
Workshop Manual

911

Carrera 4

Structure of the Workshop Manual

This Workshop Manual describes all of the important operations for which special instructions are required to ensure proper completion. This manual is essential for shop foremen and mechanics who need this information to keep the vehicles in safe operating condition. The basic safety rules, of course, also apply to all repairs on vehicles, without exception.

Breakdown of the Workshop Manual

1. Overview of repair groups
2. Record sheet for supplements
3. List of contents
4. Technical data
5. Repair groups

Breakdown of the repair groups

1. Table of tightening torques
2. Special tools required
3. Exploded diagrams
4. Legends for the exploded diagrams
5. Notes on assembly/application of special tools
6. Diagnosis for the repair groups

The Workshop Manual will be updated regularly by means of supplements which must be filed immediately to maintain the usefulness of the manual. Appropriate entries must be made in the record sheet to prove that the manual is complete.

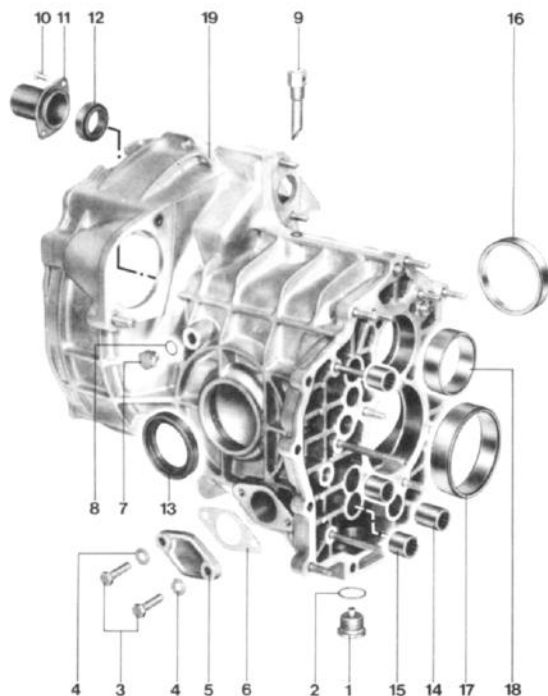
The content of this Workshop Manual will be supplemented with Technical Information Bulletins, which will be integrated into the manual from time to time.

Descriptions of design and function can be found in the service training course reference material.

Layout of the exploded diagram

A 34 B Manual Transmission, Controls, Case C 911 Carrera 4

Disassembling and assembling transmission



C 911 Carrera 4 B Manual Transmission, Controls, Case A 34

G	No	Description	Qty.	H	
				Removing	Installing
	1	Screw plug	1		Clean, tighten with 30 Nm
	2	Sealing ring	1		Replace
	3	Hexagon head screw	2		Tighten with 23 Nm (17 ftlb)
	4	Washer	2		
	5	Flange	1		
	6	Seal	1		Replace
	7	Screw plug	1		Tighten with 23 Nm (17 ftlb)
	8	Sealing ring	1		Replace
	9	Breather	1		Tighten with 35 Nm (26 ftlb). Observe installation position
	10	Fillister head screw	2		Tighten with 10 Nm (7 ftlb)
	11	Guide tube	1		
	12	Rotary shaft seal	1		Only install after assembling the gear set (also refer to Page 34-113)
	13	Rotary shaft seal	1		Drive into position with Special Tool 9252. Pack space between sealing lips with Kübler Silubrin Grease S
	14	Spherical sleeve	1	Pull out with a suitable internal puller (e.g. Schrem 14-20)	Press in with Special Tool 9254

34 - 128 Disassembling and assembling transmission Printed in Germany - VII, 1988

D

E

F

Disassembling and assembling transmission Printed in Germany - VII, 1988

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E

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D

- A - Repair group, numbers
- B - Repair groups, text
- C - Type of vehicle to be repaired
- D - Page number
- E - Operation
- F - Impressum, supplement number, year of printing
- G - Diagram item number in the order of disassembling
- H - Special notes to be observed when installing or removing

The notes on assembly/application of special tools which are given after the exploded diagram are always arranged in the order of text → diagram.

List of Repair Groups Carrera 4

General	Technical Data	Page 0.1
Repair Groups		Group
Volume I	Maintenance, Self-diagnosis	03
Engine, Maintenance	Engine, Crankcase, Suspension	10
	Engine, Crankshaft, Pistons	13
	Engine, Cylinder Head and Valve Drive	15
	Engine, Lubrication	17
	Engine, Cooling	19
	Fuel Supply	20
	Fuel System, Electronic Injection	24
	Exhaust System/Emission Controls	26
	Starter, Power Supply, Cruise Control	27
	Ignition System	28
	Diagnosis	
Volume II	Clutch, Controls	30
	Clutch	32
Transmission (manual)	Manual Transmission, Controls, Case	34
	Manual Transmission, Gears, Shafts	35
	Differential, Transaxle System, All-Wheel Drive	39
	Diagnosis	
Volume III	Clutch, Controls	30
	Torque Converter	32
Transmission (automatic)	Automatic Transmission, Controls, Case	37
	Automatic Transmission, Gears, Shafts	38
	Differential, Transaxle System	39
	Diagnosis	
Volume IV	Front Wheel Suspension	40
Chassis	Rear Wheel Suspension, Axle Shaft	42
	Wheels, Tires, Alignment	44
	Antiblock System	45
	Brakes, Mechanical	46
	Brakes, Hydraulics, Regulator, Booster	47
	Steering	48
	Diagnosis	
Volume VI	Body-Front Section	50
Body	Body-Center Section	51
	Body-Rear Section	53
	Lids	55
	Doors	57
	Electric Sunroof	60
	Hardtop	61
	Bumpers	63
	Glasses, Window Control	64
	Exterior Equipment	66
	Interior Equipment	68
	Seats	72
	Seat Covers	74
Volume VI	Heater	80
Heating, Ventilation, Air Condition	Ventilation	85
Electrics	Air Conditioner	87
	Diagnosis	
	Instruments, Fuel Gauge, Alarm System	90
	Radio, Telephone, On-board-computer	91
	Windshield Wipers and Washer	92
	Exterior Lights, Lamps, Switches	94
	Interior Lights	96
	Diagnosis	
Volume VII	Wiring	97
Electrics		
Wiring Diagrams		

Survey of Information Published in Technical Manual beginning in 1985

**6
Cyl.**

2

	TI/ QI	No.	911 C2/C4	911	911 Turbo	Remarks, Model, Also refer to...	Date
1985							
- Misfiring Because of Ground Strap Corrosion	Q	1/85	●				15.02.85
- Fuel Injector Survey L-Jetronic	Q	2/85	●				15.02.85
- Throttle Housing	Q	3/85	●			Bypass air screw	10.04.85
- Corroded Spark Plug Connectors	Q	4/85	●		●		10.04.85
- Settings of DME Control Units	T	1/85	●				18.07.85
- List of Factory Tested an Approved Spark Plugs	T	2/85	●		●	Invalid/...TI-1/86	08.07.85
- Retrofitting - Catalysor	T	◆ 3/85	●				20.12.85
- Retrofitting - Catalysor	T	◆ 4/85	●				20.12.85
- Retrofitting - Catalysor	T	◆ 5/85	●			Invalid/...TI-1/87	20.12.85
1986							
- Ignition Delay Relay	Q	1/86			●	1985-1986 Models/ Relay voltage 9 volts	16.01.86
- List of Factory Tested an Approved Spark Plugs	T	1/86	●			● Invalid/...TI-1/88	30.04.86
- BatterieDischarging	Q	2/86	●		●	Removing battery	18.04.86
- Mixture Preparation Engine Stalls While Declutching	Q	3/86	●			1986 Model/"mixture too rich"	20.06.86
- Catalytic Converter Cars Poor Pickup	Q	4/86	●				20.06.86
- Engine Damage Engine Repairs	Q	5/86	●		●	Foreign particles in in- take system	20.06.86
- Information for Cars with Catalytic Converter	T	2/86	●				26.06.86
- Turbocharger Compressor Wheel Damage	Q	6/86			●	foreign particles	10.10.86
- Faulty Wire Bridge - Terminal 28 Lean Hesitation, CO Adjustment	Q	7/86	●			Terminal 28/resistance	25.11.86
1987							
- Additional Air Pump Maintenance	Q	1/87			●	Fuel return line	20.02.87
- Troubleshooting Fuel System/Engine Electrical System	Q	2/87	●			Plug connections (cleanliness)	20.02.87
◆ = Conversion instructions or workshop campaign ▽ = Brochure ⊕ = Supplement or change for TI/QI							



SERVICE

Date

30.04.90

VKQPI

Survey of Information Published in Technical Manual beginning in 1985

6
Cyl.

2

	TI/ QI	No.	911 C2/C4	911	911 Turbo	Remarks, Model, Also refer to...	Date
- Engine Power Fuel/Air Mixture	Q	3/87		●		1986-1987 Models/ term. 28/oxygen sensor	31.03.87
- Troubleshooting Temperatur Sensor	Q ♦	4/87		●		NTC II	22.05.87
- Service Installation - Catalytic Converter	T ♦	1/87		●			25.10.87
- Starting Motor Transmission Cars	Q	5/87		●		1987 Model/115 mm	31.08.87
- Battery Discharging	Q	6/87		●	●	Only coupe/inside lights	16.10.87
- Battery Discharging New Cars	Q	7/87		●	●	Checking battery con- dition	24.11.87
1988							
- Fuel Grade Exhaust System	Q	1/88		●	●	Exhaust tailpipe dis- coloration/unleaded	19.02.88
- Survey of Factory Tested and Approved Spark Plugs	T	1/88		●	●		06.07.88
- Survey of Control Units	T	2/88		●	●		06.07.88
- Fuel/Air Mixture Throttle Valve Housing	Q	2/88		●		Hose to thermo valve disconnected	19.09.88
- Starter Starter Gear Ring	Q	3/88		●		911 Turbo starter gear- ring/...QI-5/87	30.12.88
1989							
- Unleaded Gasoling Regular RON 91 / Euro Premium RON 95 / Premium RON 98	T	1/89	●	●	●	Fuel grade table.	31.01.89
- New Catalytic Converter Conversion Kit 930.113.911.03	T	2/89		●		...with plastic filling tube.	12.06.89
- Spark Plug connectors which are hard to remove	T	3/89	●			Engine Nos.: 62 K 00607 to 62 K 00788	02.05.89
- DME Control Unit	T ♦	4/89	●			...with green dot.	08.06.89
- Lighting up of Warning Signs and Faults in DME Fault Memory	T	5/89	●			Carrera 4	12.06.89
- Service Installation of Catalytic Converter	T ♦	6/89	●			Carrera 4 M'89 (K) 964.113.911.00	05.10.89
- Fuel Hose to Rear Fuel Pump	T ♦	7/89			●	Hose laid differently.	13.11.89
♦ = Conversion instructions or workshop campaign ▽ = Brochure ⊕ = Supplement or change for TI/QI							



SERVICE

Date	
30.04.90	
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Survey of Information Published in Technical Manual beginning in 1985

**6
Cyl.**

2

	Ti/ Qi	No.	911 C2-C4	911	911 turbo	Remarks, Model, Also refer to...	Date
1990							
- Cable harness connector at the air-flow sensor	T ♦	1/90	●			Cable cluster mounted in tight loop.	21.02.90
- Securing heat shield to exhaust system	T	2/90	●			...coat with Optimoly HT	31.08.90
- Engine Temperature Sensor (NTC) II	T	3/90		●		M'84 (E)-'89 (K) spare part: 930.606.915.00	16.11.90

♦ = Conversion instructions or workshop campaign
 ▽ = Brochure
 ⊕ = Supplement or change for Ti/Qi



SERVICE

Date	
30.04.90	31.12.90
	VKQPI

The workshop manual of the Carrera 4 also includes that for the Carrera 2.
The Carrera 4 acts as the basis for description of the repairs in the manual.
"Carrera 4" also appears on every page in the header line.

Deviating descriptions for repairs on the Carrera 2 follow those of the Carrera 4. These repair descriptions for both models are separated by a yellow sheet.

"Carrera 2" appears on all pages in the header line after the separating sheet. The page number starts with 100 as an additional distinction.

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Engine, crankcase, suspension

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Removing and installing the engine	10 - 5
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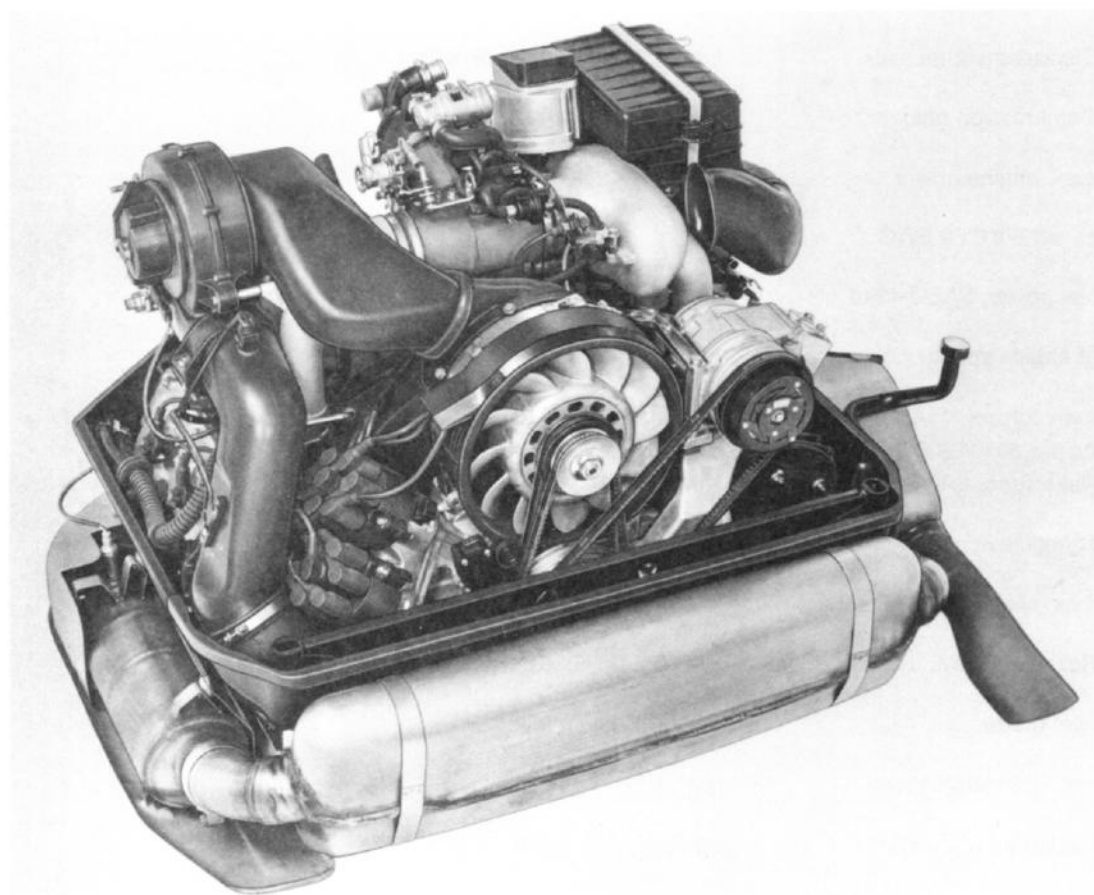
Engine, crankshaft, pistons

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911

Carrera 4



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Technical Data - 911 Carrera 4

(Adjusting values and wear limits are included in the respective repair groups)

Note: USA values in brackets (engine type M 64/01)

Drive unit

Internal engine designation		M 64/01
Number of cylinders		6
Bore	mm (in.)	100 (3.94)
Hub	mm (in.)	76.4 (3.01)
Displacement (actual)	cm ³ (in. ³)	3600 (219.7)
Compression ratio		11.0 : 1
max. engine power	kW (HP)	184 (250)
as per 80/1269 EWG		
Net power, SAE J 1349	kW (HP)	184 (247)
at engine speed	rpm	6100
max. torque	Nm (kpm)	310 (31.6)
As per 80/1269 EWG		
Net torque, SAE J 1349	Nm (ftlb)	310 (228)
at engine speed	rpm	4800
max. specific power output	kW/l (PS/l)	51.1 (69.4)
Net power, SAE J 1349	kW/l (PS/l)	51.1 (68.6)
Fuel grade	RON (MON)	95/85
max. permitted speed	rpm	6700
Engine weight (dry)	kg (lbs)	240 (529)

Engine design

Type	6-cylinder, four-stroke internal combustion engine with 2 horizontally opposed cylinder banks (flat engine)
Crankcase	Light alloy, two-piece
Crankshaft	Forged, supported by 8 bearings
Crankshaft bearings	Friction bearings
Connecting rods	Forged
Conrod bearings	Friction bearings
Pistons	Light alloy, pressed
Cylinders	Light alloy, individual cylinders
Cylinder head	Light alloy, individual cylinder heads with ceramic exhaust port liners
Valve guides	Press-fitted
Valve arrangement	1 inlet, 1 exhaust, suspended V formation
Valve timing	One overhead camshaft each on right and left
Camshaft	Cast
Camshaft drive	Double chain
Valve clearance	0.10 mm (inlet, exhaust cold)
Timing	Inlet opens 4 degrees before TDC Inlet closes 56 degrees after BDC Exhaust opens 44 degrees before BDC Exhaust closes 4 degrees after TDC
Intake system	With controlled tuning flap

Engine cooling

Type	Air-cooled system
Blower drive	Via V-belts from the crankshaft
Transmission ratio: crankshaft/blower	approx. 1:1.60
Air delivery rate	1010 l/sec at 6100 rpm of the crankshaft

Engine lubrication

Type	Dry sump lubrication with isolated oil reservoir
Oil cooling	Thermostatically controlled, front oil cooler in the front right-hand fender, 2-stage electric blower
Oil filter	In the return line
Oil pressure at $n = 5000$ rpm	approx. 5.0 bar at 90 degrees oil temperature
Oil pressure indicator	0-5 bar electric and oil pressure warning lamp
Oil consumption	Up to 1.5 l / 1000 km

Exhaust system

Single-branch system joined together outside the heat exchanger, 3-way catalytic converter with closed-loop Lambda control, intermediate and final mufflers, partial encapsulation of the engine

Emission control

Closed-loop Lambda control with 3-way catalytic converter (metal carrier).

