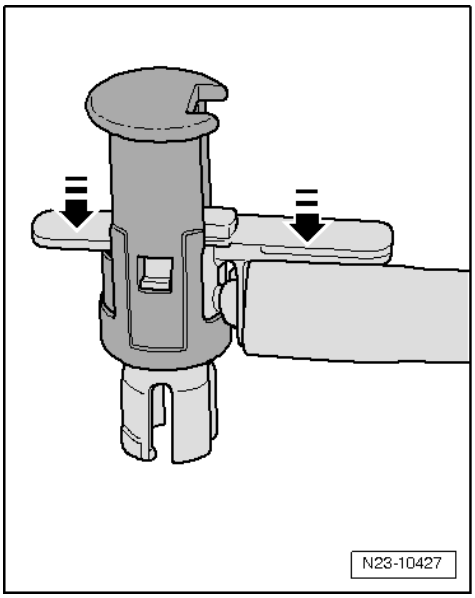
Note

For reasons of clarity, the camshaft sprocket has been left out.

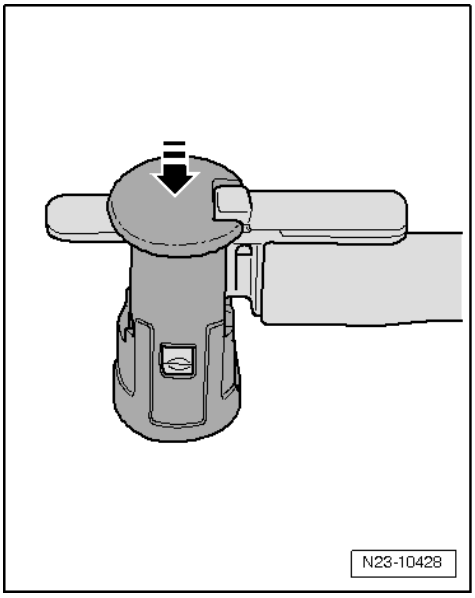
– To do this, press toothed belt guard (using a screwdriver if necessary) against cylinder head cover in area of clips -arrows- until clips audibly engage in each other.
– Check that there is sufficient clearance between hub and toothed belt guard.
– Install high-pressure lines.



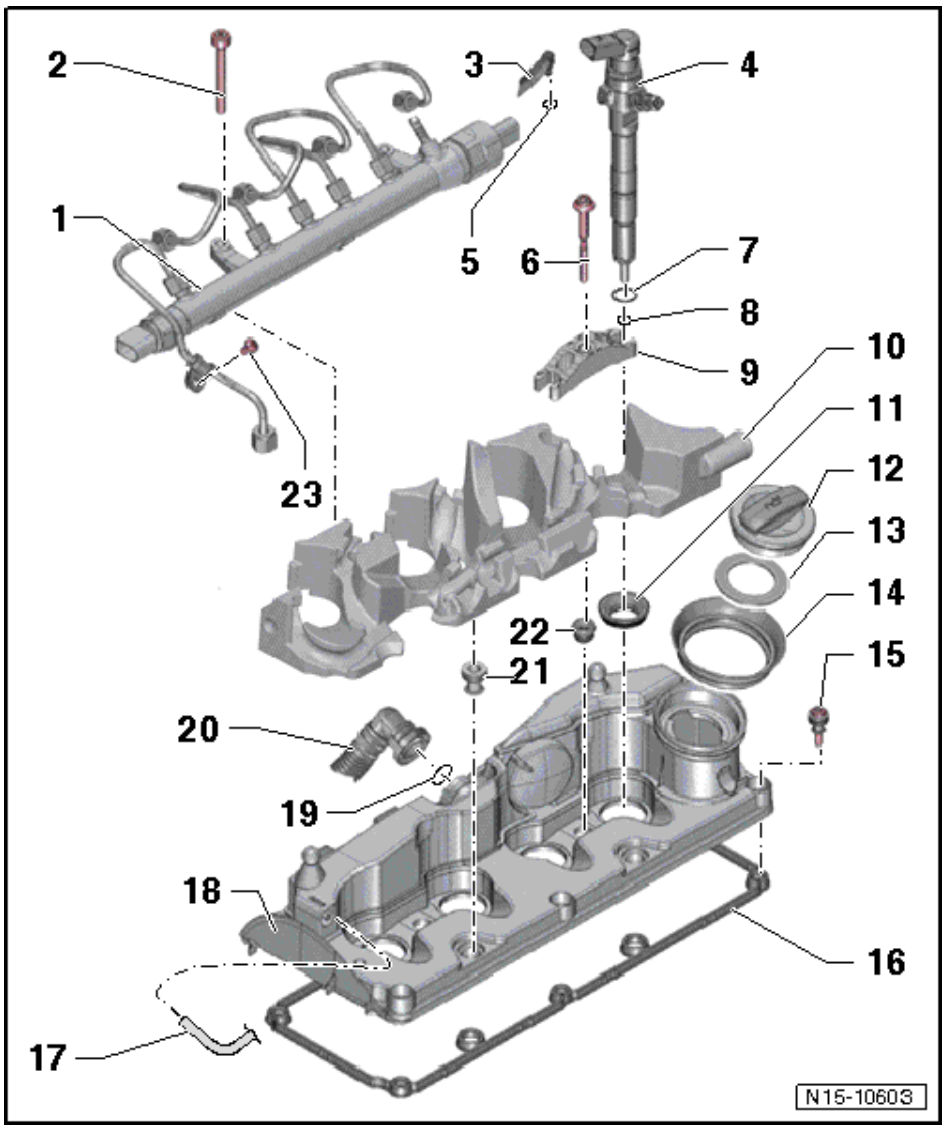
– Attach fuel return line and press the two clips downwards as far as they will go -arrows-.



– After fuel return line has been pushed on completely, press locking pin downwards -arrow-.



1.4 Assembly overview - cylinder head cover, engine codes CPYA, CPYB, CPYC, CPYD, CPYE



1 - High-pressure accumulator (fuel rail)
- ❑ Do not attempt to reshape high-pressure lines.
- ❑ Removing and installing high-pressure lines

2 - Bolt, 22 Nm

3 - Fuel return line
- ❑ Route fuel return lines in noise insulation guides ⇒ Item 10
- ❑ Cannot be renewed separately
- ❑ To fuel tank
- ❑ The fuel return line must not be kinked, damaged or blocked.
- ❑ The fuel return lines must not be dismantled.
- ❑ Removing ⇒ Fig. on page 203
- ❑ Check fasteners ⇒ Fig. on page 204
- ❑ Attach ⇒ Fig. on page 204
- ❑ Lock ⇒ Fig. on page 204

4 - Injector (piezo injectors)
- ❑ When removing and installing, always renew the following components and seals/O-rings: “copper seal”, “O-ring for injector bore”, “O-ring for injector return connection”.
- ❑ If they are to be re-installed, the injectors must always be re-fitted on the same cylinder.
- ❑ Before re-using “high-pressure pipe”, perform visual check of taper seats for damage such as transverse scores or corrosion. Always renew pipe if damaged.
- ❑ Removing and installing.

5 - O-ring
- ❑ Renew

6 - Bolt, turn 8 Nm +180° (1/2 turn) further
- ❑ Renew

7 - O-ring
- ❑ Renew

8 - Seal
- ❑ Renew

9 - Clamping plate

10 - Noise insulation

- ❑ Route fuel return lines ⇒ Item 3 in noise insulation guides.

11 - Injector seal

- ❑ Renew if damaged or leaking

12 - Cap

13 - Gasket

14 - Grommet

15 - Bolt

- ❑ Renew if gasket is damaged
- ❑ Specified torque and tightening sequence ⇒ Fig. on page 205.

16 - Gasket

- ❑ Renew if damaged or leaking

17 - Vacuum hose

18 - Cylinder head cover

- ❑ Removing and installing ⇒ Page 205

19 - O-ring

- ❑ Renew if damaged or leaking

20 - Pipe assembly

- ❑ For crankcase breather
- ❑ Press release buttons to remove.

21 - Sealing bush for fuel rail

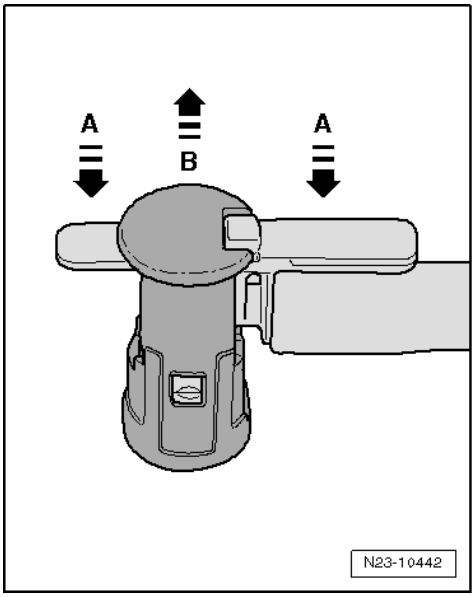
- ❑ Renew if damaged or leaking

22 - Grommet

23 - Bolt, 10 Nm

Disconnecting fuel return lines

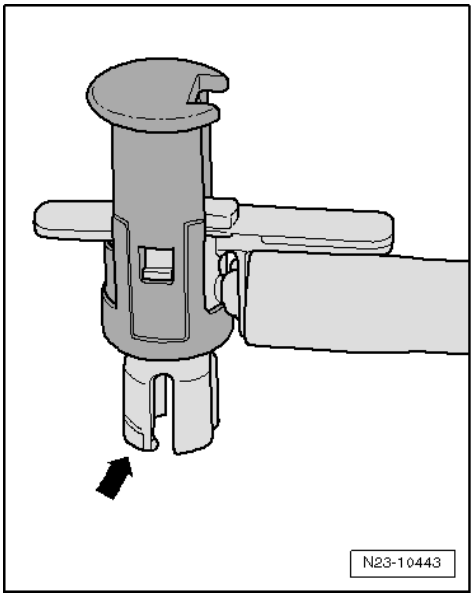
– With engine switched off, carefully pull return line connections off injectors. To do this, press both clips downwards -arrow A- and simultaneously pull release pin upwards -arrow B-.



Check catches

Caution

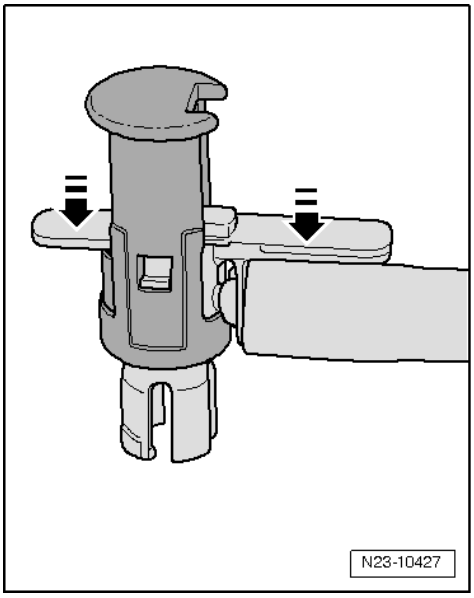
- ***Carefully pull fuel return lines upwards vertically when disconnecting, as the 4 catches -arrow- can fracture.***
- ***After disconnecting, check the 4 catches -arrow- to see whether they are fractured or have broken off.***
- ***Always replace damaged fuel return lines.***
- ***A damaged fuel return line that becomes loose when engine is running causes damage to injection valve (piezo injector). The injection valve (piezo injector) must then be replaced.***



Attach fuel return line

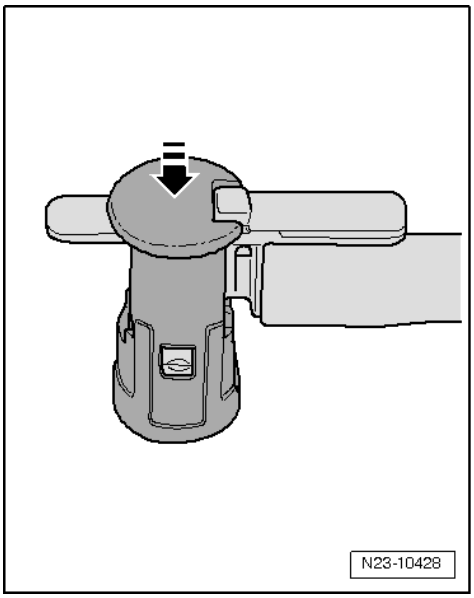
– Apply a thin coat of diesel fuel to new O-rings on return-line connections.

– Attach fuel return line and press the two clips downwards as far as they will go -arrows-.



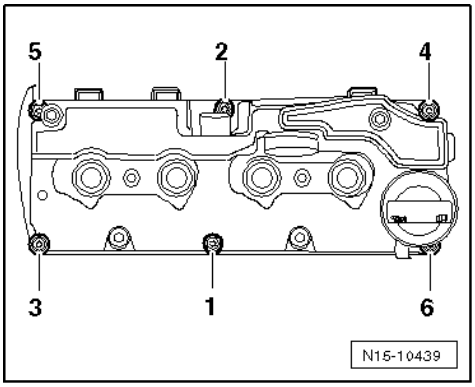
Lock fuel return line

– After fuel return line has been pushed on completely, press locking pin downwards -arrow-.



Tightening sequence

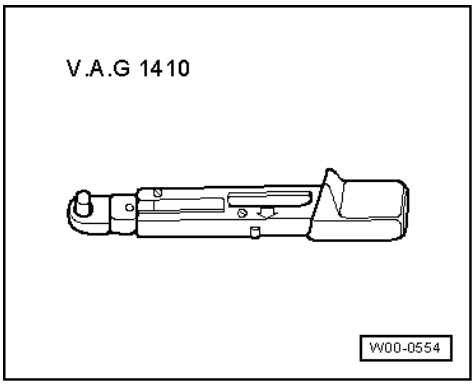
– Bolt on cylinder head cover hand-tight in the sequence -1...6-.
– Tighten bolts to 10 Nm in the sequence -1...6-.



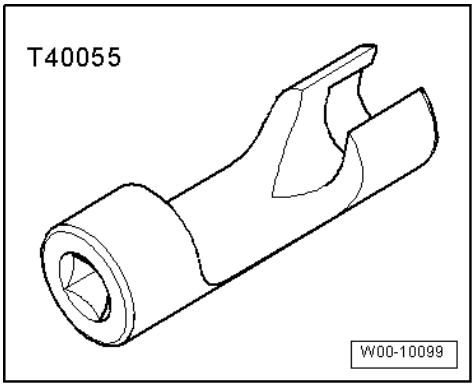
1.4.1 Removing and installing cylinder head cover

Special tools and workshop equipment required

◆ Torque wrench -V.A.G 1410-

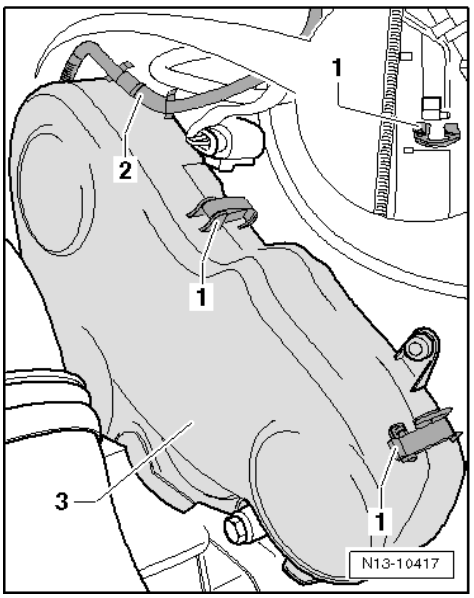


◆ Socket -T40055-

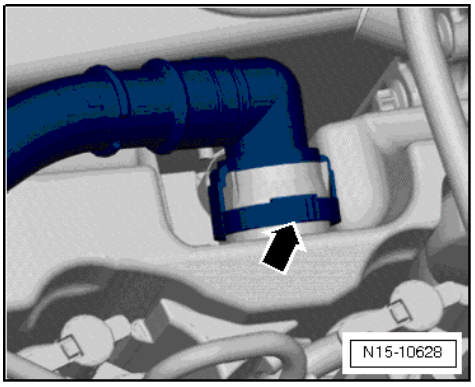


Removing

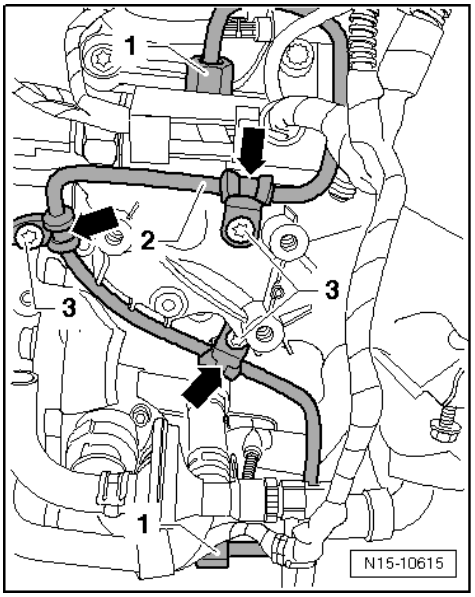
– Open clips -1- and remove toothed belt guard -3-.



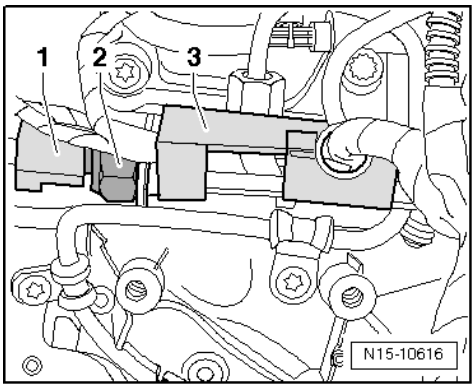
– Remove pipe from cylinder head cover -arrow-.



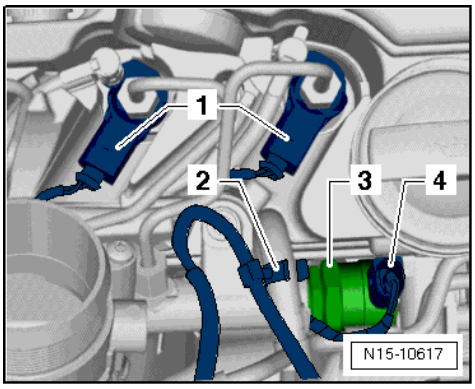
– Unscrew bolts -3-.
– Unscrew union nuts -1- using socket -T40055-, and remove fuel line -2-.
– Place removed high-pressure line on a clean surface.



– Release connector -1- and pull off from fuel pressure sender -G247- -2-.
– Pull cable guide -3- off fuel rail.



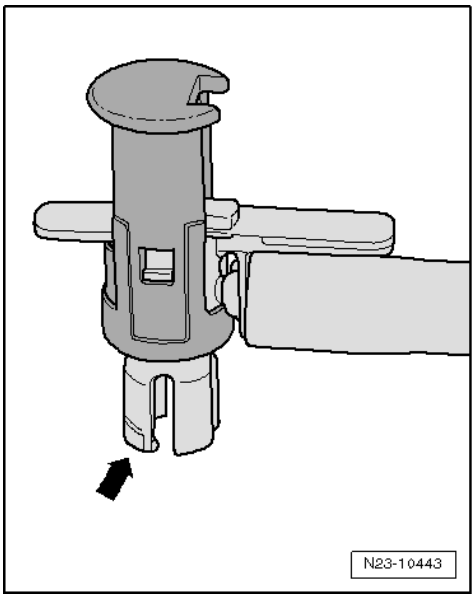
– Release all connectors -1- and pull off from injectors (piezo injectors).
– Detach all required clips, e.g. clip -2-.
– Release connector -4- and pull off from fuel pressure regulating valve -N276- -3-.
– Ensure cleanliness. No dirt must be allowed to get into disconnected return lines, fuel lines or injector connections.



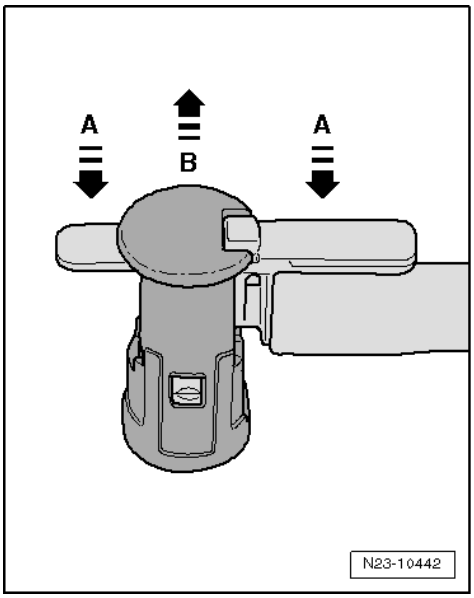
Disconnecting fuel return lines

Caution

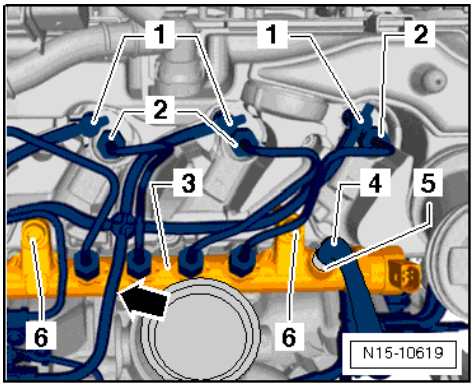
- ***Carefully pull fuel return lines upwards vertically when disconnecting, as the 4 catches -arrow- can fracture.***
- ***After disconnecting, check the 4 catches -arrow- to see whether they are fractured or have broken off.***
- ***Always replace damaged fuel return lines.***
- ***A damaged fuel return line that becomes loose when engine is running causes damage to injection valve (piezo injector). The injection valve (piezo injector) must then be replaced.***



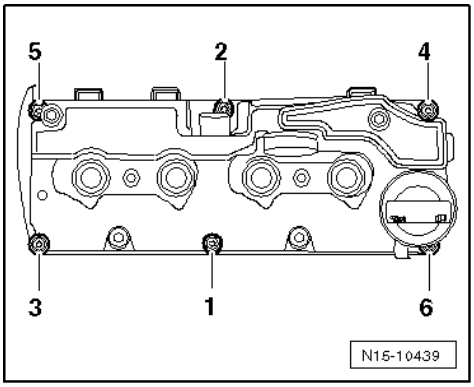
– With engine switched off, carefully pull return line connections off injectors. To do this, press both clips downwards -arrow A- and simultaneously pull release pin upwards -arrow B-.



– Pull all fuel return lines -1- off injectors (piezo injectors).
– Unscrew all union nuts -2- from injectors (piezo injectors).
– Open clip -5- and detach fuel hose -4- from high-pressure accumulator (fuel rail).
– Unscrew bolts -6- from fuel rail.
– Remove fuel rail -3- to right. Guide fuel return line -arrow- past fuel lines when doing this.
– Ensure cleanliness. No dirt may get into the injector holes on the cylinder head cover.
– Remove injectors (piezo injectors) ⇒Page 370.
– Remove noise insulation.



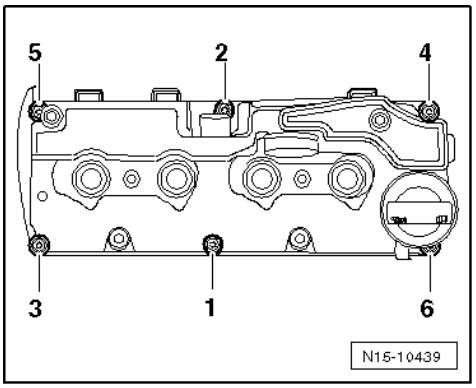
– Unscrew cylinder head cover bolts in the sequence -6 … 1- and remove cylinder head cover.



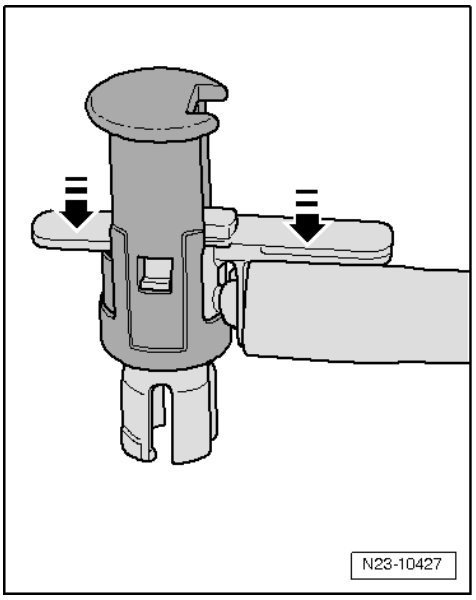
Installing

Install in reverse order. In the process, note the following:

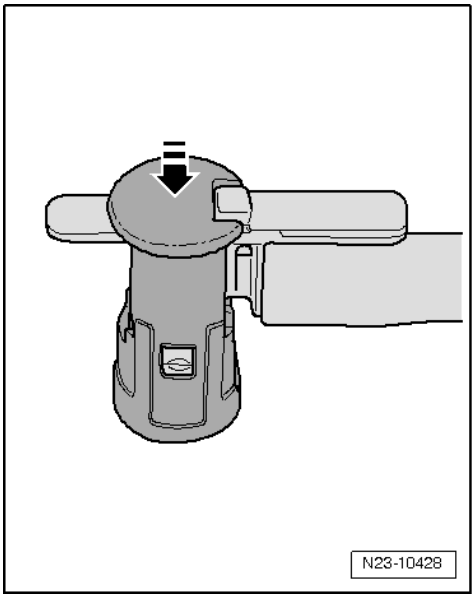
– Hand-tighten cylinder head cover in the sequence -1 … 6-.
– Tighten bolts in the sequence -1 … 6- to 10 Nm.
– Apply a thin coat of diesel fuel to new O-rings on return-line connections.



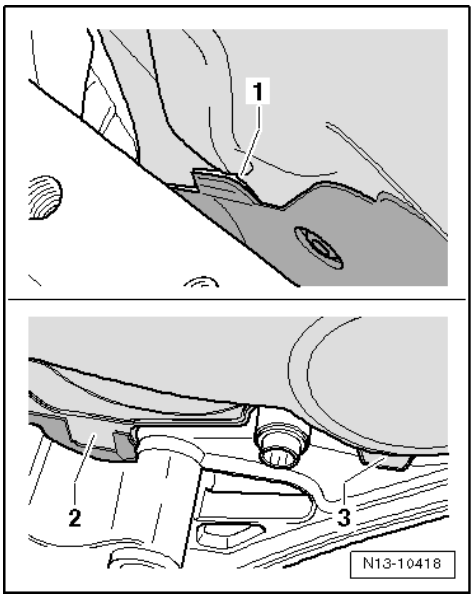
– Attach fuel return line and press the two clips downwards as far as they will go -arrows-.



– After fuel return line has been pushed on completely, press locking pin downwards -arrow-.



– First, hook back of top part of toothed belt guard to middle part -1- of toothed belt guard.
– Then, fit toothed belt guard to middle -2- and -3- of toothed belt guard at the top.



1.5 Renewing toothed belt and toothed belt tensioning roller for camshaft drive, engine codes CJDA, CJDD, CPYA, CPYB, CPYC, CPYD, CPYE

> ⚠ ***WARNING***
>
> ***Adhere to the general safety regulations and the notes on repair work on the engine!*** ⇒ **Page 1**

Note

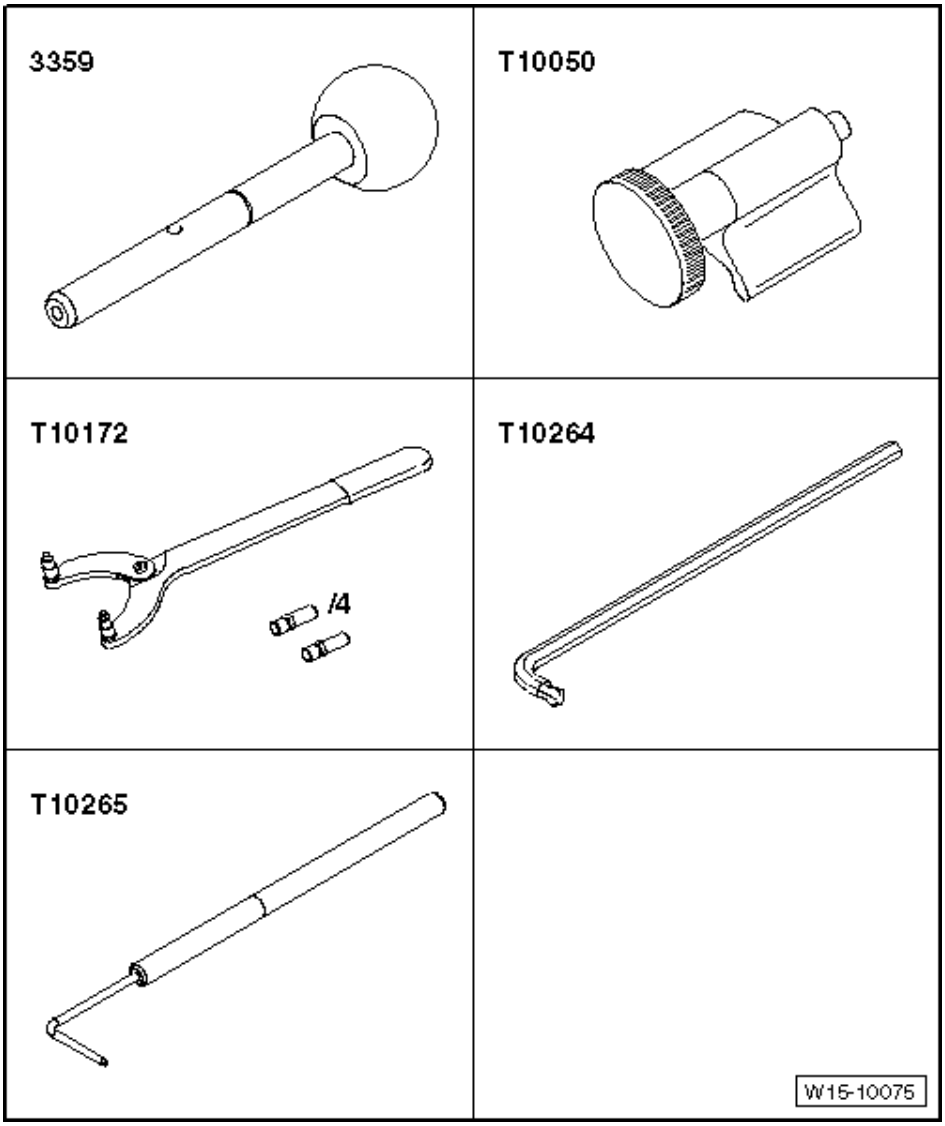
- *In general, the toothed belt does not need to be renewed before the next change interval is due. Especially cracks on the rear do not affect the service life and cannot be covered by goodwill or as a warranty-related measure.*
- *We recommend to renew the coolant pump along with the toothed belt.*
- *Take the respective service interval into account.*

Removing ⇒ Page 212.

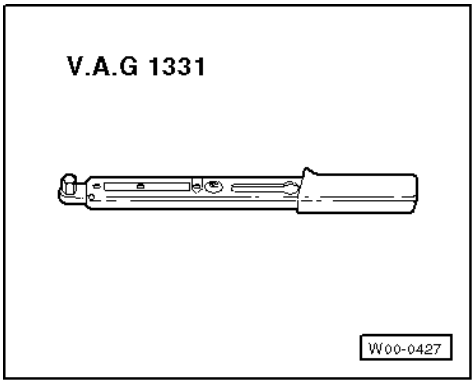
Installing, tensioning ⇒ Page 214.

Special tools and workshop equipment required

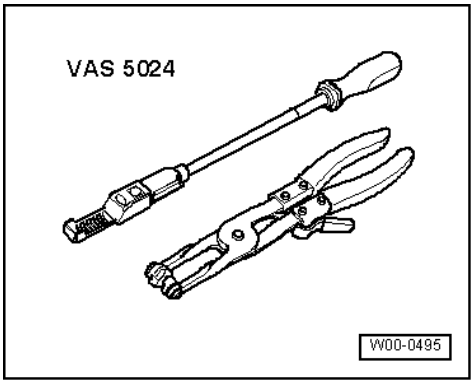
- Locking pin -3359-
- Crankshaft stop -T10050-
- Counterhold -T10172-
- Counterhold tool adapter -T10172/4-
- Counterhold tool adapter -T10172/8-
- Angle driver -T10264-
- Locking tool -T10265-



- Torque wrench (5…50 Nm) -V.A.G 1331-



◆ Spring-type clip pliers -VAS 5024-



1.5.1 Removing

Note

The toothed belt may only be adjusted on cold engines, as the indicator position on the tensioning element varies depending on the engine temperature.

Caution

When doing any repair work, pay attention to the following due to the cramped conditions:

- ***Route all the various lines (e.g. for fuel, hydraulics, coolant and refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.***
- ***Ensure that there is sufficient clearance to all moving or hot components.***

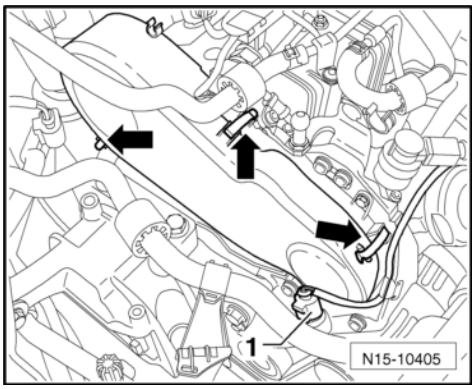
– Remove any relevant lines and hoses.

– If fitted, remove engine bracket ⇒ Page 150.

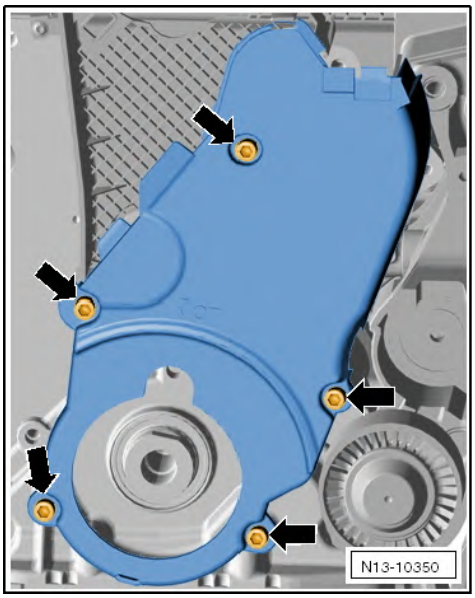
– Open clips -arrows- and remove timing belt guard.

– Remove poly V-belt.

– Remove vibration damper.



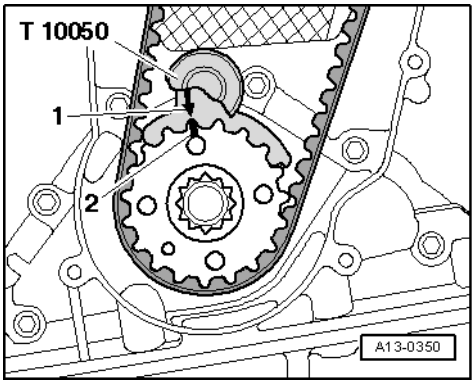
– Remove lower toothed belt guard. To do this, unscrew bolts -arrows-.



– Turn engine to TDC position, and pin crankshaft pulley using crankshaft stop -T10050-. To do this, push crankshaft stop into toothed belt pulley splines from face end. The toothed segment of the camshaft must be at the “12 o'clock position”.

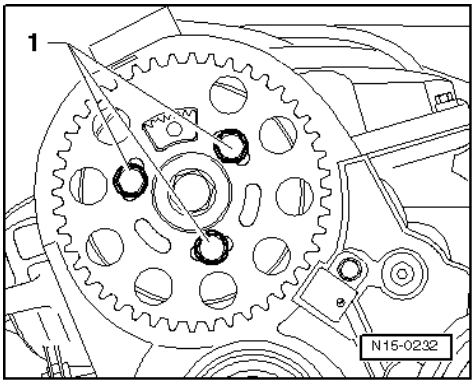
Note

The markings on the crankshaft pulley -2- and the crankshaft stop -T10050- -1- must align. At the same time, the pin of the crankshaft stop -T10050- must engage in the drilling in the sealing flange.

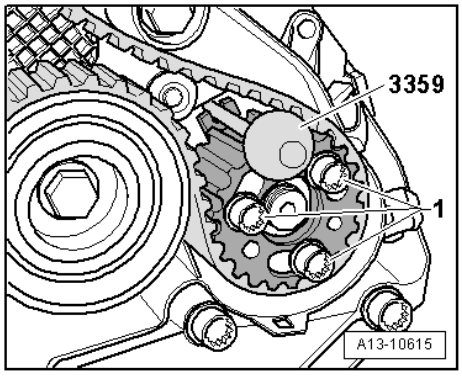


– Mark direction of rotation of toothed belt.

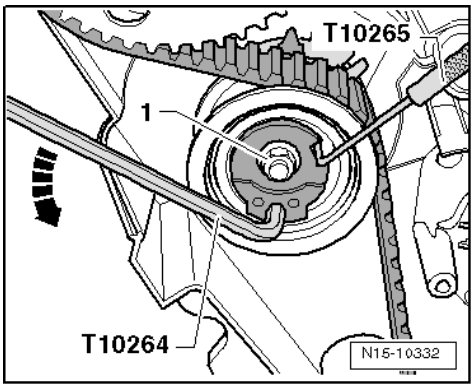
– Loosen securing bolts -1- for camshaft toothed belt pulley.



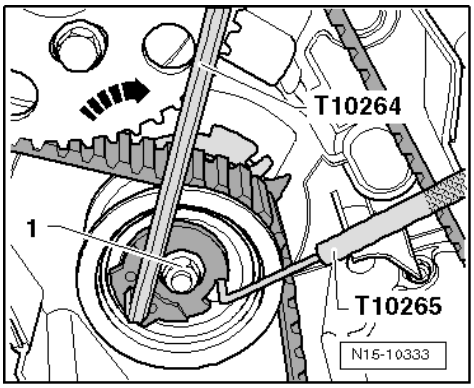
– If fitted, loosen securing bolt of coolant pipe and then securing bolts of toothed belt pulley for high-pressure pump -1-.



– Loosen tensioning roller securing nut -1-.
– Using socket -T10264-, turn eccentric of tensioning roller anti-clockwise -arrow- until the tensioning roller can be locked with locking pin -T10265-.



– Now turn tensioning roller eccentric clockwise -arrow- onto stop and tighten securing nut -1- hand-tight.
– Remove toothed belt first from idler pulley and then from remaining pulleys.



1.5.2 Installing, tensioning

Note

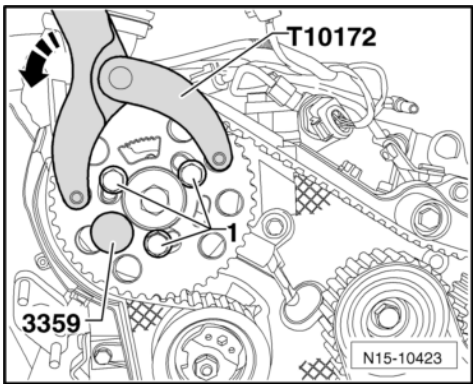
- *The toothed belt may only be adjusted on cold engines, as the indicator position on the tensioning element varies depending on the engine temperature.*
- *If the tensioning roller is to be renewed, the engine bracket must be removed.*
- *Renew securing bolts for camshaft pulley and high-pressure pump pulley.*

- Tensioning roller must be locked with locking tool -T10265- and secured to right stop.
- Crankshaft is locked using crankshaft stop -T10050-.

Note

If necessary, turn camshaft hub with counterhold tool -T10172- and adapters -T10172/4- until camshaft can be secured in position. To do this, hand-tighten at least one securing bolt -1-.

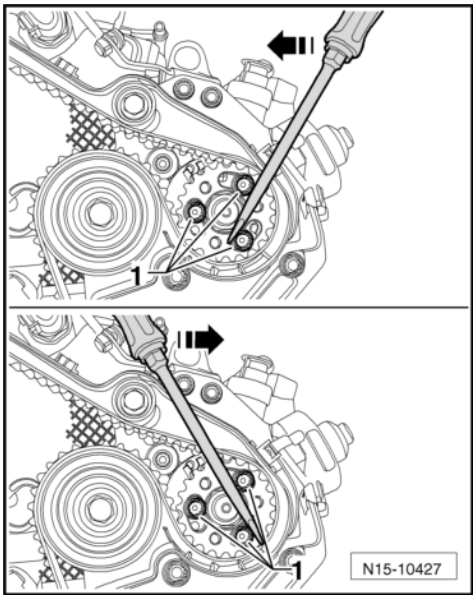
– Lock camshaft hub with locking pin -3359-. To do this, slide locking pin through outer free elongated hole into hole in cylinder head.
– Loosen bolts which had been tightened only hand-tight.



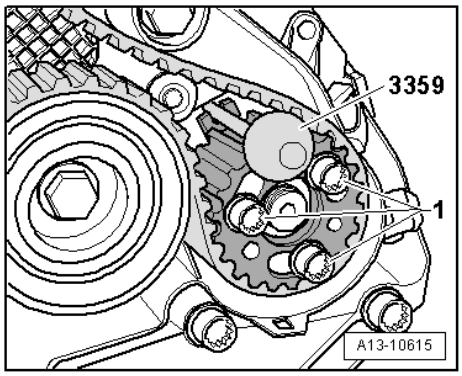
Note

If necessary, turn hub of high-pressure pump at bolt heads with screwdriver until it can be secured in position.

Positioning hub of high-pressure pump

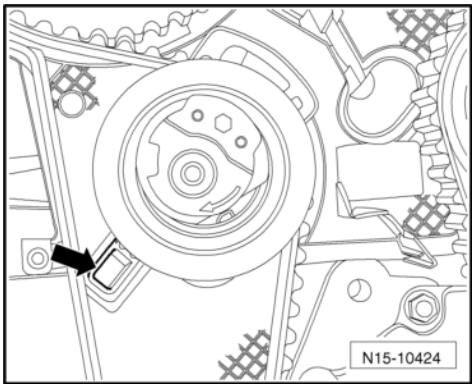


– Lock hub of high-pressure pump with locking pin -3359-. To do this, slide locking pin into adjustment hole outside toothed belt pulley.
– Turn camshaft pulley and toothed belt pulley of high-pressure pump in their elongated holes clockwise to stop.
– Fit toothed belt to crankshaft pulley, tensioning roller, camshaft pulley, toothed belt pulley of coolant pump and toothed belt pulley of high-pressure pump.
– Finally, fit toothed belt to idler pulley.
– Loosen tensioning roller securing nut and pull out locking tool -T10265-.



Note

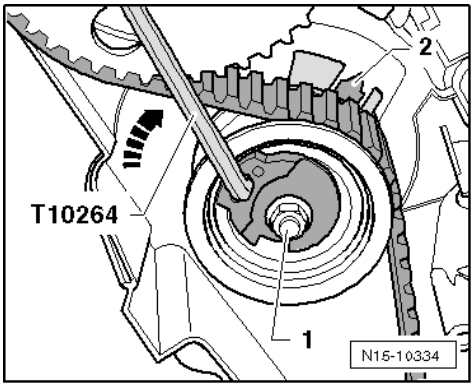
- *Ensure that tensioning roller seats correctly in rear toothed belt guard -arrow-.*



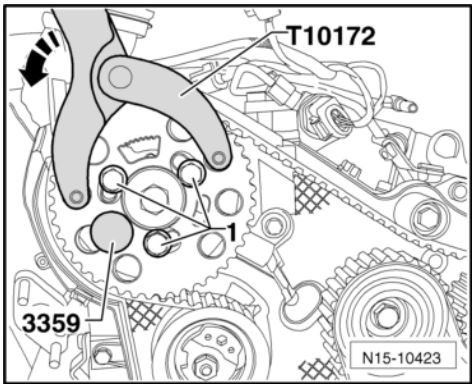
– Screw eccentric of tensioning roller clockwise carefully using angled screwdriver -T10264-. Indicator -2- must be roughly past the centre of the gap in the base plate (rectifies itself during pretensioning).

Ensure that securing nut -1- does not turn as well.

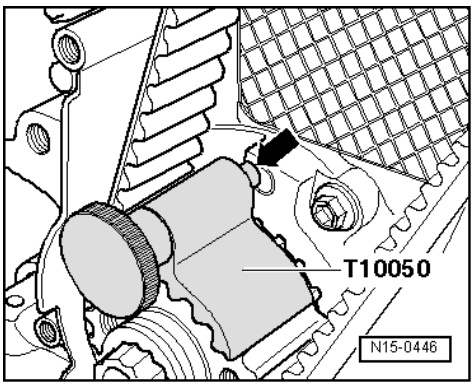
– Hold tensioning roller in this position and tighten tensioning roller securing nut as follows: 20 Nm and 45° further.



– Apply counterhold -T10172- as shown. Press counterhold -T10172- in direction of arrow, keeping camshaft toothed belt pulley under tension.
– In this position, tighten securing bolts -1- of camshaft pulley initially by hand and then to 20 Nm. Then, tighten bolts 45° further. In addition, tighten securing bolts of toothed belt pulley for high-pressure pump initially by hand and then to 23 Nm.
– Remove locking pins -3359- and crankshaft stop -T10050-.
– Turn crankshaft at least 2 rotations in engine direction of rotation and set again to TDC no. 1 cylinder.
– Fit crankshaft stop -T10050- again to crankshaft belt pulley.



– Now turn crankshaft in engine direction of rotation until pin of crankshaft stop -arrow- engages in sealing flange from rotational movement.

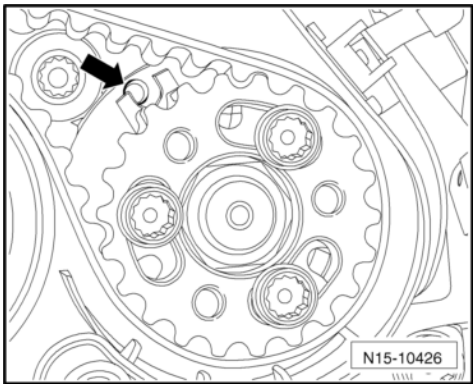


Note

- *During the following checking procedure, only the camshaft and crankshaft must be secured in position. It is very difficult to find the securing position of the high-pressure pump hub again. However, a slight deviation -arrow- does not influence the engine operation.*

– Check whether:

- Camshaft hub can be locked with locking pin -3359-.
- Tensioning roller indicator is centred or maximum 5 mm to right of base plate notch.



If camshaft hub cannot be locked:

– Pull crankshaft stop -T10050- back until pin uncovers hole.

– Turn crankshaft in opposite direction of engine rotation slightly past TDC.

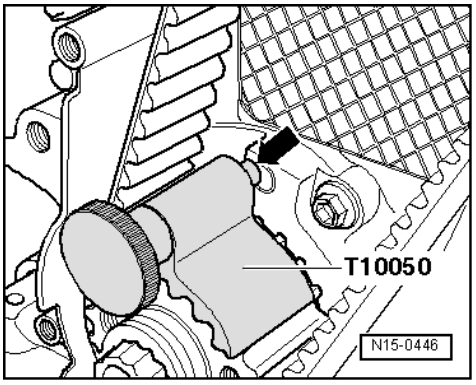
– Now turn crankshaft slowly in direction of engine rotation until camshaft hub can be secured in position.

– After locking, loosen securing nuts of camshaft pulley.

If pin of crankshaft stop -T10050- is positioned on left next to hole:

– Turn crankshaft in engine direction of rotation until crankshaft stop pin engages in sealing flange whilst turning.

– Tighten securing bolts of camshaft toothed belt pulley by hand first and then tighten to 20 Nm.



If pin of crankshaft stop -T10050- is positioned on right next to hole:

– Slightly turn crankshaft in opposite direction of engine rotation.

– Now turn crankshaft in engine direction of rotation until crankshaft stop pin engages in sealing flange whilst turning.

– Tighten securing bolts of camshaft toothed belt pulley by hand first and then tighten to 20 Nm.

Continuation

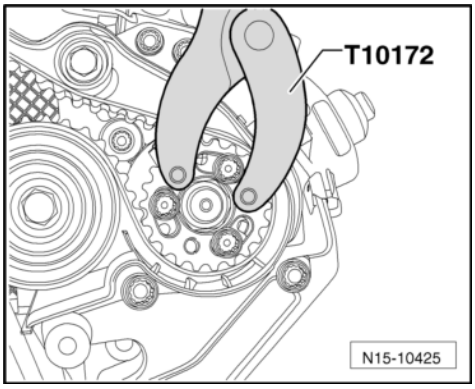
– Remove locking pin -3359- and crankshaft stop -T10050-.

– Turn crankshaft at least 2 rotations in engine direction of rotation and set again to TDC no. 1 cylinder.

– Repeat check.

– If camshaft hub can be secured in position, tighten securing bolts as follows:

- Camshaft sprocket: 45° further. Counterhold with counterhold tool -T10172- and adapters -T10172/4-.
- High pressure pump sprocket: 90° further. Counterhold with counterhold tool -T10172- and adapters -T10172/8-.



– Install centre and lower parts of toothed belt guard.
– Install belt pulley vibration damper: specified torque 10 Nm + turn 90° further.
– Install poly V-belt.
– Install upper toothed belt guard.

Further assembly is basically the reverse of the dismantling sequence. In the process, note the following:

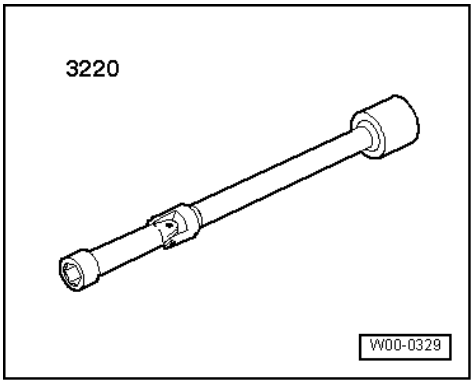
- Ensure that fuel hose connections are tight.
- Do not interchange supply and return lines.
- Adhere to specified torques and tightening sequence for engine bracket (if fitted).

1.6 Checking compression

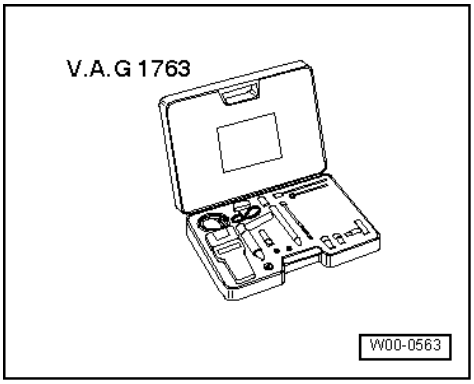
> ⚠ ***WARNING***
>
> ***Adhere to the general safety regulations and the notes on repair work on the engine!*** ⇒ **Page 1**

Special tools and workshop equipment required

- Jointed spanner -3220-



- Compression tester -V.A.G 1763- with adapter -V.A.G 1763/8-
- Torque wrench (5…50 Nm) -V.A.G 1331-



Test prerequisites

- All electrical consumers must be switched off.
- Engine oil temperature at least 30 °C.

Test procedure

– Remove glow plug from relevant cylinder using U/J extension and 10 mm socket -3220- ⇒ Page 535.
– Screw in adapter -V.A.G 1763/8- in place of glow plug.

– Check compression using compression tester -V.A.G 1763-.

Note

Using the compression tester ⇒ Operating manual.

– Turn over engine until tester shows no further pressure increase.

Compression pressures:

New: 25…31 bar

Wear limit: 19 bar

Maximum permissible difference between all cylinders: 5 bar

– Install glow plug using U/J extension and socket, 10 mm -3220- ⇒Page 535.

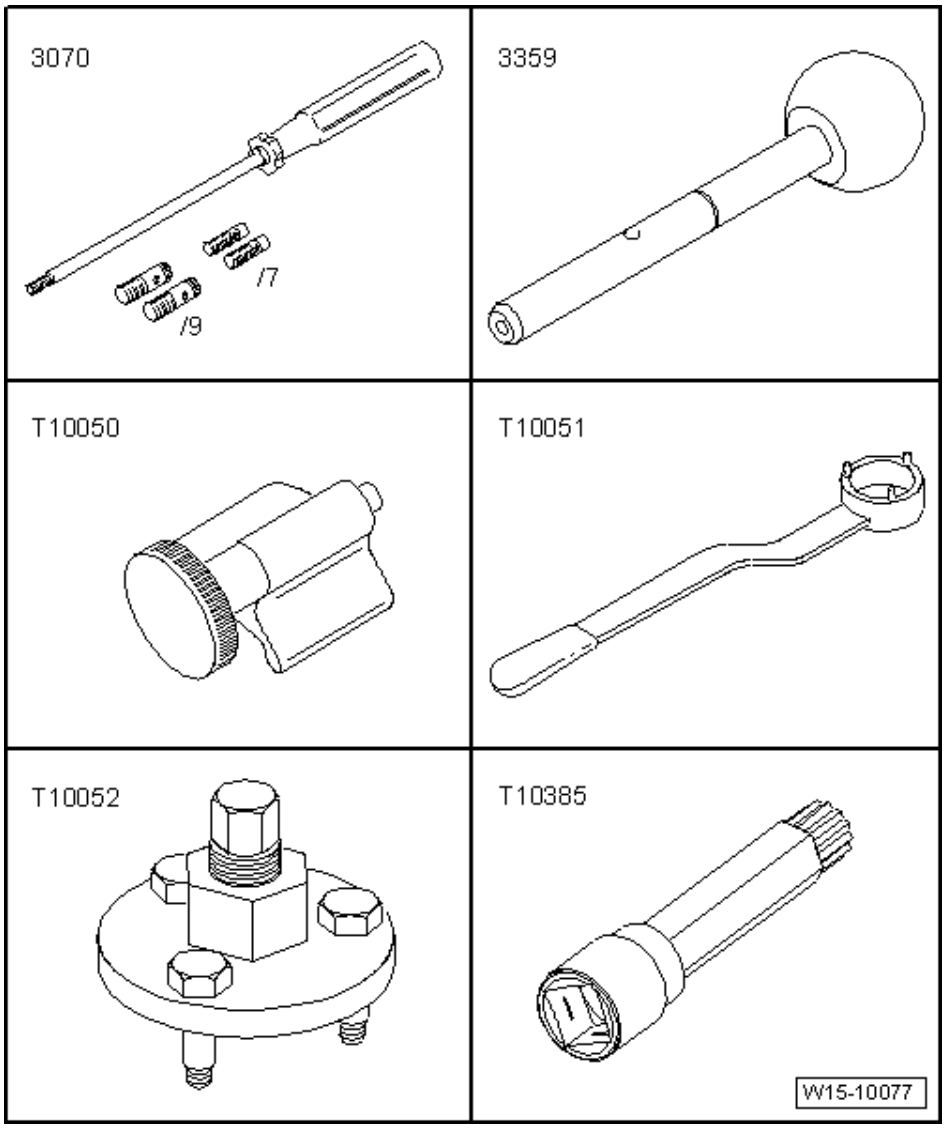
Note

Faults will have been stored because the connectors for injectors have been disconnected. Therefore, read event memory and clear if necessary.

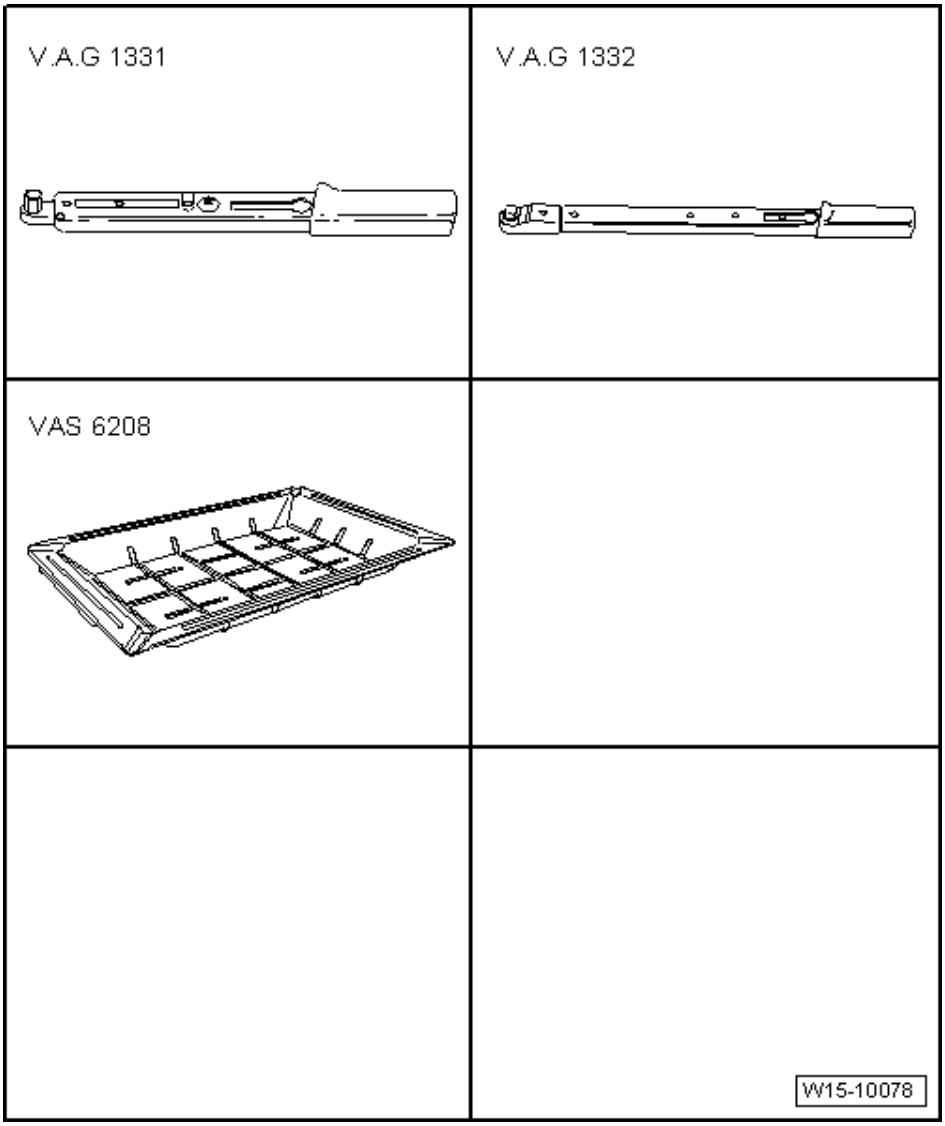
1.7 Removing and installing cylinder head

Special tools and workshop equipment required

- Guide pins -3070-
- Diesel injection pump locking pin -3359-
- Crankshaft stop -T10050-
- Counterhold -T10051-
- Puller -T10052-
- Bit XZN 10 -T10385-



- Torque wrench -V.A.G 1331-
- Torque wrench -V.A.G 1332-
- Drip tray for workshop hoist -VAS 6208-



Not illustrated:

- Container for removed parts -V.A.G 1698-
- Spring-type clip pliers -VAS 5024-
- Engine bung set -VAS 6122-
- Cable ties

Notes on removing ⇒Page 221.

Notes on installing ⇒Page 225.

1.7.1 Notes on removing

Note

The procedure described below provides only general instructions for removing and installing cylinder heads, since due to the various use cases it is not possible to specify a common procedure.

⚠ WARNING

When doing any repair work, pay attention to the following due to the cramped conditions:

- ***Route all the various lines (e.g. for fuel, hydraulics, activated charcoal filter system, coolant, refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.***
- ***Ensure that there is sufficient clearance to all moving or hot components.***

Note

- *All cable ties which are opened or cut open when engine is removed must be replaced in the same position when engine is installed.*
- *To prevent damage to removed components, place them in the container for removed parts -V.A.G 1698-.*

– Drain coolant ⇒Page 284.

– Remove cylinder head cover ⇒Page 354.

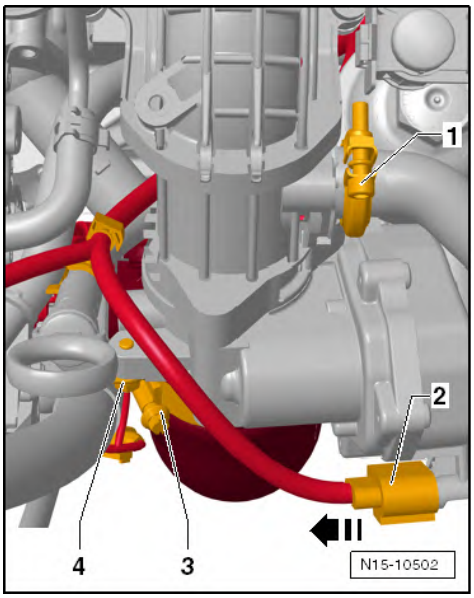
– Take toothed belt off camshaft ⇒Page 210, Removing and installing toothed belt.

– Pull connector -2- off throttle valve module -J338-.

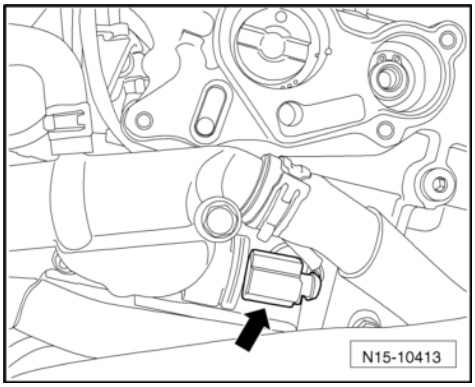
– Wires or coolant, fuel and air lines may impair the repair work. Remove these wires in lines. It may be sufficient to loosen the fasteners and to lay the lines aside.

– Unscrew securing bolts of charge air pipe, and pull connecting hose off turbocharger.

– Remove vacuum pump from cylinder head ⇒Page 190.



– Disconnect connector -arrow- from coolant temperature sender -G62- and guide line out.



Caution

Ensure that decoupling element of connecting pipe is not bent and thus stretched. There is a danger of cracking.

– Remove connecting pipes for exhaust gas recirculation system.

– Loosen securing nuts of bracket for diesel particulate filter at crankcase.

– Remove diesel particulate filter ⇒Page 427.

Engine codes CJDA, CJDD

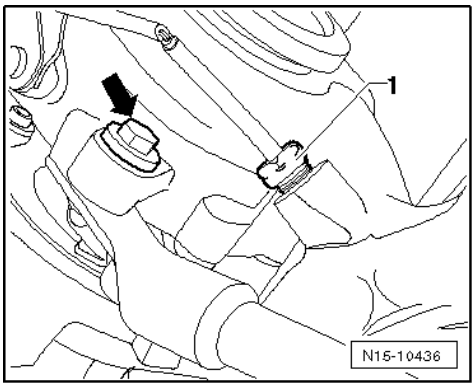
Caution

The exhaust gas temperature sender 1 -G235- covers the upper threaded connection of the turbocharger support and must not be bent. It must therefore be removed.

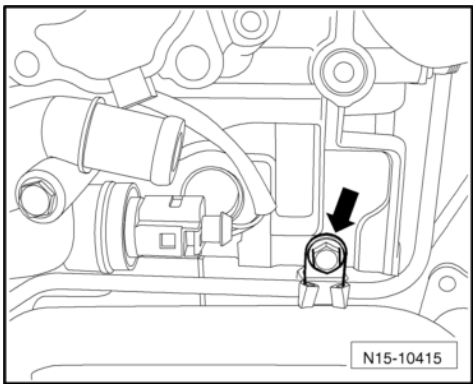
– Remove exhaust gas temperature sender 1 -G235- -1- ⇒Page 432.

– Unscrew bolt -arrow- from support on turbocharger.

– Pull coolant hoses off coolant connection of cylinder head.



– Unscrew bolt of oil supply line -arrow- and remove oil supply line.

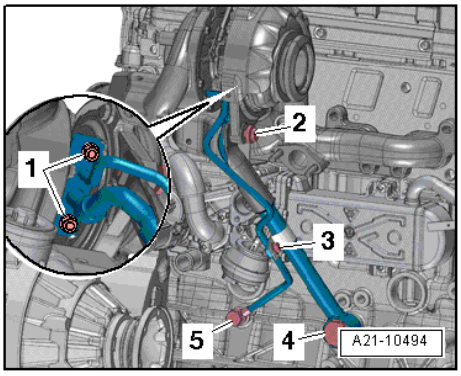


Engine codes CPYA, CPYB, CPXC, CPYD, CPYE

Caution

Exhaust gas temperature sender 1 -G235- must not be bent.

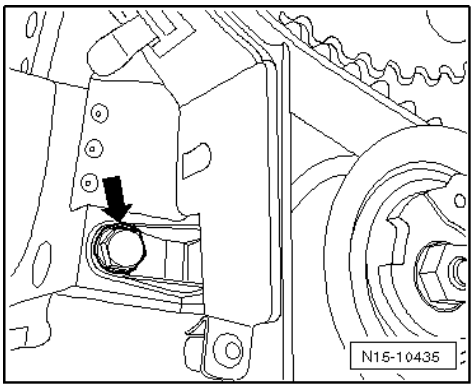
– Unscrew bolts of oil supply line -1-, -3- and -5-, and remove oil supply line.



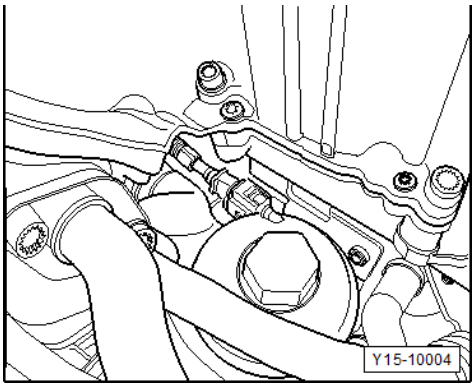
Continuation for all engine codes

– Remove camshaft pulley, and pull off camshaft hub using puller -T10052-.

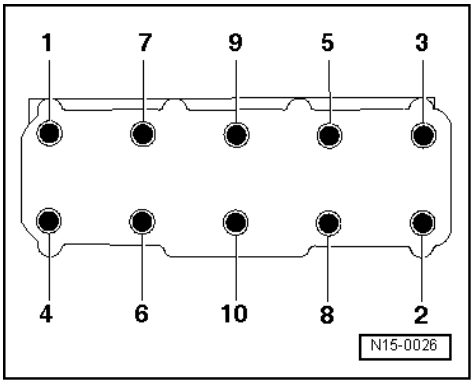
– Unscrew securing bolt -arrow- for toothed belt guard.
– Unscrew securing nut of toothed belt tensioning roller.



– Disconnect connector for Hall sender -G40- -centre-.



– Maintain sequence when loosening cylinder head bolts.



Note

- *A second mechanic is required for the removal of the cylinder head.*
- *The toothed belt tensioning roller is pulled off the stud when the cylinder head is lifted out.*
- *The oil return line of the turbocharger is pulled out of the support when the cylinder head is lifted out.*
- *The cylinder head must be guided carefully to prevent damage.*

– Guide cylinder head out of toothed belt guard. Prevent toothed belt tensioning roller from falling down.
– Place cylinder head down taking care not to bend oil return line. If necessary, place a piece of wood under exhaust manifold.

1.7.2 Notes on installing

Note

- *Always renew cylinder head bolts.*
- *In case of repair, carefully remove gasket remains from cylinder head and cylinder block. Ensure that no long scores or scratches are made on the surfaces. When using abrasive paper do not use a grade less than 100.*
- *Carefully remove emery and abrasive remains.*
- *Do not remove new cylinder head gasket from packaging until it is ready to be fitted.*
- *Handle gasket very carefully. Damage to the silicone coating or the indented area will lead to leaks.*

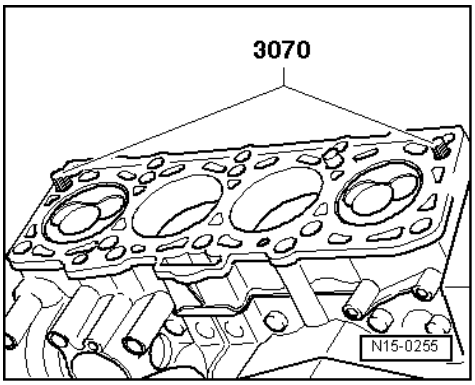
– Before fitting cylinder head, remove crankshaft stop -T10050-, and turn crankshaft in opposite direction of engine rotation until all pistons are nearly uniformly below TDC.

– Cylinder head gasket must lie with identification facing upwards.

Note

Note identification on cylinder head gasket ⇒Fig. on page 191.

– To centre, screw guide pins -3070- into outer threaded holes on intake side.



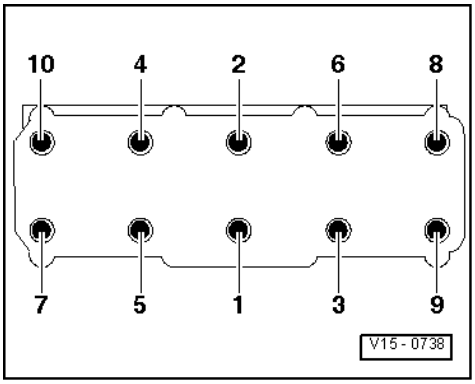
Note

Tensioning roller must be pushed onto studs when fitting cylinder head.

– Fit cylinder head, install 8 cylinder head bolts and hand-tighten.

– Remove guide pins through bolt holes using removal tool from 3070 and install cylinder head bolts.

– Tighten cylinder head in 4 stages in sequence shown as follows:



1 - Tighten initially with torque wrench:

Stage I = 30 Nm

Stage II = 50 Nm

2 - Turn further with rigid spanner:

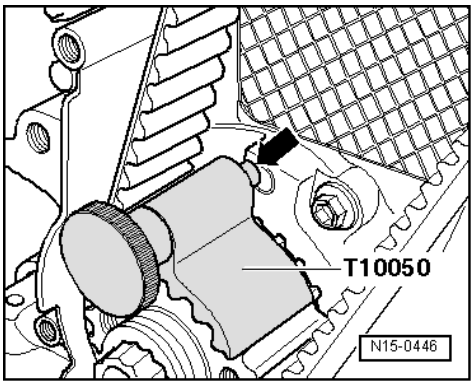
Stage III = 90°

Stage IV = 90°

Note

After repair work it is not necessary to retighten the cylinder head bolts.

– Secure toothed belt rear guard to cylinder head.
– Install hub and camshaft pulley.
– Lock camshaft and high-pressure pump with diesel injection pump locking pin -3359-
– Now rotate crankshaft in direction of rotation to TDC and lock crankshaft using crankshaft stop -T10050-.
– Fit toothed belt ⇒Page 210.



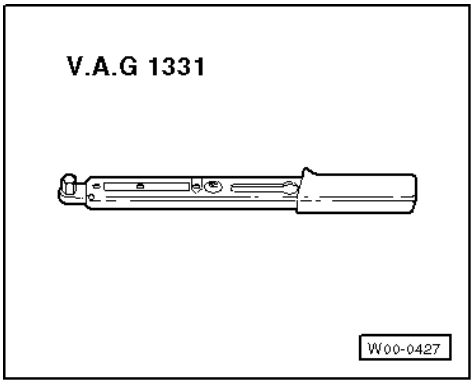
Further installation is carried out in the reverse order. In the process, note the following:

– Install cylinder head cover ⇒Page 189.
– Install poly V-belt ⇒Page 138.
– Replenish coolant ⇒Page 284.
– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

1.8 Removing and installing vacuum pump

Special tools and workshop equipment required

◆ Torque wrench -V.A.G 1331/-

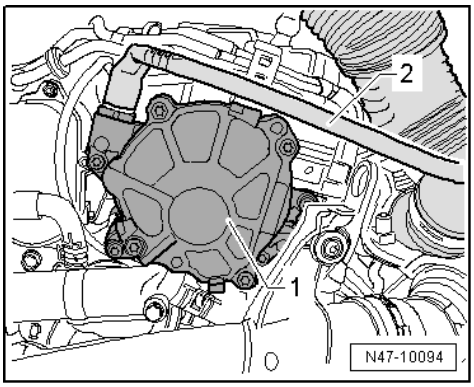


DANGER!

The vacuum pump may, under no circumstances, be dismantled as the vacuum part could otherwise malfunction. As a consequence, the connected components which are potentially safety-critical may fail.

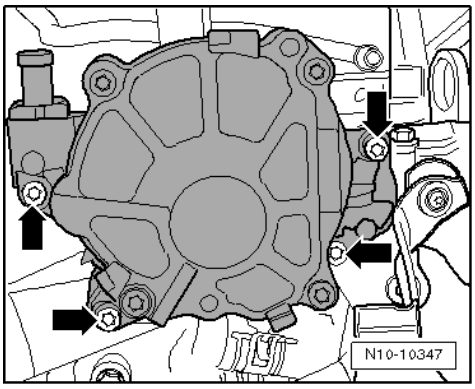
Removing

– Pull vacuum line -2- off vacuum pump -1-.
– Wires or coolant, fuel, vacuum or charge air lines may impair the repair work. Remove these wires in lines. It may be sufficient to loosen the fasteners and to lay the lines aside.



– Remove securing bolts -arrows-.

– Remove vacuum pump from cylinder head.



Installing

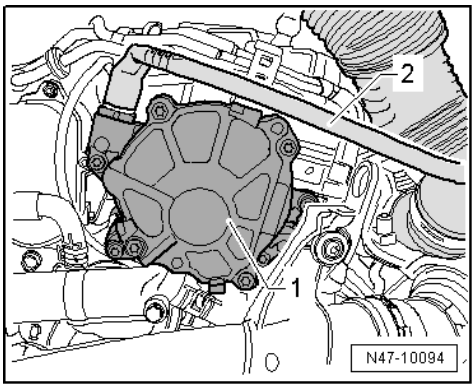
Installation is carried out in the reverse order. When installing, note the following:

Note

- *Ensure that vacuum pump coupling seats properly in camshaft.*
- *The seal must be renewed.*

– Install vacuum pump and tighten securing bolts to 10 Nm.

– Connect vacuum line -2- to vacuum pump.



2 Repairing valve gear

Note

- *The repair work described in this chapter must be carried out in a Volkswagen dealership only. Go to a Volkswagen dealership.*
- *If these instructions are not adhered to and damage results, Volkswagen is exempt from any liability and warranty claims.*

> ***WARNING***
>
> ***Adhere to the general safety regulations and the notes on repair work on the engine! ⇒Page 1***

Note

Cylinder heads with cracks between the valve seats may be used without reducing engine life, provided the cracks are small and not more than 0.5 mm wide.

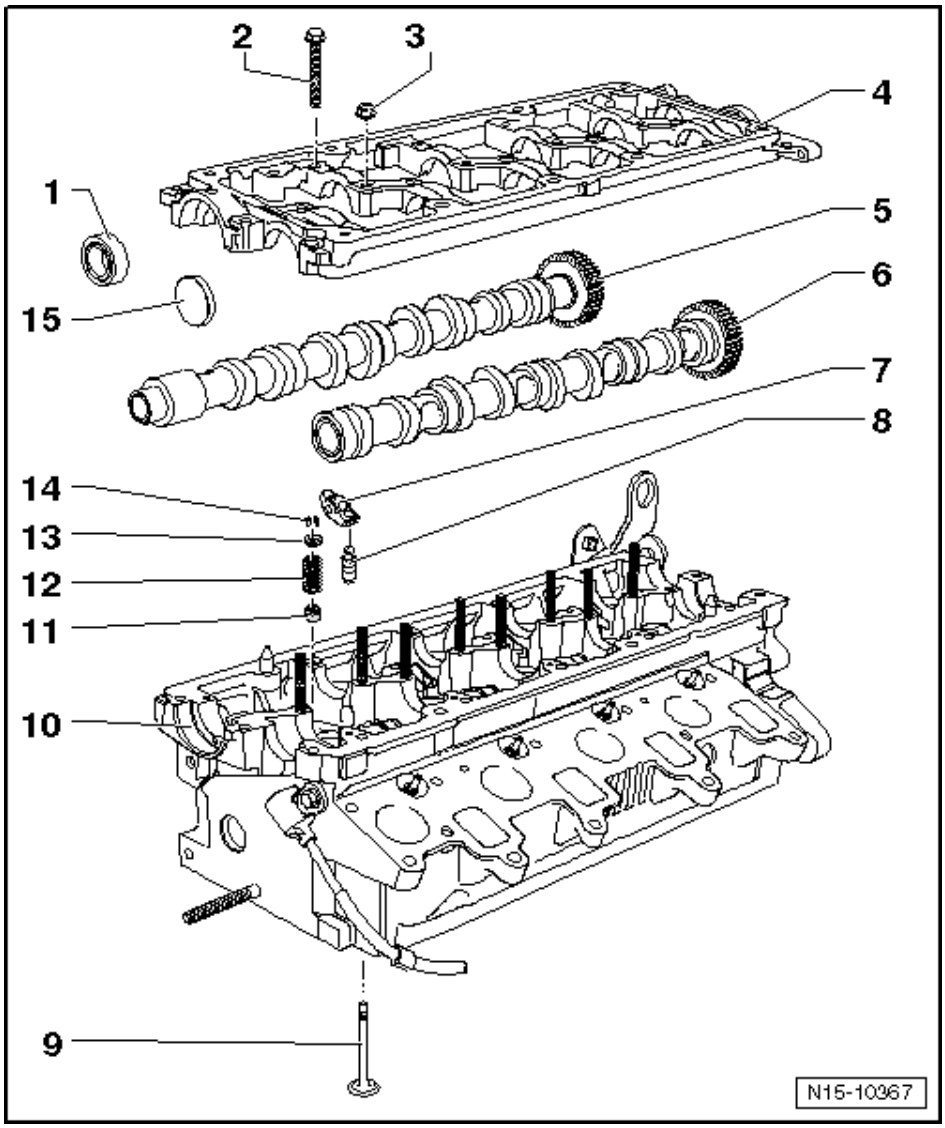
Assembly overview - valve gear ⇒Page 228.

Valves ⇒Page 229

Removing and installing camshaft ⇒Page 233.

Removing and installing camshaft seal ⇒Page 239.

2.1 Assembly overview - valve gear



1 - Seal
- ❑ Do not additionally oil or grease the oil seal sealing lip.
- ❑ Before installing, remove residual oil from camshaft journal using a clean cloth.
- ❑ To install, mask off groove on camshaft taper (e.g. using Sellotape)
- ❑ Removing and installing ⇒Page 239

2 - 10 Nm

3 - 10 Nm

4 - Retaining frame
- ❑ Observe sequence when loosening and tightening ⇒Page 233.
- ❑ Seal using silicone adhesive sealant D 176 501 A1.

5 - Exhaust camshaft

6 - Inlet camshaft

7 - Roller rocker finger
- ❑ Mark installation position.
- ❑ Do not interchange.
- ❑ Check roller bearing for ease of movement.
- ❑ Oil contact surface.

8 - Hydraulic compensation element
- ❑ Mark installation position.
- ❑ Lubricate contact surfaces before installing.

9 - Valve
- ❑ Do not rework. Only lapping in is permitted.
- ❑ Mark installation position for re-installation.
- ❑ Valve dimensions ⇒Page 229
- ❑ Checking valve guides ⇒Page 229.

10 - Cylinder head
- ❑ See note
- ❑ Removing and installing.

11 - Valve stem seal

12 - Valve spring

13 - Valve spring plate

14 - Valve cotter

15 - Cap

❑ Renew

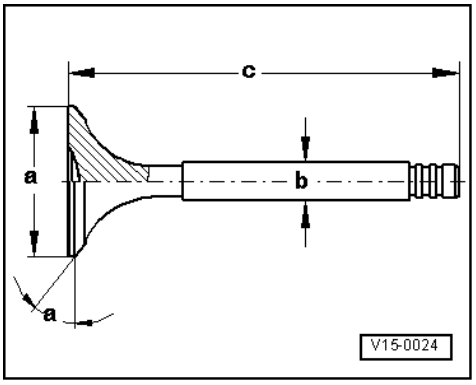
2.2 Valves

2.2.1 Valve dimensions

Note

◆ *Valves must not be reworked. Only lapping-in is permitted.*

Dimension		Inlet valve	Exhaust valve
Diameter a	mm	26.60	26.00
Diameter b	mm	5.940	5.940
c	mm	99.30	99.10
α	∠°	45	45

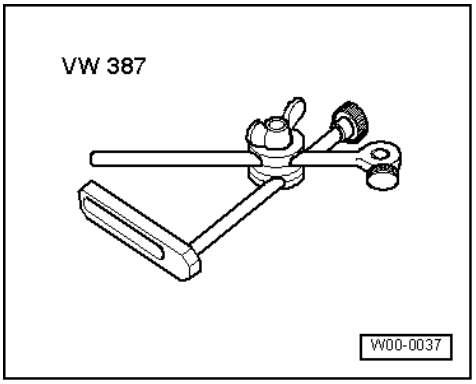


2.2.2 Checking valve guides

Special tools and workshop equipment required

◆ Universal dial gauge bracket -VW 387-

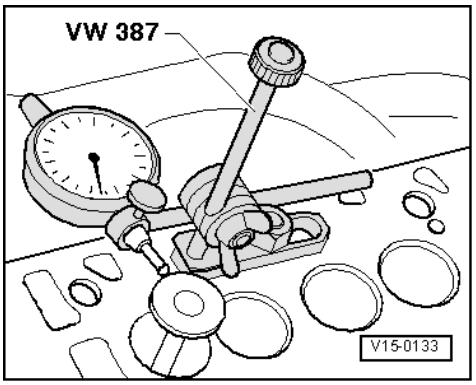
◆ Dial gauge



– Insert new valve into guide. The end of the valve stem must be flush with the guide. On account of differing stem diameters, only use inlet valve in inlet guide and exhaust valve in exhaust guide.

– Determine rock. Wear limit: max. 1.3 mm

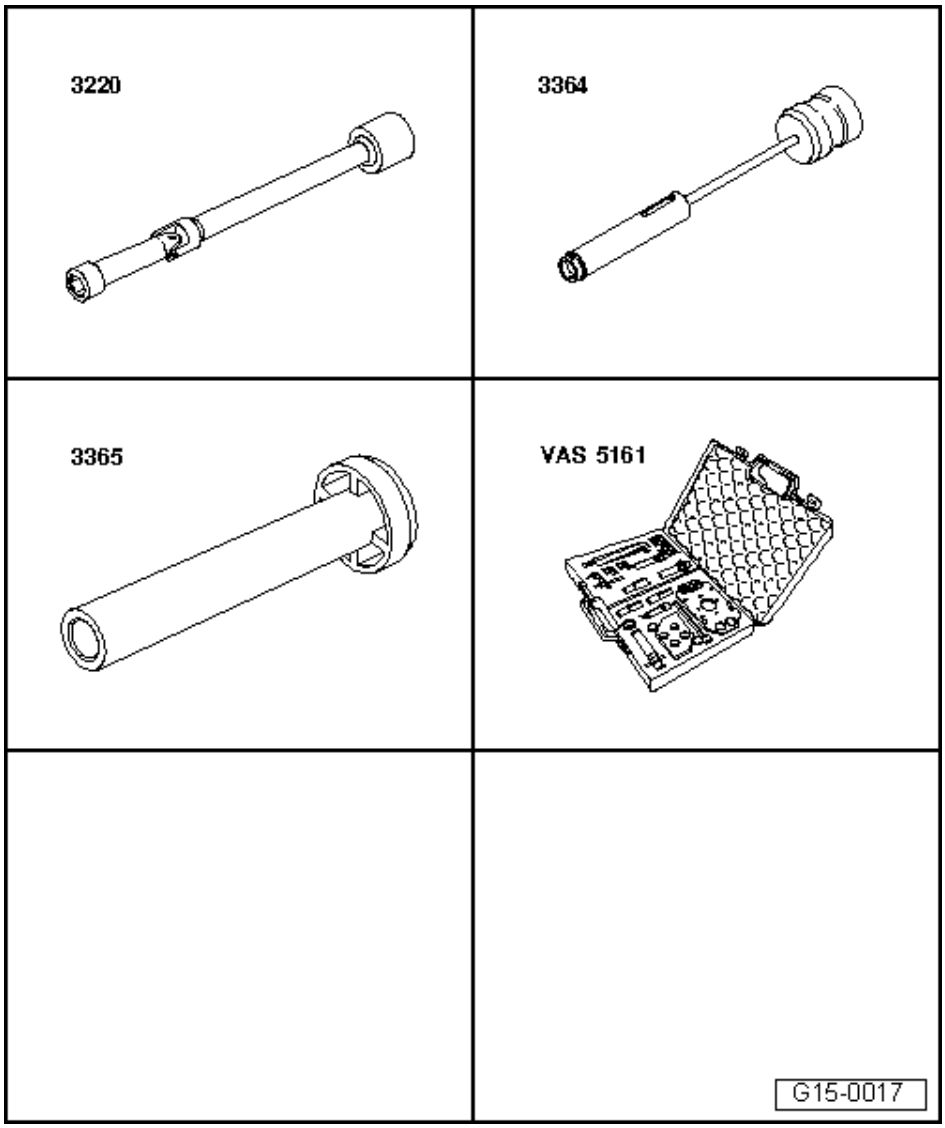
– Cylinder head must be renewed if rock exceeds wear limit.



2.3 Renewing valve stem seals

Special tools and workshop equipment required

- 10 mm jointed spanner -3220-
- Valve stem seal puller -3364-
- Valve stem seal fitting tool -3365-
- Removal and installation device for valve cotters -VAS 5161- with guide plate -VAS 5161/23- and knurled spacer ring -VAS 5161/23-1-



Procedure

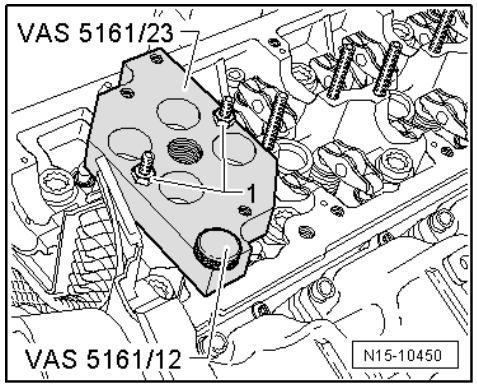
– Remove all glow plugs using U/J extension and socket -3220- ⇒Page 536.

– Remove camshafts ⇒Page 233.

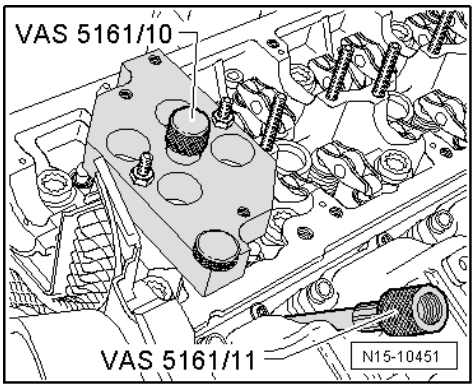
– Fit guide plate -VAS 5161/23- onto cylinder head.

– Secure guide plate on intake manifold side with knurled screw -VAS 5161/12- and tighten it hand-tight to studs using M6 collarless nuts -1-.

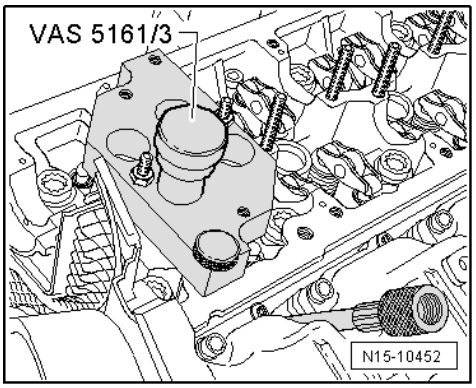
– Screw sealing pin -VAS 5161/10- into guide plate.



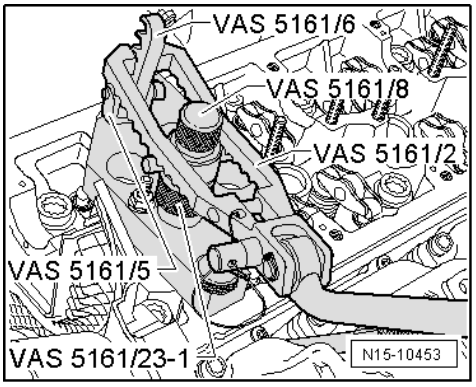
– Screw adapter -VAS 5161/11- hand-tight into glow plug hole of relevant cylinder.



– Insert drift -VAS 5161/3- into guide plate and knock valve cotters loose using a plastic hammer.



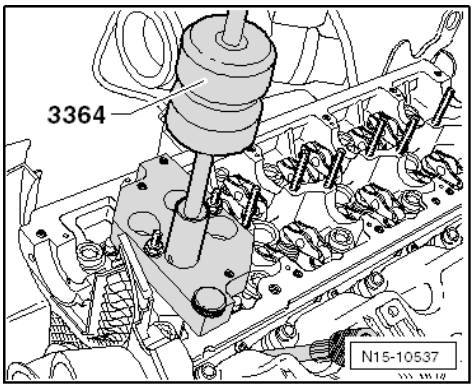
– Screw engaging fork -VAS 5161/5- with snap-in device -VAS 5161/6- into guide plate.
– Slide knurled spacer ring -VAS 5161/23-1- onto assembly cartridge -VAS 5161/8-.
– Connect adapter -VAS 5161/11- to compressed air line using a commercially available connection piece, and apply constant air pressure.



- Minimum pressure: 6 bar

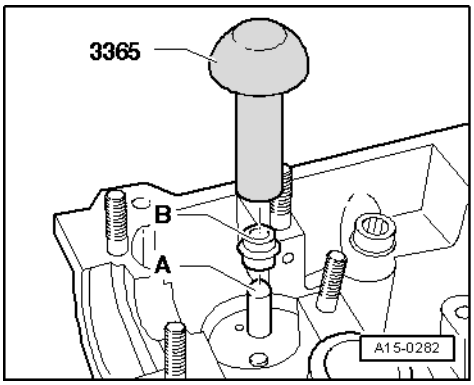
– Attach pressure fork -VAS 5161/2- to snap-in device and push assembly cartridge down.
– At the same time, turn knurled screw of assembly cartridge clockwise until tips engage in valve cotters.
– Move knurled screw back and forth lightly to press apart valve cotters and capture them in the assembly piece.
– Release pressure fork.
– Take out assembly cartridge with knurled spacer ring, valve plate and valve spring.

– Remove valve stem oil seals using valve stem seal puller -3364-.



Note

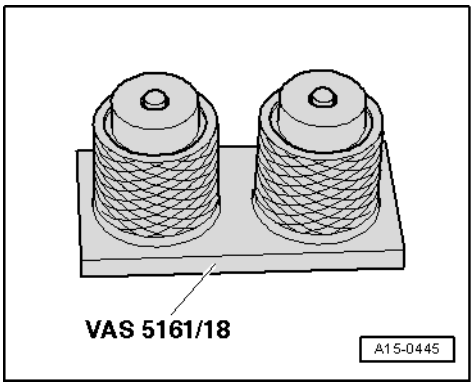
◆ *A plastic sleeve -A- is included with the new valve stem oil seals.*



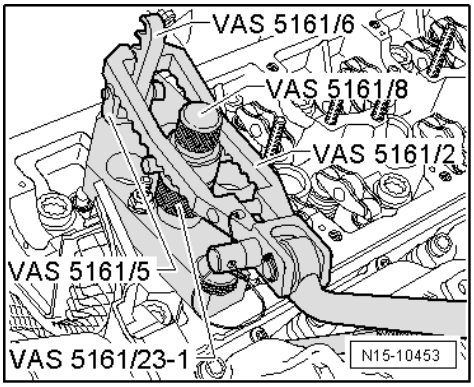
– Fit plastic sleeve -A- onto valve stem to prevent damage to new valve stem oil seal -B-.
– Lightly lubricate sealing lip of valve stem oil seal.
– Slip valve stem oil seal over plastic sleeve.
– Carefully press valve stem oil seal onto valve guide using valve stem seal fitting tool -3365-.
– If necessary, use a plastic head hammer and tap lightly on fitting tool until valve stem oil seal is fitted to stop.
– Remove plastic sleeve.
– Insert valve spring and valve spring plate into cylinder head.
– If valve cotters have been removed from assembly cartridge, they need to be put into insertion device -VAS 5161/18- first.

Note

Larger diameter of valve cotters faces upwards.



– Press assembly cartridge onto insertion device from above and pick up valve cotters.



– Re-insert assembly cartridge -VAS 5161/8- into guide plate.
– Push pressure fork down, and pull knurled screw upwards while turning to left and right - this will insert the valve cotters.
– Release pressure fork with knurled screw still in pulled position.

Installation is carried out in the reverse order; note the following:

– Install glow plugs.
– Install camshafts ⇒ Page 233.

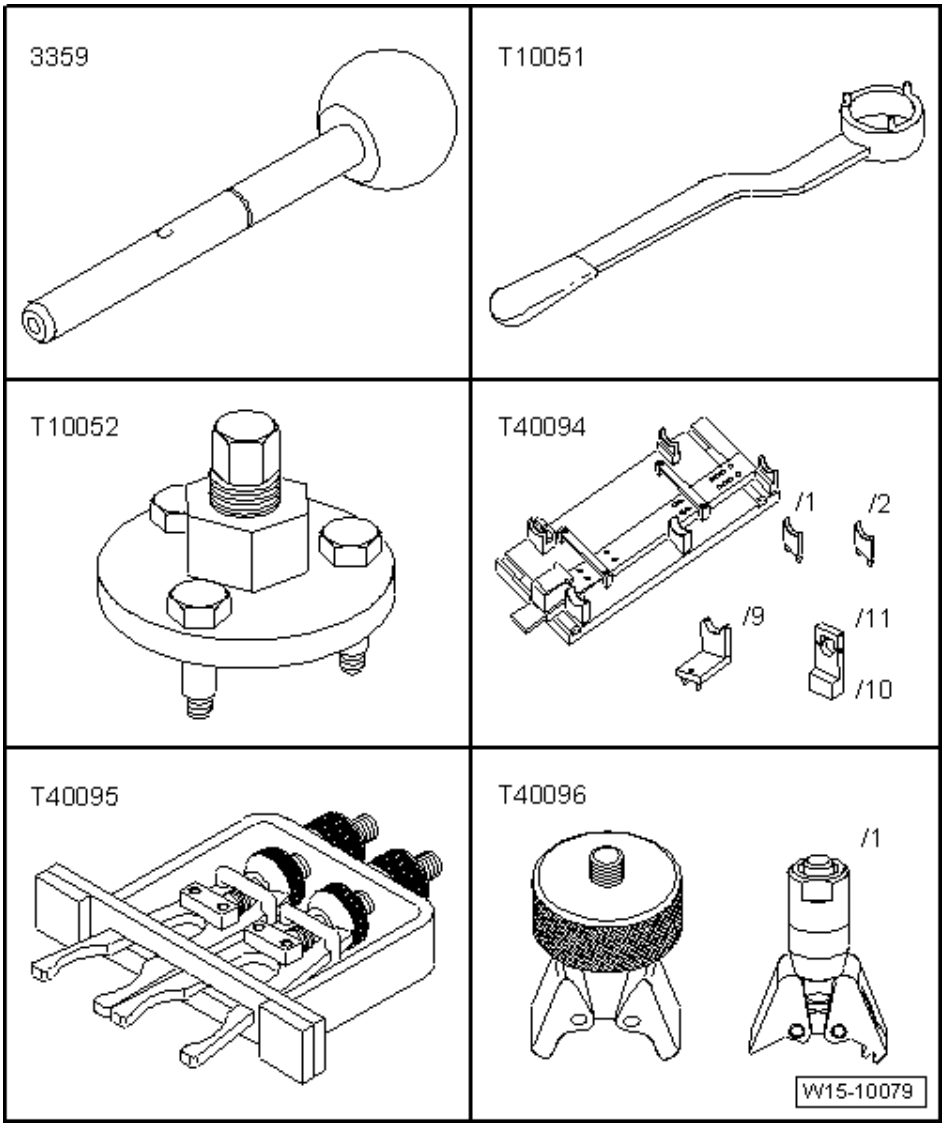
Note

- *Engine is not to be rotated for approx. 30 minutes after installing camshafts. The hydraulic compensation elements must settle (otherwise valves will strike pistons).*
- *After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.*

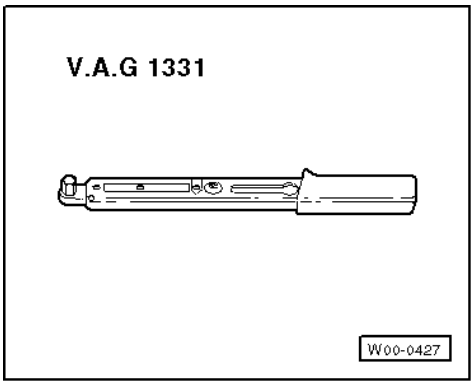
2.4 Removing and installing camshaft

Special tools and workshop equipment required

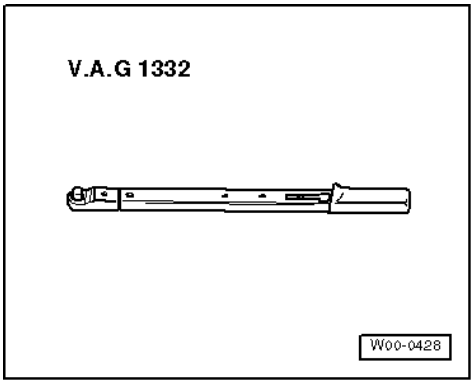
- Diesel injection pump locking pin -3359-
- Counterhold -T10051-
- Puller -T10052-
- Camshaft fitting tool -T40094-
- Camshaft clamping tool -T40095-
- Camshaft fitting tool -T40096-



- Torque wrench -V.A.G 1331/-



- Torque wrench -V.A.G 1332/-
- Silicone adhesive sealant D 176501 A1

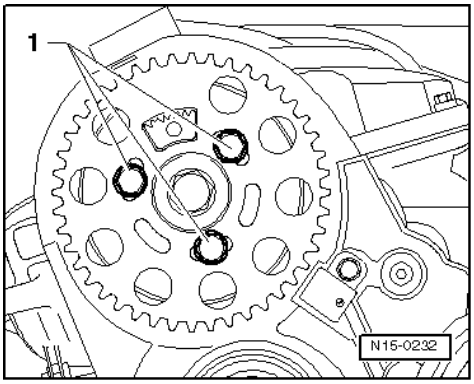


Removing ⇒Page 234.

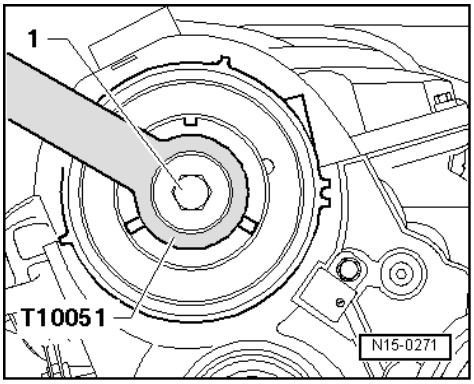
Installing ⇒Page 235.

2.4.1 Removing

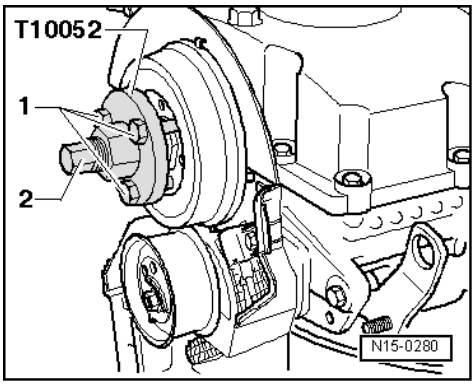
– Remove toothed belt from camshaft and high-pressure pump; Removing, installing and tensioning toothed belt.
– Remove cylinder head cover.
– Remove securing bolts for camshaft toothed belt pulley -1-.
– Detach camshaft pulley from hub.



– Counterhold hub with counterhold -T10051- and loosen securing bolt -1- of hub.
– Loosen hub securing bolt about 2 turns.



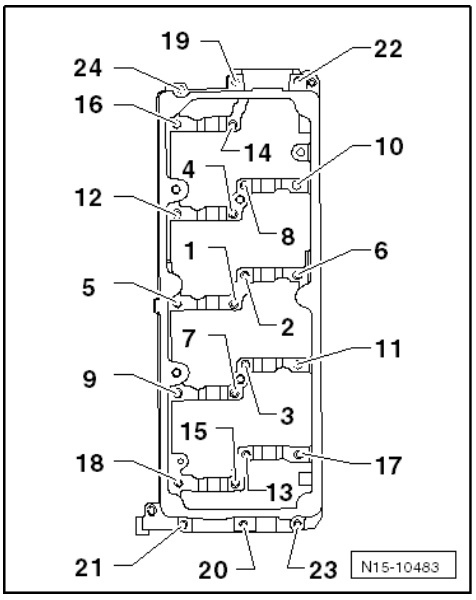
– Fit puller -T10052- and align it with holes in hub.
– Tighten securing bolts -1-.
– Apply tension to hub by evenly tightening puller -2- until hub separates from taper of camshaft.



Note

When doing this, hold puller with 30 mm spanner.

– Remove hub from taper of camshaft.
– Remove vacuum pump.
– Remove securing bolts of retaining frame in sequence -24…1-.
– Remove retaining frame.
– Carefully take out camshafts.



2.4.2 Installing

Note

Seal parting surface between retaining frame and cylinder head using silicone adhesive sealant D 176 501 A1.

Caution

The camshafts may only be installed with the camshaft fitting tool -T40094- as described below. The axial bearings in the bearing frame will otherwise be damaged beyond repair and the cylinder head will have to be renewed.

– Remove sealant residue from cylinder block and retaining frame using, for example, a plastic rotary brush.

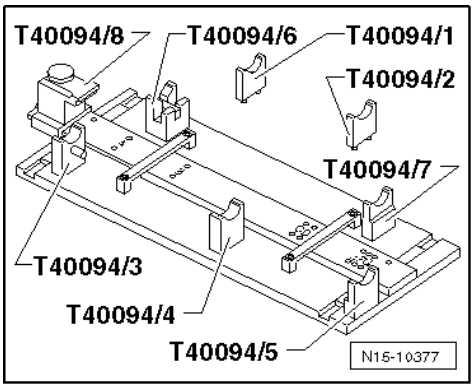
Caution

Make sure that no sealant residue gets into the cylinder head or the bearings.

– Clean sealing surfaces; they must be free of oil and grease.
– Oil the camshaft running surfaces.

Set up camshaft fitting tool -T40094- as follows:

– Remove supports -T40094/3-, -T40094/4- and -T40094/5- from base plate. Threaded connection from below.



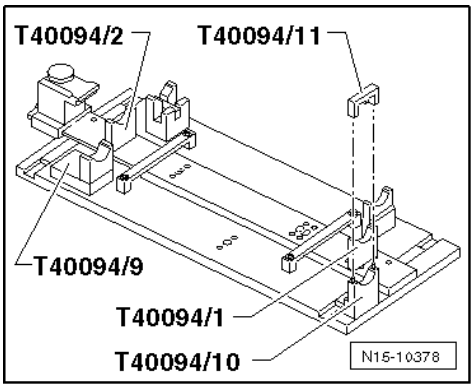
Note

If the supports of the camshaft fitting tool -T40094- are not marked at present, mark the removed supports, e.g. with number stamps, so they can be fitted in the original positions later.

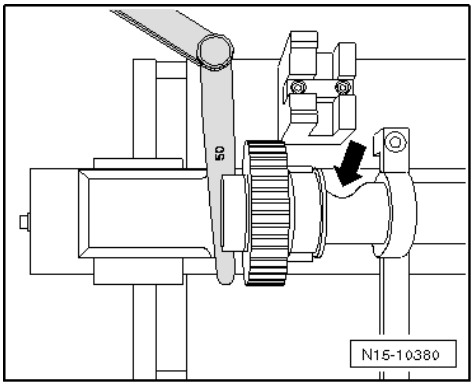
– Install supports -T40094/9- and -T40094/10- instead at vacant outer places.

– Place support -T40094/2- at position labelled “A” and support -T40094/1- at position labelled “F”.

– First position inlet camshaft as illustrated. Ensure that indentation -arrow- for cylinder head bolt faces “outwards”.



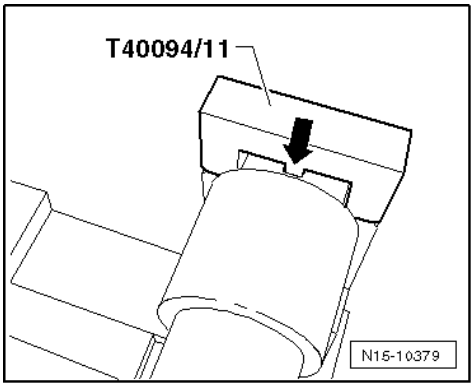
– Set 0.50 mm feeler gauge in place and push support -T40094/8- into groove on inlet camshaft.



– Now set exhaust camshaft in place and lock by inserting -cover T40094/11- into groove -arrow-.

Engine codes CJDA, up to 02.10

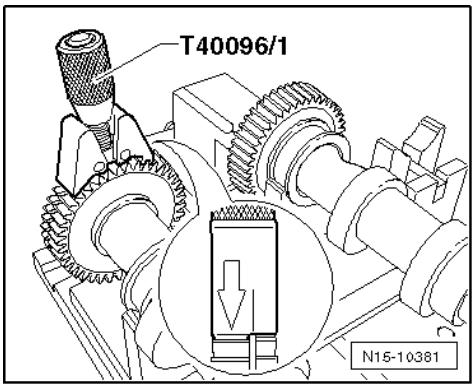
– If necessary, fit clamping tool -T40096/1- onto exhaust camshaft gears.



Caution

Ensure that the clamping jaw marked with an arrow is seated on the wider gear.

– Tighten clamping tool -T40096/1- using knurled thumb wheel so that faces of gear teeth are in alignment. If necessary, use 13 mm open-end spanner.
– Slide exhaust camshaft towards inlet camshaft until gear teeth engage.

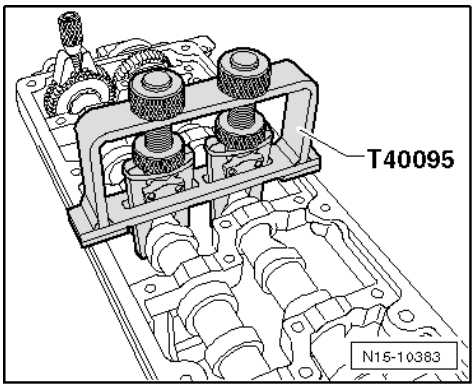


All engine codes

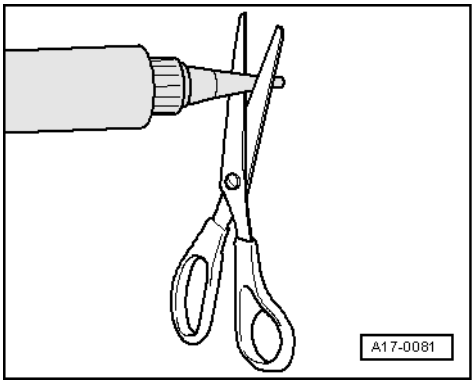
– Fit retaining frame onto camshafts.

- All camshaft bearings must be seated on the camshafts.

– Set clamping tool -T40095- in place as illustrated in order to hold camshafts in position in retaining frame.
– Remove cover -T40094/11-.
– Pull support -T40094/8- out of inlet camshaft groove.



– Cut off nozzle on tube at front marking (diameter of nozzle approx. 2 mm).
– Apply beads of sealant (approx. 2…3 mm wide) -arrows- onto clean sealing surfaces of cylinder head as illustrated.

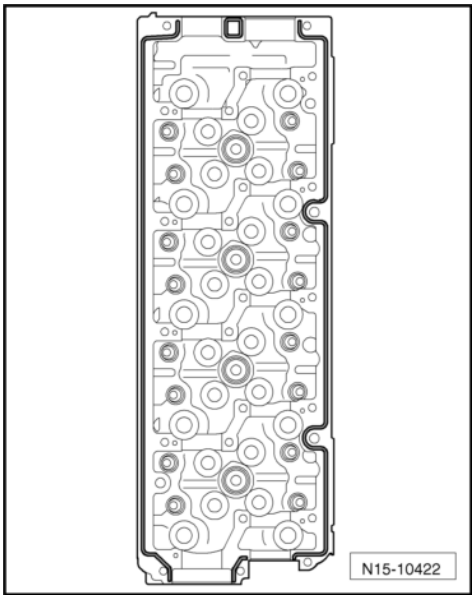


Note

- *The sealant beads must not be thicker than specified, otherwise excess sealant could enter the camshaft bearings.*

– Take camshafts out of camshaft fitting tool -T40095- together with retaining frame and clamping tool -T40094-.

– Carefully position camshafts and retaining frame in cylinder head.



– First screw on securing bolts of retaining frame hand-tight in sequence -1…24-.

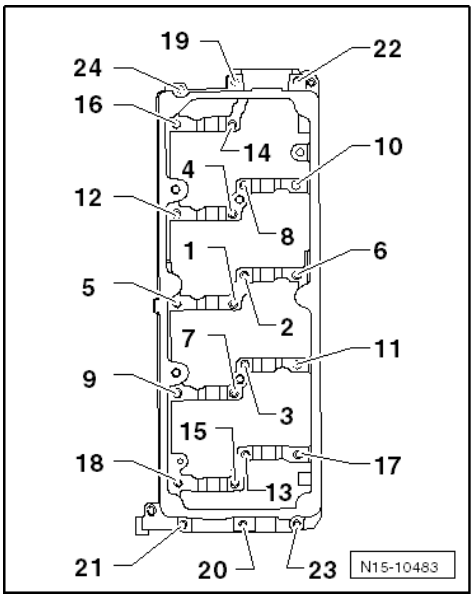
- The retaining frame should make contact with the cylinder head over the complete surface.

– Tighten retaining frame bolts to final torque in the sequence -1 … 24-. Specified torque: 10 Nm

– Remove clamping tool -T40095- and camshaft fitting tool -T40096/1-.

– Renew camshaft oil seal ⇒Page 239.

– Using a suitable drift, knock new sealing cap (core plug) ⇒Item 15 on page 229 in cylinder head until flush.



Perform further installation in reverse order, paying attention to the following:

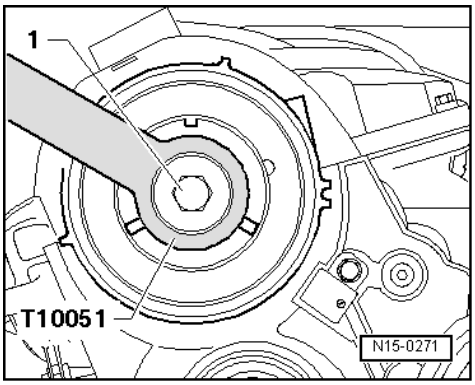
Note

- *After installing camshafts wait for approx. 30 minutes before starting engine. The hydraulic compensation elements must settle (otherwise valves will strike pistons).*
- *After working on valve gear, carefully crank engine at least 2 revolutions by hand to ensure that no valves make contact on starting.*

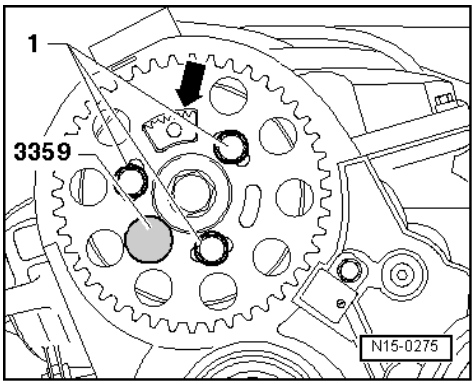
– Fit hub onto camshaft.

– Tighten hub securing bolt -1- to 100 Nm. Use counterhold tool -T10051- for this.

–



– Push camshaft toothed belt pulley onto hub.



Note

The toothed segment -arrow- of the camshaft belt pulley must be on top.

– Hand tighten securing bolts -1- to camshaft toothed belt pulley so that there is no play.

– Lock hub in position using locking pin -3359-.

– Install toothed belt and adjust timing.

