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Motor und Kupplung
Engine and Clutch
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PORSCHE

Workshop-Manual

914
914/6

DR.-ING. h. c. F. PORSCHE KG STUTTGART-ZUFFENHAUSEN

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This publication contains the essential removal, installation and adjustment procedures for the Porsche 914-914/6 vehicles sold in the USA and Canada.

Components and procedures described in this manual are identical for both types unless differences are pointed out in the text.

It is assumed that the reader is familiar with basic automotive repair procedures. Special tools required in performing certain service operations are identified in the manual and recommended for usw. Use of tools or procedures other than those recommended in this repair manual may be detrimental to the vehicle's safe operation as well as the safety of the person servicing the vehicle.

The Porsche 914 - 914/6 Workshop Manual is divided into 8 volumes. The volumes are subdivided into 10 Main Groups as follows:

1st Volume	Engine and Clutch - 914	Main Group No. 1
2nd Volume	Fuel System - 914	Main Group No. 2
3rd Volume	Engine and Clutch - 914/6	Main Group No. 1
	Fuel System - 914/6	Main Group No. 2
4th Volume	Transmission	Main Group No. 3
5th Volume	Front Axle	Main Group No. 4
	Rear Axle	Main Group No. 5
6th Volume	Brakes, Wheels, Tires	Main Group No. 6
	Pedal System and Levers	Main Group No. 7
	Maintenance, Specifications	Main Group No. 0
7th Volume	Body	Main Group No. 8
8th Volume	Electrical System	Main Group No. 9

The binders have a transparent plastic pocket on the spine into which the appropriate volume title can be inserted.

To find the individual repair operations, each main group is subdivided into "Chapters" and "Sections". Every main group is provided with a very detailed table of contents. Refer to example on next page.

The repair operations described in this Workshop Manual are based on the Type 914 vehicle. Repair operations which apply to Type 914/6 vehicles are described separately. The type vehicle to which the repair operation applies is given on the top left or right of the page.

When certain repair operations are similar for both type vehicles, the procedures are described together and the minor differences for the 914/6 emphasized by notes and remarks.

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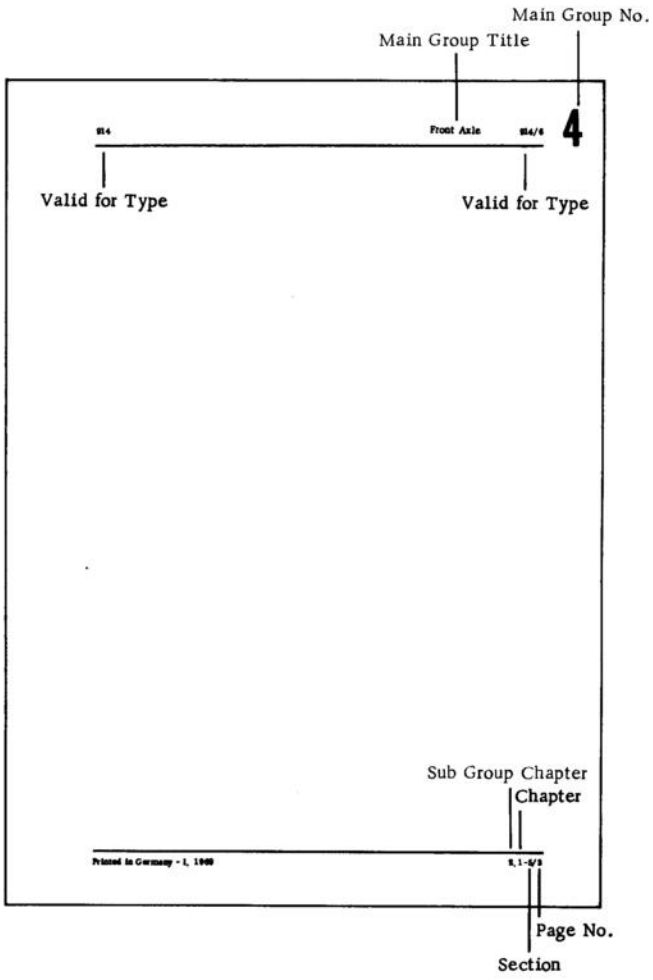

Technical Information

The "Technical Information" pages which are published from time to time should be filed in chronological order at the beginning of the respective Main Groups of the Workshop Manuals.

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The engine installed in the VW-Porsche 914 is an air-cooled four-cylinder, four-cycle flat four engine with electronically controlled gasoline injection, horizontally opposed cylinders and overhead valves. Attachment to the gearbox is by means of four screws. The power unit, that is, the gearbox and the engine - is attached at the front to the body side members by means of an engine support screwed to the crankcase and at the rear to a cross member by means of rubber-metal antivibration mounts.

Ignition System

The ignition system is a battery system with one ignition coil and one ignition distributor for automatic firing point control under the influence of centrifugal forces and a vacuum. The ignition system transforms the battery voltage from 12 Volts to the required ignition voltage and the ignition distributor feeds that voltage to each of the four spark plugs in the correct sequence and in the accurate firing order. The distributor is driven by the crankshaft via a worm gear and a distributor shaft.

Cooling

Cooling is by means of a radial blower. The impeller of the cooling blower is attached to the crankshaft hub by means of three screws. The blower sucks the air through the opening in the cooling blower housing, forcing it across the heavily ribbed cylinders and cylinder heads. The air flows through guide plates surrounding the cylinder heads and cylinders. Some of the fresh cooling air is used for the heating system and is heated on the exhaust pipes via heat exchangers.

A thermostat under cylinders 1 and 2 actuates two flaps in the inlet ducts of the front halves of the cooling blower housing via cable controls. The flaps control the cooling air volume, so that the cold engine will heat up faster and the operating temperature will remain as uniformly as possible under all loads. The air volume for the heating system is not influenced by these controls.

Oil Circuit

Lubrication is by means of forced circulation including a special oil cooling system.

The geared oil pump is at the input end of the camshaft and is driven by the latter. The oil is taken from the lowest point of the crankcase and forced into the oil ducts via the horizontal oil cooler. One portion of the oil is forced through the crankshaft bearings into the hollow crankshaft to lubricate the conrod bearings, another lubricates the camshaft bearings, a third will flow through the hollow push rods to the rocker arms to lubricate the rocker arm bearings and the valve stems. The cylinder walls, pistons and piston pins are lubricated by splash lubrication.

Impurities are held back by an oil filter in the main flow and by a strainer at the lowest point of the crankcase. When the oil filter is contaminated, a ball valve in the oil filter flange will open and will guide the oil flow directly to the bearing points.

The oil cooler is flanged laterally to the crankcase and is cooled by the air sucked up by the blower. It is installed in the oil line un such a manner that the oil delivered by the pump is forced to flow through the cooler prior to reaching the individual lube points. As a result of the cooling, the oil will keep its full lubricating properties even at high outside temperatures and under max. loads of the engine.

When the oil is cold and therefore more sluggish, a relief valve will cause the oil to flow directly into the oil ducts, partially by-passing the oil cooler. An oil pressure control valve at the end of the circuit will keep the oil pressure in the range of the crankshaft and camshaft bearings to approx. 2.0 kg/cm^2 (24.5 psi).

An automatic switch for the oil pressure pilot lamp is installed in the pressure line between the oil pump and the oil cooler and will open an electric contact at a pressure between 0.15-0.45 kg/cm^2 (2.13-6.4 psi) to break the current for the pilot lamp.

When the ignition is switched on and when the oil pressure is too low, the lamp will light up.

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Cylinder Head

Two cylinders each carry a common, removable and heavily ribbed light metal cylinder head with shrunk-fit valve seat rings and valve guides. The valves are suspended overhead. The exhaust valves are clad with particularly high-grade chrome nickel steel.

Timing System

The camshaft is mounted in the crankcase at three points in split steel bearings with babbitt metal running surface and is driven by the crankshaft via helical spur gears. Bearing 3 absorbs the axial thrust of the camshaft. The camshaft gear wheel is made of light metal alloy and is riveted to the camshaft. The valves are timed by cams via tappets, push rods and rocker arms. Each cam is alternately actuating one valve each of two opposed cylinders.

Cylinders

The four cylinders are special castings and of uniform design, permitting individual replacement together with the pertinent piston. The cooling air flows past cooling ribs for the required heat exchange.

Pistons

The light metal pistons with steel inserts carry two compression rings and one oil scraper ring. A hose spring is fitted between the oil scraper ring and the piston. The piston pins are floatingly mounted in the connecting rod eye and are laterally secured in the piston by means of locking rings.

Crankcase

The split crankcase is a light metal alloy die casting. Both halves are machined together and may also be replaced together only.

Crankshaft

The crankshaft is a symmetrical forging, all bearing points are induction-hardened. The shaft is supported in the crankcase in four bearings. Bearings 1, 3 and 4 are aluminum bushings with lead-coated running surface. Bearing 2 - seen from clutch end - is a split three-component bearing. Bearing 1 simultaneously absorbs the axial thrust of the crankshaft. The flywheel with toothing for the starter is held by five screws and secured against distortion. The drive gears for the camshaft and the ignition distributor are secured by a spring washer. The hub for the cooling blower gear wheel rests on a cone and is attached by means of a spring washer and a hexagon screw. The crankshaft is sealed at the flywheel and blower gear end by means of lip sealing rings.

Connecting Rods

The four connecting rods are steel forgings with I-shaped conrod shank. They are mounted on the crankshaft in replacable three-component bearings and are provided with steel bushings with lead bronze running surface for the piston pins.

Clutch

The single plate dry clutch between the engine and the main gearbox is fitted to the flywheel. The clutch disk is lined on two sides and slides on the splined input shaft of the transmission in axial direction. The clutch cover, the clutch pressure plate and the diaphragm spring are concentrically screwed to the flywheel. In engaged condition, the clutch disk is pressed by the clutch pressure plate against the clutch facing of the flywheel by the spring force of the diaphragm spring. The power connection between the engine and the transmission is thereby established.

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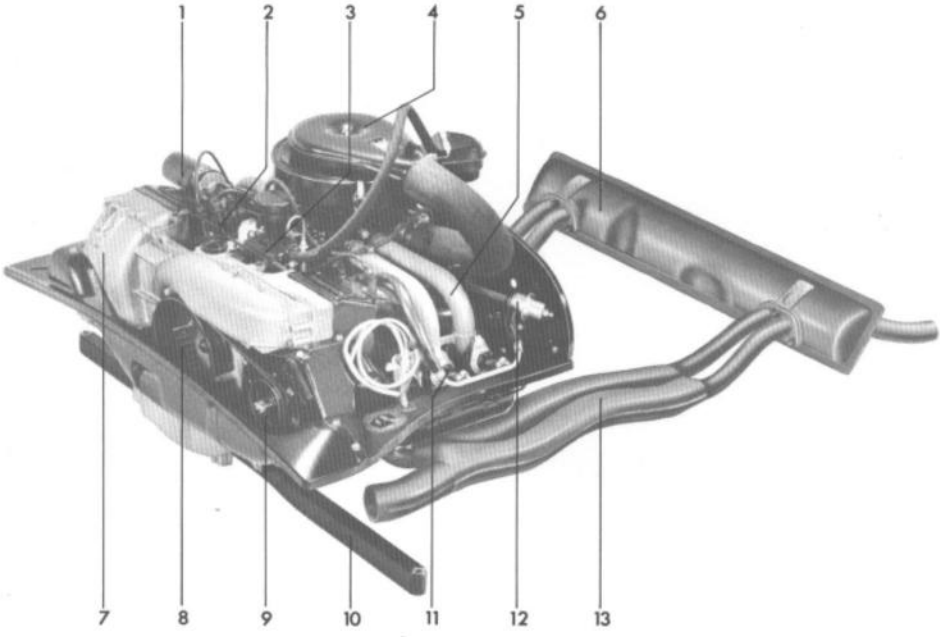

1 - Ignition coil
2 - Ignition distributor
3 - Oil breather
4 - Oil bath air filter
5 - Intake pipe
6 - Exhaust nozzle
7 - Cooling blower housing
8 - Cooling blower impeller
9 - Alternator
10 - Engine mount
11 - Injection valve
12 - Pressure regulator
13 - Heat exchanger

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CRANKCASE VENTILATION (from 1972 model)

Crankcase ventilation has been considerably improved in the engine by ducting fresh air from the air filter. This modification reduces crankcase condensation and icing at low outside temperatures.

DESCRIPTION

Fresh air is ducted from the air filter (white arrows) to the cylinder head valve covers and then through the pushrod tubes to the crankcase where it combines with the crankcase fumes (black arrows). This mixture is then drawn into the induction system and burned in the cylinders.

The flow of fresh air is regulated by a vacuum-controlled valve located between the crankcase breather and intake manifold. The valve operates on manifold vacuum which, in turn, varies with throttle position and engine speed.

A flame trap, located behind the air cleaner, prevents flashback into the crankcase.