Heating

Engine-dependent hot air heating with additional electric blowers and automatic temperature control

Fuel system

Type	DEE (Digital Engine Electronics)
Fuel supply	1 electric roller cell pump

Electrical system

Interference suppression		ECE-R 10 and 72/245/EEC
Battery voltage	V	12
Battery capacity	Ah	72
Alternator output	A/W	115/1610 3-phase current
Ignition		DEE, dual ignition, knock sensor controller
Firing order		1 - 6 - 2 - 4 - 3 - 5
Ignition timing control		via DME
Spark plugs		Bosch FR 5 DTC
Spark gap	mm (in.)	0.8 ± 0.1 (0.032 ± 0.004)

Body construction	Integral steel body, rear spoiler, coupé
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Dimensions (at DIN curb weight)

Length	mm	4250	
Width	mm	1652	
Height	mm	1320	
Wheel base (design)	mm	2272	
Front track			with rim
	mm (in.)	1380 (54.1)	6J x 16
Rear track			
	mm (in.)	1374 (54.1)	8J x 16
	mm (in.)	1369 (53.9)	7J x 16

Dimensions

Ground clearance (at max. permitted weight)	mm	120
Ramp angle (at max. permitted weight)	12.0	degrees
Front overhang angle (at max. permitted weight)	12.5	degrees
Rear overhand angle (at max. permitted weight)	12.0	degrees

Weights (as per DIN 70020)

Front curb weight	kg (lbs)	600 (1322)
Rear curb weight	kg (lbs)	850 (1872)
Total curb weight	kg (lbs)	1450 (3194)
max. total weight	kg (lbs)	1790 (3943)
max. front axle load	kg (lbs)	760 (1674)
max. rear axle load	kg (lbs)	1050 (2313)
max. roof load including roof rack	kg (lbs)	75 (165) with original Porsche roof transport system
max. trailer load, without brakes*	kg (lbs)	500 (1101)
max. trailer load, with brakes*	kg (lbs)	1200 (2643)
max. car/trailer weight	kg (lbs)	2990 (6586)
max. drawbar load	kg (lbs)	75 (165)

*Up to 16% gradient

Filling capacities

Engine	Only use approved engine oils. Refer to Technical Information Handbook
Engine oil capacity	approx. 11.5 l (approx. 9 l for oil change) determined by measurements with the oil dipstick as per Owner's Manual
Transmission with differential	Front axle 1.2 l Rear axle 3.8 l
Fuel tank	approx. 77 l (approx. 10 l reserve)
Brake-fluid reservoir	approx. 0.75 l
Washer fluid for windshield and headlights	approx. 7.4 l
Intensive washing	approx. 0.7 l
Power-assisted steering	approx. 1.0 l

Performance

Top speed	km/h (mph)	260 (162)
Acceleration from 0.100 km/h	s	5.9
Kilometer from standing start	s	25.5

Hill climbing

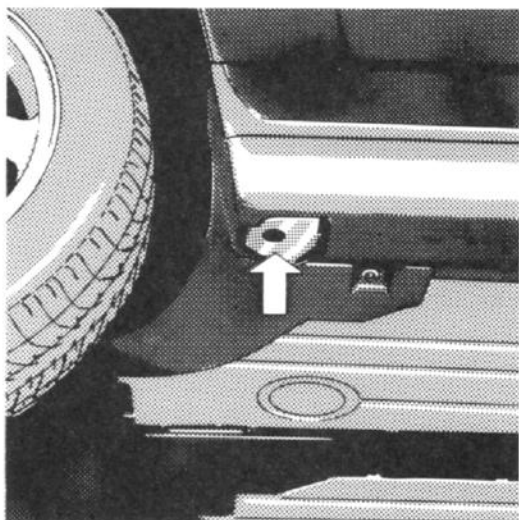
	Manual transmission	
In %	1. gear	86%
	2. gear	41%
	3. gear	24%
	4. gear	15%
	5. gear	11%

Raising the vehicle

The vehicle must only be lifted using the illustrated jacking points. When driving onto a lifting platform, make sure that there is enough clearance between the platform and the vehicle.

front

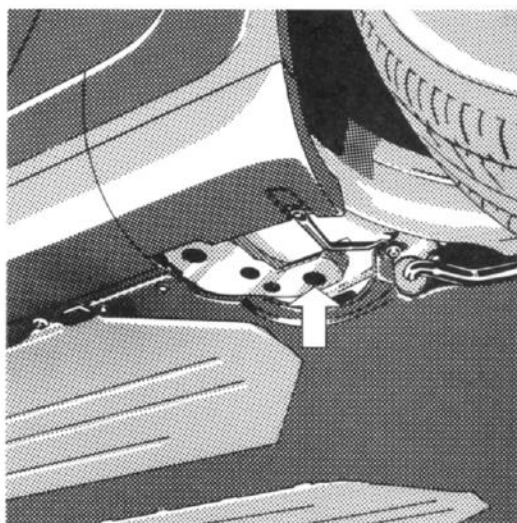
At the jacking point



132/03

Rear

At the jacking point



133/03

Maintenance Schedule

The recommended Service Intervals apply under normal driving conditions and do not take into account any Optional Equipment. Dusty areas require more frequent checking and possible replacement of the air filter element. Tyre, clutch and brake wear as well as the condition of the engine oil are all largely dependent on driving habits, and are also affected by arduous operating conditions; this could mean shorter intervals between services and replacement of parts. This applies, naturally, also to: "Battery: check fluid level and, if necessary, top up."

Vehicles with a low yearly mileage (kilometres) should be serviced at least once a year. The extent of maintenance can depend on the driving conditions. Your Official Porsche Centre will be pleased to inform you of the contents of the yearly service check. As part of this servicing, after the first 2 years the Porsche Dealer will make out a Status Report. This is intended to ensure that the conditions for the Long-life guarantee are not jeopardized. If required by the condition of the vehicle, a full upper- and lower-body cleaning may be necessary.

Exchange and new spare parts receive the same contents of service as components of new vehicles.

The terms "inspect" and "check" include all associated work such as adjustments, readjustments, corrections and replenishment. They do not include the repair, replacement or overhaul of components or assemblies.

3 000 to 4 000 km / 2 000 to 2 500 miles Servicing

Front axle: check toe adjustment incl. tyre condition, tyre pressure	3
Diagnosis System: read out system faults	5
Change engine oil and oil filter	6
Check valve clearance	7
V-belt: check tension	10
Visual inspection for leaks: oils and fluids	12
Windscreen washer, headlight washer: check function, fluid level and nozzle adjustment, regard antifreeze content for the winter season	23
Lighting system: check function	23
Brake hoses and lines: visual inspection for leaks, clearance; damage, check brake fluid level	14
Transmission / axle drives: Visual inspection for leaks, check oil levels	19
Exhaust system: visual inspection for leaks and damages	20
Check screw connections for tightness and attachment	20
Exhaust emissions test on vehicles without catalytic converter. Perform system adaptation	26

Test drive:

Brake pedal and hand brake, brake power assist unit, clutch, automatic speed control, steering, heating, air conditioner and instruments: check function	-
Drive train, longitudinal- and lateral limited slip differential: check for noises and operation	29
Visual inspection for leaks: oils and fluids	29

Service every 20 000 km / 12 000 miles

Diagnosis system: read out system faults	5
Change engine oil and oil filter	6
Check valve clearance	7
V-belt: check condition and tension	10
Toothed belt for power-steering pump: check condition	11
Change spark plugs	11
Visual inspection for leaks: oils and fluids	12
Air filter: replace filter element	12
Crankcase ventilation: check tightness of hose connections	12
Fuel system: visual inspection for leaks, damages, clearance and tightness of hose connections	12
Intake air: check hoses, lines and connections for tightness	12
Hand brake: check free travel of hand brake lever	13
Brake pedal: check play of brake pedal.	
Brake hoses and lines: visual inspection for leaks, clearance, damage, and corrosion.	14
Check brake fluid level.	
Brake system: visual inspection of brake pads and discs	15
Hydraulic clutch actuator: visual inspection for leaks, check final position of clutch pedal	17
Throttle actuator: check cables, linkages and joints for smooth running, full throttle opening and resonanz flap movement	16
Steering gear: check screw connections for tightness	
Visual inspection of the bellows for damage	18
Tie rod links: check play, tightness and dust caps	
Power-assisted steering: visual inspection for leaks and check fluid level	18
Ball joints: visual inspection of dust caps for damage	19
Wishbone: check screw connections for tightness	19
Transmission, axle drives: visual inspection for leaks, check oil levels	19
Drive shafts: visual inspection of sleeves for leaks and damage	19

Service every 20 000 km / 12 000 miles

Exhaust system: visual inspection for leaks and damages, check screw connections for tightness and attachment	20
Tyres: check condition, correct tyre pressure	20
Door arrester: check function and lubricate	20
Door hinges: lubricate	20
Check door-, front hood locks and safety hooks on front hood for tightness and function	20
Safety belt: check function and condition	21
Seals for doors, hood and roof: remove abraded rubber, apply suitable agent to lubricate seals	21
Check function of the vehicle lighting. All headlights: check setting	
Horn: check function	23
Windscreen washer, headlight washer: check function, fluid level and nozzle adjustment, regard antifreeze content for the winter season	23
Intensive cleaner: check function and fluid level	24
Battery: check fluid level	24
All other electrical equipment as well as control- and warninglights: check function	24
Heater, ventilation and air conditioner: check function and refrigerant level	24
Exhaust emission unit: check if catalytic converter, oxygen sensor and channeled filler inlet are positioned, visual inspection of all electrical connections, check function of oxygen sensor	25
Ignition circuit 1 and 2: check function	25
Exhaust emissions test: test CO content (measure before and behind the catalytic converter if equipped), Perform system adaptation	26

Test drive:

Brake pedal and hand brake, brake power assist unit, clutch, automatic speed control, steering, heating, air-conditioner and instruments: check function	29
Drive train, longitudinal- and lateral limited slip differential: check for noises and operation	29
Visual inspection for leaks: oils and fluids	29

Additional service every 40 000 km / 24 000 miles

Change fuel filter	29
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Additional service every 80 000 km / 48 000 miles

Manual transmission and axle drives: change oil	30
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Yearly service after the first 2 years

File Status Report for Long -life guarantee	-
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Service every 2 years

Change brake fluid	31
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Front axle:

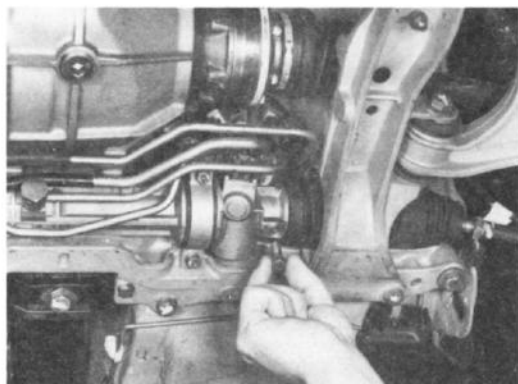
Checking the toe

Use a visual or electronic axle measuring unit to check and/or adjust the toe. Refer to the operating instructions for the respective axle measuring unit for the measuring procedure. The following preconditions must be fulfilled before checking the toe for the front axle:

- Curb weight of car according to DIN 70020 = ready-to-drive car with full fuel tank, spare wheel and tools.
 - Correct joint and wheel bearing play (wheel bearing play cannot be adjusted).
 - Correct tire pressure
1. Bounce the vehicle at rear and front axles 2-3 times and allow to return under its own power.
 2. Check the front toe with the steering wheel in the straight ahead position and adjust the tie rods if necessary. (Refer to the next page for wheel alignment values).

Necessary preparations

First check whether the steering wheel is offset in relation to the steering gear. This requires removing the underside trim panel and centering the steering gear in middle position with Special Tool 9116. If adjustment is necessary, try to get the optimum position for the steering wheel. Then remove ST 9116.



88/406

Clamp the steering wheel in middle position before adjusting toe.



88/553

Wheel alignment values

The following values apply at curb weight as per DIN 70020 (vehicle with full fuel tank, spare wheel and tools).

	Specification and tolerance	max. deviation between left and right
Front axle		
Toe (total) - unpressed	$+ 25' \pm 5'$	only influenced by replacing the steering arms
Toe difference angle at 20° lock	$- 40' \pm 30'$	
Camber	$0^\circ \pm 10'$	10'
Caster	$4^\circ 25' \pm 15'$	15'
Rear axle		
Toe per wheel	$+ 15' \pm 5'$	10'
Camber	$- 20' \pm 10'$	20'

Tire condition / inflation pressure

Tires constitute a safety element and they can only fulfill the demands made on them if the inflation pressure is correct and there is adequate tread depth.

The specified inflation pressures are minimum pressures; under no circumstances should the tire pressure be allowed to sink below these levels as this will not only detrimentally affect the driving behavior, but also increases the risk of serious tire damage.

Valve caps protect the valves from dust and dirt and therefore prevent leakage. Always screw caps on tightly and replace any that are missing.

For safety reasons, a tire-pressure check should always be accompanied by a visual inspection to ensure adequate tread depth and a check for objects piercing the tire, slits, cuts, cracks and bulges in the side wall (cord break).

Inflation pressure with the tires cold (summer and winter tires).

Front	2.5 bar
Rear	3.0 bar

Collapsible spare wheel	
front/rear	2.5 bar

Diagnosis system:

Read out the fault memory

The procedure for reading out the fault memory is described in the operating instructions for System Tester 9288. A copy of the operating instructions is supplied with each tester.

The System Tester 9288 is connected to the vehicle via a 19-pole socket outlet.



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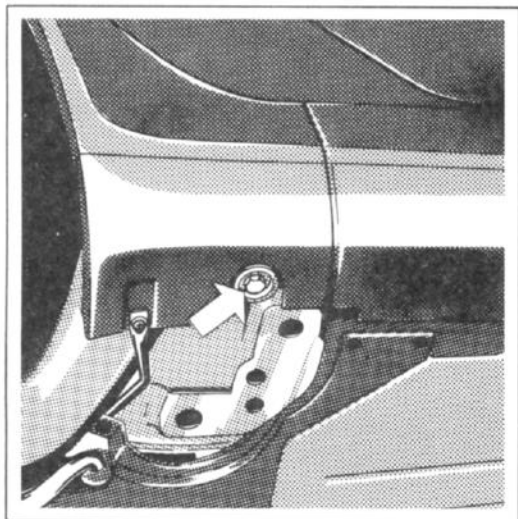
Also refer to repair group 03, self-diagnosis for operating instructions.

Replacing engine oil and filter

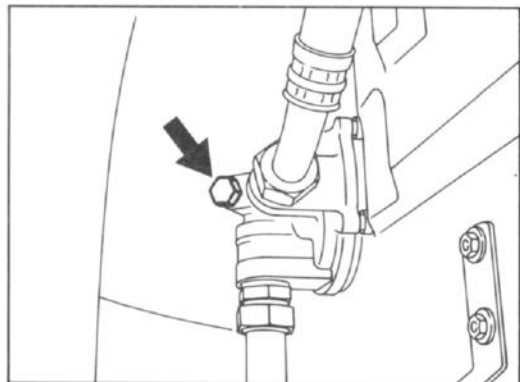
Precondition:
engine at operating temperature

1. Remove engine guard. Undo the drain plugs in the crankcase and thermostat housing and drain out the engine oil.

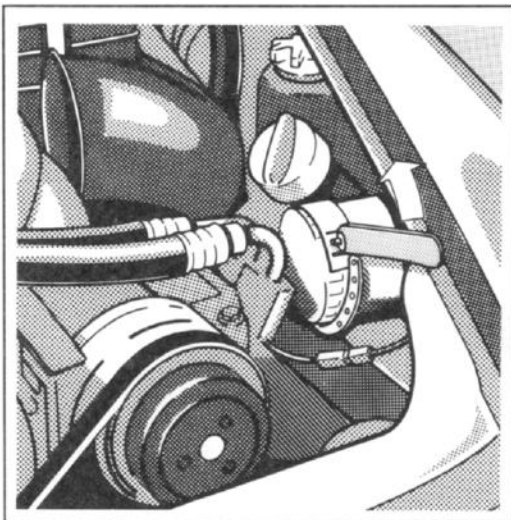
Drain plug - thermostat housing



2. Undo oil drain plug at oil filter console and drain remaining used oil into a suitable container.



3. Undo the oil filter with a standard clamping band, e.g. Hazet 2171 - 2. Catch any remaining oil.

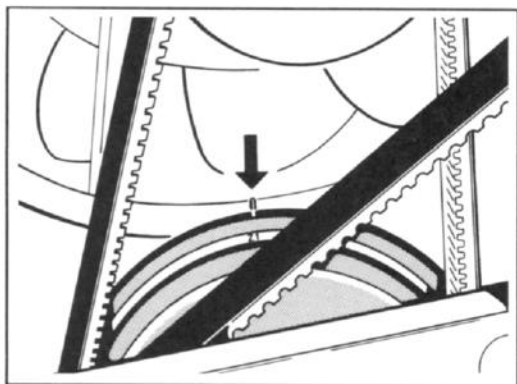


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4. Clean the drain plug. Always replace the sealing rings. Tightening torque for the drain plug on the crankcase 70 Nm (52 ftlb). Drain plug on the thermostat housing 65 Nm (48 ftlb) and oil filter console plug 31 Nm (23 ftlb).
5. Apply a light film of oil to the seal on the oil filter, install by hand, turning until the seal makes contact. Finally, tighten by a further approx. 1/2 turn.
6. Fill with approx. 6 liters of engine oil. Run the engine at idle and top up with approx. 3 liter. The oil-change volume amounts to approx. 9 liter. Only use approved engine oils. Refer to the Technical Information Handbook.

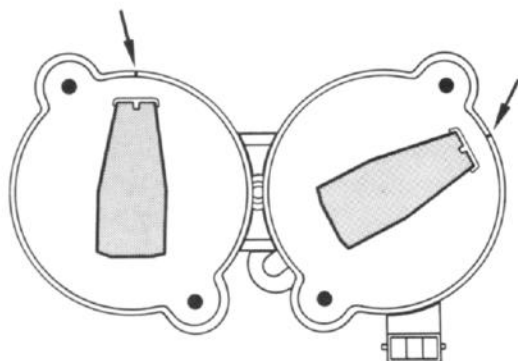
Check the oil level at operating temperature and at idle speed. Check the engine, oil reservoir, lines and front oil cooler for leaks (visual inspection)

TDC marking - pulley



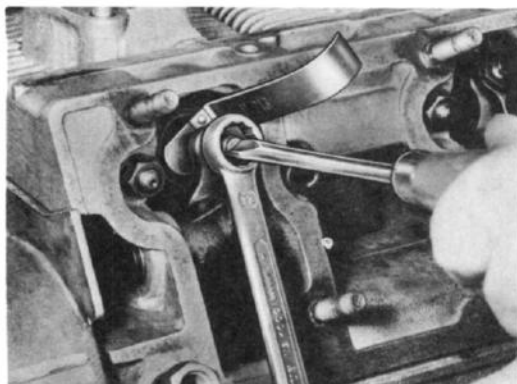
151-03

Distributor marking - cylinder 1



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2. Check the valve clearance with P 213 b; if necessary, undo the hexagon nut on the adjusting screw and correct the valve clearance by turning the adjusting screw with a suitable screwdriver, hold the adjusting screw firmly and tighten the counternut.



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3. Check the clearance again.
4. Now, continue turning the crankshaft clockwise with the pulley as far as the next marking (120°). The valves for cylinder 6 can be adjusted in this position.
5. Turn the crankshaft to the next marking (120°) to bring cylinder 2 to firing point.
6. Repeat this procedure accordingly to adjust the other valves (cylinders 4, 3 and 5).
7. Always replace the valve-cover seals and the self-locking nuts.
Tightening torque 9.7 Nm (7 ftlb)

The following assembly operations must be carried out before adjusting valves:

Assembly work from above:

1. Remove the rear wheels
2. If the vehicle is fitted with a catalytic converter, separate the plug connection to the Lambda probe, removing the hot-air blower beforehand.

