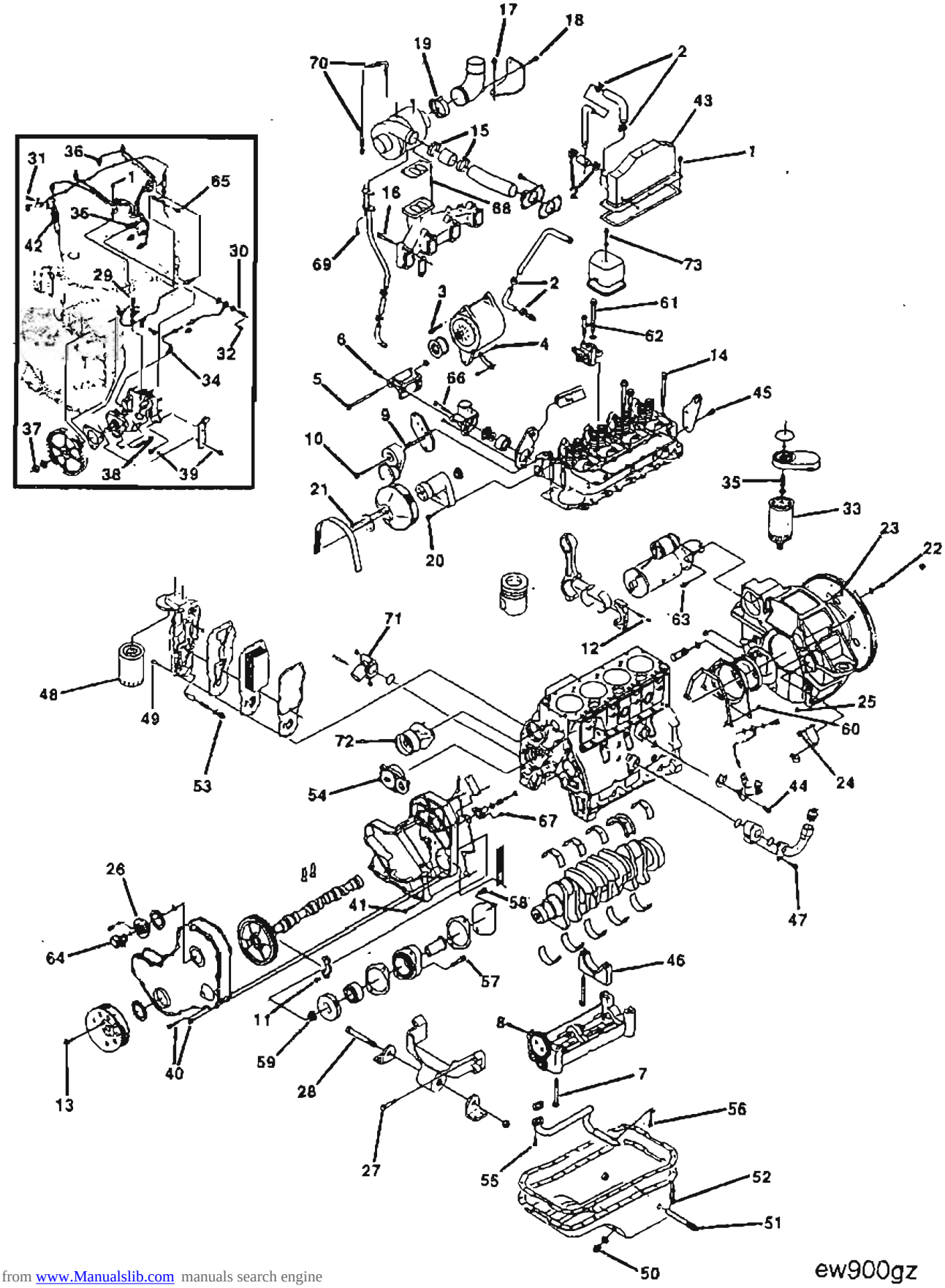
Specifications - General Information

This specification section contains the engine specifications for the B series engines. A detailed Engine Component Torque Value sheet is provided in addition to a summary listing with reduced line art of the key specifications from each section is included.



Engine Component Torque Values

Ref. No.	Socket or Wrench Size MM[Inch]		Torque N•m	[Ft-lb]
1	10	Aftercooler Mounting	24	[18]
2	[5/16]	Aftercooler Water Hose Clamp	5	[4]
3	[15/16]	Alternator Pulley	80	[59]
4	13 or [3/4]	Alternator Link (Delco 15-20-27 SI)	43	[32]
5	16	Alternator Mounting Bolt 15 SI	43	[32]
5	18	Altenator Mounting Bolt and Nut 20-27 SI	77	[57]
6	13	Alternator Support (Upper)	24	[18]
7	23	Balancer Mounting....Step 1	50	[36]
		(Alternately Tighten....Step 2	80	[58]
		in Three Steps)....Step 3	175	[129]
8	Allen 8mm	Balancer Idler Gear	43	[32]
9	Allen 5mm	Belt Tensioner Flat Bracket	24	[18]
10	15	Belt Tensioner Mounting	43	[32]
		Camshaft Bolt....Step 1	27	[20]
		....Step 2	Rotate 180 Degrees	
11	13	Cam Thrust Plate	24	[18]
	[3/8]	Coolant Heater	12	[9]
12	12	Connecting Rod Bolt....Step 1	35	[26]
		(Alternately Tighten....Step 2	70	[51]
		in Three Steps)....Step 3	100	[73]
13	15	Crankshaft Damper & Pulley	125	[92]
14	18	Cylinder Head Mounting....Step 1 (All)	90	[66]
		....Step 2 (All) Recheck to	90	[66]
		....Step 3 (Long Capscrews)	120	[90]
		....Step 4 Recheck (Long Capscrews Only)	120	[90]
		....Step 5 (All) Rotate 90°		
15	[5/16]	Crossover Clamp	5	[4]
16	13	Exhaust Manifold	43	[32]
17	13	Exhaust Outlet Pipe Brkt. Mounting	43	[32]
18	13	Exhaust Outlet Pipe, Flanged	24	[18]
19	[7/16]	Exhaust Outlet Pipe, V Band Clamp	8	[6]
20	10	Fan Bracket Mounting	24	[18]
21	13	Fan Pulley	24	[18]
22	19	Flywheel	137	[101]
23	15	Flywheel Housing	77	[57]
24	13	Flywheel Housing Access Cover	24	[18]
15	[1/2]	Flywheel Housing Plug	36	[25]
26	–	Front Cover Cap	—Hand Tighten—	
27	18	Front Engine Support Mounting	77	[57]
28	[1 1/8]	Front Engine Support (Barrel)	350	[257]
29	17	Fuel Banjo Screw (In Fuel Pump)	32	[24]
30	17	Fuel Banjo Screw (In Head)	24	[18]
31	10	Fuel Banjo Screw (In Injector)	9	[7]
32	10	Fuel Vent Screw (In Banjo)	9	[7]
33	80-95	Fuel Filter	3/4 Turn After Contact	
34	14	Fuel Low Pressure Supply (Lift Pump Outlet)	24	[18]
35	24	Fuel Filter Adapter Nut	32	[24]
36	17	Fuel Line Fitting (High Press)	24	[18]

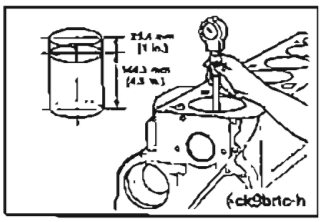
Engine Component Torque Values

Ref. No.	Socket or Wrench Size MM[Inch]		Torque N•m	[Ft-lb]
37	22	Fuel Pump Drive Gear (With Pump Unlocked)		
		Bosch (Rotary), Lucas CAV, Stanadyne DB4	65	[48]
		Nippondenso	123	[92]
		Bosch (P3000, P7100)	165	[122]
	10	Fuel Pump Lock (Bosch)	30	[22]
		Fuel Pump Unlock (Bosch	13	[10]
	[9/16]	Fuel Pump Lock (CAV) (Stanadyne DB4)	12	[9]
		Fuel Pump Unlock (CAV) (Stanadyne DB4)	12	[9]
38	13	Fuel Pump Mounting Nut (Bosch Rotary) (Stanadyne DB4)	24	[18]
		Fuel Pump Mtg. Nut (Nippondenso)	43	[32]
		Fuel Pump Mtg. Nut (Lucas CAV)	30	[22]
		Fuel Pump Mtg. Nut (Bosch In-Line)	43	[32]
		Fuel Pump Solenoid		
	24	(Bosch VE)	43	[32]
	22	(CAV)	15	[11]
39	10	Fuel Pump Support Bracket	24	[18]
40	10	Gear Cover	24	[18]
41	10	Gear Housing-to-Block	24	[18]
42	24	Injector Retaining Nut	60	[44]
43	10	Intake Manifold Cover	24	[18]
	[5/8]	Intake Heater Plug	125	[90]
44	10	Lift Pump Mounting/Cover Plate	24	[18]
45	18	Lifting Bracket (Rear)	77	[57]
46	23	Main Bearing Cap....Step 1	60	[44]
		....Step 2	119	[88]
		....Step 3	176	[129]
47	15	Oil Fill Tube Mounting	43	[32]
48	75-85	Oil Filter	3/4 Turn After Contact	
49	10	Oil Cooler Assembly	24	[18]
50	17	Oil Pan Drain Plug	80	[60]
51	17	Oil Pan Heater Plug	80	[60]
52	10	Oil Pan Mounting	24	[18]
53	19	Oil Pressure Regulator Plug	80	[60]
54	13	Oil Pump Mounting	24	[18]
55	13	Oil Suction Tube (Flange)	24	[18]
56	10	Oil Suction Tube Brace	24	[18]
57	15	PTO Adapter	77	[57]
58	13	PTO Adapter Cover Plate (A Drive)	43	[32]
	15	PTO Adapter Cover Plate (B Drive)	77	[57]
59	[3/4]	PTO Gear Nut A Drive	100	[74]
	[15/16]	PTO Gear Nut B Drive	134	[100]
60	8	Rear Seal Mounting	9	[7]
61	13	Rocker Support	24	[18]
62	[14]	Rocker Lever Nut	34	[25]
63	10	Starter Mounting	43	[32]
64	10	Tach Drive Retainer	3	[2]
65	10	Tappet Cover/Fuel Drain Line Supports	24	[18]
66	10	Thermostat Housing	24	[18]
67	T-25 Torx	Timing Pin Flange Mounting	5	[4]
	10	Turbocharger Compressor Housing V-Band	8.5	[6]
68	15	Turbocharger Mounting Nut	43	[32]

Engine Component Torque Values

Ref. No.	Socket or Wrench Size MM[Inch]		Torque N•m	[Ft-lb]
69	13	Turbocharger Oil Drain Tube	24	[18]
70	[5/8]	Turbocharger Oil Supply (Both Ends)	35	[26]
	13	Turbocharger Turbine Housing	20	[15]
		Water Hose Clamps	4-5	[4]
71	13	Water Inlet Connection	43	[32]
	[3/8]	Water Inlet Plugs	24	[18]
72	13	Water Pump Mounting	24	[18]
73	15	Valve Cover	24	[18]
	--	Valve Cover Oil Fill	Hand Tighten	

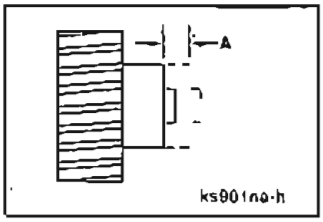
Component or Assembly (Procedure)	Ref.No./Steps	Metric		U.S.



