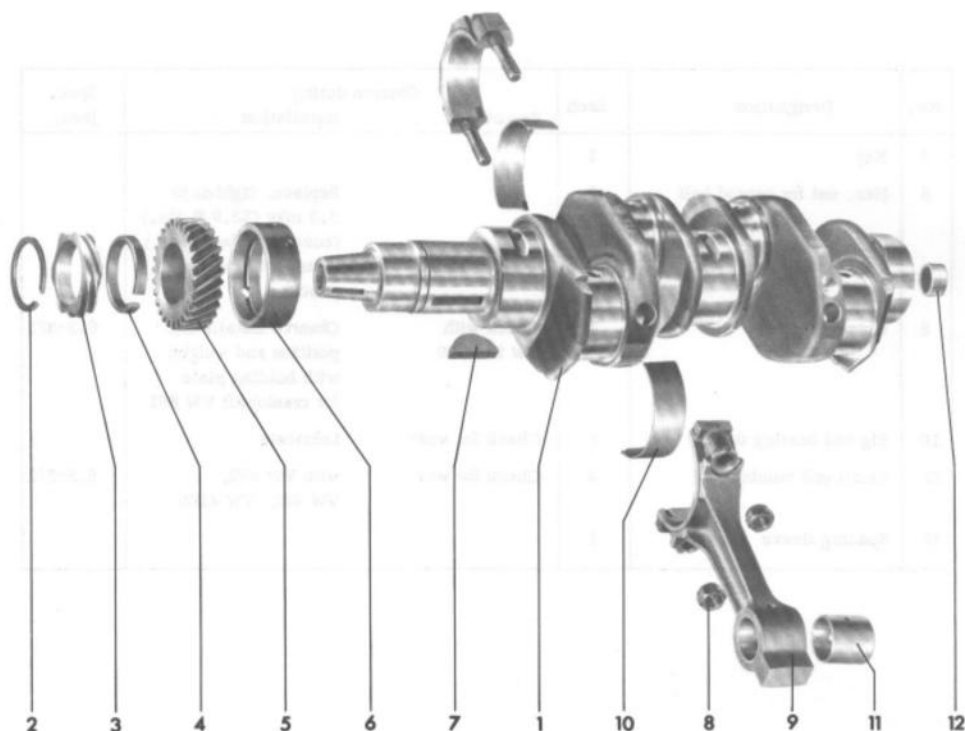


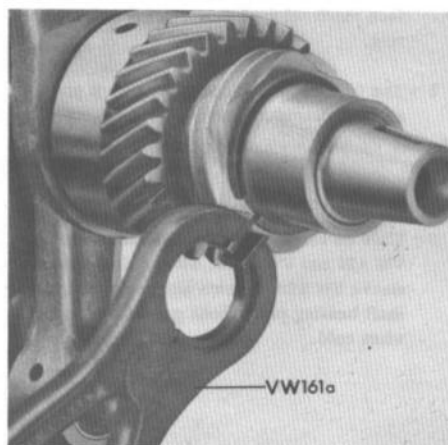
No.	Designation	Special Tool	Explanations
1	Holding rails for bearings of differential	VW 457	
2	Peening punch	VW 124b	
3	Pipe tool, 60 mm dia. (2.4")	VW 415a	
4	Guide sleeve, tapered	VW 428	
5	Guide sleeve	VW 427	
6	Holding plate for crankshaft	VW 801	
7	Inspection and reaming fixture for connecting rod	VW 214f/70	
8	Pressure plate	VW 402	
9	Pipe tool	VW 421	
10	Pipe tool	VW 416b	
11	Punch	VW 409	
12	Circlip pliers	VW 161a	
13	Feeler gauge		



No.	Designation	Each	Observe during:		Spec. Instr.
			Removal	Installation	
1	Crankshaft	1	Check for wear		6.3-2/1
2	Locking ring	1	with circlip pliers with VW 415a, VW 428, VW 161a		
3	Ignition distributor drive gear	1	Check for wear	Heat to approx. 80°C (176°F) with VW 415a, VW 427	6.3-2/1
4	Intermediate ring	1			
5	Crankshaft gear	1	Remove on press with VW 457	Heat to approx. 80°C (176°F), chamfer facing bearing 3 with VW 415a, VW 427	6.3-2/1
6	Crankshaft bearing 3	1	Check for wear	Lubricate, hole for set pin facing crank web	

No.	Designation	Each	Observe during:		Spec. Instr.
			Removal	Installation	
7	Key	1			
8	Hex. nut for conrod bolt	8		Replace, tighten to 3.3 mkg (23.9 ft.lbs.) (contact surface lubr.), secure with peening punch	
9	Connecting rod	4	Check with VW 214f/70	Observe installation position and weight, with holding plate for crankshaft VW 801	6.3-3/1
10	Big end bearing shell	8	Check for wear	Lubricate	
11	Small end bushing	4	Check for wear	with VW 402, VW 421, VW 416b	6.3-3/2
12	Spacing sleeve	1			

DISASSEMBLY AND PREASSEMBLY OF CRANKSHAFT

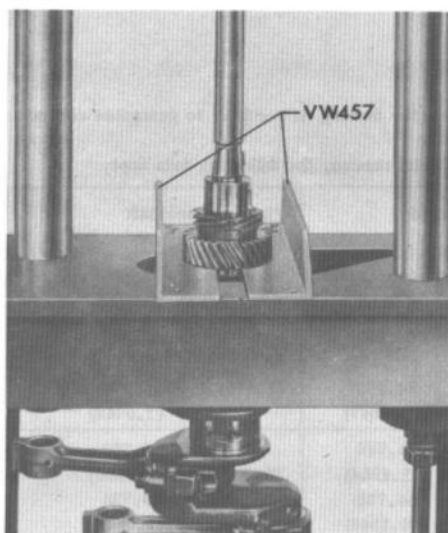


Disassembly

- 1 - Remove locking ring for ignition distributor drive gear with circlip pliers VW 161a.

Caution!

Do not store removed crankshaft without corrosion protection by oil or grease.



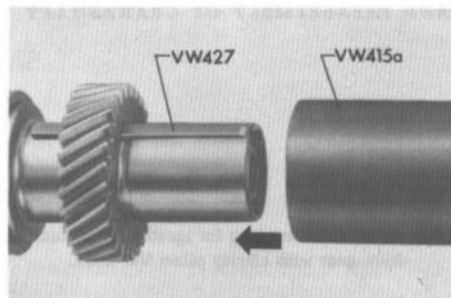
- 2 - Remove ignition distributor drive gear, intermediate ring and crankshaft gear on repair press in combination with holding rails from VW 457.

Slight seizing marks may be carefully removed, but without impairing press seat.

Checkup

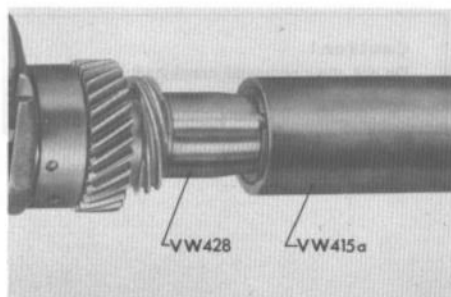
- 1 - Check crankshaft for out-of-true, cracks (resonance test) and wear. If required, regrind crankshaft or replace.
- 2 - Clean crankshaft and blow compressed air through oil ducts.
- 3 - Inspect bore of crankshaft gear and ignition distributor drive gear for seizing marks and check contact pattern of teeth.

Out-of-true on 2nd and 4th bearing (bearings 1 and 3 on V-blocks)	Bearing journals out-of-true	Unbalance
max. 0.02 mm (.0008")	max. 0.03 mm (.0012")	max. 12 cmg



Preassembly

- 1 - Heat crankshaft gear in oil bath to approx. 80°C (176°F) and fit in combination with VW 427 and VW 415a. The chamfer should face the crankshaft bearing. Fit intermediate ring.
- 2 - The ignition distributor drive gear is pressed on in the same manner.



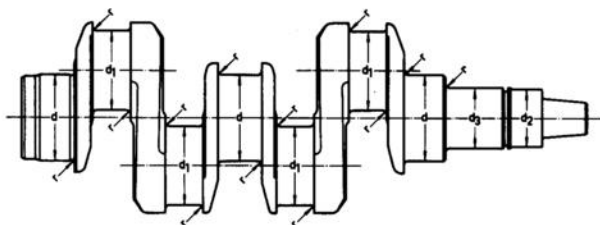
- 3 - Slide on locking ring in combination with VW 428 and VW 415a. The conical guide sleeve VW 428 prevents any damage to crankshaft bearing pin. Check gears for tight seat when cold.

RECONDITIONING OF CRANKSHAFT

Crankshafts which must be reconditioned should be sent to the factory, if possible, to guarantee accurate and expert regrinding.

In cases where the crankshaft cannot be submitted for special reasons, the following data apply:

	Pins for crankshaft bearings 1, 2 a. 3 (d_1)		Pins for conrod bearing (d_1)		Pins for crankshaft bearing 4 (d_2)	
	Rated dia. mm (in.)	Lapping dia. mm (in.)	Rated dia. mm (in.)	Lapping dia. mm (in.)	Rated dia. mm (in.)	Lapping dia. mm (in.)
Normal	60.00 (2.362)	59.990 (2.3618) 59.971 (2.3611)	55.00 (2.1654)	54.996 (2.1652) 54.983 (2.1647)	40.00 (1.575)	40.000 (1.5748) 39.984 (1.5742)
Undersize 1	59.75 (2.353)	59.740 (2.3520) 59.721 (2.3512)	54.75 (2.156)	54.746 (2.1554) 54.733 (2.1548)	39.75 (1.565)	39.750 (1.5650) 39.734 (1.5643)
Undersize 2	59.50 (2.342)	59.490 (2.3421) 59.471 (2.3414)	54.50 (2.146)	54.496 (2.1455) 54.483 (2.1450)	39.50 (1.555)	39.500 (1.5551) 39.484 (1.5545)
Undersize 3	59.25 (2.332)	59.240 (2.3323) 59.221 (2.3315)	54.25 (2.136)	54.246 (2.1357) 54.233 (2.1352)	39.25 (1.545)	39.250 (1.5453) 39.234 (1.5446)



$$\begin{aligned}
 d_3 &= \frac{42.006}{41.995} \text{ mm dia.} & r &= \frac{2.5}{2.0} \text{ mm dia.} \\
 &= \frac{1.6538}{1.6534} \text{ in. dia.} & &= \frac{.098}{.079} \text{ in. dia.}
 \end{aligned}$$

Careful grinding of radii on crankshaft and camshaft bearing pins is of decisive importance for the life of the crankshaft. Try for a value of 2,5 mm (.098 in.). The radii must be polished.

Regrinding

Never refinish bearing shells.

Following the grinding, be sure that the oil holes have no sharp edges. Chamfer edges lightly, if required.

The crankshaft gear and the ignition distributor drive gear should be pressfit to crankshaft
 42.006 mm dia. (1.6538 in.)
 41.995 mm dia. (1.6534 in.) If repeated removal and fitting of these gears will loose the pressfit, chromeplating or the spraying of metal at the pertinent spots may reestablish the required pressfit.

To be sure that the crankshaft is free of cracks, a resonance test is recommended prior to installation. Then check crankshaft for out-of-round.

INSPECTION AND INSTALLATION OF CONNECTING RODS

Checkup

- 1 - Check connecting rods for external damage. Replace entire connecting rod, even if only the bolts are damaged.

- 2 - Check connecting rod weight.

The difference in weight of the connecting rods in one engine should not exceed 6 grams.

Conrod weight = conrod complete, but without bearing shells.

2 Weight classes are available for installation,

white = 746-752 grams

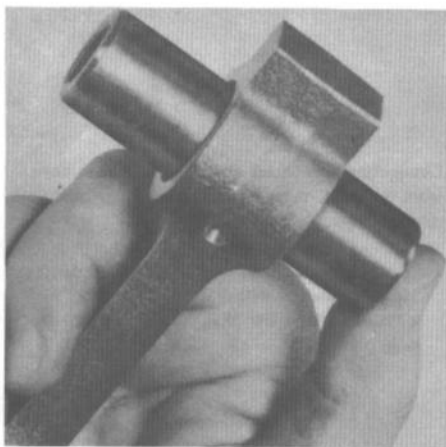
black = 769-775 grams

which are also available as spare parts.

Refinishing is therefore not required.

The colour coding is on connecting rod cap.

- 3 - Check conrod bushing. In a new bushing the normally tempered piston pin should slip in easily under light finger pressure.

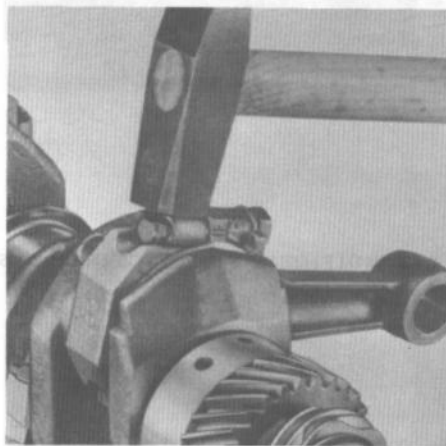


- 4 - Square connecting rod in conrod testing fixture VW 214f/70; straighten, if required.

Installation

- 1 - The code numbers on the parting joint of connecting rod top and bottom should be located on one side.

- 2 - Slight distortions which may occur when tightening the conrod bolts between the bearing halves may be removed by applying light hammer blows against both sides of connecting rod.

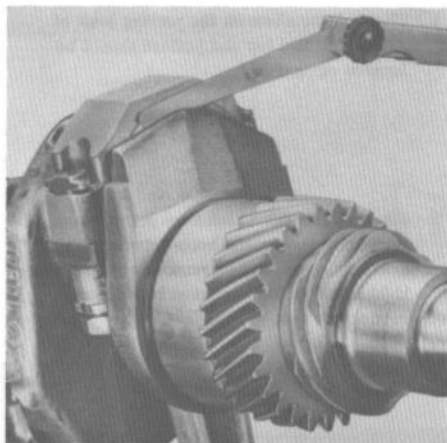


The connecting rod should slide under its own weight. Any refinishing or recessing of bearings is never permitted.

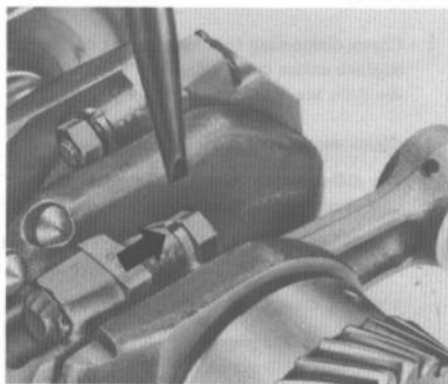
- 3 - Measuring axial play of connecting rod with feeler gauge.