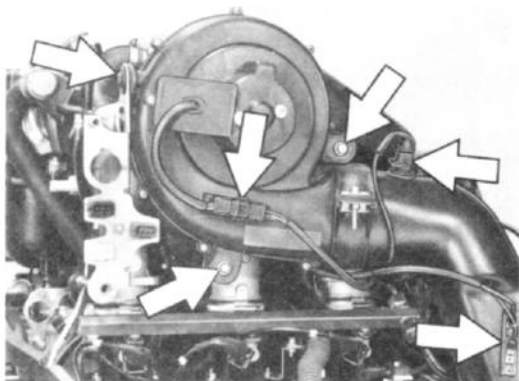


Illustration shows the engine removed

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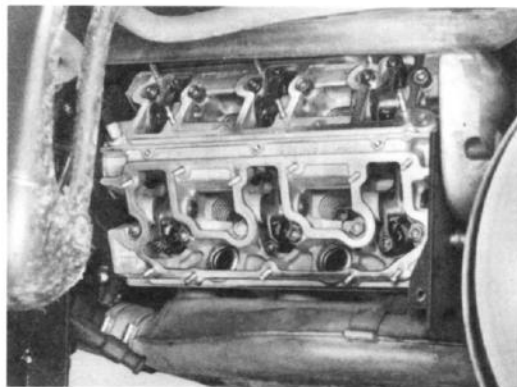
3. Push the probe cable with rubber grommet downwards through the engine paneling on the left-hand side.
4. Undo the front fastening screws on the engine side paneling beforehand.
(4 screws M 6 x 10)

Assembly work from below.

1. Remove the engine guard.
2. Remove the exhaust system complete (except heat exchanger).
3. Remove the side encapsulation panels from the engine.
4. Undo the side engine paneling.
5. Disconnect the spark plug sockets from the upper and lower ignition circuits.
6. Remove the valve covers for intake and exhaust.

Note

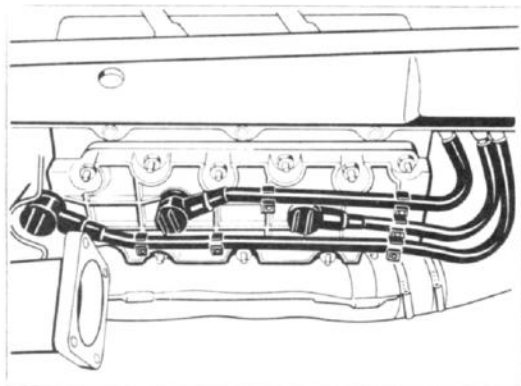
The clearance for intake and exhaust valves can now be checked and/or adjusted from below.



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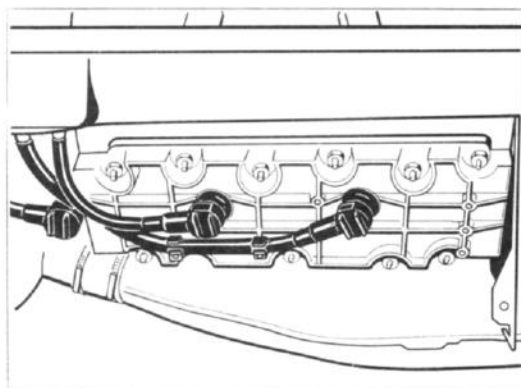
Installation of ignition leads on exhaust valve covers differs, so that valve covers must not be mixed up when installed.

Check for perfect seating of spark plug connectors and routing of ignition leads.



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Left Side – Cyl. 1 - 3



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Right Side – Cyl. 4 - 6

Checking and/or adjusting alternator, fan wheel and air conditioning compressor drive belts

Caution: Make sure the ignition key is pulled off whenever measurements are made.

Checking used drive belts (alternator and fan wheel)

Use belt tension measuring instrument (Special Tool 9574) to check tension.

A description of how to use the Special Tool is contained in Repair Group 13, page 13 - 30.

Retensioning the belt is only required if the belt tension displayed at the measuring instrument is less than 15 scale increments when the engine is cold and less than 20 scale increments when the engine is hot.

Retensioning the belts

Retension belts as described in the General Adjustment Notes section.

Before measuring the belt tension, start engine and let engine idle briefly.

Tension:

Cold engine:	15 to 23 scale increments
Engine at operating temperature:	20 to 28 scale increments

Fitting a new belt (alternator and fan wheel)

When fitting a new belt, be sure to observe the correct **assembly sequence** in order to avoid any loss of belt tension during vehicle operation.

1. Fit new belt. Adjust tension by inserting or removing shims as required.
Shims are available for belt tensioning in thicknesses of 0.5 mm and 0.7 mm. The 0.7 mm shim is identified by a 2 mm dia. drill hole.
2. Before measuring the belt tension, start engine once more and run engine at idle briefly.

Tension:

Cold engine: 23 to 35 scale increments

3. Run engine at idle for approx. 15 minutes or test drive vehicle for approx. 10 miles.

Check tension again.

Specification: 28 to 40 scale increments

Retension if required.

Test requirement: Engine at operating temperature

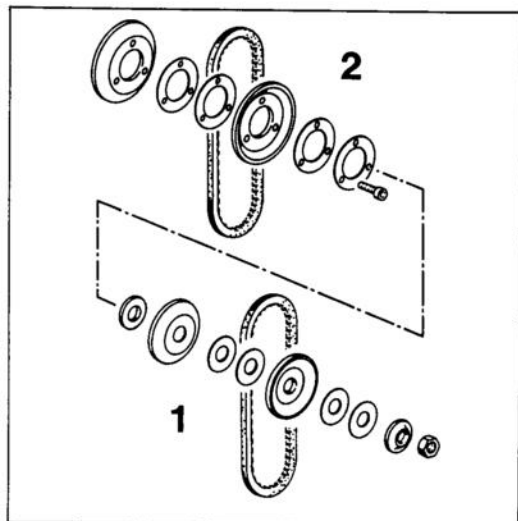
Adjustment specifications for A/C compressor drive belt

Specification: 30 to 35 scale increments

Retension if required.

General adjustment notes

Fan wheel and alternator have separate drives.



1863-27

- 1 = Alternator drive components
2 = Fan wheel drive components

Adjusting the V-belts

1. Use polygon wrench (999 571 052 02) to lock shaft and undo hexagon head nut. Remove shims and pulley half.
2. If belt tension is below specification, remove one shim from between pulley halves and refit in front of front pulley half. Tighten hexagon head nut to 50 ± 5 Nm.
3. Three additional M 6 screws have to be undone for V-belt and fan wheel.

4. Use only V-belts that have been approved by the manufacturer.

Note

Rotate engine only at lower belt pulley or by operating the starter. After completing all operations, check to make sure that hexagon head nut has been tightened sufficiently on alternator shaft.

Visual inspection for leaks:

Oils, fluids

This check can be carried out after the engine guard has been removed.

Air filter:

Replacing the filter insert

1. Release the retaining clips and remove the housing cover with filter insert.
2. Take out the filter insert and clean the inside of the filter housing with a non-fibrous cloth.
3. Install a new filter insert.
(Fins in horizontal position).

Crankcase ventilation

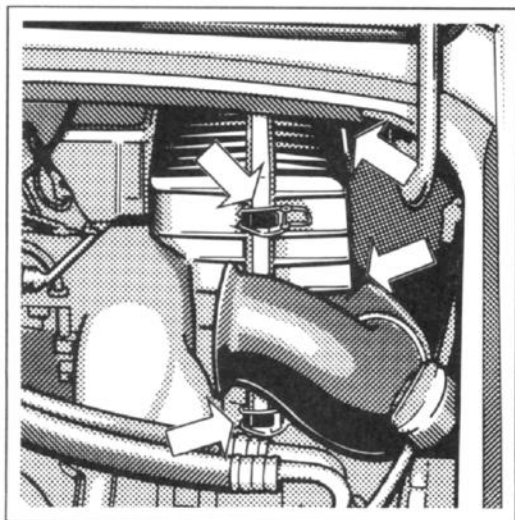
Check that all hose connections are securely fitted

Fuel system:

Visual inspection for leaks, damage, free flow and secure fitting of the line connections

Intake air guide:

Check that hoses, lines and connections are fitted securely



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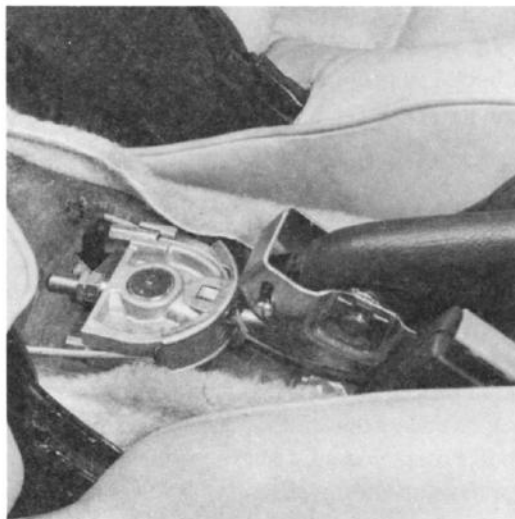
Check that the hose connections are fitted securely through-out the entire intake system

Parking brake:

Check the free movement of the parking-brake lever

The parking brake is fitted with asbestos-free brake pads. This type of parking brake must never be adjusted in such a way that the brake pad has to "grind itself free" in operation.

If it is possible to raise the lever by more than 4 notches, using average force, without any sign of a braking effect, the parking brake needs adjustment.



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Adjusting the parking brake:

1. Remove the rear wheel.
2. Release the parking brake and push the disk-brake pads on rear wheels back until the brake disk can be turned freely.
3. Undo the adjusting nuts on the turnbuckle (arrow) until the cable is slack.
4. Insert a screwdriver through the hole in the brake disk and turn the adjusting device until the wheel is locked. Then undo the adjusting device again until the wheel can be turned freely, *then undo by a further 2 notches*.
5. Pull up the brake lever by 2 notches and turn the adjusting nut on the turnbuckle until both wheels can still just be turned by hand.
6. Release the parking brake and check whether both wheels turn freely.

Note

Remove the tray behind the brake lever (2 fastening screws) to gain access to the turnbuckle.

Foot brake:

Check the play in the brake pedal

The brake pedal has no stop. As the brake pedal has no support facility in the initial position if the brake push-rod is adjusted correctly, the permanently set air play in the brake unit is guaranteed. If the brake pedal plate is pushed down by hand, you can feel a push rod play of approx. 8 mm.

If the push rod is adjusted at the swivel head (3), this alters the position of the brake pedal. In this case, you must also check the setting for the stop-lamp switch.

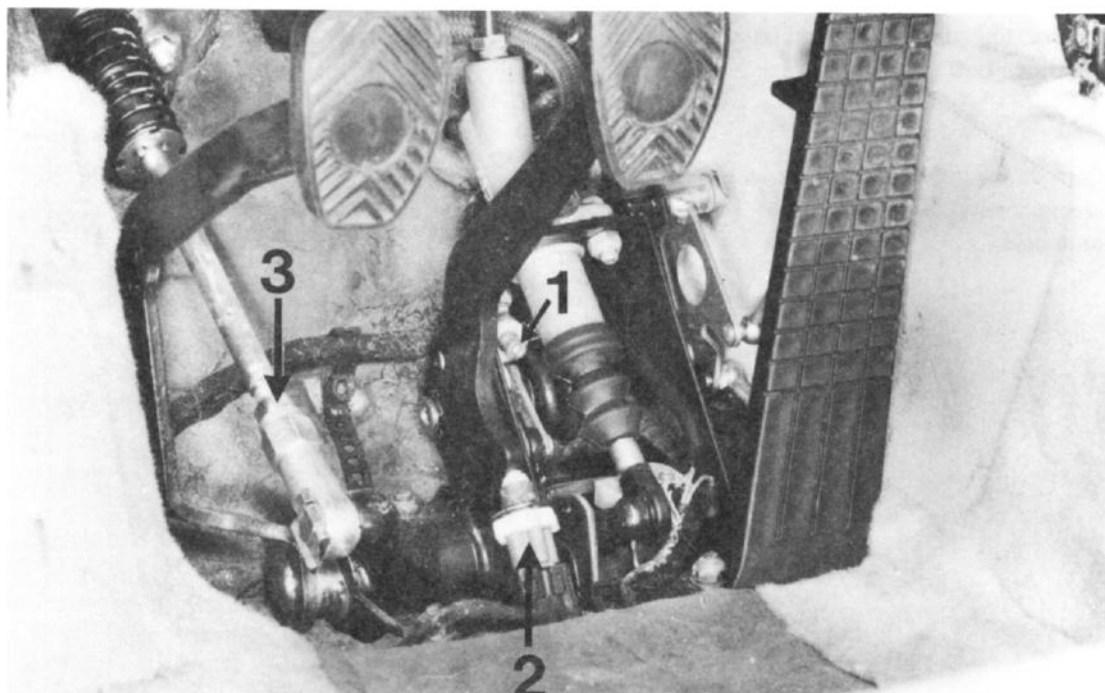
The push rod is correctly adjusted if the plate of the brake pedal is approximately level (± 3 mm with the plate on the clutch pedal. (Clutch pedal in initial position).

Check the setting for the stop-lamp switch

The stop lamp must light up after the brake pedal has travelled 6 - 16 mm (measured at middle of the pedal brake).

If the stop lamp lights up with less than 6 mm travel, turn the stop-lamp switch (2) to the right until it responds within the tolerance range. (Do not damage electric cables and connectors). If the adjusting range of the stop-lamp switch is inadequate, adjust the brake pedal with the swivel head on the push rod (shorten the push rod).

If the stop-lamp switch lights up after 16 mm travel, adjust the brake pedal with the swivel head on the push rod, (lengthen the push rod) until the stop lamp switch responds within the tolerance range.



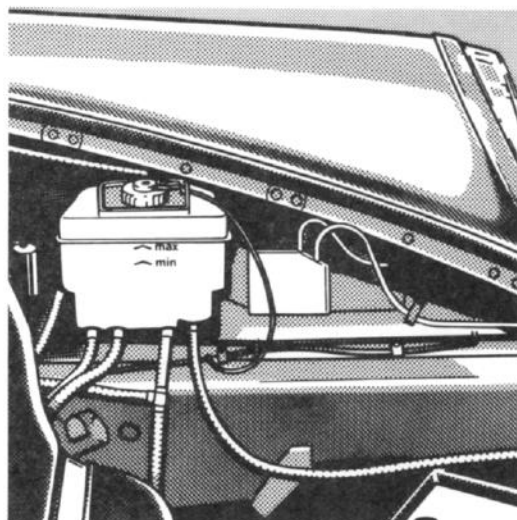
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Check the brake-fluid level

1. With the ignition switched on, pump the brake pedal repeatedly until the electric motor in the pump unit can be heard to start.

Note

The pump unit is located at the front of the luggage compartment and supplies the brake booster and the valve block for the differential lock (interaxle and wheel-to-wheel) via a diaphragm pressure accumulator.



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Brake system:

Visual inspection, checking the brake pads and brake disks for wear

Note

Brake pads must be replaced for the complete axle when the brake- pad warning lamp lights up, but at the latest when the pads have worn down to 2 mm. If the brake-pad wear is indicated by the warning lamp, the warning contact (sensor including cable and connector) must also be replaced. It is possible to avoid replacing the warning contact if the brake pads are replaced when worn down to 2.5 mm at the latest. Warning contacts must be replaced if the core of the cable has been exposed. If only the plastic part of the warning contacts has been rubbed, however, it is not necessary to replace it.

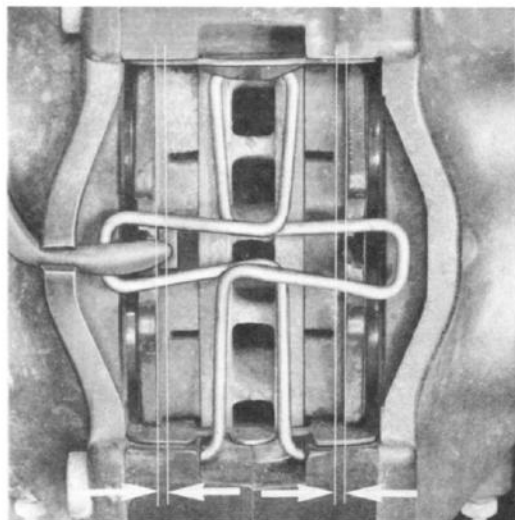


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2. Once the pump unit has switched off, the brake-fluid level must be between the min. and max. markings on the reservoir. Never fill to above the max. marking as brake fluid may be discharged through the vent line. Only use brake fluid DOT 3 or DOT 4 (SAE J 1703).

1. Remove the wheels to check the brake pads.
2. Check the brake pads for wear by means of a visual inspection.

The wear limit has been reached when the brake pad is worn down to 2 mm.



Throttle control:

Check bowden cables, linkages, joints for smooth operation. Check the tuning flap and full-throttle position.

Checking the tuning flap:

Each time the ignition is switched on, the tuning flap is opened and closed once by a vacuum.

The opening and closing noise can be heard in the engine compartment.

Hydraulic clutch control:

Visual inspection for leakage, check final position of the pedal

The clutch pedal has no stop. It is in its initial position when the master cylinder is in its initial position.

The push rod cannot be adjusted.

The preload on the servo spring, however, can be adjusted. The servo spring must fulfill 2 functions: to assist the pedal force and return the pedal.

If the clutch pedal does not return correctly, reduce the preload on the servo spring slightly. To do this, undo Allen screw No. 1 slightly until you can find a good compromise between return and pedal-force assistance.



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Steering gear:

Check that the screw connections are secure. Inspect the boots for damage

Tie rod knuckles:

Check play, fastening and dust caps

Check that all connections to the steering gear and tie rods are secure and that the dust caps, boots and joints are in working order and do not leak.

The rubber dust caps and boots on the steering gear and the tie rods may be damaged by outside influences, e.g. stone throw or during assembly work. If a rubber cap is damaged, the joint or tie rod must be replaced as the joint may be destroyed by the penetration of dirt or moisture.

Power-assisted steering

Visual inspection for leaks and checking the fluid level

General

Insufficient oil in the hydraulic system causes damage to the power-assisted steering. As a result of the high oil pressure in hydraulic system, even small leaks can lead to a drain on the fluid and damage the servo pump.

Grunting noises when locking the steering or foam in the reservoir indicate lack of oil and/or aspirated air. Before filling the reservoir, however, any leaks on the intake side must be repaired and the faulty part replaced on the pressure side.

Note

The tension of the toothed belt is not adjustable but check its condition.

Check the steering system for leaks (visual inspection)

With the engine at idle, turn the steering wheel to the stop and hold it there. This causes the greatest possible line pressure to build up.

Check all line connections for leaks in this position, tighten if necessary.

Carry out this test for max. 10 s. If the test period is longer, make a short pause after approx. 10 s.

Check the fluid level for the power-assisted steering

The reservoir with a transparent upper part is installed on the right-hand side of the engine compartment. With the engine at idle, check the ATF-fluid (ATF-Dexron II D) without moving the steering. The correct level is between the min. and max. marks on the reservoir.



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Axle joints:**Visual inspection for damage to the dust caps**

Check the dust caps for the axle joints (ball joints) on the wheel suspension as follows:

- Drive the vehicle onto the lifting platform, steering lock released.
- Turn the front wheels as far as the stop.
- After cleaning, carry out a visual inspection of the visible areas to the left and right. Press the rubber caps back with your fingers and look for concealed cracks.
- After turning the front wheels to the stop in the other direction, check the remaining rubber caps.

