

## Diesel Injection System

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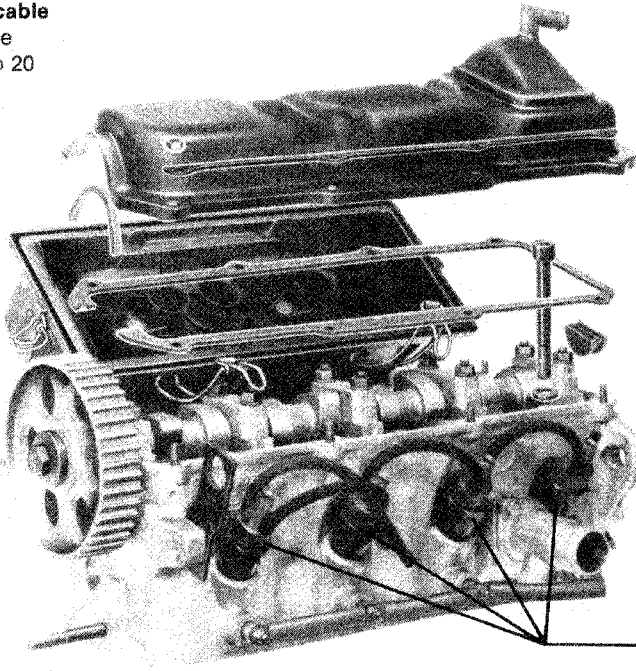
# 23 Diesel Injection System

**Accelerator cable**  
adjusting, see  
Repair Group 20

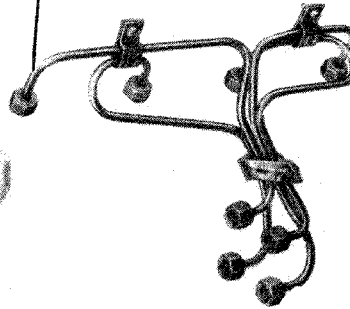
## WARNING

Disconnect battery when working on fuel system. Never smoke when working with fuel or have anything in area that can ignite it.

**Always** replace seals and fuel hose clamps



**Injector pipes**  
25 Nm (18 ft lb)



**Injectors**  
70 Nm (51 ft lb)  
removing/installing page 23.9  
cleaning page 23.9  
checking page 23.10

**Cold start cable**  
adjusting page 23.5

**Engine speed**  
checking/adjusting  
page 23.5

**Glow plugs**  
checking, see  
Repair Group 28

**Tensioner**  
use tool US 4493  
to tension

45 Nm (33 ft lb)

**Drive belt**  
removing/installing  
see Repair Group 13

20 Nm (14 ft lb)

**Injection pump**  
removing page 23.6  
installing page 23.7  
adjusting page 23.4  
checking page 23.3

**Fuel delivery valves**  
45 Nm (33 ft lb)  
checking/replacing  
page 23.8

25 Nm (18 ft lb)

25 Nm (18 ft lb)

**Injection pump sprocket**  
removing page 23.7

**Intermediate shaft pulley**

45 Nm (33 ft lb)

**Crankshaft sprocket**

**Crankshaft sprocket bolt**  
110 Nm (80 ft lb)  
do not use locking compound

**Double V-belt pulley**

13-593

## CAUTION

To avoid damage, keep injection parts clean when removing, installing, disassembling and assembling. Do not spill diesel fuel on any rubber hoses

## 23.2

Injection system

Diesel

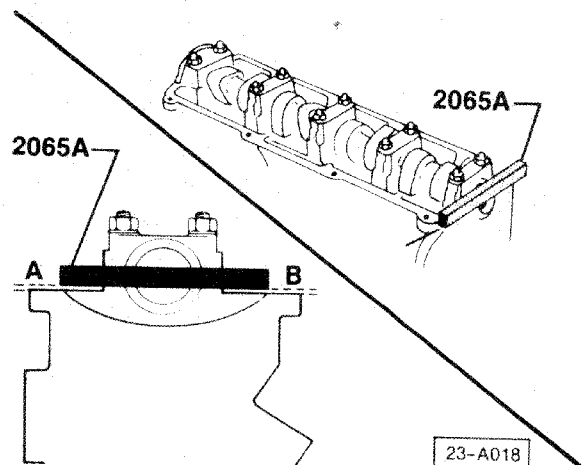
## Injection pump/Valve timing, checking

