

Volkswagen Engines

1963-73 VOLKSWAGEN TYPE 1, 2 & 3 4 CYLINDER

GENERAL SPECIFICATIONS										
Year	Displ.		Carburetor	HP at RPM	Torque (Ft. Lbs. at RPM)	Compr. Ratio	Bore		Stroke	
	cu. ins.	cc					in.	mm	in.	mm
Type 1										
1963-65	72.74	1192	1-Bbl.	42@3900	65@2400	7.0-1	3.03	77	2.52	64
1966	78.4	1285	1-Bbl.	50@4600	69@2600	7.3-1	3.03	77	2.72	69
1967-69	91.1	1493	1-Bbl.	53@4200	78@2600	7.5-1	3.27	83	2.72	69
1970	96.6	1584	1-Bbl.	57@4400	77@2200	7.5-1	3.36	85.5	2.72	69
1971	96.6	1584	1-Bbl.	60@4400	82@3000	7.5-1	3.36	85.5	2.72	69
1972	96.6	1584	1-Bbl.	60@4400	79@2600	7.3-1	3.36	85.5	2.72	69
1973	96.6	1584	1-Bbl.	46 @ 4000	72 @ 2000	7.3-1	3.36	85.5	2.72	69
Type 2										
1963-64	72.74	1192	1-Bbl.	42@3900	65@2400	7.0-1	3.03	77	2.52	64
1963-65	91.1	1493	1-Bbl.	51@4000	74@2600	7.8-1	3.27	83	2.72	69
1966-67	91.1	1493	1-Bbl.	53@4200	78@2600	7.5-1	3.27	83	2.72	69
1968-70	96.6	1584	1-Bbl.	57@4400	82@3000	7.7-1	3.36	85.5	2.72	69
1971	96.6	1584	1-Bbl.	60@4400	82@3000	7.5-1	3.36	85.5	2.72	69
Type 3										
To 1965	91.1	1493	1-Bbl.	54@4200	84@2800	7.8-1	3.27	83	2.72	69
1965	91.1	1493	2x1-Bbl.	66@4800	84@3000	8.5-1	3.27	83	2.72	69
1966-67	91.1	1493	1-Bbl.	54@4200	84@2800	7.5-1	3.27	83	2.72	69
1966-67	96.6	1584	2x1-Bbl.	65@4600	87@2800	7.7-1	3.36	85.5	2.72	69
1968-71	96.6	1584	⓪	65@4600	87@2800	7.7-1	3.36	85.5	2.72	69
1972	96.6	1584	⓪	65@4600	87@2800	7.3-1	3.36	85.5	2.72	69
1973	96.6	1584	⓪	52 @ 4000	77 @ 2200	7.3-1	3.36	85.5	2.72	69

⓪ — Electronic Fuel Injection.

TYPE 1

- Sedan (1963-73)
- Convertible (1963-73)
- Karmann Ghia (1963-73)
- Super Beetle (1971-73)

TYPE 2

- Transporter (1963-71)

TYPE 3

- Fastback Sedan (1965-73)
- Squareback Sedan (1965-73)

ENGINE IDENTIFICATION

Engine identification is determined by first digits of serial number. Engine serial number is stamped on crankcase under generator support flange on Type 1 and 2 models. Serial number is stamped on crankcase between distributor and oil breather on Type 3 models.

Model & Year	Engine Type	Engine Code
1963-65 Type 1	1200	D
1966 Type 1	1300	F
1967-69 Type 1	1500	H
1970 Type 1	1600	B
1971 Type 1 & 2	1600	AE
1972-73 Type 1	1600	AH
1973 Type 1	1600	AK
1963-64 Type 2	1200	D
1963-65 Type 2	1500	G
1966-67 Type 2	1500	H
1968-70 Type 2	1600	B
To 1965 Type 3	1500	K
From 1966 Type 3	1500	K
To 1966 Type 3	1500S	R
1966-67 Type 3	1600	T
1968-71 Type 3	1600	U
1972-73 Type 3	1600	X

ENGINE REMOVAL

Type 1 & 2 - 1) Disconnect battery ground cable and remove air cleaner. Remove throttle positioner and disconnect preheating air control cable (if equipped).

2) If equipped with Automatic Stick Shift, disconnect cable from control valve and vacuum hose from carburetor and intake manifold. Disconnect ATF pressure pipe and position so that fluid does not run out. Disconnect and plug ATF suction pipe.

3) Disconnect electrical connections from generator, coil, oil pressure switch and carburetor. Disconnect accelerator cable at carburetor. Remove upper engine mounting nuts, accessible from behind fan shroud. On Type 2 models, remove rear crossmember.

4) Raise vehicle. Disconnect and plug fuel line. Disconnect heater cables and remove heater tubes from engine. Pull accelerator cable from guide tube. On Type 2 models with double U-joint rear axle, install a suitable transmission support (VW784).

5) If equipped with Automatic Stick Shift, remove four bolts from drive plate through hole in transmission case. Engine may be rotated to gain access to all bolts.

6) Remove two nuts from lower engine mounting studs. On Type 2 models with double U-joint rear axle, remove rubber engine mounts.

7) Place a floor jack under engine to support and pull back slightly until clutch release bearing (M/Trans.) clears transmission shaft. Lower engine taking care not to damage transmission shaft and clutch. Remove engine.

NOTE — On vehicles equipped with Automatic Stick Shift, hold torque converter in place with a clamp.

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8) On manual transmission models, inspect clutch release bearing for damage. Coat transmission shaft with molybdenum-disulfide powder and lubricate starter shaft bushing with multipurpose grease. Install engine carefully to avoid damage to transmission shaft or clutch. To complete installation, reverse removal procedure, adjust accelerator cable and check ignition timing. On Automatic Stick Shift models, check ATF level.

Type 3 - 1) Disconnect battery ground cable, remove air cleaner preheating air boxes. Disconnect electrical connections from generator, coil, oil pressure switch and carburetors. On fuel injection engines, remove wires from two temperature sensors, throttle valve switch, thermostatic, cold starting valve, four injectors and pressure sensor.

2) On models equipped with Automatic Transmission, disconnect vacuum hose from balance pipe and cable from kick-down switch.

3) Disconnect accelerator cable from bellcrank. Remove dipstick and rubber boot between oil filler tube and body. Remove clamp from air intake bellows and remove bellows. Remove engine support and upper mounting nuts.

4) Raise vehicle. Disconnect heater cables and remove heater tubes from engine. Pull accelerator cable through engine cover plate. Disconnect and plug fuel line.

5) On models equipped with fuel injection, disconnect and plug line on left fuel distributor. Disconnect and plug return line on pressure regulator. Disconnect electrical connections on fuel injection wiring harness.

6) On models equipped with Automatic Transmission, remove three bolts from drive plate, accessible through hole in transmission. Engine may be rotated to gain access to all three bolts.

7) On all models remove lower engine mounting nuts from studs. On models equipped with double U-joint rear axle, install a suitable transmission support (VW785/1).