Note

It is not possible to carry out a visual inspection on a small area around the brake cover panels. Check this area by touch.

If a rubber cap is found to be leaky, the respective joint must be replaced as it will be destroyed by the penetration of dirt or moisture.

Axle links:

Check that screw connections are secure

Transmission/final drive

Visual inspection for leaks, check oil level

(Refer to Page 03-30 for notes on this)

Drive shafts:

Visual inspection for leaks and damage to the boots

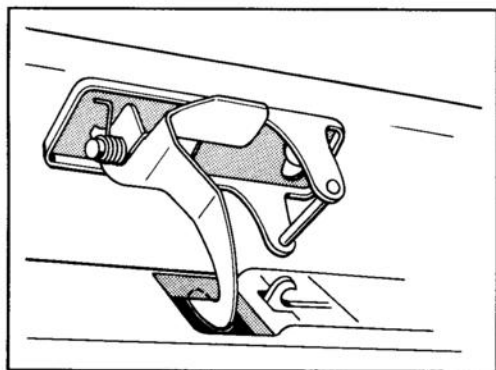
Front and rear hood locks.

When the hoods (front and rear) are closed, the hood locks must engage as the upper part of the locks are inserted and must disengage again when the hood release is pulled.

Safety catch - front hood

Once the hood release has been pulled, the front hood must be held down by the safety catch. At its lowest point, the safety catch must hook into the retaining plate.

When the hood is open, the retractor spring must pull the safety catch back to the baseplate on the upper part of these locks as far as the stop.



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Safety belts:

Check function and condition

Functional check:

When the belt strap is pulled evenly, it must roll smoothly from the seat belt retractor through the guide fitting, and the plug-in latch of the safety belt must be heard to engage in the lock. The seat belt retractor must block if the belt strap is pulled jerkily.

Condition check:

The belt strap must be inspected for damage. It must be replaced if there is any damage in the form of cuts, fraying, separating seams, etc.

Seals for doors, hoods and roof:

Remove scuffed rubber, apply a suitable preservative to maintain seals

Cleaning:

Remove scuffed rubber and soiling with benzine.

Care:

Maintain seals with glycerine, talcum or similar preservatives.

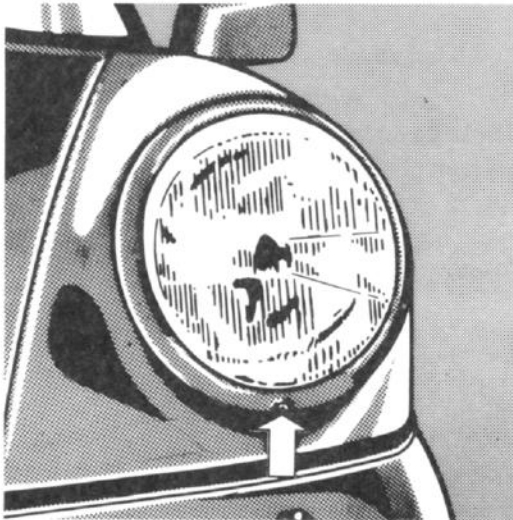
Checking the lighting system:

Adjust headlights

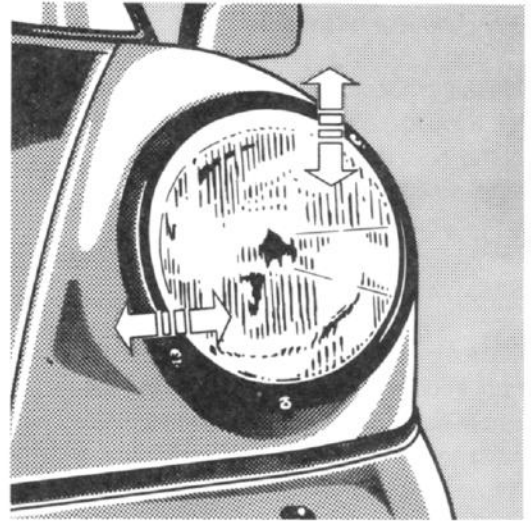
Note

Not for USA vehicles

1. Undo the fastening screw holding the trim ring.



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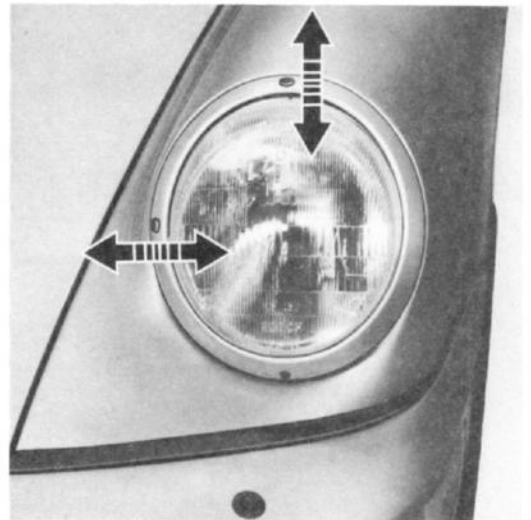
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Note

Adjust vehicles with headlight vertical aim control with the control switch in position 0.

USA vehicles

2. Ease the trim ring back at the bottom with a hardwood spatula or similar.
3. Clean the lens and switch on dipped beam.
4. Using a headlight aiming device, adjust the headlights with the vehicle in running condition (full fuel tank, driving seat occupied or loaded with 75 kg, tires inflated to the correct pressure).



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Checking the lighting system:

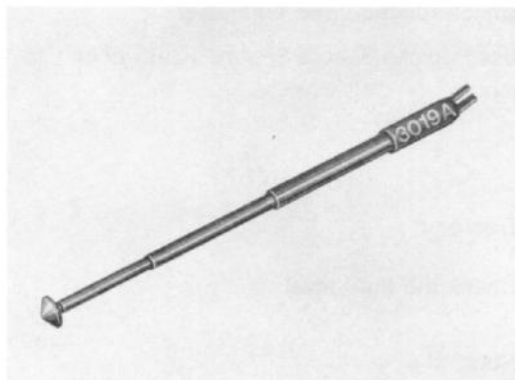
Adjust fog lamps

1. Undo the cover.
2. Using a light aiming device, adjust the fog lamps with the vehicle in running condition (full fuel tank, driving seat occupied or loaded with 75 kg, tires inflated to the correct pressure).



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Special adjusting tool 3019 A



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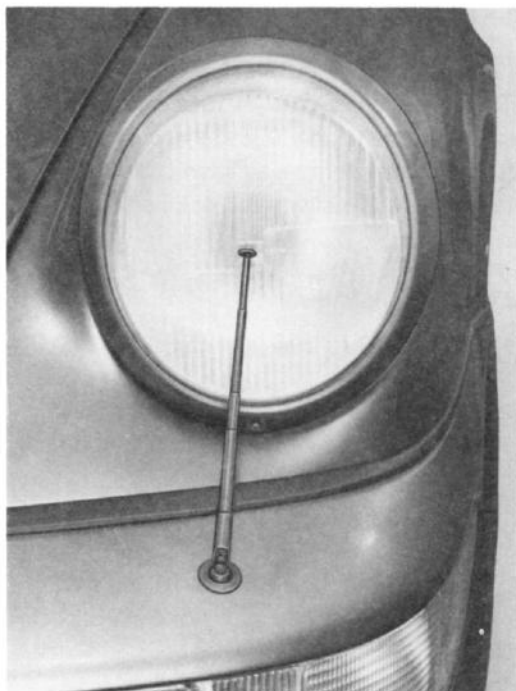
1. Insert the special tool into the spray nozzle. Turn the nozzle insert with the tool so that the telescopic extension points towards the middle of the lens.

Activate the cleaning process and check the spray jet.

Windshield washer, headlight wiper - washer:

Check function, fluid levels and nozzle adjustment

Adjust the headlight washer nozzles



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3. Start the engine and switch on the air-conditioner. If the system is filled correctly, gas bubbles rise briefly when the system is switched on and off. If gas bubbles are visible for a longer period, there is not enough coolant in the system.
In this case, top up the coolant.

Emission control system:

Check that catalytic converter, Lambda probe and restricted filler inlet are present, visual inspection of all electrical connections and line connections, check that the Lambda probe is in working order.

Precondition:

The fault memory of the DEE control unit has been read out (Tester 9268/9288).

No fault indicated in the fuel or ignition system.

Components – visual inspection

Lift the vehicle, check that catalytic converter and Lambda probe are present.

Check that the restricted filler inlet is present.

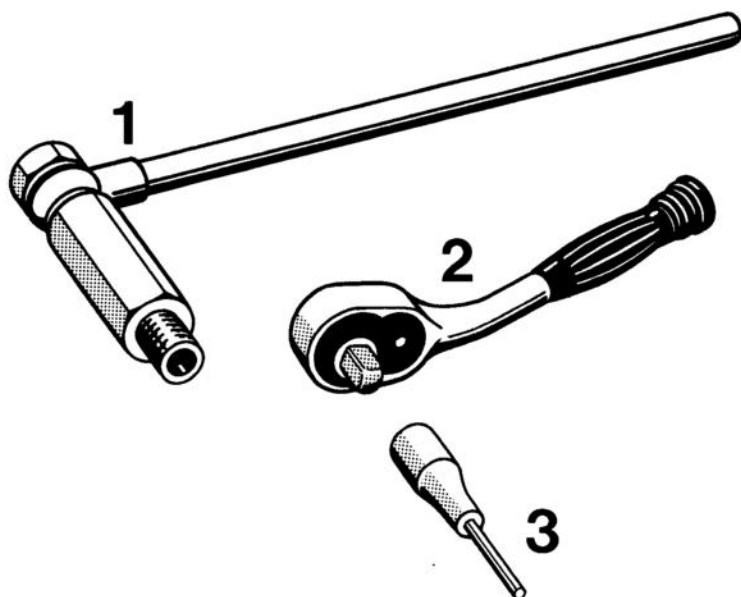
Check the vacuum line connections to the pressure regulator and pressure attenuator for leaks and secure fitting.

Ignition circuits 1 and 2:

Check the function

1. Measure the CO and HC values with the engine at operating temperature and both ignition circuits in operation.
2. Switch off the engine and disconnect the plug from the final stage of ignition circuit I.
3. Start the engine and measure the CO and HC values.
4. Switch off the engine, connect the plug for ignition circuit I and disconnect the plug from the final stage of ignition circuit II.
5. Start the engine and measure the CO and HC values.

The CO and HC values must not deviate considerably when the engine is running with only one ignition circuit.

Exhaust test:**Checking Idle speed - adjusting CO****Tools**

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No.	Description	Special Tool	Order number	Remarks
1	Exhaust adapter			Standard from: e.g. Sun Electric, Bosch; refer to the Workshop Handbook
2	Ratchet 1/4 inch to adjust the CO value	W 166	W 166	
3	Insert for Allen screw	W 165	W 165	

Exhaust test:

Checking idle speed/CO – with catalytic converter

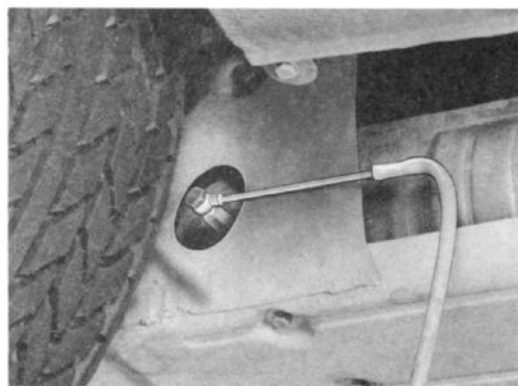
Note

It is no longer possible to adjust the idle speed and CO value for vehicles with catalytic converters. Do not disconnect the Lambda probe for the idle speed/CO check.

Precondition

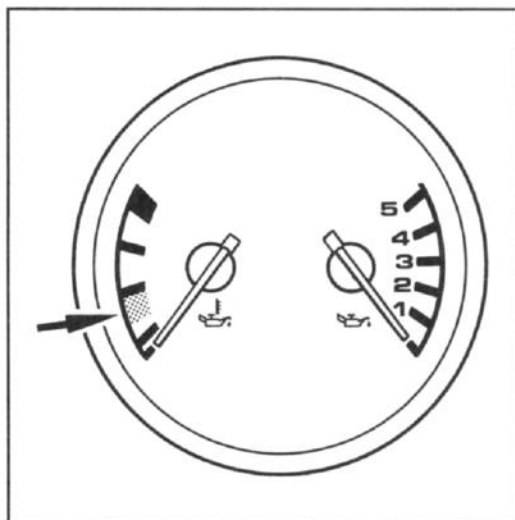
Engine in faultless mechanical condition. Consumers must be switched off during the checking work. Carry out checking operations as fast as possible to ensure that the intake channels do not heat up and falsify the CO value. Ambient temperature 15 - 35° C (59 - 95 °F).

1. Mount the exhaust adapter onto the test connector of the catalytic converter.



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2. Warm the engine up to operating temperature (70 - 90° C (158 - 194 °F) oil temperature)



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3. Do not separate the connector for the Lambda probe. Connect the CO tester and separate rev. counter according to the manufacturer's instructions.

CO control value 0.4 - 1.2 %

Idle speed 880 ± 40 rpm

Exhaust test:

Checking the idle speed - Adjusting the CO without catalytic converter

Note

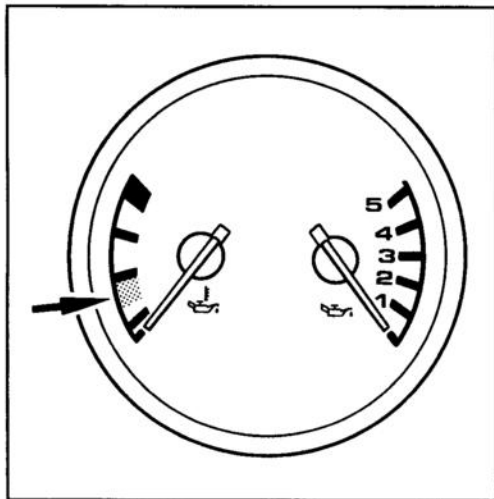
It is no longer possible to adjust the idle speed. The adjustment to the throttle housing is therefore not applicable.

Adjusting the idle speed/CO

Precondition

The engine must be in faultless mechanical condition. Consumers must be switched off during the adjusting operations. Carry out adjustments as quickly as possible to ensure that the intake channels do not heat up and falsify the CO value. Ambient temperature 15 - 35°C (59 - 95 °F)

1. Warm the engine up to operating temperature (70 - 90° C (158 - 194 °F) oil temperature).



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2. Check the CO content. If the CO content is not within the prescribed values, correct the setting of the air-flow sensor.

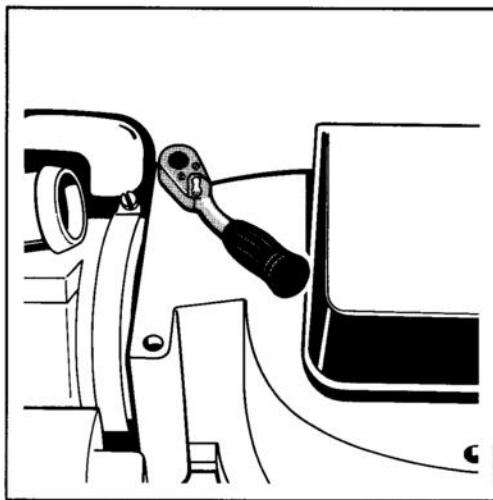


Illustration shows engine removed.

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CO setting value: 0.5 - 1.0 %

Turn to the right - richer mixture

Turn to the left - leaner mixture

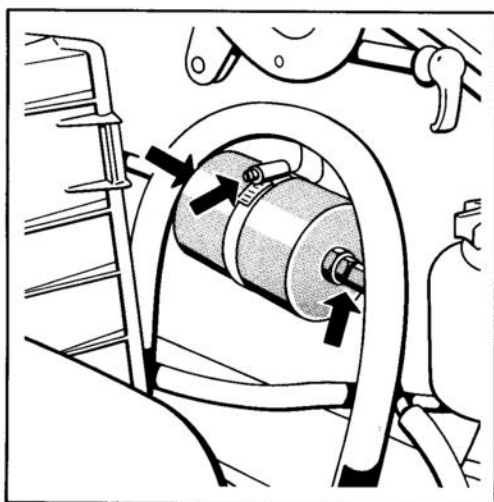
Checking the idle speed

1. Connect a separate rev. counter according to the manufacturer's

instruction. Idle speed 880 ± 40 rpm

Replace the fuel filter:

1. Release the clamps holding the air-filter cover and remove the housing cover with filter insert.
2. Undo the fuel lines, bracing under all circumstances. Catch escaping fuel.
3. Undo the strap and remove the fuel filter.



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4. Install new filter. Observe the direction of flow = direction of arrow.
5. Start the engine and check the fuel lines and filter for leaks.

Check that fuel lines and fuel-injection lines are secure and not leaking.

Test drive:**Drive train, differential locks (inter-axle and wheel-to-wheel)****Check for noises and function**

A visual indication of the differential-lock control is given by the yellow differential-lock function control lamp on the full-lock pushbutton.

A control is also possible during normal driving by virtue of irregularities in the road surface.

Visual inspection for leaks:**Oils and fluids**

It is advisable to make the test drive without the engine guard so that engine/transmission can be checked for leaks and to avoid additional assembly work if any leaks are found.

The speed must not exceed 150 km/h.

Replacing transmission oil (Manual transmission and front final drive)

Filling capacities:

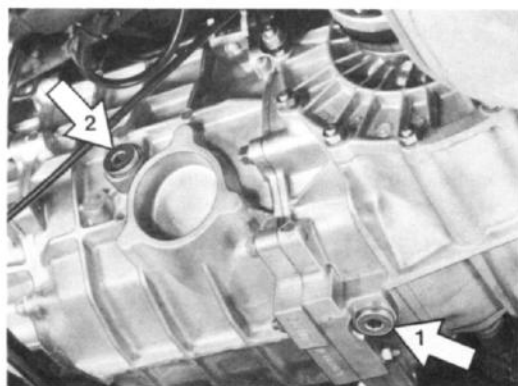
Manual transmission: approx. 3.8 l

Front final drive: approx. 1.2 l

Oil grade:

Transmission oil SAE 75 W 90 of API classification GL5 (or MIL-L-2105 B)

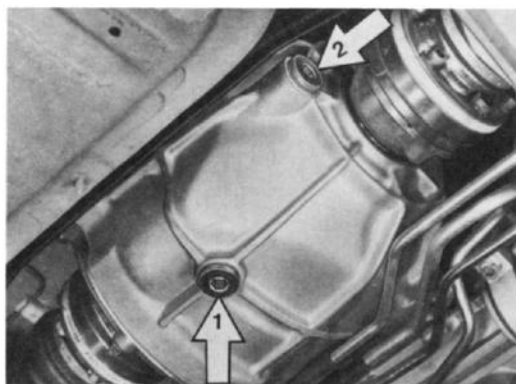
1. Remove the front underbody panel and engine guard.
2. Drain the oil with the vehicle level and transmission at operating temperature.