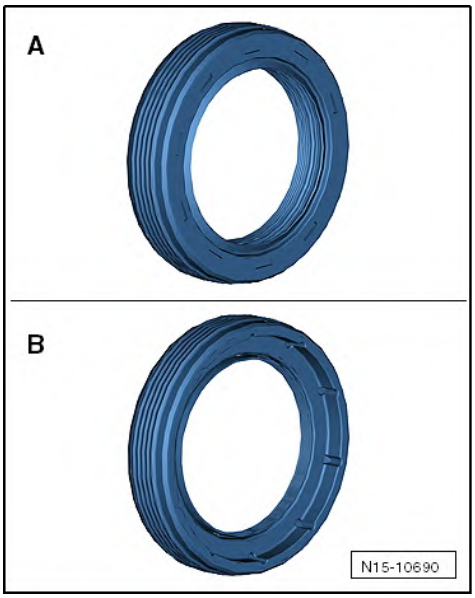
– Install vacuum pump.

– Install cylinder head cover.

2.5 Removing and installing camshaft oil seal

Note

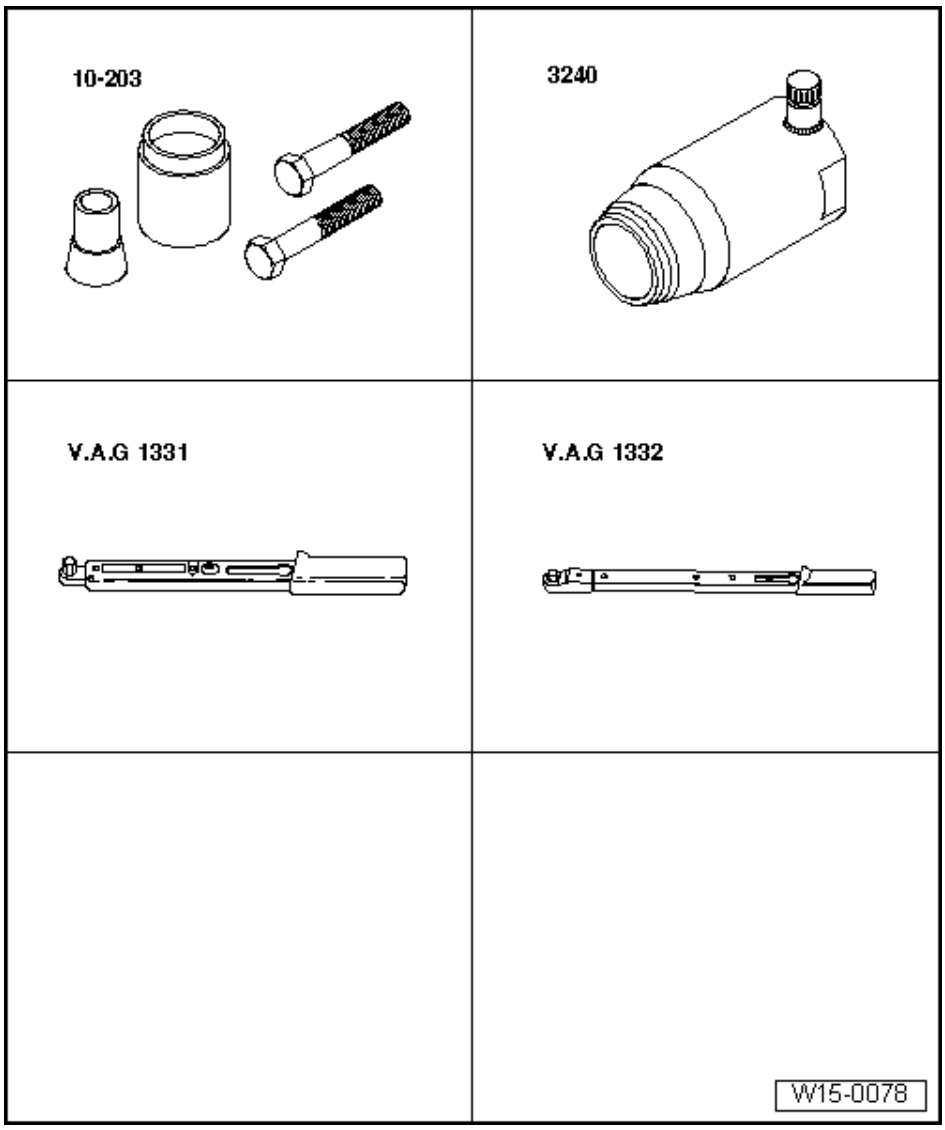
◆ *As of 09.2009, a new gasket -B- will be used, which visually has no closed surface between camshaft and cylinder head but has a fillet instead. Here a different procedure must be used* ⇒ Page 242.



2.5.1 Engines up to 08.09

Special tools and workshop equipment required

- Fitting tool -10-203-
- Oil seal extractor -3240-
- Torque wrench (5…50 Nm) -V.A.G 1331-
- Torque wrench (40… 200 Nm) -V.A.G 1332-
- Bolt M12×1.5×65



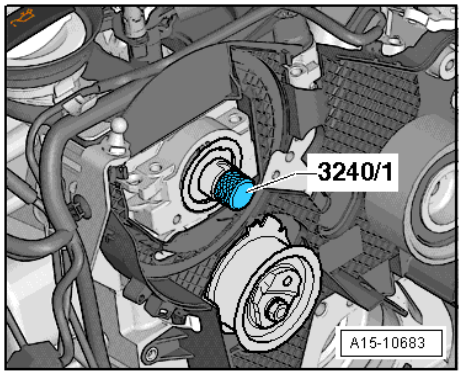
Removing

– Remove toothed belt from camshaft and high-pressure pump; Removing, installing and tensioning toothed belt.

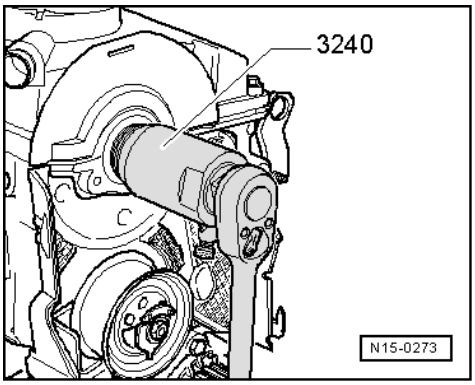
– Remove camshaft toothed belt pulley and hub ⇒Page 233, Removing and installing camshaft.

– Insert thrust piece -3240/1- into camshaft.

– Unscrew inner part of oil seal extractor -3240- 2 turns (approx. 3 mm) from outer part, and lock it in place using knurled screw.



– Lubricate threaded head of oil seal extractor, place it in position and, exerting firm pressure, screw it into oil seal as far as possible.
– Loosen knurled screw and turn inner part against camshaft until oil seal is pulled out.

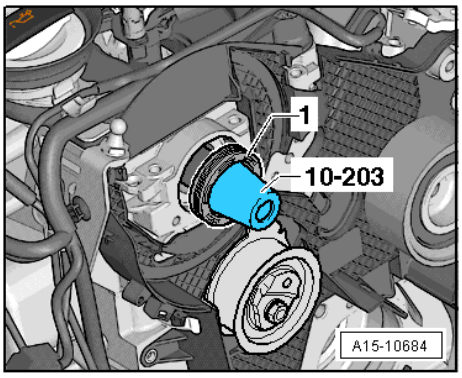


Installing

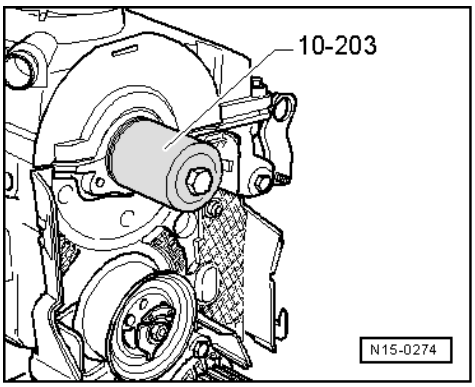
Note

The oil seal sealing lip must not be additionally oiled or greased.

– Remove oil residue from camshaft journal using a clean cloth.
– Tape over groove in taper of camshaft (e.g. with Sellotape).
– Fit guide sleeve of fitting tool -10 - 203- onto camshaft as shown in illustration.
– Carefully slide oil seal -1- over guide sleeve onto camshaft.



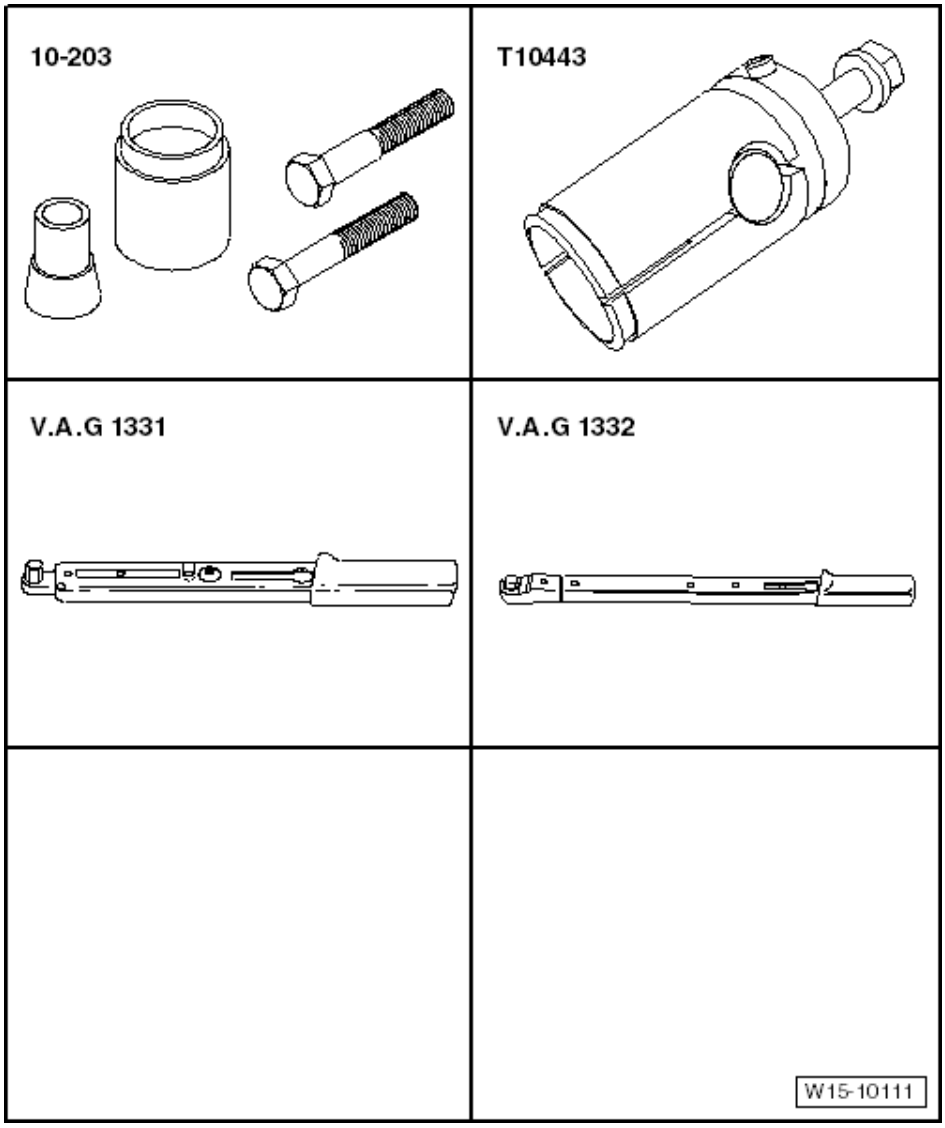
– Press seal in to stop using thrust piece from fitting tool 10-203 and bolt M12×1.5x75.
– Install camshaft pulley and hub ⇒Page 233, Removing and installing camshaft.
– Install toothed belt, and adjust valve timing, Removing, installing and tensioning toothed belt.



2.5.2 Engines as of 09.09

Special tools and workshop equipment required

- Fitting tool -V.A.G 10-203-
- Oil seal extractor -T10443-
- Torque wrench -V.A.G 1331/-
- Torque wrench -V.A.G 1332/-
- Bolt M12 x 1.5 x 75



Removing

– Remove toothed belt from camshaft and high-pressure pump; Removing, installing and tensioning toothed belt.

– Remove camshaft toothed belt pulley and hub ⇒Page 233, Removing and installing camshaft.

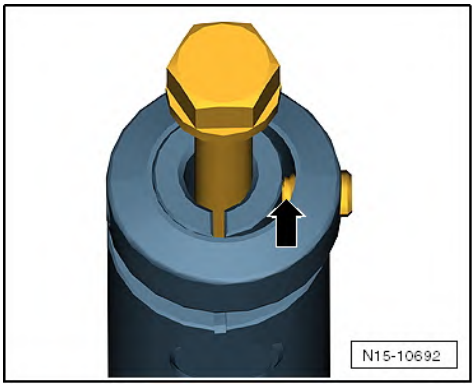
Caution

If turned back too far, the internal pressure plate moves off the pressure screw. In this case the pressure plate must be pushed back onto the pressure screw.

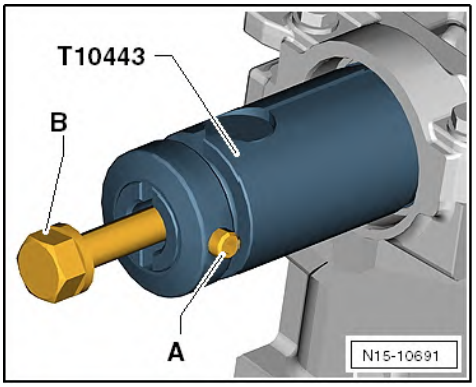
– “Gently” turn back the pressure screw of the seal extractor until you feel a slight resistance.

Note

- *The clamps of the seal extractor contain grub screws. Only one of these grub screws -arrow- causes clamping; the others are permanently fixed.*



– Apply the seal extractor straight, as shown, and clamp it in place by turning the grub screw -A-.
– Turn in the pressure screw -B- until the seal has been pulled out.

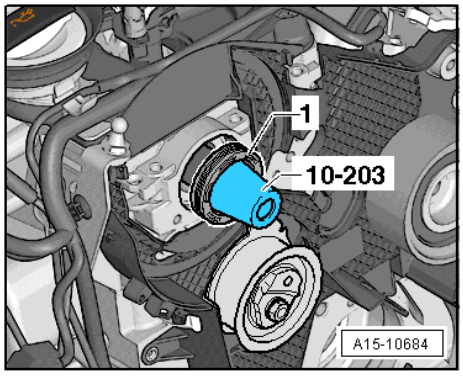


Installing

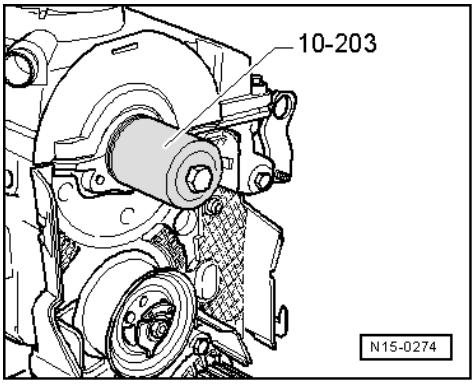
Note

The oil seal sealing lip must not be additionally oiled or greased.

– Remove oil residue from camshaft journal using a clean cloth.
– Fit guide sleeve of fitting tool -10 - 203- onto camshaft as shown in illustration. The inscription on the seal faces outwards.
– Carefully slide oil seal -1- over guide sleeve onto camshaft.



– Press seal in to stop using thrust piece from fitting tool 10-203 and bolt M12×1.5x75.
– Install camshaft pulley and hub ⇒Page 233, Removing and installing camshaft.
– Install toothed belt, and adjust valve timing, Removing, installing and tensioning toothed belt.



17 - Lubrication

1 Engine oil

> ⚠ ***WARNING***
>
> ***Adhere to the general safety regulations and the notes on repair work on the engine!*** ⇒**Page 1**

Note

The oil level must not be above the max. mark - danger of damage to catalytic converter! Check oil level markings.

Oil capacities ⇒Page 247.

Engine oil specification ⇒Page 247

Checking engine oil level ⇒Page 244.

Engine oil: draining or extracting; Renewing oil filter and replenishing engine oil ⇒Page 244.

1.1 Engine oil level: Check

Note as follows:

– After stopping the engine, wait at least 3 minutes for the oil to drain back into the sump.

– Pull out dipstick, wipe it off with a clean cloth, and insert it again to stop.

Note

Observe environmental regulations for disposal.

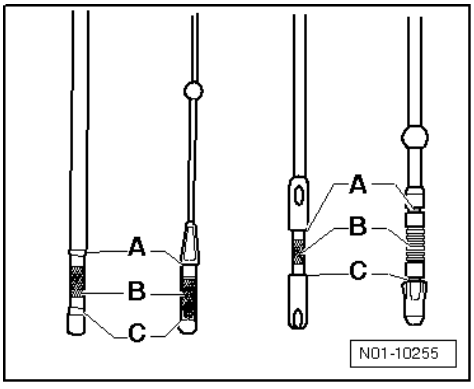
– Pull dipstick out again, and read engine oil level.

If a dipstick is present:

A - Engine oil is not to be topped up.

B - Engine oil may be replenished. The oil level may increase as far as area -A- after topping up.

C - Engine oil must be replenished. It is sufficient if the oil level is somewhere in area -B- (grooved area on dipstick) after topping up.



If the engine oil level is above the -A- marking, there is a risk of damaging the catalytic converter.

– If the engine oil level is below -C- marking, replenish engine oil up to -A- marking. Engine oil specification.

1.2 Engine oil: draining or extracting; Renewing oil filter and replenishing engine oil

Engine oil: draining or extracting and replenishing ⇒Page 245.

Renewing engine oil filter, engine codes CJDA, CJDD, CPYA, CPYB, CPYC, CPYD, CPYE ⇒ Page 246.

Fill engine oil ⇒ Page 247.

- The engine oil must be changed regularly as per the specifications in the service schedule.
- The engine oil and filter change should always be carried out in a specialist workshop as special tools and knowledge are required. This also applies to the disposal of used oil. Volkswagen recommends that these tasks are carried out at a Volkswagen dealership.
- Additives in the engine oil can cause new engine oil to discolour quickly. This is normal and does not mean that the engine oil should be changed more frequently.

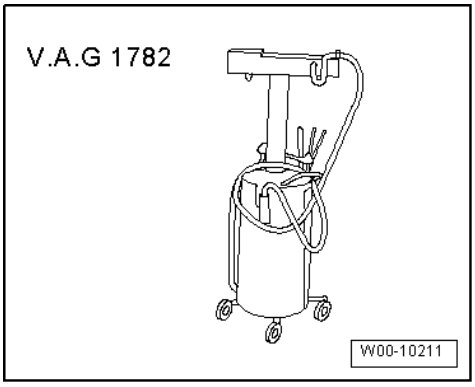
1.2.1 Draining or extracting engine oil

Caution

- ***For engines with upright oil filter module, the oil filter should be renewed before changing the engine oil. When removing the filter element a valve is opened, the oil in the filter housing automatically flows into crankcase.***
- ***The oil drain plug is fitted with a captive seal. Therefore, the oil drain plug must always be renewed.***

Special tools and workshop equipment required

- Used oil collection and extraction unit -V.A.G 1782-
- Cloth to absorb oil -VAS 6204/1-



Draining or extracting engine oil:

Carry out the following procedure:

– Extract engine oil using used oil collection and extraction unit -V.A.G 1782-.

Or

– Remove oil drain plug.
– Let engine oil drain.

Note

Use a suitable container when draining the used oil. It must be at least large enough to hold the entire quantity of engine oil required for refilling.

– Screw in oil drain plug together with seal hand-tight and then tighten to specified torque.
– Fill engine oil, specification ⇒ Page 247.

Engine oil capacity: ⇒ Page 247.

Specified torques for oil drain plug:

- Petrol engines, 30 Nm
- Diesel engines, 30 Nm

Caution

- ***Torque specifications must not be exceeded.***
- ***Excessive torque can cause leaks in the area of the oil drain plug or even damage.***

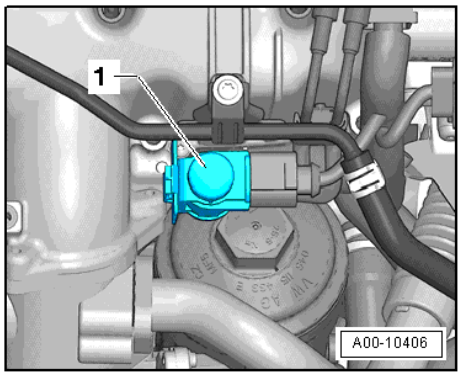
1.2.2 Renewing engine oil filter, engine codes CJDA, CJDD, CPYA, CPYB, CPYC, CPYD, CPYE

Removing

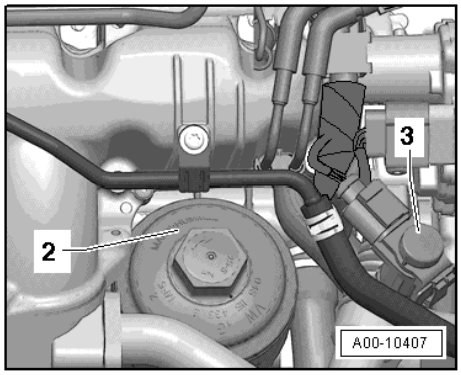
Note

- *Observe environmental regulations for disposal.*
- *Oil new O-rings before installing.*

– Unclip solenoid changeover valve -1-.



– Loosen sealing cap -2- using, for example, a suitable ring spanner or socket.



Note

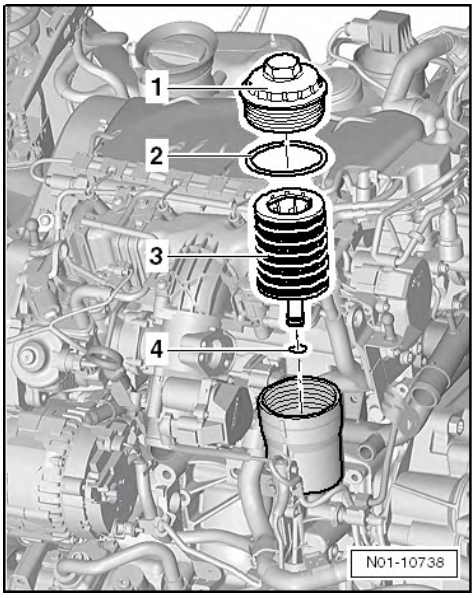
Before draining or extracting, loosen sealing cap so that the engine oil can flow out of the filter housing.

– Clean sealing surfaces on threaded cap and oil filter housing.

Installing

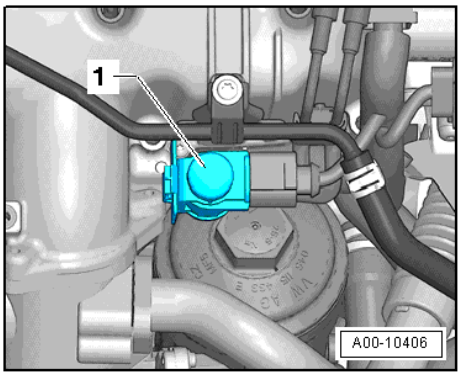
– Renew filter element -3-.

– Renew O-rings -2- and -4-.



– Install threaded cap, and tighten it to 25 Nm.

Further assembly is basically the reverse of the dismantling sequence. Make sure that the solenoid changeover valve -1- can be heard to engage.



Caution

Only engine oils approved by VW may be used.

Note

In this case, use engine oil which is in accordance with the engine oil standard 507 00 [1].

1.2.3 Replenishing engine oil

Engine oil specifications and engine oil capacity:

Note

- *Depending on the installation position of the engine, the required engine oil capacity may be different.*
- *Therefore, also observe the specifications of the machine manufacturer.*

Engine codes	With oil filter change	Engine oil specifications
CJDA	4.3 l	507 00
CJDD	4.3 l	507 00
CPYA	4.3 l	507 00
CPYB	4.3 l	507 00
CPYC	4.3 l	507 00

1) Combi product: 504 00 / 507 00

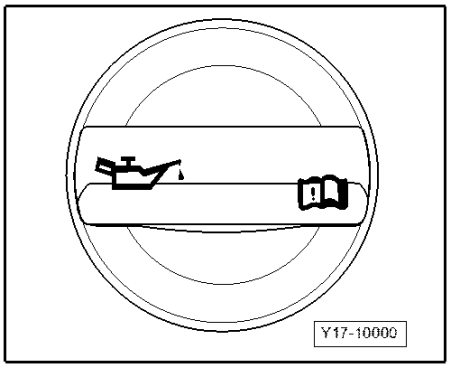
Engine codes	With oil filter change	Engine oil specifications
CPYD	4.3 l	507 00
CPYE	4.3 l	507 00

General notes

Note

Observe environmental regulations for disposal.

Replenishing engine oil

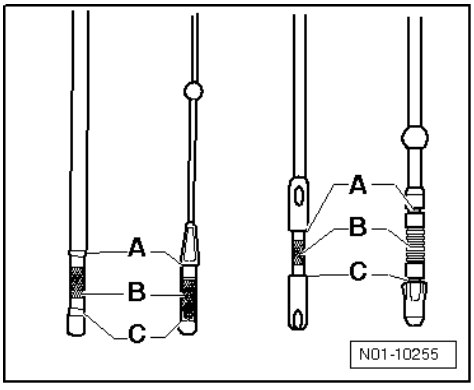


- Unscrew engine oil filler cap from cylinder head. If it is unclear where the cap is located, please contact a qualified workshop.
- Using only the engine oil approved by Volkswagen expressly for this engine, top up the oil in small gradual amounts.
- To avoid overfilling, wait after each pour to allow the engine oil to flow into the oil sump up to the marking on the engine oil dipstick.
- Check the engine oil level before refilling with a small quantity of engine oil. Never pour in too much engine oil.
- Once the engine oil level has reached at least segment -B-, push the oil dipstick into the guide tube as far as it will go in order to prevent any engine oil from escaping when the engine is running.
- After refilling, screw the oil filler cap back on correctly.

– After replenishing with oil, wait at least 3 minutes and then check oil level.

– Pull out the dipstick, wipe it off with a clean cloth, and insert it again to stop.

– Pull the dipstick out again, and read the engine oil level.



If a dipstick is present:

A - Engine oil is not to be topped up.

B - Engine oil may be replenished. The oil level may increase as far as area -A- after topping up.

C - Engine oil must be replenished. It is sufficient if the oil level is somewhere in area -B- (grooved area on dipstick) after topping up.

If the engine oil level is above the -A- marking, there is a risk of damaging the catalytic converter.

– If the engine oil level is below -C- marking, replenish engine oil up to -A- marking.

⚠ ***WARNING***

Engine oil can ignite if it comes in contact with hot engine components. This may cause fire, burns and other serious injuries.

- ***Always make sure that the cap of the engine filler opening is securely closed after refilling. This will prevent the engine oil from draining out on to hot engine components when the engine is running.***

Note

- *Do not start the engine if the engine oil level is above segment -A-. Seek expert assistance. The catalytic converter and the engine could otherwise be damaged.*
- *When refilling or changing service fluids, make sure that the contents of the containers are correct. Incorrect service fluids can cause serious functional problems and damage to the engine.*
- *The engine oil level must never be above segment -A-. Otherwise, engine oil could be drawn in through the crankcase breather and escape into the atmosphere via the exhaust system.*

2 Parts of lubrication system

Caution

Finding metal shavings or a large quantity of small metal particles during engine repair could indicate that the crankshaft bearings or conrod bearings are damaged. To prevent this from causing further damage, perform the following repairs:

Thoroughly clean oil passages,

Renew oil spray jets,

Renew oil cooler,

Renew oil filter element.

WARNING

Adhere to the general safety regulations and the notes on repair work on the engine! ⇒ **Page 1**

When doing any repair work, pay attention to the following due to the cramped conditions:

- ***Adhere to the general safety precautions, and never take any risk.***
- ***The engine is a hazardous area and can cause serious injuries.***
- ***Never leave any objects in the engine compartment, such as cleaning cloths or tools.***
- ***Many engine components become hot during operation – risk of burns. If necessary, provide appropriate protective means.***
- ***Servicing materials, such as fuel, engine oils or coolant additive, are harmful substances; adhere to the safety instructions from the manufacturer.***
- ***There is a risk of injuries, if maintenance locations are difficult to access. This risk can be reduced, by installing the engine in an appropriate location and by avoiding sharp edges.***
- ***Route all the various lines (e.g. for fuel, hydraulics, coolant and refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.***
- ***Ensure that there is sufficient clearance to all moving or hot components.***
- ***Tools are to be checked for damage and safety risks on a regular basis.***

Note

Before carrying out repair work, secure engine on engine and gearbox support -VAS 6095/1- using universal mounting -VAS 6095-.

Observe safety precautions ⇒ Page 354.

Observe rules for cleanliness ⇒ Page 354.

2.1 Assembly overview - oil pump, sump

Note

- *The repair work described in this chapter must be carried out in a Volkswagen dealership only. Go to a Volkswagen dealership.*
- *If these instructions are not adhered to and damage results, Volkswagen is exempt from any liability and warranty claims.*

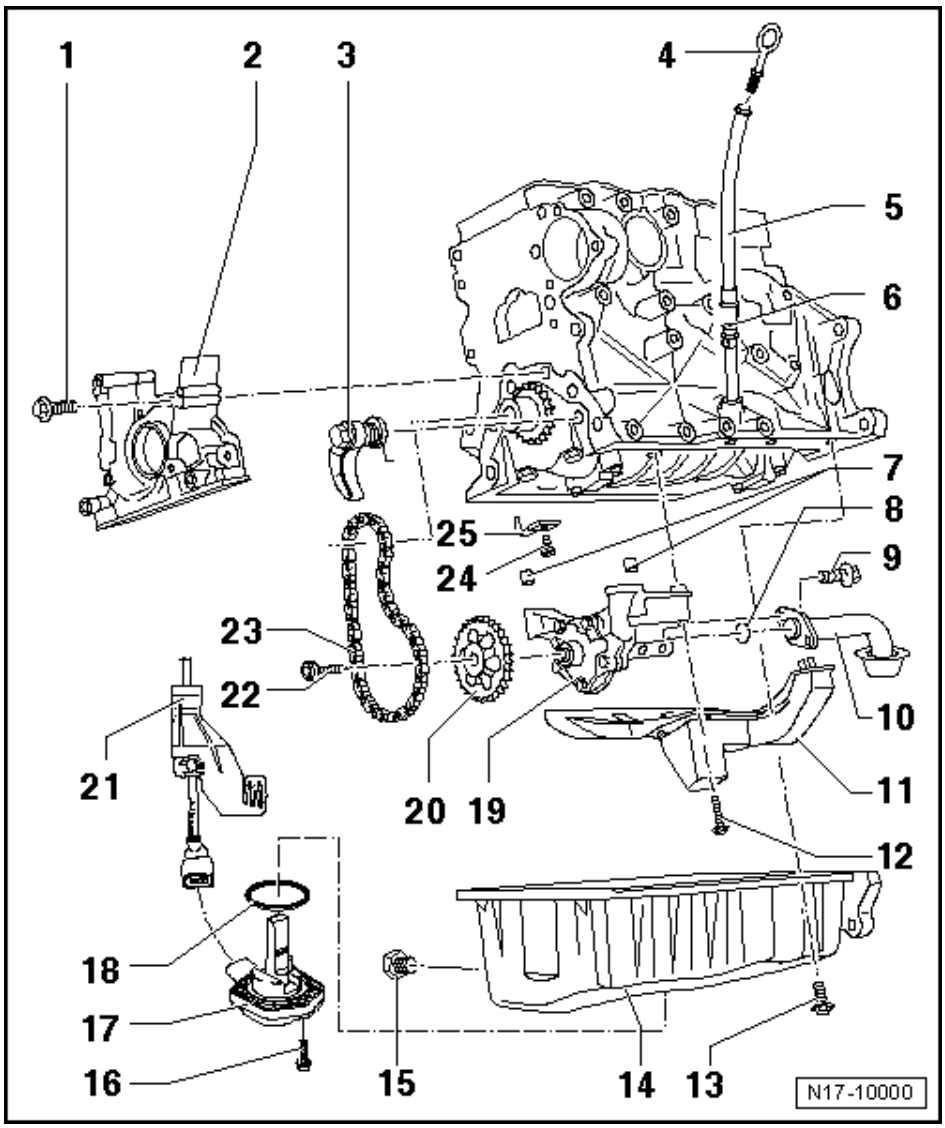
> ⚠ ***WARNING***
>
> ***Adhere to the general safety regulations and the notes on repair work on the engine!*** ⇒**Page 1**

Engine codes CJDA, CJDD ⇒Page 251.

Engine codes CPYA, CPYB, CPYC, CPYD, CPYE ⇒Page 254.

2.1.1 Engine codes CJDA, CJDD

Assembly overview - oil filter bracket and oil cooler



1 - 15 Nm

2 - Sealing flange
- ❑ With seal.
- ❑ Must be positioned on dowel sleeves.
- ❑ Removing and installing.
- ❑ Install with silicone sealant D 176 404 A2.
- ❑ Do not additionally oil or grease the oil seal sealing lip.
- ❑ Before installing, remove oil residue from crankshaft journal using a clean cloth.

3 - Chain tensioner with tensioning rail, 15 Nm
- ❑ When installing, pretension spring and fit.

4 - Oil dipstick
- ❑ The oil level must not be above the max. mark!
- ❑ Markings

5 - Dipstick guide

6 - Guide tube

7 - Dowel sleeves

8 - O-ring
- ❑ Renew

9 - 15 Nm

10 - Suction line
- ❑ Clean strainer if soiled.

11 - Baffle plate

12 - 15 Nm

13 - 15 Nm

14 - Sump
- ❑ Removing and installing.
- ❑ Clean sealing surface before fitting.
- ❑ Install with silicone sealant D 176 404 A2

15 - Oil drain plug, 30 Nm
- ❑ Renew

16 - 10 Nm

17 - Oil level and oil temperature sender -G266-

- ❑ Black connector, 3-pin.
- ❑ Removing and installing ⇒ Fig. on page 253

18 - Seal

- ❑ Renew

19 - Oil pump

- ❑ With 12 bar pressure relief valve
- ❑ Before installing, check that both dowel sleeves for centring oil pump on cylinder block are fitted.
- ❑ Check oil pump for free movement.
- ❑ Replace if tight/binding.

20 - Chain sprocket for oil pump

21 - Retainer

- ❑ For oil level and oil temperature sender -G266- wiring harness, if fitted

22 - 20 Nm + $^1/_4$ turn (90°) further

23 - Chain

24 - 25 Nm

- ❑ Insert without sealant.

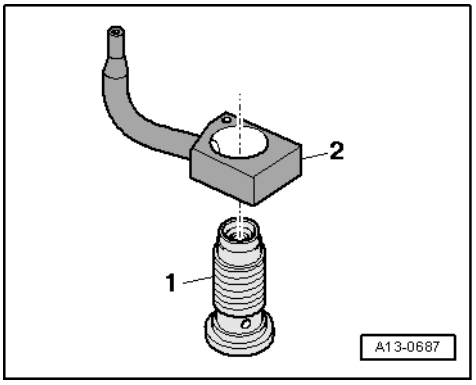
25 - Oil spray jet

- ❑ For piston cooling ⇒ Fig. on page 253.

Oil spray jet and pressure relief valve

Note

When renewing the oil spray jet, ensure correct allocation to piston.



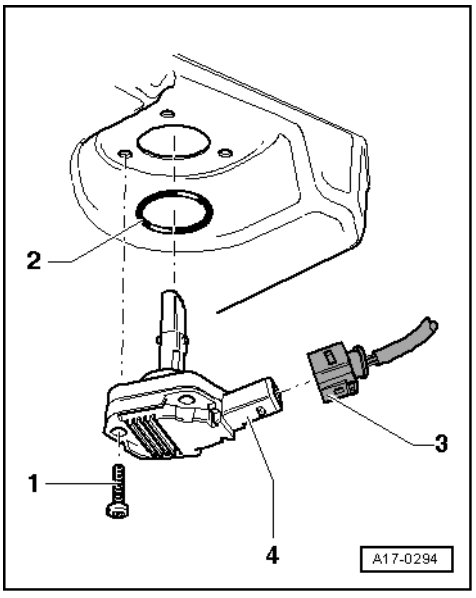
Removing and installing oil level and oil temperature sender -G266-, if fitted

1 - Bolt, 10 Nm, self-locking, renew

2 - Seal; renew

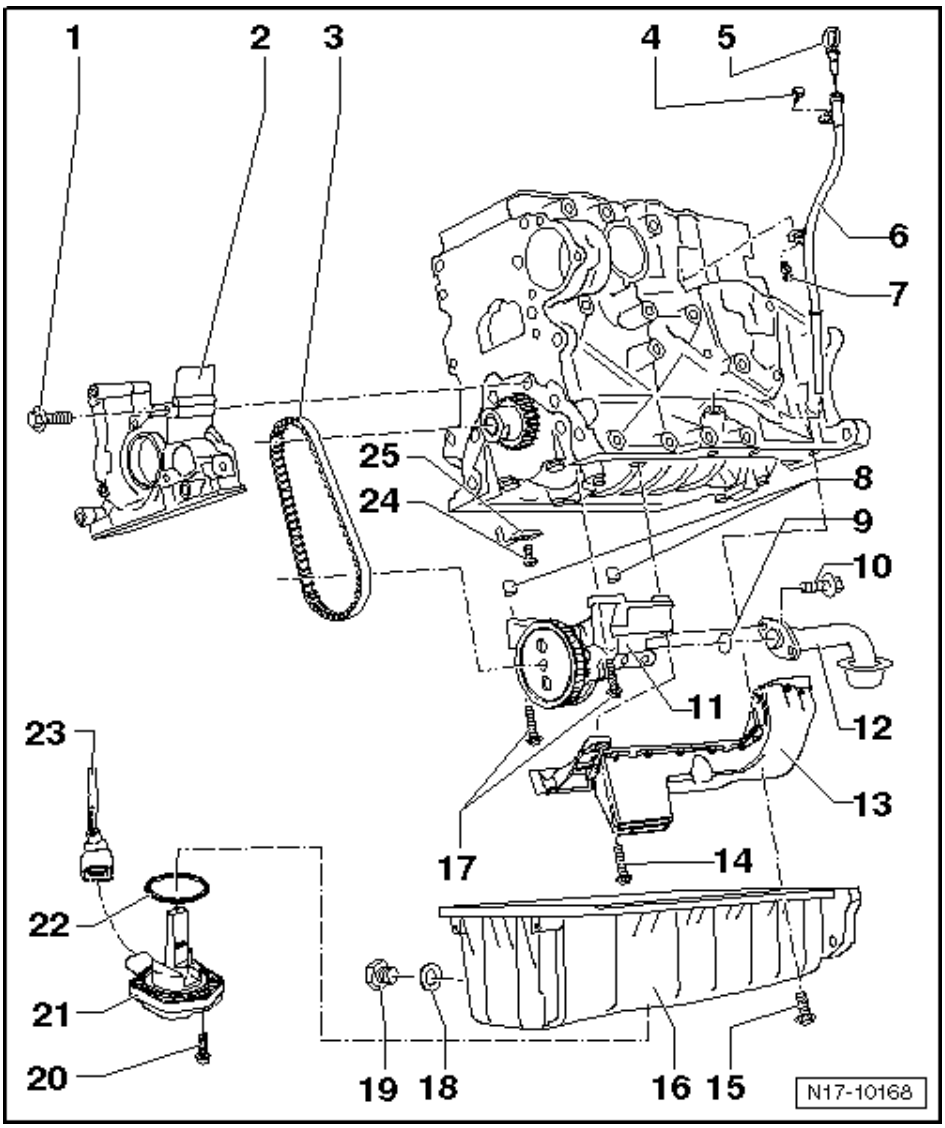
3 - Electrical connector

4 - Oil level and oil temperature sender -G266-



2.1.2 Engine codes CPYA, CPYB, CPYC, CPYD, CPYE

– Assembly overview - oil filter bracket and oil cooler



1 - 15 Nm

2 - Sealing flange

- ❑ With seal.
- ❑ Must sit on dowel sleeves
- ❑ Removing and installing.
- ❑ Insert with silicone sealant D 176 404 A2.
- ❑ Do not additionally oil or grease the oil seal sealing lip.
- ❑ Before installing, remove oil residue from crankshaft journal using a clean cloth.

3 - Toothed belt for oil pump

- ❑ Check for damage and wear
- ❑ Renew as needed

Note

- *Belts which have been in use longer can sag.*
- *This is not a fault and does not necessarily mean belt needs replacing.*

4 - 10 Nm

5 - Oil dipstick

- ❑ The oil level must not be above the max. mark!
- ❑ Markings

6 - Guide tube

- ❑ Renew O-ring.

7 - Clip

8 - Dowel sleeves

- ❑ Renew

9 - O-ring

- ❑ Renew

10 - 10 Nm

11 - Oil pump with pressed-on toothed belt pulley

- ❑ With 12 bar pressure relief valve
- ❑ Before installing, check that both dowel sleeves for centring oil pump on cylinder block are fitted.

If toothed belt or oil pump have to be removed:

Note

- *Check oil pump for free movement.*
- *It should be possible to turn toothed belt pulley easily with 1 finger.*
- *Renew if tight/sticking.*

12 - Intake manifold

- ❑ Clean strainer if soiled.

13 - Baffle plate

14 - 15 Nm

15 - Bolt

- ❑ Prescribed torques and tightening sequence .

16 - Sump

- ❑ Clean sealing surface before fitting.
- ❑ Install with silicone sealant D176404A2.
- ❑ Removing and installing.

17 - 15 Nm

18 - Seal

- ❑ Renew

19 - Oil drain plug, 30 Nm

- ❑ Renew

20 - 10 Nm

21 - Oil level and oil temperature sender -G266-

- ❑ Black 3-pin connector
- ❑ Removing and installing ⇒Fig. on page 257

22 - Seal

- ❑ Renew

23 - Oil level and oil temperature sender -G266- wiring harness

24 - 27 Nm

- ❑ Insert without sealant.

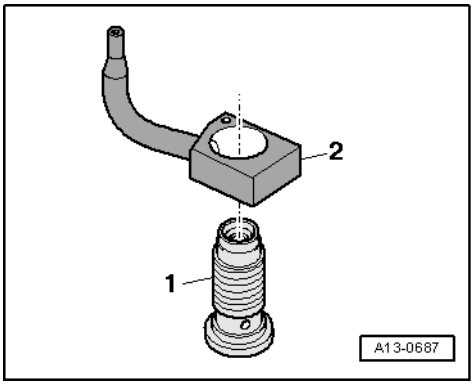
25 - Oil spray jet

- ❑ For piston cooling ⇒Fig. on page 256.

Oil spray jet and pressure relief valve

1 - Bolt with pressure relief valve, 27 Nm

2 - Oil spray jet (for cooling of pistons)



Note

When renewing the oil spray jet, ensure correct allocation to piston.

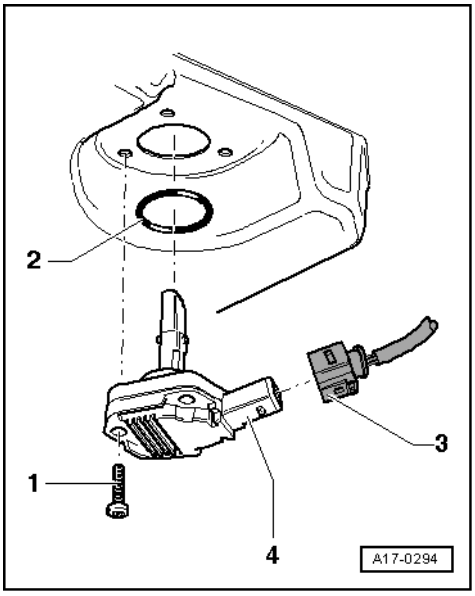
Removing and installing oil level and oil temperature sender -G266-, if fitted

1 - Bolt, 10 Nm, self-locking, renew

2 - Seal; renew

3 - Electrical connector

4 - Oil level and oil temperature sender -G266-



2.2 Removing and installing sump

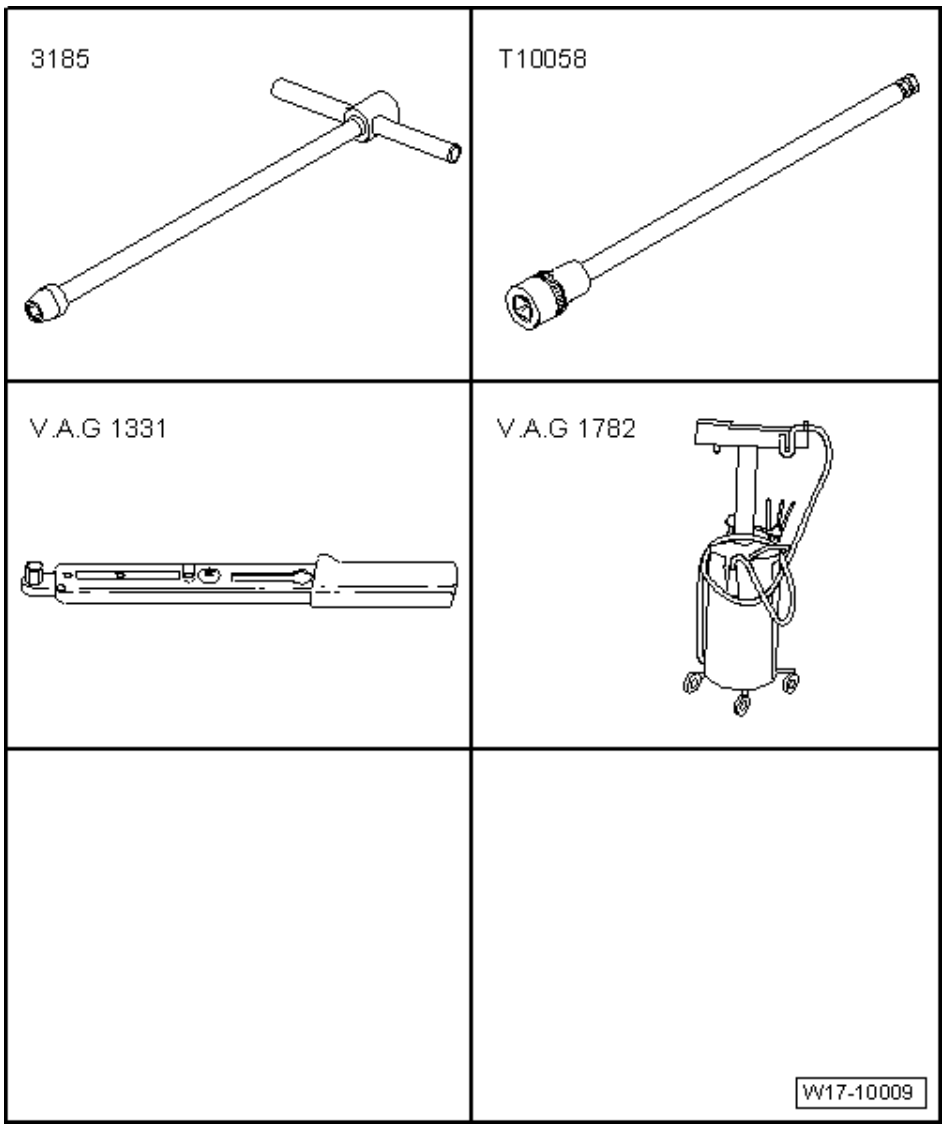
Note

- *The repair work described in this chapter must be carried out in a Volkswagen dealership only. Go to a Volkswagen dealership.*
- *If these instructions are not adhered to and damage results, Volkswagen is exempt from any liability and warranty claims.*

> ***WARNING***
>
> ***Adhere to the general safety regulations and the notes on repair work on the engine!*** ⇒ **Page 1**

Special tools and workshop equipment required

- 10 mm jointed spanner -VAS 3185-
- Allen key, long reach 5 mm -T10058-
- Torque wrench (5…50 Nm) -V.A.G 1331-
- Used oil collection and extraction unit -V.A.G 1782-



- Silicone sealant D176404A2
- Hand drill with plastic brush
- Eye protection
- Flat scraper

Removing ⇒ Page 258.

Installing ⇒ Page 259.

2.2.1 Removing

– Drain engine oil ⇒ Page 245.

Note

Observe environmental regulations for disposal.

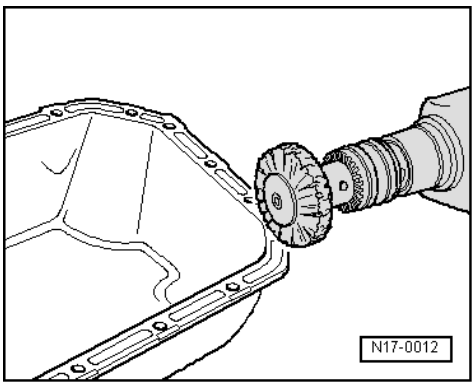
– If fitted, pull 3-pin connector off oil level and oil temperature sender -G266-.

– Remove sump.

– Loosen sump with light blows of a rubber headed hammer if necessary.
– Remove sealant residue from cylinder block with a flat scraper.

> ⚠ ***WARNING***
>
> ***Wear eye protection.***

– Remove sealant residue on sump with a rotating brush, e.g. a hand drill with a plastic brush.
– Clean sealing surfaces. They must be free of oil and grease.



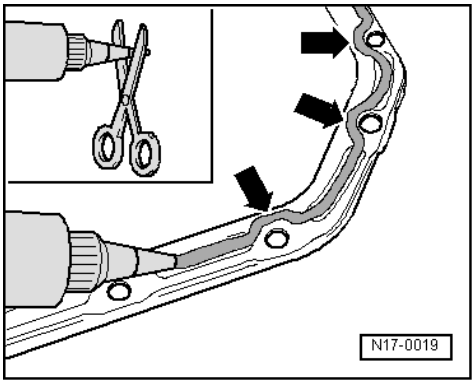
2.2.2 Installing

Note

- *Note the expiry date of the sealant.*
- *Install sump within 5 minutes of applying silicone sealant.*

– Cut off tube nozzle at front marking (nozzle diameter approx. 3 mm).
– Apply silicone sealant, as shown, to clean sump sealing surface. Sealant bead must be:

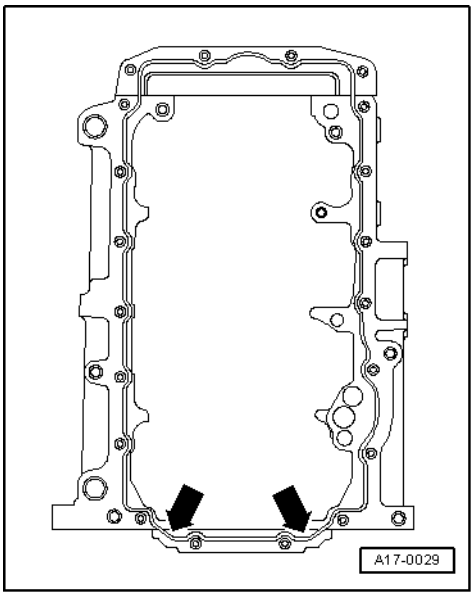
- 2…3 mm thick.
- Run bead along inner side of bolt holes -arrows-.



Note

The sealant bead must not be thicker, otherwise excess sealant may enter the oil sump and block the oil suction line strainer.

– Apply silicone sealant to clean sealing surface of sump, as shown in diagram. (The figure shows the position of the sealant bead on the cylinder block.)
– Install sump immediately and tighten all sump bolts lightly.



Note

When installing sump with engine out of vehicle, ensure that sump is flush with cylinder block at flywheel end.

– Tighten sump bolts diagonally to 15 Nm.
– Tighten bolts securing sump to gearbox to 40 Nm.

Note

Allow sealant to dry for approx. 30 minutes after installing sump. Only then fill with engine oil.

Further assembly is basically the reverse of the dismantling sequence.

3 Oil filter bracket, oil cooler and oil pressure switch

WARNING

Adhere to the general safety regulations and the notes on repair work on the engine! ⇒**Page 1**

Caution

Finding metal shavings or a large quantity of small metal particles during engine repair could indicate that the crankshaft bearings or conrod bearings are damaged. To prevent this from causing further damage, perform the following repairs:

Thoroughly clean oil passages,

Renew oil spray jets,

Renew oil cooler,

Renew oil filter element.

Note

Before carrying out repair work, secure engine on engine and gearbox support -VAS 6095/1- using universal mounting -VAS 6095-.

Observe safety precautions ⇒Page 354.

Observe rules for cleanliness ⇒Page 354.

3.1 Oil filter bracket, oil cooler and oil pressure switch, engine codes CJDA, CJDD

Assembly overview - oil filter bracket and oil cooler ⇒Page 261.

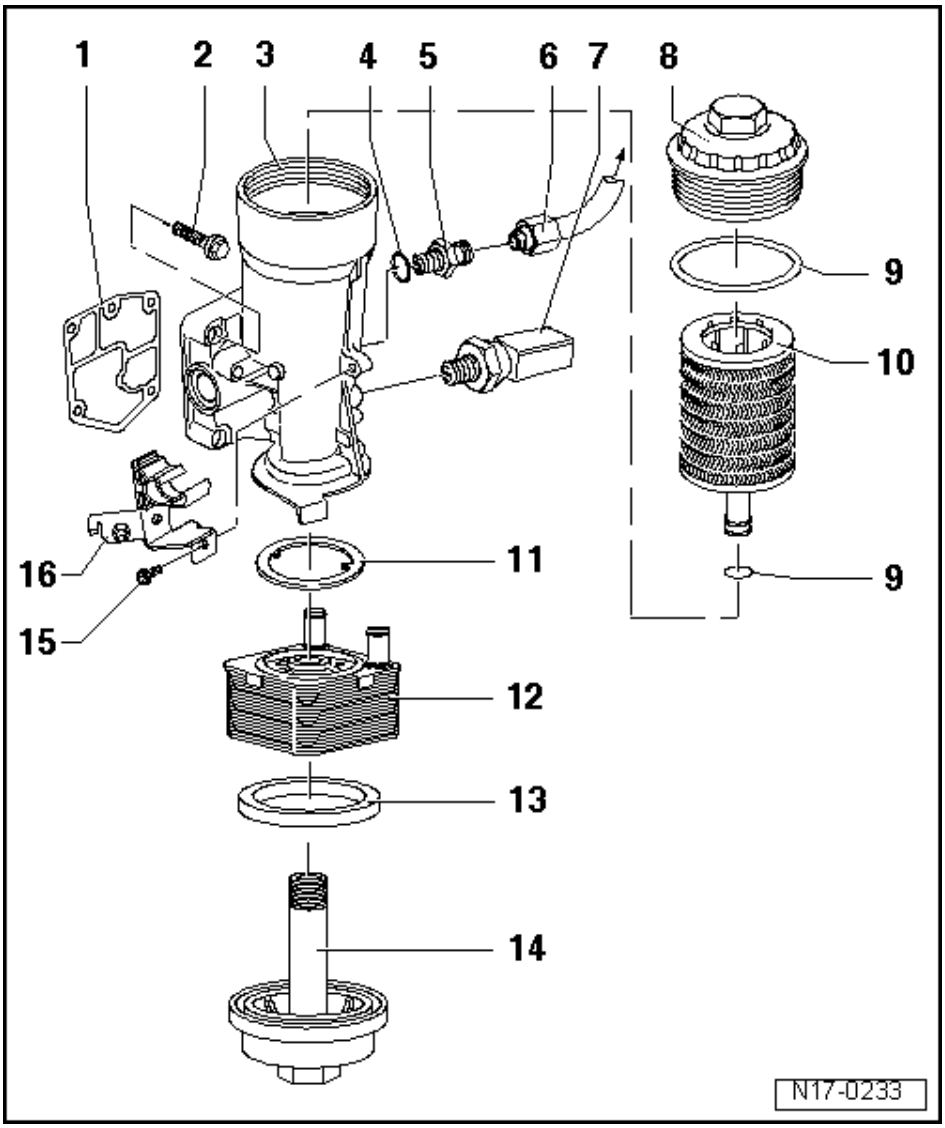
Removing and installing oil filter bracket together with oil cooler
⇒Page 262.

Checking oil pressure and oil pressure switch -F1- ⇒Page 264

Note

Observe general notes on the lubrication system.

3.1.1 Assembly overview - oil filter bracket and oil cooler



1 - Gasket
- ❑ Renew

2 - 15 Nm + 1/4 turn (90°) further
- ❑ Renew
- ❑ First fit upper left and lower right bolts and then tighten all four bolts diagonally.

3 - Oil filter bracket
- ❑ Removing and installing ⇒Page 262

4 - Seal
- ❑ Renew

5 - Connecting piece, 30 Nm

6 - Oil supply line, 22 Nm
- ❑ To turbocharger.

7 - Oil pressure switch -F1-, 22 Nm
- ❑ 0.7 bar switch: brown.
- ❑ If seal is leaking, nip open and renew.
- ❑ Checking ⇒Page 264, checking oil pressure and oil pressure switch

8 - Cap, 25 Nm
- ❑ Loosen and tighten with socket AF 36 mm -T10125-.

9 - O-ring
- ❑ Renew

10 - Oil filter element
- ❑ Observe change intervals.
- ❑ Ensure "Top" is uppermost when fitting

11 - Seal
- ❑ Renew
- ❑ Lubricate before installing.

- ❑ Fit into lugs on oil cooler.

12 - Oil cooler

- ❑ Ensure clearance to adjacent components.
- ❑ Checking oil cooler for leaks

13 - Seal

- ❑ Renew

14 - Cap, 25 Nm

- ❑ Loosen and tighten with socket AF 36 mm -T10125-.

15 - 10 Nm

16 - Bracket

3.1.2 Removing and installing oil filter bracket together with oil cooler

Special tools and workshop equipment required

- ◆ Assembly tool -T10118-
- ◆ Oil drip tray

Removing

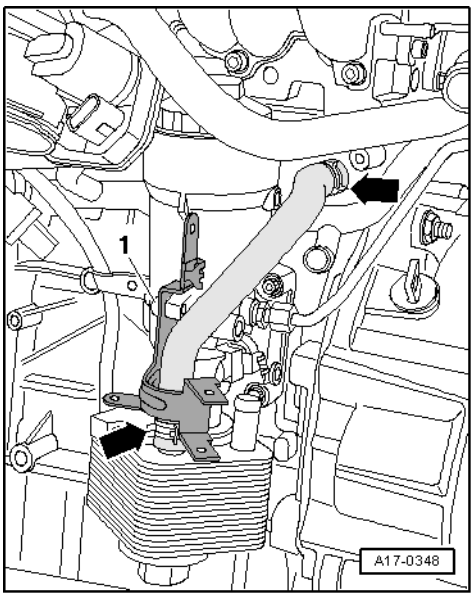
– Drain coolant.

– Detach any required wiring harnesses and connectors, and lay them to one side.

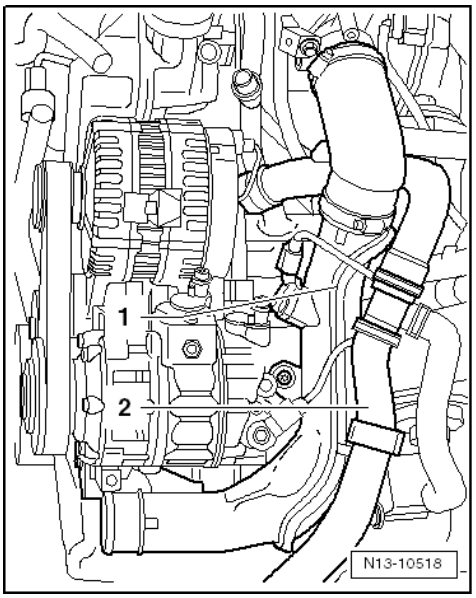
– Unscrew securing bolt -1- and remove bracket.

– Pull coolant hoses off oil cooler.

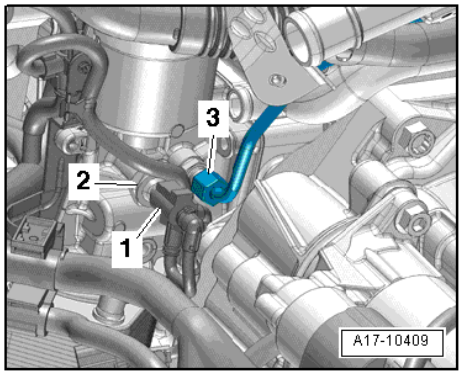
– Remove any relevant hoses and charge air pipes.



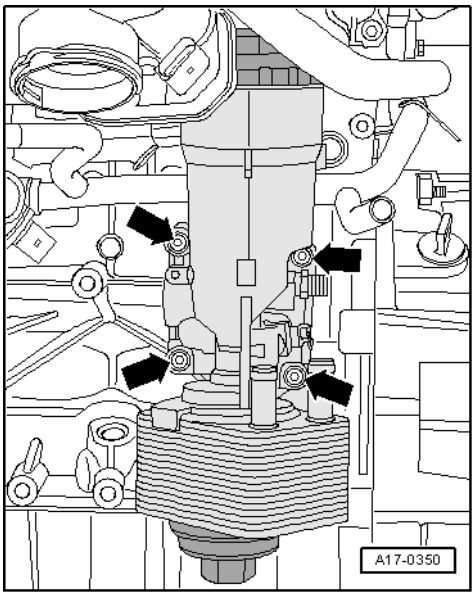
– Remove charge air pipe -1- and coolant hose -2-.
– Remove securing bolts of dipstick guide tube.
– Pull guide tube upwards out of crankcase and press it slightly aside.



– Disconnect connector -1- on oil pressure switch -F1- using assembly tool -T10118-, and unscrew oil pressure switch.
– Remove oil supply line -3- from the oil filter bracket. If necessary, counterhold with an open-ended spanner.
– Place oil drip tray below engine.



– Unscrew securing bolts -arrows- and remove oil filter bracket.



Installing

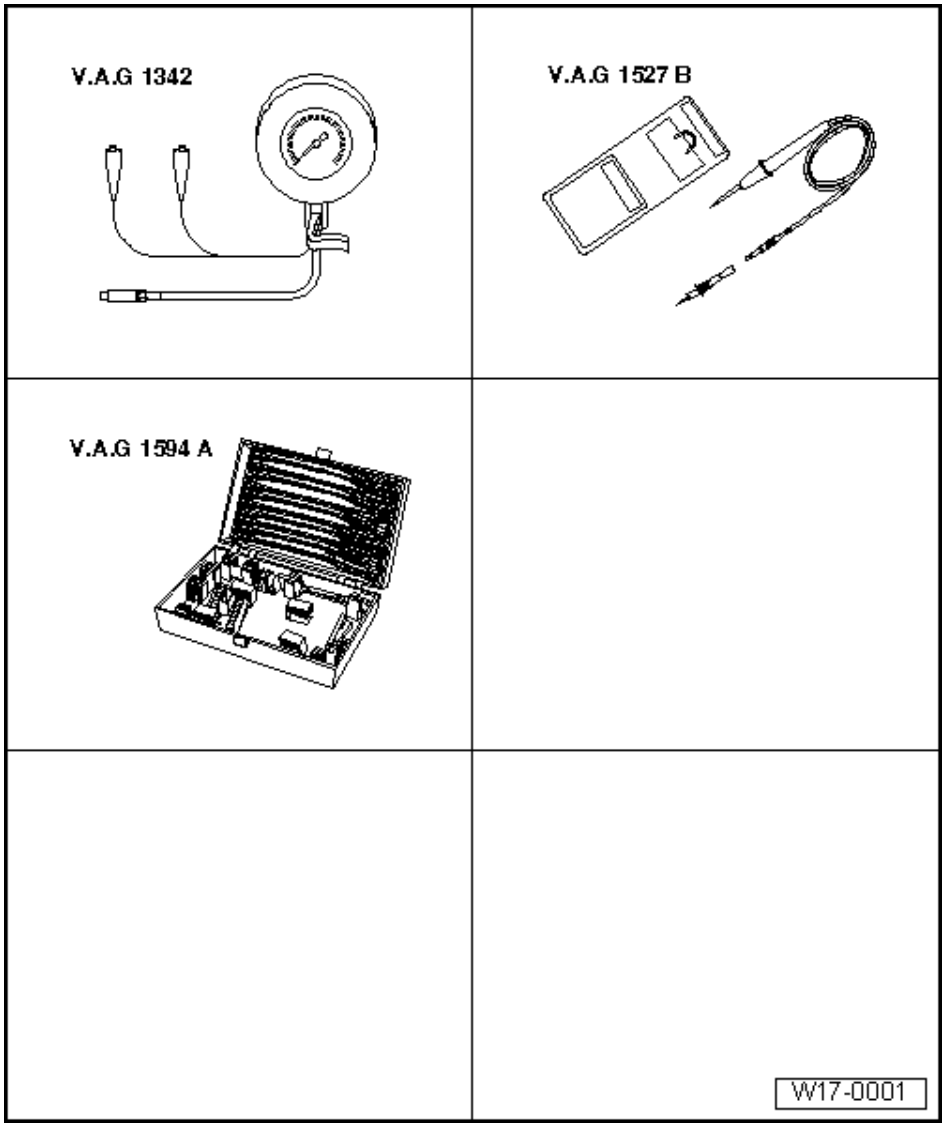
Installation is carried out in the reverse order. When installing, note the following:

- Renew gaskets, seals and O-rings.
- Specified torques for oil filter bracket ⇒ Page 261
- Filling with coolant

3.1.3 Checking oil pressure and oil pressure switch -F1-

Special tools and workshop equipment required

- Oil pressure tester -V.A.G 1342-
- Diode test lamp -V.A.G 1527 B-
- Auxiliary measuring set -V.A.G 1594 A-



Test prerequisites

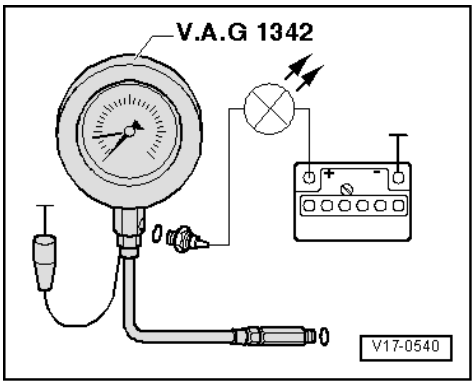
- Check whether oil level OK
- Engine oil temperature at least 80°C.

Test procedure

Note

Functional check and repair of the optical oil pressure gauge, current flow diagrams.

– Remove oil pressure switch -F1- and screw into oil pressure tester.
– Screw oil pressure tester into oil filter bracket in place of oil pressure switch.
– Connect brown wire of oil pressure tester to earth (-).
– Connect voltage tester -V.A.G 1527 B- to battery positive (+) and oil pressure switch using test leads from auxiliary measuring set -V.A.G 1594 A-. LED must not light up.



If the LED lights up:

– Renew oil pressure switch -F1-.

If LED does not light up:

– Start engine and increase speed slowly. At 0.55…0.85 bar the LED must light up, otherwise renew oil pressure switch -F1-.

Checking oil pressure

– Increase engine speed further. At 2,000 rpm and an oil temperature of 80°C the oil pressure should be at least 2.0 bar.

If the specifications are not obtained

– Rectify any mechanical damage, e.g. damaged bearings.
– Renew oil filter bracket with pressure relief valve or renew oil pump.

At higher engine speeds, the oil pressure must not exceed 7.0 bar.

If the specification is exceeded:

– Check oil channels.
– If necessary, renew oil filter bracket with pressure relief valve.

3.2 Oil filter bracket, oil cooler and oil pressure switch, engine codes CPYA, CPYB, CPYC, CPYD, CPYE

Assembly overview - oil filter bracket and oil cooler ⇒Page 266.

Removing and installing oil filter bracket together with oil cooler ⇒Page 268.

Removing and installing oil cooler ⇒Page 270.

Removing and installing oil pressure switch -F1- ⇒Page 273.

Checking oil pressure and oil pressure switch -F1- ⇒Page 274.

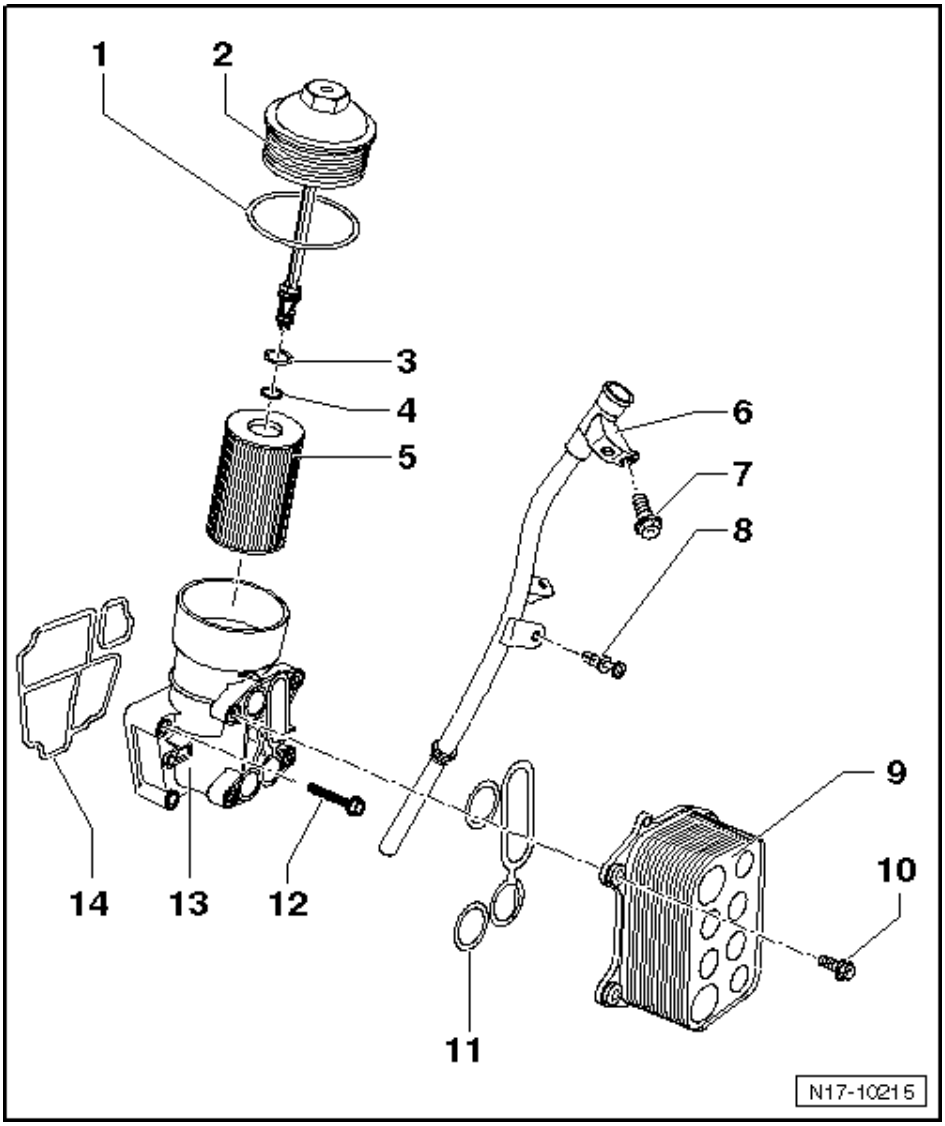
Note

Observe general notes on the lubrication system.

3.2.1 Assembly overview - oil filter bracket, oil cooler

Caution

Seals 11 and 14 must not be lubricated with oil. The coolant seals would otherwise swell up.



1 - O-ring
- ❑ Renew

2 - Cap, 25 Nm

3 - O-ring
- ❑ Renew

4 - O-ring
- ❑ Renew

5 - Oil filter element
- ❑ Observe change intervals.

6 - Guide tube
- ❑ Renew O-ring.

7 - 10 Nm

8 - Spreader clip

9 - Oil cooler
- ❑ Ensure clearance to adjacent components.
- ❑ Coolant hose schematic diagram
- ❑ Checking oil cooler for leaks

10 - 11 Nm

11 - Rubber seals
- ❑ Renew
- ❑ May not be lubricated with oil
- ❑ Fit into lugs on engine oil cooler.

12 - 14 Nm + $^1/_2$ turn (180°) further
- ❑ Renew
- ❑ First fit upper left and lower right bolts and then tighten all 4 bolts in diagonal sequence.

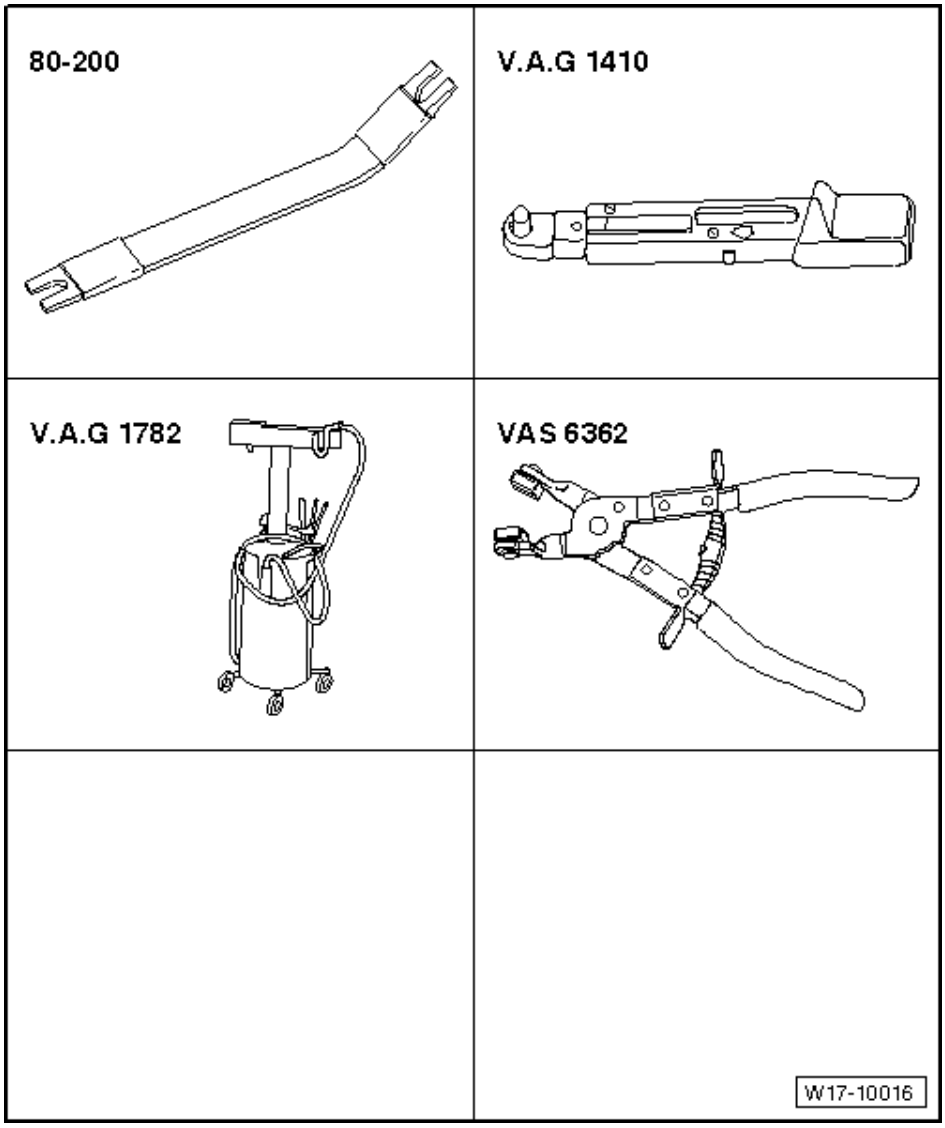
13 - Oil filter bracket
- ❑ Ensure clearance to adjacent components.

14 - Rubber seals
- ❑ Renew
- ❑ May not be lubricated with oil
- ❑ Fit into lugs on oil filter bracket.

3.2.2 Removing and installing oil filter bracket with engine oil cooler

Special tools and workshop equipment required

- Removal lever -80 - 200-
- Torque wrench -V.A.G 1410-
- Used oil collection and extraction unit -V.A.G 1782-
- Hose clip pliers -VAS 6362-

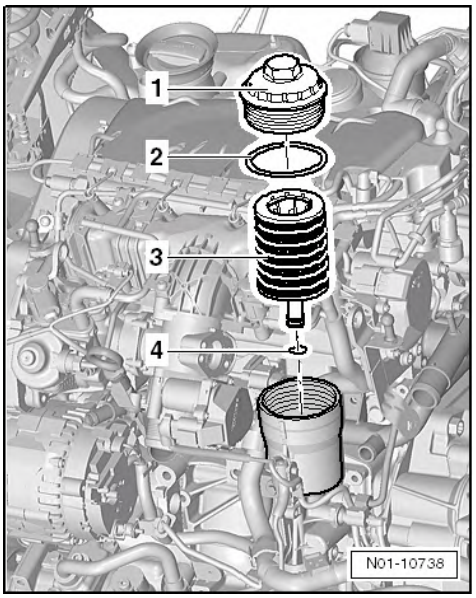


Removing

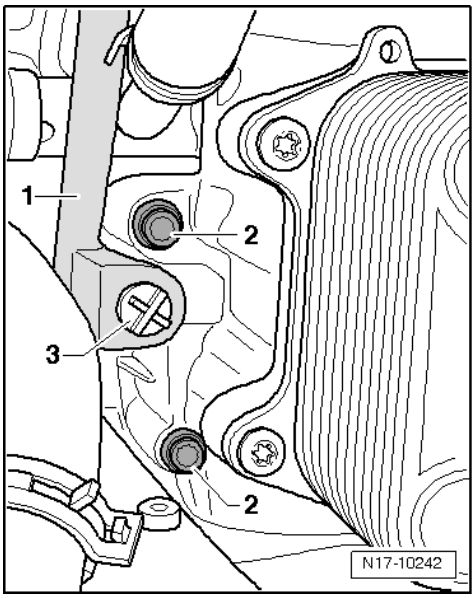
– Remove oil filter element -3-.

– Unbolt dipstick guide tube.

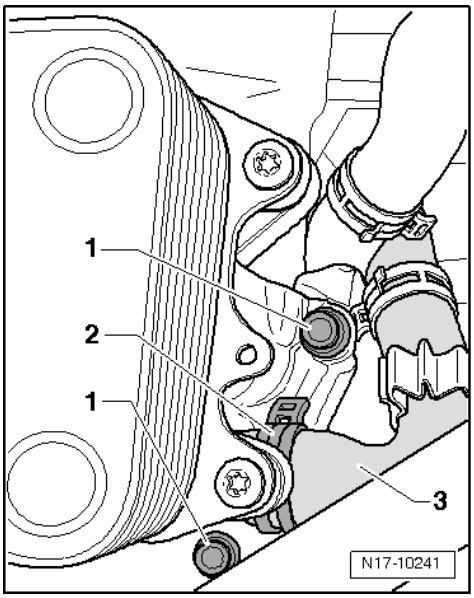
– Drain coolant.



– Push clip -3- off guide tube -1- for oil dipstick with removal lever -80 - 200-.



– Remove coolant hose -3-. To do this, release hose clip -2-.
– Place used oil collection and extraction unit -V.A.G 1782- under engine.
– Unscrew bolts -1- and remove oil filter bracket with engine oil cooler.
– Clean soiled places thoroughly.



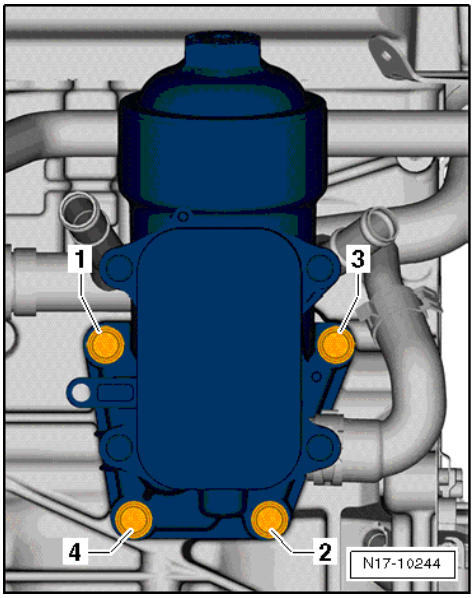
Installing

Install in reverse order. In the process, note the following:

Note

- *Renew gaskets, seals and O-rings.*
- *Hose unions and air intake pipes and hoses must be free of oil and grease before installation.*
- *Secure all hose connections with hose clips which conform to production standard.*

– Bolt on oil filter bracket hand-tight in the sequence -1 … 4-.
– Tighten bolts in the sequence -1 … 4-. Specified torque: 14 Nm + $^1/_2$ turn (180°) further.
– Bolt on dipstick guide tube.
– Install oil filter element, replenish engine oil and check oil level.
– Replenish coolant in cooling system, or change coolant if engine oil cooler has been renewed.

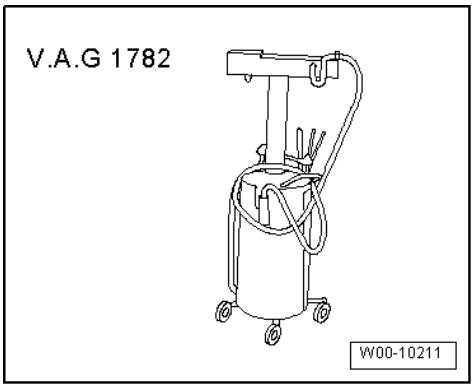


Specified torques ⇒Page 266.

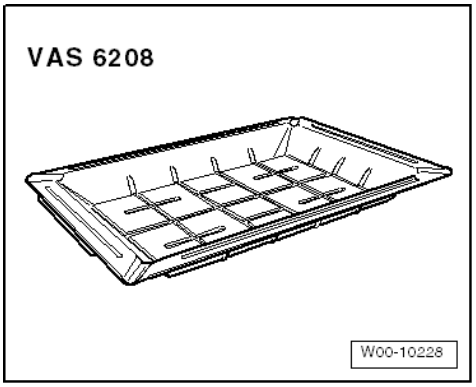
3.2.3 Removing and installing oil cooler

Special tools and workshop equipment required

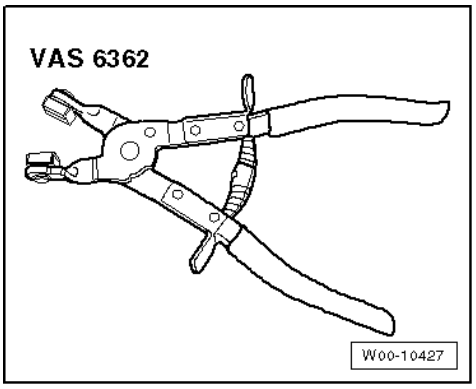
- Used oil collection and extraction unit -V.A.G 1782-



◆ Drip tray for workshop hoist -VAS 6208-



◆ Hose clip pliers -VAS 6362-

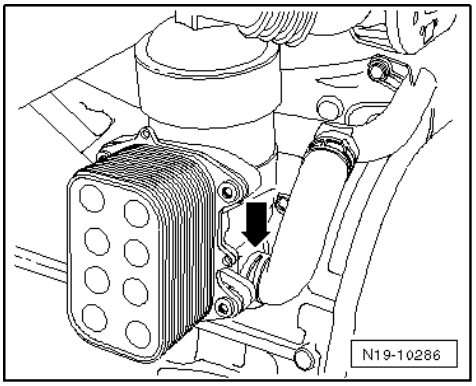


Removing

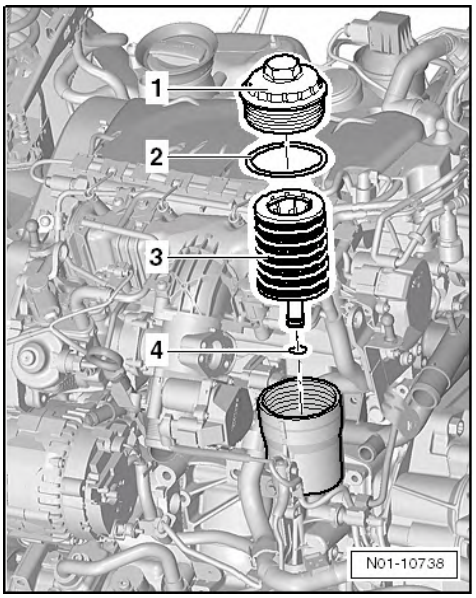
– Bring lock carrier into service position ⇒ General body repairs; Rep. gr. 50; Body - front; Lock carrier service position.

– Drain coolant.

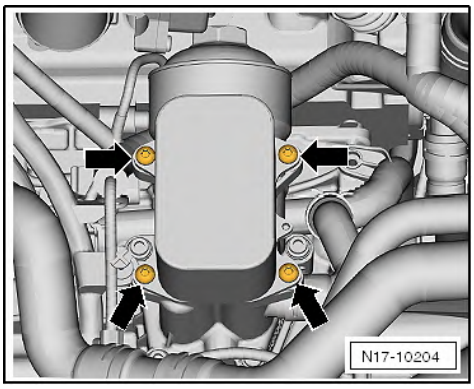
– In addition to draining coolant from engine, pull coolant hose from oil filter bracket -arrow-.



– Remove oil filter element -3-.



– Remove bolts -arrows-.
– Remove engine oil cooler from housing.



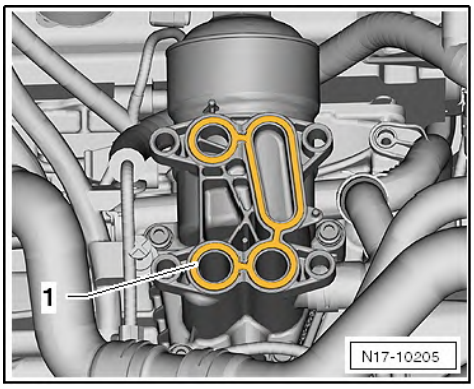
Installing

Install in reverse order. In the process, note the following:

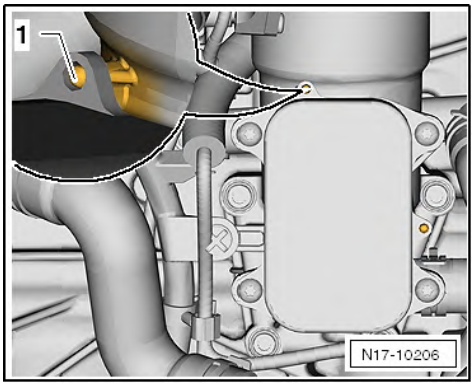
Note

- *Renew gaskets, seals and O-rings.*
- *Hose connections as well as pipes and hoses of air channels must be free of oil and grease when installing.*
- *Secure all hose connections with hose clips comparable to production standard*

– Insert new seals into oil-free lugs -arrow- on oil filter bracket.
– Carefully slide engine oil cooler onto centring pins.



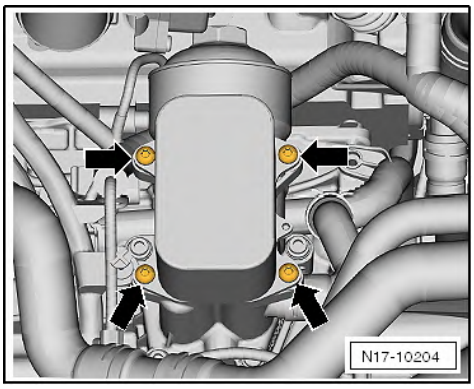
– Press oil cooler on until it is flush -1- with end of centring pins.
– Start new bolts, and screw them in until heads make contact.



– Tighten bolts -arrows- alternately in diagonal sequence in 3 steps.

- Step 1: tighten by hand
- Step 2: tighten to 5 Nm
- Step 3: tighten to 11 Nm

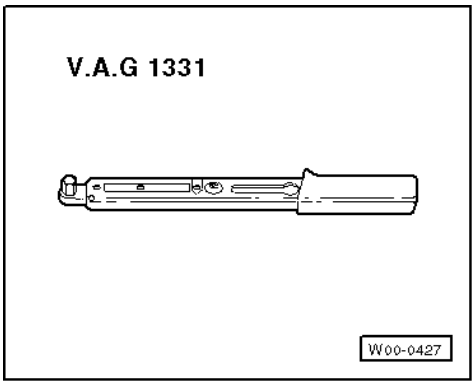
– Install oil filter element, replenish engine oil and check oil level.
– Replenish coolant in cooling system, or change coolant if engine oil cooler has been renewed.



3.2.4 Removing and installing oil pressure switch -F1-

Special tools and workshop equipment required

- Torque wrench (5…50 Nm) -V.A.G 1331-



Removing

Note

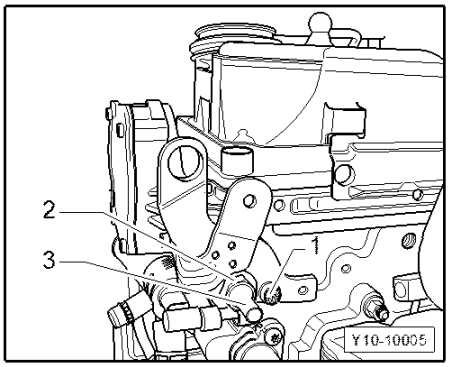
- *Oil pressure switch -F1- is installed on rear left of cylinder head.*
- *Depending on how the engine is installed, the location where the repair measure is required may be difficult to access. Remove any required components to ensure proper working conditions.*
- *Removal and installation must be carried out from right-hand side, behind cylinder head.*

– If appropriate, remove any relevant components and service fluid lines or detach line retainers to allow for laying lines to one side.

– Unscrew bolts -1-, and remove lifting eye.

– Release and pull off connector -4-.

– Unscrew oil pressure switch -F1- -3-.



Installing

Install in reverse order.

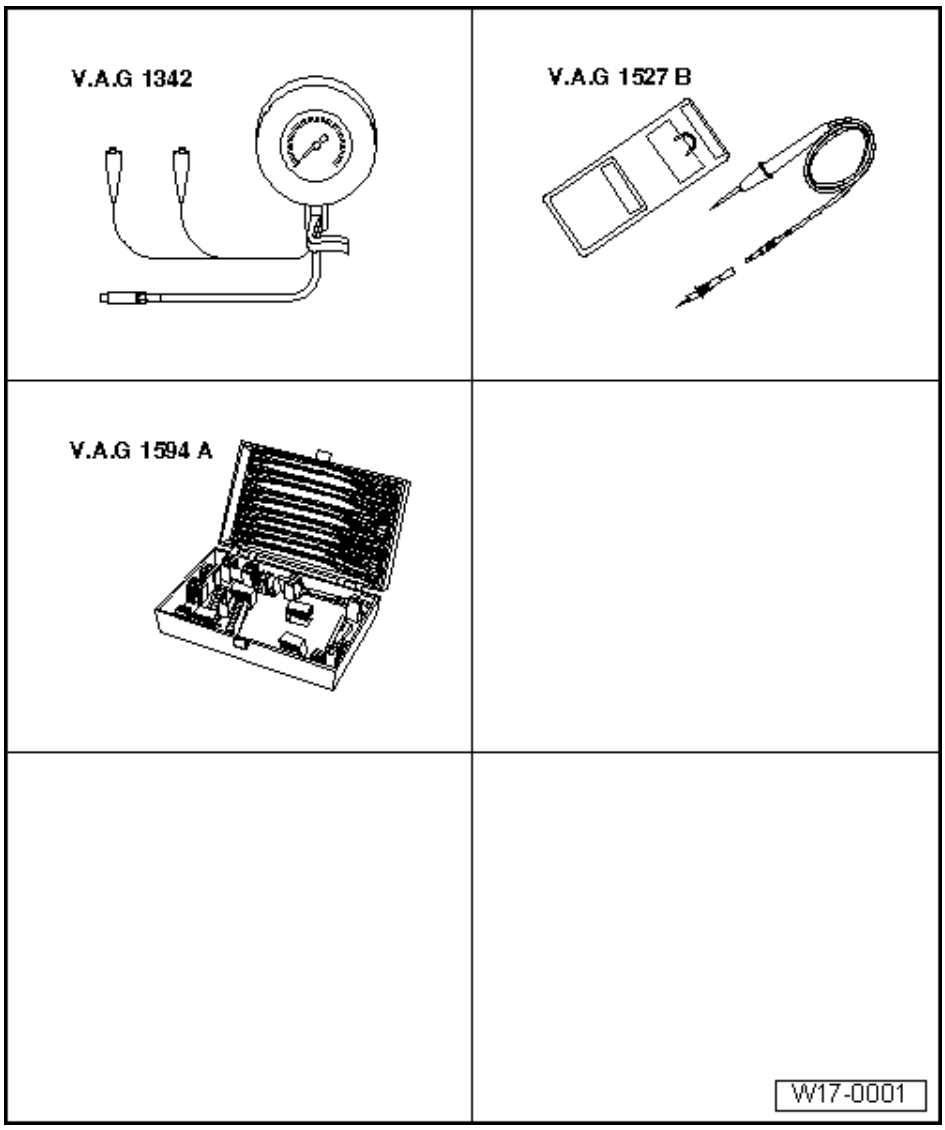
– Tighten oil pressure switch -F1- -3- to 22 Nm.

– Tighten bolts of lifting eye to 20 Nm.

3.2.5 Checking oil pressure and oil pressure switch -F1-

Special tools and workshop equipment required

- Oil pressure tester -V.A.G 1342-
- Voltage tester -V.A.G 1527 B-
- Auxiliary measuring set -V.A.G 1594 C-



Test prerequisites

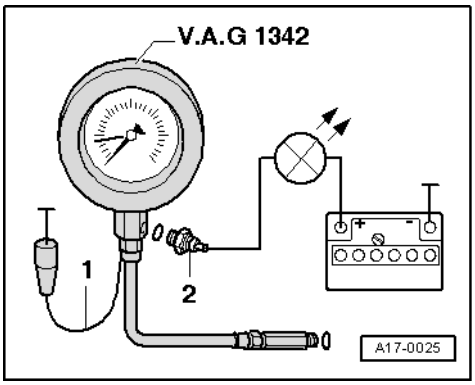
- Check whether oil level OK
- Engine oil temperature at least 80°C.

Test procedure

Note

Functional check and repair of the optical oil pressure gauge, current flow diagrams.

– Pull connector off oil pressure switch -F1-.



– Remove oil pressure switch -F1- -2- and screw into oil pressure tester -V.A.G 1342-.
– Screw tester into oil filter bracket in place of oil pressure switch.
– Connect brown wire -1- of tester to earth (-).
– Connect voltage tester -V.A.G 1527 B- to battery positive (+) and oil pressure switch using cables from auxiliary test set -V.A.G 1594 C-.

● LED must not light up.

If the LED lights up:

– Replace oil pressure switch -F1-

● Specified torque: 22 Nm

If LED does not light up:

– Start engine and increase revolutions slowly.

● From 0.30…0.60 bar the LED must light up, otherwise renew oil pressure switch -F1-.

Checking oil pressure

Prerequisite

● Oil pressure tester -V.A.G 1342- is connected.

Test procedure

– Increase engine speed further.

● At 2000 rpm and an oil temperature of 80 °C, the oil pressure should be at least 1.5 bar.
● At higher engine speeds, the oil pressure must not exceed 5.0 bar.

If specification is not attained:

– Renew oil pump if necessary.

Note

Mechanical damage, e.g. to bearings, could also be the cause for oil pressure being too low.

19 - Cooling

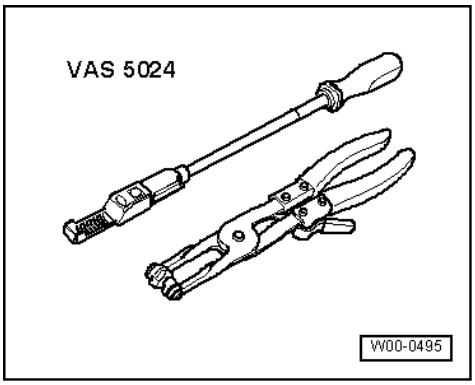
1 Removing and installing parts of cooling system

> ⚠ ***WARNING***
>
> ***Adhere to the general safety regulations and the notes on repair work on the engine!*** ⇒ **Page 1**

> ⚠ ***WARNING***
>
> ***When doing any repair work, pay attention to the following due to the cramped conditions:***
>
> - ***Adhere to the general safety precautions, and never take any risk.***
> - ***The engine is a hazardous area and can cause serious injuries.***
> - ***Never leave any objects in the engine compartment, such as cleaning cloths or tools.***
> - ***Many engine components become hot during operation – risk of burns. If necessary, provide appropriate protective means.***
> - ***Servicing materials, such as fuel, engine oils or coolant additive, are harmful substances; adhere to the safety instructions from the manufacturer.***
> - ***There is a risk of injuries, if maintenance locations are difficult to access. This risk can be reduced, by installing the engine in an appropriate location and by avoiding sharp edges.***
> - ***Route all the various lines (e.g. for fuel, hydraulics, coolant and refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.***
> - ***Ensure that there is sufficient clearance to all moving or hot components.***
> - ***Tools are to be checked for damage and safety risks on a regular basis.***

Note

- *Hoses are secured with spring-type clips. In case of repair, only use spring-type clips.*
- *Spring-type clip pliers -VAS 5024- are recommended for installation of spring-type clips.*
- *When the engine is warm, the cooling system is under pressure. If necessary, release pressure before beginning repair work.*
- *When installing coolant hoses, route stress-free so that they do not come into contact with other components (observe markings on coolant connection and hose).*
- *Perform leakage test of cooling system using cooling system tester -V.A.G 1274- and adapters -V.A.G 1274/8- and -V.A.G 1274/9-* ⇒Page 292.



Parts of cooling system - engine side ⇒Page 278.

Coolant hose schematic diagram ⇒Page 280

Draining and filling with coolant ⇒Page 284.

Coolant in mixture ratios ⇒Page 284, Draining and filling coolant.

Removing and installing coolant pump ⇒Page 287.

Removing and installing 4/2-way valve with thermostat ⇒Page 290.

Checking cooling system for leaks ⇒Page 292.

Checking oil cooler for leaks ⇒Page 293

1.1 Parts of cooling system, engine side, engine codes CJDA, CJDD

1 - Gasket
- ❑ Renew

2 - Connection
- ❑ Coolant hose schematic diagram ⇒Page 280.

3 - 9 Nm

4 - Retaining clip

5 - Coolant temperature sender -G62-
- ❑ For engine control unit -J623-.
- ❑ Before removing, release pressure in cooling system if necessary.
- ❑ Check ⇒Page 407

6 - O-ring
- ❑ Renew

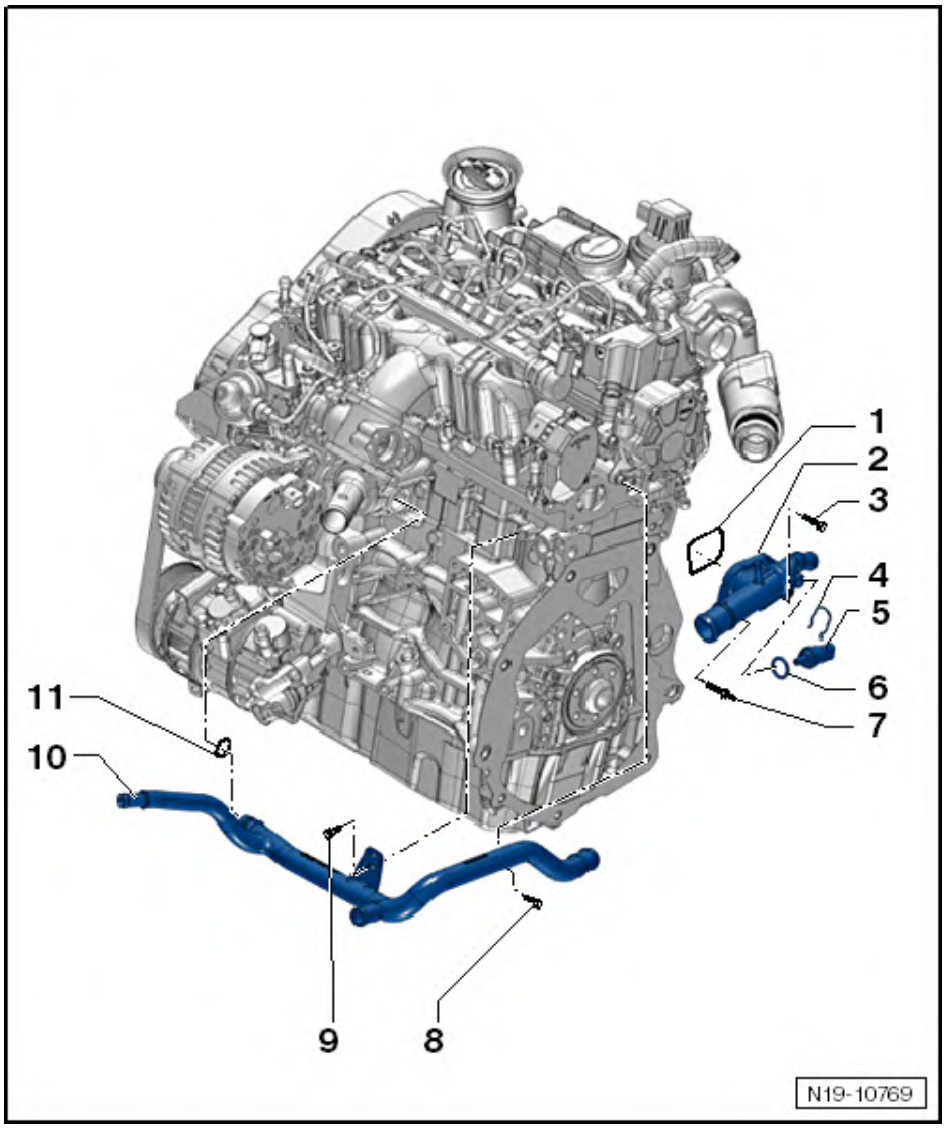
7 - Centre hex stud, 9 Nm

8 - 40 Nm

9 - 13 Nm

10 - Coolant pipe
- ❑ Coolant hose schematic diagram ⇒Page 280.

11 - O-ring
- ❑ Renew



1.2 Parts of cooling system, engine side, engine codes CPYA, CPYB, CPYC, CPYD, CPYE

1 - Gasket
- ❑ Renew

2 - Connection
- ❑ Coolant hose schematic diagram ⇒Page 280.

3 - 9 Nm

4 - Retaining clip

5 - Coolant temperature sender -G62-
- ❑ For engine control unit -J623-.
- ❑ Before removing, release pressure in cooling system if necessary.
- ❑ Check ⇒Page 407

6 - O-ring
- ❑ Renew

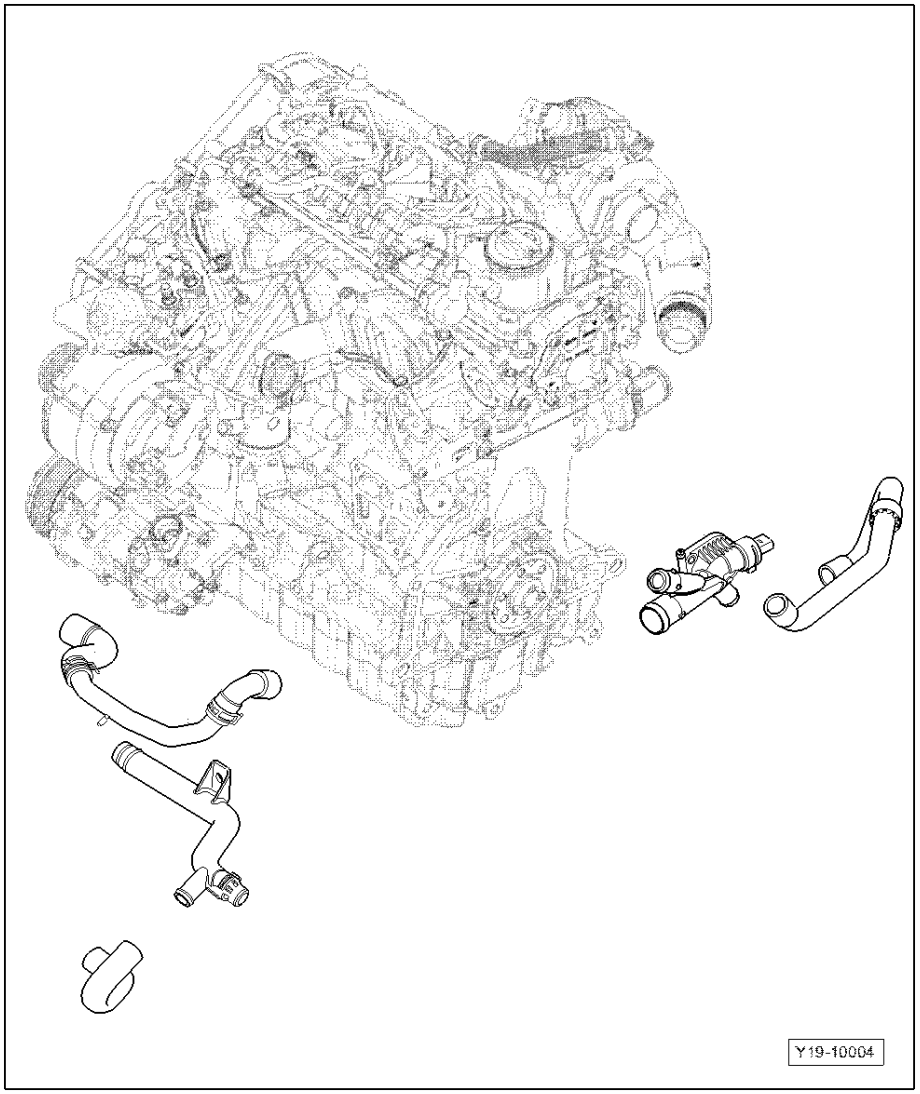
7 - Centre hex stud, 9 Nm

8 - 40 Nm

9 - 13 Nm

10 - Coolant pipe
- ❑ Coolant hose schematic diagram ⇒Page 280.

11 - O-ring
- ❑ Renew



1.3 Coolant hose schematic diagram

1 - Expansion tank

2 - Cylinder head/cylinder block

3 - Exhaust gas recirculation valve

4 - Heat exchanger for heater, optional

5 - Connection

- ❑ On cylinder head.

6 - Engine oil cooler

7 - Coolant return hose

- ❑ To radiator

8 - Radiator

9 - Coolant supply hose

- ❑ To thermostat with 4/2-way valve

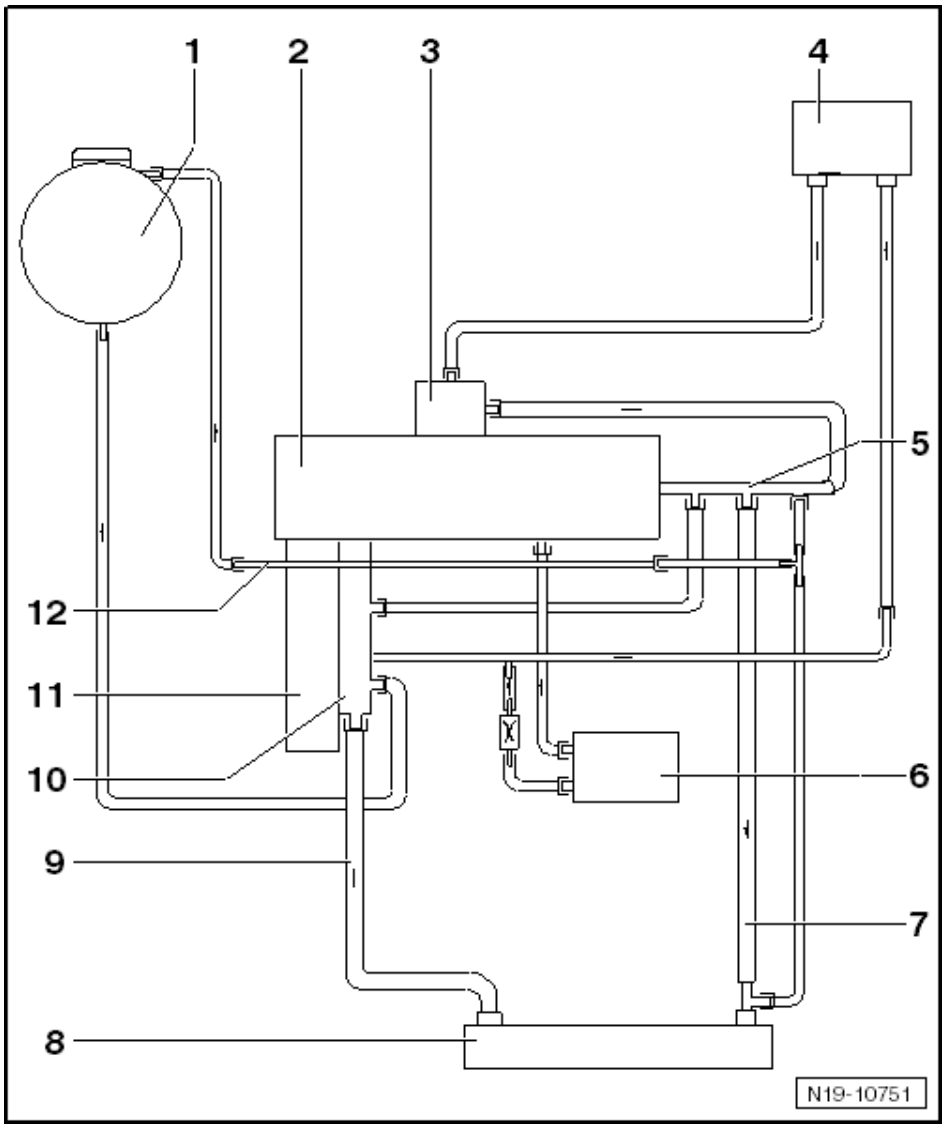
10 - 4/2-way valve

- ❑ Removing and installing 4/2-way valve ⇒ Page 290.

11 - Coolant pump

12 - Breather pipe

- ❑ To expansion tank.



1.4 Cooling system: Check frost protection and coolant level

- Checking frost protection, replenishing coolant additive if necessary ⇒ Page 281
- Checking coolant level, replenishing coolant additive if necessary ⇒ Page 282

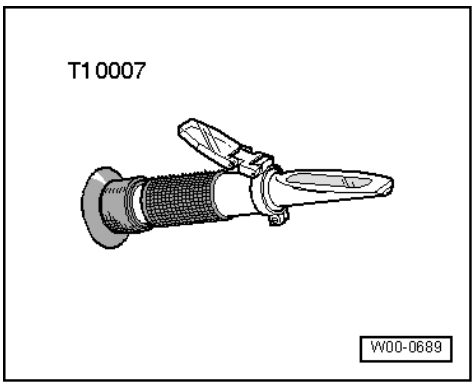
1.4.1 Checking frost protection, replenishing coolant additive if necessary

Note

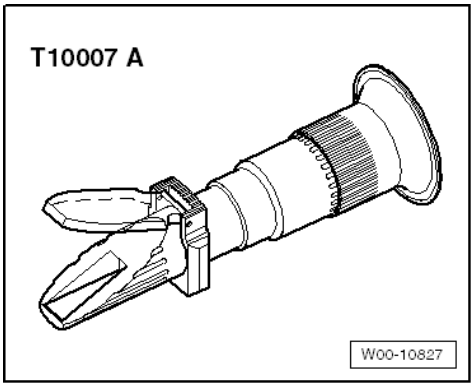
- *Replenish only new coolant according to the Volkswagen specification.*
- *The coolant level must be between the marks on the coolant expansion tank. Do not fill up over the top line of the marked area.*
- *Close the cap firmly.*
- *For engines as of model year 2008, only G 12 plus-plus according to TL VW 774 G may be used as coolant additive.*
- *Coolant additive G 12 plus-plus must only be mixed with G 12 plus! Identification: both are coloured purple.*
- *Coolant additives marked “according to TL VW 774 G” or “according to TL VW 774 F” prevent frost and corrosion damage, scaling and also raise boiling point of coolant. Therefore, the cooling system must be filled all year round with frost and corrosion protection additives.*
- *Because of its higher boiling point, the coolant improves engine reliability under heavy loads, particularly in countries with tropical climates.*
- *Frost protection is required down to about -25°C (in countries with arctic climates: down to about -35°C).*
- *The coolant concentration must not be reduced by adding distilled water even in the warm season or in hot countries. The coolant additive concentration must be at least 40%.*
- *If for climatic reasons greater frost protection is required, the amount of G 12 plus-plus can be increased, but only up to 60% (frost protection to about -40 °C). Otherwise frost protection and cooling effectiveness are reduced again.*
- *The refractometer -T10007- is recommended for determining the current anti-freeze density.*
- *If radiator, heat exchanger, cylinder head or cylinder head gasket is renewed, do not reuse old coolant.*

Special tools and workshop equipment required

- Refractometer -T10007- or



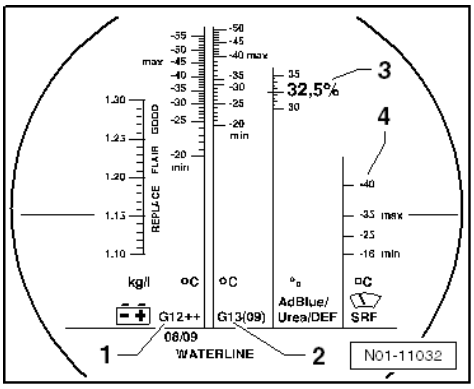
◆ Refractometer -T10007 A-



Note

Read precise value for the following tests at bright/dark boundary. Using a pipette, place a drop of water on the glass to improve the readability of the bright/dark boundary. The bright/dark boundary can be clearly recognised on the “WATERLINE”.