8) Place a floor jack under engine and raise slightly to remove four engine carrier bolts. Pull back slightly on engine until clutch release bearing (M/Trans.) clears transmission shaft. Lower engine carefully and remove from vehicle.

NOTE - On vehicles equipped with Automatic Transmission hold torque converter in place with a clamp.

9) On manual transmission models, inspect clutch release bearing for damage. Coat transmission shaft with molybdenum-disulfide powder and lubricate starter shaft bushing with multipurpose grease. Install engine carefully to avoid damage to transmission shaft or clutch.

10) On models without double U-joint rear axle, use only as many spacer washers on mount at rear of vehicle to raise engine .08-.12" with engine bolted to transaxle. Make sure vehicle is on level surface. To complete installation reverse removal procedure, adjust accelerator cable and ignition timing.

11) On models with double U-joint rear axle, tighten engine carrier bolts to specifications with engine installed and remove transmission support. If rubber engine carrier mounts on body were loosened or removed, engine and transmission assembly must be centered again.

12) To center, place a suitable measuring bar (VW360) between edges of outside axle flanges. With wheels hanging

freely, adjust engine and transmission assembly until pointer of measuring bar is centered on casting rib of transmission. Marks on sleeve of bar should be within tolerance marks.

13) Tighten rubber carrier mounts. To complete installation reverse removal procedure, adjust accelerator cable and ignition timing.

INTAKE MANIFOLD

Type 1 & 2 - 1) Intake manifold can be removed with engine still in vehicle. Remove hood, fan belt and clamp securing generator to mount on crankcase.

2) Remove warm air duct from lower right side. Remove bolt securing thermostat to bracket and unscrew thermostat from control rod. Remove hoses from fan housing. Disconnect wires from generator and coil. Remove screws at side of fan housing and remove housing.

3) Disconnect fuel and vacuum lines from carburetor. Remove nuts securing manifold to cylinder heads and bolts securing pre-heating tube to muffler. Remove intake manifold with carburetor from vehicle.

4) To install reverse removal procedure. Use new gaskets and tighten all nuts and bolts uniformly.

Type 3 Single Carburetor - 1) Intake manifold can be removed with engine in vehicle. Remove air cleaner and disconnect accelerator cable. Disconnect electrical connection at automatic choke.

2) Disconnect fuel and vacuum lines at carburetor. Remove nuts securing intake manifold to cylinder heads. Remove bolts securing pre-heating pipe to muffler and remove manifold with carburetor.

3) To install reverse removal procedure. Use new gaskets and tighten all nuts and bolts uniformly. Check pre-heating pipe valve for freedom of movement.

Type 3 Dual Carburetor - 1) Intake pipes connecting carburetors to cylinder heads can be removed with engine in vehicle. Disconnect fuel lines and electrical connections on carburetors. Remove vacuum line on left carburetor. Disconnect return springs and throttle linkage connecting rods.

2) Remove intake manifold cover plates. Remove nuts and washers securing intake pipes to cylinder heads and remove intake pipes with carburetors.

3) To install reverse removal procedure. Use new gaskets and tighten intake pipe securing nuts uniformly. Adjust throttle cable so that there is .04" clearance between throttle valve lever and stop on carburetor body when accelerator pedal is at full open position. Adjust carburetors with a synchrotester.

Type 3 Fuel Injection - 1) Fuel injection manifold can be removed with engine in vehicle. Remove air cleaner and hoses. Remove pressure switch.

2) Disconnect wires on fuel injectors and remove two screws. Pull injectors off with plate and retainer. Make sure locating bushings are removed from manifold. Disconnect hoses on injectors and remove.

3) Remove intake manifold cover plate. Remove nuts and washers securing manifold to cylinder heads. Lift up on manifold and pull from tubes on air distributor.

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4) To install reverse removal procedure. Use new gaskets and tighten intake manifold securing nuts uniformly. Make sure gray protective cap on injector is to rear and black cap is to front.

CYLINDER HEAD

Type 1 & 2 - 1) Remove engine and intake manifold as previously outlined. Remove muffler and heat exchangers. Disconnect spark plug wires. Remove cylinder cover plates and valve covers. Remove rocker arm assemblies and push rods. Remove cylinder head retaining nuts and remove cylinder heads.

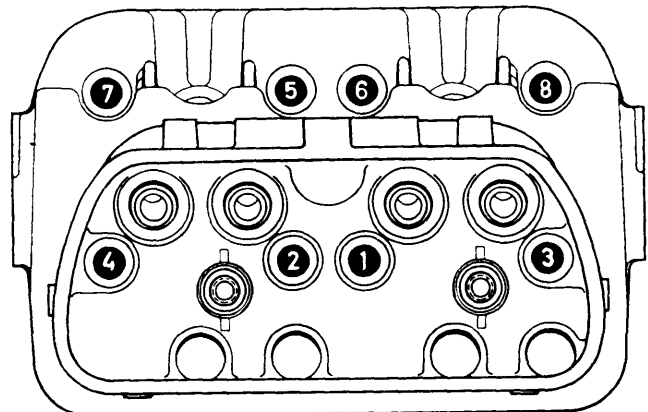
2) On fuel injection engines, remove lower left side warm air duct. Remove bolt attaching thermostat to bracket and unscrew thermostat from control rod. Disconnect rod from control lever at top.

3) To install, reverse removal procedure. Use new cylinder sealing rings. Install new rocker arm stud seals. Install push rod tubes with new seals and with seams up. Tighten cylinder heads to 7 ft. lbs. (1 mkg) in sequence shown in illustration A, then tighten to final torque in sequence shown in illustration B. Adjust valves.

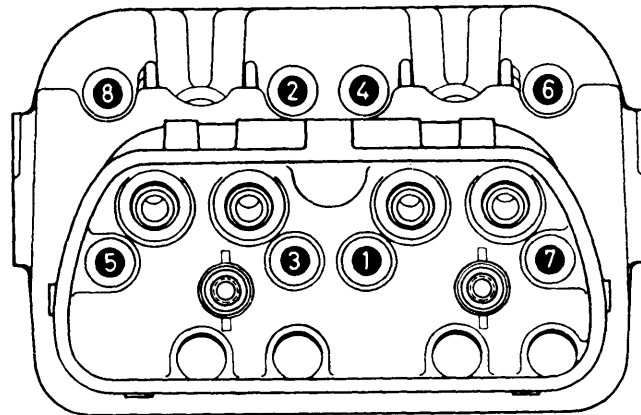
Type 3 - 1) Remove engine and intake manifold as previously outlined. Remove muffler and heat exchanger. Disconnect spark plug wires at spark plugs. Remove deflector cover plates from under cylinder cover plates and remove cylinder cover plates.

2) Remove lower left side warm air duct. Remove bolt securing thermostat to bracket and unscrew thermostat from control rod. Disconnect rod from control lever at top.

3) Remove and install cylinder heads as outlined in Type 1 and 2 procedure. Reverse removal procedure to install remaining Type 3 components.



