99 & 900 4 CYLINDER

ENGINE CODING

ENGINE IDENTIFICATION

Engine number is stamped on block and is located near the summer setting on air cleaner.

Engine Identification

Application	Code
99	BI 20 P04
900	
Man. Trans.	BI 20 P11
Auto. Trans.	BI 20 P12
Turbo	BSI 20 P02

ENGINE & CYLINDER HEAD

ENGINE

NOTE – *Engine and transaxle assembly are removed as a unit. Transaxle housing is engine lower crankcase (pan).*

Removal – 1) Remove hood and drain cooling system. Disconnect and remove battery. Disconnect ground strap between engine and chassis and disconnect positive cable from starter motor. Disconnect servo vacuum hose at manifold and remove bellows between air flow sensor and intake manifold.

2) Clean area around fuel distributor lines and detach at connectors. Cover openings and plug fuel line ends. Remove air cleaner assembly along with mixture control unit. Disconnect EGR system (if equipped). Disconnect upper and lower radiator hoses and heater hoses.

3) Disconnect the following: Ignition coil, temperature sender, cooling fan, thermostat contact, oil pressure sender, fuel injection warm-up regulator, auxiliary air valve, and throttle control wire. On model 99, disconnect headlights and remove grille. Remove retaining screws and take out entire front sheet consisting of headlights, radiator, cooling fan and supports.

4) On manual transmission models, disconnect clutch line from slave cylinder. Cap hose and slave cylinder opening, put gear lever in neutral, and drive front taper pin from shift rod joint. Separate joint from gear shift rod.

5) On automatic transmission models, remove protective cover from exhaust manifold (if equipped), and place gear selector in "P" position. Remove selector cable retaining screw, push back spring loaded sleeve on shift rod, and disconnect cable.

6) On all models, disconnect exhaust pipe at manifold. Loosen clamps and remove bellows from inner universal joints at transaxle. On model 900, place spacer tool (83 93 209) between upper control arm and body so front suspension will be unloaded when car is raised.

7) On all models, raise and support vehicle, then remove lower end piece from right side control arm. Remove rear engine mounting bolts and loosen front engine mounting nut so mount can be lifted from bracket. Turn steering wheel to left and raise engine slightly with hoisting sling.

8) Move engine to right and remove left universal joint, then move engine to left and withdraw right universal joint. Ensure that all cables and lines are free from engine and remove entire power unit from vehicle.

Installation – Ensure that universal joints are packed with grease. Lower engine assembly with flywheel end slightly low and assemble right side universal joint. Lower assembly to within 1" (20-30 mm) above engine mounts and insert left side universal joint. To complete installation, reverse removal procedure.

CYLINDER HEAD

Removal – 1) Disconnect battery leads and drain cooling system. Remove bellows between air flow meter and throttle valve housing. Disconnect throttle cable. Disconnect temperature sender wire and detach vacuum hose to servo cylinder from manifold. Disconnect and plug all fuel lines to injection valves.

2) Disconnect all coolant hoses from head and manifold. Disconnect exhaust pipe from manifold. Remove distributor cap and wires. Remove valve cover and bolt the mounting plate to center of camshaft sprocket using one of the retaining screws.

NOTE – *Tighten screw securely so chain and sprocket cannot shift to new position.*

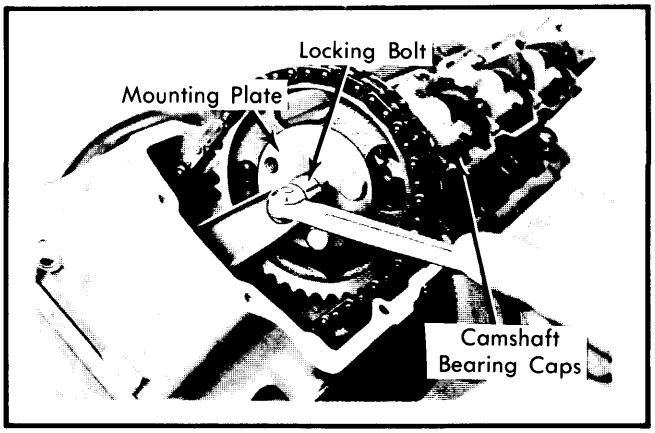

Fig. 1 Locking Camshaft Sprocket and Chain to Mounting Plate

3) Remove remaining screws from camshaft sprocket and separate sprocket from camshaft. Remove cylinder head bolts and insert 2 guide studs in 2 of the head bolt holes. Remove screws at transmission cover and lift off cylinder head.