– Check concentration of coolant additive using refractometer -T10007- (refer to operating manual) or refractometer -T10007 A- (refer to operating manual).



The scale -1- of the refractometer is calibrated for coolant additives G 11; G 12; G 12+ und G 12++.

The scale -2- is only calibrated for coolant additive G13.

Note

◆ *The frost protection must be guaranteed to approx. -25 °C.*

◆ *If a stronger anti-freeze mixture is necessary due to harsher weather conditions, it can be increased using G 12+ or G 12++. But increase it only to 60 % (frost protection to approx. -40°C), otherwise frost protection and cooling effectiveness are reduced again.*

– If frost protection is insufficient, drain coolant and top up with coolant additive G 12++ ⇒Page 282.

Note

Observe environmental regulations for disposal.

Caution

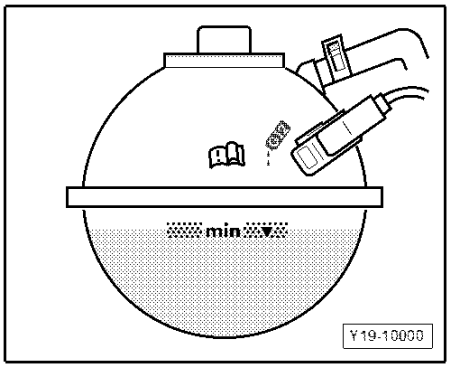
Only distilled water may be used for mixing. Tap or well water does not have the required quality to ensure the effectiveness of coolant.

– Check coolant additive concentration after road test again.

1.4.2 Checking coolant level, replenishing coolant additive if necessary

– Check coolant level in coolant expansion tank when the engine is cold.

◆ Delivery inspection: coolant level above “min.” marking.



◆ Inspection service: coolant level above “min.” marking.

– If coolant is too low, add required amount according to mixture ratio.

Note

If fluid loss is greater than can be expected through normal use, determine source and rectify (repair measure).

1.4.3 Mixture ratio:

Caution

Only distilled water may be used for mixing. Tap or well water does not have the required quality to ensure the effectiveness of coolant.

Frost protection to	Coolant additive G 12+ and G 12++	Water[1)]
-25 °C	approx. 40%	approx. 60%
-35°C	approx. 50%	approx. 50%
-40°C	approx. 60%	approx. 40%

1) Only use distilled water.

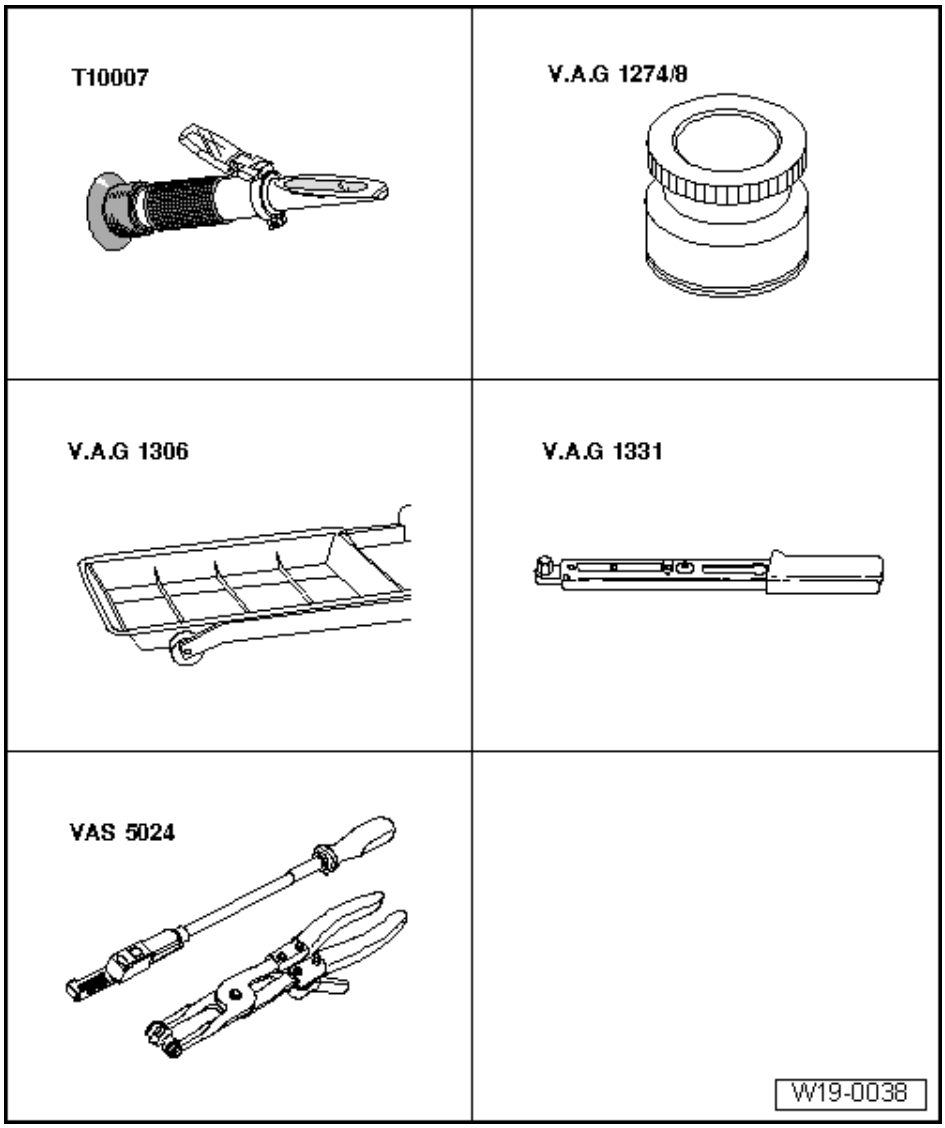
Note

- *Coolant additives G 12+ and G 12++ prevent frost and corrosion damage, limescale and also raise the boiling point. Therefore, the cooling system must be filled all year round with frost and corrosion protection additives.*
- *Because of its higher boiling point, the coolant improves engine reliability under heavy loads, particularly in countries with tropical climates.*
- *The coolant concentration must not be reduced by adding distilled water even in the warm season or in hot countries. The antifreeze portion must be at least 40%.*

1.5 Draining and filling coolant

Special tools and workshop equipment required

- Refractometer -T10007-
- Adapter -V.A.G 1274/8-
- Drip tray -V.A.G 1306- or drip tray -VAS 6208-
- Torque wrench (5…50 Nm) -V.A.G 1331-
- Spring-type clip pliers -VAS 5024-



Not illustrated:

- Cooling system charge unit -VAS 6096 -
- Coolant additive G 12 - according to TL “VW 774 F”

Draining ⇒ Page 284.

Filling ⇒ Page 285.

1.5.1 Draining

– Make sure to catch any escaping coolant. Place a drip tray -V.A.G 1306- or drip tray -VAS 6208- under locations where coolant may escape.

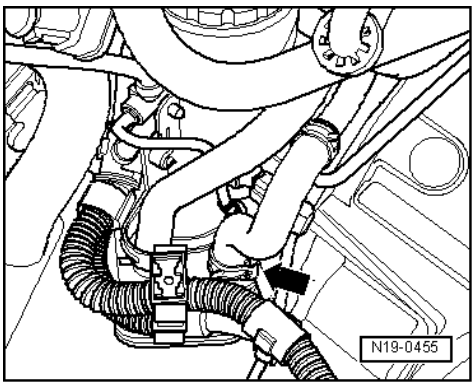
– Open cap on coolant expansion tank.

> ⚠ ***WARNING***
>
> ***Hot steam may escape when expansion tank is opened. Place rag over cap and open with caution.***

– Pull lower coolant hose off radiator. If necessary, use assembly tool for spring-type clips -VAS 5024- for this.

Engine codes CJDA, CJDD

– To drain coolant from engine, also remove coolant hose from oil cooler -arrow-.

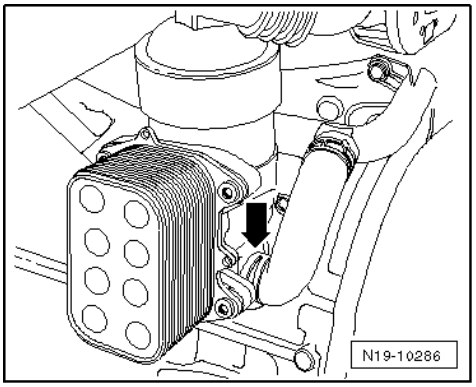


Note

Follow disposal regulations for coolant!

Engine codes CPYA, CPYB, CPYC, CPYD, CPYE

In addition to draining coolant from engine, pull coolant hose from oil filter bracket -arrow-.



Note

Follow disposal regulations for coolant!

1.5.2 Filling

Note

When mixing the coolant, only used demineralised or distilled water to standard VDE 0510. Tap water must no longer be used!

Note

The water used in the coolant mixture has a great influence on its effectiveness. Because the water quality differs from country to country and even region to region, Volkswagen has decided to define the quality of the water to be used in the coolant system. Distilled water fulfils all requirements. It is therefore recommended that distilled water be mixed with the coolant whenever an older model's coolant is replenished or replaced. For newer engines (model year 2010 ►) the use of distilled water is absolutely essential and compulsory.

Caution

Only distilled water may be mixed with G12 plus-plus. The use of distilled water ensures optimum protection against corrosion.

Note

- *Use only coolant additive G 12 plus-plus in accordance with TL VW 774 G.*
- *It is only permissible to use distilled water for mixing.*
- *Coolant additives marked "in accordance with TL VW 774 G" prevent lime accretion, frost damage and corrosion. Moreover, the boiling temperature is raised. Therefore, the cooling system must be filled all year round with coolant additive.*
- *Because of its higher boiling point, the coolant improves engine reliability under heavy loads, particularly in countries with tropical climates.*
- *Frost protection is required down to about -25°C (in countries with arctic climates: down to about -35°C).*
- *The coolant concentration must not be reduced by adding water even in warmer seasons and in warmer countries. The coolant additive concentration must be at least 40%.*
- *If a stronger anti-freeze mixture is necessary due to harsher weather conditions, it can be increased using G 12 plus-plus. It may be strengthened, however, only to 60% (anti-freeze protection to about -40°C). Otherwise, the antifreeze protection will be reduced again and the cooling effect will be impaired.*
- *If radiator, heat exchanger, cylinder head or cylinder head gasket is renewed, do not reuse old coolant.*
- *The refractometer -T10007- is recommended for determining the current anti-freeze density.*

Recommended mixture ratios

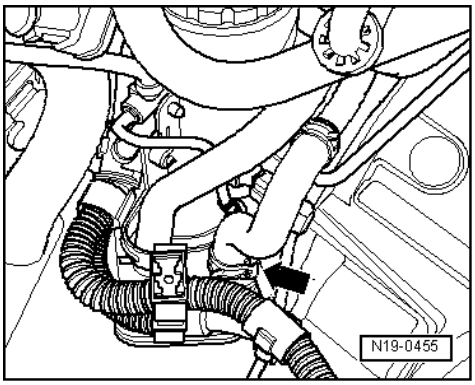
Frost protection to	Anti-freeze proportion	G 12 plus-plus [1)]	Distilled water[1)]
-25 °C	40 %	3.2 l	4.8 l
-35°C	50 %	4.0 l	4.0 l

1) The quantity of coolant may vary depending upon equipment. Observe specifications of machine manufacturer.

– Secure lower coolant hose to connecting piece of radiator.

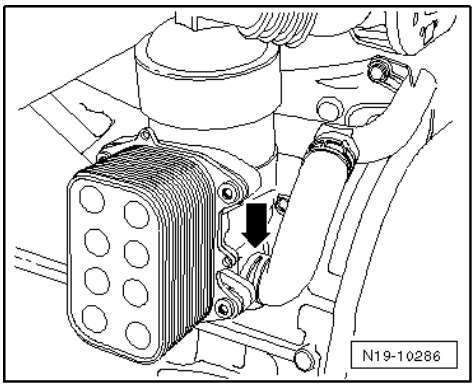
Engine codes CJDA, CJDD

– Connect coolant hose -arrow- to oil cooler.



Engine codes CPYA, CPYB, CPYC, CPYD, CPYE

Connect coolant hose -arrow- to oil filter bracket.



Continuation for all engine codes

With cooling system charge unit -VAS 6096-

– Screw adapter -V.A.G 1274/8- onto expansion tank.

– Fill coolant circuit using cooling system charge unit -VAS 6096-, refer to ⇒ Operating manual for cooling system charge unit -VAS 6096-.

Without cooling system charge unit -VAS 6096-

– Fill with coolant slowly up to max. mark on expansion tank.

With and without cooling system charge unit -VAS 6096-

– Fit expansion tank cap.

– Start engine and maintain an engine speed of about 2,000 rpm for about 3 minutes.

– Run engine until radiator fan cuts in.

> ⚠ ***WARNING***
>
> ***Hot steam may escape when expansion tank is opened. Place cloth over cap and open with caution.***

– Check coolant level and top-up if necessary. When the engine is at normal operating temperature, the coolant level must be at the max. mark; when the engine is cold, between the min. and max. marks.

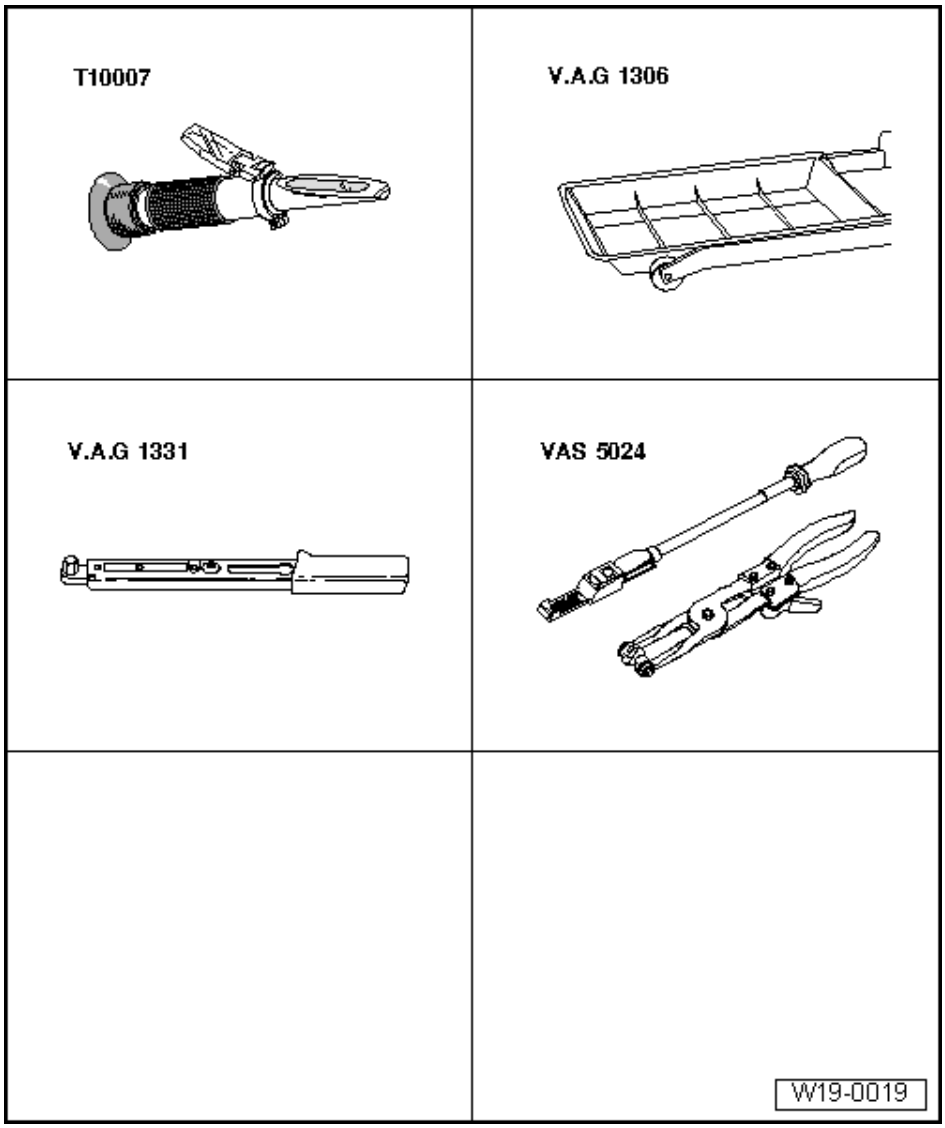
1.6 Renewing coolant pump, engine codes CJDA, CJDD, CPYA, CPYB, CPYC, CPYD, CPYE

Renewing coolant pump, engine codes CPYA, CPYB, CPYC, CPYD, CPYE, CJDA, CJDD ⇒Page 288.

1.6.1 Renewing coolant pump, engine codes CJDA, CJDD, CPYA, CPYB, CPYC, CPYD, CPYE

Special tools and workshop equipment required

- Refractometer -T10007-
- Drip tray -V.A.G 1306- or drip tray -VAS 6208-
- Torque wrench (5…50 Nm) -V.A.G 1331-
- Spring-type clip pliers -VAS 5024-



Removing

Note

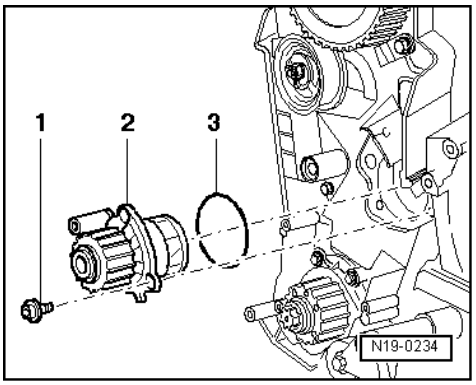
Always renew seals and gaskets.

– Drain coolant.

– Remove poly V-belt.

– Remove toothed belt; Removing, installing and tensioning toothed belt.

– Remove securing bolts -1- for coolant pump -2- and carefully remove coolant pump.

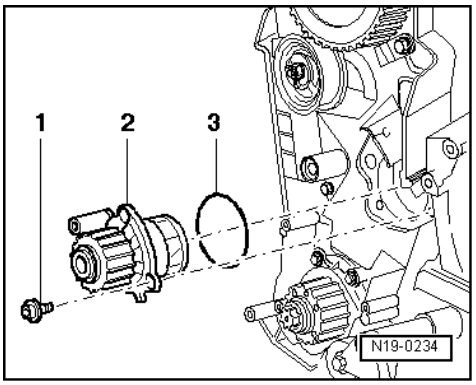


Installing

Installation is carried out in the reverse order. When installing, note the following:

– Moisten new O-ring -3- with coolant.

– Insert coolant pump -2- in cylinder block, and tighten securing bolts -1- to 15 Nm.



Note

The coolant pump plug faces downwards.

– Install and tension toothed belt.

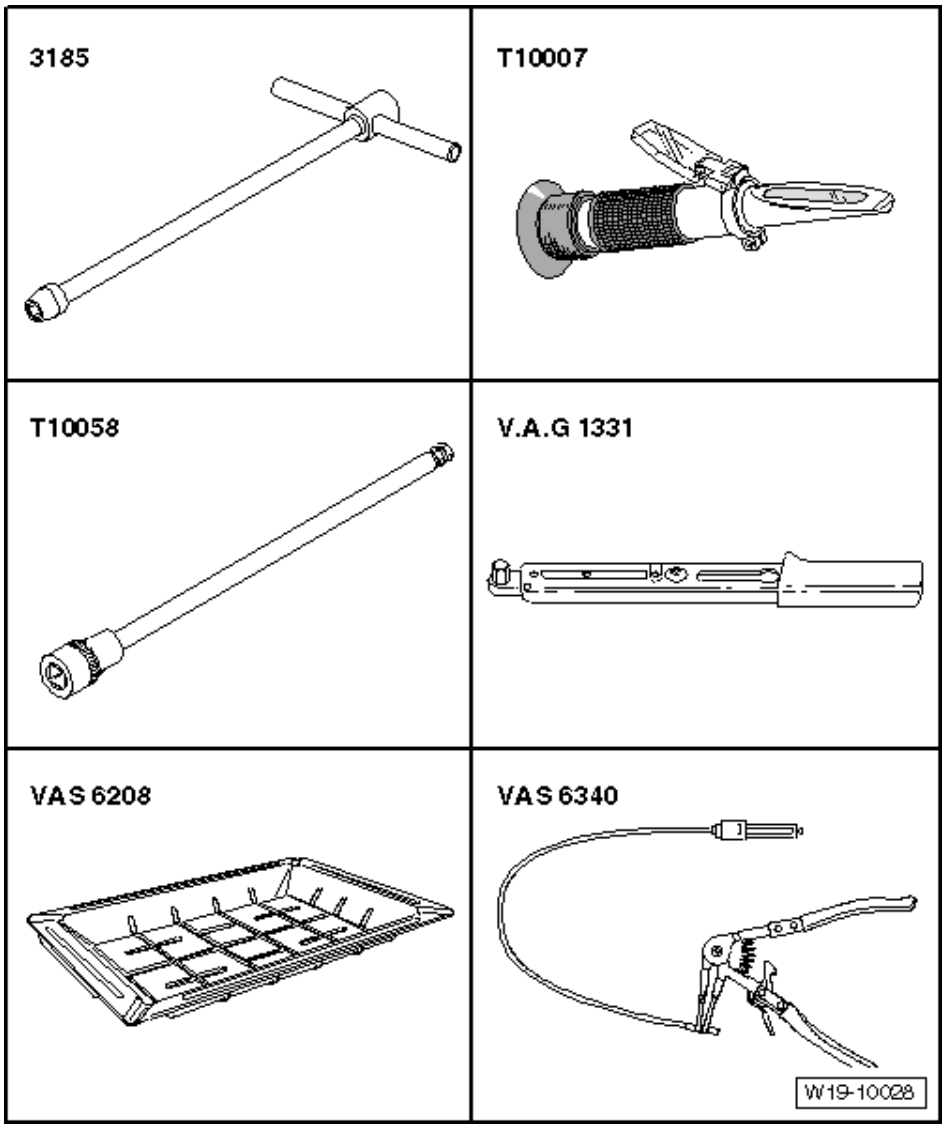
– Install poly V-belt.

– Fill with coolant.

1.7 Removing and installing 4/2-way valve with thermostat

Special tools and workshop equipment required

- 10 mm jointed spanner -3185-
- Refractometer -T10007-
- Allen key, long reach 5 mm -T10058-
- Torque wrench -V.A.G 1331/-
- Drip tray for workshop hoist -VAS 6208-
- Hose clip pliers -VAS 6340-



Removing

Note

The thermostat is located within the 4/2-way valve and cannot be replaced individually.

– Drain coolant ⇒Page 284.

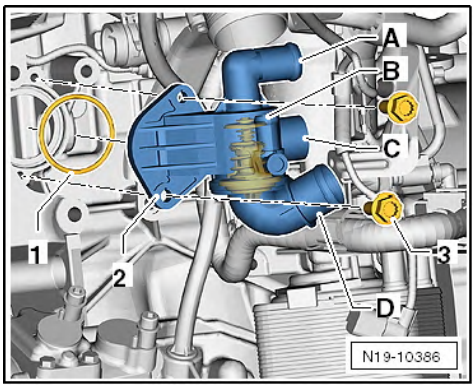
– Remove alternator ⇒Page 471

– Remove any required coolant lines, coolant pipes, components of the charge air system as well as electrical lines to allow for removing 4/2-way valve.

– If necessary, remove throttle valve module -J338- ⇒Page 355.

– If necessary, remove dipstick guide tube ⇒Page 157.

– Pull coolant hoses off connections -A, B and D-.
– Pull coolant pipe out of connection -C-.
– Remove securing bolts -3- for 4/2-way valve -2-.
– Pull valve out of cylinder block and then to the left to subsequently separate connection -C- from coolant pipe.



Installing

Installation is carried out in the reverse order. When installing, note the following:

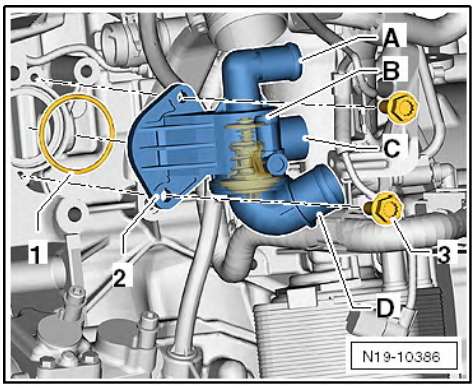
Note

Clean sealing surfaces. Renew gaskets and seals.

– First seat 2-way valve with connection -C- on coolant pipe then insert into cylinder block.
– Insert securing bolts -3-, and tighten them to 15 Nm.
– Connect coolant hoses as follows:

◆ -A-: Bypass line to cylinder head
◆ -B-: Expansion tank
◆ -D-: Radiator return line

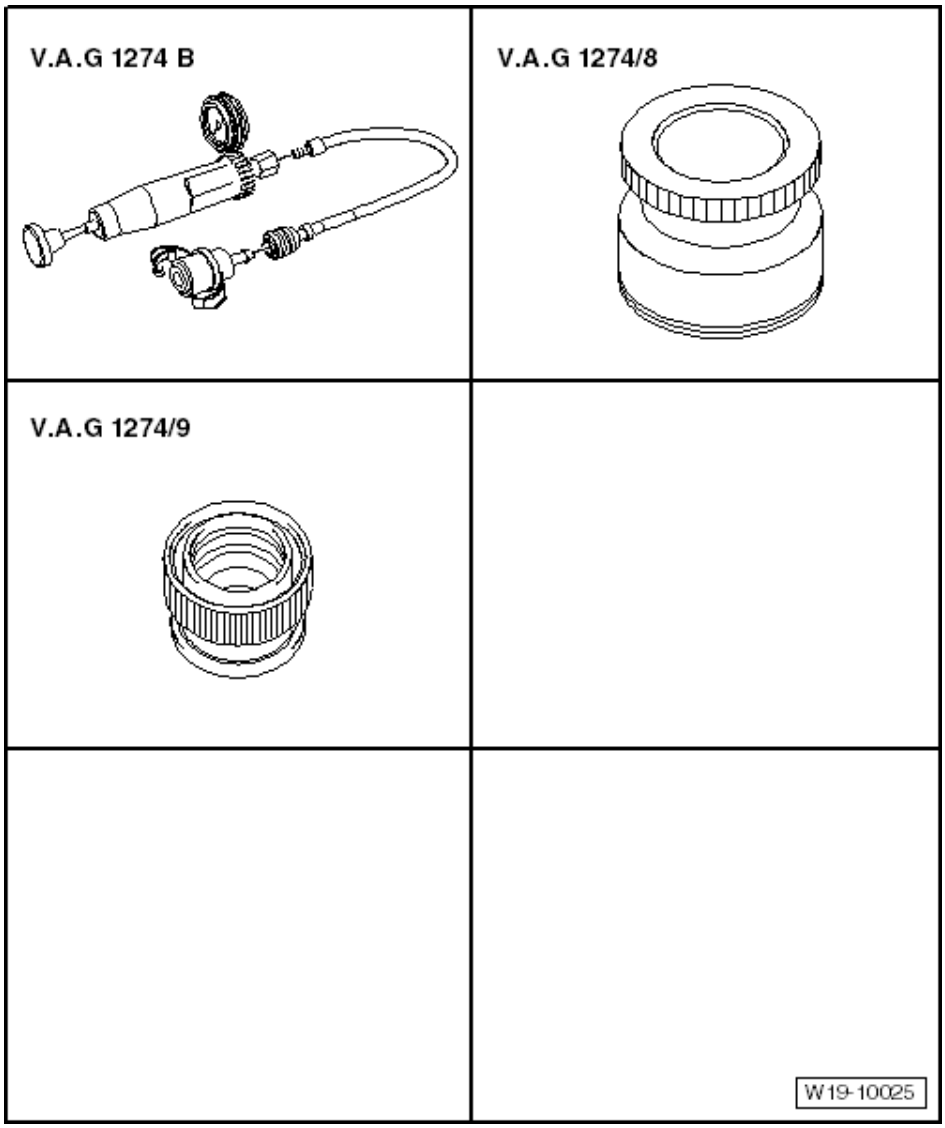
– Fill cooling system ⇒Page 284.
– Install throttle valve module -J338- ⇒Page 355.
– Install alternator ⇒Page 471.



1.8 Checking cooling system for leaks

Special tools and workshop equipment required

- Cooling system tester -V.A.G 1274 B-
- Adapter for cooling system tester -V.A.G 1274/8-
- Adapter for cooling system tester -V.A.G 1274/9-



Test prerequisite

- Engine at operating temperature.

Test procedure

> ⚠ ***WARNING***
>
> ***Steam may escape when expansion tank is opened. Wear eye protection and protective clothing to avoid eye injuries and scalding. Cover cap with cloth and open carefully.***

– Open filler cap on coolant expansion tank.

– Screw adapter for cooling system tester -V.A.G 1274/8- into coolant expansion tank.

– Clamp connector -V.A.G 1274 B/1- into adapter for cooling system tester -V.A.G 1274/8-.

– Using connecting hose supplied, join connection piece -V.A.G 1274 B/1- to cooling system tester -V.A.G 1274 B-.
– Using hand pump on tester, build up a pressure of approx. 1.0 bar.

> ⚠ ***DANGER!***
>
> ***Risk of scalding! Before the cooling system tester -V.A.G 1274 B- is disconnected from the connecting hose or the connection piece -V.A.G 1274 B/1-, it is essential that the pressure is first relieved. To do this, press pressure relief valve on cooling system tester -V.A.G 1274 B- until pressure gauge displays value of "0".***

If pressure drops:

– Find leaks and rectify.

Checking pressure relief valve in filler cap

– Screw sealing cap into adapter for cooling system tester -V.A.G 1274/9-.
– Clamp connector -V.A.G 1274 B/1- into adapter for cooling system tester -V.A.G 1274/9-.
– Using connecting hose supplied, join connection piece -V.A.G 1274 B/1- to cooling system tester -V.A.G 1274 B-.
– Using hand pump on cooling system tester, build up a pressure of approx. 1.6 bar.

The pressure relief valve must not open.

If the pressure relief valve opens prematurely:

– Renew cap.
– Increase pressure to over 1.6 bar.

The pressure relief valve must open.

If the pressure relief valve does not open:

– Renew cap.

1.9 Checking oil cooler for leaks

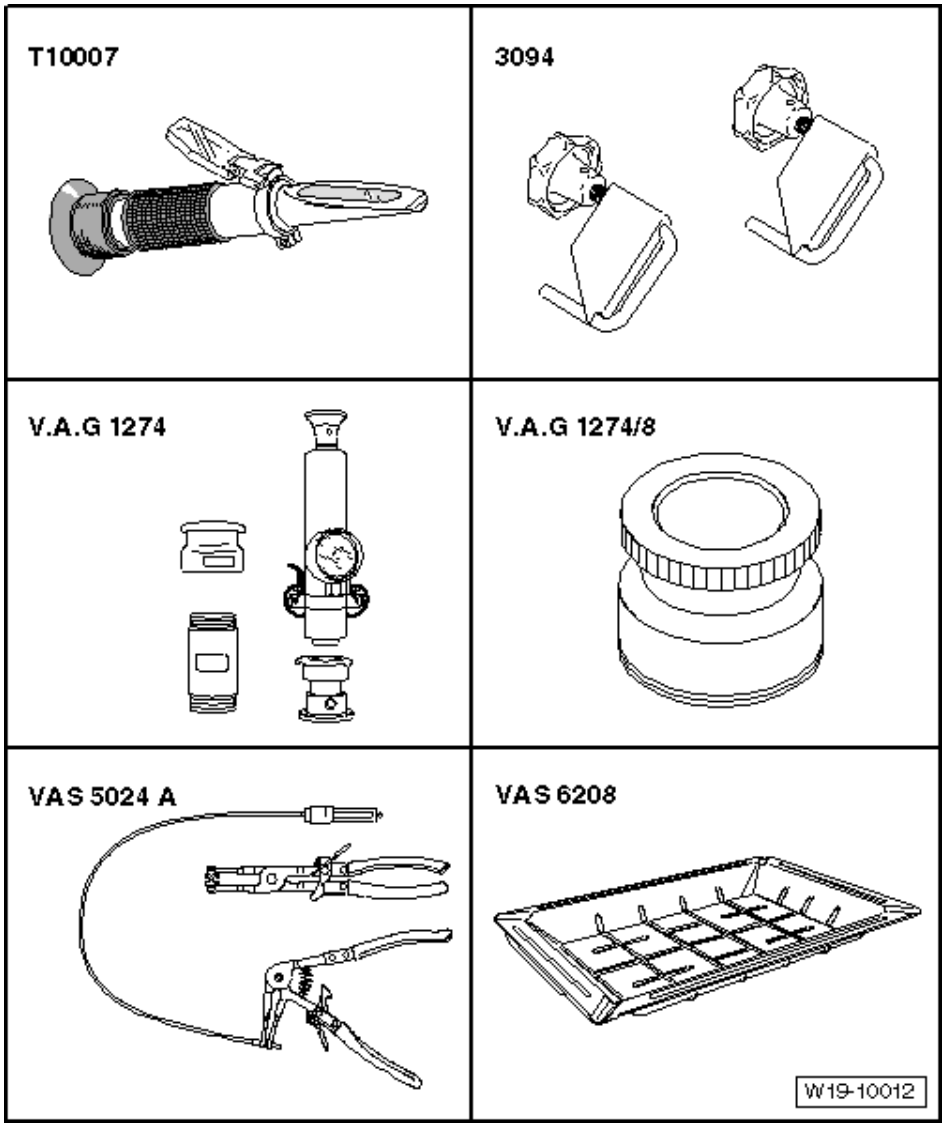
Engine codes CJDA, CJDD ⇒Page 294.

Engine codes CPYA, CPYB, CPYC, CPYD, CPYE ⇒Page 296.

1.9.1 Engine codes CJDA, CJDD

Special tools and workshop equipment required

- Refractometer -T10007-
- Hose clips, up to 25 mm in diameter -3094-
- Cooling system tester -V.A.G 1274-
- Adapter for cooling system tester -V.A.G 1274/8-
- Spring-type clip pliers -VAS 5024 A-
- Drip tray -V.A.G 1306- or drip tray -VAS 6208-



Not illustrated:

- Torque wrench (5…50 Nm) -V.A.G 1331-
- Expansion tank -1K0 121 407 A bzw. 6Q0 121 407 A bzw. 1J0 121 407 B-
- Plug -191 211 343-
- Cap -1J0 121 324-
- Coolant hose -251 265 056-

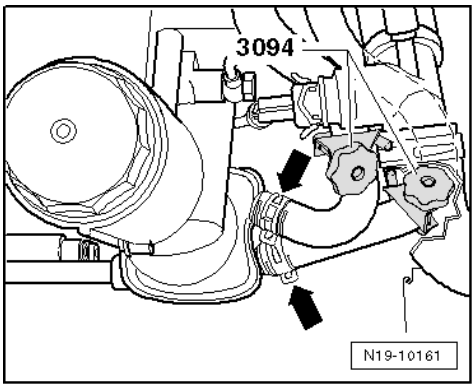
Prerequisite

- Engine cold

Test procedure

– Clamp off supply and return lines to oil cooler using hose clips, up to 25 mm -VAS 3094-.

– Loosen hose clips -arrows- using spring-type clip pliers -VAS 5024-.



Note

Collect escaping coolant with drip tray -V.A.G 1306- or drip tray -VAS 6208-.

– Pull coolant hoses off oil cooler.

– Slide sealing cap -5- onto rear connection of oil cooler -4-.

– Secure sealing plug -2- to breather connection of expansion tank -1-.

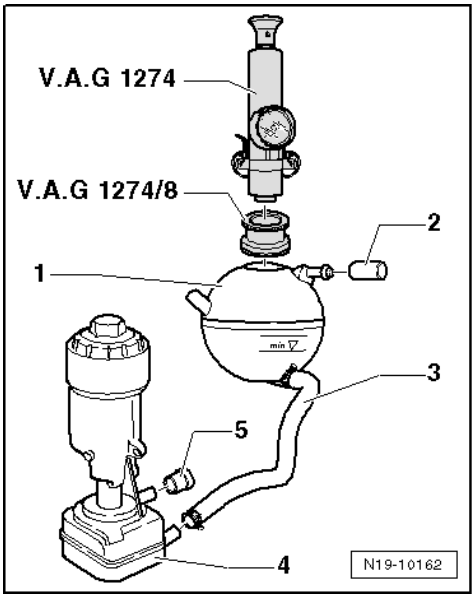
– Secure coolant hose -3- to oil cooler and expansion tank.

– Fill coolant expansion tank up to max. mark.

– Attach cooling system tester -V.A.G 1274- with cooling system tester adapter -V.A.G 1274/8- to expansion tank.

– Use hand pump on tester to create a pressure of about 1.6 bar.

– Watch pressure drop on pressure gauge. A pressure drop within 10 minutes is not permitted.



If pressure drops:

– Renew oil cooler ⇒Page 260, Assembly overview - oil filter bracket and oil cooler

Installation is carried out in the reverse order. When installing, note the following:

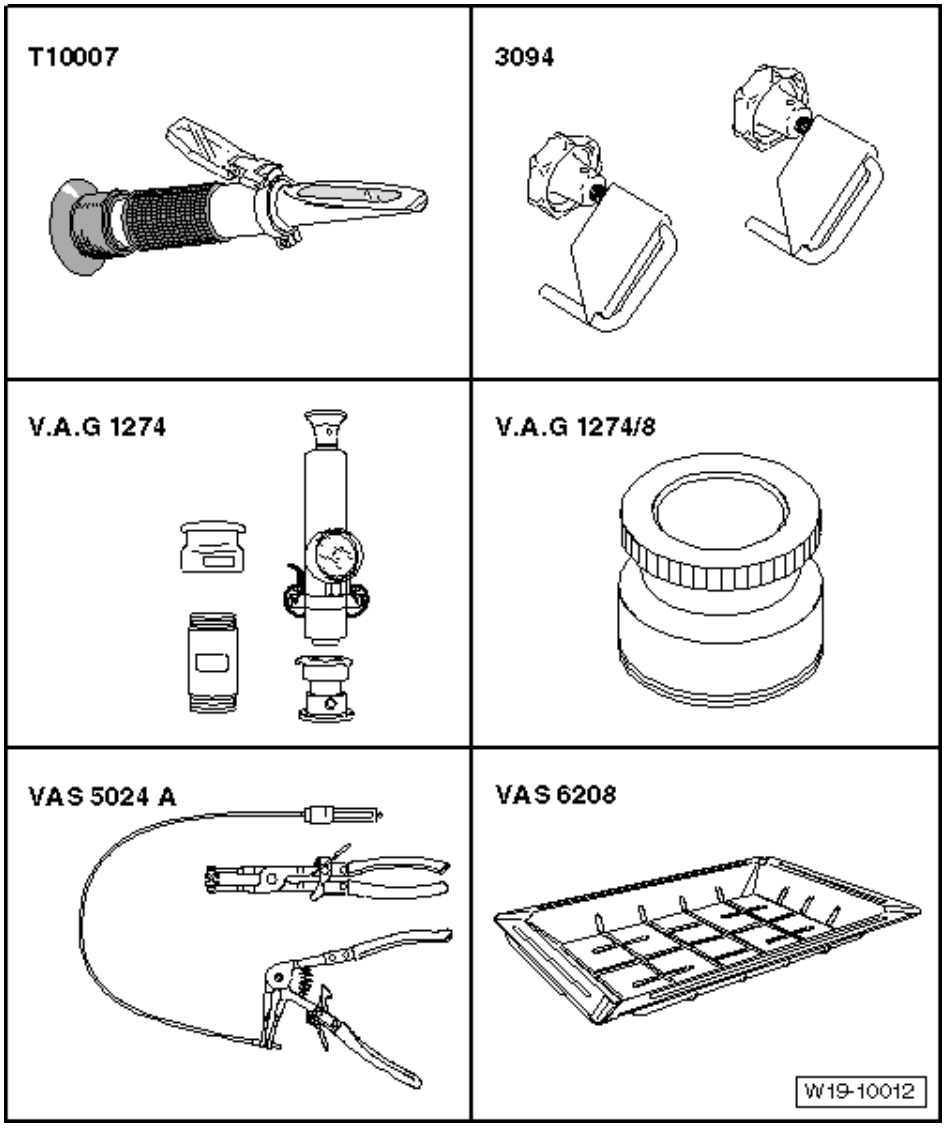
– Check coolant level, replenish coolant if necessary ⇒Page 284.

– Check engine oil level and, if necessary, replenish ⇒Page 244.

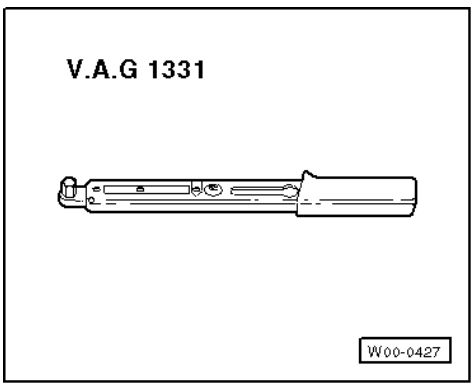
1.9.2 Engine codes CPYA, CPYB, CPYC, CPYD, CPYE

Special tools and workshop equipment required

- Refractometer -T10007-
- Hose clamps up to 25 mm -3094-
- Cooling system tester -V.A.G 1274-
- Adapter for cooling system tester -V.A.G 1274/8-
- Spring-type clip pliers -VAS 5024 A-
- Drip tray -V.A.G 1306- or drip tray for workshop hoist -VAS 6208-



- Torque wrench (5…50 Nm) -V.A.G 1331-



Not illustrated

- Expansion tank 1K0 121 407 A or expansion tank 1J0 121 407 B
- Plug 191 211 343
- Cap 1J0 121 324
- Coolant hose 251 265 056

Prerequisites:

- Engine cold

Test procedure

– Drain coolant ⇒ Page 284.

– Loosen hose clip on engine oil cooler with spring-type clip pliers -VAS 5024 A-.

Note

- *Collect escaping coolant with drip tray for workshop cranes -VAS 6208-.*
- *Collect leaking engine oil with an absorbent cleaning cloth, if necessary.*

Checking when removed

– Clamp the casing with the old gasket onto a suitable, flat clean surface with the help of a bar clamp -4-.

– Attach plug -2- to venting connection of expansion tank -1-.

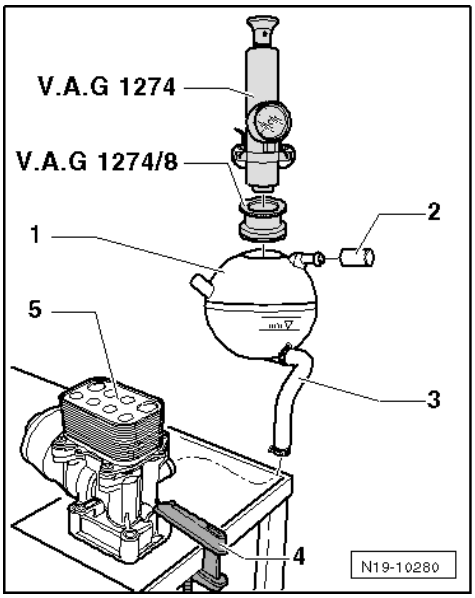
– Attach coolant hose -3- to engine oil cooler -5- and to expansion tank -1-.

– Fill expansion tank up to “max.” mark.

– Fit cooling system tester -V.A.G 1274- with adapter for cooling system tester -V.A.G 1274/8- on coolant expansion tank-1-.

– Using hand pump on tester, build up a pressure of approx. 1.6 bar.

– Observe pressure drop on pressure gauge. A pressure drop within 10 minutes is not permitted.



If pressure drops:

– Renew engine oil cooler.

Install in reverse order. In the process, note the following:

– Renew housing seal.

– Check coolant level and, if necessary, replenish ⇒Page 284.

– Check engine oil level and, if necessary, replenish ⇒Page 244.

20 - Fuel supply system

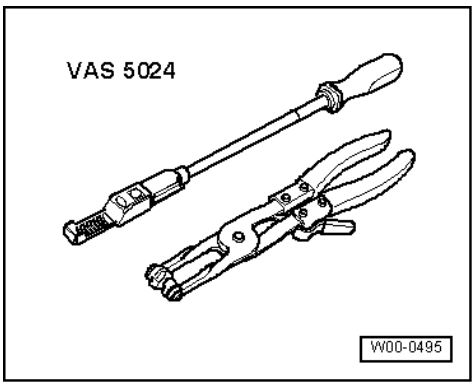
1 Removing and installing parts of fuel supply system

> ⚠ ***WARNING***
>
> ***Adhere to the general safety regulations and the notes on repair work on the engine!*** ⇒ **Page 1**

> ⚠ ***WARNING***
>
> ***When doing any repair work, pay attention to the following due to the cramped conditions:***
>
> - ***Adhere to the general safety precautions, and never take any risk.***
> - ***The engine is a hazardous area and can cause serious injuries.***
> - ***Never leave any objects in the engine compartment, such as cleaning cloths or tools.***
> - ***Many engine components become hot during operation – risk of burns. If necessary, provide appropriate protective means.***
> - ***Servicing materials, such as fuel, engine oils or coolant additive, are harmful substances; adhere to the safety instructions from the manufacturer.***
> - ***There is a risk of injuries, if maintenance locations are difficult to access. This risk can be reduced, by installing the engine in an appropriate location and by avoiding sharp edges.***
> - ***Route all the various lines (e.g. for fuel, hydraulics, coolant and refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.***
> - ***Ensure that there is sufficient clearance to all moving or hot components.***
> - ***Tools are to be checked for damage and safety risks on a regular basis.***

Note

- *Hose connections are secured with either spring-type or clamp-type clips.*
- *Always renew crimp-type clips with spring-type clips.*
- *Fuel hoses on engine must be secured with spring-type clips only. The use of crimp-type or screw-type clips is not permissible.*
- *Spring-type clip pliers -VAS 5024- are recommended for installation of spring-type clips.*



Safety precautions when working on fuel supply system ⇒Page 299.

Observe rules for cleanliness ⇒Page 300.

Assembly overview - fuel filter ⇒Page 304

Removing and installing upper part of fuel filter ⇒Page 308.

Removing and installing supplementary fuel pump -V393- (in-line electronic fuel pump) ⇒Page 313.

1.1 Safety precautions when working on fuel supply system

WARNING

When doing any repair work, pay attention to the following due to the cramped conditions:

- ***Route all the various lines (e.g. for fuel, hydraulics, activated charcoal filter system, coolant, refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.***
- ***Ensure that there is sufficient clearance to all moving or hot components.***
- ***The fuel and the fuel lines in the fuel system can become very hot (danger of scalding)!***
- ***The fuel system is also under pressure! Before opening the system, place cloths around the connections. Then carefully loosen connection to release the pressure!***
- ***Wear eye and hand protection when performing any type of repair work on the fuel system!***

Note the following when working on a full or partly filled fuel tank:

- Before beginning work, place an extraction hose close to sender opening in fuel tank to extract escaping fuel fumes and switch on exhaust extraction system. If no exhaust gas extraction system is available, a radial fan with a displacement greater than 15 m^3/h can be used providing that motor is not in air flow.
- Prevent skin contact with fuel! Wear fuel-resistant gloves!

⚠ ***WARNING***

Danger of burning from very hot fuel.

- ***In extreme cases, the fuel lines and the fuel can reach a temperature of 100 °C. Allow the fuel to cool down before disconnecting the lines - danger of scalding.***
- ***Wear protective gloves.***
- ***Wear eye protection.***

Risk of injury due to highly pressurised fuel.

- ***The fuel system is pressurised! Wear eye protection and protective clothing to avoid eye injuries and skin contact. Before loosening hose connections, wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.***

⚠ ***WARNING***

Do not damage fuel hoses in engine compartment.

1.2 Rules for cleanliness

When working on fuel supply and injection system, pay careful attention to the following “rules” for cleanliness:

- Thoroughly clean all unions and surrounding areas before disconnecting.
- Place removed parts on a clean surface and cover. Use only lint-free cloths.
- Carefully cover opened components or seal if repairs cannot be carried out immediately.
- Install clean components only. Do not remove replacement parts from packing until immediately before installing. Do not use parts that have not been stored in their packing (e.g. in tool boxes etc.).
- Existing transport and protective packaging and sealing caps must only be removed immediately prior to installation.
- When system is open: do not work with compressed air if this can be avoided. Do not move vehicle/machine unless absolutely necessary.
- Also ensure that no diesel fuel comes into contact with the coolant hoses. Should this occur, the hoses must be cleaned immediately. Damaged hoses must be renewed.

1.3 Procedure when filling with incorrect fuel

Caution

Irreversible damage to high-pressure components, especially the high-pressure pump due to lack of lubrication though diesel can occur when filling fuel tank with incorrect fuel. Damage due to seizure and metal particles can be expected. These metal particles will probably cause further damage to pressure regulating valves and injectors.

Note

These instructions are intended to guide you through the individual work steps by means of a flowchart, with various situations being taken into account.

Was the engine started with the incorrect fuel?

Yes ⇒ “Step 1 (Engine was started with incorrect fuel) ” on page 301

No ⇒ “Step 2 (Engine was not started with incorrect fuel) ” on page 302

Fuel system - ⇒ Page 358.

1.3.1 Step 1 (Engine was started with incorrect fuel)

– Empty fuel tank as far as possible via fuel filler neck using fuel extractor -VAS 5190-.

Engine codes CJDA, CJDD

Pull off fuel supply line to high-pressure pump ahead of strainer.

Engine codes CPYA, CPYB, CPYC, CPYD, CPYE

Pull fuel supply line from fuel pump -V393 (Inline EKP)- to fuel filter off fuel filter.

Continuation for all engine codes

– Put open end of line into a suitable container.

– Perform final control diagnosis, and activate fuel pump, ⇒ Page 89, final control diagnosis.

Note

The fuel pump is now activated.

– Repeat procedure, if necessary, until fuel tank is completely empty.

– Remove flange cover on fuel tank.

– Check fuel tank for filings according to manufacturer specifications, and drain any fuel from the fuel tank.

– Perform a visual inspection for foreign bodies and filings in strainer.

Metal particles found?

Yes ⇒ “Step 3 (There are filings in fuel tank and strainer)” on page 302

No ⇒ “Step 4 (There are no filings in fuel tank and strainer)” on page 303

1.3.2 Step 2 (Engine was not started with incorrect fuel)

– Empty fuel tank as far as possible via fuel filler neck using fuel extractor -VAS 5190-.

Engine codes CJDA, CJDD

Pull off fuel supply line to high-pressure pump ahead of strainer.

Engine codes CPYA, CPYB, CPYC, CPYD, CPYE

Pull fuel supply line from fuel pump -V393 (Inline EKP)- to fuel filter off fuel filter.

Continuation for all engine codes

– Put open end of line into a suitable container.

– Perform final control diagnosis, and activate fuel pump, ⇒ Page 89, final control diagnosis.

Note

The fuel pump is now activated.

– Repeat procedure, if necessary, until fuel tank is completely empty.

– Fill fuel tank with 5 litres of diesel fuel.

– Completely empty fuel tank again as described above.

– Reconnect fuel supply line to fuel filter.

– Fill up machine, and perform road test.

End

1.3.3 Step 3 (There are filings in fuel tank and strainer)

– Clean fuel tank in accordance with manufacturer specifications.

– Clean strainer.

– Fill fuel tank with 5 litres of diesel fuel.

– Completely empty fuel tank again as described above.

– Renew following high-pressure components:

◆ High-pressure pump ⇒ Page 380.

◆ High-pressure lines ⇒ Page 375.

◆ Fuel rail included ⇒ Page 362.

◆ Injector ⇒ Page 370.

◆ Fuel return lines (overflow oil lines) ⇒ Page 362.

◆ Fuel filter ⇒Page 304.

– Fill up machine.

– Bleeding fuel system ⇒Page 383.

– Perform road test.

End

1.3.4 Step 4 (There are no filings in fuel tank and strainer)

– Fill fuel tank with 5 litres of diesel fuel.

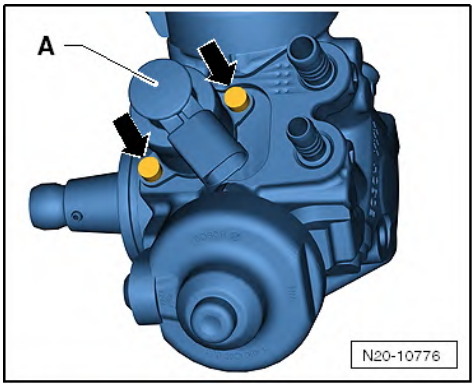
– Completely empty fuel tank again as described above.

– Renew high-pressure pump.

Caution

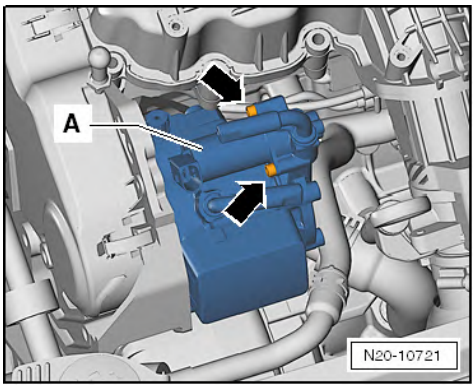
It is only permissible to do the following work when the defective high-pressure pump has been removed.

– Unscrew bolts -arrows- and remove fuel metering valve -N290- -A- from the OLD high-pressure pump.



or

– Check fuel metering valve -N290- and high-pressure pump for metal particles.



Metal particles found?

Yes ⇒“Step 5 (There are filings in high-pressure pump)” on page 303

No ⇒“Step 6 (There are no filings in high-pressure pump)” on page 304

1.3.5 Step 5 (There are filings in high-pressure pump)

– Renew following high-pressure components:

◆ High-pressure pump ⇒Page 380.

◆ High-pressure lines ⇒Page 375.

◆ Fuel rail included ⇒Page 362.

◆ Injector ⇒Page 370.

◆ Fuel return lines (overflow oil lines) ⇒Page 362.

◆ Fuel filter ⇒Page 304

– Fill up machine.

– Bleeding fuel system ⇒Page 383.

– Perform road test.

End

1.3.6 Step 6 (There are no filings in high-pressure pump)

– Replace fuel filter ⇒Page 304.

– Bleeding fuel system ⇒Page 383.

– Fill up machine, and perform road test.

End

1.4 Assembly overview - fuel filter

– Note safety precautions before beginning work ⇒Page 299.

– Observe rules for cleanliness ⇒Page 300.

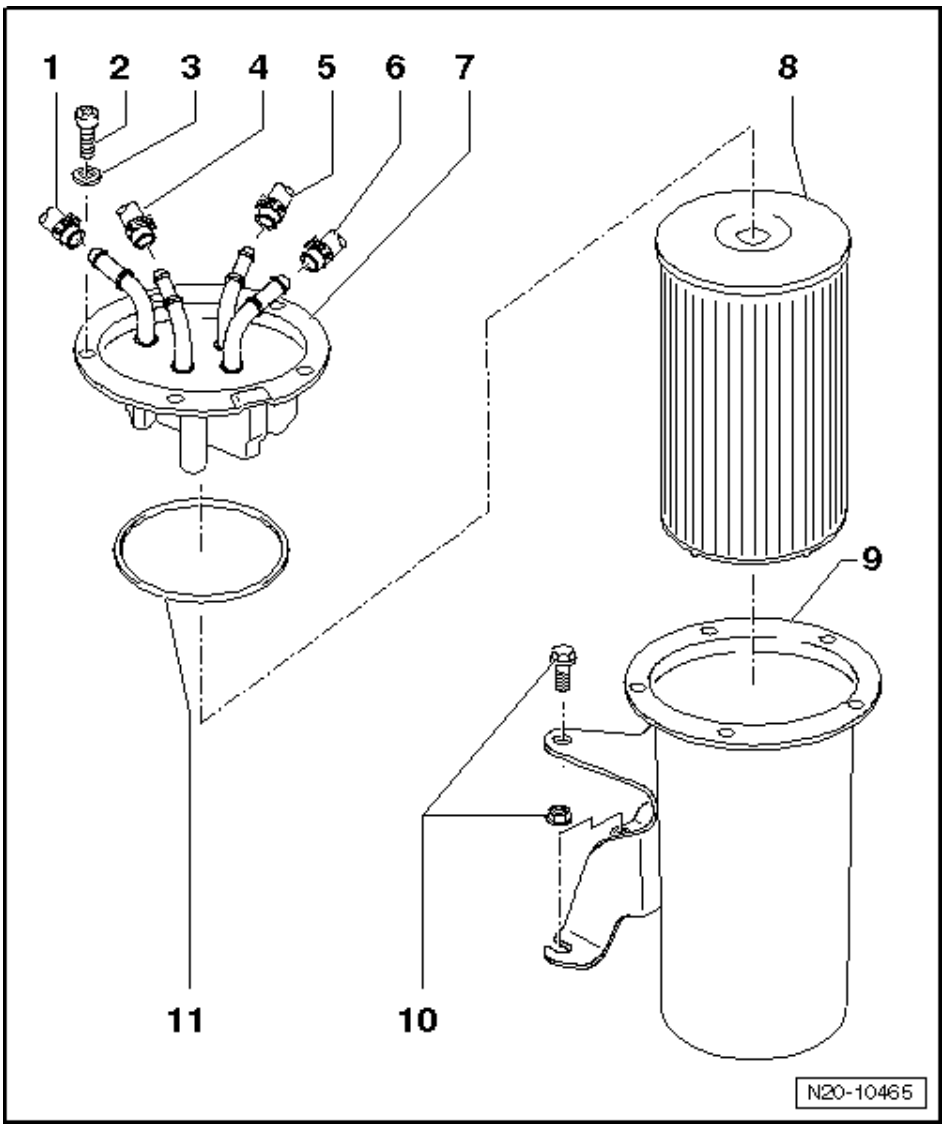
– Renew fuel filter ⇒Page 308.

Engine codes CJDA, CJDD ⇒Page 304.

Engine codes CPYA, CPYB, CPYC, CPYD, CPYE ⇒Page 307.

1.4.1 Engine codes CJDA, CJDD

Versions of upper part of fuel filter ⇒Page 305.



1 - Fuel line
- ❑ Make sure it is firmly seated
- ❑ Connection overview ⇒Page 305.

2 - 5 Nm

3 - Washer

4 - Fuel line
- ❑ Make sure it is firmly seated
- ❑ Connection overview ⇒Page 305.

5 - Fuel line
- ❑ Make sure it is firmly seated
- ❑ Connection overview ⇒Page 305.

6 - Fuel line
- ❑ Make sure it is firmly seated
- ❑ Connection overview ⇒Page 305.

7 - Upper part of fuel filter
- ❑ Observe various types ⇒Page 305
- ❑ Connection overview ⇒Page 305.
- ❑ Removing and installing ⇒Page 305

8 - Filter insert

9 - Lower part of fuel filter

10 - 10 Nm

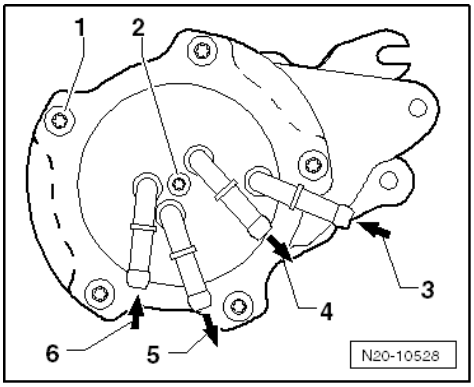
11 - Seal
- ❑ Renew

1.4.2 Upper part of fuel filter

Type A ⇒Fig. on page 306

Type B ⇒Fig. on page 306

Fuel filter upper part, type A



1 - 8 Nm

2 - (Not necessarily installed) plug for water extraction (remove and extract about 100 cm^3 of liquid using hand vacuum pump with accessories -V.A.G 1390- and water drainage container -V.A.G 1390/1-, renew seal).

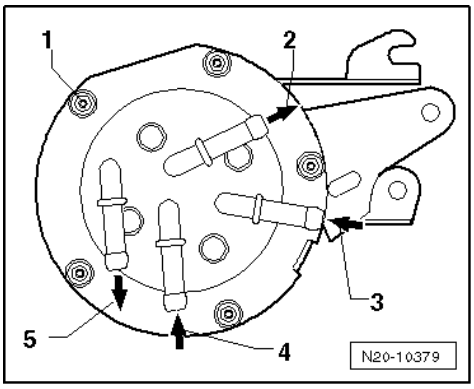
3 - Fuel supply line from fuel tank, white or white marking. Check for secure seating.

4 - Fuel return line to fuel tank, blue or blue marking. Check for secure seating.

5 - Fuel supply line to engine, white or white marking. Check for secure seating.

6 - Fuel return line from engine, blue or blue marking. Check for secure seating.

Fuel filter upper part, type B



1 - 5 Nm

2 - Fuel return line to fuel tank, blue or blue marking. Check for secure seating.

3 - Fuel supply line from fuel tank, white or white marking. Check for secure seating.

4 - Fuel return line from engine, blue or blue marking. Check for secure seating.

5 - Fuel supply line to engine, white or white marking. Check for secure seating.

1.4.3 Engine codes CPYA, CPYB, CPYC, CPYD, CPYE

1 - Fuel filter bracket

2 - Fuel filter

- ❑ The stamped arrows on the filter mark the fuel input and output.

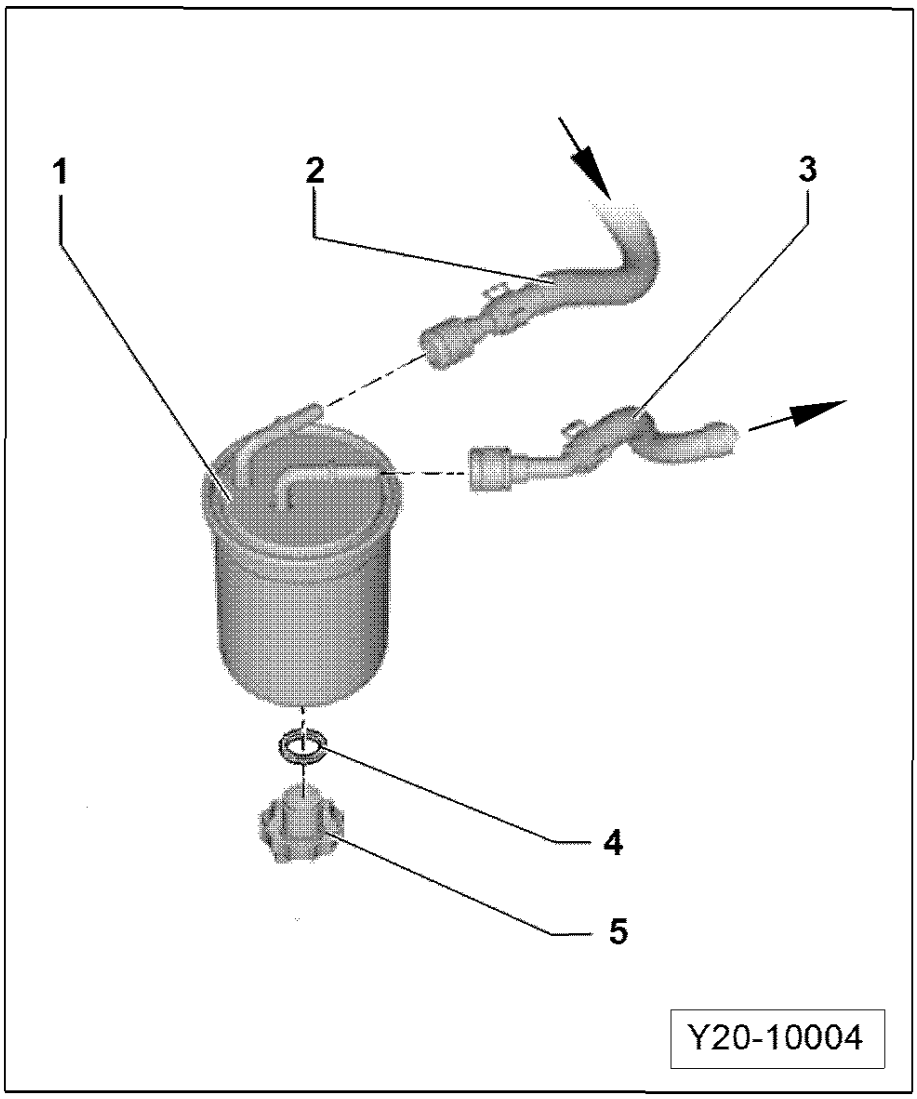
3 - Supply line

- ❑ From fuel delivery unit
- ❑ White marking

4 - Supply line

- ❑ To high-pressure fuel pump
- ❑ White marking

5 - Tighten hand-tight.



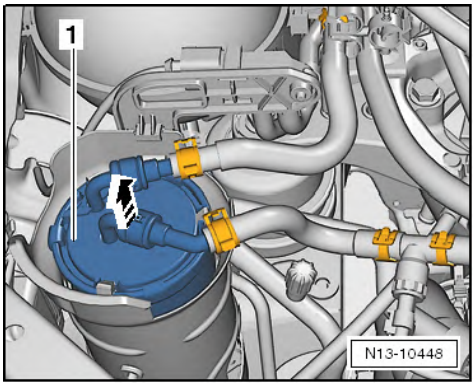
1.5 Draining water from fuel filter/fuel tank

Caution

Fill and bleed fuel system after removal or renewal of components between fuel tank and high-pressure fuel pump ***⇒ Page 383.***

– Unclip fuel filter -1- from fuel filter bracket.

– Take fuel filter -1- upwards out of fuel filter bracket. Fuel lines remain connected to filter.



Note

Collect escaping fluid using suitable methods.

– Loosen water drain plug until fluid flows out.

– Drain fluid until only diesel flows out (approx. 100 ml). If necessary, switch on ignition so that the fuel pump supplies fuel.

– Tighten water drain plug by hand.
– Switch off ignition.
– Insert fuel filter into bracket and check it is engaged correctly.

If after draining more than approx. 100 ml no pure diesel does flows out:

There is too much water in the entire fuel system. Drain water from the entire fuel system.

– Drain all components of fuel system which are not in the scope of supply from Volkswagen. ⇒ Refer to documentation of respective manufacturer.
– Renew fuel filter ⇒Page 308.
– Fill vehicle with prescribed fuel ⇒Page 6.
– Switch ignition on.
– Connect vehicle diagnostic tester and carry out guided function “Fuel pump activation (checking fuel pump)”.

Note

The fuel pump is now activated for 30 seconds.

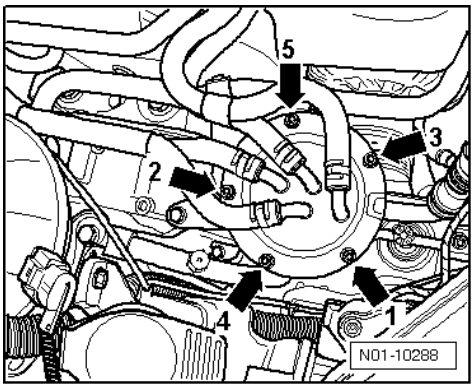
Caution

Drain off approx. 100 ml of diesel from new fuel filter to remove remains of old fuel from fuel lines.

1.6 Renewing fuel filter

Note

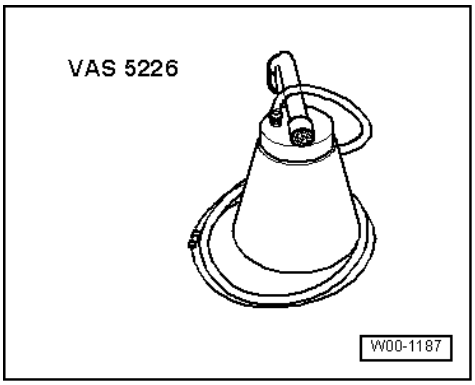
- *There are two different fuel filter system.*
- *Descriptions of work, engine codes CJDA, CJDD* ⇒Page 309.
- *Descriptions of work, engine codes CPYA, CPYB, CPYC, CPYD, CPYE* ⇒Page 312.



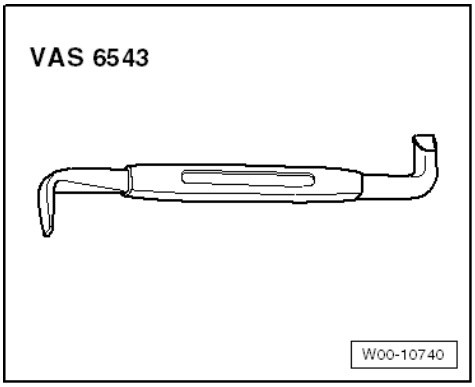
1.6.1 Renewing fuel filter or upper part of fuel filter CJDA, CJDD

Special tools and workshop equipment required

- Diesel extractor -VAS 5226-



- Angle driver -VAS 6543-



Removing:

Caution

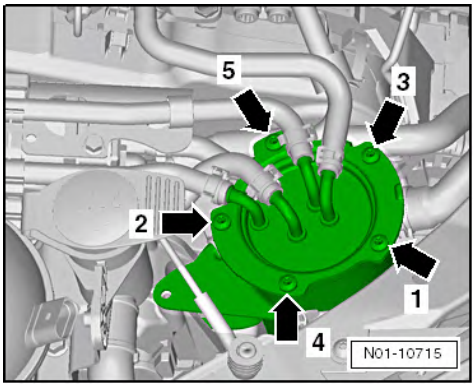
- ***Do "NOT" pull fuel hoses off fuel filter cover, and do "NOT" lever on connecting pieces. This causes leaks and can damage the upper part of the fuel filter.***
- ***Ensure that no diesel comes into contact with other components in the engine compartment. If necessary clean immediately.***

Note

Observe environmental regulations for disposal.

Carry out the following work sequence.

– Unscrew all bolts -arrows- of upper part of fuel filter, and remove upper part of fuel filter.



Note

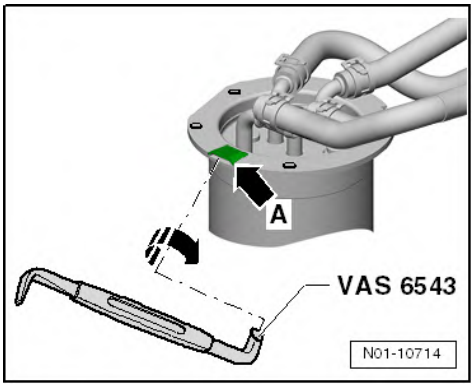
If upper part of fuel filter is tight or seized, detach upper part of fuel filter as follows:

Upper part of fuel filter can be raised at assembly groove -arrow A- using an angled screwdriver -VAS 6543-.

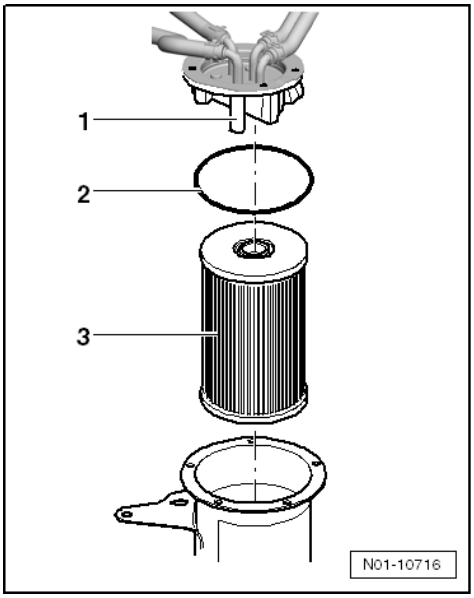
- The size of the assembly groove can vary depending on version of upper part.

– Insert respective end of angled screwdriver -VAS 6543- into assembly groove -arrow A-, and turn angled screwdriver -VAS 6543-.

This action raises the upper part of the fuel filter.



– If the filter needs to be renewed, remove filter -3- from lower part of fuel filter.



– Remove old seal -2- from upper part of fuel filter -1- by levering seal out of respective groove -arrow-.

Caution

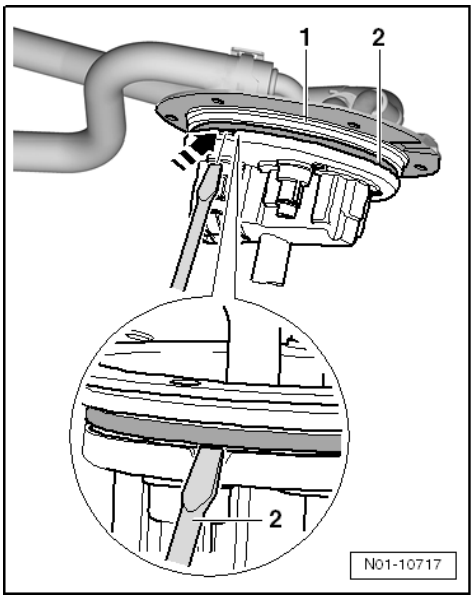
Remove any diesel, dirt and water residues from lower part of fuel filter using diesel extractor -VAS 5226-.

Note

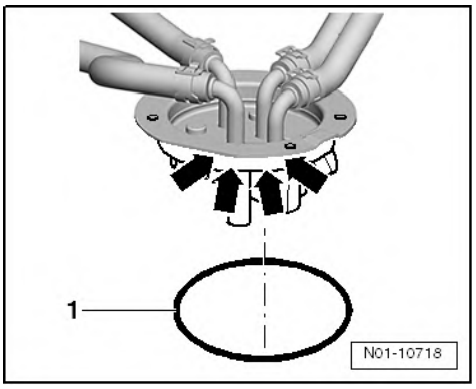
Observe environmental regulations for disposal.

Installing:

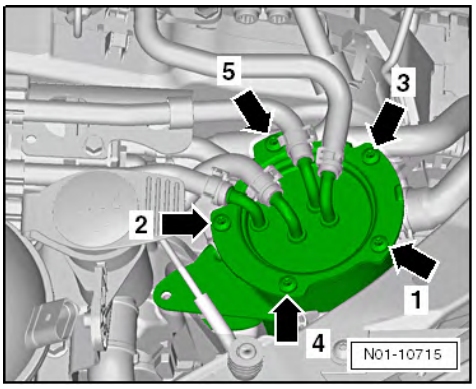
– Insert new filter into lower part of fuel filter.



– Moisten new seal -1- with diesel and insert seal into upper part of fuel filter -arrows-.



– Insert upper part of fuel filter with seal correctly onto lower part of fuel filter and press on evenly until the upper part of fuel filter seats completely.



Caution

Do "NOT" tighten the bolts for the upper part until it is fully in contact with the lower part.

– Screw all bolts into lower part of fuel filter, and tighten them by hand.

– Then, tighten bolts to specified torque of 5 Nm in sequence shown illustration.

This procedure prevents the seal from being damaged.

Bleeding fuel system

Procedure:

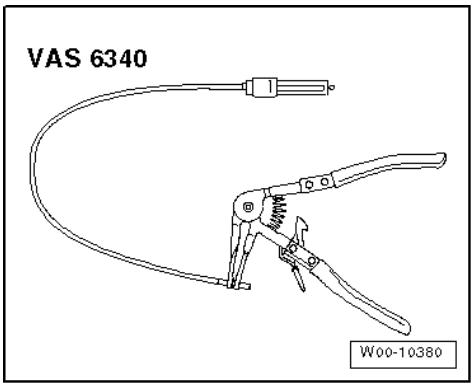
Note

- *If there is any air left in the fuel system, the engine may switch to the backup mode ('emergency running' mode) during the road test. Switch off the engine and clear the event memory.*
- *For technical reasons it is possible that several cross references are not directed to the correct chapter. In this case select the procedure manually in the information.*

1.6.2 Renewing fuel filter, engine codes CPYA, CPYB, CPYC, CPYD, CPYE

Special tools and workshop equipment required

- Hose clip pliers -VAS 6340-



Note

- *Ensure that no diesel fuel comes into contact with the coolant hoses.*
- *If necessary, clean immediately.*
- *Observe environmental regulations for disposal.*

Removing:

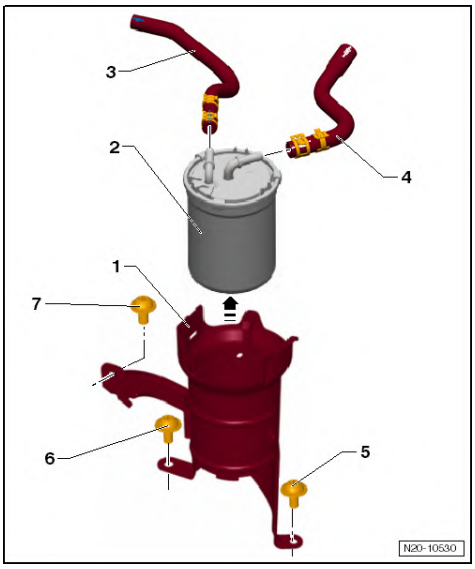
Caution

- ***Ensure that no diesel comes into contact with other components in the engine compartment. If necessary clean immediately.***

Carry out the following work sequence.

– Release and pull off fuel lines -3- and -4-.

– Remove fuel filter -2- upwards from fuel filter bracket -1- (illustration may differ).



Installing:

– Insert new fuel filter -2-.

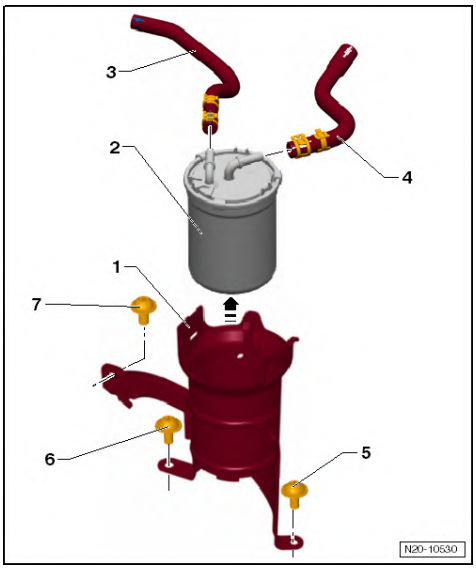
– Push new fuel filter -2- into fuel filter bracket -1- until it engages.
– Fit fuel lines -3- and -4-, and secure them with clamps.

Bleeding fuel system

Procedure:

Note

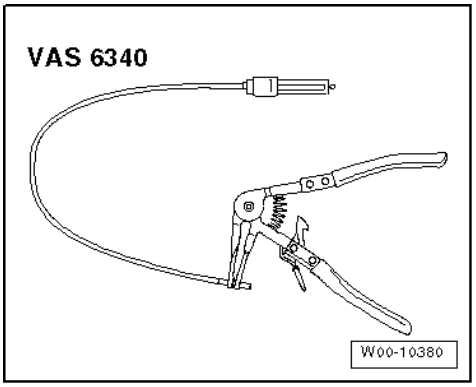
If there is any air left in the fuel system, the engine may switch to the backup mode ('emergency running' mode) during the road test. Switch off the engine and clear the event memory.



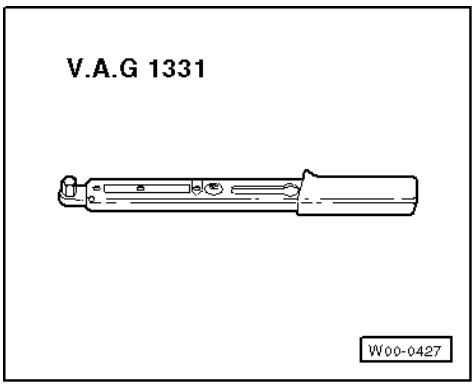
1.7 Removing and installing supplementary fuel pump -V393- (inline electronic fuel pump)

Special tools and workshop equipment required

◆ Hose clip pliers -VAS 6340-



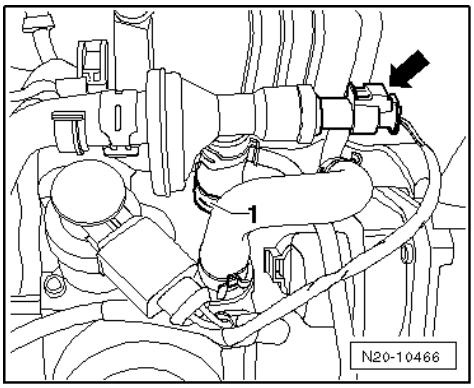
◆ Torque wrench -V.A.G 1331-



Removing

– Note safety precautions before beginning work ⇒Page 299.
– Observe rules for cleanliness ⇒Page 300.
– Move clear fuel hose, open clamp, and pull fuel hose off fuel filter.

– Disconnect connector from fuel temperature sender -G81- -arrow-, loosen clamp -1-, and pull fuel supply line off high-pressure pump.
– Unscrew securing bolts of supplementary fuel pump -V393-.



Installing

Install in reverse order. In the process, note the following:

- Route fuel hoses without kinking.
- Ensure that fuel hose connections are tight.
- Do not interchange supply and return lines.
- Clip fuel and coolant hoses into retainers again.

2 Checking components and functions

> ⚠ ***WARNING***
>
> ***Adhere to the general safety regulations and the notes on repair work on the engine!*** ⇒ **Page 1**

The described component checks and functional checks are applicable for the series components and the current flow diagrams as of page ⇒ Page 486, current flow diagrams.

If components and electric circuits differ, observe the notes of the respective industrial engine customer.

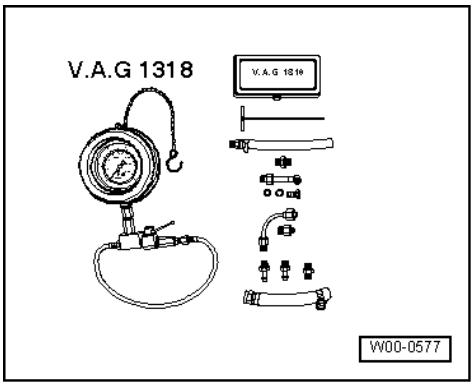
Checking supplementary fuel pump -V393- (inline electronic fuel pump) ⇒ Page 314.

Checking accelerator pedal position sender -G79-, if fitted ⇒ Page 316.

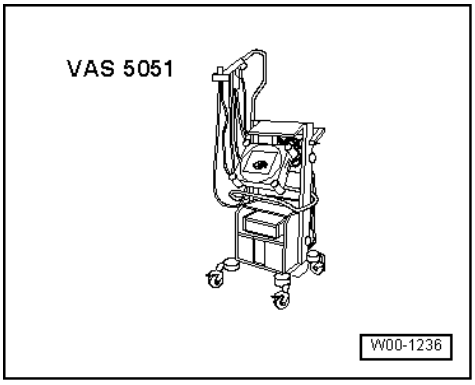
2.1 Checking supplementary fuel pump -V393- (inline electronic fuel pump)

Special tools and workshop equipment required

- K-Jetronic pressure tester -V.A.G 1318-



◆ Connect vehicle diagnosis, testing and information system -VAS 5051/B- using diagnostic cable -VAS 5051B/1-.



Test prerequisites

- Battery voltage at least 11.5 V
- Fuel filter OK.
- Fuel tank: level min “reserve”.
- Ignition switched off.

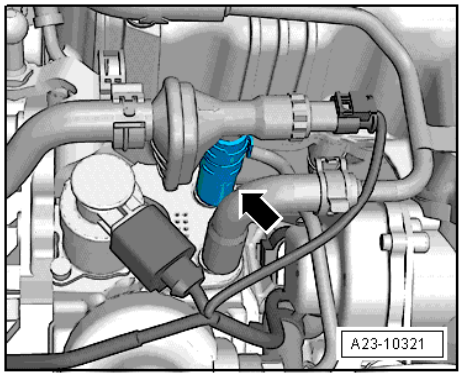
Test procedure

– Note safety precautions before beginning work ⇒Page 299.

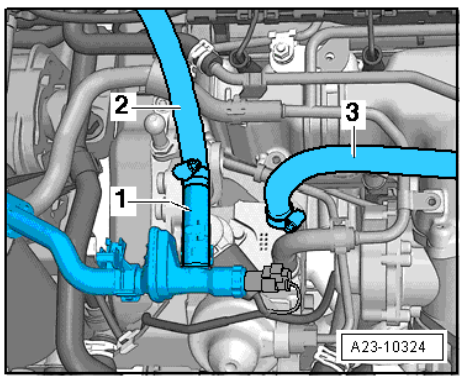
– Observe rules for cleanliness ⇒Page 300.

> ⚠ ***WARNING***
>
> ◆ ***Wrap a clean cloth around the connection before opening the fuel system. Then release pressure by carefully pulling hose off connection.***

– Pull fuel supply line -arrow- off high-pressure pump.



– Using a suitable adapter -2-, connect K-Jetronic pressure tester -V.A.G 1318- to fuel supply line -1-. Connect other adapter -3- of K-Jetronic pressure tester -V.A.G 1318- to open connection on high-pressure pump.



Note

The K-Jetronic pressure tester -V.A.G 1318- must be inserted as an intermediate element into the fuel supply line.

– Switch on ignition.

– Perform final control diagnosis, and activate fuel pump, ⇒Page 89, final control diagnosis.

– Run fuel pumps until highest fuel pressure has built up.

- Specification: at least 3.5 bar

If the specification is not attained:

– Check union between pressure gauge and fuel line for leaks.

– Test pressure gauge for leaks.

– Check fuel lines and their connections for leaks.

Check whether fuel filter is blocked.

If no fault is found:

Renew fuel pump.

Note

Check fuel system for leaks.

2.2 Checking accelerator pedal position sender -G79-, if fitted

Special tools and workshop equipment required

- Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
- Auxiliary measuring set -V.A.G 1594-
- Test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-2-
- Current flow diagram

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK

Test procedure

Note

- *The section below provides only general instructions for checking the accelerator position sender, since due to the various use cases it is not possible to specify a common procedure.*
- *The accelerator position sender -G79- and accelerator position sender 2 -G185- are installed in one common housing.*
- *Only gold-plated contacts may be used when repairing the contacts in the connector of the accelerator position sender.*

– Switch on ignition.

– Connect vehicle diagnostic tester, and select engine control unit. ⇒Page 23

– Select diagnosis function “011-Read measured value block”.

– Select “Display group 2”.

– Check accelerator position display in display zone 2. The accelerator must not be depressed. Specification: 0.0%

```
Display group 2
xxxx/min    0.0 %    xxxx1x     xxx.x°C
```

– In addition check the idling speed switch display in display zone 3. The 5th digit from the left must show 1. Display: xxxx1xxx

– Depress accelerator slowly until fully down, and observe display zones 2 and 3.

```
Display group 2
xxxx/min    100.0 %    xxxx0x     xxx.x°C
```

Display zone 2:

- The accelerator position value must increase continuously. Specification at full throttle position: 100.0%.

Display zone 3:

- The 5th digit from the left must change to 0. Display: xxxx0xxx

– Exit diagnosis function.

– Switch off ignition.

End specification value not achieved:

– Renew accelerator position sender -G79-.

– Then, read event memory of engine control unit, and clear event memory if necessary ⇒ Page 26, read event memory.

Display does not change or is erratic:

– Switch off ignition.

Checking voltage supply

– Connect multimeter to contacts 2 + 3 of connector using test leads from -V.A.G 1594- to measure voltage.

– Switch on ignition. Specification: at least 4.8...5.2 V

– Switch off ignition.

– Then, connect multimeter to contacts 1 + 5 of connector using test leads from -V.A.G 1594- to measure voltage.

– Switch on ignition. Specification: at least 4.8...5.2 V

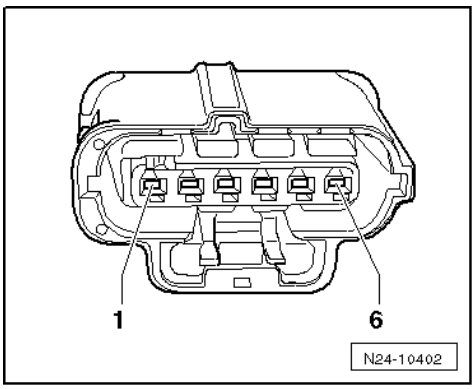
– Switch off ignition.

– Check wiring of accelerator position sender as follows:

– Using adapter cable -V.A.G 1598/39-2-, connect test box -V.A.G 1598/42- to wiring harness of control unit ⇒ Page 24. The engine control unit is not connected by this action.

– Pull 6-pin connector off accelerator position sender.

– Check wiring between test box and connector for open circuit referring to current flow diagram.



◆ Contact 1 + socket 13

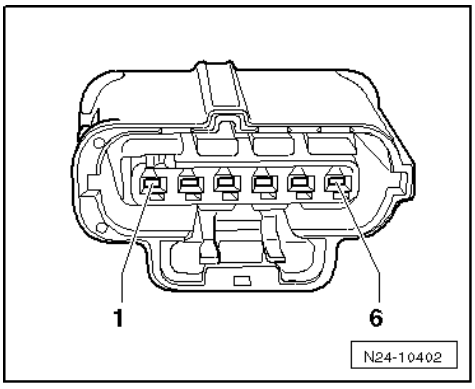
◆ Contact 2 + socket 15

◆ Contact 3 + socket 74

◆ Contact 4 + socket 53

◆ Contact 5 + socket 8

◆ Contact 6 + socket 54



- Cable resistance: max. 2.0 Ω.

– Also check wiring for short to one another, short to battery earth/engine earth and short to battery positive. Specification: ∞ Ω

If no wiring fault is detected and voltage was present between contacts 2 + 3 and 1 + 5:

Renew accelerator position sender -G79-.

– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

If no wiring fault is detected and no voltage was present between contacts 2 + 3 and 1 + 5:

– Pull connectors off any components which are connected to this voltage supply line ⇒Page 486, current flow diagrams.
– Check voltage supply and wires on these components.

If no wiring fault is detected and no voltage was present on these components:

– Renew engine control unit -J623- ⇒Page 418.

21 - Turbocharging/supercharging

1 Charge air system with turbocharger

⚠ *WARNING*

Adhere to the general safety regulations and the notes on repair work on the engine! ⇒ **Page 1**

⚠ *WARNING*

When doing any repair work, pay attention to the following due to the cramped conditions:

- ***Adhere to the general safety precautions, and never take any risk.***
- ***The engine is a hazardous area and can cause serious injuries.***
- ***Never leave any objects in the engine compartment, such as cleaning cloths or tools.***
- ***Many engine components become hot during operation – risk of burns. If necessary, provide appropriate protective means.***
- ***Servicing materials, such as fuel, engine oils or coolant additive, are harmful substances; adhere to the safety instructions from the manufacturer.***
- ***There is a risk of injuries, if maintenance locations are difficult to access. This risk can be reduced, by installing the engine in an appropriate location and by avoiding sharp edges.***
- ***Route all the various lines (e.g. for fuel, hydraulics, coolant and refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.***
- ***Ensure that there is sufficient clearance to all moving or hot components.***
- ***Tools are to be checked for damage and safety risks on a regular basis.***

Observe safety precautions when working on charge air system with turbocharger ⇒ Page 320.

Observe rules for cleanliness ⇒ Page 320.

Assembly overview - turbocharger with attachments ⇒ Page 321.

Removing and installing turbocharger ⇒ Page 326.

Vacuum hose schematic diagram ⇒ Page 334.

1.1 Safety precautions when working on charge air system with turbocharger

⚠ ***WARNING***

When doing any repair work, pay attention to the following due to the cramped conditions:

- ***Route all the various lines (e.g. for fuel, hydraulics, activated charcoal filter system, coolant, refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.***
- ***Ensure that there is sufficient clearance to all moving or hot components.***

Note the following if testers and measuring instruments have to be used during a road test:

- The test and measuring equipment must always be secured and operated by a 2nd person.

1.2 Rules for cleanliness

ⓘ ***Caution***

When a mechanical fault is found on the turbocharger, e.g. a destroyed compressor impeller, it is not sufficient to only renew the turbocharger. To avoid subsequent damage, the following work must be carried out:

- ***Check air filter housing, air filter element and intake hoses for dirt/soiling.***
- ***Check the whole charge air path and charge air cooler for foreign objects.***

If foreign objects are found in the charge air system, the charged air routing must be cleaned and the charge air cooler must be renewed, if necessary.

When working on the turbocharger, pay careful attention to the following “rules for cleanliness”:

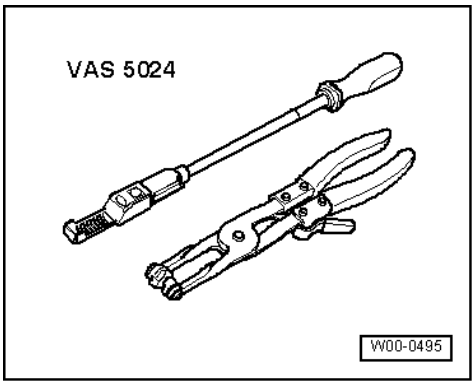
- Thoroughly clean all unions and surrounding areas before disconnecting.
- Place removed parts on a clean surface and cover. Use only lint-free cloths.
- Carefully cover opened components or seal if repairs cannot be carried out immediately.
- Install clean components only. Do not remove replacement parts from packing until immediately before installing. Do not use parts that have not been stored in their packing (e.g. in tool boxes etc.).
- Existing transport and protective packaging and sealing caps must only be removed immediately prior to installation.
- When making repairs, remove oil from connection and hose ends.

- Do not use substances containing oil, silicone or grease when assembling.
- When system is open: do not work with compressed air if this can be avoided. Do not move vehicle/machine unless absolutely necessary.

1.3 Assembly overview - turbocharger with attachments

Note

- *All hose connections are secured.*
- *Charge air system must be free of leaks.*
- *When making repairs, remove oil from connection and hose ends.*
- *All hoses of the charge air system are secured with spring-type clips or with plug-in connectors.*
- *Spring-type clip pliers -VAS 5024- are recommended for installation of spring-type clips.*
- *Renew self-locking nuts.*
- *Before installing the oil supply line, fill turbocharger with engine oil through connecting piece (engine codes CJDA, CJDD only).*
- *Before installing the turbocharger, fill the oil supply channel (smaller diameter) with a "splash" of engine oil "to prevent a dry start up" (engine codes CPYA, CPYB, CPYC, CPYD, CPYE only).*
- *After installing turbocharger, allow engine to run at idling speed for about 1 minute to ensure that oil is supplied to turbocharger.*



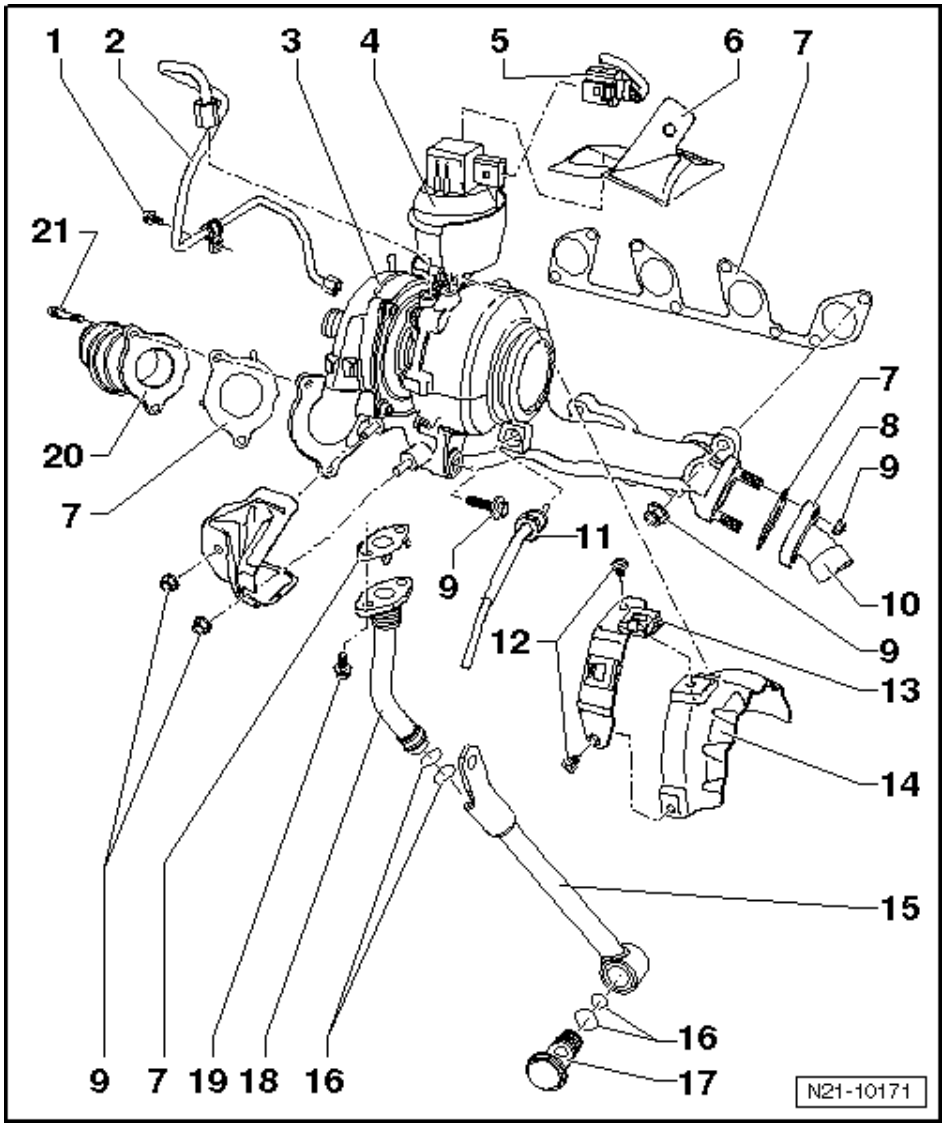
– Note safety precautions before beginning work ⇒Page 320.

– Observe rules for cleanliness ⇒Page 320.

Assembly overview - turbocharger, engine codes CJDA, CJDD ⇒Page 322.

Assembly overview - turbocharger, engine codes CPYA, CPYB, CPYC, CPYD, CPYE ⇒Page 324.

1.3.1 Engine codes CJDA, CJDD



1 - 10 Nm

2 - Oil supply line

- ❑ Before installing oil supply line, ensure that it is not blocked.
- ❑ Before installing, fill turbocharger with engine oil through oil supply line connection.

3 - Turbocharger

- ❑ Can only be renewed together with exhaust manifold
- ❑ Removing and installing ⇒ Page 326

4 - Vacuum unit

- ❑ With position sender for charge pressure positioner -G581- ⇒ Page 449.
- ❑ Check position sender for charge pressure positioner -G581- ⇒ Page 449

5 - Connector

- ❑ To position sender for charge pressure positioner -G581- ⇒ Page 449.

6 - Heat protection

- ❑ Renew if damaged

7 - Gasket

- ❑ Renew

8 - Connecting pipe

- ❑ To exhaust gas recirculation cooler.

9 - 20 Nm

10 - Flexible joint

- ❑ Do not bend or stretch.

11 - Exhaust gas temperature sender 1 -G235-

- ❑ Exhaust gas temperature sender ahead of turbocharger
- ❑ 45 Nm
- ❑ Coat thread of sender with high-temperature paste G 052 112 A3.
- ❑ Note installation position ⇒ Fig. on page 323
- ❑ Check ⇒ Page 347

12 - 10 Nm

13 - Retainer

- ❑ For oil supply line.

14 - Heat shield

15 - Support

- ❑ Between turbocharger and cylinder block.

16 - Seal

- ❑ Renew

17 - Banjo bolt, 60 Nm

- ❑ Renew

18 - Oil return pipe

19 - 15 Nm

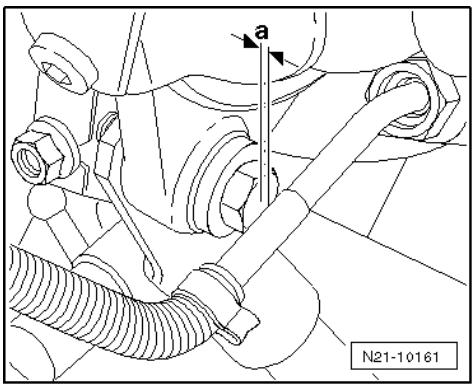
20 - Pulsation damper

21 - 10 Nm

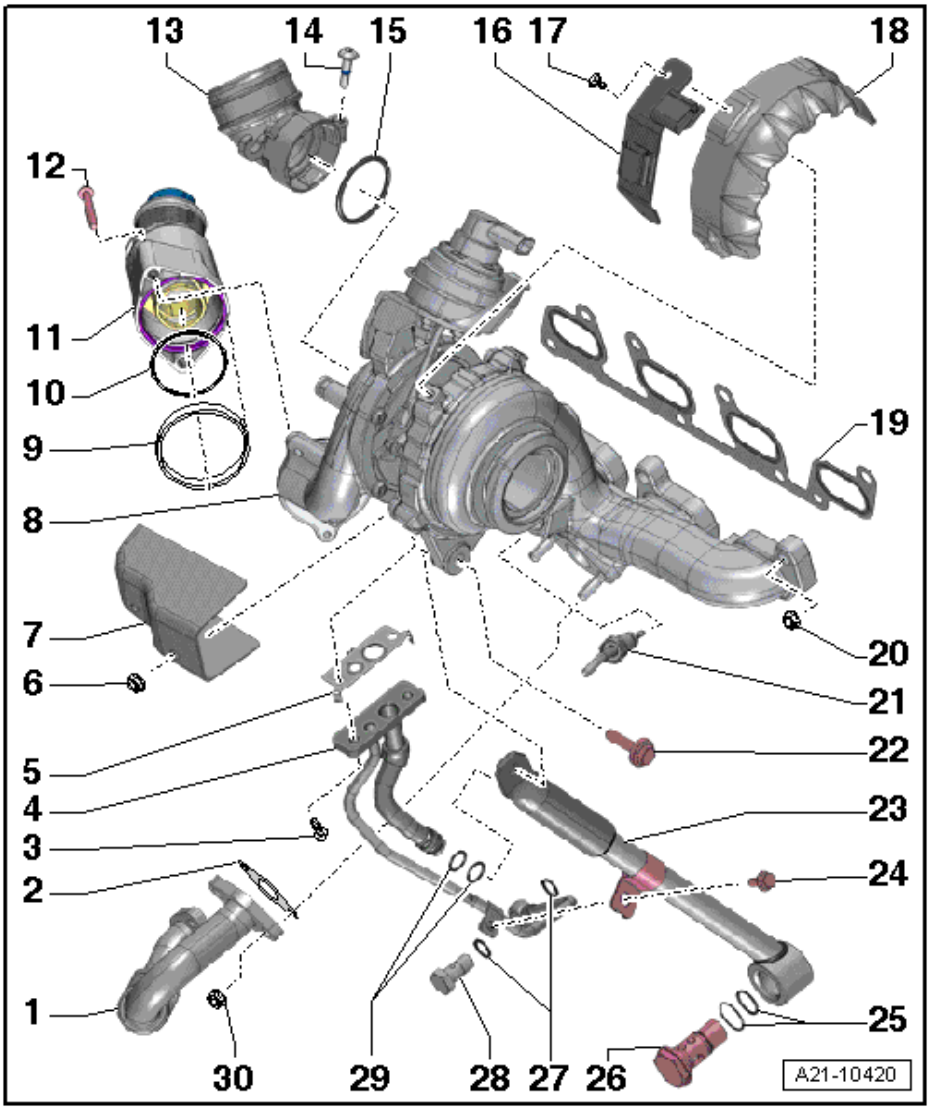
Installation position of exhaust gas temperature sender with angled cable guide

Note

When installing the exhaust gas temperature sender with angled cable guide, it is absolutely necessary to keep to dimension -a- of 3…5 mm when tightening the turbocharger support.



1.3.2 Engine codes CPYA, CPYB, CPYC, CPYD, CPYE



1 - Exhaust gas recirculation pipe
- ❑ With flexible joint; do not bend flexible joint - danger of cracking.

2 - Gasket
- ❑ Renew

3 - Countersunk bolt with double nip
- ❑ Renew
- ❑ 17 Nm

4 - Connection
- ❑ With oil supply and return line
- ❑ Before installing oil supply line, ensure that it is not blocked.

5 - Gasket
- ❑ Renew

6 - Nut
- ❑ 24 Nm

7 - Heat shield

8 - Turbocharger
- ❑ Can only be renewed complete with exhaust manifold and vacuum unit.
- ❑ Removing and installing ⇒ Page 326

9 - Retaining ring
- ❑ Installation possible in one position only.

10 - O-ring
- ❑ Renew

11 - Pulsation damper
- ❑ Note installation position of O-ring and seal ⇒ Page 326

12 - Bolt
- ❑ 9 Nm

13 - Intake connecting pipe

14 - Bolt
- ❑ 9 Nm
- ❑ Attached in inlet connection.

15 - O-ring
- ❑ Renew

16 - Retainer
- ❑ For electrical cables.

17 - Bolt
- ❑ 15 Nm

18 - Heat shield

19 - Gasket
- ❑ Renew

20 - Nut
- ❑ Renew
- ❑ 24 Nm

21 - Exhaust gas temperature sender 1 -G235-
- ❑ Exhaust gas temperature sender ahead of turbocharger
- ❑ 45 Nm
- ❑ Lubricate thread of sender using high-temperature paste G 052 112 A3
- ❑ Note installation position ⇒Fig. on page 323
- ❑ Check ⇒Page 347

22 - Bolt
- ❑ 20 Nm

23 - Support
- ❑ For turbocharger
- ❑ Before installing oil supply line, ensure that it is not blocked.
- ❑ Before installing, fill turbocharger with engine oil through oil supply line connection.

24 - Bolt
- ❑ 9 Nm

25 - O-rings
- ❑ Various diameters.
- ❑ Renew

26 - Banjo bolt
- ❑ 60 Nm
- ❑ Renew complete with O-rings.

27 - Oil seals
- ❑ Renew

28 - Banjo bolt
- ❑ 30 Nm
- ❑ Renew complete with O-rings.

29 - O-rings
- ❑ Renew

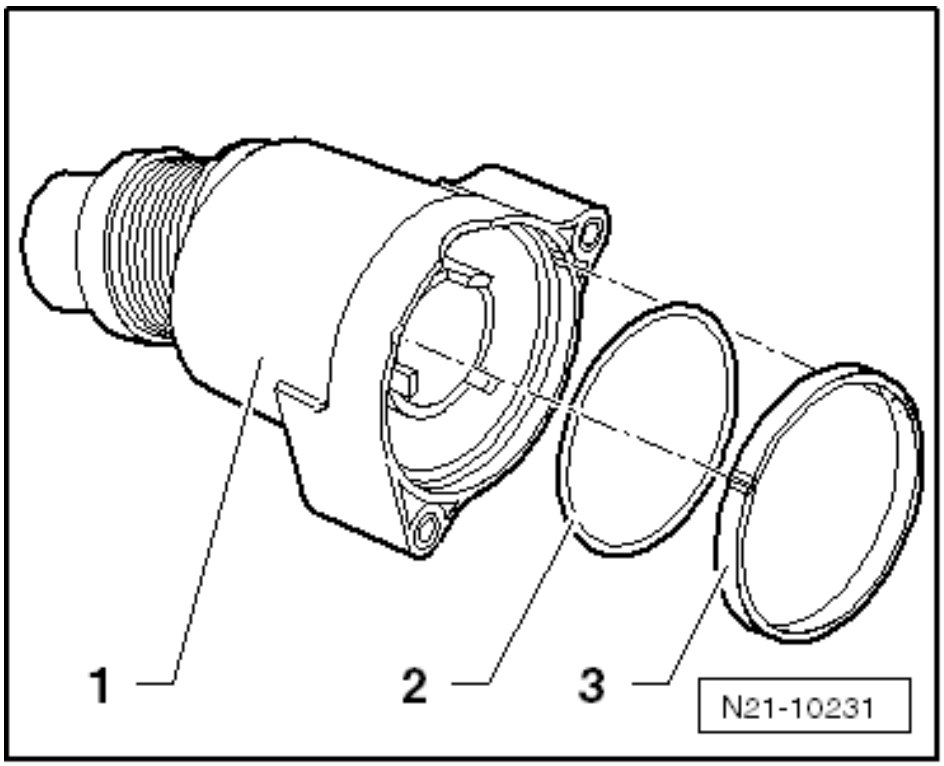
30 - Nut
- ❑ 24 Nm

Installation position of O-ring and seals in pulsation damper

1 - Damper
- ❑ With grooves.

2 - O-ring

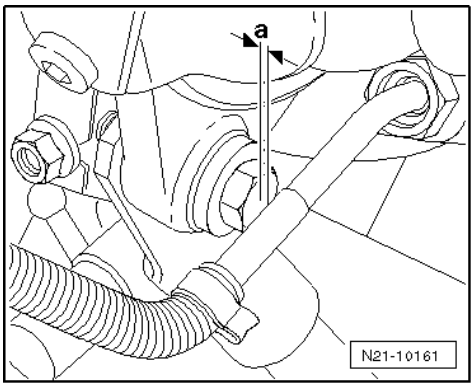
3 - Seal
- ❑ With spring.



Installation position of exhaust gas temperature sender with angled cable guide

Note

When installing the exhaust gas temperature sender with angled cable guide, adhere to dimension -a- of 3 … 5 mm from the threaded connection of the turbocharger support.



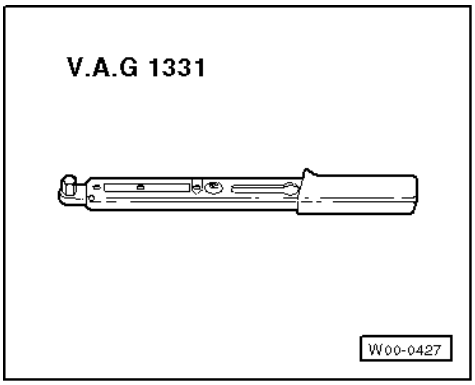
1.4 Removing and installing turbocharger

WARNING

Adhere to the general safety regulations and the notes on repair work on the engine! ⇒ **Page 1**

Special tools and workshop equipment required

- Torque wrench (5…50 Nm) -V.A.G 1331-



Caution

When a mechanical fault is found on the turbocharger, e.g. a destroyed compressor impeller, it is not only sufficient to renew the turbocharger. To prevent this from causing further damage, perform the following repairs:

- ***Check air filter housing, air filter element and intake hoses for soiling.***
- ***Check complete charge air system and, if fitted, charge air cooler for foreign objects.***

If foreign objects are found in the charge air system, the charged air routing must be cleaned and the charge air cooler must be renewed, if necessary.

Removing ⇒ Page 327.

Installing ⇒ Page 329.

1.4.1 Removing

– Note safety precautions before beginning work ⇒ Page 320.

– Observe rules for cleanliness ⇒ Page 320.