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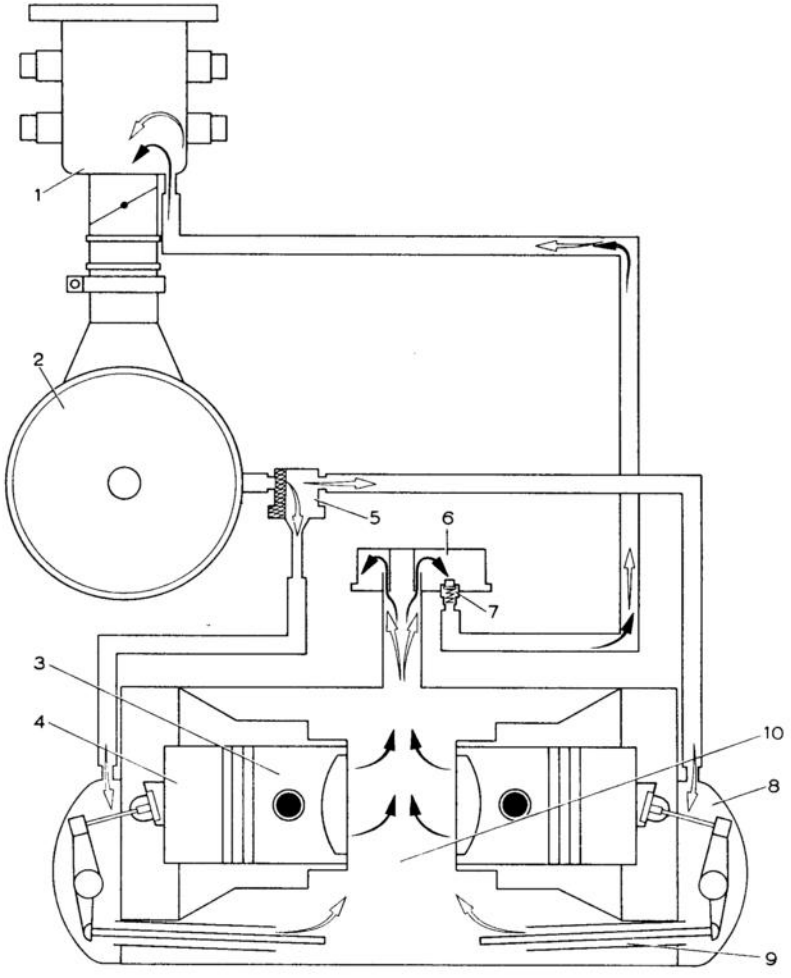

1 - Intake air distributor manifold
2 - Air cleaner
3 - Piston
4 - Combustion chamber
5 - Flame trap
6 - Oil breather
7 - Control valve
8 - Valve cover
9 - Pushrod tube
10 - Crankcase

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ENGINE CHANGES BEGINNING WITH 1974 MODELS

Beginning with 1974 models, the 1.7 liter engines have been replaced with 1.8 liter engines.

The 1.8 liter engines differ from the 1.7 liter engines in the following component areas:

1 - Cylinder heads	modified ports and combustion chambers
2 - Valves	larger diameter
3 - Valve adjusting screws and rocker arms	larger diameter
4 - Pistons and cylinders	larger diameter
5 - Ignition system	modified spark advance and ignition timing
6 - Clutch	higher clutch plate pressure
7 - Exhaust muffler	changed tail pipe location
8 - Piston pins	changed wall thickness

Detailed information may be found in the respective sections of the workshop manual. Modifications for the 1.8 liter engines are always listed after the information pertaining to the 1.7 liter engines.

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Distributor - 1975 Models

AFC Fuel Injected Engine

The distributor centrifugal spark advance vacuum retard curves are identical to the 1975 specifications (vacuum spark advance is not used).

Engine speed is controlled by the distributor rotor with a built-in speed switch (except California). California vehicles have a separate speed switch that limits the fuel supply.

Distributor rotor without speed limiter

Distributor rotor with speed limiter

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TABLE OF ENGINES

Model Year	Code	Displ. cm^3	Output DIN HP at rpm (SAE net)	Stroke/Bore mm	Compression Ratio	Fuel System	Version
1970	W	1679	80/4900 (76)	66/90	8.2 : 1	MPC	USA
1971	W	1679	80/4900 (76)	66/90	8.2 : 1	MPC	USA
1972	EA	1679	80/4900 (76)	66/90	8.2 : 1	MPC	USA
1973	EA	1679	80/4900 (76)	66/90	8.2 : 1	MPC	USA
	EB	1679	72/5000 (69)	66/90	7.3 : 1	MPC	California
	GA	1971	95/4900 (91)	71/94	7.6 : 1	MPC	USA
1974	EC	1795	76/4800 (72,5)	66/93	7.3 : 1	AFC	USA
	GA	1971	95/4900 (91)	71/94	7.6 : 1	MPC	USA
1975	EC-a	1795	76/4800 (72,5)	66/93	7.3 : 1	AFC	USA
	EC-b	1795	76/4800 (72,5)	66/93	7.3 : 1	AFC	California
	GC-a	1971	88/4900 (84)	71/94	7.6 : 1	MPC	USA
	GC-b	1971	88/4900 (84)	71/94	7.6 : 1	MPC	California

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(Differing specifications for 1.8-liter engines beginning with 1974 are shown in parentheses)

TECHNICAL DATA

Type	aircooled 4-stroke gasoline injection engine, with transmission and differential integrated into a single rear-mounted unit.
Code letter	W, EA, EB, (EC: 76 HP)
Number of cylinders	4
Cylinder arrangement	2 cylinders each opposed, flat flour
Bore	90 mm (3.543") dia (93 mm 3,66")
Stroke	66 mm (2.598")
Total piston displacement	1679 cc (102.5 cu.in.) (1795 cc 109,53 cu.in.)
Compression ratio	8.2 EB: 7.3 (EC: 7.3)
Max. horsepower (DIN)	80 HP at 4900 rpm (EC: 76/4800) EB: 72/5000
(SAE)	85 HP at 5000 rpm
Max. torque (DIN)	13.50 mkg (97.65 ft.lb.) at 2700 rpm (EC: 13/3400) EB: 12.4/2700
(SAE)	13,75 mkg (99,45 ft.lb.) at 3500 rpm
Mean piston speed	10.8 m/s (35.4 ft/sec) at 4900 rpm
Octane rating required	98 RON (Research Method) EB: 91 RON (EC: 91 RON)
Total weight, dry	approx. 126 kg (278 lbs.)
Ignition	battery ignition
	27° BTC at 3500 rpm with vacuum hoses detached
	(7,5° BTC at 800-900 rpm with vacuum hoses detached)
Firing order	1-4-3-2
Spark advance type	centrifugal and vacuum
Dwell angle	44° - 50°
Spark plugs	14 mm (long thread), heat range 175
Electrode gap	0.6 mm (0,0236")
Cooling	aircooled by radial blower on crankshaft
Delivery volume	approx. 800 lits/sec (211 US gal) at n (engine) = 4600 rpm
Lubrication	forced feed by gear pump
Oil cooling	oil cooler in blower air stream
Oil filter	in main stream
Oil pressure indic	by pilot lamp
Oil capacity	3.5 lits (0.92 US gal) with oil filter change
	3,0 lits (0.79 US gal) without oil filter change
Oil consumption	0,5-1,0 lits/1,000 km (0.13-0.26 US gal/6,214 miles)
Cylinder Head	one each for 2 cylinders with cast-on cooling ribs, aluminum alloy
Valve seat rings	shrunk-in, sintered steel
Valve guides	shrunk-in, special brass
Spark plug threads	cut into cylinder head
Valve timing	1 camshaft under crankshaft, tappets, push rods and rocker arms guided in housing
Valves	1 inlet and 1 exhaust valve per cylinder
Exhaust valve	with hard-faced seat
Arrangement	overhead
Clearance: Inlet	0.15 mm (0.006") with cold engine
Exhaust	0.15 mm (0.006")
Valve springs	1 spring per valve

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Valve timing with 1 mm (.04") valve clearance:	
Intake opens	12° BTDC
Intake closes	42° ABDC
Exhaust opens	43° BTDC
Exhaust closes	4° ATDC
Cylinders	individual cylinders, special grey iron casting with cooling ribs
Center distance	124.5 mm (4.90")
Pistons	light metal alloy with steel insert
Piston pin	floating, secured by circlips
Piston rings	2 compression rings 1 oil scraper ring
Crankcase	split, with vertical center division by crankshaft and camshaft bearings, aluminum alloy
Camshaft	grey casting, 3 plane bearings
Camshaft bearings	thin-walled steel half shells with babbitt metal running surface
Camshaft drive	spur gears, helical
Crankshaft	forged, fine steel, 4 plane bearings
Main bearings 1, 3 and 4	aluminum sleeves with lead-coated running surface
Main bearing 2 (center bearing)	half shells, three-component bearing
Main bearings 1-3	60 mm dia. (2.36")
Main bearing 4	40 mm dia. (1.87")
Conrod bearing	55 mm dia. (2.17")
Flywheel	forged, with starter ring gear, one-piece
Connecting rods	forged, with I-shaped shank cross section
Conrod bearings	thin-walled half shells, three-component bearings
Piston pin bearings	pressed-in steel bushing with lead-bronze running surface
Clutch	Diaphragm spring clutch
Type	single-plate dry clutch
Total facing area	375 cm^2 (47.3 sq.in.)

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(Differing specifications for 1.8-liter engines beginning with 1974 are shown in parentheses)

TOLERANCES AND WEAR LIMITS

The term of "wear limit" indicates parts which are coming close to or are attaining the indicated value and are not to be reinstalled during an overhaul. When determining the wear limit of pistons and cylinders, the oil consumption of the pertinent engine must be taken into account.

		Upon installation (new)	Wear limit
Cooling			
Thermostat	Opening temp.	65-70°C (149-158°F)	
Impeller/V-belt pulley	Unbalance	max. 5 cmg	
Oil Circuit			
1 - Oil pressure (for SAE 30 grades only) at 70°C (158°F)oil temp.: at 2,500 rpm	Pressure	approx. 3 kg/cm² (43 psi)	2 kg/cm² (28 psi)
2 - Spring f. oil pressure relief valve Lenght under load: 39,0 mm (1.535")	Load	6,8 - 8,8 kg (14.98-19.38 lbs)	
3 - Spring f. oil pressure contr. valve Lenght under load: 16.8 mm (.661")	Load	4.35 kg (9.59 lbs)	
4 - Oil pressure switch opens at	Pressure	0.15-0.45 kg/cm² (2.13-6.40 psi)	
Cylinder Head with Valves			
1 - Depth of cylinder seat in cylinder head		5.4-6.5 mm (.213-.256")	
2 - Combustion chamber capacity		51.1-52.6 cc (52-53.5 cc) (3.12-3.21 cu.in.)	
3 - a) Rocker arm	ID	20.0-20.02 mm (.7874-.7882")dia.	20.04 mm (.7890") dia.
b) Rocker arm shaft	Dia	19.95-19.97 mm (.7854-7862")dia.	19.93 mm (.7846") dia.
4 - Valve spring Lenght under load 30.0 mm (1.18")	Load	72.5-83.5 kg (159.8-184.1 lbs)	
5 - Valve seat a) Inlet	Width	1.8-2.2 mm (.0708-.0866")	
b) Exhaust	Width	2.0-2.5 mm (.0787-.0984")	
c) Inlet	Seat angle	30°	
d) Exhaust	Seat angle	45°	
e) External correction angle		15°	
f) Internal correction angle		75°	
6 - Valve guides Inlet	ID	8.00-8.02 mm dia. (.3150-.3158")	8.06 mm dia. (.3173")
Exhaust	ID	9.00-9.02 mm dia. (.3543-.3551")	9.06 mm dia. (.3567")
7 - Valve stem Intake	Dia.	7.94-7.95 mm dia. (.3126-.3130")	7.90 mm dia. (.3110")
Exhaust	Dia.	8.91-8.92 mm dia. (.3508-.3512")	8.87 mm dia. (.3492")
	out-of-round	max. 0.01 mm (.00039")	
8 - Valve guide - valve stem Inlet and exhaust	Rocker play	max. 0.45 mm (.0177")	0.9 mm (.0354")
9 - Valve disk Inlet	Dia.	39.0 mm dia. (1.54")	(41.0 mm dia.)
Exhaust	Dia.	33.0 mm dia. (1.30")	(34.0 mm dia.)

