21-1

Turbocharger system

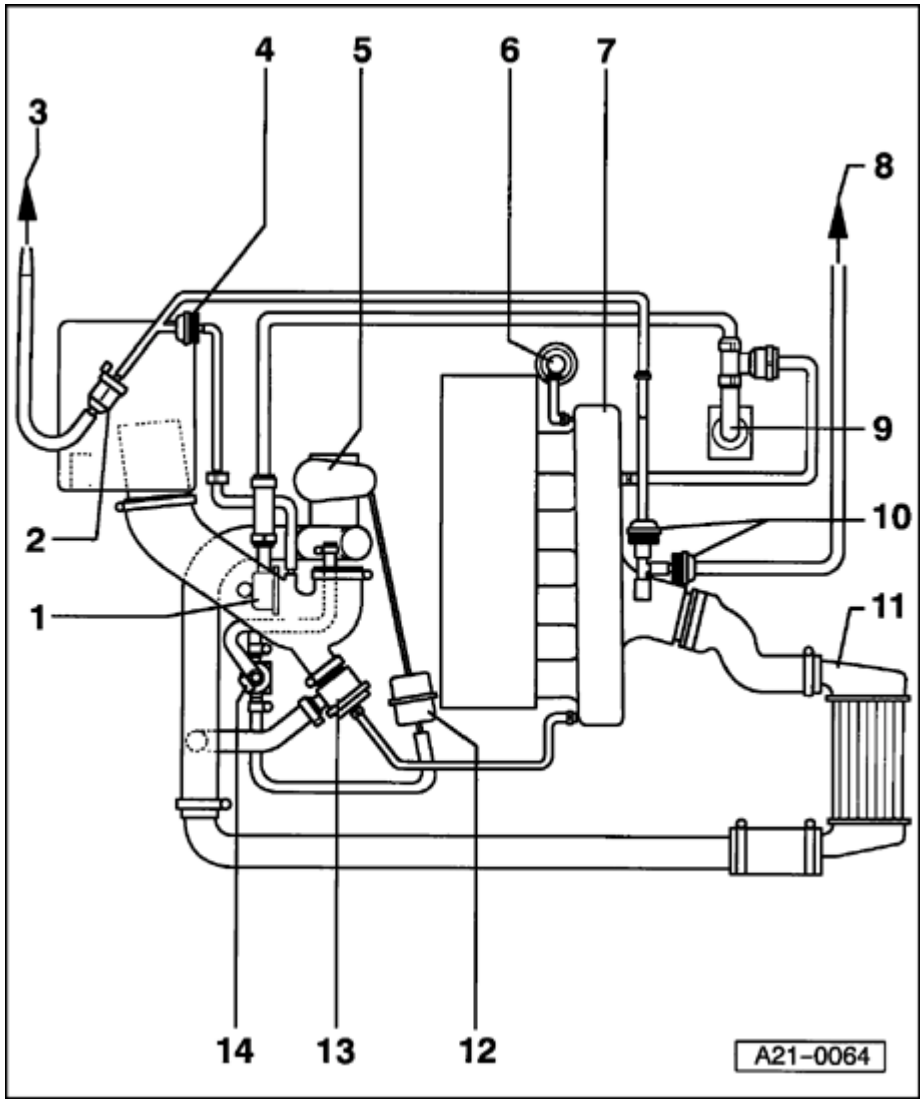
Note:

- *Observe rules of cleanliness ⇒ Page 21-22 .*
- *Charge air pressure control connection diagram ⇒ Page 21-2 .*
- *All hose connections are secured with hose clamps:*

⇒ *parts catalog.*

- *charge air pressure system must be free of leaks.*
- *Replace self-locking nuts.*
- *Always replace gaskets.*

21-2



Charge air pressure control, system overview

Vehicles with manual transmission

1 - PCV valve

- For crankcase ventilation

2 - Evaporative Emission (EVAP) canister purge regulator valve -N80-

3 - To Evaporative Emission (EVAP) canister

4 - Check valve for Evaporative Emission (EVAP) canister

- Installed position (light/dark): as shown in illustration

5 - Turbocharger

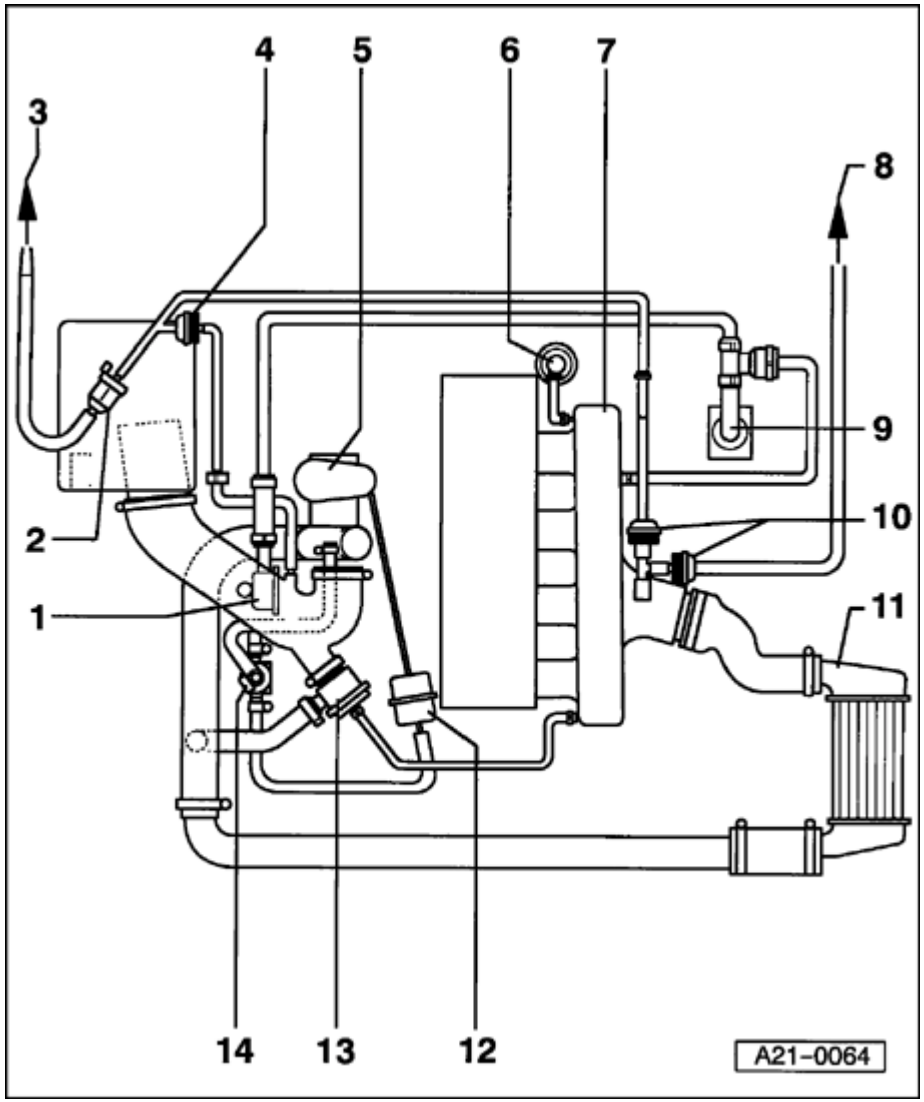
6 - Fuel pressure regulator

7 - Intake manifold

8 - To Leak Detection Pump (LDP) -V144-

9 - Crankcase ventilation

21-3



10 - Check valve for Evaporative Emission (EVAP) canister

- Installed position (light/dark): as shown in illustration

11 - Charge air cooler

12 - Vacuum diaphragm

- For wastegate

13 - Charge pressure bypass valve

- Checking ⇒ Page 21-4

14 - Wastegate bypass regulator valve -N75-

21-4

Charge pressure bypass valve, checking

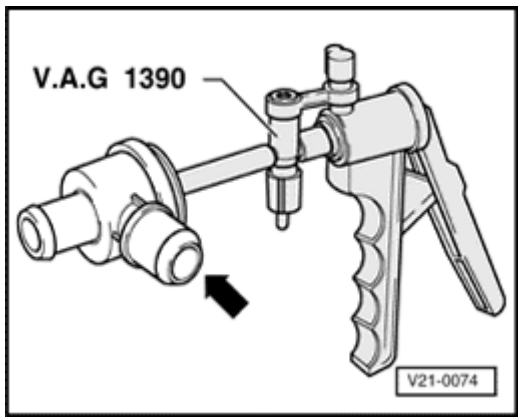
Note:

- *The charge pressure bypass valve is located in front of the turbocharger. It is opened by vacuum during deceleration and when under partial load at idle. This reduces charge air pressure in front of the throttle valve and keeps the turbocharger spinning at higher RPMs.*

- *Check the charge pressure bypass valve if experiencing reduced performance or turbo lag.*

Special tools and equipment

VAG1390 hand vacuum pump



- Connect VAG1390 hand vacuum pump to vacuum connection on recirculation valve.
- Operate hand vacuum pump.