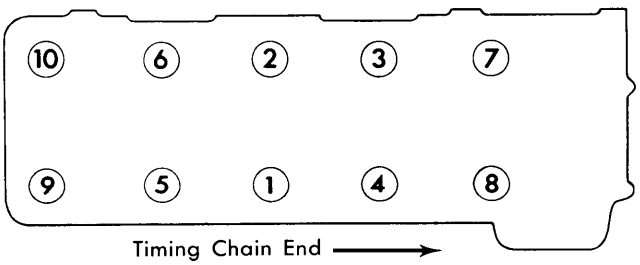

Fig. 2 Cylinder Head Tightening Sequence (Loosen in Reverse Order)

99 & 900 4 CYLINDER (Cont.)

Installation – To install reverse removal procedures and note the following: Make sure camshaft and bearing cap index marks are aligned. Align flywheel mark with mark on cylinder block. Set ignition with No. 1 piston at TDC. Retorque head bolts after engine has run and allowed to cool.

CAMSHAFT

CAMSHAFT

Removal – Remove cylinder head cover and lock camshaft as previously described. Separate sprocket from camshaft. Remove camshaft bearing caps and lift out camshaft.

Installation – Install camshaft and bearing assembly so that feeler gauge openings are at top. Ensure that crankshaft is still at TDC for No. 1 cylinder and reverse removal procedure.

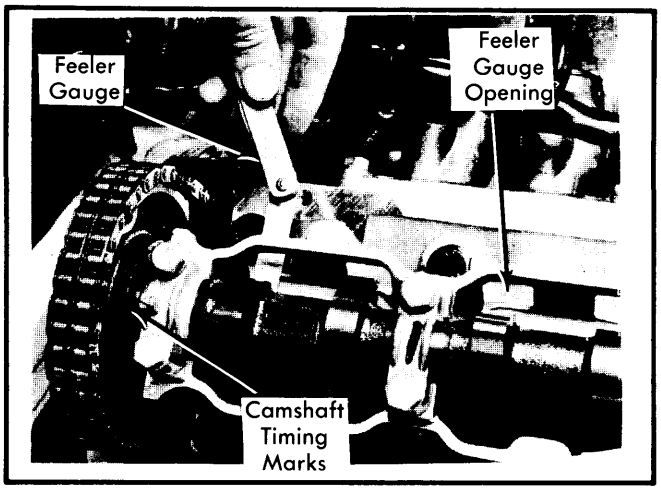

Fig. 3 Camshaft Timing Marks

VALVE TIMING & CHAIN REPLACEMENT

Removal – Remove chain and sprocket from camshaft as previously described. Remove drive belt pulley and timing chain cover. Remove, but do not disassemble, chain tensioner. Remove chain guides, mounting plate with sprocket and timing chain.

Installation – **1)** Ensure that camshaft and crankshaft are still at firing position for No. 1 cylinder. Idler shaft mounting plate hole and bulge in hole of sprocket web must be aligned. Lower timing chain and mounting plate past camshaft flange until center stud of sprocket is lined up with camshaft.

2) Rotate camshaft sprocket until screw holes match threaded holes in camshaft flange. Fit chain over other sprockets so that it hangs straight from camshaft sprocket to crankshaft. Guide center stud of camshaft sprocket into camshaft and fit attaching screws.

3) Mount chain guide and mounting plate with 2 screws so that chain is slightly stretched. Install chain tensioner. Rotate crankshaft one complete turn in normal direction and check that there is at least .020" (.5 mm) but not more than .060" (1.5 mm) between housing and tensioner neck.

4) Remove screw from center of camshaft sprocket and install remaining components in reverse order of removal.

CHAIN TENSIONER MECHANISM

If chain tensioner mechanism has been dismantled or came apart, assemble as follows before fitting to engine:

- Place lock washer with ratchet sleeve into tensioner housing, large diameter end first.
- Fit spring against ratchet sleeve.
- Push neck of tensioner and spring into housing, simultaneously pressing and turning tensioner neck until seated.