During installation (new): 0.1-0.4 mm
(0.004-0.016")

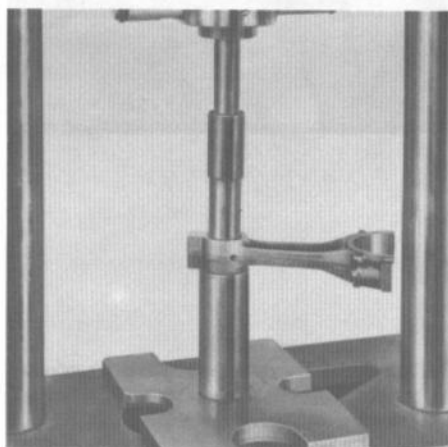
Wear limit: 0.7 mm
(0.026")



- 4 - Secure hex. nuts with peening punch VW 124a.



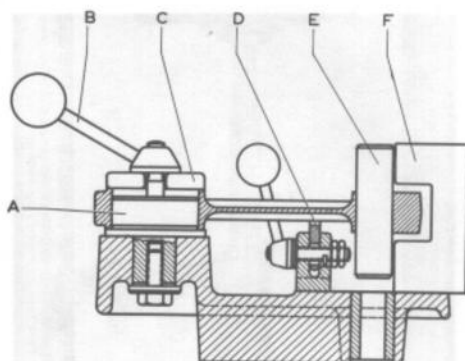
RECONDITIONING CONNECTING RODS



Connecting rods which are slightly bent or have worn bushings, must be squared and provided with new bushings.

- 1 - Remove small end bushings in VW repair press in combination with VW 402, VW 409, VW 416b, and VW 421.

2 - Insert connecting rod in fixture VW 214f/70.

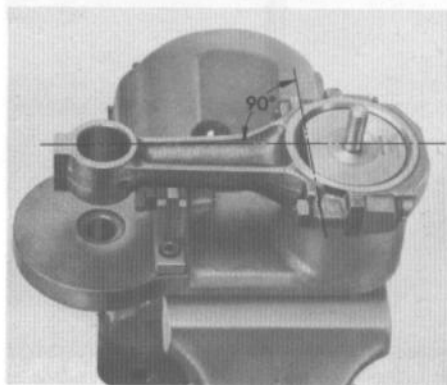


A - Receiving mandrel D - Support
B - Locking lever E - Bolt
C - Take-up washer F - Sight gauge

Turn mandrel A in such a manner that the milled surface is crosswise to center axis of connecting rod.

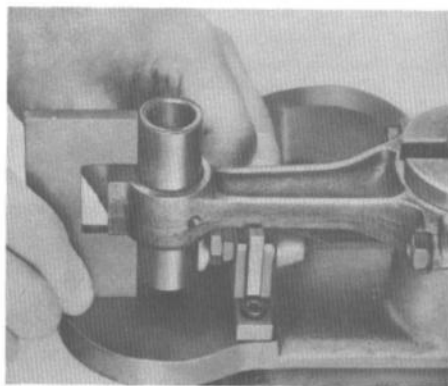
3 - After fitting washer C, tighten locking lever B only to the extent that the connecting rod is still movable in both directions. Support D is loose.

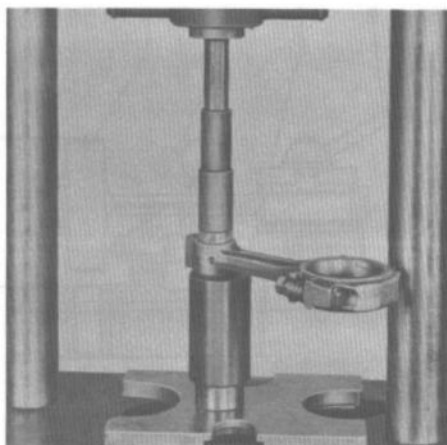
4 - Introduce bolt E into conrod eye and push with two fingers in the direction of mandrel A in such a manner that no canting will occur between the receiving mandrel and the conrod bearing or between the conrod eye and bolt.



5 - Check connecting rod for distortion and parallel alignment. (The illustration shows the inspection for parallel alignment).

If there are deviations, tighten locking lever well and straighten connecting rod with straightening mandrel.





6 - Install small end bushing on VW repair press in combination with VW 402, VW 409 and VW 421.

7 - Drill oil holes (3,5 mm dia. = 0.14").

8 - Place rod of reamer through conrod eye and pertinent bore of fixture, with the conical guide bushing serving for centering the small end bushing.

Tighten locking lever and support for holding connecting rod.

Small end bushing ID	24,015-24,024 mm dia. (0.9455-0.9458")
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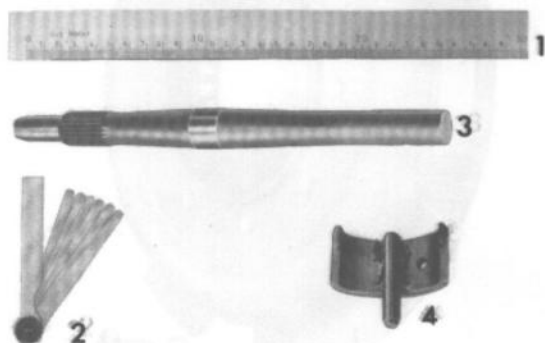


Following the reaming, the inside surface of the bushing should be free of score and chatter marks. The piston pin should slide in easily under finger pressure and without using oil. If bushings have been reamed too much by mistake, the non-permissible play between the piston pin and the bushing should not be compensated by installing an oversize piston pin. Always use a new bushing and ream.

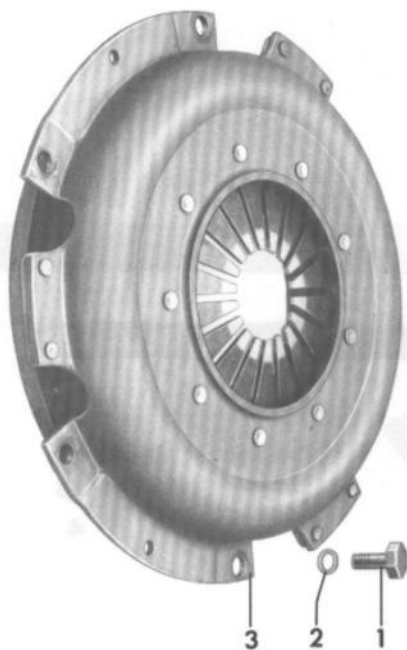
9 - Check parallel alignment and distortion once again, this time with the piston pin inserted as described above. Any slight differences can be straightened out by introducing a mandrel into piston pin.



TOOLS



No.	Designation	Special Tools	Explanations
1	Steel straightedge		at least 200 mm (7.9 in.) long
2	Feeler gauge		commercial
3	Input shaft		
4	Holding clip for flywheel	VW 215c	

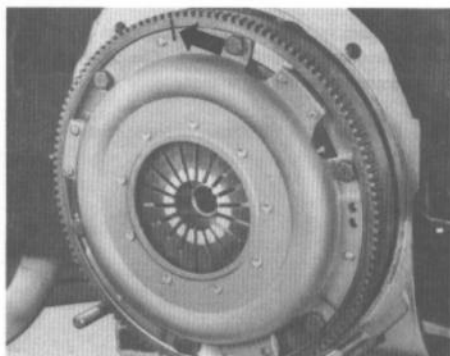


No.	Designation	Each	Observe during:		Spec. Instr.
			Removal	Installation	
1	Multi-tooth screw M 7 x 15	6		Tighten crosswise to 2,0 mkg (14,5 ft.lbs.)	
2	Spring plate	6			
3	Diaphragm spring clutch	1	Mark installation position, check for wear		7.1-2/1

REMOVAL AND INSTALLATION OF CLUTCH

Removal

- 1 - New engines are balanced following assembly, this is why the installation position of the clutch should be marked, to eliminate major unbalance during reinstallation.



- 2 - Loosen fastening bolts uniformly.

Loosen bolts alternately and crosswise by one or two turns, until the spring action stops, to eliminate any distortion of cover.

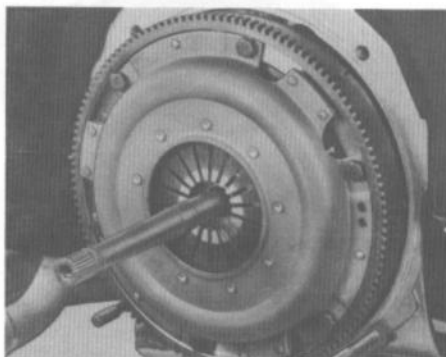
Installation

Observe the following instructions for installation:

- 1 - Clean contact surface of clutch disk in flywheel and check for wear. Surface cracks and score marks can be removed by grinding or machining. If required, replace flywheel.
- 2 - Coat needle bearing in flywheel with approx. 0.2 cm multi-purpose grease only if it has been cleaned. Moisten felt ring with engine oil. Wipe off excess lubricant.
- 3 - Check clutch and clutch disk. Instructions on how to conduct an inspection are contained in the sections "Inspection of Clutch" and "Clutch Disk".
- 4 - Check splining of input shaft and coat lightly with molybdenum disulfide powder. Apply powder with a brush or a piece of non-fraying cloth. The clutch disk should slide easily without unpermissible radial play.

- 5 - Check clutch throwout bearing. The throwout bearing requires no service. Do not wash or flush with cleaning gasoline or other cleaning agents, but with a clean cloth only. Replace bearings which are contaminated inside and out. Watch out for correct seat of holding springs. Grease guide bushing lightly with molybdenum disulfide paste.

- 6 - Insert clutch with clutch disk into flywheel. Accurate centering of clutch disk is performed with the assistance of an input shaft.



- 7 - Observe balancing marks.

When a new clutch is installed, the balancing marks on clutch and flywheel should be offset by 180°.

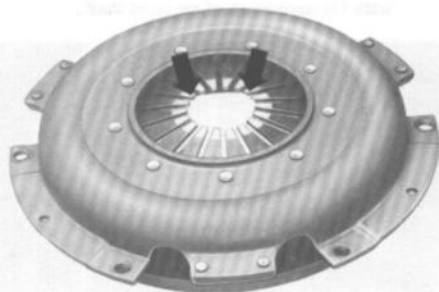
	Designation (heavy end)
Flywheel	White paint stripe on outside edge, if remaining unbalance is between 5 and 20 cmg.
Clutch	White paint stripe on outside edge, if the remaining unbalance is between 5 and 15 cmg.

- 8 - Tighten fastening bolts uniformly and crosswise to 2.0 mkg. (14.5 ft.lbs.)

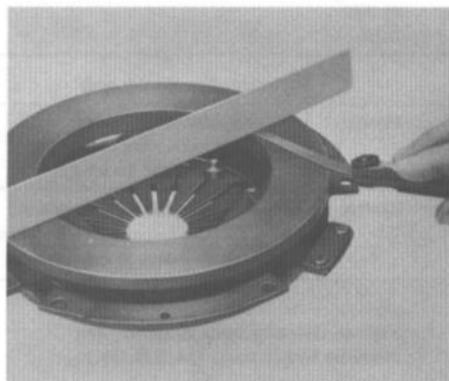
INSPECTING CLUTCH

The inspection of the diaphragm spring clutch is restricted to a thorough sight test. Any reconditioning or repairing of clutch in workshops is not intended.

- 1 - Check ends of diaphragm spring for wear marks (support of clutch throwout bearing). Wear marks of up to 0.3 mm (0.0012 in.) are of no significance.

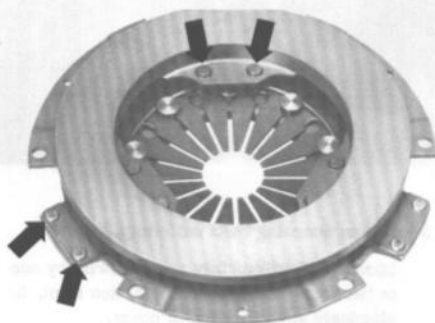


- 2 - Check supporting surface of pressure plate for cracks, burned spots and wear. Pressure plates which are bent inwards up to 0.3 mm (0.0012 in.) are still fit for installation.



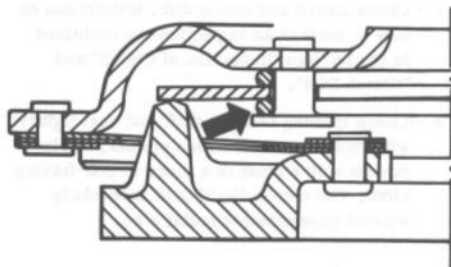
- 3 - Inspect spring connections between pressure plate and cover for cracks. Check rivet connections for tight seat.

Clutches with damaged or loose riveting

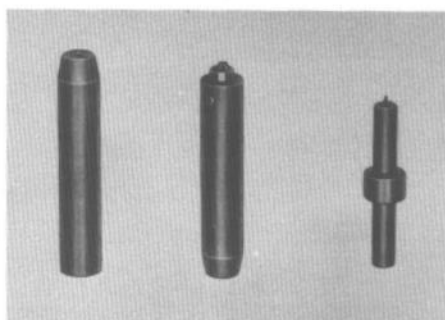


- 4 - The diaphragm spring is mounted on cover between two wire rings by means of a rivet connection.

Clutches with visible wear on rivet head or wire ring should be replaced.



TOOLS



No.	Designation	Special Tool	Explanations
1	Riveting tool for clutch disk	VW 783	

INSPECTION OF CLUTCH DISK

- Toothings:** The clutch disk should slide easily on input shaft without unpermissible radial play. Replace worn parts.
- Riveting:** Check riveting; replace clutch disk, if required.
- Spring elements:** If the spring elements or the driven plate are cracked, completely replace clutch disk.
- Clutch lining:** Replace worn, cracked, oily or burned linings.
- Out-of-true:** Check clutch disk for lateral wobble. Max. 0.5 mm (0.02 in.) at 210 mm dia. are permitted, (8.3"). Straighten slightly distorted disks with rubber hammer.

LINING CLUTCH DISK

- 1 - Unusable linings may not be removed by tearing them off but by drilling the rivets on rivet head end.

- 2 - Use only linings approved by Volkswagen.

Flywheel end: Jurid or Textar

Clutch end: Textar

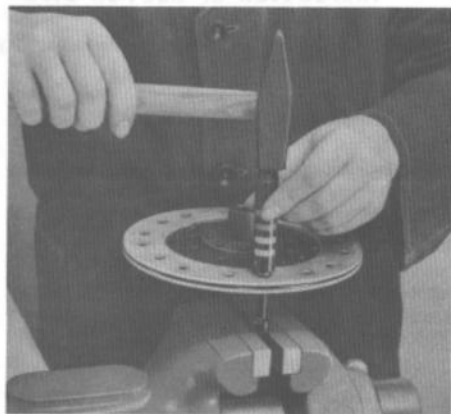
- 3 - For attaching clutch linings on clutch disk use only rivets (spare part No. 311 141 195 A), which have a 2 mm dia. (0.08 in.) bore.