– Pull off connector of position sender for charge pressure positioner -G581- on turbocharger ⇒ Page 321.

– Pull vacuum hose off vacuum unit on turbocharger.

– Disconnect connector for exhaust gas temperature sender 1 -G235- (exhaust gas temperature sender ahead of turbocharger) ⇒ Page 321.

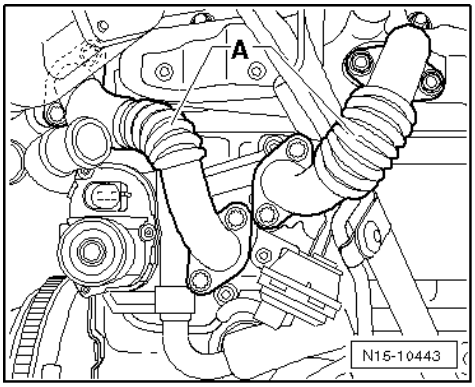
Engine codes CJDA, CJDD

– Unscrew oil supply line on turbocharger ⇒ Page 321.

– Pull charge air pipe/connecting hose off turbocharger.

– Loosen clamp for turbocharger/diesel particulate filter. If necessary, remove diesel particulate filter ⇒ Page 427.

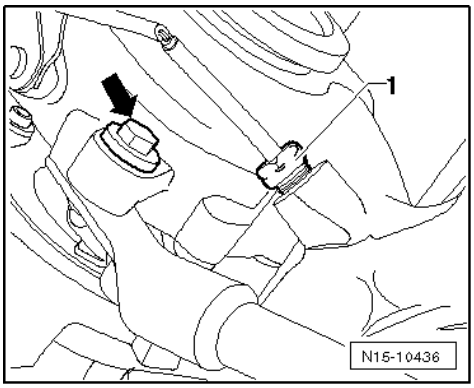
– Remove connecting pipes to exhaust gas recirculation cooler -A-.



Caution

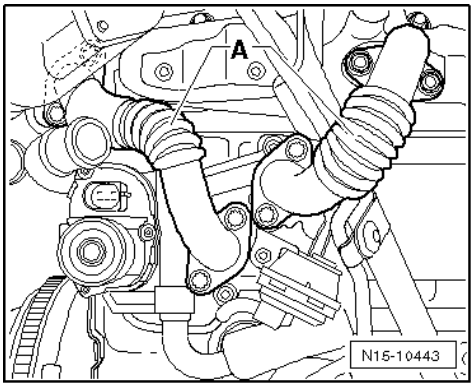
Exhaust gas temperature sender 1 -G235- conceals the upper bolt of the exhaust gas turbocharger support. The temperature sender must not be bent. It must therefore be removed.

– Remove exhaust gas temperature sender 1 -G235- -1- (exhaust gas temperature sender ahead of turbocharger) ⇒Page 432.
– Unscrew banjo bolt of turbocharger support ⇒Item 17 on page 323.
– Unscrew upper bolt -arrow- from support on turbocharger.
– Turn lower part of support 90° and pull support downwards off upper part.
– Remove heat shield from exhaust manifold.
– Unscrew securing nuts for exhaust manifold.
– Remove turbocharger, turn it so that intake side faces downwards, and remove turbocharger downwards.



Engine codes CPYA, CPYB, CPYC, CPYD, CPYE

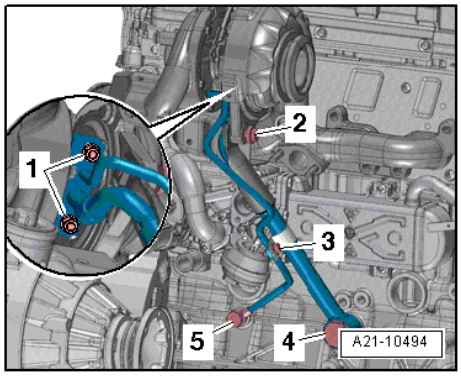
– Pull charge air pipe/connecting hose off turbocharger.
– Loosen clamp for turbocharger/diesel particulate filter. If necessary, remove diesel particulate filter ⇒Page 427.
– Remove connecting pipes to exhaust gas recirculation cooler -A-.



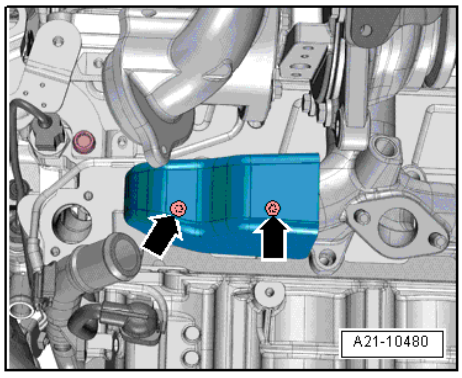
Caution

The exhaust gas temperature sender 1 -G235- must not be bent.

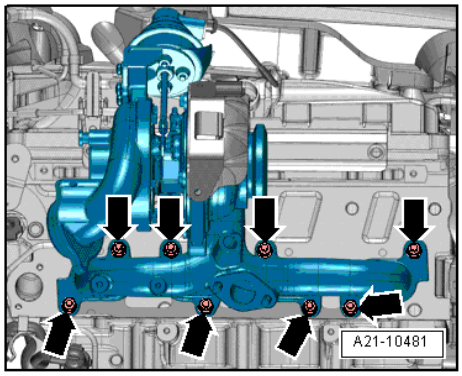
– Unscrew bolts -1, 2- and banjo bolts -4, 5-, and remove turbocharger support with oil supply line.



– Unscrew bolts -arrows- and remove heat shield.



– Remove nuts -arrows-.
– Remove turbocharger together with exhaust manifold from cylinder head and turn so that the intake side is facing downwards. Remove turbocharger together with exhaust manifold downwards.



1.4.2 Installing

– Installation of turbocharger is carried out in the reverse sequence.

Caution

Before installing, check whether decoupling element of oil return line is bent and thus stretched. If this is the case, micro cracks can have formed and may cause leakage. If necessary, renew oil return line of turbocharger before installing.

Note

- *Renew seals and gaskets.*
- *Renew self-locking nuts.*
- *Before installing the oil supply line, fill turbocharger with engine oil through connecting piece to prevent a dry start up.*
- *Fit heat shield sleeves in the same place when installing turbocharger.*
- Fit turbocharger with pressure side facing upwards.
- Position connecting hose of charge air pipe before bolting on turbocharger.
- Note installation position of exhaust temperature sender 1 -G235- exhaust gas temperature sender ahead of turbocharger) ⇒Page 321.
- Renew banjo bolt for turbocharger support and O-rings for oil return line.

- Do not overstretch decoupling element of oil return line when installing turbocharger support.

Specified torques ⇒ Page 321.

Note

After installing turbocharger, allow engine to run at idling speed for about 1 minute to ensure that oil is supplied to turbocharger.

– Then, read event memory of engine control unit, and clear event memory if necessary ⇒ Page 26, read event memory.

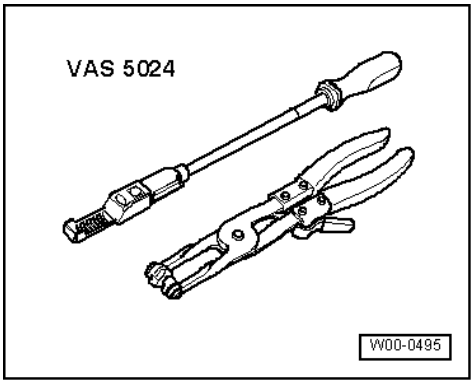
2 Checking charge air system

WARNING

Adhere to the general safety regulations and the notes on repair work on the engine! ⇒ Page 1

Note

- *The components of the charge air system are not always in the scope of supply from Volkswagen. Adhere to the manufacturing specifications when performing any maintenance and repair work.*
- *All hose connections are secured.*
- *Charge air system must be free of leaks.*
- *When making repairs, remove oil from connection and hose ends.*
- *All hoses of the charge air system are secured with spring-type clips or with plug-in connectors.*
- *Spring-type clip pliers -VAS 5024- are recommended for installation of spring-type clips.*



Observe safety precautions when working on charge air system with turbocharger ⇒ Page 320.

Observe rules for cleanliness ⇒ Page 320.

Checking charge air system for leaks ⇒ Page 331.

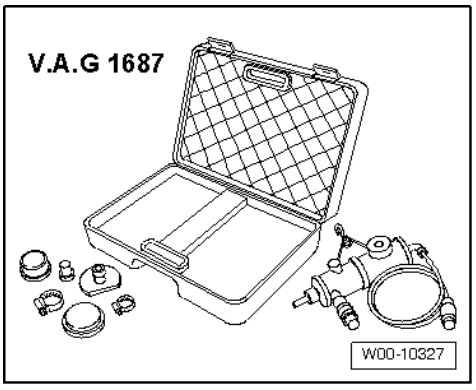
Check charge pressure control ⇒ Page 333.

Vacuum hose schematic diagram ⇒ Page 334.

2.1 Checking charge air system for leaks

Special tools and workshop equipment required

- Charge air system tester -V.A.G 1687-
- Adapter -V.A.G 1687/10-



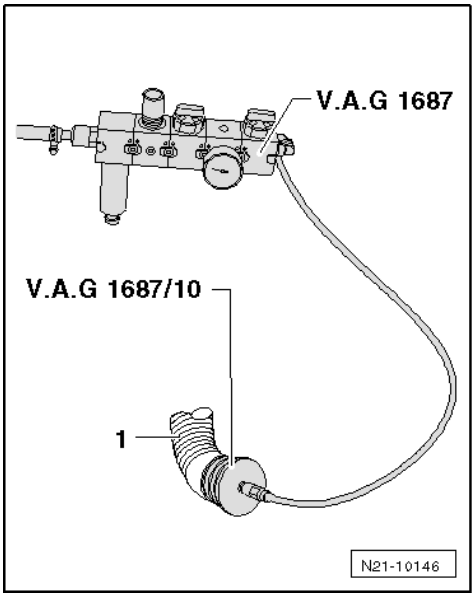
Test procedure

– Note safety precautions before beginning work ⇒Page 320.

– Observe rules for cleanliness ⇒Page 320.

– Remove intake hose -1- from air filter.

– Connect adapter -1687/10- in intake hose -1- and secure with clip.

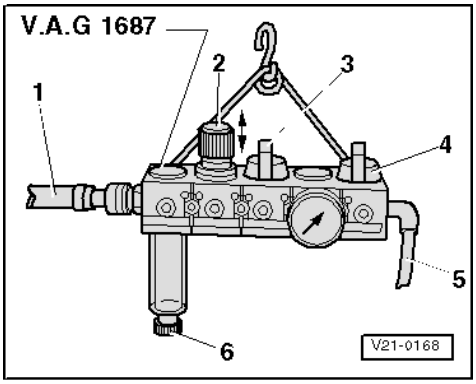


Prepare charge air system tester -V.A.G 1687- as follows:

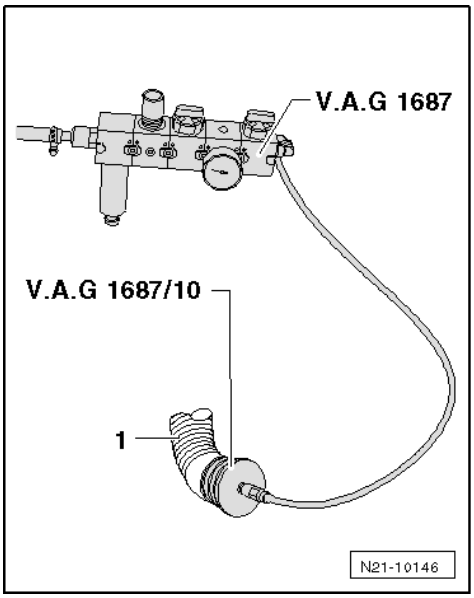
– Unscrew pressure regulating valve -2- and close valves -3- and -4-.

Note

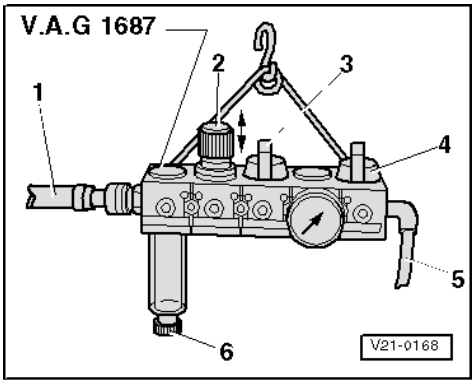
To turn the pressure regulating valve -2- the knob must be pulled upwards.



– Connect charge air system tester -V.A.G 1687- to adapter -1687/10- as shown in illustration.



– Connect compressed air hose -1- (compressed air supply) to charge air system tester -V.A.G 1687-.



Note

If there is water in the sight glass, drain at water drain screw -6-.

– Open valve -3-.

– Adjust pressure to 0.5 bar with pressure regulating valve -2-.

Caution

The test pressure must not exceed 0.5 bar. If the pressure is too high this can cause damage to the engine.

– Open valve -4- and wait until the test circuit is filled. If necessary readjust pressure to 0.5 bar.

– Check the charge air system for leaks by listening and touching, with commercially available leak detector spray or using ultrasonic tester -V.A.G 1842-.

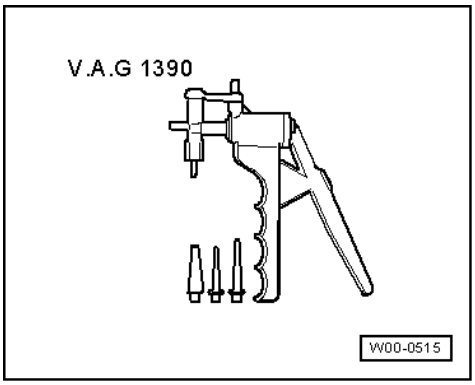
Note

- *How to use the ultrasonic tester -V.A.G 1842- ⇒ operating instructions*
- *If leaks occur, when doing any repair work observe notes for charge air system* ⇒ Page 330*.*
- *Before removing the charge air system tester -V.A.G 1687-, depressurise the test circuit by pulling the intake hose off the adapter -1687/10-.*

2.2 Checking charge pressure control

Special tools and workshop equipment required

- Hand vacuum pump with accessories -V.A.G 1390-



Test prerequisites

- Engine running at idling speed
- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK
- No leaks on intake and exhaust systems
- No faults on engine and fuel injection system or related to compression.
- No faults must be stored in event memory ⇒ Page 26, read event memory.
- Coolant temperature must be at least 80°C, ⇒ display group 1, display zone 4.

Test procedure

– Carry out final control diagnosis, and activate charge pressure control solenoid valve -N75- ⇒ Page 89, final control diagnosis.

The displays in display zones 2, 3 and 4 must fluctuate within following control range:

Display zone 2 OFF:

- Specification in display zone 3: 900…1150 mbar
- Specification in display zone 4: 90…100%

Display zone 2 ON:

- Specification in display zone 3: 100 mbar higher than with display OFF
- Specification in display zone 4: 95%

Note

- *If the engine is idling or OFF, the activation of the valve can also be checked by touching it.*
- *During activation with the engine idling, the linkage of the charge pressure control vacuum unit on the turbocharger must move back and forth.*

If the valve is not activated:

– Proceed with final control diagnosis until completed.

Note

If the engine is idling or OFF, the activation of the valve can also be checked by touching it.

– Proceed with final control diagnosis until completed.

– Exit diagnosis function.

– Switch off ignition.

If the linkage does not move with the engine idling but the solenoid valve operates:

– Pull vacuum hose off charge pressure control vacuum unit.

– Connect hand vacuum pump -V.A.G 1390- to charge pressure control vacuum unit, and check whether linkage is free to move.

If the linkage is not free to move:

– Turbocharger defective, renew vacuum unit.

If linkage does not move because solenoid valve is not working:

– Check charge pressure control solenoid valve -N75- ⇒Page 341.

If specification in display zone 4 remains unchanged:

– Check vacuum hoses for leaks. Vacuum hose schematic diagram ⇒Page 334.

Note

After the vacuum hoses have been checked for leaks, the engine must be restarted.

– Check position sender for charge pressure positioner -G581- ⇒Page 345.

If the charge pressure difference between “OFF” and “ON” in display zone 3 is not at least 100 mbar:

– Check charge pressure sender -G31- ⇒Page 343.

– Check charge air system for leaks ⇒Page 331.

If charge pressure sender -G31- and charge air system are OK:

– Turbocharger defective; renew turbocharger ⇒Page 326, Removing and installing turbocharger.

2.3 Connection for vacuum hoses

Engine codes CJDA, CJDD ⇒Page 335.

Engine codes CPYA, CPYB, CPYC, CPYD, CPYE ⇒Page 336.

Testing vacuum system ⇒Page 338

Caution

Do not kink, twist or crush the vacuum lines when routing. Otherwise the turbocharger may fail.

2.3.1 Engine codes CJDA, CJDD

1 - Air mass meter -G70-

2 - Turbocharger
- ❑ With vacuum unit
- ❑ With position sender for charge pressure positioner -G581-

3 - Air filter
- ❑ Optional

4 - Charge pressure control solenoid valve -N75-

5 - Vacuum unit

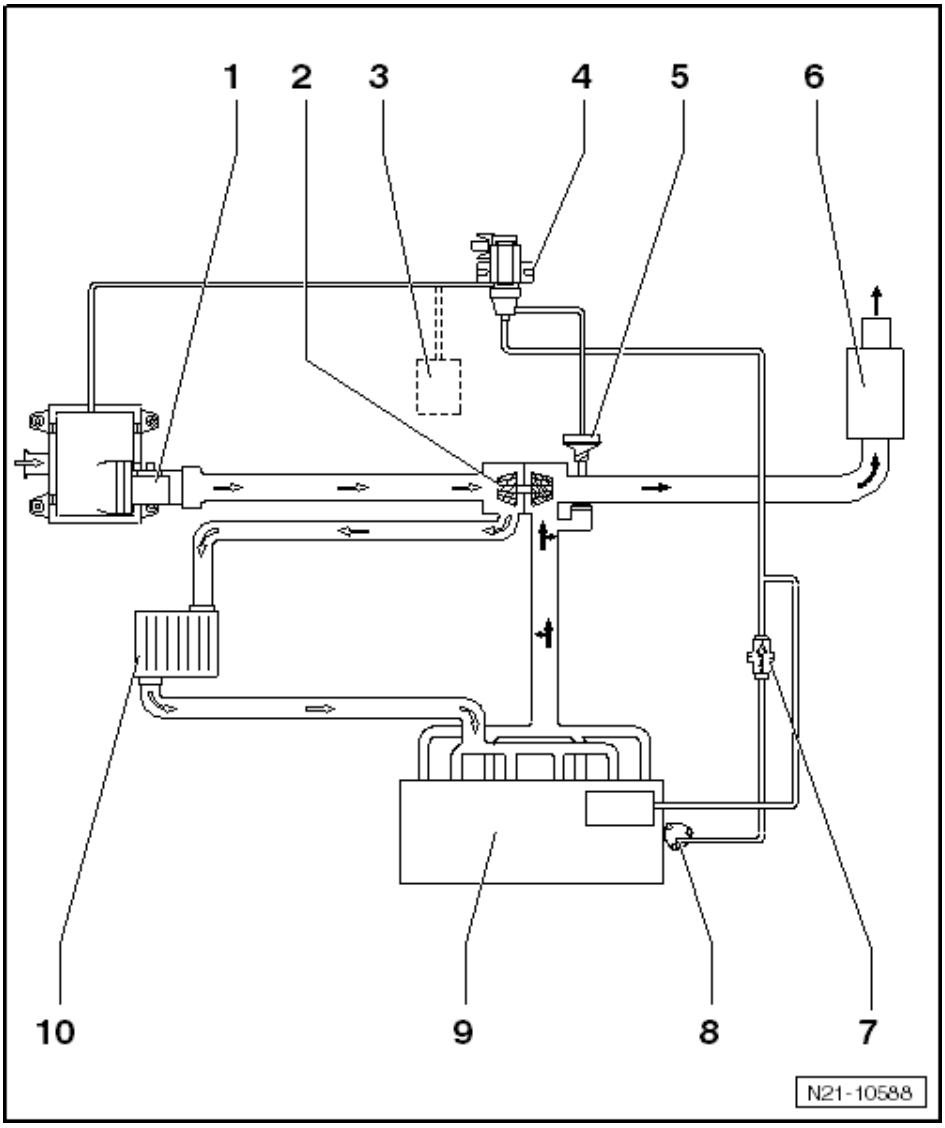
6 - Exhaust system

7 - Non-return valve
- ❑ Note installation position

8 - Vacuum pump

9 - Cylinder head cover

10 - Charge air cooler



2.3.2 Engine codes CPYA, CPYB, CPYC, CPYD, CPYE

1 - Air mass meter -G70-

2 - Turbocharger

- ❑ With vacuum unit
- ❑ With position sender for charge pressure positioner -G581-

3 - Charge pressure control solenoid valve -N75-

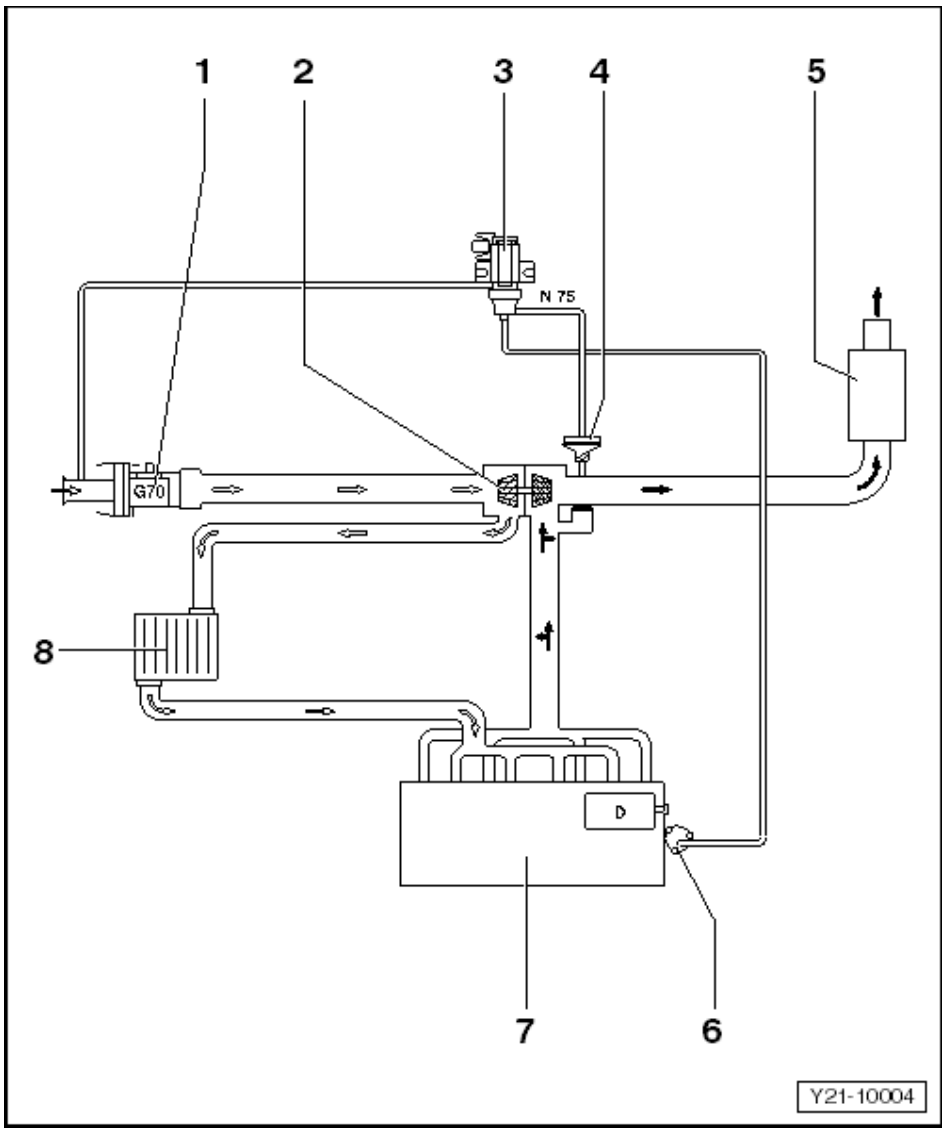
4 - Vacuum unit

5 - Exhaust system

6 - Vacuum pump

7 - Cylinder head cover

8 - Charge air cooler



2.3.3 Intake system, installation position 0°

Note

The proper position/alignment of the air mass meter is critical for the proper operation of the engine and the diesel particulate filter. The position of the connector of the air mass meter may be used as a reference ("fac-

ing away from engine", as shown in illustration). The markings on the air mass meter as well as on the elbow of the intake connecting pipe allow for a proper alignment when installing.

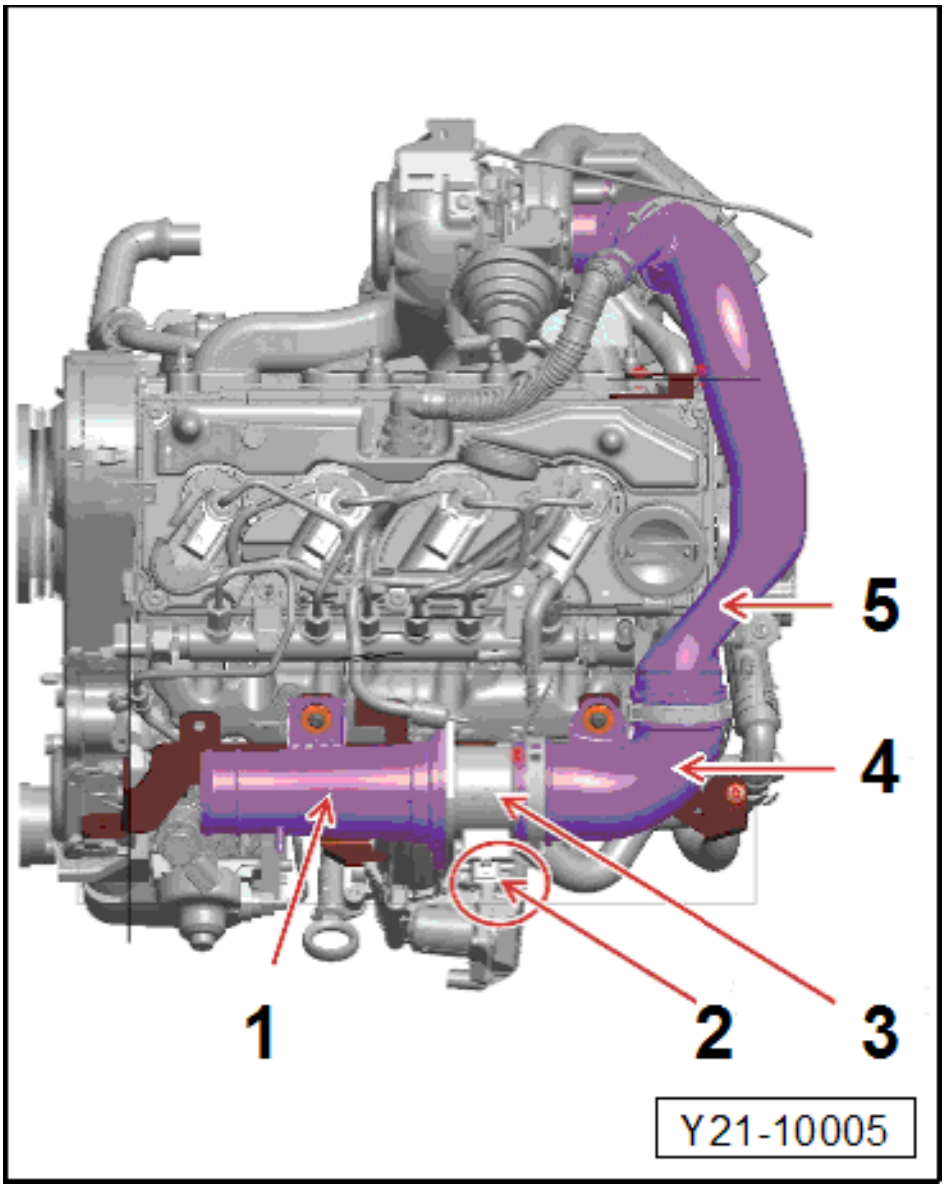
1 -

2 - Connector position of air mass meter

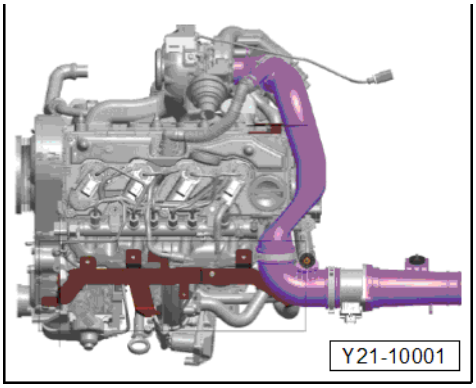
3 - Air mass meter

4 - 90° elbow of intake connecting pipe

5 - Intake connecting pipe



2.3.4 Intake system, installation position 180°



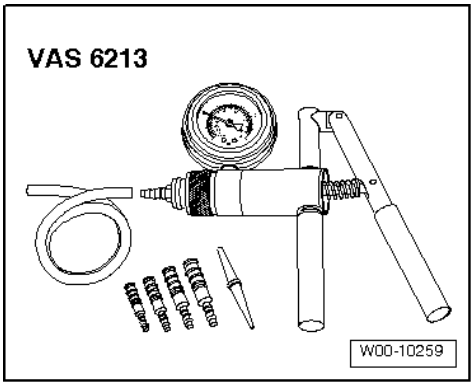
2.4 Testing vacuum system

Checking supply line and non-return valve (engine codes CJDA, CJDD only) ⇒Page 338.

Checking control line to turbocharger ⇒Page 339.

Special tools and workshop equipment required

- Hand vacuum pump -VAS 6213-



Caution

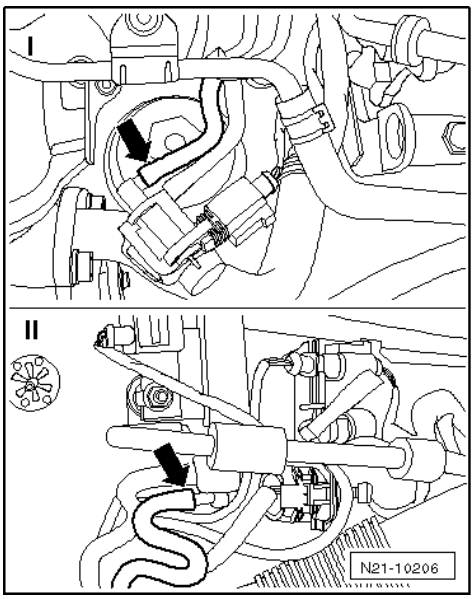
- ***Do not kink, twist or crush the vacuum lines when routing. This may cause breakdowns.***
- ***Observe safety precautions when working on charge air system and turbocharger ⇒Page 320.***
- ***Observe rules for cleanliness ⇒Page 320.***

Follow these instructions before starting work and while working on system.

2.4.1 Checking supply line and non-return valve (engine codes CJDA, CJDD only).

Pull vacuum hose off lower connecting piece of charge pressure control solenoid valve -N75- -arrow in II-.

– Seal open end of hose with a suitable sealing plug.



Note

Do not use screws or threaded bolts.

– Pull vacuum hose -arrow- off connection piece of vacuum pump.
– Connect hand vacuum pump -VAS 6213- to disconnected hose and generate a vacuum of 0.6 bar.
– Observe pressure gauge of hand vacuum pump -VAS 6213- for approx. 30 seconds.

- Vacuum must not drop.

If vacuum drops:

– Locate damage or leak in hose and replace corresponding length of hose.

If pressure does not drop:

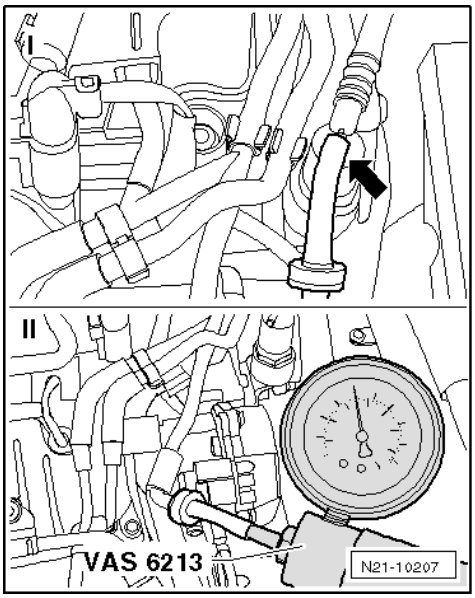
– First, pull hose off hose on hand vacuum pump -VAS 6213-.
– Remove sealing plugs from hose ends.
– If the non-return valve is functional, a clear hiss is audible when vacuum in vacuum reservoir is released.

If no hiss is audible:

– Renew non-return valve.

If a hiss is audible:

– Reconnect all disconnected vacuum hoses.
– Check control line to turbocharger ⇒ Page 339.



2.4.2 Checking control line to turbocharger, engine codes CJDA, CJDD, CPYA, CPYB, CPYC, CPYD, CPYE

– Pull off vacuum hose on connecting piece of charge pressure control solenoid valve -N75- -1- and vacuum unit of turbocharger ⇒ Page 334.
– Seal one opening of hose with a suitable sealing plug.

Note

Do not use screws or threaded bolts.

– Connect hand vacuum pump -VAS 6213- to other end of hose and generate a vacuum of 0.6 bar.
– Observe pressure gauge of hand vacuum pump -VAS 6213- for approx. 30 seconds.

- Vacuum must not drop.

If vacuum drops:

– Renew vacuum hose.
– Reconnect all disconnected vacuum hoses.

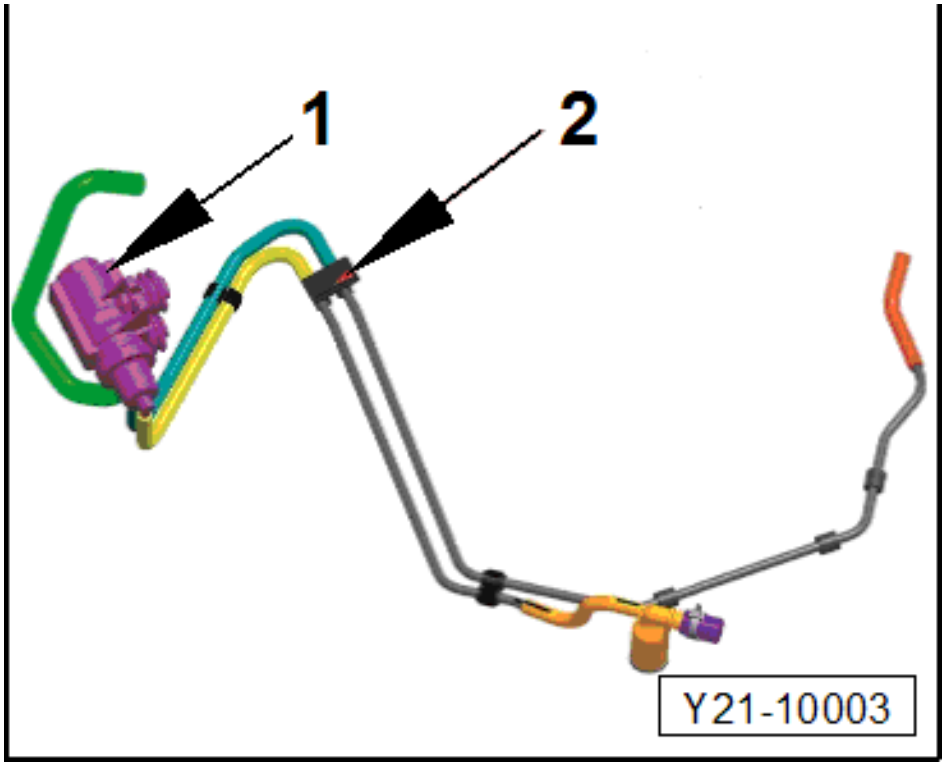
If pressure does not drop:

– Reconnect all disconnected vacuum hoses.

2.4.3 Checking vacuum hoses

1 - Charge pressure control solenoid valve - N75-

2 - Retaining clip for vacuum line on retainer



Note

The vacuum line is prefabricated.

3 Checking components and functions

WARNING

Adhere to the general safety regulations and the notes on repair work on the engine! ⇒ **Page 1**

The described component checks and functional checks are applicable for the series components and the current flow diagrams as of page ⇒ Page 486, current flow diagrams.

If components and electric circuits differ, observe the notes of the respective industrial engine customer.

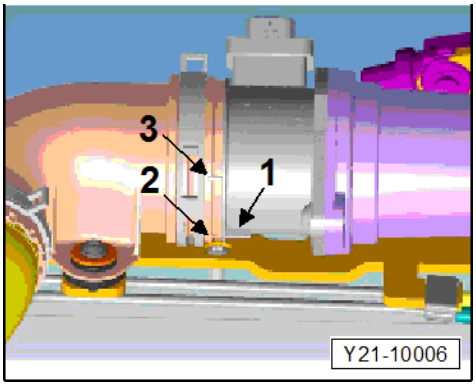
Check charge pressure control solenoid valve -N75- ⇒ Page 341.

Check charge pressure sender -G31- ⇒ Page 343.

Check position sender for charge pressure positioner -G581- ⇒ Page 345.

Check exhaust gas temperature sender 1 -G235- (exhaust gas temperature sender ahead of turbocharger) ⇒ Page 347.

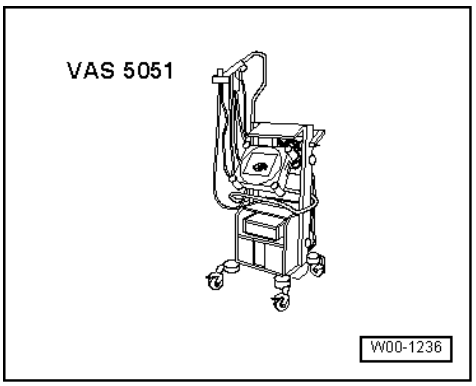
3.1 Markings on air mass meter and on elbow of the intake connecting pipe, view from turbocharger end



– To ease installation, both the air mass meter -item 1- and the elbow of the intake connecting pipe -item 2- and -item 3- are provided with markings.
– To make sure that the air mass meter is properly positioned, align marking -1- on air mass meter with marking -2- on elbow of the intake connecting pipe.
– Marking -2- is located below marking -3- on the same level as the bracket.

3.2 Checking charge pressure control solenoid valve -N75-, engine codes CJDA, CJDD, CPYA, CPYB, CPYC, CPYD, CPYE

Special tools and workshop equipment required



- Connect vehicle diagnosis, testing and information system -VAS 5051/B- using diagnostic cable -VAS 5051B/1-.
- Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
- Auxiliary measuring set -V.A.G 1594D-
- Test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-1-
- Current flow diagram

Test prerequisites

- Engine running at idling speed
- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK
- Coolant temperature must be at least 80°C, ⇒ display group 1, display zone 4.

Test procedure

– Carry out final control diagnosis, and activate charge pressure control solenoid valve -N75- ⇒Page 89, final control diagnosis.

The display in display zone 2 must fluctuate between “OFF” and “ON”:

Note

- *If the engine is idling or OFF, the activation of the valve can also be checked by touching it.*
- *During activation with the engine idling, the linkage of the charge pressure control vacuum unit on the turbocharger must move back and forth.*

– Proceed with final control diagnosis until completed.

– Exit diagnosis function.

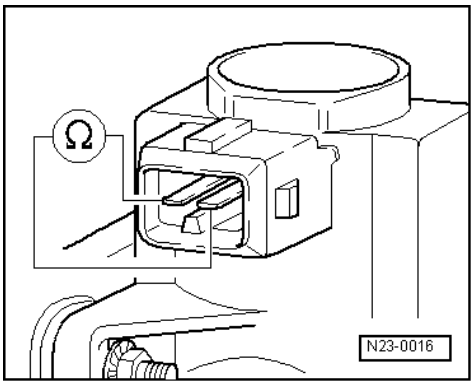
– Switch off ignition.

If the valve is not activated:

– Pull 2-pin connector off charge pressure control solenoid valve -N75-.

Checking resistance

– Connect multimeter to valve contacts using test leads from -V.A.G 1594D- to measure resistance. Specification: 14.0...20.0 Ω



Note

At room temperature the resistance is in the lower tolerance range, and at operating temperature in the upper tolerance range.

If the specification is not attained:

– Renew charge pressure control solenoid valve -N75-.

– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

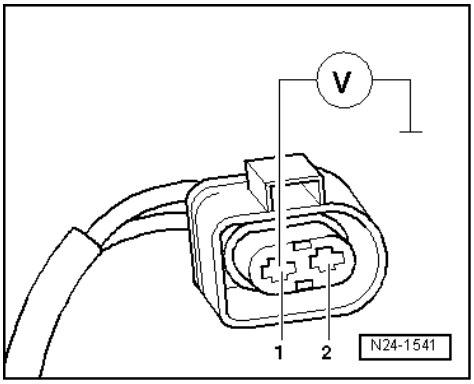
If specification is attained:

Checking voltage supply

– Connect multimeter to connector contact 1 and engine earth using test leads from -V.A.G 1594D- to measure voltage.

– Switch on ignition. Specification: at least 11.5 V

– Switch off ignition.



If the specification is not attained:

– Check terminal 30 voltage supply relay -J317- ⇒Page 486, current flow diagrams.

– Check cable connections for open circuit, short circuit and transfer resistance at contacts referring to current flow diagram.

If specification is attained:

– Check wiring of charge pressure control solenoid valve as follows:

– Using adapter cable -V.A.G 1598/39-1-, connect test box -V.A.G 1598/42- to wiring harness of control unit ⇒Page 24. The engine control unit is not connected by this action.

– Check wiring between test box and connector for open circuit referring to current flow diagram.

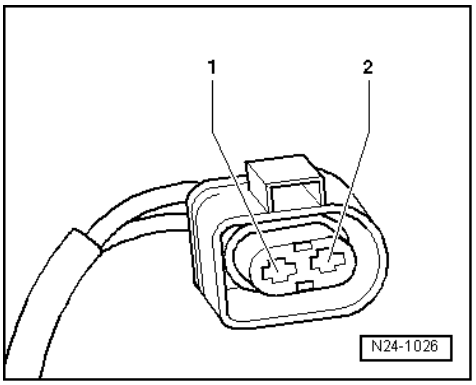
◆ Contact 2 + socket 20

● Cable resistance: max. 2.0 Ω.

– Additionally check wires for short to one another. Specification: ∞ Ω

If no wiring fault is detected and voltage supply is OK:

– Renew engine control unit -J623- ⇒Page 418.



3.3 Checking charge pressure sender -G31-

Special tools and workshop equipment required

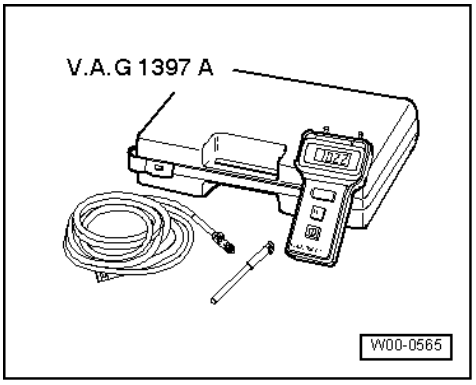
◆ Turbocharger tester -V.A.G 1397 A-

◆ Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-

◆ Auxiliary measuring set -V.A.G 1594D-

◆ Test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-2-

◆ Current flow diagram



Test prerequisites

● Fuses must be OK.

● The battery voltage must be at least 11.5 V.

● All electrical consumers must be switched off.

● Earth connections OK

Test procedure

Note

◆ *The charge pressure sender -G31- and intake air temperature sender -G42- are installed in one common housing in the charge air pipe.*

◆ *Only gold-plated contacts may be used when repairing contacts in connector.*

– Switch on ignition.

– Connect vehicle diagnostic tester, and select engine control unit. ⇒Page 23

– Select diagnosis function “011-Read measured value block”.

– Select “Display group 11”.

Indicated on display:

```
Display group 11
xxxx rpm   xxxx mbar    978 mbar  xxx%
```

– Check specification for charge pressure in display zone 3.

– Compare displayed charge pressure (actual) with display on turbocharger tester -V.A.G 1397 A-. Specification: displayed pressure values must correspond (tolerance ± 50 mbar).

Note

The turbocharger tester -V.A.G 1397 A- is required to provide an independent figure for comparison. The turbocharger tester must be set to range I (absolute pressure). A barometer can be used instead.

– Exit diagnosis function.

– Switch off ignition.

If the specification is not attained:

Checking voltage supply

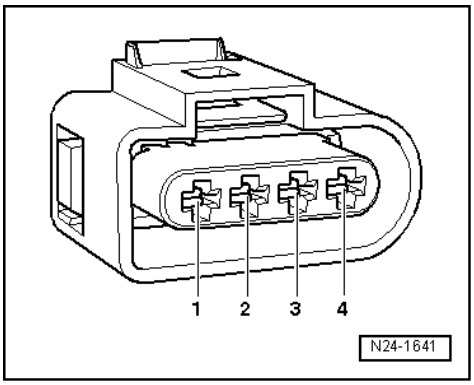
– Connect multimeter to contacts 1 + 3 of connector using test leads from -V.A.G 1594D- to measure voltage.

– Switch on ignition. Specification: at least 4.8...5.2 V

– Switch off ignition.

– Check wiring of charge pressure sender as follows:

– Using adapter cable -V.A.G 1598/39-2-, connect test box -V.A.G 1598/42- to wiring harness of control unit ⇒Page 24. The engine control unit is not connected by this action.



Note

The charge pressure sender -G31- and intake air temperature sender -G42- are installed in one common housing in the charge air pipe.

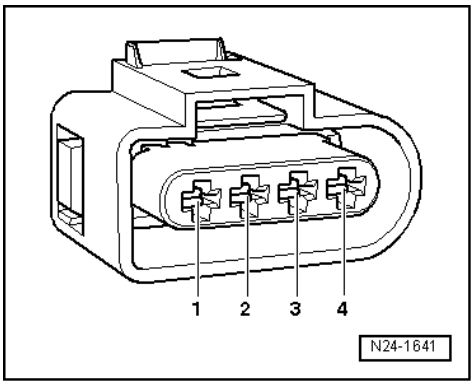
– Check wiring between test box and connector for open circuit referring to current flow diagram.

◆ Contact 3 + socket 17

◆ Contact 4 + socket 83

● Cable resistance: max. 2.0 Ω.

– Also check wiring for short to one another, short to battery earth/engine earth and short to battery positive. Specification: ∞ Ω



If no wiring fault is detected and voltage was present between contacts 1 + 3:

– Renew charge pressure sender -G31- together with intake air temperature sender -G42-.

– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

If no wiring fault is detected and no voltage was present between contacts 1 + 3:

– Pull connectors off any components which are connected to this voltage supply line ⇒Page 486, current flow diagrams.

– Check voltage supply and wires on these components.

If no wiring fault is detected and no voltage was present on these components:

– Renew engine control unit -J623- ⇒Page 418.

3.4 Checking position sender for charge pressure positioner -G581-

Special tools and workshop equipment required

- Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
- Auxiliary measuring set -V.A.G 1594D-
- Test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-1-
- Current flow diagram

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK
- Vacuum hoses OK
- Coolant temperature must be at least 80°C, ⇒ display group 1, display zone 4.

Test procedure

– Connect vehicle diagnostic tester, and select engine control unit. ⇒Page 23

– Select diagnosis function “015-Access permissions”.

– Carry out final control diagnosis, and activate charge pressure control solenoid valve -N75- ⇒Page 89, final control diagnosis.

The displays in display zones 2, 3 and 4 must fluctuate within following control range:

Note

The display zones may be shown one below the other or next to each other on the display of the vehicle diagnostic tester.

Display zone 2 OFF:

- Specification in display zone 3: 900…1150 mbar
- Specification in display zone 4: 90…100%

Display zone 2 ON:

- Specification in display zone 3: 100 mbar higher than with display OFF
- Specification in display zone 4: 95%
- Specification in display zone 3: charge pressure difference between “OFF” and “ON” must be at least 100 mbar

– Exit diagnosis function.

– Switch off ignition.

If the specifications are not attained, display zone 4 always shows 0:

- Engine codes CJDA, CJDD - renew position sender.
- Engine codes CPYA, CPYB, CPYC, CPYD, CPYE - renew complete turbocharger.

Checking voltage supply

Pull 3-pin connector off position sender for charge pressure positioner -G581- ⇒Page 321.

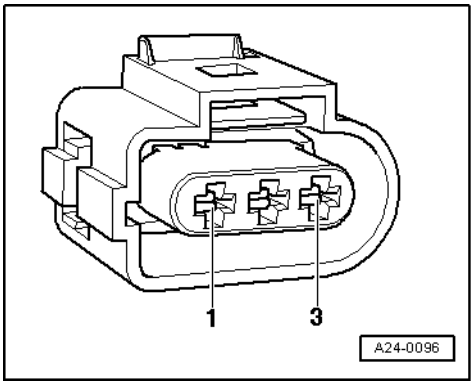
– Connect multimeter to contacts 1 + 3 of connector using test leads from -V.A.G 1594D- to measure voltage.

– Switch on ignition. Specification: at least 4.8...5.2 V

– Switch off ignition.

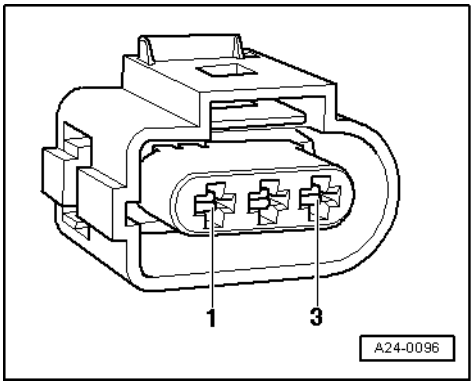
– Check wiring of position sender for charge pressure positioner -G581- as follows:

– Using adapter cable -V.A.G 1598/39-1-, connect test box -V.A.G 1598/42- to wiring harness of control unit ⇒Page 24. The engine control unit is not connected by this action.



– Check wiring between test box and connector for open circuit referring to current flow diagram.

- Contact 1 + socket 53
- Contact 2 + socket 58
- Contact 3 + socket 25



- Cable resistance: max. 2.0 Ω.

– Also check wiring for short to one another, short to battery earth/engine earth and short to battery positive. Specification: ∞ Ω

If no wiring fault is detected and voltage was present between contacts 1 + 3:

– Renew position sender for charge pressure positioner -G581-.

– Adapt position sender for charge pressure positioner -G581- ⇒Page 422.

– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

If no wiring fault is detected and no voltage was present between contacts 1 + 3:

– Pull connectors off any components which are connected to this voltage supply line ⇒Page 486, current flow diagrams.

– Check voltage supply and wires on these components.

If no wiring fault is detected and no voltage was present on these components:

– Renew engine control unit -J623- ⇒Page 418.

3.5 Checking exhaust gas temperature sender 1 -G235- (exhaust gas temperature sender ahead of turbocharger)

Special tools and workshop equipment required

- Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
- Auxiliary measuring set -V.A.G 1594D-
- Test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-2-
- Current flow diagram

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK
- Engine must be cold

Test procedure

Note

Only gold-plated contacts may be used when repairing the contacts in the connectors of the exhaust gas temperature 1.

– Start engine and run at idling speed.

– Connect vehicle diagnostic tester, and select engine control unit. ⇒Page 23

– Select diagnosis function “011-Read measured value block”.

– Select “Display group 99”.

Indicated on display:

```
Display group 99
880 rpm  114.0°C   xxx.x°C   xxx.x°C
```

Note

The display zones may be shown one below the other or next to each other on the display of the vehicle diagnostic tester.

– Increase engine speed to 2400...2800 rpm.

– Check exhaust gas temperature value from exhaust gas temperature sender 1 -G235- (exhaust gas temperature sender ahead of turbocharger) in display zone 2. The temperature value must increase evenly and continuously.

– Keep engine speed at 2400...2800 rpm for approx. 3 minutes.

Note

Make a note of temperature value in display zone 2.

– Press [←] button.

– With the engine speed being increased, select “Display group 100”.

Indicated on display:

```
Display group 100
xxx°C    xxx°C    xxx mbar    xxx mbar
```

– Check exhaust gas temperature value from exhaust gas temperature sender 3 -G495- (exhaust gas temperature sender ahead of diesel particulate filter) in display zone 1 and from exhaust gas temperature sender 4 -G648- (exhaust gas temperature sensor downstream from diesel particulate filter) in display zone 2.

Note

- *The exhaust gas temperature value in display zone 2 of display group 99 must be higher than the exhaust gas temperature values in display zones 1 and 2 of display group 100.*
- *In addition, the exhaust gas temperature value in display zone 1 of display group 100 must be higher than the exhaust gas temperature value in display zone 2 of display group 100.*

– If the value in display zone 2 of display group 100 is higher than the value in display field 1, the two senders have been interchanged.

– If the value in display zone 2 of display group 99 is not plausible, check exhaust gas temperature sender 1 -G235- (exhaust gas temperature sender ahead of turbocharger) and wiring to sender as follows:

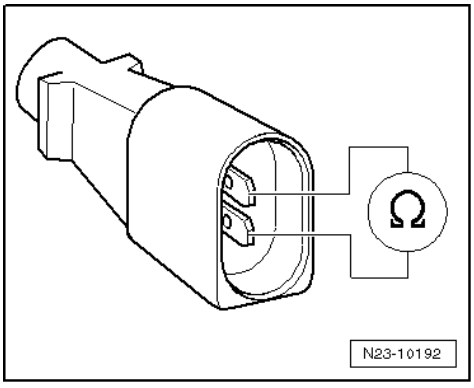
– Exit diagnosis function.

– Switch off ignition.

Checking resistance

– Disconnect 2-pin connector from exhaust gas temperature sender 1 -G235- ⇒Page 321.

– Connect multimeter to contacts on connector for sender using test leads from -V.A.G 1594- to measure resistance. Specification: 170.0...850.0 Ω



If the specification is not attained:

– Renew exhaust gas temperature sender 1 -G235- ⇒Page 321, Assembly overview - turbocharger with attachments.

– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

If specification is attained:

– Check wiring of exhaust gas temperature sender 1 -G235- as follows:

– Using adapter cable -V.A.G 1598/39-2-, connect test box -V.A.G 1598/42- to wiring harness of control unit ⇒Page 24. The engine control unit is not connected by this action.

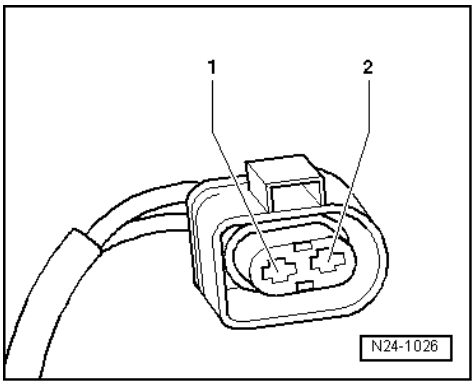
– Check wiring between test box and connector for open circuit referring to current flow diagram.

◆ Contact 1 + socket 89

◆ Contact 2 + socket 9

● Cable resistance: max. 2.0 Ω.

– Also check wiring for short to one another, short to battery earth/engine earth and short to battery positive. Specification: ∞ Ω



If no fault in lines is detected:

– Renew engine control unit -J623- ⇒Page 418.

23 - Mixture preparation - injection

1 Repairing diesel direct injection system

> ⚠ ***WARNING***
>
> ***Adhere to the general safety regulations and the notes on repair work on the engine!*** ⇒ **Page 1**

> ⚠ ***WARNING***
>
> ***When doing any repair work, pay attention to the following due to the cramped conditions:***
>
> - ***Adhere to the general safety precautions, and never take any risk.***
> - ***The engine is a hazardous area and can cause serious injuries.***
> - ***Never leave any objects in the engine compartment, such as cleaning cloths or tools.***
> - ***Many engine components become hot during operation – risk of burns. If necessary, provide appropriate protective means.***
> - ***Servicing materials, such as fuel, engine oils or coolant additive, are harmful substances; adhere to the safety instructions from the manufacturer.***
> - ***There is a risk of injuries, if maintenance locations are difficult to access. This risk can be reduced, by installing the engine in an appropriate location and by avoiding sharp edges.***
> - ***Route all the various lines (e.g. for fuel, hydraulics, coolant and refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.***
> - ***Ensure that there is sufficient clearance to all moving or hot components.***
> - ***Tools are to be checked for damage and safety risks on a regular basis.***

The engine control unit -J623- is equipped with a event memory. Read event memory and perform final control diagnosis before starting repairs, adjustments and fault finding and after the latter have been completed ⇒ Page 26.

Note

- *During some checks, the engine control unit may detect and store a fault. Therefore, after completing all checks and repairs, interrogate the event memory and erase if necessary* ⇒ Page 26, *Interrogating event memory.*
- *For trouble-free operation of electrical components, a voltage of at least 11.5 V is necessary.*
- *Renew self-locking nuts.*

Adhere to instructions for working on fuel system ⇒ Page 351.

To avoid any risk of injuries to persons and/or the destruction of the injection and glow plug system, the following must be noted ⇒ Page 353

Observe safety precautions when working on diesel direct injection fuel system ⇒ Page 354.

Observe rules for cleanliness ⇒ Page 354.

Assembly overview - intake manifold with attachments ⇒ Page 355.

Removing and installing intake manifold ⇒ Page 357.

System - ⇒ Page 358

Assembly overview - fuel system ⇒ Page 362.

Correction values for injectors ⇒ Page 368

Checking for injectors that are jammed open ⇒ Page 369

Removing and installing injector (piezo injector) ⇒ Page 370.

Install high-pressure lines ⇒ Page 375.

Check return flow rate from fuel pressure regulating valve -N276- ⇒ Page 377.

Removing and installing fuel pressure regulating valve -N276- ⇒ Page 377.

Removing and installing fuel pressure sender -G247- ⇒ Page 379.

Removing and installing high-pressure pump ⇒ Page 380.

Fill/bleed fuel system ⇒ Page 383.

Checking fuel system for leaks ⇒ Page 384

Checking pressure retention valve in fuel return line ⇒ Page 385.

1.1 Instructions for working on fuel system

To prevent the high-pressure fuel pump from running while it is empty and to ensure that the engine starts quickly after parts have been renewed, it is important to observe the following:

- If fuel system components between fuel tank and fuel high-pressure pump are removed or renewed, initial fuel filling must be carried out.
- If a fuel pump, fuel line (between fuel tank and fuel high-pressure pump) or the fuel filter is removed or renewed, the fuel system must be bled before the engine is started for the first time.
- If the high-pressure fuel pump is removed or renewed, the fuel system must be bled before engine is started for the first time.
- Clean tools and workbench etc. before working on injection system.
- Thoroughly clean all unions and surrounding areas before disconnecting.
- When removing components, seal all open connections immediately with suitable clean sealing caps.
- Do not remove sealing caps from components until immediately prior to installation. Removed components should be kept in new, sealable plastic bags (use the original new part packaging if possible).
- Before installation, check injectors and their surroundings visually; they must be undamaged and free of lint. Make sure the injector bores in the cylinder head are clean. Wipe out if necessary using a clean cloth, taking care not to cause damage. Do not use sharp objects of any kind.
- If high-pressure lines are not renewed, they must be labelled on removal. High-pressure fuel lines must always be re-installed in their original positions (i.e. on the same cylinder).
- The following components and seals/O-rings must always be renewed when injectors are removed and installed: “copper seal”, “O-ring for injector bore”, “injector return clip” “also to be used if necessary:” “O-ring for injector return connection” “, injector seal”.
- The following components and seals/O-rings must renewed on renewing an injector: “ included in the scope of supply are ” “copper seal”, “O-ring for injector bore”, “injector return clip” “also to be used if necessary” “O-ring for injector return line”“, injector seal”.
- Always fit new copper seals for the injectors. Check all new O-rings for damage before installing. Lubricate O-rings lightly with assembly oil or clean engine oil before installing.
- Take care not to damage the injectors when removing the old copper seals.
- Align high-pressure lines free from stress. First tighten all unions hand-tight and then tighten to torque.
- On high-pressure lines, tools may only be used for loosening or tightening.
- Never attempt to reshape high-pressure fuel lines.

- Disassembling individual common high-pressure accumulator components is not permitted.
- The components should be replaced as complete units if faulty.
- Never attempt to bleed the common high-pressure accumulator system by loosening high-pressure components after starting the engine.
- Do not carry out any installation work on common high-pressure accumulator system whilst engine is running.
- In particular, do not open or release high-pressure lines and electrical connectors.
- All cable ties which were opened or cut open during removal must be replaced in same position during installation.
- When the fuel system is open: do not work with compressed air if this can be avoided. Do not move vehicle/machine unless absolutely necessary.
- Also ensure that no diesel fuel comes into contact with the coolant hoses. Should this occur, the hoses must be cleaned immediately. Damaged hoses must be renewed.

1.2 To avoid any risk of injuries to persons and/or the destruction of the injection and glow plug system, the following must be noted

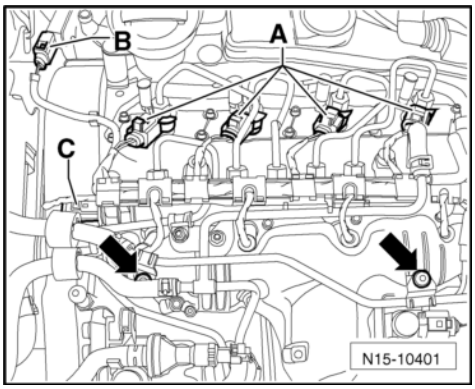
- Persons wearing a pacemaker should not lean over the engine compartment while the engine is running, as the injectors use high voltage pulses.
- It must be ensured that no fuel lines are open when the engine is running.
- Always switch off the ignition before connecting or disconnecting injection and glow plug system wiring or tester cables.
- Always switch off ignition before cleaning engine.
- The battery should only be disconnected and reconnected with ignition switched off.
- Certain tests may lead to a fault being detected by the control unit and stored. Therefore, after completing all checks and repairs, the event memory must be read and cleared as necessary.

1.3 Observe safety precautions when working on diesel direct injection fuel system

> ⚠ ***WARNING***
>
> ***When doing any repair work, pay attention to the following due to the cramped conditions:***
>
> - ***Route all the various lines (e.g. for fuel, hydraulics, activated charcoal filter system, coolant, refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.***
> - ***Ensure that there is sufficient clearance to all moving or hot components.***

To prevent injuries to persons and/or destruction of the injection and glow plug system, the following must be noted:

- Always switch off the ignition before connecting or disconnecting injection and glow plug system wiring or tester cables.
- If the engine is to be turned at starter speed without starting, e.g. to check compression, pull connector -A- off injectors.
- Disconnecting and connecting the battery must only be done with the ignition switched off, otherwise the engine control unit could be damaged.



Note the following if testers and measuring instruments have to be used during a road test:

- The test and measuring equipment must always be secured and operated by a 2nd person.

1.4 Rules for cleanliness

When working on fuel supply and injection system, pay careful attention to the following “rules” for cleanliness:

- Thoroughly clean all unions and surrounding areas before disconnecting.
- Place removed parts on a clean surface and cover. Use only lint-free cloths.
- Carefully cover opened components or seal if repairs cannot be carried out immediately.
- Install clean components only. Do not remove replacement parts from packing until immediately before installing. Do not use parts that have not been stored in their packing (e.g. in tool boxes etc.).
- Existing transport and protective packaging and sealing caps must only be removed immediately prior to installation.
- When system is open: do not work with compressed air if this can be avoided. Do not move vehicle/machine unless absolutely necessary.

- Also ensure that no diesel fuel comes into contact with the coolant hoses. Should this occur, the hoses must be cleaned immediately. Damaged hoses must be renewed.

1.5 Assembly overview - intake manifold with attachments

– Note safety precautions before beginning work ⇒Page 354.

– Observe rules for cleanliness ⇒Page 354.

Engine codes CJDA, CJDD ⇒Page 355.

Engine codes CPYA, CPYB, CPYC, CPYD, CPYE ⇒Page 356.

Removing and installing intake manifold ⇒Page 357.

1.5.1 Engine codes CJDA, CJDD

1 - Intake manifold
- ❑ Must not be dismantled.
- ❑ Removing and installing ⇒Page 357

2 - 8 Nm

3 - Gasket
- ❑ Renew

4 - Seal
- ❑ Renew

5 - Connecting pipe
- ❑ To exhaust gas recirculation cooler

6 - 20 Nm

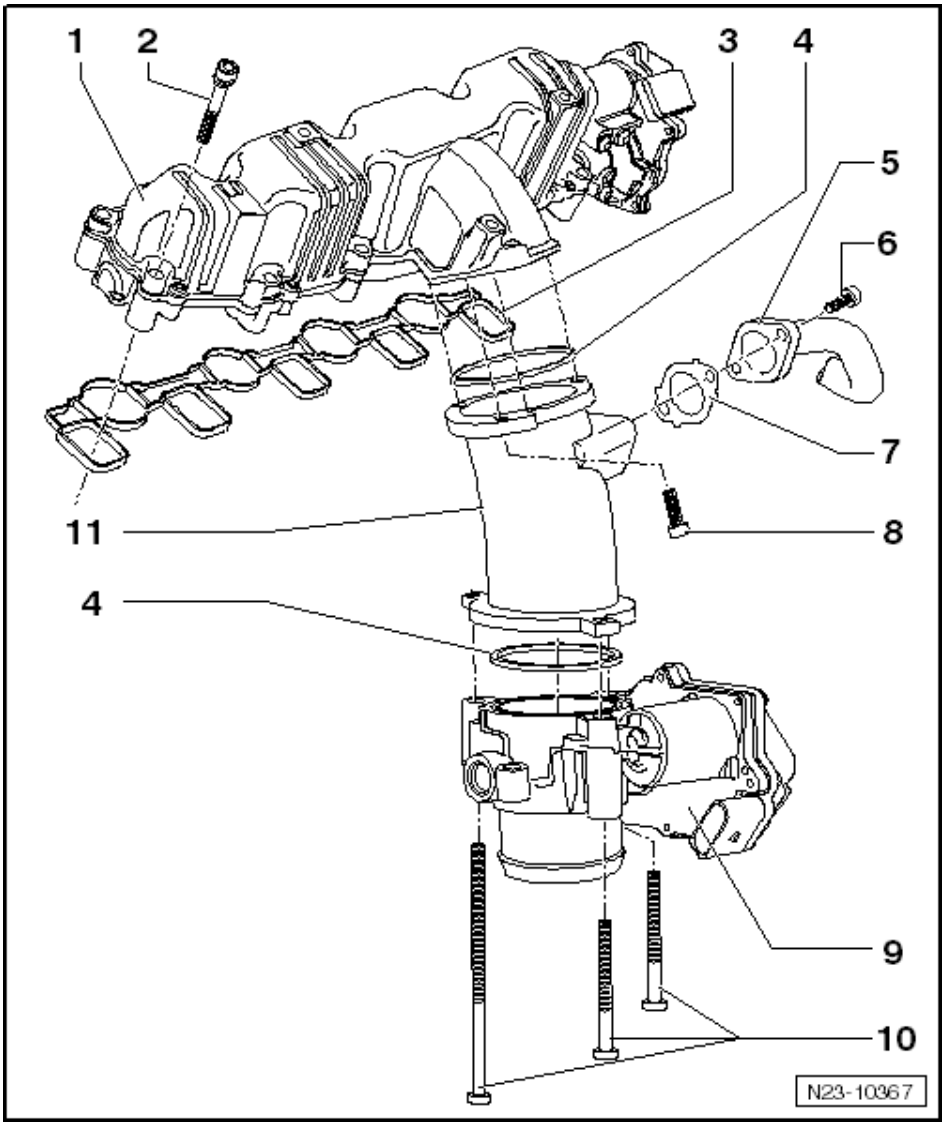
7 - Gasket
- ❑ Renew

8 - 8 Nm

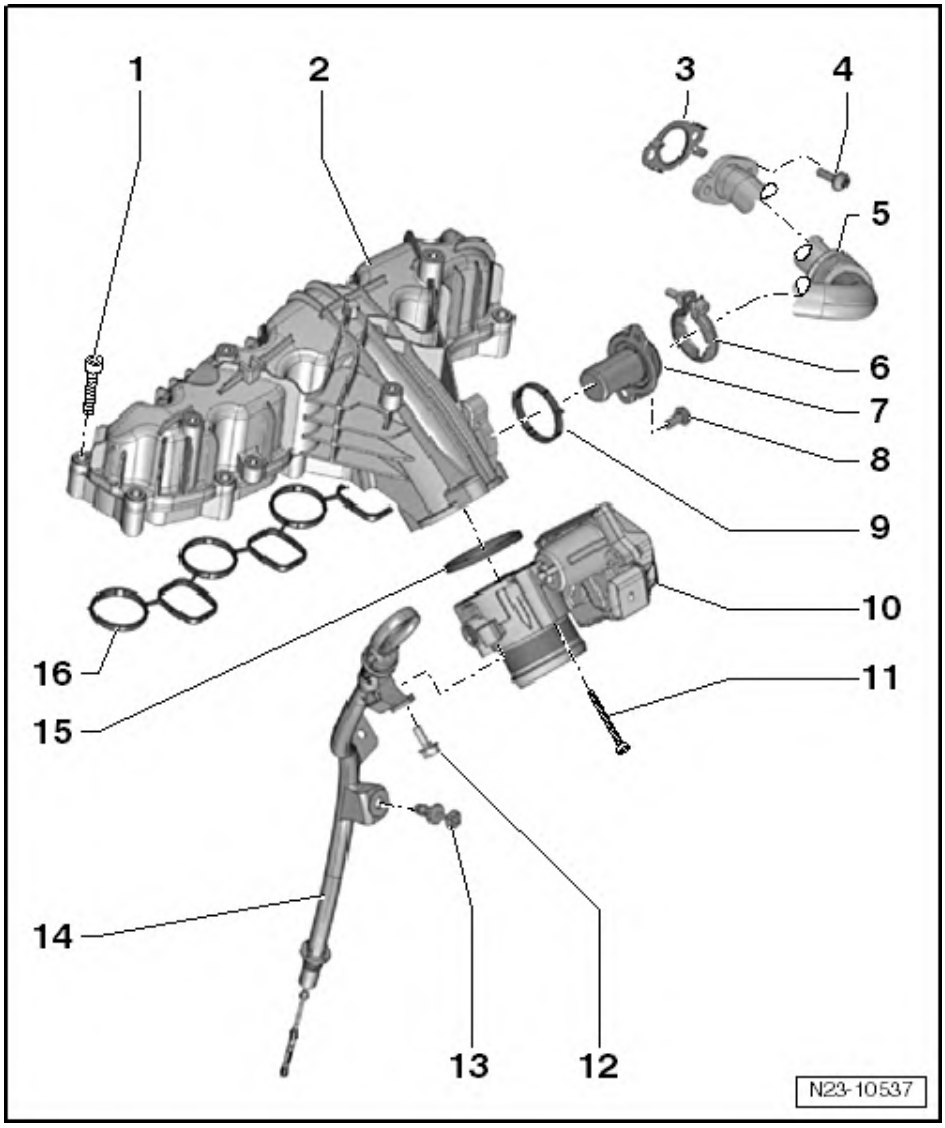
9 - Throttle valve module -J338-
- ❑ Checking ⇒Page 89, final control diagnosis

10 - 8 Nm

11 - Connection



1.5.2 Engine codes CPYA, CPYB, CPYC, CPYD, CPYE



1 - 8 Nm

2 - Intake manifold
- ❑ Must not be dismantled.
- ❑ Removing and installing ⇒Page 357

3 - Gasket
- ❑ Renew

4 - 20 Nm

5 - Connecting pipe
- ❑ To exhaust gas recirculation cooler

6 - Clamp, 5 Nm
- ❑ Renew

7 - Connection
- ❑ For exhaust gas recirculation.

8 - 8 Nm

9 - Seal
- ❑ Renew

10 - Throttle valve module -J338-
- ❑ Checking ⇒Page 89, final control diagnosis

11 - 8 Nm

12 - 8 Nm

13 - Clip

14 - Guide tube
- ❑ For oil dipstick.

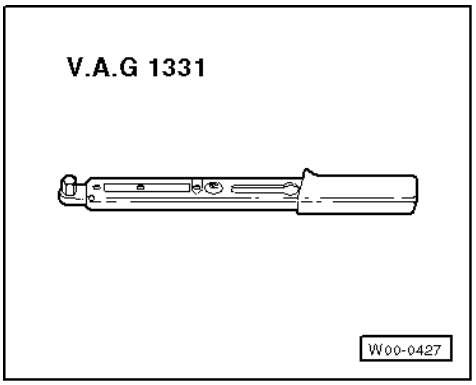
15 - Seal
- ❑ Renew

16 - Gasket
- ❑ Renew

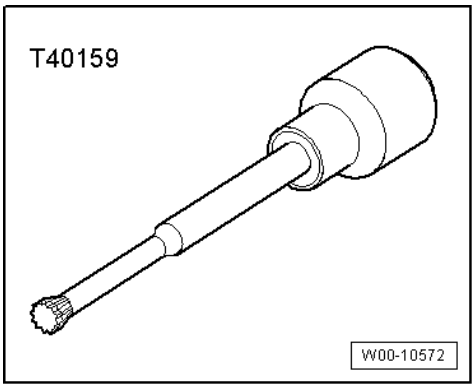
1.5.3 Removing and installing intake manifold

Special tools and workshop equipment required

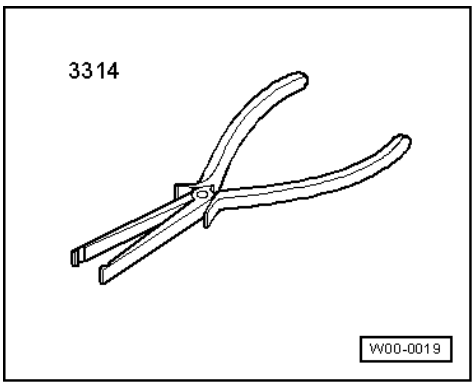
- Torque wrench -V.A.G 1331-



- Bit XZN 8 -T40159-



- Pliers -3314-

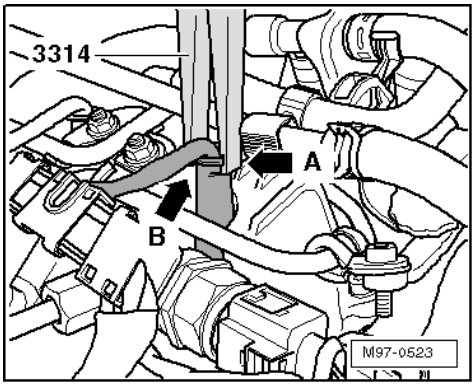


Removing

Caution

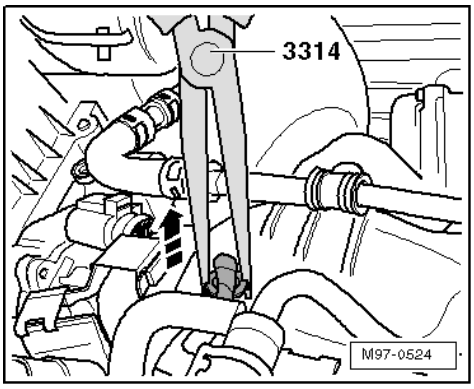
Make sure that no wiring connections are damaged when disconnecting the connectors. Otherwise the whole wiring harness will need to be renewed. Do not compress the pliers -3314- too firmly to separate the connectors, otherwise the support sleeve may be damaged.

– Position pliers -3314- with groove -arrow A- on support sleeve shoulder -arrow B-.



– Carefully pull connector in -direction of arrow- off glow plug.
– Pull fuel return lines off fuel rail, injectors and high-pressure pump.

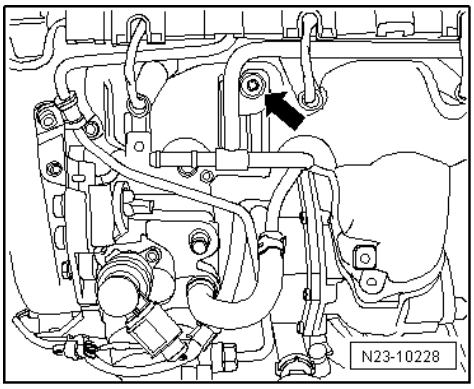
Engine codes CJDA, CJDD



– Unscrew securing bolt -arrow- and remove fuel return line.

Continuation for all engine codes

– Remove high-pressure line between high-pressure pump and fuel rail.

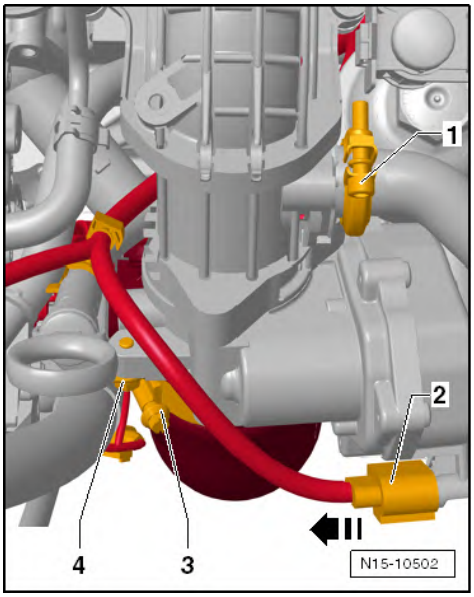


– Pull connector -2- off throttle valve module -J338-.
– Open clamp -4- and pull off charge air hose.
– Unscrew the securing bolts from the intake manifold from the outside to the inside in diagonal sequence with hexagon key extension -T40159-.
– Remove intake manifold from engine.

Installing

Installation is carried out in the reverse order. When installing, note the following:

– Renew seals
– Tighten securing bolts of intake manifold from inside out in diagonal sequence. Specified torque ⇒Page 355.



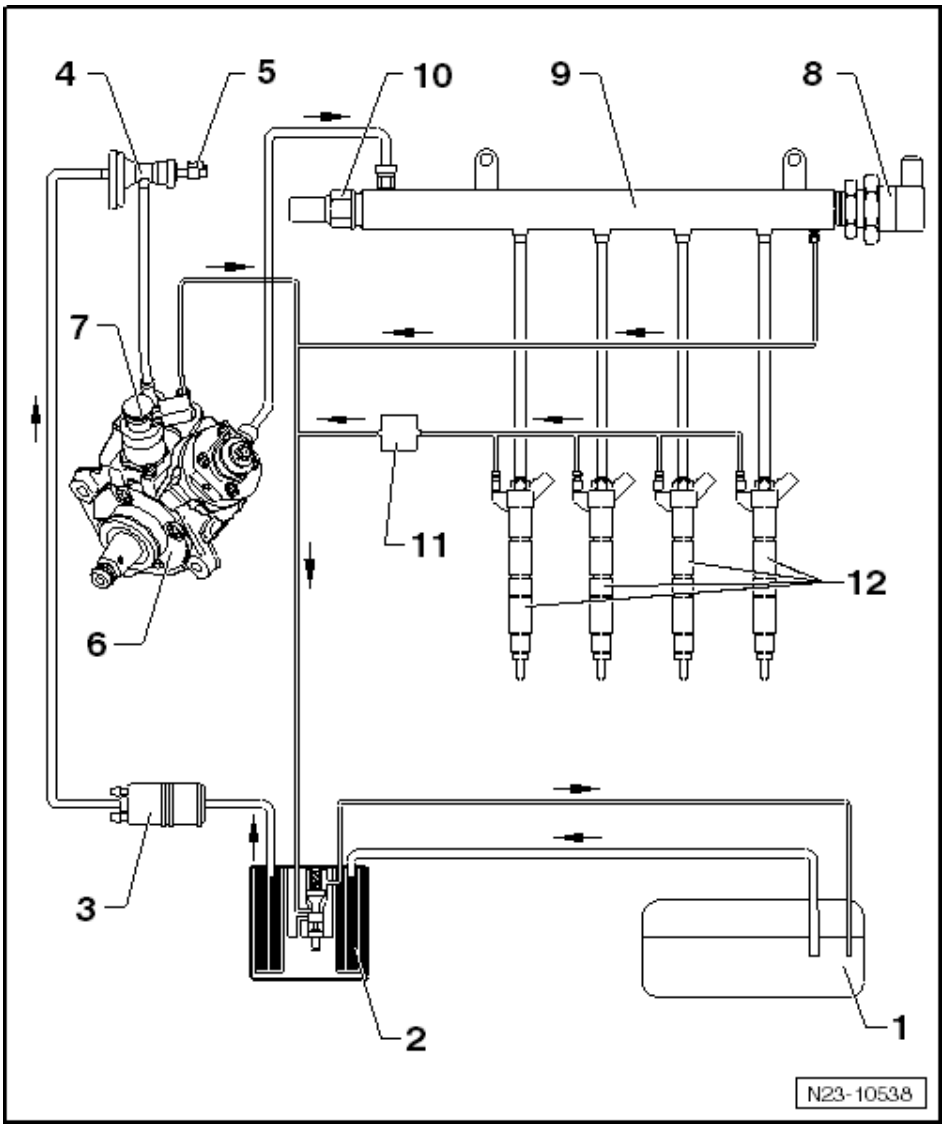
1.6 Fuel system

Engine codes CJDA, CJDD ⇒Page 359.

Engine codes CPYA, CPYB, CPYC, CPYD, CPYE ⇒Page 361.

> ⚠ ***WARNING***
>
> - ***Always read rules for cleanliness and instructions for working on fuel system ⇒Page 354.***
> - ***Always follow these rules for cleanliness and instructions before starting work and while working on the fuel system.***
> - ***If components of the fuel system between the tank and the high-pressure fuel pump are removed or renewed, the fuel system must be filled to be bled ⇒Page 383. (It is important not to allow the high-pressure pump to run while still empty.)***

1.6.1 Fuel system, engine codes CJDA, CJDD



1 - Fuel tank

2 - Fuel filter
- ❑ With pre-heating valve.
- ❑ Assembly overview - fuel filter ⇒Page 304.

3 - Supplementary fuel pump -V393-
- ❑ Removing and installing ⇒Page 313
- ❑ Checking ⇒Page 314

4 - Filter strainer

5 - Fuel temperature sender -G81-
- ❑ Checking ⇒Page 409

6 - High-pressure pump
- ❑ After renewing, a first fuel filling must be performed (never allow the pump to run while it is still empty) ⇒Page 383.
- ❑ Removing and installing ⇒Page 380

7 - Fuel metering valve -N290-
- ❑ Must not be removed.
- ❑ Checking ⇒Page 388

8 - Fuel pressure regulating valve -N276-
- ❑ Checking fuel pressure regulating valve ⇒Page 391.

- ❑ Checking return flow rate ⇒ Page 377
- ❑ Removing and installing ⇒ Page 377.

9 - Fuel rail

10 - Fuel pressure sender -G247-

- ❑ Removing and installing ⇒ Page 379.
- ❑ Checking ⇒ Page 394

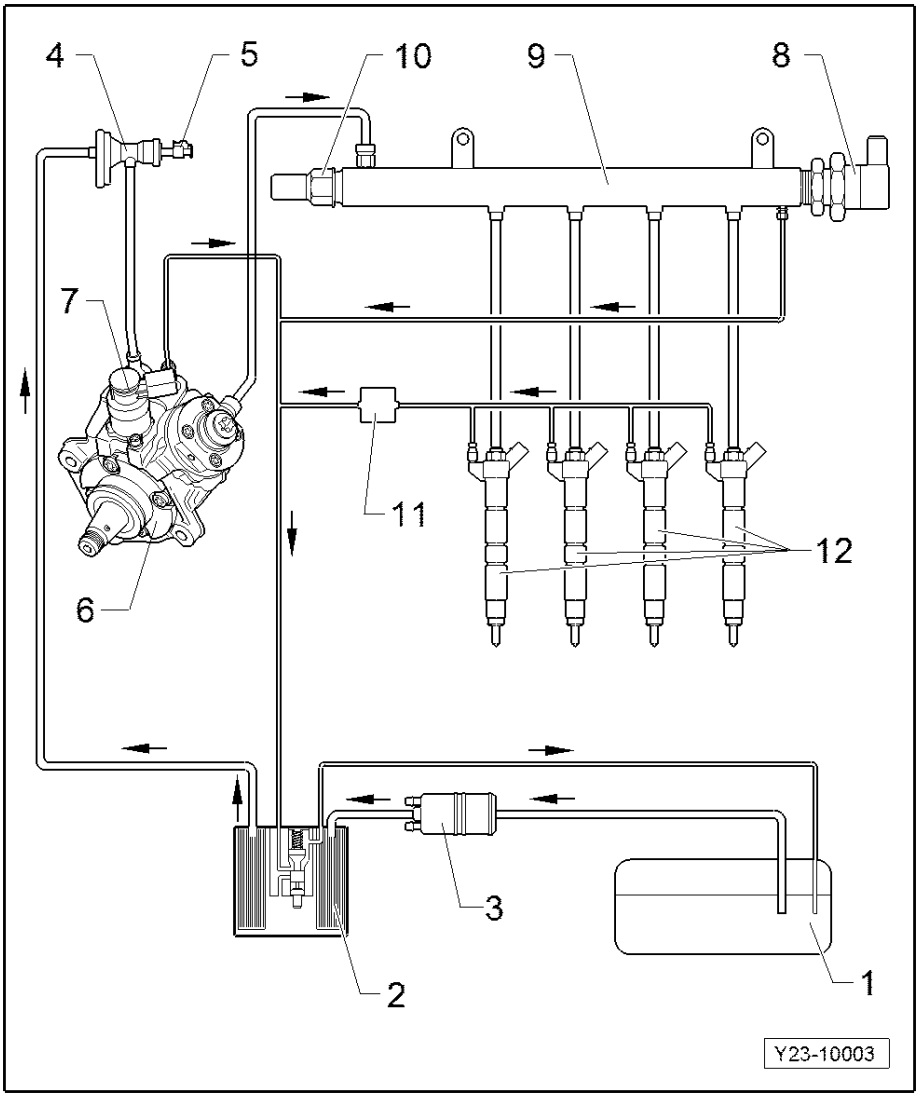
11 - Pressure retention valve

- ❑ The pressure retention valve maintains a residual pressure (for control purposes) of approx. 10 bar in the return lines.
- ❑ This residual pressure is required for the control function of the piezo injectors.
- ❑ The pressure retention valve may only be renewed together with the fuel return lines.
- ❑ After replacement, engine must be run at idling speed for approx. 2 minutes to bleed fuel system.
- ❑ Check pressure retention valve ⇒ Page 385.

12 - Injectors (piezo injectors)

- ❑ Injector, cylinder 1 -N30-
- ❑ Injector, cylinder 2 -N31-
- ❑ Injector, cylinder 3 -N32-
- ❑ Injector, cylinder 4 -N33-
- ❑ Removing and installing ⇒ Page 370.
- ❑ Checking ⇒ Page 398

1.6.2 Fuel system, engine codes CPYA, CPYB, CPYC, CPYD, CPYE



1 - Fuel tank

2 - Fuel filter

- ❑ With pre-heating valve.
- ❑ Assembly overview - fuel filter ⇒Page 304.

3 - Supplementary fuel pump -V393-

- ❑ Removing and installing ⇒Page 313
- ❑ Checking ⇒Page 314

4 - Filter strainer

5 - Fuel temperature sender -G81-

- ❑ Checking ⇒Page 409

6 - High-pressure pump

- ❑ After renewing, a first fuel filling must be performed (never allow the pump to run while it is still empty) ⇒Page 383.
- ❑ Removing and installing ⇒Page 380

7 - Fuel metering valve -N290-

- ❑ Must not be removed.
- ❑ Checking ⇒Page 388

8 - Fuel pressure regulating valve -N276-

- ❑ Checking fuel pressure regulating valve ⇒Page 391.
- ❑ Checking return flow rate ⇒Page 377
- ❑ Removing and installing ⇒Page 377.

9 - Fuel rail

10 - Fuel pressure sender -G247-

- ❑ Removing and installing ⇒Page 379.
- ❑ Checking ⇒Page 394

11 - Pressure retention valve

- ❑ The pressure retention valve maintains a residual pressure (for control purposes) of approx. 10 bar in the return lines.
- ❑ This residual pressure is required for the control function of the piezo injectors.
- ❑ The pressure retention valve may only be renewed together with the fuel return lines.
- ❑ After replacement, engine must be run at idling speed for approx. 2 minutes to bleed fuel system.
- ❑ Check pressure retention valve ⇒Page 385.

12 - Injectors (piezo injectors)

- ❑ Injector, cylinder 1 -N30-
- ❑ Injector, cylinder 2 -N31-
- ❑ Injector, cylinder 3 -N32-
- ❑ Injector, cylinder 4 -N33-
- ❑ Removing and installing ⇒Page 370.
- ❑ Checking ⇒Page 398

1.7 Assembly overview - fuel system

WARNING

- ***Always read rules for cleanliness and instructions for working on fuel system ⇒Page 354.***
- ***Always follow these rules for cleanliness and instructions before starting work and while working on the fuel system.***

To prevent the high-pressure fuel pump from running while it is empty and to ensure that the engine starts quickly after parts have been renewed, it is important to observe the following:

- If components of the fuel system between the fuel tank and the high-pressure fuel pump are removed or renewed, the fuel pump must be activated via a final control diagnosis to bleed the fuel system.
- If a fuel pump, fuel line or the fuel filter is removed or renewed, the fuel pump must be activated via the final control diagnosis for at least 60 seconds before the engine is started for the first time.
- If the high-pressure fuel pump is removed or renewed, the fuel pump must be activated via the final control diagnosis for at least 180 seconds before the engine is started for the first time.

Caution

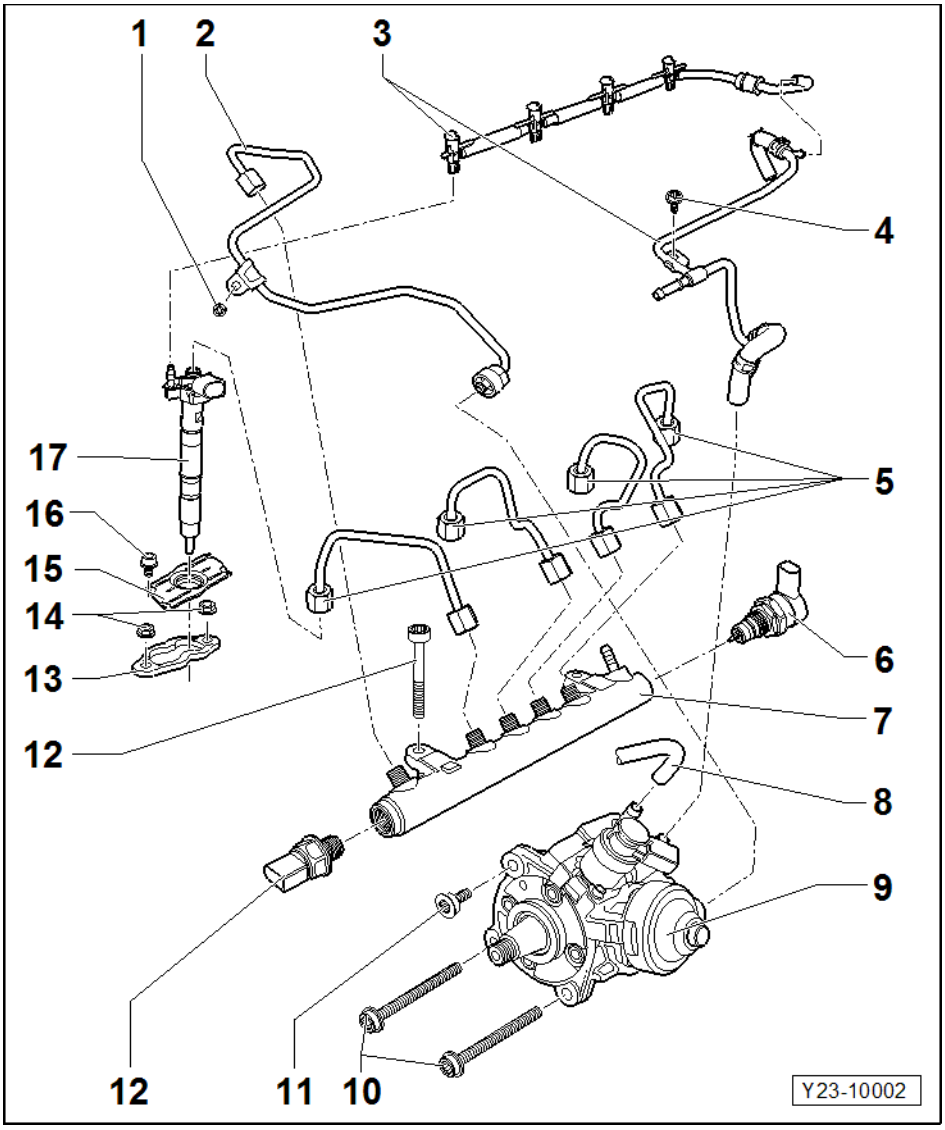
Adhere strictly to rules of cleanliness. No dirt must be allowed to get into the disconnected fuel return lines or the open connections on the injectors under any circumstances.

Protect open fuel connections from dirt entrainment using suitable methods under all circumstances.

Engine codes CJDA, CJDD ⇒Page 363.

Engine codes CPYA, CPYB, CPYC, CPYD, CPYE ⇒Page 366.

1.7.1 Engine codes CJDA, CJDD



1 - 8 Nm

2 - High-pressure line, 28 Nm

- ❑ Between high-pressure pump and fuel rail.

3 - Fuel return lines

- ❑ With pressure retention valve
- ❑ Check pressure retention valve ⇒Page 385.
- ❑ Note various versions ⇒Fig. on page 365.

4 - 8 Nm

5 - High-pressure lines, 28 Nm

- ❑ Between fuel rail and injectors

Caution

The high-pressure lines may be re-used after the following checks:

- ◆ ***Check taper seat of respective high-pressure line for deformation and cracks.***
- ◆ ***The inside of the line must not be deformed, constricted or damaged.***
- ◆ ***Corroded lines should no longer be used.***

- ❑ Do not interchange.
- ❑ Installing free of stress ⇒Page 375.

6 - Fuel pressure regulating valve -N276-, 80 Nm.

- ❑ Checking return flow rate ⇒Page 377
- ❑ Checking fuel pressure regulating valve ⇒Page 391.
- ❑ Removing and installing ⇒Page 377

7 - Fuel rail

8 - Fuel supply line

9 - High-pressure pump

- ❑ Removing and installing ⇒Page 380

10 - 20 Nm +180° (1/2 turn) further

- ❑ Renew

11 - 20 Nm +45° (1/8 turn) further

- ❑ Renew

12 - Fuel pressure sender -G247-, 100 Nm

- ❑ Removing and installing ⇒Page 379
- ❑ Checking ⇒Page 394

13 - 22 Nm

14 - Clamping piece

- ❑ Renew
- ❑ Note installation position ⇒Fig. on page 364

15 - 10 Nm

16 - Injector cover

17 - 5 Nm

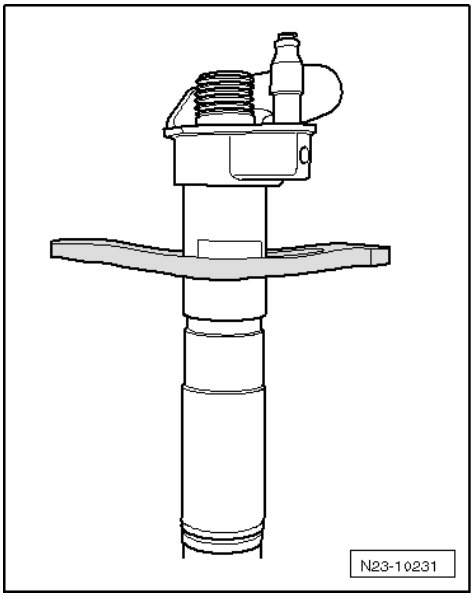
18 - Injector (piezo injectors)

- ❑ Do not interchange!
- ❑ When removing and installing an injector, always renew the following components and seals/O-rings: “copper seal”, “O-ring for injector bore”, “O-ring for injector return connection”.
- ❑ Removed injectors must always be reinstalled in their original location (on the same cylinder).
- ❑ Before reusing “high-pressure line”, perform a visual check of taper seats for damage such as transverse scores or corrosion. If the high-pressure line is damaged, it must always be renewed.

Adapting correction values ⇒Page 368

- ❑ Removing and installing ⇒Page 370
- ❑ Checking ⇒Page 398

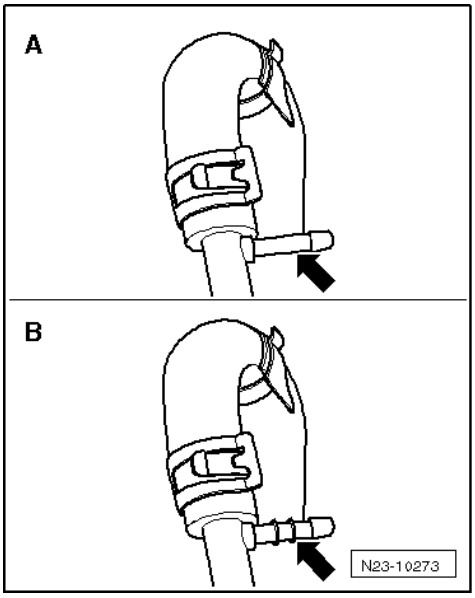
Installation position of clamping piece



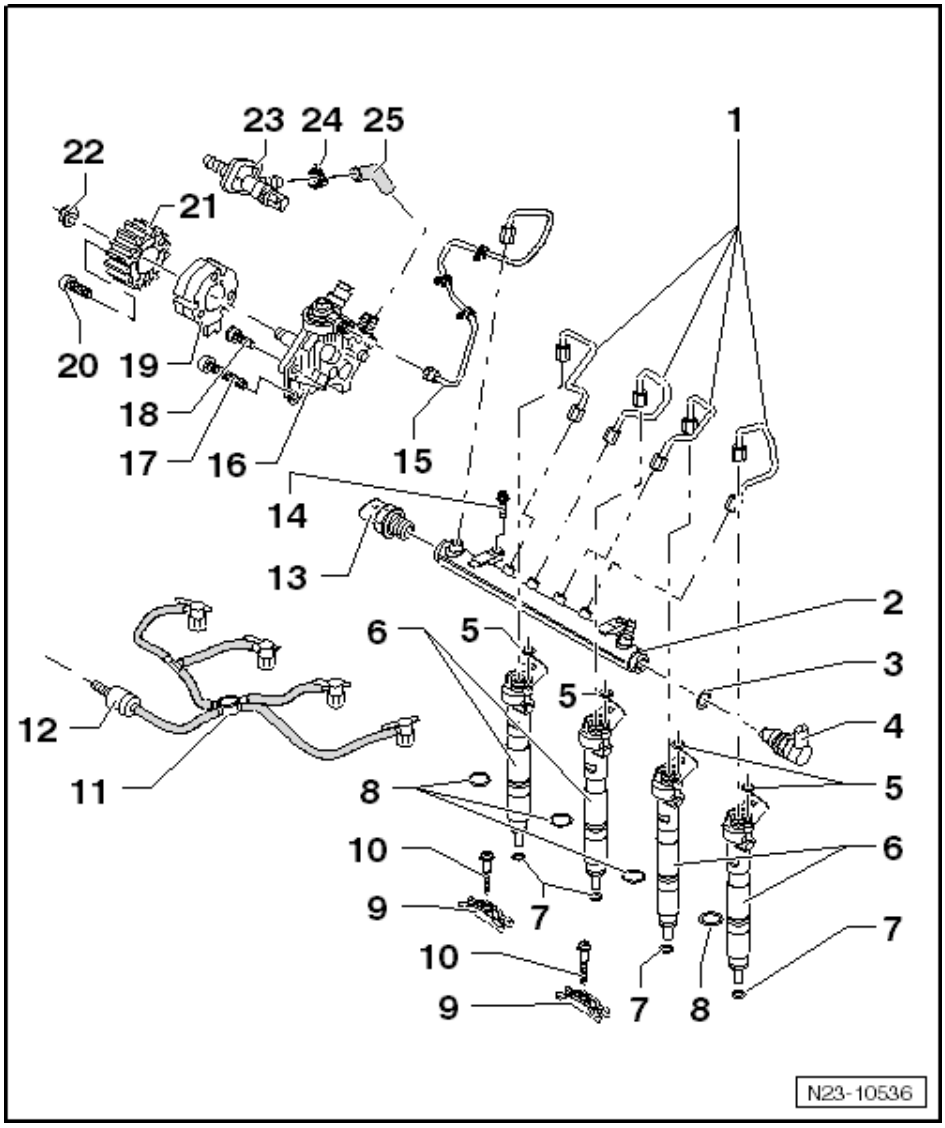
Differences on fuel return line

-A-, no riffled section: use clamp according to ⇒ ETKA (Electronic Parts Catalogue) to connect overflow oil line.

-B-, with riffled section: DO NOT use a clamp to connect overflow oil line.



1.7.2 Engine codes CPYA, CPYB, CPYC, CPYD, CPYE



1 - High-pressure line

- ❑ 30 Nm
- ❑ Between high-pressure accumulator (fuel rail) and injectors (piezo injectors).
- ❑ Install so that component is not under stress.
- ❑ Removing and installing ⇒Page 375

Note

- *The high-pressure line may be reused after the following checks:*
- *Check taper seat of high-pressure line for deformation and cracks.*
- *The inside of the line must not be deformed, constricted or damaged.*
- *Corroded lines should no longer be used.*

2 - Fuel rail

3 - Seal

- ❑ Renew

4 - Fuel pressure regulating valve -N276-, 80 Nm.

- ❑ Checking return flow rate ⇒Page 377
- ❑ Checking fuel pressure regulating valve ⇒Page 391.
- ❑ Removing and installing ⇒Page 377

5 - O-ring

- ❑ Renew

6 - Injector (piezo injectors)

- ❑ Do not interchange!
- ❑ When removing and installing an injector, always renew the following components and seals/O-rings: “copper seal”, “O-ring for injector bore”, “O-ring for injector return connection”, “bolt for clamping plate”.
- ❑ Removed injectors must always be reinstalled in their original location (on the same cylinder).
- ❑ Before reusing “high-pressure line”, perform a visual check of taper seats for damage such as transverse scores or corrosion. If the high-pressure line is damaged, it must always be renewed.

Adapting correction values ⇒Page 368

- ❑ Removing and installing ⇒Page 370
- ❑ Checking ⇒Page 398

7 - Copper washer

- ❑ Renew

8 - O-ring

- ❑ Renew

9 - Clamping plates

One clamping plate encompasses 2 injectors each.

- ❑ Reusable.

10 - Bolt, turn 8 Nm +270° (3/4 turn) further

- ❑ Renew

Note

If replacement engine is fitted, it is essential to check torque.

11 - Fuel return lines

- ❑ Cannot be renewed separately
- ❑ To fuel tank
- ❑ The fuel return line must not be kinked, damaged or blocked.
- ❑ The fuel return lines must not be dismantled.

12 - Pressure retention valve

Caution

- ◆ ***Pressure retention valve must not be disconnected or pulled off whilst engine is running as this destroys the injectors.***
- ◆ ***Fuel return lines must not be disconnected or pulled off whilst engine is running as this destroys the injectors.***
- ◆ ***Residual pressure must not be lower or higher than 10, as this destroys the injectors.***

- ❑ Renewed together with fuel return lines.
- ❑ The pressure retention valve has the task of always maintaining a residual pressure (control volume) of approx. 10 bar in the fuel return lines. The injectors require this control volume to function.
- ❑ The pressure retention valve may only be renewed completely together with the fuel return lines.
- ❑ Fill/bleed fuel system after exchanging ⇒ Page 383.
- ❑ Check pressure retention valve ⇒ Page 385.

13 - Fuel pressure sender -G247-, 100 Nm

- ❑ Removing and installing ⇒ Page 379
- ❑ Checking ⇒ Page 394

14 - Bolt, 22 Nm

15 - Fuel line, 30 Nm

- ❑ Secured with 3 clamps
- ❑ Between high-pressure pump and high-pressure accumulator (fuel rail)
- ❑ Removing and installing ⇒ Page 375

Caution

The high-pressure lines may be re-used after the following checks:

- ◆ ***Check taper seat of respective high-pressure line for deformation and cracks.***
- ◆ ***The inside of the line must not be deformed, constricted or damaged.***
- ◆ ***Corroded lines should no longer be used.***

16 - High-pressure fuel pump

- ❑ With fuel metering valve -N290- (must not be opened).
- ❑ After renewing, initial fuel filling must be carried out (never allow the pump to run while it is still empty) ⇒Page 383.
- ❑ Removing and installing ⇒Page 380

17 - Bolt, turn 20 Nm +180° (1/2 turn) further

- ❑ Renew
- ❑ Qty. 2

18 - Bolt, 20 Nm +45° (1/8 turn) further

- ❑ Renew

19 - Hub

- ❑ With sender ring
- ❑ Use counterhold tool -T10051- to loosen and tighten.
- ❑ To remove, use puller -T40064-.
- ❑ Removing and installing ⇒Page 380

20 - Bolt, 20 Nm +90° (1/4 turn) further

- ❑ Renew

21 - Toothed belt pulley on high-pressure pump

22 - Nut, 95 Nm

23 - Fuel temperature sender -G81-

24 - Clamp

25 - Hose

1.8 Correction values for injectors

The function “Adaptation of correction values for injectors” serves to correct the injection rates for each cylinder of a common rail system individually across the entire ignition map range.

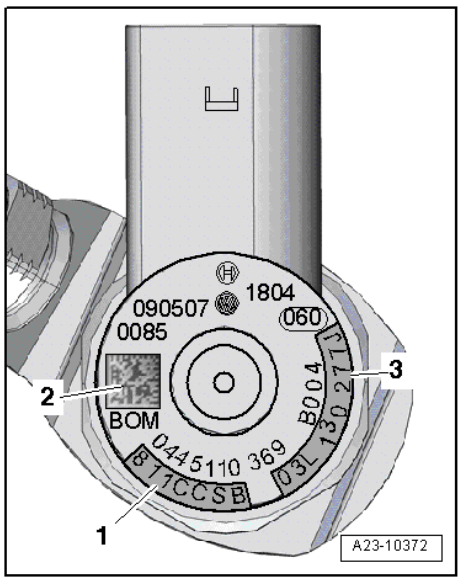
The 7-digit correction values -1- (details in illustration are only an example) are marked separately on each injector. The marked values may consist of letters and/or numbers.

Top view of injector

1 - Checksum

2 - Data Matrix Code

3 - Part number



After renewing an injector, the correction value must be written into the engine control unit.

After renewing the engine control unit, the “correction values for the injectors” must be transferred to the new engine control unit.

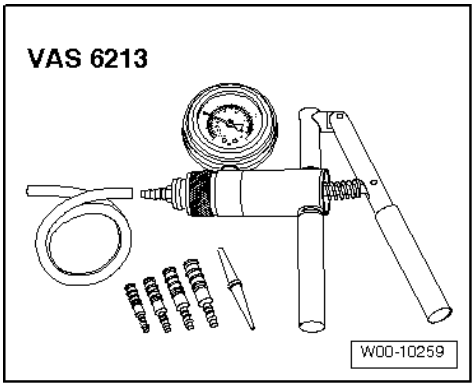
Read injector delivery calibration values/injector voltage calibration values, and store them in engine control unit ⇒Page 421.

1.9 Checking for injectors sticking open

> ⚠ ***WARNING***
>
> - ***Always read rules for cleanliness and instructions for working on fuel system*** ⇒ **Page 354*****.***
> - ***Always follow these rules for cleanliness and instructions before starting work and while working on the fuel system.***

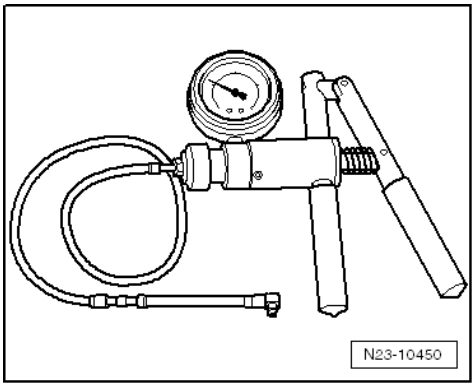
Special tools and workshop equipment required

- Hand vacuum pump -VAS 6213-



- Make an -adapter- from a return line.

– Clean all connections (e.g. with commercially available cold cleaning solvent) before removing.



Note

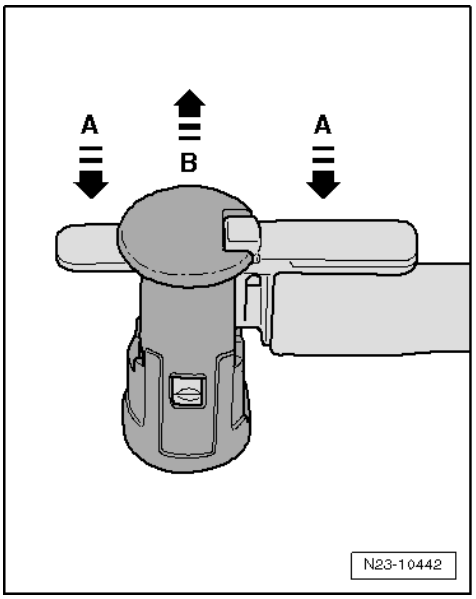
- *Make sure all parts are clean; no dirt must be allowed to enter the fuel system.*
- *Check all cylinders in turn.*

– Dry all components after cleaning.

– Start with cylinder 1.

– With engine switched off, carefully pull return line connections off injectors. To do this, press both clips downwards -arrow A- and simultaneously pull release pin upwards -arrow B-.

– Connect clean, blown-out adapter to injector to be tested.



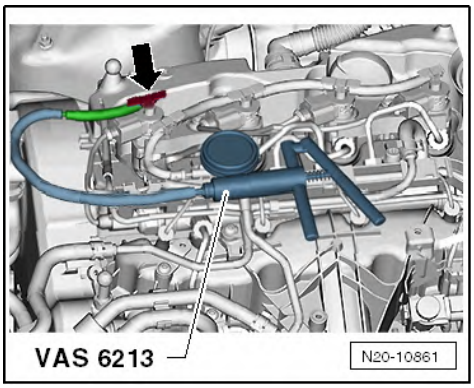
– Use hand-operated vacuum pump -VAS 6213- to generate a partial vacuum of approx. -500 mbar.

If injector is OK, pressure remains constant for 30 s.

If injectors are defective, the pressure drops within 2 ... 3 s to 0 bar

Repeat check as necessary, observe pressure loss at hand vacuum pump -VAS 6213-.