  Recirculation valve must open (arrow).
- After approx. 30 seconds, operate vent valve on hand vacuum pump.

  Recirculation valve must close (arrow).

If valve does not open/close or valve plate does not seal correctly when valve is closed:

- Replace valve and secure recirculation shut-off valve connections using hose clamps.

21-5

Turbocharger and wastegate, checking

If special testing equipment is required during test drive, heed the following WARNING:

WARNING!

- ***When driving or riding in an airbag-equipped vehicle, NEVER hold the scan tool or other test equipment in your hands or lap while in motion. Objects between you and the airbag increase the risk of injury in an accident.***

- ***During a test drive in an airbag-equipped vehicle, test equipment must always be fastened to and operated from the rear seat by a second technician.***

Special tools and equipment

- VAG1397A turbocharger tester

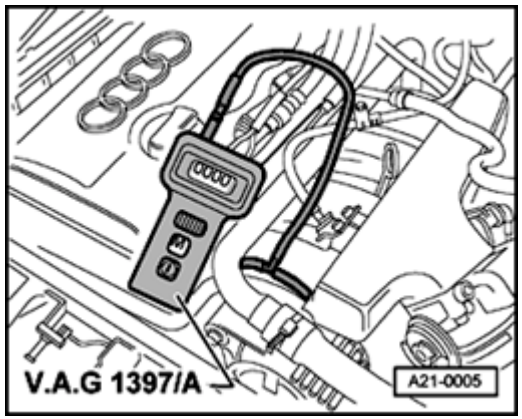
- VAG1551 scan tool with VAG1551/3 adapter

21-6

Test conditions:

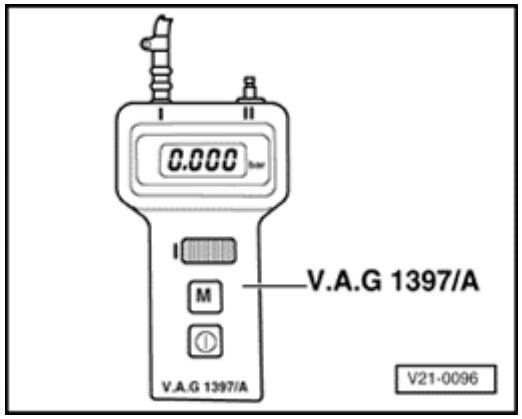
- Check DTC memory Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Repair Group 01
- Perform output diagnostic test mode (function 03)
- Minimum engine oil temperature: 60 ° C (140 ° F)
- All vacuum connections are free of leaks

Test procedure



- Using T-fitting, connect VAG1397A turbocharger tester test hose to front of intake manifold.
- Guide test hose over rear corner of hood through right window opening into vehicle interior.

21-7



- Turn turbocharger tester on and select measuring range -I- (absolute pressure).
- Connect test hose to connection flange -I-.

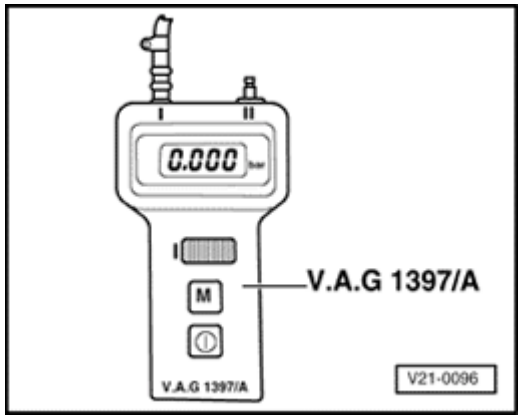
Note:

- *Hoses must be connected so there is no possibility of leaks, otherwise incorrect readings may result.*
- *Ensure test hose is not pinched at the hood and/or window.*
- *By pressing the memory button "M" on the turbocharger tester, the last test value is stored until either memory button "M" is pressed again or the turbocharger tester is shut off.*
- *A blinking comma in the display field indicates a value has been stored.*
- *An arrow appears in the top left corner of the display field if the turbocharger tester battery voltage drops below the allowed specification.*
- *Before testing, drive vehicle briskly for at least 3 km (approx. 2 miles) without frequent stops.*

WARNING!

- ***Always use a second technician to take measurements via the VAG1397A turbocharger tester when test-driving vehicle for this test.***
- ***Follow "WARNING!"*** ⇒ ***Page 21-5*** **.**

21-8



Vehicles with manual transmission:

- Accelerate vehicle in 3rd gear at full throttle from 2000 RPM and watch tachometer.
- At 3000 RPM press memory button "M" on turbocharger tester.

  Specification: 1.37-1.47 bar (19.865-21.315 psi)

Vehicles with automatic transmission:

- Drive with selector lever in range 2.
- Accelerate to 3000 RPM and wait for transmission to shift into 2nd gear.
- Press accelerator pedal to kickdown position (transmission will not shift down at this vehicle/engine speed).
- At 4500 RPM, press memory button "M" on turbocharger tester.

  Specification: 1.3-1.4 bar (18.85-20.30 psi)

21-9

Note:

For vehicles with automatic transmission the charge air pressure test may not always provide a definitive reading of proper charge air pressure regulation. If pressure readings are at the lower end of the specified range, measure charge air pressure control via load signal ⇒ *Page 21-10* *.*

All vehicles:

If measured value is above or below specification Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Repair Group 24.

Note:

If no charge air exists and a rumbling sound is heard from the engine compartment, the causes are as follows:

- *Charge pressure bypass valve malfunctioning.*
- *Vacuum line to charge pressure bypass valve leaking or disconnected.*

21-10

Charge air pressure control (via load signal), checking

WARNING!

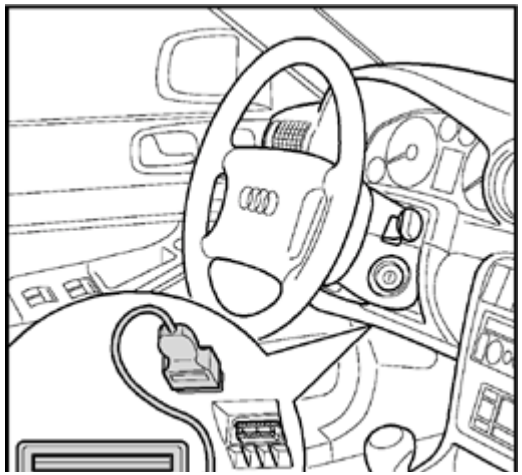
- ***Always use a second technician to take measurements via the VAG1397A turbocharger tester when test-driving vehicle for this test.***

- ***Follow "WARNING!"*** ⇒ ***Page 21-5*** .

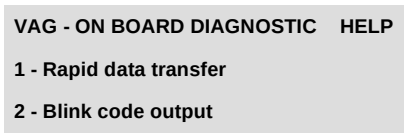
Note:

If VAG1551 scan tool is not available, use VAG1552 mobile scan tool instead.

- Unclip Data Link Connector (DLC) cover.



- Using VAG1551/3 adapter, connect VAG1551 Scan Tool (ST) or VAG1552 mobile scan tool.



➢ Indicated on display[1)]

[1)] Operating modes 1 and 2 are displayed alternately

Note:

If nothing appears on display:

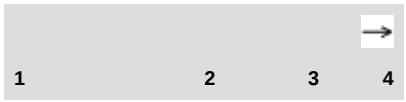
⇒ *Scan tool operating instructions*

21-11

- Press button 1 to select "Rapid data transfer" operating mode 1.

- Start engine.

Rapid data transfer HELP **Select function XX**	⮜	Indicated on display
Rapid data transfer Q **01 - Engine Electronics**	⮜	- Press buttons -0- and -1- to insert "Engine Electronics" address word 01. - Press -Q- button to confirm input.
06A906018.. 1.8l R4/5T MOTR HS 0.. → **Coding 04000 WSC 12345**	⮜	VAG1551 scan tool display indicates control module coding. - Press →button.
Rapid data transfer HELP **Select function XX**	⮜	Indicated on display - Press buttons -0- and -8- to select "Read Measuring Value Block" function 08. - Press -Q- button to confirm input.
Read Measuring Value Block HELP **Input display group number XXX**	⮜	Indicated on display - Press buttons -1-, -1- and -4- to input display group number 114 (114). - Press -Q- button to confirm input.
Read Measuring Value Block 114	⮜	The "Read Measuring Value Block" displays four display fields.



