Porsche Engines

1965-73 PORSCHE 911 & 1970-71 914/6 6 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
1965-66①										
911	121.5	1991	6x1-Bbl.③	130@6100	128.7@4200	9.0-1	3.14	80	2.60	66
1967①										
911	121.5	1991	2x3-Bbl.	130@6100	128.7@4200	9.0-1	3.14	80	2.60	66
911S	121.5	1991	2x3-Bbl.	160@6600	131.6@5200	9.8-1	3.14	80	2.60	66
1968①										
911	121.5	1991	2x3-Bbl.	130@6100	128.7@4200	9.0-1	3.14	80	2.60	66
911L	121.5	1991	2x3-Bbl.	130@6100	128.7@4200	9.0-1	3.14	80	2.60	66
911S	121.5	1991	2x3-Bbl.	160@6600	131.6@5200	9.8-1	3.14	80	2.60	66
911T	121.5	1991	2x3-Bbl.	110@5800	131.0@4200	8.6-1	3.14	80	2.60	66
1969①										
911T	121.5	1991	2x3-Bbl.	125@5800	148@4200	8.6-1	3.14	80	2.60	66
911E	121.5	1991	Fuel Inj.	140@6500	160@4500	9.1-1	3.14	80	2.60	66
911S	121.5	1991	Fuel Inj.	170@6800	164@5200	9.9-1	3.14	80	2.60	66
1970-71①										
914/6	121.5	1991	2x3-Bbl.	110@5800	131@4200	8.6-1	3.14	80	2.60	66
1970-71①										
911T	133.9	2195	2x3-Bbl.	125@5800	148@4200	8.6-1	3.31	84	2.60	66
911E	133.9	2195	Fuel Inj.	155@6200	160@4500	9.1-1	3.31	84	2.60	66
911S	133.9	2195	Fuel Inj.	180@6500	164@5200	9.8-1	3.31	84	2.60	66
1972②										
911T	142.8	2341	Fuel Inj.	133@5600	166@4000	7.5-1	3.31	84	2.77	70.4
911E	142.8	2341	Fuel Inj.	157@6200	174@4500	8.0-1	3.31	84	2.77	70.4
911S	142.8	2341	Fuel Inj.	181@6500	181@5200	8.5-1	3.31	84	2.77	70.4
1973 ②										
911T	142.8	2341	Fuel Inj.	134@5600	140@4000	7.5-1	3.31	84	2.77	70.4
911E	142.8	2341	Fuel Inj.	157@6200	147@4500	8.0-1	3.31	84	2.77	70.4
911S	142.8	2341	Fuel Inj.	181@6500	154@5200	8.5-1	3.31	84	2.77	70.4

① — DIN horsepower.
② — SAE net horsepower.
③ — Engine type 901/05 uses 2x3-Bbl. carburetors.

ENGINE IDENTIFICATION

Engine number is stamped on blower fan support leg on left side of engine on 911 models and on left upper part of crankcase below breather column on 914/6.

Engine Types

Application	Offical	Internal
1965-66 911	2000	901/01
1966-67 911	2000	901/05
1967 911	2000	901/06
1968 911 & 911L	2000	901/14 & 17
1967 911S	2000S	901/02
1968 911S	2000S	901/02 & 08
1969 911S	911S	901/10
1970-71 911S	911S-C	911/02
1972-73 911S	911S-T or C	911/53 & 63
1968 911T	2000T	901/03 & 13
1969 911T	911T	901/03, 16, 13 & 19
1970-71 911T	911T-C	911/03, 06, 07 & 08
1972-73 911T	911T-T or C	911/51 & 61
1969 911E	911E	901/09 & 11
1970-71 911E	911E-C	911/01 & 04
1972-73 911E	911E-T or C	911/52 & 62
1970-71 914/6	911T	901/36, 37, 38 & 39

Engine Serial Numbers (1965-68)
4180328

1st Digit — Number of cylinders and horsepower.
2 — 110 HP.
3 — 130 HP.
4 — 160 HP.

2nd Digit — Type.
0 — Regular.
1 — Sportomatic.
2 — Emission Control.
3 — Sportomatic and emission control.

3rd Digit — Last digit of year model.

Remaining Digits — Sequence number.

Engine Serial Numbers (1969-73)
6290325

1st Digit — Number of cylinders.
2nd Digit — Model.
1 — 911T.
2 — 911E.
3 — 911S.
3rd Digit — Last digit of year model.
Remaining Digits — Sequence number.

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1965-73 PORSCHE 911 & 1970-71 914/6 6 CYLINDER (Cont.)

ENGINE REMOVAL

911 – 1) Place vehicle on floor stands and open hood. Disconnect hot air duct from air cleaner. Remove air cleaner and disconnect oil tank vent hose. Disconnect wires from electric fuel pump.

2) Disconnect alternator cables at voltage regulator and body clamps. Disconnect coil lead at coil and fuel line at float chambers. Remove battery cables. Disconnect throttle linkage at bell crank.

3) Remove oil breather hose from oil filler. Disconnect oil pressure sensor wire. Drain engine oil and remove hoses from oil tank.

4) Disconnect axle shafts at shaft flanges. Disconnect power cable from starter. Separate air gates from hot air ducts connecting heat exchanger and air gate.

5) Loosen and withdraw clutch cable at clutch release lever. Disconnect engine ground strap. Remove back-up light wire. Disconnect throttle linkage.

6) Remove rear center tunnel cover in passenger compartment. Remove rubber boot in tunnel by pulling forward. Remove conical bolt. Disconnect shift rod clutch from shift control lever.

7) Using a carrier plate, place jack under engine at center of gravity. Tension jack slightly. Remove engine and transmission mounting bolts. Lower jack and pull engine and transmission rearward. Separate engine and transmission. To install, reverse removal procedures.

914/6 – 1) Disconnect both battery cables, negative first. Remove air cleaner and oil tank vent hose. Disconnect fuel lines from carburetors. Remove breather hose from oil filler neck.

2) Disconnect multiple connector plugs. Raise vehicle and remove muffler shroud. Remove cover and unscrew shift rod holder. Take off dust cap. Remove support bracket and lift out shift rod.

3) Remove hot air ducts, flaps and control cables. Disconnect oil hoses from oil tank and allow oil to drain.

4) Remove clutch cable adjusting nut and cable pulley retaining nut. Bend holding plate and pull clutch cable forward.

5) Disconnect speedometer drive cable. Remove carburetor linkage from cross shaft. Disconnect throttle pull rod and remove from holder.

6) Disconnect universal shafts from transmission. Remove ground strap from luggage pan and back-up wire from light switch.

7) Lower vehicle slightly. Slide floor jack with carrying plate into position under engine. Tension jack against engine. Remove engine and transmission mounting nuts. Carefully move universal shafts aside and lower engine and transmission assembly. To install, reverse removal procedures.

INTAKE MANIFOLD

Removal & Installation – Disconnect and remove control rod and linkage at ball joints. Remove transverse control rod. Disconnect fuel hoses between float housing and fuel pump, also fuel supply hose leading to carburetors. Remove nuts attaching manifolds to cylinder heads. Lift off manifolds and carburetors as an assembly. To install, reverse removal procedures.

CYLINDER HEAD

Removal – 1) With intake manifold and carburetors removed or fuel injection system removed, remove distributor cap and spark plug wires. Remove all cool air ducts and cover shrouds.

2) Remove air ducts connecting air blower outlets and heat exchanger inlets, together with cover shrouds. Remove rear engine mount (transverse leaf spring) from holder.

3) Remove fuel pump and hoses. Remove exhaust pipes and engine mounting bracket. Remove blower pulley and drive belt.

4) Loosen both screws of band strap which attaches alternator to blower housing. Pull blower housing rearward. Disconnect alternator cables and remove blower housing with alternator.