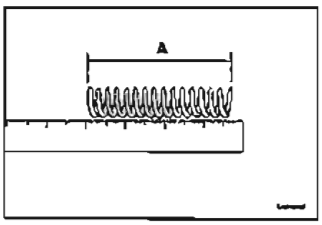
Component Specifications and Torque Values

Engine Assembly - Specifications

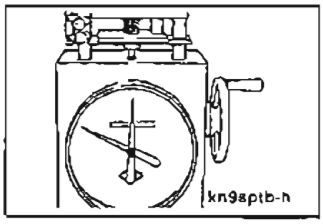
Cylinder Bores				
Cylinder Bore I.D.		102.000 mm	MIN	4.0157 in
		102.116 mm	MAX	4.0203 in
Cylinder Bore Out of Round		0.035 mm	MAX	0.0014 in
Cylinder Bore Taper		0.076 mm	MAX	0.003 in



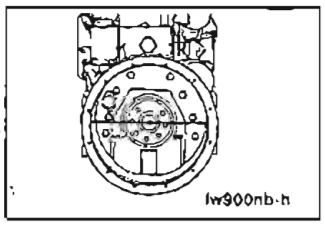
Crankshaft End Clearance	A	0.102 mm	MIN	0.004 in
		0.432 mm	MAX	0.017 in



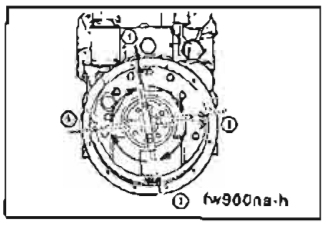
Oil Pressure Regulating Spring				
• Spring Free Length				
1991 Engines	A	60.6 mm	MIN	2.385 in
1994 Engines		66.0 mm	MIN	2.598 in



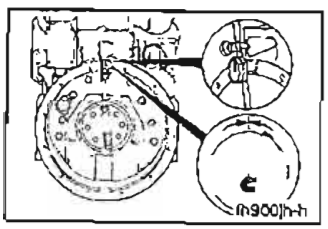
• Spring Tension at 38.50 mm [1.516 in] Height				
(A) 1991 Engines		(A) 109.0 N	MIN	24.5 lb
(B) 1994 Engines		(B) 141.2 N	MIN	31.7 lb



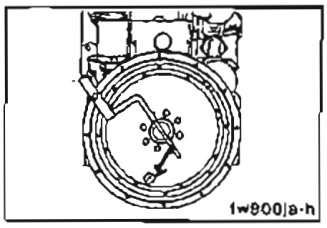
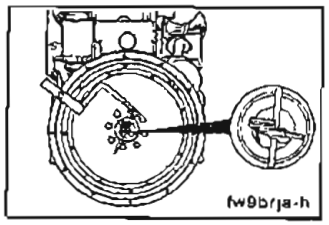
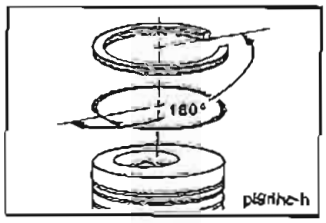
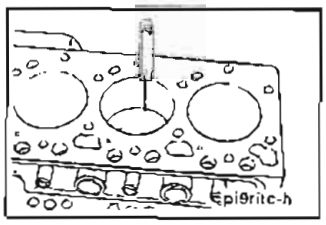
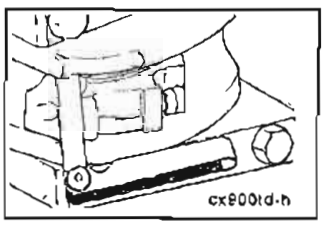
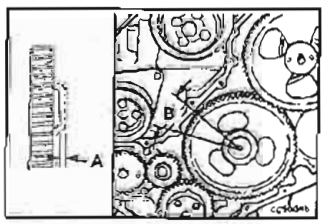
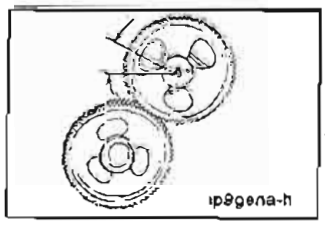
Flywheel Housing Bore I.D.	SAE No.			
	2	447.8 mm	MAX	17.63 in
	3	409.7 mm	MAX	16.13 in

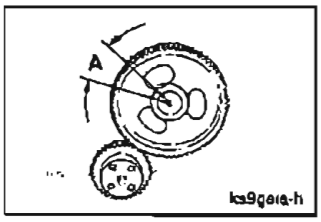
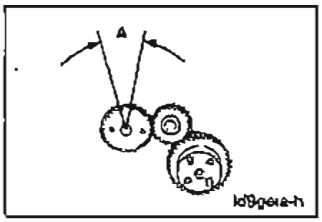
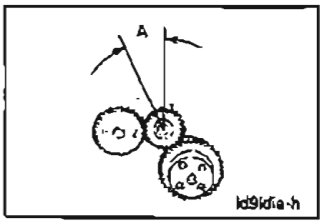
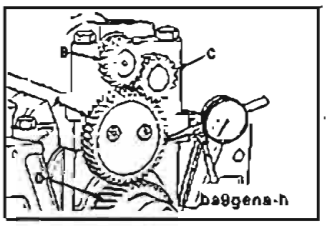
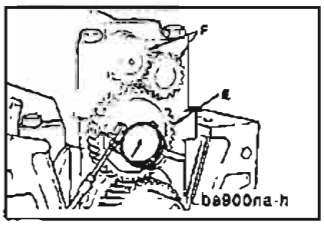
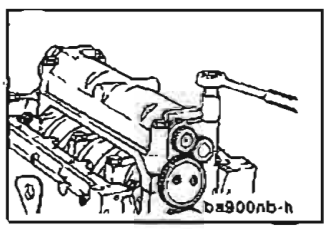
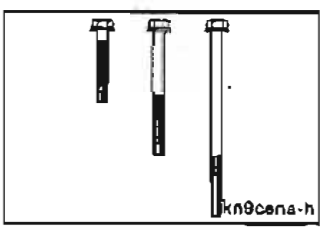


Flywheel Housing Bore Alignment TIR		0.20 mm	MAX	0.008 in

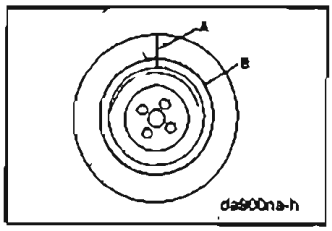


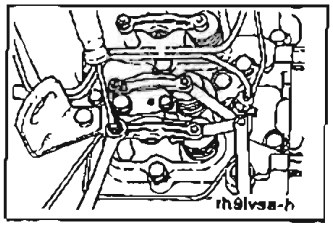
Flywheel Housing Face Alignment TIR	SAE No.			
	2	0.20 mm	MAX	0.008 in
	3	0.20 mm	MAX	0.008 in

Component or Assembly (Procedure)	Ref.No./Steps	Metric		U.S.	
Flywheel Face Runout TIR	Radius mm / in				
	254 / 10	0.254	MAX	0.010	
	205 / 8	0.203	MAX	0.008	
	181 / 7	0.152	MAX	0.006	
	157 / 6	0.152	MAX	0.006	
	133 / 5	0.152	MAX	0.006	
Flywheel Bore Runout TIR		0.127	MAX	0.0050	
Oil Control Ring End Gap The two-piece oil ring must be installed with the expander gap 180 degrees from the oil ring gap.					
Ring Gap (Feeler Gauge)					
• Top Ring Gap Naturally Aspirated		0.25 mm	MIN	0.010 in	
		0.55 mm	MAX	0.022 in	
• Top Ring Gap Turbocharged		0.40 mm	MIN	0.016 in	
		0.70 mm	MAX	0.028 in	
• Intermediate Ring Gap		0.25 mm	MIN	0.010 in	
		0.55 mm	MAX	0.022 in	
• Oil Control Ring Gap		0.25 mm	MIN	0.010 in	
		0.55 mm	MAX	0.022 in	
Connecting Rod Side Clearance **Note:** The rod must move freely from side-to-side.		0.100 mm	MIN	0.004 in	
		0.330 mm	MAX	0.013 in	
Camshaft End Clearance		0.08 mm	MIN	0.003 in	
		0.47 mm	MAX	0.0185 in	
Injection Pump Drive Gear Backlash	A	0.076 mm	MIN	0.003 in	
		0.330 mm	MAX	0.013 in	

Component or Assembly (Procedure)	Ref.No./Steps	Metric		U.S.
 Camshaft Gear Backlash	A	0.076 mm 0.330 mm	MIN MAX	0.003 in 0.013 in
 Lubricating Oil Pump Gear Backlash	A	0.076 mm 0.330 mm	MIN MAX	0.003 in 0.013 in
 Lubricating Oil Pump Idler Gear Backlash	A	0.076 mm 0.330 mm	MIN MAX	0.003 in 0.013 in
 Balancer Gear Backlash	A to D B to C A to C	0.088 mm 0.420 mm 0.153 mm 0.355 mm 0.088 mm 0.420 mm	MIN MAX MIN MAX MIN MAX	0.003 in 0.017 in 0.006 in 0.014 in 0.003 in 0.017 in
 Balancer End Clearance	E F	0.13 mm 0.63 mm 0.075 mm 0.175 mm	MIN MAX MIN MAX	0.005 in 0.024 in 0.003 in 0.007 in
 Balancer Torque Value and Sequence	1 2 3	50 N•m 80 N•m 176 N•m		36 ft-lb 58 ft-lb 129 ft-lb
 Cylinder Head Capscrew Free Length (Maximum) Short Medium Long		 71.5 mm 122.1 mm 182.9 mm	 MAX MAX MAX	 2.815 in 4.807 in 7.201 in

Component or Assembly (Procedure)	Ref.No./Steps	Metric		U.S.
Vibration Damper				
Index line out of alignment	A	1.588 mm	MAX	0.0625 in
Missing rubber member chunks	B	3.175 mm	MAX	0.1250 in
Valve Stem to Rocker Lever Clearances				
Intake		0.25 mm		0.010 in
Exhaust		0.51 mm		0.020 in
Locknut		34 N•m		25 ft-lb

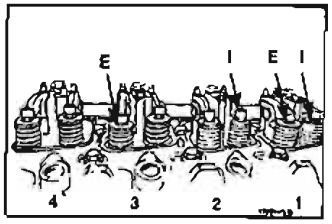




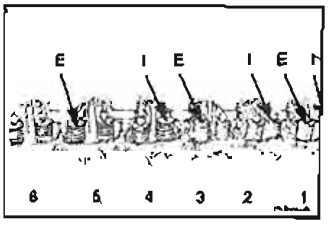
Valve Adjustment Procedure

Perform Step A of the valve set procedure with cylinder No. 1 at TDC compression stroke (timing pin will engage).

Step A Four Cylinder

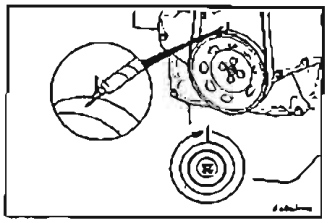


Step A Six Cylinder

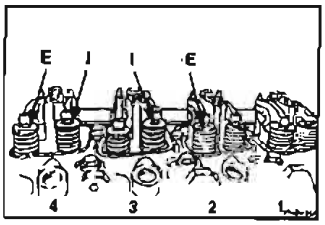


Perform Step B of the valve set procedure with cylinder No. 1 at TDC plus 360 degrees (timing pin will not engage).

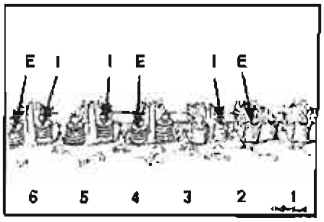
Mark the crankshaft and gear cover. Rotate the crankshaft one full turn in the direction of engine rotation.