Interpreting values 1-4 in each display field ⇒ Page 21-12 .

21-12

Interpreting display fields

Indicated on display:

Display field	Description
1	Not applicable
2	Specified engine load (after correction)
3	Current engine load
4	Duty cycle (actuation of wastegate bypass regulator valve -N75-)

- Note values in display field 2 and 3 while vehicle is under steady acceleration.

Specification

Deviation between display field 2 and 3: 0.3 ms (max.)

Note:

If the OBD for the Engine Control Module (ECM) recognizes Diagnostic Trouble Codes (DTCs) in charge air pressure regulation, duty cycle (display field 4) will indicate a constant 5%.

21-13

Diagnostic Trouble Codes (DTC) for charge air pressure regulation

Diagnostic Trouble Code (DTC)	VAG1397A Display	VAG1551 Display	Possible causes
Charge air pressure too low	• Measured value below 1.37 bar (19.9 psi) (vehicles with manual transmission) • Measured value below 1.30 bar (18.9 psi) (vehicles with automatic transmission)	• Current engine load (display field 3) less than specified engine load (display field 2) • Duty cycle (display field 4) close to 99%	♦ Wastegate bypass regulator valve -N75- malfunctioning ♦ Wiring to wastegate bypass regulator valve -N75- malfunctioning ♦ Wastegate in turbocharger stuck in open position ♦ Leak between turbocharger and intake manifold ♦ Turbocharger malfunctioning
Charge air pressure too high [1)]	• Measured value above 1.47 bar (21.3 psi) (vehicles with manual transmission) • Measured value above 1.40 bar (20.3 psi) (vehicles with automatic transmission)	• Current engine load (display field 3) higher than specified engine load (display field 2) • Duty cycle (display field 4) close to 0%	♦ Vacuum diaphragm for wastegate malfunctioning ♦ Hoses to vacuum diaphragm (for wastegate) over wastegate bypass regulator valve -N75- leaking ♦ Vacuum diaphragm wastegate in turbocharger stuck in closed position

[1)] If charge air pressure is too high, the fuel supply is shut off to protect the engine. The engine misfires at high engine speeds.

21-14

Charge pressure leak test with VAG 1687

Intake system, checking for leaks using VAG 1687 Diagnostic Tool

Diagnostic trouble codes (DTCs) related to fuel trim, charge pressure or mass air flow (MAF) may be caused by:

- Leaking (worn/torn) intake hoses during charge conditions
- Incorrectly torqued or improperly placed clamps on intake hoses etc. causing leaks during charge conditions

➢ Check the charge air pressure system using the VAG 1687 Charge air system tester.

Special tool VAG 1687 Charge air system tester preliminary set-up

➢ - Back off pressure regulator knob -2- of VAG 1687 fully to protect gauge when shop air supply is applied to assembly.

- Close valve -3- before gauge.
- Close valve -4- after gauge.

The shop air supply line will later be attached to the inlet of VAG 1687.

- Remove female fitting from tester (arrow) and install an appropriate "male" air fitting that will connect to your shop air supply line (⇒WARNING!).

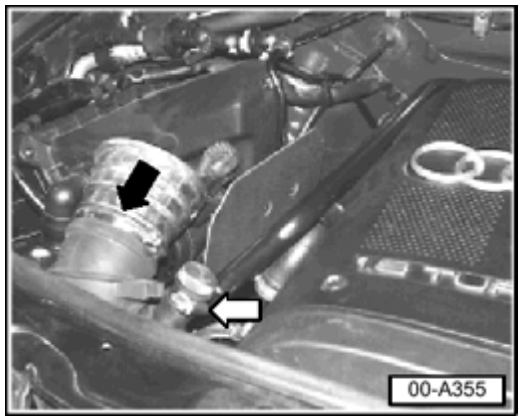
21-15

WARNING!

Use only approved air fittings to adapt shop air supply line to VAG 1687 tester.

Special tool VAG 1687/1 pressure adapter, installing (1.8L Turbo)

- Separate intake hose from Mass Air Flow (MAF) sensor assembly.

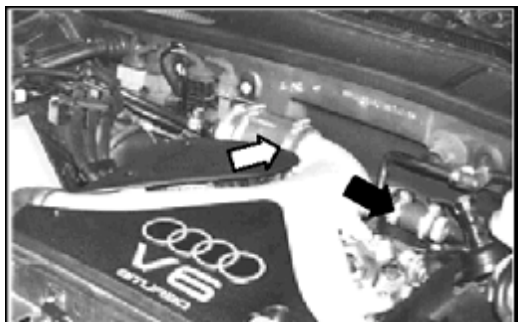


- Insert VAG 1687/1 pressure adapter in intake hose -black arrow- using existing clamp (as shown).
- Remove crankcase ventilation tube from intake hose at -white arrow-.

Special tool VAG 1687/1 pressure adapter, installing (2.7L BiTurbo)

- Remove upper air cleaner housing and hoses to intake manifold as necessary

⇒ *Repair Manual, Maintenance; Air cleaner housing, cleaning; Air cleaner element, replacing*



- Insert VAG 1687/1 pressure adapter in intake hose -white arrow- using existing clamp (as shown).
- Disconnect engine crankcase ventilation hose from intake manifold - black arrow-.
- Plug intake manifold fitting (for crankcase ventilation hose) with appropriate hose and metal plug using clamps supplied with VAG

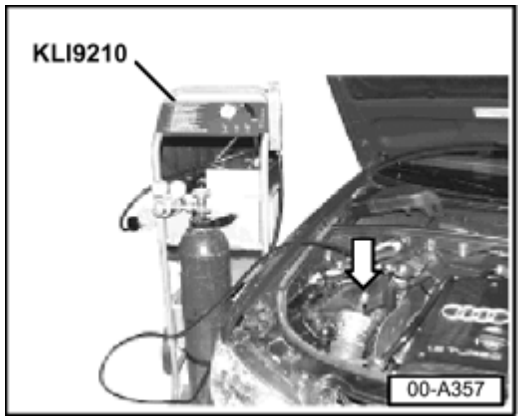
1687/1 special tool kit.

Note:

- *To help find small leaks, BEFORE pressurizing the system fill system with smoke using special tool KLI9210 and adapter KLI9210/50 as described on page ⇒ ⇒ Page 21-16 .*
- *An ultrasonic detector may also be used to detect extremely small leaks where smoke may not be visible.*

Special tool KLI9210 (Evaporative system leak detector), connecting to 1.8L Turbo

- Install optional fitting LKI9210/50 on hose of special tool KLI9210.



- Connect KLI9210 to VAG 1687/1 adapter (KLI9210 is shown attached to VAG 1687/1 at arrow on 1.8L Turbo).

Special tool KLI9210 (Evaporative system leak detector), connecting to 2.7L BiTurbo

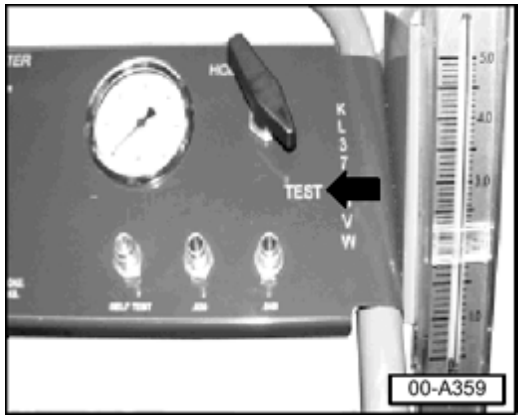
- Install optional fitting LKI9210/50 on hose of special tool KLI9210.

-
Connect KLI9210 to VAG 1687/1 adapter (KLI9210 is shown attached

to VAG 1687/1 at arrow on 2.7L BiTurbo).

Special tool LKI9210 (Evaporative system leak detector), preliminary set-up

- Connect smoke generator leads to vehicle battery.



- Turn valve to test -black arrow-.
- Press smoke generator button to fill system with smoke (see instructions printed on tester).

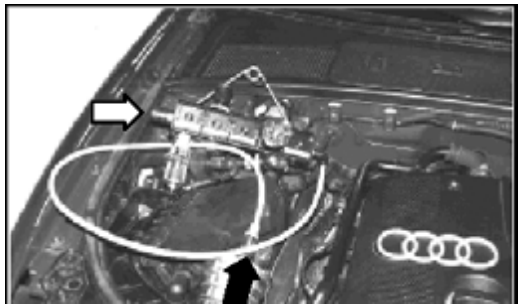
With system filled with smoke:

- Remove smoke generator hose and connect VAG1687 quickly to prevent smoke from leaking out ⇒ Page 21-17 .

