

ENGINE MECHANICAL

SECTION **EM**

EM

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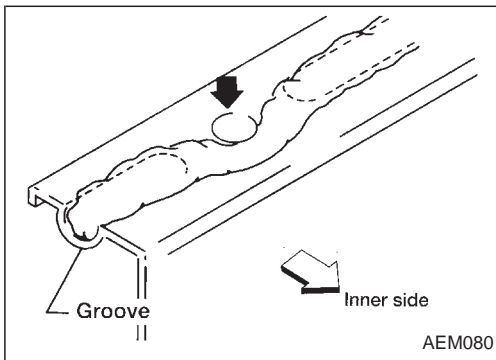
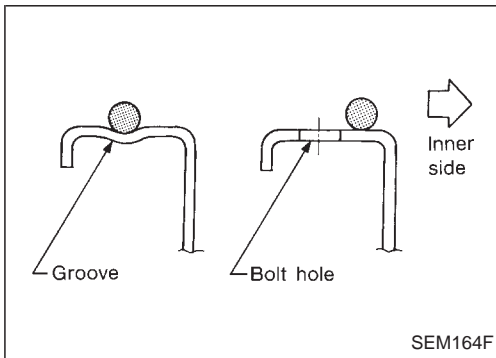
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Parts Requiring Angular Tightening

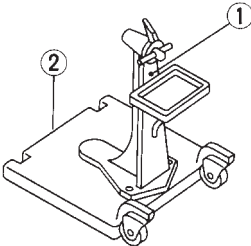
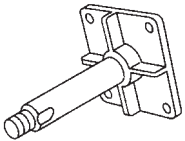
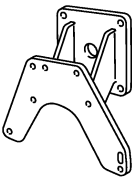
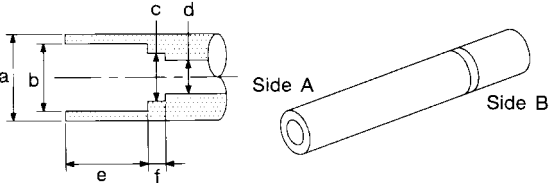
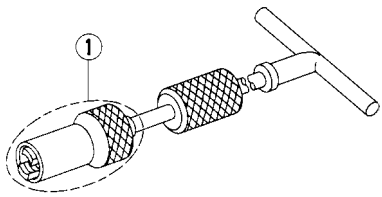
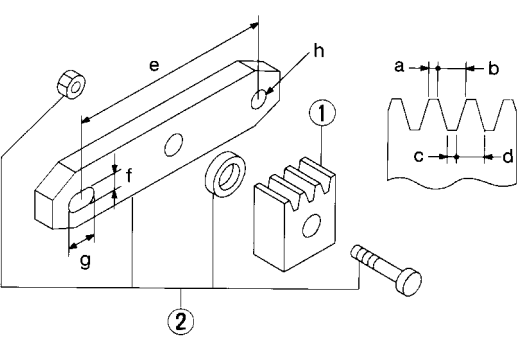
- Use an angle wrench for the final tightening of the cylinder head bolts.
- Do not use a torque value for final tightening.
- The torque value for these parts are for a preliminary step.
- Ensure thread and seat surfaces are clean and coated with engine oil.