A



B

2EM5333

CYLINDER HEAD TIGHTENING SEQUENCE

VALVES							
Engine & Valve	Head Diam. In. (mm)	Face Angle	Seat Angle	Seat Width In. (mm)	Stem Diameter In. (mm)	Stem Clearance In. (mm)	Valve Lift In. (mm)
1200 & 1300							
Int.	1.239 (31.47)	45°	45°	.05-.06 (1.27-1.52)	.3125-.3129 (7.93-7.95)	.008-.009 (.20-.23)
Exh.	1.181 (30.00)	45°	45°	.06-.08 (1.52-2.03)	.3114-.3118 (7.91-7.92)	.011-.012 (.28-.30)
1500 & 1600							
Int.	1.397 (35.48)	45°	45°	.05-.06 (1.27-1.52)	.3125-.3129 (7.93-7.95)	.008-.009 (.20-.23)
Exh.	1.259 (31.98)	45°	45°	.06-.08 (1.52-2.03)	.3114-.3118 (7.91-7.92)	.011-.012 (.28-.30)

VALVE ARRANGEMENT

E-I-I-E (front to rear), both banks.

VALVE GUIDE SERVICING

1) Place valve in valve guide with stem flush with end of guide. With dial indicator, measure valve rock at valve head. If rock exceeds .031" (.79 mm) replace valve guide or valve. Valve guide with inside machined shoulder is exhaust.

2) To replace valve guide, drill guide with shouldered drill to depth of 1.5-2" (38.1-50.8 mm) using slow speed drill. Drive

guides down through head with suitable drift. Press oversize guide in from top of cylinder head. Pressure required should be 2000-4000 lbs. (907.2-1814.4 kg). Ream guides to proper fit.

VALVE STEM OIL SEALS

Coat valve stems with molybdenum-disulfide paste and insert in cylinder head. Slide valve stem seal over valve stem using a suitable guide (VW699).

1963-73 VOLKSWAGEN TYPE 1, 2 & 3 4 CYLINDER (Cont.)

VALVE SPRINGS			
Engine	Free Length In. (mm)	PRESSURE (LBS.) Lbs. @ In. (kg @ mm)	
		Valve Closed	Valve Open
1200	90-103@ 1.305 (41-47@ 33.15)
1300 & 1500	117-135@ 1.22 (53-61@ 31.00)
1600	117-184@ 1.22 (53-83@ 31.00)

VALVE SPRINGS

NOTE — Valve spring may be removed with cylinder head installed. Apply constant air pressure, minimum 85 psi (5.97 kg/cm²), to cylinder through spark plug hole to hold valve in place while compressing spring.

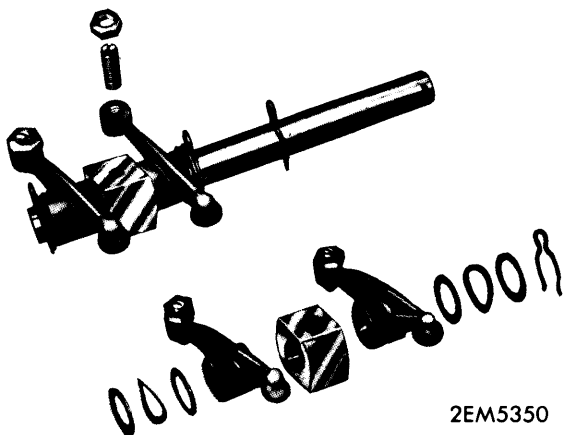
Removal — Remove cylinder head cover and rocker arm shaft. Install suitable valve spring compressor tool (VW311H with cylinder head removed, VW653/2 with cylinder head installed). Compress spring retainer and spring and remove valve keepers. Release compressor and remove spring retainer and spring.

Installation — Install valve, valve spring, valve stem oil seal and spring retainer. **NOTE** — Install spring with closely spaced coils against head. Compress spring and install valve keepers.

ROCKER ARM ASSEMBLY

1) Remove valve cover. Remove nuts from rocker arm studs and remove rocker arm assembly. Remove clips from end of shaft and remove washers, rocker arms and shaft supports.

2) Inspect shaft, supports and rocker arms for wear. Inspect sides of rocker arms and supports for wear. Smooth sides with emery paper before installing if worn.



ROCKER ARM ASSEMBLY

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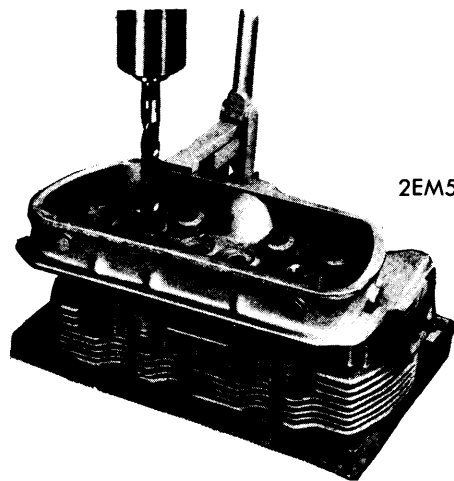
3) To assemble reverse removal procedure. Install new seals on rocker arm studs, and reverse removal procedure to install. Adjust valve clearance.

ROCKER ARM STUD REPLACEMENT

Replacement rocker studs for cylinder heads with round rocker stud bosses are available. When replacing loose or broken studs, both studs in both heads must be replaced. With replacement studs installed, valve clearance adjustment is changed to .004" for both intake and exhaust valves.

1) Remove both cylinder heads as previously outlined. Remove rocker studs from head.

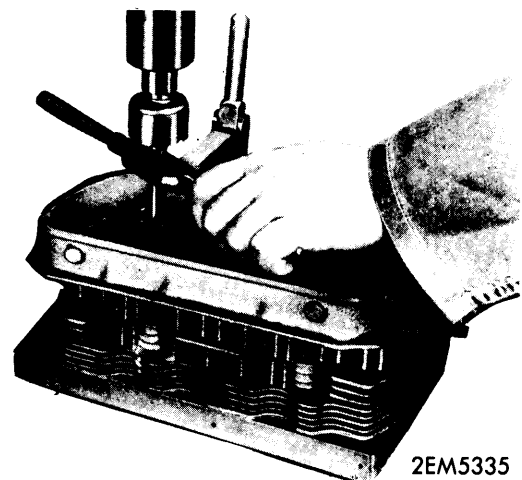
2) With cylinder heads mounted flat on a drill table, enlarge rocker stud hole with a .512" drill.



2EM5334

ROCKER ARM STUD REPLACEMENT
(DRILLING TO SIZE)

3) Tap hole with a M15 x 1.5 tap. Coat shoulder of replacement stud with D2 sealer and install stud in head.



2EM5335

ROCKER ARM STUD REPLACEMENT
(TAPPING TO SIZE)

VALVE CLEARANCE ADJUSTMENT

Valve clearance is checked or adjusted with engine cold. Rotate engine until piston of valve being adjusted is at TDC of compression stroke. Both valves can be adjusted at same time.