Special tool VAG 1687, connecting to pressure adapter VAG 1687/1 (1.8L Turbo)

For illustrations purposes VAG is shown lying in the engine compartment. In practice the tool should be hung from the hood.

- Connect VAG 1687 quickly to prevent smoke from leaking out.



VAG 1687 is shown connected to VAG 1687/1 -black arrow-

Shop air supply will be connected to VAG 1687 -at white arrow-

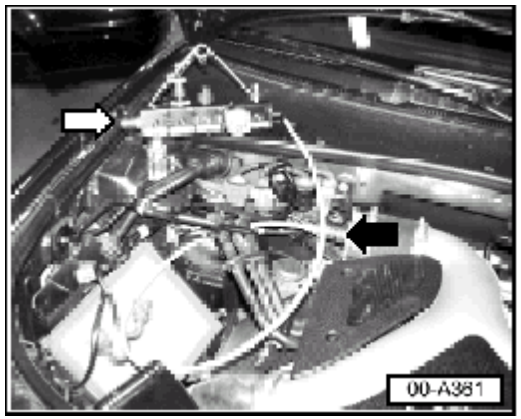
- Perform pressure test ⇒ Page 21-19 .

21-18

Special tool VAG 1687, connecting to pressure adapter VAG 1687/1 (2.7L BiTurbo)

For illustrations purposes VAG is shown lying in the engine compartment. In practice the tool should be hung from the hood.

- Connect VAG 1687 quickly to prevent smoke from leaking out.



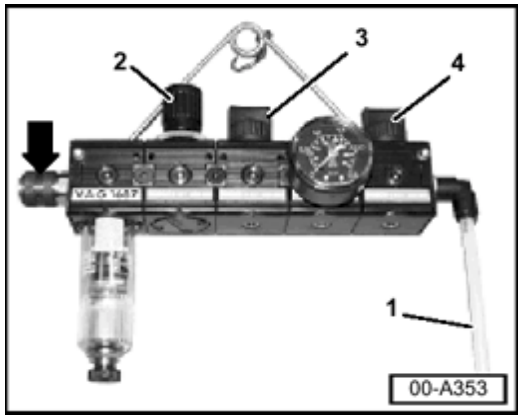
➢ VAG 1687 is shown connected to VAG 1687/1 -black arrow-

Shop air supply will be connected to VAG 1687 -at white arrow-

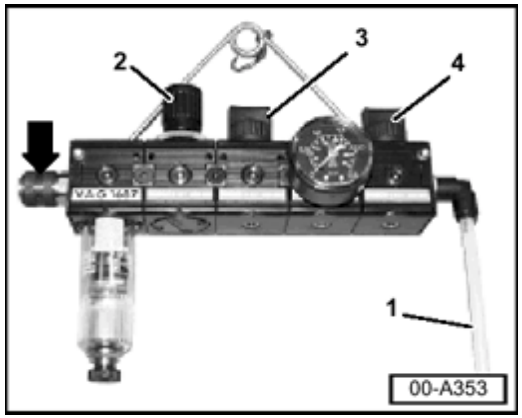
- Perform pressure test ⇒ Page 21-19 .

21-19

Performing pressure test:



- With outlet hose -1- of VAG 1687 connected to air pressure adapter:
- Attach shop air supply line to previously installed male fitting (⇒ Page 21-14 .



- Open valve -3- between regulator valve and gauge.
- Adjust test pressure up to 0.5 bar (⇒CAUTION below) by turning regulator valve -2-.

CAUTION!

- ***DO NOT pressurize the system above 0.5 bar!***
- ***Doing so may force oil into the intake system which can damage the engine.***

- Slowly open outlet valve -4- (after gauge) to test hose connections.
- Observe pressure gauge for a drop in pressure.

Note:

Some pressure will be lost past the throttle plate.

- Readjust test pressure to 0.5 bar (⇒CAUTION above) by turning regulator valve -2-.

- Listen for any very large intake leaks.

If smoke generator was used to fill the system with smoke:

- Inspect intake system connections for smoke at leaks.

Note:

An ultrasonic detector may also be used to detect extremely small leaks where smoke may not be visible.

- Repair any leaks found.

- Remove tester.

- Remove plug from crankcase ventilation hose.

- Remove air pressure adapter.

With VAS 5051 diagnostic tool connected:

- Erase DTC memory.

If smoke generator was not used to fill the system with smoke:

- Apply soapy water solution or equivalent to intake system connections.

21-21

Note:

An ultrasonic detector may also be used to detect extremely small leaks.

- Inspect intake system connections for leaks.
- Repair any leaks found.
- Remove tester.
- Remove plug from crankcase ventilation hose.
- Remove air pressure adapter.

With VAS 5051 diagnostic tool connected:

- Erase DTC memory.

21-22

Rules of cleanliness

CAUTION!

Whenever carrying out any work on the fuel supply or fuel injection systems, always observe the following rules of cleanliness.

1. Thoroughly clean fuel system line and hose connections and the surrounding area before disconnecting.

2. Place removed components on a clean surface and cover. Use plastic sheeting or paper. Do not use fluffy rags that could leave lint!

3. Carefully cover over or seal any components that have been opened if repairs are not carried out immediately.

4. Install only clean parts:

- Do not remove replacement parts from the packaging until immediately before they are to be installed.

- Do not use parts that have been stored without packaging (e.g. in toolboxes, etc.).

5. When the fuel system is opened:

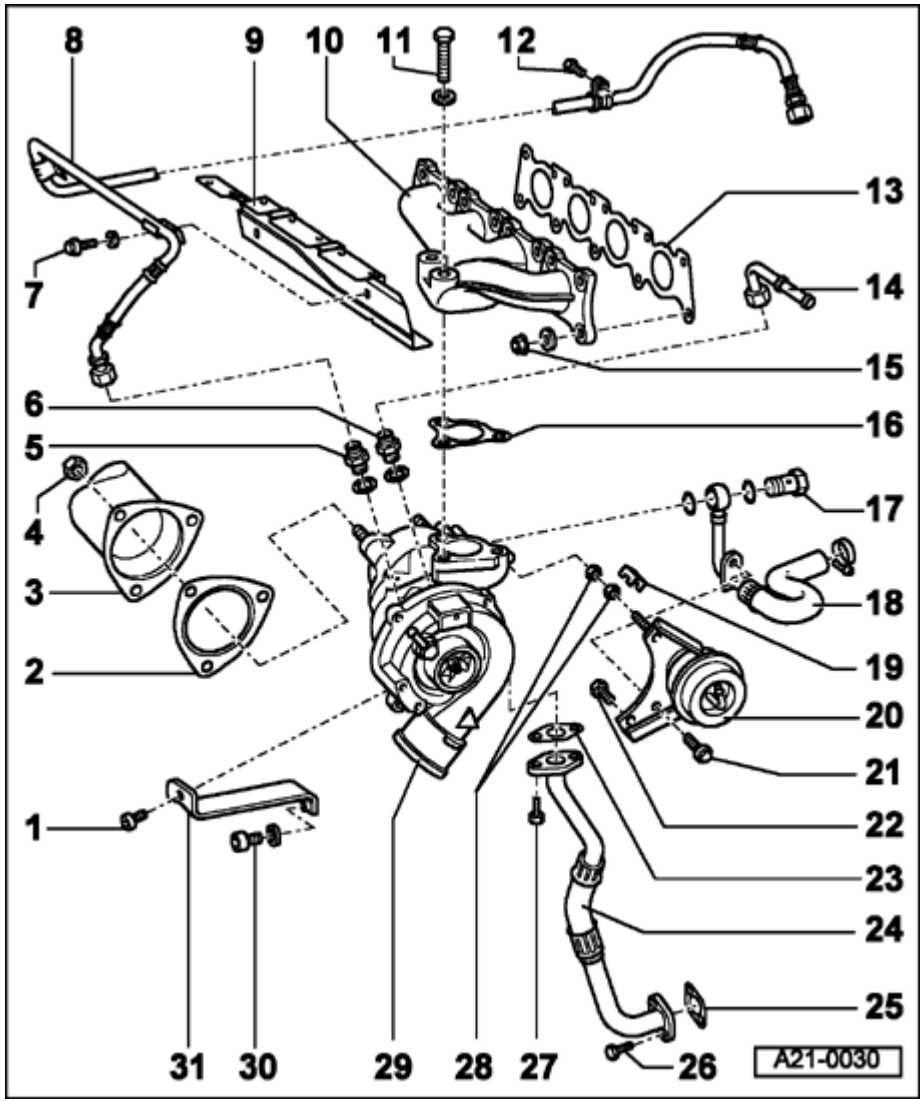
- Avoid working with compressed air whenever possible.
- Avoid moving the vehicle if possible.

