

1999 Toyota RAV4
1999-2000 ENGINES 2.0L 4-Cylinder

1999-2000 ENGINES

2.0L 4-Cylinder

ENGINE IDENTIFICATION

NOTE: For repair procedures not covered in this article, see **ENGINE OVERHAUL PROCEDURES** article in **GENERAL INFORMATION**.

Engine serial number is stamped on rear of cylinder block. See **Fig. 1** .

ENGINE IDENTIFICATION CODE

Engine	Code
2.0L 4-Cylinder	3S-FE

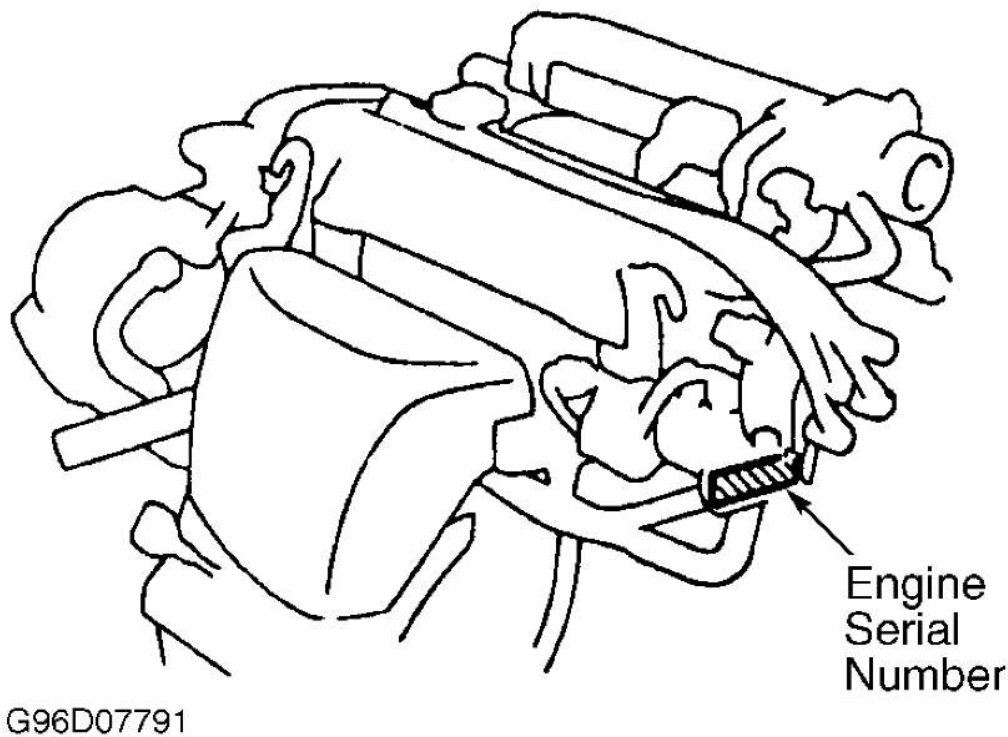


Fig. 1: Identifying Engine Serial Number
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ADJUSTMENTS

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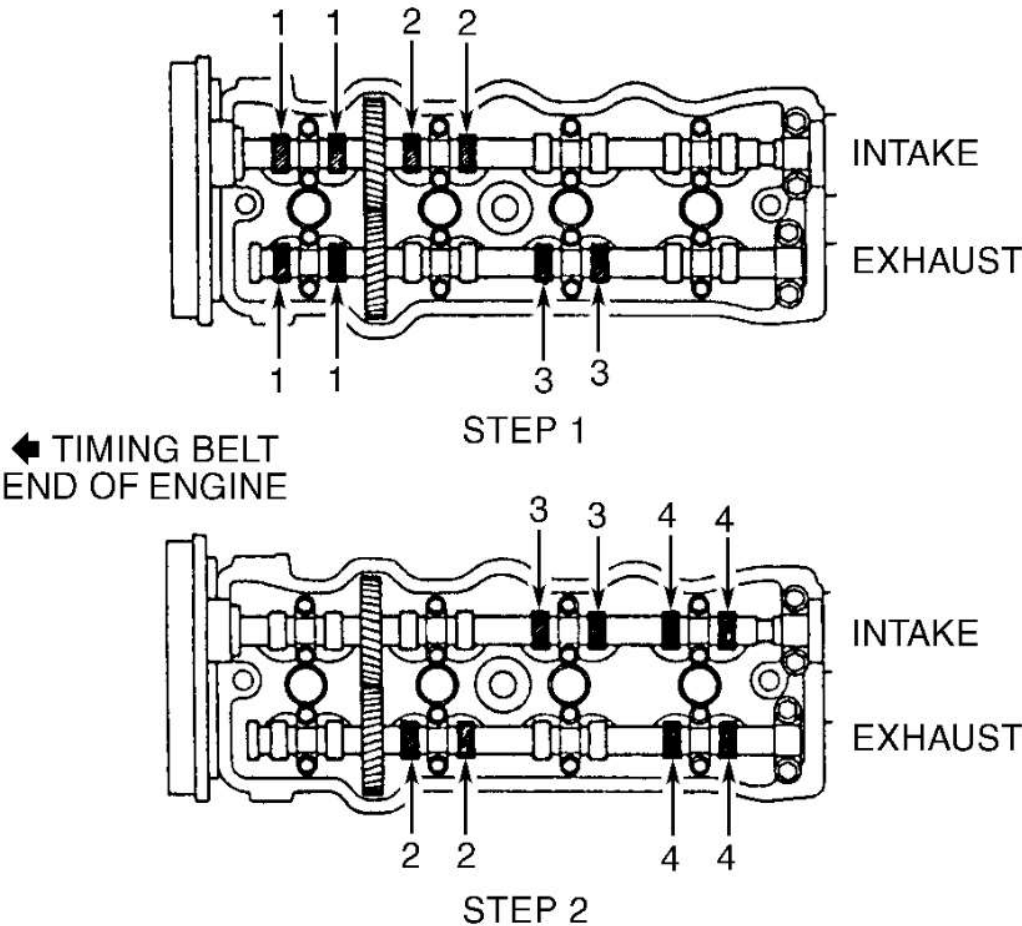
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VALVE CLEARANCE ADJUSTMENT**NOTE: Adjust valve clearance with engine cold.**

1. Disconnect power steering fluid reservoir, PCV hoses, cable brackets and control cables for access to valve cover. Disconnect spark plug wires from spark plugs.
2. Disconnect engine wiring harness protector at rear of timing belt cover for access to valve cover. When disconnecting engine wiring harness protector, remove bolt on intake manifold side of engine first, and then bolt on exhaust manifold side of engine.
3. Remove nuts, grommets, valve cover and gasket. Note location of grommets for reassembly reference, as grommets must be installed in original location.
4. Rotate crankshaft clockwise, as viewed from timing belt end of engine, so cylinder No. 1 is at TDC on compression stroke, and timing mark on crankshaft pulley aligns with "0" mark on timing belt cover. Cylinder No. 1 is front cylinder at timing belt end of engine.
5. Ensure valve lifters are loose on cylinder No. 1 and tight on cylinder No. 4. If conditions are not as described, rotate crankshaft clockwise one complete revolution (360 degrees).
6. With cylinder No. 1 at TDC on compression stroke, check valve clearance on specified valves. Perform STEP 1 in illustration. See **Fig. 2** . Using feeler gauge, measure and record valve clearance between valve lifter and camshaft.

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Fig. 2: Checking Valve Clearance
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- 7. To check remaining valves, rotate crankshaft clockwise, viewed from timing belt end of engine, one complete revolution (360 degrees) until cylinder No. 4 cylinder is at TDC on compression stroke. Measure and record valve clearance on specified valves. Perform STEP 2 in illustration. See **Fig. 2**.
- 8. Ensure valve clearance is within specification. See **VALVE CLEARANCE SPECIFICATIONS** table.

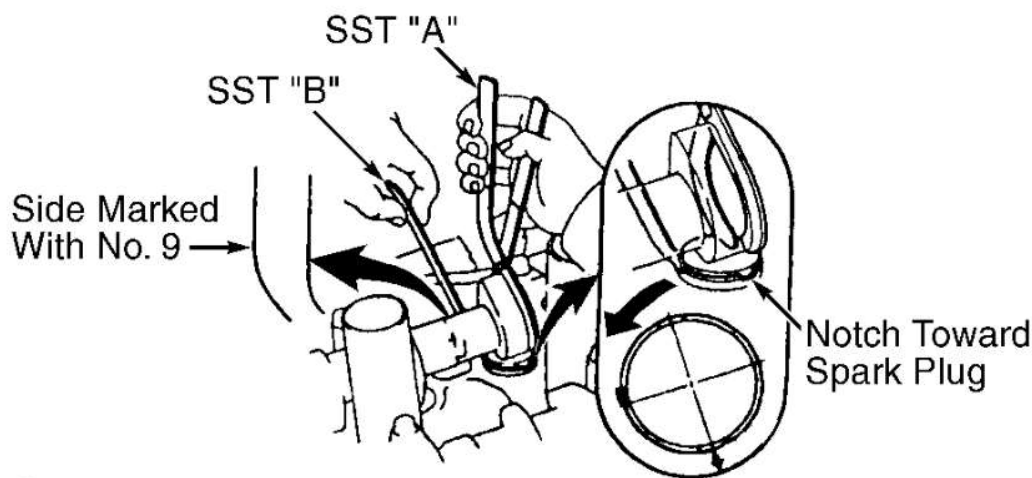
VALVE CLEARANCE SPECIFICATIONS ⁽¹⁾

Application	In. (mm)
Intake Valve	.007-.011 (.19-.29)
Exhaust Valve	.011-.015 (.29-.38)
(1) Adjust valve clearance with engine cold.	

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9. If valve clearance requires adjustment, rotate camshaft so lobe on valve to be adjusted is facing upward, away from valve lifter. Rotate valve lifter so notch on valve lifter is toward spark plug.
10. Use Valve Clearance Adjuster (SST 09248-55040) to remove adjusting shim. Using SST "A" of valve clearance adjuster, push downward on valve lifter. Place SST "B" between camshaft and valve lifter with side marked with No. 9 at designated position. See **Fig. 3** . Remove SST "A".



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Fig. 3: Adjusting Valve Clearance

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

11. Using small screwdriver and magnet, remove adjusting shim. Measure and record thickness of adjusting shim removed. Using measured valve clearance and adjusting shim thickness, select proper replacement adjusting shim. See **Fig. 4** and **Fig. 5** .

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EXAMPLE: A 0.1102" (2.800 mm) shim is installed and measured clearance is 0.0177" (0.450 mm). Replace 0.1102" (2.800 mm) shim with a No. 11 shim.

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Fig. 4: Intake Valve Adjusting Shim Selection Chart
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Installed shim thickness mm (in.)	Measured clearance mm (in.)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080	1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200	1201	1202	1203	1204	1205	1206	1207	1208	1209	1210	1211	1212	1213	1214	1215	1216	1217	1218	1219	1220	1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Fig. 5: Exhaust Valve Adjusting Shim Selection Chart
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

12. Install replacement adjusting shim. Recheck valve clearance. Apply sealant at front and rear valve cover areas on cylinder head. See **Fig. 6** . Using NEW gasket, install valve cover.

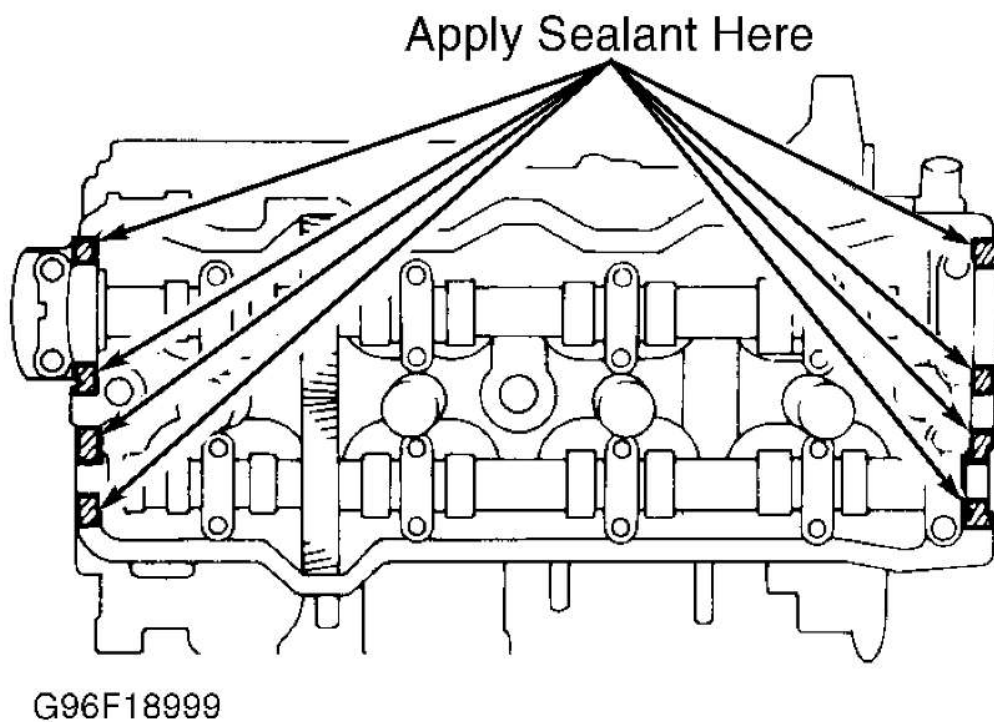
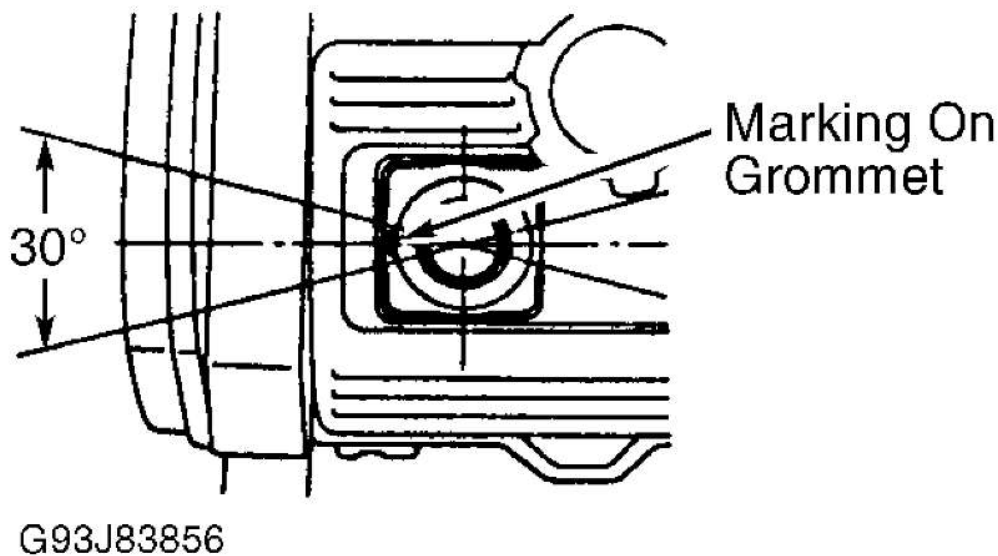


Fig. 6: Applying Sealant On Cylinder Head
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

13. Install grommets in original location with marking on grommet aligned in designated area. See **Fig. 7** . Install and tighten valve cover nuts to specification. See **TORQUE SPECIFICATIONS** .

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**Fig. 7: Aligning Valve Cover Grommets**

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TROUBLE SHOOTING

To trouble shoot mechanical engine components, see appropriate table in TROUBLE SHOOTING article in GENERAL INFORMATION.

REMOVAL & INSTALLATION

NOTE: For reassembly reference, label all electrical connectors, vacuum hoses and fuel lines before removal. Also place mating marks on engine hood and other major assemblies before removal.

CAUTION: When battery is disconnected, vehicle computer and memory systems may lose memory data. Driveability problems may exist until computer systems have completed a relearn cycle.

CAUTION: To prevent air bag deployment, disconnect negative battery cable and wait at least 90 seconds before working on vehicle.

FUEL PRESSURE RELEASE

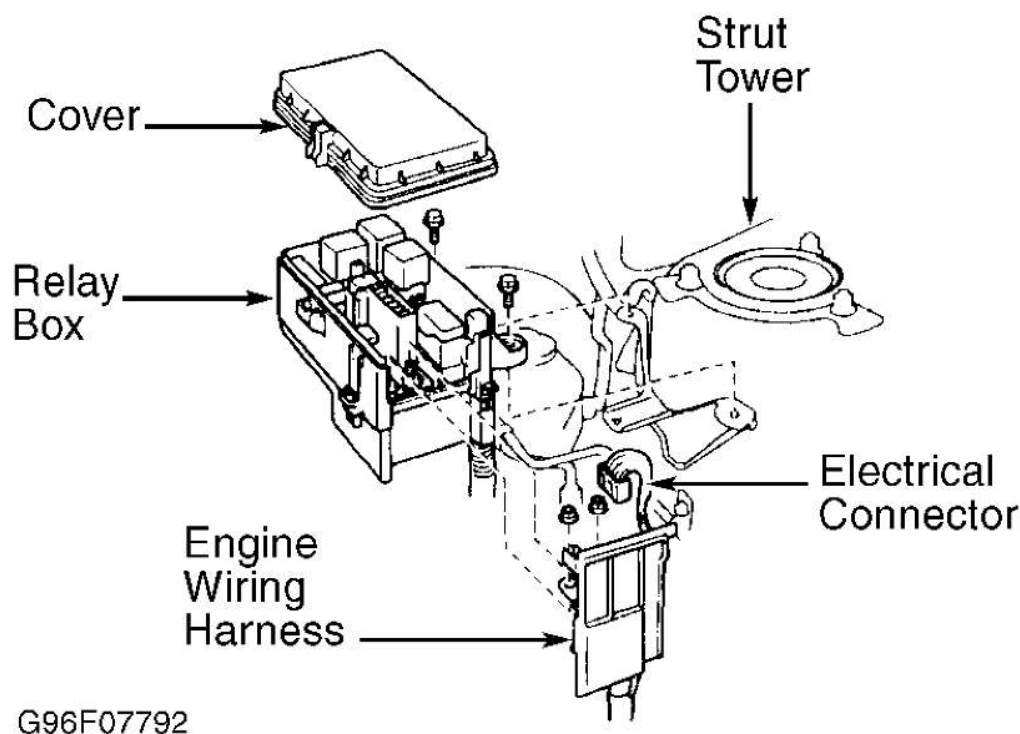
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1. Remove driver-side rear seat and floor panel cover for access to fuel pump electrical connector.
2. Disconnect fuel pump electrical connector. Start engine and allow engine to idle until engine stalls. Turn ignition off.
3. Reconnect fuel pump electrical connector. Reinstall floor panel cover and driver-side rear seat.
4. Disconnect negative battery cable. Place an approved gasoline container under fuel line. Cover fuel line connection with shop towel.
5. Slowly loosen fuel line connection to release fuel pressure. Once fuel pressure is released, fuel system components may be serviced.

ENGINE**Removal**

1. Engine and transaxle are removed as an assembly from bottom of engine compartment. Release fuel pressure. See **FUEL PRESSURE RELEASE** . Remove hood, battery and battery tray. Drain cooling system, and engine and transaxle oil.
2. Disconnect control cables at throttle body. Remove air cleaner assembly and air cleaner case. Remove bolts, and disconnect relay box from body. Relay box is located near driver-side strut tower. See **Fig. 8** .



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Fig. 8: Identifying Relay Box, Electrical Connector & Engine Wiring Harness
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3. Remove upper cover from relay box. Disconnect electrical connector from relay box. See **Fig. 8** . Remove nuts, and disconnect engine wiring harness from relay box.
4. Remove charcoal canister. Remove accessory drive belt and generator. Disconnect upper and lower radiator hoses. Remove thermostat housing from front of engine.
5. Disconnect necessary electrical connectors, coolant hoses, vacuum hoses and fuel lines for engine removal.
6. Remove scuff plate from passenger-side door opening and passenger-side kick panel. Remove center console trim panel from passenger-side of center console. See **Fig. 9** .