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Valve Clearances

Application	Intake In. (mm)	Exhaust In. (mm)
1963-73 ①	.006 (.10)	.006 (.10)

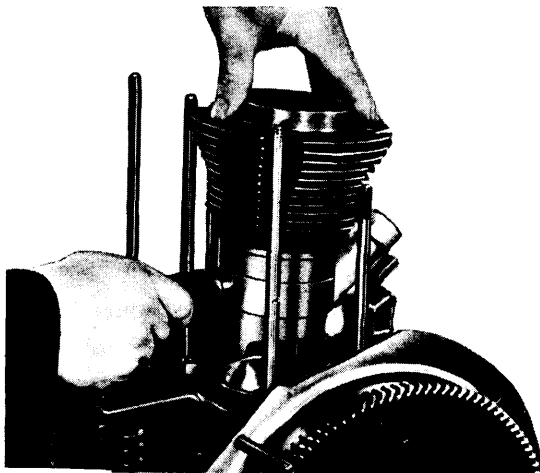
① — On 1200 engines up to No. 9205699, 1500 engines up to No. 0710799 (Type 2) and No. 0672697 (Type 3) with long rocker arm mounting studs, adjust valves intake .008" (.20 mm) and exhaust .012" (.30 mm). These heads may be identified by the round rocker arm stud bosses. Take care to note if long studs have been replaced with short studs, in which case adjust valves to .006" (.10 mm).

PISTONS, PINS, RINGS						
Engine	PISTONS	PINS		RINGS		
	Clearance In. (mm)	Piston Fit In. (mm)	Rod Fit In. (mm)	Rings	End Gap In. (mm)	Side Clearance In. (mm)
All	.0015-.002 (.04-.05)	①	.0004-.0008 (.01-.02)	No. 1	.012-.018 (.30-.46)	.0027-.0035 (.07-.09)
				No. 2	.012-.018 (.30-.46)	.0019-.0027 (.05-.07)
				Oil	.010-.016 (.25-.41)	.0012-.0019 (.03-.05)

① — Push fit with piston heated to approximately 176°F.

CYLINDERS

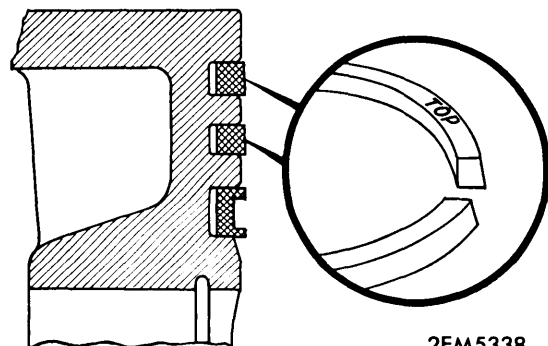
- 1) Remove cylinder heads as previously outlined. Mark cylinders to insure that they are reinstalled on same piston.
- 2) Remove deflector plates from bottom of cylinders and pull cylinders from pistons.
- 3) Check cylinders for size and wear. If cylinder is more than .008" larger than standard, cylinder must be replaced. Piston must be replaced with cylinder as they are a matched set.
- 4) Check seating surfaces of cylinders on both ends. Make sure seating areas are clean before installing cylinders.
- 5) Apply oil to piston and pin. Compress rings with a suitable ring compressor (VW123). Make sure ring gaps are equally offset and gap of oil ring is at top.
- 6) Oil cylinder wall and install new sealing gasket on crankcase side of cylinder. Install cylinder and remove ring compressor. Make sure studs do not contact cooling fins when cylinder is completely seated against crankcase.



2EM5337 CYLINDER INSTALLATION

PISTONS & PINS

- 1) Remove cylinders as previously outlined. Mark pistons to insure that they are installed on same connecting rod.
- 2) Remove piston pin circlip with a suitable remover (VW122B). Drive out piston pin with a suitable tool (VW207).
- 3) If piston pin is tight, heat piston to approximately 176°F with a suitable piston heating tool (VW205).
- 4) Remove rings if rings are being replaced. Clean carbon from ring grooves. Check piston for wear, if piston is replaced, replace with one that is not more than 5 grams difference in weight.
- 5) Check fit of pin in piston, if any side clearance is felt piston must be replaced. Check fit of pin in connecting rod, if excessive amount of side clearance is felt, bushing in connecting rod must be replaced and reamed to proper clearance with piston pin. See *Crankshaft and Connecting Rod Service*.
- 6) Check ring side clearance in piston, maximum side clearance for top compression ring is .0047". Maximum clearance for second compression ring and oil ring is .004".
- 7) Check ring gap in cylinders, maximum ring gap for 1200 models is .037", maximum for all other models is .035".



2EM5338 COMPRESSION RING 1 & 2 INSTALLATION

- 7) Install cylinder deflector plates. Install remaining components as previously outlined.

1963-73 VOLKSWAGEN TYPE 1, 2 & 3 4 CYLINDER (Cont.)

8) Pistons must be installed with word "Vorn" or arrow toward flywheel. Install circlip on flywheel side of piston and install piston closest to flywheel first.

9) If pin will not push fit into piston, use same heating procedure as used during removal to install piston pin. Install remaining circlip. Install remaining components as previously outlined.

CRANKSHAFT MAIN & CONNECTING ROD BEARINGS							
Engine	MAIN BEARINGS				CONNECTING ROD BEARINGS		
	Journal Diam. In. (mm)	Clearance In. (mm)	Thrust Bearing	Crankshaft End Play In. (mm)	Journal Diam. In. (mm)	Clearance In. (mm)	Side Play In. (mm)
1963-72							
Journal #1	2.1653 (55.00)	.0016-.0047 (.04-.12)	No. 1	.0027-.0051 (.07-.13)	2.1653 (55.00)	.0008-.0031 (.02-.08)	.004-.016 (.10-.41)
#2	2.1653 (55.00)	.0011-.0033 (.03-.08)					
#3	2.1653 (55.00)	.0016-.0047 (.04-.12)					
#4	1.5748 (40.00)	.0019-.004 (.05-.10)					
1973							
Journal #1	2.1640-2.1648 (54.96-54.98)	.0016-.0039 (.04-.10)	No. 1	.0027-.0051 (.07-.13)	2.1653 (55.00)	.0008-.0028 (.02-.07)	.004-.016 (.10-.40)
#2	2.1640-2.1648 (54.96-54.98)	.0012-.0035 (.03-.09)					
#3	2.1640-2.1648 (54.96-54.98)	.0016-.0039 (.04-.10)					
#4	1.5739-1.5748 (39.98-40.00)	.0020-.0039 (.05-.10)					

CRANKCASE DISASSEMBLY

1) Remove engine from vehicle and remove cylinder heads, cylinders and pistons as previously outlined. Remove flywheel or drive plate, distributor, fuel pump, distributor drive, distributor drive washer and oil cooler.