21-23

Note:

- *Observe rules of cleanliness ⇒ Page 21-22 .*
- *Charge air pressure control connection diagram ⇒ Page 21-2 .*
- *All hose connections are secured with hose clamps that comply with factory specifications ⇒ parts catalog.*
- *Charge air pressure system must be free of leaks.*
- *Always replace gaskets and self-locking nuts.*

21-24



Turbocharger, removing, installing and overview

Part I

1 - Bolt with collar

- 40 Nm (30 ft lb)
- Only use genuine equipment bolts ⇒ parts catalog

2 - Gasket

- Always replace

3 - Three Way Catalytic Converter (TWC)

4 - Nut

- Always replace
- 30 Nm (22 ft lb)

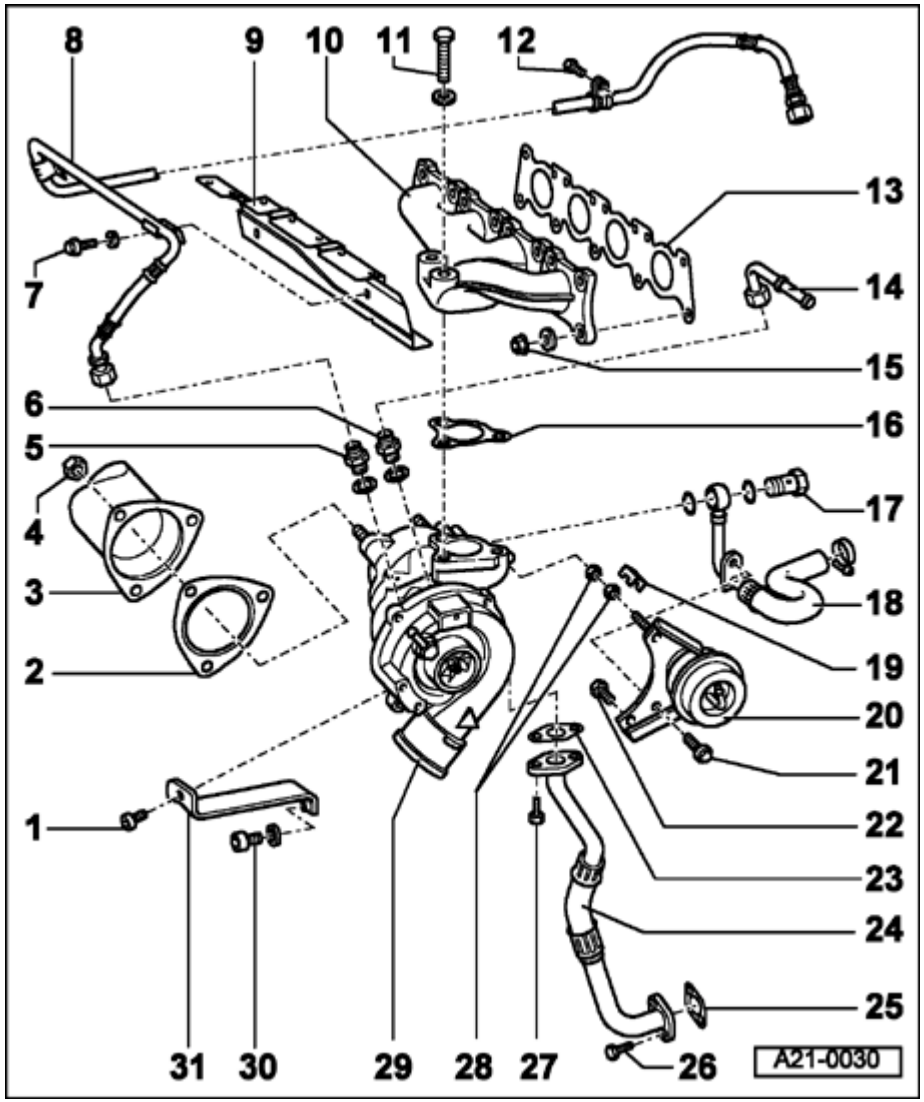
5 - Connection

- 30 Nm (22 ft lb)

6 - Connection

- 35 Nm (26 ft lb)

21-25



7 - Bolt

- 20 Nm (15 ft lb)

8 - Oil supply line

- Tightening torque for union nut: 25 Nm (18 ft lb)
- From oil filter bracket ⇒ item - 1 -, page ⇒ Page 17-6

9 - Heat shield

10 - Exhaust manifold

11 - Bolt

- Always replace
- 35 Nm (26 ft lb)
- Coat thread and bolt head seating surface with "G 052 112 A3" hot bolt paste.

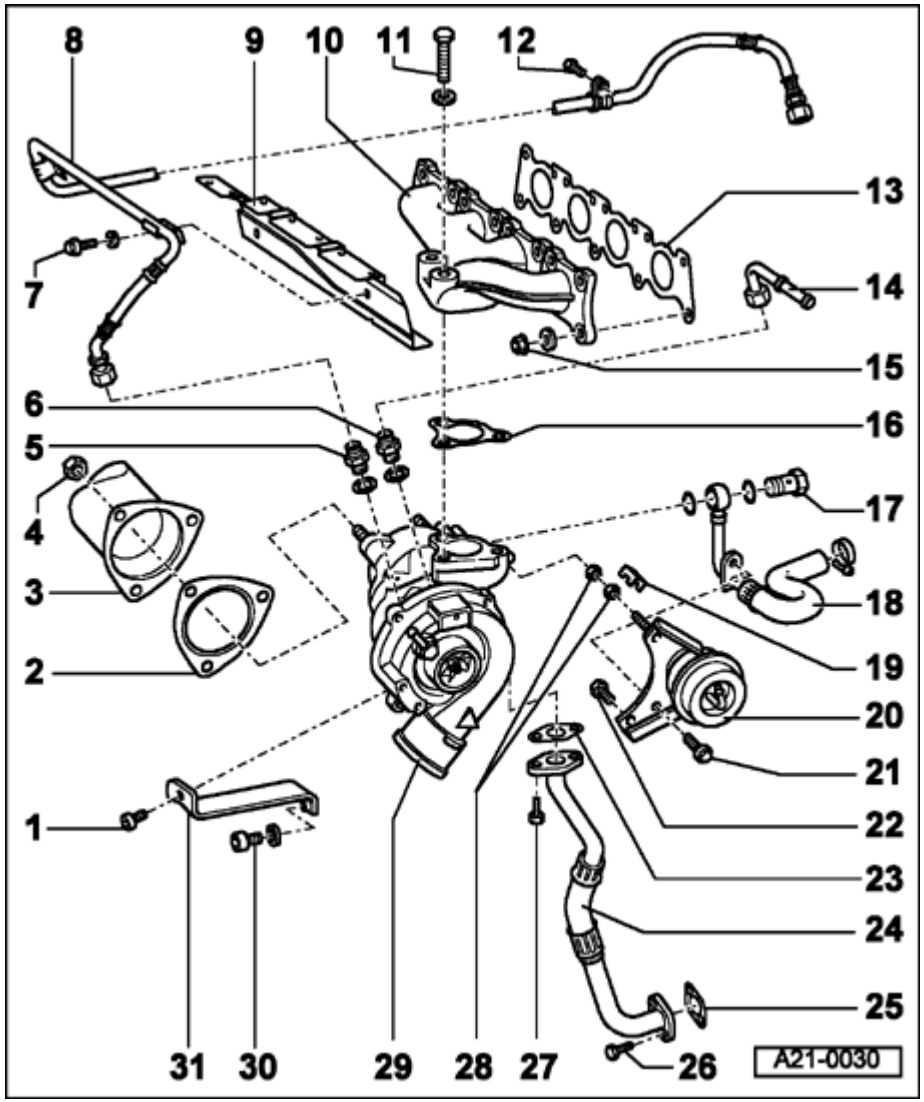
CAUTION!

Part numbers are listed here for reference only. Always check with your Parts department for the latest information.