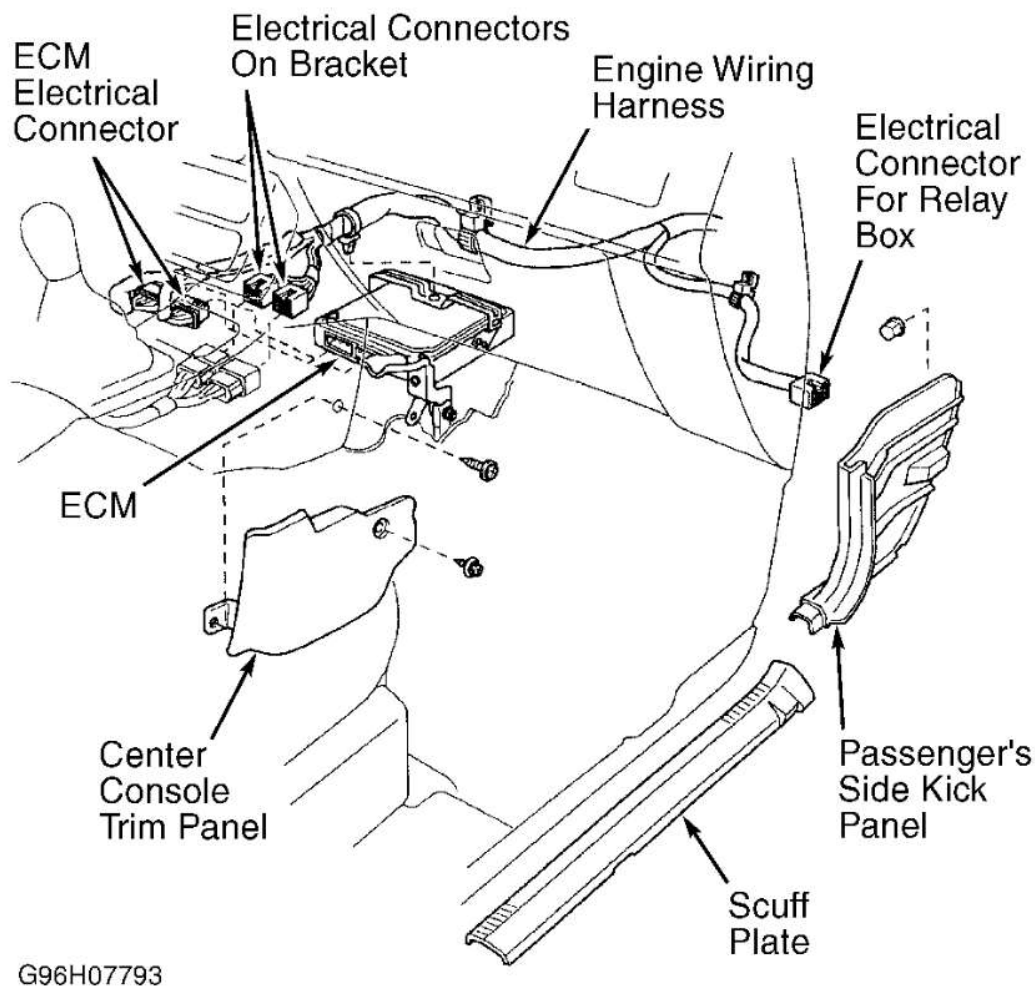


Fig. 9: Identifying ECM & Electrical Connectors
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

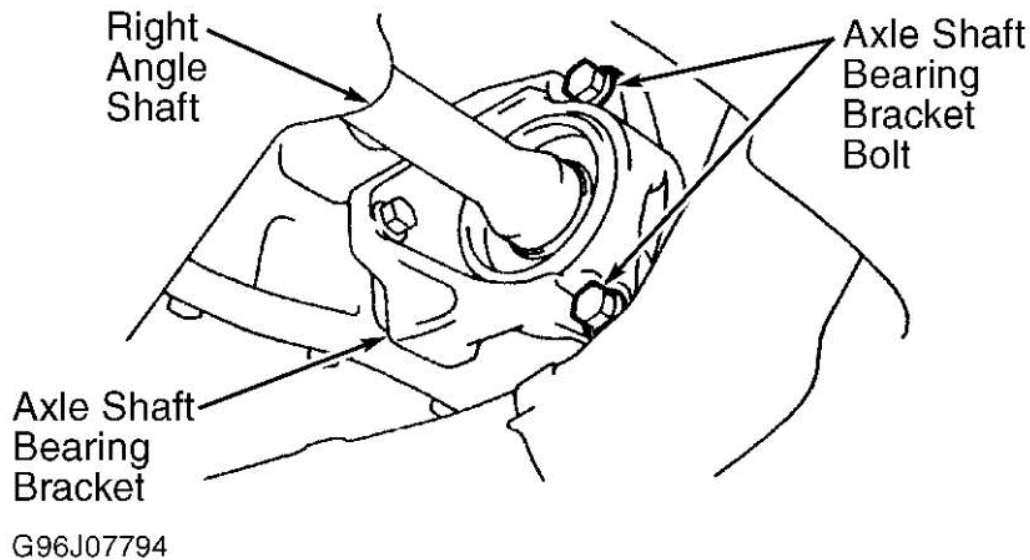
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7. Disconnect 2 electrical connectors from Engine Control Module (ECM) and 2 electrical connectors on bracket. See **Fig. 9** . Disconnect electrical connector for relay box located behind passenger-side kick panel.
8. Disconnect engine wiring harness clamp located on engine wiring harness, near firewall. Pull engine wiring harness out through firewall.
9. Raise and support vehicle. Remove lower engine covers. On M/T models, remove clutch release cylinder with hose attached, and secure aside. Disconnect transaxle control cables from transaxle. Remove starter and transaxle ground cable. On A/T, and 4WD vehicles with M/T, disconnect transaxle oil cooler hoses.
10. On A/T models, disconnect transaxle control cable from front suspension crossmember and engine mount center member. Disconnect connectors, plug wires, strap and hoses from top of engine. On 4WD M/T, disconnect ground strap from engine cowl. Disconnect differential lock control solenoid connector.
11. Using 14-mm deep socket wrench, remove 2 bolts holding front exhaust pipe to front TWC. Remove 2 bolts and 2 nuts holding front exhaust pipe to TWC. Remove front exhaust pipe and 2 gaskets.
12. Disconnect A/C compressor connector. Remove 2 bolts, nut and stud bolt. Disconnect A/C compressor from engine, and secure aside. On 4WD vehicles, remove rear drive shaft. On all models, remove front drive shaft.
13. Remove front wheel and engine undercover. On M/T vehicles drain gear oil. On A/T models, drain transmission fluid. On vehicles with ABS, remove bolt and ABS speed sensor. Remove cotter pin, lock cap and lock nut.
14. Disconnect tie rod from steering knuckle. Disconnect stabilizer bar link from lower control arm. Disconnect lower ball joint from lower control arm.
15. Using soft-face hammer, tap axle shaft from hub assembly. Pull steering knuckle outward and separate axle shaft from hub assembly.
16. On 2WD A/T models, remove axle shaft bearing bracket bolts for right (passenger-side) axle shaft. See **Fig. 10** . Remove right axle shaft assembly from transaxle and axle shaft bearing bracket.

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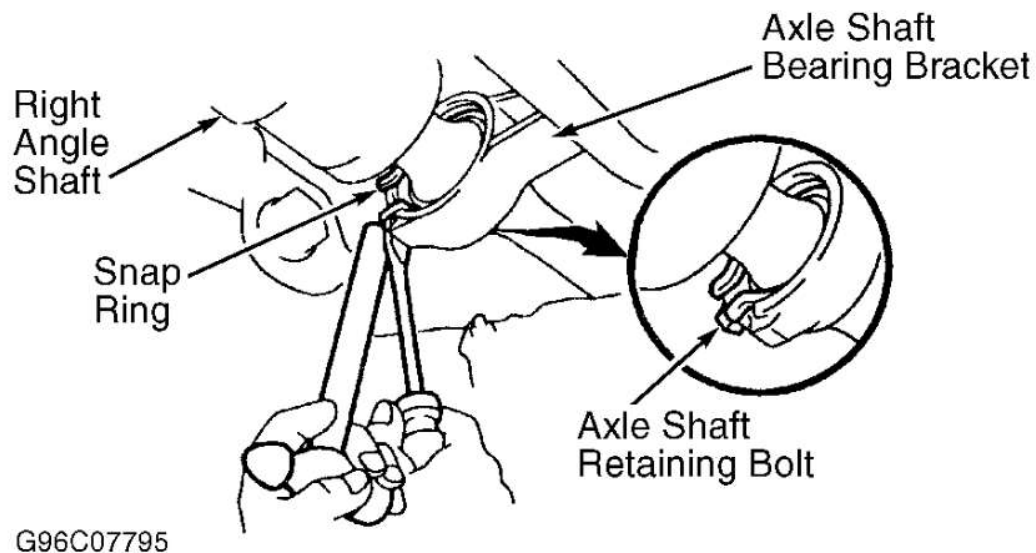
**Fig. 10: Removing Right (Passenger-Side) Axle Shaft (2WD A/T Models)**

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

17. On 2WD M/T models, remove snap ring and axle shaft retaining bolt from axle shaft bearing bracket for right (passenger-side) axle shaft. See **Fig. 11** . Remove right axle shaft assembly from transaxle and axle shaft bearing bracket.

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**Fig. 11: Removing Right (Passenger-Side) Axle Shaft (2WD M/T Models)**

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18. On 2WD models, use hammer and brass drift or a slide hammer and Drive Shaft Remover Attachment (09520-01010) to remove left (driver-side) axle shaft from transaxle. See **Fig. 12** .

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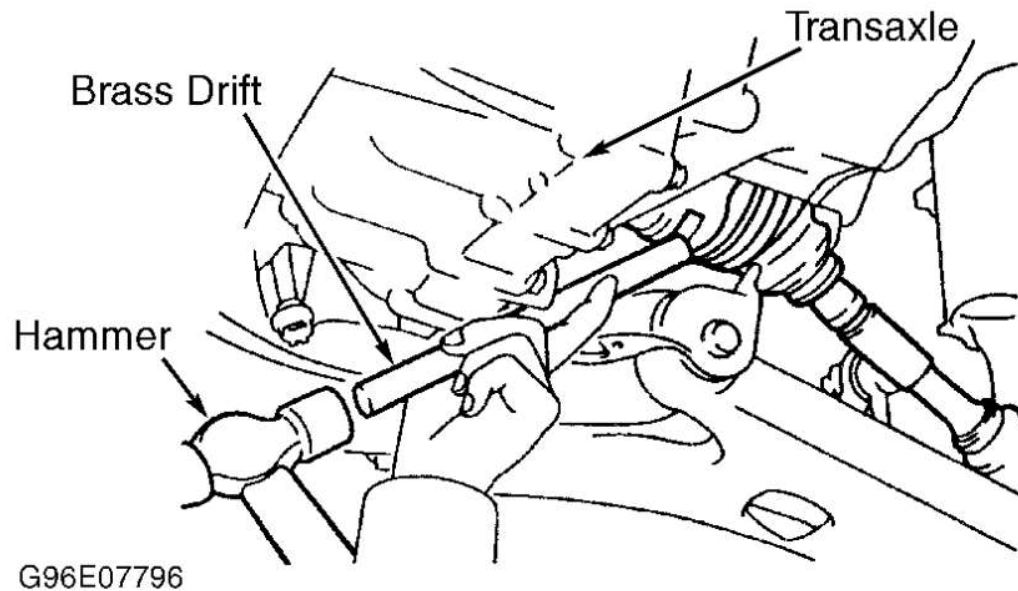


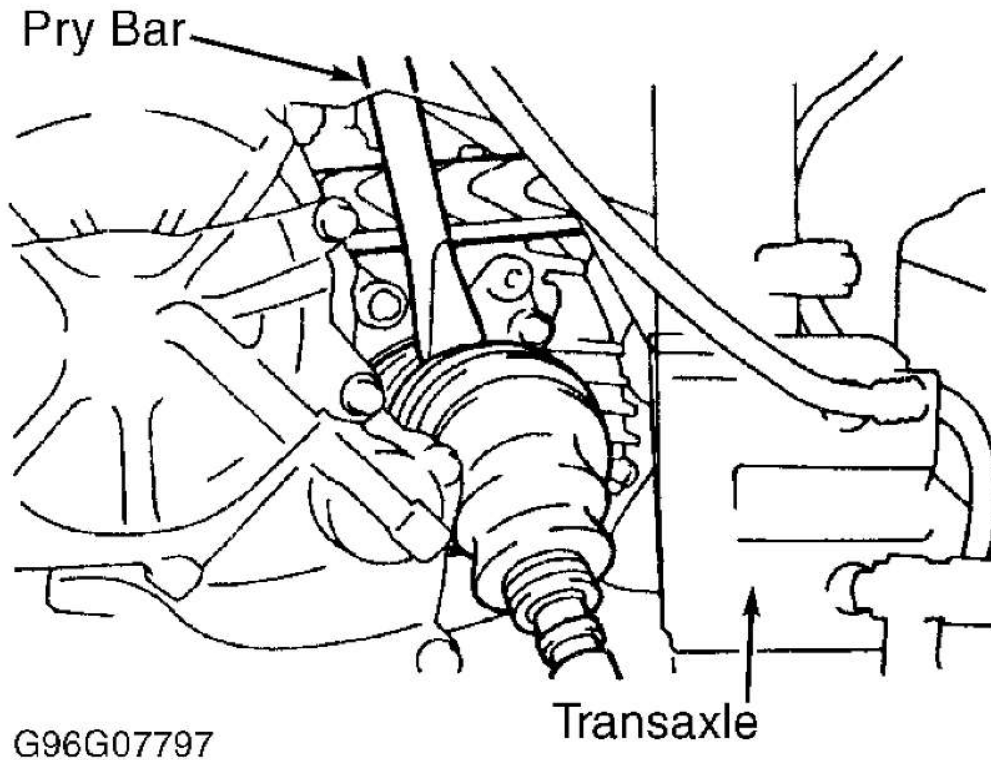
Fig. 12: Removing Left (Driver-Side) Axle Shaft (2WD Models) Or Right (Passenger-Side) Axle Shaft (4WD Models)

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

19. On 4WD models, use hammer and brass drift or a slide hammer and Drive Shaft Remover Attachment (09520-01010) to remove right (passenger-side) axle shaft from transaxle. See **Fig. 12** . Use pry bar to remove left (driver-side) axle shaft from transaxle. See **Fig. 13** .

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Fig. 13: Removing Left (Driver-Side) Axle Shaft (4WD Models)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

20. Remove stabilizer bar-to-frame mount bolts. Remove stabilizer bar with mounting brackets and insulators. Remove 2 steering gear assembly-to-front suspension crossmember bolts/nuts located at each end of steering gear assembly.
21. Support engine with hoist. Remove engine mount crossmember-to-front suspension crossmember nuts. Front suspension crossmember mounts between both lower control arms.
22. Support front suspension crossmember with floor jack. Remove front suspension crossmember bolts and front suspension crossmember.
23. Remove front (exhaust manifold side) engine mount-to-engine mount crossmember bolts. Remove engine mount crossmember-to-body bolts. Remove engine mount crossmember.
24. Remove power steering pump with hoses attached, and secure aside. Remove left (transaxle side) engine mounting bracket-to-engine mount bolts/nuts. Remove right (timing belt side) engine mounting bracket-to-engine mount bolts/nuts. Lower engine from engine compartment.

Installation

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1. Install engine in engine compartment. Loosely install right (timing belt side) engine mounting bracket-to-engine mount bolts/nuts.
2. Install and tighten left (transaxle side) engine mounting bracket-to-engine mount bolts/nuts to specification. See **TORQUE SPECIFICATIONS** . Tighten right (timing belt side) engine mounting bracket-to-engine mount bolts/nuts to specification.
3. Install power steering pump. Install and tighten bolts to specification. See **TORQUE SPECIFICATIONS** . Install engine mount crossmember with front (exhaust manifold side) engine mount-to-engine mount crossmember bolts and engine mount crossmember-to-body bolts loosely installed. DO NOT tighten bolts at this time
4. Install front suspension crossmember on body with bolts loosely installed. Loosely install engine mount crossmember-to-front suspension crossmember nuts and steering gear assembly-to-front suspension crossmember bolts/nuts. DO NOT tighten bolts/nuts at this time.
5. Install and tighten front suspension crossmember bolts to specification. See **TORQUE SPECIFICATIONS** .
6. Tighten steering gear assembly-to-front suspension crossmember bolts/nuts and then engine mount crossmember-to-front suspension crossmember nuts to specification. See **TORQUE SPECIFICATIONS** .
7. Tighten front (exhaust manifold side) engine mount-to-engine mount crossmember bolts and then engine mount crossmember-to-body bolts to specification. See **TORQUE SPECIFICATIONS** .
8. To install remaining components, reverse removal procedure. Before installing axle shafts coat axle shaft seals in transaxle with grease.

NOTE: **All axle shafts, except right (passenger-side) axle shaft on 2WD models, use a snap ring on end of axle shaft. Ensure NEW snap ring is installed.**

9. On all axle shafts except right (passenger-side) axle shaft on 2WD models, install NEW snap ring on end of axle shaft. Position snap ring on end of axle shaft with opening facing downward.
10. Install axle shaft by lightly tapping axle shaft into transaxle. Ensure axle shaft moves inward and outward approximately .079-.120" (2.00-3.00 mm) and cannot be pulled from transaxle.
11. On 2WD M/T models, when installing right (passenger-side) axle shaft, install NEW axle shaft retaining bolt. Tighten axle shaft retaining bolt to specification. See **TORQUE SPECIFICATIONS** .
12. On 4WD models, ensure reference marks on drive shaft flanges are aligned. Ensure mounting bracket on drive shaft center support bearing is straight and perpendicular to drive shaft before tightening bolts to specification.
13. Use NEW gasket and NEW nuts when installing front exhaust pipe on catalytic converter. Ensure all bolts/nuts are loosely installed before tightening to specification.
14. Adjust fluid levels and control cables. On 2WD models with A/T, use Dexron-II ATF. On 4WD models with A/T, use Type "T" ATF. On all M/T models, use SAE 75-90 GL-5 gear oil.

CYLINDER HEAD & MANIFOLDS

NOTE: **On 4WD models, manufacturer recommends engine removal for servicing of cylinder head and manifolds. See ENGINE .**

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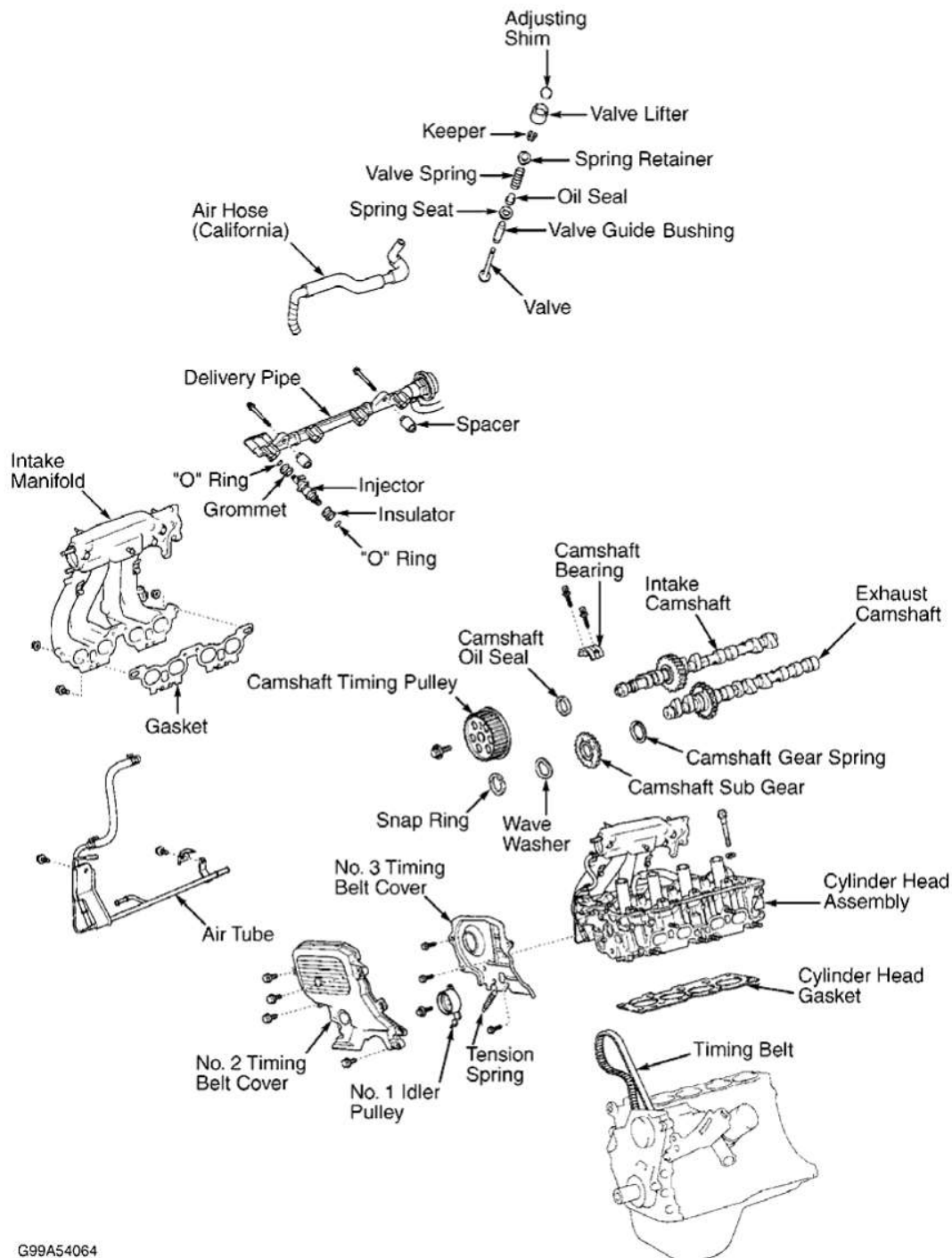
1999-2000 ENGINES 2.0L 4-Cylinder

Removal

1. Release fuel pressure. See **FUEL PRESSURE RELEASE** . Drain cooling system. Raise and support vehicle. Remove right lower engine cover.
2. Disconnect control cables at throttle body. Remove air cleaner assembly and air cleaner case. Remove accessory drive belt and generator.
3. Remove front exhaust pipe. Remove exhaust manifold and heat insulator assembly. Disconnect oxygen sensor (except California) or Air/Fuel (A/F) ratio sensor (California), and remove exhaust manifold and heat shield. Remove sensors from exhaust manifold and front catalytic converter, if equipped.
4. Remove heat insulator from front exhaust pipe. Remove throttle body and gasket. Remove ignition coils with spark plug wires attached.
5. Disconnect necessary electrical connectors, coolant hoses and vacuum hoses from cylinder head and intake manifold. Remove coolant outlet, coolant by-pass pipe and gaskets.
6. Disconnect hoses and ground strap. Remove union bolt, and disconnect fuel line at fuel filter. Remove EGR valve and vacuum modulator. Disconnect power steering idle-up hoses from air tube.
7. Remove 2 bolts and accelerator cable bracket. Disconnect PCV hoses, cable brackets and control cables for access to valve cover. Disconnect engine wiring harness protector at rear of timing belt cover for access to valve cover. Remove nuts, grommets, valve cover and gasket. Note location of grommets for reassembly reference, as grommets must be installed in original location.
8. Remove bolts, and disconnect engine wiring harness protector from left side of intake manifold. Disconnect electrical connectors at injectors, A/C compressor and crankshaft position sensor. Remove engine wiring harness clamps from timing belt cover and generator drive belt adjusting bar.
9. Remove scuff plate from passenger-side door opening and passenger-side kick panel. Remove right side cowl side trim and floor carpet center cover. Disconnect 2 electrical connectors from Engine Control Module (ECM), and 2 electrical connectors on bracket. See **Fig. 9** . Disconnect electrical connector for relay box located behind passenger-side kick panel.
10. Disconnect engine wiring harness clamp located on engine wiring, near firewall. Pull engine wiring harness out through firewall. Remove engine wiring harness from between cylinder head and intake manifold.
11. Disconnect timing belt from camshaft timing pulley. Remove camshaft timing pulley. Remove No. 1 idler pulley and tension spring. See **TIMING BELT** . Remove 3 bolts and timing belt cover. See **Fig. 14** . After removing timing belt from camshaft sprocket, support timing belt so belt does not come off crankshaft sprocket.

