4. J series engine
Chapter 00
Maintenance instructions

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Troubleshooting

Difficult starting

1. Starter does not work

Check point	Causes	Solution
Battery	Looseness and bad contact of wire joints caused by rust	Clean and /or re-fix wire joints.
	Dead battery or low battery charge	Recharge or replace the battery.
	fan belt loosening or breakage	Adjust or replace the fan belt.
Fuse	Short circuit of fuse	Replace the fuse.
Starting switch	Failure of starting switch or starting relay	Replace starting switch or starting relay
Starter motor	Failure of magnetic switch or starting relay	Repair or replace the magnetic switch.
	Failure of starting motor	Repair or replace the starting motor

2. The starting motor runs but the engine does not run.

Check point	Causes	Solution
Battery	The looseness of the battery joint causes poor contact due to rust	Clean and /or re-fix wire joints.
	Dead battery or low battery charge	Recharge or replace the battery.
	fan belt loosening or breakage	Adjust or replace the fan belt.
Starter	Failure of planetary gear	Replace planetary gear
	Failure of magnetic switch	Repair or replace the magnetic switch.
	Wear of electric rush and weak elasticity of electric brush spring	Replace electric brush and / or electric brush spring
Engine	Seizure of piston and crankshaft bearing, or other damage	Repair or replace the related parts

3. The engine rotates but does not starts.

Check point	Causes	Solution
Engine limiting device	Failure of oil breaking solenoid valve	Disconnect oil solenoid valve
Fuel is not transmitted to the injection pump.		
Fuel	No fuel in fuel tank	Fill up oil tank
Fuel pipeline	Block or damage of the fuel pipe Looseness of fuel pipe joint.	Maintain or replace of fuel pipeline Re-fix the pipe junction
Fuel filter	The overflow valve of the fuel filter is not closed	Repair or replace overflow valve
	Fuel filter element component blockage	Replace the fuel filter component or filter element.
Fuel system	There is air in the fuel system.	Exhaust the air from the fuel system.
Oil feed pump	Oil feed pump fault	Repair or replace the oil feed pump.
Fuel is transmitted to the injection pump		
Fuel	Use wrong fuel	Use right fuel
	There is water in fuel.	Replace fuel oil.
Fuel system	There is air in the injection pump	Exhaust the air from the fuel system.
Fuel injector	Fuel injector blockage	Replace the fuel injector.
	The spray opening pressure of the injector is too low and the spray condition is poor.	Adjust or replace the fuel injector.
Oil injection pump	Fuel drop leakage caused by fuel injector fault	Replace the outlet valve.
	Failure of operating the regulating rack of injection pump	Repair or replace the regulating rack of injection pump
	Wear or clog of injection pump plunger	Replace plunger assembly of injection pump
	Seizure of the drive shaft of injection pump or other damage	Change the drive shaft
	Seizure of injection pump governor spring	Change the governor spring

4. QOS system

Preparation work

1. Disconnect the thermosensitive temperature switch socket.

2. Confirm whether the glow plug is electrified.

a. Determine that the starting switch is "OFF".

b. Connect the voltage meter with the cylinder wall and any glow plug.

c. Move the starting switch to the "ON" position.

If the glow plug is being electrified, the voltmeter pointer will show the source voltage (12 V). If the voltmeter pointer does not move, it indicates that the glow plug is not energized.

3. Execute according to the troubleshooting procedure

Check point	Causes	Solution
The glow plug is electrified.		
The glow plug indicator light is not on.	Failure of indicator lamp bulb	Replace lamp bulb
quick starting timer	quick starting timer fault	Replace the quick starting timer.
The glow plug indicator light is on for 0.3s.	quick starting timer fault	Replace the quick starting timer.
The glow plug indicator light is on for 3.5s.	After starting the engine, if the running time of the glow plug relay is less than 14 seconds, the starting switch will be from the position of "START " to ON ", it is the failure of QOS timer.	Replace the quick starting timer.
	If the running time of the glow plug relay is less than 14 seconds, the starting switch will be from "OFF " to "ON ", it is the failure of the QOS timer.	Replace the quick starting timer.
Thermosensitive temperature switch	Failure of thermosensitive temperature switch	Replace thermosensitive temperature switch
Working connectedness of glow plug	Disconnection of glow plug	Change the glow plug
The glow plug is not electrified.		
The glow plug indicator light is not on.	The fuse of indicator lamp is broken.	Replace the fuse.
quick starting timer	quick starting timer fault	Replace the quick starting timer.
The glow plug indicator light is on for 3.5s.	Failure of glow plug relay When the starting switch is from "OFF" to "ON", the glow plug relay is not started.	Replace the glow plug relay
	quick starting timer fault	Replace the quick starting timer.
	Failure of assembly circuit of glow plug relay	Repair or replace assembly circuit
	The glow plug relay starts when the fuse or assembly circuit fault start switch is from "OFF" to "ON".	Replace fuse or assembly circuit

* At normal temperature, the 4KH1-TC indicator is not bright.

Unstable idle speed

Check point	Causes	Solution
Idle speed system	Improper adjustment of idle speed	Adjust the idle system
High idle speed control	Failure of high idle speed control device	Repair or replace high idle speed control device
Accelerator control system	Improper adjustment of the accelerator control system	Adjust the accelerator control system
Fuel system	Leakage or blockage of the fuel system	Repair or replace fuel system
	There is air in the fuel system.	Exhaust the air from the fuel system.
	There is water in the fuel system.	Replace fuel oil.
Fuel filter	Fuel filter element component blockage	Replace the fuel filter component or filter element.
Oil feed pump	Oil feed pump fault	Repair or replace the oil feed pump
Fuel injector	Fuel injector blockage	Replace the fuel injector.
	Too low injection opening pressure of the fuel injector Poor mist spray situation	Adjust or replace the fuel injector.
Oil injection pump	Fuel drop leakage caused by fuel injector fault	Replace the outlet valve.
	Improper adjustment of fuel injection timing	Adjust fuel injection timing.
	Insufficient fuel injection	Adjust fuel injection quantity.
	Failure of idle spring	Change the idle spring
	Operation failure of governor lever	Repair or replace governor lever
	Improper adjustment of regulating valve	Adjust or replace the regulating valve
	Rupture of plunger spring	Replace plunger spring
	Plunger wear	Replace the plunger assembly.
	Cam wear	Replace the cam.
Valve clearance	Improper valve clearance adjustment	Adjust the valve clearance.
Compression pressure	The seal gasket of the cylinder head is damaged. cylinder liner wear piston ring bonding	Replace relevant components.

* For an 4KH1-TC engine with an electronically controlled injection pump, the piston related to the fuel injection pump must be adjusted.

Insufficient power

Check point	Causes	Solution
Air filter	air filter element blockage	Clean or replace the element of air filter
Fuel	There is water in fuel.	Replace fuel oil.
Fuel filter	Fuel filter element component blockage	Replace the fuel filter component or filter element.
Oil feed pump	Oil feed pump fault	Repair or replace the oil feed pump.
Fuel injector	Fuel injector blockage	Replace the fuel injector.
	Too low injection opening pressure of the fuel injector Poor mist spray situation	Adjust or replace the fuel injector.
High pressure oil pipe	Breakage or blockage of high pressure oil pipe	Replace high pressure oil pipe
Oil injection pump	Failure of control valve	Repair or replace the regulating valve
	Failure of oil outlet valve	Replace the outlet valve.
	Failure of timer	Repair or replace the timer
	Cam wear	Replace the cam.
	Improper control of control rod	Adjust or replace the control rod
	Failure of injection timing	Adjust the timing of fuel injection, maintain or replace the timer
	Weak elasticity of governor spring	Change the speed modulation spring
	Plunger wear	Replace the plunger assembly.
Compression pressure	The seal gasket of the cylinder head is damaged. cylinder liner wear piston ring bonding	Replace relevant components.
Valve clearance	Improper valve clearance adjustment	Adjust the valve clearance.
Air valve spring	The valve spring is too soft or broken.	Change the valve spring.
Exhaust system	Blockage of exhaust pipe	Clean exhaust pipe
Seal of full load adjusting screw	Adjustment screw seal is unsuitable or unadjusted	Adjust and re-seal the adjusting screw

Excessive fuel consumption.

Check point	Causes	Solution
Fuel system	Fuel leakage	Repair or replace the related components of the fuel system
Air filter	air filter element blockage	Clean or replace the filter element of the air filter.
Idling	Improper adjustment of idle speed	Adjust idle speed
Fuel injector	Too low injection opening pressure of the fuel injector Poor mist spray situation	Adjust or replace the fuel injector.
Fuel injection timing	Improper fuel injection timing	Adjust fuel injection timing.
Oil injection pump	Fuel drop leakage caused by fuel injector fault	Replace the outlet valve.
Valve clearance	Improper valve clearance adjustment	Adjust the valve clearance.
Compression pressure	The seal gasket of the cylinder head is damaged. cylinder liner wear piston ring bonding	Replace relevant components.
Air valve spring	The valve spring is too soft or broken.	Change the valve spring.

Excessive engine oil consumption.

Check point	Causes	Solution
Engine oil	Incorrect engine number Excessive oil	Replace engine oil. Calibrate engine oil level
Oil seal and gasket	Exudation of oil from oil seal and / or gasket	Replace oil seal and / or gasket
Air blowhole	Blockage of air blowhole	Clean air blowhole
Intake valve/exhaust valve	Valve stem and valve guide wear	Replace intake valve, exhaust valve and valve tube

Overheating of the engine

Check point	Causes	Solution
Coolant	Insufficient coolant	Supplement coolant.
Fan clutch	Exudation of oil from the fan clutch	Replace the fan clutch
Fan belt	The fan belt is loosened or ruptured to cause skidding	Replace the fan belt
Radiators	Failure of radiator cap or blockage of radiator core	Replace the radiator cap or clean the core of the radiator
Water pump	Failure of pump	维修或更换水泵 Repair or replace the water pump
Cylinder head and cylinder block gasket	Failure of gasket caused by leakage of water	Change gaskets.
Thermostat	Thermostat fault	Replace thermostat
Cooling System	The cooling system is blocked by foreign objects	Remove foreign body from the cooling system
Fuel injection timing	Improper adjustment of fuel injection timing	Adjust fuel injection timing.

Exhaust smoke from engine

Check point	Causes	Solution
Coolant	Insufficient coolant	Supplement coolant.
Fuel	There is water in fuel.	Replace fuel oil.
Improper adjustment of fuel injection timing	Delay of injection timing	Adjust fuel injection timing.
Compression pressure	The seal gasket of the cylinder head is damaged. cylinder liner wear piston ring bonding	Replace relevant components.
Inlet valve and intake valve oil seal	Failure of valve oil seal Valve stem and valve guide wear	Replace valve oil seal, valve and valve tube

Exhaust smoke from the engine

Check point	Causes	Solution
Air filter	air filter element blockage	Clean or replace the filter element of the air filter.
Fuel injector	Too low injection opening pressure of the fuel injector Poor mist spray situation	Adjust or replace the fuel injector.
Improper adjustment of fuel injection timing	Improper adjustment of fuel injection timing	Adjust fuel injection timing.
Oil injection pump	Fuel drop leakage caused by fuel injector fault	Replace the outlet valve.
	Excessive fuel injection	Adjust fuel injection quantity.