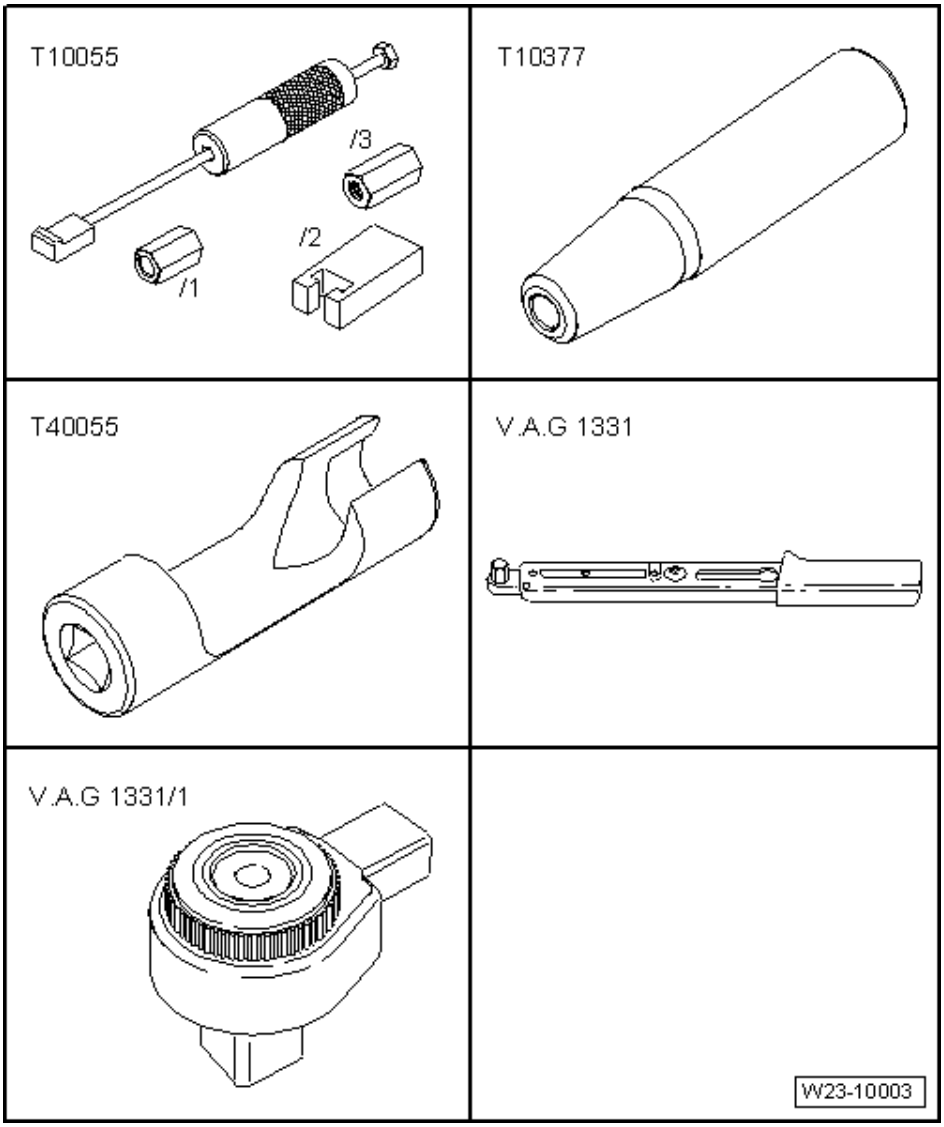
– Renew defective injectors ⇒Page 370



1.10 Removing and installing injector (piezo injector)

Special tools and workshop equipment required

- Puller -T10055-
- Assembly sleeve -T10377-
- Socket -T40055-
- Torque wrench -V.A.G 1331-
- Ratchet -V.A.G 1331/1-

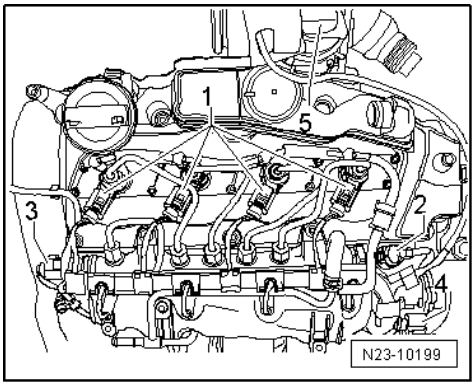


1.10.1 Removing

> ⚠ ***WARNING***
>
> - ***Always read rules for cleanliness and instructions for working on fuel system ⇒ Page 354.***
> - ***Always follow these rules for cleanliness and instructions before starting work and while working on the fuel system.***

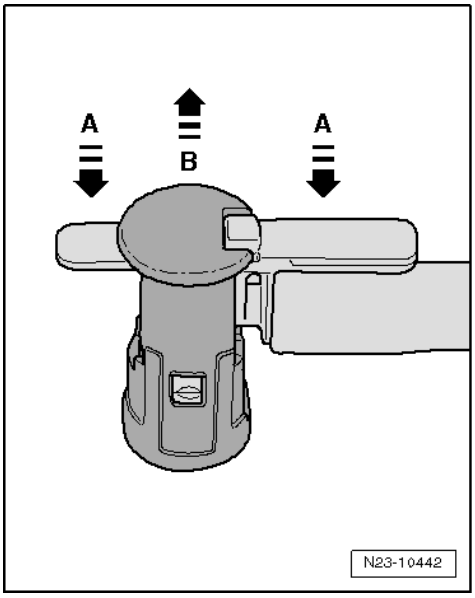
– Take noise insulation off cylinder head cover.

– Disconnect connector -1- from injectors to be removed.

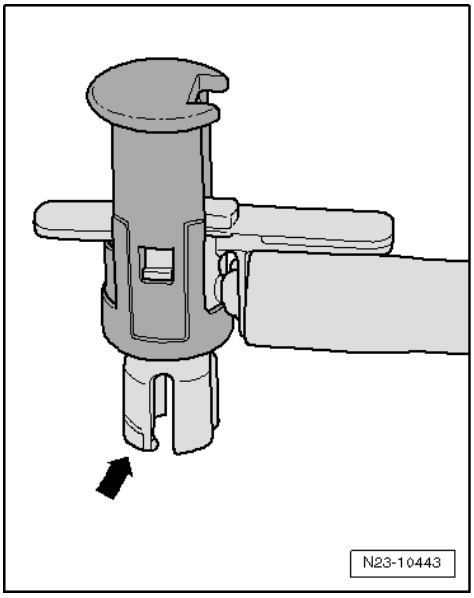


> ⓘ ***Caution***
>
> - ***Mark cylinder numbers on injectors. They must always be re-installed on the same cylinders.***
> - ***Observe rules for cleanliness when working on the injection system.***
> - ***Plug open connections with suitable sealing caps immediately.***

– With engine switched off, carefully pull return line connections off injectors. To do this, press both clips downwards -arrow A- and simultaneously pull release pin upwards -arrow B-.



Check catches



Caution

- ***Carefully pull fuel return lines upwards vertically when disconnecting, as the 4 catches -arrow- can fracture.***
- ***After disconnecting, check the 4 catches -arrow- to see whether they are fractured or have broken off.***
- ***Always replace damaged fuel return lines.***
- ***A damaged fuel return line that becomes loose when engine is running causes damage to injection valve (piezo injector). The injection valve (piezo injector) must then be replaced.***

Caution

When releasing high-pressure line, counterhold high-pressure connection using an open-ended spanner. Leaks occur if high-pressure connection is released.

– Unscrew union nuts of relevant high-pressure line -1 to 4-, and remove corresponding high-pressure line.

– Unscrew securing bolts for cover ⇒ Item 16 on page 364 of injectors to be removed.

– Slightly lift cover and turn it 90° to have access to injector securing nuts.

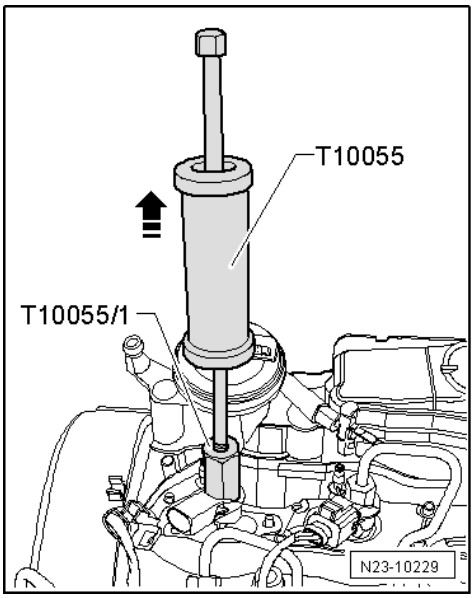
Caution

When removing securing nuts from injector there is a risk that the relevant nut will fall into the cylinder head. Proceed very carefully to prevent unnecessary dismantling or further damage.

– Unscrew securing nuts from respective injector.

– Apply puller -T10055- with adapter -T10055/1- as shown in illustration and pull injector out upwards by tapping gently.

– After removal, lay injectors on a clean cloth.



1.10.2 Installing

Important instructions for installing injectors

- When removing and installing or renewing an injector, always renew the following components and seals/O-rings: “clamping piece”, “copper seal”, “O-ring for injector bore” and “O-ring for injector return connection”.
- Used injectors may only be re-installed on the same cylinder.
- Make sure that the injectors and the installation area are clean before installing.
- The injectors must be completely undamaged.
- Lubricate all O-rings with engine oil or assembly oil before installing.
- To remove carbon deposits from the injector sealing surface, clean the injector seat in the cylinder head with a cloth soaked in engine oil or rust solvent. Take care not to damage the sealing surface.

Note

- *Observe cylinder-specific markings when reusing high-pressure lines.*
- *The high-pressure lines may be re-used after the following checks:*
- *Check taper seat of respective high-pressure line for deformation and cracks.*
- *The inside of the line must not be deformed, constricted or damaged.*
- *Corroded lines should no longer be used.*

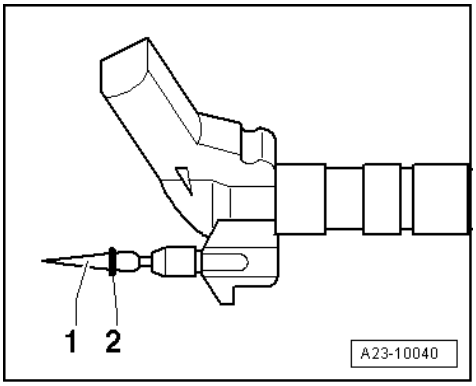
If a used injector is being re-installed:

– Spray tip of injector nozzle with rust-releasing spray. Wait approx. 5 minutes and wipe off soot particles and oil with a cloth.

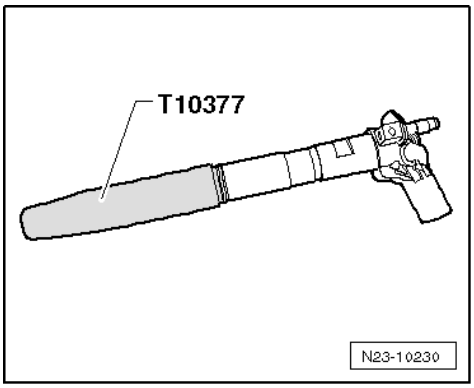
– To remove the old copper seal from the injector, clamp the seal carefully in a vice so that it is just held between the jaws without turning. Then carefully pull and twist the injector out of the copper seal by hand.

– Use a plastic bush to fit the new copper seal.

– To prevent damage to the new O-ring -2- for the fuel return line connection, push it over assembly tool -1-.



– Renew seal of injector bore. Use assembly sleeve -T10377- for this.
– To avoid damaging O-ring, carefully slide new, oiled O-ring onto fuel return connection.



Engine codes CJDA, CJDD

Caution

When removing securing nuts from injector there is a risk that the relevant nut will fall into the cylinder head. Proceed very carefully to prevent unnecessary dismantling or further damage.

– Fit injector cover.
– Slide clamping piece onto injector and note its installation position ⇒Fig. on page 364.
– Insert injector into injector bore.
– Carefully position securing nuts of clamping piece by hand and tighten. Specified torque ⇒Page 363.
– Turn injector cover onto installation position and bolt. Specified torque ⇒Page 363.

Engine codes CPYA, CPYB, CPYC, CPYD, CPYE

– Insert injector into injector bore.

Specified torque ⇒Page 366.

Continuation for all engine codes

– Install high-pressure lines ⇒Page 375.

Note

After renewing one or more injectors, the “injector delivery calibration values (IDC)” and “injector voltage calibration values (IVC)” for the new injectors must be stored in the engine control unit ⇒Page 421.

– Bleed fuel system ⇒Page 383.

Note

The high-pressure connections must not be opened for bleeding.

– Run engine at idling speed for several minutes and then switch off.
– Switch off ignition.
– Check the complete fuel system including the 4 return line connections for leaks ⇒Page 384.

Renew the affected component if leakage still occurs after tightening to the correct torque.

Note

The return lines can only be renewed together with the pressure retention valve as one unit.

– After completing the repair, road-test the vehicle over a distance of at least 20 km. Accelerate with full throttle at least once. Then inspect the high-pressure section of the fuel system again for leaks.

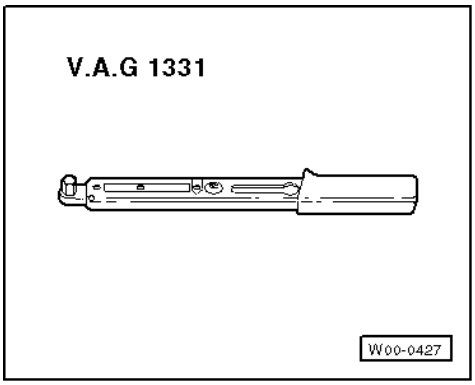
Note

If there is any air left in the fuel system, the engine may switch to the limp mode during the road test/test run. Switch off the engine and clear the event memory. Then, continue road test/test run.

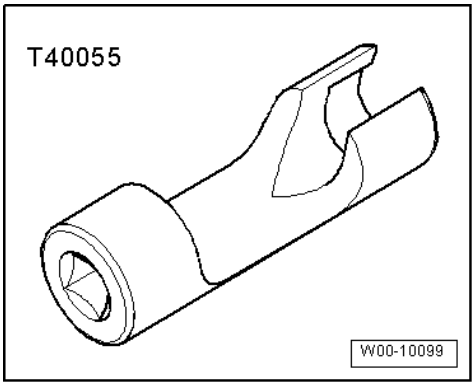
1.10.3 Installing high-pressure lines

Special tools and workshop equipment required

◆ Torque wrench -V.A.G 1331-



◆ Socket -T40055-



Caution

To ensure the injector lines are fitted free of stress, loosen fuel rail and, if necessary, move rail slightly. The lines must never be bent or tensioned. Tension would otherwise cause the respective line to break in the long-term.

Note

◆ *This section describes how to install new injection lines. If already fitted injection lines are to be used again, perform the following checks. Apart from that the procedure is identical.*

◆ *Check taper seat of respective high-pressure line for deformation and cracks.*

◆ *The inside of the line must not be deformed, constricted or damaged.*

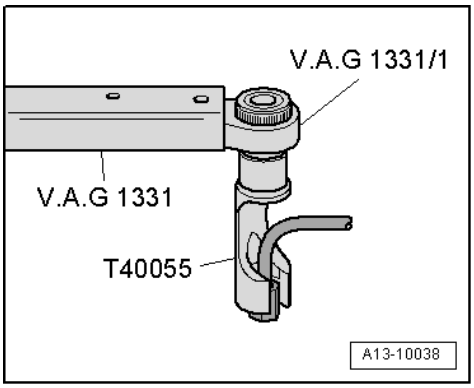
◆ *Corroded lines should no longer be used.*

Installing individual injection lines (cylinder 1 to 4, between fuel rail and injector)

– If it has not been done yet, loosen securing bolts of clamping pieces and ensure that injectors can be rotated.

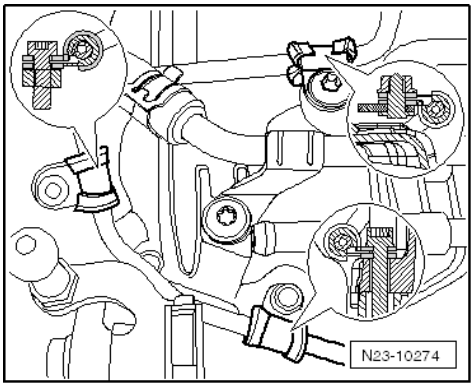
– Remove the new injector line from the packaging. Remove the sealing plugs and install the line just by itself between fuel rail and injector.

– Tighten union nuts on injection line hand-tight without any tool to start with. Ensure that line correctly gets into its seat.
– If necessary, proceed in the same way with other injection lines.
– Retighten fuel rail if necessary. Specified torque ⇒Page 362.
– Tighten union nuts of all new injection lines using torque wrench -V.A.G 1331- and socket bit -T40055-. Specified torque ⇒Page 362.



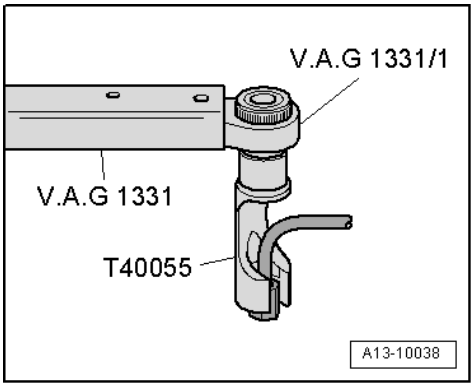
Installing fuel line (between high pressure pump and fuel rail) or a complete set of lines

– If it has not been done yet, loosen securing bolts of fuel rail and ensure that fuel rail can be moved.
– Remove the packaging from the fuel line between high pressure pump and fuel rail. Remove the sealing plugs and install the line just by itself.
– Tighten union nuts on injection line hand-tight without any tool to start with. Ensure that line correctly gets into its seat.
– If a complete set needs to be installed, adopt the same procedure for all 4 injection lines.
– Slide all securing clamps over fuel line and observe alignment.
– Screw in clamp securing bolts about 3 turns.
– Retighten fuel rail.



> ⚠ ***WARNING***
>
> ***The securing clamp for the high-pressure line between the high-pressure pump and high-pressure accumulator (fuel rail) must always be installed in the correct position. Otherwise fatigue failures or stress ruptures may occur in the high-pressure line.***

– Tighten securing clamp at top of intake manifold to 8 Nm.
– Tighten union nuts of all new injection lines using torque wrench -V.A.G 1331- and socket bit -T40055-. Specified torque ⇒Page 362.
– Now tighten remaining 2 securing clamps to 8 Nm.
– Press return line connections carefully over the seals and onto the injectors (check seal for damage). You should hear them click into place. Then press the release pin downwards carefully.
– Filling fuel system ⇒Page 383.

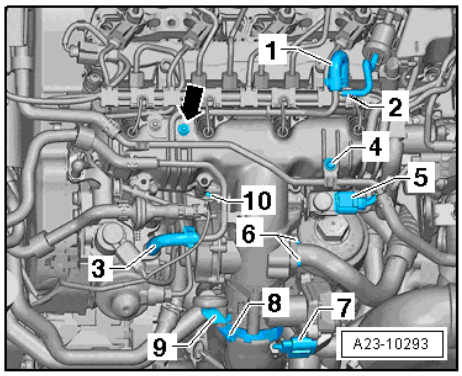


1.11 Checking return flow rate from fuel pressure regulating valve -N276-

> ⚠ ***WARNING***
>
> - ***Always read rules for cleanliness and instructions for working on fuel system ⇒Page 354.***
> - ***Always follow these rules for cleanliness and instructions before starting work and while working on the fuel system.***

– Take noise insulation out of injectors.

– Pull off fuel return line -1-.



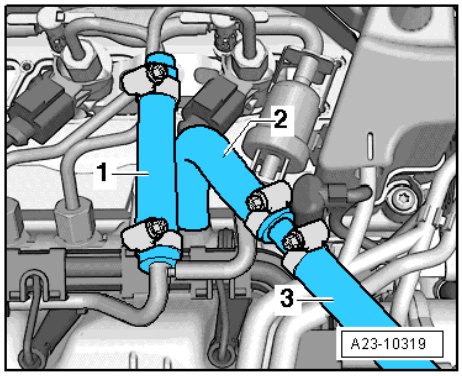
– Seal open fuel return line connection with a blanking plug -1-.

– Connect fuel return line -2- to suitable hose -3-.

– Hold end of this hose in a suitable container to measure return flow rate.

– Start engine and run at idling speed.

- Specification after 5 to 10 seconds: return flow rate = 0 ml



If the specification is not attained, the fuel pressure regulating valve -N276- is defective.

1.12 Removing and installing fuel pressure regulating valve -N276-

The fuel pressure regulating valve is located in the fuel rail. The valves ensure that pressure is constant in the high pressure accumulator and in the injector lines (fuel high pressure circuit).

If pressure is too high in the fuel high pressure circuit, the regulating valve will open. A small amount of fuel from the high pressure accumulator will thereby make its way back to the fuel tank via the return line.

If pressure is too low in the fuel high pressure circuit, the regulating valve will close. The valve seals the high pressure side against the low pressure side in this way.

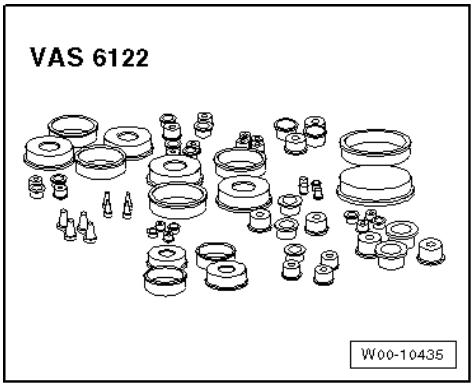
Caution

Always read rules for cleanliness and instructions for working on fuel system ⇒Page 354.

Follow these instructions before starting work and while working on the fuel system.

Special tools and workshop equipment required

- Engine bung set -VAS 6122-



Removing

– Clean threaded area around regulating valve (e.g. with commercially available cold cleaning solvent) before removing. Under no circumstances may dirt enter the hole of the fuel rail.

Note

- *Clean carefully; cleaning solvent must not enter the electrical connector.*
- *The fuel pressure regulating valve -N276- cannot be re-used.*
- *Fuel pressure regulating valve -N276- must be renewed each time after removing.*

– Dry off fuel pressure regulating valve -N276-.

– Disconnect electrical connector from fuel pressure regulating valve -N276-.

– Counterhold at housing hexagon and loosen union nut. Then unscrew and remove by hand.

– Extract dirt from fuel rail bore (threads and sealing surface). Do not use tools or other instruments for this purpose.

Note

Seal off fuel rail bore immediately with a suitable plug to prevent dirt from entering.

Installing

Note

- *Check that sealing surfaces (deformable sealing lip) and threads on fuel pressure regulating valve -N276- are undamaged.*
- *Also check sealing surface of fuel rail bore.*
- *Thread on fuel pressure regulating valve -N276- must be free of oil and grease.*

– Screw on union nut by hand.

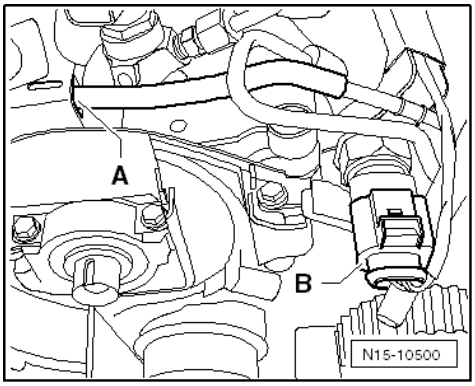
– Align fuel pressure regulating valve -N276- so that connecting wire is free of mechanical tension after electrical connector is attached.

– Counterhold at housing hexagon and tighten union nut. Specified torque ⇒Page 362.

– After installation, run engine at moderate speed for several minutes and then switch off.
– Check fuel system for leaks ⇒Page 384.
– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.
– Perform a road test/test run, accelerating to full throttle at least once. Check high pressure part of fuel system again for leaks.
– Finally, read event memory of engine control unit again ⇒Page 26.

1.13 Removing and installing fuel pressure sender -G247-

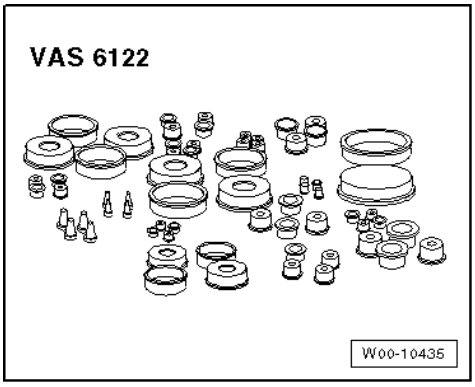
The fuel pressure sender -G247- (fuel rail pressure sensor) -B- is located in the fuel rail and continuously measures the current fuel pressure in the high-pressure system. It transmits a corresponding voltage signal to the diesel direct injection system control unit -J248-.



In the event of sender failure, pressure regulation is controlled using a map from the engine control unit. In back-up function, the maximum engine speed is limited to approx. 3,000 rpm.

Special tools and workshop equipment required

◆ Engine bung set -VAS 6122-



Removing

Caution

Always read rules for cleanliness and instructions for working on fuel system ⇒Page 354.

Follow these instructions before starting work and while working on the fuel system.

– Clean threaded area around sender (e.g. with commercially available cold cleaning solvent) before removing. Under no circumstances may dirt enter the hole of the high pressure accumulator.

Note

Clean carefully; cleaning solvent must not enter the electrical connector.

– Dry off fuel pressure sender -G247-.
– Disconnect electrical connector at fuel pressure sender -G247-.
– Unscrew fuel pressure sender -G247-.
– Extract dirt from fuel rail bore (threads and sealing surface). Do not use tools or other instruments for this purpose.

Note

Seal off fuel rail bore immediately with a suitable plug to prevent dirt from entering.

Installing

Note

- *Check that sealing surfaces (deformable sealing lip) and threads on fuel pressure sender -G247- are undamaged.*
- *Also check sealing surface of fuel rail bore.*
- *The thread on the fuel pressure sender -G247- has a special lubricating coating. The thread must therefore be free of oil and grease.*

– Screw in fuel pressure sender -G247- by hand.

– Tighten sender. Specified torque ⇒Page 362.

– After installation, run engine at moderate speed for several minutes and then switch off.

– Check fuel system for leaks.

– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

– Perform a road test/test run, accelerating to full throttle at least once. Check high pressure part of fuel system again for leaks.

– Finally, read event memory of engine control unit again ⇒Page 26, read event memory.

1.14 Removing and installing high-pressure pump

Caution

- ***Risk of irreparable damage to high-pressure pump if allowed to run dry.***
- ***The high pressure pump must be filled with fuel before the engine is started the 1st time ⇒Page 383. (It is important not to allow the high-pressure pump to run while still empty.)***
- ***Protect open fuel connections from dirt entrainment using suitable methods under all circumstances.***

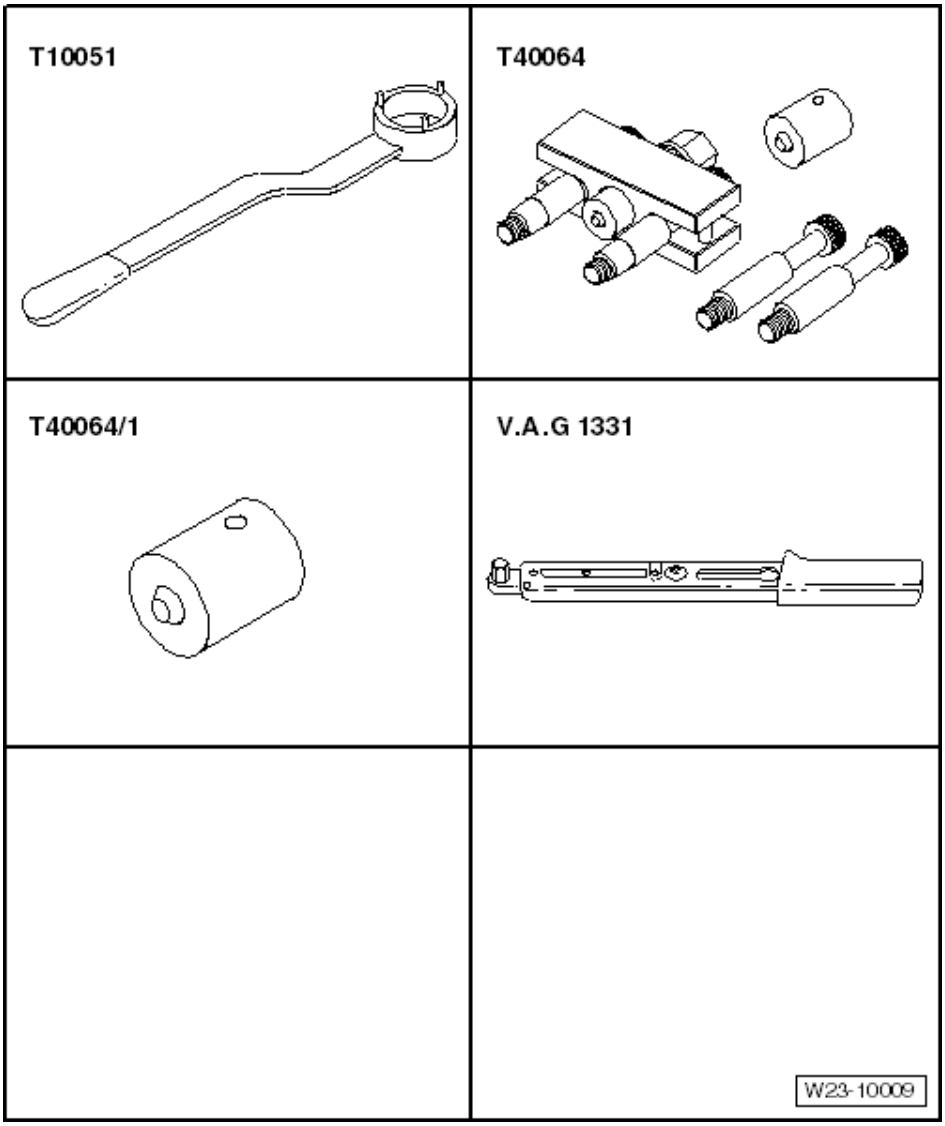
Caution

Always read rules for cleanliness and instructions for working on fuel system ⇒Page 354.

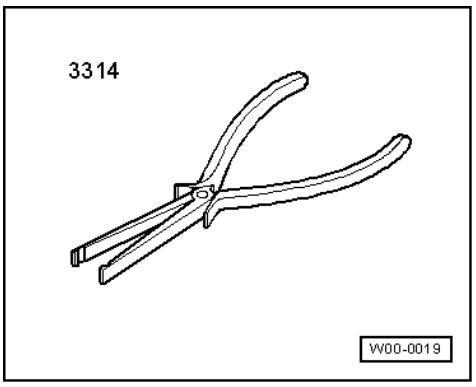
Follow these instructions before starting work and while working on the fuel system.

Special tools and workshop equipment required

- Counterhold -T10051-
- Puller -T40064- with T40064/1
- Torque wrench -V.A.G 1331-



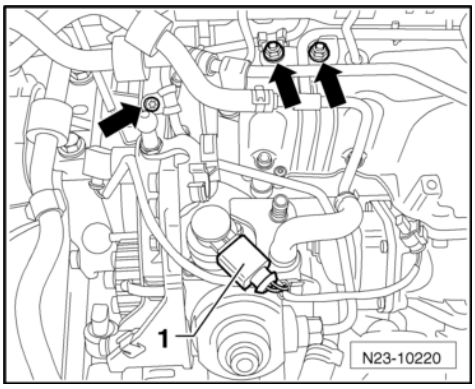
- Pliers -3314-



Removing

– Remove toothed belt from camshaft and high-pressure pump ⇒Page 210.

– Disconnect connector -1- and remove bolts -arrows-.

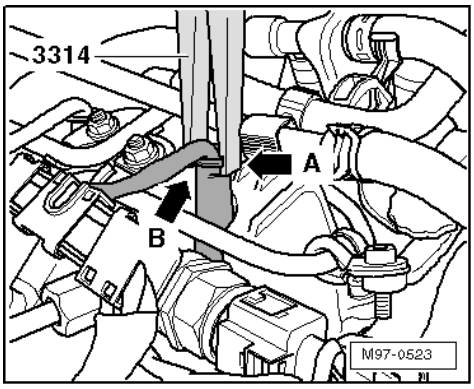


Caution

Make sure that no wiring connections are damaged when disconnecting the connectors. Otherwise the whole wiring harness will need to be renewed. Do not compress the pliers -3314- too firmly to separate the connectors, otherwise the support sleeve may be damaged.

– If fitted, remove any coolant lines from the work area. To do this, unscrew securing bolts, and lay lines to one side.

– Position pliers -3314- with groove -arrow A- on shoulder of support sleeve -arrow B- and pull connectors off glow plugs.

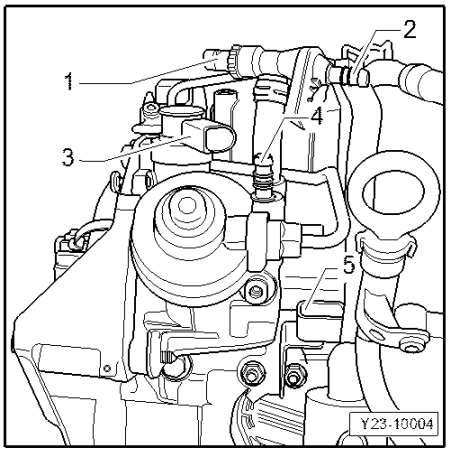


– Pull fuel return line off high-pressure pump -4-.

– Disconnect connectors -1- and -3-.

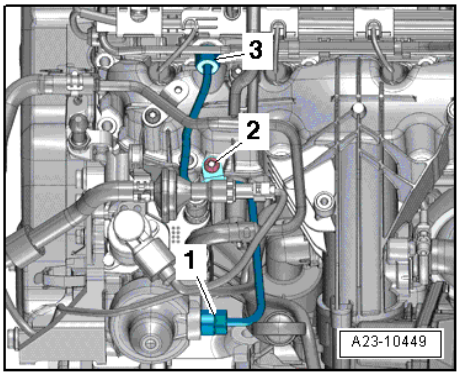
– Remove connector -5- from retainer.

– Pull fuel return line off fuel rail and lay it to side.

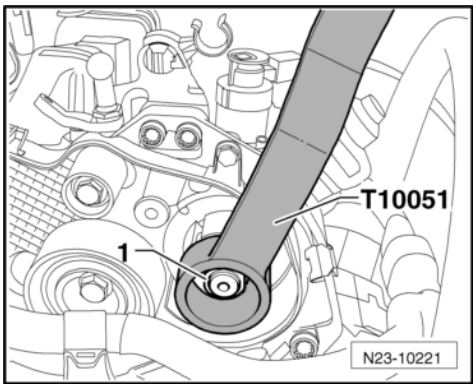


– Unscrew the two bolts -2- and union nuts -1, 3-, and remove high-pressure line.

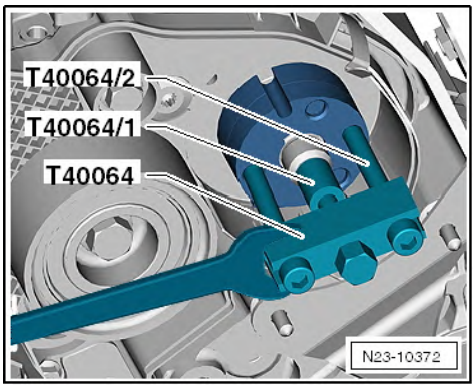
– Remove toothed belt pulley from high-pressure pump.



– Counterhold hub of high-pressure pump using counterhold -T10051- and unscrew securing nut -1-.

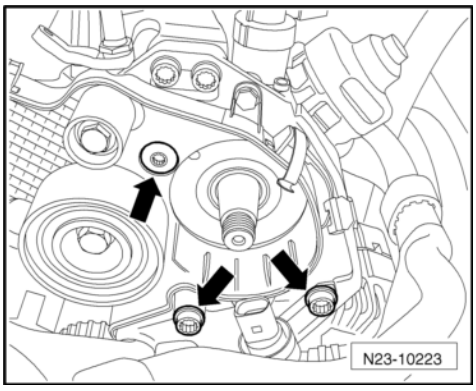


– Fit puller -T40064- with thrust piece -T40064/1- and pin -T40064/2- as shown in illustration, and pull hub off high-pressure pump. If necessary, counterhold with a 24 mm open-ended spanner.



– Unscrew securing bolts -arrows- for high-pressure pump.

– Remove high-pressure pump.



Installing

Install in reverse order.

Specified torques for fuel system ⇒Page 362.

Specified torques for toothed belt drive ⇒Page 146.

Caution

Risk of irreparable damage to high-pressure pump if allowed to run dry.

- ***The high-pressure pump must first be filled with fuel before the engine is started. The high-pressure pump must not be allowed to run while still empty. Initial fuel filling ⇒Page 383.***

1.15 Filling and bleeding fuel system

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Fuel tank: level min “reserve”.

Caution

After installation, the high pressure pump must be filled with fuel before the engine is started the 1st time (the pump must NOT be allowed to run while still empty).

Note

- *When installing the high-pressure pump, it is essential to ensure that no dirt enters the fuel system.*
- *Only remove sealing plugs immediately prior to installation of fuel lines.*
- *The fuel tank must be filled.*

Proceed as follows to fill high-pressure pump with fuel:

– Switch on ignition.

– Connect vehicle diagnostic tester, and select engine control unit. ⇒Page 23

– Perform final control diagnosis, and activate fuel pump for 120 seconds ⇒Page 89, final control diagnosis.

Note

- *The fuel pump must be activated for at least 180 seconds. Since the activation of the fuel pump is limited to 120 seconds, the final control diagnosis must be performed twice.*
- *To allow for performing the final control diagnosis a second time, switch off ignition, and switch it back on.*

– Perform final control diagnosis again, and activate fuel pump for 120 seconds.

– Then start engine.

– After filling fuel system, leave engine running at moderate speed for a few minutes and then switch off again.

– Check fuel system for leaks.

– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

– Perform a road test/test run, accelerating to full throttle at least once. Check high pressure part of fuel system again for leaks.

Note

If there is any air left in the fuel system, the engine may switch to the limp mode during the road test/test run. Switch off the engine and clear the event memory. Then, continue road test/test run.

– Finally, read event memory of engine control unit again ⇒Page 26, read event memory.

1.16 Checking fuel system for leaks

– Clean re-installed fuel connections with brake cleaner and then dry them.

– Run engine at idling speed for several minutes - do not press accelerator - and then switch engine off again. (Fuel system bleeds itself).
– Check the entire fuel system for leaks.

Renew the affected component if leakage still occurs after tightening to the correct torque.

– Perform a test run, accelerating to full throttle at least once. Then check high-pressure part of fuel system again for leakage.

Note

If there is any air left in the fuel system, the engine may switch to the limp mode during the road test/test run. Switch off the engine and clear the event memory ⇒Page 26*, read event memory. Then, continue road test/test run.*

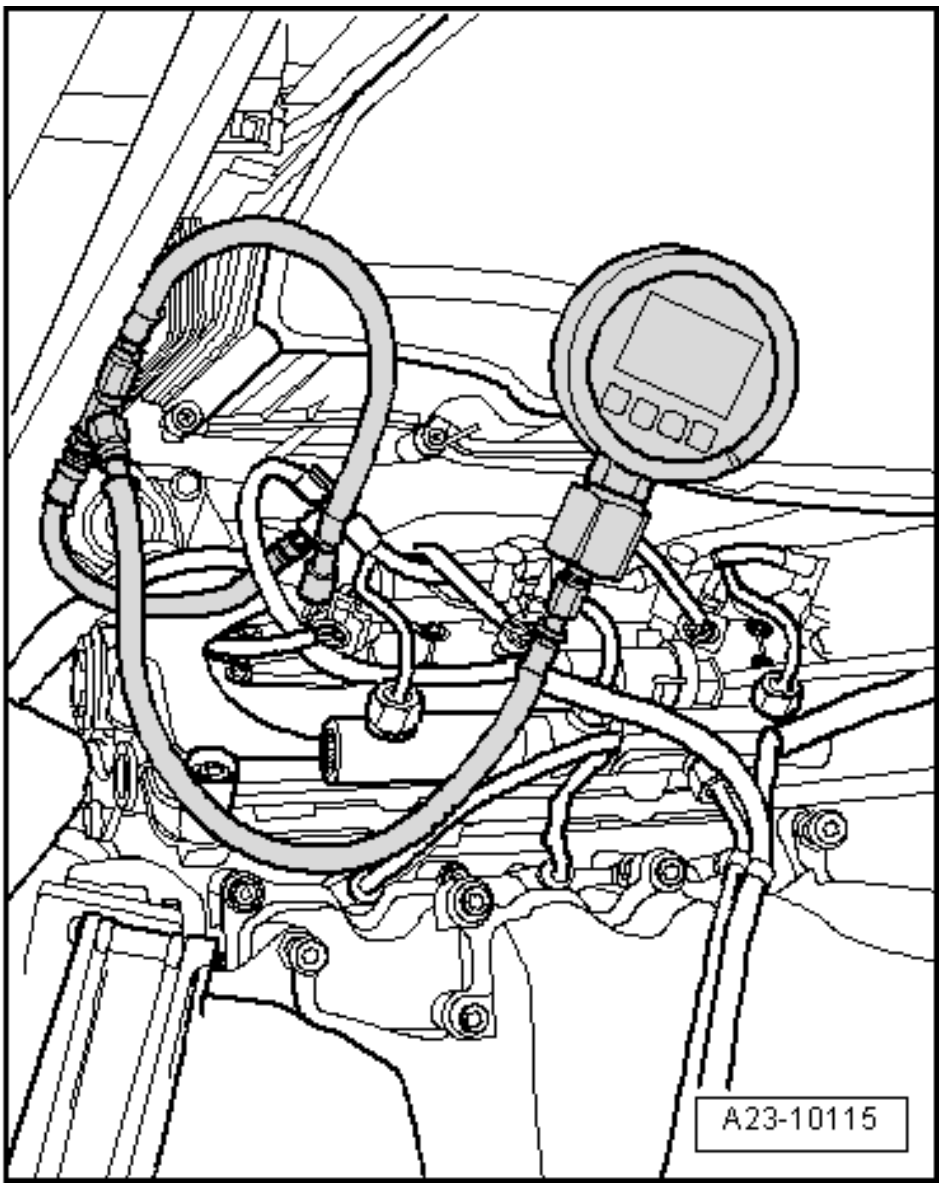
1.17 Checking pressure retention valve in fuel return line

The pressure retention valve maintains a residual pressure of approx. 10 bar in the return lines.

This residual pressure is required for the control function of the piezo injectors.

Special tools and workshop equipment required

- Tester for fuel return system -6330-



⚠ ***WARNING***

- ***Always read rules for cleanliness and instructions for working on fuel system*** ⇒ **Page 354*****.***
- ***Always follow these rules for cleanliness and instructions before starting work and while working on the fuel system.***

– Clean return line connection of cylinder no. 1 (e.g. with commercially available cold cleaning solvent) before removing.

– Dry return line connection of cylinder no. 1.

– Cover return line connection on cylinder no. 1 with a cloth.

– Pull off return line connection on cylinder no. 1. To do this, push connector downwards at tabs, and pull up centre piece to release it.

Note

Adhere strictly to rules of cleanliness. No dirt must be allowed to get into the disconnected fuel return lines or the open connections on the injectors under any circumstances.

– Install tester for fuel return system -VAS 6330- between return line connection on injector and return line.

– Start engine.

– Check pressure on pressure gauge.

◆ Specification: 8…14 bar

If the value does not match the specification, fit a new pressure retention valve.

2 Checking components and functions

WARNING

Adhere to the general safety regulations and the notes on repair work on the engine! ⇒Page 1

The described component checks and functional checks are applicable for the series components and the current flow diagrams as of page ⇒Page 486, current flow diagrams.

If components and electric circuits differ, observe the notes of the respective industrial engine customer.

Checking fuel metering valve -N290- ⇒Page 388.

Checking fuel pressure regulating valve -N276- ⇒Page 391.

Checking fuel pressure sender -G247- ⇒Page 394.

Checking injectors, cylinder 1...4 -N30...N33- ⇒Page 398.

Checking engine speed sender -G28- ⇒Page 400.

Checking Hall sender -G40- ⇒Page 403.

Checking intake air temperature sender -G42- ⇒Page 404.

Checking coolant temperature sender -G62- ⇒Page 407.

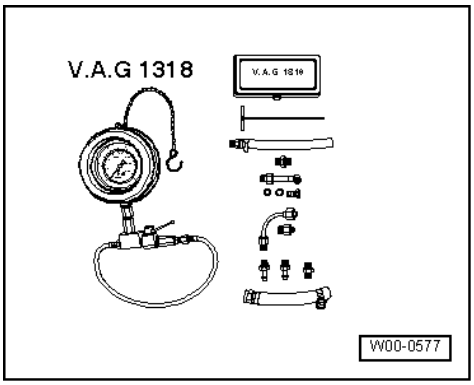
Checking fuel temperature sender -G81- ⇒Page 409.

Checking air mass meter -G70- ⇒Page 411.

Checking throttle valve module -J338- ⇒Page 414.

2.1 Checking fuel metering valve -N290-

Special tools and workshop equipment required



- K-Jetronic pressure tester -V.A.G 1318-
- Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
- Auxiliary measuring set -V.A.G 1594-
- Test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-1-
- Current flow diagram

Test prerequisites

- Fuses must be OK.
- Coolant temperature at least 80°C
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK

Test procedure

– Start engine and run at idling speed.

– Connect vehicle diagnostic tester, and select engine control unit. ⇒Page 23

– Select “011-Read measured value block”.

Note

If the engine does not start, proceed with checking the resistance ⇒Page 389.

– Select “Display group 7”.

Indicated on display:

```
Display group 7
xxx.x°C  xxx.x°C   xxx.x°C    87.3°C
```

Note

The display zones may be shown one below the other or next to each other on the display of the vehicle diagnostic tester.

– Observe display zone 4. For the check below, the coolant temperature must be at least 80°C.

– Check fuel rail pressure as follows:

– Select “Display group 20”.

Indicated on display:

```
Display group 20
880 rpm   xxxx bar   xxxx bar    xxx.x%
```

Note

The display zones may be shown one below the other or next to each other on the display of the vehicle diagnostic tester.

– Observe display zones 2 and 3 for fuel rail pressure. In addition, observe duty cycle in display zone 4.

The fuel rail pressure specification in display zone 2 and the actual fuel rail pressure in display zone 3 should be roughly within the same range, but they should not always be the same. The

difference between the pressure in display zone 2 and display zone 3 must not exceed 40 bar.

Engine codes CJDA, CJDD

- Display zone 2, pressure in high pressure fuel system (specified): 170... 350 bar.
- Display zone 3, pressure in high pressure fuel system (actual): 170... 350 bar.
- Display zone 4, duty cycle (specified): 15... 30%

Engine codes CPYA, CPYB, CPYC, CPYD, CPYE

- Display zone 2, pressure in high pressure fuel system (specified): 320... 780 bar.
- Display zone 3, pressure in high pressure fuel system (actual): 320... 780 bar.
- Display zone 4, duty cycle (specified): 25... 42 %

Continuation for all engine codes

If the specified values in display zones 2 and 3 are roughly within the same range, and if the pressure difference does not exceed 40 bar:

No fault was detected.

– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

If the display zones 2 + 3 show an alternative value of 360 bar:

– Check fuel pressure sender -G247- ⇒Page 394.

If the specification for display zone 3 has not been attained or if it has been exceeded:

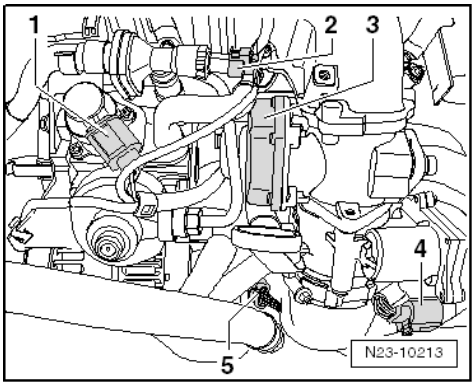
– First, check fuel pressure sender -G247- ⇒Page 394 and fuel pressure regulating valve -N276- ⇒Page 391.

If the pressure difference in display zones 2 + 3 exceeds 40 bar, or if the duty cycle specification in display zone 4 has not been attained:

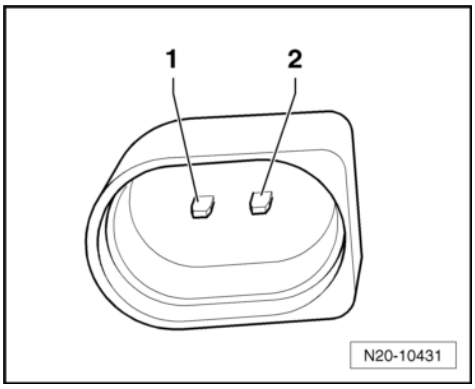
– Switch off ignition.

Checking resistance

Pull off connector -1- for fuel metering valve -N290-.



– Connect multimeter to sender contacts 1 + 2 using test leads from auxiliary measuring set -V.A.G 1594D- to measure resistance. Specification: 2.0...5.0 Ω



If the specification is not attained:

– Renew fuel metering valve -N290-.

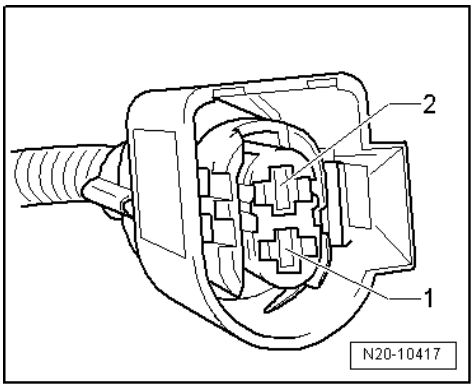
– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26.

If specification is attained:

Checking supply voltage

– Check supply voltage of fuel metering valve -N290- as follows:

– Connect multimeter to contact 2 of connector and to engine earth using test leads from auxiliary measuring set -V.A.G 1594D- to measure voltage.



– Switch on ignition. Specification: at least 11.5 V

– Switch off ignition.

If the specification is not attained:

– Check cable connections for open circuit, short circuit and transfer resistance at contacts referring to current flow diagram.

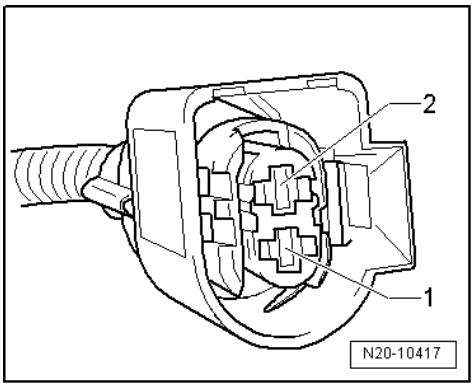
If specification is attained:

Checking wiring

– Check wiring of fuel metering valve -N290- as follows:

– Using adapter cable -V.A.G 1598/39-1-, connect test box -V.A.G 1598/42- to wiring harness of control unit ⇒Page 24. The engine control unit is not connected by this action.

– Check wiring between test box and connector for open circuit referring to current flow diagram.



◆ Contact 1 + socket 60

● Cable resistance: max. 2.0 Ω.

– Additionally check wires for short to one another. Specification: ∞ Ω

If no wiring fault is detected and voltage supply is OK:

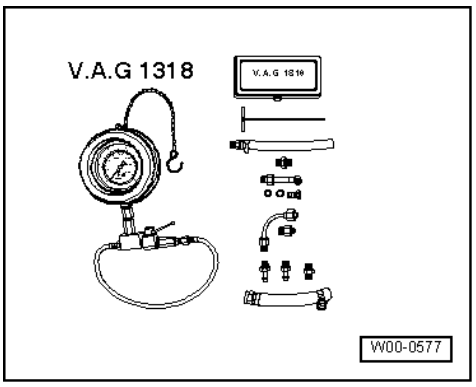
– Renew fuel metering valve -N290-.

– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

2.2 Checking fuel pressure regulating valve -N276-

Special tools and workshop equipment required

- K-Jetronic pressure tester -V.A.G 1318-
- Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
- Auxiliary measuring set -V.A.G 1594D-
- Test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-1-
- Current flow diagram



Test prerequisites

- Fuses must be OK.
- Coolant temperature at least 80°C
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK

Test procedure

– Start engine and run at idling speed.

– Connect vehicle diagnostic tester, and select engine control unit. ⇒Page 23

– Select diagnosis function “011-Read measured value block”.

– Select “Display group 7”.

Indicated on display:

```
Display group 7
xxx.x°C  xxx.x°C   xxx.x°C    87.3°C
```

Note

The display zones may be shown one below the other or next to each other on the display of the vehicle diagnostic tester.

– Observe display zone 4. For the check below, the coolant temperature must be at least 80°C.

– Check fuel rail pressure as follows:

– Select “Display group 20”.

Indicated on display:

```
Display group 20
880 rpm   xxxx bar   xxxx bar    xxx.x%
```

Note

The display zones may be shown one below the other or next to each other on the display of the vehicle diagnostic tester.

– Observe display zones 2 and 3 for fuel rail pressure. In addition, observe duty cycle in display zone 4.

The fuel rail pressure specification in display zone 2 and the actual fuel rail pressure in display zone 3 should be roughly within the same range, but they should not always be the same. The difference between the pressure in display zone 2 and display zone 3 must not exceed 40 bar.

Engine codes CJDA, CJDD

- Display zone 2, pressure in high pressure fuel system (specified): 170... 350 bar.
- Display zone 3, pressure in high pressure fuel system (actual): 170... 350 bar.
- Display zone 4, duty cycle (specified): 15... 30 %

Engine codes CPYA, CPYB, CPYC, CPYD, CPYE

- Display zone 2, pressure in high pressure fuel system (specified): 320... 780 bar.
- Display zone 3, pressure in high pressure fuel system (actual): 320... 780 bar.
- Display zone 4, duty cycle (specified): 25... 42 %

Continuation for all engine codes

If the specified values in display zones 2 and 3 are roughly within the same range, and if the pressure difference does not exceed 40 bar:

No fault was detected.

– Check return flow rate of fuel pressure regulating valve -N276- ⇒Page 377.
– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

If the display zones 2 + 3 show an alternative value of 360 bar:

– Check fuel pressure sender -G247- ⇒Page 394.

If the specification for display zone 3 has not been attained or if it has been exceeded:

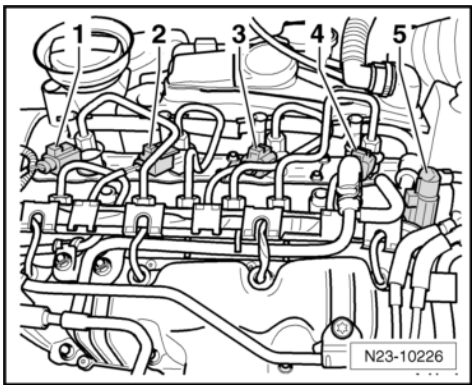
– Renew fuel pressure regulating valve -N276-.

If the pressure difference in display zones 2 + 3 exceeds 40 bar, or if the duty cycle specification in display zone 4 has not been attained:

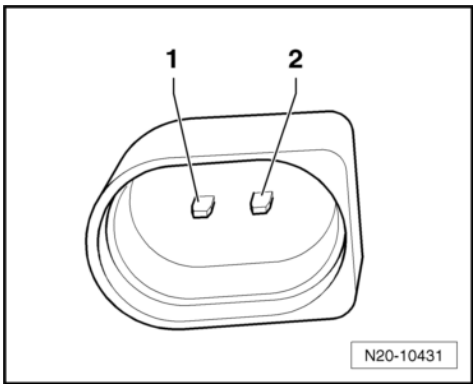
– Switch off ignition.

Checking resistance

Pull off connector -5- for fuel pressure regulating valve -N276-.



– Connect multimeter to sender contacts 1 + 2 using test leads from auxiliary measuring set -V.A.G 1594D- to measure resistance. Specification: 3.0...6.0 Ω



If the specification is not attained:

– Renew fuel pressure regulating valve -N276-.

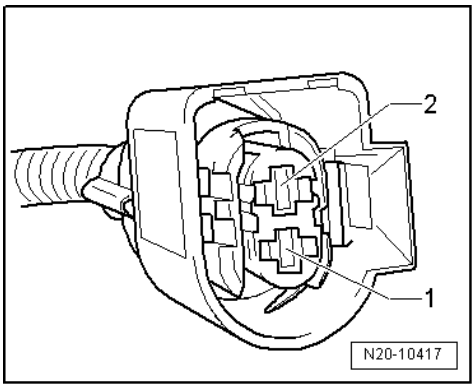
– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

If specification is attained:

Checking supply voltage

– Check supply voltage of fuel pressure regulating valve -N276- as follows:

– Connect multimeter to contact 2 of connector and to engine earth using test leads from auxiliary measuring set -V.A.G 1594D- to measure voltage.



– Switch on ignition. Specification: at least 11.5 V

– Switch off ignition.

If the specification is not attained:

– Check cable connections for open circuit, short circuit and transfer resistance at contacts referring to current flow diagram.

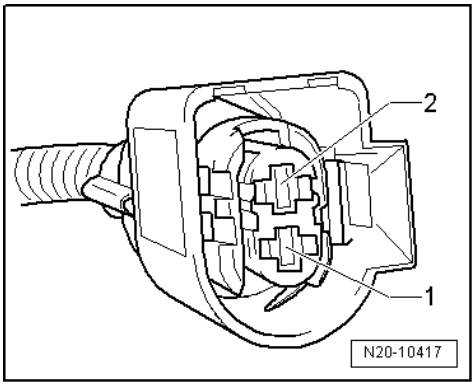
If specification is attained:

Checking wiring

– Check wiring of fuel pressure regulating valve -N276- as follows:

– Using adapter cable -V.A.G 1598/39-1-, connect test box -V.A.G 1598/42- to wiring harness of control unit ⇒Page 24. The engine control unit is not connected by this action.

– Check wiring between test box and connector for open circuit referring to current flow diagram.



◆ Contact 1 + socket 45

● Cable resistance: max. 2.0 Ω.

– Also check wiring for short to one another, short to battery earth/engine earth and short to battery positive. Specification: ∞ Ω

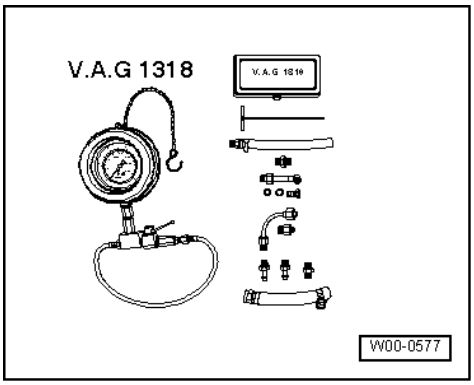
If no wiring fault is detected and voltage supply is OK:

– Renew fuel pressure regulating valve -N276-.

– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

2.3 Checking fuel pressure sender -G247-

Special tools and workshop equipment required



- K-Jetronic pressure tester -V.A.G 1318-
- Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
- Auxiliary measuring set -V.A.G 1594D-
- Test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-1-
- Current flow diagram

Test prerequisites

- Fuses must be OK.
- Coolant temperature at least 80°C
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK

Test procedure

– Note safety precautions before beginning work ⇒Page 299.

– Observe rules for cleanliness ⇒Page 300.

– Start engine.

If engine does not start:

– Check fuel pressure while starting ⇒Page 395.

If engine starts:

– Allow engine to idle.

– Connect vehicle diagnostic tester, and select engine control unit. ⇒Page 23

– Select diagnosis function “011-Read measured value block”.

– Select “Display group 7”.

Indicated on display:

```
Display group 7
xxx.x°C  xxx.x°C   xxx.x°C    87.3°C
```

Note

The display zones may be shown one below the other or next to each other on the display of the vehicle diagnostic tester.

– Observe display zone 4. For the check below, the coolant temperature must be at least 80°C.

– Check fuel rail pressure as follows:

– Select “Display group 20”.

Indicated on display:

```
Display group 20
880 rpm   xxxx bar   xxxx bar    xxx.x%
```

Note

The display zones may be shown one below the other or next to each other on the display of the vehicle diagnostic tester.

– Apply several throttle bursts, and observe display zones 2 and 3 for fuel rail pressure at idling speed. In addition, observe duty cycle in display zone 4.

The fuel rail pressure specification in display zone 2 and the actual fuel rail pressure in display zone 3 should be roughly within the same range, but they should not always be the same. The difference between the pressure in display zone 2 and display zone 3 must not exceed 40 bar.

Engine codes CJDA, CJDD

- Display zone 2, pressure in high pressure fuel system (specified): 170... 350 bar.
- Display zone 3, pressure in high pressure fuel system (actual): 170... 350 bar.
- Display zone 4, duty cycle (specified): 15... 30 %

Engine codes CPYA, CPYB, CPYC, CPYD, CPYE

- Display zone 2, pressure in high pressure fuel system (specified): 320... 780 bar.
- Display zone 3, pressure in high pressure fuel system (actual): 320... 780 bar.
- Display zone 4, duty cycle (specified): 25... 42 %

Continuation for all engine codes

If the specified values in display zones 2 and 3 are roughly within the same range, and if the pressure difference does not exceed 40 bar:

No fault was detected.

– Then, read event memory of engine control unit, and clear event memory if necessary ⇒ Page 26, read event memory.

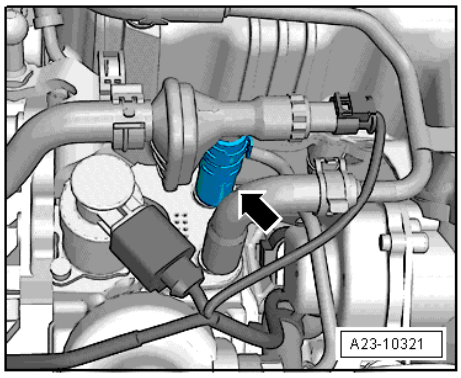
If the specified values in display zones 2 and 3 were always the same, or if the pressure difference did exceed 40 bar:

– Check wiring ⇒ Page 398.

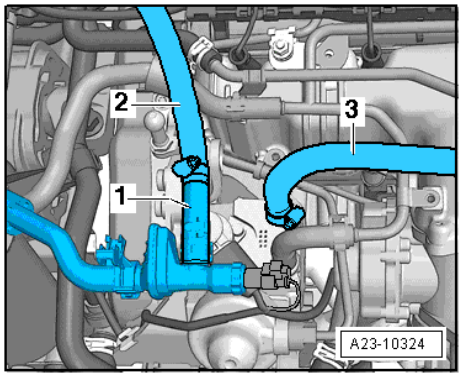
Check fuel pressure while the engine is started.

> ⚠ ***WARNING***
>
> ◆ ***Wrap a clean cloth around the connection before opening the fuel system. Then release pressure by carefully pulling hose off connection.***

– Pull fuel supply line -arrow- off high-pressure pump.



– Using a suitable adapter -2-, connect K-Jetronic pressure tester -V.A.G 1318- to fuel supply line -1-. Connect other adapter -3- of K-Jetronic pressure tester -V.A.G 1318- to open connection on high-pressure pump.



Note

The K-Jetronic pressure tester -V.A.G 1318- must be inserted as an intermediate element into the fuel supply line.

WARNING

- ***It is essential that the shut-off tap of the pressure tester is open.***
- ***Make sure that all lines are firmly connected, because they may be subject to high pressure.***

– Start engine, and observe pressure tester while the engine is started.

A pressure of > 3.5 bar must build up.

If the specification has not been attained:

– Check fuel pressure while starting ⇒Page 397.

If specification has been attained:

Fuel supply to high-pressure pump is OK.

– Then, check fuel rail pressure while starting.

– Start engine and run at idling speed.

– Connect vehicle diagnostic tester, and select engine control unit. ⇒Page 23

– Select diagnosis function “011-Read measured value block”. When doing this, the ignition must be switched on.

– Select “Display group 20”.

Indicated on display:

```
Display group 20
880 rpm   xxxx bar   xxxx bar    xxx.x%
```

Note

The display zones may be shown one below the other or next to each other on the display of the vehicle diagnostic tester.

– Have a second person start the engine, and observe display zones 2 and 3 while the engine is started.

The fuel rail pressure specification in display zone 2 and the actual fuel rail pressure in display zone 3 should be roughly within the same range, but they should not always be the same. The difference between the pressure in display zone 2 and display zone 3 must not exceed 40 bar.

If the specified values in display zones 2 and 3 are roughly within the same range, and if the pressure difference does not exceed 40 bar:

No fault was detected.

– Check fuel system for leaks ⇒ Page 384.

If no fault was found:

– Renew fuel pressure sender -G247-.

If the fault persists:

– Renew high-pressure pump ⇒ Page 380.
– Then, read event memory of engine control unit, and clear event memory if necessary ⇒ Page 26, read event memory.

If the specified values in display zones 2 and 3 were always the same, or if the pressure difference did exceed 40 bar:

– Check wiring ⇒ Page 398.

Checking fuel pressure while the engine is started

– Have a second person start the engine, and observe pressure tester while the engine is started.
– While doing this, close shut-off tap of pressure tester slowly and carefully until a pressure of max. 8 bar is displayed.
– Switch off ignition.

If specification has been attained:

Fuel supply to high-pressure pump is OK.

– Renew fuel pressure sender -G247-.
– Then, read event memory of engine control unit, and clear event memory if necessary ⇒ Page 26, read event memory.

If the fault persists:

– Renew fuel pressure regulating valve -N276-.
– Then, read event memory of engine control unit, and clear event memory if necessary ⇒ Page 26, read event memory.

If the fault persists:

– Renew fuel metering valve -N290-.
– Then, read event memory of engine control unit, and clear event memory if necessary ⇒ Page 26, read event memory.

If the fault persists:

– Renew high-pressure pump.

If the specification has not been attained:

– Check fuel lines, e.g. for kinks, and check whether fuel filter is clogged.

– Check the fuel pump ⇒Page 314.

If no fault was detected:

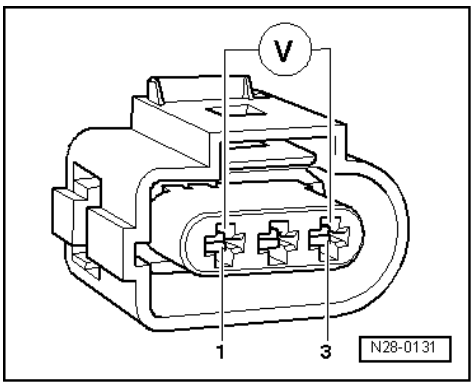
– Check fuel pump relay -J17- ⇒Page 486, current flow diagrams.

Checking voltage supply

– Connect multimeter to contacts 1 + 3 of connector using test leads from auxiliary measuring set -V.A.G 1594D- to measure voltage.

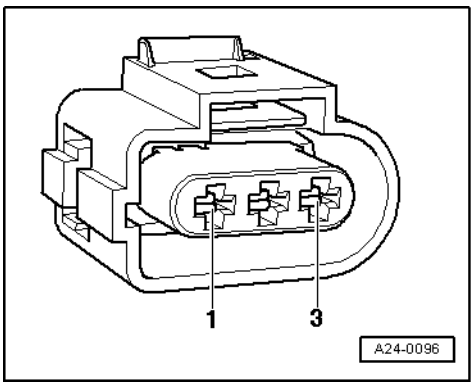
– Switch on ignition. Specification: at least 4.8...5.2 V

– Switch off ignition.



Checking wiring

– Using adapter cable -V.A.G 1598/39-1-, connect test box -V.A.G 1598/42- to wiring harness of control unit ⇒Page 24. The engine control unit is not connected by this action.



– Check wiring between test box and connector for open circuit referring to current flow diagram.

◆ Contact 1 + socket 53

◆ Contact 1 + socket 40

◆ Contact 3 + socket 25

● Cable resistance: max. 2.0 Ω.

– Also check wiring for short to one another, short to battery earth/engine earth and short to battery positive. Specification: ∞ Ω

If no wiring fault is detected and voltage was present between contacts 1 + 3:

– Renew fuel pressure sender -G247-.

– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

If no wiring fault is detected and no voltage was present between contacts 1 + 3:

– Pull connectors off any components which are connected to this voltage supply line ⇒Page 486, current flow diagrams.

– Check voltage supply and wires on these components.

If no wiring fault is detected and no voltage was present on these components:

– Renew engine control unit -J623- ⇒Page 418.

2.4 Checking injectors, cylinders 1...4 -N30...N33-

Special tools and workshop equipment required

◆ Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-

◆ Auxiliary measuring set -V.A.G 1594D-

- Test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-1-
- Current flow diagram

Note

Instead of the vehicle diagnosis, testing and information system other diagnosis systems, such as the DiagRA, may be used as well.

Test prerequisites

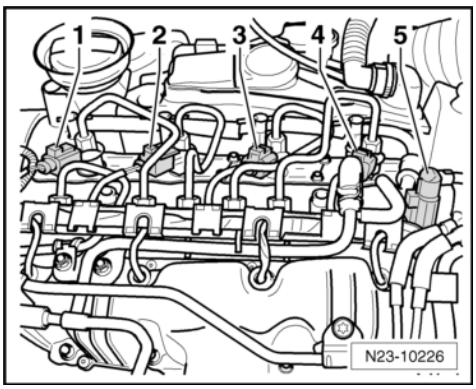
- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK

Test procedure

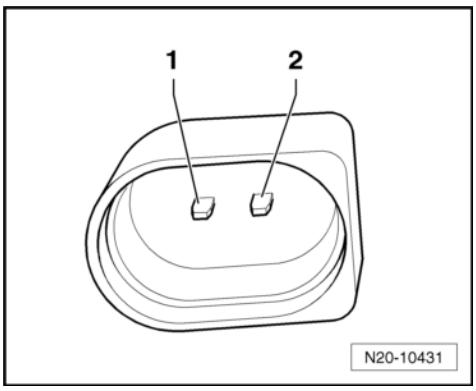
– Switch off ignition.

Checking resistance

Pull connector -1...4- off injector to be tested.



– Connect multimeter to valve contacts 1 + 2 using test leads from auxiliary measuring set -V.A.G 1594D- to measure resistance. Specification: 50.0…700.0 kΩ



If the specification is not attained:

– Renew the defective injector.
– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

If specification is attained:

Checking for short-circuit to earth

– Using test leads from auxiliary measuring set -V.A.G 1594D-, connect multimeter to relevant injector as follows:

- Injector contact 1 + engine earth
- Injector contact 2 + engine earth

Specification: ∞ Ω.

If the specification is not attained:

– Renew the defective injector.

– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

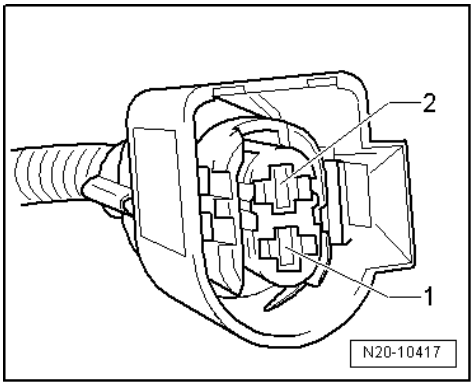
If specification is attained:

Checking wiring

– Check wiring of injector to be tested as follows:

– Using adapter cable -V.A.G 1598/39-1-, connect test box -V.A.G 1598/42- to wiring harness of control unit ⇒Page 24. The engine control unit is not connected by this action.

– Check wiring between test box and connector for open circuit referring to current flow diagram.



◆ Injector 1 -N30-: contact 1 + socket 2

◆ Injector 1 -N30-: contact 2 + socket 17

◆ Injector 2 -N31-: contact 1 + socket 47

◆ Injector 2 -N31-: contact 2 + socket 32

◆ Injector 3 -N32-: contact 1 + socket 46

◆ Injector 3 -N32-: contact 2 + socket 31

◆ Injector 4 -N33-: contact 1 + socket 1

◆ Injector 4 -N33-: contact 2 + socket 16

● Cable resistance: max. 2.0 Ω.

– Additionally, check wiring for the following:

◆ Short to positive. Specification: ∞ Ω.

◆ Short to earth. Specification: ∞ Ω.

◆ Short to one another. Specification: ∞ Ω

If no fault in lines is detected:

– Renew the defective injector ⇒Page 418.

– Store “injector delivery calibration values/injector voltage calibration values” and new injector in engine control unit ⇒Page 421.

– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

2.5 Checking engine speed sender -G28-

Function

Engine speed sender -G28- is speed and reference mark sender. The engine will not start if there is no speed signal. If the speed signal fails when the engine is running, it will cause the engine to stall immediately.

Note

- *The engine speed sender can be diagnosed via the engine control unit.*
- *During diagnosis, the engine must run at idling speed. Only "Ignition ON" causes the fault "Hall sender defective" to be displayed automatically.*

Special tools and workshop equipment required

- Auxiliary measuring set -V.A.G 1594D-
- Test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-1-
- Test instrument adapter/DSO (3 pin) -VAS 5257-
- DSO (digital storage oscilloscope) - -
- Current flow diagram

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK

Test procedure

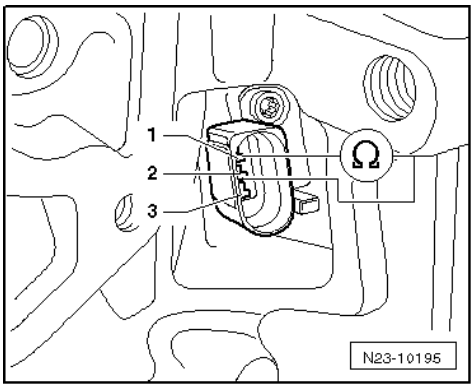
Note

Only gold-plated contacts may be used when repairing the contacts in the connectors of the engine speed sender.

– Clamp off coolant hoses at oil cooler using hose clamp and pull off hoses.
– Remove oil filter bracket ⇒Page 260, Assembly overview - oil filter bracket and engine oil cooler.
– Pull 3-pin connector off engine speed sender -G28-.
– Disconnect 3-pin connector -1- from Hall sender -G40-.
– Connect vehicle diagnostic tester, and select engine control unit. ⇒Page 23
– Select diagnosis function xxx“xxx- Read ?????”. Engine must be idling.
– If a fault with fault code 00513 has been detected, check engine speed sender.

– To do this, connect an oscilloscope, and check engine speed sender -G28- with a signal voltage of 0 - 5 V. The sender must provide an approximate square wave signal.
– In addition, measure resistance of sender.

◆ Between contacts 2 + 3 of connector, specification 480 ... 1000 Ω
◆ Check sender for short-circuit to shielding.
◆ Between contacts 1+2 as well as 1+3 specification ∞ Ω



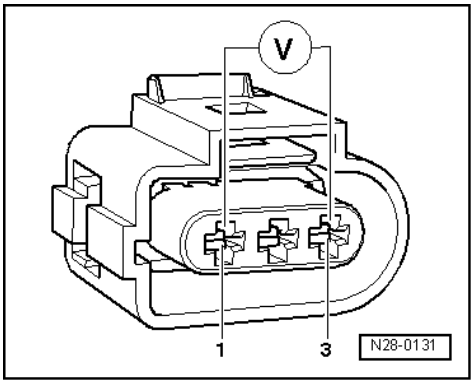
If the specifications are not obtained

– Renew engine speed sender -G28- ⇒Page 178.
– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

If the specifications are attained:

Checking voltage supply

– Connect multimeter to contacts 1 + 3 of connector using test leads from -V.A.G 1594- to measure voltage.
– Switch on ignition. Specification: at least 4.8... 5.2 V
– Switch off ignition.



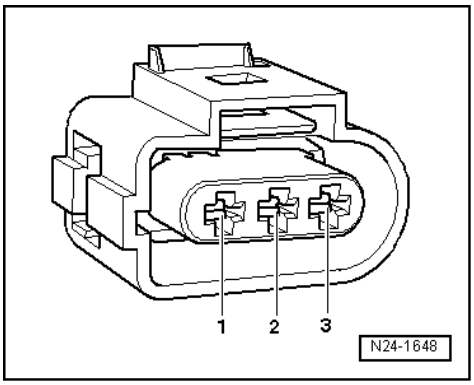
If the specification is not attained:

– Check wiring of engine speed sender as follows:
– Using adapter cable -V.A.G 1598/39-1-, connect test box -V.A.G 1598/42- to wiring harness of control unit ⇒Page 24. The engine control unit is not connected by this action.
– Check wiring between test box and connector for open circuit referring to current flow diagram.

◆ Contact 1 + socket 25
◆ Contact 2 + socket 52
◆ Contact 3 + socket 53

● Cable resistance: max. 2.0 Ω.

– Also check wiring for short to one another, short to battery earth/engine earth and short to battery positive. Specification: ∞ Ω



If no fault in lines is detected:

– Remove engine speed sender -G28- ⇒Page 178.
– Check sender wheel for:

◆ firm seating,
◆ damage,
◆ run-out,
◆ metal shavings on sender wheel or sender.

If no fault is detected on the sender wheel or in the wiring, and voltage was present between contacts 1 + 3:

– Renew engine speed sender -G28-⇒Page 178.

– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

If no fault is detected on the sender wheel or in the wiring, and no voltage was present between contacts 1 + 3:

– Pull connectors off any components which are connected to this voltage supply line ⇒Page 486, current flow diagrams.

– Check voltage supply and wires on these components.

If no wiring fault is detected and no voltage was present on these components:

– Renew engine control unit -J623- ⇒Page 418.

2.6 Checking Hall sender 2 -G40-

Special tools and workshop equipment required

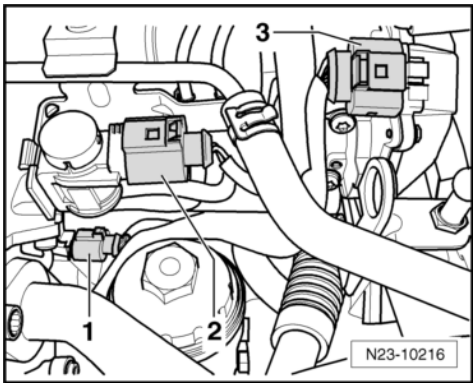
- Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
- Auxiliary measuring set -V.A.G 1594-
- Test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-1-
- Current flow diagram

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK

Test procedure

– Disconnect 3-pin connector -1- from Hall sender -G40-.



Checking voltage supply

– Connect multimeter to contacts 1 + 3 of connector using test leads from -V.A.G 1594- to measure voltage.
– Switch on ignition. Specification: at least 4.8... 5.2 V
– Switch off ignition.

If the specification is not attained:

– Check wiring of Hall sender as follows:
– Using adapter cable -V.A.G 1598/39-1-, connect test box -V.A.G 1598/42- to wiring harness of control unit ⇒Page 24. The engine control unit is not connected by this action.
– Check wiring between test box and connector for open circuit referring to current flow diagram.

◆ Contact 1 + socket 10
◆ Contact 2 + socket 44
◆ Contact 3 + socket 51

● Cable resistance: max. 2.0 Ω.

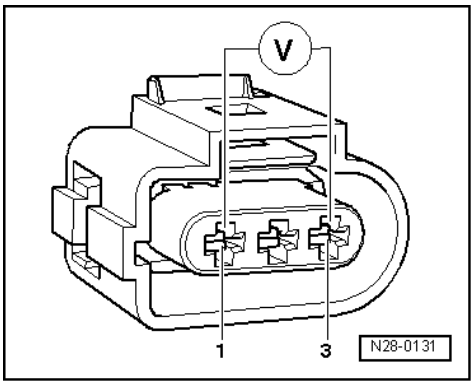
– Also check wiring for short to one another, short to battery earth/engine earth and short to battery positive. Specification: ∞ Ω

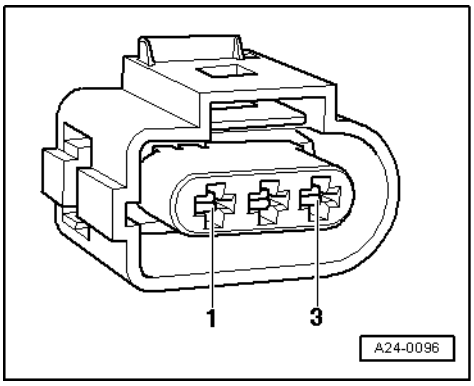
If no wiring fault is detected and voltage was present between contacts 1 + 3:

– Renew hall sender -G40-.
– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.
– Pull connectors off any components which are connected to this voltage supply line ⇒Page 486, current flow diagrams.
– Check voltage supply and wires on these components.

If no wiring fault is detected and no voltage was present on these components:

– Renew engine control unit -J623- ⇒Page 418.





2.7 Checking intake air temperature sender -G42-

Special tools and workshop equipment required

◆ Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
◆ Auxiliary measuring set -V.A.G 1594-
◆ Test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-2-
◆ Current flow diagram

Test prerequisites

● Fuses must be OK.
● The battery voltage must be at least 11.5 V.

- All electrical consumers must be switched off.
- Earth connections OK

Test procedure

Note

- *The intake air temperature sender -G42- and charge pressure sender -G31- are installed in one common housing in the charge air pipe.*
- *Only gold-plated contacts may be used when repairing contacts in connector.*

– Connect vehicle diagnostic tester, and select engine control unit. ⇒Page 23

– Select diagnosis function “011-Read measured value block”. Engine must be idling.

– Select “Display group 7”.

Indicated on display:

```
Display group 7
xxx.x°C   xxx.x°C   20.9°C   xxx.x°C
```

Note

The display zones may be shown one below the other or next to each other on the display of the vehicle diagnostic tester.

– Check intake air temperature value in display zone 3. The temperature value must correspond approx. to ambient temperature.

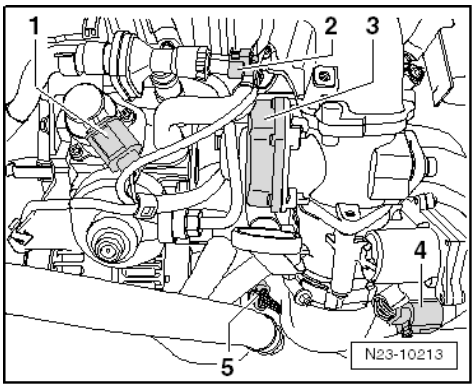
– If the value in display zone 3 is not plausible, check intake air temperature sender and wiring to sender as follows:

– Exit diagnosis function.

– Switch off ignition.

Checking resistance

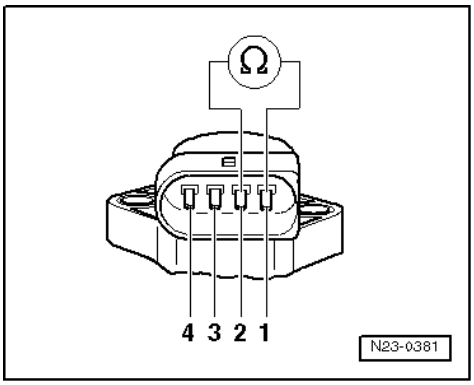
– Pull 4-pin connector off intake air temperature sender -5-.



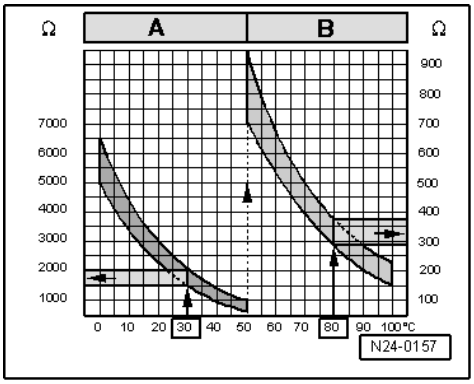
Note

The intake air temperature sender -G42- and charge pressure sender -G31- are installed in one common housing in the charge air pipe.

– Connect multimeter to contacts 1 + 2 of sender using test leads from -V.A.G 1594- to measure resistance.



Scale -A- shows resistance values for a temperature range of 0…50°C, and scale -B- shows the values for a temperature range of 50…100°C.



Examples:

- 30°C is on scale -A- and corresponds to a resistance of 1500…2000 Ω.
- 80°C is on scale -B- and corresponds to a resistance of 275…375 Ω.

If the specification is not attained:

– Renew intake air temperature sender -G42- together with charge pressure sender -G31-.

– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

If specification is attained:

Checking voltage supply

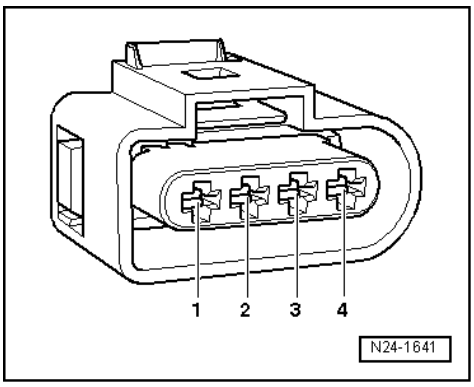
– Connect multimeter to contacts 1 + 3 of connector using test leads from -V.A.G 1594- to measure voltage.

– Switch on ignition. Specification: at least 4.8... 5.2 V

– Switch off ignition.

– Check wiring of intake air temperature sender as follows:

– Using adapter cable -V.A.G 1598/39-2-, connect test box -V.A.G 1598/42- to wiring harness of control unit ⇒Page 24. The engine control unit is not connected by this action.

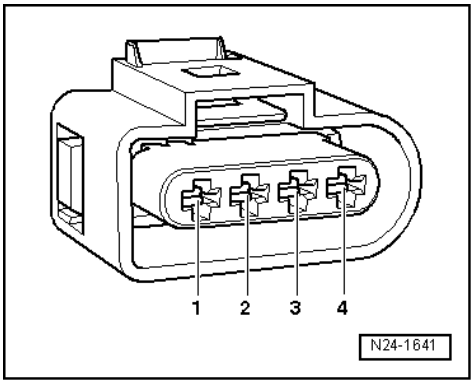


– Check wiring between test box and connector for open circuit referring to current flow diagram.

- Contact 1 + socket 66
- Contact 2 + socket 30

- Cable resistance: max. 2.0 Ω.

– Also check wiring for short to one another, short to battery earth/engine earth and short to battery positive. Specification: ∞ Ω



If no wiring fault is detected and voltage was present between contacts 1 + 3:

– Renew intake air temperature sender -G42- together with charge pressure sender -G31-.

If no wiring fault is detected and no voltage was present between contacts 1 + 3:

– Pull connectors off any components which are connected to this voltage supply line ⇒Page 486, current flow diagrams.

– Check voltage supply and wires on these components.

If no wiring fault is detected and no voltage was present on these components:

– Renew engine control unit -J623- ⇒Page 418.

2.8 Checking coolant temperature sender -G62-

Special tools and workshop equipment required

- Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
- Auxiliary measuring set -V.A.G 1594-
- Test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-1-
- Current flow diagram

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK
- Engine must be cold.

Test procedure

Note

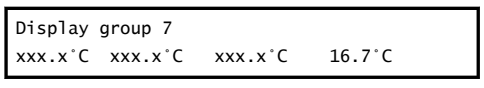
Only gold-plated contacts may be used when repairing the contacts in the connectors of the coolant temperature sender.

– Connect vehicle diagnostic tester, and select engine control unit. ⇒Page 23

– Select diagnosis function “011-Read measured value block”. Engine must be idling.

– Select “Display group 7”.

Indicated on display:



Note

The display zones may be shown one below the other or next to each other on the display of the vehicle diagnostic tester.

– Check coolant temperature value in display zone 4. The temperature value must Increase uniformly and without interruption.

Note

If there is a fault the fuel temperature will be displayed as a substitute value (display zone 1).

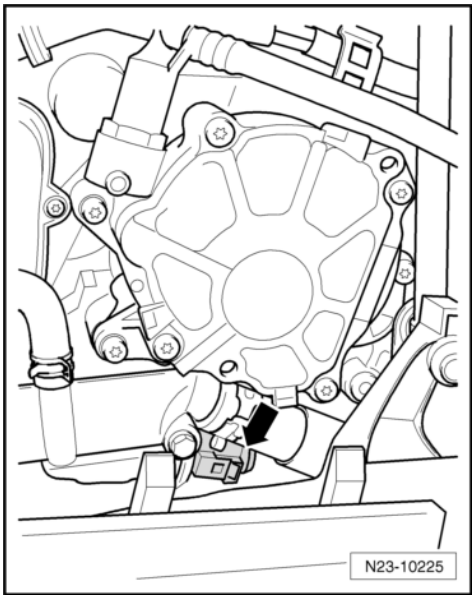
– If no realistic display appears in display zone 4 or the fuel temperature is displayed as a substitute. Check coolant temperature sender and wiring connections to sender as follows:

– Exit diagnosis function.

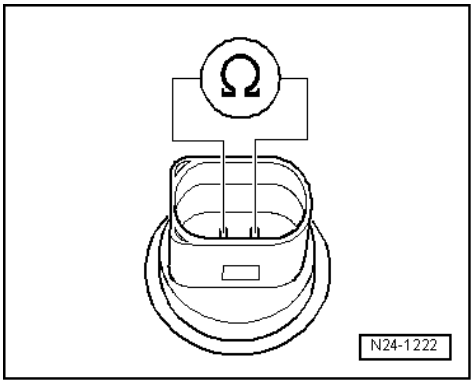
– Switch off ignition.

Checking resistance

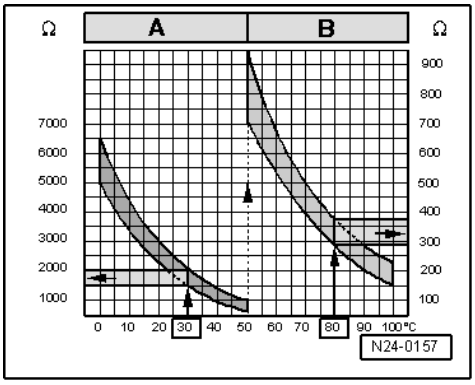
– Pull 2-pin connector -arrow- off coolant temperature sender -G62-.



– Connect multimeter to sender contacts using test leads from -V.A.G 1594- to measure resistance.



Scale -A- shows resistance values for a temperature range of 0…50°C, and scale -B- shows the values for a temperature range of 50…100°C.



Examples:

- 30°C is on scale -A- and corresponds to a resistance of 1500…2000 Ω.
- 80°C is on scale -B- and corresponds to a resistance of 275…375 Ω.

If the specification is not attained:

– Renew coolant temperature sender -G62- ⇒Page 278, parts of cooling system, engine side.

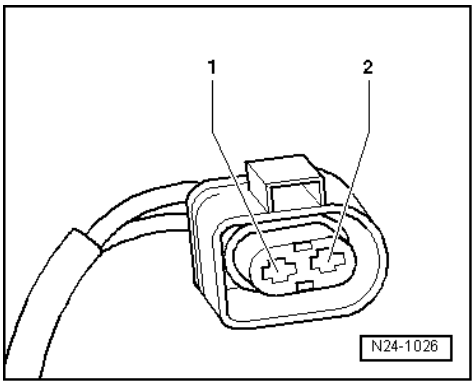
– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

If specification is attained:

– Check wiring of coolant temperature sender as follows:

– Using adapter cable -V.A.G 1598/39-1-, connect test box -V.A.G 1598/42- to wiring harness of control unit ⇒Page 24. The engine control unit is not connected by this action.

– Check wiring between test box and connector for open circuit referring to current flow diagram.



- Contact 1 + socket 53
- Contact 2 + socket 54
- Cable resistance: max. 2.0 Ω.

– Also check wiring for short to one another, short to battery earth/engine earth and short to battery positive. Specification: ∞ Ω

If no fault in lines is detected:

– Renew engine control unit -J623- ⇒Page 418.

2.9 Checking fuel temperature sender -G81-

Special tools and workshop equipment required

- Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
- Auxiliary measuring set -V.A.G 1594-
- Test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-1-
- Current flow diagram

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK

- No air in fuel system

Test procedure

Note

Only gold-plated contacts may be used when repairing the contacts in the connectors of the fuel temperature sender.

– Connect vehicle diagnostic tester, and select engine control unit. ⇒Page 23

– Select diagnosis function “011-Read measured value block”. Engine must be idling.

– Select “Display group 7”.

Indicated on display:

```
Display group 7
15.4˚C   xxx.x˚C  xxx.x˚C    xxx.x˚C
```

Note

The display zones may be shown one below the other or next to each other on the display of the vehicle diagnostic tester.

– Check fuel temperature value in display zone 1. The temperature value must correspond approx. to ambient temperature.

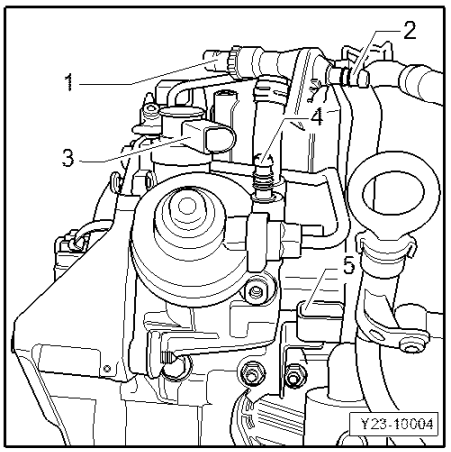
– If the value in display zone 1 is not plausible, check fuel temperature sender and wiring to sender as follows:

– Exit diagnosis function.

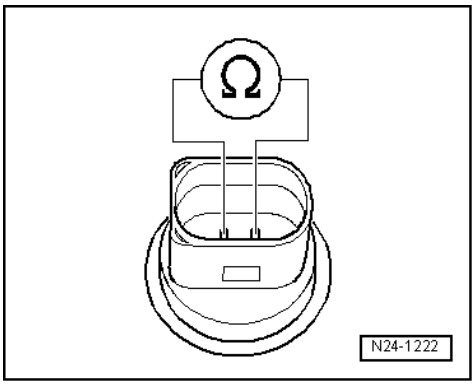
– Switch off ignition.

Checking resistance

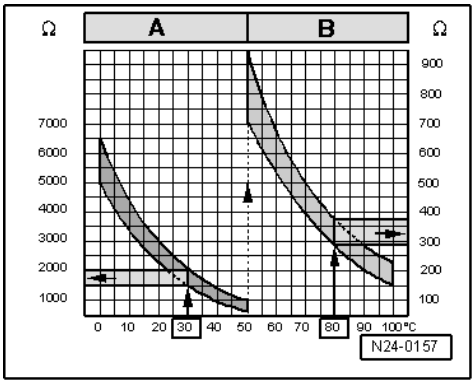
– Pull 2-pin connector -1- off fuel temperature sender.



– Connect multimeter to sender contacts using test leads from -V.A.G 1594- to measure resistance.



Scale -A- shows resistance values for a temperature range of 0…50°C, and scale -B- shows the values for a temperature range of 50…100°C.



Examples:

- 30°C is on scale -A- and corresponds to a resistance of 1500…2000 Ω.
- 80°C is on scale -B- and corresponds to a resistance of 275…375 Ω.

If the specification is not attained:

– Renew fuel temperature sender -G81-.

– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

If specification is attained:

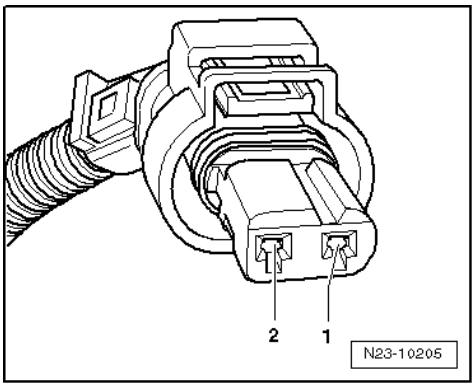
– Check wiring of fuel temperature sender as follows:

– Using adapter cable -V.A.G 1598/39-1-, connect test box -V.A.G 1598/42- to wiring harness of control unit ⇒Page 24. The engine control unit is not connected by this action.

– Check wiring between test box and connector for open circuit referring to current flow diagram.

- Contact 1 + socket 53
- Contact 2 + socket 42
- Cable resistance: max. 2.0 Ω.

– Also check wiring for short to one another, short to battery earth/engine earth and short to battery positive. Specification: ∞ Ω



If no fault in lines is detected:

– Renew engine control unit -J623- ⇒Page 418.

2.10 Checking air mass meter -G70-

Function

The air mass meter signal is used by the engine control unit to calculate the quantity injected and to control the required exhaust gas recirculation. The smaller the signal from air mass meter the smaller the quantity of fuel injected.

Special tools and workshop equipment required

- Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
- Auxiliary measuring set -V.A.G 1594-
- Test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-2-
- Current flow diagram

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK
- No leaks on intake and exhaust systems
- No faults must be stored in event memory ⇒Page 26, read event memory.
- Check whether charge pressure control is OK ⇒Page 333.
- Check whether exhaust gas recirculation system is OK ⇒Page 436.
- Coolant temperature must be at least 80°C, ⇒ display group 1, display zone 4.

Test procedure

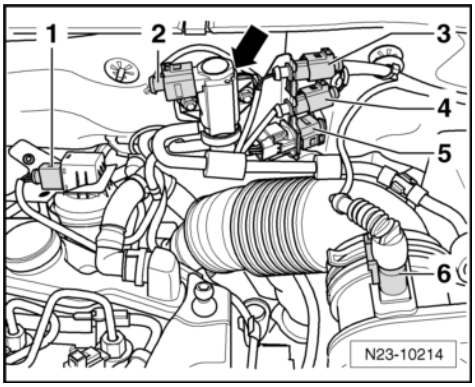
Note

Only gold-plated contacts may be used when repairing contacts in connector of air mass meter.

Checking voltage supply, engine codes CJDA, CJDD

– Pull 5-pin connector -6- off air mass meter -G70-.

– Switch on ignition.

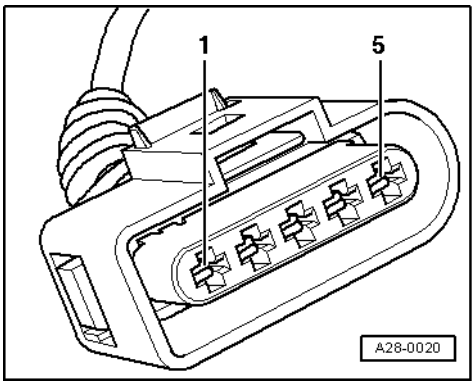


– Connect multimeter to following connector contacts and engine earth using test leads from -V.A.G 1594-.

◆ Contact 5 + engine earth

● Specification: at least 11.5 V

– Switch off ignition.

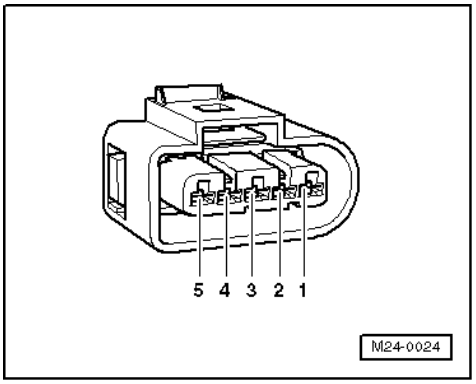


If the specification is not attained:

– Check wiring of air mass meter as follows:

– Using adapter cable -V.A.G 1598/39-2-, connect test box -V.A.G 1598/42- to wiring harness of control unit ⇒Page 24. The engine control unit is not connected by this action.

– Check wiring between test box and connector for open circuit referring to current flow diagram.



◆ Contact 1 + socket 18

◆ Contact 2 + socket 23

◆ Contact 4 + socket 39

◆ Contact 5 + socket 87

● Cable resistance: max. 2.0 Ω.

– Check wiring between contact 5 of 5-pin connector and fuse referring to current flow diagram ⇒Page 486.

– Also check wiring for short to one another, short to battery earth/engine earth and short to battery positive. Specification: ∞ Ω

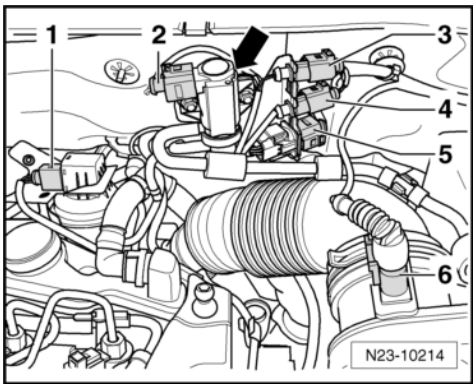
If no fault in lines is detected:

– Renew air mass meter.

Checking voltage supply, engine codes CPYA, CPYB, CPYC, CPYD, CPYE

– Pull 4-pin connector -6- off air mass meter -G70-.

– Switch on ignition.



– Connect multimeter to following connector contacts and engine earth using test leads from -V.A.G 1594-.

◆ Contact 4 + engine earth

● Specification: at least 11.5 V

– Switch off ignition.

If the specification is not attained:

– Check wiring of air mass meter as follows:

– Using adapter cable -V.A.G 1598/39-2-, connect test box -V.A.G 1598/42- to wiring harness of control unit ⇒Page 24. The engine control unit is not connected by this action.

– Check wiring between test box and connector for open circuit referring to current flow diagram.

◆ Contact 1 + socket 18

◆ Contact 2 + socket 23

◆ Contact 4 + socket 39

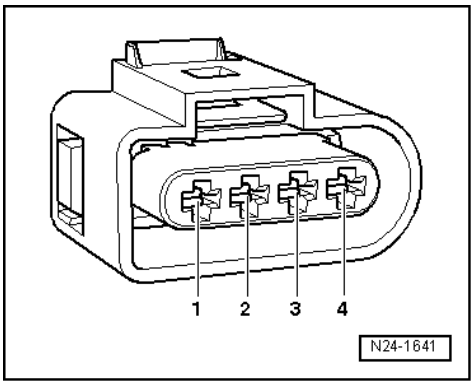
● Cable resistance: max. 2.0 Ω.

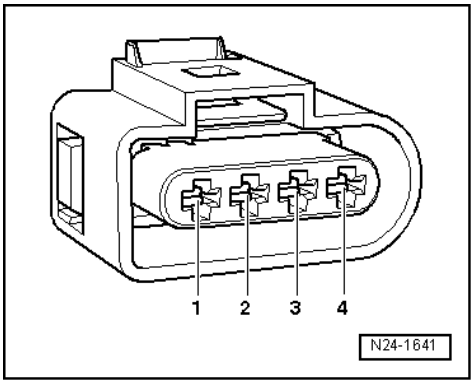
– Check wiring between contact 4 of 4-pin connector and fuse referring to current flow diagram ⇒Page 486.

– Also check wiring for short to one another, short to battery earth/engine earth and short to battery positive. Specification: ∞ Ω

If no fault in lines is detected:

– Renew air mass meter.





2.11 Checking throttle valve module -J338-

Special tools and workshop equipment required

◆ Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-

◆ Auxiliary measuring set -V.A.G 1594-

◆ Test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-1-

◆ Current flow diagram

Test prerequisites

● Fuses must be OK.

● The battery voltage must be at least 11.5 V.

● All electrical consumers must be switched off.

● Earth connections OK

● Throttle valve module not soiled.

● Engine running at idling speed

Test procedure

Note

- *The throttle valve module -J338- and throttle valve potentiometer -G69- are installed in one common housing.*
- *Only gold-plated contacts may be used when repairing contacts in connector of throttle valve module -J338-.*

– Connect vehicle diagnostic tester, and select engine control unit. ⇒Page 23

– Select diagnosis function “015-Access permissions”.

– Perform final control diagnosis, and activate throttle valve module -J338- ⇒Page 89, final control diagnosis.

- The engine must be switched off when the throttle valve module is activated.

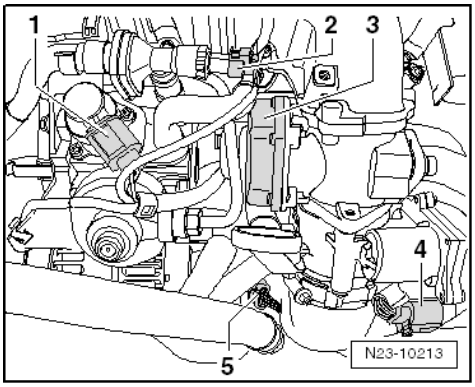
– Proceed with final control diagnosis until completed.

– Exit diagnosis function.

– Switch off ignition.

If the engine did not stop when the throttle valve module was activated:

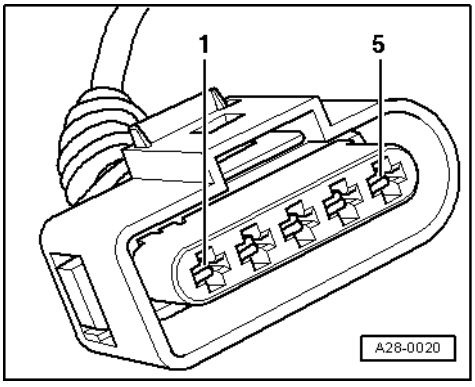
– Pull 5-pin connector -4- off throttle valve module.



Checking voltage supply

– Switch on ignition.

– Connect multimeter to following connector contacts and engine earth using test leads from -V.A.G 1594-.



- Contact 1 + engine earth
- Contact 1 + contact 3
- Specification: at least 4.8... 5.2 V

– Switch off ignition.

– Using adapter cable -V.A.G 1598/39-1-, connect test box -V.A.G 1598/42- to wiring harness of control unit ⇒Page 24. The engine control unit is not connected by this action.

– Check wiring between test box and connector for open circuit referring to current flow diagram.

◆ Contact 1 + socket 25

◆ Contact 2 + socket 41

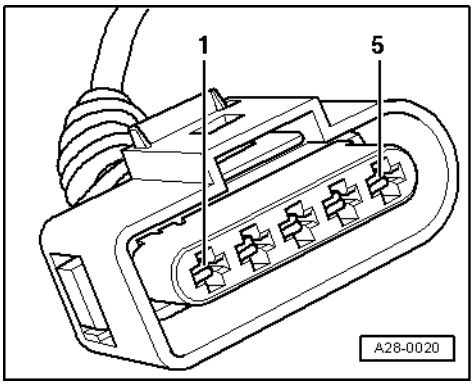
◆ Contact 3 + socket 53

◆ Contact 4 + socket 49

◆ Contact 5 + socket 34

● Cable resistance: max. 2.0 Ω.

– Additionally check wires for short to one another. Specification: ∞ Ω



If no wiring fault is detected and voltage was present between contacts 1 + engine earth and contacts 1 + 3:

– Renew throttle valve module -J338- ⇒Page 355.

– Adapt throttle valve module -J338- ⇒Page 423.

– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

If no wiring fault is detected and no voltage was present between contacts 1 + engine earth and contacts 1 + 3:

– Pull connectors off any components which are connected to this voltage supply line ⇒Page 486, current flow diagrams.

– Check voltage supply and wires on these components.

If no wiring fault is detected and no voltage was present on these components:

– Renew engine control unit -J623- ⇒Page 418.

3 Engine control unit -J623-

> ⚠ ***WARNING***
>
> ***Adhere to the general safety regulations and the notes on repair work on the engine! ⇒Page 1***

Checking voltage supply for engine control unit ⇒Page 417.

Renewing engine control unit ⇒Page 418.

Adapting exhaust gas pressure sensor 1 -G450- ⇒Page 420.

Reading injector delivery calibration values/injector voltage calibration values, and storing them in engine control unit ⇒Page 421.

Adapting engine control unit -J623- to position sender for charge pressure positioner -G581- ⇒Page 422.

Adapting engine control unit -J623- to exhaust gas recirculation valve ⇒Page 423.

Adapting engine control unit -J623- to throttle valve module -J338- ⇒Page 423.

Checking data bus ⇒Page 424.

3.1 Checking voltage supply for engine control unit

Special tools and workshop equipment required

- Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
- Auxiliary measuring set -V.A.G 1594-
- Test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-2-
- Current flow diagram

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK

Test procedure

– Using adapter cable -V.A.G 1598/39-2-, connect test box -V.A.G 1598/42- to wiring harness and to control unit ⇒Page 24.

– Connect multimeter to following test box contacts using test leads from -V.A.G 1594- to measure voltage:

- 1 + 87
- 2 + 87
- 4 + 87

- Specification: approx. 0.0 V

– Switch on ignition.

– Measure voltage again between following test box contacts:

- 1 + 18
- 1 + 49
- 2 + 18

- Specification: approx. battery voltage

– Switch off ignition.

– Connect multimeter to following test box contacts using test leads from -V.A.G 1594- to measure voltage:

- 1 + 92
- 2 + 92
- 4 + 92

- Specification: approx. battery voltage

If the specifications are not obtained

– Check terminal 30 voltage supply relay -J317- ⇒Page 486, current flow diagrams.
– Check cable connections for open circuit, short circuit and transfer resistance at contacts referring to current flow diagram.

If no fault is found in wiring and relay:

– Renew engine control unit -J623- ⇒Page 418.

3.2 Renewing engine control unit

Procedure

– First, check identification and coding of previous engine control unit as follows:
– Connect vehicle diagnostic tester, and select "Engine electronics 01". ⇒Page 23

The identification and coding of the engine control unit are shown on the display.

– Note coding.
– Compare control unit identification with new control unit.
– Read loading of diesel particulate filter ⇒Page 454. Check diesel particulate filter.

Note engine code.

– Read injector delivery calibration values/injector voltage calibration values ⇒“Reading injector delivery calibration values/injector voltage calibration values, and storing them in engine control unit” on page 421.
– To verify whether the correct injectors are installed, note injector delivery calibration codes (IMA) and compare them to the codes printed on the injectors.
– Release the tow connectors on engine control unit -J623-, and pull them off.
– Remove engine control unit, and install new engine control unit.
– Install connectors of engine control unit, and lock them.

After the new engine control unit has been installed:

– Connect vehicle diagnostic tester, and select "Engine electronics 01" ⇒Page 23.
– Code engine control unit -J623- using code which has been read and noted beforehand.
– To do this, select diagnosis function 007 in vehicle diagnostic tester.
– Enter coding, and confirm with "Q".
– Switch ignition off and on again. The coding will be applied only after having switched the ignition off and on again.

– Store injector delivery calibration values/injector voltage calibration values which have been read beforehand in engine control unit ⇒Page 421.
– Adapt exhaust gas pressure sensor 1 -G450- ⇒Page 420.
– Perform a final control diagnosis:
– Select diagnosis function “03-Final control diagnosis”. The ignition must be switched on for this purpose.
– Select exhaust gas recirculation valve 1027.
– Activated charcoal filter solenoid valve 579.
– Throttle valve 12867.
– Or perform an automatic test of all final controls.

Engine codes CJDA, CJDD

– Set the mileage which has been read beforehand in new engine control unit ⇒Page 460, check diesel particulate filter.
– If the engine control unit has been renewed, the data for the diesel particulate filter which is stored in the EEPROM of the previous (defective) control unit is lost. This data includes the ash deposit mass and the operating time of the diesel particulate filter. However, based on the mileage or the operating hours since the last change of the diesel particulate filter this data can be restored approximately.
– Log in to the menu "015-Access permissions".
– Select "Security Access".
– This channel requires the access code 12233.

Go back to the menu.

– To enter the mileage, go to “014-Long adaptation, channel 15”.

Use the Keypad button to enter a hex value.

– Instead of the mileage (in 1000 km) the operating hours (x 0.06) may be entered as well. The result is the same.
– Confirm.
– Save.

Now the ash deposit mass has been recalculated and stored (ignore error message).

Engine codes CJDA, CJDD

– Perform a regeneration with subsequent automatic ash deposit mass adaptation ⇒Page 454.

Engine codes CPYA, CPYB, CPYC, CPYD, CPYE

– Perform a regeneration ⇒Page 454.
– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

3.3 Adapting exhaust gas pressure sensor 1 -G450-

Prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- Earth connections OK
- All electrical consumers must be switched off.

Procedure

– Connect vehicle diagnostic tester, and select "Engine electronics 01". ⇒“Connecting vehicle diagnostic tester and selecting engine control unit” on page 23

– Select "015-Access permissions" (if necessary DIAGRA code = Level 03/04 - Fault code 40809).

– Select “Coding 2”.

– Enter code 30605, and confirm with "Q".

– Switch off ignition, and wait for 10 seconds.

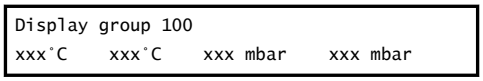
– The adaptation is carried out during shut-down of control unit.

– Connect vehicle diagnostic tester, and select engine control unit. ⇒Page 23

– Select diagnosis function “011-Read measured value block”. The ignition must be switched on for this purpose.

– Select “Display group 100”.

Indicated on display:



Note

The display zones may be shown one below the other or next to each other on the display of the vehicle diagnostic tester.

– Check specifications in display zones 3 and 4.

Engine codes CJDA, CJDD

- Specification in display zone 3: -70...+70 mbar
- Specification in display zone 4: -15...+15 mbar

Engine codes CPYA, CPYB, CPYC, CPYD, CPYE

- Specification in display zone 3: -10...+10 mbar
- Specification in display zone 4: -10...+10 mbar

Continuation for all engine codes

If the specifications are attained:

Adaptation has been performed successfully.

If the specifications are not obtained

– Repeat procedure.

If the specifications are again not attained:

– If necessary, renew exhaust gas pressure sensor 1 -G450- ⇒Page 427, Assembly overview - diesel particulate filter.

3.4 Reading injector delivery calibration values/injector voltage calibration values, and storing them in engine control unit

Note

This function can be used to adapt new injector delivery calibration values/injector voltage calibration values. The 7-digit injector delivery calibration values/injector voltage calibration values are printed on each injector.