### Work sequence

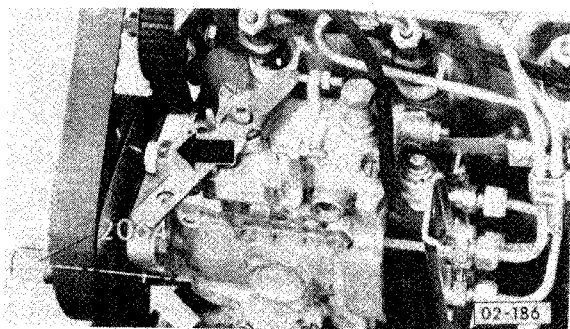
#### Note

Drive belt must be checked for proper tension and be centered in sprockets before checking injection pump/valve timing

- remove cylinder head cover/drive belt cover
- rotate engine until lobes of camshaft on cylinder No. 1 point upward (TDC position)



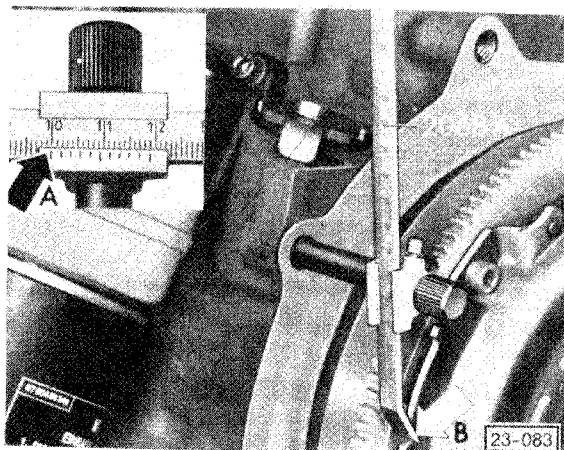
- install setting bar 2065A on cylinder head
- turn camshaft until one end of setting bar touches cylinder head
- measure gap at other end with feeler gauge
- take half of measurement and insert feeler of this thickness between bar and cylinder head at A
- turn camshaft so bar rests on feeler gauge
- insert second feeler gauge of same thickness between other end of bar and cylinder head at B



- check that marks on sprocket, pump and mounting plate (black arrow) are approximately aligned

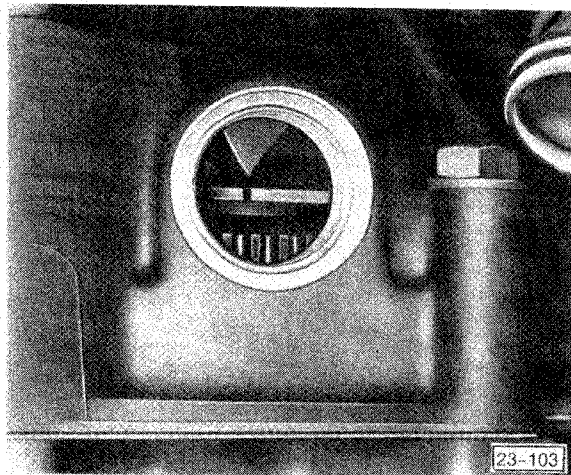
if **YES**, pump in correct position, continue with work sequence

if **NO**, pump incorrectly positioned, adjust pump/valve timing (see page 23.4)



(engine removed)

- attach tool 2068A to crankcase
- set scale to 100 mm (arrow A)
- tip of scale must align with TDC mark on clutch pressure plate (arrow B)



(engine installed)

- check that TDC mark on clutch pressure plate is in line with boss on bell housing
- if **YES**, valve timing **OK**; next check injection timing (see page 23.4)
- if **NO**, valve timing incorrect, proceed as follows:

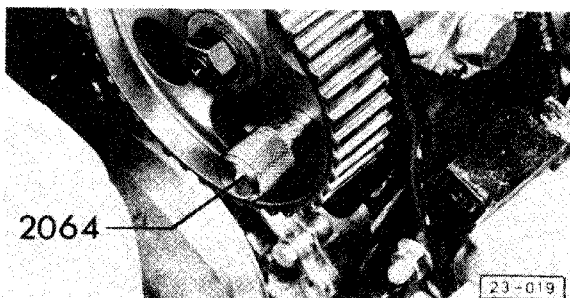
- loosen camshaft sprocket bolt 1 turn
- tap back of camshaft sprocket with rubber hammer until it is loose
- hand tighten sprocket bolt until end play is eliminated but sprocket still turns freely on camshaft
- rotate engine until TDC marks align on flywheel
- torque camshaft bolt to 45 Nm (33 ft lb)
- recheck marks
- check injection timing (see page 23.4)

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## Injection pump/Valve timing, adjusting

### Work sequence

- remove cylinder head cover/drive belt cover
- set engine to TDC No. 1 cylinder
- lock camshaft in position with setting bar (see page 23.3)
- loosen camshaft sprocket bolt 1 turn
- tap back of camshaft sprocket with rubber hammer until it is loose
  - hand tighten sprocket bolt until end play is eliminated but sprocket still turns freely on camshaft
- loosen belt tensioner
- remove belt from injection pump sprocket