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Fig. 14: Exploded View Of Camshaft & Cylinder Head Components
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

12. Remove camshafts. See **CAMSHAFT**

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CAUTION: Cylinder head bolts must be loosened in proper sequence to prevent cylinder head warpage.

13. Loosen cylinder head bolts in proper sequence using several steps. See **Fig. 15**. Remove cylinder head bolts, washers, cylinder head with intake manifold. If cylinder head is difficult to remove, carefully pry between cylinder head and block using a screwdriver. DO NOT damage contact surfaces between cylinder head and block. Remove cylinder head gasket from cylinder block.

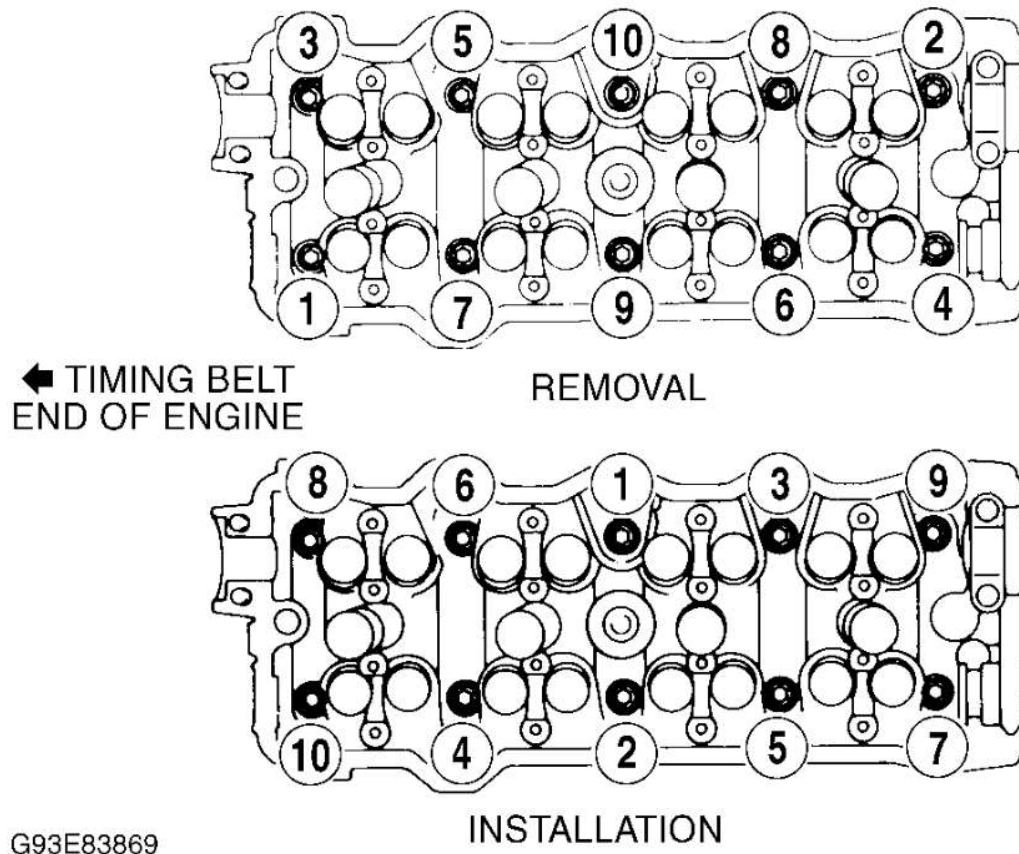


Fig. 15: Cylinder Head Bolt Removal & Installation Sequence
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

14. Remove air tube bolted onto side of intake manifold. Remove bolts/nuts, intake manifold and gasket from cylinder head. Disconnect air hose from cylinder head port. Remove air hose.
15. Remove fuel delivery pipe-to-cylinder head bolts. Remove fuel delivery pipe from cylinder head. Remove fuel injectors and spacers from cylinder head. Remove oil pressure switch from side of cylinder head.

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Inspection

1. Inspect cylinder head warpage at cylinder block, exhaust manifold and intake manifold surfaces. Replace cylinder head if warpage exceeds specification. See **CYLINDER HEAD** table under ENGINE SPECIFICATIONS.
2. Inspect cylinder block deck surface for warpage. Replace cylinder block if deck surface warpage exceeds specification. See **CYLINDER BLOCK** table under ENGINE SPECIFICATIONS.
3. Inspect intake and exhaust manifold machined surfaces for warpage. Replace component if warpage exceeds .0118" (.300 mm). Inspect camshaft and components. See **CAMSHAFT** .
4. Measure valve lifter diameter and bore diameter. Ensure oil clearance is within specification. Replace components if not within specification. See **VALVE LIFTERS** table under ENGINE SPECIFICATIONS.

Installation

1. Apply adhesive to 2 or 3 threads of oil pressure switch, and install switch. Install NEW insulator at bottom of fuel injector and NEW grommet on top of fuel injector. Coat NEW "O" rings with gasoline and install on fuel injector.
2. Install 2 spacers on cylinder head. Install fuel injectors on cylinder head. Install fuel delivery pipe on fuel injectors. Using twisting motion, push fuel injectors into fuel delivery pipe.
3. Install and slightly tighten fuel delivery pipe-to-cylinder head bolts. Ensure all fuel injectors rotate smoothly. If fuel injector fails to rotate smoothly, check for improperly installed or damaged "O" rings.
4. Position electrical connector on fuel injector facing toward top of engine. Tighten fuel delivery pipe-to-cylinder head bolts to specification. See **TORQUE SPECIFICATIONS** .
5. Using NEW gasket, install intake manifold. Install and tighten bolts/nuts to specification. See **TORQUE SPECIFICATIONS** . Install air tube on side of intake manifold.
6. Install adjusting shims and valve lifters in original location on cylinder head (if removed). Ensure valve lifters rotate smoothly in cylinder head.
7. Install NEW gasket for cylinder head on cylinder block. Ensure all holes in gasket align with holes in cylinder block.
8. Install cylinder head. Coat threads and bolt-to-cylinder contact surfaces on cylinder head bolts with engine oil. Install and tighten cylinder head bolts in several steps, to specification in sequence. See **Fig. 15** . See **TORQUE SPECIFICATIONS** .
9. If removed, install spark plug tubes. Install camshafts using proper procedure. See **CAMSHAFT** . Install No. 3 timing belt cover. Install and tighten bolts to specification. See **TORQUE SPECIFICATIONS** .
10. To install remaining components, reverse removal procedure. If camshaft or cylinder head components are serviced, adjust valve clearance. See **VALVE CLEARANCE ADJUSTMENT** under ADJUSTMENTS.
11. Before installing gasket and valve cover, apply sealant at front and rear valve cover areas on cylinder head. See **Fig. 6** . Using NEW gasket, install valve cover.
12. Install grommets in original location with marking on grommet aligned in designated area. See **Fig. 7** . Install and tighten valve cover nuts to specification. See **TORQUE SPECIFICATIONS** .
13. Install VSV for EGR. Connect ground cable to intake manifold with bolt. Connect knock sensor connector. Connect power steering idle-up air hoses to air tube. On A/T models, connect A/T throttle

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control cable to intake manifold. On all models, install NEW gasket and EGR valve with union nut and 2 nuts. Install vacuum modulator to clamp on intake manifold. Connect vacuum hoses to EGR VSV. Connect fuel inlet hose to fuel filter

14. Connect vacuum sensor hose to gas filter, and brake booster vacuum hose to intake manifold. Install throttle body. Install NEW "O" ring on coolant by-pass pipe, and NEW gasket on water pump cover before installing coolant by-pass pipe. Apply soapy water solution to "O" ring before installing coolant by-pass pipe. Install by-pass pipe.
15. Install NEW gasket and water outlet. Connect radiator, water by-pass and heater water hoses. Connect ECT sensor and sender gauge connectors. Connect oil pressure switch.
16. Install ignition coils, manifold stay and spark plug wires. Connect wire clamp to manifold stay. Connect spark plug wires to spark plugs and clamps on cylinder head cover. Connect ignition coil connectors.
17. Install 2 heat insulators. Install lower heat insulator. On California models, install A/F sensor to exhaust manifold. All others, install oxygen sensor (bank 1 sensor 1) to exhaust manifold.
18. Using a new gasket, install exhaust manifold and heat insulator assembly. Install right-side exhaust manifold stay (California). Install left-side exhaust manifold stay. Install upper manifold heat insulator. Connect A/F sensor connectors (California), or Oxygen sensor (bank 1 sensor 1).
19. Use NEW gasket and NEW nuts when installing front exhaust pipe. Ensure all bolts/nuts are loosely installed on front exhaust pipe before tightening to specification. See **TORQUE SPECIFICATIONS**
20. Install generator and air cleaner and cap. Connect accelerator cable to throttle body and cable bracket. On A/T models, connect throttle cable to throttle body and cable bracket. On all models, start engine and check for leaks. Recheck engine coolant and oil level. Install right-side engine undercover.

CRANKSHAFT FRONT SEAL

Removal & Installation (Oil Pump Installed)

1. Remove timing belt and crankshaft sprocket. See **TIMING BELT** . Using a knife, cut lip from seal. Pry seal from oil pump housing. DO NOT damage sealing surfaces.
2. To install, apply grease to lip of new seal. Using hammer and Seal Installer (SST 09226-10010), install seal until seal surface is even with oil pump housing. To install remaining components, reverse removal procedure.

Removal & Installation (Oil Pump Removed)

Using hammer and drift, remove seal from oil pump housing. To install, use hammer and Seal Installer (SST 09226-10010). Install seal until seal surface is even with oil pump housing. Apply grease to lip of new seal.

TIMING BELT

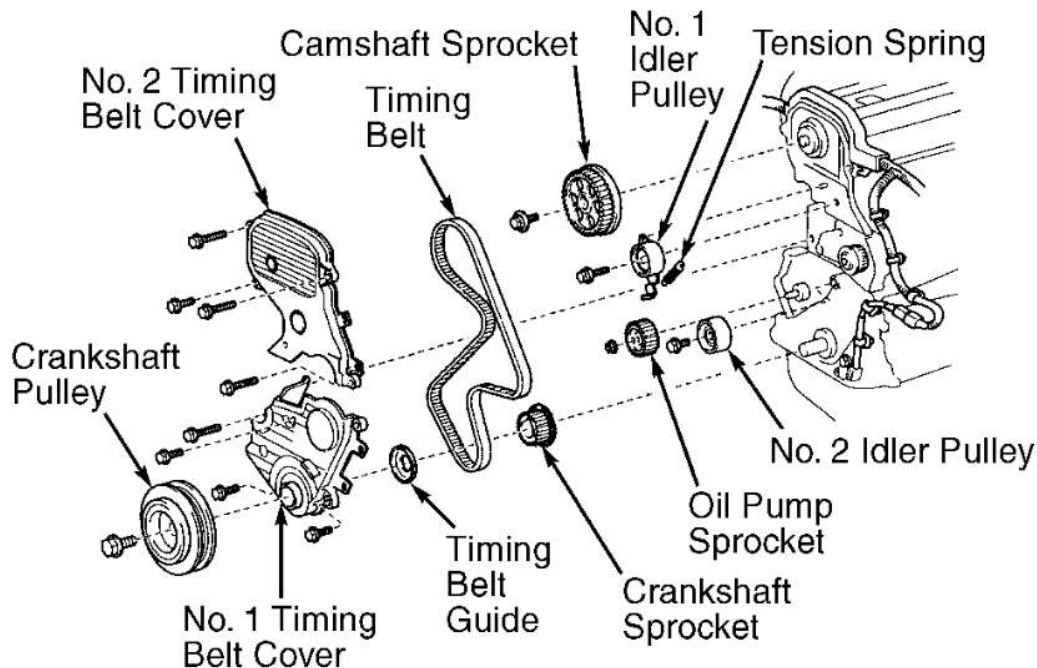
CAUTION: If reusing timing belt, mark direction of timing belt rotation, and place reference mark on timing belt at camshaft sprocket for reassembly reference. Also, place reference mark on timing belt at upper edge of No. 1 timing belt cover. DO NOT bend, twist or turn timing belt inside-out. DO NOT expose timing to oil, water or steam.

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Removal

1. Disconnect negative battery cable. Remove power steering fluid reservoir with mounting bracket. Remove accessory drive belts. Remove generator and generator mounting bracket. Remove wiring brackets for access to timing belt covers.
2. On models with Anti-Lock Brake System (ABS), disconnect electrical connectors and brake lines from ABS actuator. ABS actuator is located in front of passenger-side strut tower. Remove ABS actuator mounting bracket-to-body bolts/nuts. Remove ABS actuator with mounting bracket.
3. Raise and support vehicle. Remove passenger-side lower engine cover. Remove passenger-side front wheel.
4. Using floor jack, slightly raise engine to remove weight from right (timing belt side) engine mount at timing belt cover. Remove right (timing belt side) engine mount from body and mounting bracket on cylinder block for access to timing belt covers.
5. Remove spark plugs. Remove crankshaft pulley bolt. Using puller, remove crankshaft pulley. Remove right (timing belt side) engine mounting bracket from front of cylinder block.
6. Disconnect engine wiring harness protector from rear of No. 2 timing belt cover. When disconnecting engine wiring harness protector, remove bolt on intake manifold side of engine first and then bolt on exhaust manifold side of engine.
7. Remove No. 2 timing belt cover. See **Fig. 16** . Install crankshaft pulley on crankshaft. Temporarily install crankshaft pulley bolt.



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Fig. 16: Exploded View Of Timing Belt & Components

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

8. Rotate crankshaft clockwise, as viewed from timing belt end of engine, so cylinder No. 1 is at TDC on compression stroke and timing mark on crankshaft pulley aligns with "0" mark on timing belt cover. Cylinder No. 1 is front cylinder at timing belt end of engine.
9. Ensure hole in camshaft sprocket aligns with alignment mark on camshaft bearing cap. See **Fig. 17** . If hole in camshaft sprocket is not aligned with alignment mark, rotate crankshaft clockwise one full revolution.

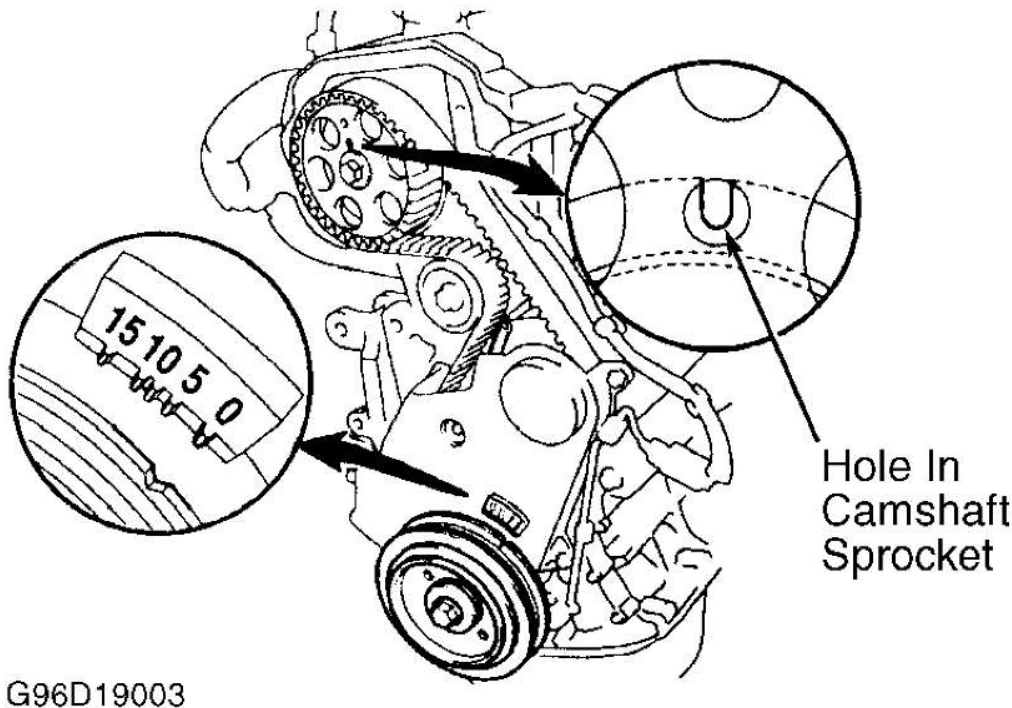


Fig. 17: Aligning Camshaft Timing Marks

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

10. Loosen No. 1 idler pulley bolt. See **Fig. 16** . Move No. 1 idler pulley outward, as far as possible, away from timing belt. Temporarily retighten No. 1 idler pulley bolt.
11. Remove timing belt from camshaft sprocket. Hold crankshaft pulley and remove crankshaft pulley bolt. Using puller, remove crankshaft pulley. DO NOT allow crankshaft to rotate when removing crankshaft pulley.
12. Remove No. 1 timing belt cover. See **Fig. 16** . Note direction of timing belt guide installation. See **Fig. 16** . Remove timing belt guide.

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13. If reusing timing belt, mark direction of timing belt rotation and place reference marks on timing belt and crankshaft sprocket for reassembly reference. Remove timing belt from crankshaft sprocket.
14. Remove idler pulleys (if necessary). If removing camshaft sprocket, use spanner wrench to hold camshaft sprocket and remove camshaft sprocket bolt. Remove camshaft sprocket.
15. If removing crankshaft sprocket, use puller to pull crankshaft sprocket from crankshaft. If removing oil pump sprocket, hold oil pump sprocket by installing spanner wrench in holes on front of oil pump sprocket. Remove oil pump sprocket nut. Remove spanner wrench and oil pump sprocket.

Inspection

1. Inspect timing belt for damaged teeth, cracking or oil contamination. Ensure idler pulleys rotate freely. Replace components if damaged or worn.
2. Ensure free length of tension spring is within specification. See **TENSION SPRING SPECIFICATIONS** table. Measure tension required to extend tension spring to specified installed length. Replace tension spring if tension is not within specification. See **TENSION SPRING SPECIFICATIONS** table.

TENSION SPRING SPECIFICATIONS

Application	Specification
Free Length	1.653" (42.00 mm)
Tension At Spring Installed Length ⁽¹⁾	7.0-8.5 lbs. (3.15-3.85 kg)
(1) Installed length of spring is 1.988" (50.5 mm).	