- 4 - When riveting, be sure that the rivet shoulder is always inserted into the larger bore of the double lining spring. Riveting is done on clutch lining.

Caution!

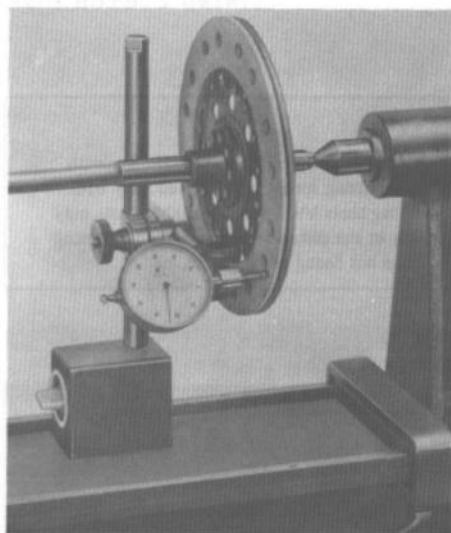
Riveting clutch linings on clutch disks with double lining spring is permitted only with riveting tools VW 783. Unsuitable tools may result in the distance between the two lining springs not being maintained.





5 - Using riveting tools VW 783:

- a - Clamp riveting support into vise.
- b - Split rivet with rivet header, but be sure not to turn header.
- c - Double-punch individual rivet segments with die.



6 - Upon application of lining, check clutch disk for out-of-true.

Permissible lateral out-of-true (measured at 210 mm dia. = 8.3"): max. 0.5 mm (0.02").

The engine used in Type 914/2.0 vehicles is an air cooled, four cylinder, four cycle unit with valves in head (OHV). The cylinders are arranged in two opposed banks of two cylinders each. The engine is attached to the transaxle by four bolts. The power train, consisting of engine, transmission, and differential, is supported by two mounts, that is, a transverse engine mount, bolted in the center to the crankcase and at both ends to the longitudinal body side members, supporting the forward part of the power train, and the rear transverse mount which rests in rubber cushions.

Ignition System

The ignition system is battery powered. It incorporates an ignition coil and a distributor with automatic spark advance with centrifugal and vacuum control. The ignition system transforms battery voltage from 12 volts to the required ignition voltage, delivering it to each of the four spark plugs in proper sequence and at an exact firing time with the aid of a distributor. The distributor is driven by the crankshaft through a worm gear and shaft.

Cooling

The cooling system utilizes a radial blower. The blower impeller is attached to the crankshaft hub by three bolts. It draws air through an opening in the blower housing and forces it through shrouds and baffles to the finned cylinders and cylinder heads. Part of the fresh cooling air is used for the interior compartment heating by passing through heat exchangers which encase part of the exhaust pipes.

A thermostat located below cylinders 1 and 2 actuates two flaps in the intake ducts of the forward half of the cooling blower housing by means of a control cable. The flaps control the flow of fresh air to permit quicker engine warmup and also maintain a fairly constant operating temperature under all load conditions; this provision does not affect the flow of heating air.

Oil Circulation

The engine is lubricated by a forced feed system with an oil cooler. The gear type oil pump is located on the driven end of the camshaft and is driven by it. The oil is picked up from the lowest point in the crankcase and forced into the oil galleries in the crankshaft to lubricate the connecting rods. Another part of the oil lubricates the camshaft bearings, while still another part flows through the hollow push rods to the rocker arms where it lubricates rocker arm bearings and the valve stems. The cylinder walls, pistons, and piston pins are splash lubricated.

Dirt particles are kept out of the lubrication system by a full flow oil filter as well as a screen located at the lowest point in the crankcase. Should the oil filter become clogged, a ball check valve located in the filter base opens a bypass channel allowing the oil to flow directly to the points of lubrication.

The oil cooler is mounted on the crankcase side and is cooled by air drawn by the cooling blower. It is located in the oil circuit in such way that oil pumped by the pump must pass through the oil cooler before reaching the individual lubrication points. This cooling system ensures that the oil retains all its lubricating qualities even at high outside air temperatures and maximum engine loads.

A bypass valve allows part of the oil to bypass the oil cooler and flow directly to the oil galleries when the oil is cold and thick. A pressure relief valve located at the oil circuit terminal end maintains an oil pressure of about 2.0 atm (25.5 psi) in the main bearing and camshaft bearing area.

An oil pressure switch (sensor) is located in the pressure line between the oil pump and oil cooler. It opens the warning lamp circuit when the oil pressure has reached 0.15 - 0.45 atm (2.2 - 6.5 psi).

The oil pressure warning lamp lights up when the ignition switch is turned on or when the oil pressure is too low.

Cylinder Heads

Each two cylinders have one common, removable, and extensively finned light alloy cylinder head with shrunk-in valve seats and guides. The valves are located overhead. The exhaust valves are armored in high grade chrome-nickel steel. In addition, to provide better heat dissipation, the stems are sodium filled.

Valve Timing

The camshaft is located in the crankcase and rides in three split-sleeve steel inserts which are coated with white metal. It is driven by the crankshaft through helical gears. Bearing number 3 takes up the axial thrust of the camshaft. Camshaft gear is made of light alloy and is riveted to the camshaft. Valve timing is effected by cams through cam followers, pushrods, and rocker arms. Each cam actuates one valve in each of two opposing cylinders.

Cylinders

The four special-cast cylinders are uniform in design and can be individually replaced together with their corresponding pistons. Cooling is by air with heat dissipation through integral cooling fins.

Pistons

The steel reinforced pistons have two compression rings and one oil scraper ring in each. An expander is located between the piston and oil scraper ring. The piston pins float in the small end bushing of the connecting rods and are secured in the pistons by circlips.

Crankcase

The two-piece crankcase is made of pressure cast light alloy. Both halves are machined together as a pair during manufacture and cannot be replaced individually.

Crankshaft

The crankshaft is symmetrically forged with all bearing journals induction hardened. Four main bearings are used. Bearings 1, 3, and 4 are aluminum-sleeve inserts with leaded surface. Bearing $\neq 2$, as seen from the clutch side, is a split-sleeve tri-metal insert. Bearing $\neq 1$ also takes up the axial thrust of the crankshaft. The flywheel, with integral starter gear, is attached with five bolts and secured against torsional slippage. Camshaft and distributor drive gears are secured with Woodruff keys. The hub of the cooling blower impeller is seated on the conical shaft end and secured with a Woodruff key and nut. Crankshaft sealing at the flywheel and cooling blower ends is by means of oil seals.

Connecting Rods

The four connecting rods are steel forgings with I-section shank. The big ends of the connecting rods ride on tri-metal bearing inserts; the small ends have lead-bronze coated steel bushings to accommodate the piston pins.

Clutch

The single plate, dry clutch disc has linings on both sides and is free to move axially on the input shaft splines. The clutch cover, which accommodates the clutch pressure plate and diaphragm spring, is bolted to the flywheel. In engaged condition, the clutch disc is pressed against the flywheel by the clutch pressure plate and diaphragm spring, thus providing for power transfer between engine and transmission.

Distributor - 1975 Models

AFC Fuel Injected Engine

The distributor centrifugal spark advance vacuum retard curves are identical to the 1974 specifications (vacuum spark advance is not used).



Distributor rotor without speed limiter



Distributor rotor with speed limiter

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.



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

TECHNICAL DATA

Power Rating	70 KW (95 DIN HP)
Identification Symbol	GA
Type	aircooled 4-stroke gasoline injection engine integrated with transmission and differential in rear of vehicle
Number of cylinders	4
Cylinder arrangement	opposed four, 2 cylinders each bank
Bore	94 mm
Stroke	71 mm
Piston displacement	1971 cc
Compression ratio	7,6:1
Max. power output (DIN) KW $\frac{1}{\text{min}}$ (HP/rpm)	70/4900 (95/4900)
Max. torque (DIN) Nt $\frac{1}{\text{min}}$ (mkg rpm)	147/3000 (15,0/3000)
Mean piston speed m/s $\frac{1}{\text{min}}$ (m/s rpm)	11,6/4900
Octane	91 RON (research method)
Total weight, dry	approx. 146 kg
Ignition	battery ignition
coil	12 V
distributor	see page 22,2-1/1 for version
engine speed limiter	5850 $\pm$ 100
firing point BTC	270
firing order	1 - 4 - 3 - 2
spark advance	centrifugal force and vacuum
dwel angle	44-500
spark plugs	M 14x1,25x19, heat range value 175
electrode gap	0,7
Cooling air	
transfer capacity ltr/sec rpm	800/4600
Lubrication	forced feed, by gear-type pump
oil cooling	oil cooler in air stream of blower
oil filter	full-flow
oil pressure indication	by control lamp
oil capacity	3,5 ltr with filter change
	3,0 ltr without filter change
oil consumption, ltr/1000 km	0,5 - 1,0
Cylinder heads	1 per 2 cylinders, with integral cooling fins, aluminum alloy
valve seats	shrunk-in, sintered steel
valve guides	shrunk-in, special brass
spark plug threads	cut into cylinder head
Valve timing	1 camshaft under crankshaft; cam followers, pushrods, and rocker arms guided in housing
Valves	1 intake and 1 exhaust valve per cylinder
exhaust valves	armored seat; sodium filled stem
arrangement	overhead
clearance - intake	0,15 mm)
exhaust	0,20 mm) with cold engine
Valve springs	1 spring per valve

TECHNICAL DATA

Power Rating	70 KW (95 DIN HP)
Identification Symbol	GA
Valve timing with 1 mm valve clearance:	
intake opens	12° BTC
intake closes	42° ATC
exhaust opens	43° BTC
exhaust closes	4° ATC
Cylinders	individual cylinders, special grey casting with integral cooling fins 124,5 mm
distance between centers	
Pistons	light alloy with steel liner floating, circlip secured
piston pins	2 compression rings
piston rings	1 oil scraper ring
Crankcase	two-piece, divided vertically through main bearings and camshaft bearings, aluminum alloy
Camshaft	grey cast, with 3 bearings
camshaft bearings	thin-wall steel split inserts with white metal surface
camshaft drive	helical gears
Crankshaft	forged high-grade steel, 4 plain bearings
main bearings $\neq$ 1, 3 and 4	aluminum sleeves, lead coated
main bearing $\neq$ 2	split sleeve, tri-metal
main bearings $\neq$ 1-3	60 mm dia.
main bearing $\neq$ 4	40 mm dia.
connecting rod bearings	50 mm dia.
flywheel	forged, integral with starter ring gear
Connecting rods	forged, with I-shaped shank cross-section
connecting rod bearings	thin-wall, tri-metal split sleeve inserts
piston pin bushings	pressed-in steel sleeves with lead-bronze surface
Clutch	diaphragm spring clutch
type	single plate, dry
total facing area	375 cm ²

TOLERANCES AND WEAR LIMITS

Parts reaching or coming close to the values shown in the "Wear Limit" column should not be reinstalled during overhaul. Consider the oil consumption of the given engine when determining the wear limits of pistons and cylinders.

NOTE: The values are in mm when unit specifications are not shown.

Power Rating	70 KW (95 HP)	
Code	GA	
	When new	Wear limit
Cooling System		
Thermostat opening pressure	65-70° C	
Impeller/V-belt pulley unbalance	max. 5 cmg	
Oil Circuit		
1 - Oil pressure (SAE 30 grade only) at 70° C oil temperature and 2500 rpm pressure	ca. 4,4 bar (4,5 atm)	2 bar (atm)
2 - Spring for oil pressure relief valve, compressed length = 39,0 mm . . . load	66,7-86,3 N (6,8-8,8 kg)	
3 - Spring for oil pressure control valve, compressed length = 16,8 mm load	42,7 N (4,35 kg)	
4 - Oil pressure switch opens at pressure	0,15 - 0,45 bar (atm)	
Cylinder Head and Valves		
1 - Seat depth for cylinder in cylinder head	5,4 - 6,6	
2 - Combustion chamber volume . . .	58,7 - 60,2 cm ³	
3 - a) Rocker arm inside diameter	20,0 - 20,02	20,04
b) Rocker arm shaft diameter	19,95 - 19,97	19,93
4 - Valve spring, compressed length = 30 mm load	711,2 - 818,1 N (72,5 - 83,5 kg)	
5 - Valve seat		
a) Intake width	1,8 - 2,2	
b) Exhaust width	2,0 - 2,5	
c) Intake seat angle	45°	
d) Exhaust seat angle	45°	
e) Outer correction bevel angle	15°	
f) Inner correction bevel angle	75°	
6 - Valve guide		
Intake bore diameter	8,00 - 8,02	8,06
Exhaust bore diameter	9,00 - 9,02	9,06
7 - Valve stem		
Intake diameter	7,94 - 7,95	7,90
Exhaust diameter	8,91 - 8,92	8,87
8 - Valve guide/valve stem		
Intake and exhaust side clearance	max. 0,30	1,2
9 - Valve head		
Intake diameter	42,0	
Exhaust diameter	36,0	
10 - Valve clearance (cold)		
Intake adjustment	0,15	
Exhaust adjustment	0,20	

Power Rating		70 KW (95 HP)	
Code		GA	
		When new	Wear limit
11 - Compression pressure (with open throttle and engine at operating temperature, all spark plugs removed, with compression gauge in spark plug seat without blowby, engine cranked by starter motor) pressure		8,3 - 10,8 bar (8,5 - 11,0 atm)	6,4 bar (6,5 atm)
Pressure difference between cylinders			max, 1,5 bar
Cylinder and Piston			
Two oversizes, each with 0,5 mm greater diameter			
1 - Cylinder	out-of-round	max, 0,01	
2 - Cylinder/piston	clearance	0,02 - 0,05	0,20
3 - a) Upper piston ring	side clearance	0,04 - 0,07	0,12
b) Lower piston ring	side clearance	0,04 - 0,07	0,10
4 - Oil scraper ring	side clearance	0,02 - 0,05	0,10
5 - a) Upper piston ring	ring gap	0,35 - 0,55	0,90
b) Lower piston ring	ring gap	0,35 - 0,55	0,90
6 - Oil scraper ring	ring gap	0,25 - 0,40	0,95
7 - Piston weight			
8 - Weight difference between pistons		max, 4 g	max, 10 g ⁺⁾
+) In the event of repairs			
Crankcase			
1 - Main bearing seat			
a) Bearings 1-3	diameter	70,00 - 70,02	70,03
b) Bearing 4	diameter	50,00 - 50,04	50,04
2 - Oil seal seat, flywheel side	diameter	95,00 - 95,05	
3 - Oil seal seat, blower side	diameter	62,00 - 62,05	
4 - Camshaft bearing seat	diameter	27,50 - 27,52	
5 - Oil pump housing seat	diameter	70,00 - 70,03	
6 - Valve lifter bore	diameter	24,00 - 24,02	24,05
Camshaft			
1 - Bearings 1-3	diameter	24,99 - 25,00	
2 - Center bearing runout (Bearings 1 and 3 on V-blocks)	runout	max, 0,02	0,04
3 - Camshaft/camshaft bearing clearance (including preload exerted by housing)	side play	0,02 - 0,05	0,12
Thrust bearing	end play	0,04 - 0,13	0,16
4 - Camshaft gear	backlash	0,00 - 0,05	
5 - Valve lifter	side play	23,96 - 23,98	23,93
6 - Housing bore/valve lifter	side play	0,02 - 0,06	0,12
7 - Pushrod	runout	max, 0,3	