- turn pump sprocket until marks on sprocket, pump and mounting plate are in line
- lock pump sprocket with pin 2064
- reinstall drive belt



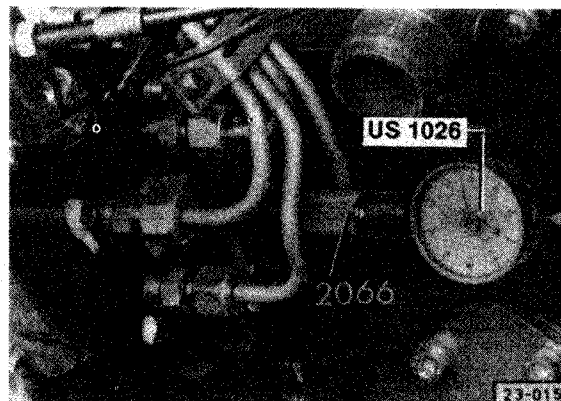
- tighten camshaft bolt to 45 Nm (33 ft lb) and remove setting bar
- remove lock pin from pump sprocket
- install belt tension gauge VW 210
- tension drive belt by turning tensioner clockwise
  - reading on belt tensioner = 12-13 (measured between camshaft sprocket and pump sprocket)
- lock tensioner
- turn crankshaft 2 complete turns and recheck belt tension
  - eliminate play in drive belt by striking once, between camshaft and pump sprockets, with rubber hammer
- recheck valve timing
- check injection timing

## Injection timing, checking/adjusting

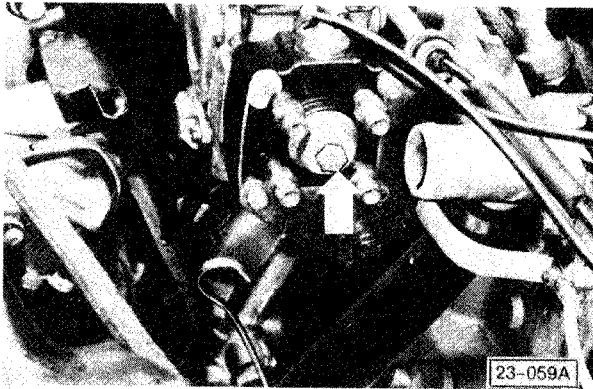
### Work sequence

#### CAUTION

Push in cold start device completely when checking or adjusting injection timing



- remove center plug from injection pump cover
- install adaptor and dial gauge 0 to 3 mm (0 to 0.118 in.) in place of plug and preload gauge to approx. 2.5 mm (0.097 in.)
- turn engine slowly counterclockwise (opposite to normal rotation) until dial gauge needle stops moving
- zero gauge
- turn engine clockwise until TDC mark on clutch pressure is aligned with boss on bell housing
- check that gauge reads 0.78-0.88 mm
- if necessary, loosen upper bolts on mounting plate and bolt of rear support
- set lift by turning pump until gauge reads  $0.86 \pm 0.02$  mm
- tighten pump mounting bolts and recheck injection timing



Tightening torque of the Diesel Injection pump center plug (arrow) is:

- $17 \pm 3$  Nm ( $12 \pm 2$  ft lb) with copper seal (reddish-brown in color)
- $22 \pm 2$  Nm ( $16 \pm 2$  ft lb) with bronze seal (yellow-brown in color)

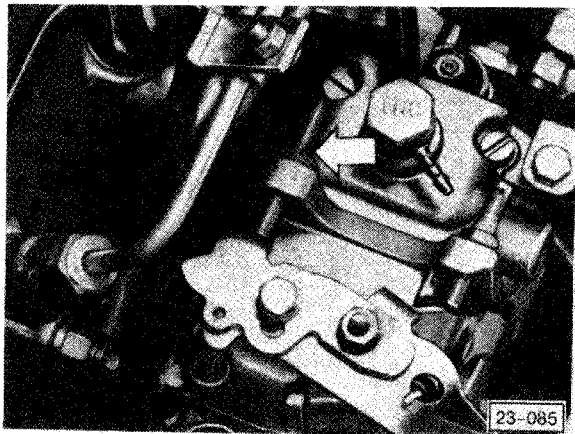
### CAUTION

To avoid fuel leaks, always replace seal for center plug (arrow)