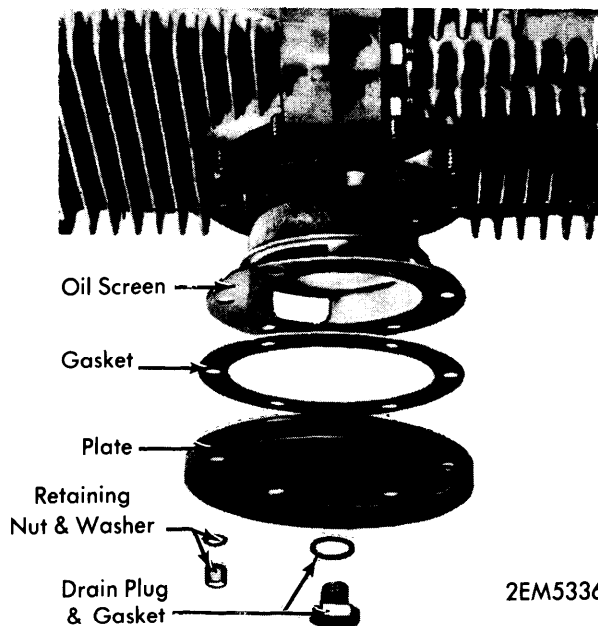
2) On Type 1 and 2 engines, remove front pulley nut and remove pulley using a suitable puller (VW203). Remove generator support housing and metal shroud from front of motor.

3) On Type 3 engines remove air intake housing. Remove crankshaft pulley and generator. Remove rear half of fan shroud and pull fan off using a suitable puller (VW176). Remove front half of fan shroud and breather support from top of motor.

4) On all models remove oil pump cover and pull oil pump from crankcase using a suitable puller (VW201). Remove retaining plate and screen from bottom of motor. Remove nuts and bolts securing crankcase halves and separate.

CAUTION - Use a rubber hammer to separate crankcase halves, do not insert any kind of tool between sealing edges.

5) Remove camshaft and crankshaft. Remove crankshaft oil seal and cam plug. Remove number two bearing halves from both sides of crankcase and remove bearing dowel pins. Remove cam bearings if equipped. Remove oil pressure relief valve.



2EM5336

OIL STRAINER (OIL PAN)

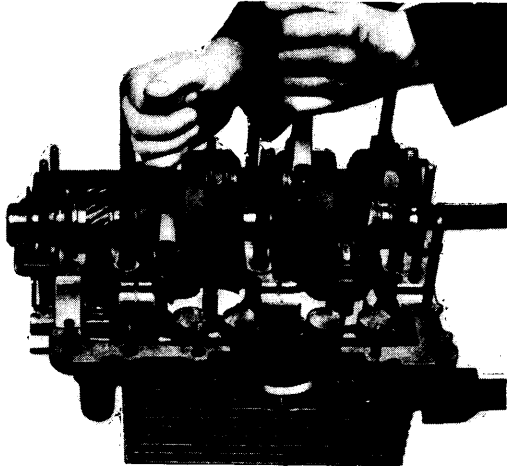
CRANKCASE ASSEMBLY

1) Thoroughly clean and inspect crankcase halves for wear or cracking. Assemble empty crankcase halves and tighten nuts to specifications. Measure crankshaft bearing bores with an inside micrometer. Maximum size for bearing bores 1 through 3 is 2.5601" and maximum size for number 4 bearing bore is 1.9700". If necessary slightly chamfer edges of bearing bores.

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2) Flush out all oil passages and blow out with compressed air. Make sure oil suction tube and all studs are tight in crankcase halves. Check valve tappets and bores in crankcase. Maximum clearance is .0047".

3) Insert valve tappets and crankshaft bearing dowel pins. Install camshaft bearings if equipped. Install number 2 bearing halves. Install crankshaft and connecting rod assembly, making sure bearings line up with dowel pins.

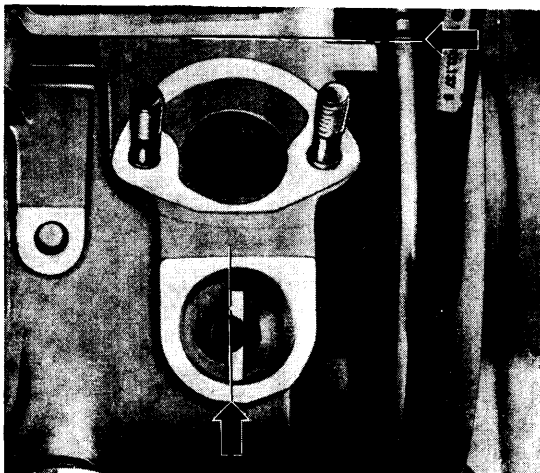


2EM5342 CRANKSHAFT REMOVAL

4) Install camshaft with "O" on cam gear centered between two teeth with punch marks on crankshaft gear. Install cam plug using sealer. Spread a thin coat of sealer on sealing edges of crankcase halves, making sure sealer does not enter oil passages.

5) On 1500 and 1600 models, install "O" ring on large crankcase studs and push "O" ring into beveled portion of crankcase. Join crankcase halves together and lightly tighten nuts. Tighten M8 nut next to M12 nut near number 1 bearing to specification then tighten all M12 nuts to specifications. Tighten remaining nuts and bolts to specifications.

6) Check crankshaft for freedom of movement. Install oil pressure relief valve. Install pistons, cylinders and cylinder

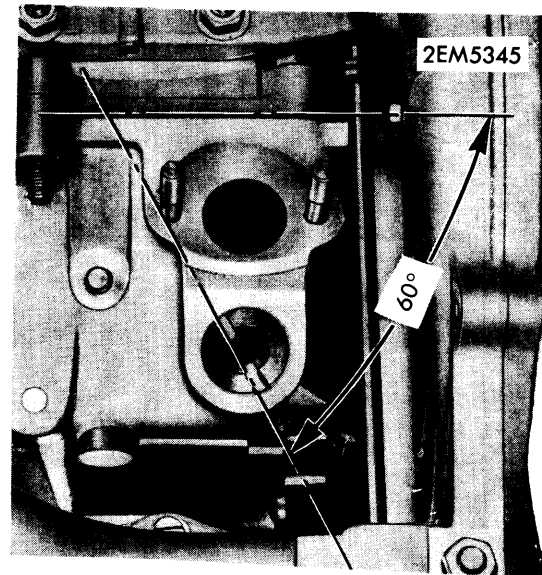


2EM5344 DISTRIBUTOR DRIVE INSTALLATION (TYPE 1 & 2)

heads as previously outlined. On Type 3 models, install front half of fan shroud with a suitable centering tool installed (VW177). Tighten shroud and remove tool.

7) On all models install all components except distributor and distributor drive in reverse of removal order. Set engine on number one firing position. Place distributor drive washer on a long screwdriver. Insert screwdriver into bottom of distributor hole, drop washer and center in bottom of hole with screwdriver.