Power Rating	70 KW (95 HP)	
Code	GA	
	When new	Wear limit
Crankshaft and Connecting Rods		
Three undersizes, each with 0.25 mm smaller diameter		
1 - a) Bearings 1 - 3 diameter	59,97 - 59,99	
b) Bearing 4 diameter	39,98 - 40,00	
c) Connecting rod bearing diameter	49,98 - 49,99	
2 - Crankshaft runout at Bearing 2 and 4 (Bearings 1 and 3 on V-blocks) . runout		0,02
3 - unbalance	max, 12 cmg	
4 - Main bearing journal out-of-round		0,03
5 - Crankpin out-of-round		0,03
6 - Crankshaft/main bearing clearance (including preload exerted by housing)		
a) Bearings 1 and 3) side play	0,05 - 0,10	0,18
b) Steel bearing 2 side play	0,03 - 0,09	0,17
c) Bearing 4 side play	0,05 - 0,10	0,19
7 - Crankshaft/main bearing 1 end play	0,07 - 0,13	0,15
8 - Crankpin/connecting rod side play	0,02 - 0,07	0,15
	0,10 - 0,40	0,70
9 - Connecting rod weight		
10 - Weight difference between connecting rods	max, 6 g	
11 - Piston pin diameter	23,99 - 24,00	
12 - Small end bushing diameter	24,01 - 24,02	
13 - Piston pin/bushing side play	0,02 - 0,03	0,04
14 - Flywheel runout (measured in center of clutch friction surface) lateral runout	max, 0,4	
	unbalance	
Oil seal contact flange outside diameter	max, 20 cmg	
Machining starter gear teeth	74,9 - 75,1	74,4
		max, 2
Clutch		
1 - Total clutch pressure pressure	4903 - 5491,8 N (500 - 560 kg)	
2 - Total clutch unbalance unbalance	max, 15 cmg	
3 - Pressure plate runout lateral runout		0,10
4 - Clutch disc (measured at 210 mm dia.) lateral runout	max, 0,5	

TIGHTENING TORQUES

Designation	Thread	Nm (mkg)	ft. lbs
1 - Bolts for U-joint shaft	M 8 x 1,25	44,1 (4,5)	32,5
2 - Transmission support nuts	M 8	19,6 (2,0)	14,5
3 - Engine support nuts (body)	M 10	29,4 (3,0)	21,7
4 - Nuts securing engine to transmission	M 10	29,4 (3,0)	21,7
5 - Spark plugs	M 14 x 1,25	34,3 (3,5)	25,3
6 - Nut for small V-belt pulley	M 14 x 1,5	58,8 (6,0)	43,4
7 - Cooling blower impeller bolts	M 8	19,6 (2,0)	14,5
8 - Oil pump nuts	M 8	19,6 (2,0)	14,5
9 - Oil drain plug	M 12 x 1,5	21,6 (2,2)	15,9
10 - Retaining nut for oil screen cover	M 8	12,7 (1,3)	9,4
11 - Nuts for rocker arm shaft	M 7	13,7 (1,4)	10,1
12 - Cylinder head nuts	M 10	31,4 (3,2)	23,1 +)
13 - Engine support bolts (crankcase)	M 8	29,4 (3,0)	21,7
14 - Bolt for blower impeller hub	M 8	31,4 (3,2)	23,1
15 - Flywheel bolts	M 12 x 1,5	107,9 (11,0)	79,6
16 - Bolts and nuts for crankcase halves	M 8	19,6 (2,0)	14,5
17 - Nuts for crankcase halves	M 10 x 1,25	32,4 (3,3)	23,9 +++)
18 - Connecting rod nuts	M 9 x 1	32,4 (3,3)	23,9 ++)
19 - Clutch bolts	M 8	23,5 (2,5)	18,1

+) Tightening sequence - see page 25, 1-2/5

++) Use new nuts, oil contact surface

+++)

SPECIAL TOOLS

1	Engine adapter for garage jack	VW 612/4
2	Bench clamp for engine mount	VW 313
3	Engine bench mount	VW 307a
4	Carburetor actuator	Local manufacture
5	Puller	Local purchase item
6	Oil cooler tester	VW 661/2
7	Oil pump cover puller	VW 803
8	Assembly plate and valve guide tester	US 4400 A
9	Valve spring depresser	VW 311s
10	Piston pin mandrel	VW 207c
11	Oil filter remover	Local purchase item
12	Oil seal installer (blower impeller side)	VW 190
13	Oil seal installer (flywheel side)	VW 191
14	Dial gauge holder	VW 659/2
15	Blower hub remover	VW 185
16	Flywheel lock	VW 215c
17	Internal-head socket adapter, M 14	Local purchase item
18	Press adapter plates (differential side bearing removal)	VW 457
19	Notching punch	VW 124a
20	Press tube, 60 mm dia.	VW 415a
21	Tapered guide sleeve	VW 428a
22	Wrench for oil pressure switch	Local purchase item
23	Crankshaft support plate	VW 801
24	Connecting rod aligning and reaming set	VW 214f/70
25	Press plate	VW 402
26	Press tube	VW 421
27	Press block	VW 409
28	Lock ring pliers	VW 161a
29	Press tube	VW 416b
30	Oil pressure and oil pressure switch test set	Local purchase item

31	Feeler gauge	Local purchase item
32	Valve adjusting wrench	Local purchase item
33	Valve lapper	Local purchase item
34	Inside micrometer	Local purchase item
35	Micrometer, 75-100 mm	Local purchase item
36	Piston ring expander	Local purchase item
37	Piston ring compressor	Local purchase item
38	Internal-head socket adapter, M 12	Local purchase item
39	Lock ring pliers, offset	Local purchase item
40	Metal straight-edge, 200 mm long	Local purchase item
41	Input shaft section	Local purchase item
42	Timing light	Local purchase item
43	Tach-dwell meter	Local purchase item
44	Vacuum gauge, measuring ranges 0-133 and 0-798 mbar (0-100 and 0-600 mmHg)	Local purchase item
45	Fuel shut-off clamp	Local purchase item

ENGINE TEST RUN AND CHECK

General

Test stands for fuel injection engines must have an electric fuel pump, a microfilter, and a fuel line for returning surplus fuel from the pressure regulator to the tank. It is appropriate to mount the necessary components as well as the fuel tank, fuel flow measuring instruments, and a holder for the control unit on a common rack.

The engine test run and checkout procedure includes the following:

- 1 - Initial check
- 2 - Running-in
- 3 - Fuel consumption check
- 4 - Performance check
- 5 - Final test

Apply the same procedure for checking engines which have been partly or fully overhauled. The work can best be done on a dynamometer where the engine load can be regulated and adjusted to the requirements for power and fuel consumption tests.

Initial Check

- a - Adjust valves
- b - Adjust breaker point gap and ignition timing
- c - Check V-belt tension
- d - Fill engine with 3,5 liters engine oil
- e - Check fuel injection system using checklist and tester. (The control unit used with the given engine, and the pressure sensor, must be used during the performance test.)

Running-in

Turn crankshaft by hand several times before starting the engine. Upon starting, the green oil pressure control light must go out with increasing engine speed, otherwise it will be an indication that the oil pump is not picking up oil and the bearings are not properly lubricated.

The red generator control light must also go out with increasing engine speed. The fuel pump and fuel lines should be checked for leaks during the running-in procedure; also checked should be the pressure in fuel ring main. The running-in of the engine of the test stand can generally be limited to about 30 minutes, as follows:

10 min.	1500 rpm at 3-5 kg load
20 min.	2500 rpm at 6-10 kg load

Fuel Consumption Check

Fuel consumption should be checked at the end of the 30-minute test run. Fuel consumption can be determined from flow rate at given engine speed and load (see table).

Engine speed RPM	Brake load N (kg)	Flow rate sec/100 cc
3000	78,5 (8,0)	40-46
5000 full throttle	min.	10,0-12,0

Performance Check

Engine performance is checked upon completion of the fuel consumption check. The respective values are shown in the power performance chart. A deviation of $\pm 5\%$ is permissible to allow for tolerances in manufacture and testing environment.

Final Test

- a - Adjust idling when engine is warm.
- b - Check for oil leaks.

Engine should be checked for oil leaks after the fuel consumption and performance checks. Particular attention should be given to the push rod cover tubes, oil pump, oil cooler, valve cover, and crankcase joining surface.

- c - Check compression.

Compression should be checked with a compression gauge, with open throttle and engine at operating temperature. All spark plugs should be removed and engine turned over by the starter.

- d - Final check.

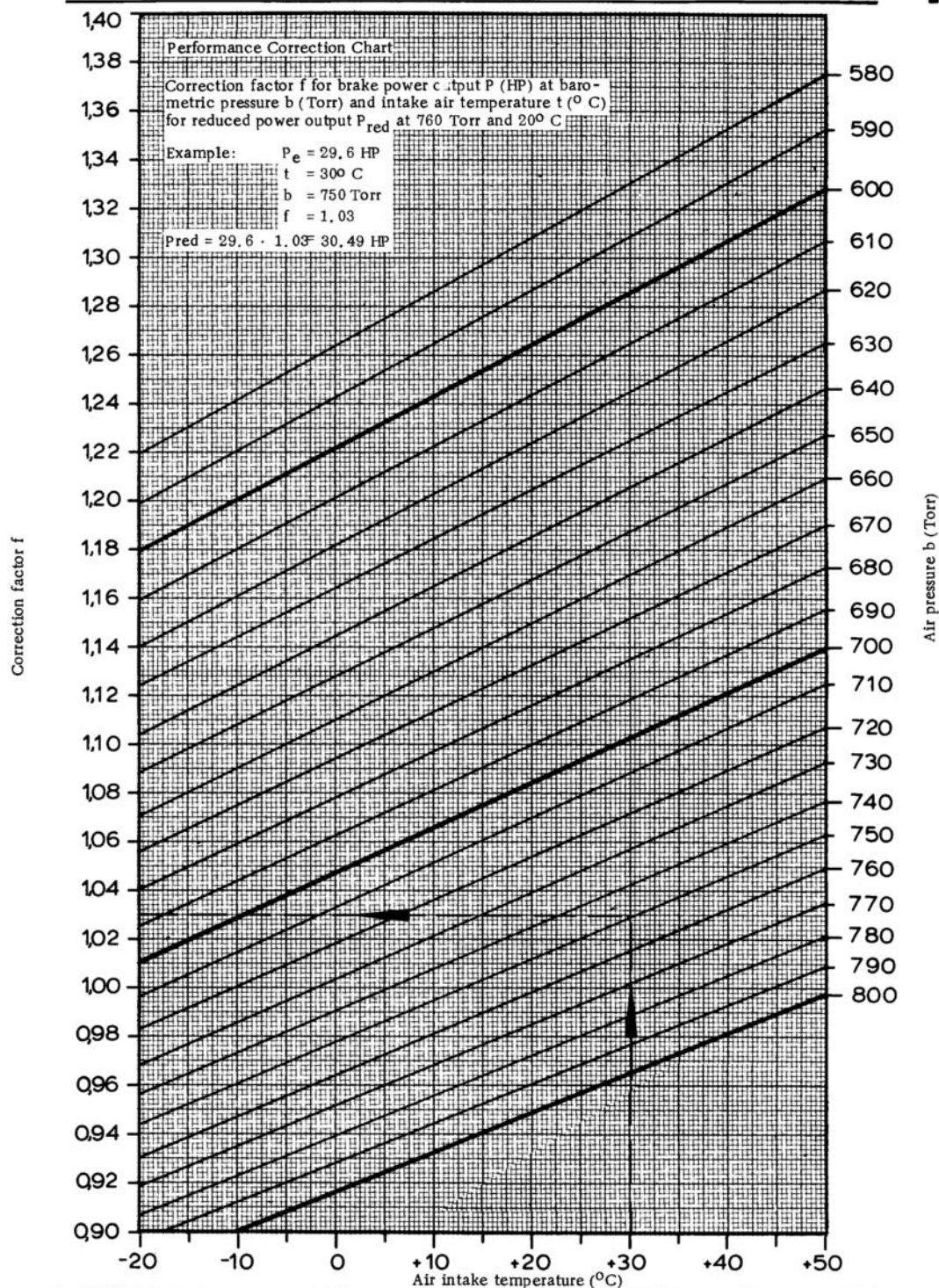
Check valve clearance and V-belt tension prior to mounting engine in vehicle. Make sure that the air cleaner is clean.

- e - Engine storage.