Insufficient engine oil pressure

Check point	Causes	Solution
Oil	Oil viscosity is not suitable Lack of engine oil	Replace engine oil Calibrate engine oil
Oil pressure meter or assembly Oil pressure indicator lamp	Failure of oil pressure meter or assembly Failure of indicator	Repair or replace oil pressure meter or assembly Replace indicator
Engine oil filter	Blockage of oil filter	Replace the oil filter element or filter core
Pressure relief valve and by-pass valve	Blockage of pressure relief valve and / or bypass valve spring is too soft	Replace the pressure relief valve and/or bypasss valve
Engine oil pump	Blockage of oil pump filter screen	Clean filter net of oil pump
	Wear and tear of related parts of oil pump	Replace related components of oil pump
Rockshaft	Wear of rocker shaft liner	Replace rocker shaft bushing
Camshaft	Wear of camshaft and its bearing	Replace camshaft and its bearing
Crankshaft and bearing	Wear of crankshaft and bearing	Replace crankshaft and / or bearings

Abnormal engine sound

1. Engine detonation

Before starting to find the fault, check whether the engine is fully preheated.

Check point	Causes	Solution
Fuel	Unsuitable fuel	Replace fuel oil.
Fuel injection timing	Improper adjustment of fuel injection timing	Adjust fuel injection timing.
Fuel injector	The injection pressure of the injector is too low Poor mist spray situation	Adjust or replace the fuel injector.
Compression pressure	The seal gasket of the cylinder head is damaged. Fracture of piston ring	Replace the cylinder cover liner or piston ring

2. Gas leakage sound

Check point	Causes	Solution
Exhaust pipe	Looseness of exhaust pipe connection Rupture of exhaust pipe	Fix the exhaust pipe junction Replace the exhaust pipe
Fuel injector and / or glow plug	Fuel injector and / or looseness of glow plug	Replace washer Fix injector and / or glow plug
Exhaust manifold	Looseness of exhaust manifold connection	Fix exhaust manifold junction
Sealing cushion of cylinder head	The seal gasket of the cylinder cap is damaged.	Replace cylinder cover seal

3. Continuous noise

Check point	Causes	Solution
Fan belt	Loose fan belt	Adjust the fan belt
Cooling fan	Looseness of cooling fan	Refix cooling fan
Water pump bearing	Wear or damage of water pump bearings	Replace the pump bearing
Generator or vacuum pump	Failure of generator or vacuum pump	Repair or replace of generator or vacuum pump
Valve clearance	Improper adjustment of clearance	Adjust the valve clearance.

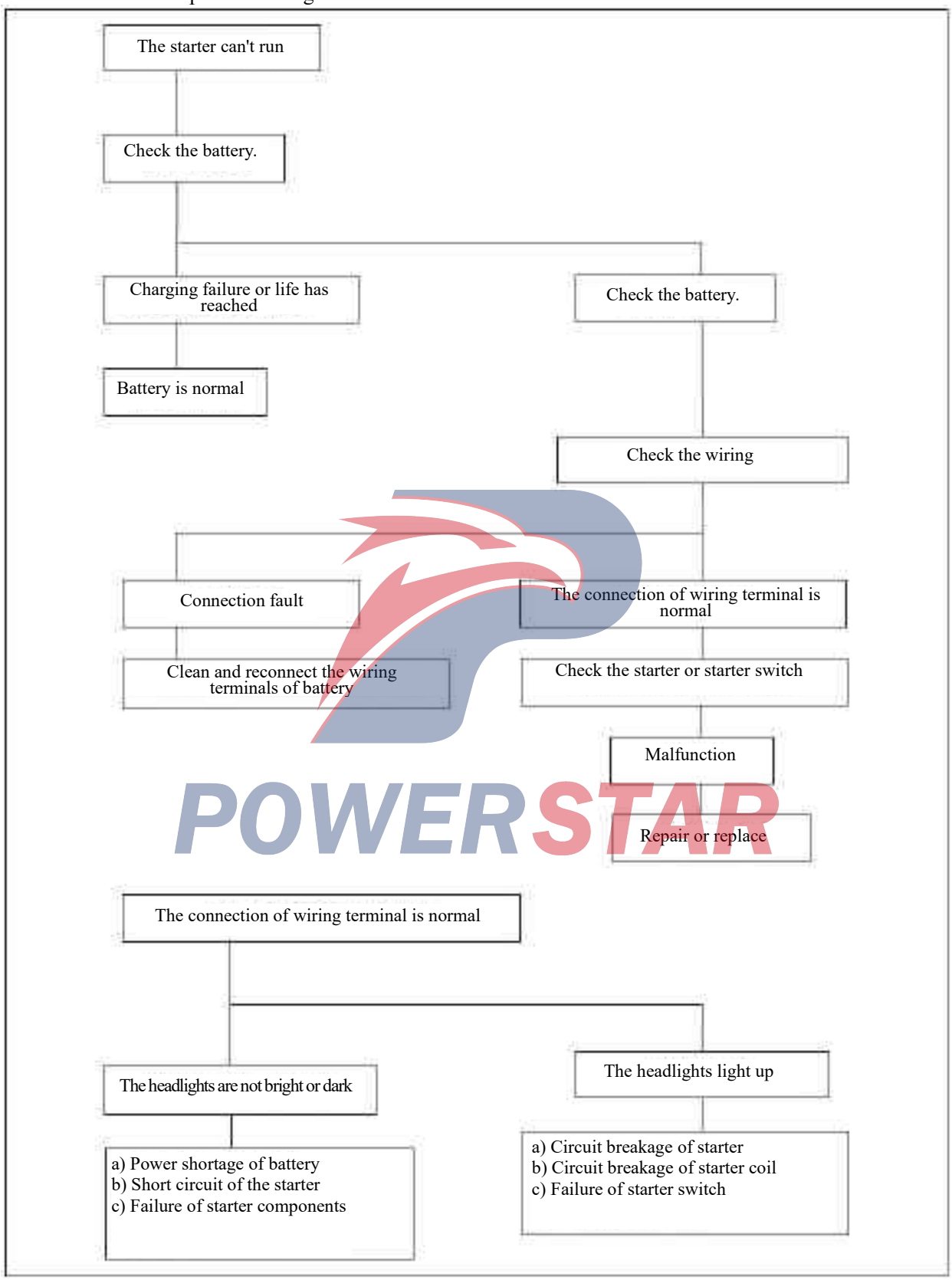
4. Engine knocking sound

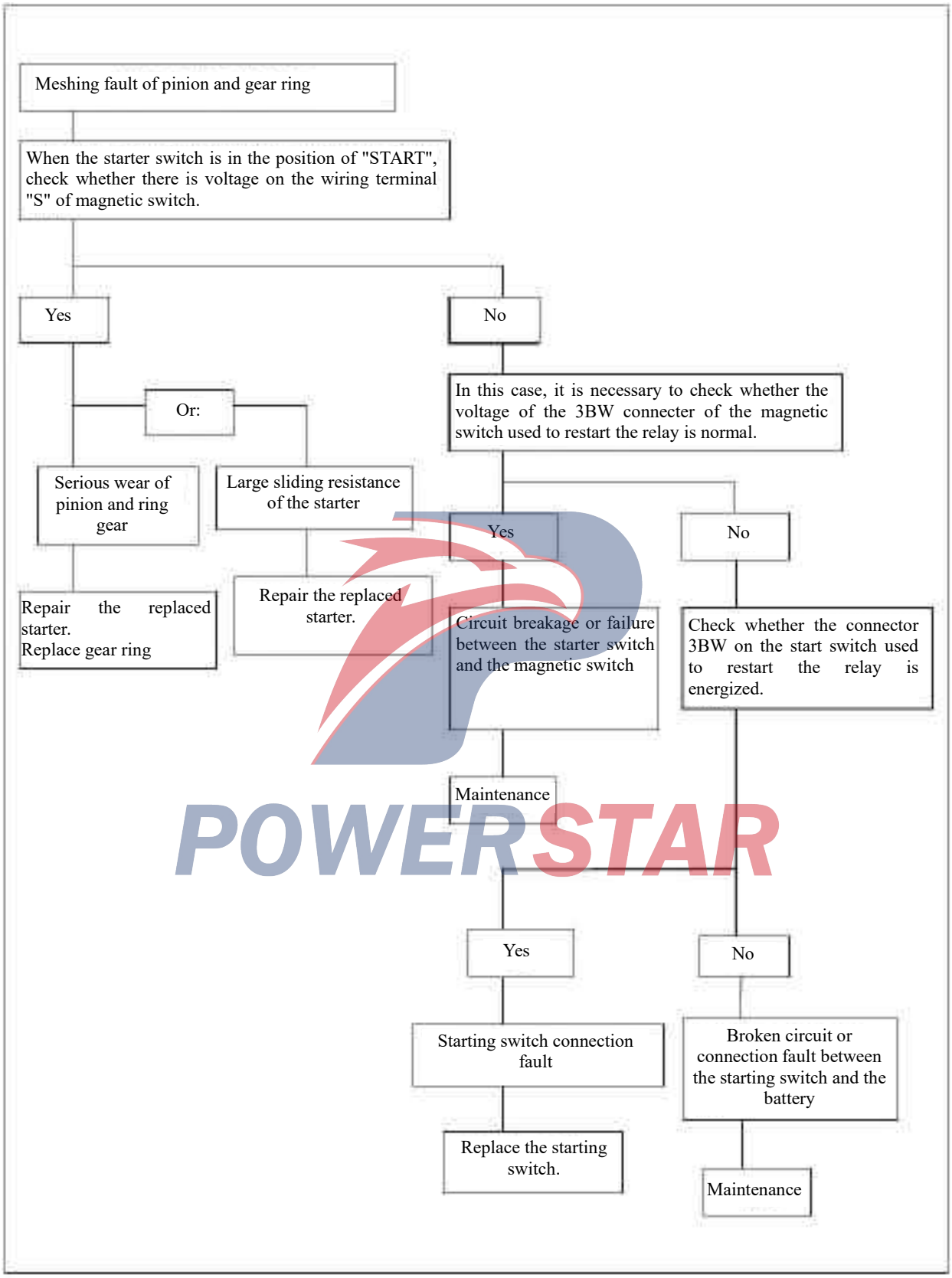
Check point	Causes	Solution
Valve clearance	Improper valve clearance adjustment	Adjust the valve clearance.
Rocker arm	Damage of rocker arm	Change the rocker arm
Flywheel	Looseness of flywheel bolt	Refix flywheel bolts
Crankshaft and thrust bearing	Wear or damage of crankshaft and / or thrust bearings	Replace crankshaft and / or thrust bearings
Crankshaft and connecting rod bearing	Wear or damage of crankshaft and / or connecting rod bearings	Replace crankshaft and / or connecting rod bearings
Connecting rod bushing and piston pin	Wear or damage of connecting rod bushing and piston pin	Replace the connecting rod bushing and / or piston pin
Piston and cylinder sleeve	Wear or damage of piston and cylinder liner	Replace the piston and cylinder sleeve