Reading injector delivery calibration values/injector voltage calibration values

– Connect vehicle diagnostic tester, and select engine control unit. ⇒Page 23

– Select diagnosis function “011-Read measured value block”. The ignition must be switched on for this purpose.

– Select diagnosis function “014-Long adaptation”. The ignition must be switched on for this purpose.

– Select respective “channel numbers” for injectors -N30...N33-:

- “Channel number 71” for injector 1 -N30-
- “Channel number 72” for injector 2 -N31-
- “Channel number 73” for injector 3 -N32-
- “Channel number 74” for injector 4 -N33-

– Compare the displayed 7-digit ASCII value with the value printed on the respective injector.

– If the values do not match, adapt the injector delivery calibration values/injector voltage calibration values for the respective injector.

Store injector delivery calibration values/injector voltage calibration values in engine control unit.

Note

If an injector or the engine control unit is to be renewed, the 7-digit injector delivery calibration values/injector voltage calibration values printed on the injectors must be stored in the engine control unit.

– Select respective “channel numbers” for injectors -N30...N33-:

- “Channel number 71” for injector 1 -N30-
- “Channel number 72” for injector 2 -N31-
- “Channel number 73” for injector 3 -N32-

- “Channel number 74” for injector 4 -N33-

– Press [Keyboard] field.

– Use the on-screen keyboard to enter the 7-digit injector delivery calibration values/injector voltage calibration values for the respective injector.

– Press [←] button.

– Press the [Save] button, to store the new injector delivery calibration values/injector voltage calibration values in the engine control unit.

3.5 Adapting engine control unit -J623- to position sender for charge pressure positioner -G581-

Note

If the position sender for charge pressure positioner -G581- has been renewed, it must be adapted to the engine control unit -J623-.

Prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- Earth connections OK
- All electrical consumers must be switched off.

Procedure

– Connect vehicle diagnostic tester, and select engine control unit. ⇒Page 23

– Select diagnosis function “014-Long adaptation”. The ignition must be switched on for this purpose.

– Select “Channel number 120”:

– Press [Keyboard] field.

– Using the on-screen keyboard, enter the value 1.

– Press [←] button.

– Press [Confirm] button to reset the learnt value.

– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

If a fault is stored in the event memory:

– Check position sender for charge pressure positioner -G581- ⇒Page 345.

– Clear event memory ⇒Page 26.

– Repeat procedure.

3.6 Adapting engine control unit -J623- to exhaust gas recirculation valve

Note

- *If the exhaust gas recirculation valve has been renewed, it must be adapted.*
- *The exhaust gas recirculation valve -N18- and exhaust gas recirculation potentiometer -G212- are installed in one common housing.*

Prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- Earth connections OK
- All electrical consumers must be switched off.

Procedure

– Connect vehicle diagnostic tester, and select engine control unit. ⇒ Page 23

– Select diagnosis function “014-Long adaptation”. The ignition must be switched on for this purpose.

– Select “Channel number 123”:

– Press Keyboard field.

– Using the on-screen keyboard, enter the value 1.

– Press ← button.

– Press Confirm button to reset the learnt value.

– Then, read event memory of engine control unit, and clear event memory if necessary ⇒ Page 26, read event memory.

If a fault is stored in the event memory:

– Check exhaust gas recirculation valve -N18- with exhaust gas recirculation potentiometer -G212- ⇒ Page 437.

– Clear event memory ⇒ Page 26.

– Repeat procedure.

3.7 Adapting engine control unit -J623- to throttle valve module -J338-

Note

- *If the throttle valve module -J338- has been renewed, it must be adapted.*
- *The throttle valve module -J338- and throttle valve potentiometer -G69- are installed in one common housing.*

Prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.

- Earth connections OK
- All electrical consumers must be switched off.

Procedure

– Select diagnosis function “014-Long adaptation”. The ignition must be switched on for this purpose.
– Select “Channel number 124”:
– Press Keyboard field.
– Using the on-screen keyboard, enter the value 1.
– Press ← button.
– Press Confirm button to reset the learnt value.
– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

If a fault is stored in the event memory:

– Check throttle valve module -J338- ⇒Page 414.
– Clear event memory ⇒Page 26.
– Repeat procedure.

3.8 Checking data bus

Note

The section below provides only general instructions for checking, since due to the various use cases of industrial engines it is not possible to specify a common procedure.

Function

The engine control unit uses the CAN bus to communicate with all bus-enabled control units.

These bus-enabled components are connected via twisted pair data bus wires (CAN_High and CAN_Low) and exchange information (messages). Missing information on the data bus is detected and recognised as a fault.

The data bus requires a terminal resistor to function fault-free. This central terminal resistor is located in the engine control unit.

Special tools and workshop equipment required

◆ Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
◆ Auxiliary measuring set -V.A.G 1594-
◆ Test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-2-
◆ Current flow diagram

Test prerequisite

- Ignition switched off.
- A fault has been recognised by the CAN data bus self-diagnosis ⇒Page 26, read event memory.

Test procedure

– Pull 94-pin connector off engine control unit -J623-.

– Using adapter cable -V.A.G 1598/39-2-, connect test box -V.A.G 1598/42- to engine control unit and to -connections A and B- of test box. The control unit wiring harness is not connected by this action.

– Check terminal resistor in engine control unit:

– To do this, connect multimeter to following test box contacts using test leads from -V.A.G 1594- to measure resistance:

◆ 67 + 68

● Specification: 60…72 Ω

If the specification is not attained:

– Renew engine control unit -J623- ⇒Page 418.

If specification is attained:

– Eliminate the fault in the wiring and in other data bus components referring to current flow diagram ⇒Page 486, current flow diagrams.

– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

26 - Exhaust system

1 Removing and installing parts of exhaust system

> ⚠ ***WARNING***
>
> ***Adhere to the general safety regulations and the notes on repair work on the engine!*** ⇒ **Page 1**

> ⚠ ***WARNING***
>
> ***When doing any repair work, pay attention to the following due to the cramped conditions:***
>
> - ***Adhere to the general safety precautions, and never take any risk.***
> - ***The engine is a hazardous area and can cause serious injuries.***
> - ***Never leave any objects in the engine compartment, such as cleaning cloths or tools.***
> - ***Many engine components become hot during operation – risk of burns. If necessary, provide appropriate protective means.***
> - ***Servicing materials, such as fuel, engine oils or coolant additive, are harmful substances; adhere to the safety instructions from the manufacturer.***
> - ***There is a risk of injuries, if maintenance locations are difficult to access. This risk can be reduced, by installing the engine in an appropriate location and by avoiding sharp edges.***
> - ***Route all the various lines (e.g. for fuel, hydraulics, coolant and refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.***
> - ***Ensure that there is sufficient clearance to all moving or hot components.***
> - ***Tools are to be checked for damage and safety risks on a regular basis.***

Note

- *The section below provides only general instructions, since due to the various use cases of industrial engines it is not possible to specify a common procedure.*
- *After working on the exhaust system, ensure that the system is not under tension and that there is sufficient clearance to the bodywork. If necessary, align silencer and exhaust pipe so that sufficient clearance is maintained to the bodywork and the support rings are evenly loaded.*
- *Renew self-locking nuts.*

Assembly overview - diesel particulate filter ⇒Page 427.

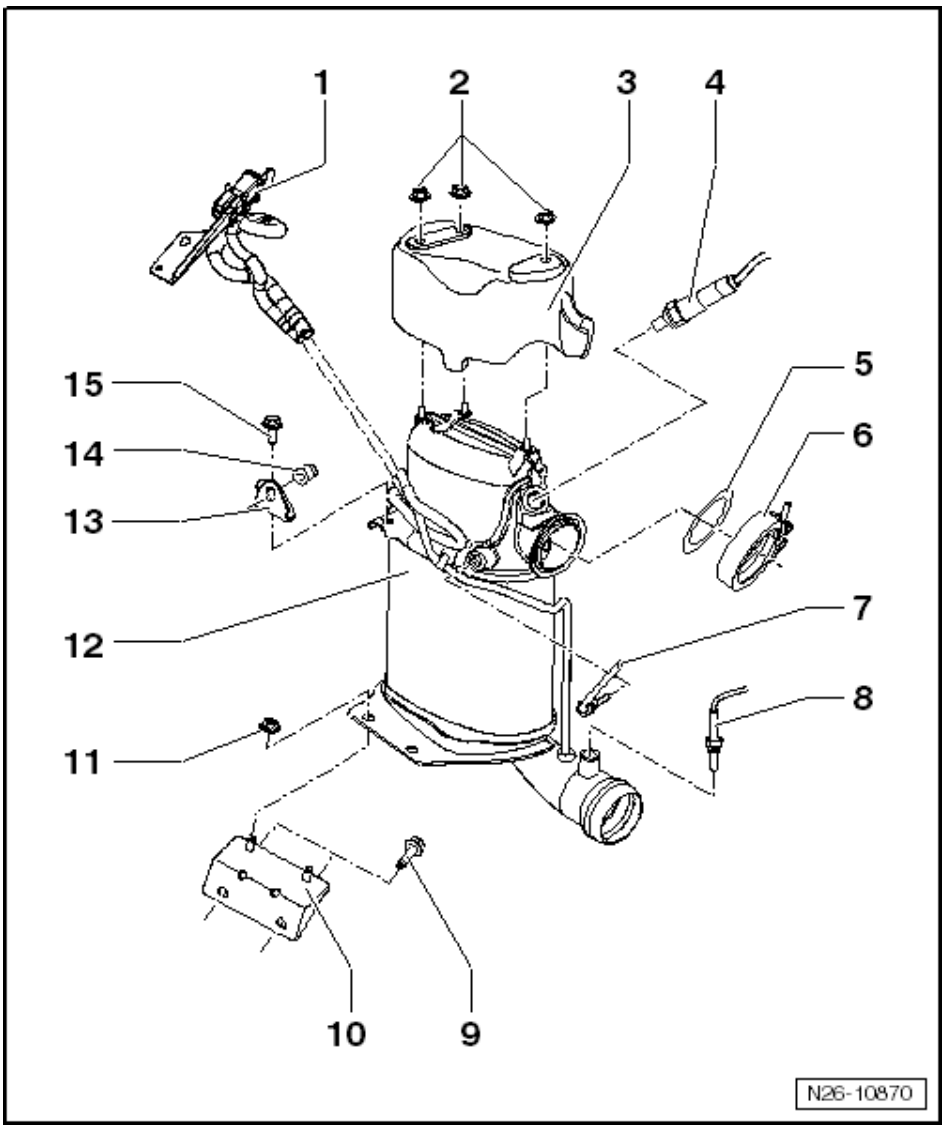
Removing and installing diesel particulate filter, engine codes CPYA, CPYB, CPYC, CPYD, CPYE ⇒Page 430.

1.1 Assembly overview - diesel particulate filter

Engine codes CJDA, CJDD ⇒Page 427.

Engine codes CPYA, CPYB, CPYC, CPYD, CPYE ⇒Page 428.

1.1.1 Engine codes CJDA, CJDD



1 - Exhaust gas pressure sensor 1 -G450-
- ❑ Checking ⇒Page 446

2 - 10 Nm

3 - Shield

4 - Lambda probe -G39-
- ❑ 50 Nm
- ❑ Grease only the threads with high-temperature paste G 052 112 A3; high-temperature paste -G 052 112 A3- must not get into the slots of probe body.
- ❑ To remove use socket AF 22 mm for lambda probe --T10491--.
- ❑ Checking ⇒Page 439

5 - Gasket
- ❑ Renew
- ❑ Note installation position

6 - Clamp, 7 Nm
- ❑ Make sure it is firmly seated

7 - Exhaust gas temperature sender 3 -G495-, 45 Nm
- ❑ (exhaust gas temperature sender ahead of diesel particulate filter)
- ❑ Grease thread of sender using high-temperature paste G 052 112 A3.
- ❑ Checking ⇒Page 442

8 - Exhaust gas temperature sender 4 -G648-, 45 Nm
- ❑ (exhaust gas temperature sender downstream of diesel particulate filter)
- ❑ Grease thread of sender using high-temperature paste G 052 112 A3.

- ❑ Checking ⇒Page 444

9 - 25 Nm

10 - Bracket

- ❑ Bolted to cylinder block.

11 - 25 Nm

12 - Diesel particulate filter

- ❑ With oxidising catalytic converter
- ❑ Check diesel particulate filter ⇒Page 460
- ❑ After diesel particulate filter has been renewed, adaptation value for ash deposit mass must be set to “0” ⇒Page 460, check diesel particulate filter

13 - Bracket

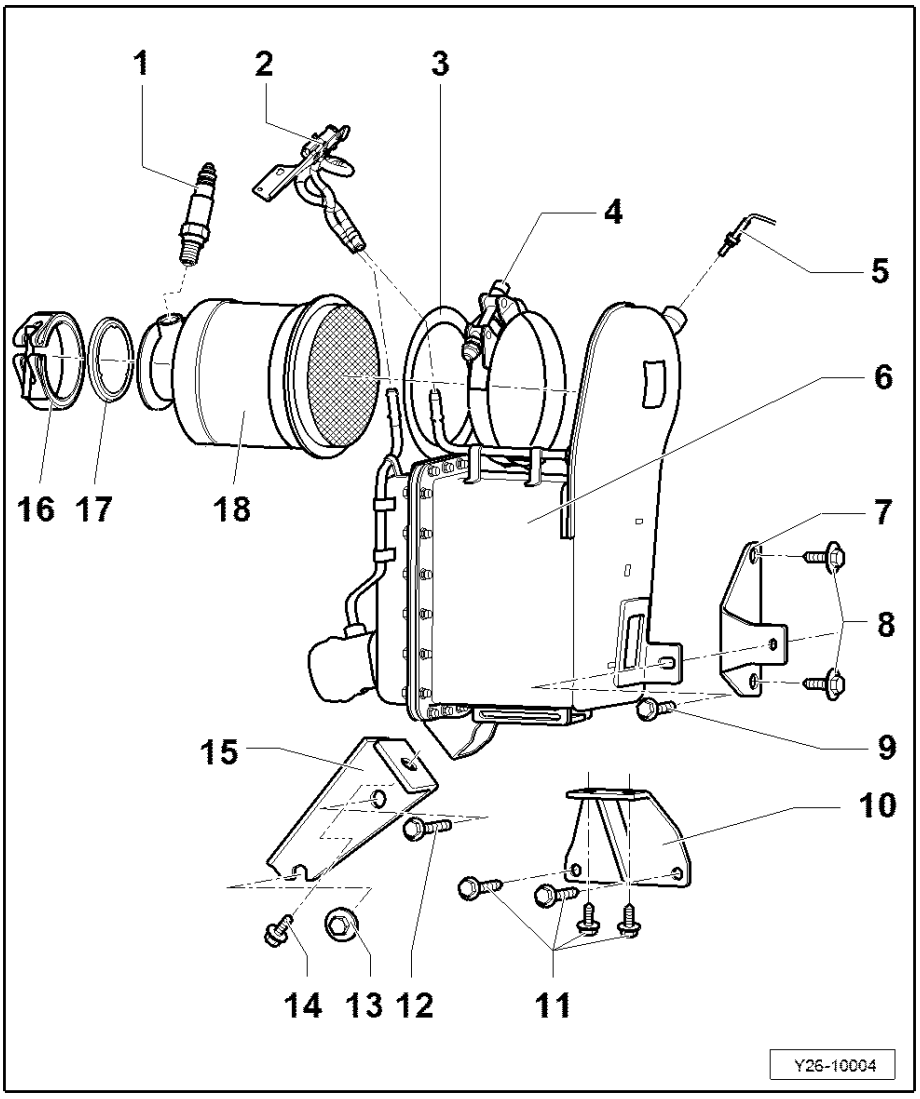
- ❑ Bolted to cylinder head.

14 - 25 Nm

15 - 25 Nm

1.1.2 Engine codes CPYA, CPYB, CPYC, CPYD, CPYE

Removing and installing diesel particulate filter, engine codes CPYA, CPYB, CPYC, CPYD, CPYE ⇒Page 430.



1 - Lambda probe -G39-
- ❑ 50 Nm
- ❑ Grease only the threads with high-temperature paste G 052 112 A3; high-temperature paste -G 052 112 A3- must not get into the slots of probe body.
- ❑ To remove use socket AF 22 mm for lambda probe --T10491--.
- ❑ Checking ⇒Page 439

2 - Exhaust gas pressure sensor 1 -G450G-
- ❑ Checking ⇒Page 446

3 - Gasket
- ❑ Renew.

4 - Clamp ahead of diesel particulate filter
- ❑ Note installation position. Keep a clearance to housing of approx. 2 mm.
- ❑ 15 Nm
- ❑ Apply light blows all-round with a plastic hammer.
- ❑ Retighten to 15 Nm

5 - Exhaust gas temperature sender 3 -G495-, 45 Nm
- ❑ (exhaust gas temperature sender ahead of diesel particulate filter)
- ❑ Grease thread of sender using high-temperature paste G 052 112 A3.
- ❑ Checking ⇒Page 442

6 - Diesel particulate filter
- ❑ Check diesel particulate filter ⇒Page 460
- ❑ Removing and installing diesel particulate filter ⇒Page 430
- ❑ If a new diesel particulate filter has been installed, adaptation value for ash deposit mass must be set to “0” ⇒Page 459
- ❑ If a used diesel particulate filter has been installed or the engine control unit has been renewed, perform a regeneration of the diesel particulate filter with subsequent automatic ash deposit mass adaptation.

7 - Bracket

8 - 40 Nm + 1/2 turn (180°) further
- ❑ Renew

9 - 25 Nm
- ❑ Or no. 14 installed

10 - Bracket

- ❑ Or no. 14 installed

11 - 25 Nm

12 - 25 Nm

13 - 25 Nm

14 - Bracket

- ❑ Or no. 9 installed

15 - Bracket

- ❑ Or no. 9 installed

16 - Clamp ahead of oxidising catalytic converter, 7 Nm

- ❑ Make sure it is firmly seated
- ❑ Note installation position

17 - Seal

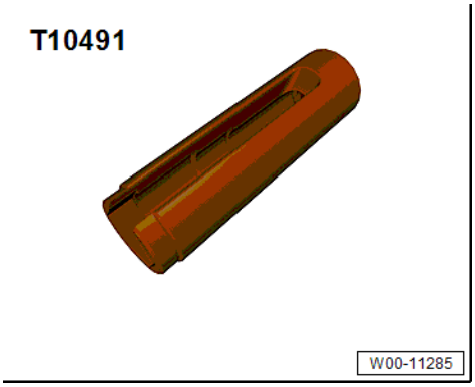
- ❑ Renew
- ❑ Note installation position

18 - Oxidising catalytic converter

1.2 Renewing diesel particulate filter, engine codes CPYA, CPYB, CPYC, CPYD, CPYE

Special tools and workshop equipment required

- Socket AF 22 mm for lambda probe -T 10491-
- Torque wrench -V.A.G 1331-

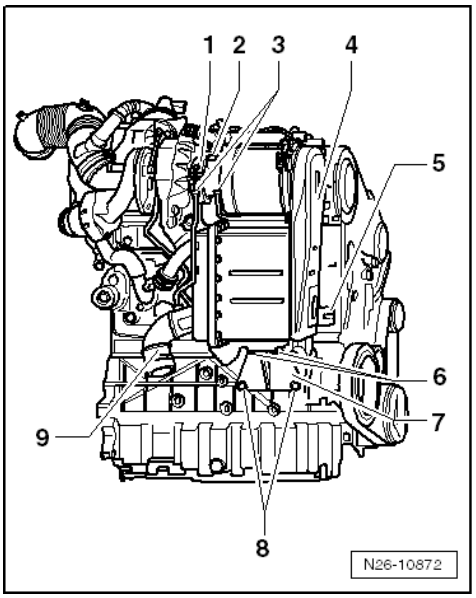


Note

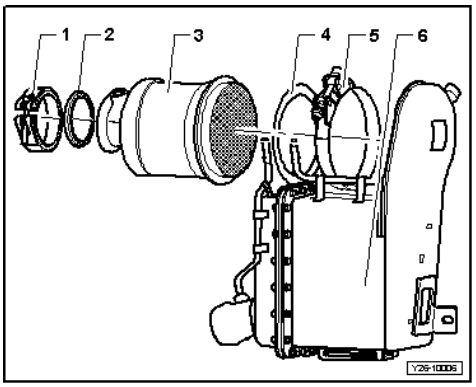
- *If the diesel particulate filter has to be renewed before 5400 operating hours have been completed due to excessive ash deposit mass or soot loading, perform the following work beforehand:*
- *Check charge air system for leaks.*
- *Check exhaust gas recirculation system.*

Removing

– Detach connectors from exhaust gas temperature senders.
– Disconnect connector of lambda probe -2-.
– Remove lambda probe -2- and exhaust gas temperature senders.
– Pull pressure differential line -3- off diesel particulate filter.
– Remove exhaust pipe from connection on diesel particulate filter -9-.
– The installed bracket -7- may differ from the bracket shown.
– Unscrew securing nuts/bolts -6- and -8- on bracket.
– Remove bracket for diesel particulate filter -7-.
– Unscrew securing bolt -5-.
– Loosen bolt and clamp -1-, and remove diesel particulate filter with oxidising catalytic converter -4-.



– After removing, loosen clamp -5-, and separate diesel particulate filter -6- and oxidising catalytic converter -3-.
– Renew diesel particulate filter -6-.



Installing

Install in reverse order.

– Renew seal -4-.
– Join diesel particulate filter -6- and oxidising catalytic converter -3- using clamp -5- and seal -4-. Note installation position of clamp -5-. There must be a clearance of at least 2 mm between lower joint of clamp -5- and housing of diesel particulate filter.
– Tighten clamp -5- to 15 Nm.
– Apply light blows all-round clamp -5- with a plastic hammer. Retighten bolts to 15 Nm.

Install to engine in reverse order of removal. When doing this note the following:

Note

- *Renew seal seals on clamps.*
- *Fit all cable ties in the original position when installing.*

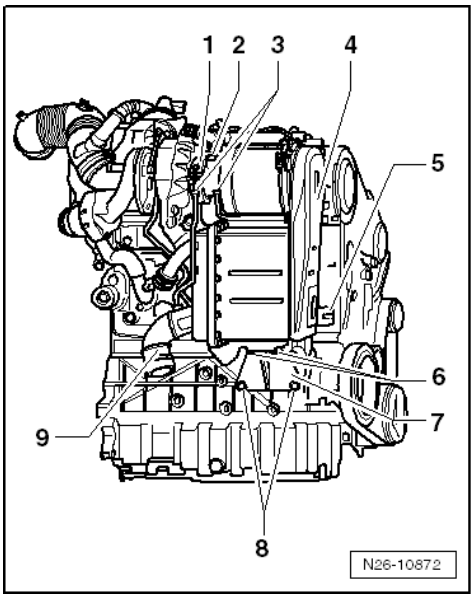
Note

All stretch bolts must always be renewed and tightened to specified torque.

– Tighten all bolts and clamps initially by hand.

Note

- *Diesel particulate filter and bracket must still be free to move.*
- *Install to engine in reverse order of removal.*



Tightening sequence:

1 - Tighten clamp -1- to 7 Nm.

2 - Tighten bolt -5- to 23 Nm.

3 - Tighten bolts -6- to 23 Nm.

4 - Tighten bolts -8- to 23 Nm.

Note

Grease threads of exhaust gas temperature sender and lambda probe with high-temperature paste G 052 112 A3, and tighten them to 45 Nm.

– Install lambda probe and exhaust temperature senders.

Renewing a diesel particulate filter

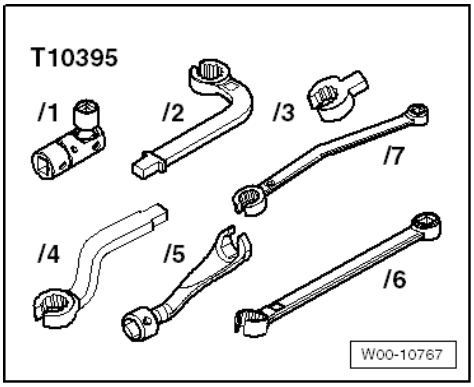
If the diesel particulate filter is replaced by a new und unused diesel particulate filter, the adaptation value for ash deposit mass must be set to “0” ⇒Page 459.

If the diesel particulate filter is replaced by a used diesel particulate filter, perform a regeneration of the diesel particulate filter ⇒Page 455 with subsequent automatic ash deposit mass adaptation ⇒Page 458.

1.3 Removing and installing exhaust gas temperature sender 1 -G235-

Special tools and workshop equipment required

- Tool set, 17 mm -T10395-



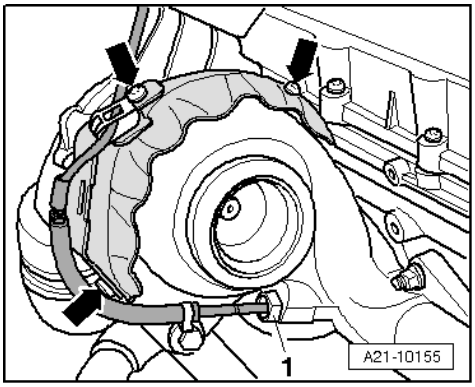
Removing

– Disconnect electrical connector for exhaust gas temperature sender 1 -G235- and free electrical wiring.

Note

- *The threaded connection is accessible from below.*

– Unscrew exhaust temperature sender 1 -G235- -item 1- from exhaust manifold.



Installing

- Specified torque ⇒Item 21 on page 325.

Installation is carried out in the reverse order; note the following:

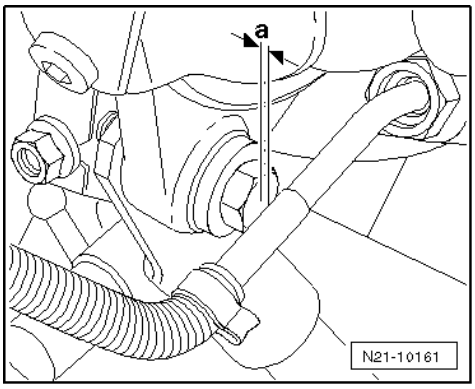
Note

- *Coat thread of exhaust gas temperature sender with high-temperature paste; high-temperature paste ⇒ Electronic Parts Catalogue.*
- *Fit cable tie in same place when installing.*

Installation position of exhaust gas temperature sender -G235-.

- Angled shaft must have a distance -a- = 3 … 5 mm to bolting of turbocharger support.

– Electrical connections and routing ⇒Current flow diagrams, Electrical fault finding and Fitting locations.



2 Exhaust gas recirculation system

WARNING

Adhere to the general safety regulations and the notes on repair work on the engine! ⇒Page 1

Note

- *The section below provides only general instructions, since due to the various use cases of industrial engines it is not possible to specify a common procedure.*
- *Renew self-locking nuts.*

Assembly overview - exhaust gas recirculation cooler ⇒Page 434.

Vacuum hose schematic diagram ⇒Page 334.

2.1 Assembly overview - exhaust gas recirculation cooler

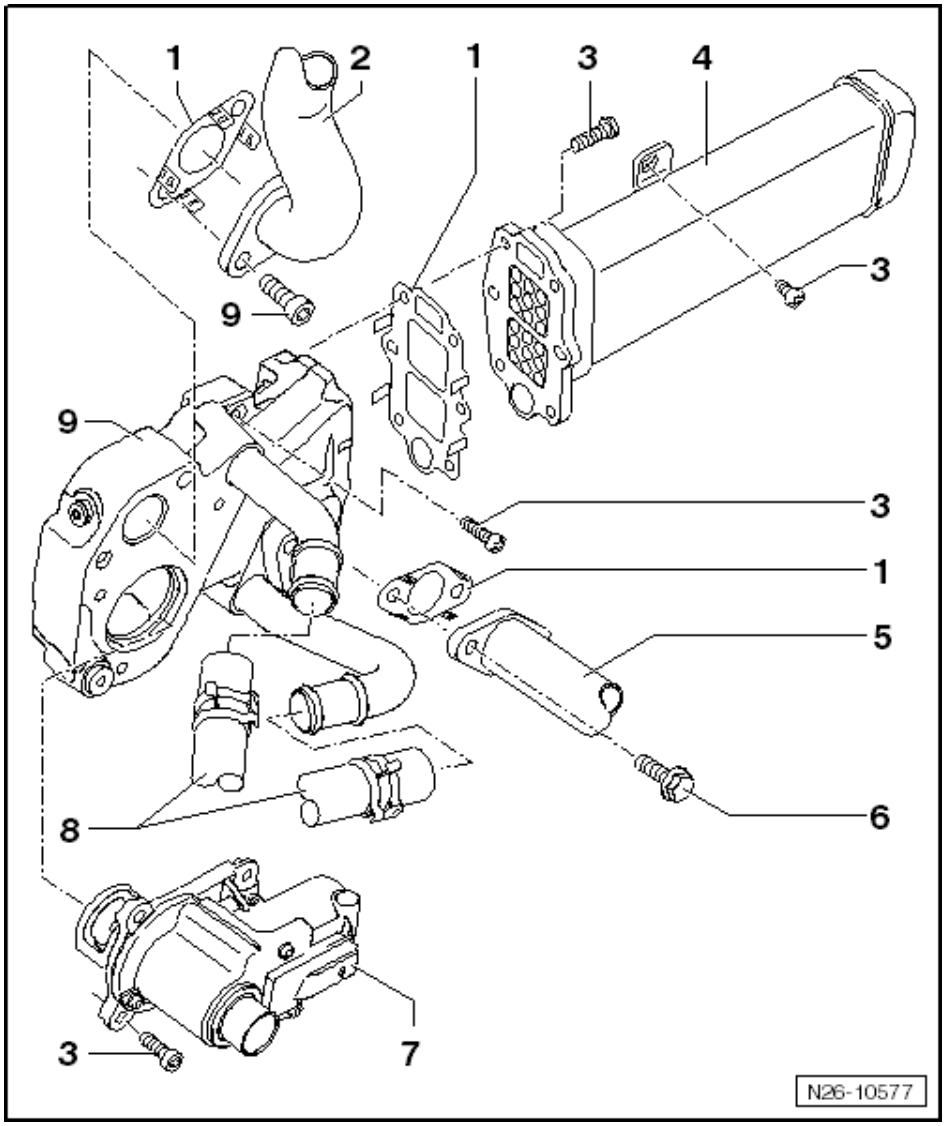
– Note safety precautions before beginning work ⇒ Page 354.

– Observe rules for cleanliness ⇒ Page 354.

Engine codes CJDA, CJDD ⇒ Page 434.

Engine codes CPYA, CPYB, CPYC, CPYD, CPYE ⇒ Page 435.

2.1.1 Engine codes CJDA, CJDD



1 - Gasket
- ❑ Renew
- ❑ Note installation position

2 - Connecting pipe

Caution

Ensure that decoupling element of connecting pipe is not bent and thus stretched. There is a danger of cracking.

3 - 8 Nm

4 - Radiator
- ❑ For exhaust gas recirculation.

5 - Connecting pipe

Caution

Ensure that decoupling element of connecting pipe is not bent and thus stretched. There is a danger of cracking.

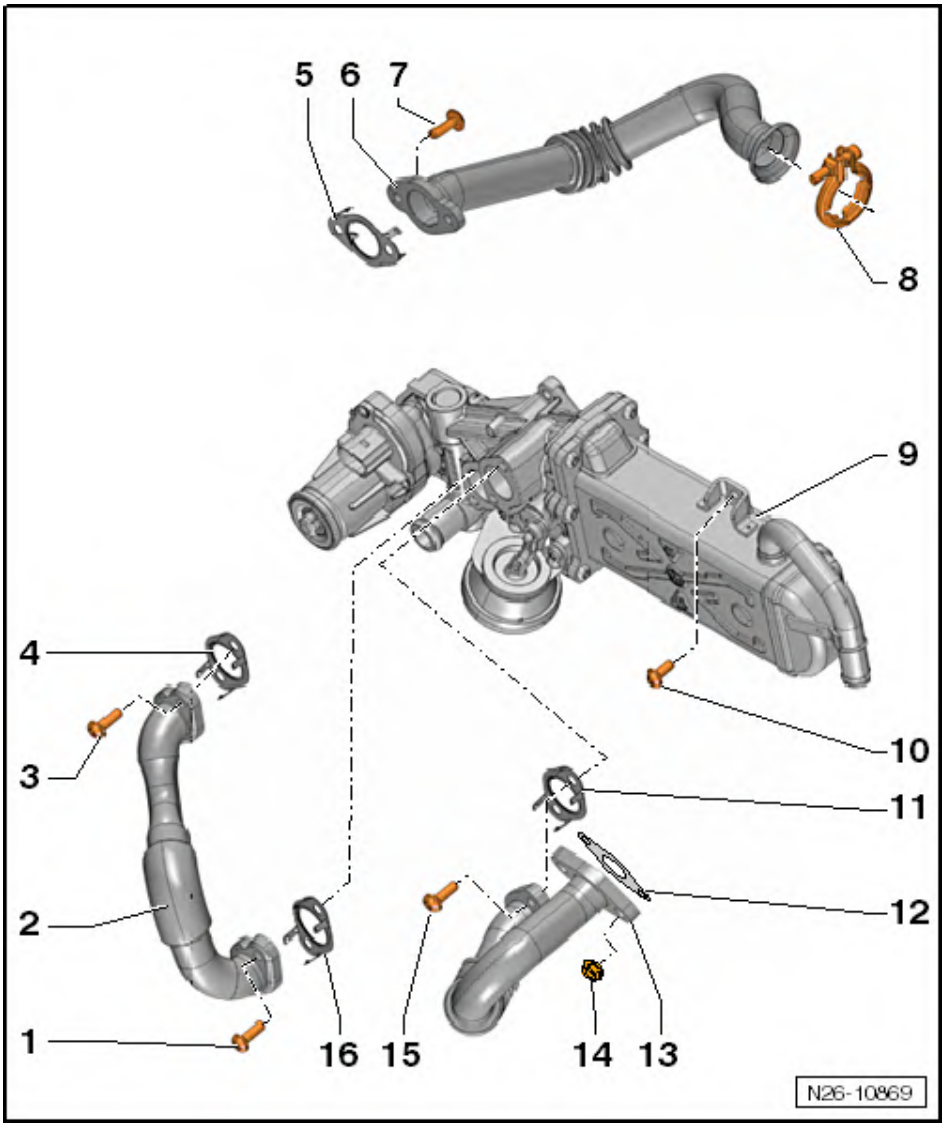
6 - 23 Nm

7 - Exhaust gas recirculation valve -N18- with exhaust gas recirculation potentiometer -G212-
- ❑ Mark installation position before removing.
- ❑ Before installation, thoroughly clean fitting area on valve and housing, oil lightly as required.
- ❑ Checking ⇒ Page 89, final control diagnosis

8 - Coolant hose
- ❑ Check for secure seating.

9 - Housing
- ❑ For exhaust gas recirculation valve

2.1.2 Engine codes CPYA, CPYB, CPYC, CPXD, CPYE



1 - 9 Nm

2 - Exhaust gas recirculation pipe
- ❑ With flexible joint; do not bend flexible joint - danger of cracking.

3 - 9 Nm

4 - Gasket
- ❑ Renew

5 - Gasket
- ❑ Renew

6 - Exhaust gas recirculation pipe
- ❑ With flexible joint; do not bend flexible joint - danger of cracking.

7 - 9 Nm
- ❑

8 - Clamp, 5 Nm

9 - Exhaust gas recirculation cooler
- ❑ With integrated exhaust gas recirculation valve -N18- with exhaust gas recirculation potentiometer -G212-

10 - 9 Nm

11 - Gasket
- ❑ Renew

12 - Gasket
- ❑ Renew

13 - Exhaust gas recirculation pipe
- ❑ With flexible joint; do not bend flexible joint - danger of cracking.

14 - 9 Nm

15 - 9 Nm

16 - Gasket
- ❑ Renew

3 Checking components and functions

> ⚠ ***WARNING***
>
> ***Adhere to the general safety regulations and the notes on repair work on the engine!*** ⇒ **Page 1**

The described component checks and functional checks are applicable for the series components and the current flow diagrams as of page ⇒ Page 486, current flow diagrams.

If components and electric circuits differ, observe the notes of the respective industrial engine customer.

Checking exhaust gas recirculation system ⇒ Page 436.

Checking exhaust gas recirculation valve -N18- ⇒ Page 437.

Adapting exhaust gas recirculation valve -N18- ⇒ Page 423.

Checking lambda probe -G39- ⇒ Page 439.

Checking lambda probe heater -Z19- ⇒ Page 441.

Checking exhaust gas temperature sender 3 -G495- (exhaust gas temperature sender ahead of diesel particulate filter) ⇒ Page 442.

Checking exhaust gas temperature sender 4 -G648- (exhaust gas temperature sender downstream of diesel particulate filter) ⇒ Page 444.

Checking exhaust gas pressure sensor 1 -G450- ⇒ Page 446.

Check diesel particulate filter, engine codes CJDA, CJDD ⇒ Page 460.

Regeneration of diesel particulate filter, engine codes CJDA, CJDD ⇒ Page 463.

Renewing diesel particulate filter, engine codes CJDA, CJDD ⇒ Page 465.

Regeneration of diesel particulate filter, engine codes CPYA, CPYB, CPYC, CPYD, CPYE ⇒ Page 454.

Checking diesel particulate filter, engine codes CPYA, CPYB, CPYC, CPYD, CPYE ⇒ Page 460.

Adapting ash deposit mass, engine codes CPYA, CPYB, CPYC, CPYD, CPYE ⇒ Page 458.

Setting adaptation value for ash deposit mass to “0”, engine codes CPYA, CPYB,CPYC, CPYD, CPYE ⇒ Page 430.

3.1 Checking exhaust gas recirculation system

Note

The exhaust gas recirculation system is checked via the diagnosis function “05-Final control diagnosis”. This allows for acti-

vating the exhaust gas recirculation valve -N18- in a synchronised manner, so that the extreme values for the exhaust gas recirculation system can be read in the measured value block.

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK
- No leaks on intake and exhaust systems
- No faults on engine and fuel injection system or related to compression.
- No faults must be stored in event memory ⇒Page 26, read event memory.
- Coolant temperature must be at least 80°C, ⇒ display group 1, display zone 4.

Test procedure

– Connect vehicle diagnostic tester, and select engine control unit. ⇒Page 23

– Select diagnosis function “015-Access permissions”.

– Carry out final control diagnosis, and activate exhaust gas recirculation valve -N18- ⇒Page 89, final control diagnosis.

The displays in display zones 3 and 4 must fluctuate within following control range:

- Specification in display zone 3: 180…370 mg/stroke
- Specification in display zone 4: 70…100%

Note

The activation of the valve can also be checked by touching it.

– Proceed with final control diagnosis until completed.

– Exit diagnosis function.

– Switch off ignition.

If the specifications are not obtained

– Check exhaust gas recirculation valve -N18- ⇒Page 437.

– Check vacuum hoses for leaks. Vacuum hose schematic diagram ⇒Page 334.

3.2 Checking exhaust gas recirculation valve -N18-

Special tools and workshop equipment required

- ◆ Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
- ◆ Auxiliary measuring set -V.A.G 1594-
- ◆ Test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-1-

◆ Current flow diagram

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK
- Coolant temperature must be at least 80°C, ⇒ display group 1, display zone 4.

Test procedure

Note

◆ *The exhaust gas recirculation valve -N18- and exhaust gas recirculation potentiometer -G212- are installed in one common housing.*

◆ *Only gold-plated contacts may be used when repairing the contacts in the connector of the exhaust gas recirculation valve.*

– Connect vehicle diagnostic tester, and select engine control unit. ⇒Page 23

– Select diagnosis function “015-Access permissions”.

– Carry out final control diagnosis, and activate exhaust gas recirculation valve -N18- ⇒Page 89, final control diagnosis.

The displays in display zones 3 and 4 must fluctuate within following control range:

- Specification in display zone 3: 180…470 mg/stroke
- Specification in display zone 4: 70…100%

Note

The activation of the valve can also be checked by touching it.

– Proceed with final control diagnosis until completed.

– Exit diagnosis function.

– Switch off ignition.

If the valve is not activated:

– Pull off 6-pin connector on exhaust gas recirculation valve -N18- with exhaust gas recirculation potentiometer -G212--3- ⇒Page 433.

Checking voltage supply

– Switch on ignition.

– Connect multimeter to following connector contacts and engine earth using test leads from -V.A.G 1594-.

◆ Contact 1 + engine earth

◆ Contact 1 + contact 3

● Specification: at least 4.8... 5.2 V

– Switch off ignition.

– Using adapter cable -V.A.G 1598/39-1-, connect test box -V.A.G 1598/42- to wiring harness of control unit ⇒ Page 24. The engine control unit is not connected by this action.

– Check wiring between test box and connector for open circuit referring to current flow diagram.

◆ Contact 1 + socket 25

◆ Contact 2 + socket 19

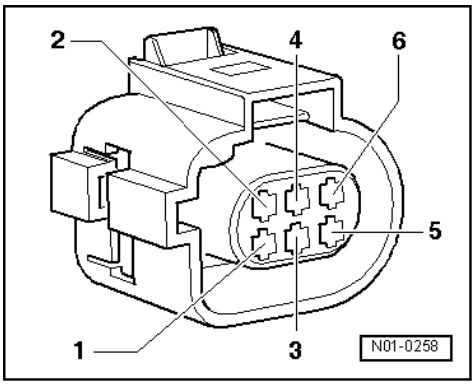
◆ Contact 3 + socket 53

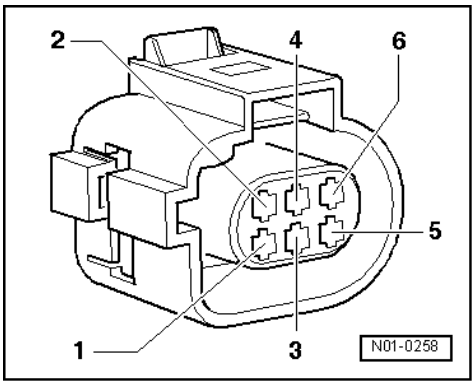
◆ Contact 5 + socket 57

◆ Contact 6 + socket 4

● Cable resistance: max. 2.0 Ω.

– Also check wiring for short to one another, short to battery earth/engine earth and short to battery positive. Specification: ∞ Ω





If no wiring fault is detected and voltage was present between contacts 1 + engine earth and contacts 1 + 5:

– Renew exhaust gas recirculation valve -N18- with exhaust gas recirculation potentiometer -G212-.

– Adapt exhaust gas recirculation valve -N18- ⇒ Page 423.

– Then, read event memory of engine control unit, and clear event memory if necessary ⇒ Page 26, read event memory.

If no wiring fault is detected and no voltage was present between contacts 1 + engine earth and contacts 1 + 3:

– Pull connectors off any components which are connected to this voltage supply line ⇒ Page 486, current flow diagrams.

– Check voltage supply and wires on these components.

If no wiring fault is detected and no voltage was present on these components:

– Renew engine control unit -J623- ⇒ Page 418.

3.3 Checking Lambda probe -G39-

Special tools and workshop equipment required

◆ Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-

◆ Auxiliary measuring set -V.A.G 1594-

◆ Test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-2-

◆ Current flow diagram

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK
- Exhaust system must be free of leaks.
- Check whether lambda probe heater -Z19- is OK ⇒Page 441.

Test procedure

Note

◆ *The lambda probe -G39- and lambda probe heater -Z19- are installed in one common housing.*

◆ *Only gold-plated contacts may be used when repairing contacts in connector of lambda probe and lambda probe heater.*

– Disconnect 6-pin connector from lambda probe -G39- ⇒Page 427.

Checking basic voltage

– Connect multimeter to contacts 2 + 6 of connector using test leads from -V.A.G 1594- to measure voltage.

– Switch on ignition. Check basic voltage after approx. 8 seconds. Specification: 0.4...0.5 V

– Switch off ignition.

If the specification is not attained:

– Check wiring of lambda probe as follows:

– Using adapter cable -V.A.G 1598/39-2-, connect test box -V.A.G 1598/42- to wiring harness of control unit ⇒Page 24. The engine control unit is not connected by this action.

– Check wiring between test box and connector for open circuit referring to current flow diagram.

◆ Contact 1 + socket 77

◆ Contact 2 + socket 56

◆ Contact 5 + socket 55

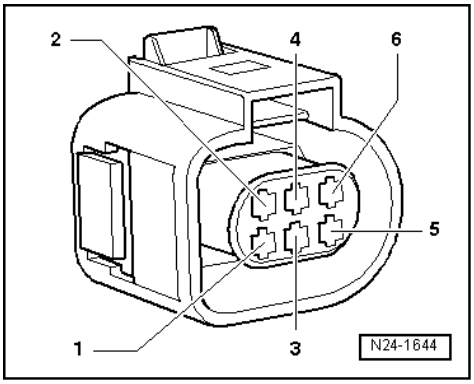
◆ Contact 6 + socket 78

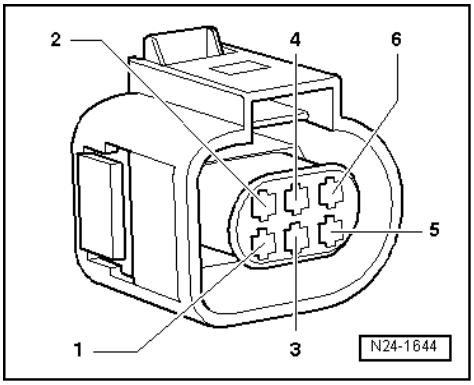
- Cable resistance: max. 2.0 Ω.

– Additionally check wires for short to one another. Specification: ∞ Ω

If no wiring fault is detected and voltage was present between contacts 2 + 6:

– Renew lambda probe -G39- ⇒Page 427, Assembly overview - diesel particulate filter.





– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

If no wiring fault is detected and no voltage was present between contacts 2 + 6:

– Renew engine control unit -J623- ⇒Page 418.

3.4 Checking lambda probe heater -Z19-

Special tools and workshop equipment required

- Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
- Auxiliary measuring set -V.A.G 1594-
- Test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-2-
- Current flow diagram

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK

Test procedure

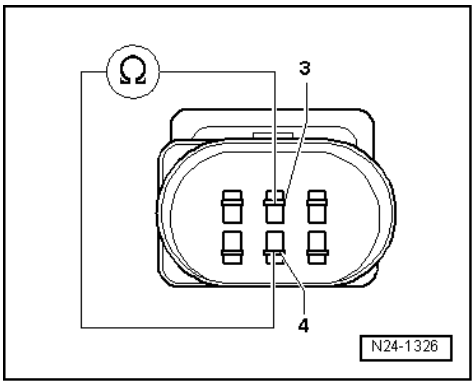
Note

- *The lambda probe heater -Z19- and lambda probe -G39- are installed in one common housing.*
- *Only gold-plated contacts may be used when repairing contacts in connector of lambda probe and lambda probe heater.*

– Disconnect 6-pin connector from lambda probe -G39- ⇒Page 427.

Checking resistance

– Connect multimeter to contacts 3 + 4 of connector to lambda probe heater using test leads from -V.A.G 1594- to measure resistance. Specification: 25.0 Ω (at room temperature)



If the specification is not attained:

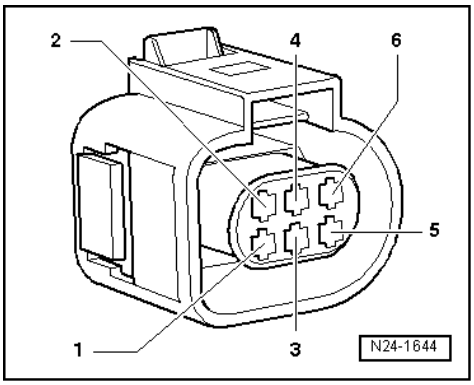
– Renew lambda probe -G39- ⇒Page 427, Assembly overview - diesel particulate filter.

– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

If specification is attained:

Checking voltage supply

– Connect multimeter to connector contact 4 and engine earth using test leads from -V.A.G 1594- to measure voltage.
– Switch on ignition. Specification: at least 11.5 V
– Switch off ignition.

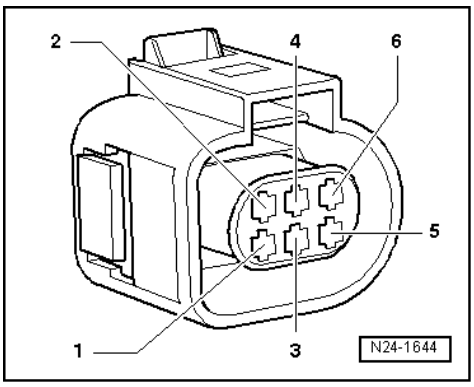


If the specification is not attained:

– Check terminal 30 voltage supply relay -J317- ⇒Page 486, current flow diagrams.
– Check cable connections for open circuit, short circuit and transfer resistance at contacts referring to current flow diagram.

If specification is attained:

– Check wiring of lambda probe heater as follows:
– Using adapter cable -V.A.G 1598/39-2-, connect test box -V.A.G 1598/42- to wiring harness of control unit ⇒Page 24. The engine control unit is not connected by this action.
– Check wiring between test box and connector for open circuit referring to current flow diagram.



◆ Contact 3 + socket 73

● Cable resistance: max. 2.0 Ω.

– Additionally check wires for short to one another. Specification: ∞ Ω

If no wiring fault is detected and voltage supply is OK:

– Renew engine control unit -J623- ⇒Page 418.

3.5 Checking exhaust gas temperature sender 3 -G495- (exhaust gas temperature sender ahead of diesel particulate filter)

Special tools and workshop equipment required

◆ Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
◆ Auxiliary measuring set -V.A.G 1594-
◆ Test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-2-
◆ Current flow diagram

Test prerequisites

● Fuses must be OK.
● The battery voltage must be at least 11.5 V.
● All electrical consumers must be switched off.
● Earth connections OK
● Engine must be cold

Test procedure

Note

Only gold-plated contacts may be used when repairing the contacts in the connectors of the exhaust gas temperature sender 3.

– Connect vehicle diagnostic tester, and select engine control unit. ⇒Page 23
– Select diagnosis function “011-Read measured value block”. Engine must be idling.
– Select “Display group 99”.

Indicated on display:

```
Display group 99
880 rpm  114.0°C   xxx.x°C   xxx.x°C
```

Note

The display zones may be shown one below the other or next to each other on the display of the vehicle diagnostic tester.

– Increase engine speed to 2400...2800 rpm.
– Check exhaust gas temperature value from exhaust gas temperature sender 1 -G235- in display zone 2. The temperature value must increase evenly and continuously.
– Keep engine speed at 2400...2800 rpm for approx. 3 minutes.
– With the engine speed being increased, select “Display group 100”.

Note

Make a note of temperature value in display zone 2.

Indicated on display:

```
Display group 100
xxx°C    xxx°C    xxx mbar    xxx mbar
```

– Check exhaust gas temperature value from exhaust gas temperature sender 3 -G495- (exhaust gas temperature sender ahead of diesel particulate filter) in display zone 1 and from exhaust gas temperature sender 4 -G648- (exhaust gas temperature sensor downstream from diesel particulate filter) in display zone 2.

Note

- *The exhaust gas temperature value in display zone 2 of display group 99 must be higher than the exhaust gas temperature values in display zones 1 and 2 of display group 100.*
- *In addition, the exhaust gas temperature value in display zone 1 of display group 100 must be higher than the exhaust gas temperature value in display zone 2 of display group 100.*

– If the value in display zone 2 of display group 100 is higher than the value in display field 1, the two senders have been interchanged.
– If the values in display zones 1 and 2 of display group 100 are not plausible, check exhaust gas temperature sender 3 -G495- (exhaust gas temperature sender ahead of diesel particulate filter) and wiring to sender as follows:

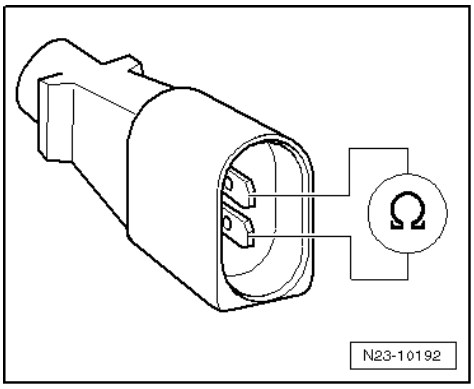
– Exit diagnosis function.

– Switch off ignition.

Checking resistance

– Disconnect 2-pin connector from exhaust gas temperature sender 3 -G495- ⇒Page 427.

– Connect multimeter to contacts on connector for sender using test leads from -V.A.G 1594- to measure resistance. Specification: 170.0..0.850.0 Ω



If the specification is not attained:

– Renew exhaust gas temperature sender 3 -G495- ⇒Page 427.

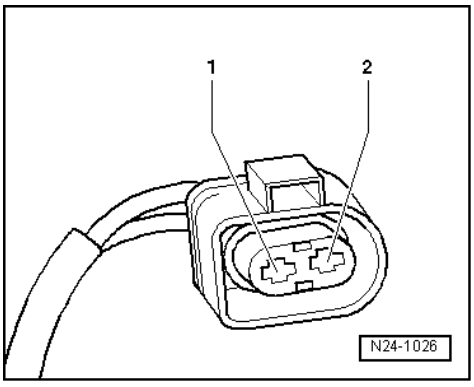
– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

If specification is attained:

– Check wiring of exhaust gas temperature sender 3 -G495- as follows:

– Using adapter cable -V.A.G 1598/39-2-, connect test box -V.A.G 1598/42- to wiring harness of control unit ⇒Page 24. The engine control unit is not connected by this action.

– Check wiring between test box and connector for open circuit referring to current flow diagram.



◆ Contact 1 + socket 89

◆ Contact 2 + socket 32

● Cable resistance: max. 2.0 Ω.

– Also check wiring for short to one another, short to battery earth/engine earth and short to battery positive. Specification: ∞ Ω

If no fault in lines is detected:

– Renew engine control unit -J623- ⇒Page 418.

3.6 Checking exhaust gas temperature sender 4 -G648- (exhaust gas temperature sender downstream of diesel particulate filter)

Special tools and workshop equipment required

◆ Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-

◆ Auxiliary measuring set -V.A.G 1594-

◆ Test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-2-

◆ Current flow diagram

Test prerequisites

● Fuses must be OK.

● The battery voltage must be at least 11.5 V.

- All electrical consumers must be switched off.
- Earth connections OK
- Engine must be cold

Test procedure

Note

Only gold-plated contacts may be used when repairing the contacts in the connectors of the exhaust gas temperature sender 4.

– Connect vehicle diagnostic tester, and select engine control unit. ⇒Page 23

– Select diagnosis function “011-Read measured value block”. Engine must be idling.

– Select “Display group 99”.

Indicated on display:

```
Display group 99
880 rpm  114.0°C   xxx.x°C   xxx.x°C
```

Note

The display zones may be shown one below the other or next to each other on the display of the vehicle diagnostic tester.

– Increase engine speed to 2400...2800 rpm.

– Check exhaust gas temperature value from exhaust gas temperature sender 1 -G235- in display zone 2. The temperature value must increase evenly and continuously.

– Keep engine speed at 2400...2800 rpm for approx. 3 minutes.

Note

Make a note of temperature value in display zone 2.

– With the engine speed being increased, select “Display group 100”.

Indicated on display:

```
Display group 100
xxx°C    xxx°C    xxx mbar    xxx mbar
```

– Check exhaust gas temperature value from exhaust gas temperature sender 3 -G495- (exhaust gas temperature sender ahead of diesel particulate filter) in display zone 1 and from exhaust gas temperature sender 4 -G648- (exhaust gas temperature sensor downstream from diesel particulate filter) in display zone 2.

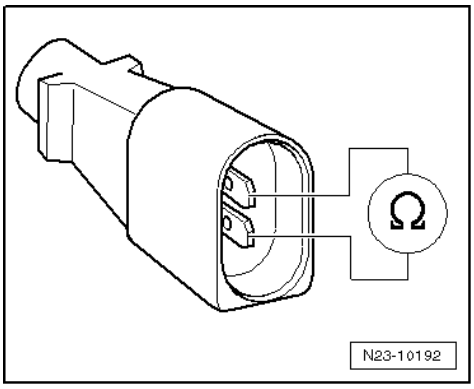
Note

- *The exhaust gas temperature value in display zone 2 of display group 99 must be higher than the exhaust gas temperature values in display zones 1 and 2 of display group 100.*
- *In addition, the exhaust gas temperature value in display zone 1 of display group 100 must be higher than the exhaust gas temperature value in display zone 2 of display group 100.*

– If the value in display zone 2 of display group 100 is higher than the value in display field 1, the two senders have been interchanged.
– If the values in display zones 1 and 2 of display group 100 are not plausible, check exhaust gas temperature sender 4 -G648- (exhaust gas temperature sender downstream of diesel particulate filter) and wiring to sender as follows:
– Exit diagnosis function.
– Switch off ignition.

Checking resistance

– Disconnect 2-pin connector from exhaust gas temperature sender 4 -G648- ⇒Page 427.
– Connect multimeter to contacts on connector for sender using test leads from -V.A.G 1594- to measure resistance. Specification: 170.0..0.850.0 Ω

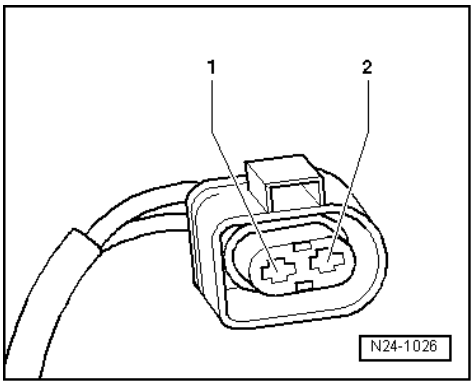


If the specification is not attained:

– Renew exhaust gas temperature sender 4 -G648- ⇒Page 427.
– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

If specification is attained:

– Check wiring of exhaust gas temperature sender 4 -G648- as follows:
– Using adapter cable -V.A.G 1598/39-2-, connect test box -V.A.G 1598/42- to wiring harness of control unit ⇒Page 24. The engine control unit is not connected by this action.
– Check wiring between test box and connector for open circuit referring to current flow diagram.



◆ Contact 1 + socket 89
◆ Contact 2 + socket 75
● Cable resistance: max. 2.0 Ω.

– Also check wiring for short to one another, short to battery earth/engine earth and short to battery positive. Specification: ∞ Ω

If no fault in lines is detected:

– Renew engine control unit -J623- ⇒Page 418.

3.7 Checking exhaust gas pressure sensor 1 -G450-

Special tools and workshop equipment required

◆ Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
◆ Auxiliary measuring set -V.A.G 1594-
◆ Test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-2-

◆ Current flow diagram

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK
- The control lines between exhaust gas pressure sensor 1 and diesel particulate filter must not be clogged or damaged. Check them accordingly ⇒Page 427, Assembly overview - diesel particulate filter.

Test procedure

Note

Only gold-plated contacts may be used when repairing the contacts in the connectors of the exhaust gas pressure sensor 1.

– Connect vehicle diagnostic tester, and select engine control unit. ⇒Page 23
– Select diagnosis function “011-Read measured value block”. The engine must be running at idling speed.
– Select “Display group 100”.

Indicated on display:

```
Display group 100
xxx.x°C  xxx.x°C  4.20 mbar  x.xx mbar
```

Note

The display zones may be shown one below the other or next to each other on the display of the vehicle diagnostic tester.

– Check differential exhaust gas pressure in display zone 3.
– Increase engine speed to 2500...2800 rpm.
– Check differential exhaust gas pressure (actual) in display zone 3. The differential exhaust gas pressure should increase significantly.
– Exit diagnosis function.
– Switch off ignition.

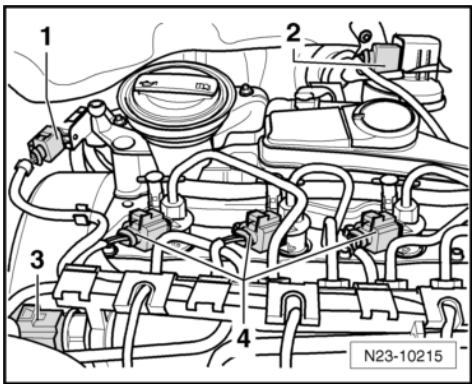
If the differential exhaust gas pressure (actual) in display zone 3 is constantly at 0 mbar:

– Check diesel particulate filter for cracks .

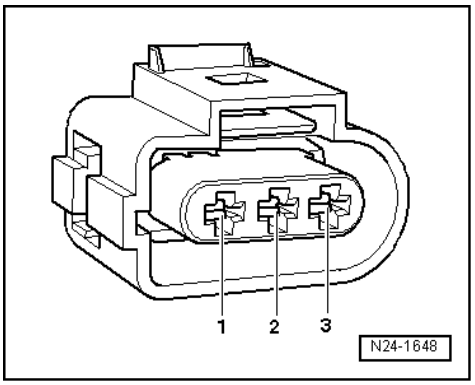
If the differential exhaust gas pressure (actual) in display zone 3 is not constantly at 0 mbar and the specifications are not attained:

Check voltage supply

– Pull3-pin connector -1- off exhaust pressure sensor 1 -G450-.

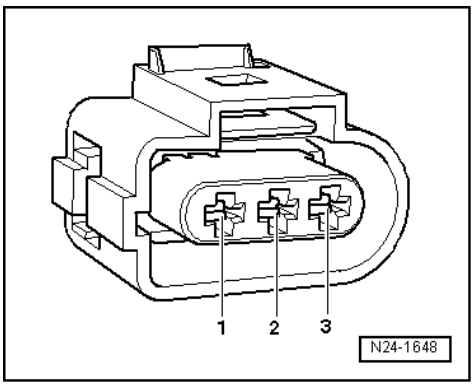


– Connect multimeter to contacts 1 + 2 of connector using test leads from -V.A.G 1594- to measure voltage.
– Switch on ignition. Specification: at least 4.8... 5.2 V
– Switch off ignition.



If the specification is not attained:

– Check wiring of exhaust gas pressure sensor 1 as follows:
– Using adapter cable -V.A.G 1598/39-2-, connect test box -V.A.G 1598/42- to wiring harness of control unit ⇒Page 24. The engine control unit is not connected by this action.
– Check wiring between test box and connector for open circuit referring to current flow diagram.



◆ Contact 1 + socket 14
◆ Contact 2 + socket 79
◆ Contact 3 + socket 34

● Cable resistance: max. 2.0 Ω

– Also check wiring for short to one another, short to battery earth/engine earth and short to battery positive. Specification: ∞ Ω.

If no wiring fault is detected and voltage was present between contacts 1 + 2:

– Renew exhaust gas pressure sensor 1 -G450- ⇒Page 427, Assembly overview - diesel particulate filter.
– Adapt new exhaust gas pressure sensor 1 -G450- ⇒Page 420.
– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, readevent memory.

If no wiring fault is detected and no voltage was present between contacts 1 + 2:

– Pull connectors off any components, which are connected to this voltage supply line ⇒Page 486, current flow diagrams.
– Check voltage supply and wires on these components.

If no wiring fault is detected and no voltage was present on these components:

– Renew engine control unit -J623- ⇒Page 418.

3.8 Renewing vacuum unit with position sender for charge pressure positioner -G581-

Special tools and workshop equipment required

- Socket AF 10 mm --T10422- -
- Socket --T40055--
- Ring spanner --T10423--
- Vehicle diagnostic tester

Caution

The special tools indicated, in particular the socket -T10422-, is designed solely for use according to the following work instructions and must not be used for other threaded connections. There is a danger of deformation if high torques are applied.

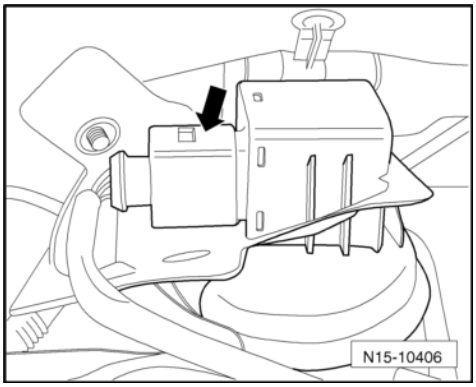
Note

A replacement parts kit is available for renewing the vacuum unit with position sender for charge pressure positioner -G581- → Electronic Parts Catalogue (ETKA).

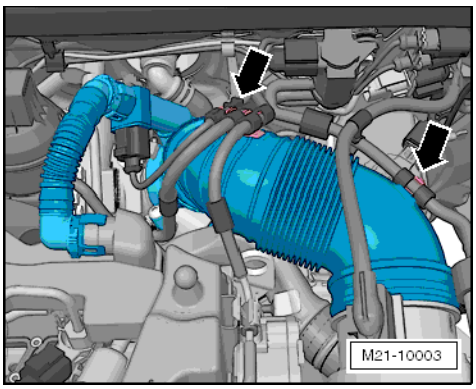
Removing

– Remove air filter housing with air mass meter and connecting pipe .

– Open insulation mat, and disconnect connector -arrow- on position sender for charge pressure positioner -G581-.



– Move clear vacuum hoses -arrows-.

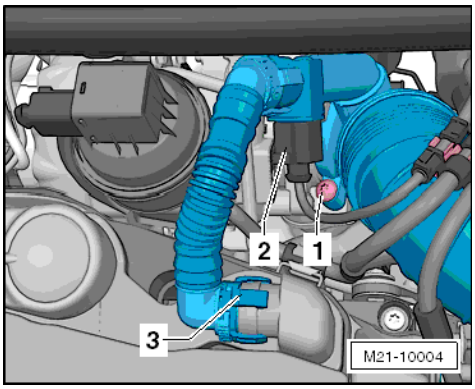


– Remove crankcase breather connecting pipe-3- from cylinder head cover; press release buttons to do this.

– Pull off connector -2-.

– Unscrew bolt -1- (captive), swing air pipe with inlet connection to rear and pull off from turbocharger.

– Seal opening in turbocharger with the sealing cap from the spare-parts kit.
– Pull off vacuum line at turbocharger.

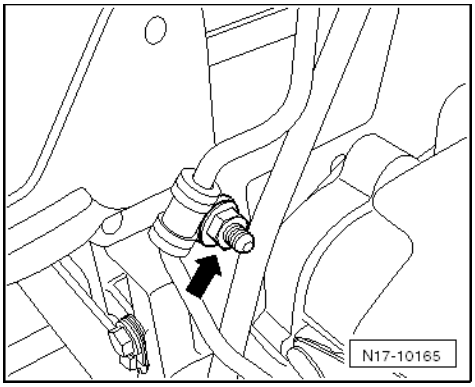


– Unscrew securing nut -arrow- where the oil supply line/vacuum line is connected to the cylinder head.

Caution

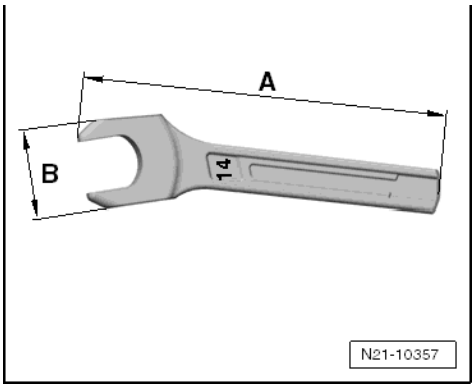
When detaching the oil supply line, counterhold the connection. Risk of secondary damage.

– Prepare a 14 mm open-ended wrench for counterholding.

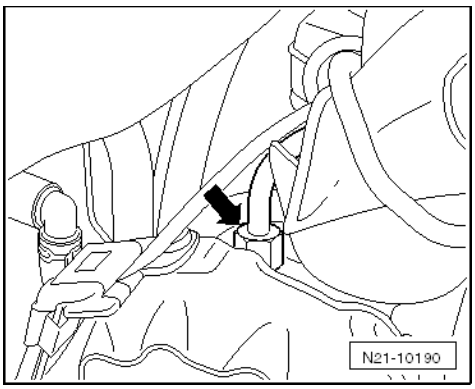


14 mm open-end wrench for counterholding connecting piece of oil supply line

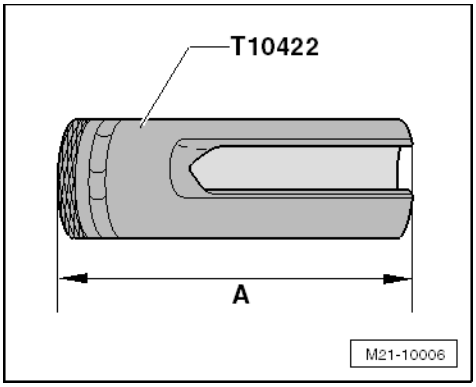
- A = 110 mm
- B = 25 mm



– Counterhold connecting piece with 14 mm open-end wrench, and unscrew oil supply line -arrow- on turbocharger using socket -T40055-.
– Seal oil supply opening in turbocharger with the plug from the spare-parts kit.
– Modify socket -T40055- to dimension -A-.

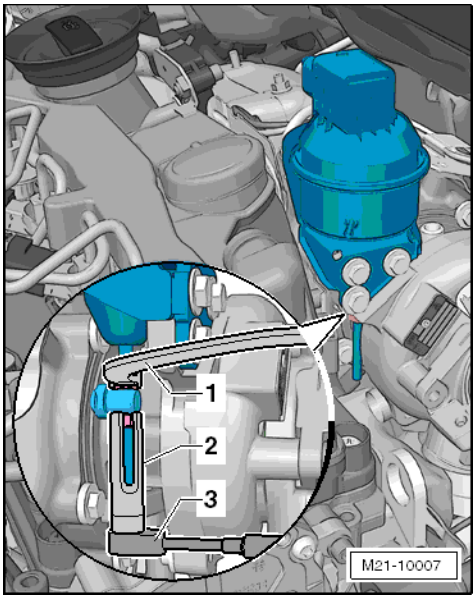


◆ A = 57 mm



– Fit ring spanner -T10423- -1- and socket AF 10 mm -T10422- -2- with reversible ratchet -3-, as shown in illustration.

– Counterhold lock nut -B- using ring spanner -T10423-, and unscrew securing nut -A- from the control rod using socket AF 10 mm -T10422-.



– Unscrew securing bolts of the vacuum unit -arrows- and remove the vacuum unit -A-.

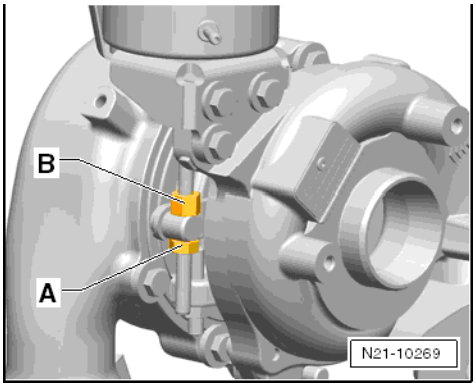
Caution

Only use new bolts and nuts from the spare-parts kit!

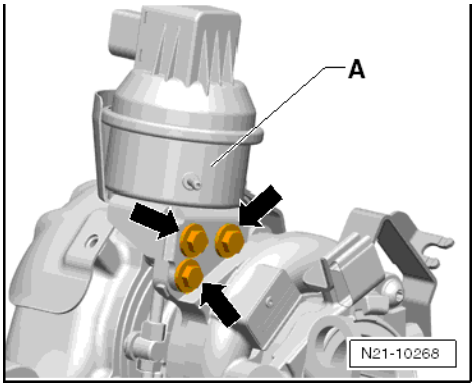
– If necessary, remove lower securing nut of control rod from vacuum unit.

– Screw locknut by hand onto the control rod as far as possible in the direction of the vacuum unit.

– Push control rod through the adjusting lever, fit vacuum unit -A- and tighten fastening bolt.



– Tighten securing bolts -arrows- to 8 Nm.



Note

Make sure that the guide is free to move along the control rod.

– Remove protective cap, fit oil supply line to turbocharger, and tighten it to 22 Nm.

– Connect connector -2- to position sender for the charge pressure positioner -G581-, and close insulation mat.

– Connect vehicle diagnostic tester.

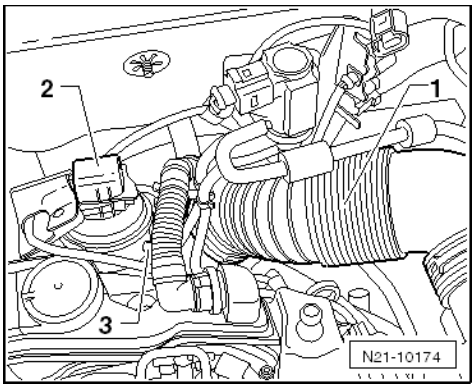
Select operating mode

– Press "Vehicle self-diagnosis" button on display.

Select vehicle system

– Press button "01 - Engine electronics" on display.

– The display indicates the control unit identification and the coding of the engine control unit.



Select diagnostic function

– Press button "011 - Measured values" on display.

– Use the numeric keypad to enter the measured value block "120", and confirm entry with the "Q" key.

– Connect hand vacuum pump -VAS 6213- to vacuum unit.

– Observe the lowest value of the measured value block and set a voltage of 0.760 V by causing a partial vacuum.

Caution

During the following procedure for adjusting the control rod, keep the partial vacuum and thus the voltage of 0.760 V constant.

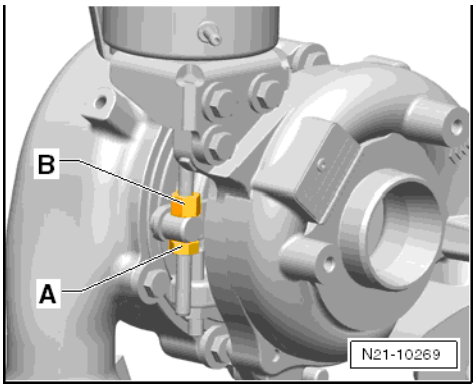
– Slowly screw the locknut-B- of the control rod downwards by hand. Adjusting lever is resting on the lower “stop”.

– Counterhold locknut-B- and screw securing nut-A- onto the control rod towards the adjusting lever. Tighten slightly using ring spanner -T10423-.

– Allow partial vacuum to escape from the vacuum unit.

– Observe the lowest value of the measured value block. When there is no pressure, the value should be 3.30 to 3.90 V.

– Fit socket inset -T10422-, counterhold locknut -B- with ring spanner -T10423- and tighten securing nut -A-.



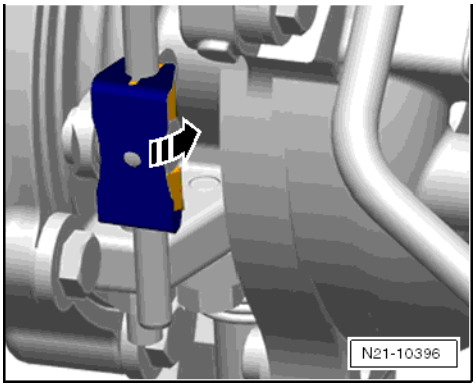
Caution

Cause a partial vacuum of 0.75 ± 0.05 bar to act on the vacuum unit to ensure that the adjusting lever rests against the stop. When this is done, the voltage should automatically be set to 0.760 V.

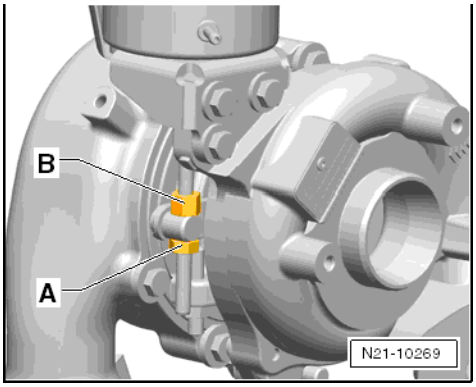
Voltage OK

– Press locking plate by hand onto control rod, and turn it 90° in -direction of arrow-.
– Seal connection between control rod and securing nut with sealing paint from the spare-parts kit.

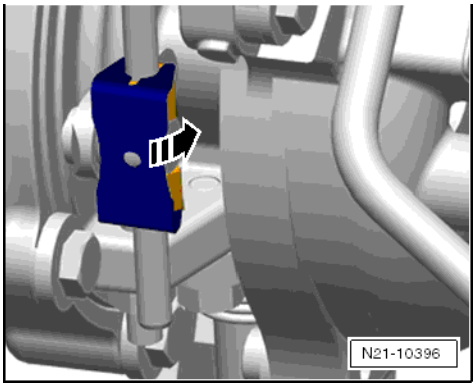
Voltage not OK



– Counterhold locknut -B-, undo securing nut -A- of the control rod and correct the voltage by turning the locknut -B-. Counterhold locknut -B-, turn securing nut -A- in opposite direction, and tighten it with socket AF 10 mm -T10422-.
– Press locking plate by hand onto control rod, and turn it 90° in -direction of arrow-.



– Seal connection between control rod and securing nut with sealing paint from the spare-parts kit.



Continuation

– Fit securing nut -arrow- connecting the oil supply line/vacuum line to the cylinder head and tighten it.
– Remove sealing cap from turbocharger.
– Complete the engine.
– Check setting as follows:

Select diagnostic function:

– Press button "006 - Basic setting" on display.
– Use the numeric keypad to enter the measured value block "120", and confirm entry with the "Q" key.

– Click the "Activate" button in the lower half of the screen.

– Observe value in lower part of screen. It must fluctuate between 0.65 ... 0.85 V and 3.30 ... 3.90 V (vacuum unit travels to both end stops alternately).

If voltage OK:

– End basic setting procedure.

3.9 Performing service work on diesel particulate filter, engine codes CPYA, CPYB, CPYC, CPYD, CPYE

The service regeneration is used to estimate when the diesel particulate filter must be renewed. Therefore, record the measured values of display group 108 prior to each service regeneration. This allows for preparing the renewal of the diesel particulate filter in a timely manner.

Checking diesel particulate filter, engine codes CPYA, CPYB, CPYC, CPYD, CPYE ⇒Page 454.

Regeneration of diesel particulate filter, engine codes CPYA, CPYB, CPYC, CPYD, CPYE ⇒Page 455.

Adapting ash deposit mass of diesel particulate filter, engine codes CPYA, CPYB, CPYC, CPYD, CPYE ⇒Page 458.

Diesel particulate filter has been renewed

If the diesel particulate filter is replaced by a new und unused diesel particulate filter, the adaptation value for ash deposit mass must be set to “0” ⇒Page 459.

If the diesel particulate filter is replaced by a used diesel particulate filter, perform a regeneration of the diesel particulate filter ⇒Page 455 with subsequent automatic ash deposit mass adaptation ⇒Page 458.

Engine control unit has been renewed

If the engine control unit has been renewed, perform a regeneration of the diesel particulate filter ⇒Page 455 with subsequent automatic ash deposit mass adaptation ⇒Page 458.

3.9.1 Checking diesel particulate filter, engine codes CPYA, CPYB, CPYC, CPYD, CPYE

Evaluate filter status ⇒Page 455.

Test prerequisites

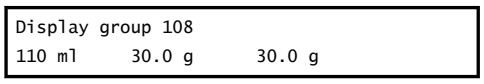
- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK
- No fault entry in event memory, read event memory ⇒Page 26.

Test procedure

Evaluating filter status

– Connect vehicle diagnostic tester, and select engine control unit. ⇒Page 23
– Select diagnosis function “011-Read measured value block”. The ignition must be switched on.
– Select “Display group 108”.

Indicated on display:



– Check ash deposit mass in display zone 1. Specification: < 500 ml.
– Check calculated soot loading in display zone 2. Specification: < 35 g.
– Check read soot loading in display zone 3. Specification: < 35 g.

If the ash deposit mass exceeds 500 ml or the soot loading in display zones 2 or 3 exceeds 35 g:

– Exit diagnosis function.
– Switch off ignition.
– Renew diesel particulate filter ⇒Page 430.

If the soot loading is between 0 - 35 g:

– Perform a regeneration of the diesel particulate filter ⇒Page 455.

Note

If the soot loading exceeds 22 g, the DPF warning lamp lights up.

> ***DANGER!***
>
> ***If the soot loading in the display zones 2 and 3 exceeds 35 g, NEVER start a regeneration! Risk of fire.***

3.9.2 Regeneration of diesel particulate filter, engine codes CPYA, CPYB, CPYC, CPYD, CPYE

– Make sure that the vehicle stands safely.

⚠ *WARNING*

During a regeneration the diesel particulate filter becomes very hot - risk of fire.

- ***Place the vehicle/machine in such a way that the diesel particulate filter does not get in contact with dry grass or any other flammable materials.***
- ***Never use any additional undercoating or anti-corrosion material for exhaust pipes, heat shields or the diesel particulate filter. Such substances may ignite when the engine becomes hot.***
- ***In hazardous situations it may be necessary to cancel the regeneration of the diesel particulate filter. Cancelling regeneration of diesel particulate filter*** ***⇒Page 457.***

– The vehicle diagnostic tester must be connected. ⇒Page 23

– Select diagnosis function “015-Access permissions”. The engine must run at idling speed.

– If available, select “015.2 Security Access (automatic)”.

– Enter following access code:

- Access code: 40809

– Confirm access code.

– Press [←] button 3 times to go back to diagnosis function menu.

Select diagnosis function “014-Long adaptation”.

– Select “Channel number 13”.

– Klick on [Keyboard].

– Enter adaptation value “0001”.

– Press [→] button.

– Confirm value with [Confirm] button.

– Start regeneration by pressing [Save] button.

The engine speed increases automatically to 1500 rpm. If a coolant temperature of at least 80°C and an exhaust gas temperature ahead of the diesel particulate filter of at least 161°C has been reached, the regeneration starts automatically.

– Press [←] button 2 times to go back to diagnosis function menu.

– Select diagnosis function “011-Read measured value block”.

– Select “Display group 108”.

Indicated on display:

```
Display group 108
110 ml     30.0 g      30.0 g
```

Note

- *During regeneration the values in the display zones 2 and 3 should decrease.*
- *The two values may decrease down to 0, and the regeneration may still continue.*
- *The regeneration will be completed after 20 min. at the latest, and the engine returns to idling speed.*
- *Allow the engine to run at idling speed for some time so that the fan can cool down the engine compartment.*

– Check soot loading in display zones 2 and 3. Specification: < 35 g.

– Press [←] button.

– Select “Display group 254”.

If display zone 2 shows the value "1", the regeneration has been completed successfully.

– Leave the engine switched on.

– Adapt the ash deposit mass ⇒Page 458.

Display zone 2 shows "0"

– If display zone 2 shows "0" or "255", secure machine or read event memory and rectify faults, read event memory ⇒Page 26.

– Repeat regeneration of diesel particulate filter ⇒Page 455.

If the 2nd regeneration has been completed and the display zone of “display group 254” does not show "1", the oxidising catalytic converter is presumably defective.

– Then, read event memory of engine control unit, and clear event memory if necessary, read event memory.

Note

- *If the specifications have been attained, the regeneration of the diesel particulate filter has been completed successfully.*
- *The DPF warning lamp goes off after the regeneration of the diesel particulate filter has been completed successfully.*

3.9.3 Cancelling regeneration of diesel particulate filter, engine codes CPYA, CPYB, CPYC, CPYD, CPYE

– The regeneration of the diesel particulate filter is in progress, and the vehicle diagnostic tester is connected. ⇒Page 23

– Select diagnosis function “015-Access permissions”.

– If available, select “015.2 Security Access (automatic)”.

– Enter following access code:

- Access code: 23456

– Confirm access code.

– Press [←] button 3 times to go back to diagnosis function menu.

Select diagnosis function “014-Long adaptation”.

– Select “Channel number 14”.
– Klick on [Keyboard].
– Enter adaptation value “0001”.
– Press [→] button.
– Confirm value with [Confirm] button.
– Stop regeneration by pressing [Save] button.

The regeneration is cancelled and must be restarted as necessary.

> ⚠ ***WARNING***
>
> ***Before restarting the regeneration, makes sure that the hazard will not occur again.***

3.9.4 Adapting ash deposit mass of diesel particulate filter, engine codes CPYA, CPYB, CPYC, CPYD, CPYE

Note

- *The ash deposit mass can only be adapted if the regeneration of the diesel particulate filter has been performed beforehand. The adaptation must be performed after each regeneration.*
- *By adapting the ash deposit mass, the calculated ash deposit mass in the engine control unit will be recalibrated.*
- *The ash deposit mass must be adapted right after the regeneration has been completed and without the ignition being switched on and off.*

– The engine is still running since the previously completed regeneration.
– Select diagnosis function “015-Access permissions”.
– If available, select “015.2 Security Access (automatic)”.
– Enter following access code:

- Access code: 18711

– Confirm access code.
– Press [←] button 3 times to go back to diagnosis function menu.
– Select diagnosis function “14-Long adaptation”.
– Select “Adaptation channel 17”.
– Klick on [Keyboard].
– Enter adaptation value “0001”.
– Press [→] button.

– Press Confirm button to reset the learnt value.

Note

- *The engine speed is now increased automatically and the adaptation starts.*
- *The adaptation takes approx. 30 seconds.*

– Exit diagnosis function.

– Select diagnosis function “011-Read measured value block”.

– Select “Display group 254”.

– The value in display zone 2 must change from "1" to "2".

When the operating point of the adaptation has been reached, the display changes from "2" to "3", and the adaptation is in progress.

The ash deposit mass has been successfully adapted if the value in display zone 2 changes from 3 to 4.

If display zone 2 shows the value "4", the adaptation has been completed successfully.

If the display zone 2 shows "255", the ash deposit mass adaptation is locked.

Note

To repeat the adaptation of the ash deposit mass, the regeneration of the diesel particulate filter must be performed beforehand.

Caution

Allow the engine to run for another 2 to 3 minutes after the adaptation of the ash deposit mass has been completed. This helps to cool down the engine and to prevent the accumulation of heat.

– After the engine cooled off, it can be switched off.

– After the ash deposit mass has been adapted, read and evaluate measured values of display group 108 again ⇒Page 454.

3.9.5 Setting adaptation value for ash deposit mass to “0”, engine codes CPYA, CPYB, CPYC, CPYD, CPYE

Note

Only if a new and unused diesel particulate filter has been installed, the adaptation value for the ash deposit mass must be set to “0”.

– Switch on ignition.

– Connect vehicle diagnostic tester, and select engine control unit. The ignition must be switched on ⇒Page 23.

– Select diagnosis function “015-Access permissions”.

– If available, select “015.2 Security Access (automatic)”.

– Enter following access code:

- Access code: 18711

– Confirm access code.

– Press [←] button 3 times to go back to diagnosis function menu.

– Select diagnosis function “14-Long adaptation”.

– Select “Adaptation channel 16”.

– Press [Keyboard] field.

– Using the on-screen keyboard, enter the value 1.

– Press [←] button.

– Press [Confirm] button to reset the learnt value.

– Exit diagnosis function.

– Switch ignition off, and after 60 seconds switch it on again.

– Select “Display group 108” “011-Read measured value block”.

Indicated on display:

Display group 108		
xxx ml	0.0 g	0.0 g

– Check whether the adaptation value for the ash deposit mass which has been set beforehand is “0”.

– Switch off ignition.

– Adapt exhaust gas pressure sensor 1 -G450-.

3.10 Checking diesel particulate filter, engine codes CJDA, CJDD

Note

- *If the diesel particulate filter is renewed, the adaptation value for the ash deposit mass must be set to “0”, renew diesel particulate filter.*
- *If the engine control unit has been renewed, the adaptation value for the ash deposit mass must be set to the adaptation value which has been read before.*

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK
- No fault entry in event memory ⇒Page 26, read event memory.

Test procedure

Reading mileage since last regeneration

– Switch ignition on.

– Connect vehicle diagnostic tester, and select engine control unit. ⇒Page 23
– Select diagnosis function “011-Read measured value block”.
– Select “Display group 106”.

Indicated on display:

```
Display group 106
----      0-60       0-1500km    0-36000
```

Note

The display zones may be shown one below the other or next to each other on the display of the vehicle diagnostic tester.

– Mileage since last regeneration in display zone 3 (in 1000 km)
– Mileage since last regeneration in display zone 106/3 (in 1000 km) For stationary/industrial engines the displayed value is always 0 km. In this case, the operating hours are converted accordingly and entered at a later point (read operating hours of machine and note value). Instead of the mileage (in 1000 km) the operating hours (x 0.06) must be entered. The result is the same.

Example: 1000 operating hours x 0.06 = 60 (entry in control unit "0060") corresponds to 60,000 km.

Evaluating filter status

– Start engine.
– Press [←] button.
– Select “Display group 1”.

Indicated on display:

```
Display group 1
880 rpm   xxx.x mg/stroke  xxxx bar   53 3°C
```

– Increase engine speed to 1200..1500 rpm.
– Keep engine running at increased engine speed for approx. 10 minutes, and then allow engine to run at idling speed.
– Check coolant temperature in display zone 4. Specification: 80°C. Do not continue with test until specified coolant temperature has been reached.
– Press [←] button.
– Select “Display group 108”.

Indicated on display:

```
Display group 108
110 ml     30.0 g      30.0 g
```

– Check ash deposit mass in display zone 1. Specification: < 175 ml.
– Check calculated soot loading in display zone 2. Specification: < 40.0 g.
– Check read soot loading in display zone 3. Specification: < 40.0 g.

Note

If the soot loading exceeds 30.0 g, the DPF warning lamp lights up.

> ⚠ ***DANGER!***
>
> ***If the soot loading in the display zones 2 and 3 exceeds 40 g, NEVER start a regeneration! Risk of fire.***

If soot loading in display zones 2 and 3 is between 30.0 ... 37 g:

– Perform a regeneration of the diesel particulate filter ⇒Page 463.

If the ash deposit mass in display zone 1 exceeds 175 ml or the soot loading in display zones 2 or 3 exceeds 40.0 g:

– Exit diagnosis function.

– Switch off ignition.

– Renew diesel particulate filter.

3.11 Checking diesel particulate filter, engine codes CPYA, CPYB

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK
- No fault entry in event memory ⇒Page 26, read event memory.

Test procedure

– Press [←] button.

– Select “Display group 108”.

Indicated on display:

```
Display group 108
110 ml     30.0 g      30.0 g
```

– Check ash deposit mass in display zone 1. Specification: < 500 ml (for large diesel particulate filter).

– Check calculated soot loading in display zone 2. Specification: < 35.0 g.

– Check read soot loading in display zone 3. Specification: < 35.0 g.

– If the difference between the calculated and the read soot loading exceeds 20 g, there may be a fault in the following components: EGR cooler, air mass meter, charge pressure, injection quantities, injectors (IMA-code), air filter, leak on pressure differential sender with hoses, charge air system/ turbocharger. Note and evaluate measured value blocks 100, 104, 108.

Note

If the soot loading exceeds 30.0 g, the DPF warning lamp lights up.

> ⚠ ***DANGER!***
>
> ***If soot loading in display zones 2 and 3 exceeds 35 g, the intake manifold is locked. In this case, NEVER start a regeneration.***

If soot loading in display zones 2 and 3 is between 30.0 ... 35 g:

– Perform a regeneration of the diesel particulate filter ⇒Page 463; regeneration of diesel particulate filter.

– The vehicle manufacturer may specify a different value. Observe the specifications of the vehicle manufacturer.

If the ash deposit mass in display zone 1 exceeds 500 ml or the soot loading in display zones 2 or 3 exceeds 40.0 g:

– Exit diagnosis function.

– Switch off ignition.

– Renew diesel particulate filter.

3.12 Regeneration of diesel particulate filter, engine codes CJDA, CJDD

Note

- *A regeneration of the diesel particulate filter can only be performed if the coolant temperature is at least 80°C and the exhaust gas temperature ahead of the diesel particulate filter is at least 161°C.*
- *The regeneration takes 20 min.*

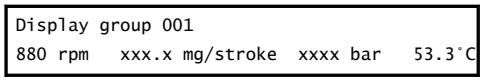
– Start engine and run at idling speed.

– Connect vehicle diagnostic tester, and select engine control unit. ⇒Page 23

– Select diagnosis function “011-Read measured value block”.

– Select “Display group 001”.

Indicated on display:



– Check coolant temperature in display zone 4. Specification: at least 80°C.

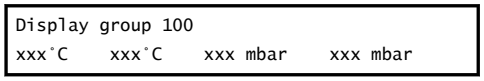
– Increase engine speed to above 1500 rpm.

Do not continue with test until coolant temperature of 80°C has been reached.

– Press ⏎ button (back).

– Select “Display group 100”.

Indicated on display:



– Check exhaust gas temperature value from exhaust gas temperature sender 3 -G495- (exhaust gas temperature sender ahead of diesel particulate filter) in display zone 1. Specification: at least 161°C.

Do not continue with test until specified exhaust gas temperature ahead of diesel particulate filter has been reached.

– Start service regeneration as follows:

– Press [←] button (back) twice.

Select diagnosis function “015-Access permissions”.

– Enter following access code:

● Access code: 40809

– Confirm access code.

– Press [←] button (back) 3 times to go back to diagnosis function menu.

Select diagnosis function “014-Long adaptation”.

– Select “Channel number 13”.

– Enter adaptation value “1”.

– Confirm value with [Confirm] button.

– Press [←] button (back) 2 times to go back to diagnosis function menu.

– Select diagnosis function “011-Read measured value block”.

– Select “Display group 108”.

– Increase engine speed to approx. 1700 rpm.

Indicated on display:

```
Display group 108
110 ml     30.0 g      30.0 g
```

Note

During service regeneration the values in the display zones 2 and 3 should decrease.

– Check soot loading in display zones 2 and 3. Specification: < 5 g.

If specification is attained:

– Press [←] button (back).

– Select “Display group 104”.

Indicated on display:

```
Display group 104
FFXX      FFXX 0000 0000 km    0000 0000
```

– If display zone 2 shows "FF02", the regeneration is still in progress. Keep engine speed at 1700 rpm and wait.

– If display zone 2 shows "FF01", the regeneration has been completed. Allow engine to cool down at idling speed.

– Press [←] button (back).

– Select “Display group 106”.

Indicated on display:

```
Display group 106
----   0-60    0-1500 km          0-36000
```

– Check fuel consumption since last regeneration in display zone 2. Specification: 0.

– Check time elapsed since last regeneration in display zone 4. Specification: 0.

Note

- *If the specifications have been attained, the regeneration of the diesel particulate filter has been completed successfully.*
- *The DPF warning lamp goes off after the regeneration of the diesel particulate filter has been completed successfully.*

– Then, read event memory of engine control unit, and clear event memory if necessary ⇒ Page 26, read event memory.

3.13 Renewing diesel particulate filter, engine codes CJDA, CJDD

– Renew diesel particulate filter ⇒ Page 427.

If the diesel particulate filter has been renewed, the adaptation value for the ash deposit mass must be set to “0” as follows:

– Switch on ignition.

– Connect vehicle diagnostic tester, and select engine control unit. ⇒ Page 23

– Select diagnosis function “14-Long adaptation”.

– Select “Adaptation channel 16”.

– Press Keyboard field.

– Using the on-screen keyboard, enter the value 1.

– Press ← button (back).

– Press Confirm button to reset the learnt value.

– Exit diagnosis function.

– Switch ignition off, and after 60 seconds switch it on again.

– Select “Display group 108” “011-Read measured value block”.

Indicated on display:

```
Display group 108
110 ml    30.0 g     30.0 g        ----
```

– Check whether the adaptation value for the ash deposit mass which has been set beforehand is “0”.

– Adapt exhaust gas pressure sensor 1 -G450- ⇒ Page 420.

– Switch off ignition.

Set engine control unit to the mileage which has been read before.

Prerequisites

- Mileage since last regeneration has been read.
- Engine control unit has been renewed.

– Set the mileage which has been read beforehand in new engine control unit ⇒ Page 462, check diesel particulate filter.

Procedure

If the engine control unit has been renewed, the data for the diesel particulate filter which is stored in the EEPROM of the previous (defective) engine control unit is lost. This data in-

cludes the ash deposit mass and the operating time of the diesel particulate filter. However, based on the mileage or the operating hours since the last change of the diesel particulate filter this data can be restored approximately.

– Log in to the menu “015-Access permissions”.
– Select “Security Access”.
– This channel requires the access code 12233.
– Enter access code “12233”:
– Go back to the menu.
– To enter the mileage, go to “014-Long adaptation”.
– Select "Adaptation channel 15".
– Use the Keypad button to enter a hex value.
– Instead of the mileage (in 1000 km) the operating hours (x 0.06) may be entered as well. The result is the same.

Example: 1000 operating hours x 0.06 = 60 (entry in control unit "0060") corresponds to 60,000 km.

– Confirm and save this value.
– Now the ash deposit mass has been recalculated and stored (ignore error message).
– Select “Display group 108” “011-Read measured value block”.

Indicated on display:

```
Display group 108
110 ml     30.0 g      30.0 g
```

– Check condition of diesel particulate filter.
– Select “Display group 106” “011-Read measured value block”.

Indicated on display:

```
Display group 106
----     0-60      0-1500        0-36000
```

– Check whether the adaptation value for the mileage is displayed which has been set beforehand.
– Exit diagnosis function.
– Store injector delivery calibration values/injector voltage calibration values which have been read beforehand in engine control unit ⇒Page 420.
– Adapt exhaust gas pressure sensor 1 -G450- ⇒Page 420.
– Then, read event memory of engine control unit, and clear event memory if necessary ⇒Page 26, read event memory.

27 - Starter, current supply, CCS

1 Starter -B-

> ⚠ ***WARNING***
>
> ***Adhere to the general safety regulations and the notes on repair work on the engine! ⇒ Page 1***

Observe rules for cleanliness ⇒ Page 354.

Connections on solenoid switch ⇒ Page 467.

Starter -B- not turning ⇒ Page 467.

Starter -B- turning too slowly and not cranking engine properly ⇒ Page 468.

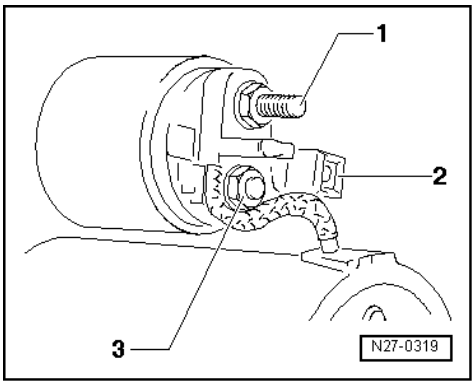
Removing and installing starter -B- ⇒ Page 469.

1.1 Connections on solenoid switch

1 - Terminal 30 - from battery -A-

2 - Terminal 50 - from ignition/starter switch -D-

3 - Connection for coil



1.2 Starter -B- not turning

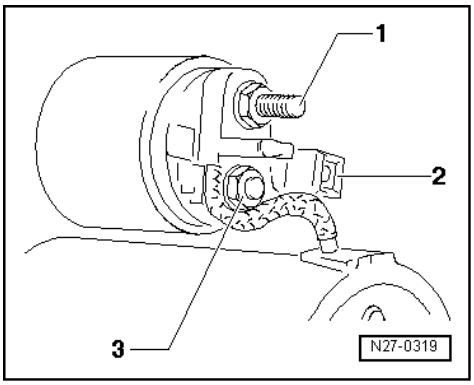
Special tools and workshop equipment required

- Auxiliary measuring set -V.A.G 1594-
- Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
- Current flow diagram

Test prerequisites

- Fuses must be OK.
- Battery charged and tested.
- Earth connections OK
- All electrical consumers must be switched off.
- The connections on the solenoid switch/earth strap – between engine, power unit and battery – must be firmly seated and must not be corroded.

Test procedure



– Connect multimeter between terminal 50 -2- (with connector connected) and battery earth/engine earth to measure voltage.
– Operate ignition/starter switch, and check the voltage supply. Specification: at least 8.0 V

If there is voltage on terminal 50 -2- on solenoid switch:

– Check voltage on coil connection -3- and battery earth/engine earth.
– Operate ignition/starter switch, and check the voltage. Specification: at least 8.0 V

If specification is attained:

– Repair starter -B-.

If the specification is not attained:

– Renew solenoid switch.

If there is no voltage on terminal 50 -2- on solenoid switch:

– Check voltage on terminal 50 on ignition/starter switch and battery earth/engine earth referring to current flow diagram ⇒Page 486, current flow diagrams.
– Operate ignition/starter switch, and check the voltage. Specification: at least 8.0 V

If the specification is not attained:

– Renew ignition/starter switch -D-.

If specification is attained:

– Check wiring between Ignition/starter switch and starter for open circuit referring to current flow diagram. Cable resistance: max. 2.0 Ω.

1.3 Starter -B- turning too slowly and not cranking engine properly

Test prerequisites

- Battery charged and tested.
- Poly V-belt tension OK and alternator secured properly
- All electrical consumers must be switched off.
- The connections on the solenoid switch/earth strap – between engine, power unit and battery – must be firmly seated and must not be corroded.

Test procedure

– Operate ignition/starter switch.

If starter does not crank engine properly:

– With ignition switched off, disconnect earth strap from battery.

– Clean connections on starter and earth strap between engine and power unit. Do not disconnect earth strap from power unit when doing this.
– Tighten connections after cleaning.
– Connect earth strap to battery.
– Operate ignition/starter switch.

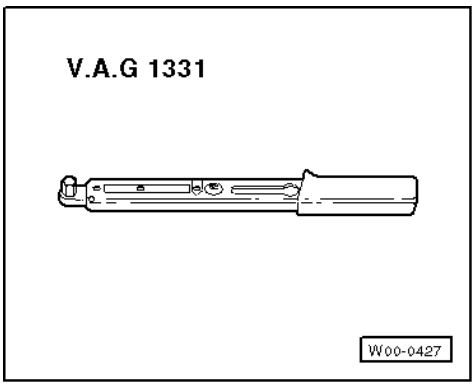
If starter does not crank engine properly again, one of the following may be the cause:

◆ Insufficient contact between carbon brush and collector
– Check carbon brush for wear, and renew it as necessary.
◆ Collector is scored, burnt or soiled
– Renew rotor.

1.4 Removing and installing starter -B-

Special tools and workshop equipment required

◆ Torque wrench (5…50 Nm) -V.A.G 1331-
◆ Torque wrench (40…200 Nm) -V.A.G 1332-



Removing ⇒ Page 469.

Installing ⇒ Page 471.

Specified torques ⇒ Page 471.

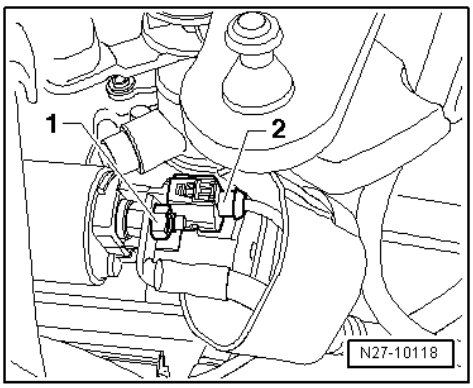
1.4.1 Removing

Note

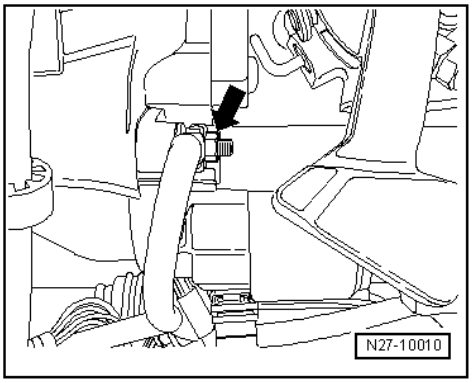
The procedure described below provides only general instructions for removing and installing the starter, since due to the various use cases it is not possible to specify a common procedure.

– Note safety precautions before beginning work ⇒ Page 354.
– Observe rules for cleanliness ⇒ Page 354.
– With ignition switched off, disconnect battery.

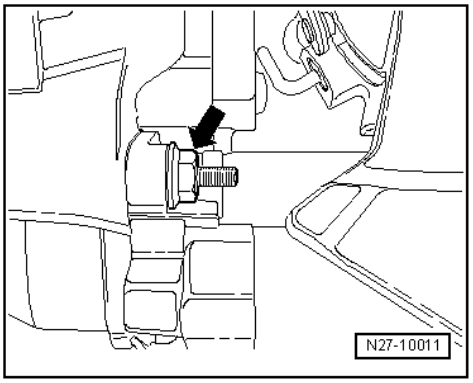
– Unbolt positive wire of terminal 30 -1-, and disconnect connector of terminal 50 -2-.



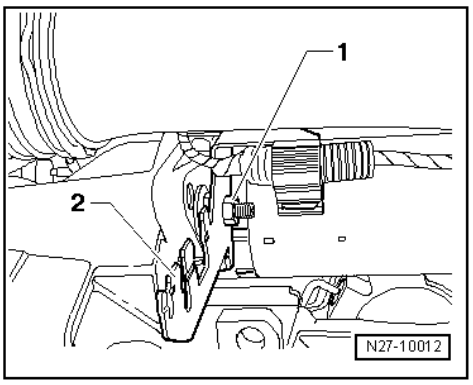
– Unbolt earth wire from securing bolt of starter -arrow-.



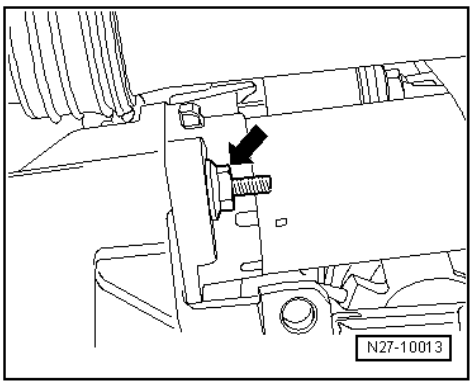
– Unscrew securing bolt of starter -arrow-.



– Unscrew securing nut -1- from lower securing bolt of starter.
– Remove line retainer -2-.



– Unscrew securing bolt of starter -arrow-.
– Remove starter downwards.



1.4.2 Installing

Install in reverse order. In the process, note the following:

– Tighten threaded connections to specified torque ⇒Page 471.
– With ignition switched off, connect battery.

1.4.3 Specified torques

Threaded connection		Specified torque
Starter to power unit	M10	40 Nm
	M12	60 Nm
Earth wire to securing bolt of starter	M8	15 Nm
Line retainer to securing bolt for starter	M8	15 Nm
Positive wire to solenoid switch of starter	M8	15 Nm

2 Alternator -C-

> ⚠ ***WARNING***
>
> ***Adhere to the general safety regulations and the notes on repair work on the engine! ⇒Page 1***

Observe rules for cleanliness ⇒Page 354.

Assembly overview - alternator -C- ⇒Page 472.

Tightening sequence and specified torque, ancillary bracket to cylinder block ⇒Page 144.

Checking alternator -C- and voltage regulator -C1- ⇒Page 474.

Removing and installing alternator -C- ⇒Page 475.

Removing and installing voltage regulator -C1- ⇒Page 477.

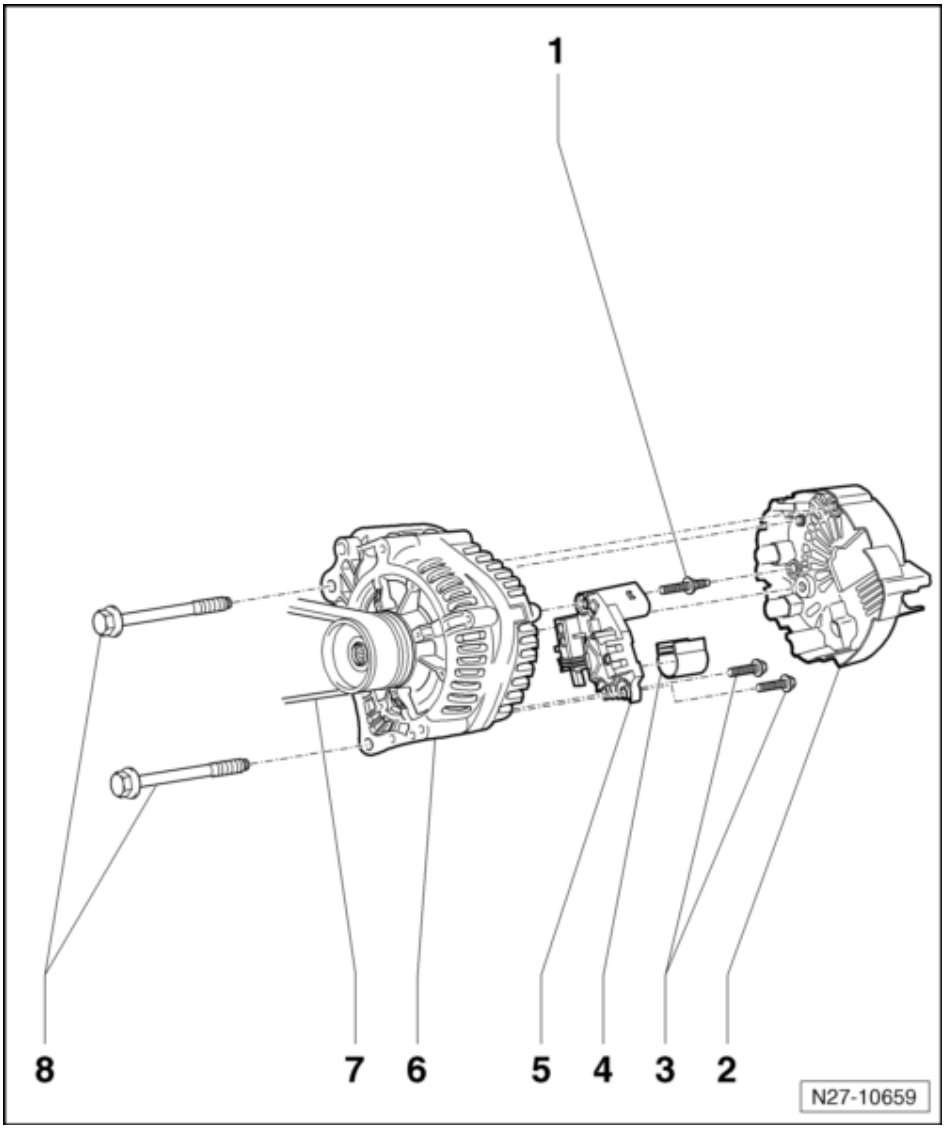
Removing and installing poly V-belt pulley ⇒Page 480.

Checking operation of freewheel clutch ⇒Page 485.

2.1 Assembly overview - alternator -C-

Note

Removing and installing bracket for ancillary units ⇒ Page 144.



1 - Hexagon bolt with washer and threaded element, 2 Nm
- ❑ M4 x 20
- ❑ M4 x 15

2 - Protective cap
- ❑ For alternator

3 - Phillips head screw, 2 Nm
- ❑ M4 x 20

4 - Protective cap
- ❑ For carbon brushes

5 - Voltage regulator -C1-
- ❑ Check ⇒Page 474, checking alternator -C- and voltage regulator -C1-
- ❑ Removing and installing ⇒Page 477

6 - Alternator -C-
- ❑ Attachment of “battery positive wire” to alternator ⇒Fig. on page 474
- ❑ Check ⇒Page 474, checking alternator -C- and voltage regulator -C1-
- ❑ Removing and installing ⇒Page 475
- ❑ Removing and installing poly V-belt pulley ⇒Page 138
- ❑ Checking operation of freewheel clutch ⇒Page 485

7 - Poly V-belt
- ❑ Mark direction of rotation before removing.
- ❑ Do not kink
- ❑ Removing and installing ⇒Page 138
- ❑ Check for wear ⇒Page 143

8 - Hexagon head flange bolt, 23 Nm
- ❑ M8 x 90
- ❑ Tightening sequence and specified torque, ancillary bracket to cylinder block ⇒Page 144

Attachment of “battery positive wire” to alternator

Special tools and workshop equipment required

- Torque wrench (5…50 Nm) -V.A.G 1331-

Note

The threaded connection for the positive wire on the alternator is labelled with “B1+”.