## Engine speed, checking/adjusting

### Work sequence

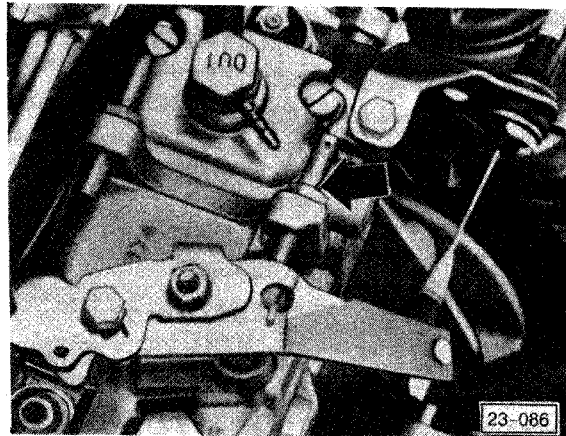
- start engine and warm up
- place engine RPM sensor US 1324 on cylinder head cover and attach to battery
- install positive lead of VAG 1367 to US 1324



- check that idle speed is 800–850 RPM
  - oil temperature  $60^\circ\text{C}$  ( $140^\circ\text{F}$ )

if **NO**

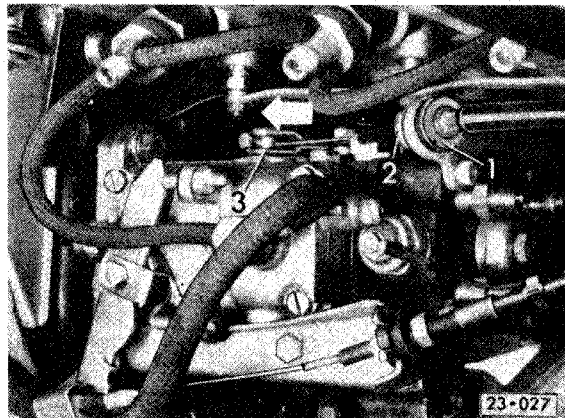
- loosen locknut (arrow)
- adjust idle speed screw
  - turning clockwise increases RPM
- tighten locknut



- check that maximum speed is  $4800 \pm 50$  RPM
- if **NO**
  - loosen locknut (arrow)
  - adjust maximum speed screw
    - turning clockwise decreases RPM
  - tighten locknut

## Cold-start cable, adjusting

### Work sequence



- insert washer 1 onto cable
- install cable in bracket with rubber bushing and insert inner cable into pin 3
- install horseshoe lock clip 2
- push in cold-start knob fully
- move lever to stop in direction of arrow
- pull inner cable tight and secure pin 3 with clamping screw

### WARNING

Disconnect battery when working on fuel system. Never smoke when working with fuel or have anything in area that can ignite it.

**Always** replace seals and fuel hose clamps.

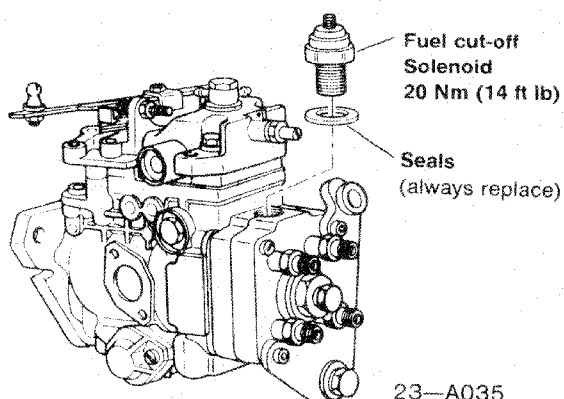
**Diesel**

Engine speeds  
Cold-start cable  
Fuel cut-off solenoid

# 23.5

# 23 Diesel Injection System

## Fuel cut-off solenoid, testing



The following test procedure must be performed **before** replacement of fuel cut-off solenoid:

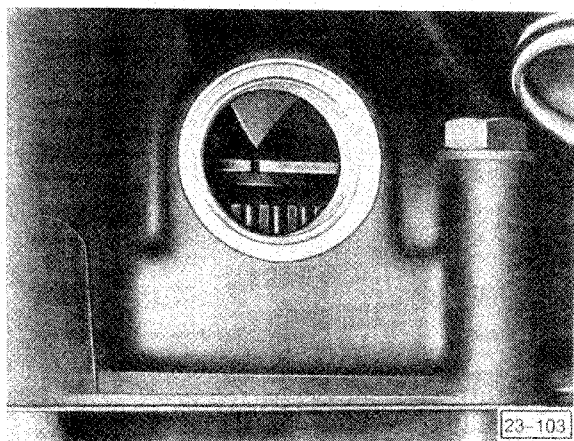
- Clean surrounding area and remove fuel cut-off solenoid from injection pump
- Inspect solenoid plunger and seat for foreign matter
- Clean solenoid plunger and check for free movement in solenoid
- Clean solenoid mounting surfaces
- Reinstall fuel cut-off solenoid using new seal and tighten to 20 Nm (14 ft lb)
- Check for proper operation