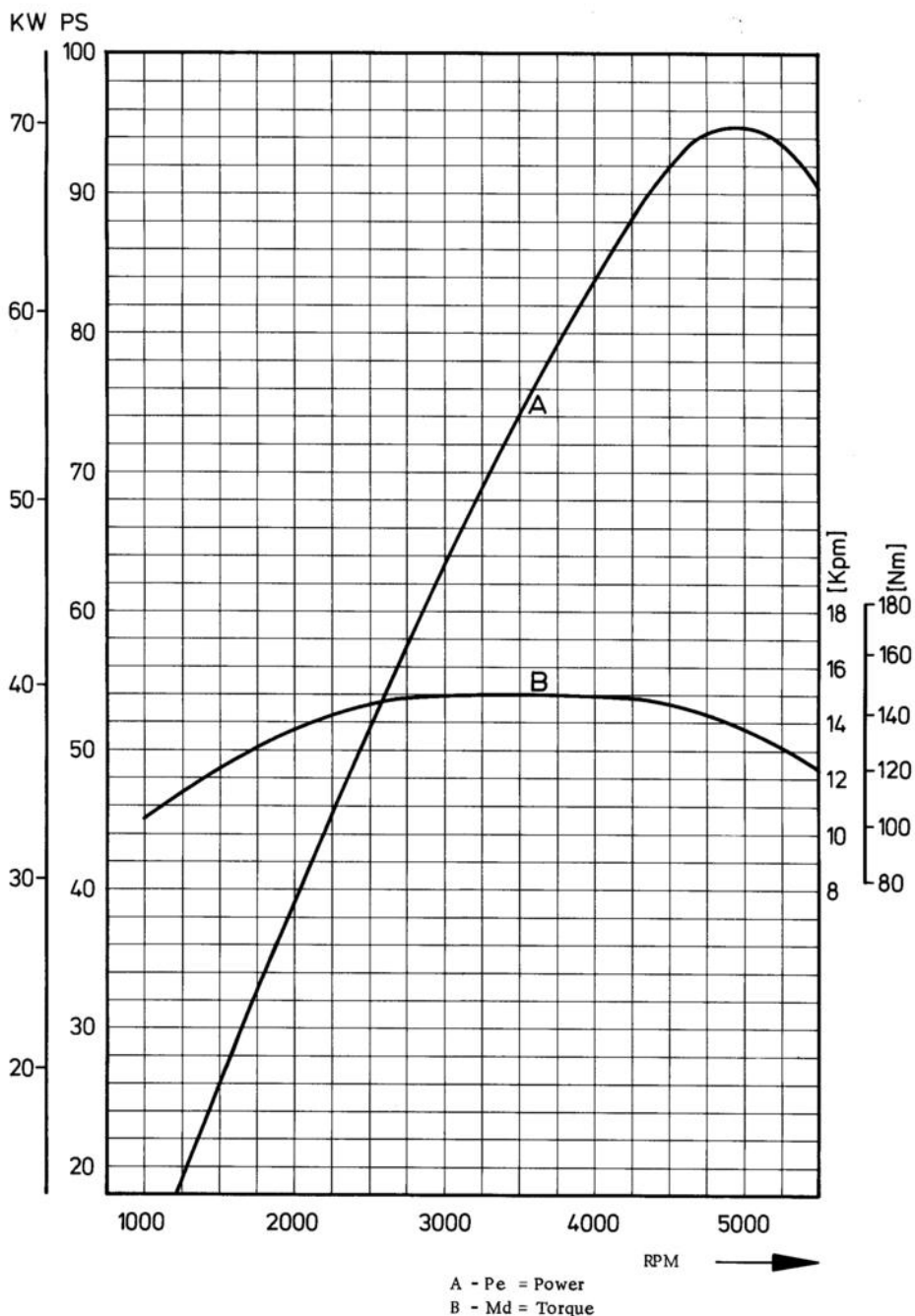
Engines stored for extended periods of time must be corrosion-proofed. Fuel and exhaust gas remnants cause corrosion in cylinders and valve guides, etc, when left in the engine over long periods of time. Such damage can be avoided by pouring some anti-corrosion oil into the intake manifolds during the engine shut-off time or else through the spark plug openings. External engine surfaces should also be sprayed with anti-corrosion oil.

Dynamometer Tests

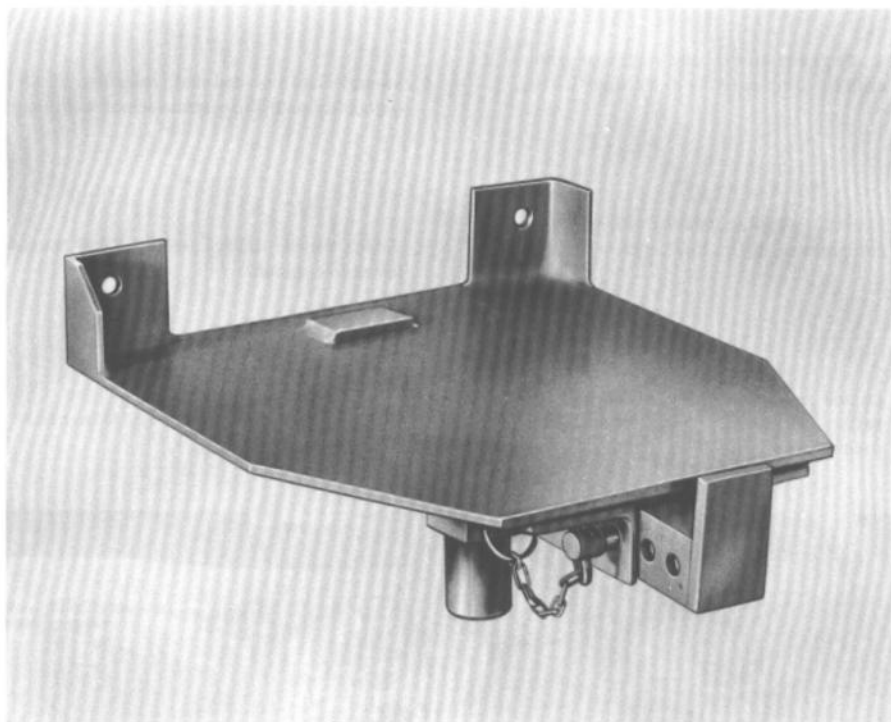
Power performance and fuel consumption can also be checked on a dynamometer. Test requirements and readout values can be found in the data specification cards.



POWER PERFORMANCE CURVE



TOOLS



No.	Description	Special Tool	Remarks
1	Engine adapter and support	US 612/4 US 612/3	

Removal

The engine and transmission are removed or installed as one unit.

1. Mark the installed location of the luggage compartment lid on the hinges and remove lid.
2. Detach ground strap and positive lead from the battery, and remove slotted screw from the positive lead.



3. Unscrew control unit from the holder (do not detach electrical control wire) and lay control unit on engine.
4. Detach electrical connections (3 multiple plugs in the regulator plate, wire connector in pressure sensor, connector for oil temperature sensor).

5. Detach vacuum hose from pressure sensor.

6. Separate fuel line and fuel return line at the connection near the pressure sensor and plug it up.

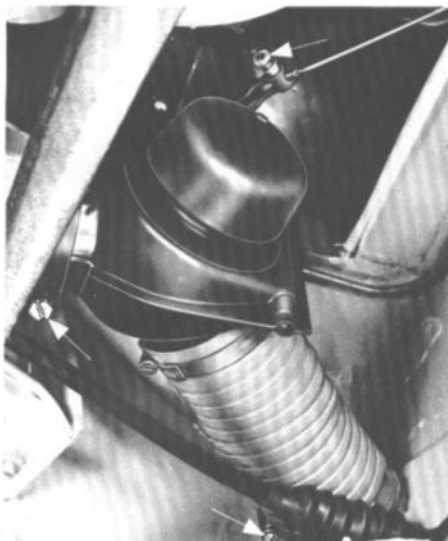
7. Detach throttle control cable and push through the engine shroud.

8. Loosen hose clamp at the heater blower and detach heating duct.



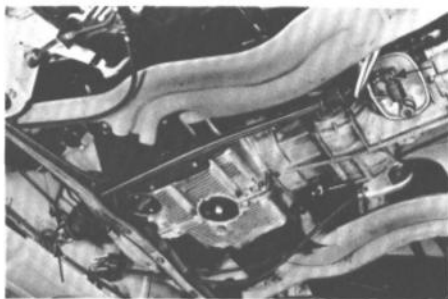
9. Raise the car.

10. Remove heater box with control cables and hoses.



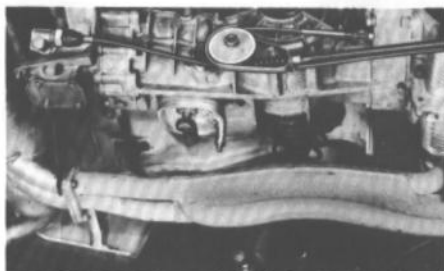
11. Remove cover cap from the rear of the gear shift rod and grommet from the front.

12. Loosen conical screws in the shift rod, remove shift finger from the shift rod, and pull shift rod out rearward.



13. Remove clutch cable adjusting nut and cable pulley retaining nut, bend open the retaining clip and pull clutch cable out forward through the engine support.

14. Unscrew speedometer drive cable and pull forward.



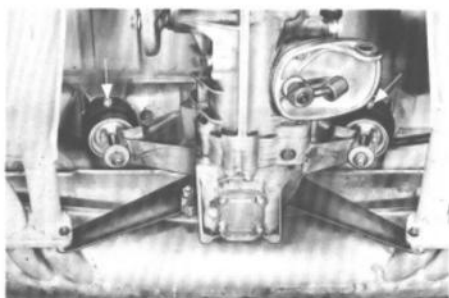
15. Unscrew ground strap from luggage pan.

16. Detach wire connector for backup light.

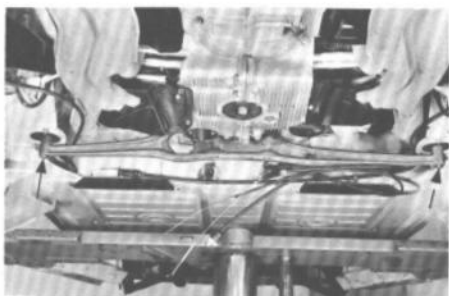
17. Detach axle shaft flanges from differential.

18. Lower the vehicle somewhat. Place garage jack (with US 612/4 engine adapter and US 612/3 support) under the engine-transmission assembly with slight preload.

19. Remove four M8 nuts from transmission support.



20. Remove engine support fasteners.



21. Carefully lower the engine-transmission assembly, being sure not to damage the axle shafts.

1. Check the clutch throwout bearing for wear before bolting transmission to engine.

2. Lightly coat the throwout bearing guide bushing, splines in the input shaft, and the starter bushing with MoS₂ paste.

3. When installing the engine-transmission assembly be sure that the fuel lines near the injectors are not damaged.

4. Torque engine support retaining bolts, transmission support retaining nuts, and Allen bolts in axle shafts as specified. Use new locking plates.

5. Adjust clutch play.

Installation

Note the following points during reassembly:

6. Adjust throttle control cable.

NOTE: Watch for possibly chafed electrical wires or fuel lines.

Disassembly and reassembly is accomplished in the following order:

Disassembly:

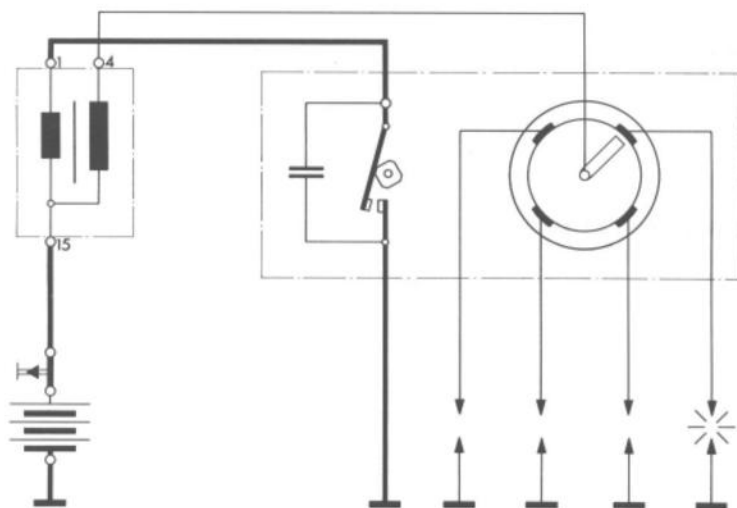
- 1 - Drain engine oil
- 2 - Remove muffler and heat exchanger
- 3 - Remove rear engine shield
- 4 - Remove intake manifold with stacks and injectors
- 5 - Remove oil filler and breather assembly
- 6 - Remove ignition distributor
- 7 - Remove front engine shields
- 8 - Remove blower impeller
- 9 - Remove cooling blower housing and alternator
- 10 - Remove engine mount
- 11 - Remove front and rear cylinder shrouds and hot air ducts
- 12 - Remove oil cooler
- 13 - Remove oil filter
- 14 - Remove oil pump
- 15 - Remove rocker arm shafts, push rods, push rod cover 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:

Reassembly is accomplished in reverse order of the above. Special instructions are contained in subsequent sections.

DESCRIPTION

The ignition system is battery powered. Ignition voltage is produced by the ignition coil which transforms battery voltage into the required ignition voltage of 15000 to 20000 volts. The process is described below. A breaker cam, located on the camshaft-driven distributor shaft, opens the breaker points just before the piston in the firing cylinder has reached its firing position. This interrupts the flow of current through the primary winding in the ignition coil, causing the magnetic field to collapse and simultaneously induce high voltage in the coil secondary winding. This high ignition voltage passes through an ignition lead to the distributor rotor which, at this instant, aligns with an electrode in the distributor cap; the electrode is connected to the spark plug in the firing cylinder. The ignition voltage crosses the spark plug electrodes in the form of an electric arc and ignites the compressed fuel/air mixture in the cylinder.



Ignition Coil

The ignition coil consists of a laminated iron core with a few turns of large primary winding wire and many turns of small secondary winding wire. The end of the primary winding and secondary winding is connected to the battery through terminal 15. The other end of the primary winding is connected to the ground through terminal 1 and breaker points. The secondary winding leads to the high tension terminal.

Distributor

The distributor directs high voltage to each of the four spark plugs in proper sequence and at the most advantageous time.

A centrifugal and vacuum ignition advance mechanism built into the distributor maintain correct ignition timing at all engine speeds.

a - Centrifugal Advance

The centrifugal advance is actuated by weights mounted on a supporting plate. As the engine speed increases, the weights are forced outward, causing a lever to move the breaker cam in the direction of rotation of the distributor shaft. This movement results in advanced timing. Return springs pull the centrifugal weights back into their original position when the engine speed decreases.

b - Vacuum Advance

Intake manifold vacuum drawn from a point near the throttle valve advances the breaker points, in addition to the centrifugal advance, by moving the points against the direction of rotation of the breaker cam on the distributor shaft; this occurs primarily under part-throttle conditions.

Spark Plugs

Spark plugs operate under constantly severe electrical, mechanical, chemical, and particularly thermal stresses. The use of the right kind of spark plugs is essential if good starting, idling, acceleration, and engine performance are to be expected. In addition to electrical and mechanical considerations, heat range plays a very important role. The higher the heat range, the smaller the possibility of hot spots but so much the greater the possibility of fouling. Spark plugs of low heat range qualities have opposite characteristics.

SPECIFICATIONS

Ignition Coil

Type/Model	Version	Comments
914/2,0	022905115 A	12 volts

Distributor

Type/Model	Spark Advance	Version
914/2,0	Centrifugal advance and double-action vacuum advance	039 905 205 039 905 205 A (from Model 74 on)
914/2,0 from 1975 Models USA except California	Centrifugal and single action vacuum	039 905 205 A
914/2,0 from 1975 Models California	Centrifugal and single action vacuum	039 905 205 B

Spark Plugs

Type/Model	Spark Plug Type ⁺⁾	Remarks
914/2,0	BERU 175/14/3 BOSCH W 175 T2	Threads M14x1, 25x19, 0
914/2,0 from 1975 Models USA only	Beru 175/14/3 L Bosch W 175 M 30	M 14x1, 25x19, 0 threads

⁺⁾ Or other name-brand factory-approved spark plugs of proper heat range.

MAINTENANCE

Ignition Coil:

Keep coil cap clean and dry.