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		Upon installation (new)	Wear limit
10 - Valve clearance (cold) Inlet	Adjustment	0.15 mm (0.006")	
Exhaust	Adjustment	0.15 mm (0.006")	
11 - Compression pressure (with throttle valve open and engine at operating temp., all plugs unscrewed, with practically no-loss pressure gauge in plug seat, cranking with starter)	Pressure	9.0-11.0 kp/cm^2 (128-156 psi)	7.0 kp/cm^2 (100 psi)
Pressure difference between individual cylinders		max. 1.5 kg/cm^2 (21.3 psi)	
Cylinders and Pistons			
2 Excess sizes, each with 0.5 mm (.0197") higher dia.			
1 - Cylinder	out-of-round	max. 0.01 mm (.0004)	
2 - Cylinder/Piston	Clearance	0.04-0.06 mm (0.015-0.045) (.0016-.0024")	0.20 mm (.0079")
3 - a) Upper piston ring	Side clearance	0.06-0.09 mm (.0024-.0035")	0.12 mm (.0048")
b) Lower piston ring	Side clearance	0.04-0.07 mm (.0016-.0028")	0.10 mm (.0039")
4 - Oil scraper ring	Side clearance	0.02-0.05 mm (.0008-.0020")	0.10 mm (.0039")
5 - a) Upper piston ring	Gap width	0.35-0.55 mm (.0138-.0216")	0.90 mm (.0354")
b) Lower piston ring	Gap width	0.30-0.35 mm (.0118-.0138")	0.90 mm (.0354")
6 - Oil scraper ring	Gap width	0.25-0.40 mm (.0098-.0157")	0.95 mm (.0374")
7 - Piston weight			
- Weight (brown)		472-480 grams	
+ Weight (grey)		480-488 grams	
8 - Weight difference of pistons of one engine		max. 4 grams	max. 10 grams *)
*) In the event of repairs			
Crankcase			
1 - Bore for crankshaft bearings		70.00-70.02 mm	70.03 mm
a) Bearings 1-3	Dia.	dia. (2.7559-2.7567")	dia. (2.7571")
b) Bearing 4	Dia.	50.00-50.04 mm dia. (1.9685-1.9701")	50.04 mm dia. (1.9701")
2 - Bore for sealing ring/ flywheel end	Dia.	95.00-95.05 mm dia. (3.7402-3.7422")	
3 - Bore for sealing ring/ blower gear end	Dia.	62.00-62.05 mm dia. (2.4409-2.4429")	
4 - Bore for camshaft bearing	Dia.	27.50-27.52 mm dia. (1.0827-1.0835")	

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		Upon installation (new)	Wear limit
5 - Bore for oil pump housing	Dia.	70.00-70.03 mm dia. (2.7559-2.7571")	
6 - Bore for tappet	Dia.	24.00-24.02 mm dia. (.9449-.9457")	24.05 mm dia. (.9469")
Camshaft			
1 - Bearings 1-3	Dia.	24.99-25.00 mm dia. (.9839-.9843")	
2 - Measured on center bearing (1st and 3rd bearing point on V-blocks).	Out-of-true	max. 0.02 mm (.0008")	0.04 mm (.0016")
3 - Camshaft/camshaft bearings (including bearing pressure through housing	Radial play	0.02-0.05 mm (.0008-.0020")	0.12 mm (.0048")
Guide bearing	Axial play	0.04-0.13 mm (.0016-.0051")	0.16 mm (.0063")
4 - Camshaft gear	Backlash	0.00-0.05 mm (.00-.0020")	
5 - Tappet	Dia.	23.96-23.98 mm dia. (.9433-.9441")	23.93 mm dia. (.9421")
6 - Housing bore/tappet	Radial play	0.02-0.06 mm (.0008-.0024")	0.12 mm (.0047")
7 - Push rod	Out-of-true	max. 0.3 mm (.0118")	
Crankshaft with Connecting Rods			
3 Undersizes, with dia. reduced in 0.25 mm (.0098") steps			
1 - a) Bearings 1-3	Dia.	59.97-59.99 mm dia. (2.3610-2.3618")	
b) Bearing 4	Dia.	39.98-40.00 mm dia. (1.5740-1.5748")	
c) Connecting rod bearing	Dia.	54.98-55.00 mm dia. (2.1646-2.1654")	
2 - Crankshaft on 2nd and 4th bearing point (1st and 3rd bearing point on V-blocks	Out-of-true		0.02 mm (.0008")
3 -	Unbalance	max. 12 cmg	
4 - Main bearing pin	Out-of-true		0.03 mm (.0012")
5 - Conrod bearing pin	Out-of-true		0.03mm (.0012")
6 - Crankshaft/main bearing (including bearing pressure through housing)		0.05-0.10 mm (.0020-.0039")	0.18 mm (.0071")
a) Bearings 1 and 3	Radial play	0.03-0.09 mm (.0012-.0035")	0.17 mm (.0067")
b) Bearing 2	Radial play	0.05-0.10 mm (.0020-.0039")	0.19 mm (.0075")
c) Bearing 4	Radial play	0.07-0.13 mm (.0028-.0051")	0.15 mm (.0059")
7 - Crankshaft/main bearing 1	Axial play		

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		Upon installation (new)	Wear limit
8 - Crank pin/conrod	Radial play	0.02-0.07 mm (.0008-.0028")	0.15 mm (.0059")
	Axial play	0.10-0.40 mm (.0039-.0157")	0.70 mm (.0276")
9 - Conrod weight			
- Weight (white)		746-752 grams	
+ Weight (black)		769-775 grams	
10 - Weight difference of conrods of one engine		max. 6 grams	
11 - Piston pins	Dia.	23.996-24.000 mm dia. (.94472-.94488")	
12 - Small end bushing	Dia.	24.015-24.024 mm dia. (.94547-.94582")	
13 - Piston pin/small end bushing	Radial play	0.02-0.03 mm (.0008-.0012")	0.04 mm (.0016")
14 - Fly wheel (measured in center of clutch area)	Lat.wobble	max. 0.4 mm (.0157")	
	Out-of-balance	max. 20 cmg	
Shoulder for sealing ring	OD	74.9-75.1 mm dia. (2.949-2.957")	74.4 mm dia. (2.929")
Refinishing of tooth width			max. 2 mm(.08")
15 - Driven plate	Unbalance	max. 5 cmg	
Clutch			
1 - Total clutch pressure	Pressure	420-480 kg (420-485 kg) (926-1,058 lbs)	
2 - Total clutch unbalance		max. 15 cmg	
3 - Clutch pressure plate	Out-of-true		0.10 mm (.0039")
4 - Clutch disk (measured at 210 mm dia. = 463")	Lat. wobble	max. 0.5 mm (.0197")	

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MAINTENANCE

Complete the following maintenance and lubrication jobs in accordance with valid service instructions:

1 - Air filter:	Check, clean base and fill in fresh oil.
2 - Fuel filter:	Replace.
3 - Ignition distributor:	Lubricate, check contact points and replace, if required. Adjust timing angle and firing point.
4 - Spark plugs:	Clean, check spark gap and adjust, check compression pressure.
5 - Exhaust system:	Check for damage.
6 - V-belts:	Check and tighten, if required, or replace.
7 - Engine:	Check oil level and replenish, if required or change oil.
8 - Full-flow oil filter:	Replace.
9 - Valves:	Adjust valve clearance and replace seals for cylinder head cover.
10 - Engine:	Sight test for leaks.
11 - Clutch:	Adjust clutch play.

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TIGHTENING TORQUES

Designation	Threads	mkg	ft.lbs.
1 - Screws for universal shaft	M 8 x 1.25	4.5	32.5
2 - Nuts for transmission support	M 8	2.0	14.5
3 - Nuts for engine support (body)	M 10	3.0	21.7
4 - Screws for torque converter	M 8	3.0	21.7
5 - Nuts for engine attachment to transmission	M 10	3.0	21.7
6 - Spark plugs	M 14 x 1.25	3.5	25.3
7 - Nut for small pulley	M 14 x 1.5	6.0	43.4
8 - Screws for blower impeller	M 8	2.0	14.5
9 - Nuts for oil pump	M 8	2.0	14.5
10 - Oil drain plug	M 12 x 1.5	2.2	15.9
11 - Closing nut for oil strainer cover	M 8	1.3	9.4
12 - Nuts for rocker arm shaft	M 7	1.4	10.1
13 - Cylinder head nuts	M 10	3.2[1)]	23.1
14 - Screws for engine support (crankcase)	M 8	3.0	21.7
15 - Screw for blower wheel hub	M 8	3.2	23.1
16 - Screws for flywheel	M 12 x 1.5	11.0	79.6
17 - Screws for carrier plate	M 12 x 1.5	8.5	61.5
18 - Screws and nuts for crankcase halves	M 8	2.0	14.5
19 - Nuts for crankcase halves	M 10 x 1.25	3.3[3)]	23.9
20 - Conrod nuts	M 9 x 1	3.3[2)]	23.9
21 - Screws for clutch	M 7	2.0	14.5

1) For tightening sequence refer to 5.1-2/2

2) Replace, contact surface oiled

3) Sealing ring outwards

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		SPECIAL TOOLS
1	Engine support for garage jack	VW 612/4
2	Clamping support	VW 313
3	Holder	VW 307a
4	Actuating fixture for carburetor	VW 798/2
5	Puller for starter bushing	VW 228b
6	Tester for oil cooler	VW 661/2
7	Puller for oil pump cover	VW 803
8	Clamping plate with wear measuring instrument for valve guides	VW 689/1
9	Valve spring pusher	VW 311s
10	Piston pin mandrel	VW 207c
11	Piston ring strap	VW 123d
12	Fitting fixture for crankshaft sealing ring (impeller end)	VW 190
13	Fitting fixture for crankshaft sealing ring (flywheel end)	VW 191
14	Dial gauge holder	VW 659/2
15	Plate for impeller hub	VW 185
16	Holding clip for flywheel	VW 215c
17	Holding ring for driven plate	VW 184
18	Holding bars for bearings of differential	VW 457
19	Notch punch	VW 124a
20	Tube section, 60 mm dia.	VW 415a
21	Guide sleeve, tapered	VW 428
22	Guide sleeve	VW 427
23	Holding plate for crankshaft	VW 801
24	Conrod testing and friction fixture	VW 214f/70
25	Pressure plate	VW 402
26	Tube section	VW 421
27	Pressure ram	VW 409
28	Circlip spreader	VW 161a
29	Tube section	VW 416b
30	Riveting tool for clutch disk	VW 783

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TRIAL RUN AND THE CHECKING OF ENGINES

General

Test benches for checking engines with injection systems require an electric fuel pump, a fine filter and the means to return the fuel flowing out of pressure regulator back into the tank. It will be of advantage to combine the required parts, as well as a fuel tank, a special fuel measuring instrument and a bracket for the control unit on one frame. (For do-it-yourself instructions refer to 0.4 - 3/1).

The trial run and the checking of an engine comprise the following points:

1 - Initial check

2 - Running-in

3 - Measuring fuel consumption

4 - Performance test

5 - Final check

Proceed likewise when checking basically or partially reconditioned engines. Using a test bench with hydraulic brake will be of advantage. The brake permits governing the engine load and matching the load to the requirements of the performance and consumption test.

Initial Check

a - Adjustment of valve clearance

b - Adjustment of contact points and ignition

c - Checking V-belt tension

d - Filling in 3.5 liters of engine oil

e - Test injection system according to checklist with tester EFAW 19 and adapter EFAW 243, or tester EFAW 238, respectively. (For the performance test, always include the control unit and the pressure feeler which belong to the engine.)

Running-in

Prior to starting, crank engine several times manually.
Following the starting, the green oil pressure pilot lamp should extinguish with increasing speed. If not, the oil pump has not sucked up oil and the bearing points and sliding surfaces are not receiving the required lubrication.

The red pilot lamp for the alternator should also extinguish when the idling speed increases.
During the running-in period, check fuel pump and lines for leaks. The checkup should also include the pressure in the fuel ring line.
The running-in period of the engine on the test bench can generally be restricted to 30 minutes, which are divided up as follows:

10 minutes at 1500 rpm with 3-5 kg (6.6-11 lbs) load,

20 minutes at 2500 rpm with 6-10 kg (13-22 lbs)load.

Measuring the Fuel Consumption

Toward the end of the 30 minutes test run, check fuel consumption. At given engine speeds an load (refer to table) the flow rates permit judging the fuel consumption.

Engine speed rpm	Brake load kg (lbs)	Flow rate for 100 cm^3 in seconds
2900	6.5 (14.3)	49-51
5000 at full throttle	min.	13.0-13.8

Performance Check

After measuring the fuel consumption, measure the engine performance. The ratings are shown in the power diagram. To take manufacturing tolerances and differences in the test conditions into account, a deviation of $\pm$ 5% is permitted.

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The measured performance is converted to 760 mm mercury and 20°C by the following formular:

$$\boxed{P_o = P_e \cdot f} \ (PS_o)$$

$$P_e = \frac{F \cdot n}{1000} \ (PS_e)$$

$$f = \frac{760}{b} \cdot \sqrt{\frac{273 + t}{293}} \ (-)$$

In which:

F	(kg)	= brake load
n	(rpm)	= engine speed
P_e	(PS_e)	= effective engine performance (measured)
P_o	(PS_o)	= normal engine performance
t	(°C)	= intake air temperature
b	(mm mercury)	= air pressure
f	(-)	= correction factor

In addition to diagrams for taking weather conditions into account, the Workshop Manual M contains instructions, which must be observed when measuring the performance of VW engines.