Installation

1. If installing oil pump sprocket, align cutout areas on oil pump sprocket with areas on oil pump shaft. Install oil pump sprocket. Install and tighten oil pump sprocket nut to specification while holding oil pump sprocket with spanner wrench. See **TORQUE SPECIFICATIONS**.
2. If installing crankshaft sprocket, align crankshaft sprocket with key in crankshaft. Install crankshaft sprocket with sensor teeth toward cylinder block. See **Fig. 16**.
3. Install No. 2 idler pulley (if removed). Install and tighten bolt to specification. See **TORQUE SPECIFICATIONS**. Ensure idler pulley is clean and rotates smoothly.
4. Install No. 1 idler pulley and tension spring (if removed). DO NOT tighten bolt at this time. Ensure pivot hole on No. 1 idler pulley mounting flange engages with pin on front of cylinder block.
5. Move idler pulley away from timing belt area as far as possible. Temporarily tighten No. 1 idler pulley bolt. Ensure idler pulley is clean and rotates smoothly.
6. If installing camshaft sprocket, align pin groove in camshaft sprocket with pin in camshaft. Install camshaft sprocket. Install and tighten camshaft sprocket bolt to specification. See **TORQUE SPECIFICATIONS**. Using crankshaft pulley bolt, rotate crankshaft so key on crankshaft is at 12 o'clock position.

CAUTION: If reusing timing belt, ensure reference mark on timing belt aligns with reference mark placed on crankshaft sprocket, and timing belt is

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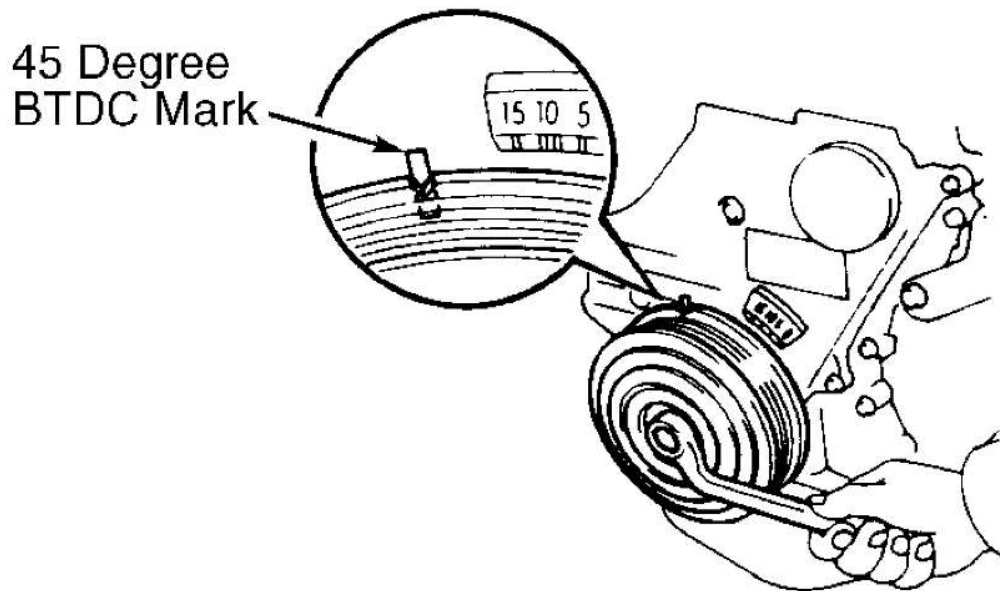
1999-2000 ENGINES 2.0L 4-Cylinder

installed in original direction of rotation.

7. Ensure all sprockets and idler pulleys are clean. Install timing belt on crankshaft sprocket, oil pump sprocket, water pump sprocket, No. 1 idler pulley and then No. 2 idler pulley.
8. Install timing belt guide with cupped side away from crankshaft sprocket and flat side toward timing belt. Install No. 1 timing belt cover.
9. Remove crankshaft pulley bolt. Align crankshaft pulley key groove with key in crankshaft. Install crankshaft pulley. Temporarily install and tighten crankshaft pulley bolt.
10. If using new timing belt, go to step 15 . If reusing timing belt, ensure reference mark placed on timing belt aligns with upper edge of No. 1 timing belt cover when timing mark on crankshaft pulley aligns with "0" mark on No. 1 timing belt cover. If reference mark is aligned, proceed to step 15 .
11. If reference mark is below surface of No. 1 timing belt cover, pull upward on water pump side of timing belt while rotating crankshaft pulley counterclockwise. Align reference mark with surface of No. 1 timing belt cover.
12. After aligning matchmark, hold timing belt and rotate crankshaft pulley clockwise so timing mark on crankshaft pulley aligns with "0" mark on No. 1 timing belt cover.
13. If reference mark is above surface of No. 1 timing belt cover, pull upward on No. 1 idler pulley side of timing belt while rotating crankshaft pulley clockwise. Align reference mark with surface of No. 1 timing belt cover.
14. After aligning matchmark, hold timing belt and rotate crankshaft pulley counterclockwise so timing mark on crankshaft pulley aligns with "0" mark on No. 1 timing belt cover.
15. Install timing belt on camshaft sprocket. If reusing timing belt, ensure reference mark on timing belt aligns with reference mark placed on camshaft sprocket. Ensure tension exists on timing belt between crankshaft and camshaft sprockets.
16. Loosen No. 1 idler pulley bolt 1/2 turn. Rotate crankshaft pulley 2 full revolutions clockwise from TDC to TDC. DO NOT rotate crankshaft counterclockwise.
17. Ensure timing mark on crankshaft pulley aligns with "0" mark on No. 1 timing belt cover, and hole in camshaft sprocket aligns with alignment mark on camshaft bearing cap. See **Fig. 17** . If timing marks are not aligned, remove timing belt and reinstall.
18. Rotate crankshaft clockwise 1 7/8 revolutions and align crankshaft pulley "0" mark with 45-degree Before Top Dead Center (BTDC) mark on No. 1 timing belt cover. See **Fig. 18** .

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Fig. 18: Aligning Crankshaft Pulley With 45-Degree BTDC Mark
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

19. Tighten No. 1 idler pulley bolt to specification. See **TORQUE SPECIFICATIONS** . Install right (timing belt side) engine mounting bracket on front of cylinder block with bolts loosely installed. DO NOT tighten bolts at this time.
20. Install No. 2 timing belt cover. Install engine wire harness and engine wire harness protector on rear of No. 2 timing belt cover. When installing engine wire harness protector, install bolt on exhaust manifold side of engine first, and then bolt on intake manifold side of engine.
21. Remove crankshaft pulley bolt and crankshaft pulley. Tighten right (timing belt side) engine mounting bracket-to-cylinder block bolts to specification. See **TORQUE SPECIFICATIONS** .
22. Reinstall crankshaft pulley. Install and tighten crankshaft pulley bolt to specification. See **TORQUE SPECIFICATIONS** .
23. Install right (timing belt side) engine mount on body and mounting bracket on cylinder block. Tighten right (timing belt side) engine mount-to-body bolts to specification. See **TORQUE SPECIFICATIONS** .
24. Tighten right (timing belt side) mounting bracket-to-engine mount bolts/nuts to specification. See **TORQUE SPECIFICATIONS** . To install remaining components, reverse removal procedure. On models with ABS, bleed brake system after install ABS actuator. See HYDRAULIC SYSTEM BLEEDING in appropriate article in BRAKES.

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VALVE LIFTER**Removal**

Remove camshaft. See **CAMSHAFT** . Note location of adjusting shims and valve lifters for reassembly reference. Remove adjusting shims and valve lifters from cylinder head.

Inspection

Inspect components for damage. Measure valve lifter diameter and bore diameter. Ensure oil clearance is within specification. Replace components if not within specification. See **VALVE LIFTERS** table under ENGINE SPECIFICATIONS.

Installation

To install, reverse removal procedure. Ensure components are installed in original location and valve lifters rotate smoothly in cylinder head. If camshaft, adjusting shims or valve lifters are replaced, check valve clearance. See **VALVE CLEARANCE ADJUSTMENT** under ADJUSTMENTS.

CAMSHAFT**Removal (Exhaust Side)**

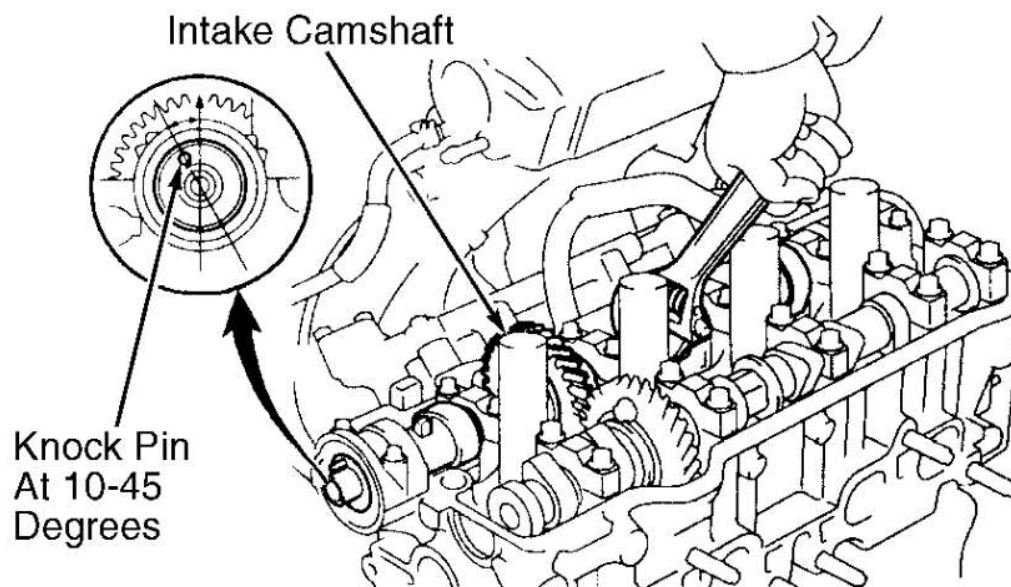
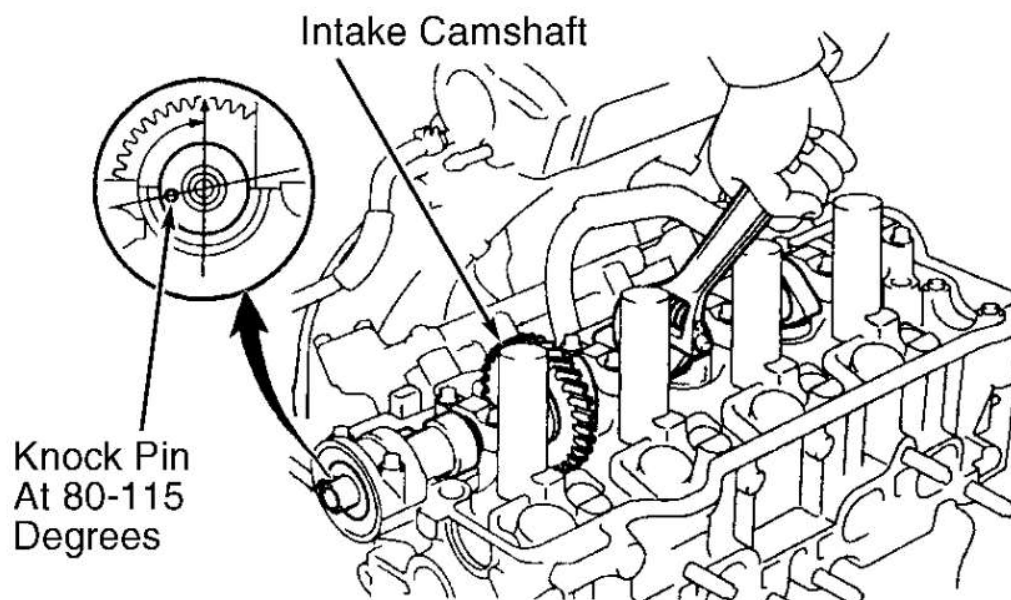
1. Remove timing belt and camshaft sprocket. See **TIMING BELT** . Remove No. 3 timing belt cover. See **Fig. 14** .
2. Disconnect power steering fluid reservoir, PCV hoses, cable brackets and control cables for access to valve cover. Disconnect spark plug wires from spark plugs. Remove nuts, grommets, valve cover and gasket. Note location of grommets for reassembly reference, as grommets must be installed in original location.

CAUTION: Camshafts must be properly positioned to lift camshaft straight from cylinder head to prevent damage to cylinder head and camshaft. **DO NOT** pry or force camshafts from cylinder head or component damage will result.

3. For servicing of exhaust camshaft, rotate intake camshaft so knock pin is 10-45 degrees from vertical position. See **Fig. 19** . This aids in exhaust camshaft removal by using camshaft lobes on cylinders No. 2 and 4 to push on valve lifters.

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**SERVICING EXHAUST CAMSHAFT****SERVICING INTAKE CAMSHAFT**

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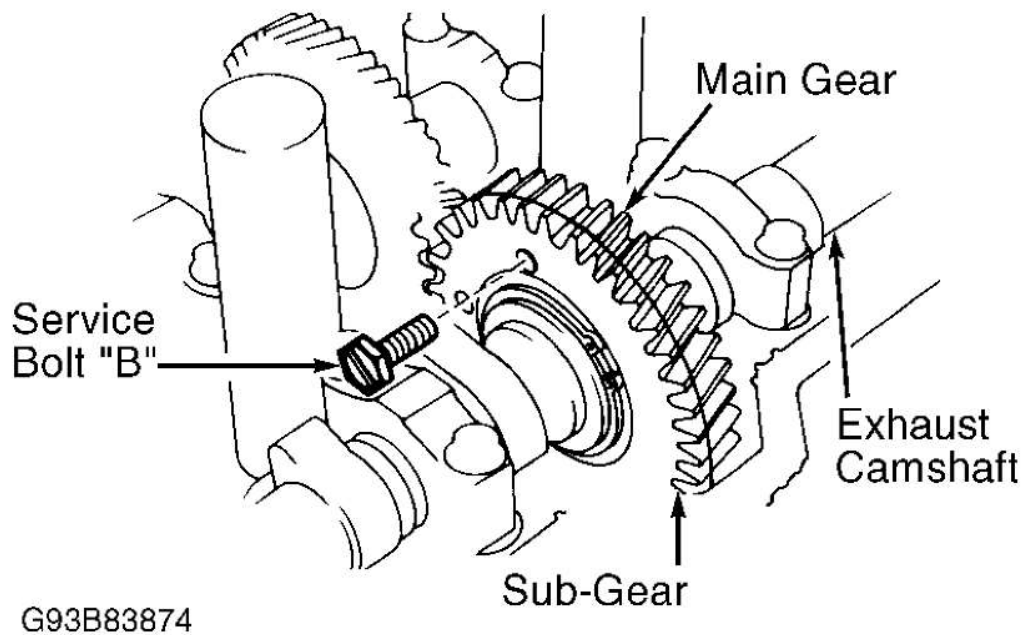
Fig. 19: Positioning Camshafts

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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4. Secure sub-gear to main gear on exhaust camshaft with a 6 x 1.0 x 18 mm service bolt "B". See **Fig. 20** . Before removing camshaft bearing cap bolts, ensure torsional spring force of sub-gear is secured by service bolt "B".

**Fig. 20: Securing Sub Gear-To-Main Gear**

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: Camshaft bearing caps are numbered for location, and have an arrow on top of cap. Front camshaft bearing cap on intake camshaft and rear camshaft bearing cap on exhaust camshaft are not numbered. All other camshaft bearing caps are numbered starting with No. 1 at timing belt end of engine. Arrow on top of camshaft bearing cap must point toward timing belt end of engine. See **Fig. 21** .

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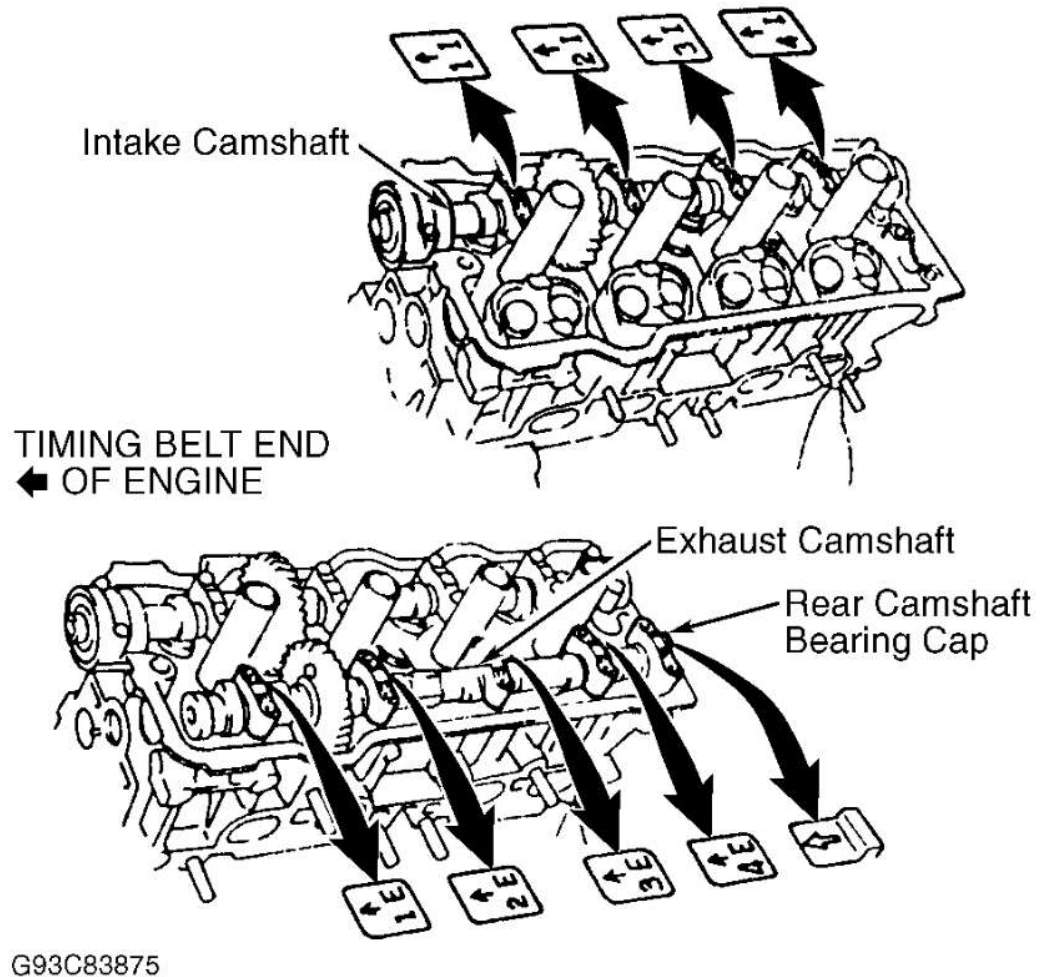
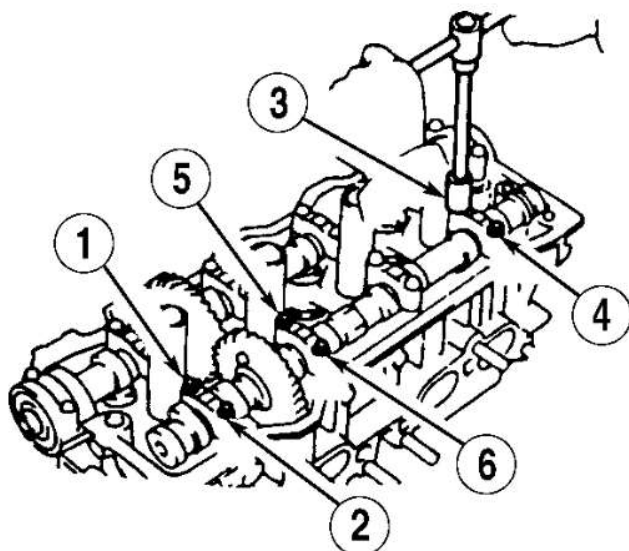


Fig. 21: Identifying Camshaft Bearing Caps
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. Remove bolts and rear camshaft bearing cap from exhaust camshaft. Remove bolts from No. 1, 2 and 4 camshaft bearing caps on exhaust camshaft in proper sequence. See **Fig. 22** . DO NOT remove bolts from No. 3 camshaft bearing cap at this time. Remove No. 1, 2 and 4 camshaft bearing caps from exhaust camshaft.

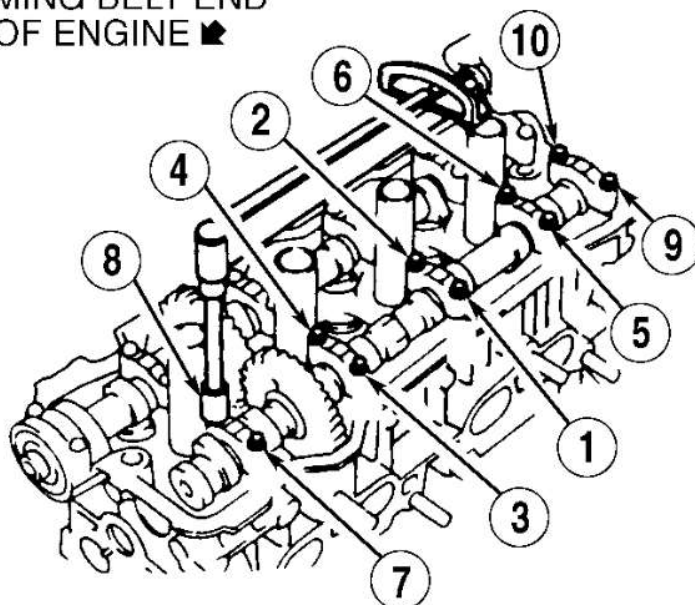
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REMOVAL

TIMING BELT END
OF ENGINE ➡



INSTALLATION

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Fig. 22: Exhaust Camshaft Bearing Cap Bolt Removal & Installation Sequence
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. Alternately loosen bolts on No. 3 camshaft bearing cap on exhaust camshaft. Ensure exhaust camshaft is

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lifted upward as No. 3 camshaft bearing cap bolts are loosened.