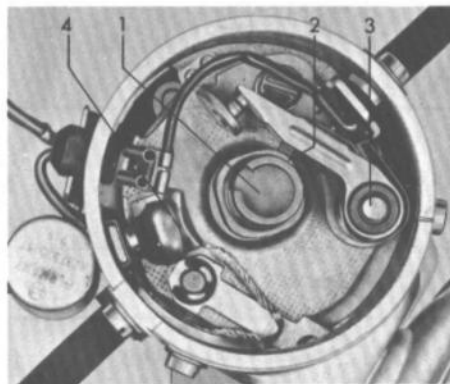
Distributor:

- 1 - Inspect breaker points for pitting, replace if necessary.
- 2 - Lubricate breaker arm rubbing block with a little multipurpose grease.
- 3 - Lubricate the breaker arm pivot and the distributor shaft oil felt with a drop of oil.
- 4 - Inspect distributor cap for dirt deposits, cracks, and signs of arcing, cleaning or replacing the cap if necessary.
- 5 - Check and adjust dwell angle.
- 6 - Check and correct ignition timing adjustment.

Spark Plugs:

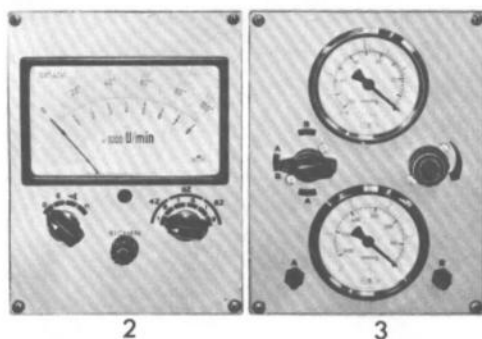
Clean spark plugs, check and adjust electrode gap.

Special Instructions:



- A - Regularly lubricate oil felt (1) and breaker arm pivot (3) with a drop of oil.
- B - Lubricate breaker point rubbing block (2) and ball (4) with multipurpose oil. Keep grease off breaker contact points.

TESTING EQUIPMENT

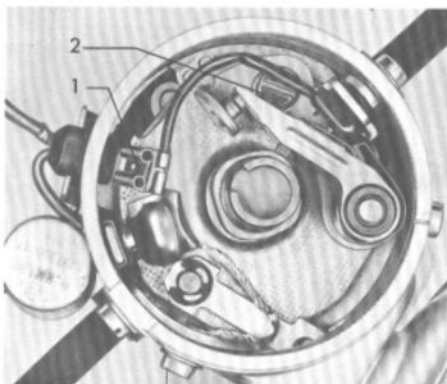


No.	Description	Special Tool	Remarks
1	Timing light		
2	Tach-dwell meter		
3	Vacuum gauge		Scale range 0-100 and 0-600 mm Hg
4	Carburetor actuator		Local manufacture

REPLACING DISTRIBUTOR BREAKER POINTS

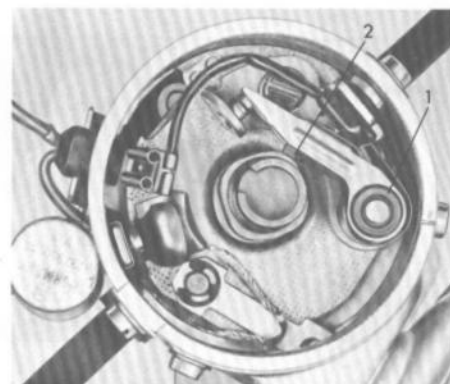
Breaker points pit in the course of use. In addition, the plastic rubbing block wears and reduces breaker point gap. For this reason, the breaker points should be replaced at 12,000-mile intervals.

Removal



Installation

- 1 - Lubricate breaker arm pivot (1) with a drop of oil.



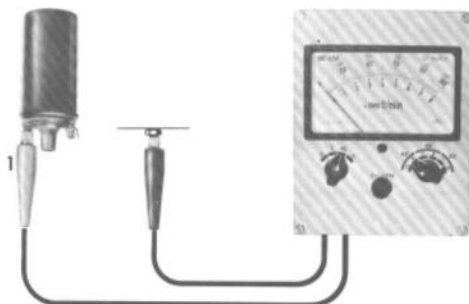
- 2 - Lightly lubricate breaker cam and plastic rubbing block (2) with a little multipurpose grease.
- 3 - Thoroughly remove any grease or oil from the breaker points if any should have gotten there inadvertently.
- 4 - Adjust breaker point gap.

ADJUSTING BREAKER POINTS WITH TACH-DWELL METER

When using a different tach-dwell meter than that shown in the illustration, be sure to follow instructions for its use.

1 - Connecting meter:

Green clip to Terminal 1 on the ignition coil, black clip to metal ground.



2 - Calibrating meter:

Turn test mode selector of meter to "A". Turn calibration knob (marked "Abgleich") until meter needle is exactly on last dial mark (12/80).



- A - Test mode selector
- B - Zero-adjust
- C - Range selector

3 - Checking dwell angle:

Turn test mode selector to " $\angle$ " and range selector to "4 Z" (number of cylinders).

Start engine and run at about 1000 rpm while reading dwell angle indication on lower part of meter dial (each mark equals 2°).

4 - Run engine at about 2000 rpm. The dwell meter indication at this speed should not deviate by more than $\pm 1^\circ$ from the previously shown value. A greater deviation indicates worn distributor shaft in which case it will be necessary to remove the distributor and check it on a distributor test bench.

Compare measured values with specifications.

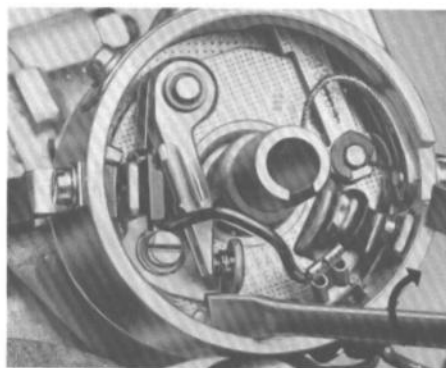
Dwell angle specification:	44-50°
Wear limit:	42-58°

This means that new breaker points should be adjusted to the specified dwell angle value, and that breaker points in use should not be readjusted as long as the dwell angle reading falls within the permissible wear limit.

5 - Adjusting dwell angle.

Remove distributor cap, withdraw rotor, and loosen breaker point base plate.

With ignition switched on and engine cranked with starter, adjust breaker point gap until correct dwell angle value shows on the meter. Tighten the breaker point base plate and check dwell angle again to see that the adjustment has not been altered excessively in the process.



6 - Install rotor and distributor cap, recheck dwell angle again.

NOTE: The ignition timing must be readjusted whenever the dwell angle has been reset.

ADJUSTING IGNITION TIMING WITH TIMING LIGHT

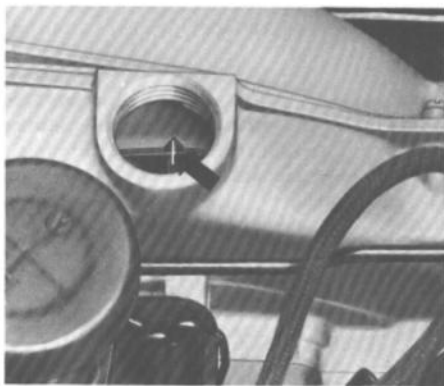
When using different instruments than those shown below, be sure to follow instructions for their use.

- 1 - Check dwell angle and adjust if necessary.
- 2 - Bring engine oil temperature to 30-70° C.
- 3 - Connect tach-dwell meter and calibrate. Turn test mode selector to "n". Turn range selector to "4 Z" and adjust to "12" within this range setting.
- 4 - Connect timing light.

Engine speed is indicated on the upper scale.

The timing light sensor is connected into the ignition circuit for Cylinder 1. The selector wheel in the timing light grip must be turned to the zero-stop.

- 7 - The ignition timing notch must align with the reference mark on the cooling blower housing.



NOTE: Two reference marks will be found on the blower impeller:

- 1 - "0" mark indicating top dead center (TDC).
- 2 - Ignition timing notch.

- 5 - Detach both vacuum hoses from the vacuum unit.
- 6 - Run engine at 3500 rpm and point the timing light at the blower impeller.

CHECKING AUTOMATIC SPARK ADVANCE

When using different instruments than those shown below, be sure to follow instructions for their use.

Checking Centrifugal Spark Advance

- 1 - Connect and calibrate tach-dwell meter. Turn test mode selector to "n". Turn range selector to "4 Z" and adjust to "80" within this range setting. Engine speed is indicated on the lower scale.
- 2 - Connect timing light.
- 3 - Detach vacuum hoses from the distributor vacuum unit.
- 4 - Start engine and check basic adjustment of ignition timing, correcting if necessary.
- 5 - Increase engine speed slowly. Start of the spark advance is shown by the movement of the reference notch. See table on page 22.2-2/4 for specifications.
- 6 - Set engine rpm to values shown in the table. Bring the reference notch back by turning the selector wheel in the spark advance tester. The spark advance is shown on the meter in degrees.
- 7 - Determine end of spark advance by further increasing the engine rpm.
- 8 - If the test values do not correspond with specifications, repair the spark advance mechanism in the distributor (free the components, replace stretched springs) or replace distributor. (See page 22.2-2/4 for specifications.)

Checking Vacuum Spark Advance

Operation of the vacuum spark advance unit can be checked by reconnecting the previously detached vacuum hoses to the engine while it is running at a fast idle; engine speed should thus increase noticeably.

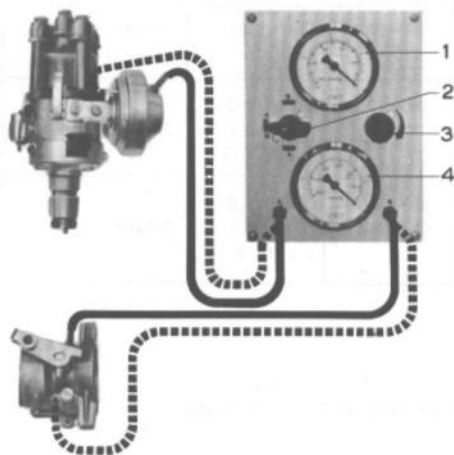
NOTE:

Spark advance and retard functions must be checked separately in double-action vacuum units, at which time it is necessary to disconnect the vacuum hose from that part of the vacuum unit which is not under test.

- 2 - Detach vacuum hoses from the vacuum unit.
- 3 - Run engine at 3500 rpm.
- 4 - Direct the timing light on the 0° mark. Read the value on tester and make a mental note.
- 5 - Connect vacuum hose of the advance unit to the retard unit.
- 6 - The vacuum retard value is determined from the difference between the now indicated value and that noted mentally in step 4, above.

Vacuum retard

- 1 - Connect timing light. Connect vacuum gauge between vacuum retard unit at the distributor and vacuum line at the intake manifold.



- 1 - Vacuum gauge 0-133 mbar (0-100 mm Hg)
- 2 - Selector valve
- 3 - Regulator
- 4 - Vacuum gauge 0-800 mbar (0-600 mm Hg)

Vacuum advance

- 1 - Connect vacuum gauge between vacuum advance unit and vacuum line.
- 2 - Detach vacuum line from the vacuum retard unit.
- 3 - Run engine at 3500 rpm and direct the timing light on the 0° mark (vacuum regulator valve must be open).

4 - Read the value on tester and make a mental note.

5 - Close vacuum regulator valve.

6 - The vacuum advance value is determined from the difference between the now indicated value and that noted mentally in step 4, above.

7 - If deviations from the values given in the table are noted during the test, check as follows:

a - Check breaker point plate for free movement. If necessary, disassemble the distributor and free the plate.

b - Check vacuum lines and vacuum unit for leaks, replace if necessary.

IGNITION TIMING DATA FOR INSTALLED DISTRIBUTORS

Distributor Number	Begin at rpm	RPM degrees	End at rpm degrees	Begin at mbar (mm Hg)	End at mbar (mm Hg) degrees	Direction of change
039 905 205	900-1100	1500 6-10	3000 20-24	133,3- 173,3 (100-130)	193,3-211,0 (145-165) 6-8	Advance
				80,0-133,3 (60-100)	197,3-210-6 (148-158) 8-12	Retard
039 905 205 A	950-1050	1500 4-9	3000 22	40-173,3 (30-130)	253,5-273,5 (190-205) 5,5-7	Advance
				40-133,3 (30-100)	200-213,5 (150-160) 8,5-12,5	Retard

x) Advanced ignition vacuum control does not apply to USA Versions from 1975 Models.

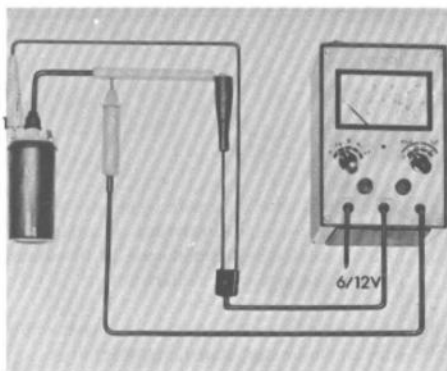
TROUBLE DIAGNOSIS

Checking Ignition Coil

- 1 - Clean coil cap and keep dry to prevent current leakage or arcing.
- 2 - Check terminal tab connectors for firm seating to ensure absence of voltage leaks.
- 3 - Check ignition output with ignition coil tester. Connect the tester as shown in the illustration. Follow instructions furnished with the unit.

Principle of operation:

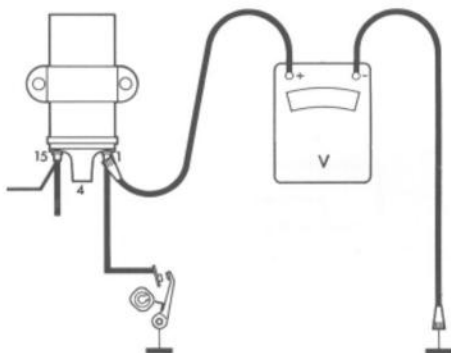
The high tension side of the coil (terminal 4) is connected through a load resistor and is activated over terminal 1 by a constant electrical pulse generated by the tester. Ignition voltage occurring under this load is the measured. Nominal voltage is approx. 18,000 volts (18 kV).



- 4 - If a coil tester is not available, proceed as follows:

Pull ignition lead out of terminal 4 in the distributor cap (in center of cap) and hold the end about 1/2" from ground (use insulated pliers). When engine is cranked with starter, an electric spark should cross between the ground and the lead's end. If there is no spark, first check voltage at terminal 15 in the coil with the aid of a voltmeter. In a 12-volt system, the voltage should be at least 9 volts.

If higher voltage is noted, connect a voltmeter or test lamp to terminal 1 in the ignition coil (distributor connection) to make sure that no current flows when the breaker points are closed, and that current flows when the points are open. If the voltmeter shows no reading with open breaker points as well (distributor has no short circuit), then the ignition coil has an open circuit and should be replaced.

Checking Breaker Points
(electrically)

Connect voltmeter between ignition coil terminal 1 and the ground. Crank engine until distributor breaker points have closed; the voltmeter needle should not deflect. Open the breaker points; the voltmeter needle now must have deflected. If the voltmeter needle should deflect with breaker points closed, it is an indication that the points are either dirty or burned.