8) On Type 1 and 2 models insert distributor drive with slot at a 90° angle with crankshaft and small segment of slot toward pulley. On Type 3 models, install distributor drive at a 60° angle with center line of crankcase and with small segment of slot toward oil cooler. Install distributor and check crankshaft endplay. **NOTE** — See *Thrust Bearing Alignment*. Install engine as previously outlined.



DISTRIBUTOR DRIVE INSTALLATION (TYPE 3)

MAIN & CONNECTING ROD BEARING SERVICE

1) Split crankcase and remove crankshaft and connecting rod assembly as previously outlined. Attach crankshaft to a suitable holding fixture (VW310A).

2) Remove Woodruff key, oil thrower and number 4 bearing. Remove connecting rods and bearings. Remove snapping from end of crankshaft.

3) Press distributor drive gear, spacer and crankshaft gear from crankshaft. Remove number 3 bearing. Thoroughly clean crankshaft and blow out all oil passages with compressed air.

4) Check crankshaft for runout, maximum runout is .0011". Check crankshaft journals for out-of-round, maximum out-of-round is .0011". If excessive out-of-round conditions exist, crankshaft must be ground to next undersize.

5) Bearings for undersize crankshafts are available in .010, .020 and .030" undersize. Connecting rod bearing journals are also available in same undersizes.

6) Clean and inspect connecting rods. If bushing has been determined to be worn excessively, press old bushing out. Install new bushing, making sure oil holes align with holes in

1963-73 VOLKSWAGEN TYPE 1, 2 & 3 4 CYLINDER (Cont.)

connecting rods. Ream bushing to specified clearance with a new piston pin.

7) Check connecting rod for twist and parallelism. Earlier model rods use bolts to secure rod cap to rod. These bolts must be replaced when reassembling connecting rod. Later model rod use studs in rod cap, nuts must be replaced. If studs are defective, connecting rod must be replaced.

8) If connecting rod is replaced, make sure there is no more than 10 grams difference in weight between new and old connecting rods.

9) Main bearing clearance is checked by the Plastigage method. Place a piece of Plastigage wire across crankshaft journal. Install bearings on crankshaft and install crankshaft in empty crankcase halves. Bolt crankcase together at specified torque. Do not turn crankshaft. Separate crankcase and remove crankshaft. Remove bearings and compare flattened wire to scale on Plastigage package. Compare to specified clearance.

10) If clearance is more than specified, crankshaft can be ground to .010", .020" and .030" undersize. Replacement bearings of appropriate size must be used. This same procedure is used when determining connecting rod bearing clearance.



2EM5340

CONNECTING ROD SIDE CLEARANCE CHECKING

11) Install bearing halves in rod and rod cap. Install on crankshaft with numbers on rod and rod cap together and with forged mark on rod up when crankshaft is installed. Tighten rod bolts or nuts to specifications. Check rod side clearance.

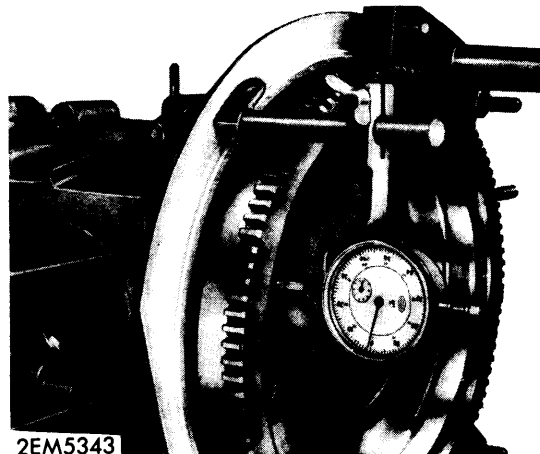
12) Oil and install number 3 bearing on crankshaft with dowel pin hole toward flywheel. Press on crank gear, spacer and distributor drive gear. Install snap ring. Oil and install number 4 bearing with groove toward oil thrower. Install oil thrower and Woodruff key.

13) Oil and install number 1 bearing and install crankshaft in crankcase as previously outlined.

THRUST BEARING ALIGNMENT

1) Crankshaft endplay must be adjusted with crankshaft oil seal removed. Install two shims, flywheel gasket (paper or metal) and flywheel.

2) Correct endplay is .0023-.0047". Mount a dial indicator to crankcase so back and forth movement of crankshaft can be determined. Rock crankshaft back and forth and determine thickness of third shim.



2EM5343

CRANKSHAFT ENDPLAY CHECKING

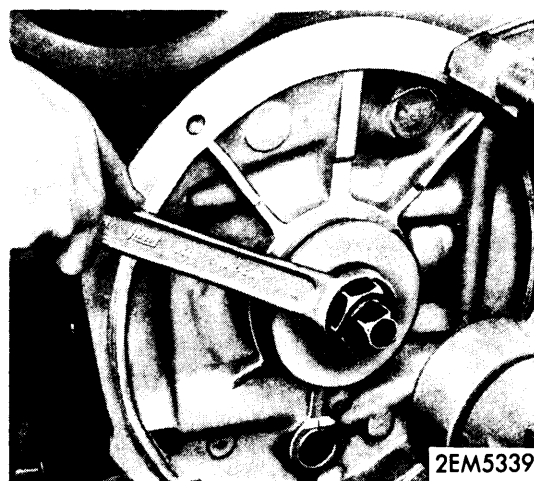
3) Install third shim, oil seal and flywheel with gasket. Recheck endplay. The following shim sizes are available:

Millimeter Marking (Etched in Shim)	Inch Equivalent
0.24 mm	.0094"
0.30 mm	.0118"
0.32 mm	.0126"
0.34 mm	.0133"
0.36 mm	.0142"
0.38 mm	.0159"

MAIN BEARING OIL SEAL SERVICE

1) Remove flywheel and pry out old seal. Clean recess in crankcase and coat with a thin film of sealer.

2) Install a new seal using a suitable installer (VW240D). Make sure seal is squarely seated in recess.



2EM5339

CRANKSHAFT OIL SEAL INSTALLATION

3) Lubricate contact surface of seal and install flywheel. Tighten flywheel retaining nut to specification.

1963-73 VOLKSWAGEN TYPE 1, 2 & 3 4 CYLINDER (Cont.)

CAMSHAFT			
Engine	Journal Diam. In. (mm)	Clearance In. (mm) ①	Lobe Lift In. (mm)
All	.9837-.9842 (24.98-25.00)	.0008-.0019 (.02-.04)

① — End play is .0016-.0051" (.04-.13 mm).

CAMSHAFT REMOVAL

1) Split crankcase and remove camshaft as previously outlined. Clean camshaft and inspect riveted joint between camshaft and gear.

2) Inspect camshaft lobes and bearing journals for excessive wear. Maximum wear for bearing journals is .0015" (.04 mm). Check camshaft runout on number two bearing journal. Maximum runout is .0016" (.04 mm).