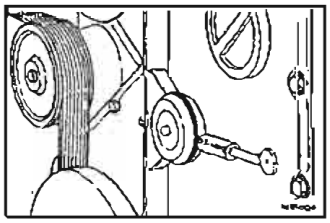
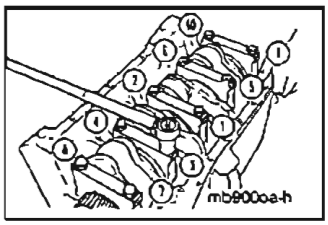
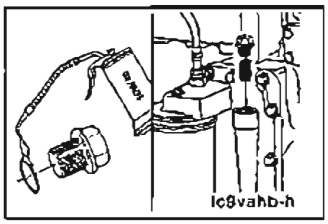
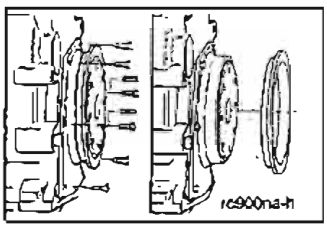
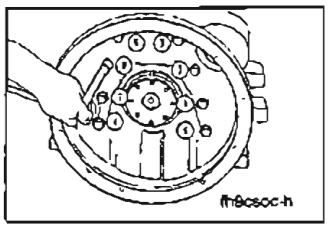
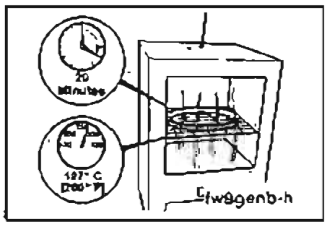
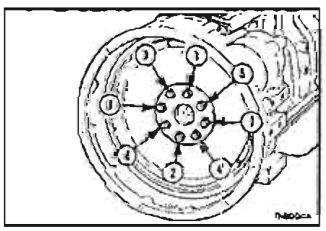


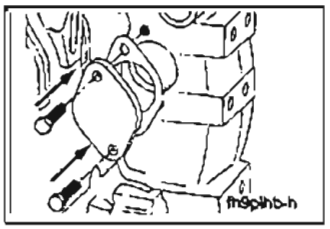
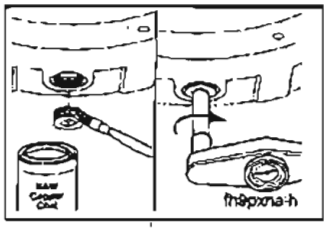
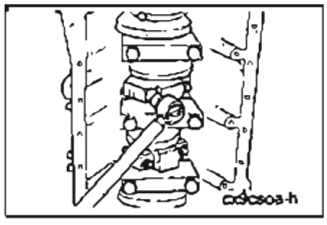
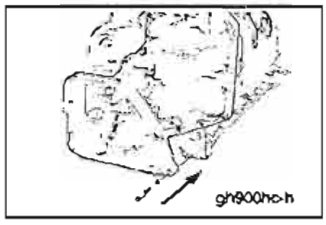
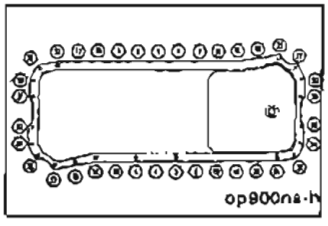
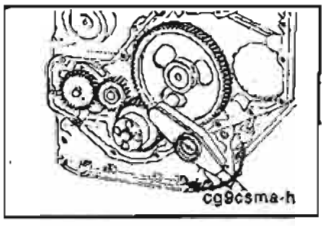
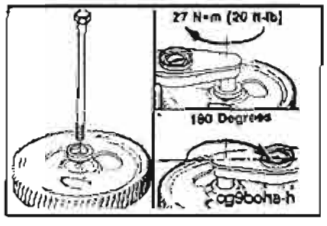
Step B Four Cylinder

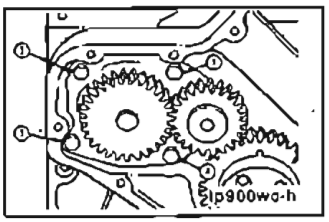
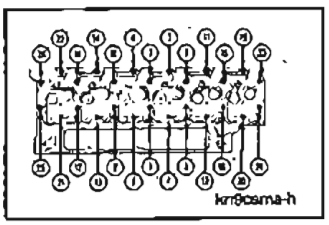
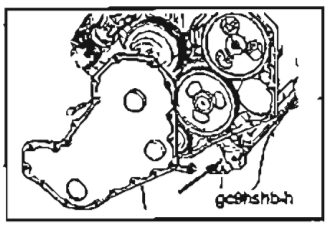
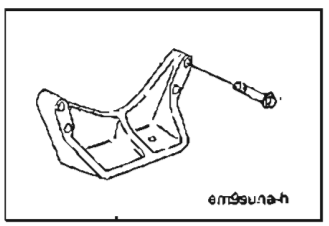
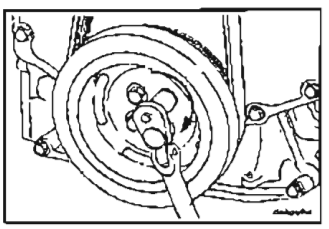
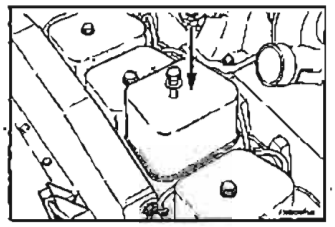
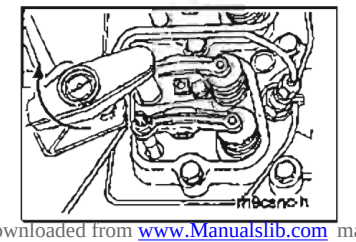


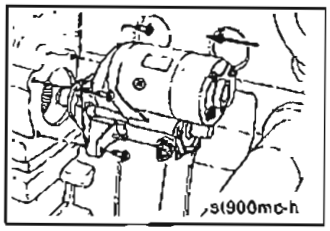
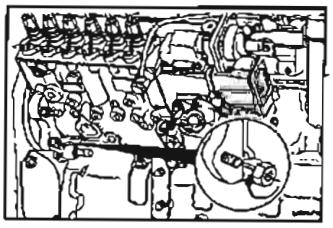
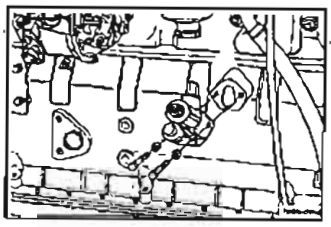
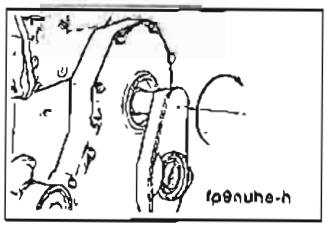
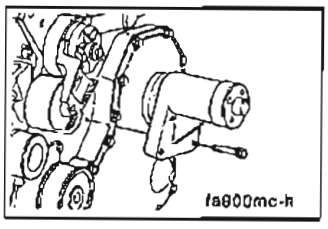
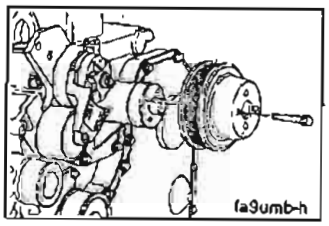
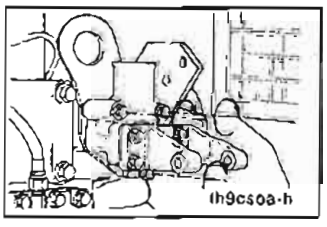
Step B Six Cylinder

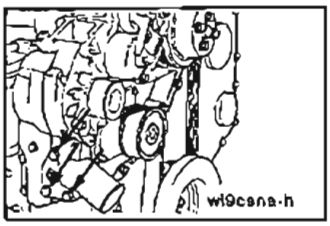
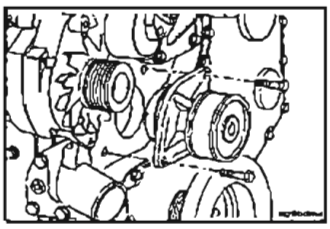
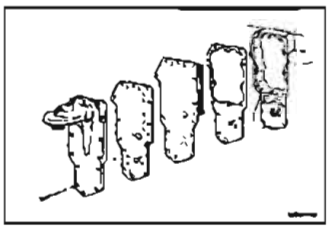
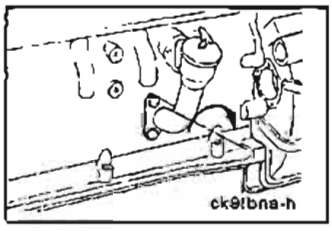
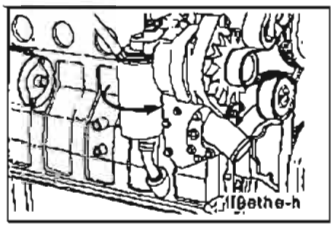
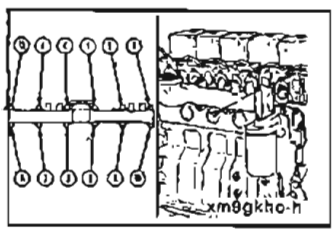
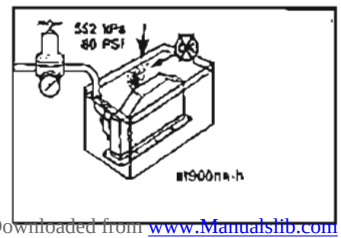


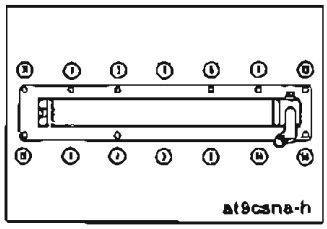
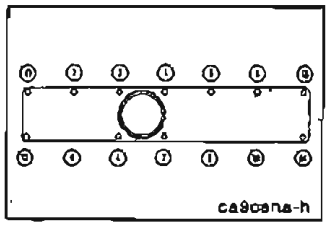
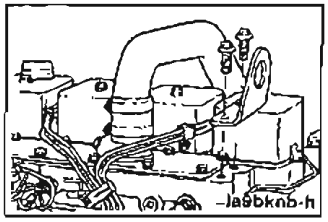
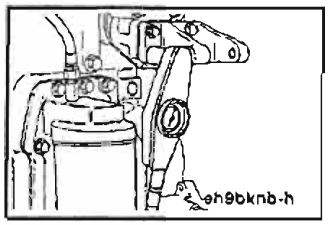
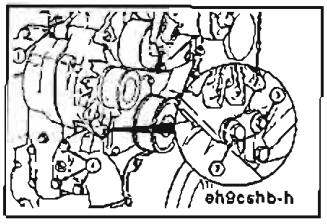
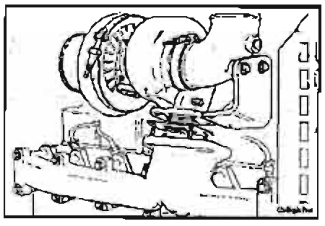
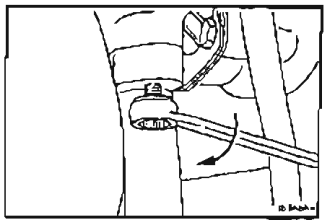
Component or Assembly (Procedure)	Ref.No./Steps	Metric		U.S.
Belt Tension - Fan Drive				
				
Belt Tension		267 N 578 N	MIN MAX	60 lbf 130 lbf
Engine Assembly - Capscrew Torque Values				
				
Main Bearing Capscrew Torque Value and Sequence	1 2 3	60 N•m 119 N•m 176 N•m		44 ft-lb 88 ft-lb 129 ft-lb
				
Oil Pressure Regulator Retainer Plug		80 N•m		60 ft-lb
				
Rear Seal Cover Mounting		9 N•m		84 in-lb
				
Flywheel Housing Capscrews Note: Tighten the capscrews in the sequence shown.		77 N•m		57 ft-lb
				
Ring Gear Replacement Heat the new ring gear for 20 minutes in an oven preheated to 127°C [260°F].				
				
Flywheel Mounting Capscrews Tighten in the sequence shown		137 N•m		101 ft-lb

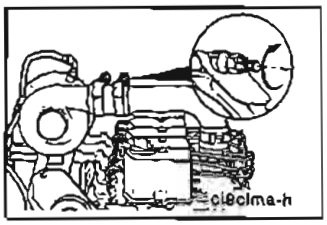
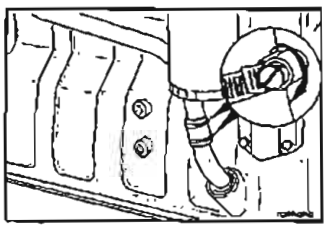
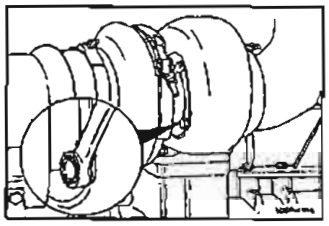
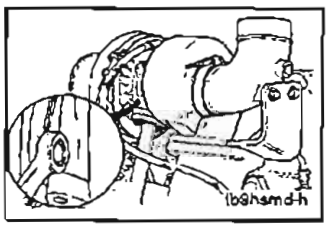
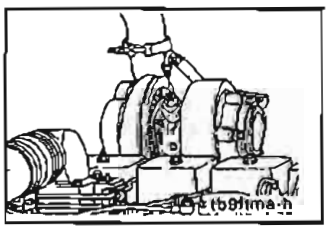
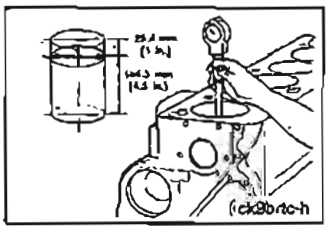
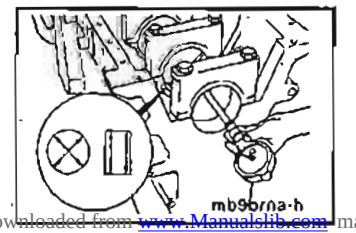
Component or Assembly (Procedure)	Ref.No./Steps	Metric	U.S.	
Flywheel Housing Access Cover		24 N•m	18 ft-lb	
Flywheel Housing Plug		36 N•m	27 ft-lb	
Connecting Rod Bolt	1 2 3	35 N•m 70 N•m 100 N•m	26 ft-lb 52 ft-lb 74 ft-lb	
Gear Housing Mounting Capscrews		24 N•m	18 ft-lb	
Lubricating Oil Pan Note: Tighten the capscrews in the sequence shown. Start at the center of the oil pan and alternate toward both ends.		24 N•m	18 ft-lb	
Camshaft Thrust Plate Capscrew		24 N•m	18 ft-lb	
Camshaft Bolt Step 1 Step 2		27 N•m Rotate 180 Degrees	20 ft-lb	