Checking Condenser

The condenser is important in the ignition system as it prevents breaker point arcing and their premature wear.

Burned breaker points, weak spark and starting problems, or a complete absence of spark can be the result of a defective condenser. However, it is seldom that a condenser does fail.

Use a test lamp to check condenser for shorts:

Detach from the coil wire # 1 which connects to the distributor. Connect a test lamp between terminal # 15 in the coil and distributor wire # 1. The lamp should not light when breaker points are open and ignition is switched on; if the lamp does light up, condenser is shorted.

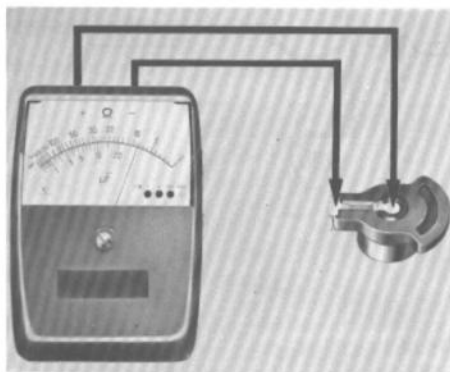
Condenser insulation resistance, capacity, and series resistance can be checked with special instruments. When such instruments are used, follow the manufacturer's instructions.

Replace condensers only with a specified type (see spare parts catalog) because wrong condenser capacity can have a detrimental effect on breaker point life.

Checking Radio Interference Suppressors

Resistance in copper core ignition leads is too low to comply with radio interference regulations in some countries. For this reason, suppressors have been placed in spark plug connectors and distributor rotor. Many radio installations include suppressors in ignition lead connectors.

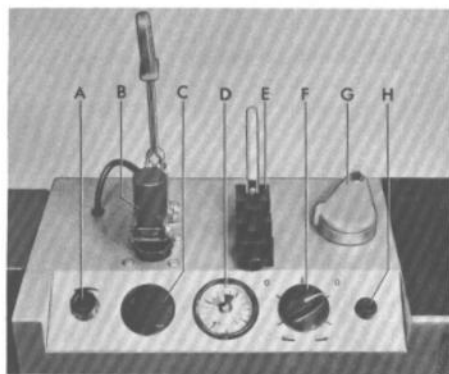
The interference suppressors with excessive resistance can be responsible for engine misfiring.



- 1 - Check distributor rotor with an ohmmeter.
A suppressor-equipped rotor has a cast-in resistor which should not exceed 10,000 ohms. If resistance is higher, replace rotor.
- 2 - Check spark plug and ignition lead connectors with an ohmmeter. Resistance should not exceed 5-10,000 ohms.

CLEANING AND CHECKING SPARK PLUGS

When instruments other than those shown here are used, be sure to follow the manufacturer's instructions.



- A - Regulating valve
- B - Quick-release clamp (on testing socket)
- C - Inspection window with mirror
- D - Pressure gauge with calibrated scale
- E - Electrode gap adjuster
- F - Selector valve
- G - Sandblast socket with swinging cover
- H - Push button

Turn selector valve to position  and clean dust with compressed air. Make sure that all sand and dust is completely removed. Turn selector valve to position "0" before taking the spark plug out. Should the electrodes and insulator still not be clean, repeat sand blasting with subsequent air cleaning.



- 1 - Spark plugs with heavy deposits of carbon or other matter should first be cleaned with a wooden pick to keep the coarse dirt out of the sand blaster; do not scrape with a metal tool. If the insulator is oily, wash spark plug in gasoline and blow clean with compressed air prior to sandblasting. Swing the socket cover to the side and place spark plug slightly sideways into the rubber socket. Turn selector valve to position  and sandblast spark plug for about 10-15 seconds while moving it around in a circular motion.

2 - Adjusting Electrode Gap to 0,7 mm

Place spark plug into the electrode gap adjuster so that the feeler gauge is between the electrodes. The connecting point between the negative electrode and spark plug body should be facing up.

Move the adjustable receptacle to within 1 mm distance from the spark plug body. Bend negative electrode by pulling actuating lever. The electrode gap is thus correctly set.



3 - Checking Spark Plugs

Adjust calibrated scale in pressure gauge to 0,7 mm gap. Place spark plug in testing socket and secure with quick-release clamp.

NOTE:

Do not insert Spark plugs wet with fuel in tester since this can lead to an explosion.

Turn selector valve to "  ". Close regulating valve. The pressure chamber is now pressurized. The pressure gauge indicator must be higher than the green field in the scale, that is, so high that all sparks travel across the parallel spark path.

The spark plug insulation can be considered good if no sparks are in evidence anywhere except the parallel spark path.

Lower the pressure by opening the regulating valve until sparks begin to travel across the spark plug gap.

The position of the indicator in the pressure gauge shows the ignition voltage requirements of the spark plug and thus the condition of the electrodes:



Indicator in green area (C) =
Spark plug in good condition

Indicator in yellow area (B) =
Spark plug still usable

Indicator in red area (A) =
Replace spark plug

Further reduce the pressure until the sparks jump evenly across the spark plug electrodes. When in this position, pay close attention to tracking along the insulator.

A spark plug is also defective when no sparks can be seen to cross the electrodes or the parallel spark path or when only individual sparks occur in the spark plug with pressure adjusted to below 5 atmospheres. This can be the result of a cracked insulator in the spark plug body.

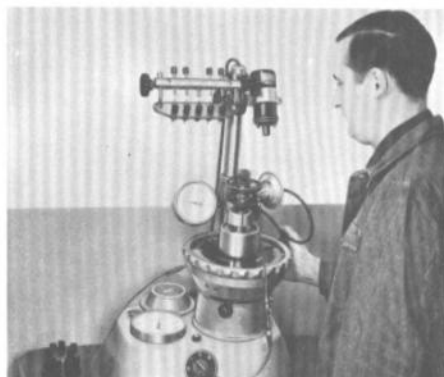
CHECKING DISTRIBUTOR ON TEST BENCH

The vacuum advance, centrifugal advance, and dwell angle can be checked on the distributor test bench. Various distributor test benches are in use. The following requirements apply to all:

Variable-speed motor, tachometer, vacuum pump, and vacuum gauge with an additional range of 0-133 mbar (0-100 mm Hg) for servicing distributors used in VW engines.

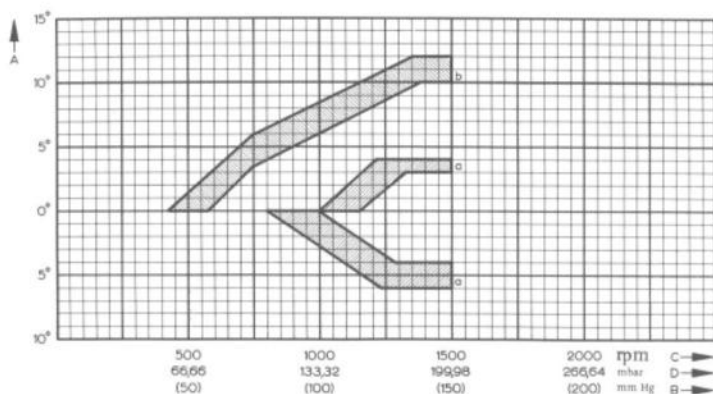
The following test procedure is necessary:

- 1 - Install distributor and check for quiet operation.
- 2 - Check dwell angle and correct it if necessary.
- 3 - Adjust speed to 400 rpm, observing that the centrifugal advance has not operated at this point.
- 4 - Connect hose between vacuum pump and vacuum advance unit of the distributor. Use pump to create full vacuum condition.
- 5 - Check vacuum advance unit for leaks. A vacuum of 133 mbar (100 mm Hg) should remain constant for about 1 minute with vacuum line closed.



- 6 - Check vacuum advance under decreasing vacuum conditions. Repeat the test as many times as possible while selecting different points in the vacuum curve and noting the actual advance values on the test bench scale. These test values must fall within the shaded areas of the advance curves shown on the chart. If this is not the case, repeat the tests with a new vacuum advance unit.
- 7 - Run test according to the speed-dependent advance curve. Centrifugal advance is checked with decreasing speed from 1500 rpm down.

Advance Curve for Removed Distributors



A - Advance in degrees at distributor shaft

B - Vacuum in mm

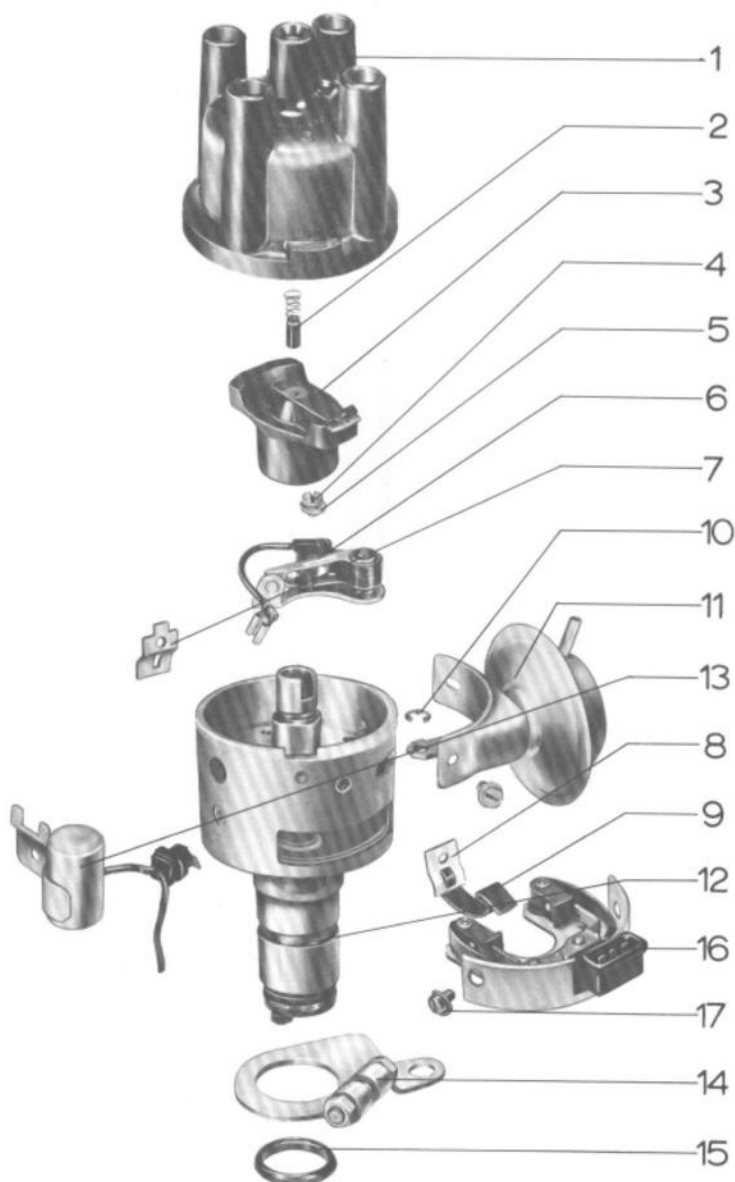
C - Distributor shaft speed in rpm

a - Vacuum control curve

b - Centrifugal control curve



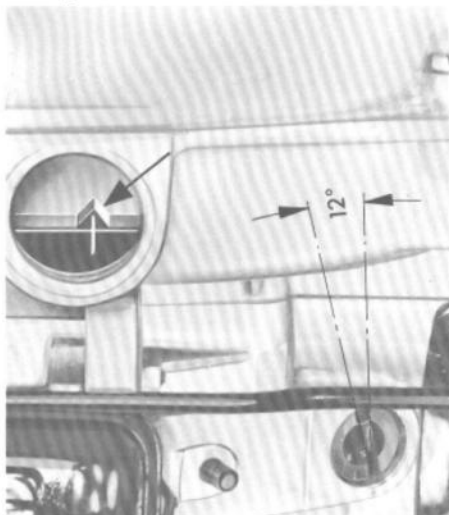
No.	Description	Special Tool	Remarks
1	Puller	--	Standard type



No.	Description	Qty	Note when		Remarks
			removing	installing	
1	Distributor cap	1		Check for cracks, carbonized current paths and good condition of the carbon contact	
2	Carbon contact with spring	1		Check for good seating	
3	Rotor	1			
4	Screw	1			
5	Washer	1			
6	Breaker points	1	Remove wire and lock screw	Contacts must be free of oil and grease and parallel to each other. Lubricate breaker arm pivot with 1 drop engine oil. Lubricate cam and rubbing block with multipurpose grease.	
7	Retaining clip with lug	1			
8	Shackle	1			
9	Spring clip	2			
10	Snap ring	1			
11	Vacuum unit	1		Check for leaks.	
12	Distributor housing	1	When excessive shaft clearance is noted, replace shaft or housing		
13	Condenser	1			
14	Distributor mounting clamp	1			
15	O-ring	1			
16	Trigger contacts	1		Replace contacts if oily. Lightly lubricate rubbing blocks with multipurpose grease.	
17	Screw	4			

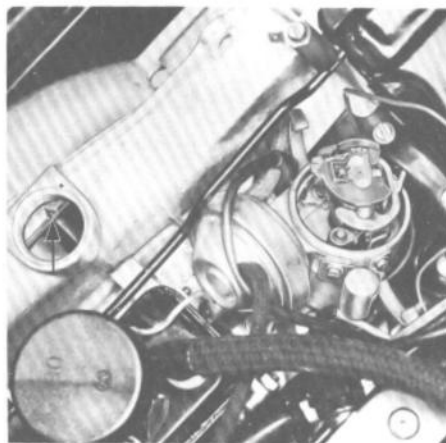
INSTALLING DISTRIBUTOR

- 1 - Adjust cylinder 1 to firing point. The offset slot in the top end of the distributor shaft should be at an angle of approximately 12° in relation to the longitudinal axis of the engine; the larger segment is on the crankshaft side of engine.

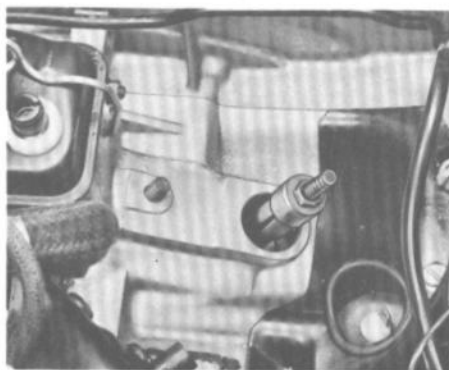


- 2 - Turn distributor rotor on ignition distributor until it points toward the mark for cylinder 1 on distributor housing.

- 3 - Adjust ignition timing.