5) Remove heat exchanger using suitable wrenches (No. P 205 & P 217). Disconnect camshaft oil lines between crankcase and chain housing covers. Remove covers.

6) Remove chain tensioner, pivot lever and chain sprocket as an assembly. Remove camshaft sprocket nuts using suitable tools (No. P 202 & P 203). Withdraw sprocket dowel pin, using suitable tool (No. P 212).

7) With a screwdriver lift spring retainers from groove and remove chain guides. Remove camshaft sprockets and flanges. Pry Woodruff keys from camshafts.

NOTE – Each cylinder has a separate cylinder head. If camshaft housing is removed, any single head may be removed. If camshaft housing is left attached to cylinder heads, cylinder heads and camshaft housing may be removed as an assembly.

8) To remove a single head, rotate camshaft to take load off of rocker arm shaft to be removed. Loosen rocker arm shafts and push out shafts. Remove camshaft housing.

9) Using a suitable tool (No. P 119), remove cylinder head nuts and lift off cylinder head.

NOTE – Mark cylinder heads, cylinders and camshaft housings so they will be reassembled in their original positions.

10) To remove all three cylinder heads and camshaft housing as an assembly, evenly loosen and unscrew cylinder head nuts using suitable tool (No. P 119).

Installation – 1) Place cylinder head gaskets on cylinders with perforated side of steel insert facing cylinder. Install cylinder heads and oil return tubes at same time. Coat oil return tubes with engine oil for easier installation. Lightly tighten cylinder head nuts.

2) Install cool air shrouds and attach with clamps. Thinly coat camshaft housing gasket with gasket compound. Slide camshaft housing onto mounting studs. Tighten camshaft housing nuts down a few turns to ensure gasket seal. Install Allen screws in proper location and tighten camshaft housing in a crosswise pattern.

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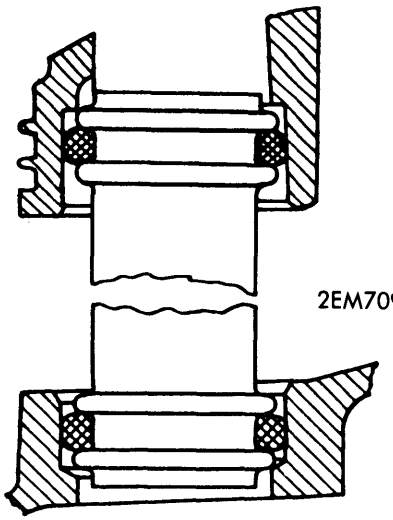
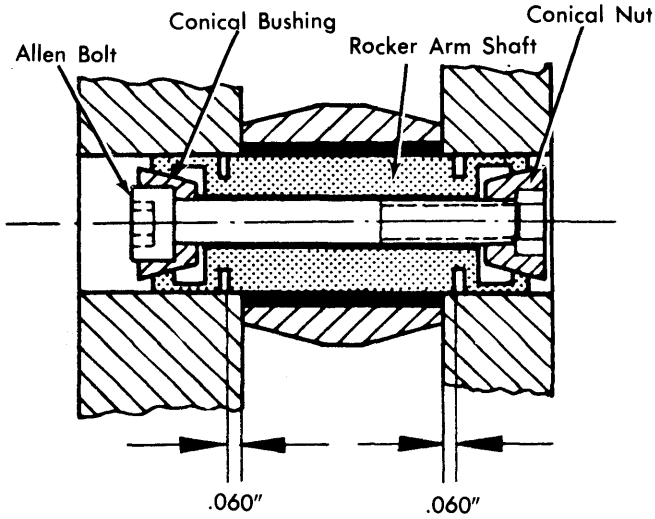
1965-73 PORSCHE 911 & 1970-71 914/6 6 CYLINDER (Cont.)



CYLINDER HEAD OIL RETURN INSTALLATION

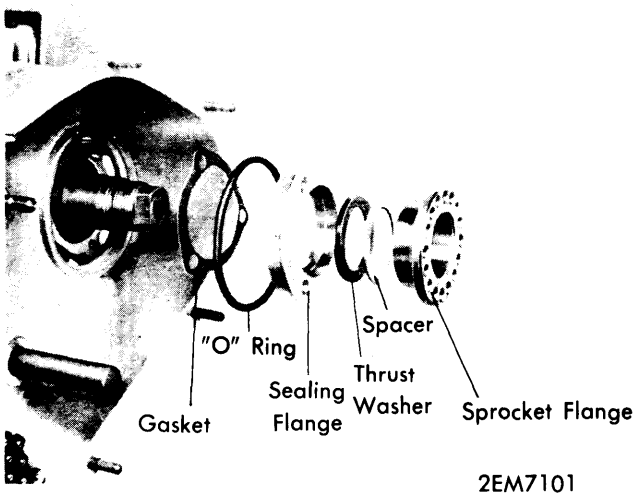
NOTE — Camshaft housings are interchangeable, but camshafts are not. Camshafts must be positioned on their proper side as shown in illustration. See Camshaft Removal.

3) Tighten cylinder head nuts in a crosswise pattern, checking that camshaft does not bind in housing. If camshaft binds, loosen cylinder head nuts and tighten in a different sequence. With cylinder head nuts tight, camshaft must be free to rotate.



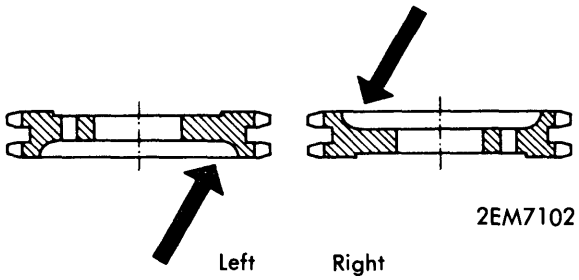
ROCKER ARM SHAFT

4) Install rocker arms and shafts. Install rocker arm shaft with approximately .060" from shaft grooves to mounting face (see illustration). Tighten Allen bolts to 156 INCH lbs. using suitable tools (No. P 210 & P 211).



CAMSHAFT SPROCKET FLANGE INSTALLATION

5) Install gasket, "O" ring, sealing flange, thrust plate, spacer, Woodruff key and camshaft sprocket flange (see illustration). No provision is made to adjust camshaft end play, if sealing flange is worn replace.



CAMSHAFT SPROCKET POSITION (VIEWED FROM BLOWER END OF ENGINE)

6) Install camshaft sprockets (see illustration). Check chain alignment. *See Timing Chain Replacement.*

7) Install heat exchanger before chain tensioner. Slide chain guides on mounting studs. With a screwdriver lift retaining spring and slide chain guide into place. Install chain tension pivot lever and sprocket. Check that oil holes in pivot stud face upward.

8) Fill and bleed chain tensioners, depress chain tensioners and install. Left chain tensioner may be positioned in only as far as to let camshaft nut to be installed after valve timing. See *Valve Timing.*

9) Install chain housing covers and camshaft oil lines. Reverse removal procedures for remaining components.

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1965-73 PORSCHE 911 & 1970-71 914/6 6 CYLINDER (Cont.)