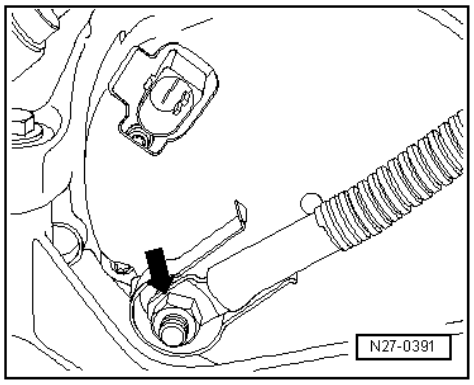
Caution

If the battery positive wire is not tightened to the specified torque, there is a risk of the following:

- ***The battery will not be charged fully.***
- ***Total failure of electrical system/electronics.***
- ***Danger of fires from sparks***
- ***Damage to electronic components and control units due to excessive voltage***

– With ignition switched off, disconnect earth strap from battery.

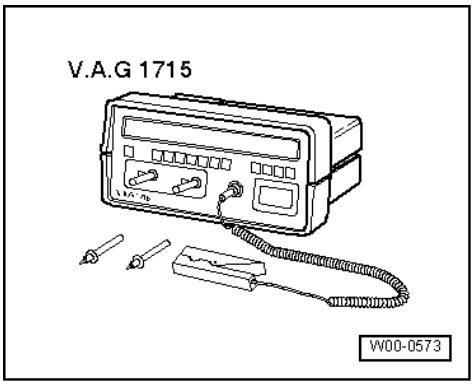
– Tighten securing nut of “B1+ wire” -arrow-. Specified torque: 15 Nm.



2.2 Checking alternator -C- and voltage regulator -C1-

Special tools and workshop equipment required

- Multimeter -V.A.G 1715-
- Auxiliary measuring set -V.A.G 1594 C-

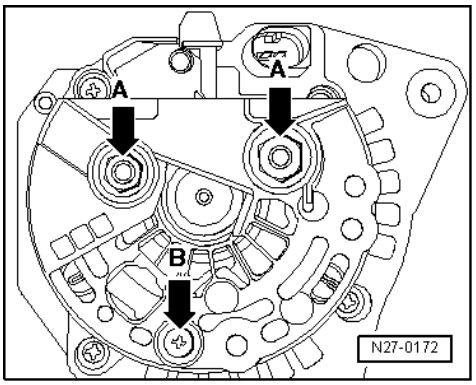


Test prerequisites

- Fuses must be OK.
- Battery charged and tested.
- Earth connections OK
- Poly V-belt tension OK and alternator secured properly
- No faults must be stored in event memory ⇒Page 26, read event memory.

Test procedure

– Unscrew securing nuts -arrows A- and securing bolt -arrow B- of protective cap, and remove protective cap.
– Switch on multimeter -V.A.G 1715-.
– Connect black measuring cable (-) to battery earth strap.
– Connect red measuring cable (+) to “clamp D+” on alternator.
– Switch on all electrical consumers.
– Start engine, and allow it to run between 1500...2000 rpm for a few seconds.



If the multimeter -V.A.G 1715- display does not show “OK”:

– Renew voltage regulator -C1- ⇒Page 477, removing and installing voltage regulator -C1-.
– Repeat the test procedure.

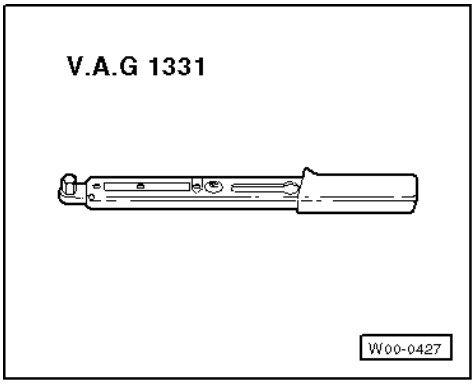
If the multimeter -V.A.G 1715- display again does not show “OK”:

– Renew alternator -C- ⇒Page 475, Removing and installing alternator -C-.

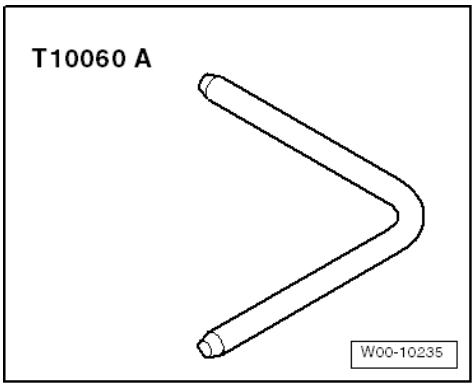
2.3 Removing and installing alternator -C-

Special tools and workshop equipment required

◆ Torque wrench (5…50 Nm) -V.A.G 1331-



◆ Locking pin -T10060 A-



Removing ⇒Page 476.

Installing ⇒Page 477.

2.3.1 Removing

Note

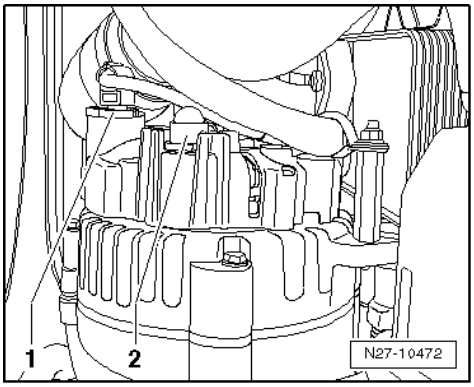
- *The procedure described below provides only general instructions for removing and installing the alternator, since due to the various use cases it is not possible to specify a common procedure.*
- *Depending on how the engine is installed, the location where the repair measure is required may be difficult to access. Remove any required components to ensure proper working conditions. If available, adhere to the descriptions of work from the respective manufacturer.*

– Note safety precautions before beginning work ⇒Page 354.

– Observe rules for cleanliness ⇒Page 354.

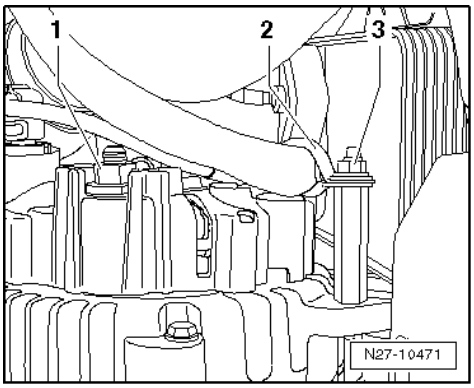
– Remove poly V-belt ⇒Page 138.

– Disconnect connector of DF wire -1-, and, if fitted, pull off protective cap -2-.



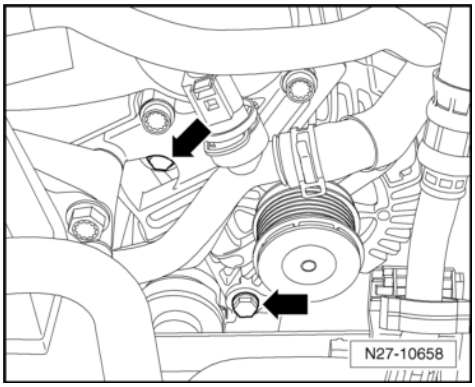
– Unscrew securing nut -1-, and remove “B1+ wire” located below it from alternator connection.

– Unscrew securing nut -3-, and remove line retainer -2- from alternator.



– Unscrew securing bolts of alternator -arrows-.

– Remove alternator.



2.3.2 Installing

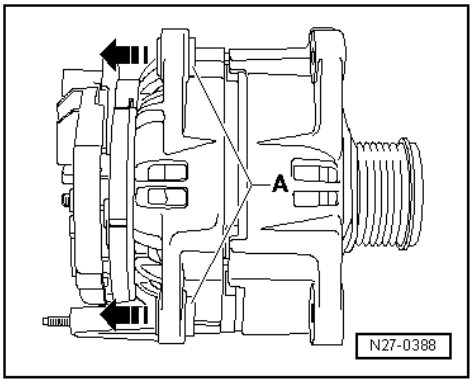
Install in reverse order. In the process, note the following:

– To prevent any damage to the cylinder block and ancillary bracket, always adhere to the tightening sequence and specified torque for the ancillary bracket ⇒ Page 144.

– Drive threaded sleeves -A- about 4 mm in -direction of arrow- out of alternator housing.

Caution

Do not damage threaded sleeves while driving them out.

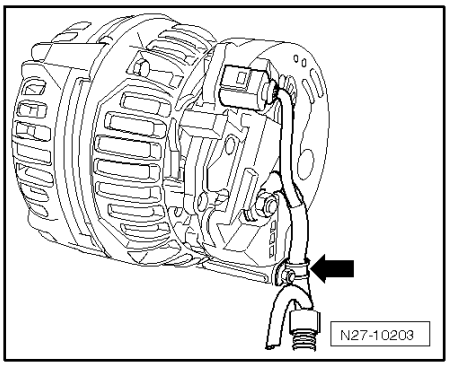


– Secure line retainer -arrow- in 3 o'clock position on back of alternator.

– Tighten threaded connections to specified torque given in assembly overview ⇒ Page 472.

– With ignition switched off, connect battery.

– Install poly V-belt ⇒ Page 138.



2.4 Removing and installing voltage regulator -C1-

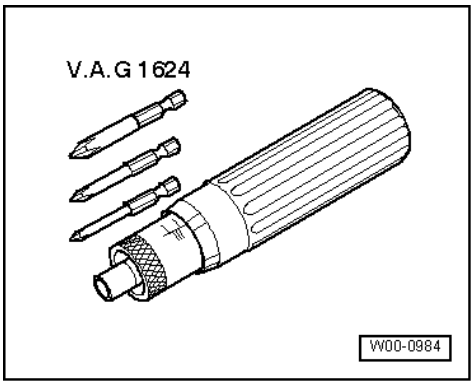
Removing and installing voltage regulator -C1-:

- Bosch ⇒ Page 478,
- Valeo ⇒ Page 479.

2.4.1 Removing and installing voltage regulator -C1-, Bosch

Special tools and workshop equipment required

- Torque screwdriver (1…5 Nm) -V.A.G 1624-



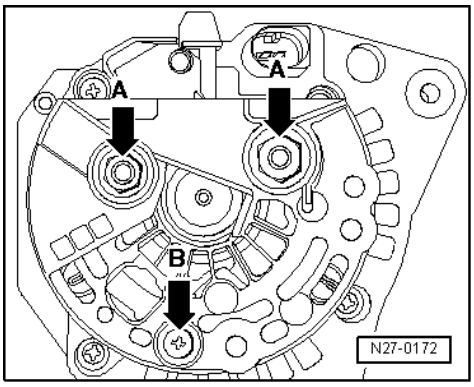
Removing ⇒Page 478.

Installing ⇒Page 478.

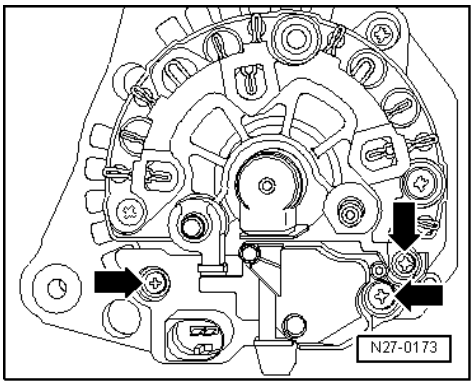
Removing

– Remove alternator -C- ⇒Page 475.

– Unscrew securing nuts -arrows A- and securing bolt -arrow B- of protective cap, and remove protective cap.



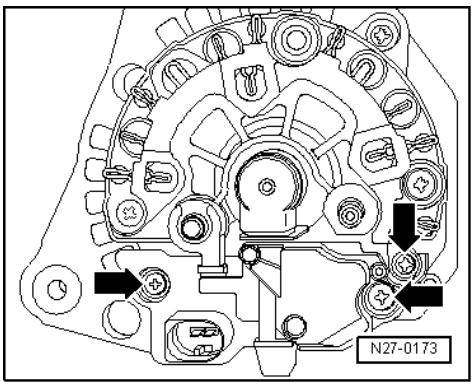
– Unscrew securing bolts -arrows- of voltage regulator, and remove voltage regulator.



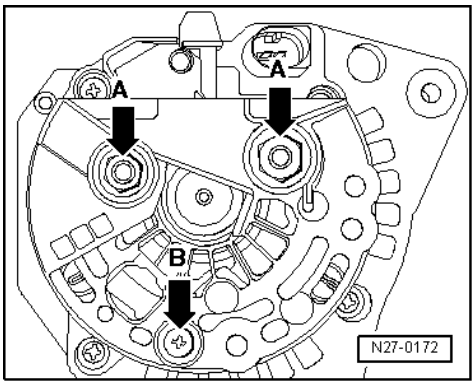
Installing

Install in reverse order. In the process, note the following:

– Tighten securing bolts -arrows- of voltage regulator on alternator to 2 Nm.



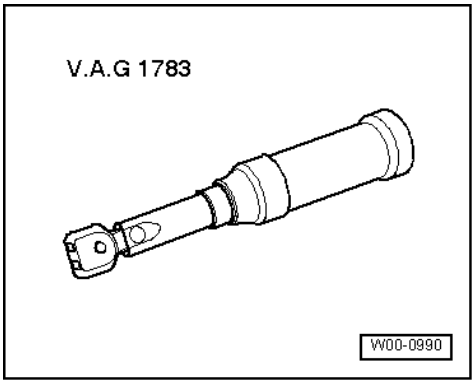
– Install protective cap, and tighten securing nuts -arrows A- and securing bolt -arrow B- to 25 Nm.
– Install alternator -C- ⇒ Page 475.



2.4.2 Removing and installing voltage regulator -C1-, Valeo

Special tools and workshop equipment required

◆ Torque wrench (2…10 Nm) -V.A.G 1783-



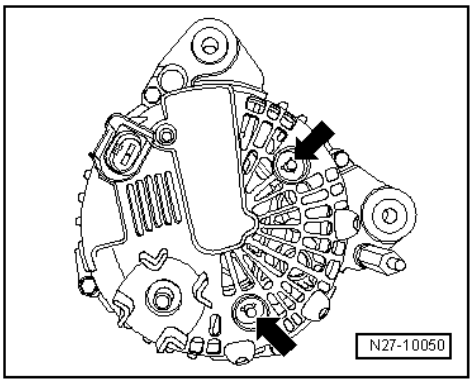
Removing ⇒ Page 479.

Installing ⇒ Page 479.

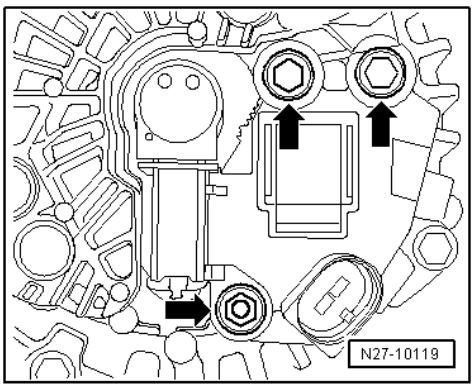
Removing

– Remove alternator -C- ⇒ Page 475.

– Remove spring clips -arrows-, and remove protective cap from alternator.



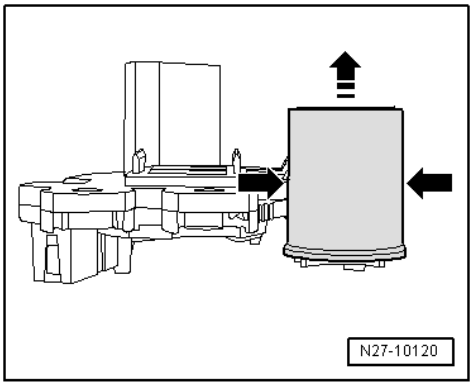
– Unscrew securing bolts and securing nut -arrows- of voltage regulator, and remove voltage regulator.



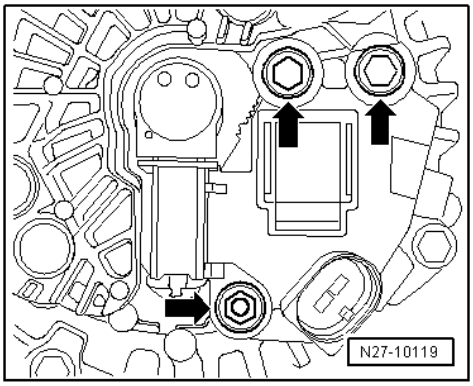
Installing

Install in reverse order. In the process, note the following:

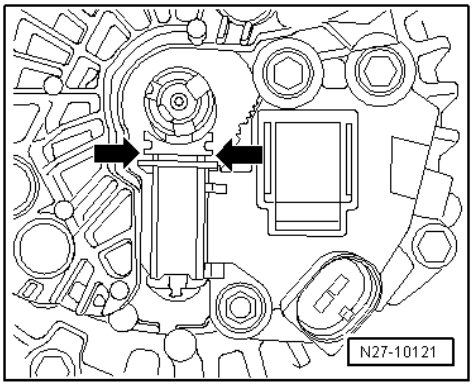
– Release locking lugs -arrows-, and pull protective cap off voltage regulator.
– Push carbon brushes into housing of voltage regulator, and insert voltage regulator in alternator.



– Tighten securing bolts and securing nut -arrows- of voltage regulator on alternator to 2 Nm.



– Push protective cap into guides -arrows- until it can be heard to engage.
– Install alternator -C- ⇒Page 475.



2.5 Removing and installing poly V-belt pulley

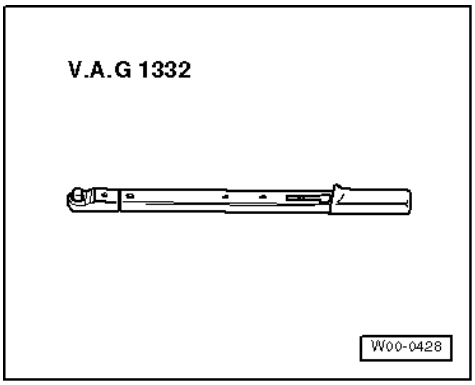
Removing and installing poly V-belt pulley:

- without freewheel ⇒Page 481.
- with freewheel, Bosch ⇒Page 482.
- with freewheel, Valeo ⇒Page 484.

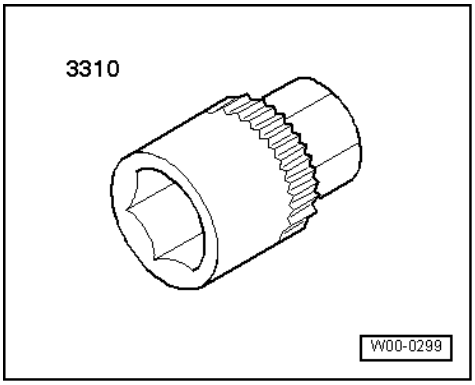
2.5.1 Removing and installing poly V-belt pulley without freewheel

Special tools and workshop equipment required

- Torque wrench (40…200 Nm) -V.A.G 1332-



- Socket 24 mm -3310-



Removing ⇒ Page 481.

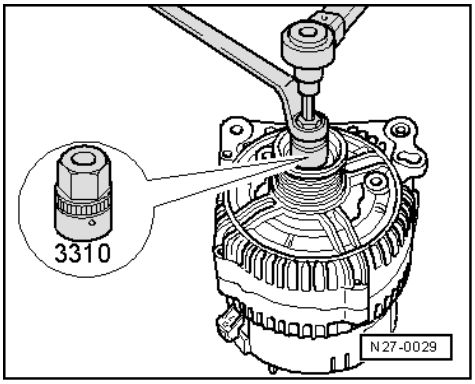
Installing ⇒ Page 481.

Removing

– Remove alternator -C- ⇒ Page 475.

– Clamp alternator in a vice at mounting points.

– Use socket -VAS 3310- to unscrew poly V-belt pulley securing nut from alternator shaft.

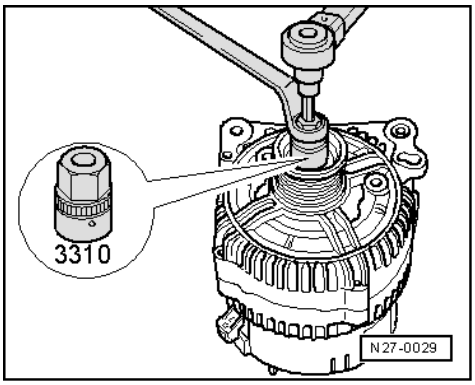


Installing

Installation is carried out in the reverse order. When installing, note the following:

– Tighten securing nut of poly V-belt pulley on alternator shaft to 65 Nm.

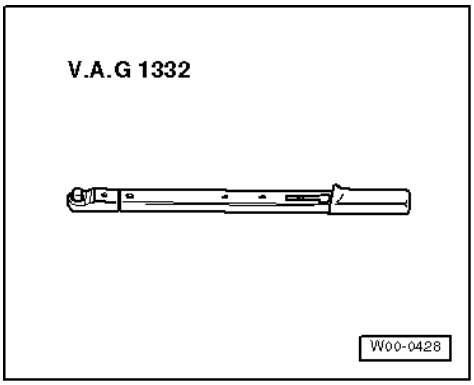
– Install alternator -C- ⇒ Page 475.



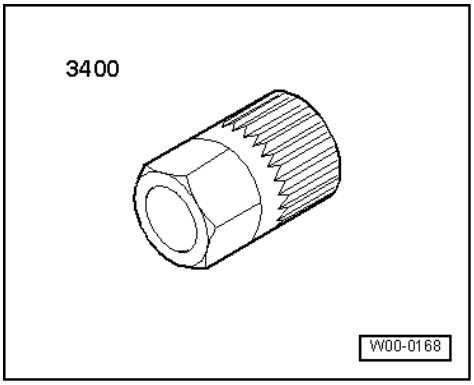
2.5.2 Removing and installing poly V-belt pulley with freewheel, Bosch

Special tools and workshop equipment required

- Torque wrench (40…200 Nm) -V.A.G 1332-



- Adapter -3400-

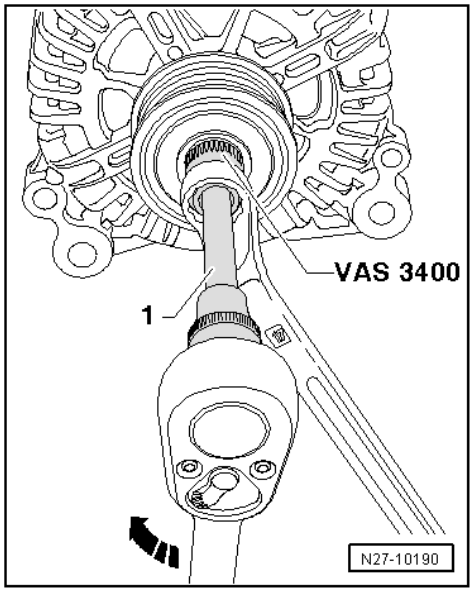


Removing ⇒Page 482.

Installing ⇒Page 482.

Removing

– Remove alternator -C- ⇒Page 475.
– Clamp alternator in a vice at mounting points.
– Remove protective cap from poly V-belt pulley with freewheel.
– Insert adapter -3400- with 17 mm ring spanner in poly V-belt pulley (with freewheel) on alternator.
– Insert a M10 multi-point bit -1- into alternator shaft.
– Loosen threaded connection by turning clockwise. Counter-hold with ring spanner when doing this.
– Hold poly V-belt pulley with freewheel by hand. Turn drive shaft of alternator until poly V-belt pulley with freewheel can be removed.



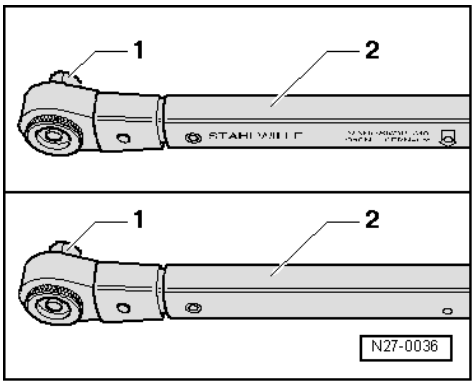
Installing

Installation is carried out in the reverse order. When installing, note the following:

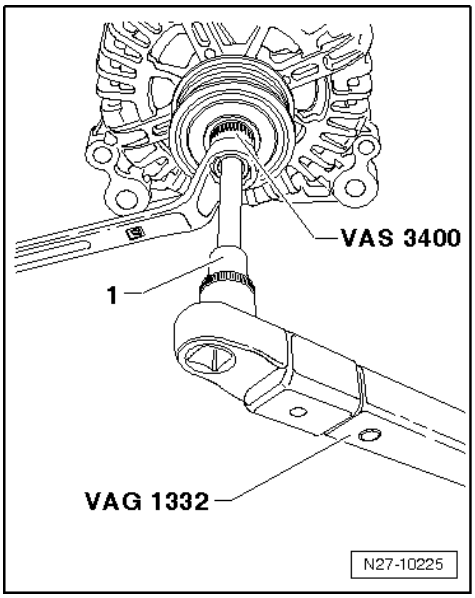
– First, screw poly V-belt pulley with freewheel to stop onto drive shaft of alternator by hand.

The torque wrench must be modified for assembly of poly V-belt with freewheel as follows:

– Release socket drive -1- and pull off grip -2-.
– Turn grip -2- of torque wrench through 180 degrees, and re-insert socket drive.
– Set direction of rotation of torque wrench to anti-clockwise on socket drive.



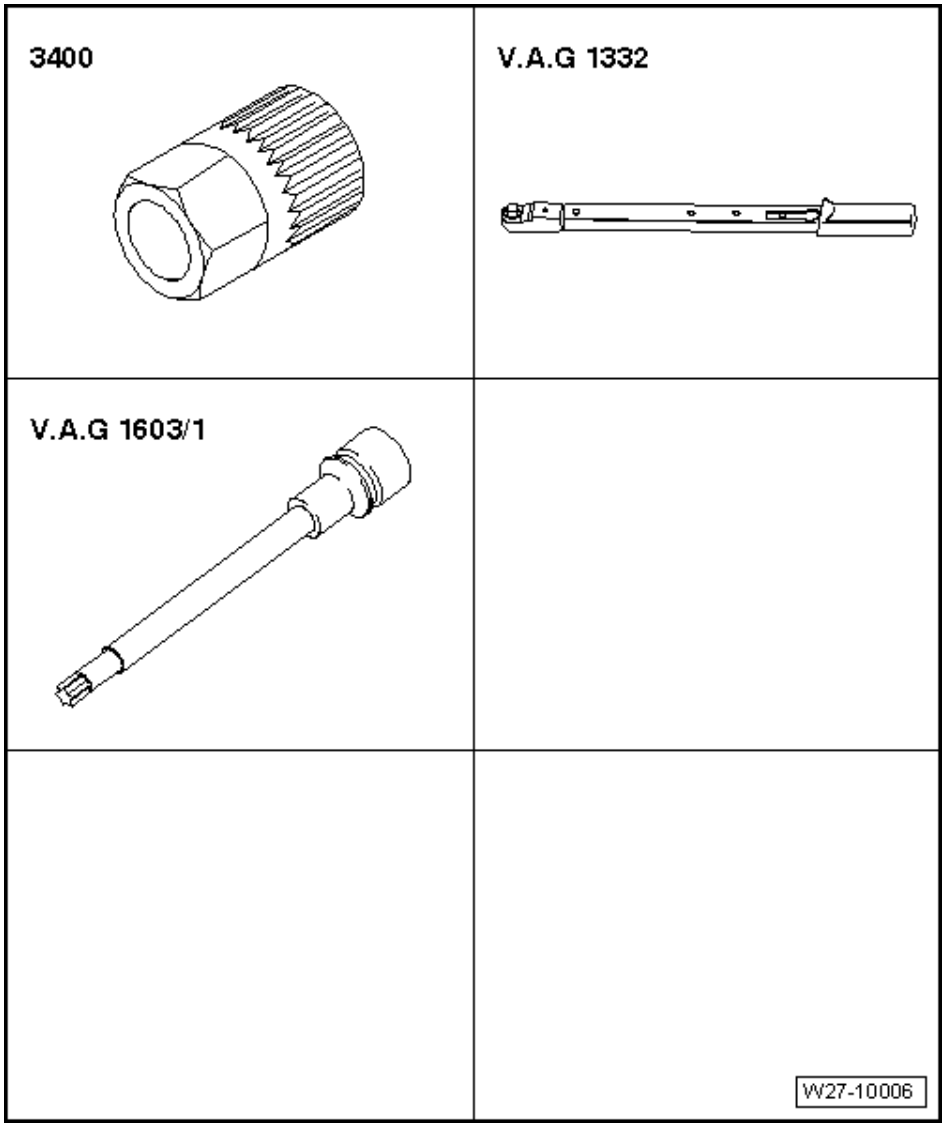
– Insert a M10 multi-point bit -1- into alternator shaft.
– Counterhold using adapter -3400- and 17 mm ring spanner.
– Tighten poly V-belt with freewheel by turning drive shaft of alternator anti-clockwise using torque wrench -V.A.G 1332-.
– Tighten threaded connection of poly V-belt pulley on alternator shaft to 80 Nm.
– Install alternator -C- ⇒ Page 475.



2.5.3 Removing and installing poly V-belt pulley with freewheel, Valeo

Special tools and workshop equipment required

- Adapter -3400-
- Torque wrench (40… 200 Nm) -V.A.G 1332-
- TORX key -V.A.G 1603/1-



Removing ⇒Page 484.

Installing ⇒Page 485.

Removing

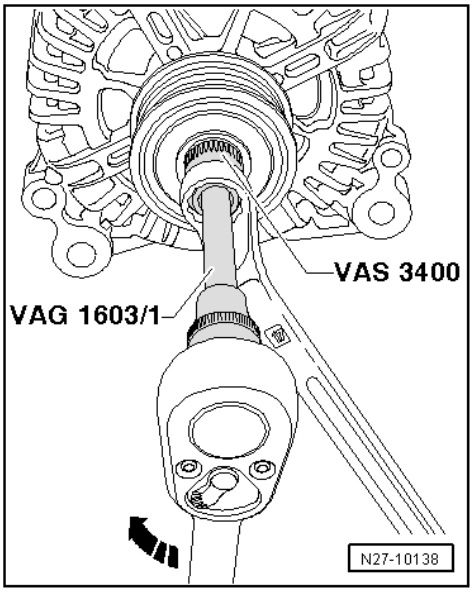
– Remove alternator -C- ⇒Page 475.

– Clamp alternator in a vice at mounting points.

– Remove protective cap from poly V-belt pulley with free-wheel.

– Insert adapter -3400- with 17 mm ring spanner in poly V-belt pulley (with freewheel) on alternator.

– Insert TORX key -V.A.G 1603/1- in alternator shaft.
– Loosen threaded connection by turning clockwise. Counterhold with ring spanner when doing this.
– Hold poly V-belt pulley with freewheel by hand. Turn drive shaft of alternator until poly V-belt pulley with freewheel can be removed.



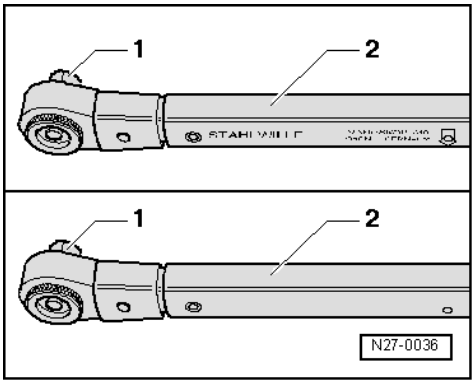
Installing

Installation is carried out in the reverse order. When installing, note the following:

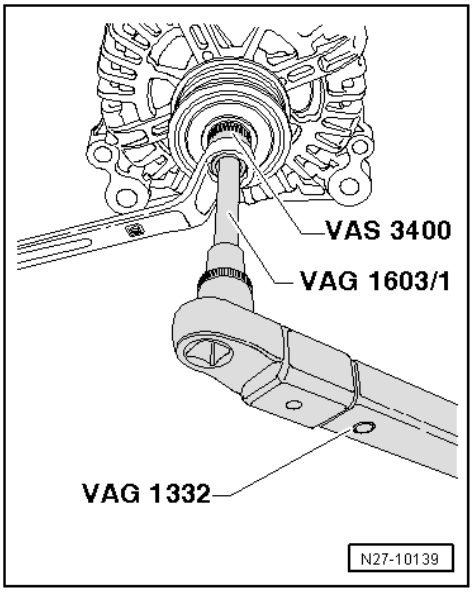
– First, screw poly V-belt pulley with freewheel to stop onto drive shaft of alternator by hand.

The torque wrench must be modified for assembly of poly V-belt with freewheel as follows:

– Release socket drive -1- and pull off grip -2-.
– Turn grip -2- of torque wrench through 180 degrees, and re-insert socket.
– Set direction of rotation of torque wrench to anti-clockwise on socket drive.



– Insert TORX key -V.A.G 1603/1- in alternator shaft.
– Counterhold using adapter -3400- and 17 mm ring spanner.
– Tighten poly V-belt with freewheel by turning drive shaft of alternator anti-clockwise using torque wrench -V.A.G 1332-.
– Tighten threaded connection of poly V-belt pulley on alternator shaft to 80 Nm.
– Install alternator -C- ⇒ Page 475.



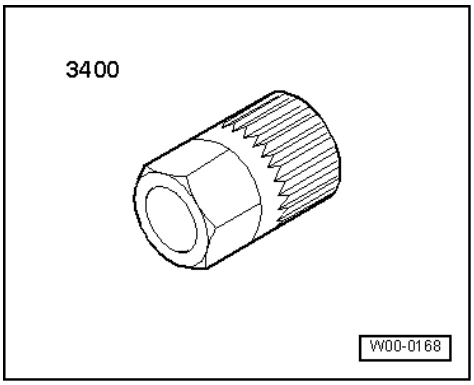
2.6 Checking operation of freewheel clutch

Note

On alternators 05.99 ► the poly V-belt pulley with freewheel is the same on all alternators in use.

Special tools and workshop equipment required

- Adapter -3400-



Test prerequisite

- Poly V-belt tension OK and alternator secured properly

Test procedure

– Remove protective cap from poly V-belt pulley with freewheel.

– Insert adapter -3400- in poly V-belt pulley (with freewheel) on alternator.

– Using a 17 mm ring spanner on adapter -3400-, turn drive shaft of alternator anti-clockwise via poly V-belt pulley.

If only the drive shaft in the poly V-belt pulley turns and the contact surface of the pulley remains stationary:

– Renew poly V-belt pulley with freewheel clutch ⇒Page 480, removing and installing poly V-belt pulley.

If the contact surface of the poly V-belt pulley turns along with the drive shaft in poly V-belt:

– Clip protective cap onto poly V-belt pulley with freewheel.

– Check alternator -C- and voltage regulator -C1- ⇒Page 474.

3 Current flow diagrams

Note

- *The current flow diagrams below are only examples for circuits, since due to the various use cases of industrial engines it is not possible to specify common circuits.*
- *The specified cross-section values are minimum values. Depending on the relevant unit, larger cross-sections may apply and must be adhered to accordingly when performing any repair work.*

> ***WARNING***
>
> ***Always disconnect the battery earth strap before working on the electrical system.***

Observe safety precautions ⇒Page 354.

Observe rules for cleanliness ⇒Page 354.

Current flow diagrams:

- Vehicles/machines compliant with emission standard (97/68 stage 3a), engine codes CPYA, CPYB,CPYC, CPYD, CPYE ⇒Page 487.
- Vehicles/machines compliant with emission standard (97/68 stage 3b), engine codes CPYA, CPYB, CPYC, CPYD, CPYE ⇒Page 501.

- Vehicles/machines compliant with emission standard (EU 5), engine codes CJDA, CJDD ⇒Page 517.

3.1 Current flow diagrams, engine codes CPYA, CPYB, compliant with emission standard (97/68 stage 3a)

Battery, starter, alternator, voltage regulator, ignition/starter switch ⇒Page 488.

Electric fuel pump 2 relay, automatic glow period control unit, glow plugs, fuses, supplementary fuel pump ⇒Page 489.

Terminal 30 voltage supply relay, engine control unit, fuses ⇒Page 490.

Jumpers, charge pressure sender, intake air temperature sender, air mass meter, engine control unit ⇒Page 491.

Accelerator position sender, accelerator position sender 2, engine control unit, injectors, cylinders 1 - 4 ⇒Page 492.

Hall sender, coolant temperature sender, engine control unit, fuel pressure regulating valve, fuel metering valve ⇒Page 493.

Engine speed sender, throttle valve potentiometer, fuel temperature sender, position sender for charge pressure positioner, throttle valve module, engine control unit ⇒Page 494.

Exhaust gas recirculation potentiometer, exhaust gas temperature sender 1, fuel pressure sender, engine control unit, exhaust gas recirculation valve ⇒Page 495.

Brake light switch, brake pedal switch, engine control unit, charge pressure control solenoid valve, heater element for crankcase breather ⇒Page 496.

Working speed control switch, working speed control, resume button, preset speed switch 1 and 2, clutch pedal switch, engine control unit ⇒Page 497.

Preset speed switch 3, engine control unit, alternator warning lamp, glow period warning lamp, exhaust emissions warning lamp ⇒Page 498.

Working speed control, safety contact switch, working speed control, decrease speed button, working speed control, increase speed button, working speed control switch 2, engine control unit, working speed warning lamp ⇒Page 499.

Jumpers, radiator fan relay, engine control unit, radiator fan single fuse, radiator fan ⇒Page 500.

Diagnostic connection, oil pressure switch, engine control unit, oil pressure warning lamp ⇒Page 501.

3.1.1 Battery, starter, alternator, voltage regulator, ignition/starter switch fuses

A - Battery

B - Starter

C - Alternator

C1 - Voltage regulator

D - Ignition/starter switch

S5 - Fuse

- ❑ 15 A
- ❑ In fuse holder

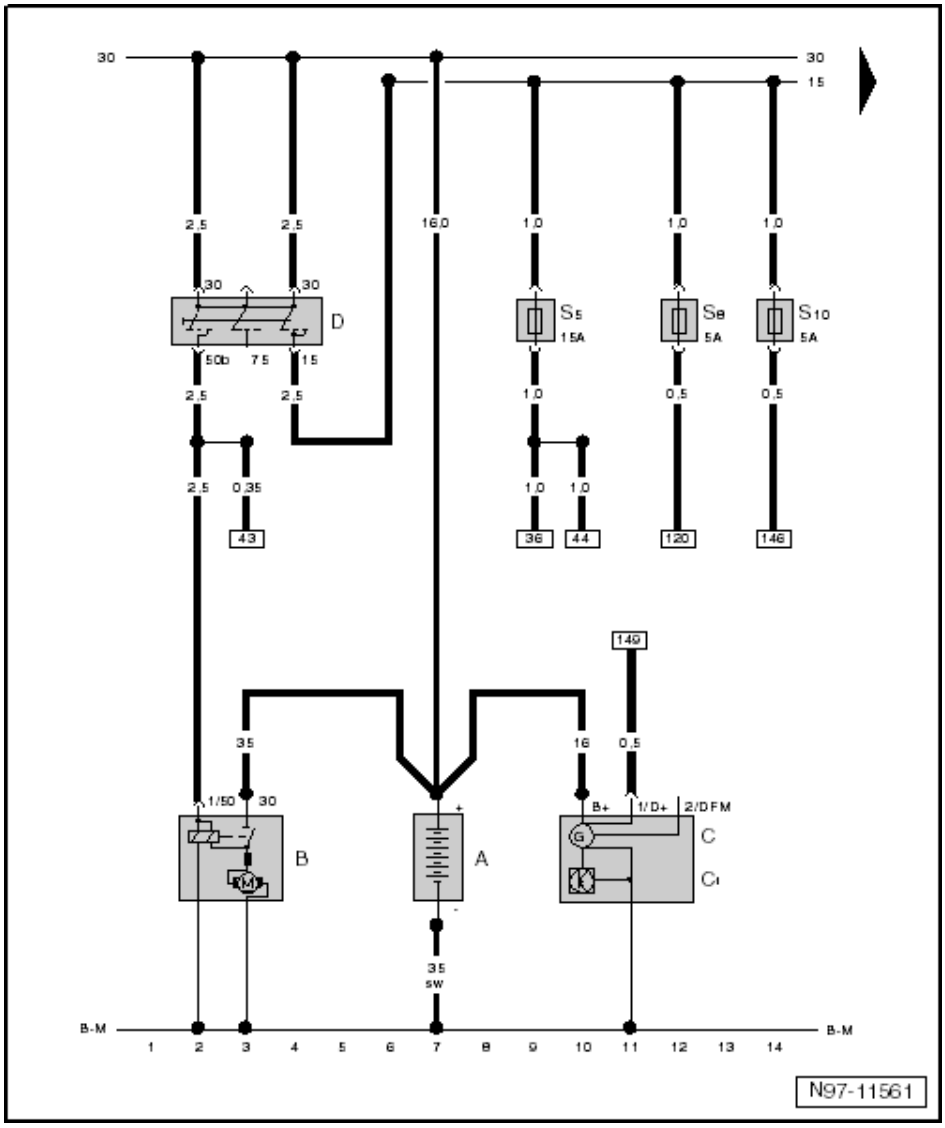
S8 - Fuse

- ❑ 5 A
- ❑ In fuse holder

S10 - Fuse

- ❑ 5 A
- ❑ In fuse holder

B-M - Battery earth/engine earth



3.1.2 Electric fuel pump 2 relay, automatic glow period control unit, glow plugs, fuses, supplementary fuel pump

J49 - Electric fuel pump 2 relay

J179 - Automatic glow period control unit

Q10 - Glow plug 1

Q11 - Glow plug 2

Q12 - Glow plug 3

Q13 - Glow plug 4

S1 - Fuse

- ❑ 20 A
- ❑ In fuse holder

S3 - Fuse

- ❑ 50 A
- ❑ In fuse holder

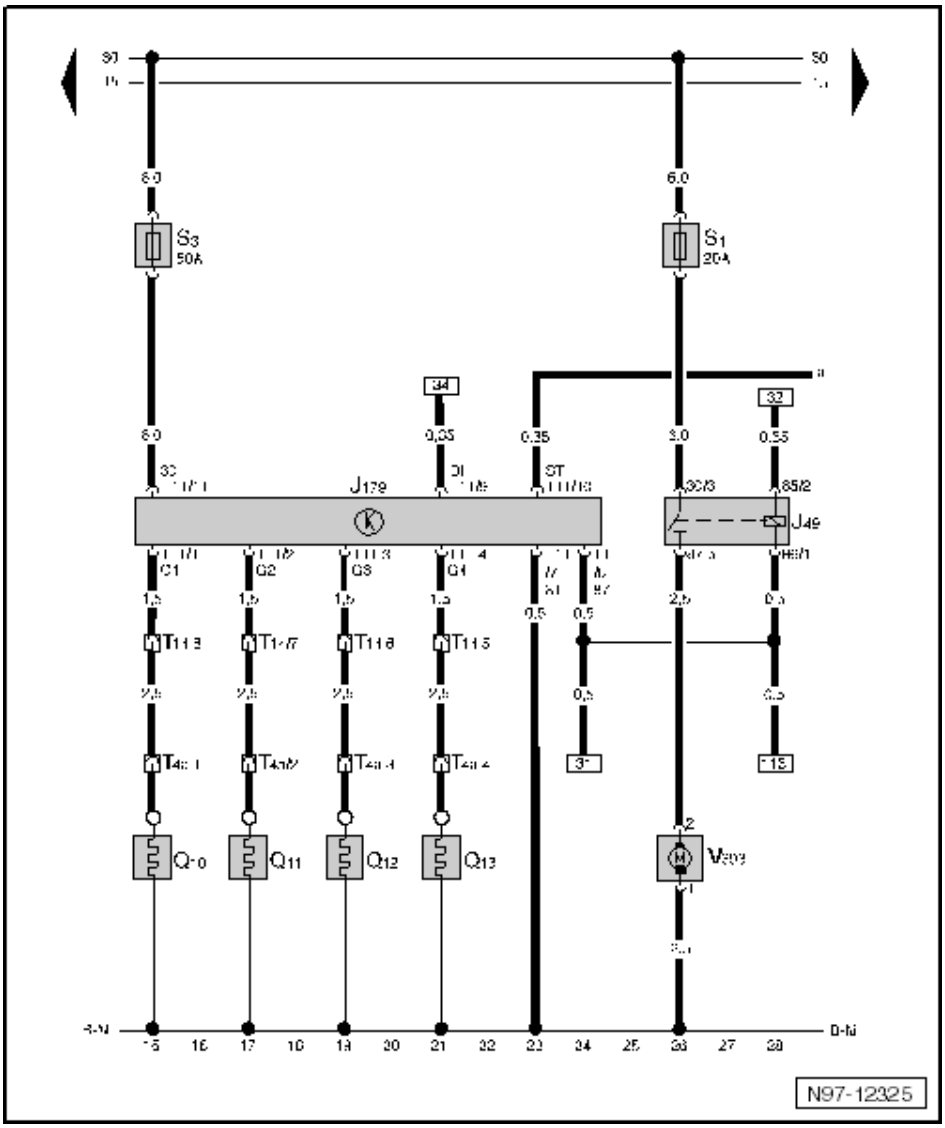
T4a - 4-pin connector

T11 - 11-pin connector

T14 - 14-pin connector

V393 - Supplementary fuel pump

B-M - Battery earth/engine earth



3.1.3 Terminal 30 voltage supply relay, engine control unit, fuses

J317 - Terminal 30 voltage supply relay

J623 - Engine control unit

S2 - Fuse

- ❑ 20 A
- ❑ In fuse holder

S4 - Fuse

- ❑ 15 A
- ❑ In fuse holder

S6 - Fuse

- ❑ 5 A
- ❑ In fuse holder

S7 - Fuse

- ❑ 30 A
- ❑ In fuse holder

S9 - Fuse

- ❑ 5 A
- ❑ In fuse holder

T14 - 14-pin connector

T60 - 60-pin connector

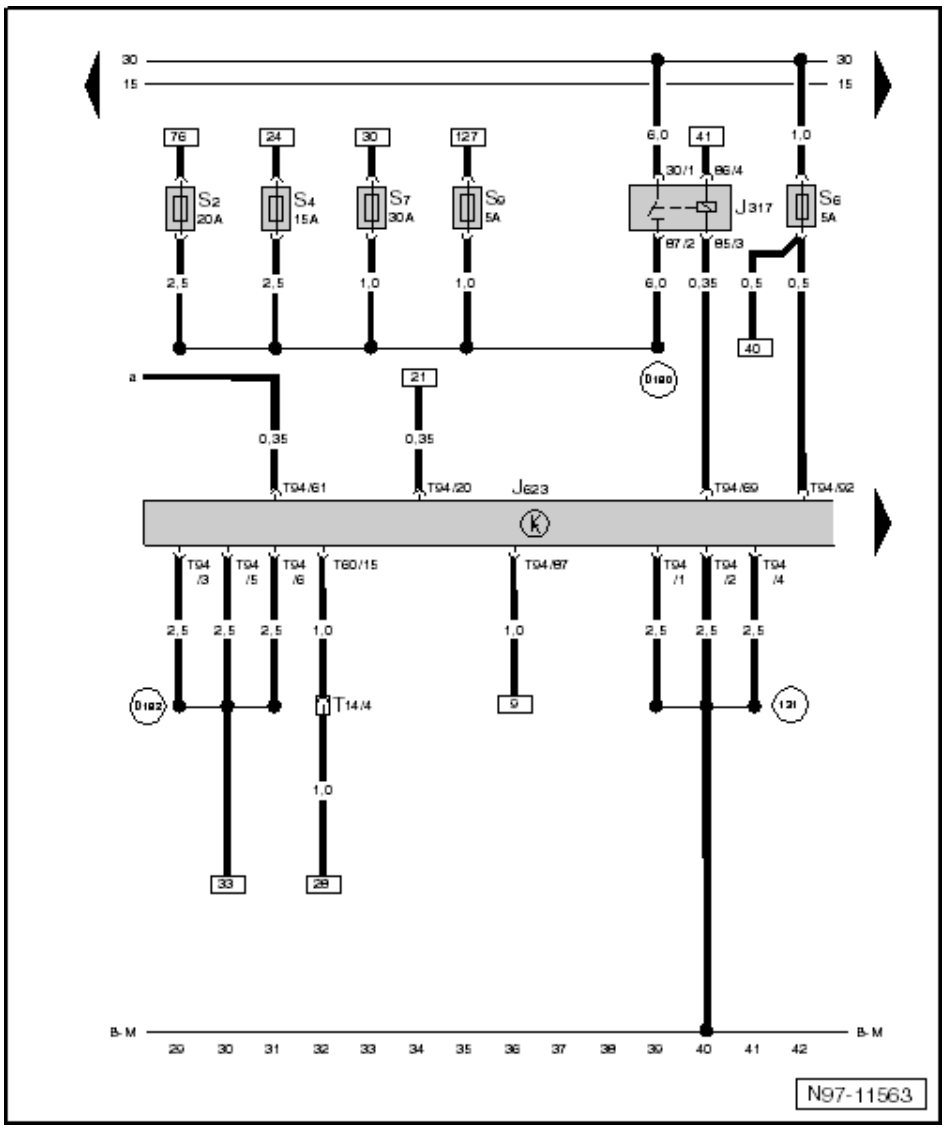
T94 - 94-pin connector

131 - Earth connection 2, in engine compartment wiring harness

D180 - Connection (87a), in engine compartment wiring harness

D182 - Connection 3 (87a), in engine compartment wiring harness

B-M - Battery earth/engine earth



3.1.4 Jumpers, charge pressure sender, intake air temperature sender, air mass meter, engine control unit

G31 - Charge air pressure sender

G42 - Intake air temperature sender

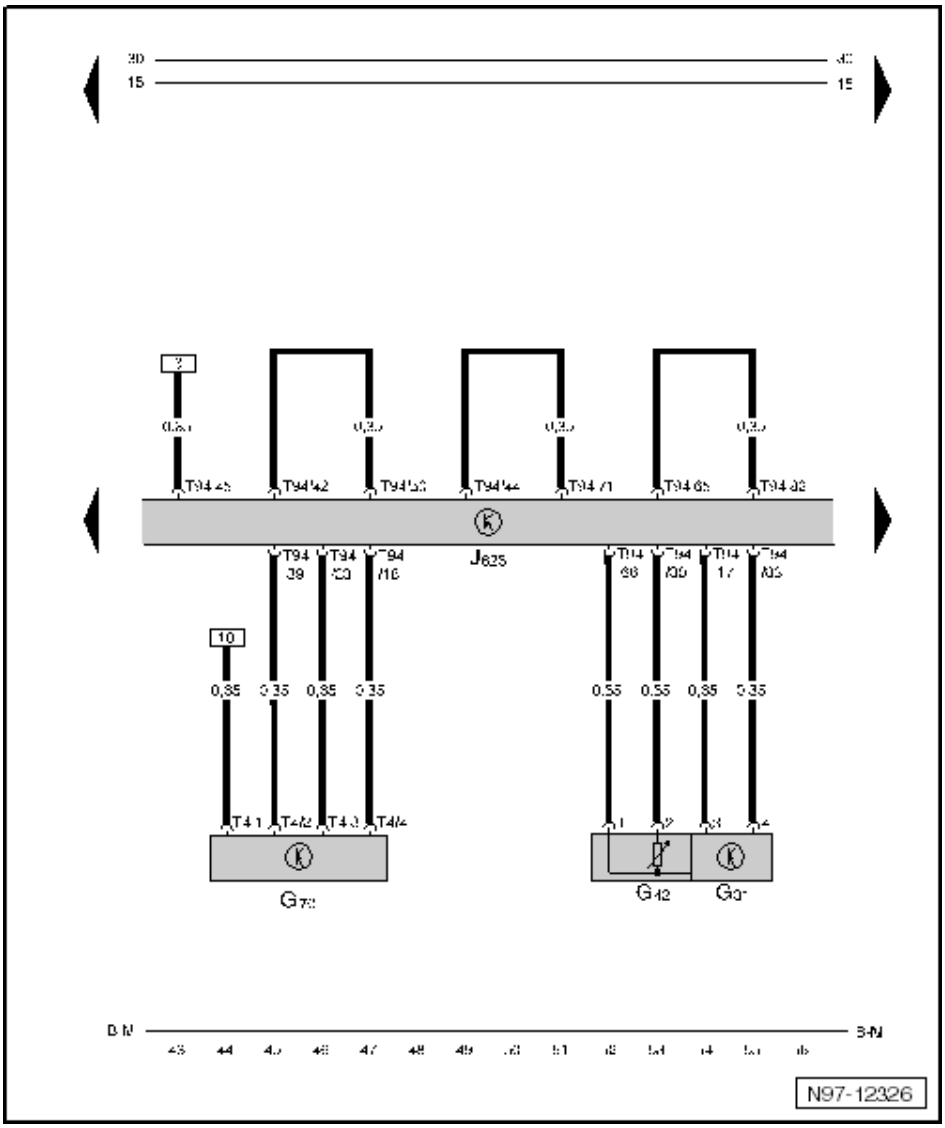
G70 - Air mass meter

J623 - Engine control unit

T4 - 4-pin connector

T94 - 94-pin connector

B-M - Battery earth/engine earth



3.1.5 Accelerator position sender, accelerator position sender 2, engine control unit, injectors, cylinders 1 - 4

G79 - Accelerator position sender

G185 - Accelerator position sender 2

J623 - Engine control unit

N30 - Injector, cylinder 1

N31 - Injector, cylinder 2

N32 - Injector, cylinder 3

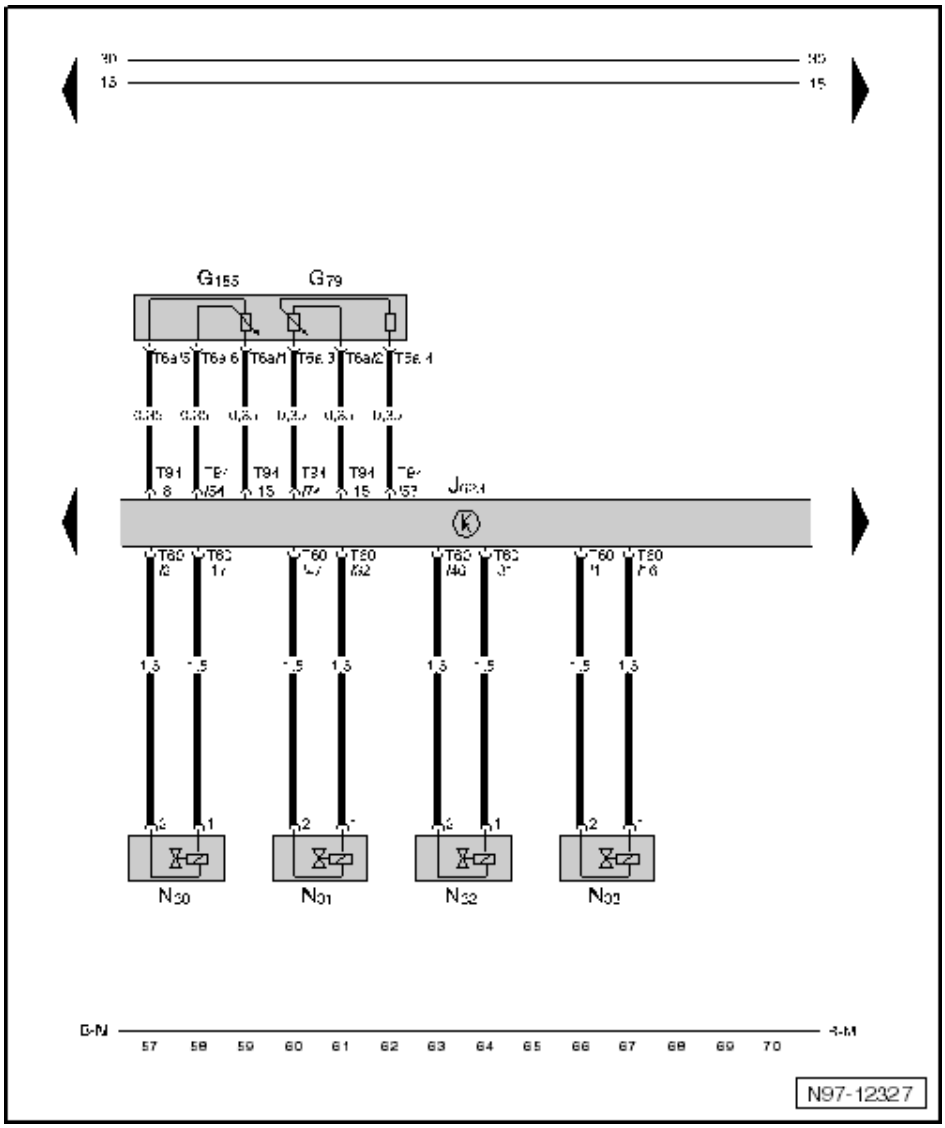
N33 - Injector, cylinder 4

T6a - 6-pin connector

T60 - 60-pin connector

T94 - 94-pin connector

B-M - Battery earth/engine earth



3.1.6 Hall sender, coolant temperature sender, engine control unit, fuel pressure regulating valve, fuel metering valve

G40 - Hall sender

G62 - Coolant temperature sender

J623 - Engine control unit

N276 - Fuel pressure regulating valve

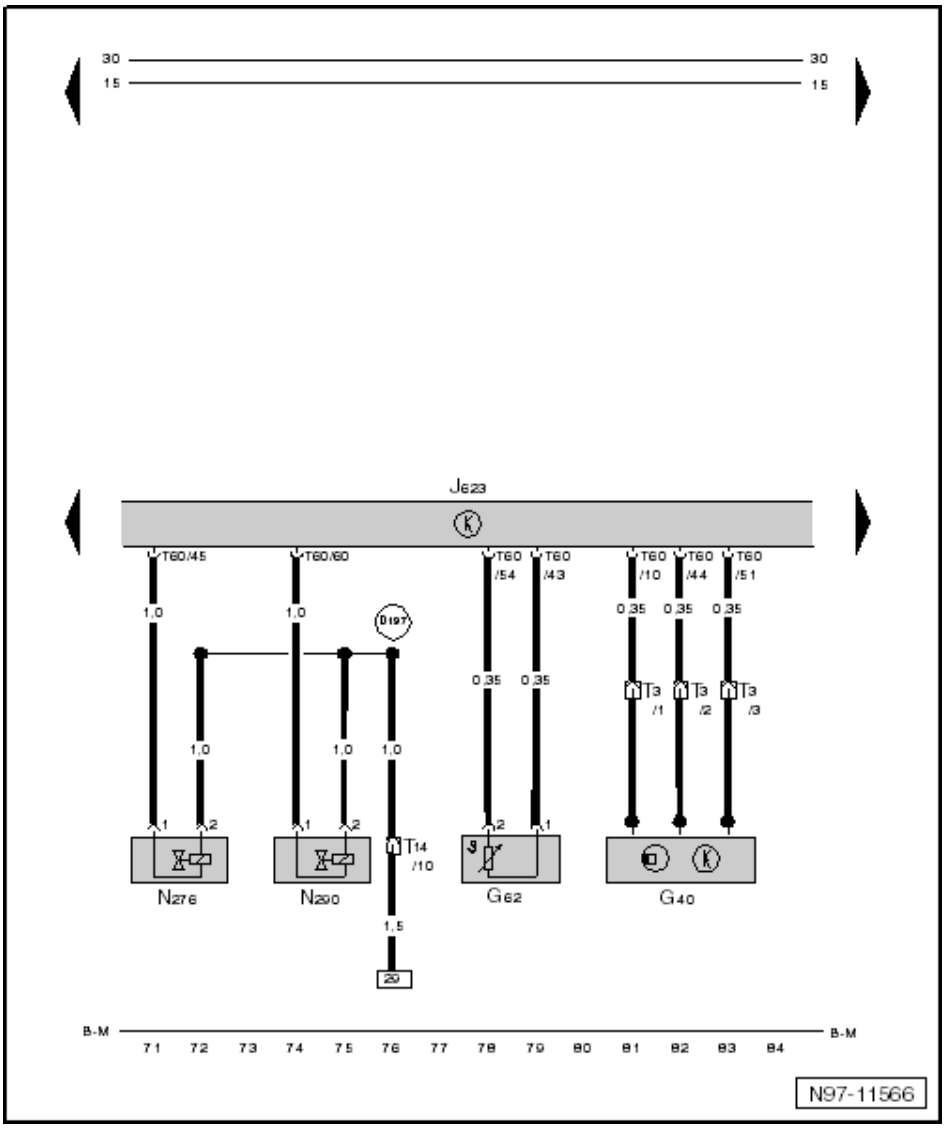
N290 - Fuel metering valve

T3 - 3-pin connector

T14 - 14-pin connector

T60 - 60-pin connector

B-M - Battery earth/engine earth



3.1.7 Engine speed sender, throttle valve potentiometer, fuel temperature sender, position sender for charge pressure positioner, throttle valve module, engine control unit

G28 - Engine speed sender

G69 - Throttle valve potentiometer

G81 - Fuel temperature sender

G581 - Position sender for charge pressure positioner

J338 - Throttle valve module

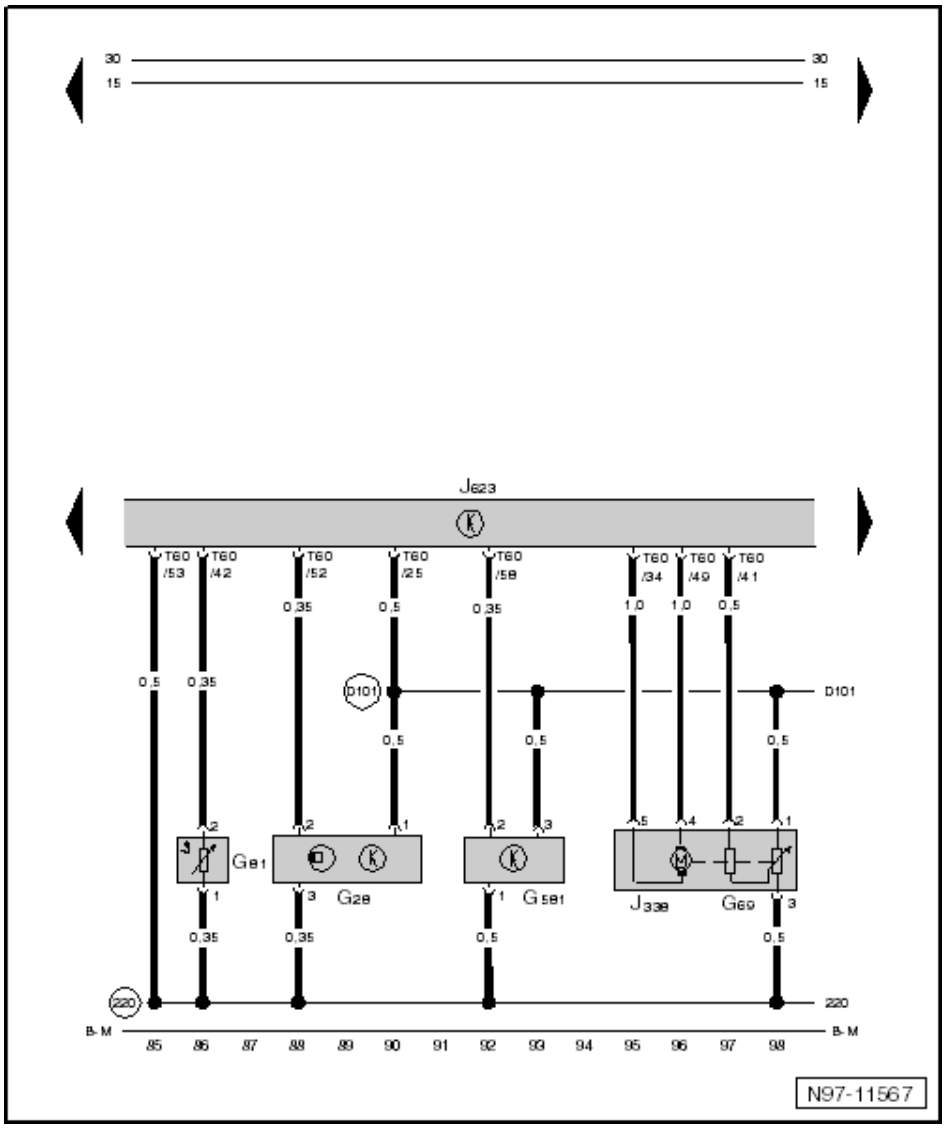
J623 - Engine control unit

T60 - 60-pin connector

220 - Earth connection (sender earth), in engine wiring harness

D101 - Connection 1 in engine compartment wiring harness

B-M - Battery earth/engine earth



3.1.8 Exhaust gas recirculation potentiometer, exhaust gas temperature sender 1, fuel pressure sender, engine control unit, exhaust gas recirculation valve

G212 - Exhaust gas recirculation potentiometer

G235 - Exhaust gas temperature sender 1

G247 - Fuel pressure sender

J623 - Engine control unit

N18 - Exhaust gas recirculation valve

T2a - 2-pin connector

T6 - 6-pin connector

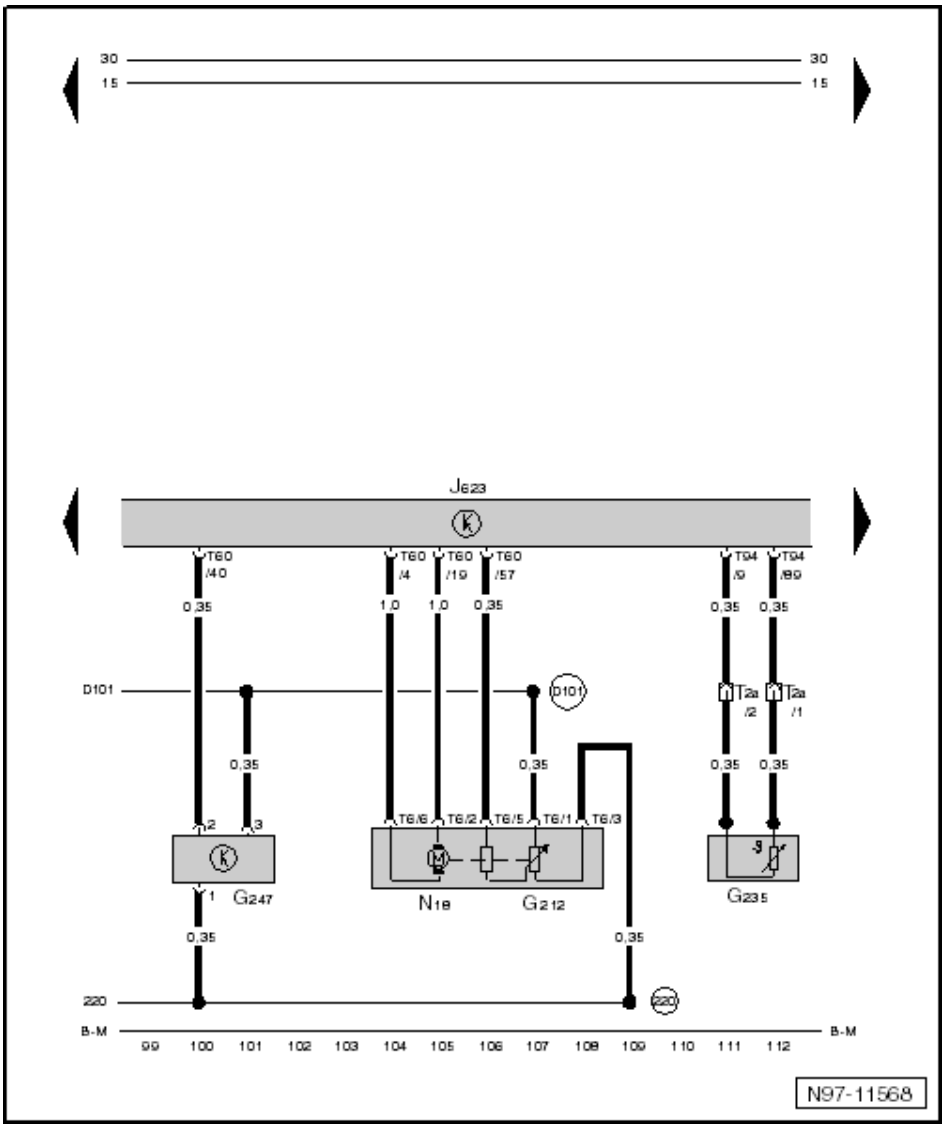
T60 - 60-pin connector

T94 - 94-pin connector

220 - Earth connection (sender earth), in engine wiring harness

D101 - Connection 1 in engine compartment wiring harness

B-M - Battery earth/engine earth



3.1.9 Brake light switch, brake pedal switch, engine control unit, charge pressure control solenoid valve, heater element for crankcase breather

F - Brake light switch

F47 - Brake pedal switch

- ❑ * Safety circuit

J67 - Brake system check blocking diode

J111 - Brake light relay

- ❑ ** If fitted (customer-specific)

J623 - Engine control unit

N75 - Charge pressure control solenoid valve

N79 - Heater element for crankcase breather

- ❑ ** If installed

S12 - Fuse

- ❑ 10 A
- ❑ In fuse holder
- ❑ ** If installed

T1 - 1-pin connector

T14 - 14-pin connector

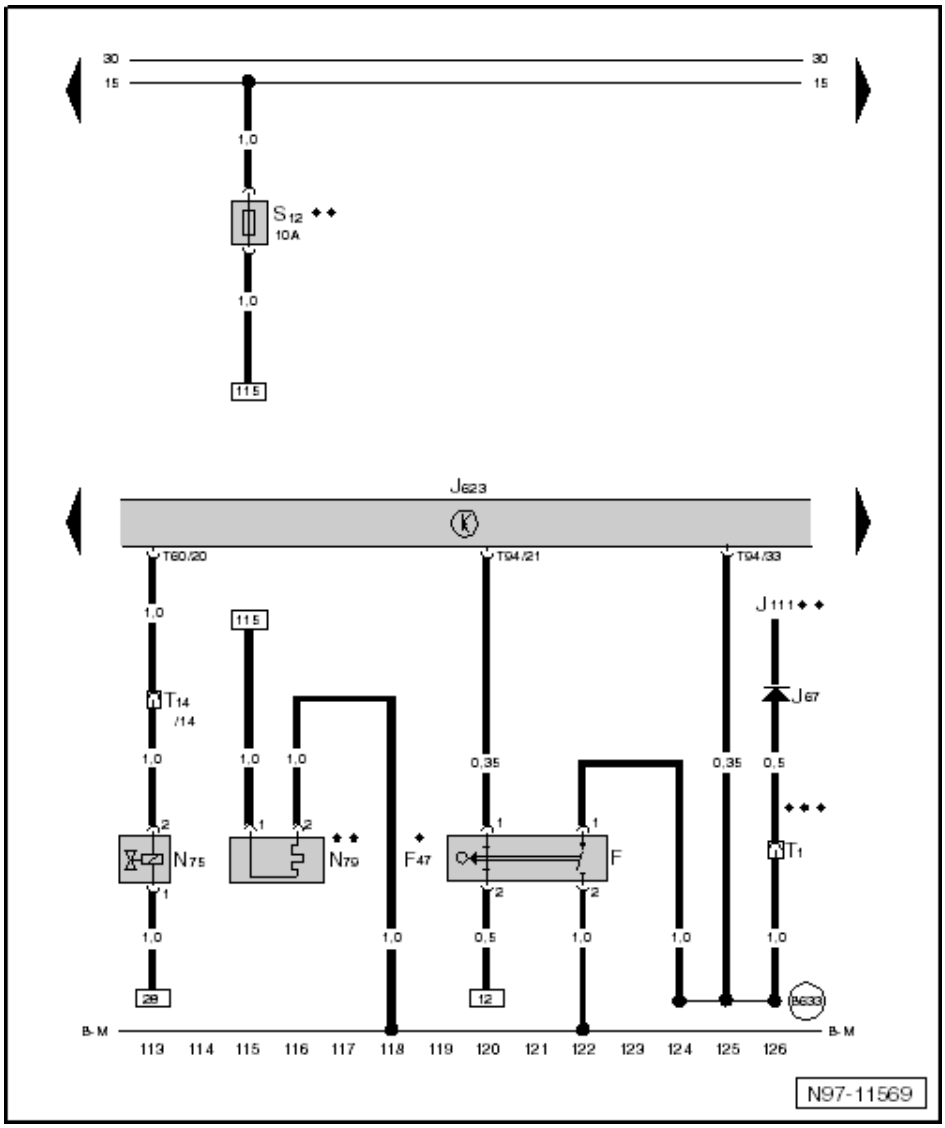
T60 - 60-pin connector

T94 - 94-pin connector

B633 - Connection (brake pedal switch), in main wiring harness

*** - Brake light output, terminal 31b**

B-M - Battery earth/engine earth



3.1.10 Working speed control switch, working speed control, resume button, preset speed switch 1 and 2, clutch pedal switch, engine control unit

E261 - Working speed governor switch

E426 - Working speed control, resume button

E433 - Preset speed 1 switch

E434 - Preset speed 2 switch

F36 - Clutch pedal switch

J623 - Engine control unit

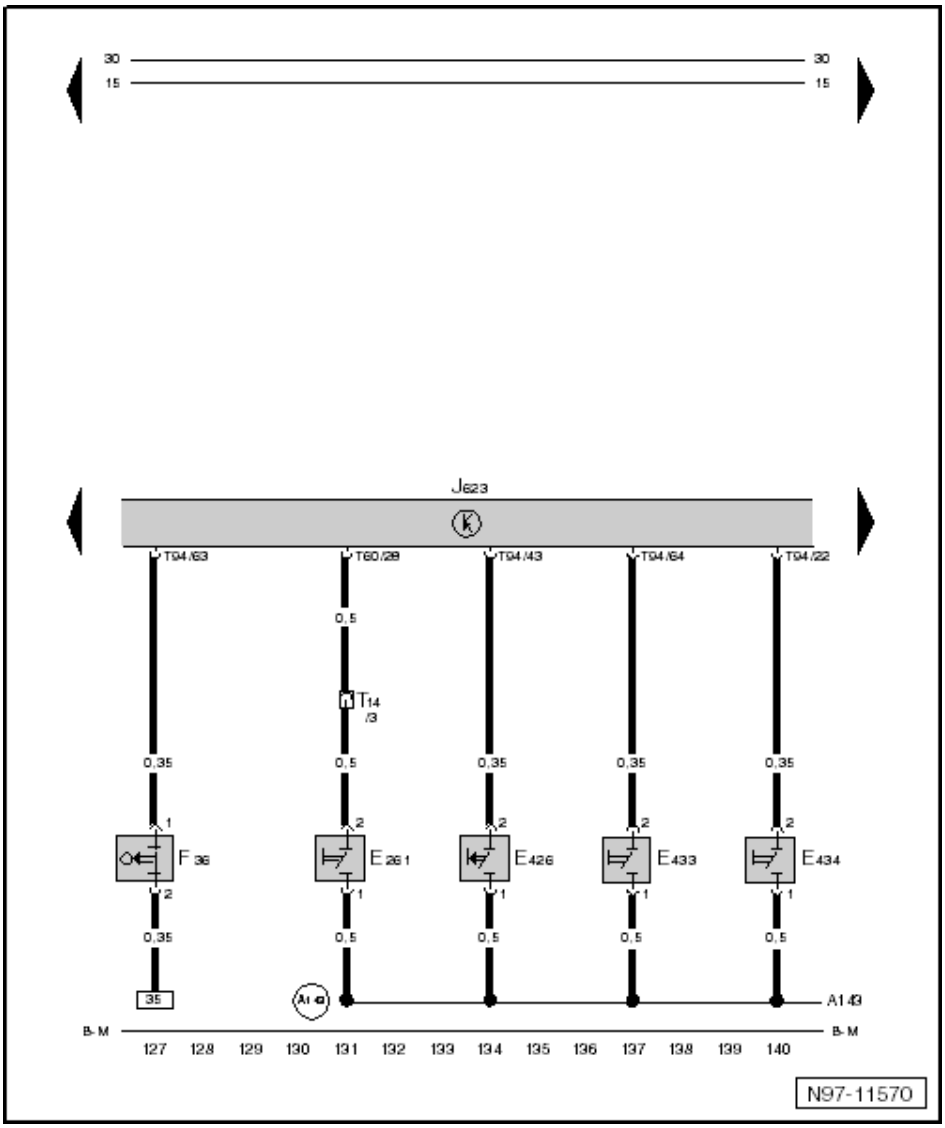
T14 - 14-pin connector

T60 - 60-pin connector

T94 - 94-pin connector

A143 - Connection (working speed control), in dash panel wiring harness

B-M - Battery earth/engine earth



3.1.11 Preset speed switch 3, engine control unit, alternator warning lamp, glow period warning lamp, exhaust emissions warning lamp

E435 - Preset speed 3 switch

J623 - Engine control unit

K2 - Warning lamp for alternator

K29 - Glow period warning lamp

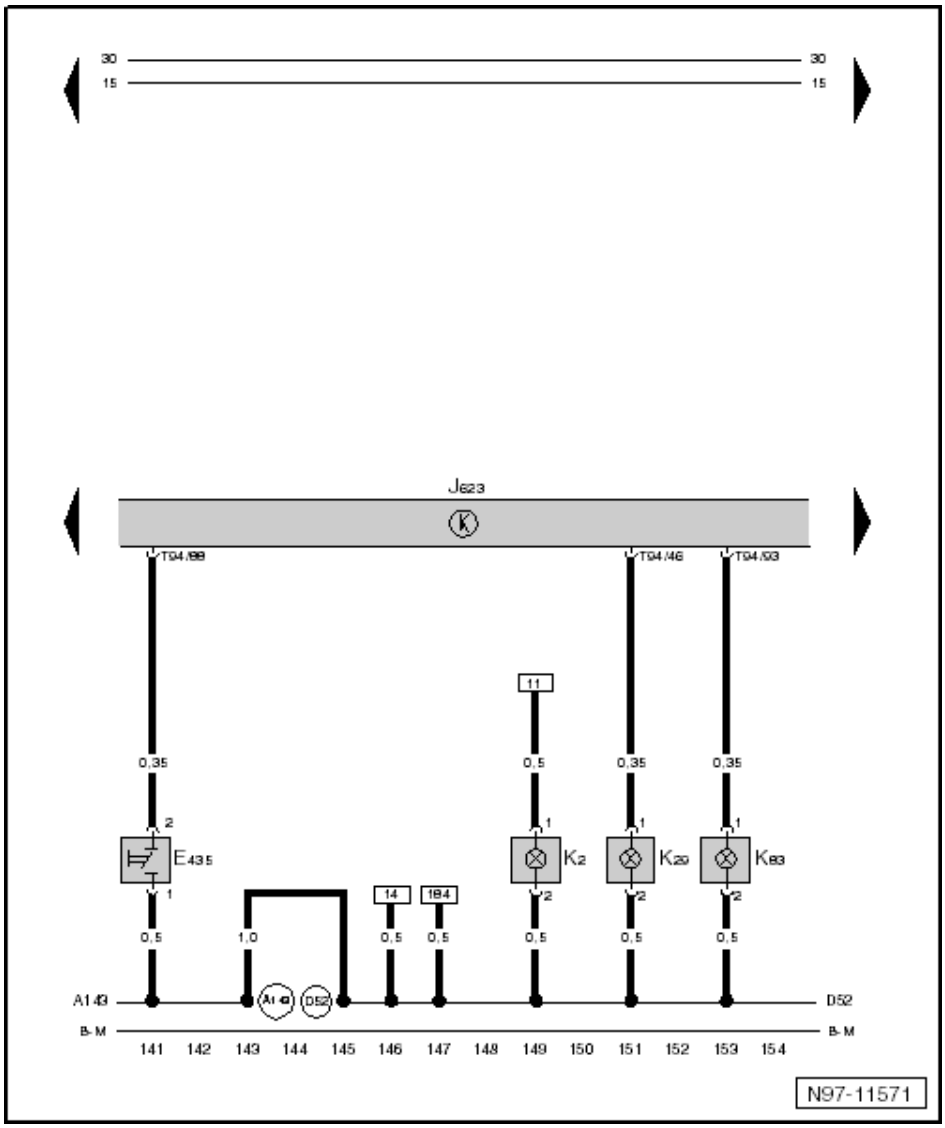
K83 - Exhaust emissions warning lamp

T94 - 94-pin connector

A143 - Connection (working speed control), in dash panel wiring harness

D52 - Positive connection (15a), in engine compartment wiring harness

B-M - Battery earth/engine earth



3.1.12 Working speed control, safety contact switch, working speed control, decrease speed button, working speed control, increase speed button, working speed control switch 2, engine control unit, working speed warning lamp

E427 - Working speed control, safety contact switch

E428 - Working speed control, decrease speed button

E429 - Working speed control, increase speed button

E604 - Working speed governor switch 2

J623 - Engine control unit

K158 - Working speed control warning lamp

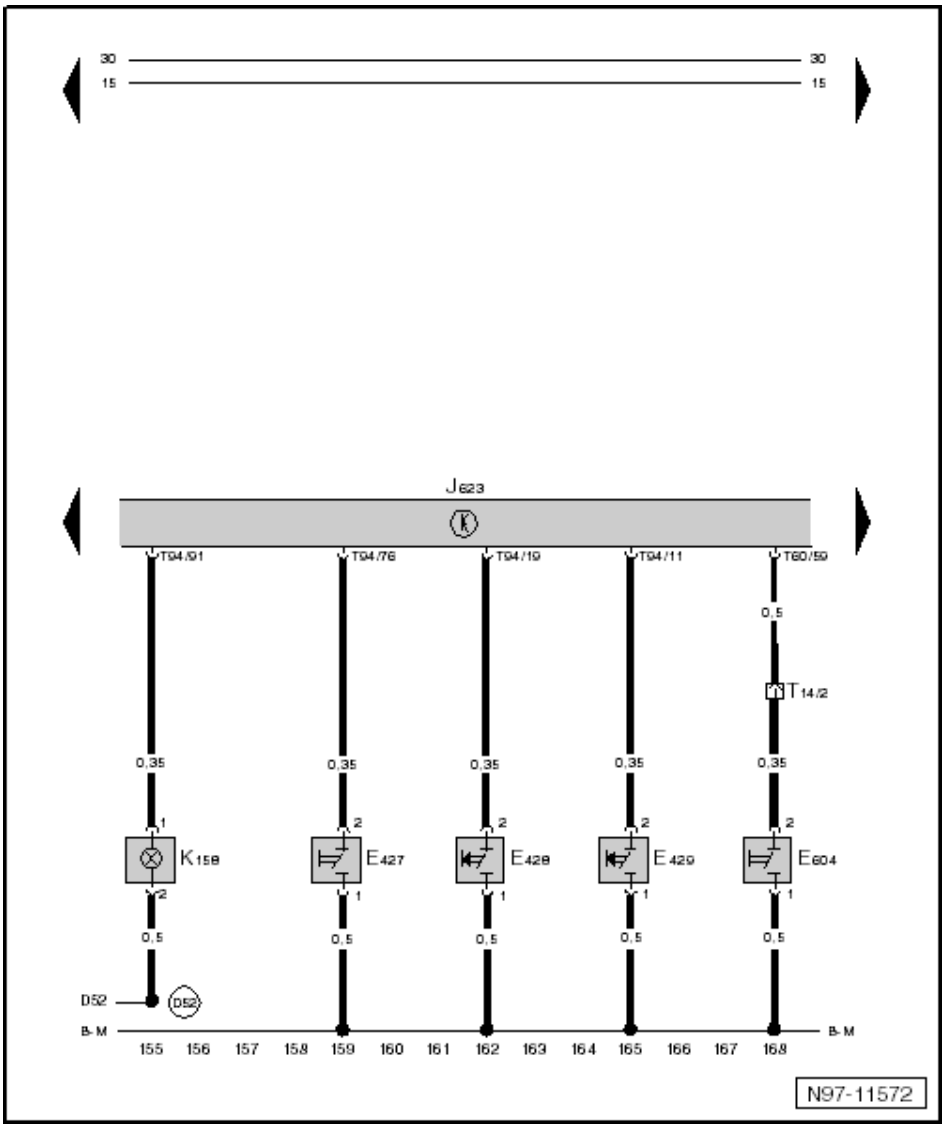
T14 - 14-pin connector

T60 - 60-pin connector

T94 - 94-pin connector

D52 - Positive connection (15a), in engine compartment wiring harness

B-M - Battery earth/engine earth



3.1.13 Jumpers, radiator fan relay, engine control unit, radiator fan single fuse, radiator fan

J26 - Radiator fan relay

J623 - Engine control unit

S... - Fuse

- 5 A
- In fuse holder

S42 - Radiator fan single fuse

- * Fuse rating depends on used radiator fan used

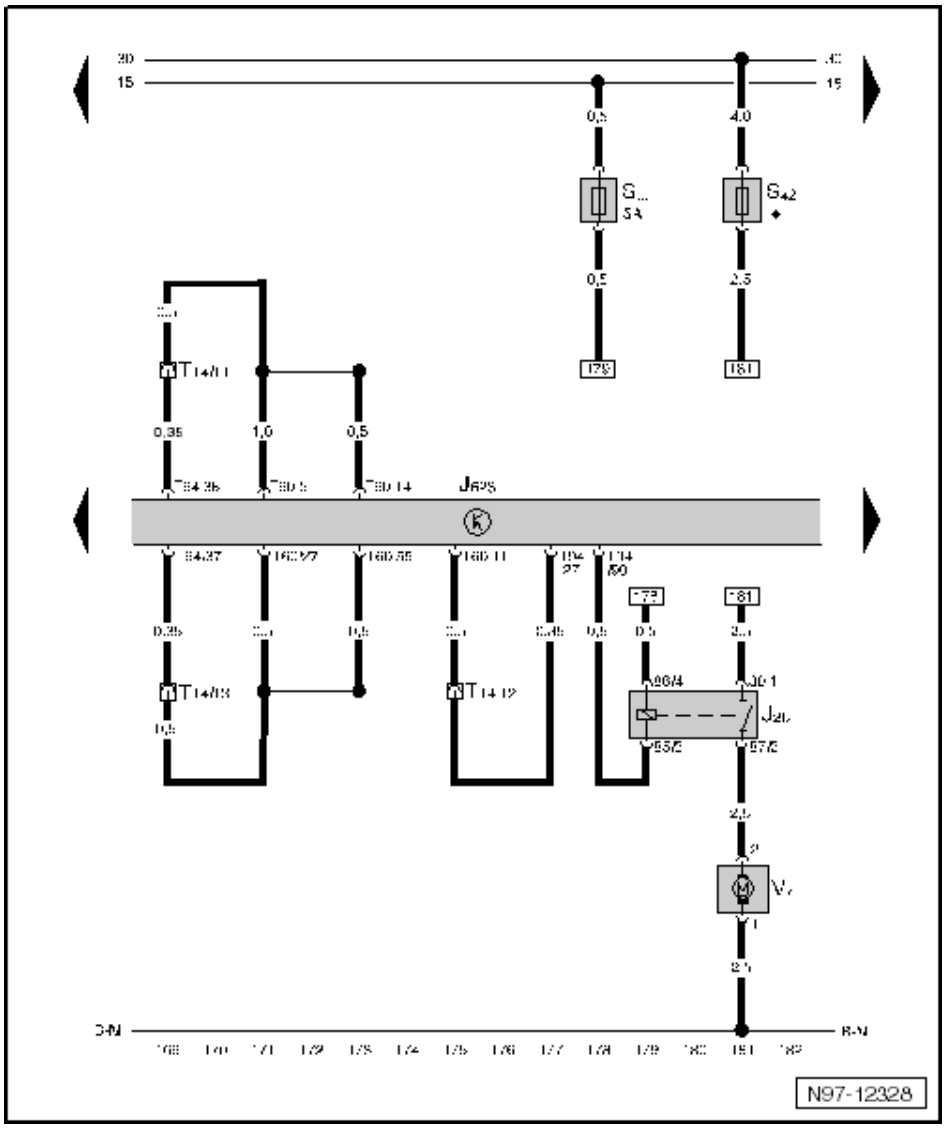
T14 - 14-pin connector

T60 - 60-pin connector

T94 - 94-pin connector

V7 - Radiator fan

B-M - Battery earth/engine earth



3.1.14 Diagnostic connection, oil pressure switch, engine control unit, oil pressure warning lamp

F1 - Oil pressure switch

J150 - Oil pressure monitor delay relay

- ❑ * Customer-specific

J623 - Engine control unit

K3 - Oil pressure warning lamp

S... - Fuse

- ❑ 5 A
- ❑ In fuse holder

T14 - 14-pin connector

T16 - 16-pin connector

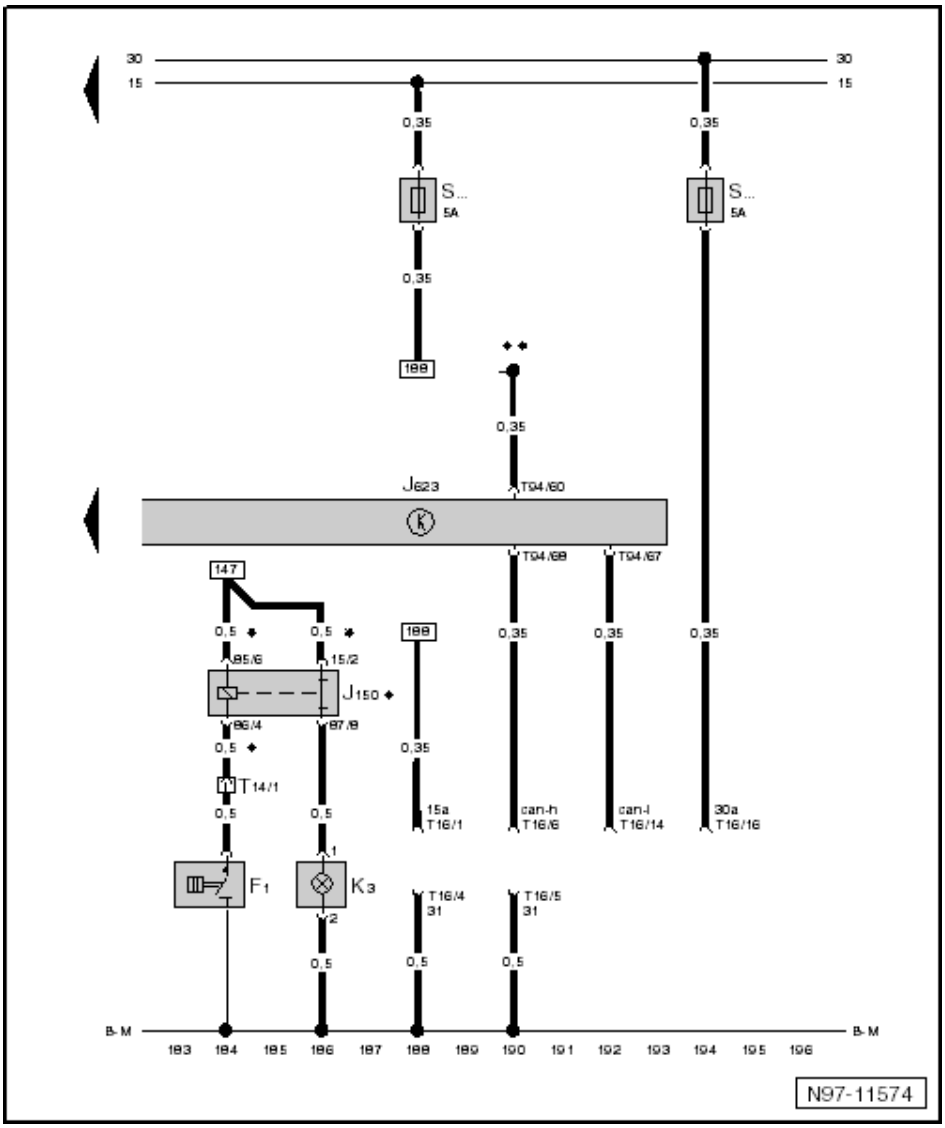
- ❑ Diagnostic connection

T94 - 94-pin connector

*** - Customer-specific**

**** - Speed signal output**

B-M - Battery earth/engine earth



3.2 Current flow diagrams, engine codes CPYA, CPYB, compliant with emission standard (97/68 stage 3b)

Battery, starter, alternator, voltage regulator, ignition/starter switch fuses ⇒Page 503.

Electric fuel pump 2 relay, automatic glow period control unit, glow plugs, fuses, supplementary fuel pump ⇒Page 504.

Terminal 30 voltage supply relay, engine control unit, fuses ⇒Page 505.

Jumpers, charge pressure sender, intake air temperature sender, air mass meter, engine control unit ⇒Page 506.

Accelerator position sender, accelerator position sender 2, engine control unit, injectors, cylinders 1 - 4 ⇒Page 506.

Hall sender, coolant temperature sender, engine control unit, fuel pressure regulating valve, fuel metering valve ⇒Page 507.

Engine speed sender, throttle valve potentiometer, fuel temperature sender, position sender for charge pressure positioner, throttle valve module, engine control unit ⇒Page 508.

Exhaust gas recirculation potentiometer, fuel pressure sender, engine control unit, exhaust gas recirculation valve ⇒Page 509.

Exhaust gas temperature sender 1, exhaust gas temperature sender 3, exhaust gas temperature sender 4, engine control unit ⇒Page 510.

Lambda probe, exhaust gas pressure sensor 1, engine control unit, lambda probe heater ⇒Page 511.

Brake light switch, brake pedal switch, engine control unit, charge pressure control solenoid valve, heater element for crankcase breather ⇒Page 512.

Working speed control switch, working speed control, resume button, preset speed switch 1 and 2, clutch pedal switch, engine control unit ⇒Page 513.

Preset speed 3 switch, engine control unit, alternator warning lamp, glow period warning lamp, exhaust emissions warning lamp, diesel particulate filter warning lamp ⇒Page 514.

Working speed control, safety contact switch, working speed control, decrease speed button, working speed control, increase speed button, working speed control switch 2, engine control unit, working speed warning lamp ⇒Page 515.

Jumpers, radiator fan relay, engine control unit, radiator fan single fuse, radiator fan ⇒Page 516.

Diagnostic connection, oil pressure switch, engine control unit, oil pressure warning lamp ⇒Page 517.

3.2.1 Battery, starter, alternator, voltage regulator, ignition/starter switch fuses

A - Battery

B - Starter

C - Alternator

C1 - Voltage regulator

D - Ignition/starter switch

S5 - Fuse

- ❑ 15 A
- ❑ In fuse holder

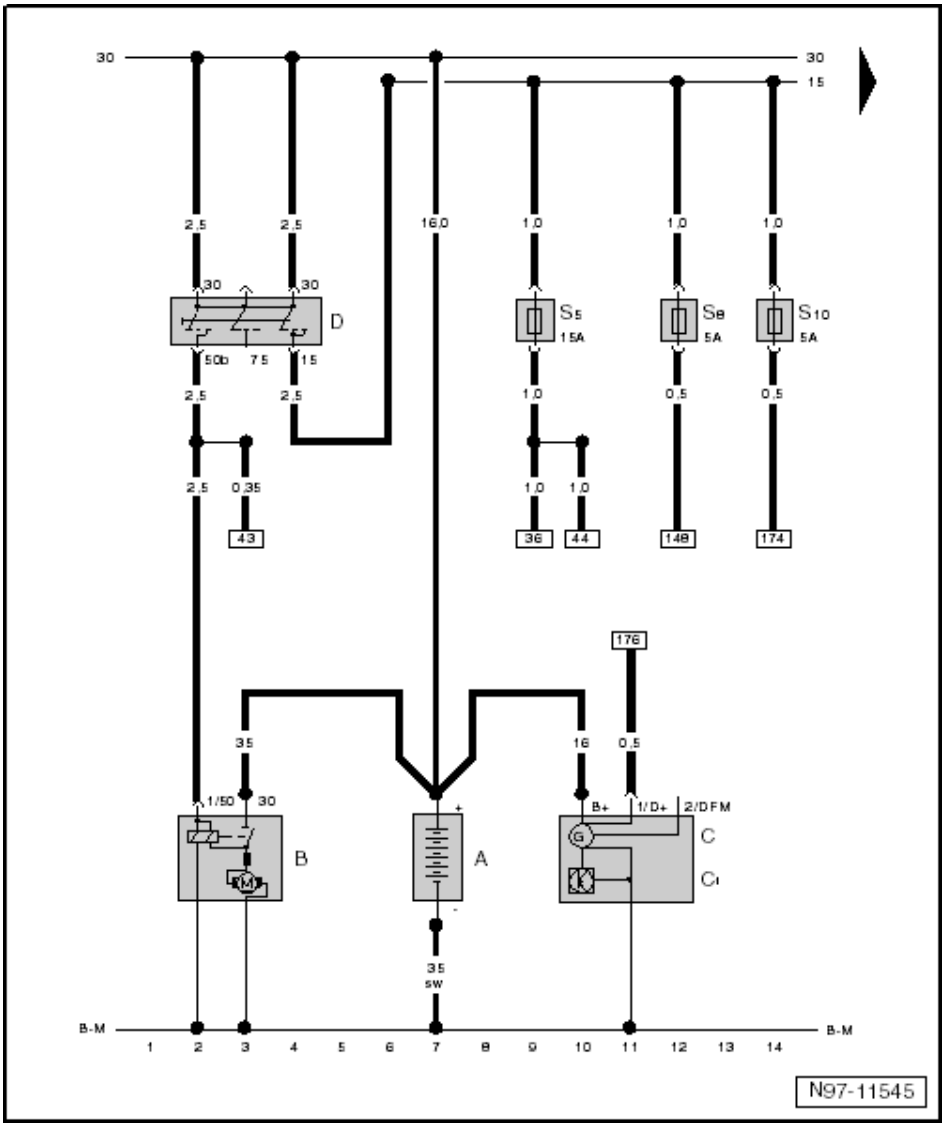
S8 - Fuse

- ❑ 5 A
- ❑ In fuse holder

S10 - Fuse

- ❑ 5 A
- ❑ In fuse holder

B-M - Battery earth/engine earth



3.2.2 Electric fuel pump 2 relay, automatic glow period control unit, glow plugs, fuses, supplementary fuel pump

J49 - Electric fuel pump 2 relay

J179 - Automatic glow period control unit

Q10 - Glow plug 1

Q11 - Glow plug 2

Q12 - Glow plug 3

Q13 - Glow plug 4

S1 - Fuse

- ❑ 20 A
- ❑ In fuse holder

S3 - Fuse

- ❑ 50 A
- ❑ In fuse holder

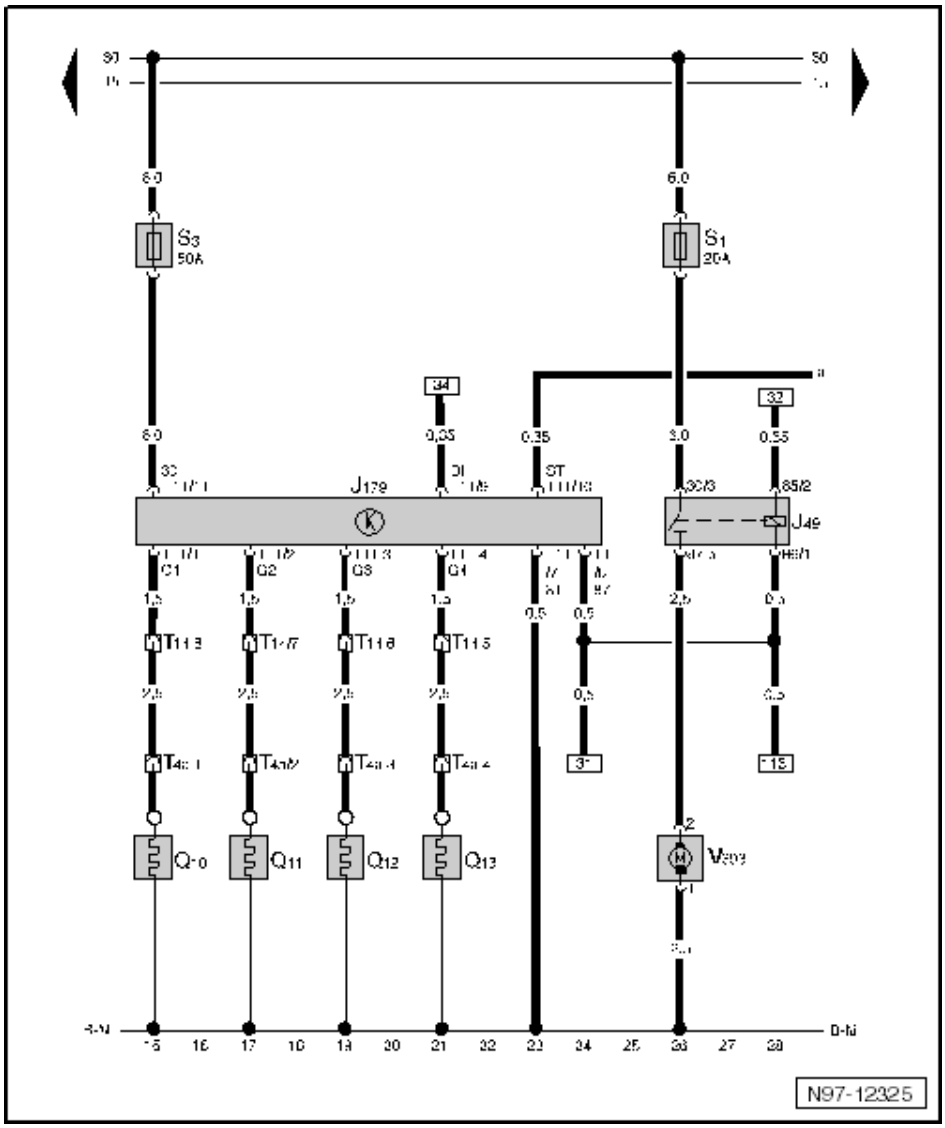
T4a - 4-pin connector

T11 - 11-pin connector

T14 - 14-pin connector

V393 - Supplementary fuel pump

B-M - Battery earth/engine earth



3.2.3 Terminal 30 voltage supply relay, engine control unit, fuses

J317 - Terminal 30 voltage supply relay

J623 - Engine control unit

S2 - Fuse
- ❑ 20 A
- ❑ In fuse holder

S4 - Fuse
- ❑ 15 A
- ❑ In fuse holder

S6 - Fuse
- ❑ 5 A
- ❑ In fuse holder

S7 - Fuse
- ❑ 30 A
- ❑ In fuse holder

S9 - Fuse
- ❑ 5 A
- ❑ In fuse holder

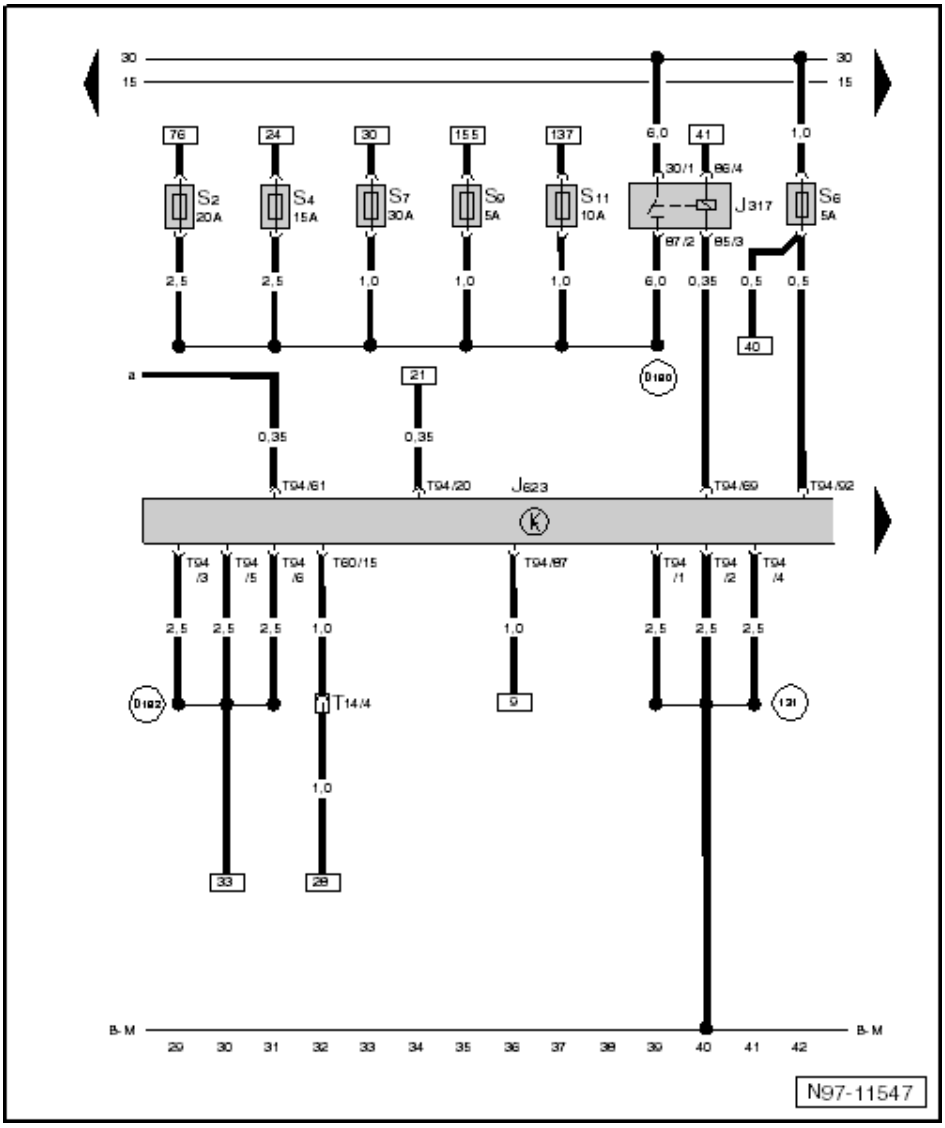
S11 - Fuse
- ❑ 10 A
- ❑ In fuse holder

T14 - 14-pin connector

T60 - 60-pin connector

T94 - 94-pin connector

131 - Earth connection 2, in engine compartment wiring harness



D180 - Connection (87a), in engine compartment wiring harness

D182 - Connection 3 (87a), in engine compartment wiring harness

B-M - Battery earth/engine earth

3.2.4 Jumpers, charge pressure sender, intake air temperature sender, air mass meter, engine control unit

G31 - Charge air pressure sender

G42 - Intake air temperature sender

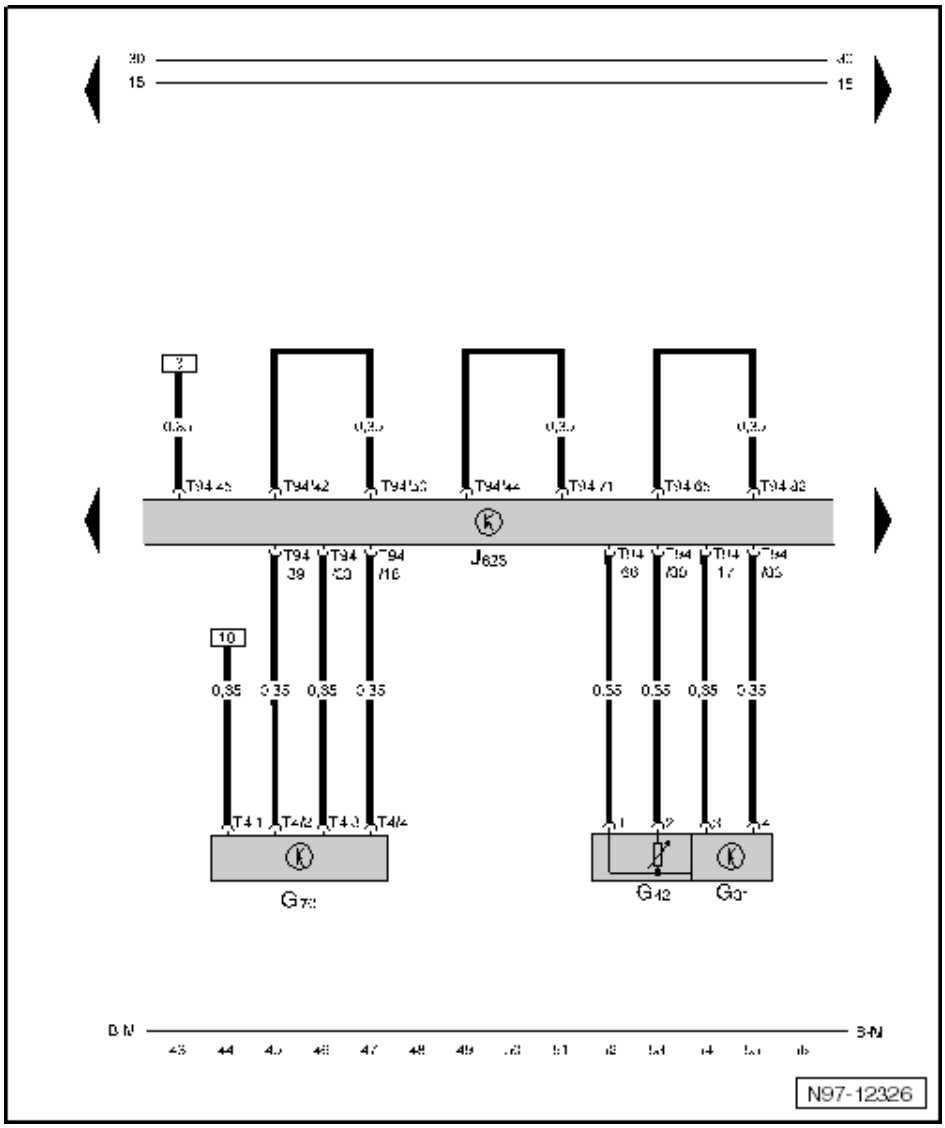
G70 - Air mass meter

J623 - Engine control unit

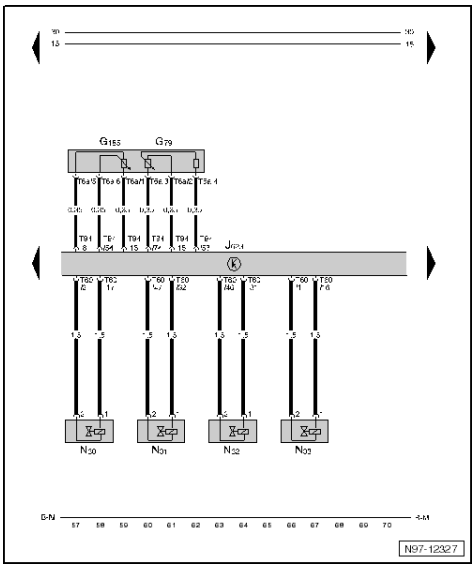
T4 - 4-pin connector

T94 - 94-pin connector

B-M - Battery earth/engine earth



3.2.5 Accelerator position sender, accelerator position sender 2, engine control unit, injectors, cylinders 1 - 4



3.2.6 Hall sender, coolant temperature sender, engine control unit, fuel pressure regulating valve, fuel metering valve

G40 - Hall sender

G62 - Coolant temperature sender

J623 - Engine control unit

N276 - Fuel pressure regulating valve

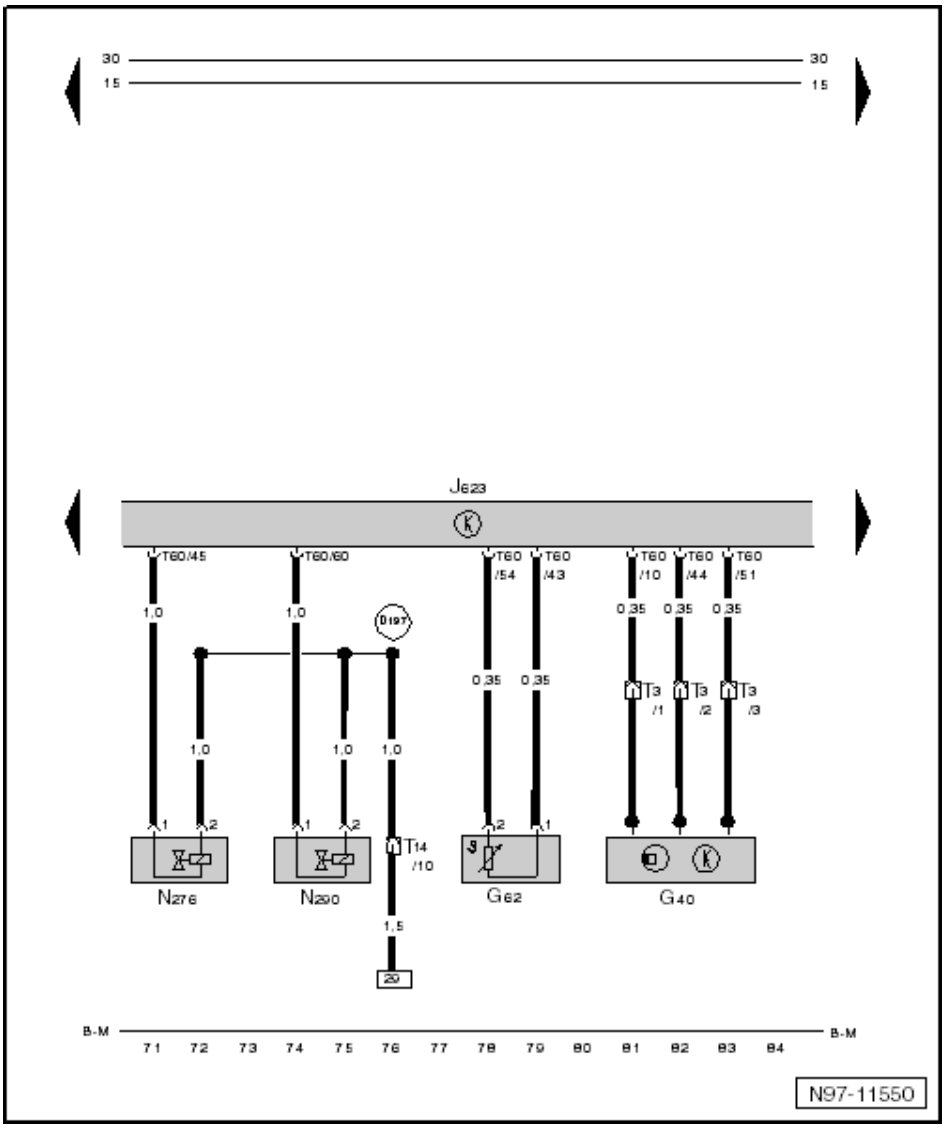
N290 - Fuel metering valve

T3 - 3-pin connector

T14 - 14-pin connector

T60 - 60-pin connector

B-M - Battery earth/engine earth



3.2.7 Engine speed sender, throttle valve potentiometer, fuel temperature sender, position sender for charge pressure positioner, throttle valve module, engine control unit