12 - Bolt

- 10 Nm (7 ft lb)

21-26



13 - Gasket

- Always replace
- Note installed position

14 - Coolant return line

- Union nut tightening torque: 30 Nm (22 ft lb)

15 - Nut

- Always replace
- 25 Nm (18 ft lb)

16 - Gasket

- Always replace
- Note installed position

17 - Banjo bolt

- 25 Nm (18 ft lb)

18 - Coolant supply line

19 - Fuse

20 - Vacuum diaphragm

- For wastegate

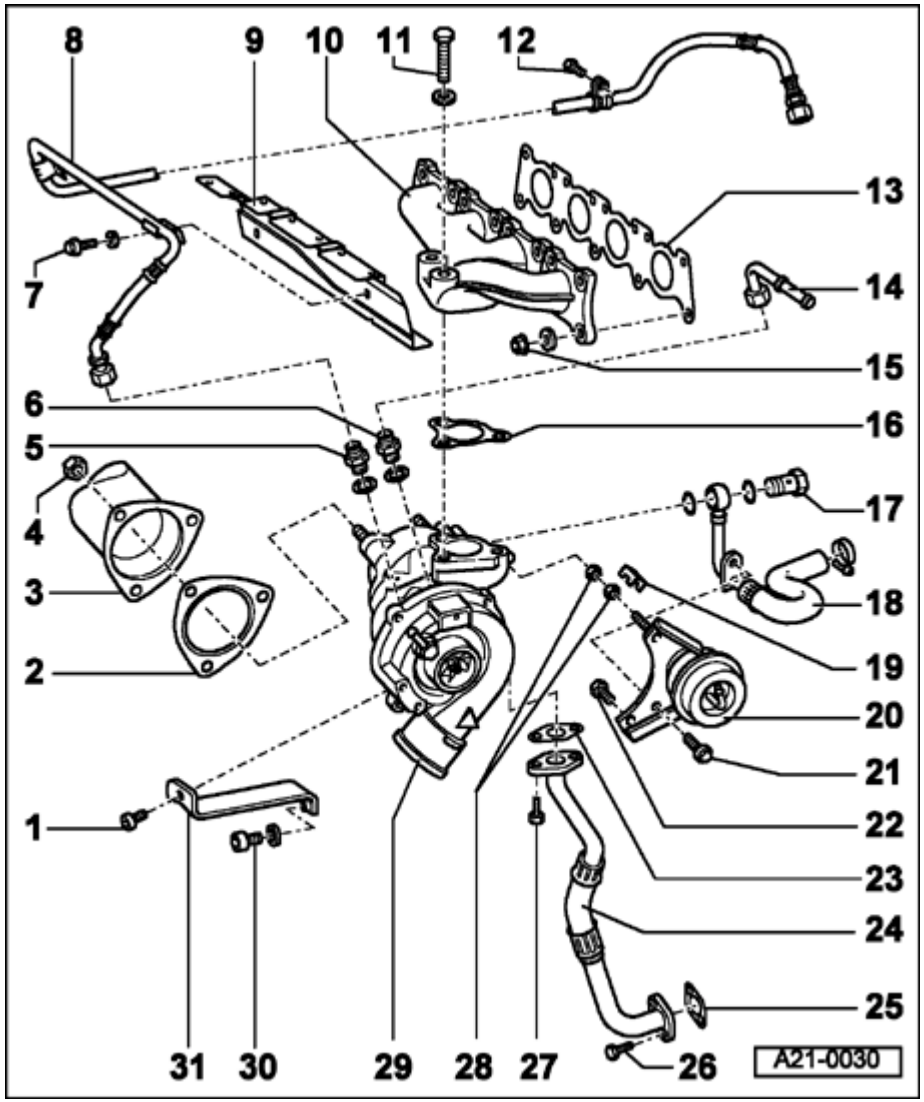
21 - Bolt

- 10 Nm (7 ft lb)

22 - Bolt

- 10 Nm (7 ft lb)
- Install with D 000 600

21-27



23 - Gasket

- Always replace

24 - Oil return line

- To oil pan

25 - Gasket

- Always replace

26 - Bolt

- 10 Nm (7 ft lb)

27 - Bolt

- 10 Nm (7 ft lb)

28 - Nuts

- 10 Nm (7 ft lb)
- Install with D 000 600
- Do not change adjustment

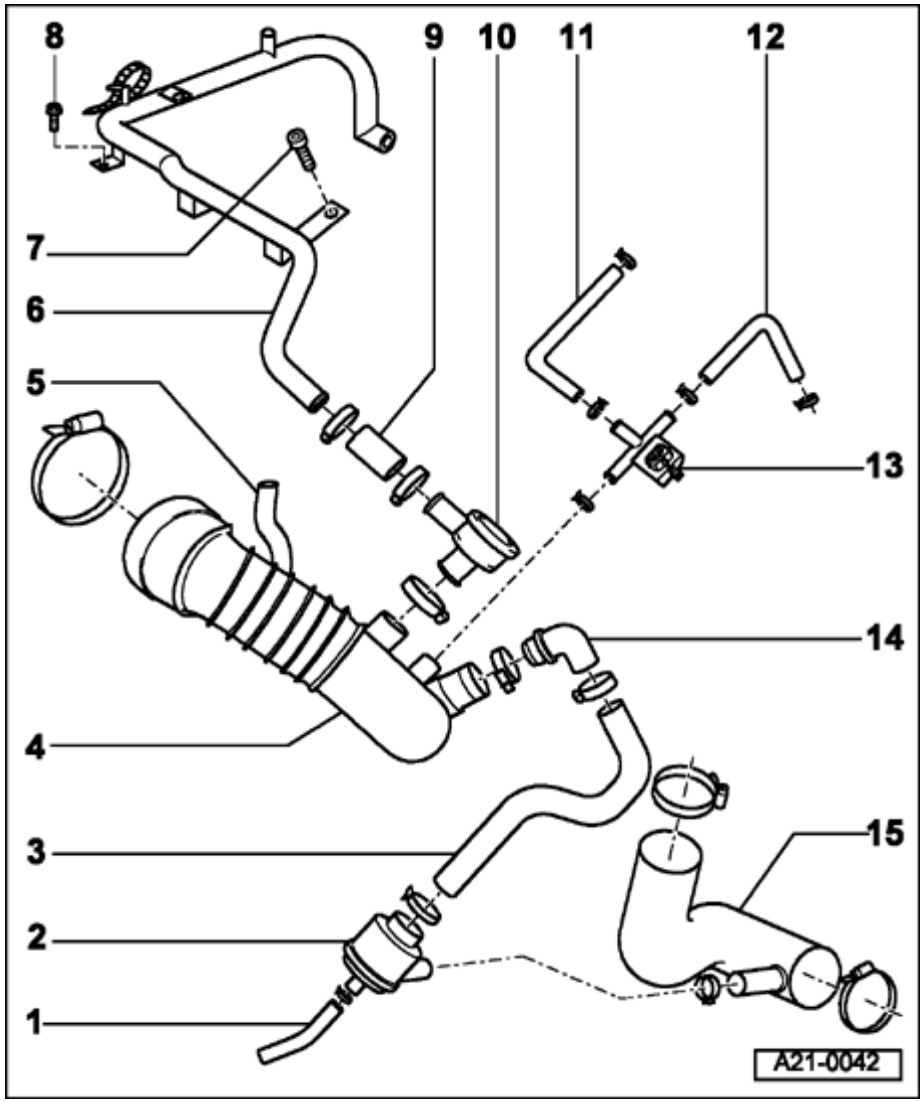
29 - Turbocharger

- Check ⇒ Page 21-5

30 - Bolt

- 45 Nm (33 ft lb)