3) Check backlash between camshaft and crankshaft gears. Correct backlash is 0-.002". If backlash is incorrect, camshafts

with different pitch radius are available. Pitch radius is stamped on inner face of gear.

4) Check end thrust of camshaft with a dial indicator, maximum endplay is .0063". Install camshaft as previously outlined.

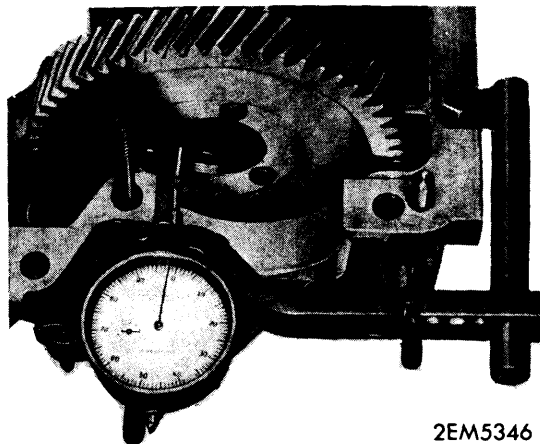
VALVE TIMING				
Engine	INTAKE		EXHAUST	
	Open (BTDC)	Close (ABDC)	Open (BBDC)	Close (ATDC)
1963-72 1200 & 1300 1500 & 1600	6°	35°	42°	3°
	7°	37°	44°	4°
1973 1600	7.5°	37°	44.5°	4°

CAMSHAFT BEARING REPLACEMENT

Later model engines are equipped with cam bearings. See *Crankcase Assembly and Disassembly*.

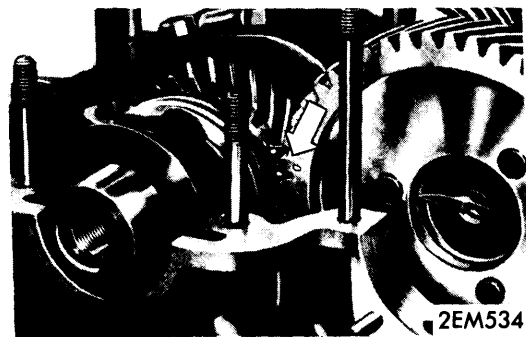
VALVE TIMING

Install camshaft with "O" stamped in tooth of gear between two teeth with punch marks on crankshaft gear.



2EM5346

CAMSHAFT ENDPLAY CHECKING



2EM5341

CAMSHAFT TIMING GEAR POSITION

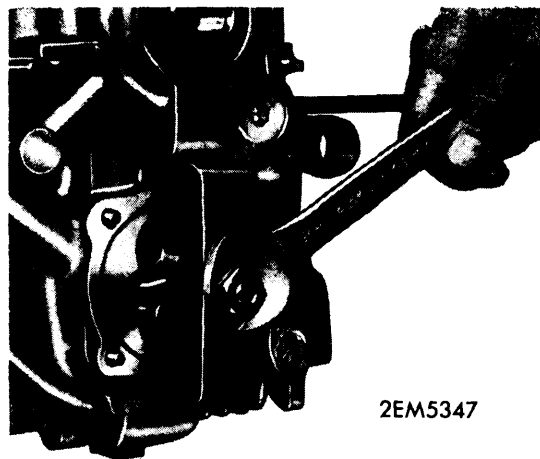
ENGINE OILING

Oil Capacity — 2.65 qts.

Normal Oil Pressure — Minimum oil pressure at 550 RPM is 7 psi (.49 kg/cm²). At 2500 RPM minimum oil pressure is 28 psi (1.96 kg/cm²) and standard oil pressure is 42 psi (2.95 kg/cm²).

ENGINE OILING SYSTEM

Full pressure lubrication system with gear type oil pump. Oil pump is mounted at front of engine and driven by the camshaft. Oil is pumped through oil cooler into oil passages. Crankshaft main and connecting rod journals oil through cross drilled holes in crankshaft. Oil is pumped to camshaft through oil passages that also lubricate valve tappets. Oil flows through tappets and into push rods to lubricate rocker arms and shafts. Valves and valve stems are lubricated by splash oil. Excess oil flows back into crankcase through push rod tubes. Cylinder walls, pistons and piston pins are oiled by splash oil.



2EM5347

OIL PUMP REMOVAL

1963-73 VOLKSWAGEN TYPE 1, 2 & 3 4 CYLINDER (Cont.)

ENGINE OILING (Cont.)

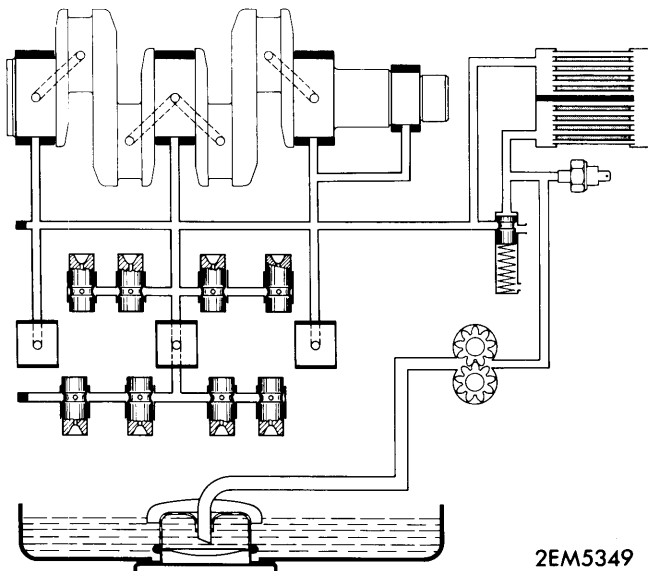
OIL PUMP REPLACEMENT

W/Man. Trans. 1) On Type 1 & 2 models, remove crankshaft pulley and metal shroud from under pulley. On Type 3 models, remove air intake duct, crankshaft pulley, generator, rear fan shroud half, fan and front fan shroud half.

2) On all models remove oil pump cover and gears. Pull pump housing from crankcase using a suitable puller (VW201). Check gear backlash and endplay, see table for specifications.

3) Inspect pump body mating surfaces for wear or damage. Install pump body and gasket (without sealer) in crankcase. Insert a suitable pilot in housing in place of gear.

4) Rotate crankshaft 360° twice to center pump body with slot in camshaft. Remove pilot and install gears. Inspect cover and machine flat if necessary. Use new gasket (without sealer) and install cover. Tighten bolts and install remaining components as previously outlined.