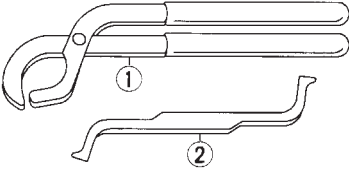
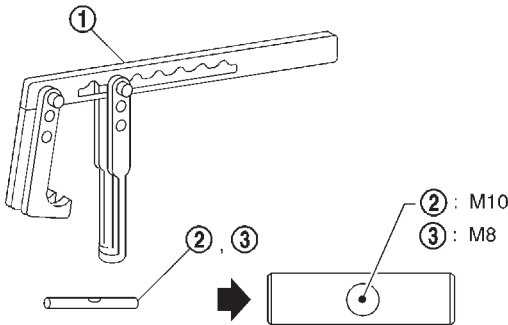
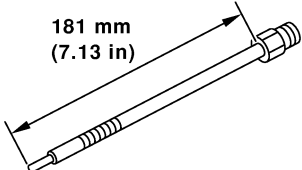
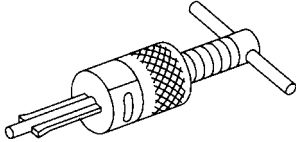
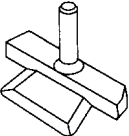
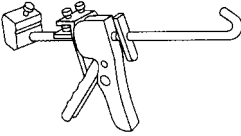
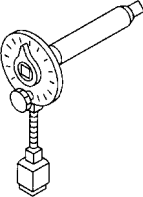
Liquid Gasket Application Procedure

1. Use a scraper to remove old liquid gasket from mating surfaces and grooves. Also, completely clean any oil from these areas.
2. Apply a continuous bead of liquid gasket to mating surfaces. (Use Genuine Liquid Gasket or equivalent.)
 - Be sure liquid gasket diameter is as specified.
3. Apply liquid gasket around the inner side of bolt holes (unless otherwise specified).
4. Assembly should be done within 5 minutes after coating.
5. Wait at least 30 minutes before refilling engine oil and engine coolant.

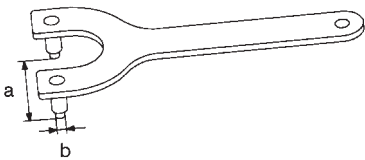
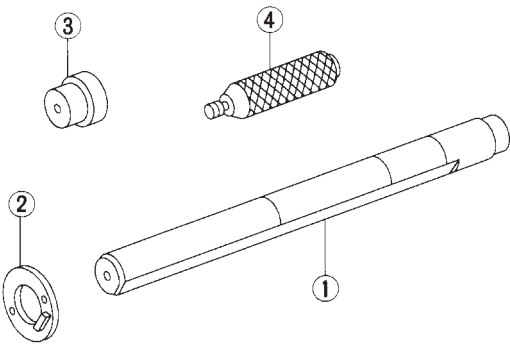
Special Service Tools

Tool number Tool name	Description
ST0501S00 Engine stand assembly ① ST05011000 Engine stand ② ST05012000 Base	 <p>Disassembling and assembling</p> <p>NT042</p>
KV10106500 Engine stand shaft	 <p>NT028</p>
KV11106101 Engine sub-attachment	 <p>NT819</p>
KV10115600 Valve oil seal drift	 <p>Installing valve oil seal</p> <p>Use side A. Side A a: 20 (0.79) dia. b: 13 (0.51) dia. c: 10.3 (0.406) dia. d: 8 (0.31) dia. e: 10.7 (0.421) f: 5 (0.20) Unit: mm (in)</p> <p>NT603</p>
KV10107902 Valve oil seal puller ① KV10116100 Valve oil seal puller adapter	 <p>Removing valve oil seal</p> <p>NT605</p>
KV101056S0 Ring gear stopper ① KV10105630 Adapter ② KV10105610 Plate	 <p>Preventing crankshaft from rotating</p> <p>a: 3 (0.12) b: 6.4 (0.252) c: 2.8 (0.110) d: 6.6 (0.260) e: 107 (4.21) f: 14 (0.55) g: 20 (0.79) h: 14 (0.55) dia. Unit: mm (in)</p> <p>NT617</p>

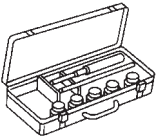
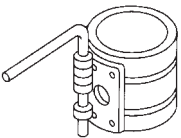
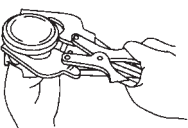
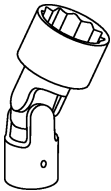
Special Service Tools (Cont'd)