## Injection pump, removing

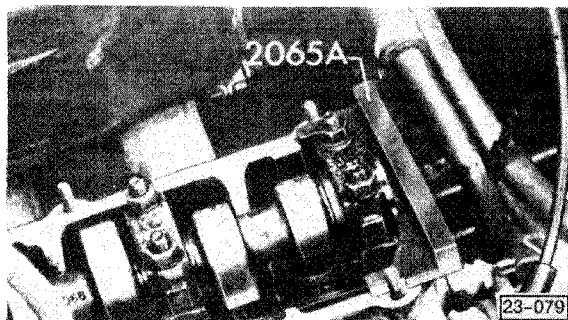
### Work sequence

#### CAUTION

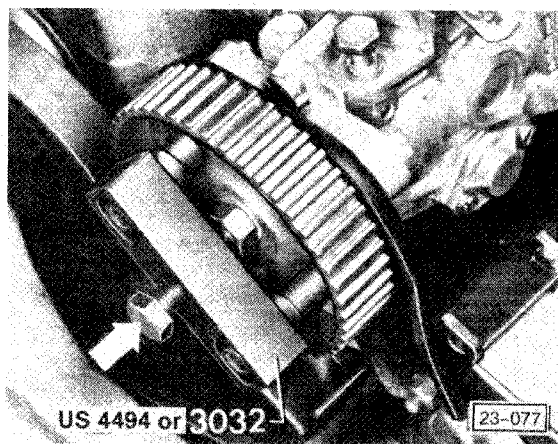
When working on injection system, everything must be kept extremely clean. Wipe pipe unions clean before loosening



- turn engine until TDC mark on clutch pressure plate is in line with boss on bell housing
- disconnect battery ground strap



- remove cylinder head cover
- lock camshaft with setting bar
- remove drive belt
- loosen injection pump sprocket retaining nut slightly



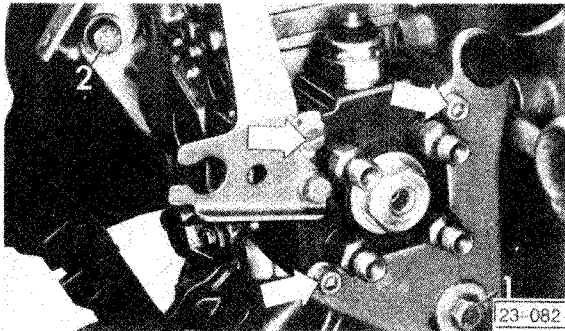
- attach puller so jaws are at right angles to cross bar and point in direction of spindle rotation
- carefully apply tension with puller

#### CAUTION

Never apply excessive tension with puller. as this may damage sprocket



- hit puller spindle head (arrow) with light hammer taps until sprocket loosens from injection pump shaft taper
- remove puller and nut
- remove sprocket by hand
- detach all fuel pipes from pump. Cover unions with clean cloth
- disconnect wire from fuel shutoff solenoid on injection pump and detach accelerator and cold start cables



- remove three bolts from injection pump mounting plate 2

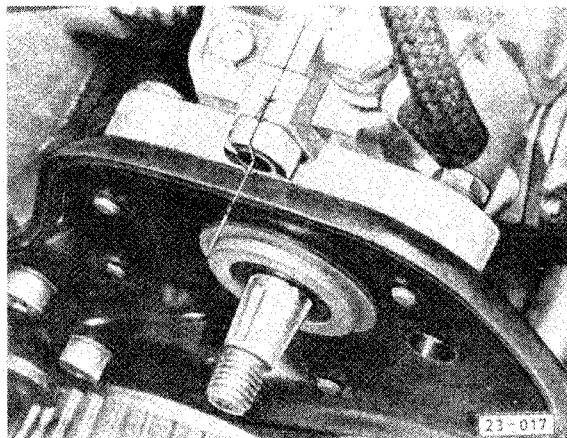
## CAUTION

To avoid damage to distributor plunger, **do not** loosen bolts (arrows) on fuel distributor head