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Manual transmission

- 1 - Drain plug with magnet
- 2 - Filler plug



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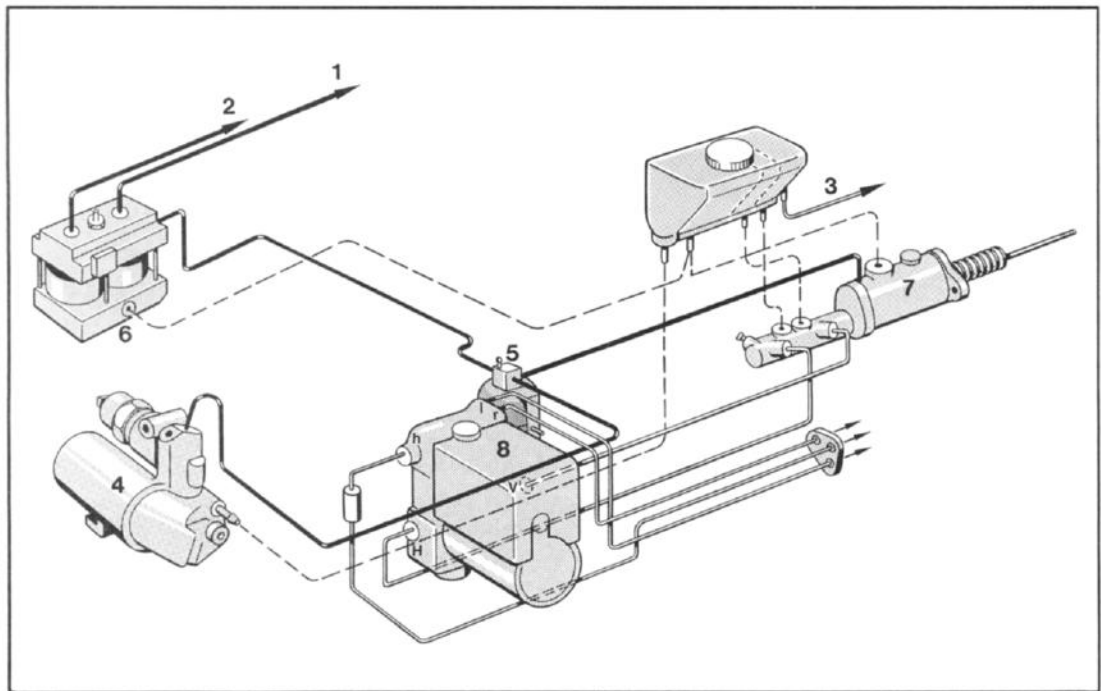
Front final drive

- 1 - Drain plug with magnet
- 2 - Filler plug
3. Clean filter plug and drain plug, replace seals and tighten with 30 Nm (22 ftlb).
4. With the vehicle level, fill with transmission oil until the filler plug overflows.

Replacing Brake Fluid / Bleeding Brakes and Lock Control

General Information

Since brake master cylinder circuits, consisting of the push rod circuit (for front axle) and intermediate piston circuit (for rear axle) with the ABS hydraulic control unit, are completely independent of the booster circuit (brake booster and lock control), brake fluid replacing and bleeding procedures are divided into different jobs (see next page).



709/11

- ==== Brake master cylinder circuits (exception 3)
- ==== Booster circuit (brake booster and lock control)
- Return / feed or intake end
- 1 + 2 To axial and lateral lock cylinders (Q and L)
- 3 Feed to clutch master cylinder
- 4 Pump assembly
- 5 Pressure reservoir
- 6 Valve assembly (solenoids for axial and lateral locks)
- 7 Brake booster
- 8 ABS hydraulic control unit

Notes

- Only use new DOT 3 or DOT 4 (SAE J 1703) brake fluid.
Total brake fluid change volume = approx. 1.6 liters.
- Brake fluid must be replaced at least every two years.
- Brake fluid supply tank is divided into chambers from about the middle downwards.

Procedures / Division

1. Replace brake fluid (brakes, lock control and clutch).
2. Bleed lock cylinders and pressure pipes, *insofar as the hydraulic system had been disconnected after the valve assembly for lock operation.*

Described in Rep.-Group 47.

3. Bleed lock or brake booster circuit, *insofar as parts of the booster circuit had been replaced or the system (including intake end of the pump assembly) had been disconnected.*

Described in Rep.-Group 47.

Ref. 1: (Replacing Brake Fluid)

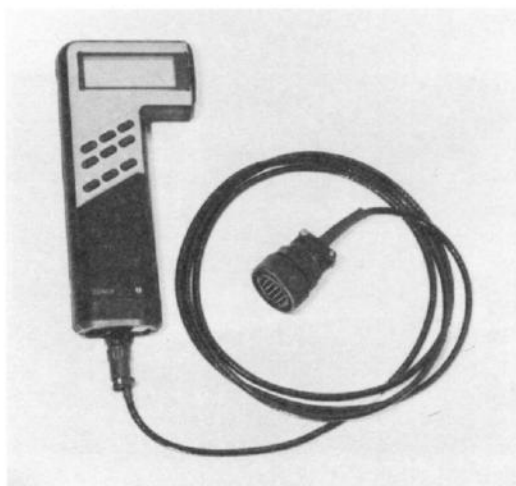
Replacing brake fluid is divided into two steps.

- Step 1: Replace brake fluid for the brake master cylinder circuit and clutch hydraulic system (conventional).
- Step 2: Replace brake fluid for the booster circuit (brake booster and lock control). This requires activating the lock solenoids with a 9288 System Tester and removing the brake fluid from each lock cylinder.

Use of an electric filling and bleeding machine is recommended to guarantee fast and practical **replacement of the brake fluid**.

- Pour new brake fluid in the supply tank until the level reaches the upper edge. Connect bleeder on the supply tank. **Clamp the overflow hose (venting) with a hose clamp.** Switch on bleeding machine.
- A bottle must be used to catch the escaping brake fluid and therefore be able to check it for dirt and air bubbles as well as to determine the brake fluid consumption. Change volume for each wheel: approx. 250 cc. Bleed on both bleeder valves of each wheel.
- Also drain about 50 to 100 cc of brake fluid on the bleeder valve of the clutch slave cylinder.
- **Switch off and disconnect the bleeding machine.** Remove hose clamp on the overflow hose (venting).

- Connect System Tester 9288 in conjunction with connecting lead 9288/1 in the diagnostics socket in the passenger's footwell (underneath a cover). **Turn on ignition and tester. Select type of vehicle and PDAS system afterwards. Then go into the drive menu.**



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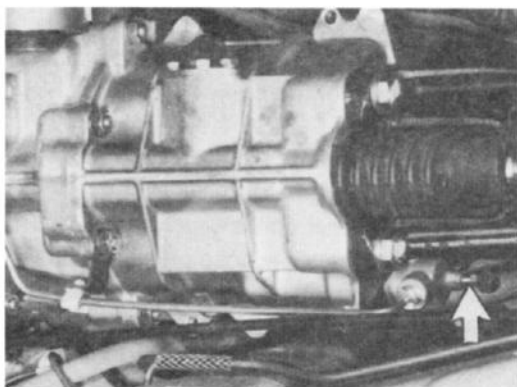
Note

The rear underside trim panel must first be removed for the next step (booster circuit). If applicable for reasons of space, unscrew and also remove the engine splash guard. In addition, the battery should be in well charged condition.

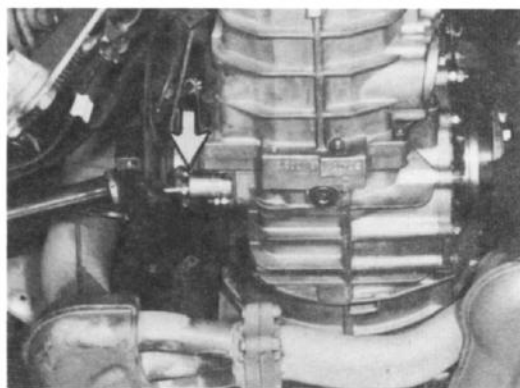


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- **Select the bleeding position in the drive menu.** Unscrew bleeder valve on the lateral lock cylinder and **drain about 250 to 300 cc (max. 300 cc) of brake fluid** after pressing the start key displayed in the tester.
Press stop key and tighten the bleeder valve.
Go into the pressure discharging position with the tester.

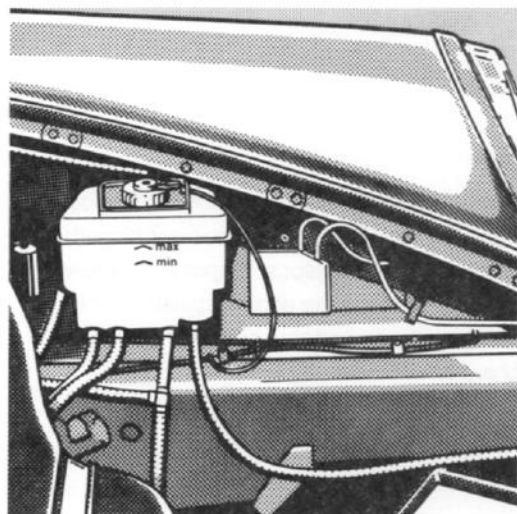


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- **Pour in new brake fluid.** Operate the brake pedal several times while the ignition remains turned on.
- Afterwards activate the solenoids again with a 9288 System Tester (bleeding position in the drive menu) and **drain about 200 cc of brake fluid** on the bleeder valve of the **axial lock cylinder**.



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Operating instructions for System Tester 9288



1. General information

1.1 Application

The Systemtester 9288 (BOSCH KTS 301) is a microprocessor-controlled self-diagnosis tester.

All systems which have a diagnosis interface as per ISO Standard can be tested with this tester. The following tests are possible:

- Reading out the fault memory
- Testing of the actuators
- Testing the circuit inputs
- System adaptation
- Engine-knock detection
- Sensor and status checks, tire-pressure monitoring (RDK)

The Systemtester 9288 is a high-quality piece of electronic equipment. In order to prevent damage to the equipment as a result of improper use, please read the information in the operating instructions carefully and comply with it.

In addition, the instructions (specifications) of the vehicle manufacturer are also to be observed.

If the tester should fail, check the following points before sending it in for repair:

1. Has the tester been operated incorrectly?
2. Is the battery sufficiently charged?
3. Is the adapter cable OK?

(Please note when checking the adapter cable that a highly sensitive electronic matching circuit is installed in the vicinity of the 19-pole plug).

1.2 Construction (Fig. 1)

No.	Description	Function	Remarks
1	LCD indicator	Dot matrix 5 x 8 4 lines each with 20 characters Foreign languages possible Illumination	If the Systemtester 9288 is switched on without the program module, following the self-test the tester switches off automatically and informs the user that the program module is not fitted.
2	Keyboard	Keys 1, 2, 3 = Selection key Keys < > = Previous page/next page Key H = Help menu, e.g.: Illumination Screens stored Control-unit overview Setting up printer Switching off unit Key N = Return to the next higher program level following termination of a test sequence or, during a test sequence, return to the last display Key ↻ = Storing indication Key ↺ = Playing back stored reading	Switching on: = Press any key Switching off: = 180 s after last depression of a key or if no data stream flows across the serial interface. The last field in the top right-hand corner is filled completely, this means that this is a stored figure and not an actual, real-life figure.
3	Power supply	Fitted accumulator with NiCd batteries. The Systemtester 9288 must be switched off during the initial battery charging process. Charging time > 8 hours	Discharged upon delivery. Following charge: Operating time: 4–8 hours without scale illumination 1–2 hours with scale illumination
	If the voltage is not sufficient, "Charge battery" appears on the display. If this is not done, the unit switches itself off.	Connection to vehicle battery by means of vehicle-specific adapter lead (see 1.4)	Connection through ISO-interface Charging voltage supply
		Battery charger (accessory)	For test operation and for charging the NiCd batteries.
4	Connection for input and output devices	Connection facility for Printer e.g. Epson, IBM, Hewlett Packard (HP)	The Systemtester 9288 transmits data with the following configurations: 8 data bits / 1 start bit / 1 stop bit / No parity (for printer matching)
5	Connection for vehicle specific adapter lead	Reading out the data	Input for flashing-code support
6	Plug-in programme module (see also Figure 2)  C-MOS ! Do not touch plug !	Operating system LCD drive Keyboard Interface communication Computations and data conversions	Plug in module: remove rubber protector, insert module fully.

1.3 Battery charger run off mains voltage (Figure 3)

– Accessory –

Item 1 Charger with connecting cable, 1.5 m long

Item 2 8-pin AMP plug

1.4 Vehicle-specific adapter cable

Porsche No. 000 721 928.81

1.5 Connecting lead (Figure 4)

– Self-fabrication –

for printer, programme load station or similar unit.

For interface-trunk assignment, see manual of corresponding unit.

Printer cable for standard D 25

BOSCH No. 1 684 465 193

Printer cable for EPSON

BOSCH No. 1 684 465 194

2. Connection**The following points must be observed:**

- No gear must be engaged on the vehicle (Automatic transmission in position N-P) – Danger of Accident !
- ALL work on the vehicle must only be carried out with the ignition switched off.

After having connected the vehicle-specific adapter cable, the instructions listed under "3" are displayed on the Systemtester 9288:

2.1 Charging with the battery charger (Fig. 3)

Connecting the Systemtester 9288 to the battery charger. (Fig.1, pos.5).

2.2 Diagnosis

Connecting the Systemtester 9288 to the diagnosis plug in the vehicle by means of the vehicle-specific adapter cable.

Switch on the tester and proceed according to the instructions displayed.

2.3 No diagnosis possible (see page 03 - 43)**3. Testing**

Scope of module:

Guidance through the menu, communication with the ECU, reading out the error memory and selection of the "Help" menus, actuator diagnosis, circuit inputs and system adaptation, engine-knock detection, sensor and event check for the tire-pressure monitor (RDK).

3.1 Reading-out the error memory

Connect the Systemtester 9288 (see 2.)

Switch on the Systemtester,
(possible with every key!)

Display:

```

PORSCHE
Eprom modul      eng
Mod. intro.  xx.xx.xx

```

If a specific instruction does not appear in a display, it is always possible to proceed by pressing the button >.

Due to the fact that the Systemtester 9288 can store error displays (see Chapter 3.7), the following display will appear if errors have been stored in the image memory:

```

Stored displays
erased ?
1 = yes
3 = no

```

Key 3

Display:

```

Print out
displays:      H

continue:      >

```

H = Help menu (see 3.6) or key 1

Display:

```

Vehicle types
1 = 944 S
2 = 911 Carrera 4
3 = 928 S 4

```

Selection of the vehicle type with key 1, 2 or 3.

After the vehicle type has been selected, the following instruction appears:

```

Connect adapter
cable to veh. plug.
Ignition "ON".
After completion:  >

```

The following then appears:

```

Wait for
Data

Break off test:  N

```

After a short pause, the Systemtester 9288 reports all the systems that are installed in the particular vehicle. If a system is preceded by " # ", this means that at least 1 error is stored in that particular system.

Examples:

```

Installed systems
1 = # LH
2 = # EZK
3 = RDK

```

The particular system can be selected by means of key 1, 2 or 3.

After selection (for instance with key 1), the following display appears:

```

LH
System:  L01 LH-JET
Ser. No.: 92861812313
RB. No.: 0280002507

```

After pressing the key > , a selection menu is displayed:

Menu
1 = Fault memory
2 = Drive links
3 = Input signals >

< Menu
1 = System adaptation

In the example – press key 1. There then follows the display of the number of errors which are stored (if any).

Number of faults
→ 2 ←

Proceed with key >

Additional info to every display with key 1
continue: >

Proceed with key >

Error output:

1: Engine temperature sensor 2
Short to ground not present

If key 1 is pressed instead of the > key, the corresponding error code display appears (the last two digits of the flashing code).

Fault code: – 14 –

Proceed with key >

Further errors are displayed (if they exist):

2: Idle contact
Short to ground present

If key 1 is pressed instead of key > the corresponding error-code display appears (the last two digits of the flashing code).

Fault code: – 12 –

After the last displayed error, the following instruction appears:

Repair fault according to repair instructions
Continue: >

Proceed with key >

Fault repaired ?
1 = yes
3 = no

Return to display "No. of errors" with key 3.

Proceed with key 1:

Fault memory
1 = Erase
3 = Do not erase

If key 3 is pressed:
= Return to menu "error memory".
The error memory is not erased!

Proceed with key 1:

Fault memory has been cleared
Return: N

The test scope "Read-out error memory" is terminated at this point.

3.2 Actuator diagnosis

If an actuator is selected, this is triggered by the ECU so that it can be checked for correct functioning.

The various actuators components are gone through one after the other and are selected with the > key.

Operate the Systemtester 9288 as described under 3.1 until the following menu display appears:

Menu
1 = Fault memory
2 = Drive links
3 = Input signals >

After pressing key 2, the display for the first actuator appears:

Injector to activate
1 = Start
Continue: >

If key > is pressed, the next actuator is selected.

Pressing key 1 results in the following instruction:

Can injectors be heard / felt ?
1 = yes
3 = no

Key 1 selects the next actuator (e.g. idle actuator). Following instruction:

Repair fault according to repair instructions
Continue: >

After pressing key >, the following display appears:

Injector to activate
1 = Start
Continue: >

Proceed with key 1

Can injectors be heard / felt ?
1 = yes
3 = no

Proceed with key 1 to the next actuator.

Idle stabilizer to activate
1 = Start
Continue: >

Proceed with key 1

Can idle stabilizer be heard / felt ?
1 = yes
3 = no

By pressing key 1, the next actuator is selected. After pressing key 3, the next instruction appears:

Repair fault according to repair instructions
Continue: >

Proceed with key >

Idle stabilizer to activate
1 = Start
Continue: >

After pressing key 1, the following display appears:

Can idle stabilizer be heard / felt ?
1 = yes
3 = no

By pressing key 1, the next actuator is selected. The actuators are selected one after the other and triggered until the following display appears:

Drive link test completed
Return: N

By pressing the key N, the operator is returned to the menu.

3.3 Circuit inputs

In addition to the actuators, the Systemtester 9288 can also check circuit inputs. To this end, operate the Systemtester 9288 in accordance with 3.1 until this menu display appears:

Menu
1 = Fault memory
2 = Drive links
3 = Input signals >

Press key 3

Idle contact
1 = Start
Continue: >

By pressing key > the next circuit input is selected.

The next display appears when key 1 is pressed.

Activate accl. pedal
Idle contact
- closed -
Continue: >

Operate the accelerator pedal, the following display appears:

Activate accl. pedal
Idle contact
- open -
Continue: >

The next circuit input is selected by pressing key >. Repeat until this display appears:

Input signals testing completed
Return: N

Press key N for return to menu

3.4 System adaptation

When the function "System adaptation" is triggered, the ECU registers the basic air requirement of the engine.

To this end, operate the Systemtester 9288 as per 3.1 until the following menu display appears:

Menu
1 = Fault memory
2 = Drive links
3 = Input signals >

Proceed with key >

< Menu
1 = System adaptation

Proceed with key 1

Prerequisite:
Eng. at oper. temp.
with all consumers
and ignition off.

Proceed with key >

System adaptation
1 = Start

Return: N

If key N is pressed
= return to menu.