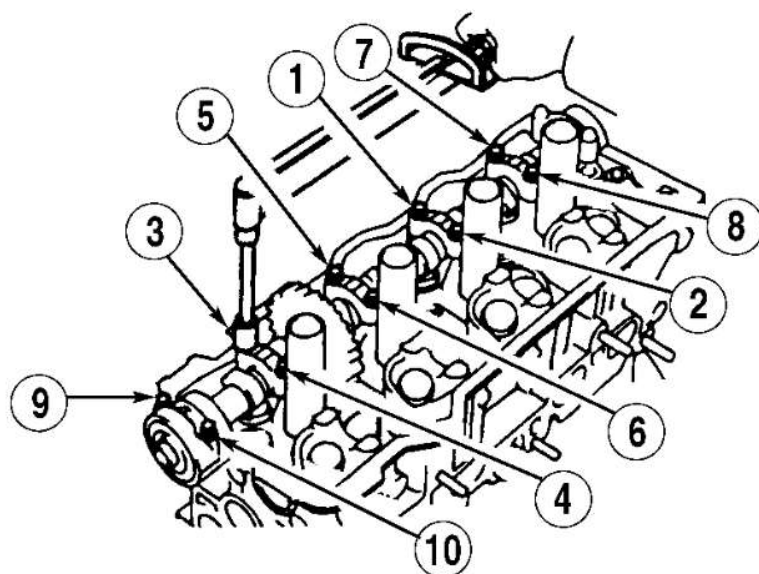
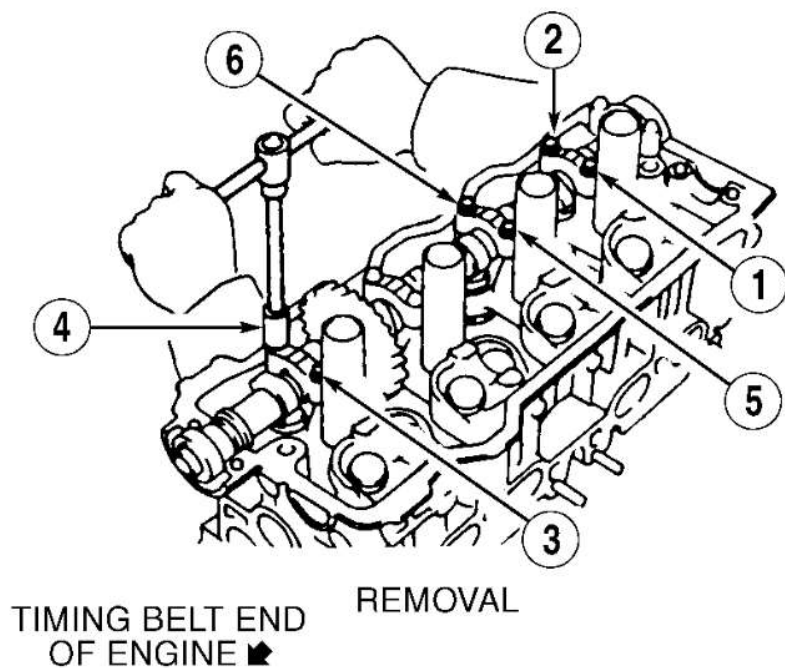
7. If exhaust camshaft is not lifted upward, reinstall all camshaft bearing caps. Reposition intake camshaft so knock pin is 10-45 degrees from vertical position. See **Fig. 19** . Repeat steps **5)** and **6)** . Remove No. 3 camshaft bearing cap and exhaust camshaft.

Removal (Intake Side)

1. Remove distributor, if equipped. Rotate intake camshaft so knock pin is 80-115 degrees from vertical position. See **Fig. 19** . This aids in intake camshaft removal by using camshaft lobes on cylinders No. 1 and 3 to push on valve lifters.
2. Remove bolts, front camshaft bearing cap and oil seal from intake camshaft. Remove bolts from No. 1, 3 and 4 camshaft bearing caps on intake camshaft in proper sequence. See **Fig. 23** . DO NOT remove bolts from No. 2 camshaft bearing cap at this time. Remove No. 1, 3 and 4 camshaft bearing caps from intake camshaft.

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Fig. 23: Intake Camshaft Bearing Cap Bolt Removal & Installation Sequence
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

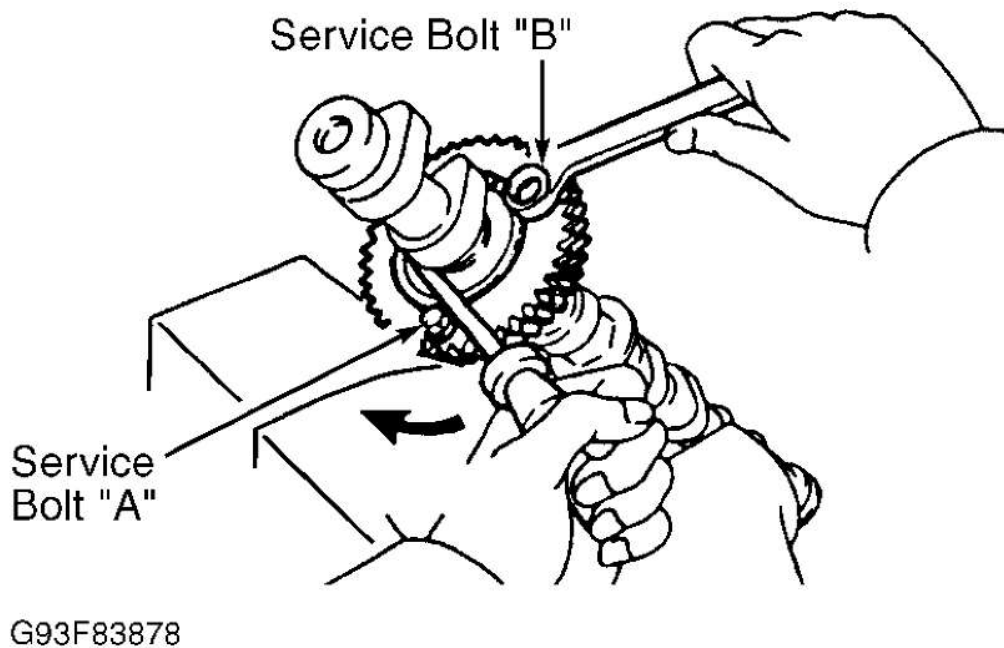
3. Alternately loosen bolts on No. 2 camshaft bearing cap on intake camshaft. Ensure intake camshaft is

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lifted upward as No. 2 camshaft bearing cap bolts are loosened.

4. If intake camshaft is not lifted upward, reinstall all camshaft bearing caps. Reposition intake camshaft so knock pin is 80-115 degrees from vertical position. See **Fig. 19** . Repeat steps 9) and 10) . Remove No. 2 camshaft bearing cap and intake camshaft.
5. If removing sub-gear from exhaust camshaft, mount camshaft in soft-jaw vise on hexagonal area of camshaft. Install service bolt "A" in camshaft. See **Fig. 24** .



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Fig. 24: Removing & Installing Sub-Gear On Main Gear
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. Using screwdriver, rotate sub-gear clockwise and remove service bolt "B". Remove snap ring, wave washer, sub-gear and camshaft gear spring from exhaust camshaft. See **Fig. 14** .
7. Note location of adjusting shims and valve lifters for reassembly reference. Remove adjusting shims and valve lifters from cylinder head (if necessary).

Inspection

1. Inspect components for damage. Check camshaft journal diameter, lobe height and journal runout. Replace camshaft if not within specification. See **CAMSHAFT** table under ENGINE SPECIFICATIONS. Install camshaft in cylinder head.
2. Using Plastigage, check camshaft oil clearance with camshaft bearing cap bolts tightened to specification in sequence. See **Fig. 22** and **Fig. 23** . See **TORQUE SPECIFICATIONS** .

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3. Check camshaft end play with camshaft bearing cap bolts tightened to specification. Replace camshaft and/or cylinder head if camshaft end play is not within specification. See **CAMSHAFT** table under ENGINE SPECIFICATIONS.
4. Install both camshafts in cylinder head without sub-gear installed on exhaust camshaft. Install and tighten camshaft bearing cap bolts to specification in sequence. See **Fig. 22** and **Fig. 23** . See **TORQUE SPECIFICATIONS** .
5. Using dial indicator, check gear backlash between gears on camshafts. Replace camshafts if gear backlash exceeds specification. See **CAMSHAFT** table under ENGINE SPECIFICATIONS.
6. Measure length of camshaft gear spring. Replace camshaft gear spring if distance is not within specification. See **CAMSHAFT** table under ENGINE SPECIFICATIONS. Measure valve lifter diameter and bore diameter. Ensure oil clearance is within specification. Replace components if not within specification. See **VALVE LIFTERS** table under ENGINE SPECIFICATIONS.

Installation

1. If installing sub-gear on exhaust camshaft, install camshaft gear spring, sub-gear, wave washer and snap ring on exhaust camshaft. Ensure pins on main gear and sub-gear engage with ends of camshaft gear spring.
2. Install service bolt "A" on sub-gear. See **Fig. 24** . Using screwdriver, rotate sub-gear clockwise and align hole in sub-gear with hole on main gear. Install service bolt "B". Remove service bolt "A".
3. Install adjusting shims and valve lifters in original location on cylinder head (if removed). Ensure valve lifters rotate smoothly in cylinder head.
4. Coat thrust surfaces of camshafts with multipurpose grease. To install intake camshaft, rotate intake camshaft so knock pin is at 80-115 degrees from vertical position, and install into cylinder head. See **Fig. 19** .
5. Coat seal lip of NEW oil seal for intake camshaft with grease. Install oil seal onto front of intake camshaft until oil seal is fully seated in cylinder head. Apply sealant to front camshaft bearing cap for intake camshaft. See **Fig. 25** .

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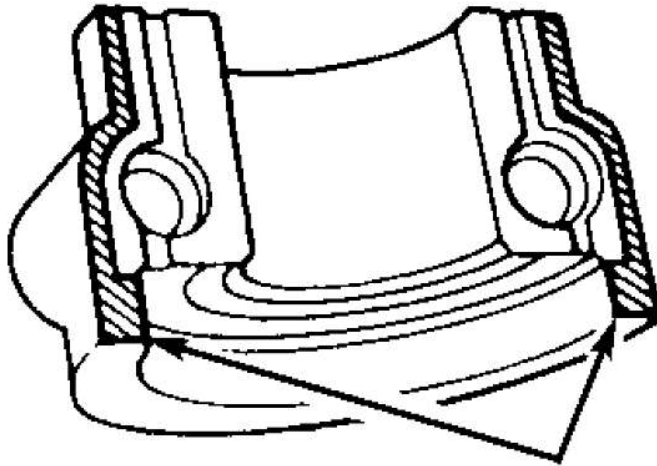
**Apply Sealant Here****G93G83879**

Fig. 25: Applying Sealant To Front Camshaft Bearing Cap
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. Install front camshaft bearing cap for intake camshaft onto cylinder head. Install remaining camshaft bearing caps for intake camshaft onto cylinder head in numerical sequence with arrow pointing toward timing belt end of engine. See **Fig. 21** .
7. Coat threads and bolt head-to-camshaft bearing cap contact surfaces of camshaft bearing cap bolts with engine oil. Install and tighten camshaft bearing cap bolts to specification in sequence using several steps. See **Fig. 23** . See **TORQUE SPECIFICATIONS** .
8. To install exhaust camshaft, rotate intake camshaft so knock pin is 10-45 degrees from vertical position. See **Fig. 19** . Install exhaust camshaft so timing mark aligns with timing mark on intake camshaft. DO NOT use assembly reference marks. See **Fig. 26** . Ensure exhaust camshaft is fully seated in cylinder head.

NOTE: It may be necessary to slightly rotate intake camshaft so exhaust camshaft fully seats in cylinder head.

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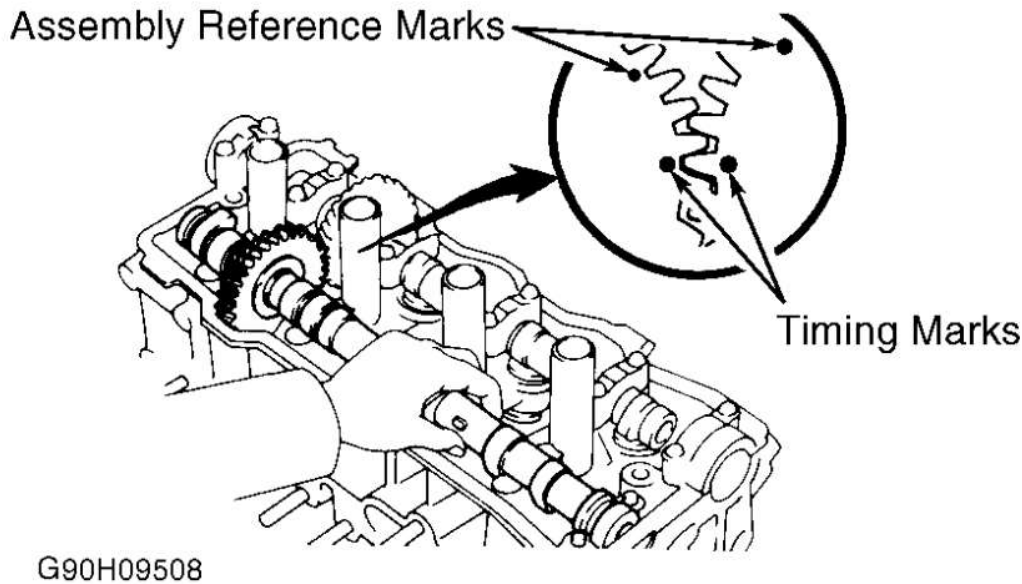


Fig. 26: Aligning Camshaft Timing Marks

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

9. Install camshaft bearing caps for exhaust camshaft on cylinder head in numerical sequence with arrow pointing toward timing belt end of engine. See **Fig. 21** .
10. Coat threads and bolt head-to-camshaft bearing cap contact surfaces of camshaft bearing cap bolts with engine oil. Install and tighten camshaft bearing cap bolts to specification in sequence using several steps. See **Fig. 22** . See **TORQUE SPECIFICATIONS** .
11. Remove service bolt "B" from camshaft gear. See **Fig. 24** . Install No. 3 timing belt cover. Install and tighten bolts to specification. See **TORQUE SPECIFICATIONS** . Install timing belt using proper procedure. See **TIMING BELT** .
12. Check valve clearance. See **VALVE CLEARANCE ADJUSTMENT** under ADJUSTMENTS. Apply sealant in grooves on rear side of semi-circular plugs located on exhaust camshaft side of cylinder head. Install semi-circular plugs in cylinder head.
13. Before installing gasket and valve cover, apply sealant at front and rear valve cover areas on cylinder head. See **Fig. 6** .
14. Using NEW gasket, install valve cover. Install grommets in original location with marking on grommet aligned in designated area. See **Fig. 7** . Install and tighten valve cover nuts to specification. See **TORQUE SPECIFICATIONS** .
15. If installing distributor, install NEW "O" ring on distributor. Coat "O" ring with engine oil.
16. Rotate crankshaft clockwise, as viewed from timing belt end of engine, so cylinder No. 1 is at TDC on compression stroke and timing mark on crankshaft pulley aligns with "0" mark on timing belt cover. Cylinder No. 1 is front cylinder at timing belt end of engine.

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17. Ensure slot area on intake camshaft is vertically positioned. Rotate coupling on distributor so cutout aligns with alignment mark on distributor housing.
18. Install distributor so center of flange on distributor is aligned with bolt hole on cylinder head. Install distributor hold-down bolt(s). Adjust ignition timing.

CRANKSHAFT REAR OIL SEAL

NOTE: On 4WD models, manufacturer recommends removing engine with transaxle for transaxle removal. On 2WD models, transaxle may be removed with engine in vehicle.

Removal

Remove transaxle, clutch assembly (if equipped) and flywheel/drive plate. Using a knife, cut seal lip from oil seal. Pry oil seal from rear seal housing. DO NOT damage sealing surfaces.

Installation

1. Ensure all sealing surfaces are clean. Apply grease to seal lip of new oil seal. Using Oil Seal Installer (SST 09223-15030), install oil seal into rear seal housing until oil seal is even with surface of rear seal housing.
2. Apply Loctite to flywheel/drive plate bolts. Install flywheel/drive plate. Install bolts and tighten to specification using a crisscross pattern. See **TORQUE SPECIFICATIONS** . To install remaining components, reverse removal procedure.

WATER PUMP**Removal**

1. Disconnect negative battery cable. Drain cooling system. Remove timing belt and idler pulley(s) as needed for access to water pump. See **TIMING BELT** .
2. Disconnect lower radiator hose from thermostat housing. Remove generator adjusting bracket. Remove coolant by-pass pipe-to-water pump nuts. See **Fig. 27** .

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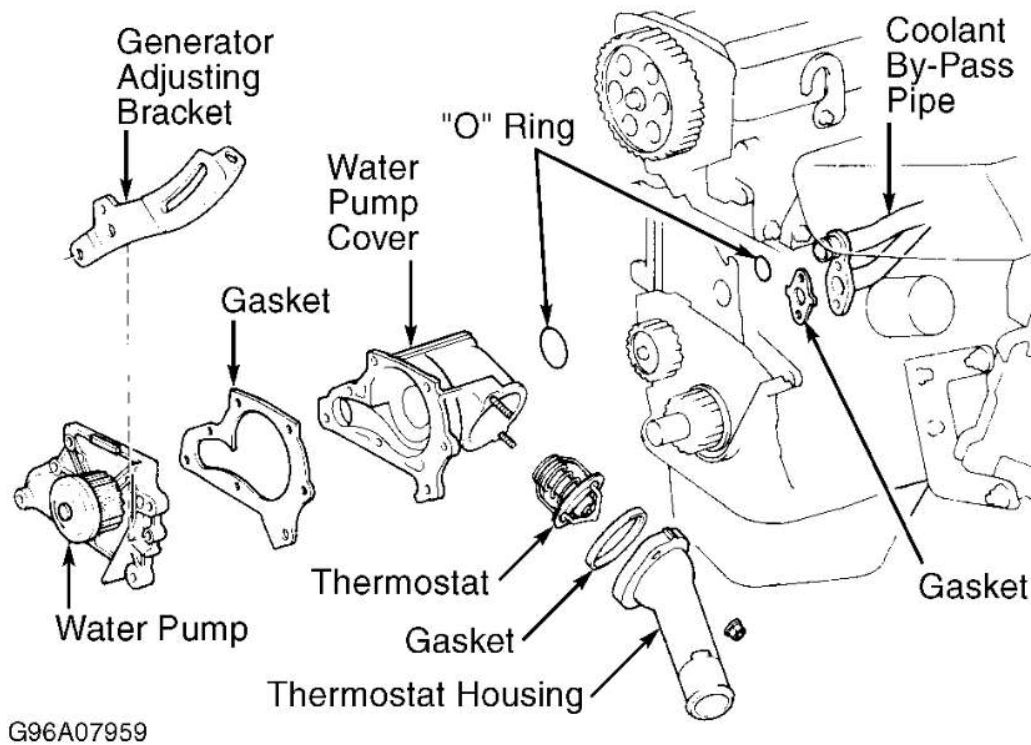
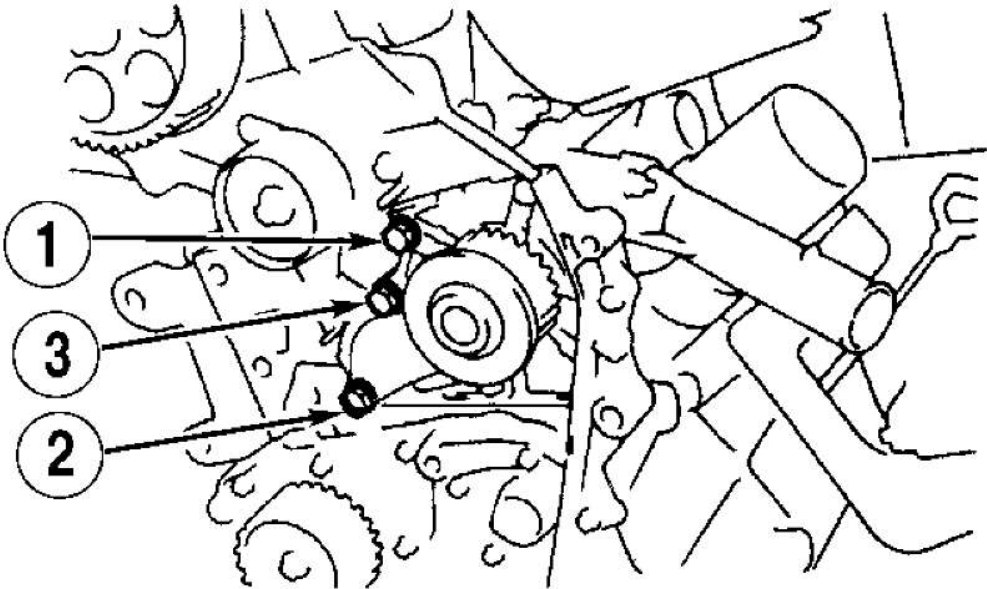


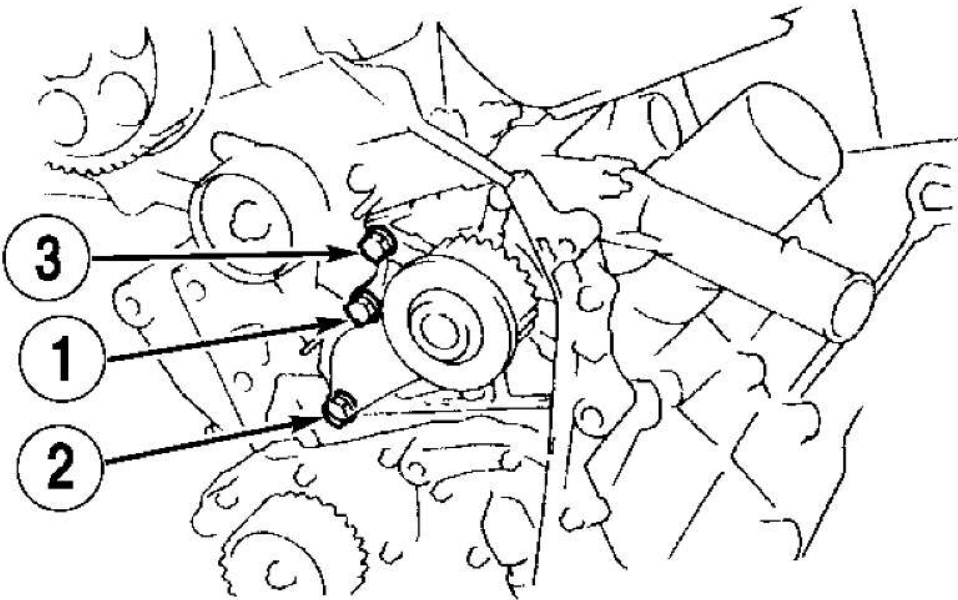
Fig. 27: Exploded View Of Typical Water Pump & Components
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. Remove water pump bolts in sequence. See **Fig. 28** . Remove water pump, water pump cover and "O" rings. See **Fig. 27** . Remove water pump-to-water pump cover bolts. Remove water pump and gasket from water pump cover.