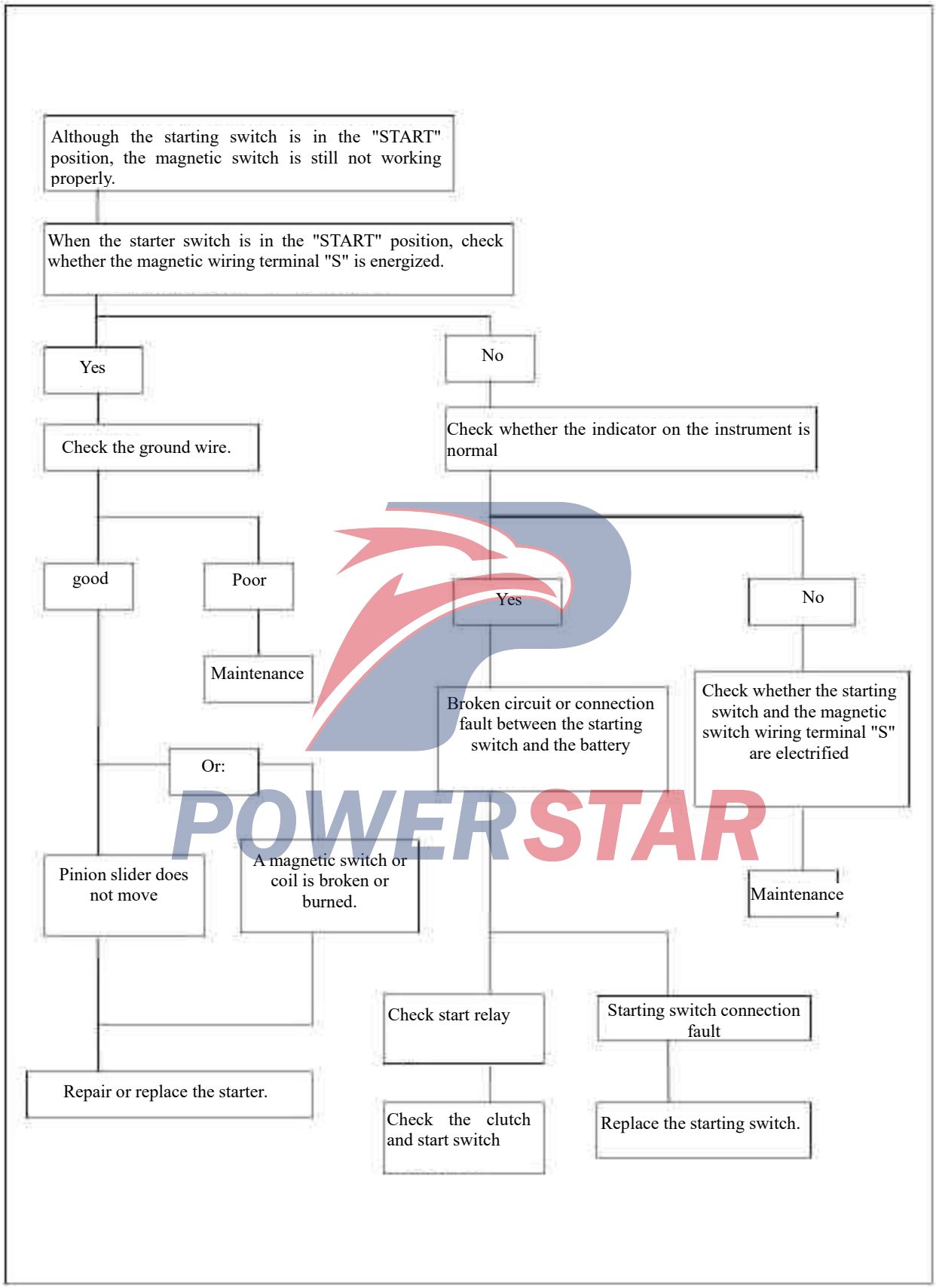
Engine cooling fault

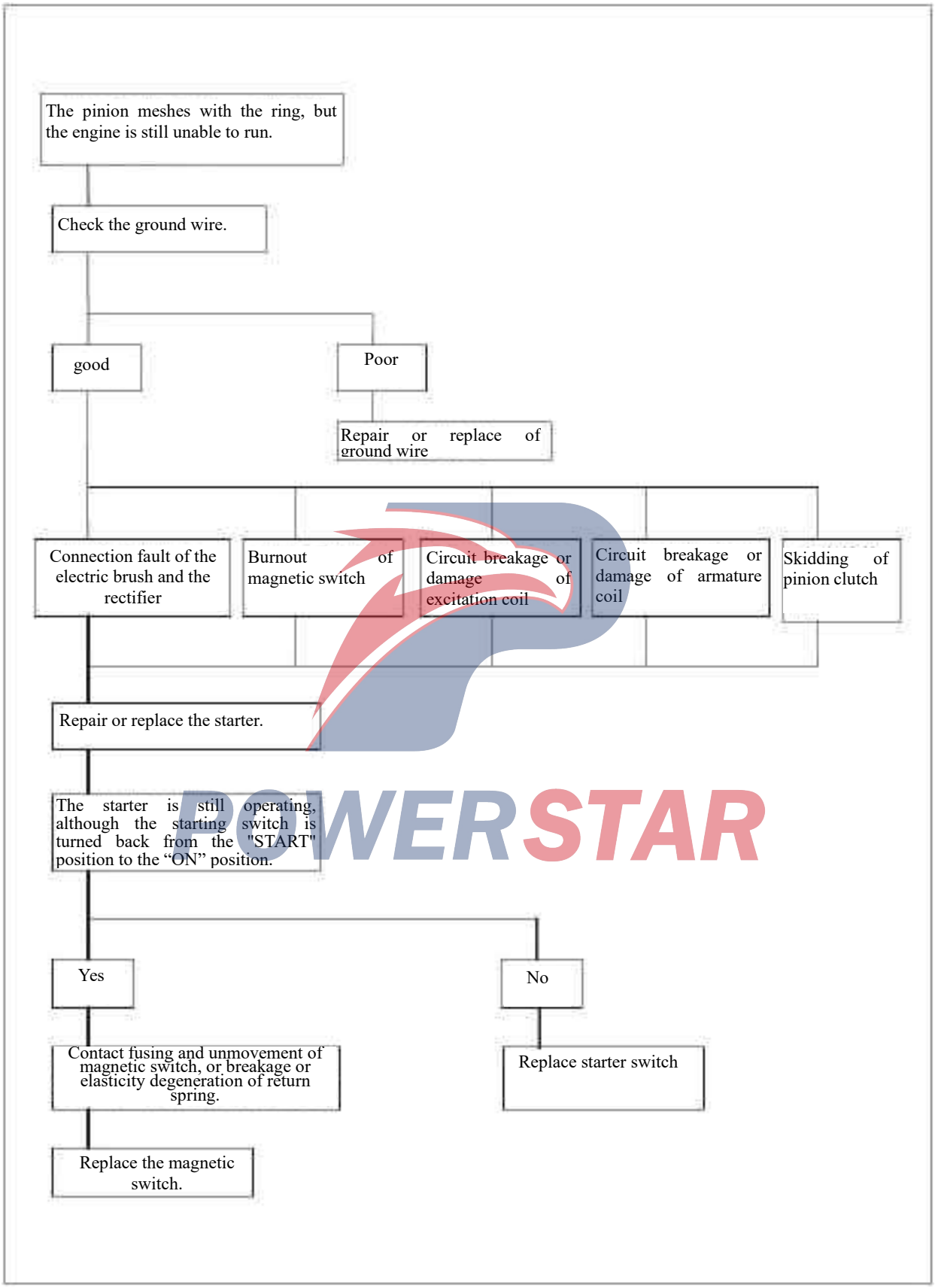
Check point	Causes	Solution
Overheating of the engine	Low liquid level of coolant	Fill it up again
	Heat sensitive temperature device fault	Replace
	Thermostat fault	Replace
	Failure of cooling device	Repair or replace
	Radiator blockage	Clean or replace.
	Failure of radiator cover	Replace
	Low oil level or improper use of engine oil	Fill the oil or change the oil
	The seal gasket of the cylinder cap is damaged.	Replace
	Exhaust system blockage	Clean the exhaust system or replace the scrap part
	Loose fan belt	Adjustment
	Excessive fuel injection	Adjustment
	Improper fuel injection timing	Adjustment
Engine overcooling	Thermostat fault	Replace
The preheating time of engine is too long.	Thermostat fault	Replace
	Heat sensitive temperature device fault	Replace

Fault of the electrical part of the engine




Meshing fault of pinion and gear ring
When the starter switch is in the position of "START", check whether there is voltage on the wiring terminal "S" of magnetic switch.
Yes
No
Or:
Serious wear of pinion and ring gear
Large sliding resistance of the starter
Repair the replaced starter.
Replace gear ring
Repair the replaced starter.
In this case, it is necessary to check whether the voltage of the 3BW connecter of the magnetic switch used to restart the relay is normal.
Yes
No
Circuit breakage or failure between the starter switch and the magnetic switch
Check whether the connector 3BW on the start switch used to restart the relay is energized.
Maintenance
Yes
No
Starting switch connection fault
Broken circuit or connection fault between the starting switch and the battery
Replace the starting switch.
Maintenance


Although the starting switch is in the "START" position, the magnetic switch is still not working properly.
When the starter switch is in the "START" position, check whether the magnetic wiring terminal "S" is energized.
Yes
No
Check the ground wire.
Check whether the indicator on the instrument is normal
good
Poor
Yes
No
Maintenance
Broken circuit or connection fault between the starting switch and the battery
Check whether the starting switch and the magnetic switch wiring terminal "S" are electrified
Or:
Pinion slider does not move
A magnetic switch or coil is broken or burned.
Maintenance
Check start relay
Starting switch connection fault
Repair or replace the starter.
Check the clutch and start switch
Replace the starting switch.


The pinion meshes with the ring, but the engine is still unable to run.
Check the ground wire.
good
Poor
Repair or replace of ground wire
Connection fault of the electric brush and the rectifier
Burnout of magnetic switch
Circuit breakage or damage of excitation coil
Circuit breakage or damage of armature coil
Skidding of pinion clutch
Repair or replace the starter.
The starter is still operating, although the starting switch is turned back from the "START" position to the “ON” position.
Yes
No
Contact fusing and unmovement of magnetic switch, or breakage or elasticity degeneration of return spring.
Replace starter switch
Replace the magnetic switch.