REMOVING AND INSTALLING DISTRIBUTOR DRIVE SHAFT

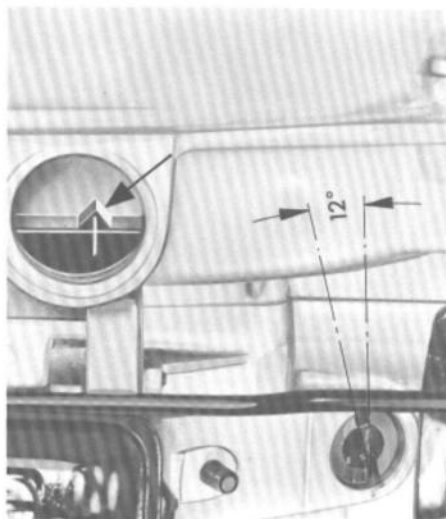


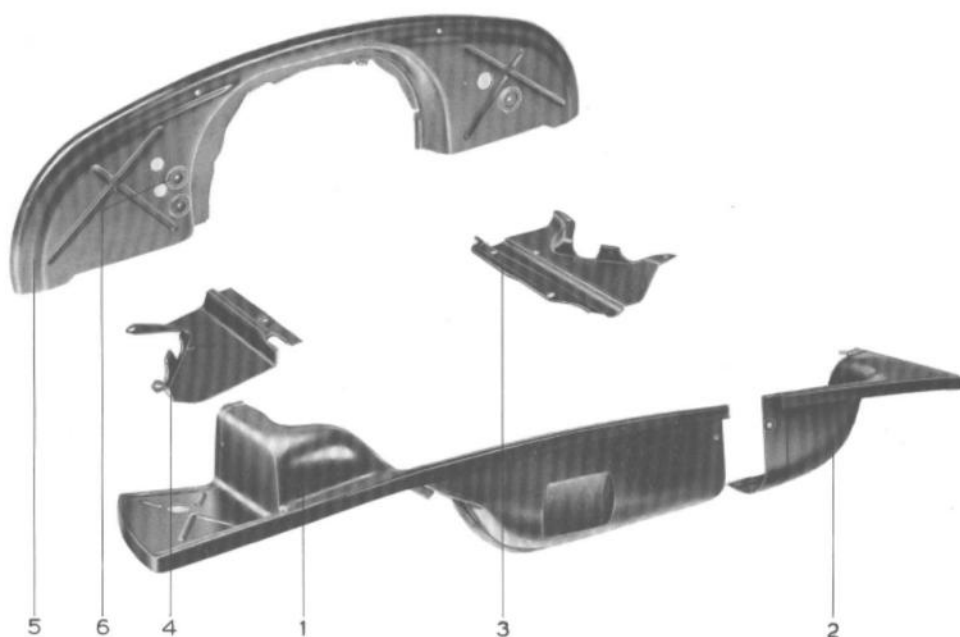
- 1 - Remove washer located under the distributor drive shaft.

NOTE: Proceed with caution - don't drop washer inside!

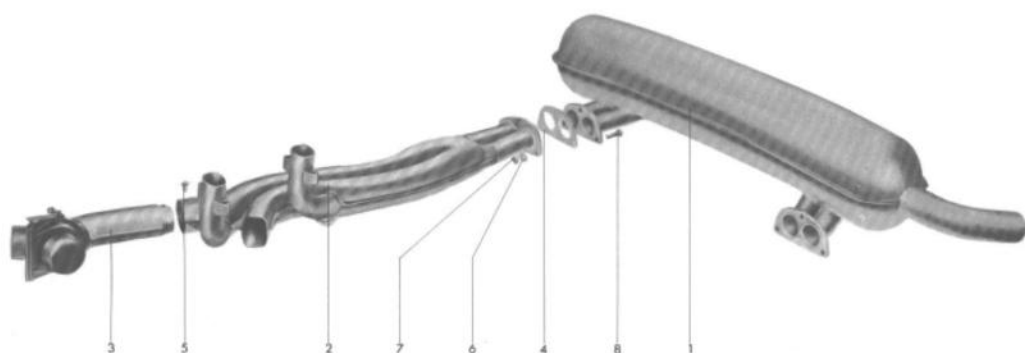
The washer can be removed from the installed engine with the aid of a magnet. Removed engine can be turned 180° around so that the washer can fall out.

- 2 - The offset slot in the top end of the distributor shaft should be at an angle of approximately 12° in relation to the longitudinal axis of the engine; the larger segment is on the crankshaft side of the engine.



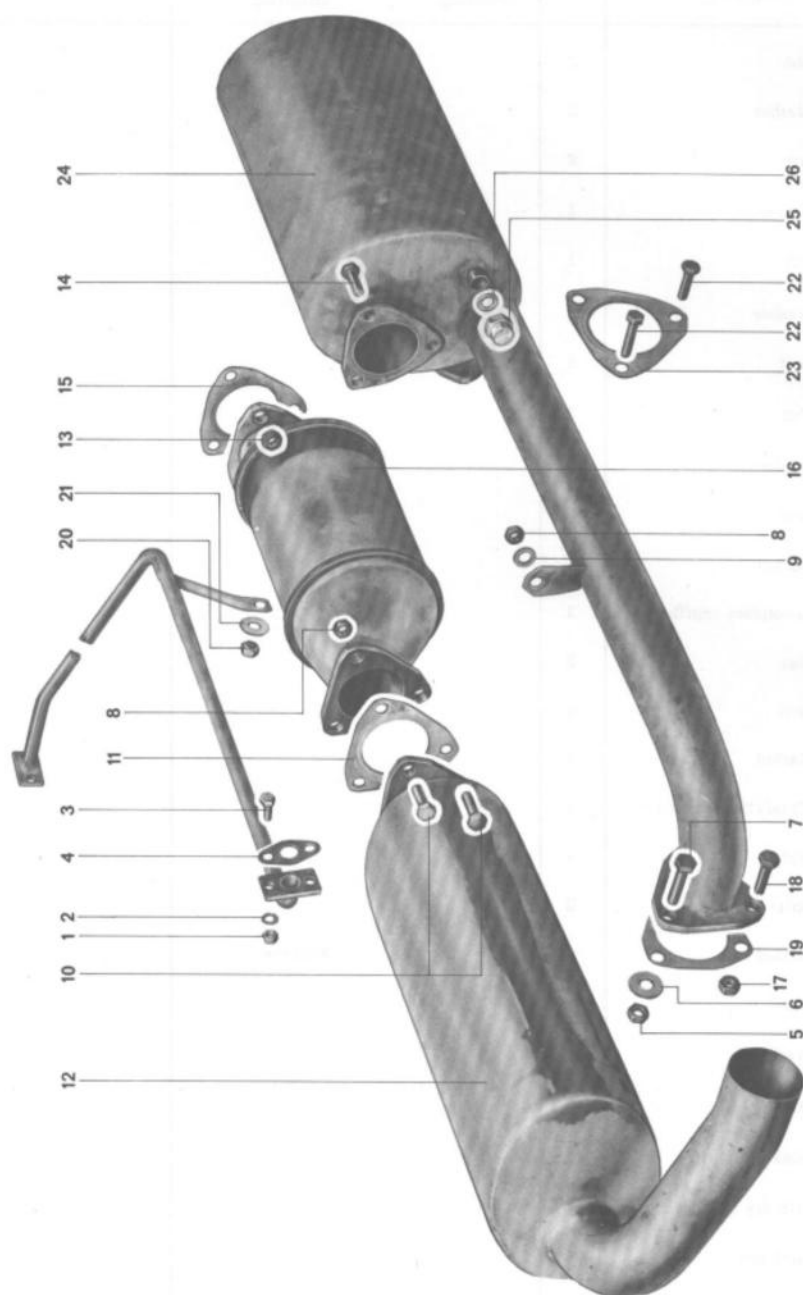


No.	Description	Qty	Note when		Remarks
			removing	installing	
1	Engine cover plate, right front	1			
2	Engine cover plate, left front	1			
3	Warm air guide, bottom left	1			
4	Warm air guide, bottom right	1			
5	Engine cover plate, rear	1			
6	Grommet	3			



No.	Description	Qty	Note when		References
			removing	installing	
1	Muffler	1	Replace when badly rusted		
2	Heat exchanger	2	Left and right side differ from each other. Check for damage. Rework sealing connections if necessary.		
3	Warm air duct	2			
4	Gasket	2		Replace	
5	Screw	2			
6	Washer	6			
7	Self-locking nut, M8	6			
8	Bolt, M8	6			

DISMANTLING AND ASSEMBLING EXHAUST SYSTEM - 1975 MODELS

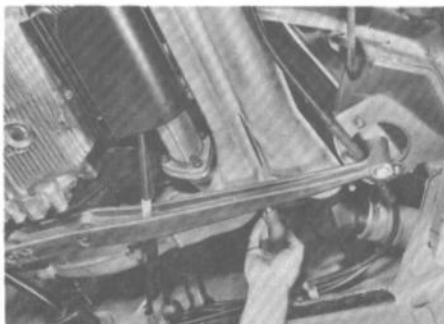


No.	Description	Qty.	Note when		Remarks
			removing	installing	
1	Nut	2			
2	Washer	2			
3	Bolt	2			
4	Gasket	1		Replace	
5	Nut	1			
6	Washer	1			
7	Bolt	1			
8	Nut	3			
9	Washer	1			
10	Bolt	3			
11	Gasket	1		Replace	
12	Secondary muffler	1			
13	Nut	3			
14	Bolt	3			
15	Gasket	1			
16	Catalytic converter	1			
17	Nut	2			
18	Bolt	2			
19	Gasket	1		Replace	
20	Nut	3			
21	Washer	1			
22	Bolt	3			
23	Gasket	1			
24	Primary muffler	1			
25	Lock nut	1			
26	Gasket 8x12 Copper	1		Replace	

REMOVING AND INSTALLING HEAT EXCHANGER

Removing

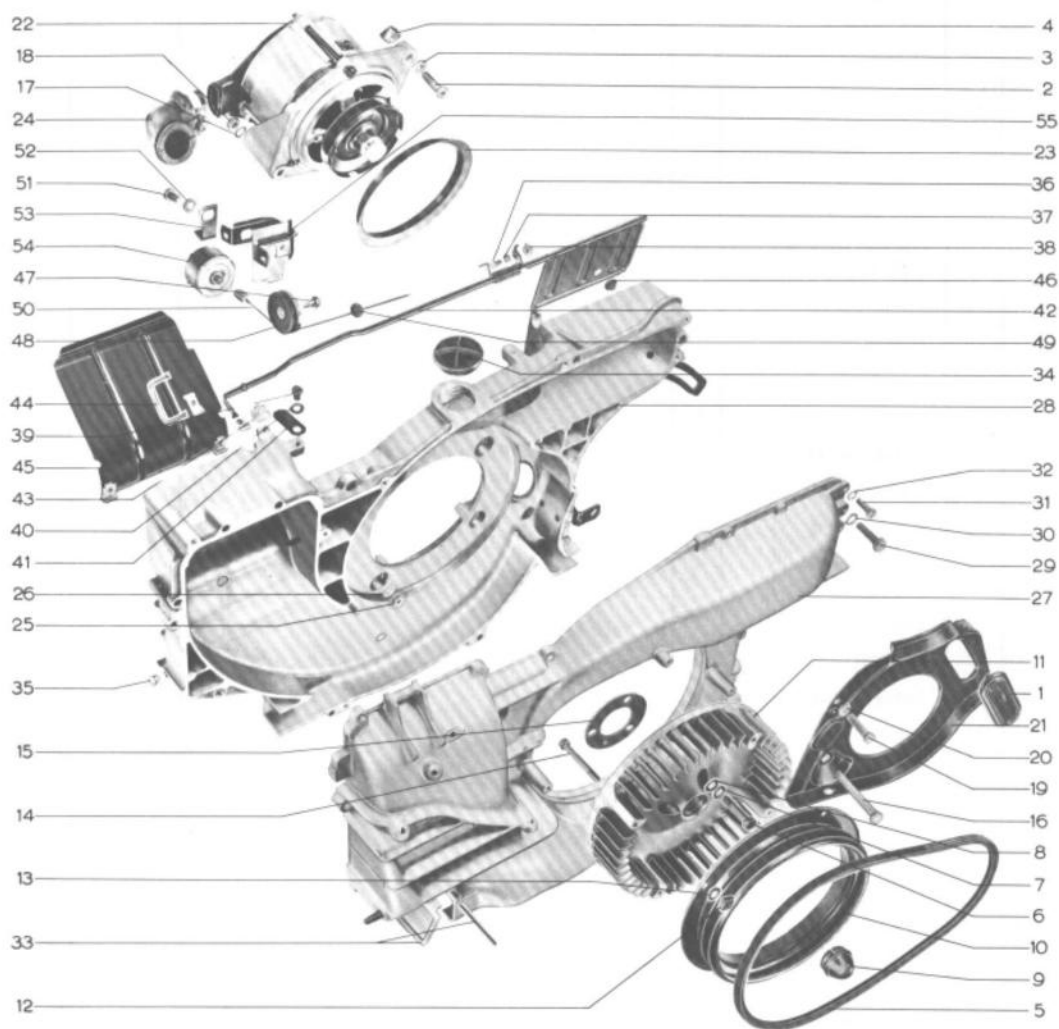
1. Detach floor air guide plate.
2. Disconnect heater cable. Remove flap support.
3. Remove heater air support cap screw on heat exchanger.
4. Loosen and remove warm air guide cover.
5. Remove bolts at flanges of heat exchanger.
6. Remove heat exchanger with gaskets.



Installing

Check air flap for ease of movement before installing heat exchanger.





No.	Description	Qty	Note when		References
			removing	installing	
1	Cover plate closure	1			
2	Internal-head bolt, M8	1		Loosen when adjusting V-belt	Fig. 1,2
3	Spring washer	1			
4	Nut, M8	1			
5	V-belt	1	Check for wear. Washer oily V-belts in detergent solution and rinse with water	Adjust tension to deflect 15 mm in length center under vigorous thumb pressure	Fig. 1,2
6	Internal-head bolt, M8x39	3		Torque to 19,6 Nm (2,0 mkg)	
7	Spring washer	3			
8	Washer	3			
9	Cap	1			
10	Pulley	1			
11	Cooling blower impeller	1	Remove and install together since parts are balanced together		
12	Square nut, M7	4			
13	Spring washer	4			
14	Internal head bolt, M7x52	4			
15	Spacer	1			
16	Bolt, M8	1			
17	Spring washer	1			
18	Nut, M8	1			
19	Bolt, M6x30	1			
20	Spring washer	1			
21	Alternator shroud	1			
22	Alternator	1			
23	Alternator seal	1			
24	Connecting elbow for alternator	1		Insert into front cooling blower housing half	Fig. 5
25	Nut, M8	4			
26	Spring washer	4			
27	Cooling blower housing rear half	1	Remove and install together		3, 3-2/2
28	Cooling blower housing front half	1			
29	Nut, M8x30	3			