Final Check

a - Adjust idling speed with the engine warm

b - Check for oil leaks.

Following the full load and fuel consumption measurements, check whether engine is oil-tight. Pay special attention to tube protecting tappet, oil pump, oil cooler, cylinder head cover and parting line of housing.

c - Testing the compression pressure.

The compression pressure is tested with a compression tester, with the throttle valve open and the engine at aperating temperature. Unscrew all spark plugs and crank engine with starter.

d - Final check

Prior to installing engine into vehicle, check valve clearance and V-belt tension. The oil bath air filter should be cleaned and filled with the specified quantity of oil.

e - Reservation of engines

Engines which are laid up for extended periods should be given a special treatment to prevent corrosion damage. Remnants of fuel and combustion gases are gradually chemically aggressive with regard to the working surfaces of cylinders, to valve guide surfaces etc. Spraying anti-corrosion oil into the intake air distributor during the final revolutions of the engine prior to shut-off or through the spark plug holes provide protection against such attacks. Engines should also be sprayed externally with anti-corrosion oil.

Measuring Output on Dynamometer

Output and fuel consumption can be measured on a dynamometer. Test conditions and ratings are shown on the respective rated value cards.

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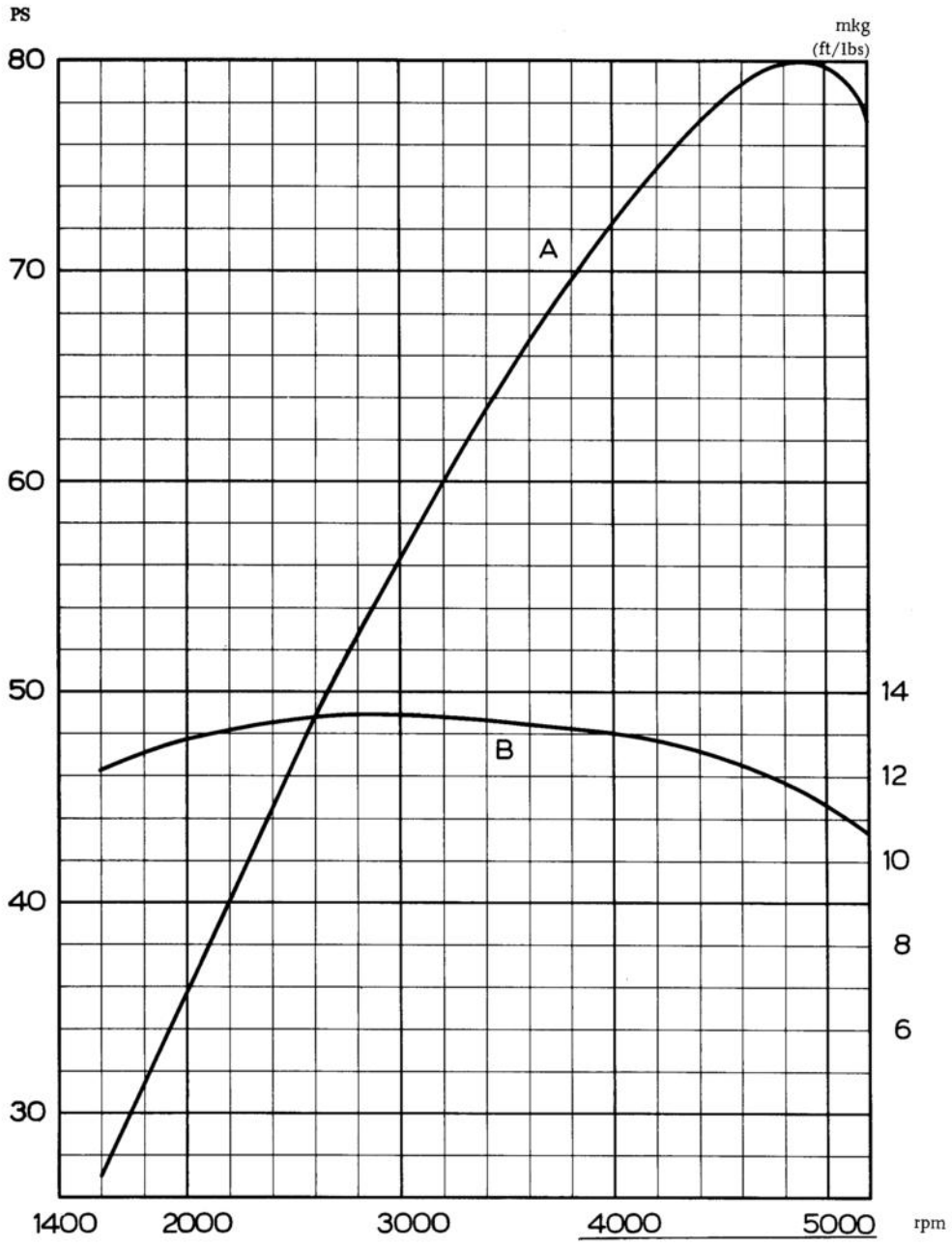
PERFORMANCE DIAGRAM



A-Pe = performance (HP)
B-Md = torque (mkg/ft/lbs)

1 mkg = 7.233 ft/lbs

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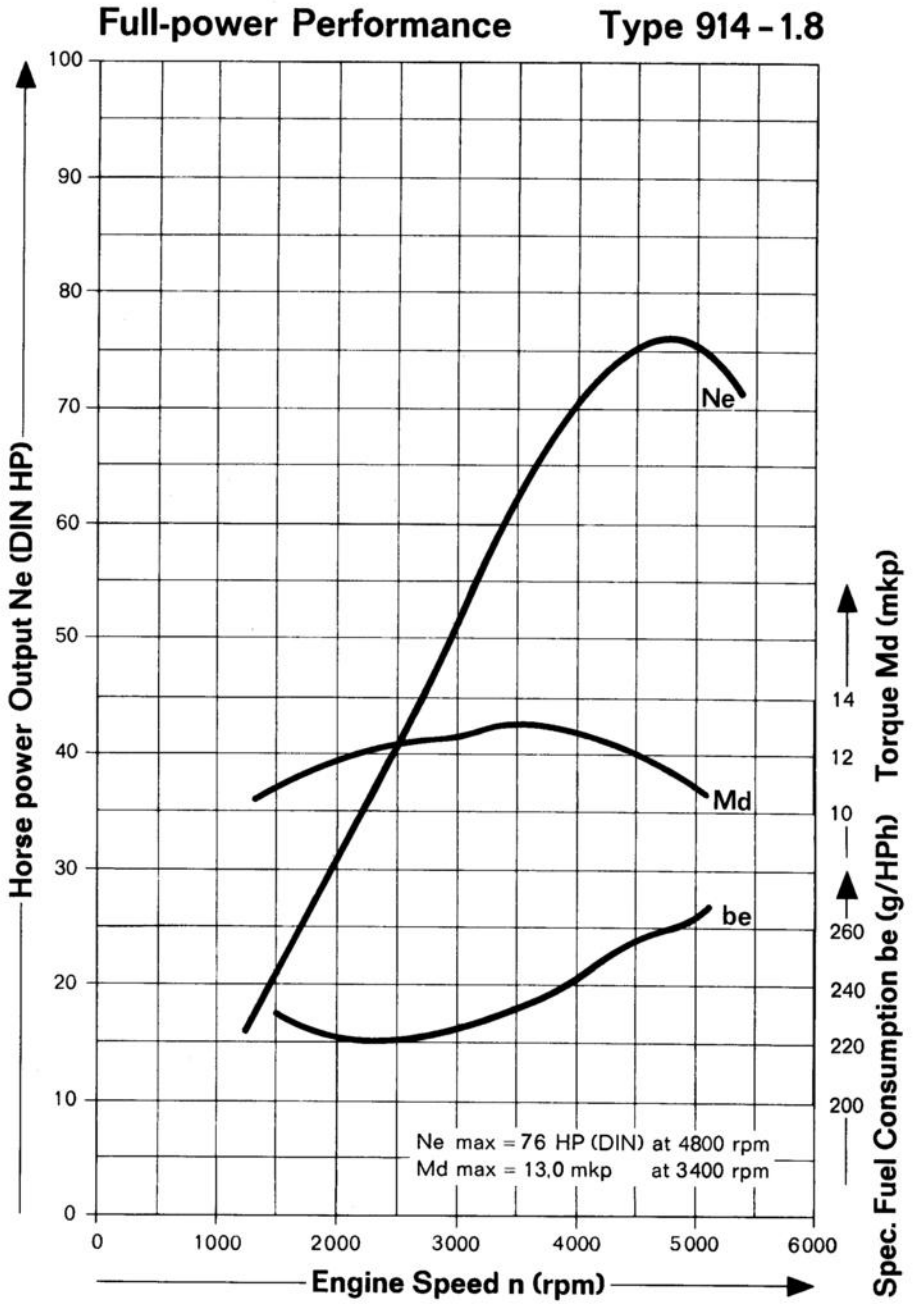
PERFORMANCE DIAGRAM



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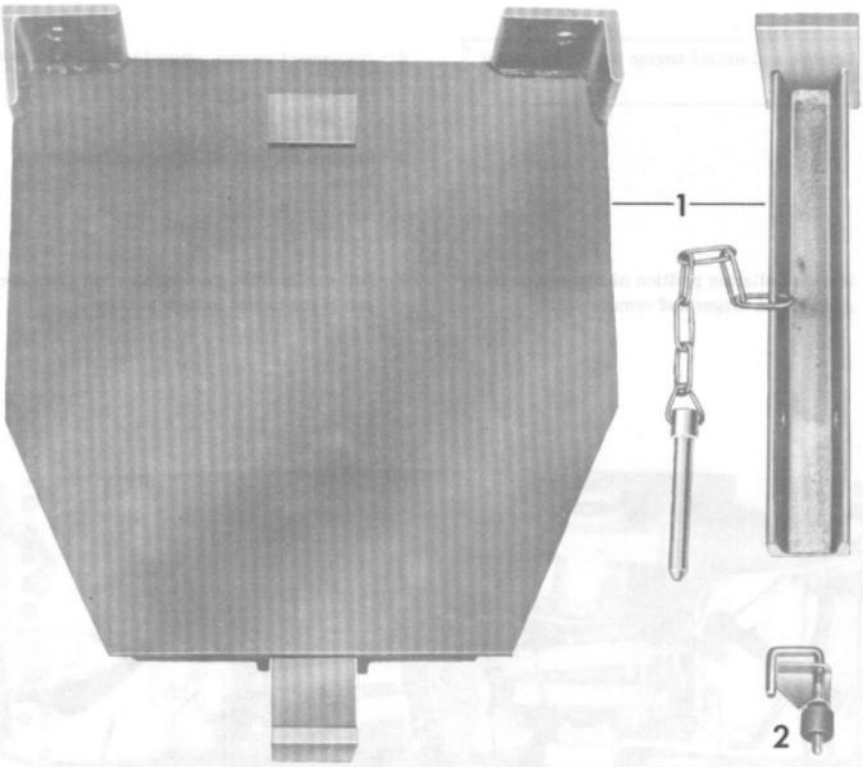
TOOLS



No.	Designation	Special tools	Explanations
1	Engine support for garage jack with extension for transmission	VW 612/4 VW 612/3	
2	Clamp for fuel hose		commercial

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Removal:

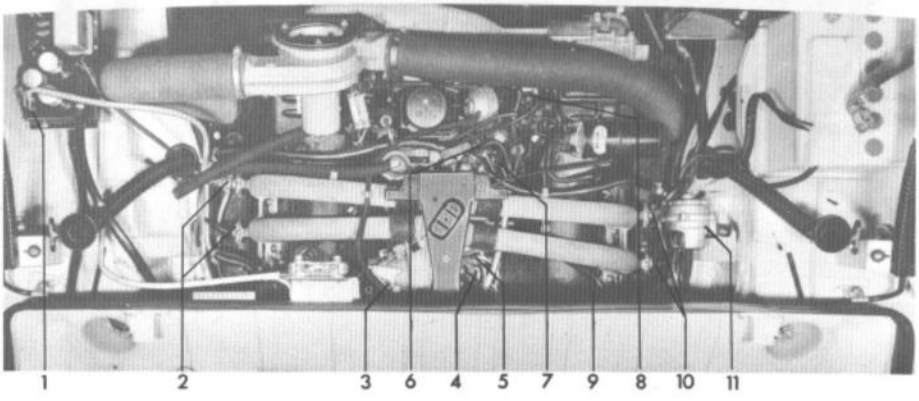
Remove and install engine and transmission together.

1 - Mark installation position of luggage compartment lid on hinges and remove lid.