Disconnect the wire connection end of starting switch to see if the starting switch works.

Key position	Battery B1	IG1	Battery B2	ACC	IG2	ST
LOCK						
OFF						
ACC			•	•		
0N	•	•	•	•	•	
START	•	•	•		•	•

In addition to the above circuits, other circuits must be in the state of circuit breakage.

Turbocharger

Engine power is lower than normal level.

Check point		Fault cause	Solution
Air filter	Failure to run	Failure to run	Blockage
Normal running			
Intake pipe and hose	Failure to run	Blockage	Clean or replace.
Normal running			
Compressor / intake manifold	Failure to run	Loosening (leakage)	Clean or replace.
Normal running			
Exhaust manifold / turbine inlet	Failure to run	Loosening (leakage)	Maintenance
Normal running			
Exhaust pipeline and muffler	Failure to run	Blockage	Clean or replace.
Normal running			
Ventilator	Failure to run	Failure to run	Blockage
Normal running			
Boost compensator (fuel injection pump)	Failure to run	Defect	Repair or replace

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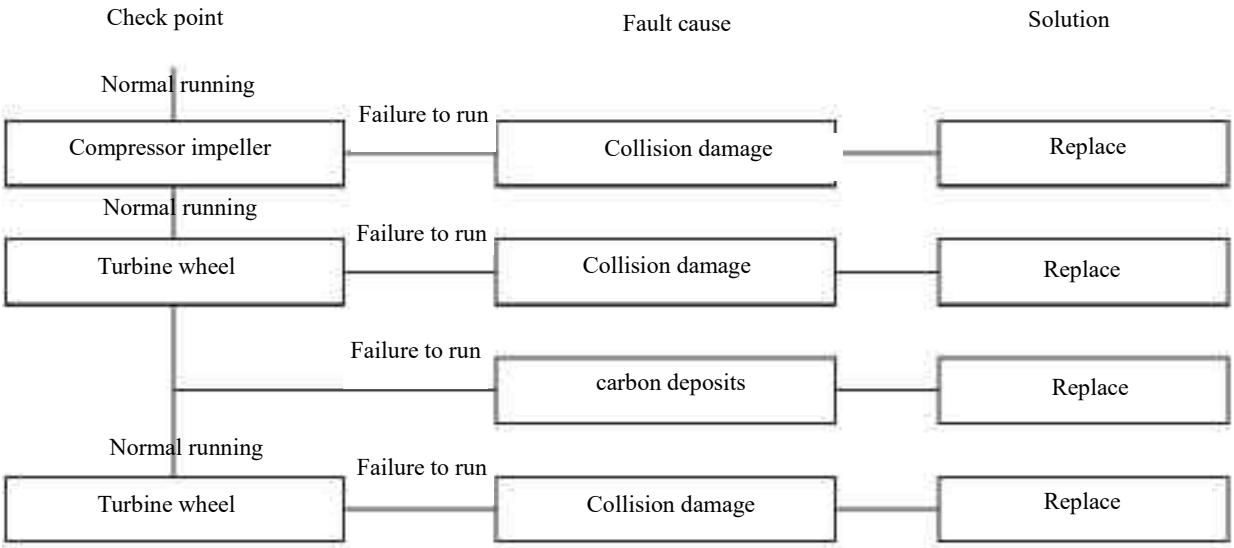
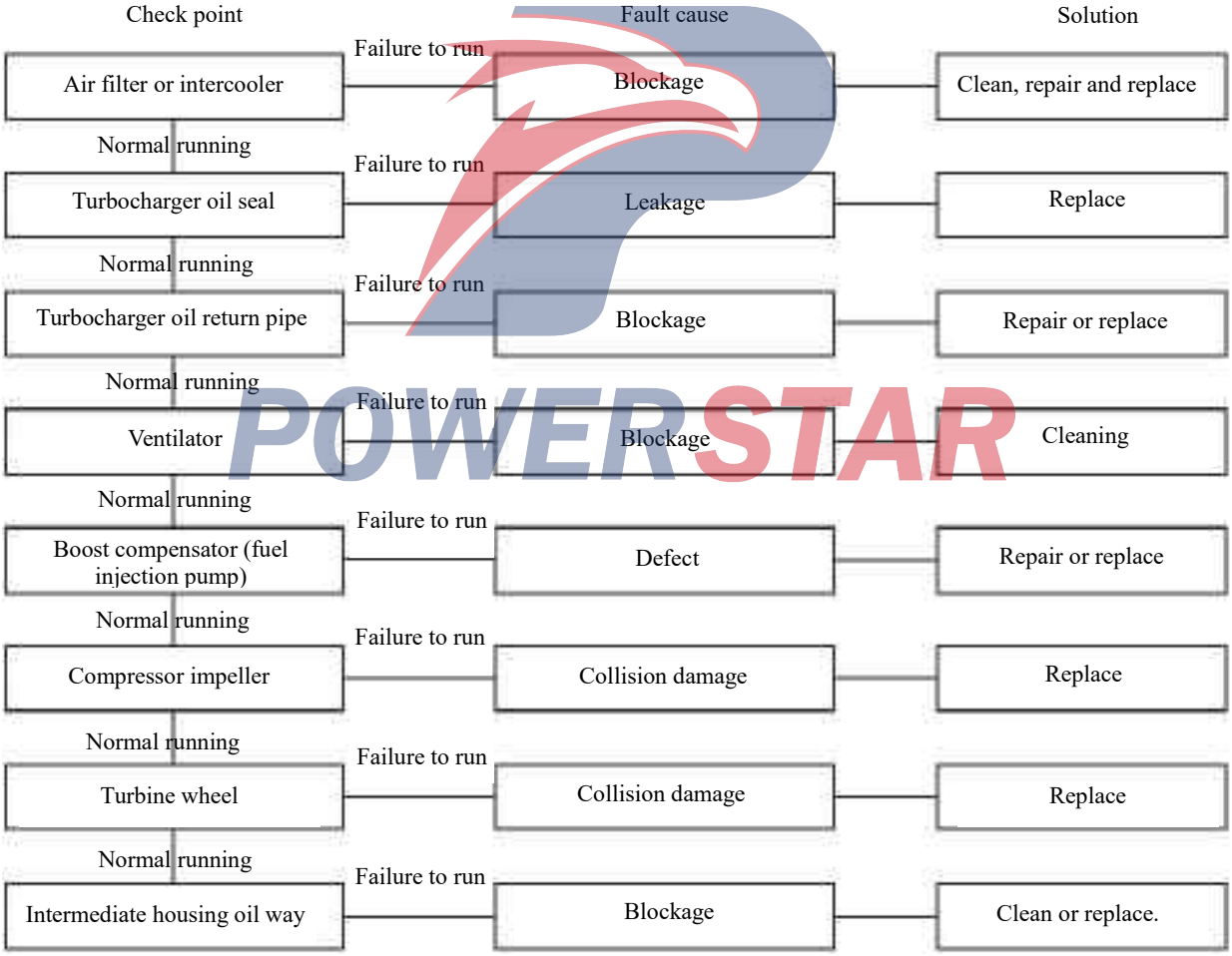
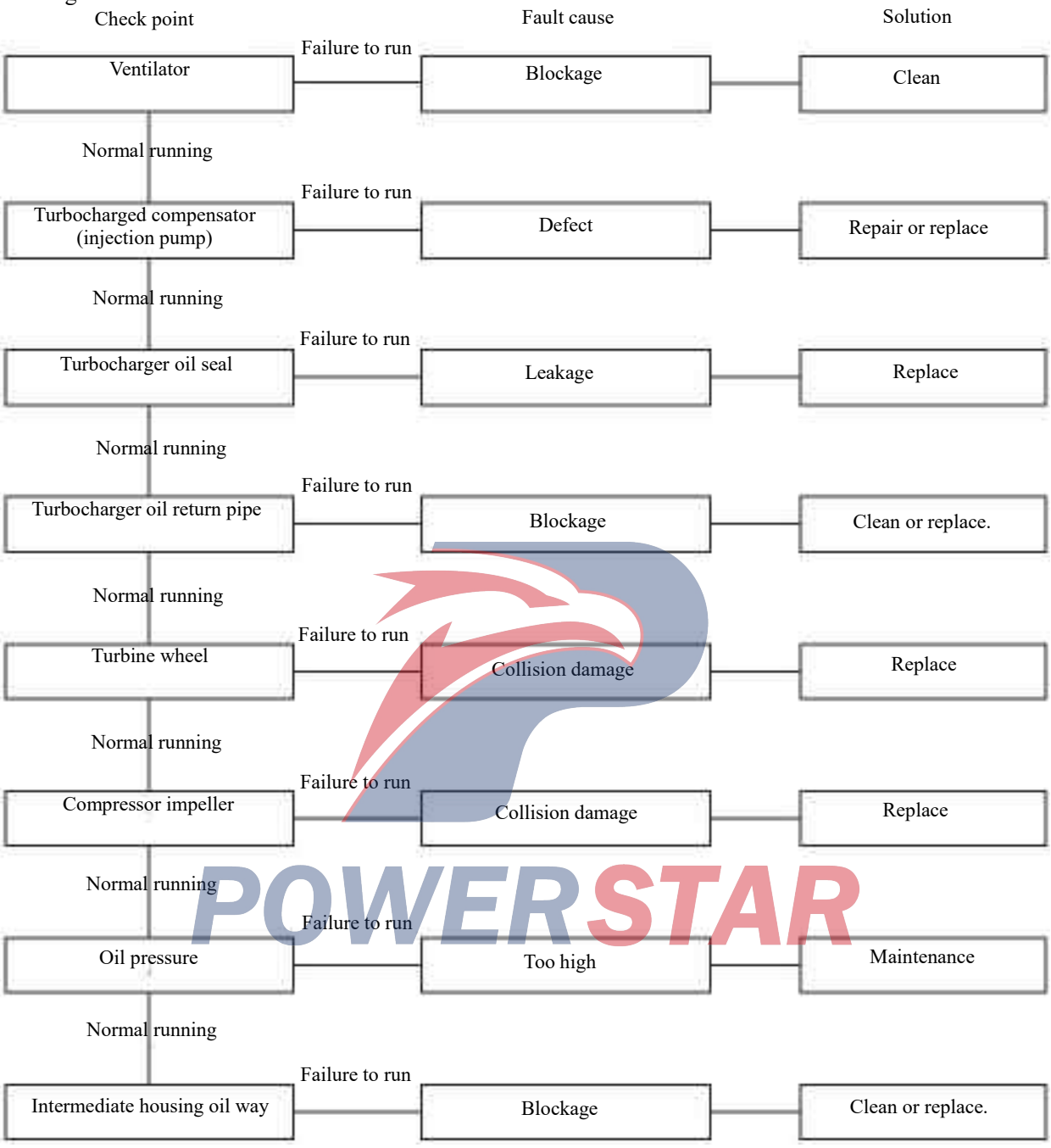
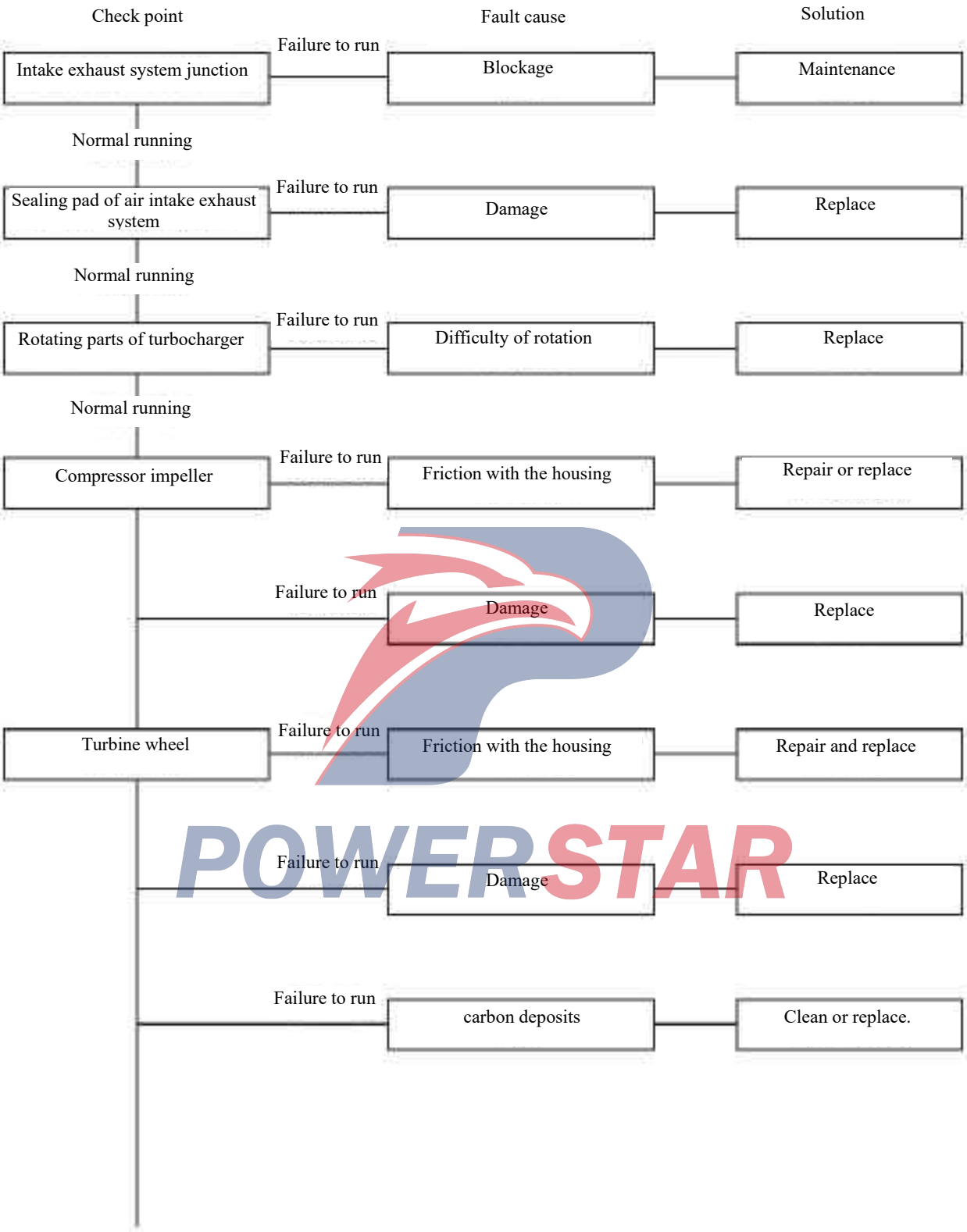