Tool number Tool name	Description
KV101151S0 Lifter stopper set ① KV10115110 Camshaft pliers ② KV10115120 Lifter stopper	 <p>NT041</p> <p>Changing shims</p>
KV101092S0 Valve spring compressor ① KV10109210 Compressor ② KV10109220 Adapter	 <p>NT718</p> <p>Disassembling and assembling valve components</p>
ED19600620 Compression gauge adapter	 <p>NT820</p> <p>Checking compression pressure</p>
ST16610000 Pilot bushing puller	 <p>NT045</p> <p>Removing crankshaft pilot bushing</p>
KV10111100 Seal cutter	 <p>NT046</p> <p>Removing steel oil pan and rear timing chain case</p>
WS39930000 Tube presser	 <p>NT052</p> <p>Pressing the tube of liquid gasket</p>
KV10112100 Angle wrench	 <p>NT014</p> <p>Tightening bolts for bearing cap, cylinder head, etc.</p>

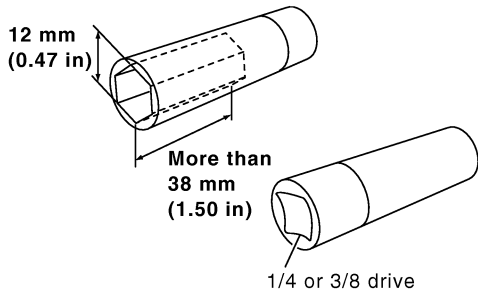
Special Service Tools (Cont'd)

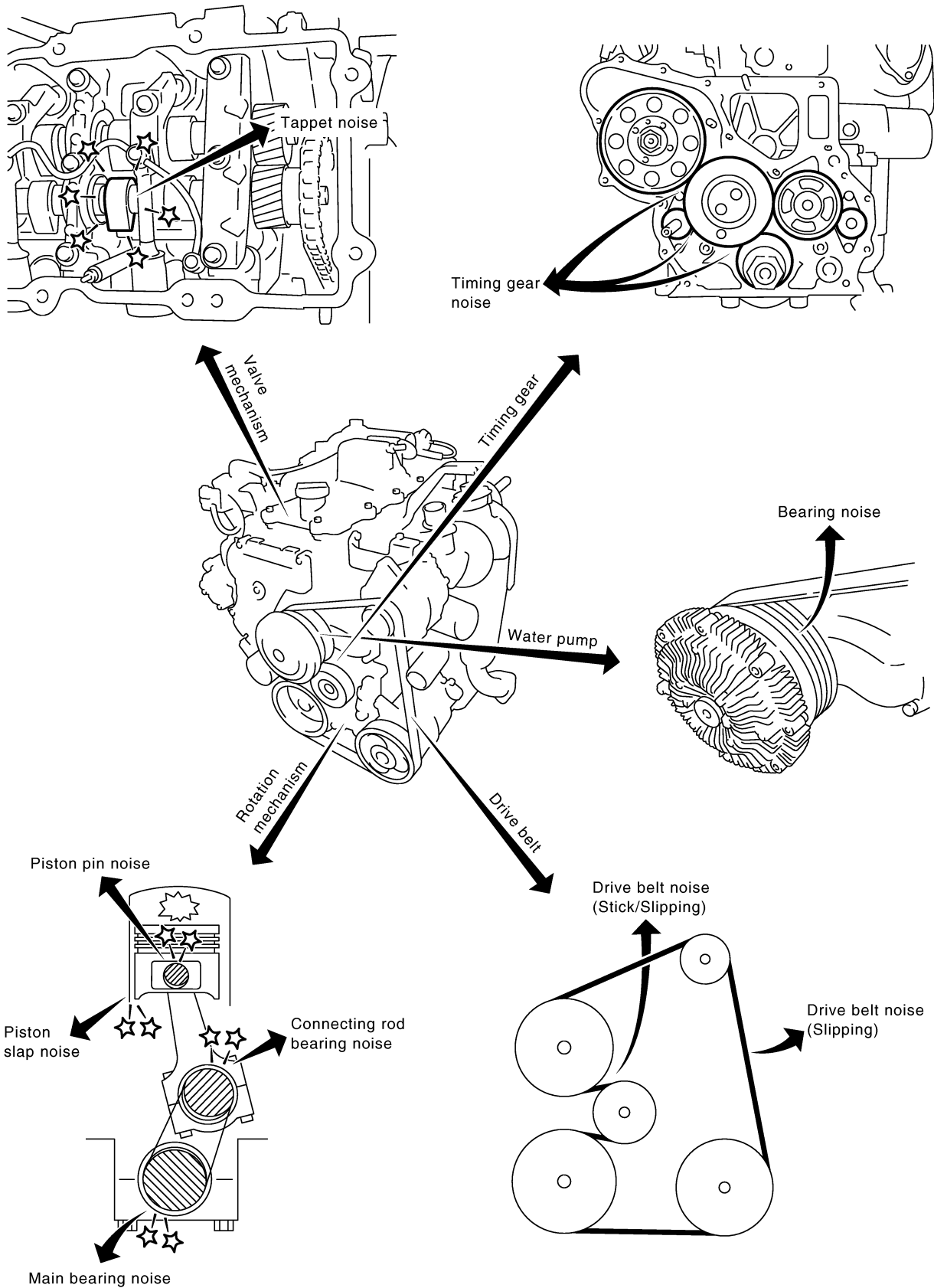
Tool number Tool name	Description
KV10109300 Pulley holder	 <p>NT628</p> <p>a: 68 mm (2.68 in) b: 8 mm (0.31 in) dia.</p>
KV111045S1 Balancer shaft bearing replacer set ① KV11104510 Replacer bar ② KV11104521 Guide plate ③ KV11104530 Adapter (Front bearing) ④ ST15243000 Drift	 <p>NT258</p> <p>Removing and installing balancer shaft bearing</p>