2 - Disconnect ground connection cable on battery.

3 - Remove oil bath air filter and heating air hoses.

4 - Pull cables from gasolin injection components and place cables in high position.



Connections for Gasolin Injection:

1 - Voltage supply relay 4-pole
2 - Two injection valves left 2-pole
3 - One throttle valve switch 4-pole
4 - Temperature feeler 1-pole
5 - Mass connections 3-pole
6 - Cold starting valve 2-pole
7 - Thermal switch 1-pole
8 - Ignition distributor release contact 3-pole
9 - Temperature feeler 1-pole
10 - Two injection valves right 2-pole
11 - Pressure feeler 4-pole

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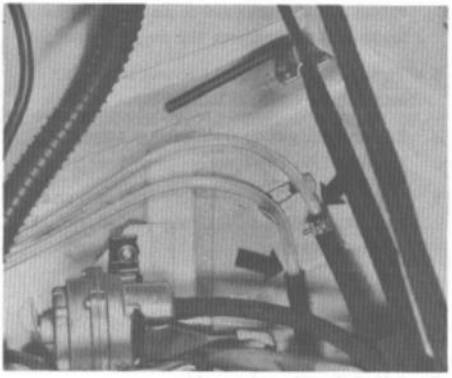
5 - Disconnect throttle valve cable and push through engine cover plate.

6 - Unbend metal plate and separate fuel hoses on connecting points near to pressure feeler and close.



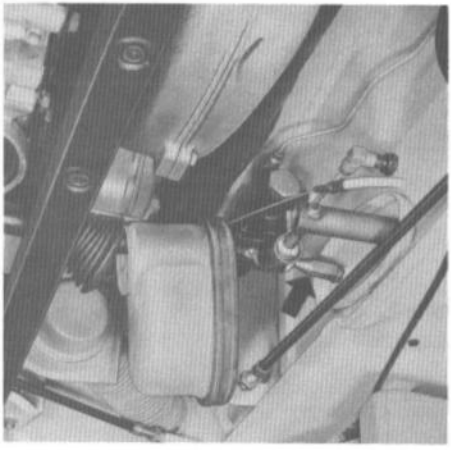
7 - Unscrew hex nut for attaching starter.

8 - Raise vehicle.

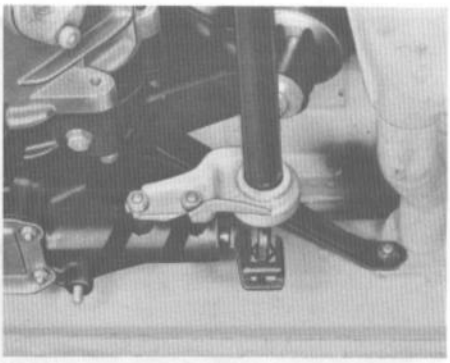
9 - Remove exhaust muffler molding.

10 - Remove lower components for warm air flow.

11 - Remove protective cab and unscrew shift rod holder.

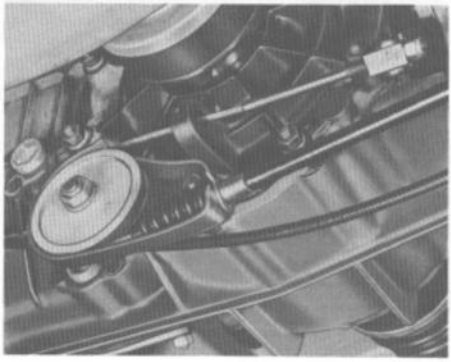


12 - Pull off protective cabs, unscrew hex bolt with ball (arrow) and remove rear shift rod.



13 - Remove heater flap box with hoses and cables.

14 - Loosen adjusting nut and hex nut for guide roller, bend holding plate and pull clutch cable forward.



15 - Loosen drive shaft for speedometer and pull forward.

16 - Remove starter and loosen earth connection strap on luggage pan.

17 - Loosen universal shafts on transmission and suspend with wire hooks on body.

18 - Lower vehicle slightly. Place garage jack with engine support VW 612/4 in combination with transmission extension VW 612/3 under engine/transmission unit and raise again slightly.

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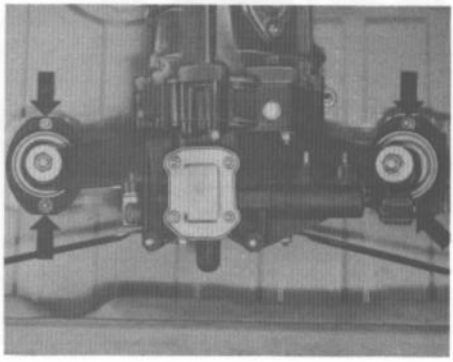
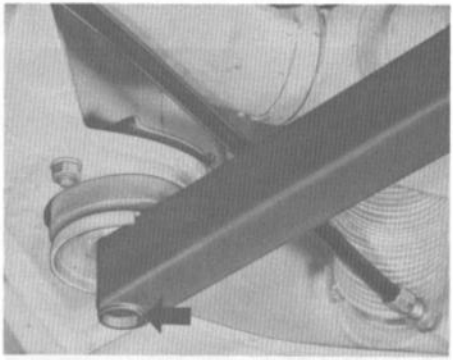
19 - Unscrew 4 hex nut M 8 on transmission support.



20 - Unscrew hexagon socket screws M 10 left and right on engine mount.



21 - Carefully lower engine/transmission unit.

Installation:

During installation, the following points must be observed:

1 - Prior to attaching transmission to engine on vehicles with manual gearbox:

a - Check clutch throwout bearing for wear (do not wash out, only wipe off).

b - Coat guide bushing of throwout bearing, splining input shaft and bushing for starter shaft lightly with MOS_2-paste.

2 - When positioning the engine/transmission unit, be sure that the fuel lines near the injection valves are not squeezed in and that the hand brake cables are above the engine mount.

3 - Tighten hexagon socket screws on engine mount to 3.0 mkg (21.7 ft/lbs)

4 - Tighten hex nut on transmission support to 2.0 mkg (14.5 ft/lbs).

5 - Tighten hexagon socket screws of universal shaft attachment to 4.5 mkg (325 ft/lbs). Use new lock washers.

6 - Adjust free play of clutch.

7 - Pull engine compartment seal into proper position.

8 - Adjust throttle valve cable.

9 - Connect cable and protective rubber caps carefully.

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For disassembly and assembly proceed as follows:

Disassembly

1 - Drain engine oil

2 - Remove exhaust muffler and heat exchanger

3 - Remove rear engine cover plate

4 - Remove intake distributor with intake pipe and injection valves

5 - Remove oil filler neck with oil vent

6 - Remove ignition distributor

7 - Remove front engine cover plate

8 - Remove impeller

9 - Remove cooling blower housing with alternator

10 - Remove engine mount

11 - Remove cylinder jackets with warm air guides front and rear

12 - Remove oil cooler

13 - Remove oil filter

14 - Remove oil pump

15 - Remove rocker arm shafts with push rods, protective tubes and tappets

16 - Remove cylinder heads

17 - Remove cylinders and pistons

18 - Remove clutch and flywheel

19 - Disassemble crankcase

20 - Remove camshaft and crankshaft with connecting rods

Assembly

For assembly proceed vice versa. The following sections provide instructions which should be particularly observed during assembly.

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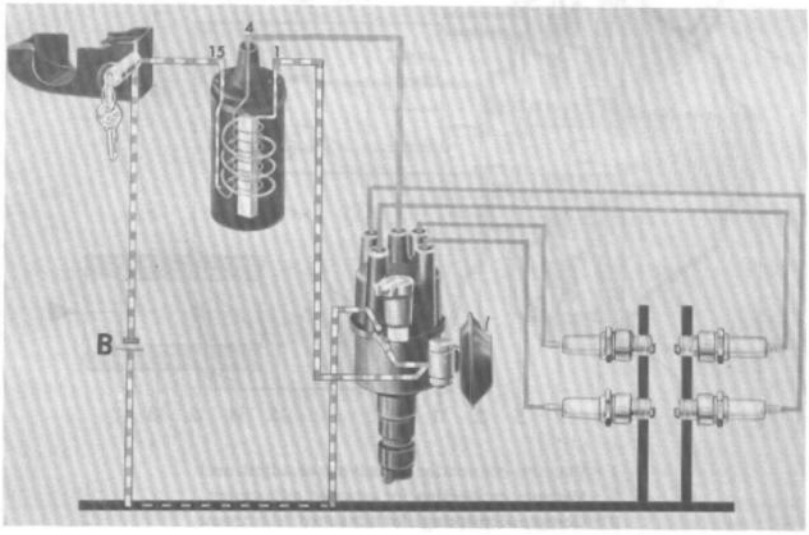
DESCRIPTION

Ignition System

The ignition system operates as a battery ignition with an ignition coil and an ignition distributor with automatic firing point adjustment. The battery voltage is transformed to the required ignition voltage of 15, 000 - 20, 000 volt in the ignition coil, similar to a transformer as follows: The distributor shaft with the contact breaker cams driven by the crankshaft opens the breaker contact shortly before the piston has attained an upper TDC in the cylinder to be fired. As a result, the current in the primary winding of the ignition coil is interrupted. The magnetic field established by the current suddenly collapses and thereby induces the ignition voltage in the secondary winding. This ignition voltage travels via an ignition cable to the rotor of the ignition distributor which, at this moment, is accurately opposite the contact in the ignition distributor head to which the spark plug of the cylinder to be ignited is connected. A spark can jump at the electrodes of the spark plug to ignite the compressed fuel/air mixture in the cylinder.



Ignition Coil

The ignition coil consists of a laminated iron core, which carries a primary winding consisting of a few windings of heavy wire outside and a secondary winding consisting of numerous windings of thin wires inside. The one end of the primary winding is connected to the battery together with the secondary winding via terminal 15. The other end of the primary winding is connected to ground via terminal 1 and the contact breaker points. The secondary winding leads to the high voltage line connection.

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Ignition Distributor

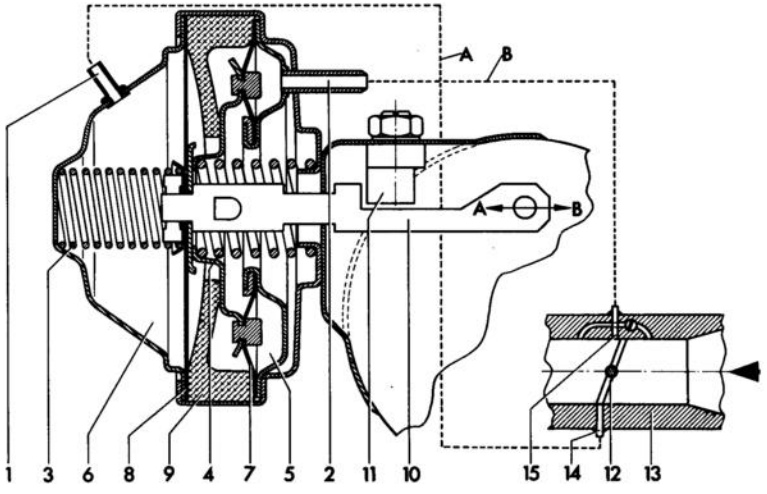
The distributor serves the purpose of feeding the ignition current to each of the four spark plugs in the correct sequence and at the accurate firing moment.

A centrifugal and double-acting combination vacuum control installed in the ignition distributor will automatically adjust the most favourable firing point for each speed and load of the engine.

a - Centrifugal Adjustment

Two flyweights on a supporting plate are forced outwards at increasing speed. This will turn the breaker cam in the direction of rotation of the drive shaft via a lever. Restoring springs will pull the flyweight in their rest position back when the speed drops.

b - Vacuum Adjustment



1 - Vacuum connection for advanced adjustment
2 - Vacuum connection for retarded adjustment
3 - Compression springs for advanced adjustment
4 - Compression springs for retarded adjustment
5 - Vacuum chamber (angular) for retarded adjustment
6 - Vacuum chamber for advanced adjustment
7 - Diaphragm for retarded adjustment
8 - Diaphragm for advanced adjustment
9 - Supporting ring
10 - Pull rod
11 - Adjusting cam for restricting retarded adjustment
12 - Throttle valve
13 - Intake duct (intake distributor)
14 - Vacuum tapping point advanced adjustment
15 - Vacuum tapping point retarded adjustment

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The vacuum tapped in front of and behind the throttle valve is taken in separate lines to the two vacuum chambers inside the vacuum box. The diaphragm of these chambers actuate the contact breaker plate via a pull rod either with the direction of rotation of the distributor shaft in the direction of "retarded ignition" or against the direction of rotation in the direction of "advanced ignition".

The vacuum for the adjustment in the direction of "retarded ignition" required for idling speed is tapped behind the completely closed throttle valve with the vacuum acting on the contact breaker plate via the angular vacuum diaphragm.