G28 - Engine speed sender

G69 - Throttle valve potentiometer

G81 - Fuel temperature sender

G581 - Position sender for charge pressure positioner

J338 - Throttle valve module

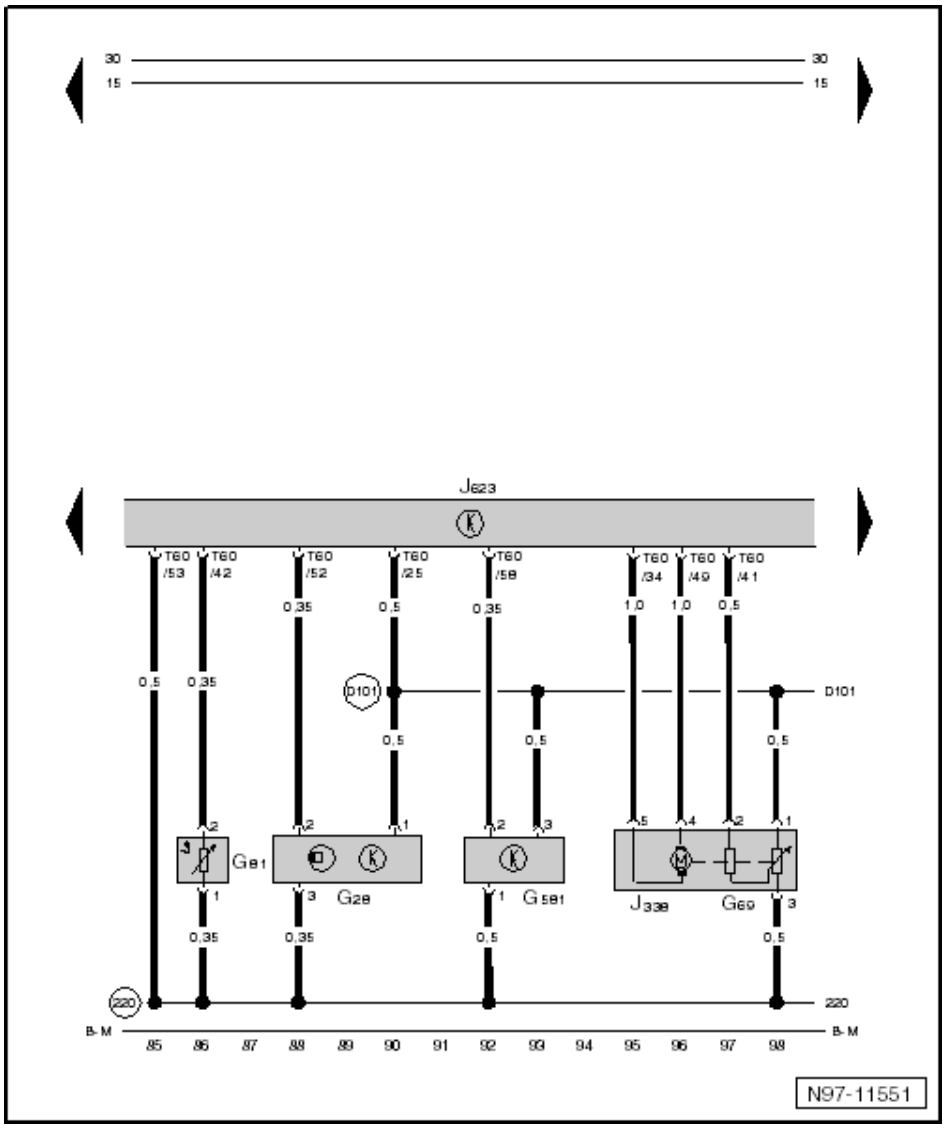
J623 - Engine control unit

T60 - 60-pin connector

220 - Earth connection (sender earth), in engine wiring harness

D101 - Connection 1 in engine compartment wiring harness

B-M - Battery earth/engine earth



3.2.8 Exhaust gas recirculation potentiometer, fuel pressure sender, engine control unit, exhaust gas recirculation valve

G212 - Exhaust gas recirculation potentiometer

G247 - Fuel pressure sender

J623 - Engine control unit

N18 - Exhaust gas recirculation valve

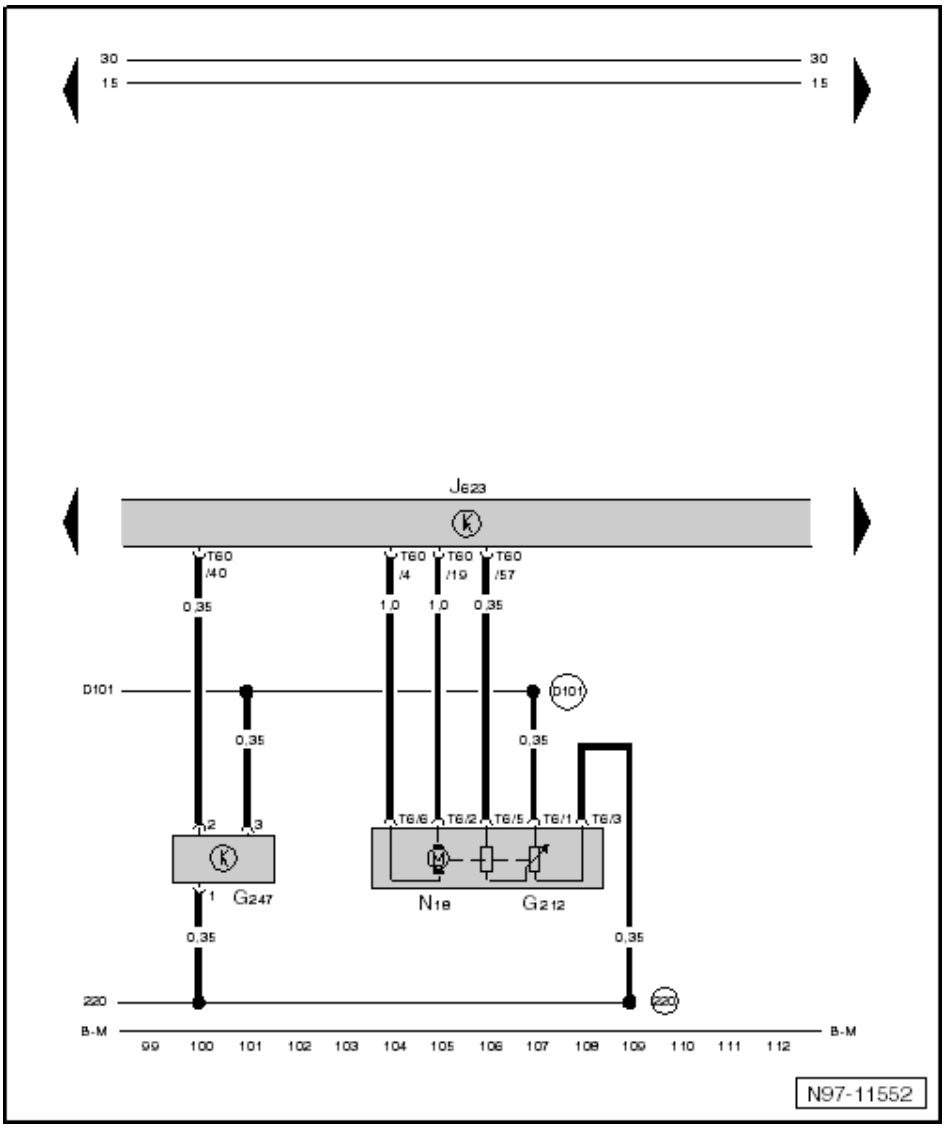
T6 - 6-pin connector

T60 - 60-pin connector

220 - Earth connection (sender earth), in engine wiring harness

D101 - Connection 1 in engine compartment wiring harness

B-M - Battery earth/engine earth



3.2.9 Exhaust gas temperature sender 1, exhaust gas temperature sender 3, exhaust gas temperature sender 4, engine control unit

G235 - Exhaust gas temperature sender 1

G495 - Exhaust gas temperature sender 3

G648 - Exhaust gas temperature sender 4

J623 - Engine control unit

T2a - 2-pin connector

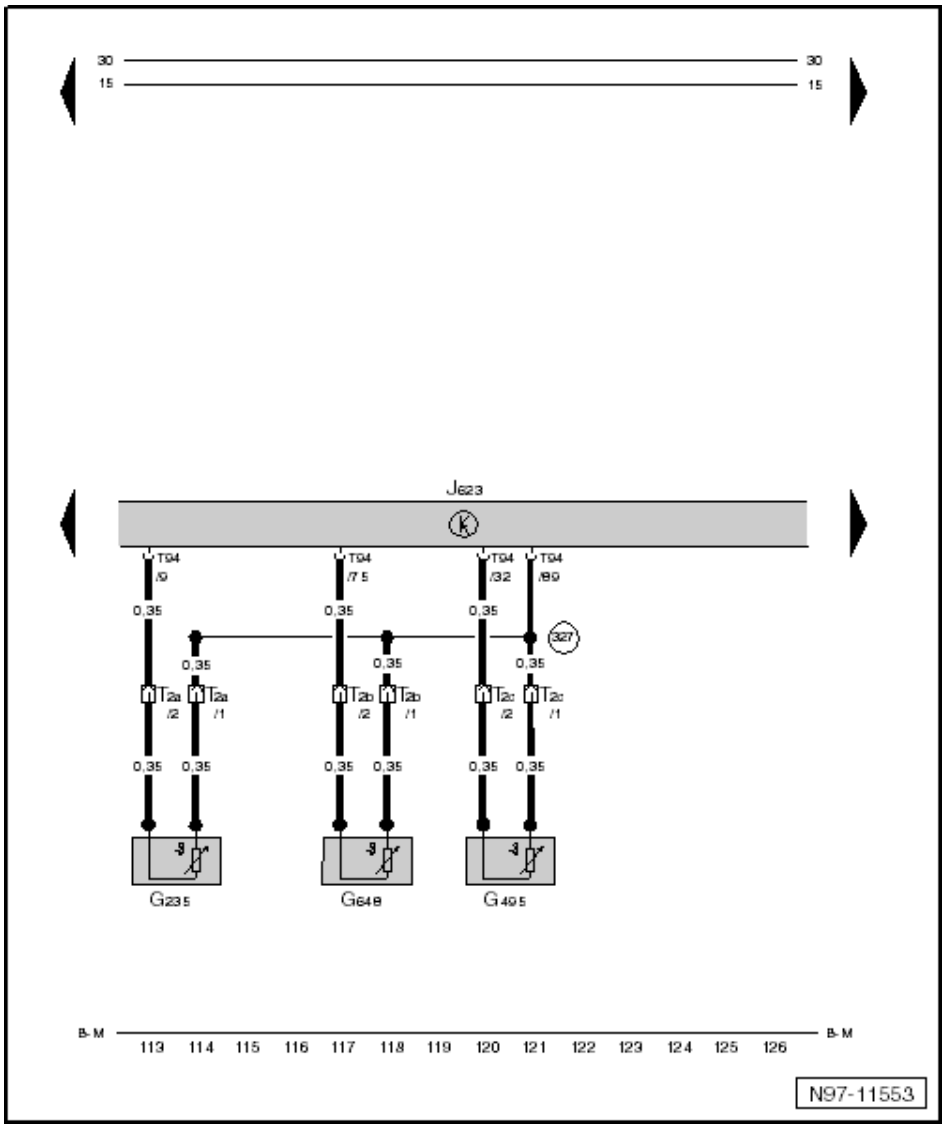
T2b - 2-pin connector

T2c - 2-pin connector

T94 - 94-pin connector

327 - Earth connection (sender earth), in engine wiring harness

B-M - Battery earth/engine earth



3.2.10 Lambda probe, exhaust gas pressure sensor 1, engine control unit, lambda probe heater

G39 - Lambda probe

G450 - Exhaust gas pressure sensor 1

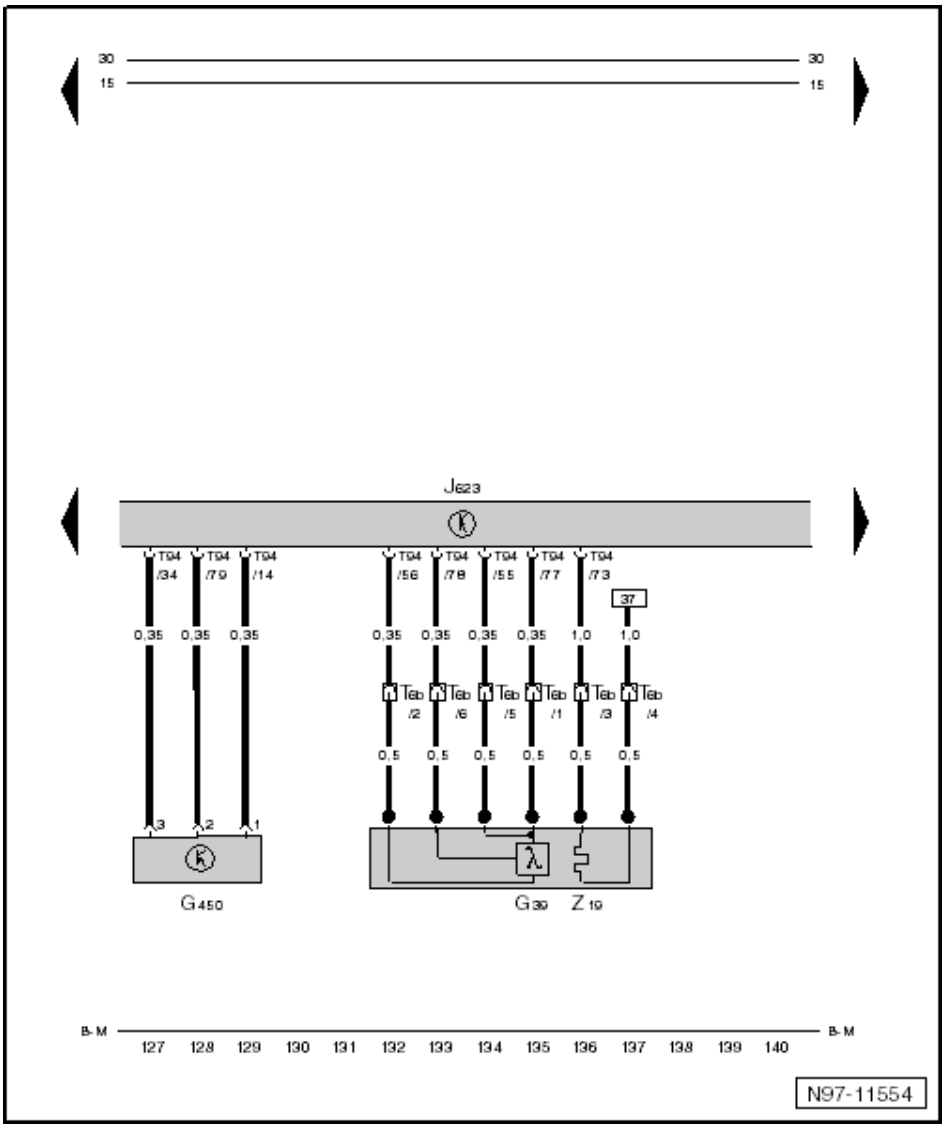
J623 - Engine control unit

Z19 - Lambda probe heater

T6b - 6-pin connector

T94 - 94-pin connector

B-M - Battery earth/engine earth



3.2.11 Brake light switch, brake pedal switch, engine control unit, charge pressure control solenoid valve, heater element for crankcase breather

F - Brake light switch

F47 - Brake pedal switch

- ❑ * Safety circuit

J67 - Brake system check blocking diode

J111 - Brake light relay

- ❑ ** If fitted (customer-specific)

J623 - Engine control unit

N75 - Charge pressure control solenoid valve

N79 - Heater element for crankcase breather

- ❑ ** If installed

S12 - Fuse

- ❑ 10 A
- ❑ In fuse holder
- ❑ ** If installed

T1 - 1-pin connector

T14 - 14-pin connector

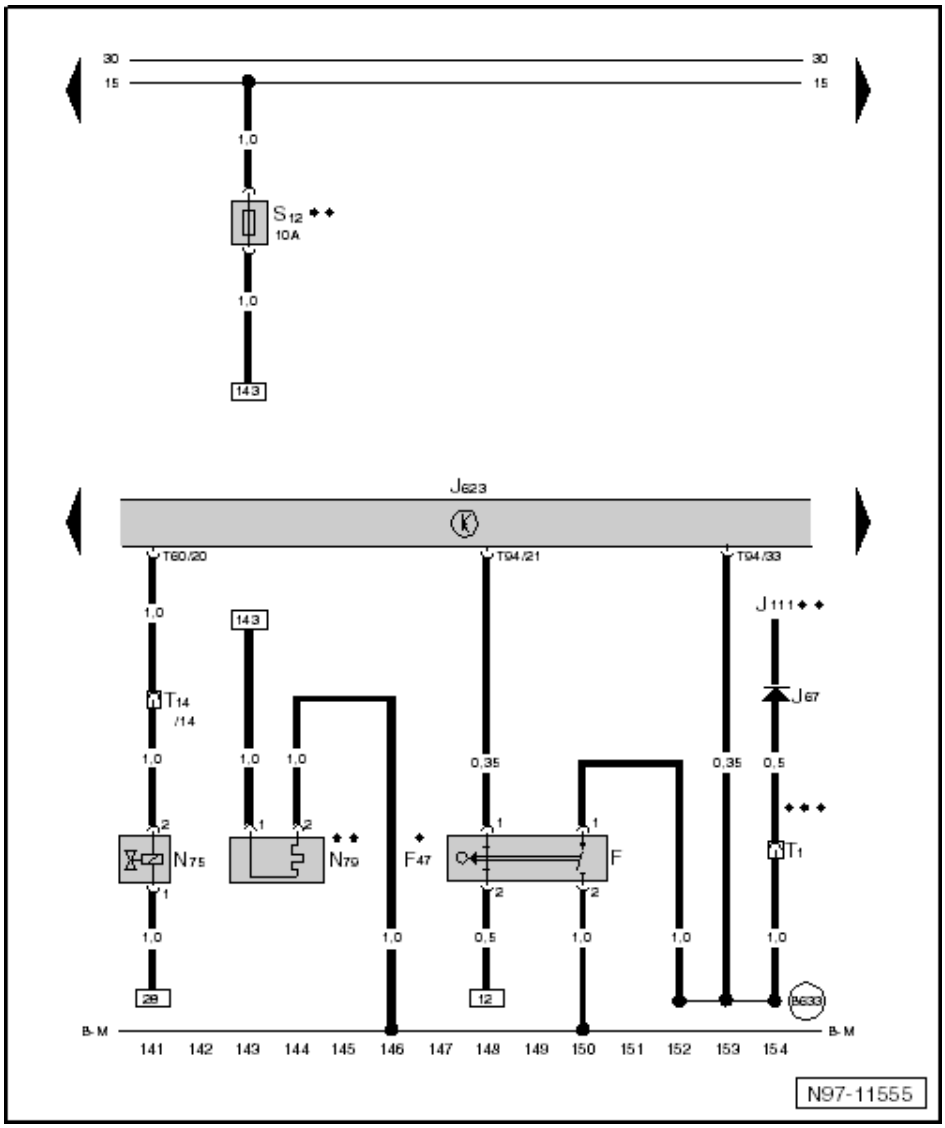
T60 - 60-pin connector

T94 - 94-pin connector

B633 - Connection (brake pedal switch), in main wiring harness

*** - Brake light output, terminal 31b**

B-M - Battery earth/engine earth



3.2.12 Working speed control switch, working speed control, resume button, preset speed switch 1 and 2, clutch pedal switch, engine control unit

E261 - Working speed governor switch

E426 - Working speed control, resume button

E433 - Preset speed 1 switch

E434 - Preset speed 2 switch

F36 - Clutch pedal switch

J623 - Engine control unit

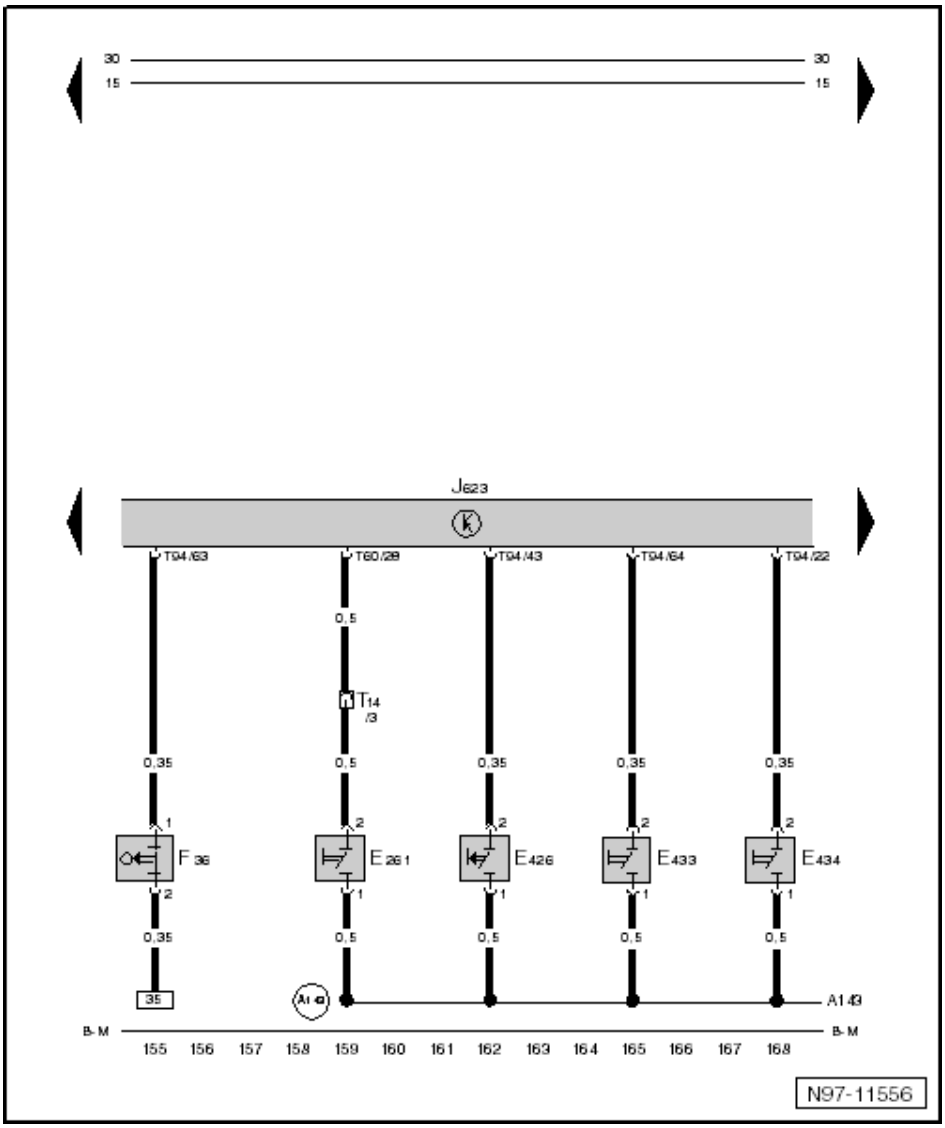
T14 - 14-pin connector

T60 - 60-pin connector

T94 - 94-pin connector

A143 - Connection (working speed control), in dash panel wiring harness

B-M - Battery earth/engine earth



3.2.13 Preset speed 3 switch, engine control unit, alternator warning lamp, glow period warning lamp, exhaust emissions warning lamp, diesel particulate filter warning lamp

E435 - Preset speed 3 switch

J623 - Engine control unit

K2 - Warning lamp for alternator

K29 - Glow period warning lamp

K83 - Exhaust emissions warning lamp

K231 - Warning lamp for diesel particle filter

T14 - 14-pin connector

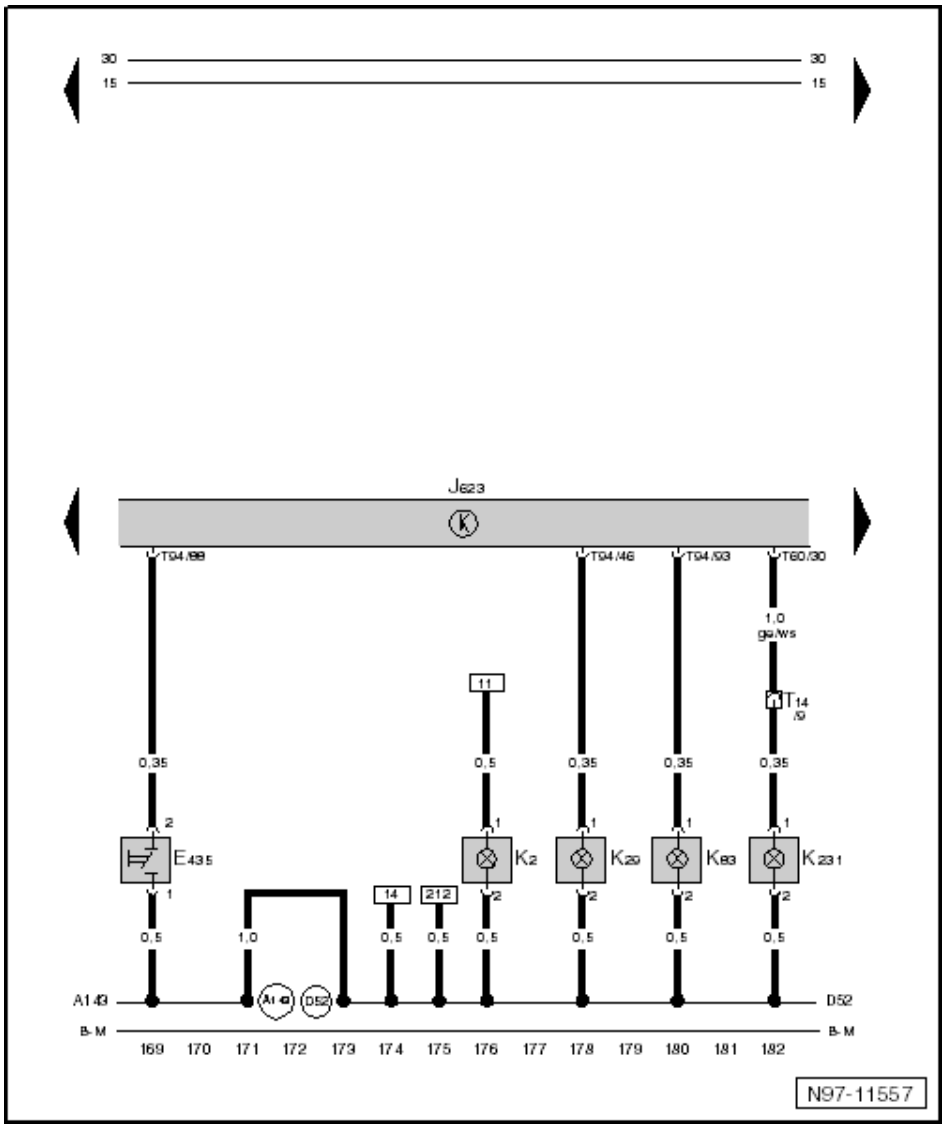
T60 - 60-pin connector

T94 - 94-pin connector

A143 - Connection (working speed control), in dash panel wiring harness

D52 - Positive connection (15a), in engine compartment wiring harness

B-M - Battery earth/engine earth



3.2.14 Working speed control, safety contact switch, working speed control, decrease speed button, working speed control, increase speed button, working speed control switch 2, engine control unit, working speed warning lamp

E427 - Working speed control, safety contact switch

E428 - Working speed control, decrease speed button

E429 - Working speed control, increase speed button

E604 - Working speed governor switch 2

J623 - Engine control unit

K158 - Working speed control warning lamp

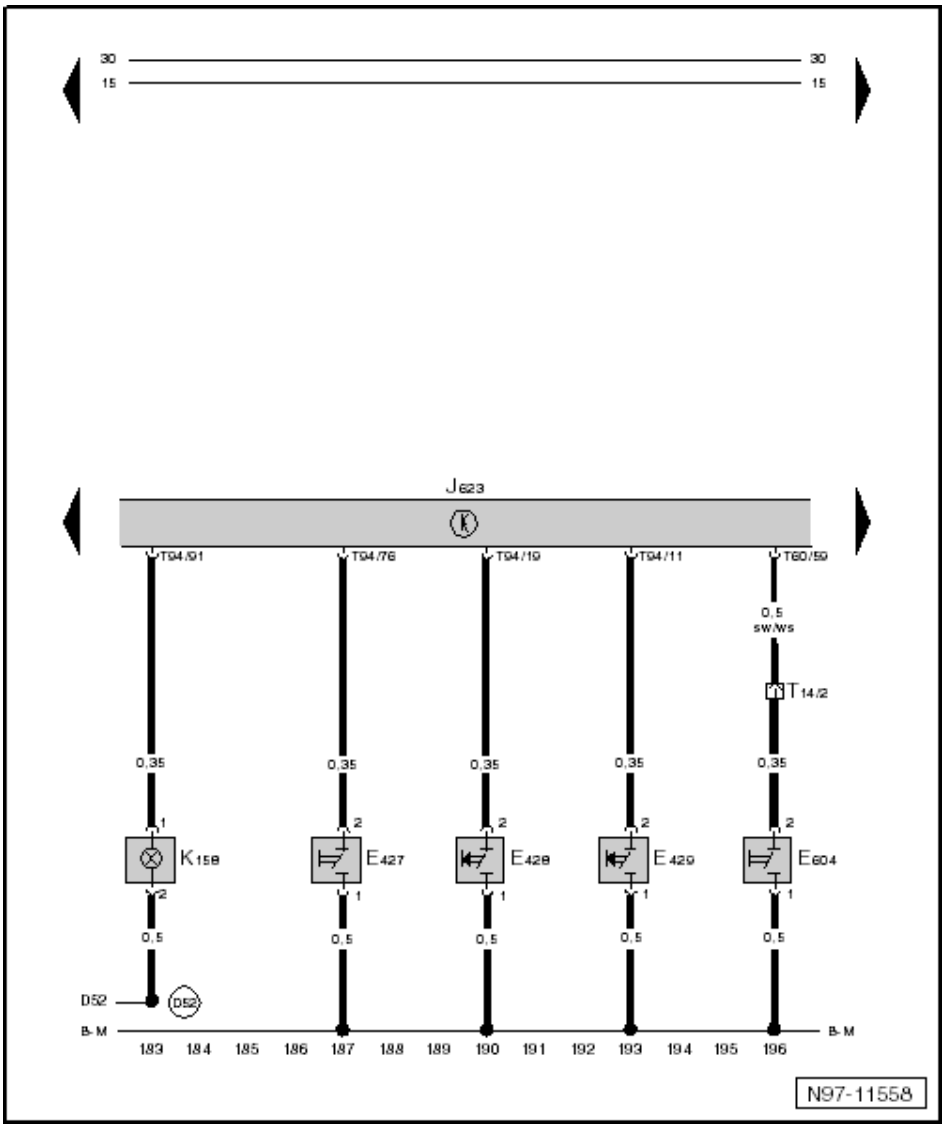
T14 - 14-pin connector

T60 - 60-pin connector

T94 - 94-pin connector

D52 - Positive connection (15a), in engine compartment wiring harness

B-M - Battery earth/engine earth



3.2.15 Jumpers, radiator fan relay, engine control unit, radiator fan single fuse, radiator fan

J26 - Radiator fan relay

J623 - Engine control unit

S... - Fuse

- 5 A
- In fuse holder

S42 - Radiator fan single fuse

- * Fuse rating depends on used radiator fan used

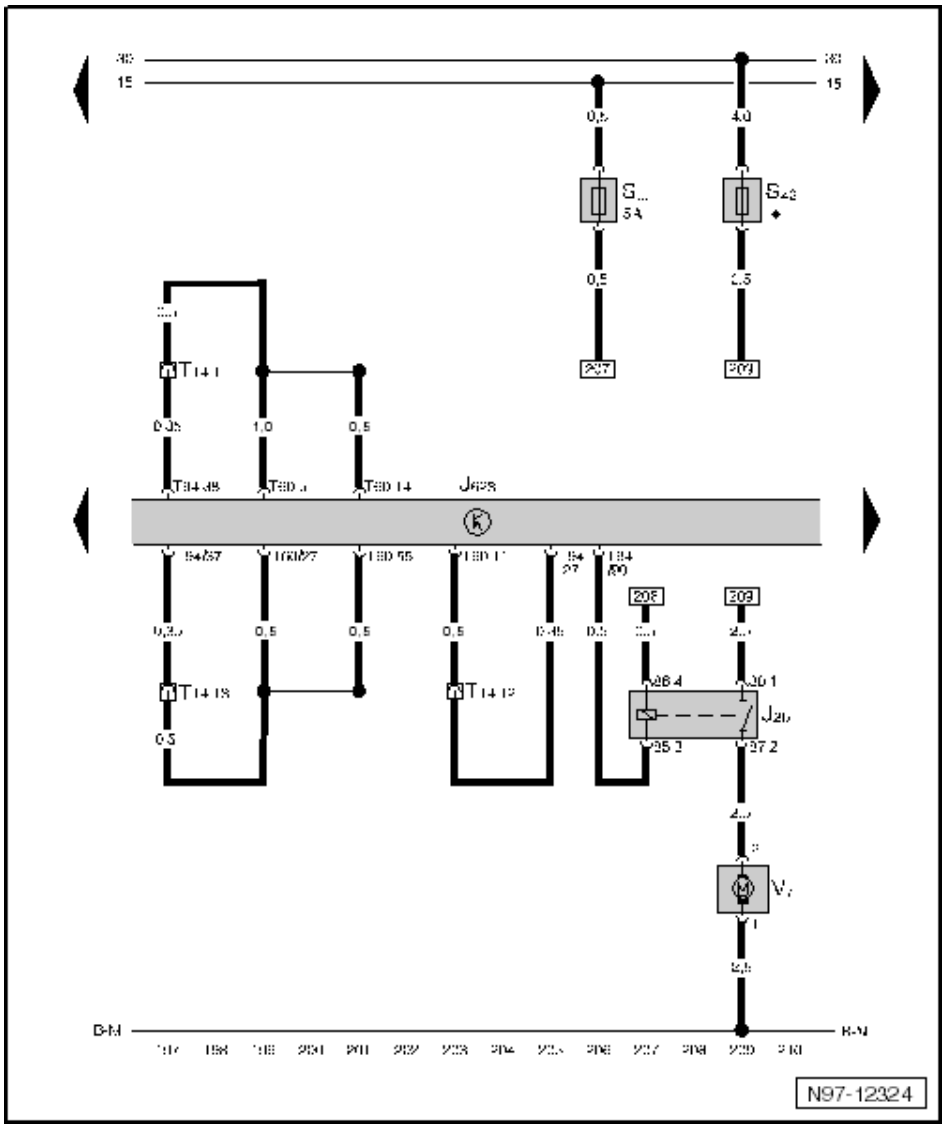
T14 - 14-pin connector

T60 - 60-pin connector

T94 - 94-pin connector

V7 - Radiator fan

B-M - Battery earth/engine earth



3.2.16 Diagnostic connection, oil pressure switch, engine control unit, oil pressure warning lamp

F1 - Oil pressure switch

J150 - Oil pressure monitor delay relay

- ❑ * Customer-specific

J623 - Engine control unit

K3 - Oil pressure warning lamp

S... - Fuse

- ❑ 5 A
- ❑ In fuse holder

T14 - 14-pin connector

T16 - 16-pin connector

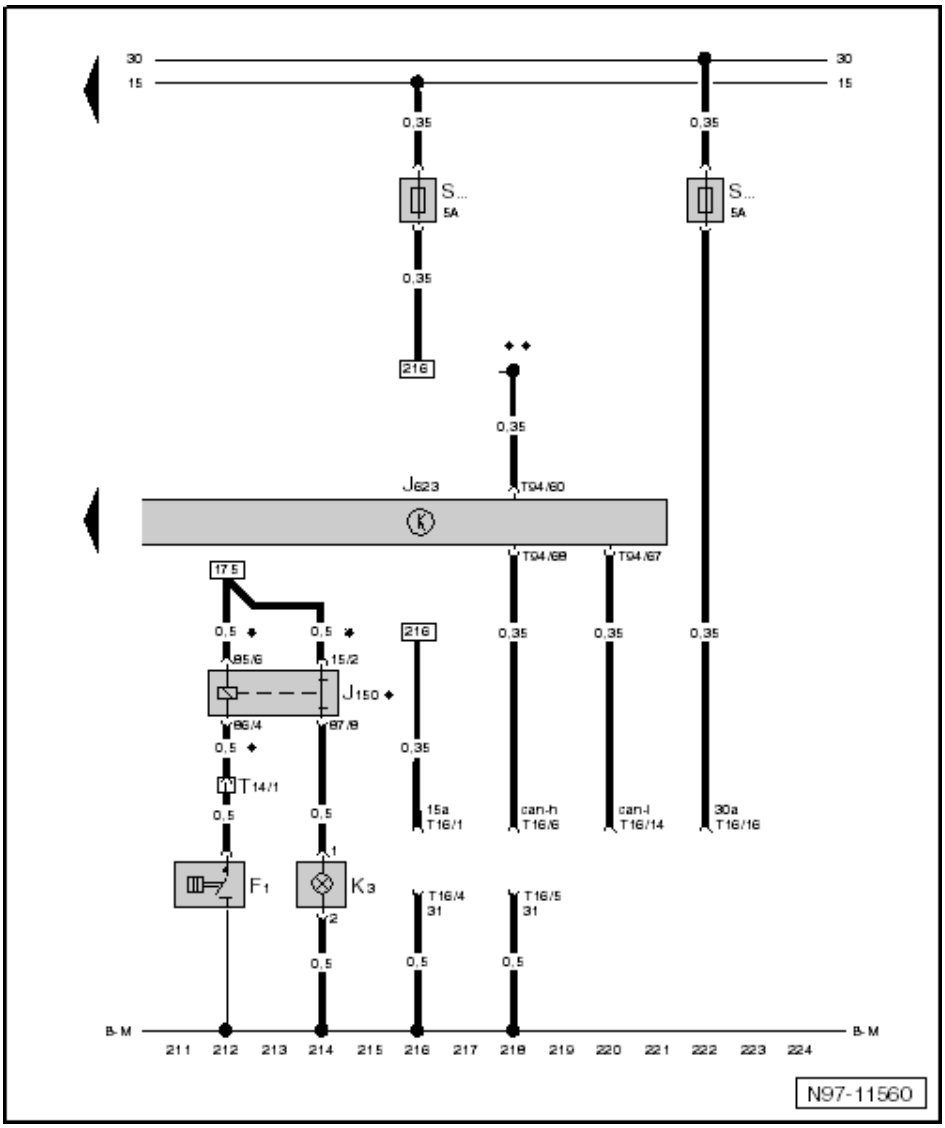
- ❑ Diagnostic connection

T94 - 94-pin connector

*** - Customer-specific**

**** - Speed signal output**

B-M - Battery earth/engine earth



3.3 Current flow diagrams, engine codes CJDA, CJDD, compliant with emission standard (EU5)

Battery, starter, alternator, voltage regulator, ignition/starter switch ⇒Page 519.

Electric fuel pump 2 relay, automatic glow period control unit, glow plugs, fuses, supplementary fuel pump ⇒Page 520.

Terminal 30 voltage supply relay, engine control unit, fuses ⇒Page 521.

Jumpers, charge pressure sender, intake air temperature sender, air mass meter, engine control unit ⇒Page 522.

Accelerator position sender, accelerator position sender 2, engine control unit, injectors, cylinders 1 - 4 ⇒Page 523.

Hall sender, coolant temperature sender, engine control unit, fuel pressure regulating valve, fuel metering valve ⇒Page 524.

Engine speed sender, throttle valve potentiometer, fuel temperature sender, position sender for charge pressure positioner, throttle valve module, engine control unit ⇒Page 525.

Exhaust gas recirculation potentiometer, fuel pressure sender, engine control unit, exhaust gas recirculation valve ⇒Page 526.

Exhaust gas temperature sender 1, exhaust gas temperature sender 3, exhaust gas temperature sender 4, engine control unit ⇒Page 527.

Lambda probe, exhaust gas pressure sensor 1, engine control unit, lambda probe heater ⇒Page 528.

Brake light switch, brake pedal switch, engine control unit, charge pressure control solenoid valve, heater element for crankcase breather ⇒Page 529.

Working speed control switch, working speed control, resume button, preset speed switch 1 and 2, clutch pedal switch, engine control unit ⇒Page 530.

Preset speed 3 switch, engine control unit, alternator warning lamp, glow period warning lamp, exhaust emissions warning lamp, diesel particulate filter warning lamp ⇒Page 531.

Working speed control, safety contact switch, working speed control, decrease speed button, working speed control, increase speed button, working speed control switch 2, engine control unit, working speed warning lamp ⇒Page 532.

Jumpers, radiator fan relay, engine control unit, radiator fan single fuse, radiator fan ⇒Page 533.

Diagnostic connection, oil pressure switch, engine control unit, oil pressure warning lamp ⇒Page 534.

3.3.1 Battery, starter, alternator, voltage regulator, ignition/starter switch fuses

A - Battery

B - Starter

C - Alternator

C1 - Voltage regulator

D - Ignition/starter switch

S5 - Fuse

- ❑ 15 A
- ❑ In fuse holder

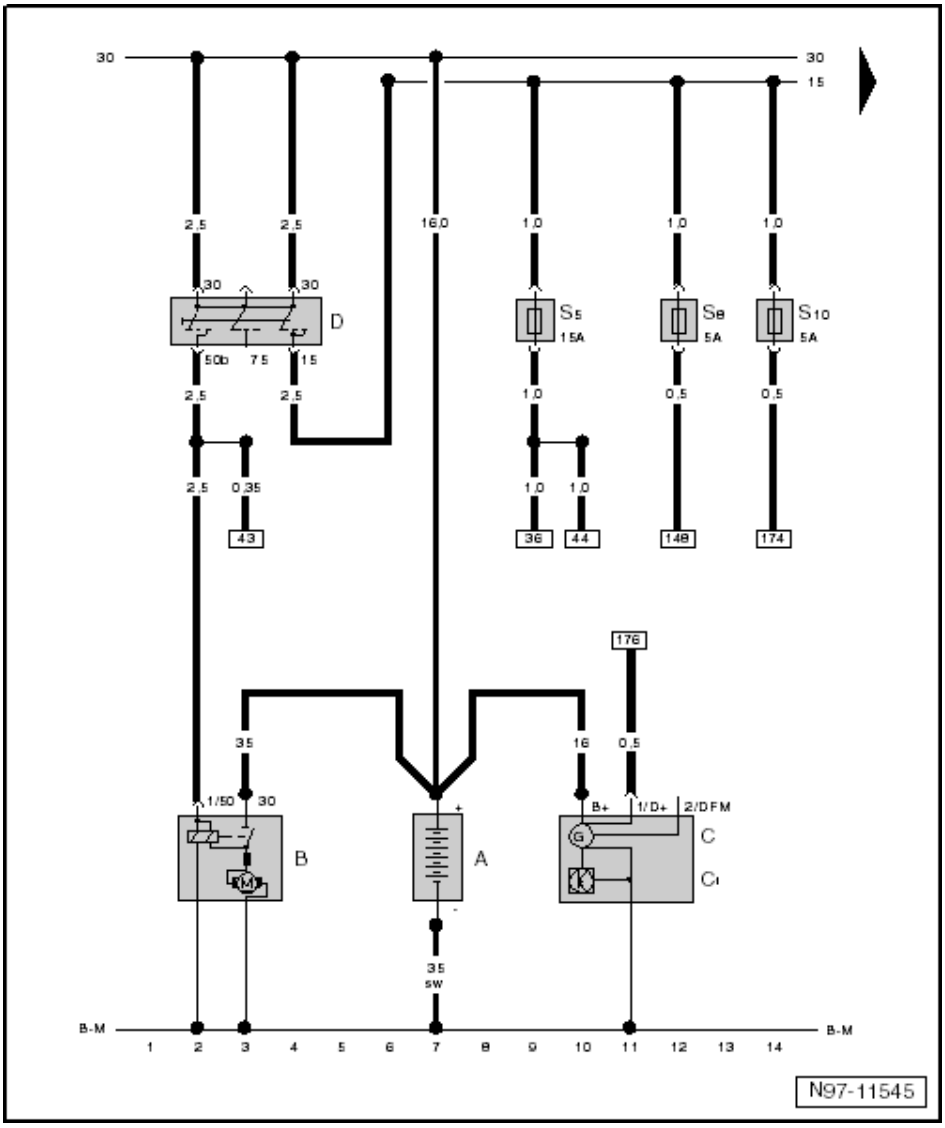
S8 - Fuse

- ❑ 5 A
- ❑ In fuse holder

S10 - Fuse

- ❑ 5 A
- ❑ In fuse holder

B-M - Battery earth/engine earth



3.3.2 Electric fuel pump 2 relay, automatic glow period control unit, glow plugs, fuses, supplementary fuel pump

J49 - Electric fuel pump 2 relay

J179 - Automatic glow period control unit

Q10 - Glow plug 1

Q11 - Glow plug 2

Q12 - Glow plug 3

Q13 - Glow plug 4

S1 - Fuse

- ❑ 20 A
- ❑ In fuse holder

S3 - Fuse

- ❑ 50 A
- ❑ In fuse holder

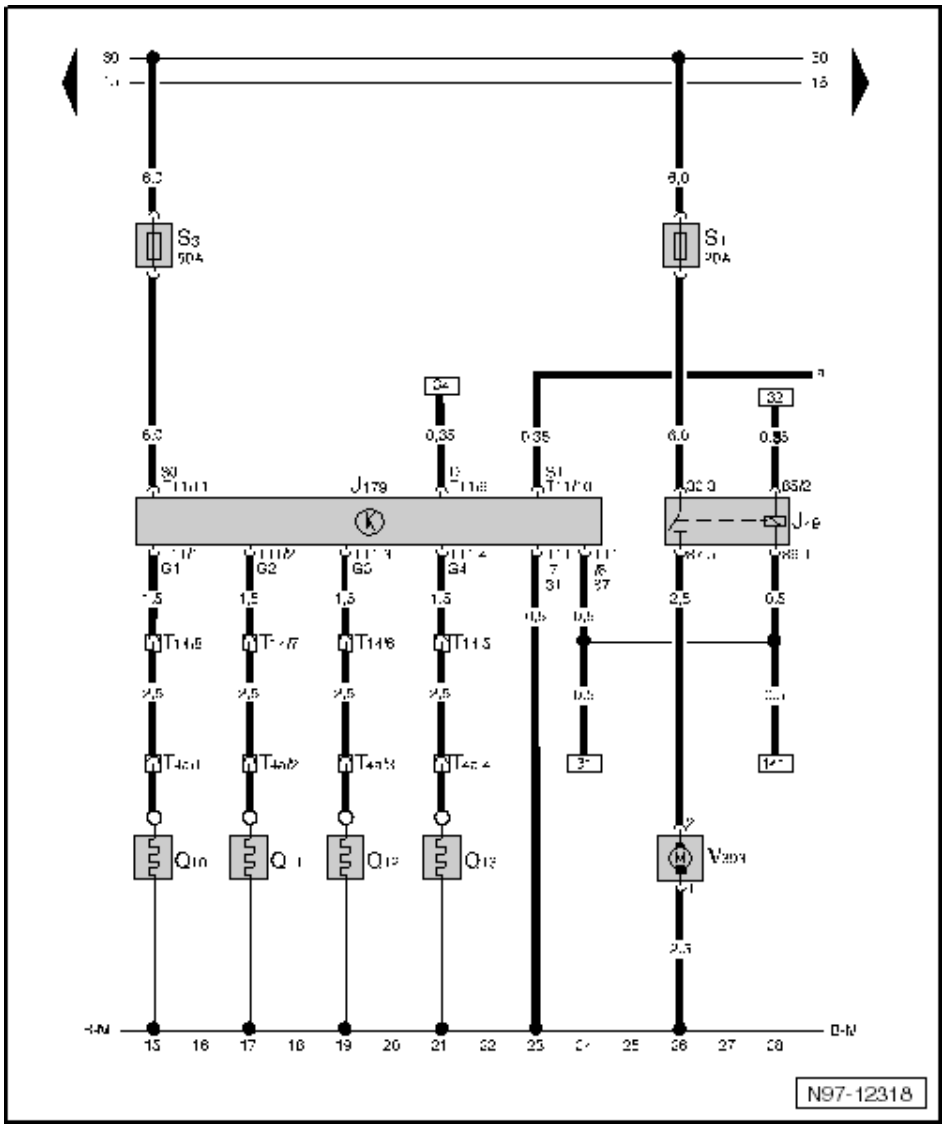
T4a - 4-pin connector

T11 - 11-pin connector

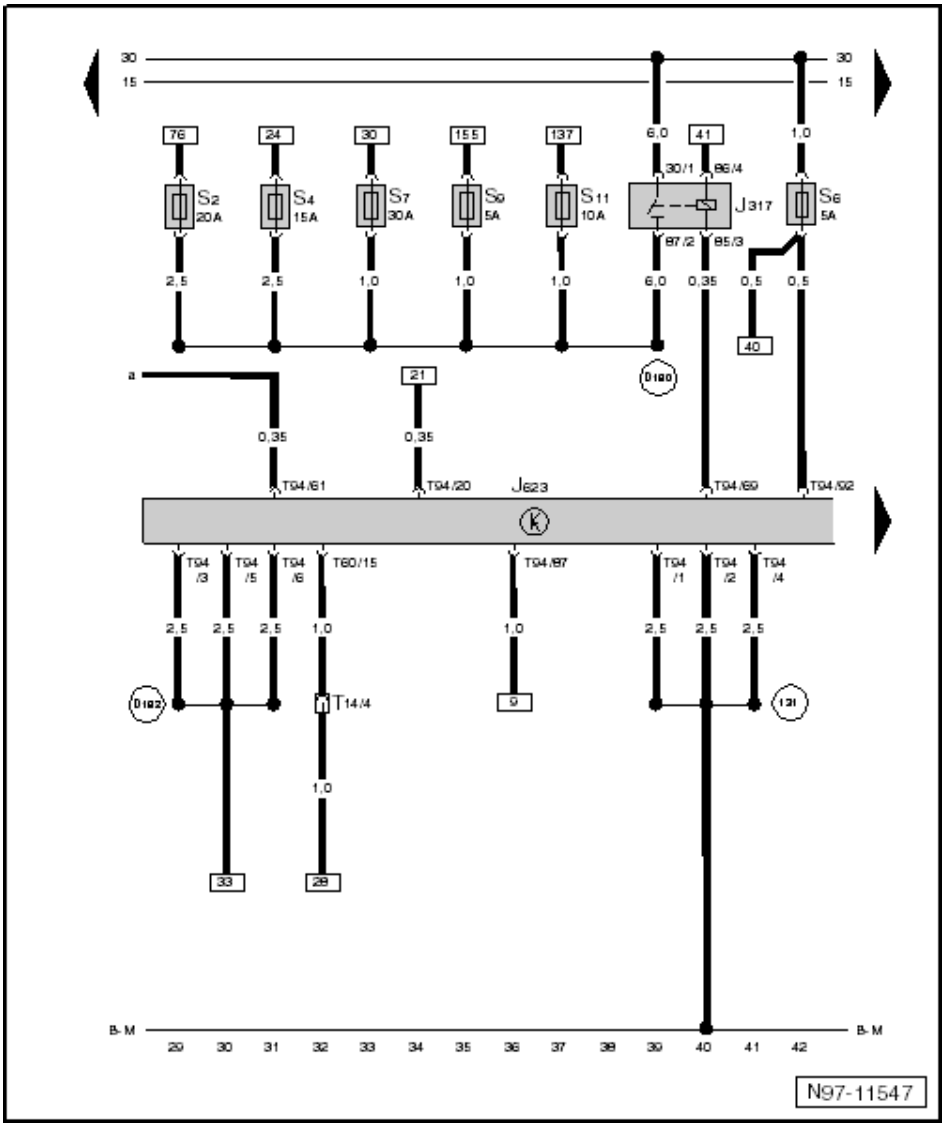
T14 - 14-pin connector

V393 - Supplementary fuel pump

B-M - Battery earth/engine earth



3.3.3 Terminal 30 voltage supply relay, engine control unit, fuses



J317 - Terminal 30 voltage supply relay

J623 - Engine control unit

S2 - Fuse

- ❑ 20 A
- ❑ In fuse holder

S4 - Fuse

- ❑ 15 A
- ❑ In fuse holder

S6 - Fuse

- ❑ 5 A
- ❑ In fuse holder

S7 - Fuse

- ❑ 30 A
- ❑ In fuse holder

S9 - Fuse

- ❑ 5 A
- ❑ In fuse holder

S11 - Fuse

- ❑ 10 A
- ❑ In fuse holder

T14 - 14-pin connector

T60 - 60-pin connector

T94 - 94-pin connector

131 - Earth connection 2, in engine compartment wiring harness

D180 - Connection (87a), in engine compartment wiring harness

D182 - Connection 3 (87a), in engine compartment wiring harness

B-M - Battery earth/engine earth

3.3.4 Jumpers, charge pressure sender, intake air temperature sender, air mass meter, engine control unit

G31 - Charge air pressure sender

G42 - Intake air temperature sender

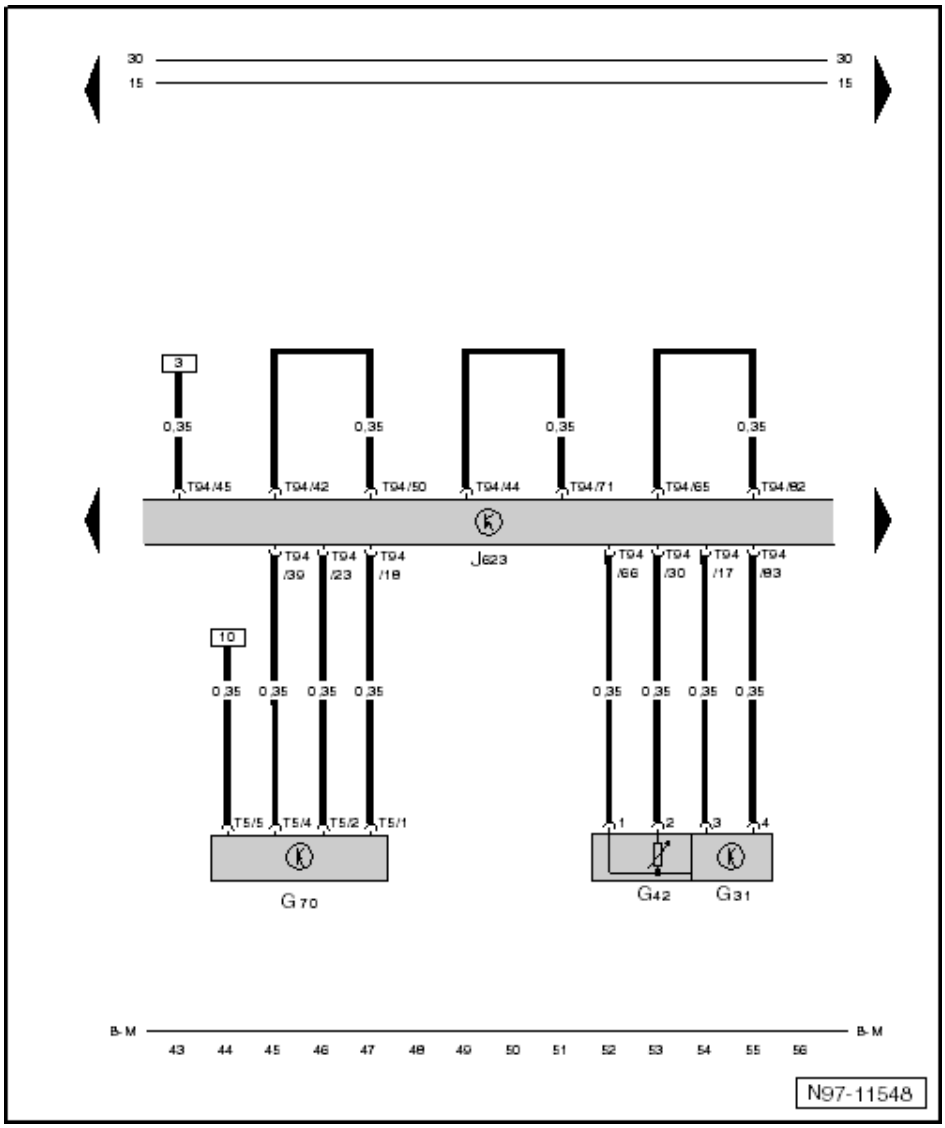
G70 - Air mass meter

J623 - Engine control unit

T5 - 5-pin connector

T94 - 94-pin connector

B-M - Battery earth/engine earth



3.3.5 Accelerator position sender, accelerator position sender 2, engine control unit, injectors, cylinders 1 - 4

G79 - Accelerator position sender

G185 - Accelerator position sender 2

J623 - Engine control unit

N30 - Injector, cylinder 1

N31 - Injector, cylinder 2

N32 - Injector, cylinder 3

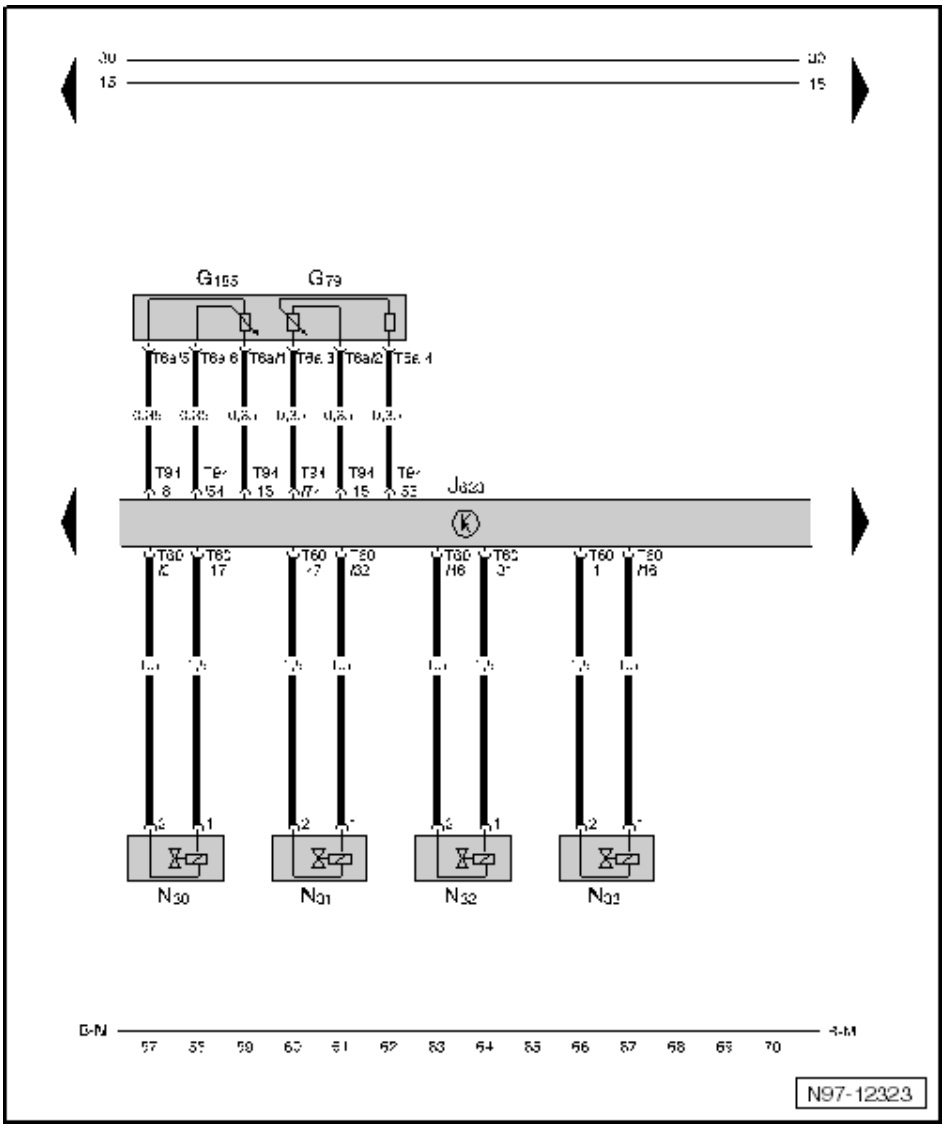
N33 - Injector, cylinder 4

T6a - 6-pin connector

T60 - 60-pin connector

T94 - 94-pin connector

B-M - Battery earth/engine earth



3.3.6 Hall sender, coolant temperature sender, engine control unit, fuel pressure regulating valve, fuel metering valve

G40 - Hall sender

G62 - Coolant temperature sender

J623 - Engine control unit

N276 - Fuel pressure regulating valve

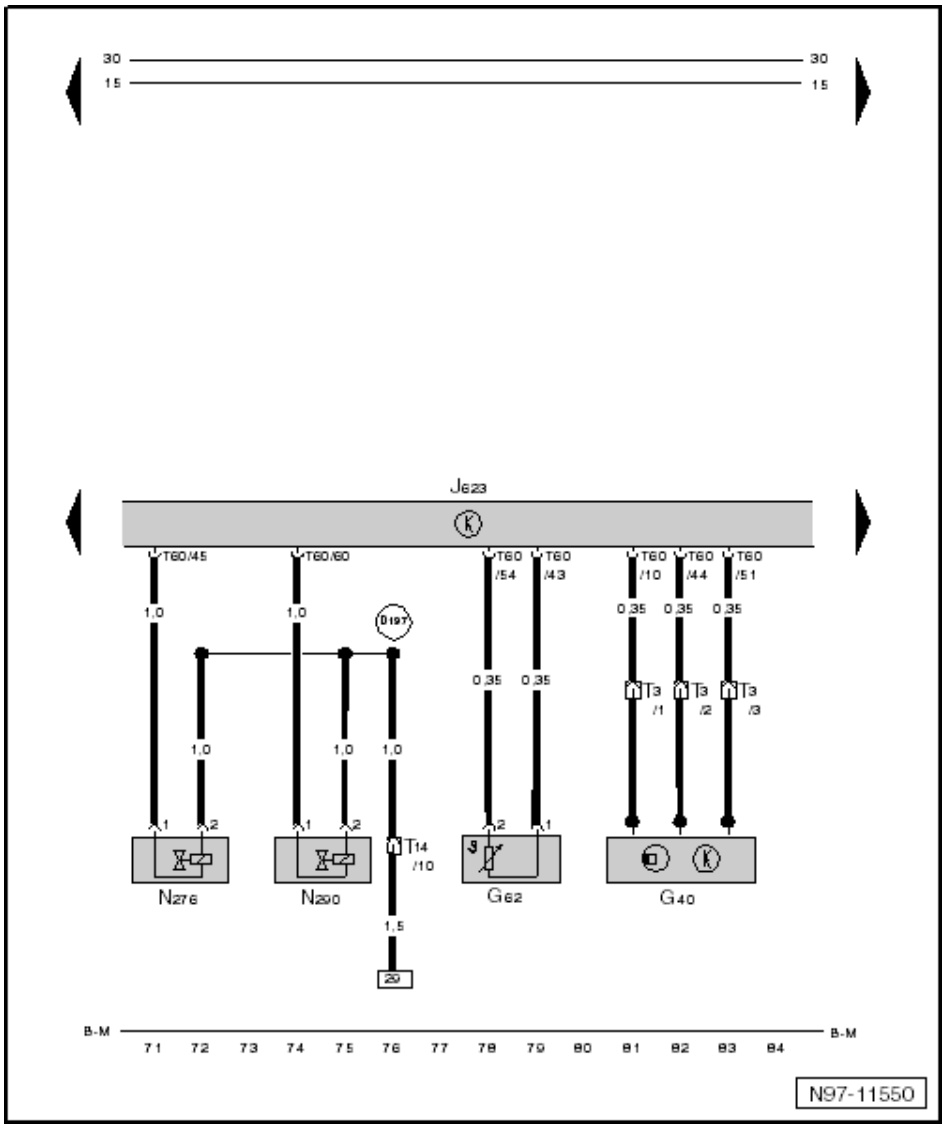
N290 - Fuel metering valve

T3 - 3-pin connector

T14 - 14-pin connector

T60 - 60-pin connector

B-M - Battery earth/engine earth



3.3.7 Engine speed sender, throttle valve potentiometer, fuel temperature sender, position sender for charge pressure positioner, throttle valve module, engine control unit

G28 - Engine speed sender

G69 - Throttle valve potentiometer

G81 - Fuel temperature sender

G581 - Position sender for charge pressure positioner

J338 - Throttle valve module

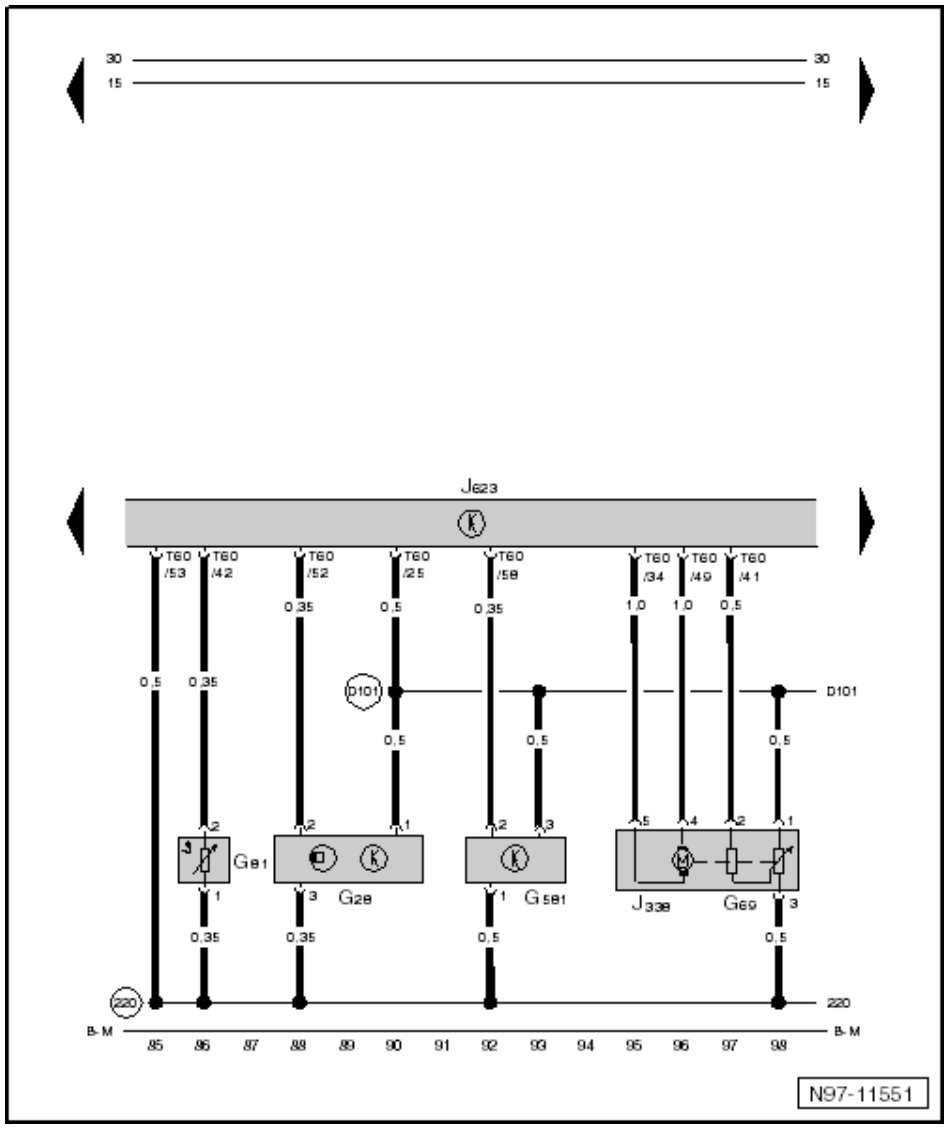
J623 - Engine control unit

T60 - 60-pin connector

220 - Earth connection (sender earth), in engine wiring harness

D101 - Connection 1 in engine compartment wiring harness

B-M - Battery earth/engine earth



3.3.8 Exhaust gas recirculation potentiometer, fuel pressure sender, engine control unit, exhaust gas recirculation valve

G212 - Exhaust gas recirculation potentiometer

G247 - Fuel pressure sender

J623 - Engine control unit

N18 - Exhaust gas recirculation valve

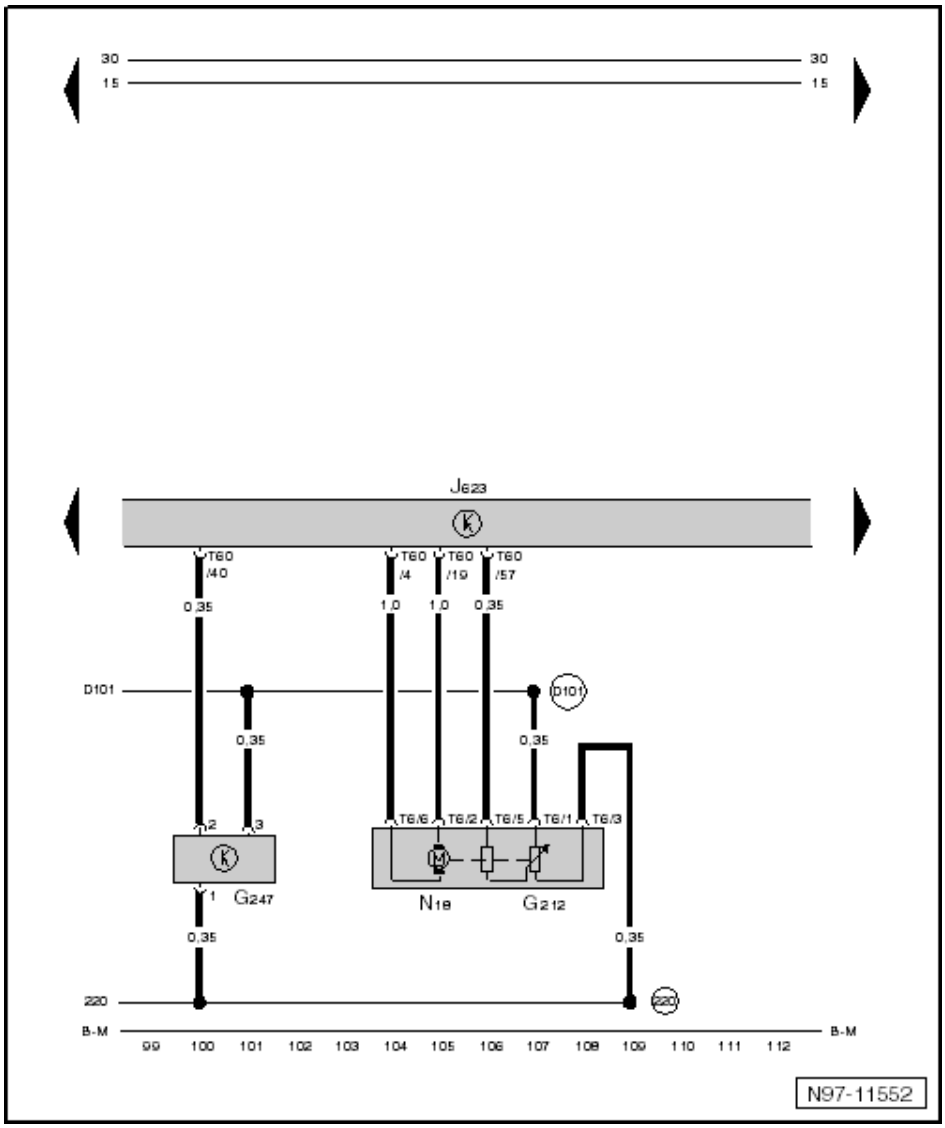
T6 - 6-pin connector

T60 - 60-pin connector

220 - Earth connection (sender earth), in engine wiring harness

D101 - Connection 1 in engine compartment wiring harness

B-M - Battery earth/engine earth



3.3.9 Exhaust gas temperature sender 1, exhaust gas temperature sender 3, exhaust gas temperature sender 4, engine control unit

G235 - Exhaust gas temperature sender 1

G495 - Exhaust gas temperature sender 3

G648 - Exhaust gas temperature sender 4

J623 - Engine control unit

T2a - 2-pin connector

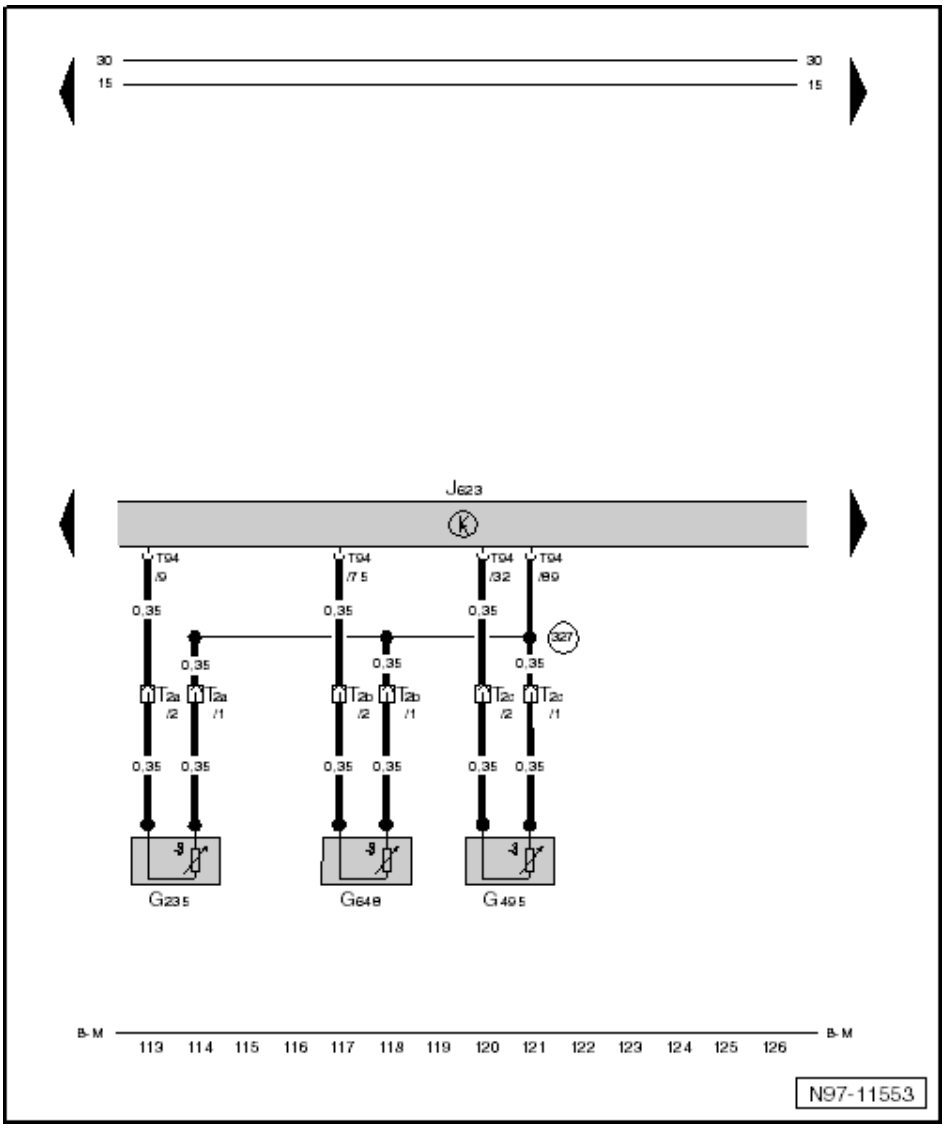
T2b - 2-pin connector

T2c - 2-pin connector

T94 - 94-pin connector

327 - Earth connection (sender earth), in engine wiring harness

B-M - Battery earth/engine earth



3.3.10 Lambda probe, exhaust gas pressure sensor 1, engine control unit, lambda probe heater

G39 - Lambda probe

G450 - Exhaust gas pressure sensor 1

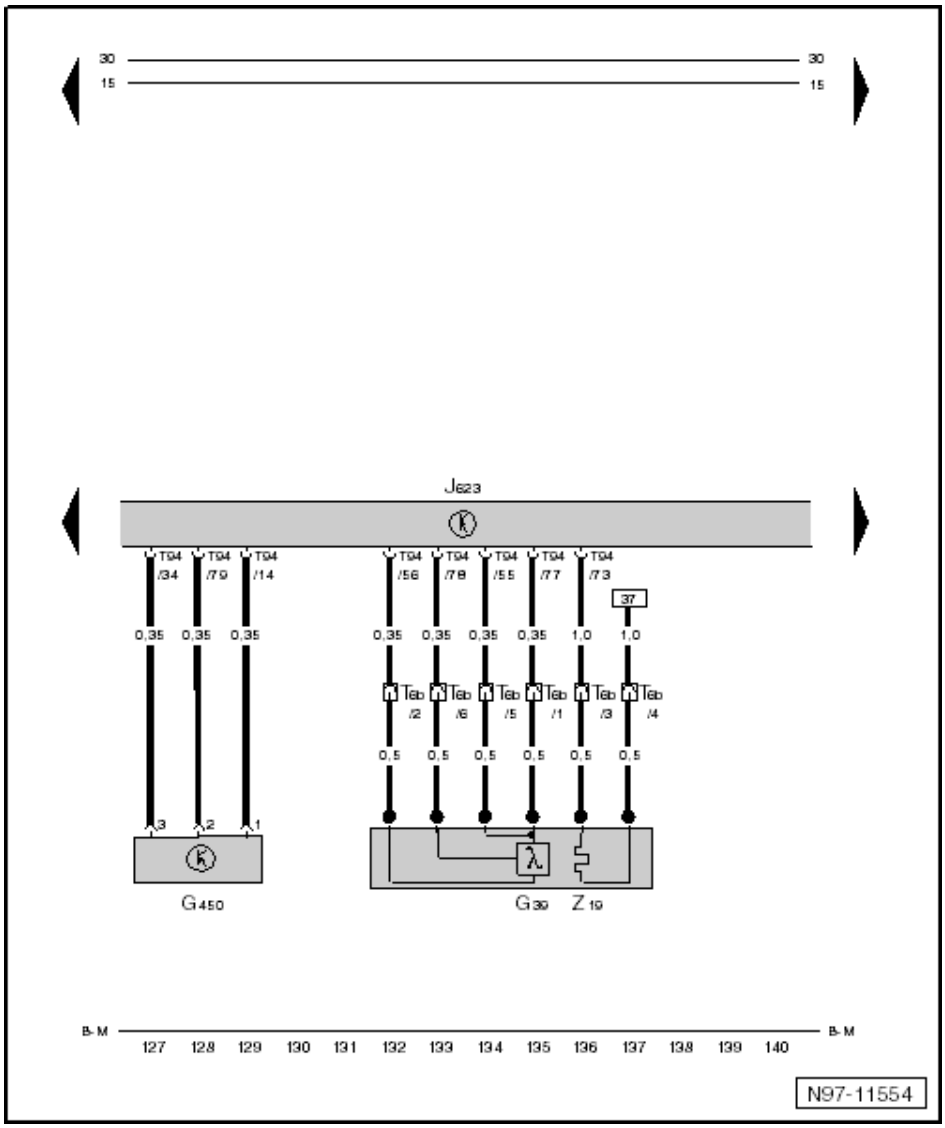
J623 - Engine control unit

Z19 - Lambda probe heater

T6b - 6-pin connector

T94 - 94-pin connector

B-M - Battery earth/engine earth



3.3.11 Brake light switch, brake pedal switch, engine control unit, charge pressure control solenoid valve, heater element for crankcase breather

F - Brake light switch

F47 - Brake pedal switch

- ❑ * Safety circuit

J67 - Brake system check blocking diode

J111 - Brake light relay

- ❑ ** If fitted (customer-specific)

J623 - Engine control unit

N75 - Charge pressure control solenoid valve

N79 - Heater element for crankcase breather

- ❑ ** If installed

S12 - Fuse

- ❑ 10 A
- ❑ In fuse holder
- ❑ ** If installed

T1 - 1-pin connector

T14 - 14-pin connector

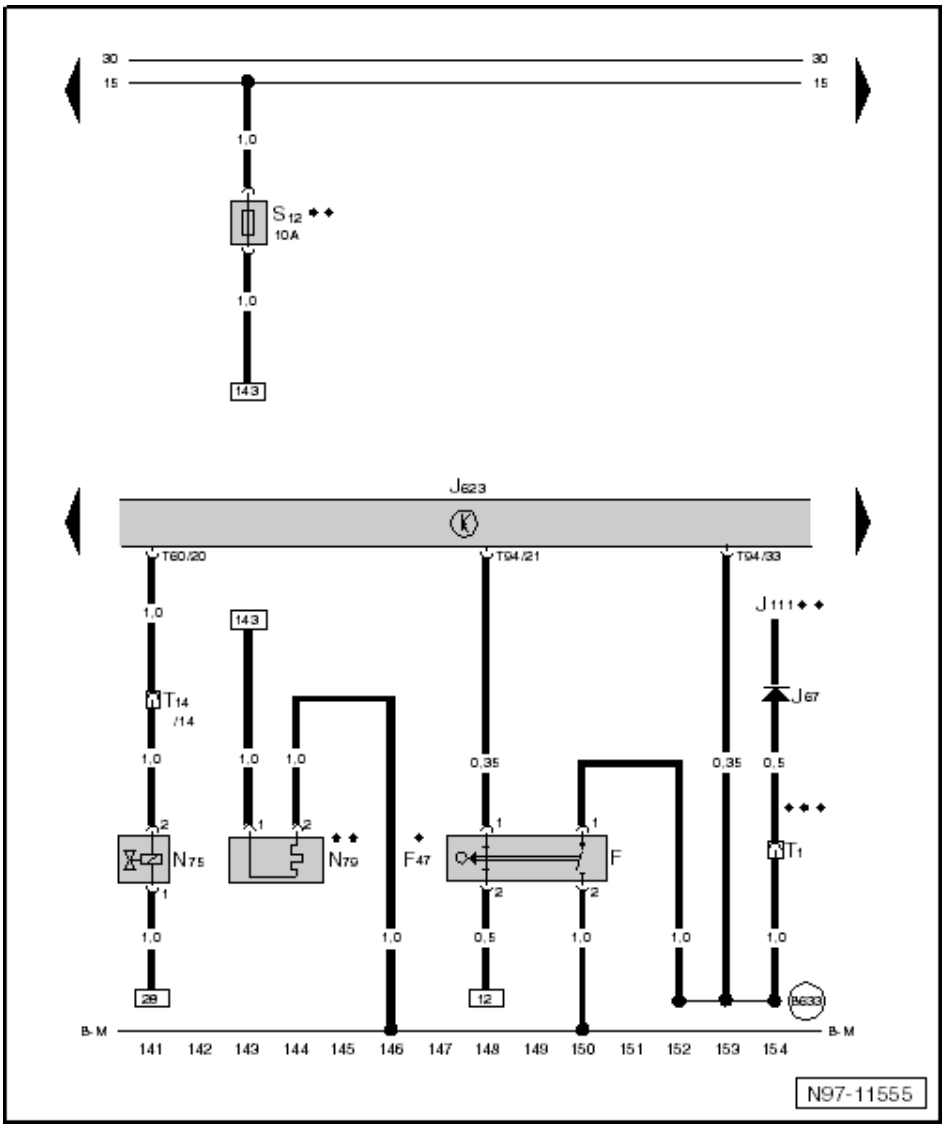
T60 - 60-pin connector

T94 - 94-pin connector

B633 - Connection (brake pedal switch), in main wiring harness

***** - Brake light output, terminal 31b**

B-M - Battery earth/engine earth



3.3.12 Working speed control switch, working speed control, resume button, preset speed switch 1 and 2, clutch pedal switch, engine control unit

E261 - Working speed governor switch

E426 - Working speed control, resume button

E433 - Preset speed 1 switch

E434 - Preset speed 2 switch

F36 - Clutch pedal switch

J623 - Engine control unit

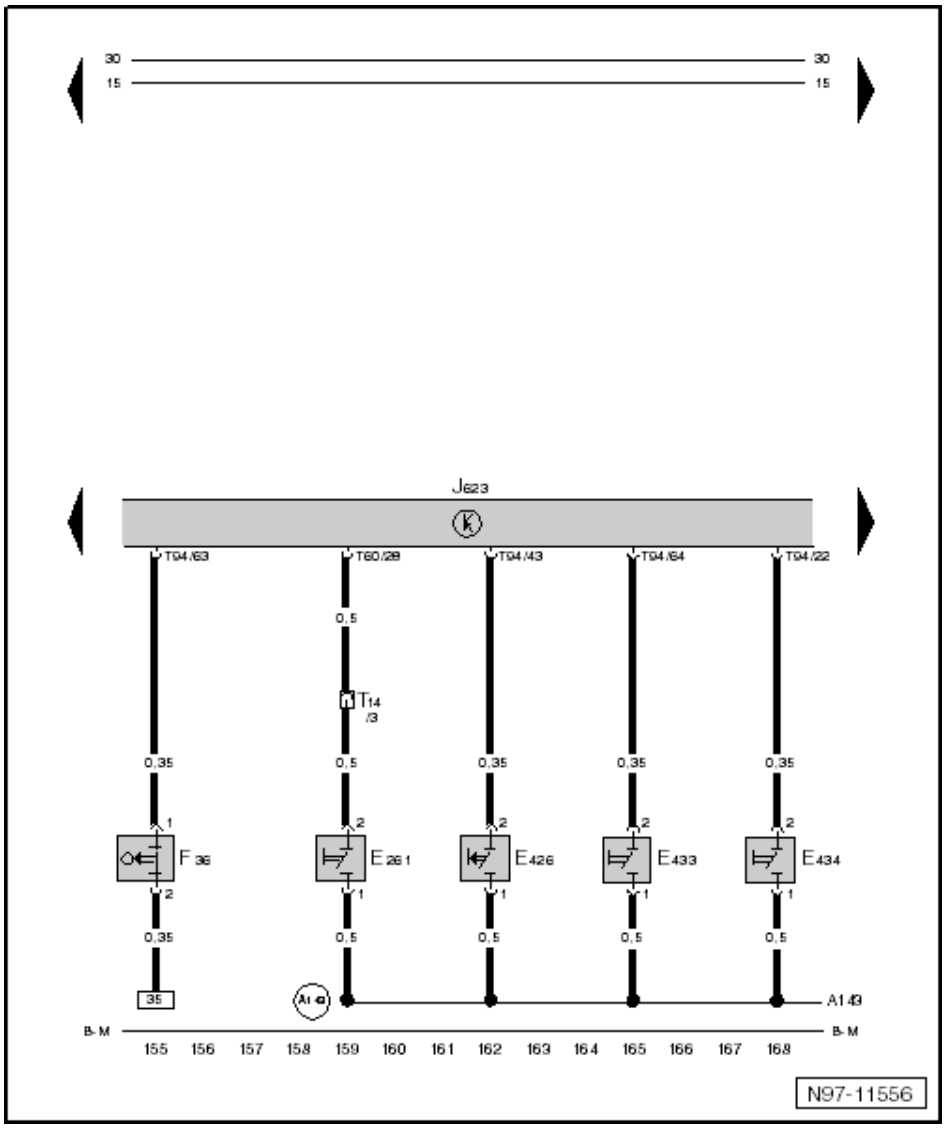
T14 - 14-pin connector

T60 - 60-pin connector

T94 - 94-pin connector

A143 - Connection (working speed control), in dash panel wiring harness

B-M - Battery earth/engine earth



3.3.13 Preset speed 3 switch, engine control unit, alternator warning lamp, glow period warning lamp, exhaust emissions warning lamp, diesel particulate filter warning lamp

E435 - Preset speed 3 switch

J623 - Engine control unit

K2 - Warning lamp for alternator

K29 - Glow period warning lamp

K83 - Exhaust emissions warning lamp

K231 - Warning lamp for diesel particle filter

T14 - 14-pin connector

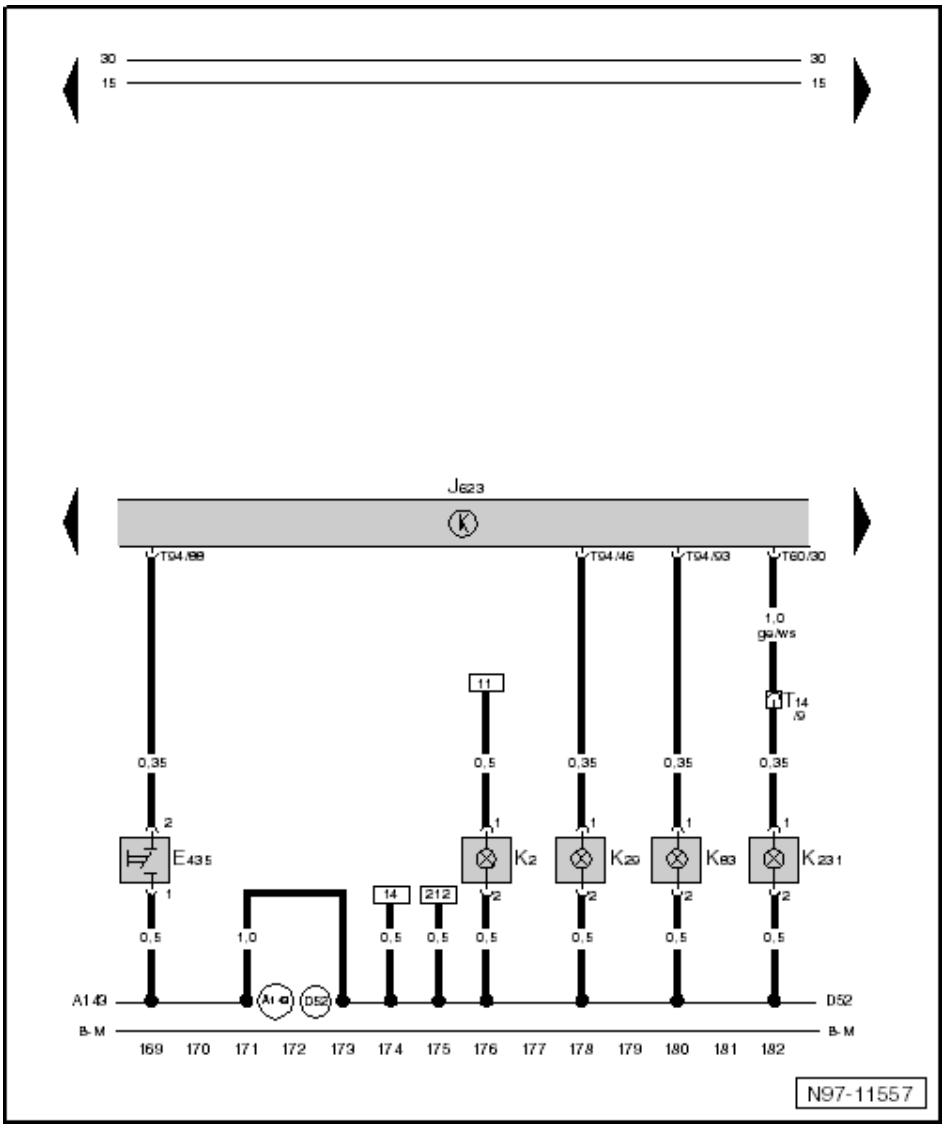
T60 - 60-pin connector

T94 - 94-pin connector

A143 - Connection (working speed control), in dash panel wiring harness

D52 - Positive connection (15a), in engine compartment wiring harness

B-M - Battery earth/engine earth



3.3.14 Working speed control, safety contact switch, working speed control, decrease speed button, working speed control, increase speed button, working speed control switch 2, engine control unit, working speed warning lamp

E427 - Working speed control, safety contact switch

E428 - Working speed control, decrease speed button

E429 - Working speed control, increase speed button

E604 - Working speed governor switch 2

J623 - Engine control unit

K158 - Working speed control warning lamp

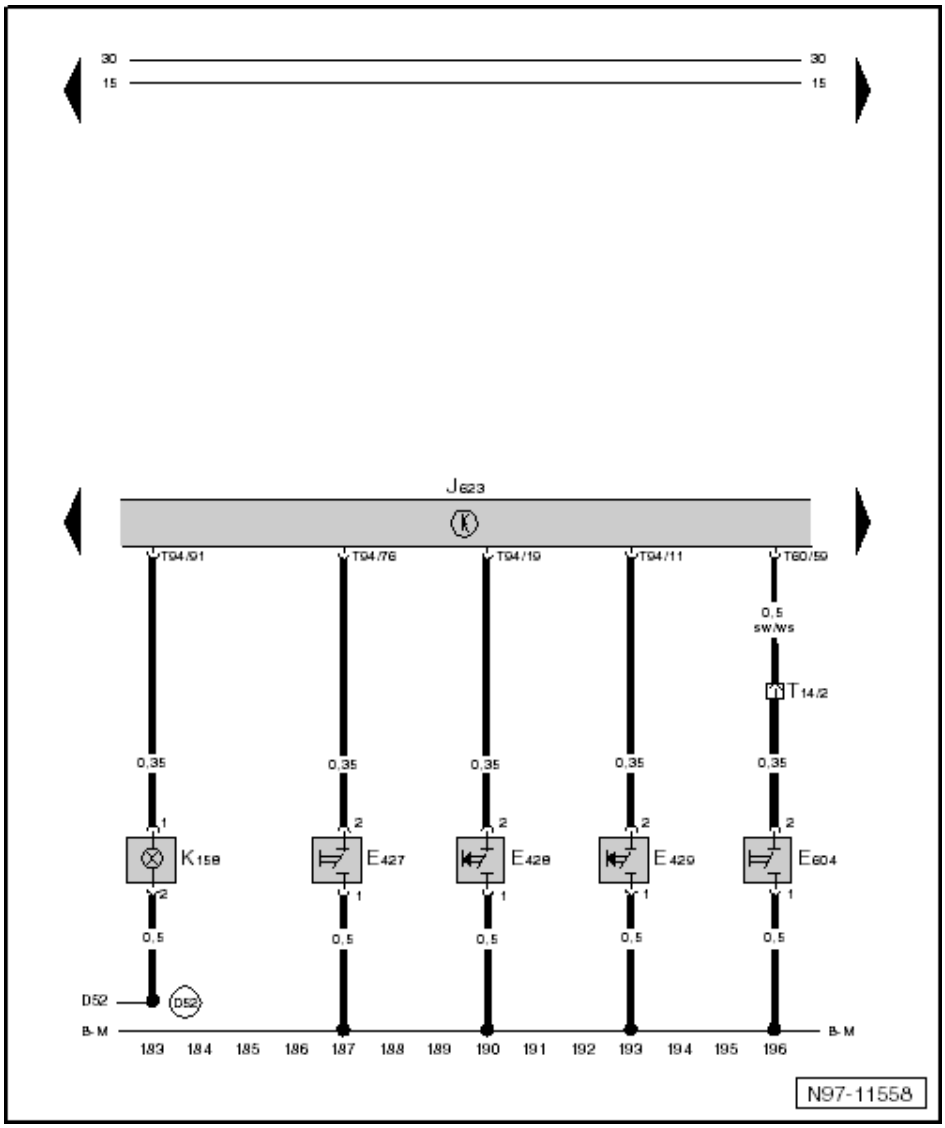
T14 - 14-pin connector

T60 - 60-pin connector

T94 - 94-pin connector

D52 - Positive connection (15a), in engine compartment wiring harness

B-M - Battery earth/engine earth



3.3.15 Jumpers, radiator fan relay, engine control unit, radiator fan single fuse, radiator fan

J26 - Radiator fan relay

J623 - Engine control unit

S... - Fuse

- ❑ 5 A
- ❑ In fuse holder

S42 - Radiator fan single fuse

- ❑ * Fuse rating depends on used radiator fan used

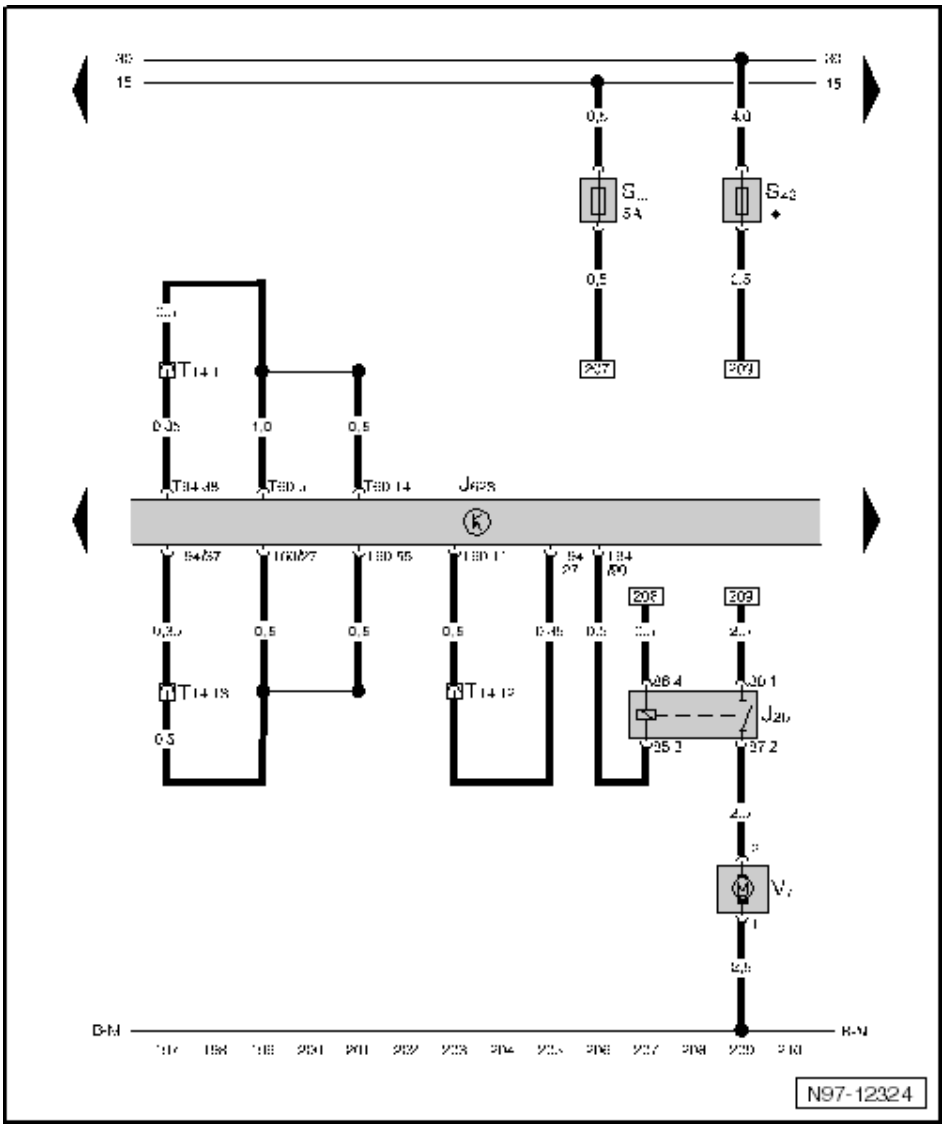
T14 - 14-pin connector

T60 - 60-pin connector

T94 - 94-pin connector

V7 - Radiator fan

B-M - Battery earth/engine earth



3.3.16 Diagnostic connection, oil pressure switch, engine control unit, oil pressure warning lamp

F1 - Oil pressure switch

J150 - Oil pressure monitor delay relay

- * Customer-specific

J623 - Engine control unit

K3 - Oil pressure warning lamp

S... - Fuse

- 5 A
- In fuse holder

T14 - 14-pin connector

T16 - 16-pin connector

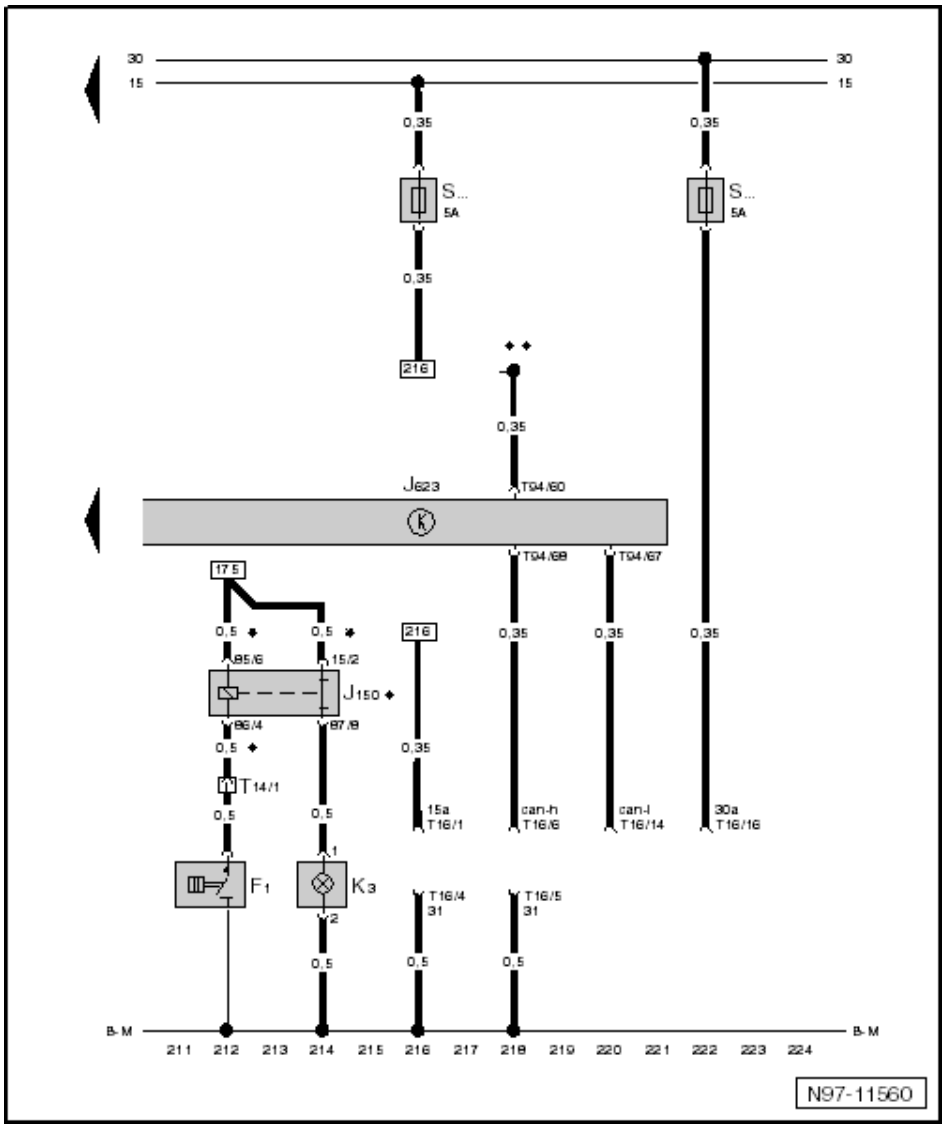
- Diagnostic connection

T94 - 94-pin connector

*** - Customer-specific**

**** - Speed signal output**

B-M - Battery earth/engine earth



28 - Glow plug system

1 Glow plug system

> ⚠ ***WARNING***
>
> ***Adhere to the general safety regulations and the notes on repair work on the engine!*** ⇒ **Page 1**

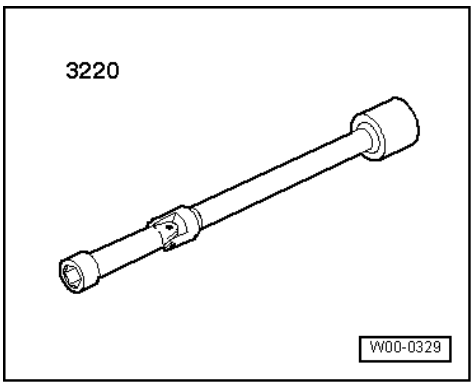
> ⚠ ***WARNING***
>
> ***When doing any repair work, pay attention to the following due to the cramped conditions:***
>
> - ***Adhere to the general safety precautions, and never take any risk.***
> - ***The engine is a hazardous area and can cause serious injuries.***
> - ***Never leave any objects in the engine compartment, such as cleaning cloths or tools.***
> - ***Many engine components become hot during operation – risk of burns. If necessary, provide appropriate protective means.***
> - ***Servicing materials, such as fuel, engine oils or coolant additive, are harmful substances; adhere to the safety instructions from the manufacturer.***
> - ***There is a risk of injuries, if maintenance locations are difficult to access. This risk can be reduced, by installing the engine in an appropriate location and by avoiding sharp edges.***
> - ***Route all the various lines (e.g. for fuel, hydraulics, coolant and refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.***
> - ***Ensure that there is sufficient clearance to all moving or hot components.***
> - ***Tools are to be checked for damage and safety risks on a regular basis.***

Removing, installing and checking glow plugs ⇒ Page 536.

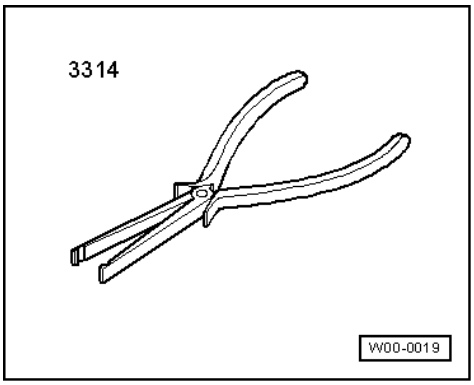
1.1 Removing, installing and checking glow plugs

Special tools and workshop equipment required

- Jointed spanner -3220-



- Pliers -3314-
- Torque wrench (5…50 Nm) -V.A.G 1331-
- Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
- Auxiliary measuring set -V.A.G 1594-
- Current flow diagram



Test prerequisites

- Ignition switched off.

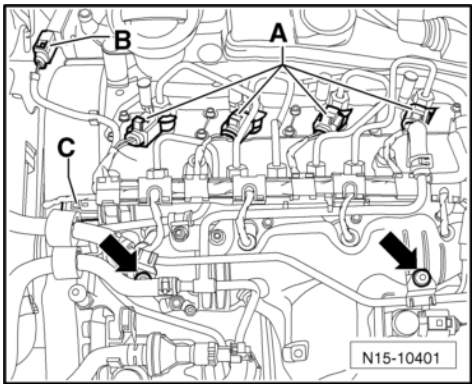
Procedure

– Switch off ignition.

– Remove noise insulation from injectors.

– Pull connectors off injectors -A- and fuel rail pressure sensor -C-.

– If fitted, unscrew securing bolts of coolant line -arrows- from intake manifold, and set down coolant line in front of intake manifold.

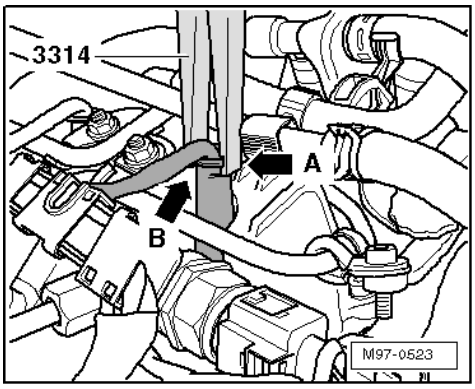


Caution

Make sure that no wiring connections are damaged when disconnecting the connectors. Otherwise the whole wiring harness will need to be renewed. Do not compress the pliers -3314- too firmly to separate the connectors, otherwise the support sleeve may be damaged.

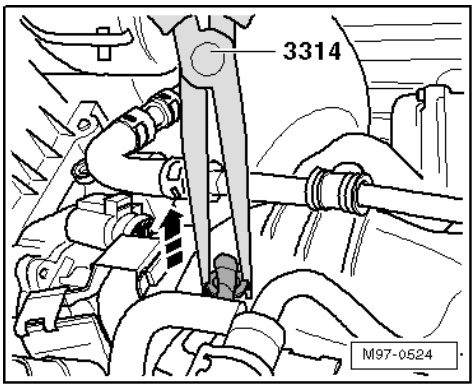
– Wires or coolant, fuel and air lines may impair the repair work. Remove these wires in lines. It may be sufficient to loosen the fasteners and to lay the lines aside.

– Position pliers -3314- with groove -arrow A- on support sleeve shoulder -arrow B- and pull plugs off glow pin plugs.



– Carefully pull connector off glow plug in direction of -arrow-.

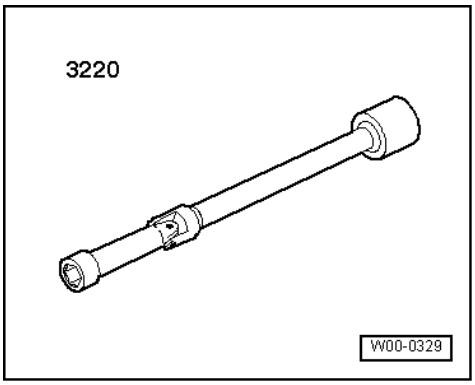
– Clean glow plug opening in cylinder head, ensuring no dirt makes its way into the cylinder.



Note

- *Cleaning procedure:*
- *Use a vacuum cleaner to remove coarse dirt.*
- *Spray brake cleaner or suitable cleaning agent into glow plug opening, let it work in briefly, and blow out with compressed air.*
- *Then clean glow plug opening using a cloth moistened with oil.*

– To loosen glow plugs use special tool U/J extension and 10 mm socket -3220-



Installing

Installation is carried out in the reverse order. When installing, note the following:

– To tighten glow plugs use special tool U/J extension and 10 mm socket -3220- with a suitable torque wrench.

– Then tighten glow plugs to specified torque.

- Specified torque: 18 Nm

– Always perform a resistance test on all glow plugs after installing them and before starting the engine for the first time.

- Specification: max. 1.0 Ω

– If the specification is exceeded, renew defective glow plug.

– Attach glow plug connectors correctly and make sure they are securely fitted.

Then, clear event memory ⇒Page 26.