Commercial Service Tools

Tool name	Description
Valve seat cutter set	 <p>NT048</p> <p>Finishing valve seat dimensions</p>
Piston ring compressor	 <p>NT044</p> <p>Installing piston assembly into cylinder bore</p>
Piston ring expander	 <p>NT030</p> <p>Removing and installing piston ring</p>
Standard Universal	 <p>NT808</p> <p>Removing and installing transmission mount</p>

Commercial Service Tools (Cont'd)

Tool name	Description
Deep socket (12 mm)	<p>Removing and installing glow plugs</p>  <p>NT821</p>



NVH Troubleshooting Chart — Engine Noise

Use the chart below to help you find the cause of the symptom.

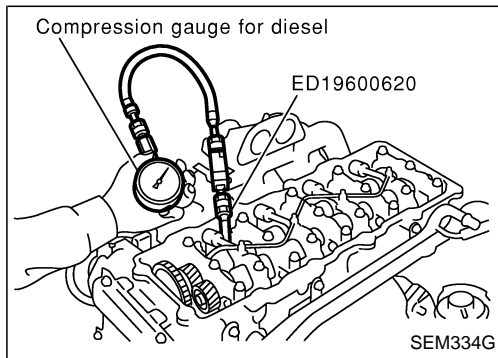
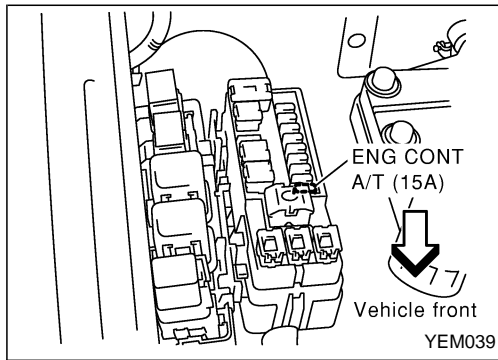
1. Locate the area where noise occurs.
2. Confirm the type of noise.
3. Specify the operating condition of engine.
4. Check specified noise source.

If necessary, repair or replace these parts.