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REMOVAL



INSTALLATION

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Fig. 28: Water Pump Bolt Removal & Installation Sequence

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Installation

1. To install, reverse removal procedure. Use NEW gaskets and NEW "O" rings. Apply soapy water solution to coolant by-pass pipe "O" ring before installing water pump.
2. Tighten water pump bolts to specification in sequence. Tightening coolant by-pass pipe-to-water pump nuts. See **Fig. 28** . See **TORQUE SPECIFICATIONS** . To install remaining components, reverse removal procedure. Fill cooling system.

OIL PAN**Removal**

1. Disconnect negative battery cable. Raise and support vehicle. Remove lower engine covers. Drain engine oil. Remove oil dipstick. Remove front exhaust pipe from between front catalytic converter on exhaust manifold and rear exhaust pipe for access to oil pan.
2. Remove stiffener plate at rear of oil pan for access to oil pan. Stiffener plate fits between sides of cylinder block and front of transaxle. Remove bolts/nuts and oil pan.

Installation

1. Ensure sealing surfaces are clean. Apply bead of sealant at center of oil pan sealing surface, between bolt/nut holes and on inside of bolt/nut holes.
2. Install oil pan. Install and tighten bolts/nuts to specification. See **TORQUE SPECIFICATIONS** .
3. To install remaining components, reverse removal procedure. Use NEW gasket and NEW nuts when installing front exhaust pipe onto catalytic converter. Ensure all bolts/nuts are loosely installed before tightening to specification. See **TORQUE SPECIFICATIONS** .

OVERHAUL**CYLINDER HEAD****Cylinder Head**

1. Inspect cylinder head warpage at cylinder block, exhaust manifold and intake manifold areas. Replace cylinder head if warpage exceeds specification. See **CYLINDER HEAD** table under ENGINE SPECIFICATIONS.
2. Install camshaft into cylinder head. Using Plastigage, check camshaft oil clearance with camshaft bearing cap bolts tightened to specification in sequence. See **Fig. 22** and **Fig. 23** . See **TORQUE SPECIFICATIONS** .
3. Check camshaft end play with camshaft bearing cap bolts tightened to specification. Replace camshaft and/or cylinder head if camshaft oil clearance or end play is not within specification. See **CAMSHAFT** table under ENGINE SPECIFICATIONS.

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4. Ensure valve lifter bore diameter in cylinder head is within specification. See **VALVE LIFTERS** table under ENGINE SPECIFICATIONS.

Valve Springs

Ensure valve spring free length, pressure and out-of-square are within specification. See **VALVES & VALVE SPRINGS** table under ENGINE SPECIFICATIONS.

CAUTION: Valve stems oil seals are painted a different color on top of oil seal for specified valve application. Intake valve stem oil seal is Brown and exhaust valve stem oil seal is Black. Ensure valve stem oil seal is installed in proper location.

Valve Stem Oil Seals

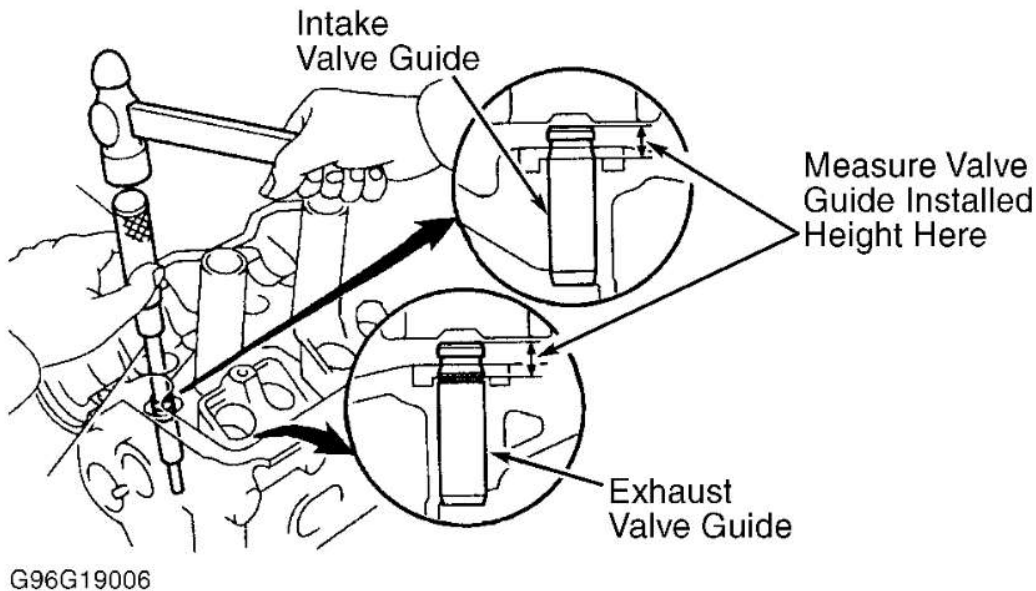
Intake valve stem oil seal is Brown. Exhaust valve stem oil seal is Black. Ensure proper valve stem oil seal is installed. Lubricate valve stem oil seal with engine oil. Install valve stem oil seal using Oil Seal Installer (SST 09201-41020).

Valve Guides

1. Ensure valve guide inside diameter is within specification. See **CYLINDER HEAD** table under ENGINE SPECIFICATIONS. Replace valve guide if inside diameter exceeds specification.
2. To replace valve guide, heat cylinder head to 176-212°F (80-100°C). Using a hammer and Valve Guide Remover/Installer (SST 09201-01060), drive valve guide from camshaft side of cylinder head.
3. Measure cylinder head valve guide bore inside diameter. If bore inside diameter is .4325-.4335" (10.985-11.012 mm), use standard valve guide. If bore inside diameter is .4344-.4355" (11.035-11.062 mm), use oversize valve guide.
4. If bore inside diameter exceeds .4335" (11.012 mm), machine valve guide bore to .4344-.4355" (11.035-11.062 mm) for oversize valve guide. If bore inside diameter exceeds .4355" (11.062 mm), replace cylinder head.
5. Intake valve guide is 1.516" (38.50 mm) long. Exhaust valve guide is 1.594" (40.50 mm) long. Ensure proper valve guide is installed.
6. To install valve guide, heat cylinder head to 176-212°F (80-100°C). Using hammer and valve guide remover/installer, drive valve guide in from camshaft side of cylinder head until valve guide installed height is .315-.346" (8.00-8.80 mm). Valve guide installed height is measured from top of valve guide to cylinder head surface. See **Fig. 29**.
7. On all valve guide applications, use .236" (6.00 mm) reamer to ream valve guide to obtain correct valve stem-to-guide oil clearance. See **CYLINDER HEAD** table under ENGINE SPECIFICATIONS.

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**Fig. 29: Measuring Valve Guide Installed Height**

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Valve Seat

Ensure valve seat angle and seat width are within specification. See **CYLINDER HEAD** table under ENGINE SPECIFICATIONS. Valve seat replacement information is not available from manufacturer.

Valves

Ensure minimum refinish length, stem diameter and valve margin are within specification. See **VALVES & VALVE SPRINGS** table under ENGINE SPECIFICATIONS.

Valve Seat Correction Angles

Use 30-degree and 45-degree stones to lower valve seat contact area. Use 45-degree and 75-degree stones to raise valve seat contact area.

VALVE TRAIN**Valve Lifters**

Ensure valve lifter diameter, bore diameter and oil clearance are within specification. See **VALVE LIFTERS** table under ENGINE SPECIFICATIONS.

CYLINDER BLOCK ASSEMBLY

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Piston & Rod Assembly

1. Ensure connecting rod and connecting rod cap are marked with matching cylinder number for reassembly reference. Piston, connecting rod and connecting rod must be installed with front mark toward timing belt end of engine. See **Fig. 31**.
2. Before disassembling piston and connecting rod, try to move piston back and forth on piston pin. Replace piston and piston pin as a set, if any movement is felt.
3. Remove 2 compression rings using a piston ring expander. Remove 2 oil rings and oil ring expander by hand. Using Piston Pin Remover/Replacer (09221-25026), press piston pin from piston, and remove connecting rod. See **Fig. 32**.
4. Ensure piston pin diameter is within specification. See **PISTONS, PINS & RINGS** table under ENGINE SPECIFICATIONS. Ensure connecting rod bend, twist and piston pin bore diameter (connecting rod small end) are within specification. See **CONNECTING RODS** table under ENGINE SPECIFICATIONS.
5. If piston pin bore diameter is not within specification, replace connecting rod assembly. See **CONNECTING RODS** table under ENGINE SPECIFICATIONS.
6. Using hand pressure, ensure nut rotates easily on connecting rod bolt. If nut fails to rotate easily, use caliper to measure connecting rod bolt outside diameter .59" (15.0 mm) from end of bolt. Standard connecting rod bolt outside diameter is .3094-.3150" (7.860-8.000 mm). Replace connecting rod bolt and nut assembly if bolt outside diameter is less than .2992" (7.600 mm).
7. Pistons with different diameters are used. Piston diameter is identified by size mark ("1", "2" or "3") stamped on top of piston. See **Fig. 30**.

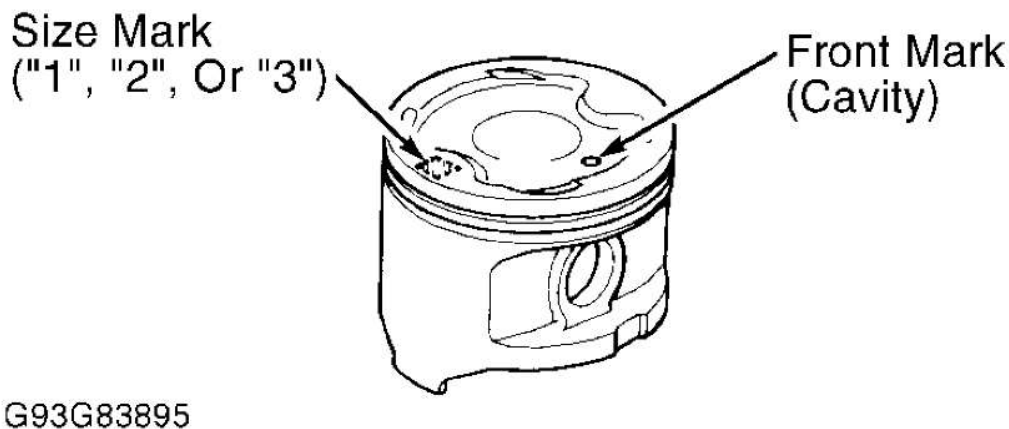


Fig. 30: Identifying Piston Size Marks

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

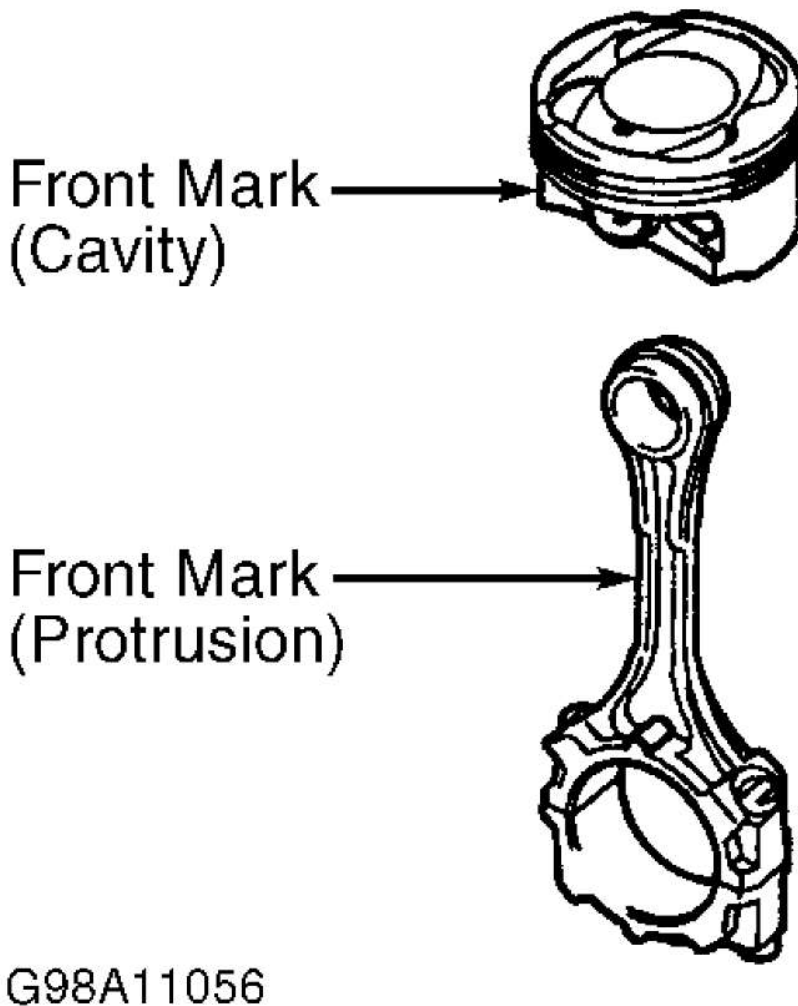
8. To determine piston diameter, measure piston skirt diameter .91-1.024" (23-26 mm) from top of piston, at 90-degree angle to piston pin. Ensure piston diameter is within size mark specification. See **PISTONS**.

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PINS & RINGS table under ENGINE SPECIFICATIONS.

9. To reassemble, position piston and connecting rod so front mark (cavity) on top of piston aligns with front mark (protrusion) on connecting rod. See **Fig. 31** . Coat piston bore and piston pin with engine oil. Using Piston Pin Remover/Replacer (09221-25026), press piston pin into piston and connecting rod. See **Fig. 32** .



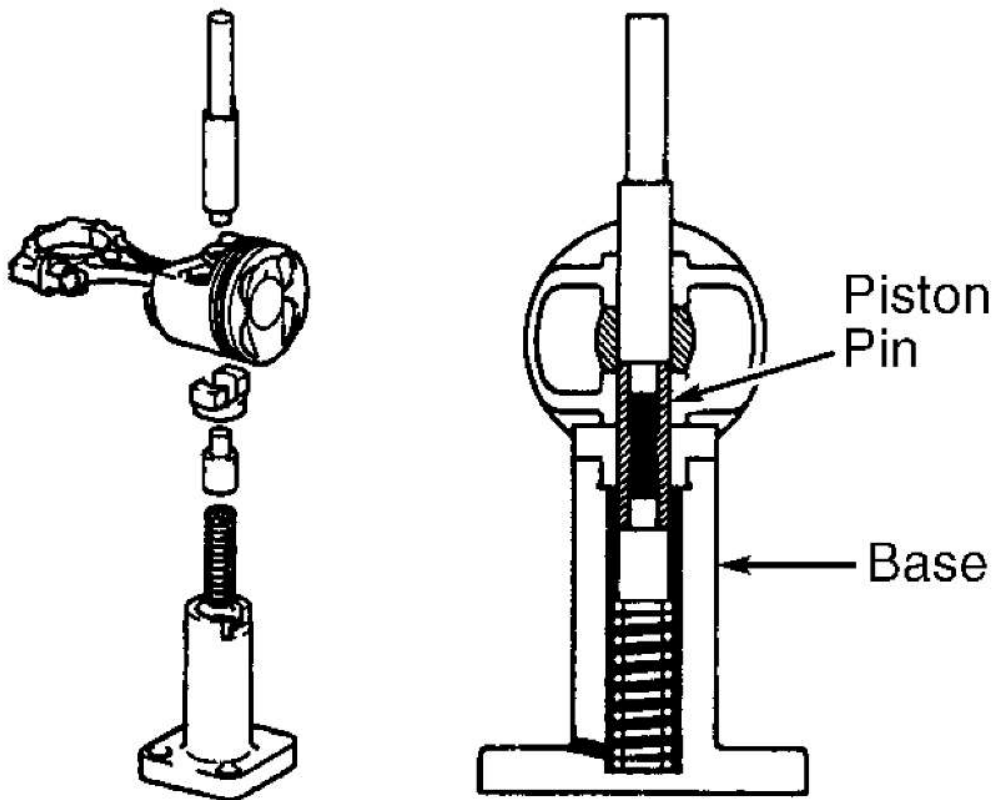
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Fig. 31: Identifying Piston Front Marks

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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Fig. 32: Removing & Installing Piston Pin

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Fitting Pistons

1. Different diameter pistons are used. Piston diameter is identified by size mark ("1", "2" or "3") stamped on top of piston. See **Fig. 30**.
2. Different cylinder bore diameters are used. Cylinder bore diameter may be identified by size mark ("1", "2" or "3") stamped on cylinder block deck surface. See **Fig. 33**.

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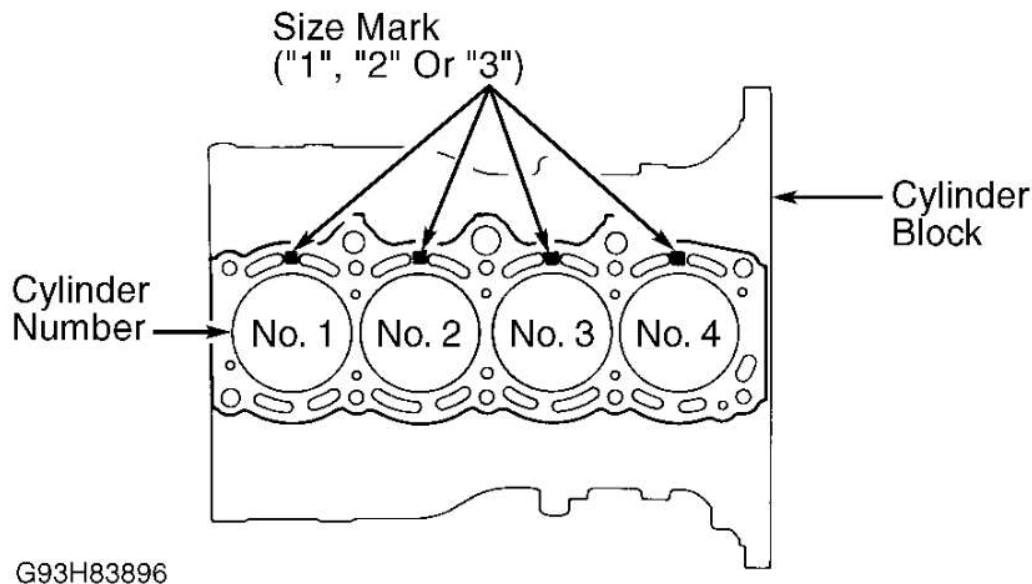


Fig. 33: Identifying Cylinder Bore Size Marks (Typical)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. To determine piston-to-cylinder clearance, measure piston diameter and cylinder bore diameter. Measure piston skirt diameter .91-1.024" (23-26 mm) from top of piston.
4. Measure cylinder bore diameter at 3 different positions, 90 degrees apart, .39" (10.0 mm) from top and bottom of cylinder bore, and at center of cylinder bore. Ensure piston diameter and cylinder bore diameter are within specification. See **PISTONS, PINS & RINGS** and **CYLINDER BLOCK** tables under ENGINE SPECIFICATIONS.
5. Calculate piston-to-cylinder clearance. Replace piston, or bore cylinder block for oversize pistons, if clearance is not within specification. See **PISTONS, PINS & RINGS** table under ENGINE SPECIFICATIONS. Pistons are available in .020" (.50 mm) oversize. If replacing piston, ensure replacement piston contains same size mark as size mark on cylinder block.