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)
1965-68							
911, 911L & 911T							
Intake	1.53-1.54 (38.9-39.1)	45°	45°	.045-.053 (1.14-1.35)	.3526 (8.96)	.0017 (.043)	.4527 ① (11.50)
Exhaust	1.37-1.38 (34.8-35.1)	45°	45°	.057-.065 (1.45-1.65)	.3518 (8.94)	.0025 (.064)	.4133 ① (10.50)
911S							
Intake	1.65-1.66 (41.9-42.2)	45°	45°	.045-.053 (1.14-1.35)	.3526 (8.96)	.0017 (.043)	.4527 (11.50)
Exhaust	1.49-1.50 (37.9-38.1)	45°	45°	.057-.065 (1.45-1.65)	.3518 (8.94)	.0025 (.064)	.4133 (10.50)
1969							
911T & 911E							
Intake	1.65-1.66 (41.9-42.2)	45°	45°	.045-.053 (1.14-1.35)	.3526 (8.96)	.....	.....
Exhaust	1.49-1.50 (37.9-38.1)	45°	45°	.057-065 (1.45-1.65)	.3518 (8.94)	.....	.....
911S							
Intake	1.76-1.77 (44.7-45.0)	45°	45°	.045-.053 (1.14-1.35)	.3526 (8.96)	.....	.....
Exhaust	1.53-1.54 (38.9-39.1)	45°	45°	.057-.065 (1.45-1.65)	.3518 (8.94)	.....	.....
1970-73							
914/6							
Intake	1.65-1.66 (41.9-42.2)	45°	45°	.045-.053 (1.14-1.35)	.3526 (8.96)	.....	.....
Exhaust	1.49-1.50 (37.9-38.1)	45°	45°	.060-.064 (1.52-1.63)	.3518 (8.94)	.....	.....
911T, 911E & 911S							
Intake	1.80-1.81 (45.7-46.0)	45°	45°	.055-.062 (1.40-1.58)	.3526 (8.96)	.....	.....
Exhaust	1.57-1.58 (39.9-40.1)	45°	45°	.055-.062 (1.40-1.58)	.3518 (8.94)	.....	.....

① — 911T valve lift is; Intake .3818" (9.7 mm) and Exhaust .3503" (8.9 mm).

VALVE ARRANGEMENT

All upper valves are intake.

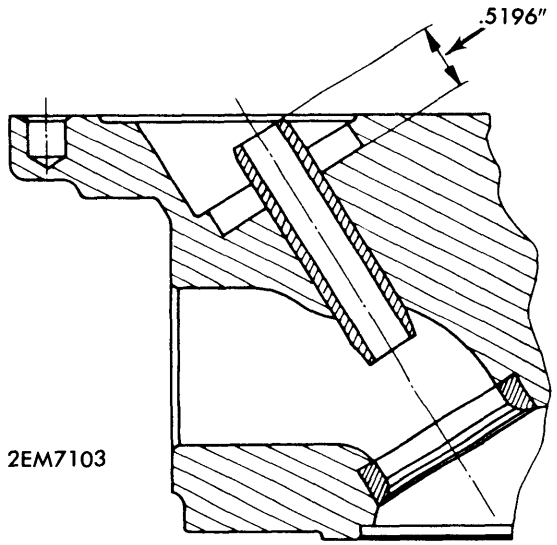
All lower valves are exhaust.

VALVE GUIDE SERVICING

1) Drill out valve guide with a .433" drill from camshaft side of head. Drift out remaining valve guide into combustion chamber.

2) Using a hole gauge, measure guide bore in cylinder head. Turn oversize guide in a lathe until O.D. gives an interference fit of .00122-.00236".

3) Press valve guide into head from camshaft side until a measurement of .5196" is reached (see illustration). Use tallow as a lubricant when pressing in guides. Bore or ream guide I.D. to .3543-.3549".



VALVE GUIDE REPLACEMENT

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1965-73 PORSCHE 911 & 1970-71 914/6 6 CYLINDER (Cont.)

Valve Guide Specifications

Application	Valve Guide O.D. In. (mm)	Cylinder Head I.D. In. (mm)
Std.	.5137-.5141 (13.05-13.06)	.5118-.5125 (13.00-13.02)
1st OS	.5216-.5220 (13.25-13.26)	.5196-.5203 (13.20-13.22)
2nd OS	.5294-.5299 (13.45-13.46)	.5275-.5282 (13.40-13.42)

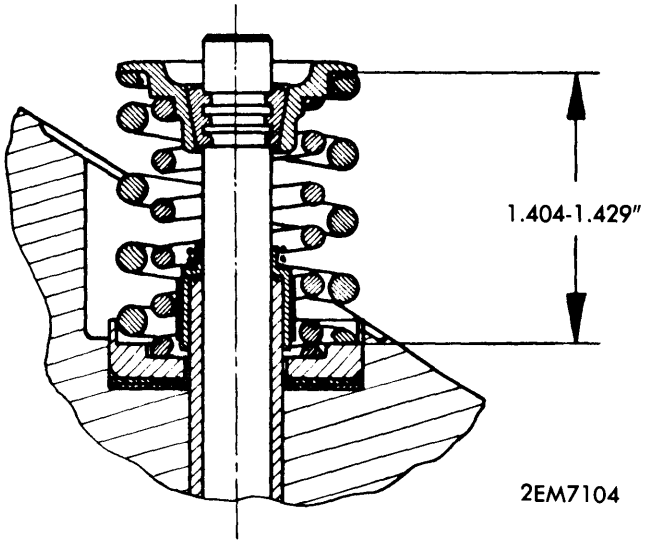
VALVE STEM OIL SEALS

1) Using a suitable spring compressor, remove valve keepers. Withdraw collar and springs. Remove valve stem oil seal from end of valve guide.

2) Slide a new oil seal over valve stem, using care not to damage seal as is passes over keeper grooves. Force seal over end of valve guide. Reverse removal procedure for springs, collar and keepers.

VALVE SPRINGS

Engine	Free Length In. (mm)	PRESSURE Lbs. @ In. (kg @ mm)	
		Valve Closed	Valve Open
1965-73 911, 911L 911E & 911S	.....	44@1.673 (20@42.5)	Int. 176.4@1.22 (80@31) Exh. 165.3@1.26 (75@32)
911T	1.827 (46.4)	57.3@1.88 (26@47.8)	Int. 163@1.377 (74@35) Exh. 158@1.397 (71.6@35.5)
914/6 Inner	1.51 (38.4)	16@1.40 (7@35.6)	.....
Outer	1.65 (41.9)	40@1.38 (18@35)	.....



VALVE SPRING INSTALLED HEIGHT

VALVE SPRING REMOVAL

1) Using a suitable spring compressor, remove valve keepers and collar. Check springs for wear or fatigue, replace as necessary.

2) Install outer spring with close wound coils next to cylinder head. Measure installed height of springs, add or remove spacers under valve springs to arrive at a measurement of 1.405-1.429" for both intake and exhaust springs (see illustration).

ROCKER ARM ASSEMBLY

1) Using an Allen wrench, loosen rocker arm shaft bolt. Slide rocker shaft out of cylinder head and remove arm.

2) Check rocker arm shaft and rocker bushing for wear.

Rocker Arm Specifications

Application	Diameter In. (mm)	Wear Limit In. (mm)
Rocker Arm Bushing	.7092-.7096 (18.02-18.03)	.7127 (18.11)
Rocker Arm Shaft	.7083-.7086 (17.99-18.00)	.7117 (18.08)
Rocker Arm Width	1.0157-1.0196 (25.8-25.9)	1.0392 (26.4)
Housing Width	1.0236-1.0295 (26.00-26.15)	1.0491 (26.65)

3) Install rocker arm and shaft. Center rocker arm shaft in housing as shown in illustration. See *Cylinder Head Installation*. Tighten rocker arm Allen bolt to specifications. *NOTE — Install outside rocker arm shafts with Allen bolt facing either cylinder two or five.*

VALVE CLEARANCE ADJUSTMENT

1) Valve clearance is .004" (cold). If valves or seats have been reground set clearance to .010", run engine for half an hour and reset to .004" (cold).

2) Adjust valves in firing order sequence 1, 6, 2, 4, 3 and 5. Rotate to TDC of firing stroke on No. 1 cylinder and adjust clearance.

3) Rotate engine 120° until No. 6 cylinder is at TDC and adjust. Rotate engine 120° for each cylinder to be adjusted.