Check point
Fault cause
Solution
Normal running
Compressor impeller
Failure to run
Collision damage
Replace
Normal running
Turbine wheel
Failure to run
Collision damage
Replace
Failure to run
carbon deposits
Replace
Normal running
Turbine wheel
Failure to run
Collision damage
Replace


Check point
Fault cause
Solution
Air filter or intercooler
Failure to run
Blockage
Clean, repair and replace
Normal running
Turbocharger oil seal
Failure to run
Leakage
Replace
Normal running
Turbocharger oil return pipe
Failure to run
Blockage
Repair or replace
Normal running
Ventilator
Failure to run
Blockage
Cleaning
Normal running
Boost compensator (fuel injection pump)
Failure to run
Defect
Repair or replace
Normal running
Compressor impeller
Failure to run
Collision damage
Replace
Normal running
Turbine wheel
Failure to run
Collision damage
Replace
Normal running
Intermediate housing oil way
Failure to run
Blockage
Clean or replace.

The engine exhausts blue smoke or black smoke





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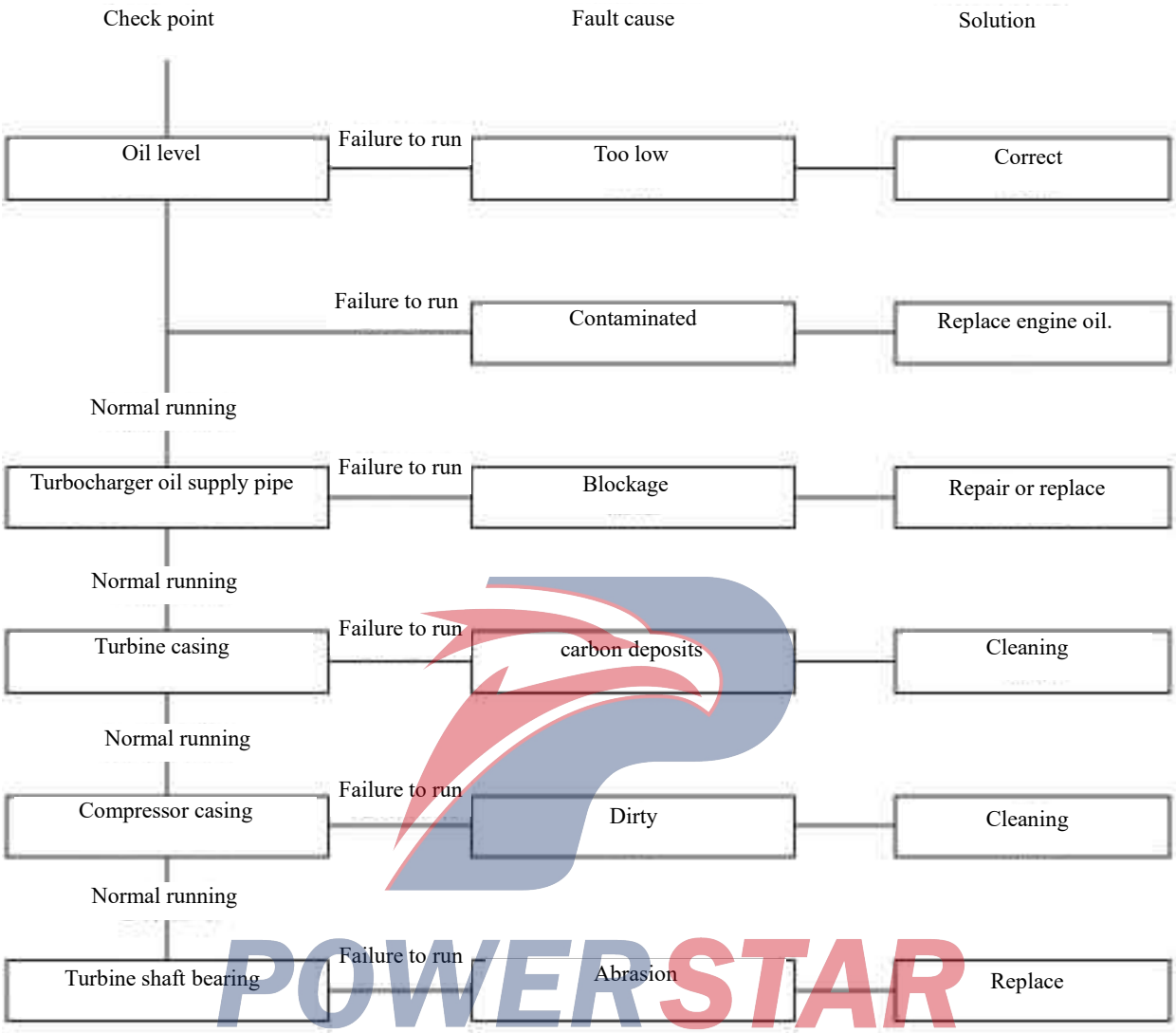
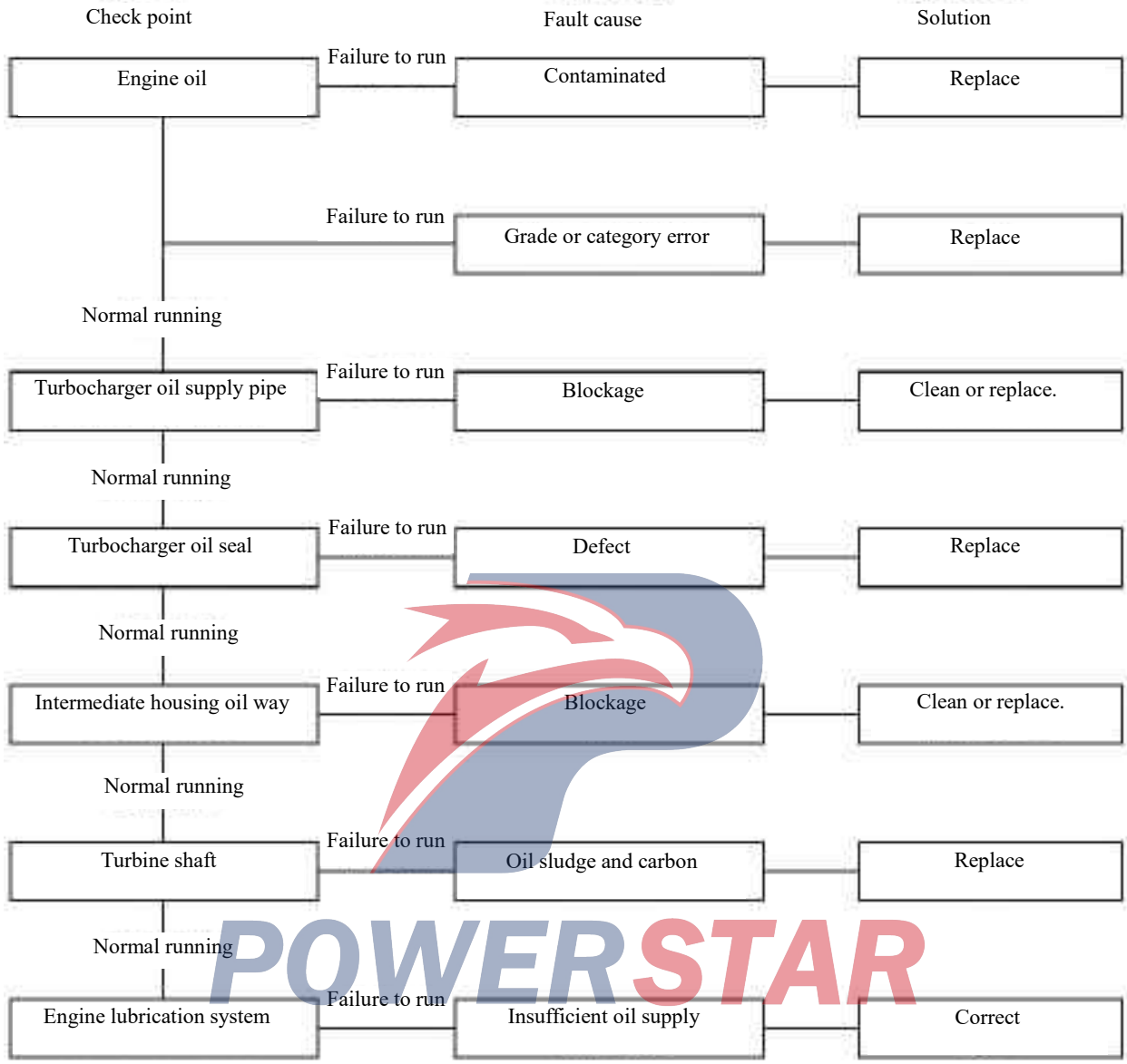
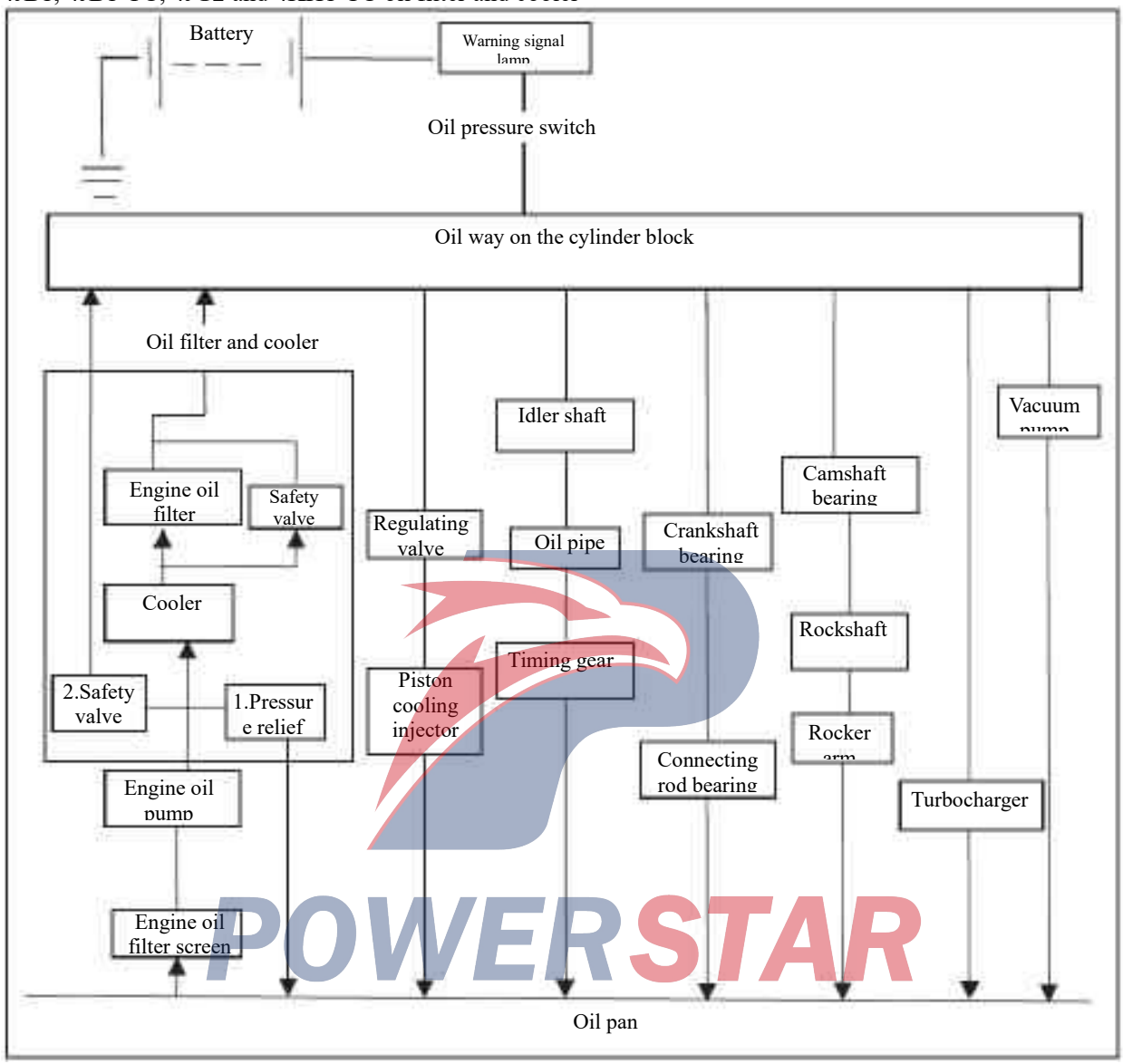