- remove bolt 1 from rear support and remove pump

## Injection pump, installing

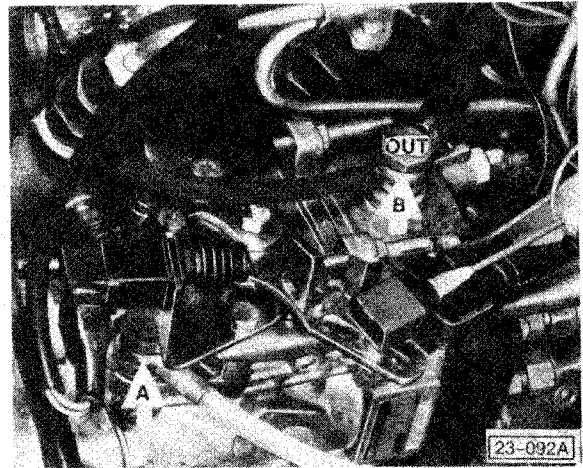
### Work sequence



- install pump, align marks on pump and mounting plate. Install pump sprocket

### Tightening torques

• Pump bolts	25 Nm (18 ft lb)
• Fuel pipes	25 Nm (18 ft lb)
• Pump sprocket	45 Nm (33 ft lb)



## CAUTION

Do not interchange fuel supply (arrow A) and return (arrow B) pipe union screws. For identification, fuel return pipe union screw is marked **OUT** on hex. head

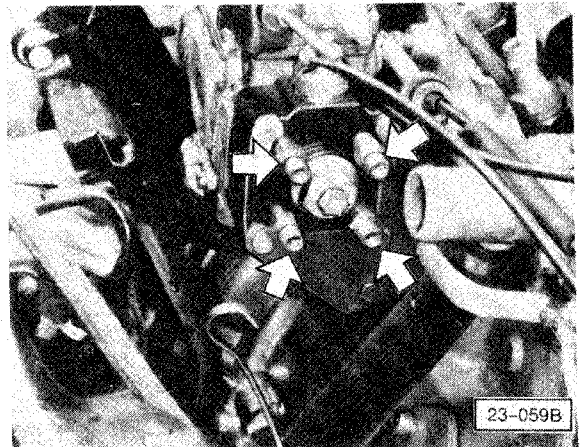
- adjust injection pump/valve timing (see page 23.4)
- adjust injection timing (see page 23.4)

## Fuel delivery valves, checking

### Work sequence

#### Note

Fuel leaks from fuel delivery valves are usually caused by improper removal of injector pipes. If fuel delivery valve leaks proceed as follows:



- remove injector pipes
- retorque fuel delivery valves (arrows) to 45 Nm (33 ft lb)
- reinstall injector pipes and tighten to 25 Nm (18 ft lb)
- start engine and check for leaks
  - if fuel leak did not stop replace fuel delivery valve housing and seal

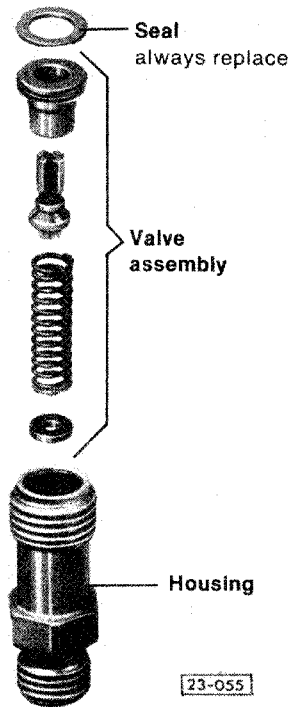
# 23 Diesel Injection System

## Fuel delivery valve housing, replacing

### Work sequence

#### CAUTION

When removing or replacing fuel delivery valves, do not interchange valve assemblies



- clean all injector pipe fittings
- remove injector pipes
- remove fuel delivery valve
- transfer valve assembly to new housing
- install fuel delivery valve, with new seal and tighten to 45 Nm (33 ft lb)
- reinstall injector pipes and tighten to 25 Nm (18 ft lb)
- start engine and check for leaks

## Fuel injectors, removing/installing

### Work sequence

#### Note

First signs of injector trouble usually appear as follows:

- knocking in one or more cylinders
- engine overheating
- loss of power
- smoky black exhaust
- increased fuel consumption

Faulty injectors can be located by loosening pipe union on each injector in turn with engine at fast idle. If engine speed remains constant after loosening a pipe union, this indicates a faulty injector

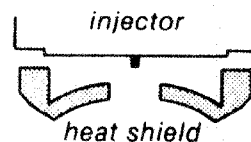
### Removing

#### CAUTION

To avoid damage, keep injection parts clean when removing, installing, disassembling and assembling

- clean all injector pipe fittings
- remove injector pipes
- disconnect fuel return hoses
- remove injectors using US 2775 or equivalent
- remove heat shields and discard

### Installing



23-A011

- install new heat shields as shown
- install injectors and tighten to 70 Nm (51 ft lb)
- install injector pipes and tighten to 25 Nm (18 ft lb)
- reconnect fuel return hoses
- start engine and accelerate a few times to clear air bubbles
- check for leaks