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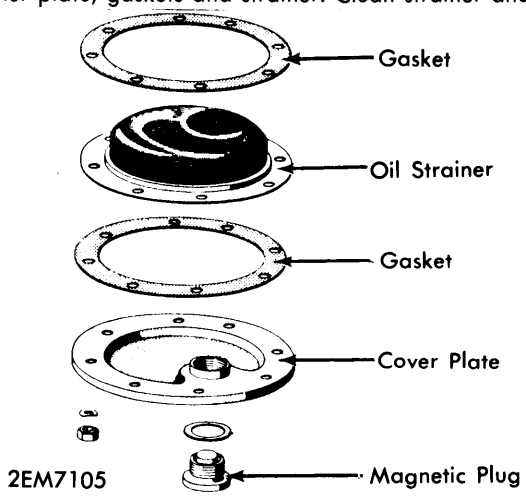
1965-73 PORSCHE 911 & 1970-71 914/6 6 CYLINDER (Cont.)

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)
1965-71						
911	.0018-.0026 (.046-.066)	Press Fit	.0007-.0015 (.018-.038)	1 & 2	.006-.018 (.15-.46)	.0029-.0042 (.074-.107)
				Oil	.006-.018 (.15-.46)	.0009-.0020 (.023-.051)
911L & 911E	.0013-.0022 (.033-.056)	Press Fit	.0007-.0015 (.018-.038)	1 & 2	.006-.018 (.15-.46)	.0029-.0042 (.074-.107)
				Oil	.006-.018 (.15-.46)	.0009-.0020 (.023-.051)
911T	.0009-.0018 (.023-.046)	Press Fit	.0007-.0015 (.018-.038)	1 & 2	.006-.018 (.15-.46)	.0029-.0042 (.074-.107)
				Oil	.006-.018 (.15-.46)	.0009-.0020 (.023-.051)
911S	.0018-.0025 (.046-.064)	Press Fit	.0007-.0015 (.018-.038)	1 & 2	.006-.018 (.15-.46)	.0029-.0042 (.074-.107)
				Oil	.006-.018 (.15-.46)	.0009-.0020 (.023-.051)
914/6	.0010-.0020 (.025-.051)	Press Fit	.0007-.0015 (.018-.038)	1	.012-.018 (.30-.46)	.003-.004 (.08-.10)
				2	.012-.018 (.30-.46)	.002-.003 (.05-.08)
				Oil	.010-.016 (.25-.41)	.001-.002 (.03-.05)
1972-73						
911T	.0009-.0018 (.023-.046)	Press Fit	.0007-.0015 (.018-.038)	1 & 2	.006-.018 (.15-.46)	.0029-.0042 (.074-.107)
				Oil	.006-.018 (.15-.46)	.0009-.0020 (.023-.051)
911S	.0018-.0025 (.046-.064)	Press Fit	.0007-.0015 (.018-.038)	1 & 2	.006-.018 (.15-.46)	.0029-.0042 (.074-.107)
				Oil	.006-.018 (.15-.46)	.0009-.0020 (.023-.051)
911E	.0010-.0018 (.025-.046)	Press Fit	.0007-.0015 (.018-.038)	1 & 2	.006-.018 (.15-.46)	.0029-.0042 (.074-.107)
				Oil	.006-.018 (.15-.46)	.0009-.0020 (.023-.051)

OIL PAN REMOVAL

Remove nuts attaching oil pan (strainer cover plate). Remove strainer plate, gaskets and strainer. Clean strainer and cover plate. Using new gaskets, replace strainer and cover plate, making sure oil strainer hole slides over pickup tube.



OIL STRAINER & COVER PLATE

PISTON ASSEMBLY

NOTE — Connecting rods are not removed from crankshaft until crankcases are separated and crankshaft has been removed. Therefore pistons are removed with connecting rods still attached to crankshaft.

1) Mark piston and cylinder for location in crankcase. Remove cylinders and note triangle with either number five or six enclosed in triangle. All cylinders on one side must be same number. Cylinder height with number five is 3.2362-3.2372" and number six is 3.2372-3.2382" (see illustration).

2) Remove piston circlips. Heat piston to approximately 176°F and press out wrist pin with a drift. Clean and inspect piston, rings and wrist pin. Replace as necessary. To install, reverse removal procedures.

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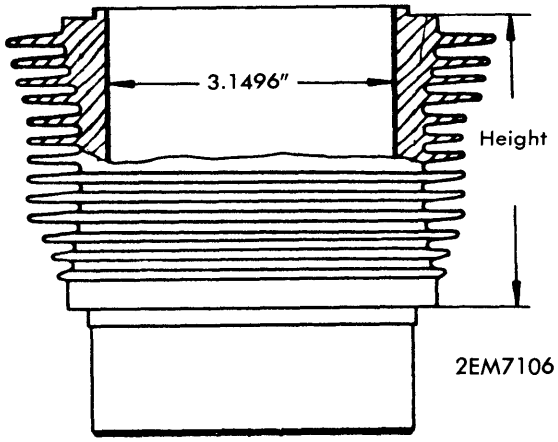
1965-73 PORSCHE 911 & 1970-71 914/6 6 CYLINDER (Cont.)



CYLINDER HEIGHT & MARKINGS

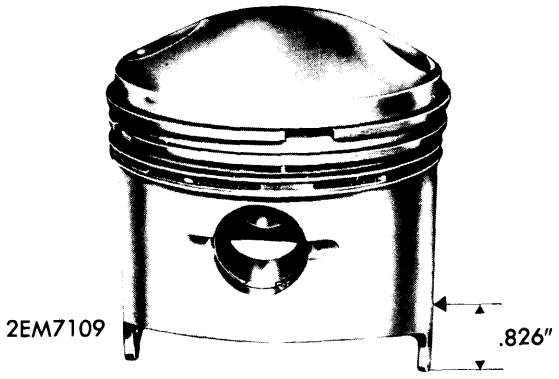
PISTON TYPE 911L (901/01, 05 & 06)

CAUTION — When installing pistons place large valve pocket (intake on Schmidt pistons) or flat (intake on Mahle pistons) upward.

PISTON PIN SPECIFICATIONS

Application	Piston I.D. In. (mm)	Piston Pin O.D. In. (mm)
White	.8660-.8661 (21.999-22.000)	.8661-.8662 (22.000-22.002)
Black	.8659-.8660 (21.993-21.999)	.8659-.8660 (21.993-21.999)
①	.8661-.8663 (22.000-22.005)	.8660-.8661 (21.999-22.000)

① — 914/6 only, there is no color coding of piston or piston pin.

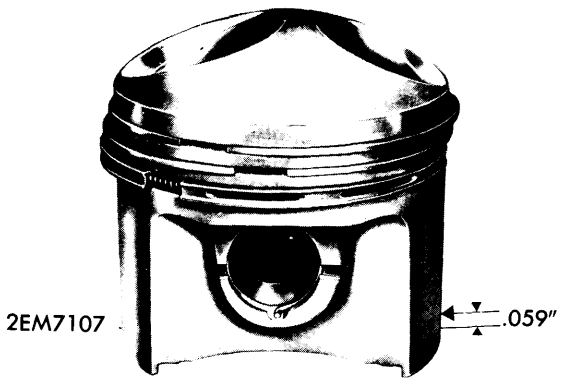


PISTON TYPE 911T (901/03)

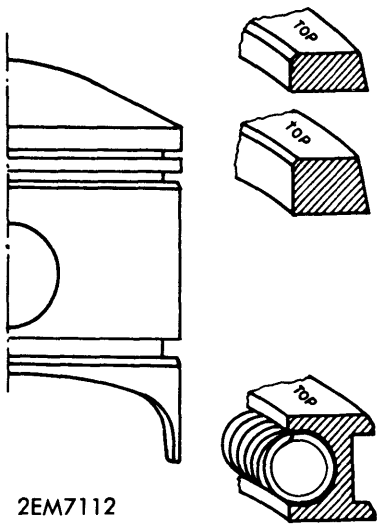
FITTING PISTONS

1) Measure pistons and cylinders for wear and taper. If piston or cylinders exceed wear limits, bore cylinders and install next oversize piston. Weight of piston should be within six grams of each other. Piston measurements are taken at 90° to wrist pin on skirt of piston (see piston specification table).