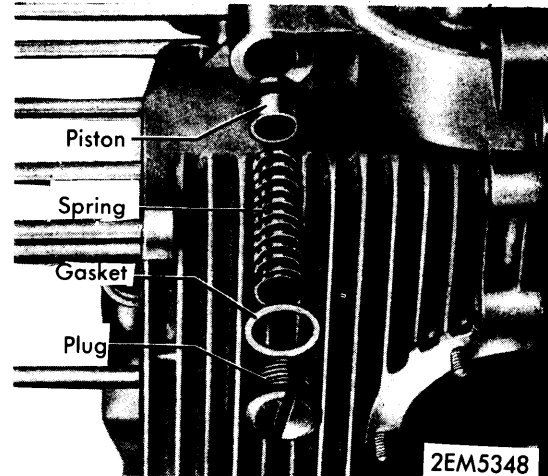
OIL CIRCULATION DIAGRAM

W/Automatic Stick Shift – Follow same procedure as for manual transmission, noting the following:

Remove Woodruff keys to avoid damage to intermediate plate seals. If intermediate plate or front cover are damaged, replace complete oil pump.

Pressure Regulator Valve

1) Remove plug from bottom of crankcase and remove spring and plunger. Inspect plunger and bore in crankcase for signs of wear or seizure. Replace plunger if worn.



RELIEF VALVE COMPONENTS

2) Check spring against specifications in Oil Pump Specifications table. Install plunger and spring and screw in plug using a new gasket.

Oil Pump Specifications

Application	In. (mm)
Gear Backlash.....	0-.008 (0-.20)
Maximum End Play (W/O Gasket).....	.004 (.10)
Regulator Valve Spring	
Free Length.....	2.44-2.52 (61.97-64.00)
Loaded to 17 ft. lbs. (7.71 kg).....	.93 (23.62)

ENGINE COOLING

COOLING SYSTEM

Type 1 & 2 – Engine is cooled by a radial fan mounted on end of generator and inside fan shroud. Fan draws air thru hole in fan shroud. Air is directed over finned cylinders and cylinder heads by deflector plates. On 1200 models up to 1965, a thermostatically controlled ring mounted in air intake hole in fan shroud controls amount of air drawn into fan shroud. As engine warms up, ring pivots out of air intake hole to allow total flow of air into fan shroud. On 1965 and later models, a thermostat is mounted under number 1 and 2 cylinders. A rod connected to thermostat controls amount of air directed into deflector plates by opening two flaps mounted inside fan shroud. As engine warms up, flaps open to allow total flow of air into deflector plates.

Type 3 – Engine is cooled by a radial fan mounted to end of crankshaft by means of a vibration damper. Fan draws air

thru air intake duct at rear of engine. A fan shroud is mounted around fan and bolted to crankcase. Air is directed over finned cylinders and cylinder heads by means of deflector plates. A thermostatically controlled flap system similar to Type 1 and 2 models from 1965 on is employed.

FAN SHROUD

Type 1 & 2 – 1) This operation can be accomplished with engine in or out of vehicle. Hood must be removed if engine is in vehicle. Remove heater hoses and fan belt.

2) Remove generator strap and wires to generator if engine is in vehicle. Pull coil wire from coil and remove distributor cap. Disconnect spark plug wires at spark plugs.

3) Remove screws from both sides of shroud. On 1964 and earlier models, unhook air control return spring and remove

1963-73 VOLKSWAGEN TYPE 1, 2 & 3 4 CYLINDER (Cont.)

ENGINE COOLING (Cont.)

screws from air control ring. Pull fan shroud off with generator.

4) On 1965 and later models, remove bolt from bracket securing thermostat, accessible thru hole in warm air duct on bottom of engine. Unscrew thermostat from connected rod and pull shroud off with generator.

5) Reverse removal procedure to install. Check belt tension. **NOTE** - See *BELT TENSION ADJUSTMENT*. Adjust air control ring on 1964 and earlier models. **NOTE** - See *AIR CONTROL RING ADJUSTMENT*.

Type 3 - 1) Remove engine as previously outlined. Remove muffler, generator and coil. Remove air intake duct from rear of engine. Remove plastic cap from center of pulley.

2) Remove bolt from center of pulley and remove pulley. Remove rear fan shroud half. Pull fan off using a suitable puller (VW176). Disconnect linkage and spring at right hand air control flap. Remove front fan shroud half.

3) To install, center front fan shroud half on crankcase with a suitable centering tool (VW177). Tighten shroud retaining bolts and remove centering tool.

4) Reverse removal procedure to install remaining components. Install new paper gasket under pulley and tighten bolt to specification. Check belt tension. **NOTE** - See *BELT TENSION ADJUSTMENT*. Adjust air control flap. **NOTE** - See *AIR CONTROL FLAP ADJUSTMENT*.

FAN REMOVAL

Type 1 & 2 - 1) Remove fan shroud as previously outlined. Remove four bolts securing generator mount to shroud and pull out generator with fan.

2) Remove nut from center of fan and remove fan, spacer washer and hub from generator. Reverse removal procedure to install. Distance between fan and cover should be approximately .079". Install spacer between hub and thrust washer to obtain this distance.

BELT TENSION ADJUSTMENT

Type 1 & 2 - Press in on belt firmly at midpoint. Belt should depress in approximately .6". If adjustment is required, remove nut from generator pulley. Pull front pulley half off. Add or remove shims between pulleys to obtain correct adjustment.

Type 3 - Remove air intake housing cover as previously outlined. Press in on belt firmly at midpoint. Belt should depress in approximately .6". Remove nut from generator pulley and

remove front half of pulley. Add or remove shims between pulley halves to obtain correct adjustment.

AIR CONTROL RING ADJUSTMENT

Adjustment When Assembling Engine - Lift thermostat to upper stop of bracket. Adjust ring until it opens .80". Tighten operating lever. Tighten thermostat bracket. Connect return spring.

Adjustment With Engine in Vehicle - Disconnect return spring and release air control ring actuating lever. Warm engine until top of thermostat touches top of bracket. Adjust ring until it opens 1 - 1 1/2 inches. Tighten actuating lever and connect return spring.

AIR CONTROL FLAP ADJUSTMENT

Remove right hand cylinder head cover plate. Lubricate all joints of linkage with molybdenum-disulfide paste. Press flaps into closed position. Tighten clamp screw on actuating lever. Connect long end of spring to flap and short end to actuating plate.

TIGHTENING SPECIFICATIONS

Application	Ft. Lbs. (mkg)
Cylinder Heads.....	23 (3.2)
Connecting Rods	24 (3.3)
Crankcase Halves	
8 mm Nuts	14 (1.9)
12 mm Nuts	25 (3.5)
Rocker Shaft	18 (2.5)
Intake Manifold	14 (1.9)
Oil Pump	14 (1.9)
Oil Drain Plug	25 (3.5)
Oil Strainer	5 (.7)
Oil Cooler	5 (.7)
Flywheel	
1963-72	217 (30.0)
1973	253 (35.0)
Clutch-to-Flywheel	18 (2.5)
Converter-to-Driveplate	18 (2.5)
Engine-to-Transmission	22 (3.0)
Generator Pulley	
Type 1 & 2	34 (4.7)
Type 3	43 (5.9)
Fan Nut (Type 1 & 2)	43 (5.9)
Crankshaft Pulley (Type 1 & 2)	32 (4.4)
Fan & Pulley (Type 3)	108 (14.9)