Excessive wear and tear of rotating parts



Lubricating system drawing
4JB1, 4JB1-TC, 4JG2 and 4KH1-TC oil filter and cooler



Working pressure
Pressure relief valve of oil filter (1): 559-618 kPa (5.7-6.3 kg/cm^2 /81-90 psi)
Safety valve of cooler (2): 314-373 kPa (3.2-3.8 kg/cm^2 /46-54 psi)
Safety valve of oil filter (3): 78-118 kPa (0.8-1.2 kg/cm^2 /1-1 psi)
Oil pressure switch (4): 29.4-49.0 kPa (0.3-0.5 kg/cm^2 /4.3- 7.1 psi)
The 4J series engine lubrication system is full flow type.
The lubricating oil is pumped out from the oil pump and passes through the cooler and the oil filter (the exchangeable oil filter on the cooler) to the longitudinal oil channel of the cylinder body. Then, it is transmitted from the longitudinal oil channel to the important part of the engine.

Main data and parameters

Main data and parameters

Engine model Project		4JB1 / 4JB1-TC	4J G2	4KH1-TC
Engine type		Four stroke, top valve and water cooling type		
Type of combustor		direct injection	Votex-type	direct injection
Type of cylinder liner		Dry, chromeplate and stainless steel tubes		
Timing system		Gear drive	Gear and belt drive	Gear drive
The number of cylinder - bore * stroke mm (in)		4-93×102 (3.66×4.02)	4-95.4×107 (3.76× 4.21)	4-95.4×104.9 (3.76×4.16)
Number of piston rings		Compression ring: 2, oil ring: 1		
Total piston displacement mm^3 (in^3)		2,771 (169.0)	3,059 (186.6)	2,999 (183.3)
Compression ratio (:: 1)		18.2 (4JB1) 18.1 (4JB1-TC)	20. 1	18.3
Compression pressure kPa (kg/cm2/psi)		3,038 (31/441)	3,334 (34/483.8)	2,746 (28/398)
Engine weight (dry weight) N (kg/lb)		About 2,245 (229/505) (4JB1) 2,511 (256/564) (4JB1-TC)	About 2,403 (245/540)	About 2,500 (255/562)
Injection order		1 — 3 — 4 — 2		
Injection timing deg		12 (4JB1) before TDC 4 (4JB1-TC) before TDC	TDC 0°	Computer control
Specified fuel type		SAE No. 2 diesel		
Idle speed r/min		750—790	700 — 740	675 — 725
Valve gap (at the cold state)	Intake air: mm(in)	0.40 (0.016)		
	Exhaust: mm(in)	0.40 (0.016)		
Valve gap (at the hot state)	Intake air: mm(in)	0.45 (0.018)		
	Exhaust: mm(in)	0.45 (0.018)		
Air Intake valve	Open (BTDC) deg	24.5		
	Close (ABDC) deg	55.5		
Exhaust valve	Open (BBDC) deg	54		
	Close (ATDC) deg	26		

Engine model Project	4JB1 / 4JB1-TC	4J G2	4KH1-TC
Lubricating system			
Lubrication method	Compression cycle		
Specified oil (API brand)	CC (4JB1) CF-4 (4JB1-TC)	CC	CF - 4
Oil pump type	Gear type		
Engine oil cleaner type	Paper filter core		
Oil capacity L (USA / UK) (including oil filter)	6. 6 — 7. 1 (1. 74 — 1. 87/2. 62 — 2. 82)		6.0 — 8.0(1.59 — 2. 11/2.38 — 3. 18)
Type of cooler	Water-cooled type		
Fuel system			
Fuel injection pump type	Bosch distribution type		BoschVP44 (electronic control)
Speed regulator type	Mechanical (partial transmission) (EC variable speed)		Electronic control injection system
Type of injector	Hole type	Single spring hole type	Hole type
Opening pressure of the injector kPa (kg/cm2/psi)	18,142 (185/2,631) (4JB1) No.1: 19, 500 (199/ 2, 830) No.2: 26, 500 (270/ 3,840) (4JB1-TC)	14,710 (150/2,133)	First : 19,500 (199/ 2, 830) Second : 33,800 (345/ 4, 906)
Main filter type	Paper filter core and oil-water separator		oil and water separator with paper filter core
Air filter type	Dray paper filter element		
Generator capacity V - A (W)	12—40 (480) 12 — 60 (720)	12 — 50	12 — 60 (720) 12—80 (960)
Motor output of starter V - kW	12 — 2.0 12 —2. 2	12 — 2.0	12—2.8
Turbocharger	IHI RHF4 (4JB1-TC)		IHI RHF5

Engine cooling system

Cooling System		Coolant forced circulation (2 pipes per row) corrugated pipes
Radiators		
Heat elimination capacity	kcal/h	71400
Heat dissipating area (ft^2)	m^2	11.78 (126.8)
Surface area	m2(ft2)	0.2 16 (2.325)
dry weight	N(kg/lb)	105 (10.7/23.6)
Radiator cover		
Valve opening pressure	kPa (kg/cm2/psi)	88.2 — 116. 7 (0.899 — 1.199/12.78 —17.05)
Coolant capacity	L (UK/US)	3. 1 (2. 73/3. 28)(used for EC 5. 8 (5. 1/6. 13))
Coolant pump		
Pulley type		Centrifugal impeller type
Pulley ratio		1.2
Thermostat type		Pellet with exhaust valve
Valve opening	° C (° F)	82 (180)
Full open of valve	° C (° F)	95 (203)
Total coolant	L (UK/USA)	10 (8. 80/10. 57) (For EC 7. 3 (6. 42/7. 71))