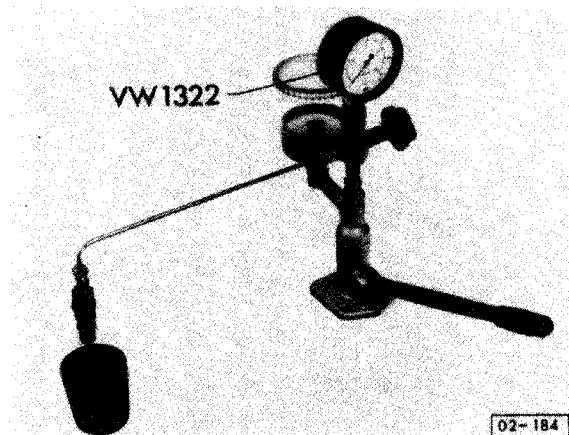


## Fuel injectors, checking

### Work sequence

#### WARNING

Diesel fuel will penetrate skin if hands are exposed to working pressure of injector spray



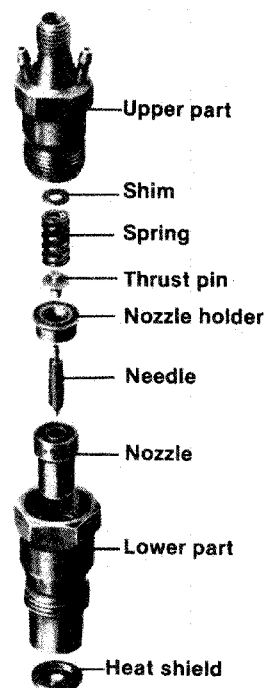
—test injectors with US 1111

#### Spray test

- fill tester container with clean diesel fuel
- attach injector to tester
- pump tester a few times to clear air bubbles
- turn valve on tester so pressure gauge is **OFF**
- pump tester with rapid short strokes (4 to 6 strokes per sec.)
  - spray should be even, well atomized and stop cleanly
  - injector must not drip

#### Opening pressure test

- turn valve on tester so pressure gauge is **ON**
  - press pump lever down slowly
  - note opening pressure when injector sprays
    - used injectors = 120 to 130 bar (1740 to 1885 psi)
    - new injectors = 130–138 bar (1885–2001 psi)
- if **NO**—continue as follows



- remove injector from tester and disassemble
- remove shim and measure
- select proper shim
  - thicker shim increases pressure
  - a change in thickness of 0.05 mm (0.0019 in.) changes pressure approximately 5 bar (72 psi)
  - shims are available from 1 to 1.95 mm (0.039–0.070 in.) in steps of 0.05 mm (0.0019 in.)
- reassemble injector and retest until correct opening pressure is reached

#### Note

When servicing used injectors, set opening pressure to value for new injectors

#### Leakage test

- pressure gauge still **ON**
- press pump lever down slowly
- hold pressure at approximately 110 bar (1595 psi) for 10 seconds
  - fuel should not drip from injector at nozzle

#### Note

All **new** and **rebuilt** injectors have a settling effect of approx. 5 bar. When installing new/ rebuilt injectors, they must have a 5 bar higher opening pressure.

# 23 Diesel Injection System

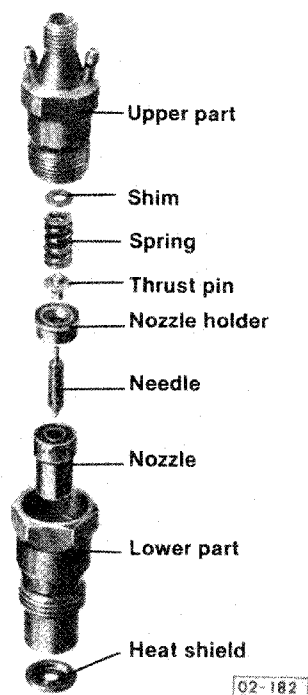
## Fuel injectors, cleaning

### Work sequence

#### CAUTION

Disassemble and clean one injector at a time. Effectiveness of injectors will change if parts from other injectors are interchanged

- clamp upper part of injector in vise and loosen lower part
- turn injector over, lightly clamp lower part of injector in vise and disassemble



- clean parts of injectors in clean diesel fuel
  - gasoline may be used to clean carbon deposits but part must be rinsed in diesel fuel immediately
- visually check injector parts for
  - damaged, carbonized or rough needle seat
  - worn or damaged injection needle and nozzle
  - needle binding in nozzle
- reassemble injector and tighten halves to 70 Nm (51 ft lb)