If key 1 is pressed:

Start engine !

Following engine start there appears:

System is being
adapted

Please wait !

After approx. 30 secs there appears:

System adaptation
completed

Return: N

If it is impossible to carry out system adaptation (idle contact not closed, or defective), the following display appears:

No system adaptation
possible
Idle contact ?
Return: N

After completion of the system adaptation, return to the menu with key N.

3.5 Engine-knock registration

The engine-knock registration function can only be triggered through the EZK or DME control unit.

To this end, operate the Systemtester 9288 as described in 3.1 until the following display appears:

Installed systems
1 = # LH
2 = # EZK
3 = RDK

The particular system can be selected by means of key 1, 2 or 3.
For instance with key 2 the following display appears:

EZK
System: E01EZK
Ser. No.: 92861812415
RB. No.: 0227400154

Proceed with key >

The following menu display appears:

< Menu
1 = Fault memory
2 = Knock registration

Proceed with key 2

Condition:
Engine at operating
temperature >

Proceed with key >

< Start knock
registration before
test drive >

Proceed with key >

< A normal test
drive is a pre-
requisite >

Proceed with key >

< Stop the test
drive only if the
display with the no.
of knocks comes on.

Proceed with key >

Knock registration
1 = Start

Return: N

Pressing key 1 activates the engine-knock counter:

Knock registration
in progress

Please wait!

The knock counter registers 10,000 ignitions before the display with the actual number of combustion "knocks" appears.

Number
Knocks: xxx
Combustion: xxxxx
Continue: >

Proceed with key >

Knock registration
completed

Return: N

If knock registration is impossible (due to lack of engine-speed signal), the following display appears:

No knock regi-
stration possible.
RPM signal ?
Return: N

Following completion of the knock registration test, return to the menu with key N.

3.6 Help menu

The "Help" menu can be selected from every display by pressing key H. Return to the initial display with key N.

Help menu
1 = Illumination
2 = Display stored
3 = Ctrl. unit chart >

Proceed, for instance with key 1:

Key 1:

The scale illumination is switched on and the tester returns to the previous display.

Or with key 2:

Data display stored
1 = Print
2 = Clear

Proceed with key 1

Stored displays are printed out (If printer connected).

Proceed with key 2

Stored displays are erased.

With the "Help" menu, for instance

Help menu
1 = Illumination
2 = Display stored
3 = Ctrl. unit chart >

if the key > is pressed, a further section of the "Help" menu is displayed:

< Help menu
1 = Printer setting
2 = Switch off equip.
3 = Baud Rate

Proceed for instance with key 1

Printer setting
1 = IBM
2 = HP Quiet Jet
3 = EPSON

The selection of the printer results in the tester being set up for the printer type in question.

3.7 Store measurement displays (Key ⇄)

Using key ⇄, all displays can be stored manually.

The following displays are stored automatically:

- ECU-identity
- Installed systems
- All existing errors

When the memory limit is reached, the following instruction is displayed:

Data display mem.
full !

Return: N

3.8 Show stored measurement displays (Key ⇄)

Using the keys < or >, the stored displays for the selected system can be shown.

The stored displays can be called up by means of the ⇄ key.

The system selection (LH - EZK - RDK) takes place with the keys 1, 2 or 3.

4. Service and wear parts (BOSCH)

Fig.	BOSCH Part No.	Designation	Comment
1/3	1 687 335 002	NC - battery	9pole
4/1	1 684 483 152	Plug	
4/2	1 684 485 170	Socket	
4/3	1 680 552 005	Screw cap	
	1 684 465 193	Printer cable (Standard D 25)	
	1 684 465 194	Printer cable (EPSON)	

4.1 Service parts (Porsche)

Designation	Porsche Part No.	Special tool No.
Systemtester 9288	000.721.928.80	9288
Adapter cable	000.721.928.81	9288/1
Battery charger	000.721.928.82	9288/2
Module (D)	000.721.928.84	9288/4
Module (GB/USA)	000.721.928.85	9288/5
Module (F)	000.721.928.86	9288/6
Module (I)	000.721.928.87	9288/7
Module (E)	000.721.928.88	9288/8

Operating conditions for start of diagnosis

Systems	Ignition on Engine standing still	Engine running
964		
Motronic	yes	to n < 2000 rpm
ABS/lock	yes	no
Tiptronic	yes	to n < 1500 rpm
Airbag	yes	yes
Alarm system	yes	yes
Heating*	yes	yes

- * Mixing chamber temperature RH/LH < 80 °C
 Rear fan temperature < 95 °C
 Oil temperature < 105 °C

No diagnosis possible

If the System Tester 9288 cannot enter the diagnosis, check the following items:

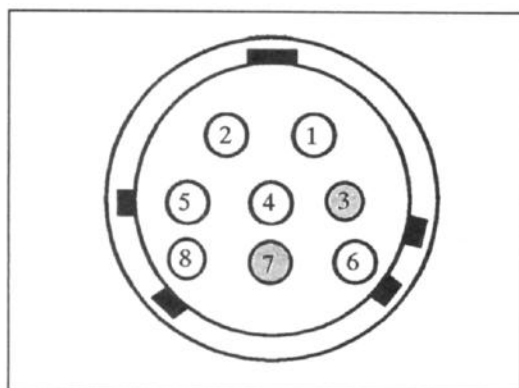
Note: If the DME relay is faulty, no diagnosis is possible (engine cannot run).
Power is supplied to some control units of the diagnosable systems via the DME relay !

- **Check adapter cable 9288/1 for continuity**

Check K and L wires to adapter lead 9288/1 for continuity.

Socket 3 (8-pin connector) to pin 7 (19-pin socket).

Socket 7 (8-pin connector) to pin 8 (19-pin socket).



Socket 3 = L lead

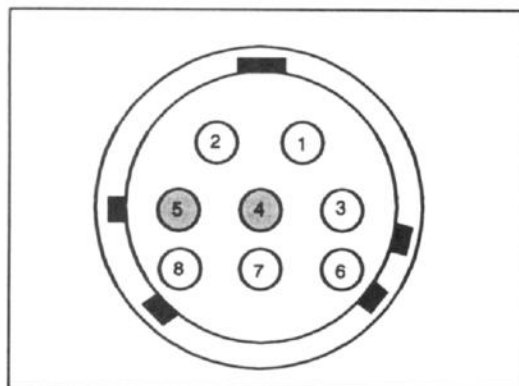
Socket 8 = K lead

1211 - 03

Connector at tester

- **Check power supply**

Check ground and terminal 15 of adapter cable 9288/1 for power supply.



Socket 4 = Ground

Socket 5 = Terminal 15

1211 - 03

Connector at tester

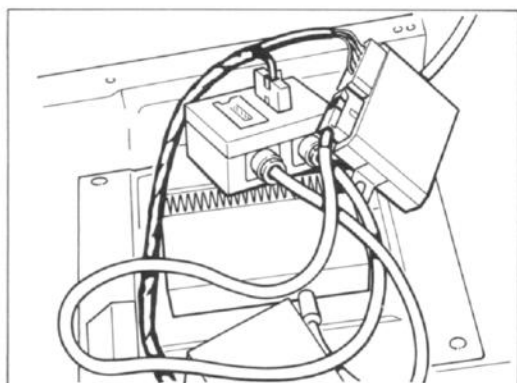
- Check K and L leads with oscilloscope and Special Tool 9540

Checking the L lead:

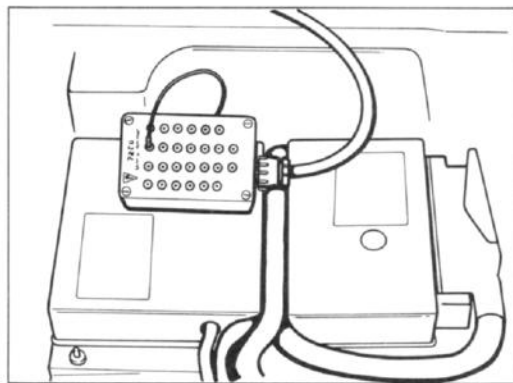
Disconnect connector 2 (yellow) from alarm control unit. Connect Special Tool 9540 between alarm control unit and connector 2. Connect oscilloscope to Special Tool 9540, socket 14 (L lead). Check L lead, turning ignition on and switching System Tester 9288 on. Start diagnosis (trigger).

Checking the K lead:

Same procedure as for L lead, but connect to socket 15 for K lead instead of socket 14 for L lead.

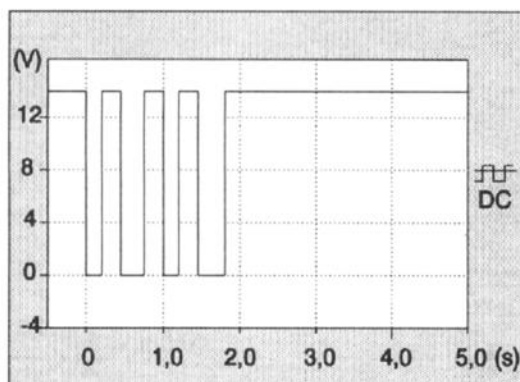


1214 - 03



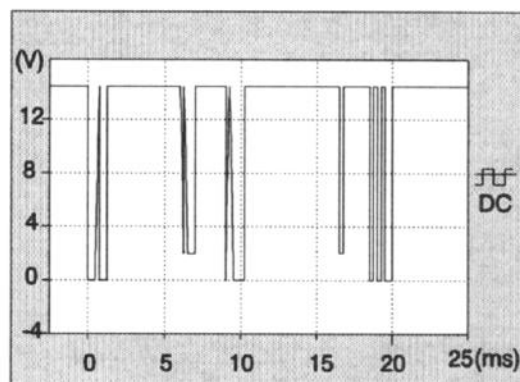
1215 - 03

In case of the L lead, the following signal must be displayed:



1212 - 03

In case of the K lead, the following signal must be displayed:



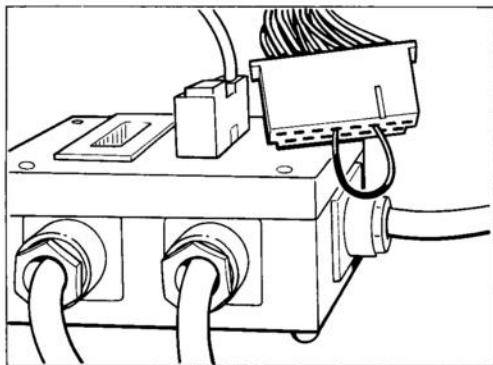
1213 - 03

Note: If the displayed signals differ from the above, this may be due to interference caused by a control unit connected to the K and L leads (for diagnosable systems, refer to wiring diagram). Pull off control unit connectors one after another and repeat test of K and L leads. Start with alarm control unit, as described above. After the last control has been disconnected, one of the control units disconnected earlier must be reconnected since otherwise no signal will be present anymore.

If the airbag control unit is disconnected, control of the DME relay and, hence, of terminal 15 of the DME control unit is interrupted.

Note: The on-board computer (tachometer) is connected to the K and L leads, but is not a diagnosable component. It may cause the above interference, though!

- **Disconnect alarm control unit and fit jumper**



Disconnect connector 1 (black) from alarm control unit. Connect jumper to connector 1 of the alarm control unit, pin 4 and pin 6

Recheck signals of K and L leads, as described above

1216 - 03

- **Disconnect other control units**

Disconnect next control unit, turn ignition on, switch tester on and off and start diagnosis (trigger again).

Check signals of K and L leads.

Repeat process until all control units have been checked.

- **Check K and L leads for shorts to ground**

- **Check each control unit for continuity to diagnosis socket**

Tightening torques for the engine

Location	Thread	Tightening torque Nm (ftlb)
Crankshaft/crankcase		
Connecting rod bolt (marked 12,9)	M 9 x 1.25	
First stage:		15 (11)
Second stage:		2 x 90° ± 2° Angle of rotation
Oil pump	M 8	23 (17)
Crankcase - screw connection (Tension rod union)	M 10 x 1.25	50 (37)
Hexagon nuts or hexagon head screws on the crankcase	M 8	23 (17)
Flywheel to crankshaft	M 10 x 1.25	90 (66)
Two-mass flywheel to crankshaft	M 10 x 1,25 x 70	85
Driving plate to crankshaft (Tiptonic)		90
V-belt pulley to crankshaft	M 14 x 1.5	235 (173)
Screw plug - relief and safety valve	M 18 x 1.5	60 (44)
Oil drain plug	M 20 x 1.5	70 (51)
Screw neck in the left crankcase half (oil return to the oil tank)	M 22 x 1.5	70 (51)
Screw neck in the right crankcase half (oil feed to the oil pump)	M 24 x 1.5	90 (66)

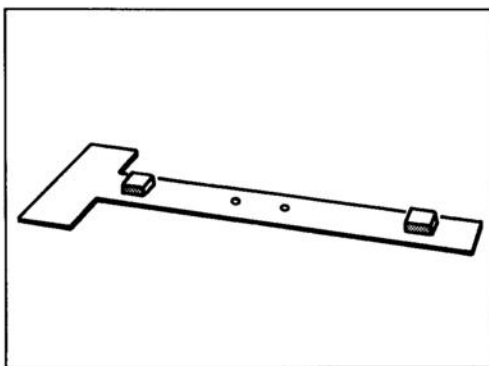
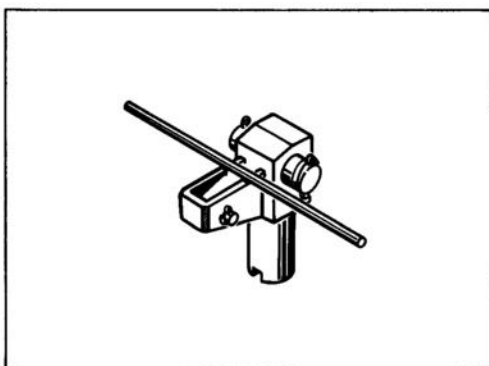
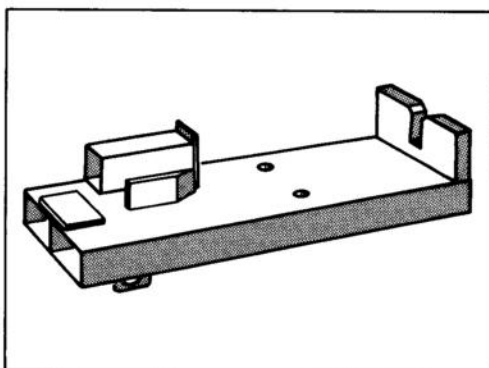
Location	Thread	Tightening torque Nm (ftlb)
Cylinder and cylinder head		
Cylinder head bolt		
First stage:		15 (11)
Second stage:		1 x 90° ± 2°
		Angle of rotation
Camshaft housing / cylinder head	M 8	23 (17)
Antiknock bridge to cylinder bank	M 6	9.7 (7)
Knock sensor to antiknock bridge		20 ± 5 (15 ± 3)
Engine - NTC to cylinder head 3		10 - 12 (max. 15) (7 - 9 (max. 11) ftlb)
Rocker shaft	M 7 Allen	20 (15)
Spark plugs	M 14 x 1.25	20 - 30 (15 - 22)
Timing		
Sprocket to camshaft	M 12 x 1.5	120 (88)
Gear wheel / power steering pump to camshaft		120 (88)
Collar bolt (slide rail and tension blade to crankcase)		30 (22)
Chain housing to crankcase		23 (17)
Cover for chain housing		5.5 (4)
Valve cover to camshaft housing	M 6	9.7 (7)
Bearing bridge/chain housing		9.7 (7)

Location	Thread	Tightening torque Nm (ftlb)
Blower		
Restraining strap		8 (6)
Alternator pulley (Carrera RS)		50 ± 5 (37 ± 3) 40 (29.5)
Pulley half / impeller	M 6	9.7 (7)
Fan wheel for alternator cooling		14 ± 1 (10)
Exhaust system		
Heat exchanger cylinder head		23 (17)
Heat exchanger - primary muffler or catalytic converter		23 (17)
Primary muffler / catalytic converter - intermediate muffler (spherical clip)		25 - 30 (18 - 22)
Intermediate muffler - final muffler (spherical clip)		25 - 30 (18 - 22)
Restraining strap to intermediate muffler		14 (10)
Lambda probe to catalytic converter	M 18 x 1.5	50 - 60 (37 - 44)
Screw plug on catalytic converter	M 8 x 1	15 (11)
Belt monitor		
Bracket to crankcase	M 6	15 - 20 (11 - 15)
Belt monitor bracket	M 6	9.7 (7)
Fuel system		
Cap nut on the fuel distribution line	M 12 x 1.5	12 (9)
Tank sensor		30

Location	Thread	Tightening Torque Nm (ftlb)
Clutch - two-mass-flywheel		
Two-mass flywheel to crankshaft	M 10 x 1.25 x 70	85 (62)
Primary flywheel to cover plate	M 7 x 34	22 (16)
Primary flywheel to secondary flywheel	M 8 x 21	35 (26)
Pressure plate	M 8 x 40	23 (17)

Removing and installing the engine

Special Tools



No.	Description	Special Tool	Order number	Remarks
1	Engine mounting plate	9111/3	000.721.911.13	
2	Adapter for engine mounting plate	9111/1	000.721.911.11	
3	Support plate	9111/2	000.721.911.12	
	Crow's foot wrench	9501	000.721.950.10	36 mm A/F

Removing and installing the engine

The engine/transmission assembly is removed complete from below.

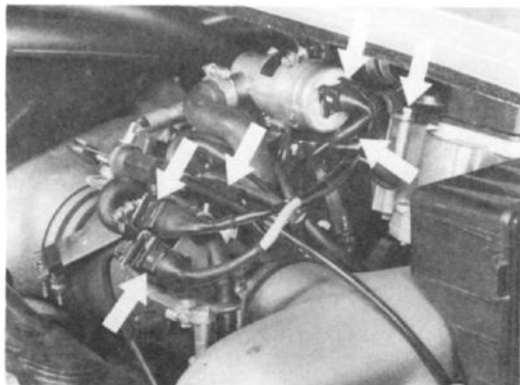
Removing

1. Raise the vehicle at the jacking points.

Note:

Adjust the right-hand rear jacking point in such a way that the transmission guard can be removed later.

2. Disconnect the battery ground cable.
3. Disconnect the plug for the differential lock control/pump assembly (in the area of the luggage compartment lock panel).
4. Disconnect the plugs (5) from the intake distributor and remove the cable clip from the air-flow sensor.