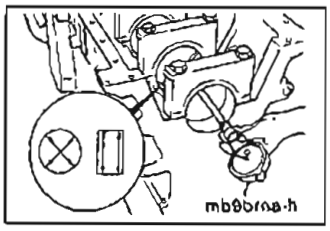
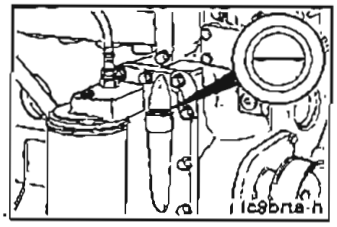
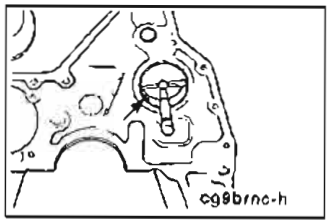
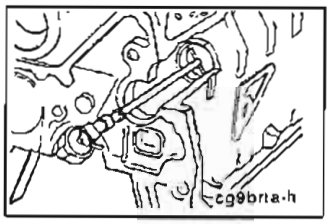
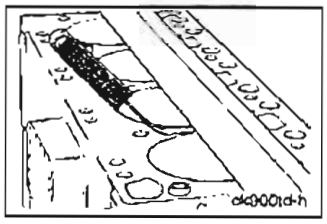
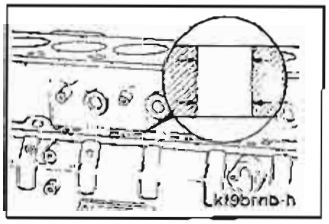
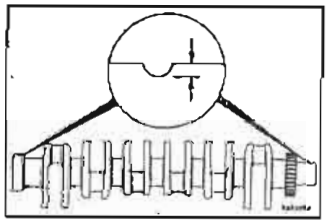
Component or Assembly (Procedure)	Ref.No./Steps	Metric	U.S.
 **Oil Pump Mounting Capscrews** Tighten in the sequence shown		24 N•m	18 ft-lb
 **Cylinder Head Mounting Capscrew (Tighten Capscrews in the Sequence Shown)**			
Step 1		90 N•m	66 ft-lb
Step 2 Recheck to		90 N•m	66 ft-lb
Step 3 (Long capscrews only)		120 N•m	90 ft-lb
Step 4 (Long capscrews only) Recheck to		120 N•m	90 ft-lb
Step 5 Rotate 90 degrees			
 **Gear Cover Capscrews**		24 N•m	18 ft-lb
 **Front Engine Support Mounting**		77 N•m	57 ft-lb
 **Crankshaft Pulley Capscrew**		125 N•m	92 ft-lb
 **Rocker Cover Capscrews**		24 N•m	18 ft-lb
 **Rocker Pedestal Capcrews (8 mm)**		24 N•m	18 ft-lb

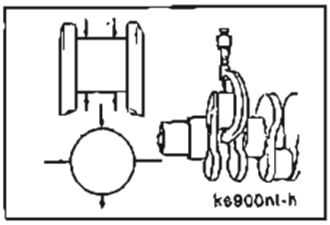
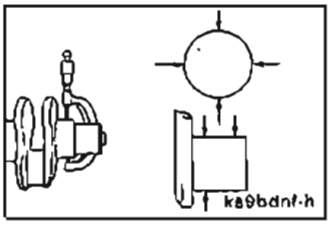
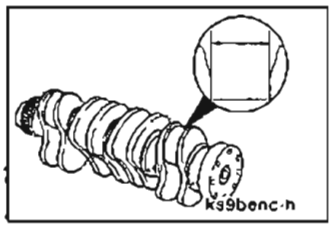
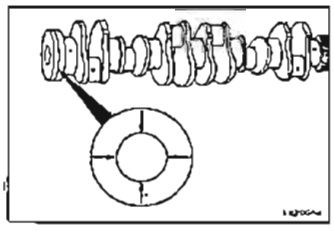
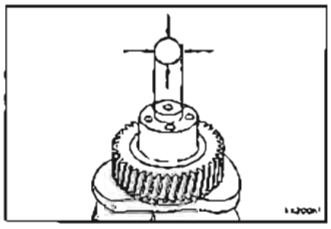
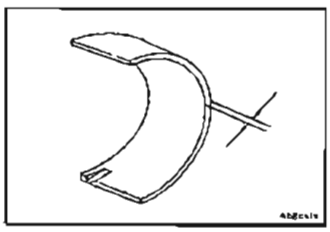
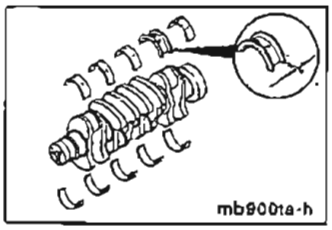
Component or Assembly (Procedure)	Ref.No./Steps	Metric	U.S.	
Starting Motor Mounting Capscrews		43 N•m	32 ft-lb	
Injection Pump Mounting Nuts				
Nippondenso		43 N•m	32 ft-lb	
Lucas CAV, Bosch (Rotary), Stanadyne DB4		30 N•m	22 ft-lb	
Bosch (In-Line)		43 N•m	32 ft-lb	
Fuel Transfer Pump Mounting Capscrews		24 N•m	18 ft-lb	
Injection Pump Drive Gear Nut				
Bosch (Rotary), Lucas CAV, Stanadyne DB4		65 N•m	48 ft-lb	
Nippondenso		123 N•m	92 ft-lb	
Bosch (P3000, P7100)		165 N•m	122 ft-lb	
Fan Hub Mounting Capscrews		24 N•m	18 ft-lb	
Fan Hub Pulley Mounting Capscrews	8 mm	24 N•m	18 ft-lb	
	10 mm	43 N•m	32 ft-lb	
Thermostat Housing Mounting Capscrews		24 N•m	18 ft-lb	

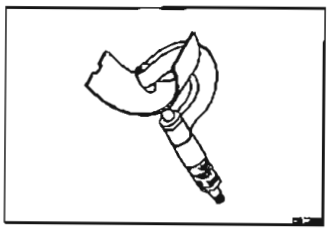
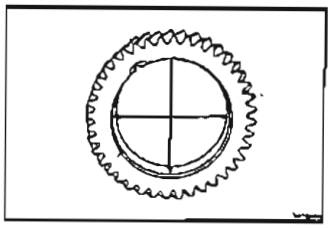
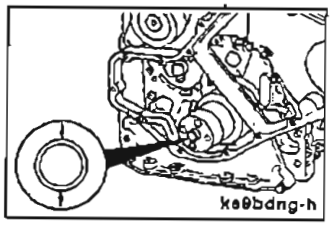
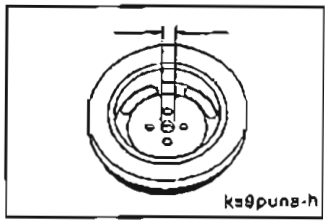
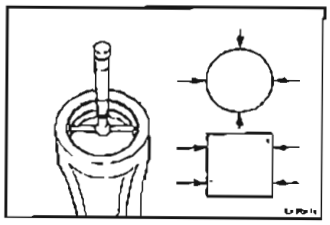
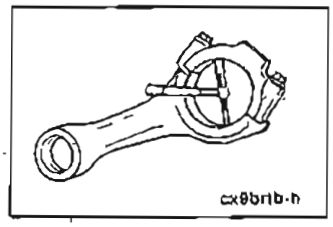
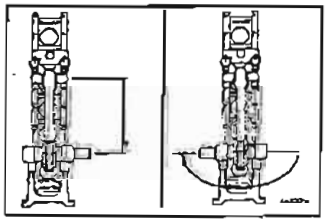
	Component or Assembly (Procedure)	Ref.No./Steps	Metric	U.S.
	**Coolant Inlet Connection**		43 N•m	32 ft-lb
	**Water Pump Mounting Capscrews**		24 N•m	18 ft-lb
	**Oil Cooler Mounting Capscrews**		24 N•m	18 ft-lb
	**Oil Fill Tube Capscrews**		43 N•m	32 ft-lb
	**Oil Filter**		3/4 Turn after contact	
	**Exhaust Manifold Capscrews** **Note:** Tighten the capscrews in the sequence shown.		43 N•m	32 ft-lb
	**Aftercooler Inspection** Inspect the housing and core for damage. Check the core for leaks: • Plug the bottom inlet tube • Pressurize the core to 483 kPa [70 psi] and submerge in a container of water. • Water temperature at 60°C [140°F].			

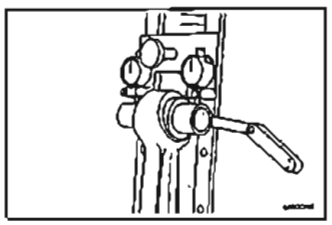
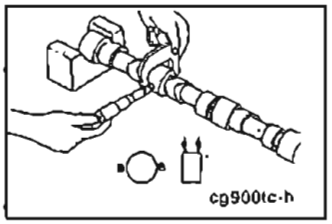
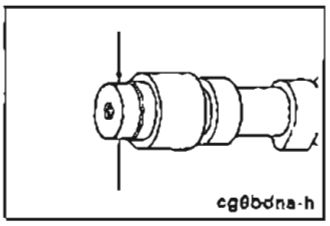
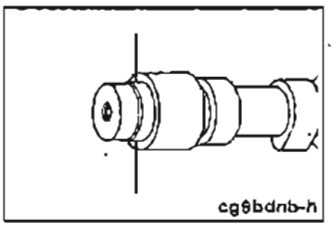
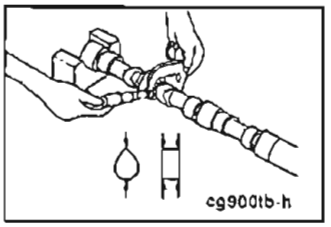
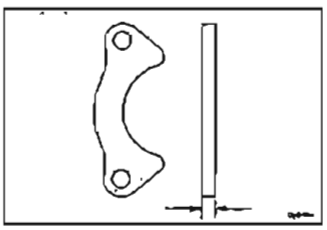
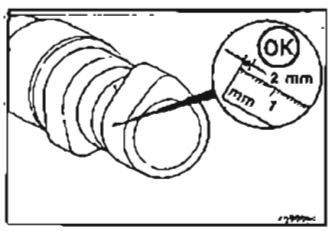
Component or Assembly (Procedure)	Ref.No./Steps	Metric	U.S.	
Aftercooler Capscrews **Note:** Tighten the capscrews in the sequence shown.		24 N•m	18 ft-lb	
Air Intake Manifold Capscrews **Note:** Tighten the capscrews in the sequence shown.		24 N•m	18 ft-lb	
Lifting Bracket (Rear)		77 N•m	57 ft-lb	
Alternator Mounting Bracket Capscrews		24 N•m	18 ft-lb	
Alternator Assembly Torque Sequence **Note:** Tighten the capscrews in the sequence shown.				
Turbocharger Mounting Nuts		43 N•m	32 ft-lb	
Turbocharger Oil Drain Tube Mounting Capscrew		24 N•m	18 ft-lb	

Component or Assembly (Procedure)	Ref.No./Steps	Metric		U.S.
 Turbocharger Air Crossover Hose Clamps		5 N•m		44 in-lb
 Turbocharger Oil Drain Line Hose Clamps		6 N•m		53 in-lb
 Turbocharger Turbine Housing Capscrews		20 N•m		15 ft-lb
 Turbocharger Compressor Housing • Diffuser Plate Capscrews • V Band Clamp (Silver Plated Nut)		8.5 N•m 8.5 N•m		75 in-lb 75 in-lb
 Turbocharger Oil Supply Line Connection		35 N•m		26 ft-lb
 **Cylinder Block - Rebuild Specifications**				
Cylinder Bore Diameter		102.000 mm 102.116 mm	MIN MAX	4.0157 in 4.0203 in
Out-of-Roundness		0.035 mm	MAX	0.0014 in
Taper		0.076 mm	MAX	0.003 in
 Main Bearing Diameter (Bearings Installed) With Capscrews Tightened to 176 N•m [130 ft-lb]		83.106 mm	MAX	3.27720 in