When the throttle flap is opened, the vacuum in the tapping hole located in front of the throttle valve dominates and the contact breaker plate is adjusted in the direction of "advanced ignition".

Spark Plugs

Since spark plugs are constantly subject to very high electrical, mechanical, chemical and particulary thermic stresses, the startability, the idling speed characteristic, the acceleration and the maximum output of an engine depend to a great extent on the selection of the proper plug. In addition to the mechanical and electrical properties of a spark plug, the thermal value is of considerable importance. The thermal value indicates the heat-carrying capacity. The higher this capacity, the higher the resistance against spontaneous ignition (pre-ignition), and the lower the resistance against contamination. These characteristics are reversed in spark plugs with lower thermal values.

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EQUIPMENT LIST

Ignition Coil

Type	Version	Remarks
914	022905115	12 volts

Ignition Distributor

Type	Type of Advance	Version
914	Centrifugal weights and double-action vacuum unit	022905205 D
914 from engine Nr. W 0007334	Centrifugal weights and double-action vacuum unit	022905205 E
914 from engine Nr. W 0039126	Centrifugal weights and double-action vacuum unit	022905205 F (same as E except with speed limiter)
914/1,8 (AFC)	Centrifugal weights and double-action vacuum unit	022905205 AA (with speed limiter)
914/1,8 (AFC)	Centrifugal weights and single-action vacuum unit	022905205 AB (without speed limiter)

Spark Plugs

Type	Spark Plug Type (*)	Remarks
914	BERU 175/14/3 BOSCH W 175 T2	M 14x1, 25x19,0 threads
914/1,8 from 1975 model	BERU 175/14/3 L BOSCH W 175 M 30	M 14x1,25x19,0 threads

(*) Or else VW-Approved spark plugs of appropriate heat range of other spark plug manufacturers.

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MAINTENANCE

Ignition Coil: Keep insulating cap clean and dry.

Ignition Distributor:

1 - Sight test of breaker contact for pitting and humps, replace if required.

2 - Grease slide piece of contact lever with some multi-purpose grease.

3 - Lubricate bearings of contact breaker and lube felt of distributor shaft with a few drops of engine oil.

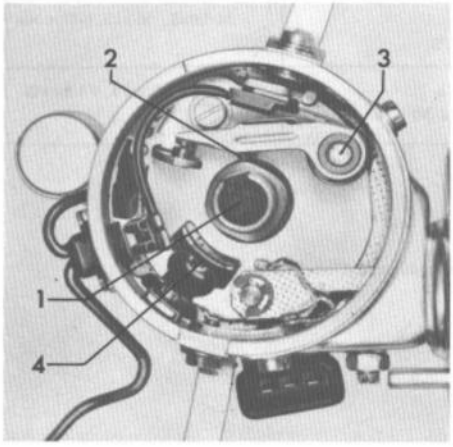
4 - Sight test of distributor head for cleanliness, cracks and traces of leakage current, clean or replace, if required.

5 - Check timing angle and adjust.

6 - Check firing point adjustment and correct.

Spark Plugs: Clean, check electrode gap and adjust.

Special Instructions:



1 - Lubricate felt in ignition distributor shaft (1) and the bearings of the contact breaker (3) regularly with a few drops of engine oil.

2 - The slide piece on the contact breaker lever should be greased with multi-purpose grease. To prevent any grease from touching the contact surfaces, the grease should just cover the tip of a thin chip of wood and should be applied into the corner between the slide piece and the contact breaker lever (2) against the ball (4).

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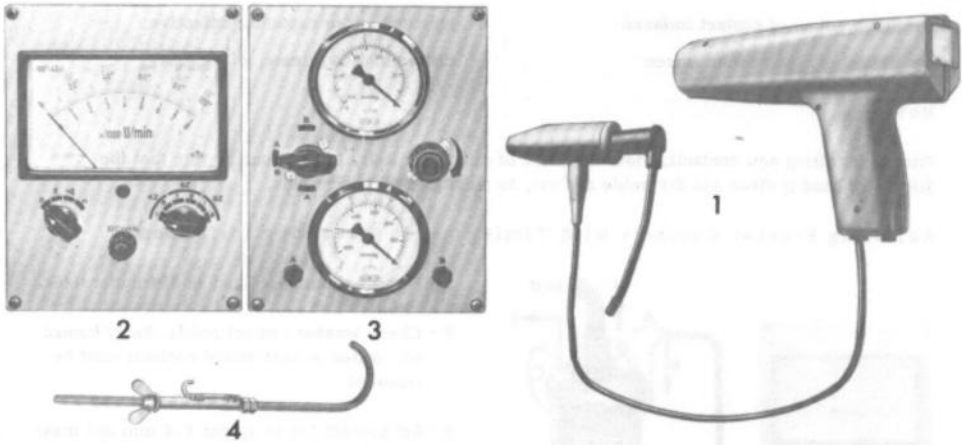
TESTING EQUIPMENT



No.	Designation	Special tool	Explanations
1	Stroboscopic lamp		
2	Timing angle speed tester		
3	Vacuum measuring instrument		Measuring ranges 0-100 and 0-600 mm mercury
4	Actuating device for carburetor	VW 798/2	Self-made

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TESTING AND ADJUSTING CONTACT BREAKER POINTS

Testing Contact Breaker Points

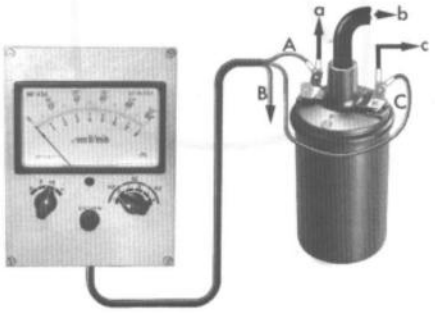
In the course of time, contact breaker points are subject to burn-off, which deveclops in the shape of small humps and pits (contact creep with DC). This will generally not interrupt operation. But if the contacts are badly burnt, the must be replaced. A sight test permits conclusions concerning faults in the ignition system.

1 - Pits and humps with bright contact surfaces:	normal wear.
2 - Greyish colour of contact surfaces:	insufficient contact gap and contact pressure (rated value 400-600 g).
3 - Bluish colour of contact surfaces:	Ignition coil or capacitor defective.
4 - Yellow or black porous scares:	contamination (grease, oil or dust).

Note

Prior to installing new contacts, blow out inside of distributor well. In addition, be sure that the distributor head is clean and dry inside and out, to prevent creeping currents.

Adjusting Breaker Contacts with Timing Angle Measuring Instrument



a - to ignition lock (15)
b - to ignition distributor (4)
c - to ignition distributor (1) (breaker contact)

A - red clip
B - black clip
C - green clip

1 - Remove distributor head an distributor rotor.

2 - Check breaker contact points. Badly burned off, soiled or heat-tinted contacts must be replaced.

3 - Set contact gap to approx 0.4 mm and make sure that the contact surfaces are plane in relation to each other.

Caution!
Contact surfaces should never be touched by grease or oil.

4 - Connect timing angle measuring instrument and calibrate.

Note concerning connection diagram:

When connecting other timing measuring instruments, be sure to read the respective Operating Instructions!

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5 - Run engine at 1000 to 1200 rpm and read value.

Adjusting value: 44-50° or 49-55 %
Wear limit: 42-58° or 47-64 %

Wear limit means that the timing angle need not be adjusted as long as it is between 42 and 58° or 47 and 64 %.

6 - Run engine at 2000 to 2500 rpm and read values again.

Renember:

Small contact gap = large timing angle
Large contact gap = small timing angle

Evaluation of measuring results:

The contact gap should not be below 0.3 mm. If timing angle measurements show that a smaller gap would be required (measured with feeler gauge), a mechanical fault in the distributor is indicated.

If the speed is raised during measuring (to approx 2000-2500 rpm), the timing angle indicated should not change considerably (max. ±1°). Larger deviations indicate fault in the distributor, for example worn bearings or runout distributor cams.

Restless, jerky motions of the needle are generally caused by burned-out and unuseable contact breaker points.

Caution!

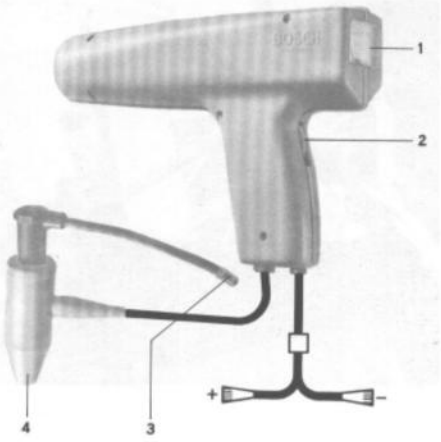
Upon adjustment of the braker contact points be sure to adjust the firing point again, since a change of the contact gap by 0.1 mm correspond to a change of the firing point by approx. 3° crankshaft.

ADJUSTMENT OF FIRING POINT WITH STROBOSCOPIC LAMP

1 - Prior to each adjustment of the firing point, be sure to check the timing angle of the contact breaker points and adjust, if required.

2 - Be sure that the engine oil temperature is between 60 and 70° C. (140 and 158° F).

3 - Check whether the markings are easily seen (mark by a colour stripe, if required).



1 - Timing angle measuring instrument
2 - Adjusting wheel
3 - to ignition cable cylinder 1
4 - in ignition distributor cap cylinder 1

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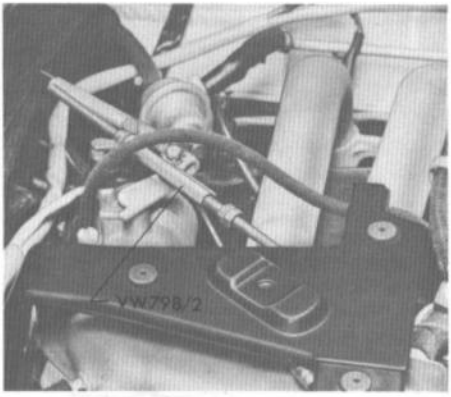
4 - Connect stroboscopic lamp and revolution counter in accordance with instructions of manufacturer (into ignition line of cylinder 1). On stroboscopic lamps with adjusting angle measuring instrument be sure that the adjusting wheel in the grip of the stroboscopic lamp is turned back against the zero stop.

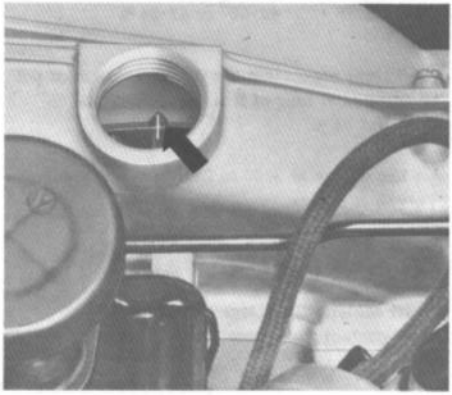
5 - Pull both vacuum hoses from vacuum box of distributor.

6 - Run engine at 3500 rpm and direct stroboscopic lamp against impeller.

The required speed can be adjusted by means of fixture VW 798/2 (self-made).



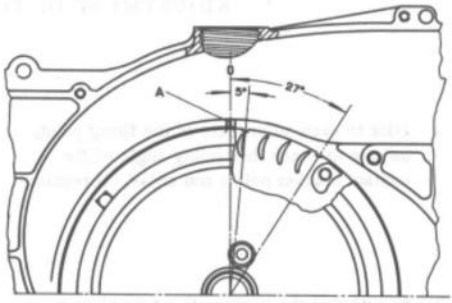
The firing point of all four cylinders is correctly adjusted when the red 27° mark on the impeller is in alignment with the reference mark on the cooling blower housing.



7 - Correct faulty adjustments by turning the ignition distributor.

Note:

The impeller has two notches. The indicate:



27° before TDC = red
5° before TDC = black
A = notch in cooling blower housing

The black 5° mark serve only for the basic adjustment of the firing point with the engine stopped following an assembly and checking the adjusting curves.

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ADJUSTING IGNITION TIMING - 1.8 LITER ENGINES

The following ignition timing specifications for 1.8 liter, 1974-model engines differ from those shown on pages 2.3 - 1/3 and 1/4:

1. With vacuum hoses detached run engine at idle speed and note the following engine rpm:

   AFC injection engine: 800 - 900 rpm

   1975 Models with AFC fuel injected engines also have a distributor with a single action vacuum control.

2. Turn distributor until the mark on the blower impeller lines up with the notch on the cooling blower housing when flashed with the stroboscopic timing light.

   When so adjusted, the correct ignition timing of 7.5° BTC is attained.

(The ignition advance monitor, built into the stroboscopic timing light, must be switched off during this test.)

The blower impeller on the 1.8 liter engines has only the 7.5° timing mark.

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CHECKING AUTOMATIC ADJUSTMENT OF FIRING POINT

Checking the Centrifugal Timer

The effect of the centrifugal timer can be observed by turning the attached distributor rotor manually and clockwise. Upon release, the rotor should automatically return to its starting position, the opposite stop. If not, the conclusion would be that the centrifugal timer is either contaminated or the spring tension of the restoring springs has declined.