88/502

5. Remove the hot-air blower

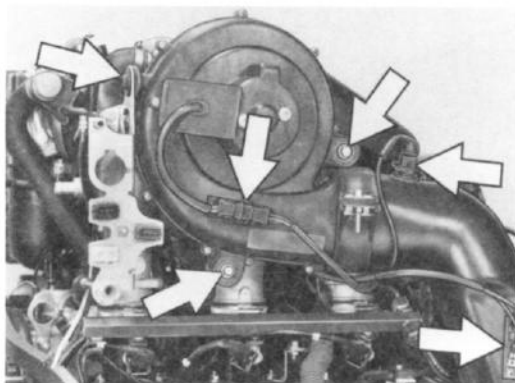
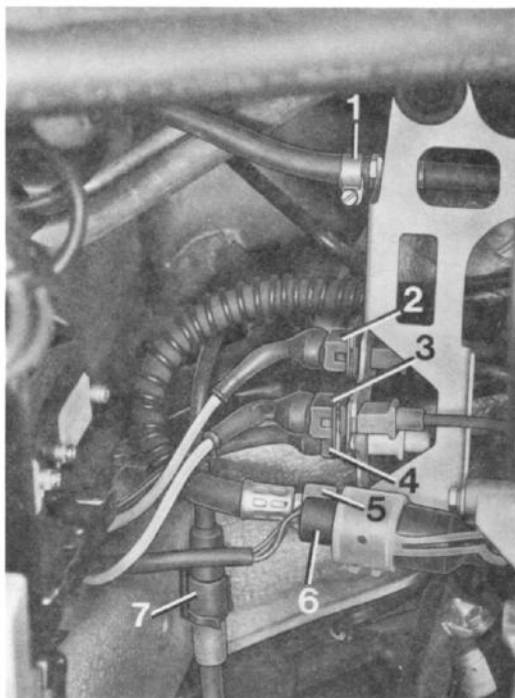


Illustration shows engine removed

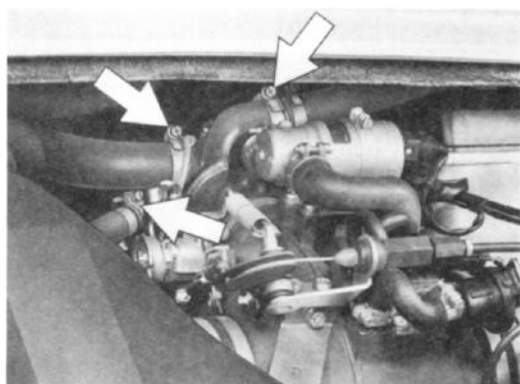
88/288

6. Disconnect the following plug connections / lines on the left-hand side of the engine department



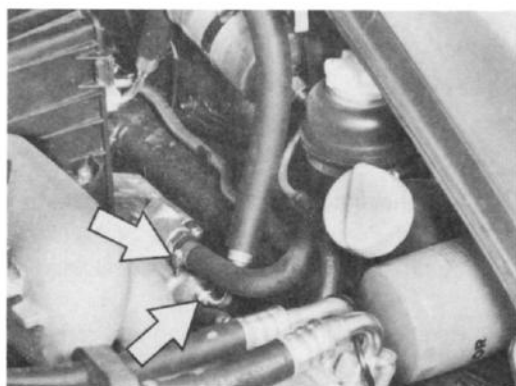
88-500

- 1 - To the carbon canister
 - 2 - To the reference mark sensor
 - 3 - To the knock sensor
 - 4 - To temperature sensor II (cylinder 3)
 - 5 - Fuel return line*
 - 6 - Plug connection - cruise control
 - 7 - Plug connection - Lambda probe
- * To prevent fuel running out if the fuel tank is full, join the disconnected line to Special Tool 9507 connection line, order No. 000 721 950 70 and pinch the connection line with a standard hose clamp.
- 7. Remove the cover from the engine electrics board. Pull off both multiple connectors.
 - 8. Pull off both ignition cables 4 and the plugs from the dual ignition distributor.
 - 9. Pull off the plug from the pulley control unit.
 - 10. Disconnect the vent line.



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- 11. For vehicles with air-conditioner, disassemble the compressor from the console and, with lines still connected, laid it on the adequately protected left-hand rear fender.
- 12. Remove the air filter cover with filter insert.
- 13. Disconnect the fuel supply line to the fuel filter, while bracing. Catch the escaping fuel.
- 14. Empty the reservoir for the power steering pump. Draw-off fluid.
 - a. Undo the hose clip and pull off the upper line, catch any oil.
 - b. Release the lower line and remove with bracket, catch any oil.



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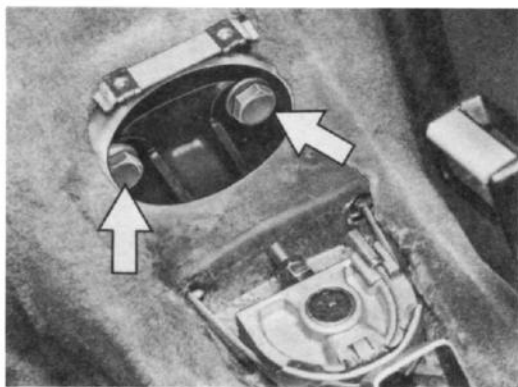
- 15. Remove the rear wheel.

16. Undo the upper fastening screw for the central pipe - transmission; for this, remove the rear tray from the transmission tunnel console. Remove the layer of PVC and take off the cover.

Note

The cover can also be pushed out from below.

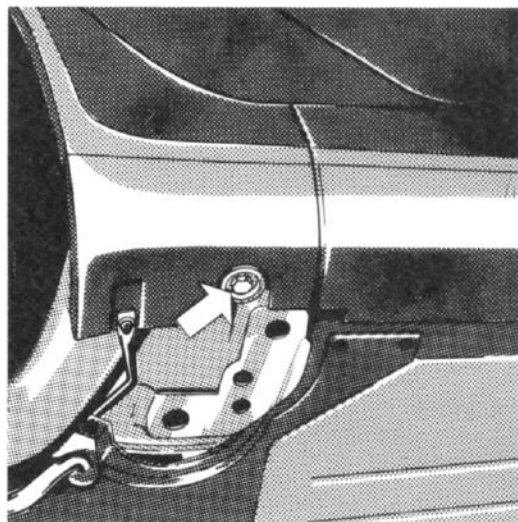
Illustration shows section without console.



88/511

Note

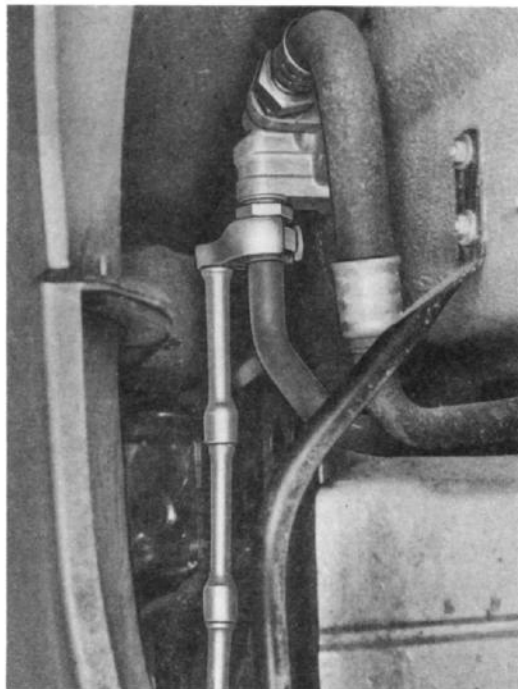
If an engine is being overhauled, also drain the engine oil from the crankcase.



122-03

17. Disconnect the throttle operating cable from the reverse-transfer lever of the foot controls, and remove the spherical head.
18. Remove engine, transmission and central pipe guard.
19. Drain engine oil from the thermostat housing.

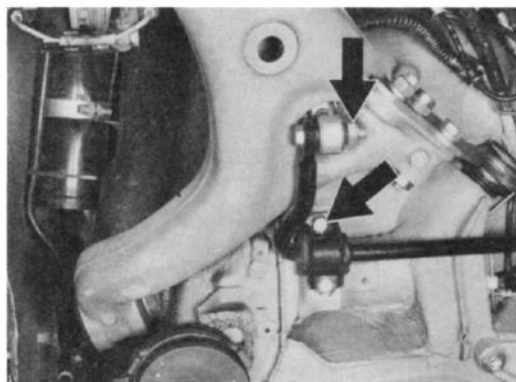
20. Undo the oil line in the rear right-hand wheel house with Special Tool 9501, bracing under all circumstances. Remove the retaining clip for the line from the wheel house. Block the line.



88/501

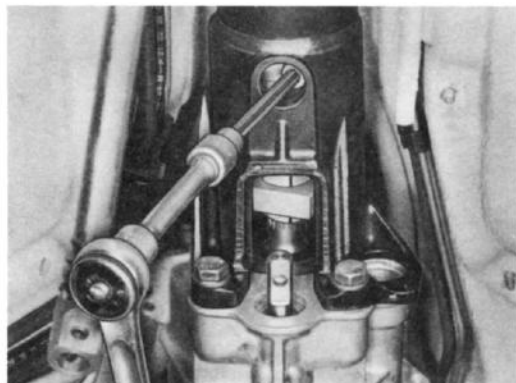
21. Disconnect the drive shaft at the flange from the differential. Left-hand side: remove the profiled sheet beforehand.
22. Detach the heater lines from the heat exchanger.
23. Disconnect the ground strap between body and starter from the lower starter fastening point.
24. Disconnect cable terminal 30 from the starter.
25. Detach the clutch slave cylinder and, with line still attached, lay aside.

26. Remove stabilizer.



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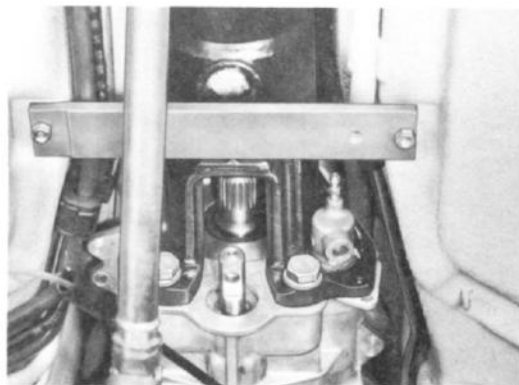
27. Pull the rubber sleeve forwards over the shift rod coupling and undo the body-fit screw.
28. Undo both Allen screws for the clamping sleeve and slide the sleeve forwards along the central shaft.



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29. Pull the throttle operating cable out of the guide tube in the floor group.

30. Mount a self-made flat steel tool. (To support the central tube when disconnecting the flange).



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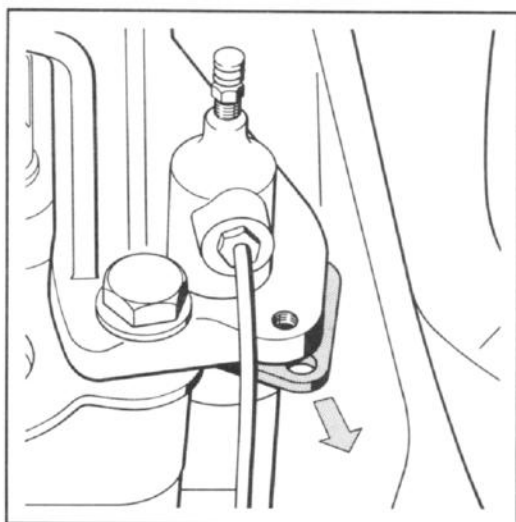
Sketch of the self-made tool



156-10

31. Undo the fastening nuts from the slave cylinder for the wheel-to-wheel differential lock. Do not undo the line.

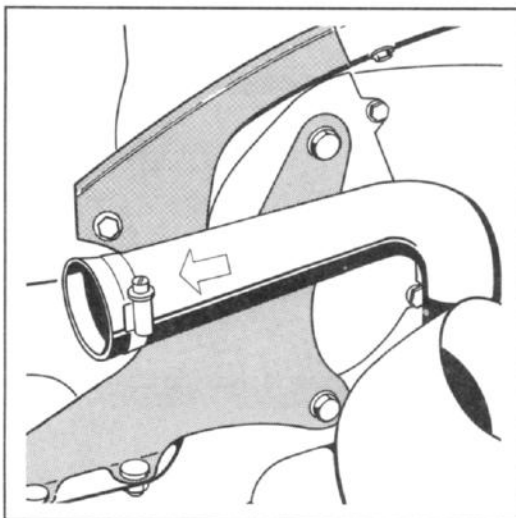
32. Undo the Allen screw from the slave cylinder for the interaxle differential lock and pull out the lock. Do not undo the line.



148-10

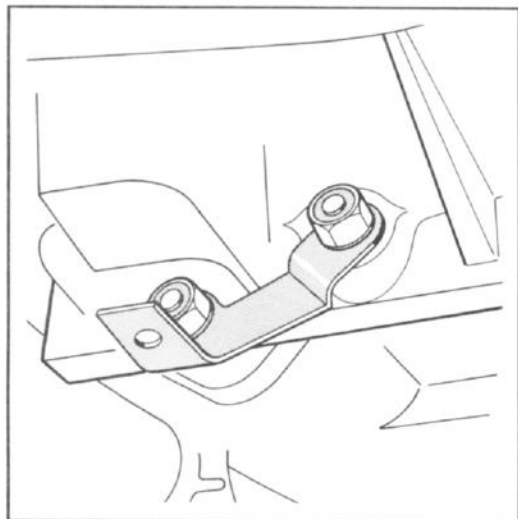
33. Unclip the connecting line at the transmission and suspend both cylinders on one side with the lines still connected.

34. Undo the oil hose from the oil line in the rear right-hand wheel house and block the oil line.



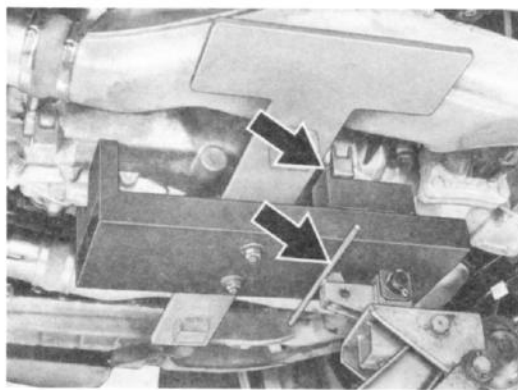
146/03

35. Undo the bracket for the engine guard, remove it and retighten the hexagon nuts or hexagon screws. (Contact surface for the engine mounting plate)



147-10

36. Position the jack with engine mounting plate under the vehicle with a certain amount of preload. Make sure that the adapter is in the right position. (Engine/transmission horizontal)

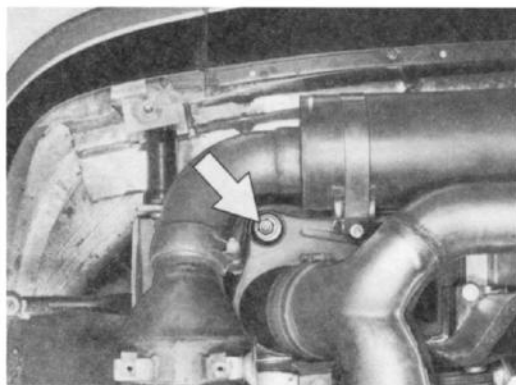


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37. Undo the lower fastening screws from the central transmission pipe flange.

38. Undo the transmission cross members (6 screws).

39. Remove the cap from the engine mount assembly hole in the rear engine cover panel and undo the hexagon nuts from the engine bearings from below.



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40. Lower the engine/transmission assembly until the central tube makes contact with the self-made flat steel tool. Pull off the multiple connector from the air-flow sensor.

41. Pull the engine/transmission assembly slightly to the rear and lower carefully.

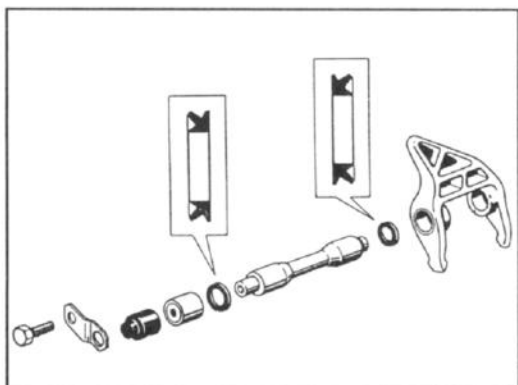
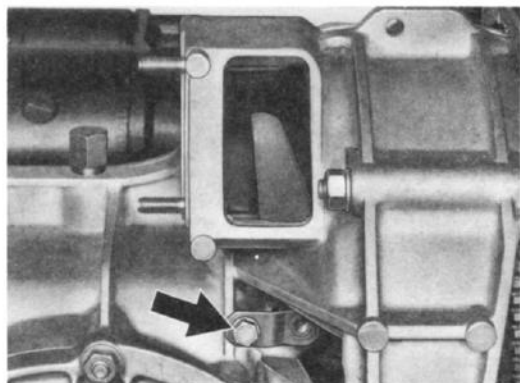
Note:

Pay attention to the drive shafts and slave cylinder.

Engine/transmission assembly, separating and joining

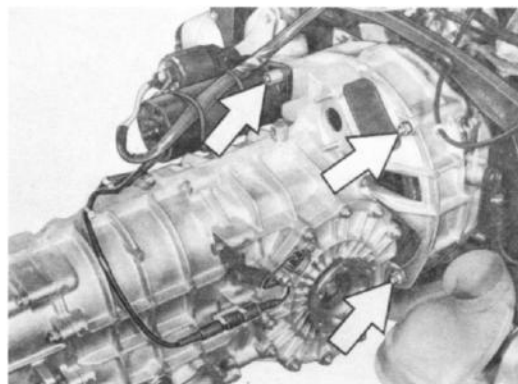
Separating:

1. Disconnect the cable from the starter and the cable from the switch for the backup lamp.
2. Undo the hexagon head screw. Remove the bracket and cap. Pull out the clutch release shaft with hexagon head screw M 6 x 40.



30-1

3. Undo 4 fastening nuts and separate the transmission from the engine. Undo the upper fastening nut on the starter with Special Tool P119.



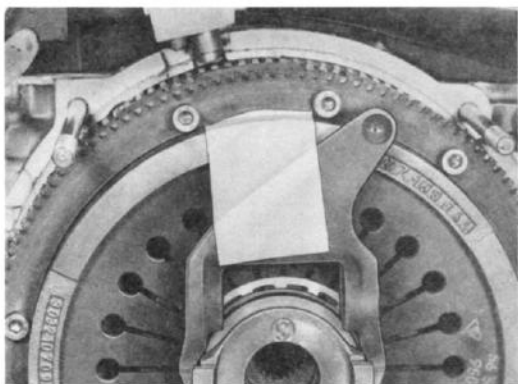
88-513

Joining

Note:

Lubricate all sliding surfaces of the clutch release mechanism and the gear teeth of the drive shaft with Olista Longtime 3 EP.

1. Guide the clutch release fork in the release bearing and fix in the installation position provisionally with suitable adhesive tape.



2. Flange-mount the transmission to the engine.
3. Guide the clutch release shaft with sealing rings into the release fork.
4. Remove the adhesive tape through the assembly hole.
5. Install needle bearing, cap and bracket and secure with fastening screw (M 6 x 16).

Note:

Pack the cap with grease. Also refer to notes on installation in Volume 3, Group 30, Page 30 - 1.

Installing

The following points must be observed during installation.