NOTE – *Tensioner neck must be kept depressed while tensioner mechanism is being fitted.*

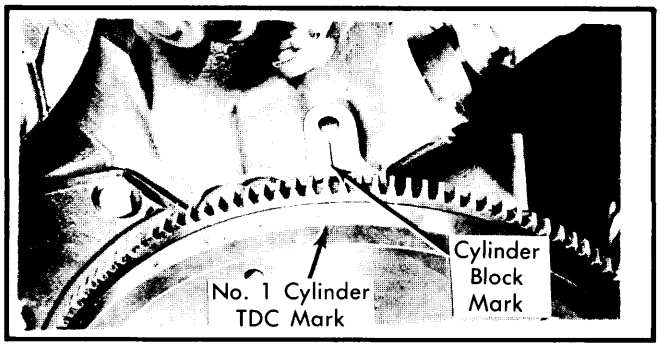

Fig. 4 Flywheel and Cylinder Block Markings

IDLER SHAFT

Removal – Ensure that crankshaft is at firing position for No. 1 cylinder. Counterhold idler shaft sprocket and remove retaining bolt. Remove sprocket and take out distributor. Unscrew idler shaft keeper plate and carefully withdraw idler shaft.

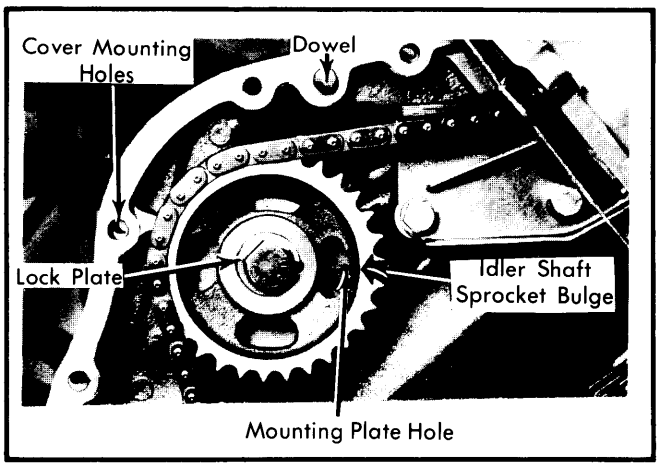

Fig. 5 Idler Shaft Index Marks. Bow in Cutout on Idler Shaft Sprocket Must Line Up with Small Hole in Mounting Plate.

Installation – Ensure that engine is at TDC for No. 1 and install idler shaft and lock plate. Bulge in hole of idler shaft sprocket must line up with small hole in lock plate. Install and adjust timing chain as previously described.

99 & 900 4 CYLINDER (Cont.)

VALVES

VALVE ARRANGEMENT

E-I-I-E-E-I-I-E

VALVE SPRINGS

NOTE – *Valve spring replacement is possible without removing cylinder head from engine.*

Removal & Installation – Remove camshaft as previously described. With cylinder head installed, take out spark plug of applicable cylinder and fit air hose connector. Supply air pressure to keep valve from dropping into cylinder. Remove valve depressors and adjusting pallets. Use suitable spring compressor and remove retainers (keepers) with a magnet. To install, reverse removal procedure.

VALVE GUIDE SERVICING

To check for wear, pull valve about .12" (3 mm) from its seat and check radial play at valve head. If play exceeds .020" (.5 mm), replace valve and/or guide. To replace guide, run hot water through head and pull guide from head using suitable puller (8392632). To install, ensure that head is warm as in removal. Use guide tool (8392632) and press new guide in from top.

VALVE CLEARANCE ADJUSTMENT

1) Check clearance with valve cover removed by rotating crankshaft so that cam lobe of valve to be measured points away from valve. Measure clearance with feeler gauge between heel of cam and follower. Clearance should be between .006-.012" (.15-.30 mm) for intake and .014-.020" (.35-.50 mm) for exhaust. Turbo exhaust valve clearance is .016-.020" (.40-.50 mm).

2) If any valve clearance is beyond limits, direct measurement of all valve clearance is required. Use tool (8391450) and a dial indicator to measure actual clearance. Record clearance readings on all valves. Adjust intake clearances if beyond .008-.010" (.20-.25 mm) and exhaust clearances if beyond .016-.018" (.40-.45 mm). Turbo exhaust clearance should be adjusted if beyond .018-.020" (.45-.50 mm).

3) Remove camshaft, followers and adjusting pallets of any valve requiring adjustment. Measure pallet thickness and add noted valve clearance to determine total clearance. Subtract proper valve clearance to find needed pallet thickness. Install new pallets. Install followers and camshaft and recheck valve clearance.

PISTONS, PINS & RINGS

PISTON & ROD ASSEMBLY

Removal – With cylinder head and pan removed, note that rods and rod caps are numbered. Remove carbon or wear ridge from top of cylinders. Remove bearing caps and place plastic sleeves over rod bolts. Push piston/rod assembly out of cylinder.