2) Position rings in bottom of cylinder and measure ring gap. Check side clearance in piston ring grooves. Install rings on piston with marking "TOP" facing upward (see illustration).



PISTON TYPE 911S (901/02)



PISTON RING INSTALLATION

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1965-73 PORSCHE 911 & 1970-71 914/6 6 CYLINDER (Cont.)

1965-67 PISTON SPECIFICATIONS

Application & Marking	In.	mm
All Models		
Std. Cylinder		
-1	3.1492-3.1496	79.99-80.00
0	3.1496-3.1500	80.00-80.01
+1	3.1500-3.1504	80.01-80.02
OS Cylinder		
-1 KD 1	3.1689-3.1692	80.49-80.50
0 KD 1	3.1692-3.1696	80.50-80.51
+1 KD 1	3.1696-3.1700	80.51-80.52
All Models		
Std Piston ①		
-1	3.1466-3.1470	79.92-79.93
0	3.1470-3.1474	79.93-79.94
+1	3.1474-3.1478	79.94-79.95
OS Piston ①		
−1 KD 1	3.1663-3.1667	80.42-80.43
0 KD 1	3.1667-3.1671	80.43-80.44
+1 KD 1	3.1671-3.1675	80.44-80.45

① — Measure at .610" (15.49 mm) from bottom of skirt.

1968-69 PISTON SPECIFICATIONS

Application & Marking	In.	mm
All Models		
Std. Cylinder		
0	3.1496-3.1499	80.00-80.01
1	3.1499-3.1503	80.01-80.02
2	3.1503-3.1507	80.02-80.03
OS Cylinder		
0 KD 1	3.1692-3.1696	80.50-80.51
1 KD 1	3.1696-3.1700	80.51-80.52
2 KD 1 or 2	3.1700-3.1704	80.52-80.53
911S		
Std. Piston ①		
0	3.1474-3.1478	79.94-79.95
1	3.1478-3.1482	79.95-79.96
2	3.1482-3.1486	79.96-79.97
OS Piston ①		
0 KD 1	3.1671-3.1675	80.44-80.45
1 KD 1	3.1675-3.1679	80.45-80.46
2 KD 1	3.1679-3.1683	80.46-80.47
911L		
Std Piston ②		
0	3.1478-3.1482	79.95-79.96
1	3.1482-3.1486	79.96-79.97
2	3.1486-3.1490	79.97-79.98
OS Piston ②		
0 KD 1	3.1675-3.1679	80.45-80.46
1 KD 1	3.1679-3.1683	80.46-80.47
2 KD 1	3.1683-3.1686	80.47-80.48

1968-69 PISTON SPECIFICATIONS (Cont.)

Applicaton & Marking	In.	mm
911T ③		
Std. Piston (Mahle) ④		
0	3.1482-3.1486	79.96-79.97
1	3.1486-3.1490	79.97-79.98
2	3.1490-3.1494	79.98-79.99
OS Piston (Mahle) ④		
0 KD 1	3.1679-3.1683	80.46-80.47
1 KD 1	3.1683-3.1686	80.47-80.48
2 KD 2	3.1686-3.1690	80.48-80.49
Std. Piston (Schmidt) ④		
0	3.1477-3.1482	79.95-79.96
1	3.1481-3.1486	79.96-79.97
2	3.1485-3.1490	79.97-79.98
OS Piston (Schmidt) ④		
0 KD 1	3.1674-3.1679	80.45-80.46
1 KD 1	3.1678-3.1683	80.46-80.47
2 KD 2	3.1682-3.1685	80.47-80.48

① — Measure piston at .590" (14.99 mm) from bottom of skirt.
② — Measure piston at .610" (15.49 mm) from bottom of skirt.
③ — Do not mix Mahle and Schmidt pistons because of weight difference. Mahle pistons weigh 353-359 grams and Schmidt 363-369 grams.
④ — Measure piston at .826" (20.98 mm) from bottom of skirt.

1970-73 PISTON SPECIFICATIONS

Application & Marking	In.	mm
914/6		
Std. Cylinder		
0	3.1496-3.1499	80.00-80.01
1	3.1499-3.1503	80.01-80.02
2	3.1503-3.1507	80.02-80.03
OS Cylinder		
0 KD 1	3.1692-3.1696	80.50-80.51
1 KD 1	3.1696-3.1700	80.51-80.52
2 KD 2	3.1700-3.1704	80.52-80.53
All Models Exc. 914/6		
Std. Cylinder		
0	3.3070-3.3074	84.00-84.01
1	3.3074-3.3078	84.01-84.02
2	3.3078-3.3082	84.02-84.03
OS Cylinder		
0 KD 1	3.3169-3.3173	84.25-84.26
1 KD 1	3.3173-3.3177	84.26-84.27
2 KD 1	3.3177-3.3181	84.27-84.28

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1965-73 PORSCHE 911 & 1970-71 914/6 6 CYLINDER (Cont.)

1970-73 PISTON SPECIFICATIONS (Cont.)

Application & Marking	In.	mm
914/6 ①		
Std Piston (Mahle) ②		
0	3.1482-3.1486	79.96-79.97
1	3.1486-3.1490	79.97-79.98
2	3.1490-3.1494	79.98-79.99
OS Piston (Mahle) ②		
0 KD 1	3.1679-3.1683	80.46-80.47
1 KD 1	3.1683-3.1686	80.47-80.48
2 KD 2	3.1686-3.1690	80.48-80.49
Std. Piston (Schmidt) ②		
0	3.1477-3.1482	79.95-79.96
1	3.1481-3.1486	79.96-79.97
2	3.1485-3.1490	79.97-79.98
OS Piston (Schmidt) ②		
0 KD 1	3.1674-3.1679	80.45-80.46
1 KD 1	3.1678-3.1683	80.46-80.47
2 KD 2	3.1682-3.1685	80.47-80.48
911S		
Std. Piston ③		
0	3.3049-3.3053	83.94-83.95
1	3.3053-3.3057	83.95-83.96
2	3.3057-3.3060	83.96-83.97
OS Piston ③		
0 KD 1	3.3147-3.3151	84.19-84.20
1 KD 1	3.3151-3.3155	84.20-84.21
2 KD 1	3.3155-3.3159	84.21-84.22
911E		
Std. Piston ③		
0	3.3053-3.3057	83.95-83.96
1	3.3057-3.3060	83.96-83.97
2	3.3060-3.3064	83.97-83.98
OS Piston ③		
0 KD 1	3.3151-3.3155	84.20-84.21
1 KD 1	3.3155-3.3158	84.21-84.22
2 KD 1	3.3158-3.3163	84.22-84.23

1970-73 PISTON SPECIFICATIONS (Cont.)

Application & Marking	In.	mm
911T ④		
Std. Piston (Mahle) ⑤		
0	3.3053-3.3060	83.95-83.97
1	3.3060-3.3064	83.97-83.98
2	3.3064-3.3068	83.98-83.99
OS Piston (Mahle) ⑤		
0 KD 1	3.3155-3.3159	84.21-84.22
1 KD 1	3.3159-3.3163	84.22-84.23
2 KD 1	3.3163-3.3167	84.23-84.24
Std. Piston (Schmidt) ⑥		
0	3.3051-3.3057	83.95-83.96
1	3.3055-3.3061	83.96-83.97
2	3.3059-3.3065	83.97-83.99
OS Piston (Schmidt) ⑥		
0 KD 1	3.3150-3.3156	84.20-84.22
1 KD 1	3.3154-3.3160	84.21-84.23
2 KD 1	3.3158-3.3164	84.22-84.24

① — Measure piston at .826" (20.98 mm) from bottom of skirt.

② — Do not mix Mahle and Schmidt pistons because of weight difference. Mahle pistons weigh 353-359 grams and Schmidt 363-369 grams.