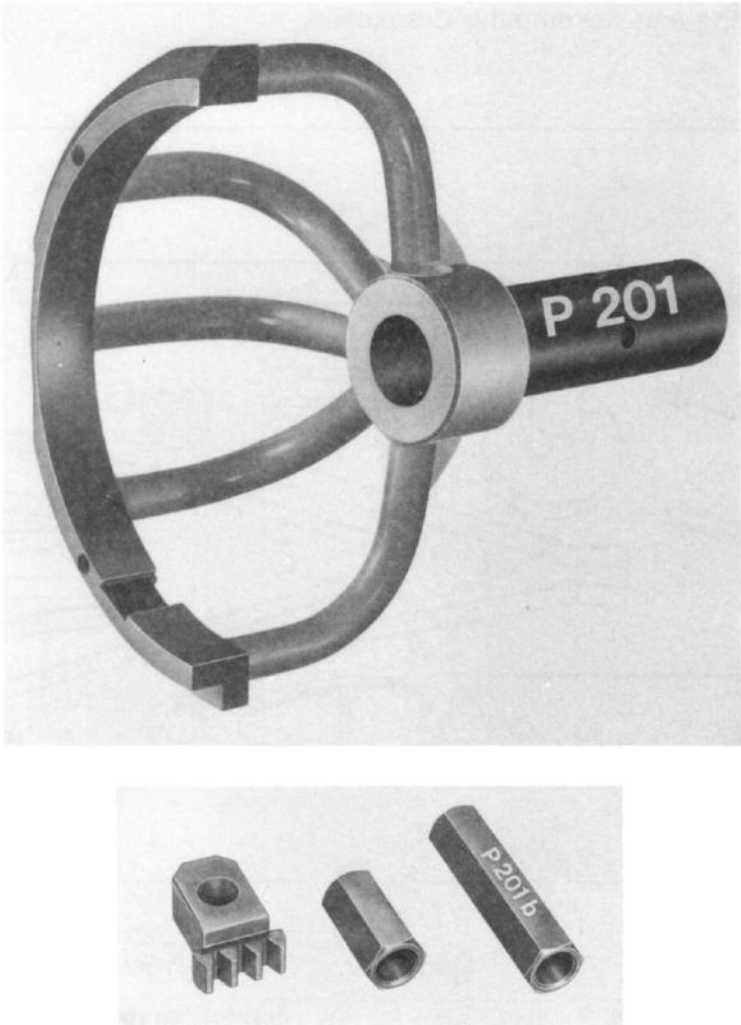
1. Do not pinch the heating lines, slide on to the heat exchanger shortly before the engine/transmission assembly has reached the correct installation position.
2. Make sure that the inner rubber seal of the connector is seated correctly.

Tightening torques: removing and installing the engine/transmission assembly

Location	Thread	Tightening torque Nm (ftlb)
Engine mount to engine bearing	M 12	85 (62)
Transmission mount to body	M 12	46 (34)
Central tube to transmission	M 12	85 (52)
Twin clamping sleeve to the central shaft		75 (65)
Shift rod (body-fit screw)		23 (17)
Drive shaft to transmission flange		42 (31)
Stabilizer to stabilizer mount	M 10	46 (34)
Oil drain plug in thermostat housing		60 (44)
Oil drain plug in crankcase		70 (51)
Oil line to oil filter housing		80 (59)

Disassembling and Assembling Crankcase

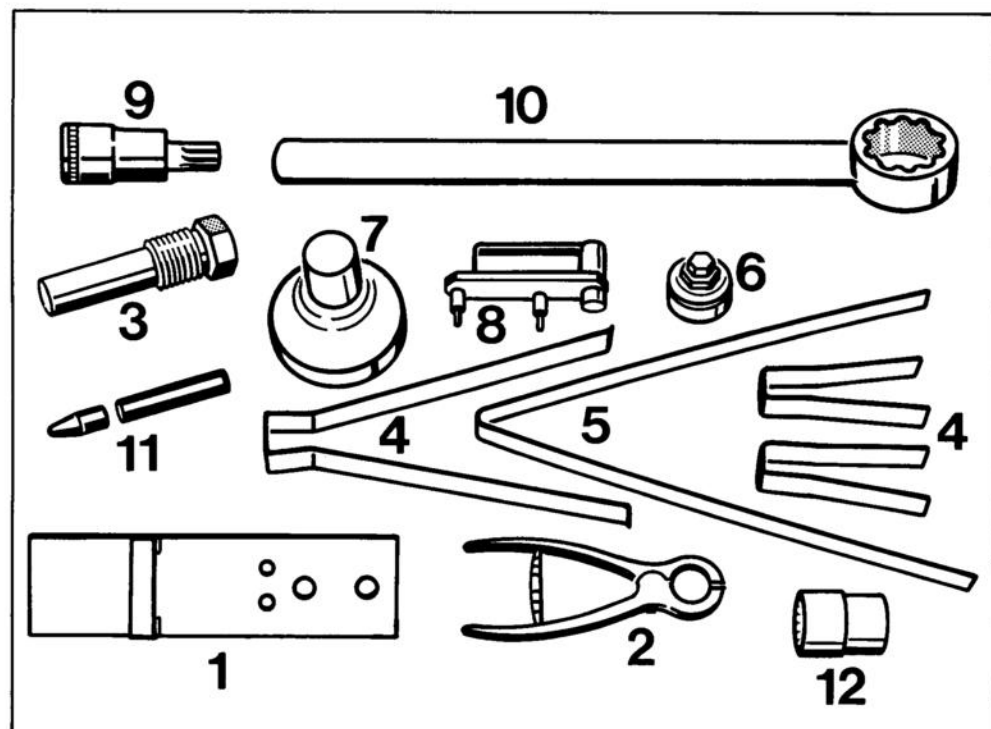
Engine Holder



No.	Description	Special Tool	Order Number	Remarks
1	Engine holder	P 201	000.721.201.00	Old version with three or four arms should no longer be used in the interest of safety. Mount engine holder on right crankcase section (cyl. 4 ... 6). Use spacers.
2	Toothed element and mounting parts	P 201 b	000.721.201.20	

Disassembling and Assembling Crankcase

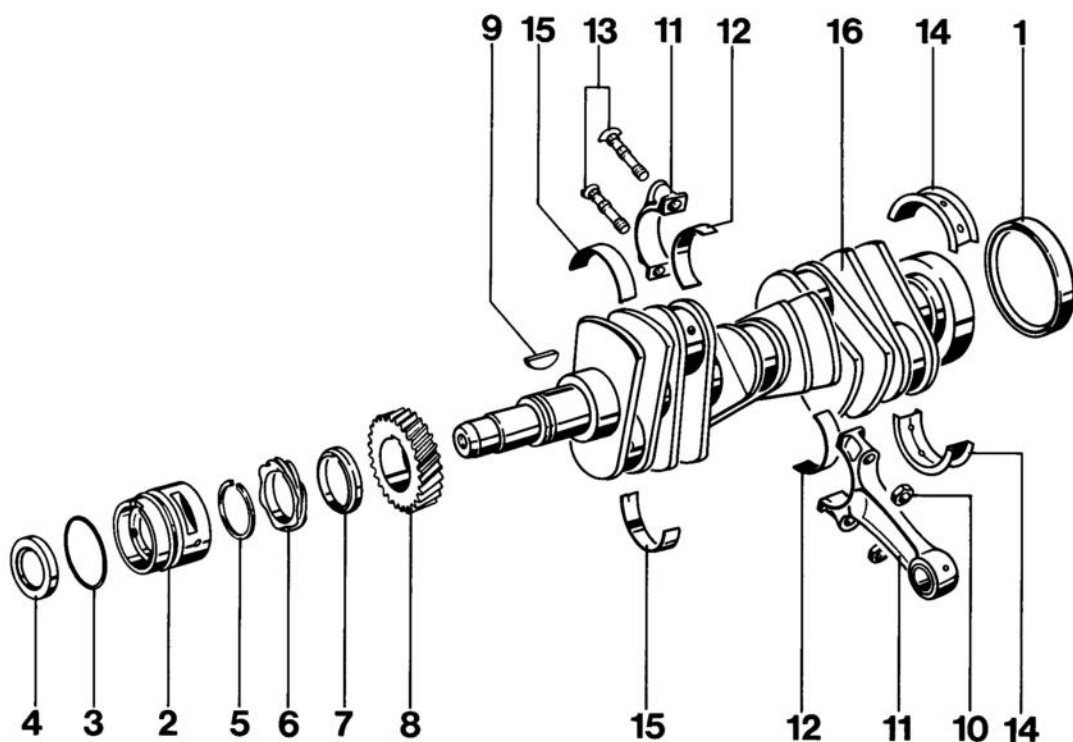
Tools



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No.	Description	Special Tool	Order Number	Remarks
1	Holding plate	209 a	000.721.209.10	Bolt crankshaft on holding plate with multiple-tooth socket bolts, Part No. 928 102 152 01.
2	Circlip pliers			Standard
3	Extracting bolt	9285/1	000.721.928.51	
4	Straps (conrods)	P 221	000.721.221.00	
5	Strap (timing chain)	P 222	000.721.220.00	

No.	Description	Special Tool	Order Number	Remarks
6	Pulling tool for seal (pulley end)	P 216 a	000.721.216.10	
7	Pressing tool for seal (flywheel end)	9126	000.721.912.60	
8	Installing tool for flywheel	P 238 b	000.721.238.20	
9	Multiple-tooth screwdriver socket		standard	
10	Holder for pulley	9290	000.721.929.00	
11	Installing sleeves for studs	9511	000.721.951.10	
12	M 14 wrench socket for studs		Snap-on Order No. FM 14 (2 required)	

Disassembling and Assembling Crankshaft

329/13

No.	Description	Qty.	Note When:	
			Removing	Installing
1	Radial oil seal	1		Replace
2	Sleeve for bearing no. 8	1		Lubricate with oil
3	Round seal	1		Replace
4	Radial oil seal	1		Replace
5	Circlip	1		
6	Drive gear for distributor	1		
7	Intermediate ring	1		Check installed position
8	Timing gear	1		Matched with intermediate shaft, only install together
9	Woodruff key	1		
10	Conrod nut M 9 x 1.25	12		Replace. Tightening torque: Initial: 15 Nm (11 ft. lbs.) Final: $2 \times 90^\circ \pm 2^\circ$ torque angle, threads and bearing surfaces lubricated lightly with oil
11	Connecting rod	6		Check installed position and weight
12	Conrod bearing shell	12	Inspect for wear	Lubricate with oil
13	Conrod bolts	12		Always replace
14	Thrust main bearing shells no. 1	2	Inspect for wear	Lubricate with oil
15	Main bearing shells no. 2-7	12		Lubricate with oil
16	Crankshaft	1	Inspect for wear	

Crankshaft - Standard and Repair Dimensions

Sizes	Main bearing dia. d 1	Big end bearing dia. d 2	Main bearing. dia. d 3 (bearing 8)	
Standard	59.971...59.990	54.971...54.990	30.980...30.993	
- 0.25	59.721...59.740	54.721...54.740	30.730...30.743	
- 0.50	59.471...59.490	54.471...54.490	30.480...30.493	
Sizes	Flange dia. d 4	Timing gear fit dia. d 5	Support dia. d 6	Guide bearing with A
Standard	89.780...90.000	42.002...42.013	29.960...29.993	28.000...28.060
Wear dia.	89.580		29.670	
	Crankcase dia. Bearing 1...8			
	Standard 65.000...65.019			
	Oversize 65.250...65.269			

Grind bearing surface for oil seals to dimensions 29.670 and 89.580 only if score marks are too deep.

In other cases, repolish if required, $R_t = 3$.

Oil bores are rounded to $R 0.5$ after grinding.

Remove sharp edges with $R = 0.2$ to 0.5 .

Max. permissible radial runout relative to support in---max. 0.04.

Surface treatment requirements: Gas carbonitrided PN 2063.

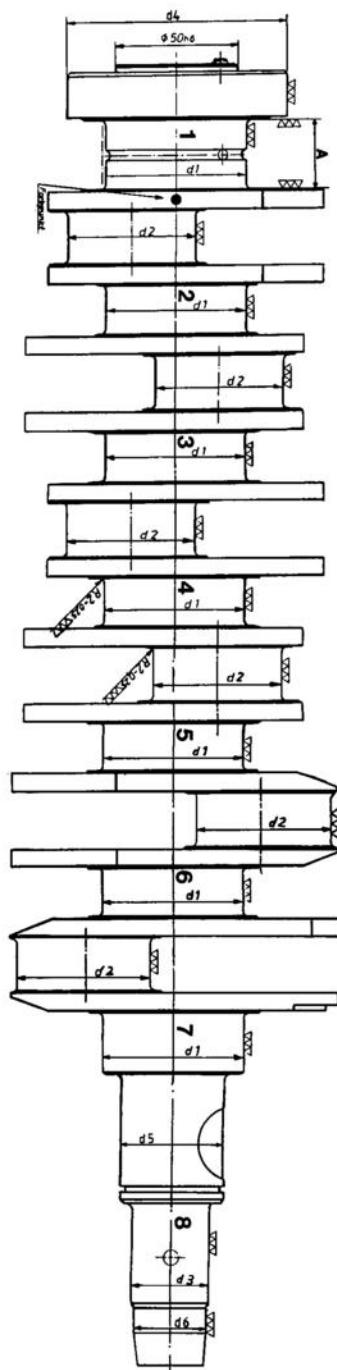
Do not straighten main bearings 3 and 5 after nitriding treatment.

Straightening the other main bearing journals by levering at the radii is permissible.

Bearing surfaces of main and big end bearing journals are polished after nitriding treatment.

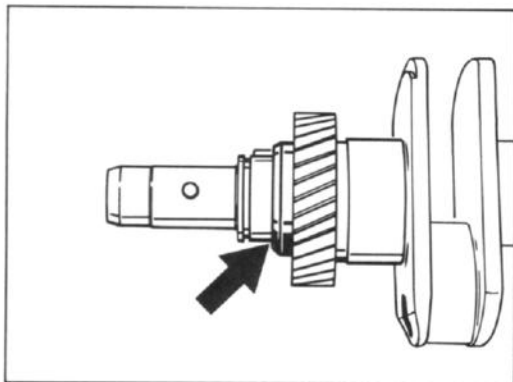
Color coding of repair stages:

1st repair stage	blue color dot
2nd repair stage	green color dot



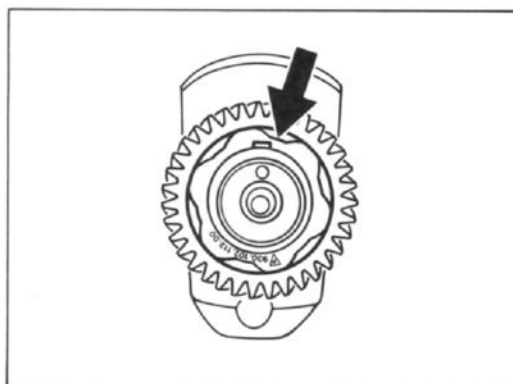
1008-30

4. Heat up the intermediate ring and push on up to the stop. The chamfer points to bearing 8.

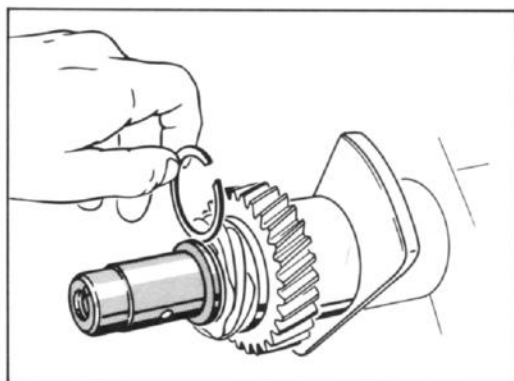


448-13

5. Heat up the ignition distributor drive wheel to approx. 100°C and push on up to the stop. The Porsche trademark and part number point to bearing 8.



449-13



450-13

The following circlips are available:

Part number	Thickness mm	Identification
901.102.148.00	2.4	bright
901.102.148.01	2.3	blue-tempered*
901.102.148.02	2.2	yellow/brown-tempered
901.102.148.03	2.1	black-finished

* circlip used most for initial assembly

6. Select the appropriate circlip by an insertion test. The circlip must be installed so that it is free of play.

Connecting Rod Weight Groups

Connecting rods are divided into different weight groups.

Pertinent weight groups are indicated by the final digit of the part number.

This final digit is inscribed in the shank of connecting rods which are supplied for replacements.

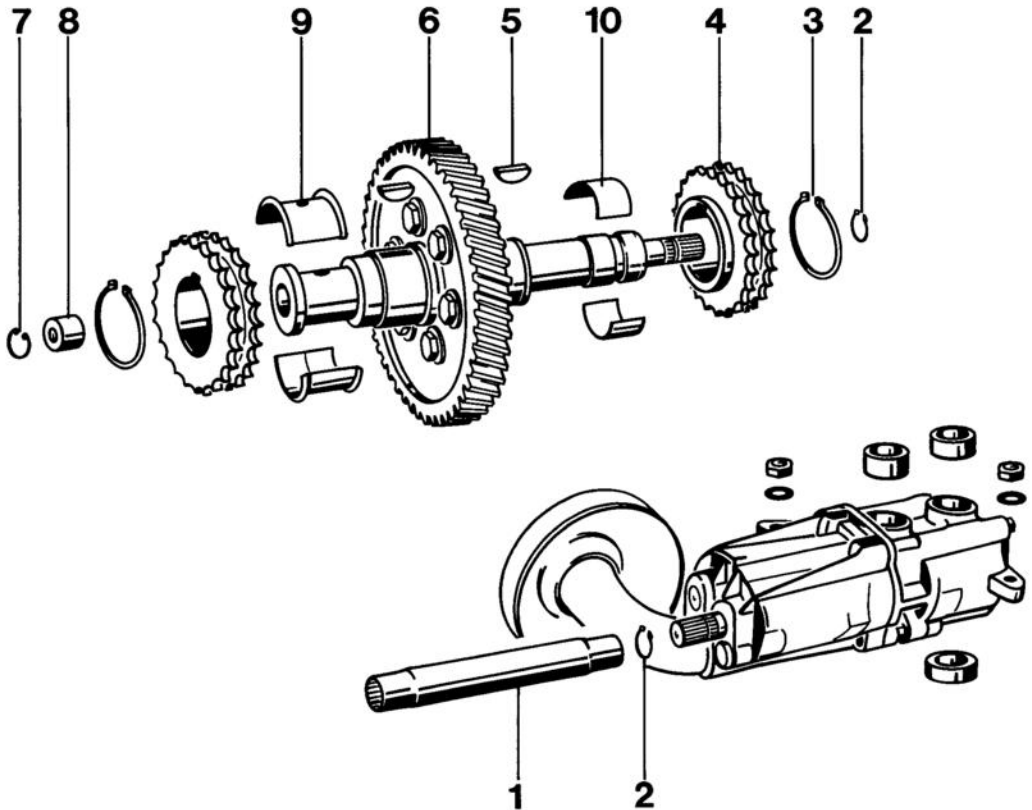
Weight above g	to g	Weight Group for Service	Service Conrod Part Number	Connecting Rod Code
615	624	3	964.103.020.53	53
624	633	4	964.103.020.54	54
633	642	5	964.103.020.55	55
642	651	6	964.103.020.56	56
651	660	7	964.103.020.57	57
660	669	8	964.103.020.58	58
669	678	9	964.103.020.59	59
678	687	10	964.103.020.60	60
687	696	11	964.103.020.61	61

Note

Only connecting rods, the difference in weight of which does not exceed 9 grams, may be installed in one engine. Weigh a complete connecting rod, but without bearing shells, to determine a weight group.

Connecting rod codes for Service parts are inscribed electrically.

Dismantling and assembling intermediate shaft



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