Piston Rings

1. Ensure piston ring end gap and side clearance are within specification. See **PISTONS, PINS & RINGS** table under ENGINE SPECIFICATIONS.
2. Install oil ring expander and 2 side rails by hand. Using a piston ring expander, install No. 2 compression ring with 2N or 2T identification mark facing up. Using a piston ring expander, install No. 1 compression ring with 1N or "T" identification mark facing up. Ensure compression rings and oil side rails are positioned correctly. See **Fig. 34**.

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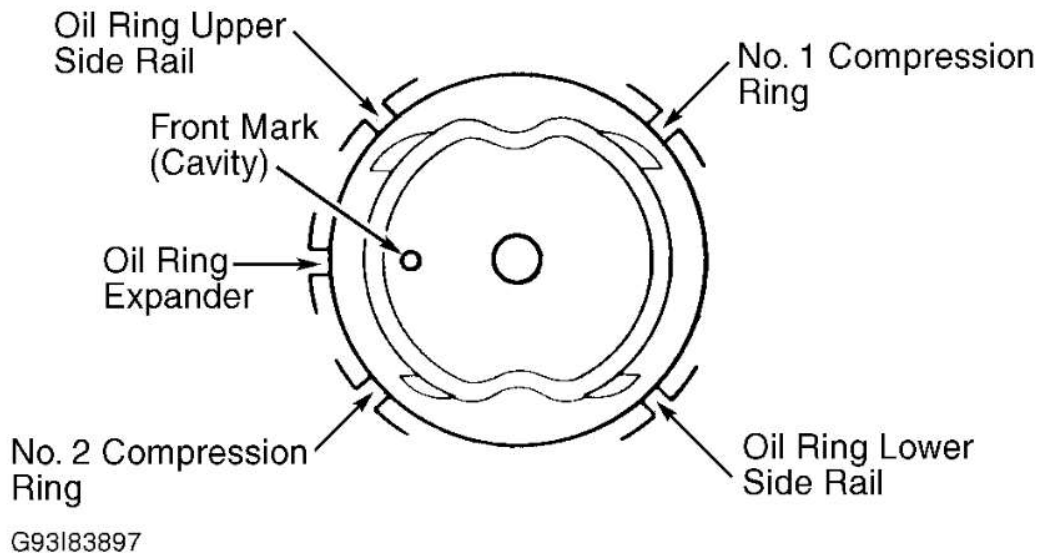


Fig. 34: Positioning Piston Rings

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Rod Bearings

1. Ensure connecting rod and connecting rod cap are marked with matching cylinder number for reassembly reference. Ensure connecting rod is installed so front mark (protrusion) at center of connecting rod is toward timing belt end of engine. Front mark (protrusion) on connecting rod cap must also face timing belt end of engine. See **Fig. 31**.
2. Connecting rod cap and rod bearing are stamped with size mark ("1", "2" or "3"). See **Fig. 35**. Ensure size marks on connecting rod cap and rod bearing are same.

NOTE: If replacing rod bearing, ensure size mark on replacement rod bearing is same as size mark on original rod bearing.

3. Rod bearing thickness is determined by size mark. See **ROD BEARING SPECIFICATIONS** table.
4. Ensure nut rotates easily on connecting rod bolt. If nut fails to rotate easily, use caliper to measure connecting rod bolt outside diameter at .59" (15.0 mm) from end of bolt. Replace connecting rod bolt and nut as an assembly if bolt outside diameter is less than .2992" (7.600 mm).
5. Install connecting rod cap with front mark (protrusion) toward timing belt end of engine. See **Fig. 31**. Coat threads of connecting rod bolts and nut-to-connecting rod cap surface with engine oil before tightening nuts to specification. See **TORQUE SPECIFICATIONS**.
6. Ensure bearing oil clearance and connecting rod side play are within specification. See **CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS** and **CONNECTING RODS** tables under ENGINE SPECIFICATIONS.

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ROD BEARING SPECIFICATIONS

Bearing Size Mark	Bearing Thickness - In. (mm)
"1"	.0584-.0586 (1.484-1.488)
"2"	.0586-.0587 (1.488-1.492)
"3"	.0587-.0589 (1.492-1.496)

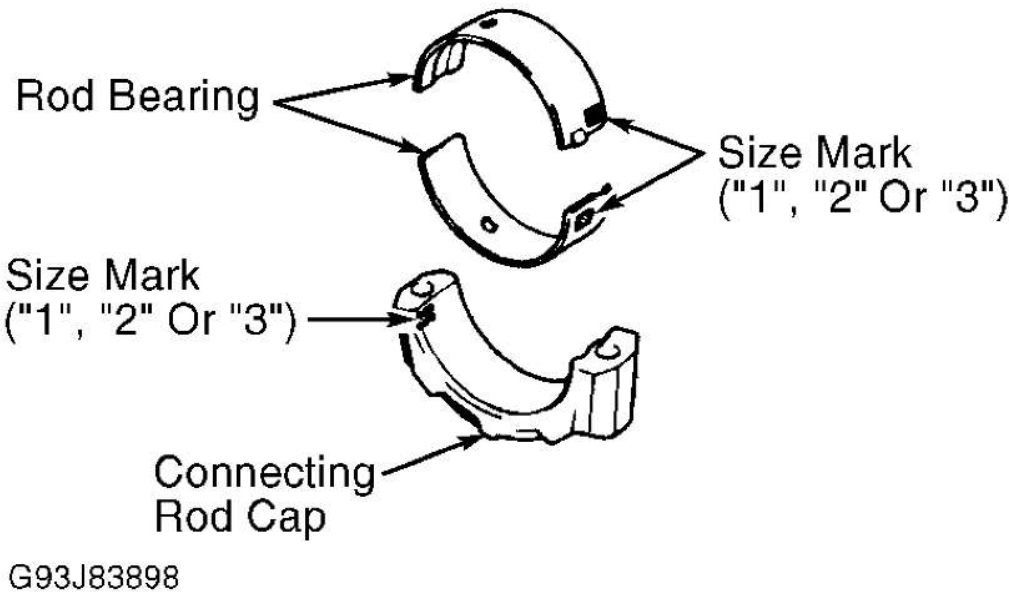


Fig. 35: Identifying Connecting Rod Cap & Rod Bearing Size Marks
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Crankshaft & Main Bearings

1. Main bearing caps are numbered on top of cap for location reference. No. 1 main bearing cap is at timing belt end of engine and No. 5 is at flywheel/drive plate end of engine. Ensure arrow on top of main bearing cap points toward timing belt end of engine.
2. Remove main bearing cap bolts in sequence. See **Fig. 36** . Remove main bearing caps, crankshaft, thrust bearings and main bearings.
3. Cylinder block main bearing bore inside diameter is identified by main bearing bore size mark ("1", "2" or "3") stamped on cylinder block. See **Fig. 37** . Front size mark indicates No. 1 main bearing bore and rear size mark indicates No. 5 main bearing bore.
4. Crankshaft main bearing journal diameter is identified by main bearing journal size mark ("0", "1" or "2") located on crankshaft counterweight. See **Fig. 37** .
5. Ensure crankshaft runout, journal diameter, taper and out-of-round are within specification. See **CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS** table under ENGINE

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SPECIFICATIONS.

6. Main bearing size mark ("1", "2", "3", "4" or "5") is located on side of main bearing. See **Fig. 37** . If replacing main bearing, ensure size mark on replacement main bearing is same as size mark on original main bearing.
7. If main bearing size mark cannot be obtained, add size marks on cylinder block and crankshaft to determine size mark of main bearing to be used. For example, if size mark on cylinder block is "2" and size mark on crankshaft is "1", use main bearing with size mark "3".

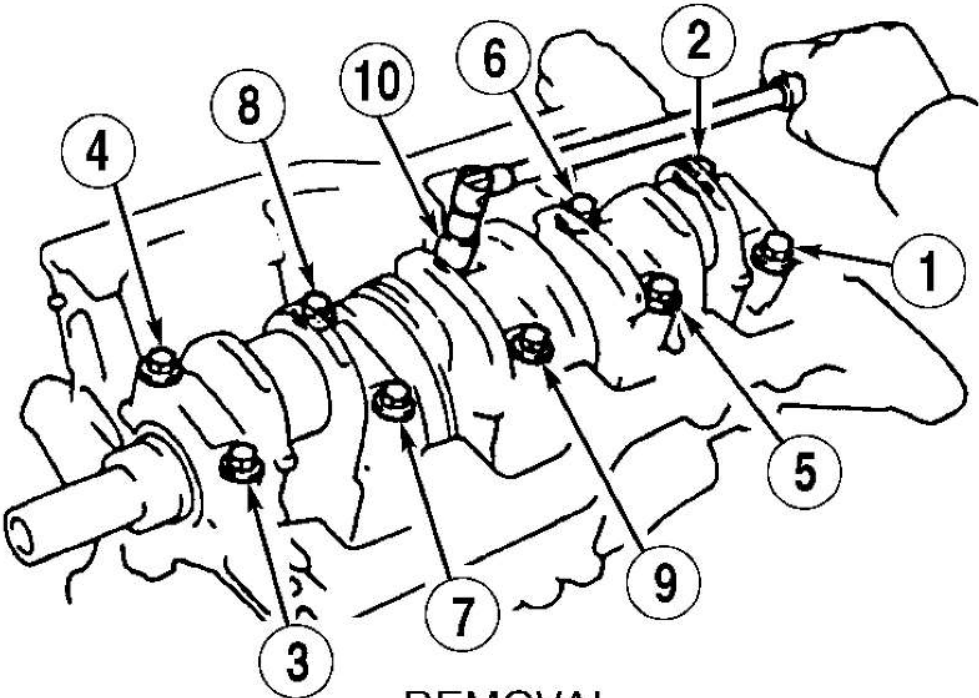
NOTE: **Different width main bearings are used. Install wide main bearing on No. 3 journal and narrow main bearings on all other journals.**

8. Main bearing thickness is determined by size mark. See **MAIN BEARING SPECIFICATIONS** table. Install main bearings, thrust bearings, crankshaft and main bearing caps.
9. Ensure main bearing caps are properly installed in numerical sequence with No. 1 at timing belt end, and No. 5 at flywheel/drive plate end of engine. Ensure arrow on top of main bearing cap points toward timing belt end of engine.
10. Coat threads and bolt-to-main bearing cap contact surfaces on main bearing cap bolts with engine oil. Install and tighten main bearing cap bolts to specification in sequence. See **Fig. 36** . See **TORQUE SPECIFICATIONS** .
11. Ensure crankshaft main bearing oil clearance and crankshaft end play are within specification. See **CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS** table under ENGINE SPECIFICATIONS. Replace thrust bearing if end play is not within specification.

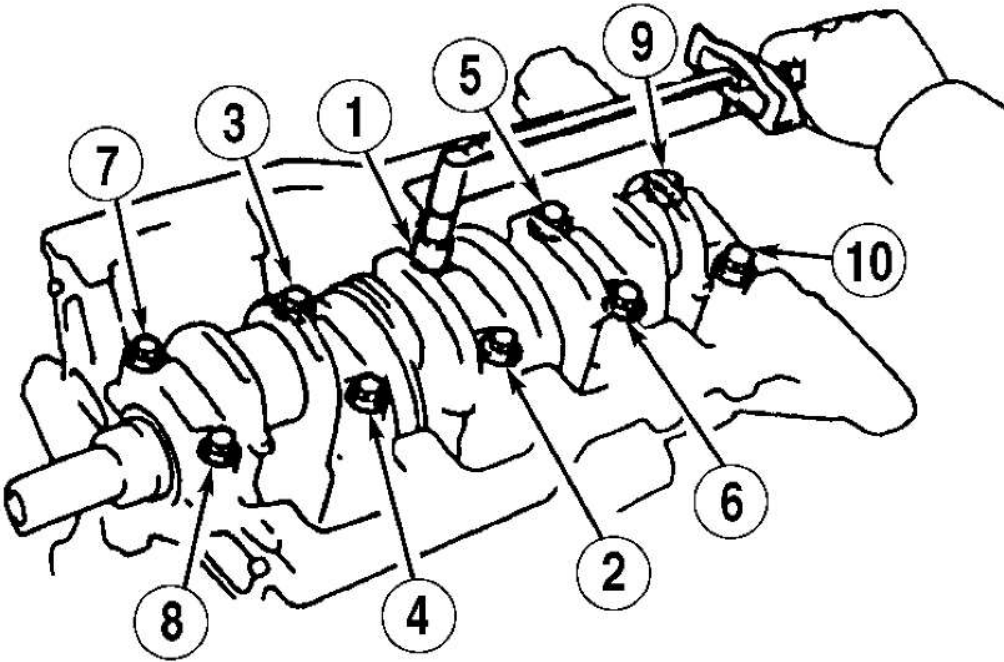
MAIN BEARING SPECIFICATIONS

Bearing Size Mark	Bearing Thickness - In. (mm)
No. 3 Main Bearing	
"1"	.07842-.07854 (1.9920-1.9950)
"2"	.07854-.07866 (1.9950-1.9980)
"3"	.07866-.07877 (1.9980-2.0010)
"4"	.07877-.07889 (2.0010-2.0040)
"5"	.07889-.07901 (2.0040-2.0070)
All Others	
"1"	.07862-.07874 (1.9970-2.0000)
"2"	.07874-.07885 (2.0000-2.0030)
"3"	.07885-.07897 (2.0030-2.0060)
"4"	.07897-.07909 (2.0060-2.0090)
"5"	.07909-.07921 (2.0090-2.0120)

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REMOVAL



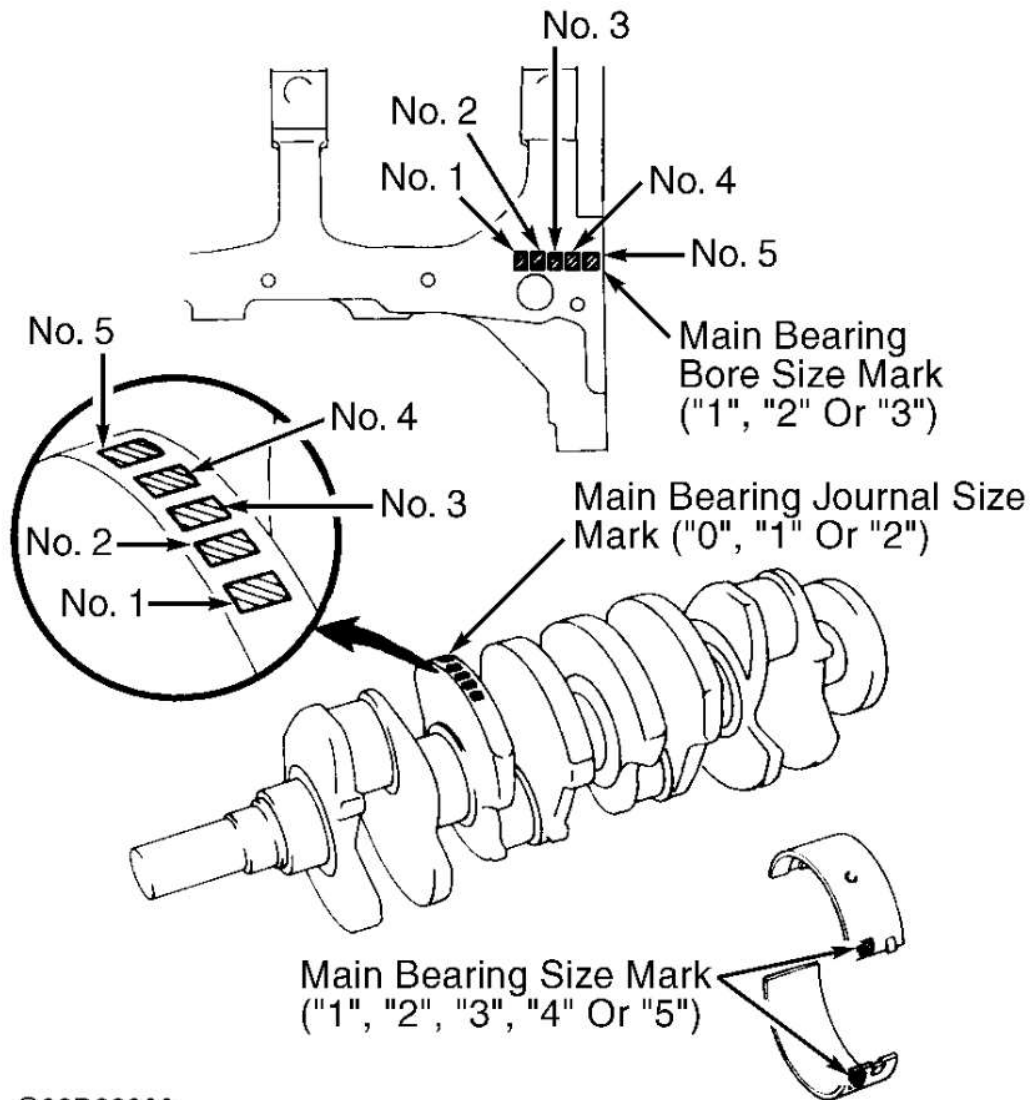
INSTALLATION

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Fig. 36: Main Bearing Cap Bolt Removal & Installation Sequence
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.



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Fig. 37: Identifying Cylinder Block, Crankshaft & Main Bearing Size Marks
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Thrust Bearing

Install thrust bearing on No. 3 main bearing with grooves facing toward crankshaft, and away from cylinder block and main bearing cap. Replace thrust bearing if crankshaft end play is not within specification. See

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CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS table under ENGINE SPECIFICATIONS.

Cylinder Block

1. Inspect cylinder block deck surface warpage. Replace cylinder block if deck warpage exceeds specification. See **CYLINDER BLOCK** table under ENGINE SPECIFICATIONS.
2. Different cylinder bore diameters are used. Cylinder bore diameter may be identified by size mark ("1", "2" or "3") on cylinder block deck surface. See **Fig. 37**.
3. Measure cylinder bore diameter at 2 different places, 90 degrees apart at .39" (10.0 mm) from top and bottom of cylinder bore and at center of cylinder bore. Ensure cylinder bore diameter is within specification. See **CYLINDER BLOCK** table under ENGINE SPECIFICATIONS.
4. Bore cylinder block for oversize pistons if cylinder bore diameter is not within specification. Pistons are available in .020" (.50 mm) oversize.
5. Install main bearing caps in numerical sequence with No. 1 at timing belt end, and No. 5 at flywheel/drive plate end of engine. Ensure arrow on top of main bearing cap points toward timing belt end of engine.
6. Install and tighten main bearing cap bolts to specification in sequence. See **Fig. 36**. See **TORQUE SPECIFICATIONS**.
7. Ensure main bearing bore inside diameter is within specification. See **CYLINDER BLOCK** table under ENGINE SPECIFICATIONS.

NOTE: Main bearing bore inside diameter is identified by main bearing bore size mark ("1", "2" or "3") stamped on cylinder block. See **Fig. 37**.

ENGINE OILING

ENGINE LUBRICATION SYSTEM

Crankshaft driven oil pump provides pressurized engine lubrication. Oil cooler is installed between oil filter and cylinder block.

Crankcase Capacity

Drain and refill capacity with oil filter is approximately 4.3 qts. (4.1L). Dry fill capacity is approximately 4.8 qts. (4.6L).

Oil Pressure

With engine at normal operating temperature, oil pressure should be at least 4.3 psi (0.3 kg/cm²) at idle and 36-71 psi (2.5-5.0 kg/cm²) at 3000 RPM.

OIL PUMP

Removal & Disassembly

1. Remove timing belt, No. 2 idler pulley, crankshaft sprocket and oil pump sprocket. See **TIMING BELT**

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under REMOVAL & INSTALLATION. Remove oil pan. See **OIL PAN** under REMOVAL & INSTALLATION.