③ — Measure piston at .980" (24.89 mm) from bottom of skirt.

④ — Do not mix Mahle and Schmidt pistons because of weight difference. Mahle pistons weight 377-383 grams and Schmidt 389-397 grams.

⑤ — Measure piston at .452" (11.48 mm) from bottom of skirt.

⑥ — Measure piston at .590" (14.99 mm) from bottom of skirt.

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)
1965-71							
No. 1-7	2.242-2.243 (56.95-56.97)	.0003-.0028 (.008-.071)	No. 1	.0043-.0076 (.11-.19)	2.242-2.243 (56.95-56.97)	.0011-.0034 (.028-.086)	.....
No. 8	1.219-1.220 (30.96-30.99)	.004 (.102)		.0043-.0076 (.11-.19)			
1972-73							
No. 1-7	2.243-2.244 (56.97-56.99)	.0003-.0028 (.008-.071)	No. 1	.0043-.0076 (.11-.19)	2.046-2.0468 (51.97-.5199)	.0011-.0034 (.028-.086)	.....
No. 8	1.219-1.220 (30.96-30.99)	.004 (.102)		.0043-.0076 (.11-.19)			

MAIN BEARING SERVICE

1) Separate crankcase halves. Lift out crankshaft and connecting rods. Place crankshaft on a suitable stand and remove connecting rods.

NOTE — Replace connecting bolts whenever rods are disassembled. Connecting rod bolts are stretch bolts and should never be reused.

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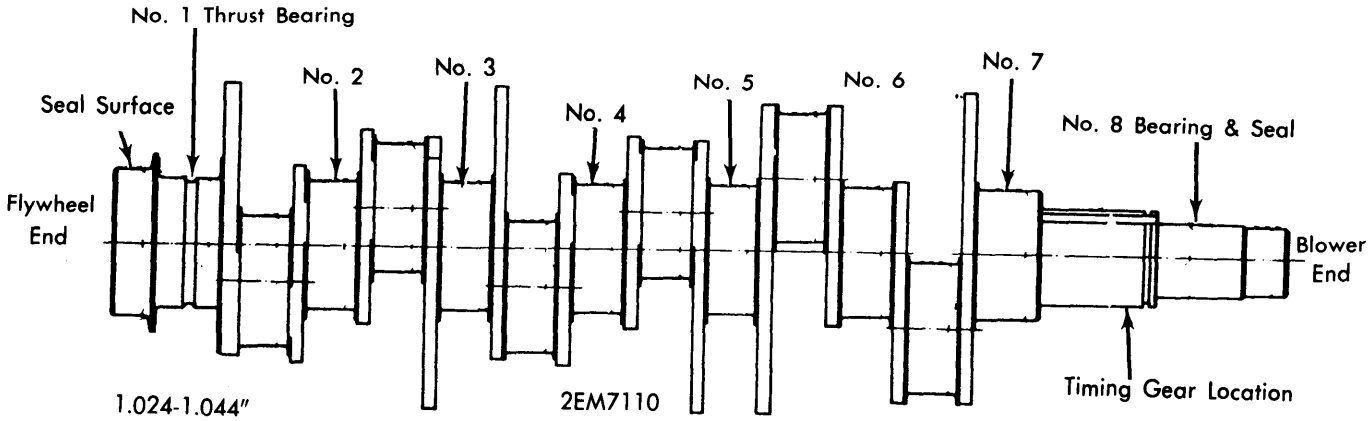
1965-73 PORSCHE 911 & 1970-71 914/6 6 CYLINDER (Cont.)



CRANKSHAFT BEARING LOCATION

2) Inspect crankshaft and connecting rods for wear, damage or out-of-true. Crankshaft main journals one through seven and all connecting rod journals have the same diameter. Replace bearings or fit undersize bearings as required.

3) Main bearing number eight is a special bearing with an external "O" ring and internal oil seal. A steel dowel pressed in crankcase is used to locate number eight bearing and prevent it from turning. Use care when installing bearing that dowel engages hole and not groove in bearing.

4) All bearing diameters in crankcase have the same inside diameter. Standard (2.4409-2.4417") or oversize (2.4515-2.4508") bearings may be fitted.

5) Following crankshaft grinding, radius oil holes to .020". Apply Tenifer treatment to crankshaft. Heat crankshaft for two hours at 1058°F and quench in water at 194°F. Polish all bearing and thrust surfaces. Remove crankshaft plugs and clean oil passages. Install new crankshaft plugs.

THRUST BEARING ALIGNMENT

Check end play at No. 1 main bearing. Width of No. 1 bearing is 1.1024-1.1044". Maximum wear limit is .011". Replace main bearing or crankshaft if excessive wear is present.

MAIN BEARING OIL SEAL (BLOWER END)

Remove belt pulley. Using a screwdriver, pry out old seal. Coat new seal with oil and press in place using suitable tool (No. P 216).

MAIN BEARING OIL SEAL (FLYWHEEL END)

Remove flywheel. With a chisel or drift, displace oil seal. With a screwdriver pry out seal. Coat outer seal edges with sealing compound and press into crankcase until seal is flush with face of crankcase, using suitable tool (P 215).

INTERMEDIATE SHAFT BEARING SERVICE

With crankcase halves separated, lift out intermediate shaft and bearings. Inspect shaft and bearings for wear or damage. Replace shaft and bearings as necessary. No undersize bearings are available.

CAMSHAFT

LOBE LIFT

Application	Intake In. (mm)	Exhaust In. (mm)
911 & 911L		
1965-66	1.4645 (37.20)	1.4370 (36.50)
1967-68	1.4370 (36.50)	1.4251 (36.20)
911S		
1967-68	1.4645 (37.20)	1.4291 (36.30)
1969-73	1.4685 (37.30)	1.4346 (36.44)
911T		
1968-73	1.4271 (36.25)	1.3980 (35.51)
911E		
1969-73	1.4401 (36.58)	1.4271 (36.25)
914/6		
1970-71	1.4271 (36.25)	1.3980 (35.51)

Camshaft Journal Diameter	1.8474-1.8481" (46.92-46.94 mm)
Bearing Clearance	.0009-.0025" (.023-.064 mm)
End Play	.006-.008" (.15-.20 mm)

CAMSHAFT REMOVAL

1) Remove rocker covers and rocker arm assemblies. Disconnect exhaust muffler. Remove oil hose from crankcase to chain housing cover. Remove chain tensioner and chain tensioner sprocket.

2) On 911S models, remove belt pulley from left camshaft. Remove bearing and chain housing covers. With a puller, remove ball bearing from camshaft.

3) Unscrew nuts attaching camshaft sprocket, using suitable tools (No. P 202 & P203). Using suitable tool (No. P 212), withdraw dowel pin from camshaft sprocket.