Installation – Ensure that ring gaps are staggered and fit suitable ring compressor. Notch on piston top must face transmission end. Remove protectors from rod bolts and install bearing and cap.

PISTON PIN REPLACEMENT

Pistons are retained by circlips. Remove circlips and press out piston pins. Check pins and bearings for wear or damage and replace as required.

FITTING PISTONS

1) To fit pistons to cylinder bores, use a feeler gauge .500" (12.7 mm) wide and .0005-.0016" (.014-.040 mm) thick. Oil cylinder lightly and insert piston without rings.

2) Attach feeler gauge to a spring scale. Insert feeler gauge between piston and cylinder wall at right angles to piston pin. When feeler gauge can be pulled out of cylinder with a force of 1.8-2.6 lbs. (.816-1.18 kg), piston clearance has been determined.

3) Repeat test at several different depths in cylinder bore. Graded standard and non-graded oversize pistons are available.

Piston Specifications

Application	Diameter In. (mm)
Std. (AB)	3.5425-3.5427 (89.980-89.986)
Std. (C)	3.5433-3.5437 (89.999-90.010)
1st Oversize	3.5619-3.5625 (90.472-90.487)
2nd Oversize	3.5816-3.5822 (90.972-90.987)

4) Check piston rings for end gap and side clearance, using an inverted piston to position ring in bore. On worn bores, measure at lower end of bore.

5) Install rings on piston, making sure gaps of compression rings are 180° apart with lower compression ring mark "TOP" facing up. On three piece oil ring make sure ends are staggered.

CRANKSHAFT MAIN & CONNECTING ROD BEARINGS

BEARING SERVICE

1) Remove connecting rods and main bearing caps. Measure journals with a micrometer. Out-of-round should not exceed .002" (.051 mm). If crankshaft is near or over stated limit of wear, regrind journals and fit undersize bearings.

2) Using "V" blocks and a dial indicator check crankshaft for bend. If bend exceeds .002" (.051 mm), replace or repair crankshaft.

99 & 900 4 CYLINDER (Cont.)

3) Using Plastigage method, check main bearing and connecting rod bearing journals. If clearance is found excessive, combine suitable undersize bearings to correct clearance. Undersize bearings are available in various thicknesses.

THRUST BEARING ALIGNMENT

Center main bearing is thrust bearing. Check crankshaft endplay. If beyond specifications, replace thrust washers with oil grooves facing crankshaft.

ENGINE OILING

Crankcase Capacity – 4.0 quarts with filter. (4.5 quarts for turbocharged engine.)

Oil Filter – Full-flow type.

Normal Oil Pressure – 43 psi (3.0 kg/cm²) @2000 RPM.

Pressure Regulator Valve – Non-adjustable; opens at 57-71 psi (4.0-5.0 kg/cm²).

ENGINE OILING SYSTEM

Oil pressure is generated by a dual-rotor pump mounted on the outside of the engine and driven by an idler shaft. Oil is forced through a full-flow filter and oil channels to crankshaft main and connecting rod bearings.

OIL PUMP

Removal – **1)** Remove 4 screws attaching pump to engine and withdraw pump and "O" ring. Remove 2 screws attaching pump cover to housing. Remove rotors and "O" ring from housing.

2) Pull cotter pin from cover and remove plug, "O" ring, spring and pressure relief valve piston. Using a straightedge and feeler gauge, measure clearance between rotors and housing face. If clearance exceeds .002-.0035" (.05-.09 mm), use fine emery paper to resurface housing or sides of rotors.

Installation – **1)** Clean and oil all parts. Install outer rotor with chamfered edge inward facing toward drive shaft. Install valve piston, spring plug, "O" ring and cotter pin in pump cover.

2) Place "O" ring in pump housing groove. Install cover and tighten screws. Rotate pump up until drive shaft engages in engine. Slide pump up against engine and install four attaching bolts.

ENGINE COOLING

Cooling System Capacity – Model 99, 8.5 quarts. Model 900, 10.5 quarts.

Thermostat – Thermostat begins to open at approximately 190°F (88°C).

Radiator Cap – Radiator pressure cap opens at approximately 14.2 psi.

WATER PUMP

Removal – **1)** Drain coolant. Disconnect battery. Remove intake manifold. Remove alternator. Remove bolt mounting bracket to pump cover. Unbolt rear engine mounts. Raise rear of engine. Remove bolt mounting alternator bracket to transmission cover. Loosen lower bolt and twist bracket away from engine. Remove last two bolts from cover and remove.