Starting system

Engine model Project	4JB1 / 4JB1-TC	4J G2	4KH1-TC
Rated value			
Voltage V		12	
Output kW	2.0	2.2	2.8
Time second		30	
Number of pinion teeth		9	
Rotation direction (from the direction of pinion)	Clockwise		
Weight (about) kg	4.6	5.4	6.0
No-load characteristics			
Voltage/current V/A	≥11.5/100		11.5/120
Rotary Speed r/min	≥3700		4000
Load characteristics			
Voltage/current V/A	< 7.5/500		7.5/500
Torque N•m (kg•m/lb•ft)	13.7 (1.4/10.1)		12.7 (1.3/9.4)
Rotary Speed r/min	≤1200	≥1400	1400
Braking characteristics			
Voltage/current V/A	<2.4/800	≥2.0/850	2.0/850
Torque N·m (kg·m/Lb·ft)	18(≥ 1.8/13)	≥16(1.6/12)	15.7(1.6/12)

Charging system

Model		HITACHI LR150-449B	HITACHI LR160-502B	HITACHI LR180-512
Rated voltage	V	12	12	12
Rated output	A	50	60	80
Rotation direction (from the direction of the pulley)		Clockwise	Clockwise	Clockwise
Effective diameter of pulley	mm(in)	80 (3. 15)	82(3.23)	82(3.23)
Weight (with pump)	kg(lb)	6.0 (13.27) 4JB1-TC 4JB1/4JG2	5.8(12. 78) 4KH1-TC	6.3(13. 88) 4KH1-TC

Maintenance standard

Mechanical system of engine

mm(in)

Part	Project	Maintenance standard			Service restriction		Remarks
		4KH1-TC 4JG2	4JBl / 4JB1-TC	4KH1-TC	4J G2	4JBl / 4JB1-TC	
Cylinder head	The flatness of the junction between the cylinder head plane and the exhaust manifold Cylinder head height The warpage of the bottom plane of the cylinder head Warpage of manifold The force imposed by a combustor set down on a combustor	≤0. 05 (0.002) 92.0 (3.622) ≤0. 05 (0. 002) ≤0. 05 (0. 002) — 4, 500- 5, 500 kg (9922. 5 -12127.5 lbs)		0.2 (0.0079) 91.55 (3.6043) 0. 20 (0.008) 0.20 (0.008) 0. 02 (0.0008) —			Not grind
Air valve spring	Free height Verticality Spring tension N (Kg/lb)	48.0 (1.891) — 296 (30). 2/66. 4)		47. 10 (1. 856) 1.7 (0. 067) 257. 9 (26. 3/57. 9)			Height of installation 38.9 (1.531)
Valve and valve tube	Diameter of valve rod intake Gap between valve and valve tube Height of the upper end of the valve catheter (measured from the surface of the cylinder head) Valve duct remainder	7.946 — 7. 961 (0. 3128 —0. 3134) 7.921 — 7. 936 (0.3118 —0. 3124) 0.039 — 0. 069 (0. 0015 —0. 0027) 0. 064 — 0. 096 0. 0025 —0. 0038) 13.0(0.512) 1.1 (0.0433)		7.880 (0.3102) 7. 850 (0. 3090) 0.200 (0.0079) 0.250 (0.0098) — 1.6 (0.0630)			
	Valve thickness inlet valve Exhaust valve	1.41 (0. 0556) 1.39 (0. 0547)	1.79 (0. 0705) 1. 8S (0. 0720)	1.1 (0.0433) 1.1 (0. 0433)		1.5 (0. 06) 1.5 (0. 06)	
	Contact face angle of the valve seat. Valve seat intake Contact width exhaust	45。 1.7 (0.0669) 2.0 (0.0787)		2.2 (0.0866) 2.5 (0. 0984)			
Push rod	Bending degree	—		≤0.4 (0.0157)			

mm(in)							
Part	Project	Maintenance standard				Use restrictions	Remarks
		4KH1-TC	4J G2	4JBI / 4KH1-TC 4JG2 4JB1-TC		4JBl / 4JB1-TC	
Camshaft	Shaft end gap	0. 08 (0.0031)			0.2 (0.0079)		
	Cam height	42.02 (1.6543)			41.65 (1.6397)		
	Journal diameter	945-49.975 (I. 9663- 1.9675)			49.60 (1.9527)		
	Radial runout	(0.02 (0.0008)			0.10 (0.0039)		
	Cam bearing ID	000-50. 030 (1.9685-1.9697)			50.08 (1.9716)		
	Camshaft oil gap	0. 025- 0. 085 (0. 0098-0. 00334)			0.12 (0.0047)		
Tappet	Outer diameter	12. 97-12. 99 (0.5106-0.5114)			12.95 (0.5098)		
	Oil clearance (between tappet and cylinder)	0. 03 (0.0118)			0.10 (0.0039)		
Rocker arm assembly	External diameter of rocker arm	98-19. 00 (0. 7472-0. 7480)			18.90 (0.7440)		
	Rocker arm ID	036-19. 060 (0. 7494-0. 7504)			19.10 (0. 7520)		
		0. 06-0. 08 (0. 00235-0. 00315)			0.10 (0.004)		
	Oil clearance (between the rocker arm and the rocker arm axis)	—			≤0.2 (0.0079)		
Engine oil pump	Radial runout of rockshaft	0. 14 (0. 0055)			0.20 (0.0079)	0.15 (0.0059)	
	Oil gap pump body and tooth number pump cover and gear	0.06 (0. 0024)			0.15 (0.0059)		
Crankshaft	Thrust clearance	0.10 (0.0039)			0. 30 (0.018)		
	Main bearing clearance (between the main bearing and the crankshaft)	0.0.037-0. 068 (0.0015-0. 0027)	0.031-0. 063 (0.0012-0.0 025)	0.035-0.080 (0.0014-0.0 032)	0.11 (0.0043)		
	Radial runout of crankshaft	≤0.05 (0.00197)			0.08 (0. 0031)		
	Main journal diameter	69. 917- 69932 (2. 7526-2. 7532)			69.91 (2.7524)		
	Crank pin diameter	52. 915-52930 (2.083-2. 0839)			52.90 (2.0827)		
	Uneven wear of crankshaft journal and crank pin	≤0.05 (0.002)			0. 08 (0.003)		
	Clearance between crank pin and bearing	0. 029-0.066 (0.0011-0. 0026)			0. 100 (0. 0039)		

	mm(in)							
Part	Project	Maintenance standard			Use restrictions			Remarks
		4KH1-TC	4J G2	4JBl / 4JB1-TC	4KH1-TC	4J G2	4JBl / 4JB1-TC	
Pistons and piston pin and piston ring And connecting rod	Piston diameter	95.355-95.394	95.365-95.404	92.985-93.024				
					—			
		(3.7541-3.7557)	(3.7545-3.9039)	(3.6600-3.6623)				
	piston clearance (piston and cylinder liner)	0. 047-0. 065 (0. 0019-0. 0026)		0.025-0.045				
				(0.0010-0.0018)				
	Ring 1 of opening gap of piston ring	0.30-0.50	0.20-0.35	0.20-0.40	1.5 (0. 0591)			
		(0.0118-0.0197)	(0. 0079-0. 0138)	(0. 0079-0. 0157)				
	Ring II	0.30-0. 50	0.37-0. 52	0.20-0. 40	1.5 (0.0591)			
		(0.0118-0. 0197)	(0. 0146-0. 0205)	(0. 0079-0. 00157)				
	Oil ring	0. 25-0. 45	0. 20-0. 10	0.10-0. 30	1.5 (0.0591)			
		(0. 0098-0. 0177)	(0. 0079-0. 00157)	(0.0039-0.0118)				
	Ring 1 of piston ring gap	0.09-0.13(0. 0035-0. 0051)		0.090-0. 125				
				(0. 0035-0. 0049)				
	Ring II	0. 05-0.09(0. 002-0. 0035)		0.050-0. 075	0.15 (0.0059)			
				(0. 0020-0. 0030)				
	Oil ring	0.03-0. 07(0. 0012-0. 0028)			0.15 (0.0059)			
	Piston pin diameter	30. 995-31.000	33. 995-34. 000	30. 995-31. 000	30. 970 (1.2190)	33. 970 (1 3374)	30.970 (1.2190)	
		(1.2202-1.2204)	(1.3384-1.3386)	(1.2202-1.2204)				
	Fit clearance (between the connecting rod and the piston pin)	0. 008-0.020 (0. 0003-0. 0008)			0.05 (0. 0020)			
	Gap (between the piston and the piston pin)	0.002- 0. 015 (0. 0001-0. 0006)			0.04 (0.0016)			

mm(in)								
Part	Project	Maintenance mark		I	Service reistrictions			Remarks
		4KH1-TC	4J G2	4JBl / 4JB1-TC	4KH1-TC	4J G2	4JBl / 4JB1 -TC	
Piston, piston pin, piston ring and connecting rod	Oil clearance Correction of connecting rod bending degree Torsional degree Clearance between piston pin and connecting rod bushing Clearance between connecting rod thrusts (between crank pin and connecting rod)	≤0. 08 (0.031) ≤0. 05 (0.020) 0.008-0.020 (0.003-0.008) 0.230 (0.0091) 0.029-0.083 (0.0014-0. 0033)		0. 029-0. 066 (0. 0011-0. 0026)	0. 20 (0. 0079) 0. 15 (0. 0059) 0. 050 (0. 0020) 0.35 (0.0138) 0. 100 (0. 0039)			every 100 (3.94) every 100 (3.94)
Cylinder body	The warpage of the upper surface of the cylinder body	—			0.20 (0.0079)			
	Cylinder bore diameter	97.000-97.040 (3. 8189-3. 8205)		95.100-95.040 (3. 7406 — 3.7417)				
	Cylinder liner outburst	0.0— 0.1(0. 00-0. 0039)						
	Inner diameter of cylinder liner	95.420-95.460 (3. 7567-3. 7583)		93. 020-93. 060 (3. 6622-3. 6638)				
	cylinder liner OD	97.011-97.050 (3. 8193 -3. 8209)		95.011-95. 050 (3. 7405-3.742 I)				

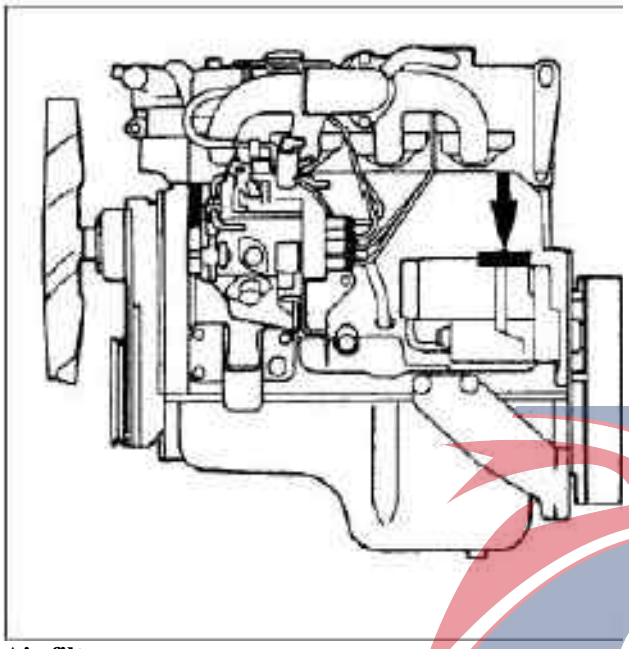
Maintenance

All maintenance work should be operated by qualified maintenance personnel in strict accordance with the maintenance procedures.