The centrifugal adjustment of the built-in ignition distributor can be tested by means of an adjusting angle measuring instrument in combination with a revolution counter:

Note

An accurate inspection of the ignition adjusting curve is possible only on an ignition distributor test bench.

1 - Connect stroboscopic lamp with adjusting angle measuring device or adjusting angle measuring instrument, as well as the revolution counter, in accordance with the instruction of the pertinent Operating Instructions of the respective manufacturer.

1 - Adjusting angle measuring instrument
2 - Adjusting wheel
3 - to ignition cable cylinder 1
4 - in ignition distributor cap cylinder 1

2 - Check basic adjustment of firing point and correct, if required.

3 - Pull both vacuum hoses from vacuum box of ignition distributor.

4 - Run engine at max. 900 rpm and flash black 5° mark.

5 - Determine the deviations from the basic ignition adjustment resulting from the absent vacuum connections by means of the adjusting wheel on the adjusting angle measuring instrument. Renember difference.

6 - Increase speed slowly. The begin of the adjustment is indicated by the shifting of the notch. For rated values refer to 2.3-2/3.

7 - Adjust speed to values given on table. Use adjusting wheel on adjusting angle measuring instrument to "return the notch to mark in blower housing". Read adjustment in degrees on measuring instrument. Deduction of the difference (item 5) will show the centrifugal adjustment.

8 - If the test values are not in agreement with the rated values, repair the adjusting device of the ignition distributor (make operable, replace weak springs) or replace distributor.

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Checking the Vacuum Control Unit

The effect of the vacuum control unit can be checked by placing the previously removed vacuum hoses back on the engine now running at increased speed. The engine speed should rise considerably.

Caution!

On double-acting vacuum control units the advanced and retarded adjustment is checked separately, with the vaccum hose being pulled off the box which is not checked!

Vacuum adjustment "retarded"

1 - Connect stroboscopic lamp with adjusting angle measuring device and switch vacuum tester between the "retard box" of the ignition distributor and vacuum line to carburetor.

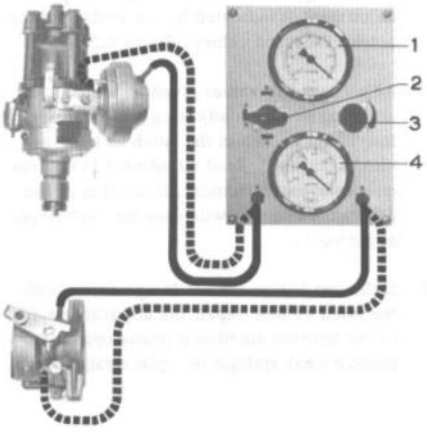
2 - Pull vacuum hoses from vacuum box.

3 - Run engine at 3500 rpm.

4 - Flash black mark. Read adjusting angle on adjusting angle measuring device and renember.

5 - Place vacuum hose for advance box on retard box.

6 - The difference between the adjusting angle now indicated and the remembered value is the vacuum adjustment "retarded".



1 - Vacuum indication 0-100 mm mercury
2 - Change-over valve
3 - Control valve
4 - Vacuum indication 0-600 mm mercury

Vacuum adjustment "advanced"

1 - Connect vacuum tester between "advance box" and vacuum line.

2 - Pull vacuum line from "retard box".

3 - Run engine at 3500 rpm and flash black mark (vacuum control valve must be opened).

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4 - Read adjusting angle on adjusting angle measuring instrument and remember.

5 - Close vacuum control valve.

6 - The difference between the adjusting angle now indicated an the remembered value is the vacuum adjustment "advance".

7 - If differences from the values stated in the table are shown during the test, proceed with the following checkup:

a - Check contact breaker plate for smooth operation, disassemble distributor, if required, and make contact breaker plate operable.

b - Check vacuum line and vacuum box for leaks and replace, if required.

IGNITION TIMING DATA FOR INSTALLED DISTRIBUTORS
(Component identification is shown in tables on page 2.2-1/1)

Distributor Type	Centrifugal Change				Vacuum Change		Direction of timing change
	Beginning RPM	RPM Degrees	RPM Degrees	Ending RPM Degrees	Beginning mm Hg	Ending mm Hg Degrees	
022 905 205 D	1050-1200	1500 14-17	2000 17-20	2900 22-27	100-130	200 11-14	Advanced
					60-100	150 8-12	Retarded
022 905 205 E+F	700-1050	1500 10-15	2000 14-19	3000 22-27	100-130	200 11-14	Advanced
					60-100	150 8-12	Retarded
022 905 205 J	700-1100	1500 10-15		3000 22-27	100-130	180-200 11-13	Advanced

NOTE:

Engine speed and degree values are with reference to the crankshaft.

Read ignition timing changes in relation to the white notch, i.e., TDC mark.

Check timing advance and retard separately, with vacuum hose removed. Observe instructions on page 2.3-2/1.

Beginning with engine No. W 0039 126 all distributors are equipped with a speed-limiting rotor. The speed limiter becomes effective at 5750 - 5950 rpm by short-circuiting the rotor to ground.

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Checking Centrifugal Advance - 1.8 liter engines beginning with 1974 models

1. Remove vacuum hoses and check ignition timing, readjusting if necessary.

2. Increase rpm slowly and adjust to the first specification in the table.

3. Turn adjusting knob in tester until the mark on the blower impeller is even with the notch in the housing.

   Add 7.5° to the timing angle shown in the tester and compare the sum of both with the specifications shown in the table.

   Proceed by setting the next higher rpm and continuing in same way.

Checking Vacuum Advance - 1.8 liter engines beginning with 1974 models

Accomplish the test as outlined on page 2.3-2/2. However, the single 7.5° mark is to be used in the 1.8 liter engines instead of the mentioned black mark.

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4 - Read adjusting angle on adjusting angle measuring instrument and remember.

5 - Close vacuum control valve.

6 - The difference between the adjusting angle now indicated an the remembered value is the vacuum adjustment "advance".

7 - If differences from the values stated in the table are shown during the test, proceed with the following checkup:

a - Check contact breaker plate for smooth operation, disassemble distributor, if required, and make contact breaker plate operable.

b - Check vacuum line and vacuum box for leaks and replace, if required.

ADJUSTING VALUES FOR INSTALLED IGNITION DISTRIBUTOR
(For equipment lists refer to 2.2-1/1)

Ignition distributor type	Centrifugal adjustment begin rpm	rpm degree	rpm degree	end rpm degree	Vacuum adjustment begin mm mercury	end mm mercury	direction of adjustment
022 905 205 A	1000-1200	1500 9-12	2200 15-18	2900 22-25	100-130 60-100	190 12-15 150 8-10	advanced retarded
022 905 205 B	1000-1200	1500 14-17	2100 14-17	2900 22-25	100-130 60-100	190 12-15 150 8-10	advanced retarded

Note:

All data on speed an degress are with reference to crankshaft.

Use black mark for checking the adjustment.

Check advanced and retarded adjustment of vacuum control unit separately, pulling the hose from the box not tested, observe instructions on page 2.3-2/1!

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TIMING ADVANCE SPECIFICATIONS FOR INSTALLED DISTRIBUTORS
1.8 LITER ENGINES BEGINNING WITH 1974 MODELS

Distributor	Beginning RPM Degrees	Centrifugal Advance		Termination RPM Degrees	Beginning mbar (mmHG)	Termination mbar (mmHG) Degrees	Direction of Change
		RPM Degrees	RPM Degrees				
022 905 205AA	980 - 1180	1500 14,5 - 19	2500 23,5 - 26,5	3400 29 - 32	120 - 160 (90-120)	240 - 267 (180 - 200) 9-12	advance
					73 - 160 (55-120)	193 - 254 (145-190)	retard
022 905 205 AB	980 - 1180	1500 14,5-19	2500 23,5-26,5	3400 29 - 32	73 - 160 (55-120)	193 - 254 145-190)	retard

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TEST IN THE EVENT OF FAULTS

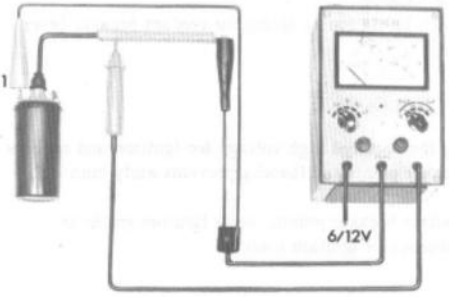
Testing the Ignition Coil

1 - Clean insulating cap and keep dry to eliminate arcing and creeping currents.

2 - Check flat plug for tight seat to eliminate voltage losses.

3 - Check ignition output with ignition coil tester.

Connect tester as shown in illustration. Operation is shown in the pertinent Operating Instructions.



Operation:

The high voltage end of the ignition coil (terminal 4) is loaded with a resistance and operated with a constant impulse sequence of the test instrument. The ignition voltage resulting from this load is measured. An approximate value is 18, 000 V (18 kV .

4 - If no ignition coil tester is available, test as follows:

First loosen cable from terminal 4 on ignition distributor cap (central cable) and hold against an earth connection at a distance of approx. 10 mm (0.4 inches). The test should be made with insulating pliers. When cranking the engine with the starter, a spark should jump from the cable end to mass. When there is no spark, first measure voltage on terminal 15 of ignition coil with a voltmeter. In a 12 volt system, the voltage should be at least 9 volts.

If the voltage is above that value, check with voltmeter or an inspection lamp on terminal 1 of ignition coil (connection to ignition distributor) whether no voltage is available with the contacts closed and voltage with the contacts open. If the voltmeter does not deflect even with the contact breaker points open (ignition distributor has no short circuit), the ignition coil is interrupted an should be replaced.

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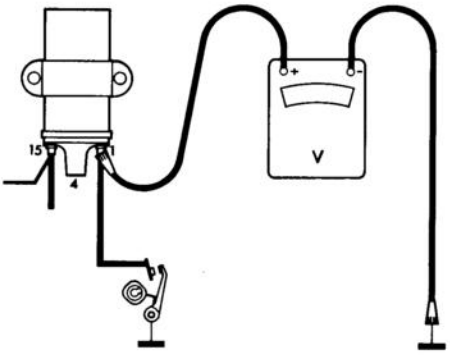
Testing the Contact Breaker Points (electrically)

Connect voltmeter to terminal 1 of ignition coil and to mass. Crank engine until the contact breaker points in the ignition distributor are closed. The indicator should deflect. Open contact breaker points - the indicator should not deflect. If the indicator does not deflect with the contact breaker points closed, the contacts are either contaminated or burned.

But if the indicator deflects with the contacts opened the ignition distributor has a short circuit. Check the following points:



1 - Capacitor
2 - Cable passage
3 - Cable
4 - Insulation on spring for contact breaker lever

Checking the Capacitor

The capacitor has a considerable influence for attaining the required high voltage for ignition and reduces simultaneously sparking when separating the contact breaker points and thereby prevents early burn-off.

A defective capacitor is indicated by heavily burned contact breaker points, weak ignition sparks in combination with starting troubles or by the complete absence of ignition sparks.

Defective ignition capacitors are extremely rare.

Capacitors can be checked for shorts by means of an inspection lamp:

Pull cable 1 to ignition distributor on ignition coil. Connect an inspection lamp between terminal 15 of ignition coil and cable 1 on ignition distributor. With the contact breaker points open and the ignition switched on, the lamp should not light up, if it does, the capacitor has a short.

There are testers in which in addition the insulation resistance, the capacity and the series resistance on the capacitor can be determined. When such testers are used, always observe pertinent Operation Instructions.

For replacement use only capacitors of the specified type, since capacitors with different capacities may have unfavourable influence on breaker contact points (see Spare Parts Catalogue .

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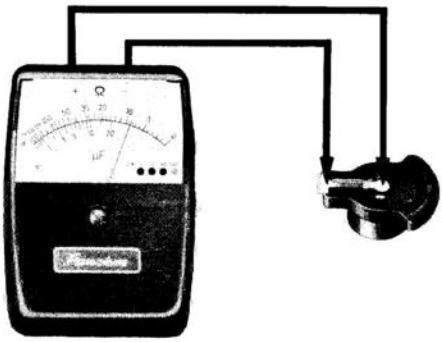
Checking Suppression Resistors

The resistance of ignition lines with copper core is too low to suit the radio suppression regulations of some countries. For this reason, suppression resistors are installed into spark plugs and into distributor rotors. In addition, upon installation of an automobile radio the plugs of the ignition lines are suppressed in many cases.

These suppression resistors may be the cause for misfiring.

1 - Checking distributor rotor with an ohmmeter.

The suppressed distributor rotor has a cast-in resistor which may be of a size of up to 10 k ohm. If a higher value is shown, replace distributor rotor.



2 - Checking spark plugs and ignition line plugs with an ohmmeter.