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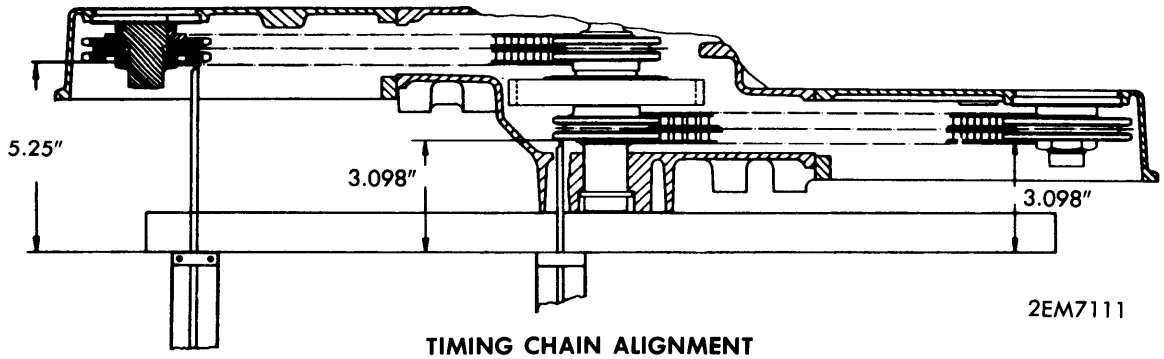
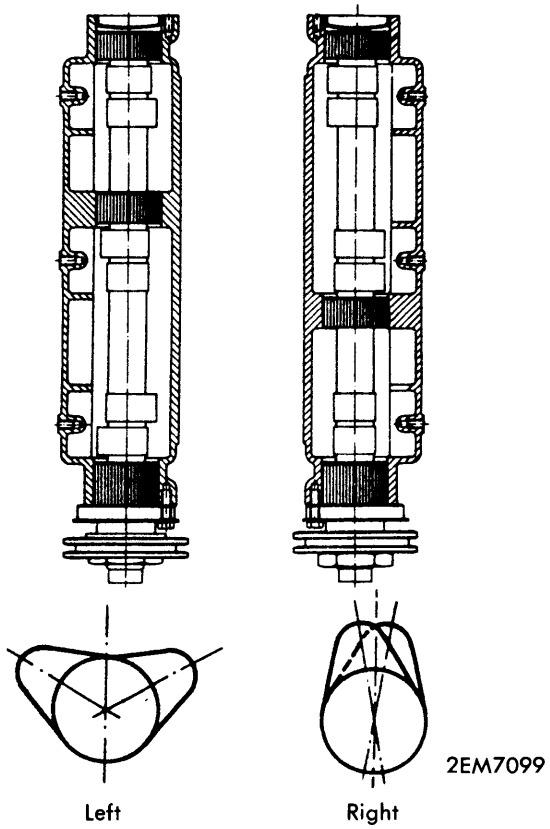
1965-73 PORSCHE 911 & 1970-71 914/6 6 CYLINDER (Cont.)



TIMING CHAIN ALIGNMENT

4) Pull sprocket and sprocket flange. Remove Woodruff key from camshaft. Remove three attaching screws, "O" ring and withdraw camshafts rearward.

NOTE — Camshafts are not symmetrical and must be replaced on side they were removed from during disassembly.



CAMSHAFT & HOUSING LOCATION (VIEWED FROM BLOWER END OF ENGINE)

CAMSHAFT END THRUST

With a dial indicator measure camshaft end play. If end play is excessive replace aluminum thrust washer located behind camshaft sprocket flange.

TIMING CHAIN REPLACEMENT

Remove chain housing covers, chain tensioner and chain tensioner sprocket. Remove old chains. Install new chains. Reverse removal procedures to reassemble. Check valve timing and timing chain alignment (see illustration).

VALVE TIMING ①

Engine	INTAKE Open (BTDC)	INTAKE Close (ABDC)	EXHAUST Open (BBDC)	EXHAUST Close (ATDC)
1965-66 911	29°	39°	39°	19°
1967-68 911	20°	34°	40°	6°
1967-73 911S	38°	50°	40°	20°
1968-73 911T	15°	29°	41°	5°
1968 911L	20°	34°	40°	6°
1969 911E	29°	39°	39°	19°
1970-73 911E	20°	34°	40°	6°
1970-71 914/6	15°	29°	41°	5°

① — Set valve clearance to .004" when checking timing.

VALVE TIMING

1) Rotate crankshaft until mark "Z 1" on crankshaft pulley aligns with mark on crankcase.

NOTE — Use care when rotating crankshaft or camshafts so that valve and piston do not collide. If resistance is felt, backoff a little and rotate camshaft until you are free to continue.

2) Using suitable tool (No. P 202) to rotate camshaft until dot on end of shaft is on top of camshaft vertical center line (see illustration). Find a hole in camshaft sprocket which exactly lines-up with camshaft flange and insert dowel pin. Install lock washer and nut, torque to specifications.

3) Adjust cylinder No. 1 intake valve clearance to .004". Install a dial indicator so that pressure foot is resting squarely on valve spring collar. Preload dial indicator to .3937" to provide for valve movement.

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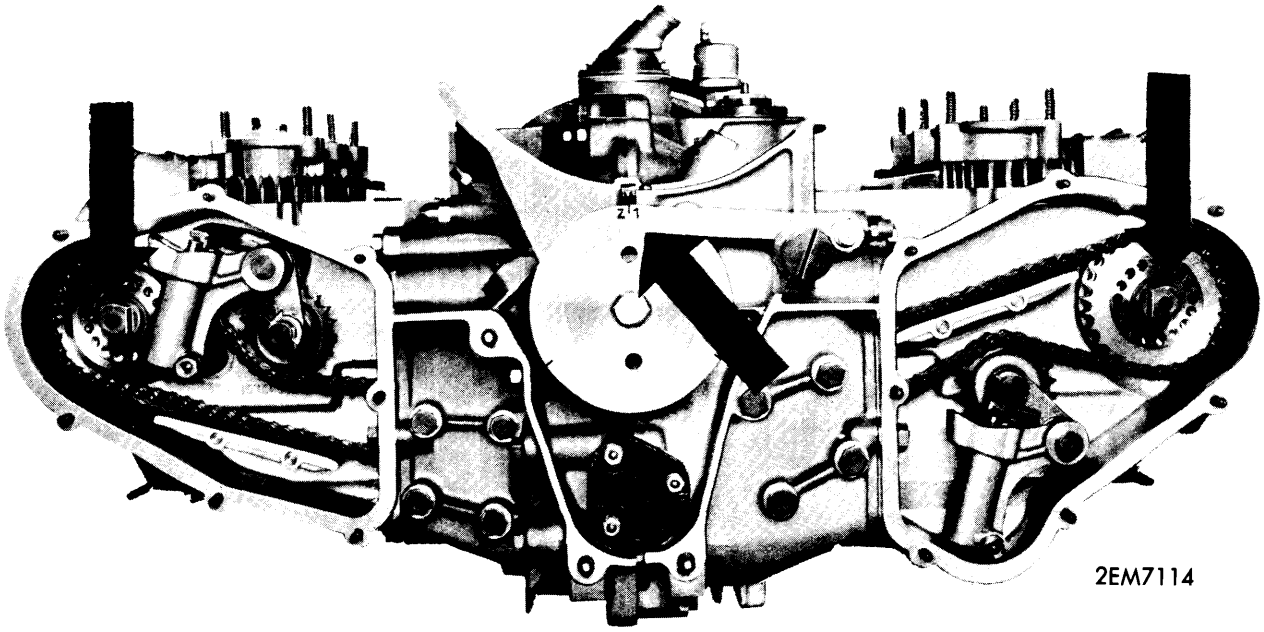
1965-73 PORSCHE 911 & 1970-71 914/6 6 CYLINDER (Cont.)



VALVE TIMING MARKS

4) Using a screwdriver, depress chain tensioner on side to be measured and block it with piece of metal. Rotate crankshaft 360° until "Z 1" (TDC) mark is aligned with mark on crankcase. Read dial indicator and compare with measurement given in *Intake Valve Lift Table*.

5) If correct valve opening measurement is not achieved, loosen camshaft nut, remove dowel pin and rotate camshaft until valve is open correct amount. Locate holes which align exactly and install dowel pin. Make sure crankshaft remains on TDC. Rotate crankshaft two complete revoulutions and recheck valve lift, repeat timing procedure if necessary. Repeat procedure on No. 4 cylinder for other side of engine.

Intake Valve Lift at Overlap TDC

Application	Intake Valve Lift In. (mm)
911 901/01, 05	.165-.181 (4.2-4.6)
911 901/06, 14	.118-.129 (3.0-.3.3)
911L & 911E	.118-.129 (3.0-3.3)
911T	.090-.106 (2.3-2.7)
911S	.196-.212 (5.0-5.4)

ENGINE OILING

ENGINE OILING SYSTEM

Lubrication is dry sump type. Two independent oil pumps provided for pressure and suction in system. Pressure pump takes oil from an externally mounted oil tank and forces oil to individual oil passages for all main bearings. From main bearings a drilled passage in crankshaft carries oil to connecting rod bearings. Another passage leads to front bearing of intermediate shaft. A passage in intermediate shaft takes oil to rear bearing of shaft.