Location of noise	Type of noise	Operating condition of engine						Source of noise	Check item	Reference page
		Before warm-up	After warm-up	When starting	When idling	When racing	While driving			
Top of engine Rocker cover Cylinder head	Ticking or clicking	C	A	—	A	B	—	Tappet noise	Valve clearance	MA section ("Adjusting Intake & Exhaust Valve Clearance", "ENGINE MAINTENANCE")
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft bushing clearance Camshaft runout	EM-31, 31
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston and piston pin clearance Connecting rod bushing clearance	EM-71, 73
	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston-to-bore clearance Piston ring side clearance Piston ring end gap Connecting rod bend and torsion	EM-75, 72, 72, 73
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing clearance (Small end) Connecting rod bearing clearance (Big end)	EM-73, 77
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-78, 76
Front of engine Timing gear cover	Tapping or ticking	A	A	—	B	B	B	Timing gear noise	Timing gear backlash	EM-41
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Other drive belts (Sticking or slipping)	Drive belts deflection	MA section ("Checking Drive Belts", "ENGINE MAINTENANCE")
	Creaking	A	B	A	B	A	B	Other drive belts (Slipping)	Idler pulley bearing operation	MA section ("Checking Drive Belts", "ENGINE MAINTENANCE")
	Squall Creak	A	B	—	B	A	B	Water pump bearing noise	Water pump bearing operation	LC section ("Water Pump Inspection", "ENGINE COOLING SYSTEM")

A: Closely related B: Related C: Sometimes related —: Not related

MEASUREMENT OF COMPRESSION PRESSURE



1. Warm up engine.
2. Turn ignition switch OFF.
3. Using CONSULT-II, make sure no error codes are indicated for self-diagnosis items. Refer to EC section, "Fuel Pressure Release".
 - Do not disconnect CONSULT-II until the end of this operation; it will be used to check engine rpm and for error detection at the end of this operation.
4. Disconnect the negative battery terminal.
5. Remove the following parts.
 - Intercooler
 - Throttle body
 - Rocker cover
6. To prevent fuel from being injected during inspection, remove fuel injection pump fuse [ENG CONT A/T (15A)] from fuse box on the right side of engine compartment.
7. Remove glow plugs from all the cylinders.
 - **Before removal, clean the surrounding area to prevent entry of any foreign materials into the engine.**
 - **Carefully remove glow plugs to prevent any damage or breakage.**
 - **Handle with care to avoid applying any shock to glow plugs.**
8. Install adapter (SST) to installation holes of glow plugs and connect compression gauge for diesel engine.
 - **Torque: 15 - 19 N·m (1.5 - 2.0 kg-m, 11 - 14 ft-lb)**
9. Connect battery negative terminal.
10. Set the ignition switch to "START" and crank. When gauge pointer stabilizes, read compression pressure and engine rpm. Repeat the above steps for each cylinder.
 - **Always use a fully-charged battery to obtain specified engine speed.**

Unit: kPa (bar, kg/cm², psi)/rpm

Standard	Minimum	Difference limit between cylinders
2,942 (29.42, 30.0, 427)/ 200	2,452 (24.52, 25.0, 356)/ 200	294 (2.94, 3.0, 43)/200

- When engine rpm is out of the specified range, check the specific gravity of battery liquid. Measure again under corrected conditions.
 - If engine rpm exceeds the limit, check valve clearance and combustion chamber components (valves, valve seats, cylinder head gaskets, piston rings, pistons, cylinder bores, cylinder block upper and lower surfaces) and measure again.
11. Complete this operation as follows:
 - a. Turn the ignition switch to "OFF".
 - b. Disconnect battery negative terminal.
 - c. Replace glow plug oil seals and install glow plugs.
 - d. Install fuel injection pump fuse [ENG CONT A/T (15A)].
 - e. Connect battery negative terminal.
 - f. Using CONSULT-II make sure no error code is indicated for items of self-diagnosis. Refer to EC section, "Trouble Diagnosis — Index".