## Fuel filter water indicator kit, installing

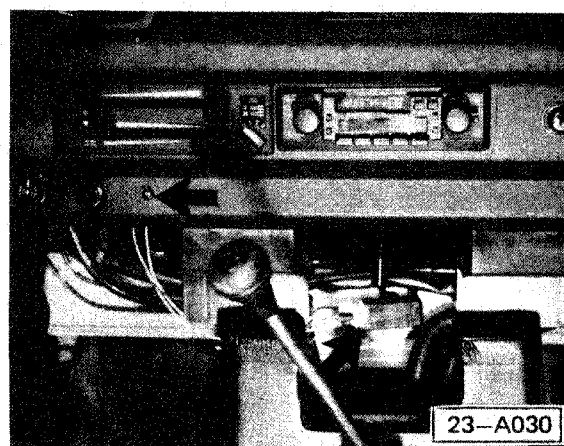
Water level indicator light will light when it is necessary to drain water from trap in fuel filter

### Parts required

Qty	Description	Part No.
1	water level indicator kit	175 998 030
1	"double" (single female into double male) electrical connector	local supply
1	"ring type" electrical connector	local supply
1	grommet	171 971 913
	blue 18 ga. electrical wire	local supply

### Installation procedure

- disconnect battery ground cable
- drop down Fuse/Relay Panel



- remove trim cover from front of floor duct

Mount control unit as follows:

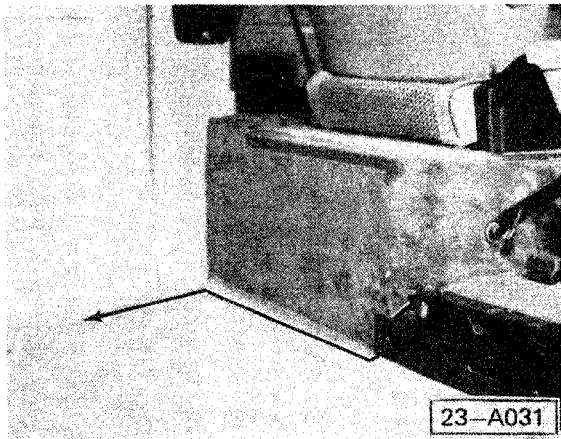
- mount retaining clip (included in Kit) to fresh air tube with sheet metal screw (included in Kit) so control unit will clip into position shown in photo
- also attach brown ground wire (included in Kit) under mounting screw with "ring type" connector
- install double connector on terminal 15 of control unit and clip unit in place
- connect ground wire from mounting screw to terminal 31 of control unit

Install and connect indicator light as follows:

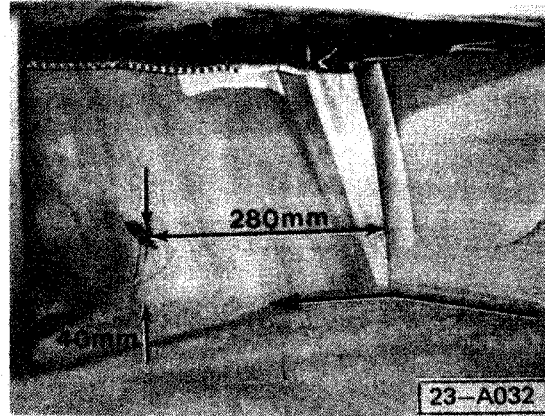
- mark and drill a 9 mm hole approx. 50 mm to right of cold start cable and mount indicator light
- connect white wire (included in Kit) to light
- route wire to control unit and attach to one male terminal of double connector on terminal 15
- connect yellow wire (included in Kit) to light
- route wire to control unit and attach to terminal 31b

Install and connect water sensor as follows:

- replace water drain-screw in fuel filter with drain-screw/sensor, included in Kit
- connect blue wire (included in Kit) to terminal A of control unit



- route wire under left side of floor vent, between handbrake and left seat base. Continue around back of left seat base under carpeting and to rear along left side of passenger compartment under carpeting



- continue to route wire under carpeting under left side of rear seat
- route wire out from under carpeting where shown

## Note

Blue wire provided is too short and must be lengthened to reach fuel filter in engine compartment

- mark and drill a 13 mm hole at location shown in rear panel under back seat
- insert grommet in hole and route wire through to left rear wheel well area
- from wheel well, carefully route wire across vehicle above transmission, and then back to fuel filter
- connect wire to terminal on new drain-screw/sensor
- connect black wire (included in Kit) to remaining male terminal of double connector on terminal 15 of control unit
- route wire to rear of Fuse/Relay Panel and connect to fused side of fuse 12
- reinstall Fuse/Relay Panel
- reinstall trim cover for floor duct
- reconnect battery ground cable
- test system by switching ignition on and grounding blue wire from sensor on fuel filter casing. Light should come on and remain on until ignition is switched off