Component or Assembly (Procedure)	Ref.No./Steps	Metric		U.S.	
Main Bearing Bore I.D. (Without Bearings) With Capscrews Tightened to 176 N•m [130 ft-lb]		87.982 mm 88.018 mm	MIN MAX	3.4639 in 3.4653 in	
Main Oil Pressure Regulator Valve Bore I.D.		18.30 mm 18.35 mm	MIN MAX	0.7205 in 0.7224 in	
Camshaft Bore Diameter (Number 1 bore without bushing) (Number 1 bore with bushing installed)		57.222 mm 57.258 mm 54.107 mm 54.146 mm	MIN MAX MIN MAX	2.2528 in 2.2543 in 2.1302 in 2.1317 in	
Camshaft Bore Diameter All Journals Except No. 1		54.089 mm 54.164 mm	MIN MAX	2.1295 in 2.1324 in	
Cylinder Block Overall Flatness • End-to-end • Side-to-side		 0.076 mm 0.051 mm	 MAX MAX	 0.003 in 0.002 in	
Valve Tappet Bore Diameter		16.000 mm 16.055 mm	MIN MAX	0.630 in 0.632 in	
Crankshaft Front and Rear Oil Seal Wear Groove		0.25 mm	MAX	0.010 in	

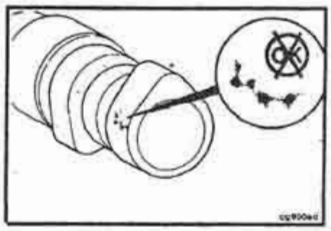
Component or Assembly (Procedure)	Ref.No./Steps	Metric		U.S.
 ke900nt-h	**Crankshaft Connecting Rod Journal O.D.**	68.962 mm 69.013 mm	MIN MAX	2.7150 in 2.7170 in
	Out of roundness	0.050 mm	MAX	0.002 in
	Taper	0.013 mm	MAX	0.005 in
	Bearing clearance	0.114 mm	MAX	0.0045 in
 ke9bdnf-h	**Crankshaft Main Bearing Journal Diameter**	82.962 mm 83.013 mm	MIN MAX	3.2662 in 3.2682 in
	Out of roundess	0.050 mm	MAX	0.002 in
	Taper	0.013 mm	MAX	0.005 in
	Bearing clearance	0.119 mm	MAX	0.0047 in
 ke9benc-h	**Crankshaft Thrust Face Width**	37.475 mm 37.602 mm	MIN MAX	1.4754 in 1.4804 in
	**Crankshaft Rear Oil Seal Flange O.D.**	129.975 mm 130.025 mm	MIN MAX	5.1171 in 5.1191 in
	**Crankshaft Damper Pilot O.D.**	18.924 mm 19.000 mm	MIN MAX	0.7450 in 0.7480 in
	**Main Bearing Shell Thickness (Standard)**	2.438 mm 2.464 mm	MIN MAX	0.0960 in 0.0970 in
 mb900ta-h	**Crankshaft Thrust Bearing Flange Thickness**	2.45 mm 2.55 mm	MIN MAX	0.096 in 0.100 in

Component or Assembly (Procedure)	Ref.No./Steps	Metric		U.S.	
Connecting Rod Bearing Thickness (Standard)		1.955 mm 1.968 mm	MIN MAX	0.0769 in 0.0775 in	
Crankshaft Gear Bore I.D.		63.910 mm 63.934 mm	MIN MAX	2.5161 in 2.5171 in	
Crankshaft Gear Journal O.D.		63.987 mm 64.006 mm	MIN MAX	2.5192 in 2.5199 in	
Crankshaft Pulley Crankshaft Pilot Bore I.D.		19.05 mm 19.15 mm	MIN MAX	0.7500 in 0.7539 in	
Connecting Rod Piston Pin Bore I.D. Bushing Removed		42.987 mm 43.013 mm	MIN MAX	1.6924 in 1.6934 in	
Bushing Installed (1991 Engines)		40.053 mm 40.076 mm	MIN MAX	1.5769 in 1.5778 in	
Bushing Installed (1994 Engines)		40.019 mm 40.042 mm	MIN MAX	1.5756 in 1.5765 in	
Connecting Rod Crankshaft Bore I.D. (Bearings Installed)		69.051 mm 69.103 mm	MIN MAX	2.7185 in 2.7205 in	
(Bearings Removed)		72.987 mm 73.013 mm	MIN MAX	2.8735 in 2.8745 in	
Connecting Rod Length		191.975 mm 192.025 mm	MIN MAX	7.5581 in 7.5600 in	
Connecting Rod Alignment: • (With Bushing)		0.15 mm	MAX	0.006 in	

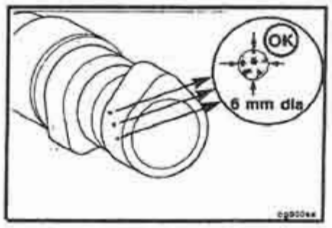
Component or Assembly (Procedure)	Ref.No./Steps	Metric		U.S.
 **Connectind Rod Twist:** • (With Bushing)		0.15 mm	MAX	0.006 in
 **Camshaft Bearing Journal Diameter**		53.962 mm 54.013 mm	MIN MAX	2.1245 in 2.1265 in
 **Camshaft Gear Mounting Surface O.D.**		41.575 mm 41.593 mm	MIN MAX	1.6368 in 1.6375 in
 **Camshaft Thrust Bearing Journal O.D.**		45.550 mm 45.750 mm	MIN MAX	1.7933 in 1.8012 in
 **Camshaft Diameter at Peak of the Lobe**	Intake Exhaust Fuel Transfer Pump	47.040 mm 47 492 mm 46.770 mm 47.222 mm 35.50 mm 36.26 mm	MIN MAX MIN MAX MIN MAX	1.852 in 1.870 in 1.841 in 1.859 in 1.398 in 1 428 in
 **Camshaft Thrust Plate Thickness**		9.4 mm 9.6 mm	MIN MAX	0.370 in 0.378 in
 **Camshaft Pitting Reuse Guidelines** A single pit should not be greater than the area of a 2mm [0.079 in] diameter circle.				

Component or Assembly (Procedure)	Ref.No./Steps	Metric	U.S.

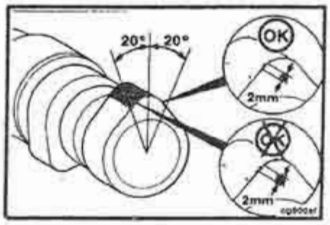
Interconnection of pits is not allowable and is treated as one pit.



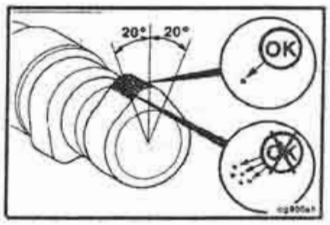
The total pits, when added together, should not exceed a circle of 6 mm [0.236 in].



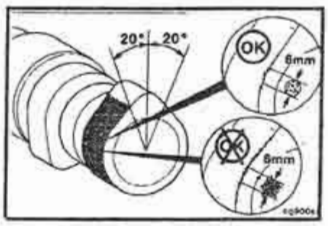
Only one pit is allowed within + or 20 degrees of the nose of the camshaft lobe.



Edge Deterioration (Breakdown):
The area of edge deterioration should not be greater than the equivalent area of a 2 mm [0.079 in] circle within + or 20 degrees of the nose of the camshaft lobe.



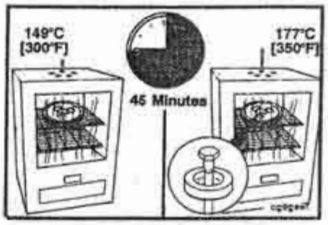
Outside of the + or 20 degrees of the nose of the camshaft lobe, the areas of edge deterioration should not be greater than the equivalent area of a 6 mm [0.236 in] circle.



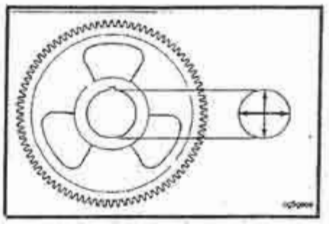
Caution: The camshaft gear will be permanently distorted if overheated. The oven temperature should never exceed 177°C [350°F].

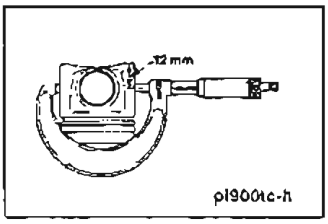
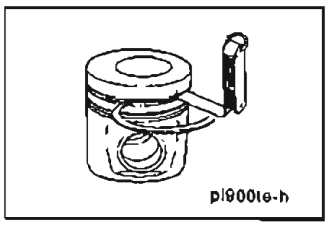
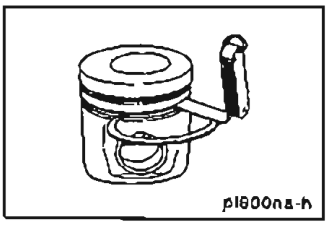
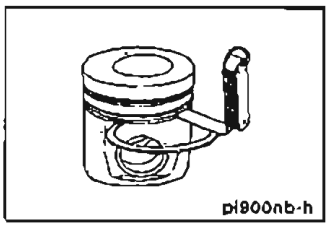
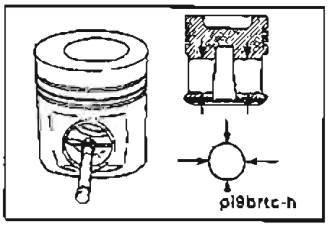
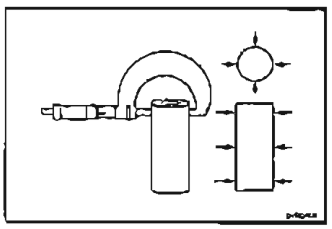
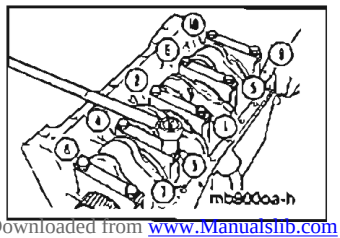
Heat the camshaft gear for **non-bolted** 1991 and non-automotive 1994 camshafts in an oven at 149°C [300°F] for 45 minutes.

Heat the camshaft gear for **bolted** 1991 camshafts (steel gear) and **all** 1994 automotive to 177°C [350°F].

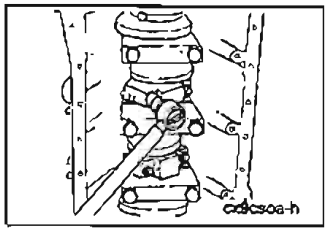


Camshaft Gear Bore I.D.	41.500 mm	MIN	1.6339 in
	41.525 mm	MAX	1.6348 in



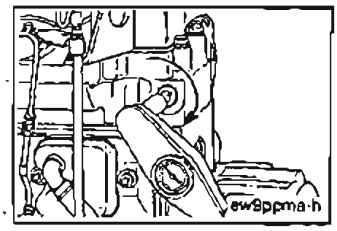
Component or Assembly (Procedure)	Ref.No./Steps	Metric		U.S.
 Piston Skirt O.D. (Worn Limit)		101.823 mm 101.887 mm	MIN MAX	4.0088 in 4.0113 in
 Top Ring Side Clearance • (Naturally Aspirated Only)		0.15 mm	MAX	0.006 in
 Intermediate Ring Side Clearance		0.15 mm	MAX	0.006 in
 Oil Control Ring Side Clearance		0.13 mm	MAX	0.005 in
 Piston Pin Bore I.D.		40.006 mm 40.025 mm	MIN MAX	1.5750 in 1.5758 in
 Piston Pin O.D.		39.990 mm 40.003 mm	MIN MAX	1.5744 in 1.5749 in
 **Cylinder Block - Torque Values**				
Main Bearing Capscrew	1 2 3	60 N•m 119 N•m 176 N•m		44 ft-lb 88 ft-lb 129 ft-lb

Component or Assembly (Procedure)	Ref.No./Steps	Metric	U.S.
Connecting Rod Capscrews	1	35 N•m	26 ft-lb
	2	70 N•m	52 ft-lb
	3	100 N•m	74 ft-lb

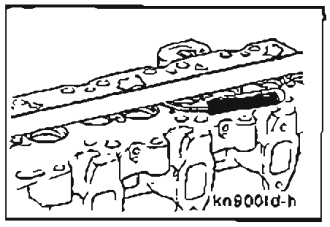


Cylinder Block Pipe Plugs

Refer to "Pipe Plug Torque Value Table" at the rear of this section for torque value of various plug sizes.