The resistance rating of a spark plug or ignition line plug may be max 5-10 k ohm.

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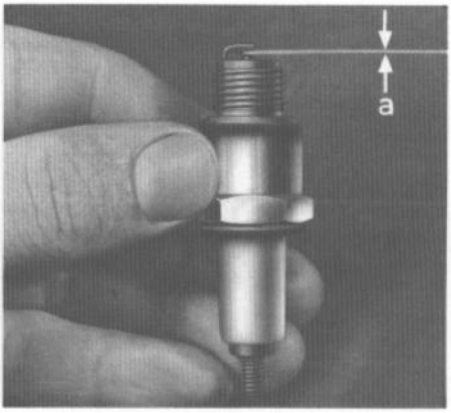
CHECKING DISASSEMBLED COMPONENTS OF IGNITION SYSTEM

Checking Spark Plugs

In operation, the electrode gap of the spark plugs will increase by natural burn-off. If the gap is too large, the plug may fail. In addition, there may be ignition troubles by contaminated plugs.

The electrode gap is measured with a spark plug gauge and the earth electrode is bent to the specified value "a".

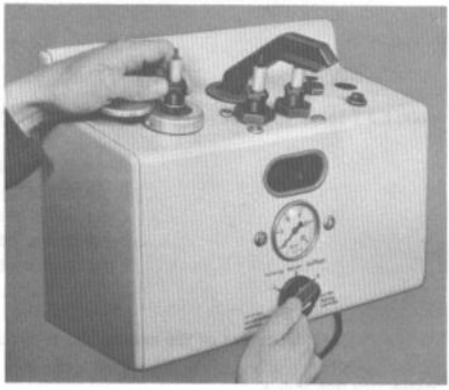
"a" = 0.7 mm (.0275 inch)



Spark plugs are checked for perfect operation by means of testers, in which the spark must jump under pressure (6-8 kg/cm^2 = 85-122 psi) and can be observed through a sight hole.

Most of these equipments can also be used for cleaning spark plugs. An older principle is using a sand jet. Modern equipment uses special cleaning agents.

Contaminated plugs may be cleaned only with a cleaning unit. Steel brushes and similar tools are not suited for cleaning spark plugs.



Checking the Ignition Distributor on Test Bench

The cam offset, the vacuum adjustment, the centrifugal adjustment and the timing angle can be checked on an ignition timer test bench. Various test benches of this type are available. The following equipment applies to all of them:

Controllable drive motor, revolution counter, vacuum pump and vacuum measuring instrument, which must have an additional measuring range of 0-100 mm mercury for ignition distributors installed in VW engines.

The foolowing test sequence will be suitable:

1 - Attach ignition distributor, watch out for quiet operation.

2 - Test timing angle (refer to 2.3-1/2). If required, adjust contact gap and thereby the timing angle.

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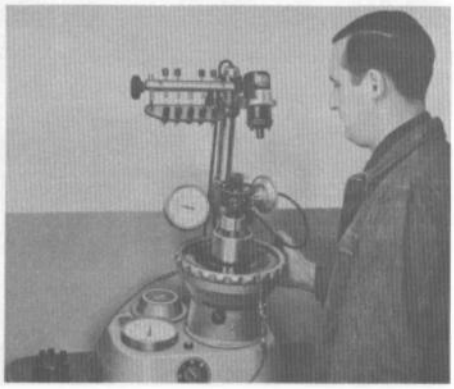
3 - Set speed to max. 500 rpm, watching out that the centrifugal adjustment has not yet begun.



4 - Check vacuum boxes for leaks. With the vacuum line closed, a vacuum of 100 mm mercury should remain constant for approx. 1 minute.

5 - When the vacuum drops, check advanced and retarded adjustment separately, keeping the connection of the untested box open. Adjust as many points of vacuum curve as possible and read the actually attained adjusting values on scale of test bench. The measured values should be within the hatched fields of the adjusting curve. If they are outside, repeat measurements with a new vacuum box.

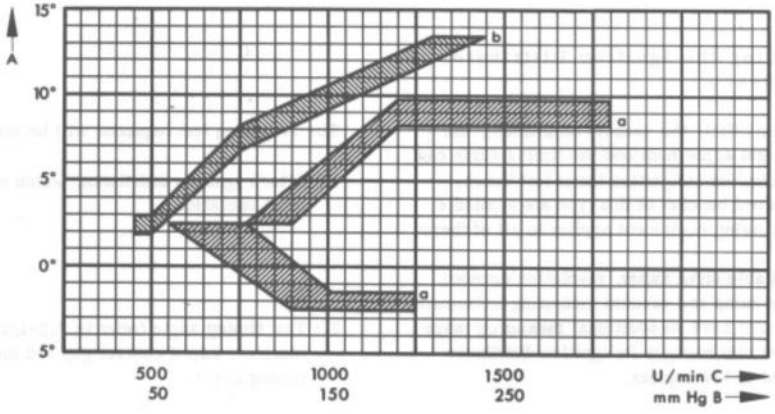
6 - Check speed-dependent adjusting curve. Here too, the measured values should remain within the hatched fields of the adjusting curve.

ADJUSTING CURVES FOR REMOVED IGNITION DISTRIBUTORS

A - Adjustment in degrees distributor shaft
B - Vacuum in mm mercury
C - rpm on distributor shaft
a - Vacuum adjusting curve
b - Centrifugal adjusting curve

The adjustment of the centrifugal force is measured starting from 1500 rpm with declining speed.

Bosch 022 905 205 A



2.3-4/2 Checking Disassembled Components of Ignition System Printed in Germany
Adjusting Curves for Removed Ignition Distributors

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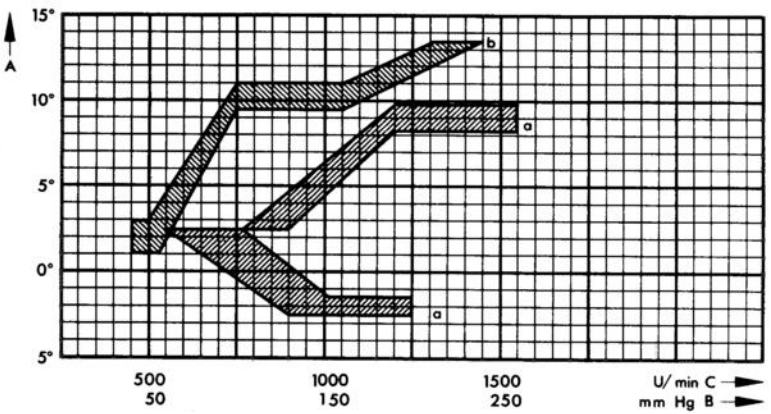
Bosch 022 905 205 B



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TOOLS

No.	Designation	Special Tool	Explanations
1	Puller for starter bushing	VW 228b	

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REMOVAL AND INSTALLATION OF IGNITION DISTRIBUTOR

Removal

1 - Disconnect both cables between ignition coil and ignition distributor. Pull vacuum hoses from vacuum box.

2 - Remove distributor head.

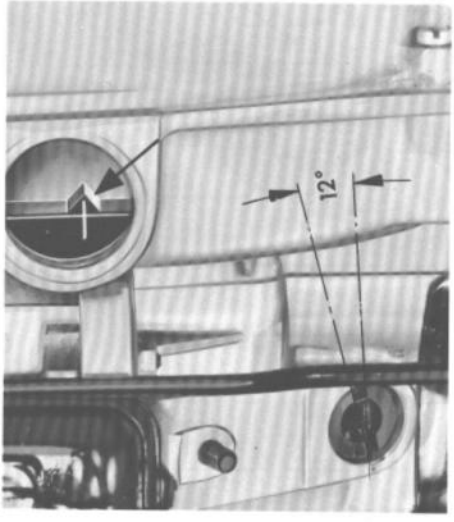
3 - Loosen screw on holder for ignition distributor.

4 - Remove ignition distributor.

5 - Cover opening in crankcase.

Installation

1 - Adjust Cylinder 1 to firing point. The white notch, i.e., the TDC mark, should coincide with the reference mark. The offset slot in the top end of the distributor drive shaft should be at an angle of approx 12° in relation to the longitudinal axis of the engine; the smaller sector faces towards vehicle outside.



2 - Turn distributor rotor on ignition distributor until it points toward the mark for cylinder 1 on distributor housing.

3 - Insert ignition distributor.

4 - Adjust ignition.

When installing the distributor in 1.8-liter engines, beginning with the 1974 models, use the 7.5° mark instead of the indicated TDC mark.

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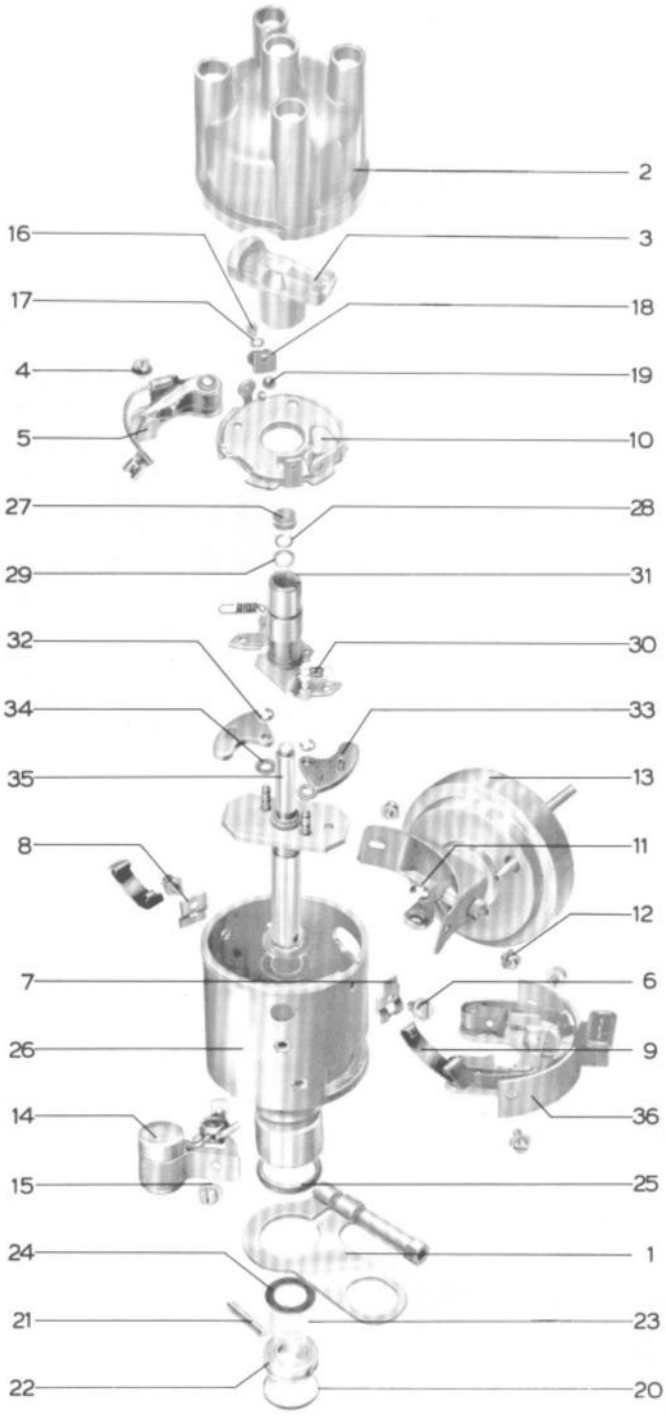

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No.	Designation	Each	Observe during: Removal	Observe during: Installation	Special Instr.
1	Holder for ignition distributor	1			
2	Ignition distributor head	1		Watch out for cracks, traces of creeping currents and for perfect condition of carbon	
3	Distributor rotor	1			
4	Fastening screw for contact breaker	1			
5	Contact breaker	1		Replace, adjust gap	
6	Cheesehead screw	2			
7	Fastening plate with lug for holding spring	1		Install close to cutout in ignition distributor housing	
8	Fastening plate for holding spring	1			
9	Holding spring	2			
10	Contact breaker plate	1		Grease with multi-purpose grease on running surfaces	
11	Circlip for pull rod attachment	1			
12	Cheesehead screw	2			
13	Vacuum box	1		Check for leaks	
14	Capacitor	1			2.3-3/2
15	Cheesehead screw	1			
16	Cheesehead screw	1			
17	Spring ring	1			
18	Holding spring for ball	1		Grease with multi-purpose grease	
19	Ball	1			
20	Circlip for driver claw	1			
21	Pin for driver claw	1			
22	Driver claw	1		Watch out for correct position	2.4-2/2
23	Compensating washer 0.1 mm	1		Should rest against claw	
24	Fiber washer	1		Should rest against distributor housing	
25	Rubber sealing ring	1		Replace	
26	Distributor housing	1	Do not wash bushings w. gasoline		
27	Felt washer	1		Soak with engine oil	

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