2. Remove oil pump pick-up tube, gasket and oil baffle plate. Disconnect electrical connector for crankshaft position sensor located on front of oil pump housing. Remove bolt and crankshaft position sensor from front of oil pump housing.
3. Remove oil pump-to-cylinder block bolts. Using soft-face hammer, tap oil pump housing from cylinder block. To disassemble oil pump, remove oil pump body cover bolts, oil pump body cover and "O" ring. Disassemble oil pump components. See **Fig. 38**. Remove oil pump oil seal and crankshaft front oil seal (if necessary).

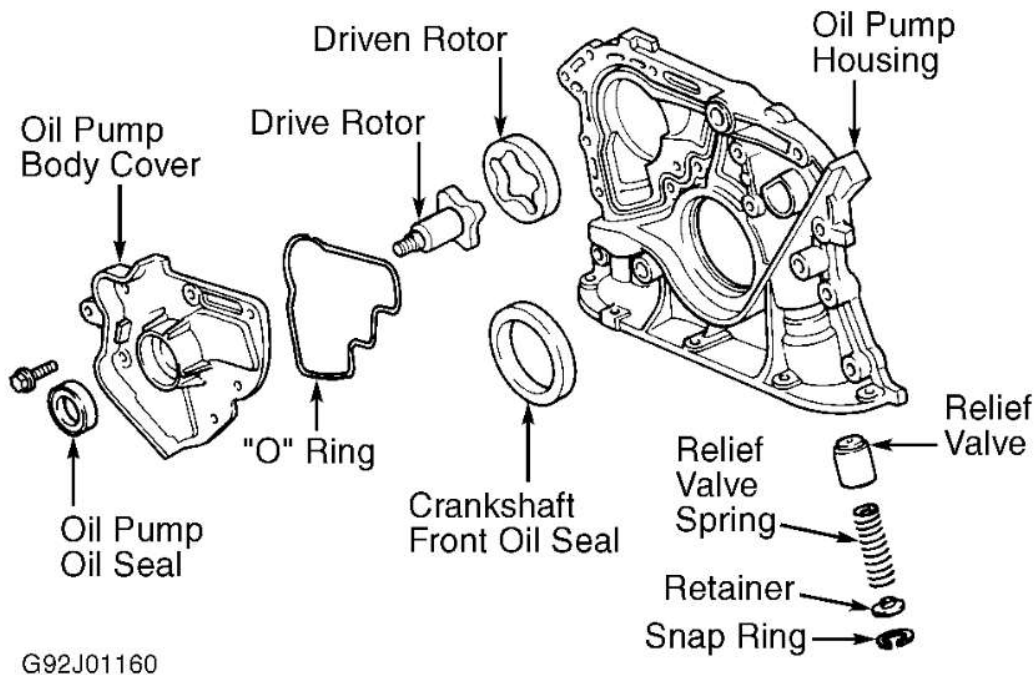


Fig. 38: Exploded View Of Oil Pump

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Inspection

1. Inspect components for damage. Coat relief valve with engine oil and ensure relief valve slides freely in bore of oil pump housing. Replace relief valve and/or oil pump housing if relief fails to slide freely.
2. Install rotors in oil pump housing. Using feeler gauge, measure driven rotor-to-oil pump housing clearance. Replace rotor assembly or oil pump housing if clearance exceeds specification. See **OIL PUMP SPECIFICATIONS** table.
3. Using feeler gauge, measure rotor tip clearance between tip of drive rotor and tip of driven rotor. Tip of drive rotor is on outside of rotor and tip of driven rotor is on inside of rotor. Replace rotor assembly if clearance exceeds specification. See **OIL PUMP SPECIFICATIONS** table.

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OIL PUMP SPECIFICATIONS

Application	In. (mm)
Driven Rotor-To-Oil Pump Housing Clearance	
Standard	.0039-.0063 (.100-.160)
Wear Limit	.0079 (.200)
Rotor Tip Clearance	
Standard	.0016-.0063 (.040-.160)
Wear Limit	.0079 (.200)

Reassembly & Installation

1. To reassemble, reverse disassembly procedure. Ensure reference marks (dot area) on rotors face toward oil pump body cover, away from oil pump housing.
2. Using hammer and Oil Seal Installer (SST 09950-60010), install NEW crankshaft front oil seal (if removed) until oil seal surface is even with oil pump housing. Coat lip of oil seal with grease.
3. Install NEW oil pump oil seal (if removed) until oil seal surface is even with oil pump body cover. Coat lip of oil seal with grease.
4. Install oil pump body cover using NEW "O" ring. Install and tighten oil pump body cover bolts to specification. See **TORQUE SPECIFICATIONS** . Using NEW gasket, install oil pump on cylinder block.
5. Ensure 2 longest oil pump-to-cylinder block bolts are located in lowest outside holes nearest to oil pan flange on each side of oil pump. Tighten oil pump-to-cylinder block bolts to specification. See **TORQUE SPECIFICATIONS** . To install remaining components, reverse removal procedure.

OIL COOLER

Removal

1. Oil cooler is mounted between oil filter and cylinder block. Disconnect negative battery cable. Drain cooling system.
2. Remove passenger-side lower engine cover. Remove front exhaust pipe from between front catalytic converter on exhaust manifold and rear exhaust pipe. Remove generator.
3. Remove exhaust manifold with catalytic converter and heat insulators for access to oil cooler. Remove oil filter. Disconnect coolant hoses from oil cooler. Remove oil cooler relief valve and plate washer from center of oil cooler housing. Remove oil cooler-to-cylinder block nut. Remove oil cooler, gasket and "O" ring.

Inspection

1. Inspect oil cooler for damage. Apply air pressure to coolant hose pipe on oil cooler. Ensure air flows through oil cooler, and oil cooler is not restricted. Replace oil cooler if damage or restricted.
2. Using wooden stick, push inward on check valve located in center of oil cooler relief valve. Push inward from threaded end (opposite oil filter threads) on oil cooler relief valve. Replace oil cooler relief valve if check valve fails to move.

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Installation

1. To install, reverse removal procedure. Use a NEW "O" ring and gasket. Coat "O" ring with engine oil. Coat threads and area below head of oil cooler relief valve with engine oil.
2. Install oil cooler with oil cooler-to-cylinder block nut and oil cooler relief valve loosely installed. Tighten oil cooler relief valve, and then nut, to specification. See **TORQUE SPECIFICATIONS**.
3. Use NEW gasket and NEW nuts when installing front exhaust pipe to catalytic converter. Ensure all bolts/nuts are loosely installed before tightening to specification. See **TORQUE SPECIFICATIONS**. Add engine oil as needed. Fill cooling system.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
ABS Actuator Mounting Bracket-To-Body Bolt/Nut	14 (19)
A/C Compressor Bolt/Nut	
Bolt	27 (37)
Nut	20 (27)
Stud Bolt	34 (46)
Axle Shaft Bearing Bracket Bolt	
2WD A/T Models	47 (64)
Axle Shaft Bearing Bracket-To-Cylinder Block Bolt	
2WD A/T & M/T Models	47 (64)
Axle Shaft Nut	159 (216)
Axle Shaft Retaining Bolt	
2WD M/T Models	24 (33)
Ball Joint-To-Lower Control Arm Bolt/Nut	94 (127)
Brake Line-To-ABS Actuator Nut	11 (15)
Camshaft Bearing Cap Bolt ⁽¹⁾	14 (19)
Camshaft Sprocket Bolt	40 (54)
Connecting Rod Nut	
Step 1	18 (24)
Step 2	Additional 90 Degrees
Coolant Outlet Nut	11 (15)
Crankshaft Pulley Bolt	80 (108)
Cylinder Head Bolt ⁽²⁾	
Step 1	36 (49)
Step 2	Additional 90 Degrees
Distributor Hold-Down Bolt	14 (19)
Drive Shaft Center Support Bearing Bolt	

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4WD Models	27 (37)
Drive Shaft Flange Bolt/Nut	
4WD Models	54 (73)
EGR Valve	
Nut	(3)
Union Nut	43 (58)
Engine Mounts & Brackets	
Front (Exhaust Manifold Side) Engine Mount-To-Engine Mount Crossmember Bolt	59 (80)
Left (Transaxle Side) Engine Mounting Bracket-To-Engine Mount Bolt/Nut	47 (64)
Right (Timing Belt Side) Engine Mounting Bracket-To-Cylinder Block Bolt	38 (52)
Right (Timing Belt Side) Engine Mount-To-Body Bolt	47 (64)
Right (Timing Belt Side) Engine Mounting Bracket-To-Engine Mount Bolt/Nut	
Bolt	27 (37)
Nut	38 (52)
Engine Mount Crossmember-To-Body Bolt	26 (35)
Exhaust Manifold Nut	36 (49)
Flywheel/Drive Plate Bolt	
A/T	61 (83)
M/T	65 (88)
Front Catalytic Converter Brace Bolt/Nut	31 (42)
Front Catalytic Converter-To-Exhaust Manifold Bolt/Nut	45 (61)
Front Exhaust Pipe-To-Front Catalytic Converter Nut	46 (62)
Front Exhaust Pipe-To-Rear Exhaust Pipe Bolt/Nut	35 (47)
Front Suspension Crossmember Bolt	
Bolt At Body	152 (206)
Bolt At Lower Control Arm	101 (137)
Fuel Line-To-Fuel Filter Union Bolt	21 (28)
Fuel Pipe-To-Delivery Pipe Union Bolt	25 (34)
Generator Adjusting Bracket Bolt	20 (27)
Generator Mounting Bracket Bolt	31 (42)
Intake Manifold Bolt/Nut	14 (19)
Intake Manifold Brace Bolt	31 (42)
Main Bearing Cap Bolt ⁽⁴⁾	43 (58)
No. 1 & No. 2 Idler Pulley Bolt	31 (42)
Oil Cooler Relief Valve	58 (79)
Oil Pump Sprocket Nut	18 (24)
Oxygen Sensor-To-Exhaust Manifold Nut	15 (20)
Oxygen Sensor-To-Front Catalytic Converter	33 (45)
Power Steering Pump Bolt	32 (43)

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Power Steering Pump Mounting Bracket-To-Cylinder Block Bolt	32 (43)
Spark Plug	13 (18)
Spark Plug Tube	39 (53)
Stabilizer Bar Link-To-Lower Control Arm Nut	
2-Door Vehicles	33 (45)
4-Door Vehicles	54 (73)
Stabilizer Bar-To-Frame Mount Bolt	22 (30)
Starter Bolt	29 (39)
Steering Gear Assembly-To-Front Suspension Crossmember Bolt/Nut	83 (113)
Stiffener Plate Bolt	27 (37)
Throttle Body Bolt/Nut	14 (19)
Tie Rod Nut	41 (56)
Valve Cover Nut	33 (45)
Wheel Lug Nut	76 (103)
INCH Lbs. (N.m)	
ABS Speed Sensor Bolt	71 (8.0)
Clutch Release Cylinder Bolt	106 (12.0)
Coolant By-Pass Pipe-To-Water Pump Nut	82 (9.3)
Crankshaft Position Sensor Bolt	71 (8.0)
Fuel Delivery Pipe-To-Cylinder Head Bolt	115 (13.0)
No. 3 Timing Belt Cover Bolt	69 (7.8)
Oil Baffle Plate-To-Cylinder Block Bolt/Nut	48 (5.4)
Oil Cooler-To-Cylinder Block Nut	78 (8.8)
Oil Pan Bolt/Nut	48 (5.4)
Oil Pump Body Cover Bolt	78 (8.8)
Oil Pump Pick-Up Tube Bolt/Nut	48 (5.4)
Oil Pump-To-Cylinder Block Bolt	78 (8.8)
Rear Plate-To-Cylinder Block Bolt	82 (9.3)
Rear Seal Housing Bolt	115 (13.0)
Thermostat Housing Nut	78 (8.8)
Water Pump-To-Cylinder Block Bolt ⁽⁵⁾	78 (8.8)
Water Pump-To-Water Pump Cover Bolt	78 (8.8)

(1) Tighten bolts to specification in sequence. See **Fig. 22** and **Fig. 23** .

(2) Tighten bolts to specification in sequence. See **Fig. 15** .

(3) Tighten nut to 115 INCH lbs. (13.0 N.m).

(4) Tighten bolts to specification in sequence. See **Fig. 36** .

(5) Tighten bolts to specification in sequence. See **Fig. 28** .

ENGINE SPECIFICATIONS

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GENERAL SPECIFICATIONS

Application	Specification
Displacement	122 Cu. In. (2.0L)
Bore	3.39" (86.0 mm)
Stroke	3.39" (86.0 mm)
Compression Ratio	9.5:1
Fuel System	SFI

CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS

Application	In. (mm)
Crankshaft	
End Play	
Standard	.0008-.0087 (.020-.220)
Wear Limit	.0118 (.300)
Maximum Runout	.0024 (.060)
Main Bearings	
Journal Diameter ⁽¹⁾	
Size Mark "0"	2.1653-2.1655 (54.998-55.003)
Size Mark "1"	2.1651-2.1653 (54.993-54.998)
Size Mark "2"	2.1649-2.1651 (54.988-54.993)
Journal Out-Of-Round	.0008 (.020)
Journal Taper	.0008 (.020)
Oil Clearance	
Standard Crankshaft Journal	
No. 3 Journal	
Standard	.0010-.0017 (.025-.044)
Wear Limit	.0031 (.080)
All Other Journals	
Standard	.0006-.0013 (.015-.034)
Wear Limit	.0031 (.080)
.010" (.25 mm) Undersize Crankshaft Journal	
No. 3 Journal	
Standard	.0011-.0026 (.027-.067)
Wear Limit	.0031 (.080)
All Other Journals	
Standard	.0007-.0023 (.019-.059)
Wear Limit	.0031 (.080)
Connecting Rod Bearings	
Journal Diameter	
Standard	2.0466-2.0472 (51.985-52.000)
Undersized .010" (.25 mm)	2.0372-2.0376 (51.745-51.755)

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Journal Out-Of-Round	.0008 (.020)
Journal Taper	.0008 (.020)
Oil Clearance	
Standard Crankshaft Journal	
Standard	.0009-.0022 (.024-.055)
Wear Limit	.0031 (.080)
.010" (.25 mm) Undersize Crankshaft Journal	
Standard	.0009-.0027 (.024-.069)
Wear Limit	.0031 (.080)
(1) Main bearing journal diameter is determined by size mark stamped on crankshaft. See Fig. 37 .	

CONNECTING RODS

Application	In. (mm)
Piston Pin Bushing	
Bore Diameter	.8660-.8665 (21.997-22.009)
Piston Pin Oil Clearance ⁽¹⁾	
Standard	.0002-.0004 (.005-.010)
Wear Limit	.0020 (.050)
Maximum Bend	.002 Per 3.94 (.05 Per 100.0)
Maximum Twist	.0059 Per 3.94 (.150 Per 100.0)
Side Play	
Standard	.0063-.0123 (.160-.312)
Wear Limit	.0138 (.350)
(1) Piston pin oil clearance is the difference between the inside diameter of the connecting rod piston pin bushing bore and the outside diameter of the piston pin.	

PISTONS, PINS & RINGS

Application	In. (mm)
Pistons	
Clearance	
Standard	.0056-.0064 (.143-.163)
Wear Limit	.0072 (.183)
Diameter ⁽¹⁾	
Size Mark "1"	3.3798-3.3802 (85.847-85.857)
Size Mark "2"	3.3802-3.3806 (85.857-85.867)
Size Mark "3"	3.3806-3.3810 (85.867-85.877)
Over Size .1969" (.50 mm)	3.3995-3.4007 (86.347-

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1999-2000 ENGINES 2.0L 4-Cylinder

	86.377)
Pins	
Diameter	.8660-.8665 (21.997-22.009)
Piston Fit	(2)
Rod Fit (Oil Clearance)	
Standard	.0002-.0004 (.005-.011)
Wear Limit	.0020 (.050)
Rings	
No. 1	
End Gap ⁽³⁾	
Standard	.0106-.0185 (.270-.470)
Wear Limit	.0421 (1.070)
Side Clearance	.0012-.0028 (.030-.070)
No. 2	
End Gap ⁽³⁾	
Standard	.0177-.0256 (.450-.650)
Wear Limit	.0492 (1.250)
Side Clearance	.0012-.0028 (.030-.070)
No. 3 (Oil)	
End Gap ⁽³⁾	
Standard	.0056-.0064 (.143-.163)
Wear Limit	.0072 (.183)
(1) Piston diameter is determined by size mark stamped on top of piston. See Fig. 30 .	
(2) Piston pin has an interference fit and pin must be pressed into connecting rod and piston.	
(3) Using a piston with rings removed, push ring into cylinder bore 4.33" (110 mm) from the top.	

CYLINDER BLOCK

Application	In. (mm)
Cylinder Bore ⁽¹⁾	
Size Mark "1"	3.3858-3.3862 (86.000-86.010)
Size Mark "2"	3.3862-3.3866 (86.010-86.020)
Size Mark "3"	3.3866-3.3870 (86.020-86.030)
Maximum Standard Size	3.3949 (86.230)
.020" (.50 mm) Oversize	3.4146 (86.731)
Maximum Deck Warpage	.0020 (.050)
Main Bearing Bore I.D. ⁽²⁾	
Size Mark "1"	2.3236-2.3239 (59.020-59.026)
Size Mark "2"	2.3239-2.3241 (59.026-59.032)
Size Mark "3"	2.3241-2.3243 (59.032-59.038)

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- (1) Cylinder bore diameter is determined by size mark on cylinder block deck surface. See **Fig. 33** .
- (2) Main bearing bore I.D. is determined by main bearing bore size mark on cylinder block. See **Fig. 37** .

VALVES & VALVE SPRINGS

Application	Specification
Intake Valves	
Face Angle	44.5°
Minimum Margin	.020" (.50 mm)
Minimum Refinish Length	3.823" (97.10 mm)
Stem Diameter	.2350-.2356" (5.970-5.985 mm)
Exhaust Valves	
Face Angle	44.5°
Minimum Margin	.020" (.50 mm)
Minimum Refinish Length	3.858" (98.00 mm)
Stem Diameter	.2348-.2354" (5.965-5.980 mm)
Valve Springs	
Free Length	1.6520-1.6531" (41.96-41.99 mm)
Out-Of-Square Limit	.079" (2.00 mm)
	Lbs. @ In. (kg @ mm)
Pressure	37-43 @ 1.366 (16.7-19.5 @ 34.70)

CYLINDER HEAD

Application	Specification
Maximum Warpage	
Cylinder Block Surface	.0020" (.050 mm)
Intake & Exhaust Manifold Surface	.0031" (.080 mm)
Valve Seats	
Intake Valve	
Seat Angle	45°
Seat Width	.039-.055" (1.00-1.40 mm)
Exhaust Valve	
Seat Angle	45°
Seat Width	.039-.055" (1.00-1.40 mm)
Valve Guides	
Intake Valve	
Valve Guide Cylinder Head Bore I.D.	
Standard Valve Guide	.4325-.4335" (10.985-11.012 mm)

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	mm)
Oversize Valve Guide	.4344-.4355" (11.035-11.062 mm)
Valve Guide I.D.	.2366-.2374" (6.010-6.030 mm)
Valve Guide Installed Height	.315-.346" (8.00-8.80 mm)
Valve Stem-To-Guide Oil Clearance	
Standard	.0010-.0024" (.025-.060 mm)
Wear Limit	.0031" (.080 mm)
Exhaust Valve	
Valve Guide Cylinder Head Bore I.D.	
Standard Valve Guide	.4325-.4335" (10.985-11.012 mm)
Oversize Valve Guide	.4344-.4355" (11.035-11.062 mm)
Valve Guide I.D.	.2366-.2374" (6.010-6.030 mm)
Valve Guide Installed Height	.315-.346" (8.00-8.80 mm)
Valve Stem-To-Guide Oil Clearance	
Standard	.0012-.0026" (.030-.065 mm)
Wear Limit	.0039" (.100 mm)

CAMSHAFT

Application	In. (mm)
End Play	
Intake Camshaft	
Standard	.0018-.0039 (.045-.100)
Wear Limit	.0047 (.120)
Exhaust Camshaft	
Standard	.0012-.0033 (.030-.085)
Wear Limit	.0039 (.100)
Gear Backlash	
Standard	.0008-.0079 (.020-.200)
Wear Limit	.0118 (.300)
Gear Spring Free Length	.886-.902 (22.50-22.91)
Journal Diameter	1.0614-1.0620 (26.959-26.975)
Journal Runout	.0016 (.040)
Lobe Height	
Intake Camshaft	
Standard	1.6539-1.6579 (42.010-42.110)
Wear Limit	1.6496 (41.900)
Exhaust Camshaft	

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Standard	1.5772-1.5811 (40.060-40.160)
Wear Limit	1.5728 (39.950)
Oil Clearance	
Standard	.0010-.0024 (.025-.062)
Wear Limit	.0039 (.100)

VALVE LIFTERS

Application	In. (mm)
Bore Diameter	1.2205-1.2211 (31.000-31.016)
Lifter Diameter	1.2191-1.2195 (30.966-30.976)
Oil Clearance	
Standard	.0009-.0020 (.024-.052)
Wear Limit	.0028 (.070)