Cylinder Head - Rebuild Specifications

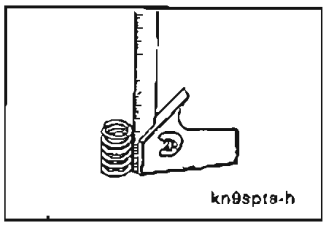


Cylinder Head Flatness

• End-to-End	4 Cylinder	0.203 mm	MAX	0.008 in
	6 Cylinder	0.305 mm	MAX	0.012 in
• Side-to-Side		0.076 mm	MAX	0.003 in

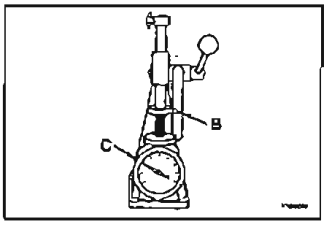
Valve Spring Free Height:

1991	55.63 mm	Nominal	2.190 in
Exhaust Brake	70.64 mm	Nominal	2.781 in
Marine/Rotator	56.00 mm	Nominal	2.208 in
1994	60.00 mm	Nominal	2.362 in

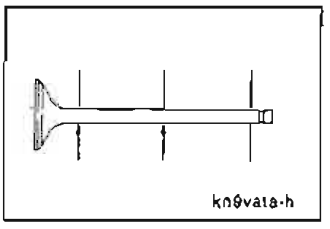


Valve Spring Working Height and Load

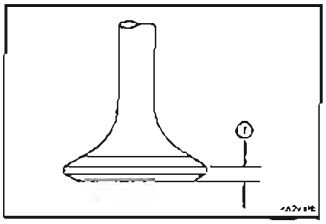
	Working Height (B)	Load For Working Height (C)		
HD Exhaust Brake	48.97 mm 1.927 in	643.2 N 691.2 N	MIN MAX	144.6 lbf 155.4 lbf
Marine With Rotator	47.24 mm 1.859 in	282.7 N 323.1 N	MIN MAX	63.5 lbf 72.6 lbf
1994	49.25 mm 1.94 in	359 N 397 N	MIN MAX	80.7 lbf 89.2 lbf
All Others	49.25 mm 1.94 in	285 N 321 N	MIN MAX	64.0 lbf 72.1 lbf

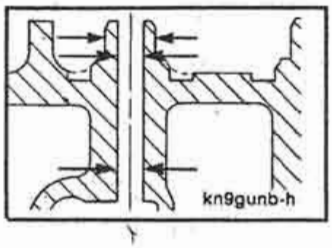
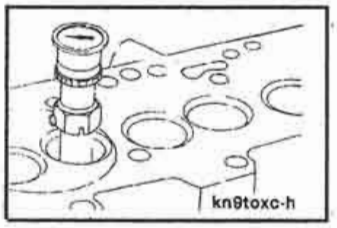
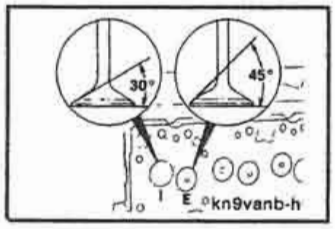
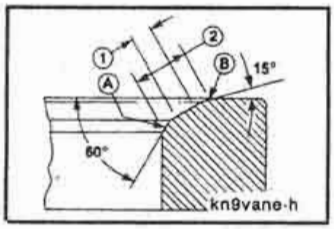
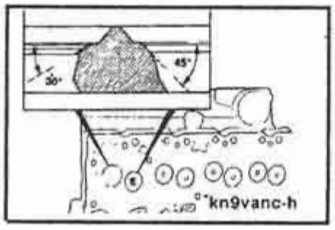
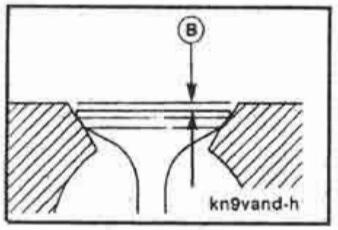
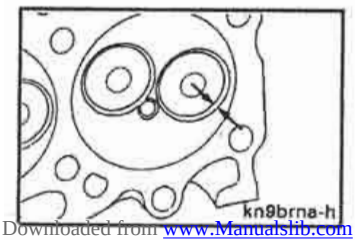


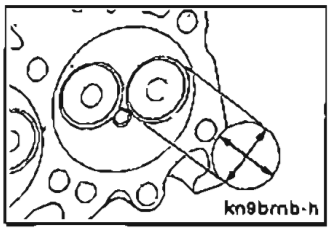
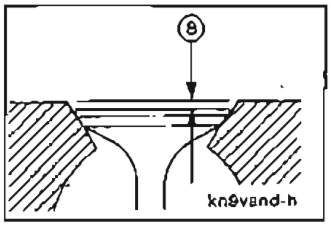
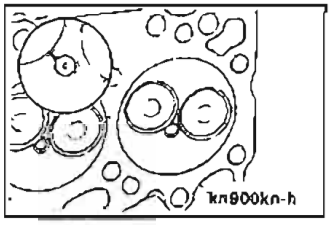
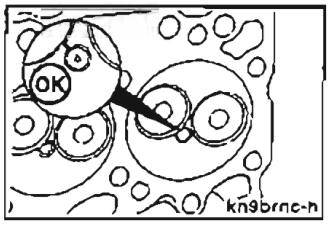
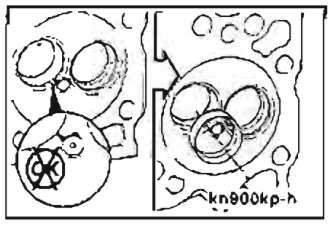
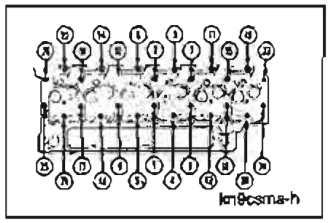
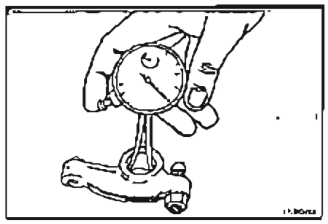
Valve Stem O.D. 7.98 mm MAX 0.3142 in

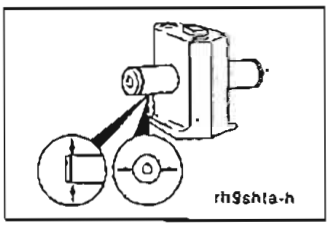
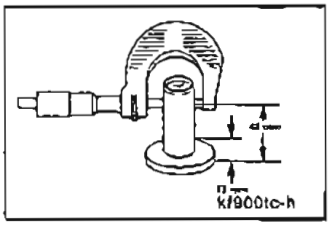
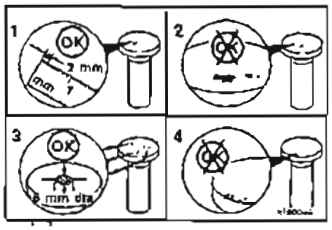
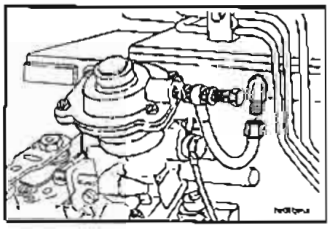
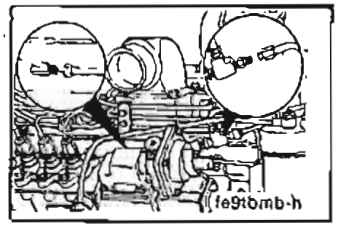
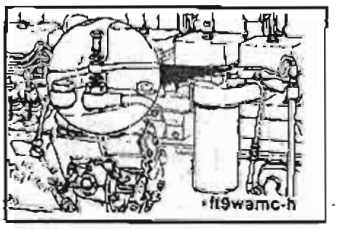
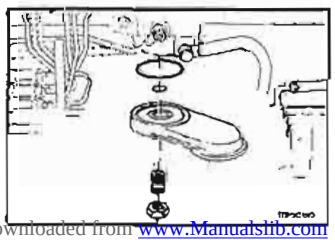


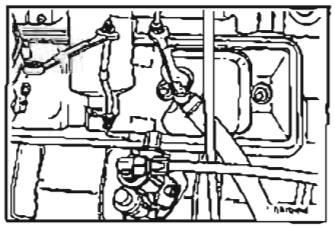
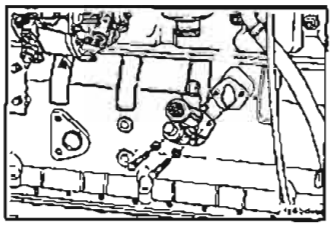
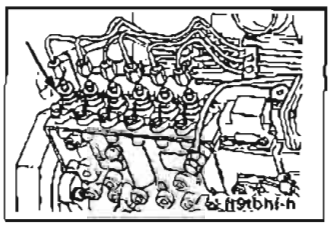
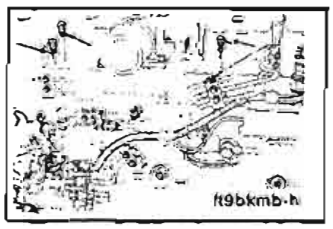
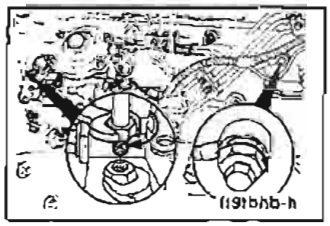
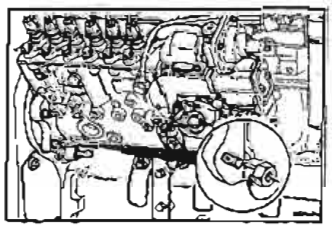
Valve Head Thickness at O.D. T 0.79 mm MIN 0.031 in

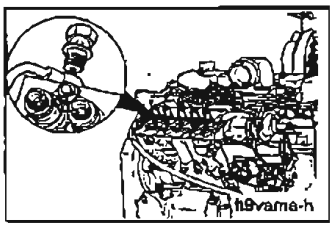
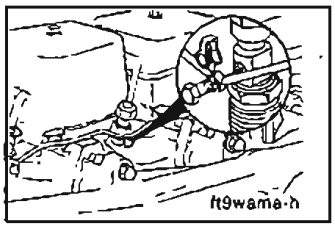
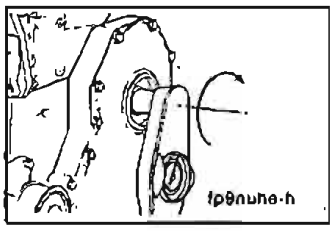
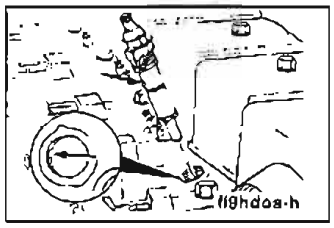
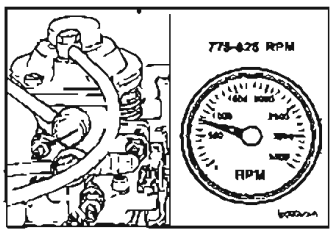
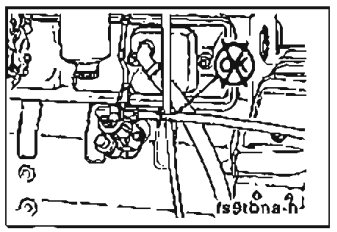
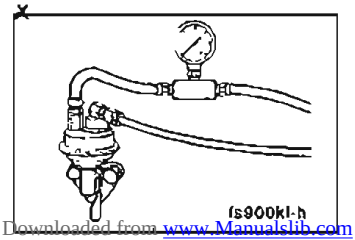