31 - Bracket



Part II

1 - Vacuum hose

- To intake manifold

2 - Charge pressure bypass valve

- Check ⇒ Page 21-4

3 - Hose

- To charge pressure bypass valve

4 - Intake air duct

- To connection at turbocharger

5 - Hose

- To Evaporative Emissions (EVAP) purge regulator valve

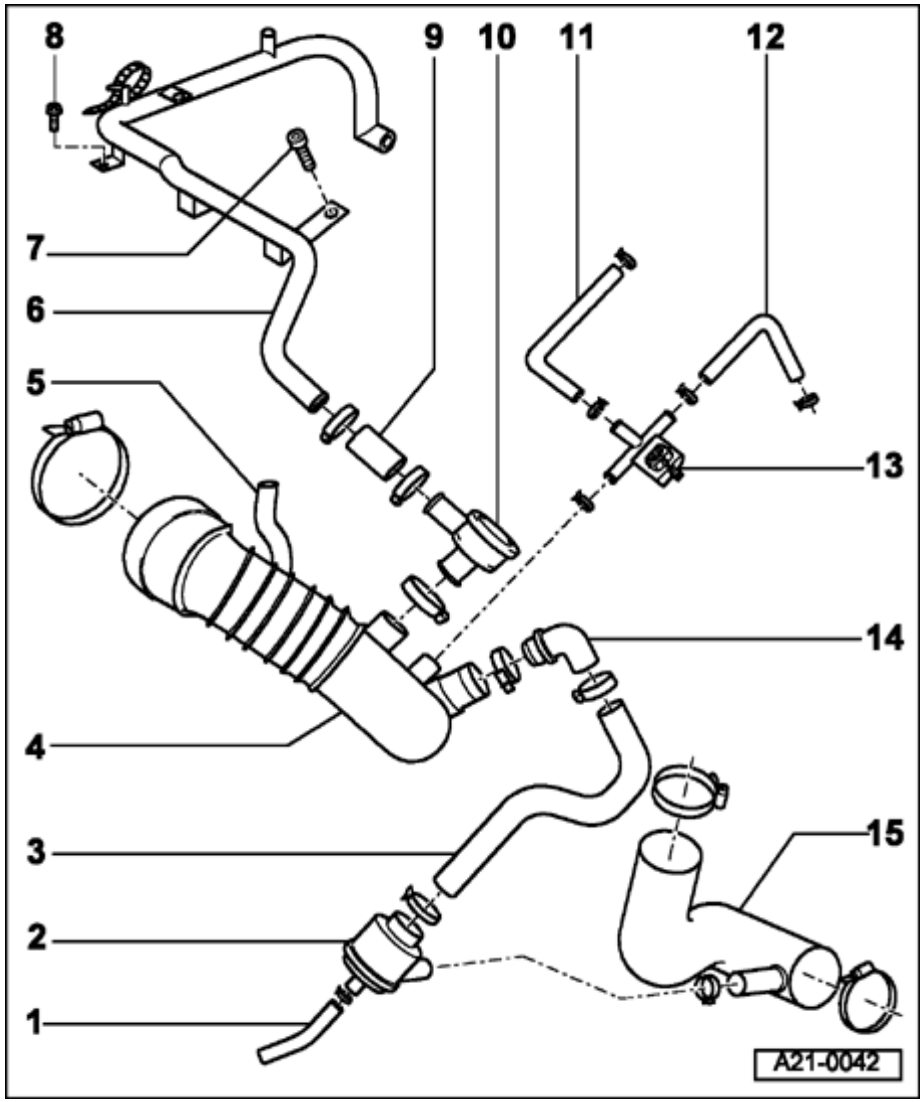
6 - Line

- To crankcase ventilation

7 - Socket-head bolt

- 10 Nm (7 ft lb)

21-29



8 - Sheet metal screw

9 - Hose

- To crankshaft ventilation line

10 - PCV valve

- For crankcase ventilation

11 - Hose

- To turbocharger

12 - Hose

- To vacuum diaphragm for wastegate

13 - Wastegate bypass regulator valve -N75-

14 - Elbow

15 - Hose

- To turbocharger

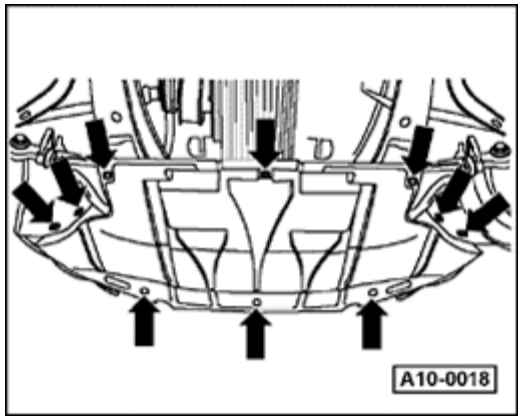
21-30

Turbocharger, removing and installing

Note:

Replace gaskets and self-locking nuts.

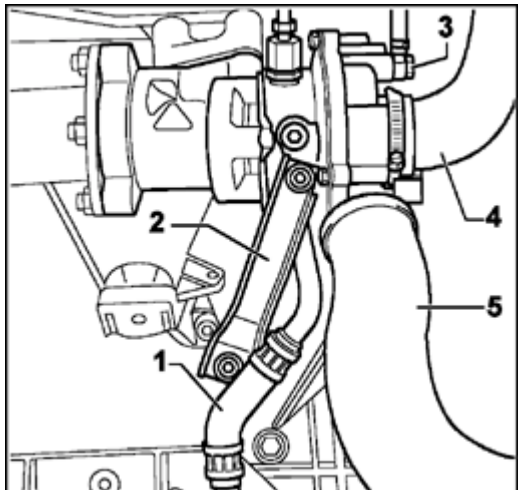
Removing



- Remove noise insulation panel (arrows).
- Unbolt A/C compressor.

WARNING!

Do NOT open A/C refrigerant circuit.



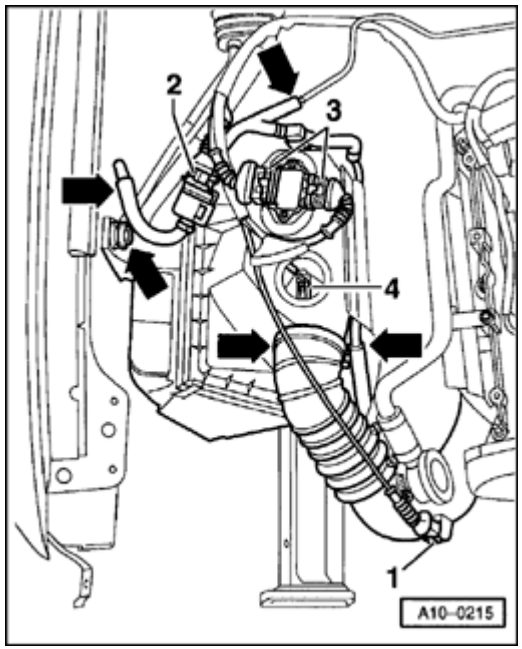
- Unbolt turbocharger bracket -2-.
- Disconnect oil return line -1- at turbocharger and lay aside.
- Remove air guide ducts -4- and -5- at turbocharger.
- Remove pressure line banjo fitting -3-.
- Disconnect hose from support for charge air pressure regulation valve vacuum diaphragm.
- Unbolt bracket for coolant supply line at charge air pressure regulation valve vacuum diaphragm.

- Use 3094 hose clamp to pinch off coolant supply hose.

21-31

- Remove intake air duct between cowl and air cleaner housing.

- Remove air cleaner housing cover.



- Remove the following lines/harness connectors:

1 - At wastegate bypass regulator valve -N75-

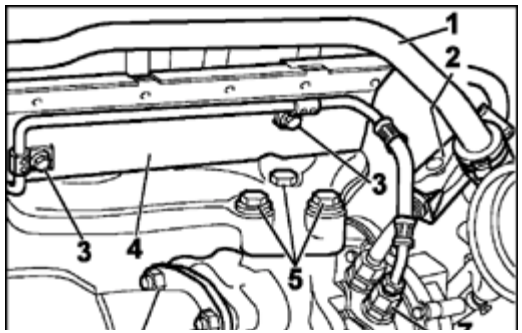
2 - At Evaporative Emissions (EVAP) purge regulator valve -N80-

3 - At power output stage -N122-

4 - At Mass Air Flow (MAF) sensor -G70-

- Remove hose connections and remove air cleaner housing (arrows).

- Remove engine covers.



- Unbolt crankcase ventilation hose -1- at cylinder head cover and heat shield.

- Unbolt both oil supply line bolts -3-.

- Remove heat shield -4-.

- Remove sleeve -2- from coolant return hose.

- Use 3094 hose clamp to pinch off coolant return hose.

- Remove coolant return hose at line to turbocharger. Line remains bolted to turbocharger.

- Unbolt oil supply line -7- at turbocharger.

Note:

The exhaust flexpipe must not be bent more than 10° , otherwise it may be damaged.

- Unbolt Three Way Catalytic Converter (TWC) from turbocharger -6-.

- Unbolt turbocharger from exhaust manifold -5- .

- Move turbocharger to side and remove coolant supply line banjo fitting.

- Remove turbocharger.

Installing

Installation is the reverse of removal, noting the following:

- Perform the following steps before tightening turbocharger:

- Loosely bolt coolant supply line to vacuum diaphragm for charge air pressure regulation valve.

- Tighten banjo fitting, then tighten mounting bolt for bracket to proper torque.

21-33

Note:

Add oil to turbocharger through oil supply line connection flange.

- Fill up coolant ⇒ Page 19-4 .

WARNING!

The cooling system is pressurized when the engine is warm. When opening the expansion tank, wear gloves and other appropriate protection, cover the cap with a cloth and open carefully to relieve system pressure slowly.

Note:

After installing the turbocharger, let engine idle for approx. 1 minute without increasing engine speed. This ensures adequate oil supply to the turbocharger.

- Check engine oil level ⇒ Page 17-27 .