2) Use extractor (8362649) or equivalent and pull pump from engine. Do NOT use slide hammer or similar tool to remove pump from engine. If bearing housing remains in cylinder block, it may be necessary to use slide hammer for removal of bearing.

Installation – To install, reverse removal procedure and note: It may be necessary to use sleeve 8392490 (or equivalent) to seat bearing housing.

TIGHTENING SPECIFICATIONS

Application	Ft. Lbs. (mkg)
Main Bearings	79 (10.9)
Rod Bearings	40 (5.5)
Camshaft Bearing Caps	13 (1.8)
Camshaft Cover	1 (.14)
Crankshaft Pulley	137 (19.00)
Cylinder Head	
Step One	43 (6.0)
Step Two	69 (9.5)
Flywheel	43 (6.0)
Oil Pump	13 (1.8)
Idler Sprocket	18 (2.5)
Camshaft Sprocket	14 (1.9)
Intake Manifold	13 (1.8)
Exhaust Manifold	14 (1.9)

ENGINE SPECIFICATIONS

GENERAL SPECIFICATIONS

Year	Displ.		Carburetor	HP at RPM	Torque (Ft. Lbs. at RPM)	Compr. Ratio	Bore		Stroke	
	cu. ins.	cc					in.	mm	in.	mm
1980										
99 & 900										
Federal	121	1985	Fuel Inj.	115@5500	123@3500	9.25:1	3.54	90	3.07	78
Calif.	121	1985	Fuel Inj.	110@5500	119@3500	8.7:1	3.54	90	3.07	78
Turbo	121	1985	Fuel Inj.	135@5000	160@3500	7.2:1	3.54	90	3.07	78

99 & 900 4 CYLINDER (Cont.)

ENGINE SPECIFICATIONS (Cont.)

CAMSHAFT

Engine	Journal Diam. In. (mm)	Clearance In. (mm) ①	Lobe Lift In. (mm) ②
1985 cc	1.139 (28.94)	.....	Int. .421 (10.7) Exh. .433 (11.0)

① — End play is .003-.010" (.08-.25 mm).

② — Turbo lobe lift is .358" (9.1 mm) for intake, .413" (10.5 mm) for exhaust.

VALVE TIMING

Engine	INTAKE① Open (BTDC)	INTAKE① Close (ABDC)	EXHAUST② Open (BBDC)	EXHAUST② Close (ATDC)
1985 cc				
99 & 900	10°	54°	46°	18°
Turbo	12°	40°	62°	2°

① — With .014" (.35 mm) valve clearance.

② — With .022 (.55 mm) valve clearance.

VALVE SPRINGS

Engine	Free Length In. (mm)	PRESSURE Lbs. @ In. (kg @ mm) Valve Closed	PRESSURE Lbs. @ In. (kg @ mm) Valve Open
1985 cc	1.700 (43.1)	.....	170-183@1.161 (77-83@29.5)

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)
1985 cc							
Int.	1.654 (42.0)	44.5°	45°	.004-.008 (1-2)	.313-.314 (7.950-7.976)	0.02 (0.5)	.....
Exh.	1.398 (35.5)	44.5°	45°	.004-.008 (1-2)	.313-.314 (7.950-7.976)	0.02 (0.5)	.....

PISTONS, PINS, RINGS

Engine	PISTONS Clearance In. (mm)	PINS Piston Fit In. (mm)	PINS Rod Fit In. (mm)	RINGS Rings	RINGS End Gap In. (mm)	RINGS Side Clearance In. (mm)
1985 cc	.0006-.0016 (.014-.040)	.0002-.0006 (.005-.014)	①	No. 1	.014-.021 (.35-.55)	.002-.003 (.050-.082)
				No. 2	.012-.018 (.30-.45)	.0016-.003 (.040-.072)
				Oil	.015-.055 (.38-1.40)	.....

① — Interference fit.

CRANKSHAFT MAIN & CONNECTING ROD BEARINGS

Engine	MAIN BEARINGS Journal Diam. In. (mm)	MAIN BEARINGS Clearance In. (mm)	MAIN BEARINGS Thrust Bearing	MAIN BEARINGS Crankshaft End Play In. (mm)	CONNECTING ROD BEARINGS Journal Diam. In. (mm)	CONNECTING ROD BEARINGS Clearance In. (mm)	CONNECTING ROD BEARINGS Side Play In. (mm)
1985 cc	2.283-2.284 (57.981-58.000)	.001-.002 (.026-.062)	Center	.003-.011 (0.08-0.28)	2.046-2.047 (51.981-52.000)	.001-.002 (.026-.062)	.....