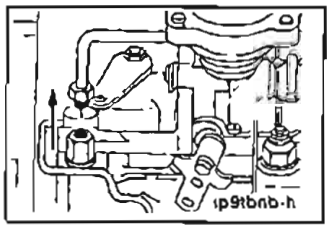
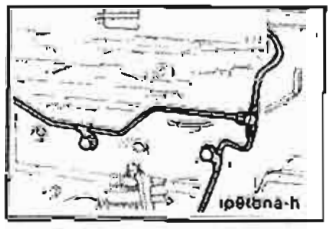
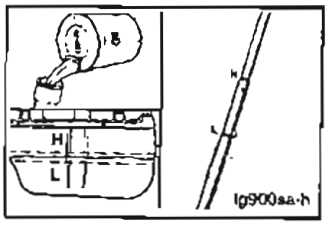
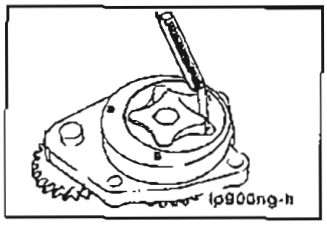
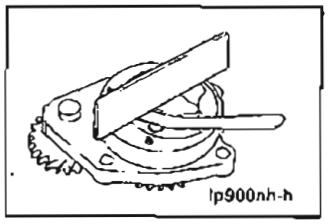
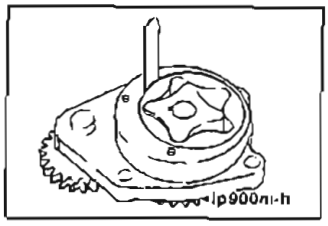
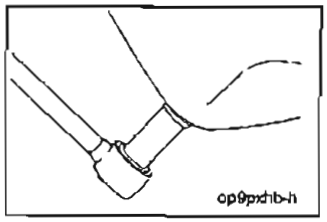
Component or Assembly (Procedure)	Ref.No./Steps	Metric		U.S.
 **Valve Guide Bore Diameter**		8.019 mm 8.090 mm	MIN MAX	0.3157 in 0.3185 in
 **Valve Seat-to-Valve Guide Runout** 360 Degrees		0.10 mm	MAX	0.004 in
 **Valve Face Grinding Angle** Intake: Exhaust:		30 degrees 45 degrees		
 **Valve Seat Width Limit** Grind area (A) with a 60 degree stone and (B) with a 15 degree stone to center the seat on the valve face and obtain the valve seat width limits.	1 2	1.5 mm 2.0 mm	MIN MAX	0.060 in 0.080 in
 **Valve Seat Grinding Angle** Intake: Exhaust:		30 degrees 45 degrees		
 **Valve Recess in Cylinder Head**	B	0.99 mm 1.52 mm	MIN MAX	0.039 in 0.060 in
 **Valve Insert Bore Depth (Standard Insert)**		10.30 mm 10.50 mm	MIN MAX	0.4055 in 0.4139 in

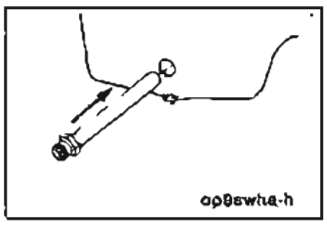
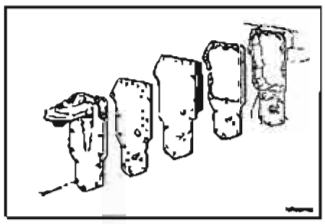
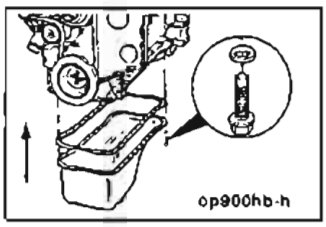
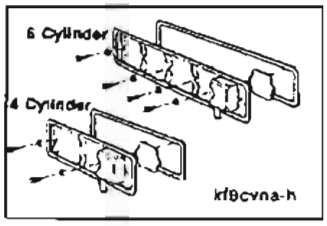
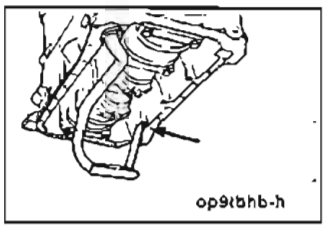
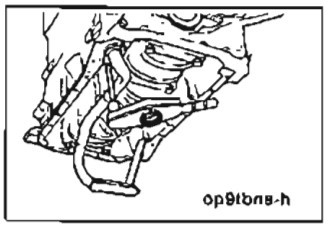
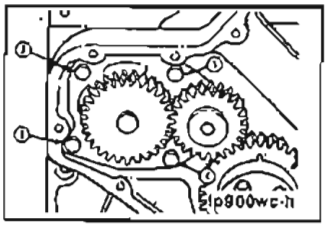
Component or Assembly (Procedure)	Ref.No./Steps	Metric		U.S.	
Valve Insert Bore I.D. (Standard Insert) **Note:** Refer to Cylinder Head Oversize Valve Seat Installation for oversize valve insert dimensions.		46.987 mm 47.013 mm	MIN MAX	1.8499 in 1.8509 in	 kn9bmb-h
Valve Seat Grinding Depth Seat grinding depth is the difference in dimension 'B' before and after grinding.	B	0.254 mm	MAX	0.010 in	 kn9vand-h
Cylinder Head Cracks Reuse Guidelines These guidelines apply only to cracks extending from the injector bore to the intake valve seats. Replace cylinder heads which exhibit valve bridge cracks in any other location.					 kn900kn-h
The reuse guidelines for a cylinder head with a crack extending from the injector bore to the intake valve seat are as follows: If the crack does not extend into the valve seat, the head is reusable.					 kn9brnc-h
If the crack extends into or through the valve seat, the head must be repaired by installing a valve seat insert as described in the Alternative Repair Manual, Bulletin No. 3810234.					 kn900kp-h
Cylinder Head - Torque Values **Cylinder Head Mounting Capscrew (Tighten in the Sequence Shown)** Step 1 All Step 2 Recheck to Step 3 (Long Capscrews Only) Step 4 (Long Capscrews Only) - Recheck to Step 5 Rotate 90 degrees All		 90 N•m 90 N•m 120 N•m 120 N•m		 66 ft-lb 66 ft-lb 90 ft-lb 90 ft-lb	 kn9csma-h
Rocker Levers and Pedestals **Rocker Lever Bore Diameter**		19.000 19.051	MIN MAX	0.7480 in 0.7500 in	

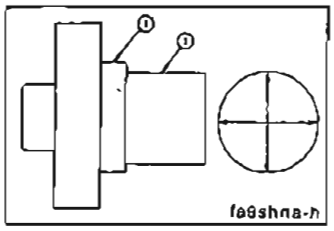
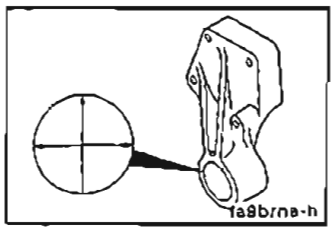
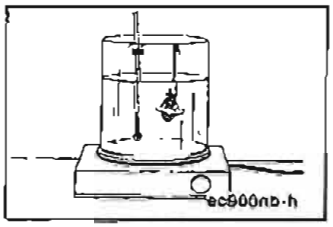
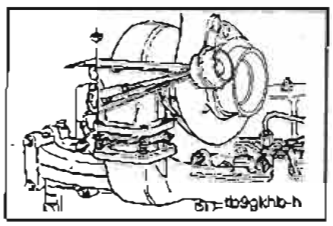
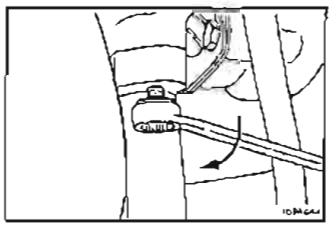
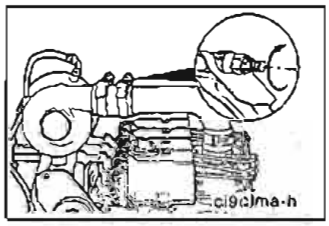
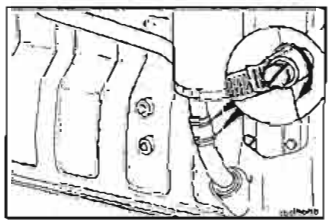
Component or Assembly (Procedure)	Ref.No./Steps	Metric		U.S.
 **Pedestal Shaft Diameter**		18.938 mm 18.975 mm	MIN MAX	0.7456 in 0.7470 in
 **Tappet and Push Rods**				
Valve Tappet Stem Diameter		15.936 mm 15.977 mm	MIN MAX	0.627 in 0.629 in
 Pit marks on the tappet face are acceptable. The following criteria defines the size of the pits allowed: 1 A single pit cannot be greater than 2mm [0.078 in] diameter. 2. Interconnection of pits is not allowed. 3. Total pits when added together should not exceed 6 mm [0.236 inch] diameter or a total of 4 percent of the tappet face.				
 **Fuel System**				
Air Fuel Control (AFC) Banjo Fitting (Rotary Pump)		12 N•m		106 in-lb
 **Air Fuel Control (AFC) Banjo Fitting (In-Line Pump)**				
Pipe Adapter (in cylinder head)		24 n•m		18 ft-lb
Tube Fittings		9 N•m		7 ft-lb
 **Fuel Filter Banjo Fittings**				
Supply Line Fittings		24 N•m		18 ft-lb
Return Line Fitting		13 N•m		10 ft-lb
Vent Screw		9 N•m		7 ft-lb
 **Fuel Filter Head Adapter**		32 N•m		24 ft-lb

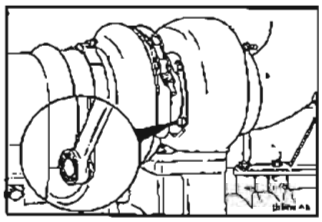
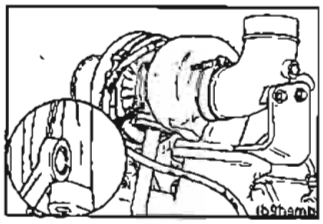
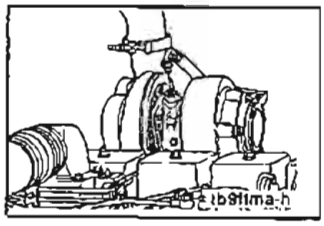
Component or Assembly (Procedure)	Ref.No./Steps	Metric	U.S.	
Fuel Pump Solenoid (Bosch VE) (CAV)		43 N•m 15 N•m	32 ft-lb 11 ft-lb	
Fuel Supply Line (Fuel Transfer Pump Outlet)		24 N•m	18 ft-lb	
Fuel Transfer Pump Mounting Capscrews		24 N•m	18 ft-lb	
High Pressure Fuel Line Fittings		24 N•m	18 ft-lb	
High Pressure Fuel Line Support Clamp Bracket		 6 N•m 24 N•m	 53 in-lb 18 ft-lb	
Injection Pump Supply Line Inlet		32 N•m	24 ft-lb	
Injection Pump Mounting Nuts Nippondenso Lucas, CAV, Bosch (Rotary), Stanadyne DB4 Bosch (In-Line)		 43 N•m 30 N•m 43 N•m	 32 ft-lb 22 ft-lb 32 ft-lb	

Component or Assembly (Procedure)	Ref.No./Steps	Metric		U.S.
	**Injection Pump Fuel Return Banjo Fitting**	32 N•m		24 ft-lb
	**Injector Drain Manifold**			
	Injector Banjo	9 N•m		80 in-lb
	Filter Head Banjo	13 N•m		10 ft-lb
	Bracket	24 N•m		18 ft-lb
	**Injection Pump Drive Gear Nut**			
	Bosch (Rotary), Lucas CAV, Stanadyne DB4	65 N•m		48 ft-lb
	Nippondenso	123 N•m		92 ft-lb
	Bosch (P3000, P7100)	165 N•m		122 ft-lb
	**Injector**	60 N•m		44 ft-lb
	**Engine Low Idle Speed (Typical)**	700 RPM	MIN	
	(Refer to Engine Data Tag)	800 RPM	MAX	
	**Fuel Transfer Pump Inlet Restriction**	100 mm Hg	MAX	4 in Hg
	**Fuel Transfer Pump Outlet Pressure at Rated Speed**			
	In-Line Injection Pump (Minimum)	172 kPa		25 psi
	Rotary Injection Pump (Maximum)	70 kPa		10 psi