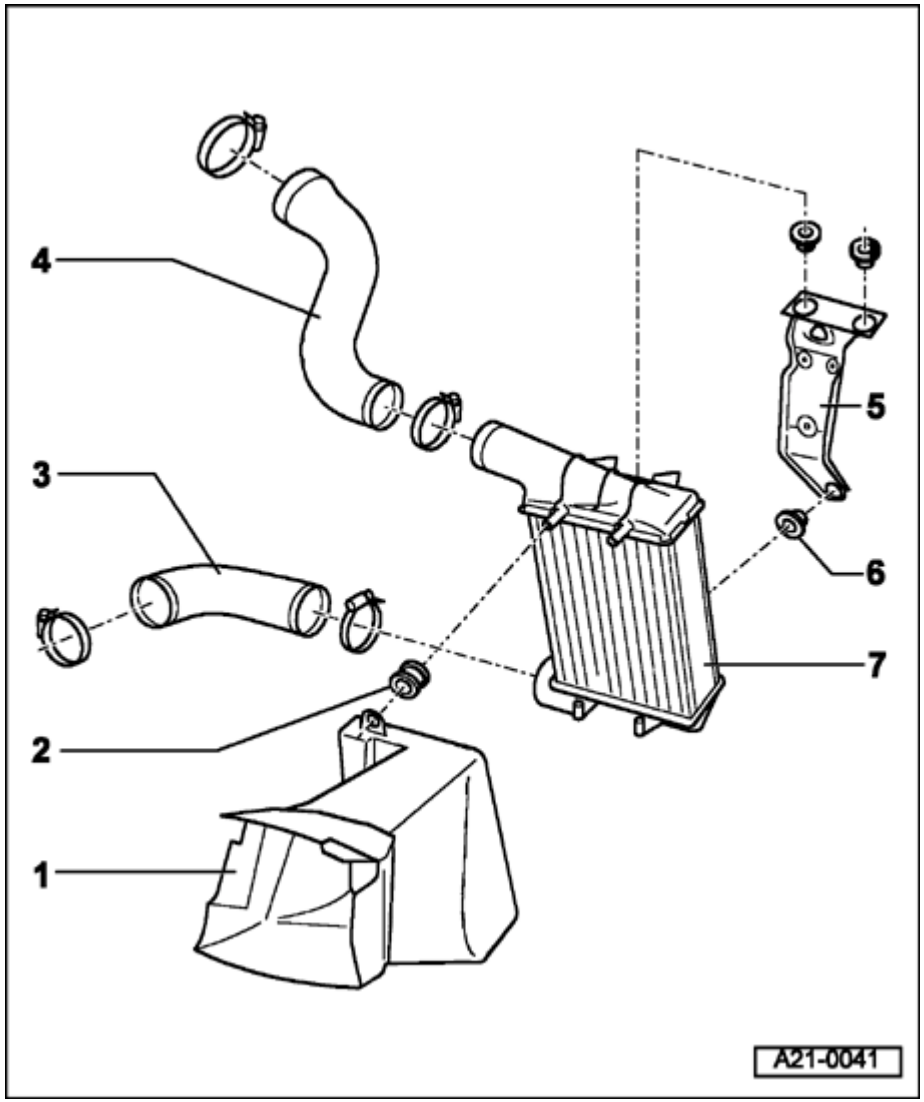
21-34

Tightening torques

Component	Tightening torques
Oil return line to turbocharger	10 Nm (7 ft lb)
Turbocharger bracket to turbocharger (bolt and washer assembly M8)[1)]	40 Nm (30 ft lb)
Turbocharger bracket to cylinder block	45 Nm (33 ft lb)
Oil feed line to turbocharger	25 Nm (18 ft lb)
Coolant supply pipe bracket to turbocharger	10 Nm (7 ft lb)
Oil supply line bracket to cylinder head	20 Nm (15 ft lb)
Coolant supply line to turbocharger	25 Nm (18 ft lb)
Crankcase ventilation line to cylinder head	10 Nm (7 ft lb)
Coolant return line to turbocharger	30 Nm (22 ft lb)
Turbocharger to exhaust manifold	35 Nm (26 ft lb)
Three Way Catalytic Converter	30 Nm (22 ft

(TWC) to turbocharger	lb)
1) Bolt strength: 10.9	

21-35



Charge air cooler components, removing and installing

Note:

- *All hose connections are secured with hose clamps ⇒parts catalog.*
- *charge air pressure system must be free of leaks.*

1 - Air duct

2 - Grommet

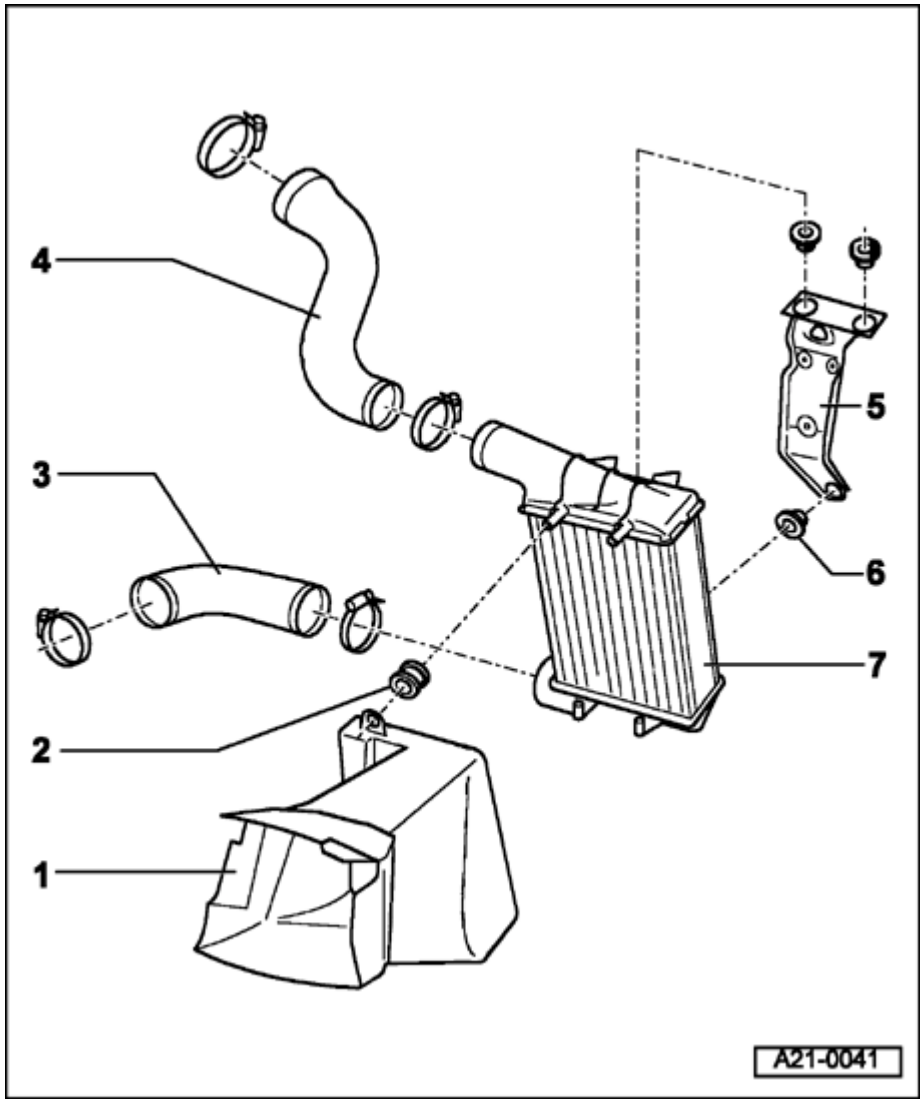
3 - Hose

- Between charge air cooler and air guide in cowl

4 - Hose

- Between intake manifold and charge air cooler

21-36



5 - Bracket

- Riveted to body

6 - Grommet

- With sleeve

7 - Charge air cooler

- Removing and installing ⇒ Page 21-37

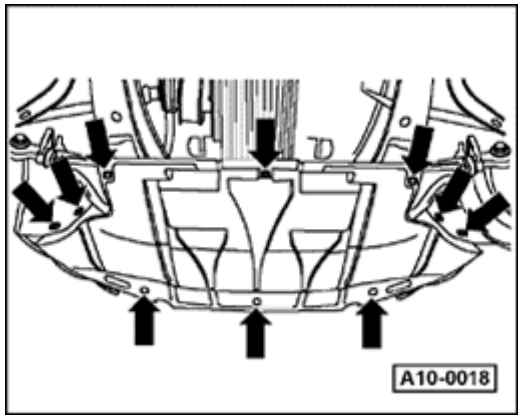
21-37

Charge air cooler, removing and installing

- Lock carrier in service position ⇒ Page 13-1 .

Removing

- Remove upper air duct at charge air cooler.



- Remove noise insulation panel (arrows).
- Disconnect air guide at charge air cooler.
- Remove lower air duct at charge air cooler.
- Remove charge air cooler from below.

Installing

Installation is the reverse of removal.