In early engines, camshaft oiling is accomplished by; a passage from main oil gallery leading to center inlet point on each camshaft. Through camshaft oil is delivered to an opening in each camshaft lobe. Excess oil from camshaft lobes splashes onto rocker arms and valve stems. On late engines, camshaft oiling is accomplished by; at end of main oil gallery in both crankcase halves, external oil lines lead to camshaft housings. In camshaft housings are aluminum tubes with holes, three holes of .120" diameter carry oil to camshaft bearings. Six holes of .040" diameter splash oil on camshaft lobes. Remaining three holes allow oil to splash against intake valve cover in such a manner that it will drip on rocker arms and valve stems.

Suction pump takes oil from engine sump through a strainer and forces it through oil filter to oil tank. Oil collected in lower part of camshaft housing is returned to crankcase by oil return pipes. Suction pump then returns oil to oil tank. A tube in oil tank carries oil to base of oil tank and filter.

Oil pressure regulation is controlled by means of four separate valves. A thermostatically controlled valve directs oil directly to engine when temperature is below 176°F. When temperature is above 176°F oil flows through oil cooler and then to main bearings. A pressure relief and safety valve located in right crankcase half opens if oil pressure rises above 76.9-99.6 psi and oil is passed directly into crankcase. A safety valve is mounted in left crankcase half immediately after oil pump. It operates in event of a defective pressure relief valve to prevent damage to oil cooler or oil lines. As a safety measure, by-pass valves are built into filter base and filter body. If oil pressure exceeds 28.4 psi, oil by-passes oil filter and flows directly into oil tank.

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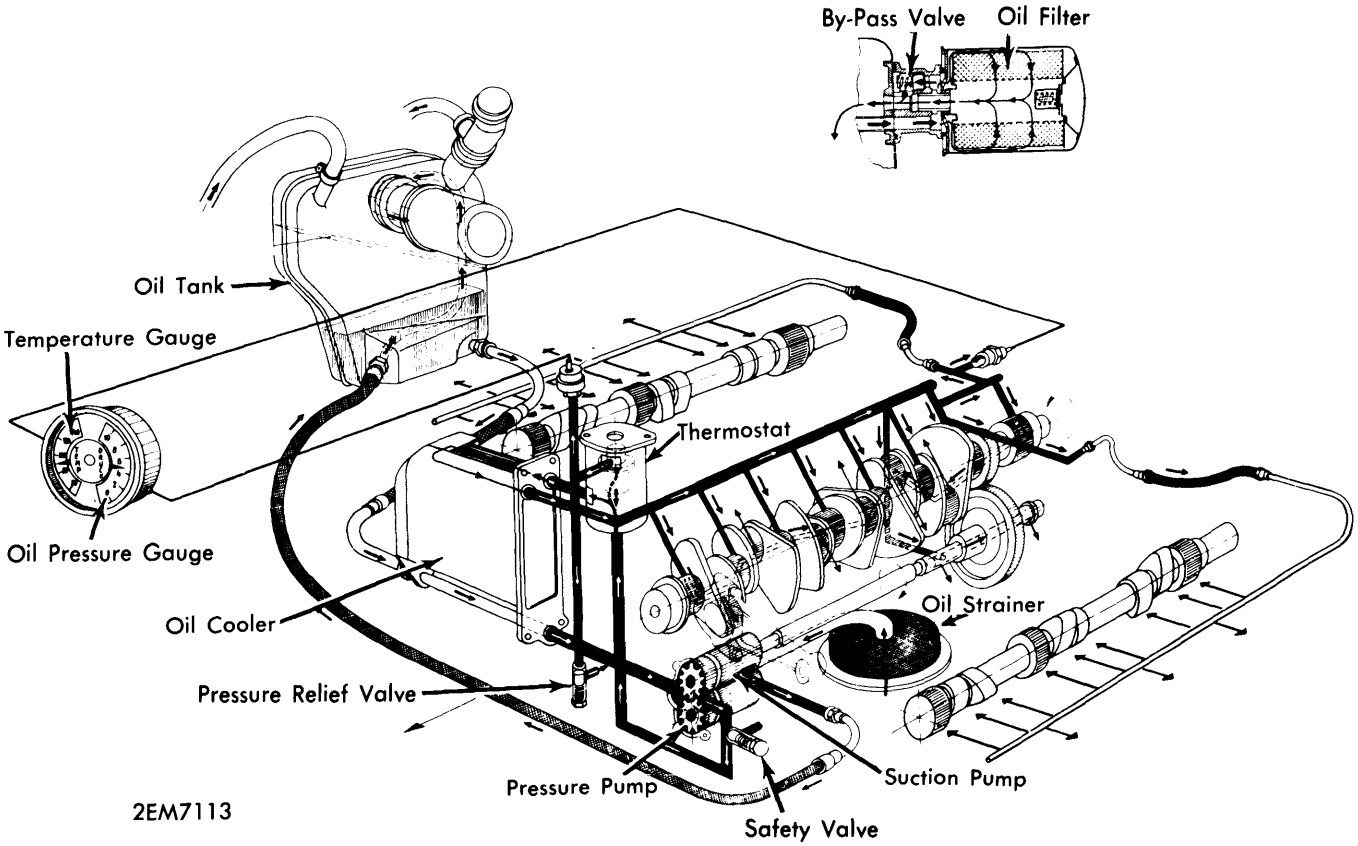
1965-73 PORSCHE 911 & 1970-71 914/6 6 CYLINDER (Cont.)

ENGINE OILING (Cont.)



ENGINE OILING SYSTEM

Oil Tank Capacity – 1965-68 models require 4.2 qts. (3.9 ltr.). 1969-72 models require 9.5 qts. (9.0 ltr.). 1973 models require 11.6 qts (11 ltr.) for models with manual transmission and 14.2 qts. (13.4 ltr.) for models with automatic transmission. Add 2.6 qts. (2.5 ltr.) for models with optional oil cooler. Oil change on 1973 models requires only 10.6 qts. (10 ltr.).

Oil Filter – Replace every 6,000 miles.

Normal Oil Pressure – 78-99.5 psi @ 5,000 RPM.

Pressure Relief Valve – Non-adjustable.

OIL PUMP

Oil pump may be removed when crankcase halves are separated. No repair of pump is possible, replace if defective.

ENGINE COOLING

Cooling is accomplished by means of a blower, consisting of an impeller and blower housing. Center of blower housing holds support for alternator. Impeller and belt pulley are attached to alternator shaft. Blower delivers air required for cooling engine, oil cooler, alternator as well as fresh air for heating system. Cooling air flows through upper molded plastic air guides to cylinders and heads. Baffle plates provide uniform distribution of air. A duct incorporated into upper air guide leads air flow directly to oil cooler. Ducting for air delivery to heat exchangers is on both sides of blower housing. Adjustment of blower drive belt is done by adding or removing spacers between impeller housing and pulley half. This will cause belt to ride higher or lower on pulley, thereby loosening or tightening drive belt.

TIGHTENING SPECIFICATIONS

Application	Ft. Lbs. (mkg)
Crankcase Joining Bolts	18 (2.5)
Camshaft Housing	16 (2.2)
Main Bearing Caps	25 (3.5)
Flywheel	108 (14.9)
Connecting Rods	36 (5.0)
Cylinder Heads	24 (3.3)
Camshaft Nut	72 (10.0)
Rocker Arm Shafts	13 (1.8)
Crankshaft Pulley	58 (8.0)
Alternator	29 (4.0)

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