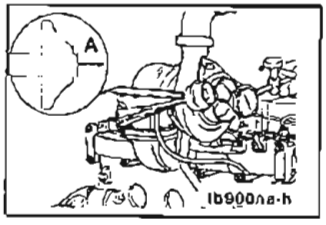
Component or Assembly (Procedure)	Ref.No./Steps	Metric		U.S.	
Fuel Injection Pump Inlet Pressure at Rated Speed					
Rotary		0 to 70 kPa		0 to 10 psi	
In-Line (minimum)		172 kPa		25 psi	
Fuel Injection Pump Return Line Restriction		518 mm Hg	MAX	20.4 in Hg	
Lubricating Oil System - Specifications					
Oil Pan Capacity	4 Cylinder	8.6 liters	Low	9 qts.	
		9.5 liters	High	10 qts.	
	6 Cylinder	12.4 liters	Low	13 qts.	
		14.2 liters	High	15 qts.	
	6 Cylinder Optional	9.5 liters	Low	10 qts.	
		10.4 liters	High	11 qts.	
Oil Pump Tip Clearance		0.1778 mm	MAX	0.007 in	
Oil Pump Port Plate Clearance		0.127 mm	MAX	0.005 in	
Oil Pump Body Bore Clearance		0.381 mm	MAX	0.015 in	
Oil Pan Drain Plug		80 N•m		60 ft-lb	

	Component or Assembly (Procedure)	Ref.No./Steps	Metric	U.S.
	Oil Pan Heater Plug		80 N•m	60 ft-lb
	Oil Cooler Mounting Capscrews		24 N•m	18 ft-lb
	Oil Pan Mounting Capscrews		24 N•m	18 ft-lb
	Tappet Cover Mounting Capscrews		24 N•m	18 ft-lb
	Oil Pump Suction Tube Brace Capscrews		24 N•m	18 ft-lb
	Oil Pump Suction Tube Mounting Capscrews		24 N•m	18 ft-lb
	Oil Pump Mounting Capscrews		24 N•m	18 ft-lb

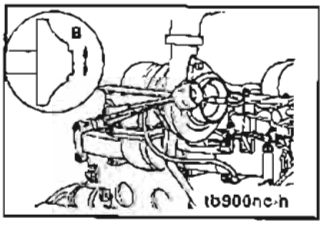
Component or Assembly (Procedure)	Ref.No./Steps	Metric		U.S.	
Fan Hub - Specifications					
Fan Hub Shaft O.D.	1	41.75 mm	MIN	1.644 in	
		42.25 mm	MAX	1.663 in	
	2	35.004 mm	MIN	1.3781 in	
		35.024 mm	MAX	1.3789 in	
Hub Bearing Bore I.D.		63.938 mm	MIN	2.5172 in	
		63.956 mm	MAX	2.5179 in	
Thermostat, Coolant Operating Temperature					
• Initial Opening Temperature		80°C	MIN	176°F	
		83°C	MAX	182°F	
• Fully Open Temprature		95°C	MAX	203°F	
• Maximum Opening Distance		6.6 mm	MAX	0.260 in	
Combustion Air System					
Turbocharger Mounting Nuts		43 N•m		32 ft-lb	
Turbocharger Oil Drain Tube Mounting Capscrew		24 N•m		18 ft-lb	
Turbocharger Air Crossover Hose Clamps		5 N•m		44 in-lb	
Turbocharger Oil Drain Line Hose Clamps		6 N•m		53 in-lb	

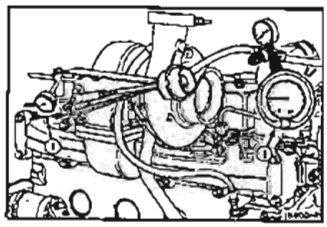
Component or Assembly (Procedure)	Ref.No./Steps	Metric	U.S.
 Turbocharger Turbine Housing Capscrews		20 N•m	15 ft-lb
 Turbocharger Compressor Housing Capscrews			
• Diffuser Plate Capscrews		8.5 N•m	75 in-lb
• V Band Clamp (Silver Plated Nut)		8.5 N•m	75 in-lb
 Turbocharger Oil Supply Line Connection		35 N•m	26 ft-lb

Air Intake System

 Turbocharger Axial Clearance		*0.10 mm	MIN	0.004 in
		0.16 mm	MAX	0.006 in
		**0.03 mm	MIN	0.001 in
		0.08 mm	MAX	0.003 in

* For turbochargers with a serial number before 840638.
** For turbochargers with a serial number after and including 840638.

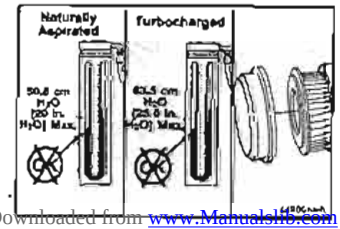
 Turbocharger Radial Clearance		0.30 mm	MIN	0.012 in
		0.46 mm	MAX	0.018 in



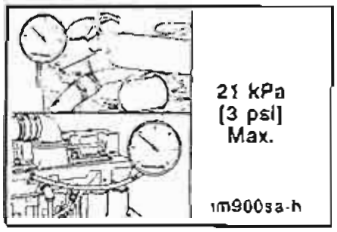
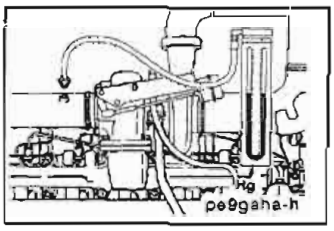
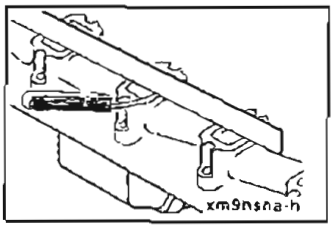
Wastegate Rod Travel at the Following Wastegate Applied Pressure

		0.33 mm	Min	0.013 in
		1.3 mm	Max	0.050 in

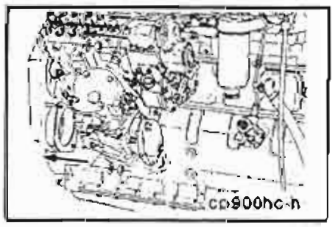
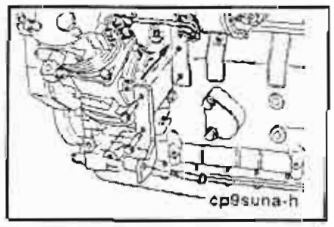
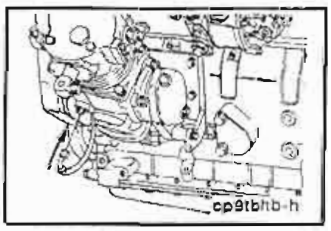
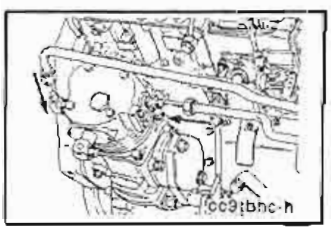
Engine Year	HP Rating	Application	Wastegate Applied Pressure
1991	110	Automotive (4B)	133 kPa [19.3 psi]
1991	190-230	Automotive	153 kPa [22.2 psi]
1994	160-175	Automotive	133 kPa [19.3 psi]
1994	190-230	Automotive	198 kPa [28.7 psi]
1994	All	Industrial	191 kPa [27.7 psi]

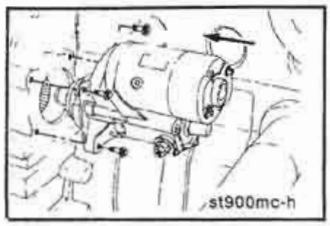
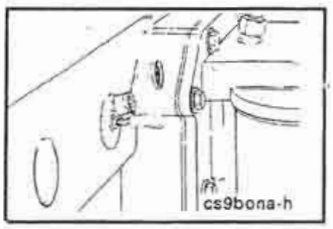
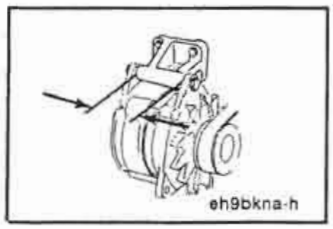
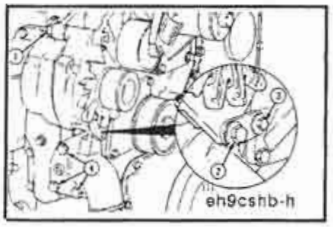
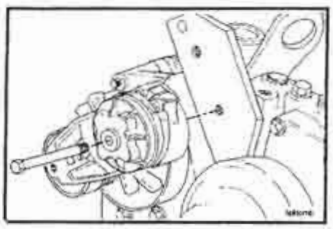
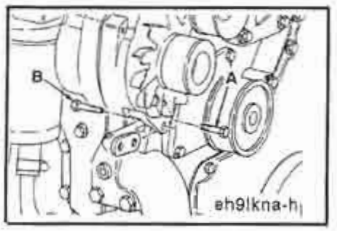
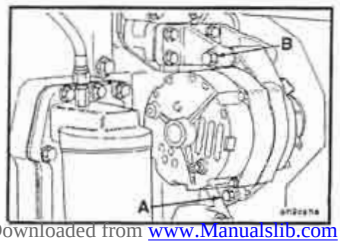


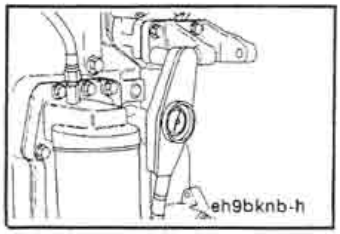
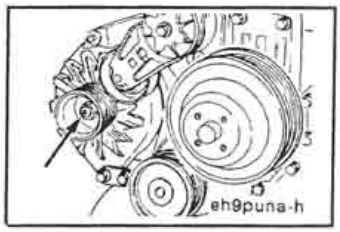
Intake Air Restriction (Rated Speed and Load)			
• Naturally Aspirated Engine	508 mm H_2O	MAX	20 in H_2O
• Turbocharged Engine	635 mm H_2O	MAX	25 in H_2O

Component or Assembly (Procedure)	Ref.No./Steps	Metric		U.S.	
Charge Air Cooler Differential Pressure Across Cooler		21 kPa	Max	3 psi	
Exhaust Air Restriction (Rated Speed and Load) (Naturally aspirated engines are checked at rated speed and no load). Automotive With Catalyst Automotive Without Catalyst		76.2 mm Hg 114.3 mm Hg 152.4 mm Hg	MAX MAX MAX	3 in Hg 4.5 in Hg 6.0 in Hg	
Exhaust Manifold Flatness		0.10 mm	MAX	0.004 in	

Compressed Air System Torque Values

Air Compressor Mounting Nuts		77 N•m		57 ft-lb	
Air Compressor Support Capscrews		24 N•m		18 ft-lb	
Air Compressor Oil Suppy Line		15 N•m		12 ft-lb	
Air Compressor Coolant Lines		24 N•m		18 ft-lb	

Component or Assembly (Procedure)	Ref.No./Steps	Metric	U.S.
Electrical System			
 st900mc-h **Starting Motor Mounting Capscrews**		43 N•m	32 ft-lb
 cs9bona-h **Coolant Heater**		12 N•m	108 in-lb
 eh9bkna-h **Alternator Mounting Bracket Dimension**			
Delco 10/15SI		55.72 mm	2 3/16 in
Motorola 100 Amp		81 mm	3 3/16 in
Delco 20/27SI		98 mm	3 7/8 in
Lucas		78 mm	3 in
 eh9cshb-h **Alternator Assembly Torque Sequence**	1. Alternator-to-alternator bracket capscrew. 2. Lower brace-to-alternator capscrew. 3. Alternator-to-water inlet capscrew. 4. Water inlet-to-block capscrews.		
 **Belt Tensioner Capscrew**		43 N•m	32 ft-lb
 eh9lkna-h **Alternator Link**			
8 mm Capscrew	A	24 N•m	18 ft-lb
10 mm Capscrew	B	43 N•m	32 ft-lb
 **Alternator Mounting Bolt**	B		
Delco 10 to 15SI, Lucas, Motorola and Bosch		43 N•m	32 ft-lb
Delco 20SI, 27SI, 29SI		80 N•m	59 ft-lb

Component or Assembly (Procedure)	Ref.No./Steps	Metric	U.S.	
Alternator Bracket Mounting Capscrews 8 mm		24 N•m	18 ft-lb	
Alternator Pulley Nut		80 N•m	59 ft-lb	

Batteries State of Charge

Specific Gravity at 27°C [80°F]	State of Charge
1.260 to 1.280	100%
1.230 to 1.250	75%
1.200 to 1.220	50%
1.170 to 1 190	25%
1 110 to 1 130	Discharged

Battery State of Charge	Specific Gravity @ 27°C [80°F]
100%	1.260-1.280
75%	1.230-1.250
50%	1.200-1.220
25%	1.170-1.190
Discharged	1.110-1.130

Engine Testing - Test Specifications

Note: The specifications and instructions for testing the engine are provided in the Shop Manual, Bulletin No. 3810206. Refer to Engine Testing Group 14, Page 14-1