Model mark

Engine serial number

The engine number is printed in front of the left cylinder.



Air filter

Dray paper filter element

According to the different type of filter core, the cleaning procedure of the filter core is different.

Dust-polluted filter element

Turn the filter element by hand while blowing compressed air into the filter element.

Dust can thus be blown out.

Compressed gas pressure	kPa (kg/cm^2/psi)
392 - 490 (4 - 5 / 5 7 - 7 1)	

Caution

When cleaning the filter core, it is not necessary to clean the filter core by collision with another object. This is because doing this will damage the filter element.

Carbon and dust pollution filter core

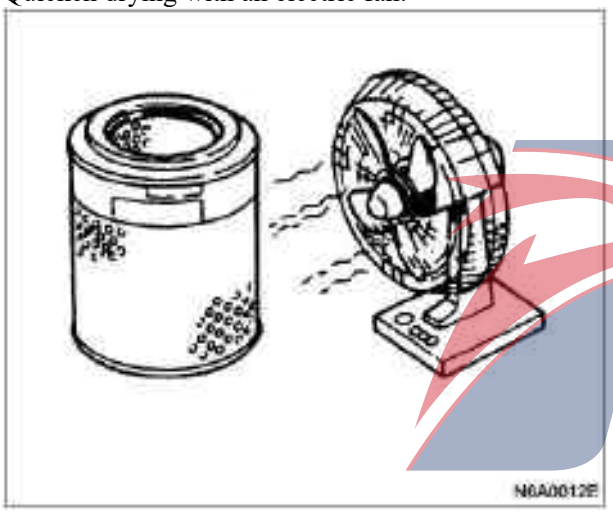
The cleaning liquid for the original Isuzu filter is used and diluted with water.

1. The filter core is immersed in the solution for 20 minutes.

2. Take out the filter element from solution, and clean it with flowing water.

The water pressure shall not exceed 274kPa(6.17 lb/cm^2/40psi).

4. Dry the filter element at the full ventilation place. Quicken drying with an electric fan.



Caution

Do not use compressed air or open fire to quickly dry the filter element. Because this will cause damage to the filter core. It usually takes 2 or 3 days for the filter core to be completely dried. Therefore, it is a good way to use the backup in the hand during this period.

Lubricating system

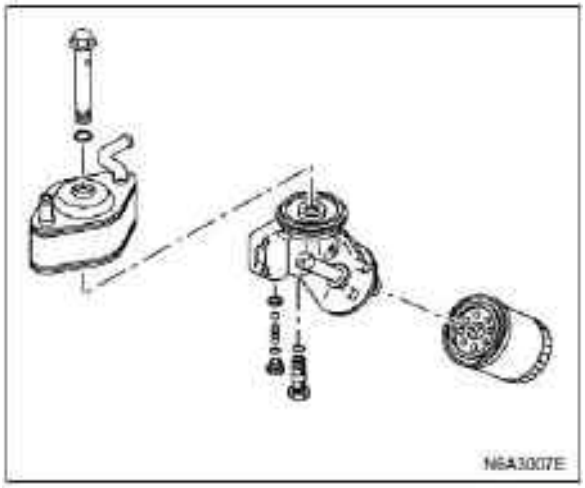
Replacement procedures of main oil filter (paper filter core)

1. Use a filter wrench to unscrew the used filter in counterclockwise direction.
2. Clean the installation surface of filter.

So that the new filter is installed in the appropriate position.

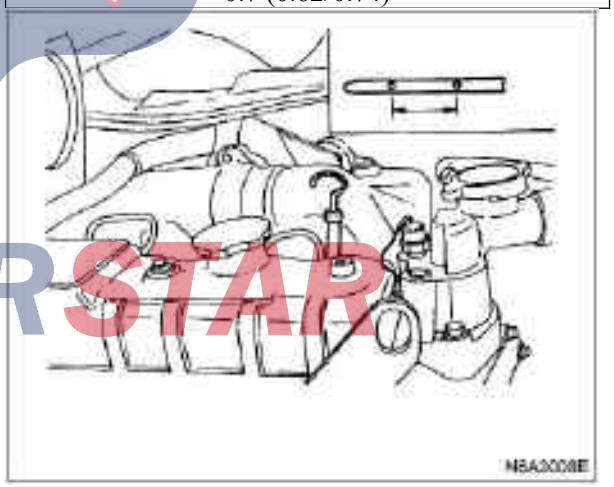
3. Apply a layer of oil on the O ring.
4. Tighten the new filter until the O ring of filter is close to the seal face.
5. Use the filter wrench and tighten for 1.25 laps.

Filter wrench:
5-8840-0200-0 (89mm/3.5in)
5-8840 0202-0 (106mm/4.2in)
5-8840-2209-0 (1 00.6mm/4.0in)



6. Check the oil level. If needed, the oil should be added again until the level reaches the specified level.

Add oil	L (UK/US)
0.7 (0.62/0.74)	



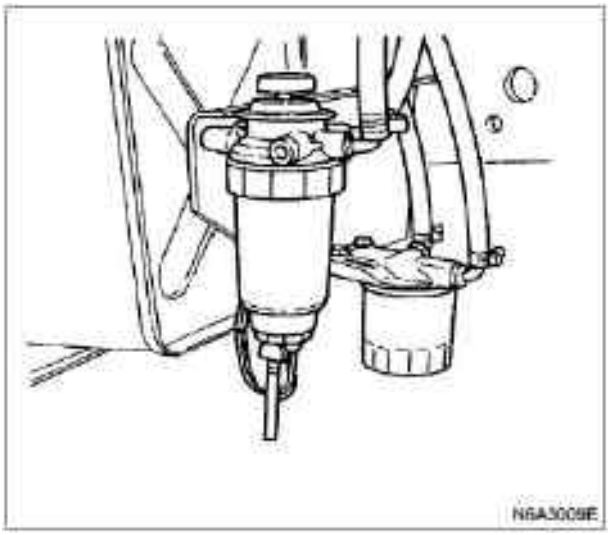
7. Start the engine to see if the engine oil filter has oil leakage.

Fuel system

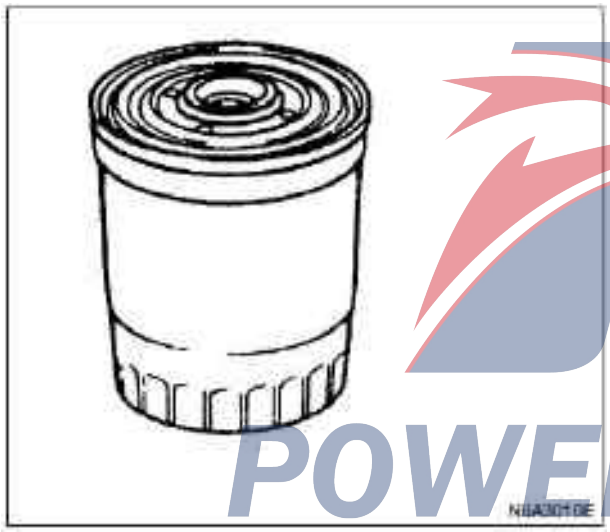
Replacement procedures of fuel filter

1. Use a filter wrench to unscrew the used fuel filter in counter clockwise direction.

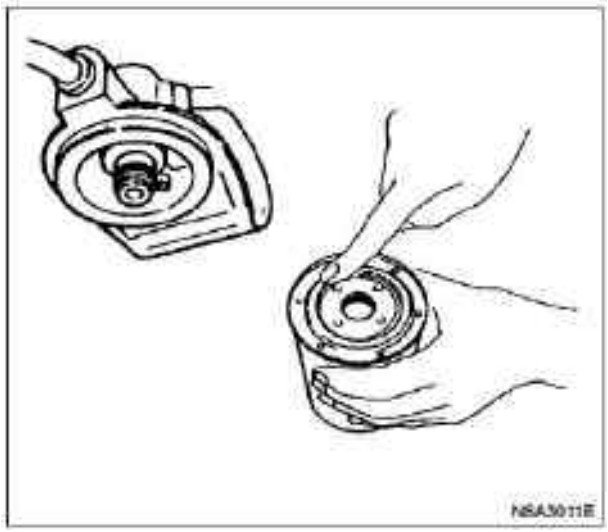
Filter wrench: 5-8840-0253-0 (J-22700)



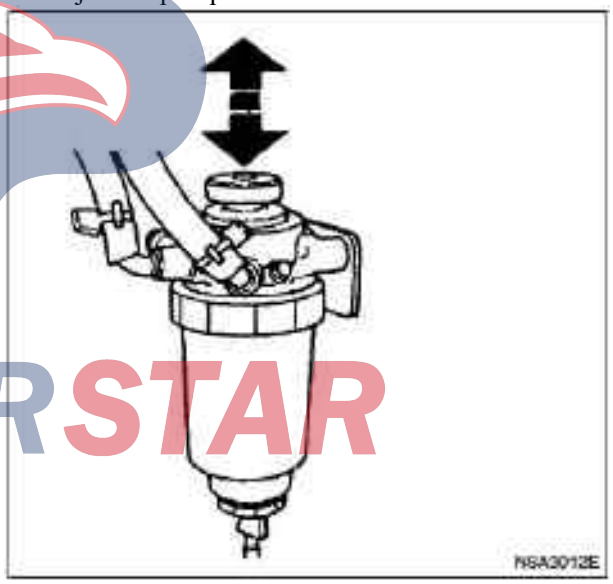
2. Clean the installation surface of filter. So that the new fuel filter is installed in the appropriate position.



3. Tighten the fuel filter until it is contacted with the sealing surface.



4. Use the filter wrench and tighten for 2/3 laps on the fuel filter.
Filter wrench: 5-8840-0253-0 (J-22700)
5. Release the drain slug on the overflow valve of the fuel injection pump.



6.Operate the oil pump until the fuel begins to flow out of the fuel filter.
7. Re-tighten the drain slug.
8. Press the hand oil pump several times to check for fuel leakage.

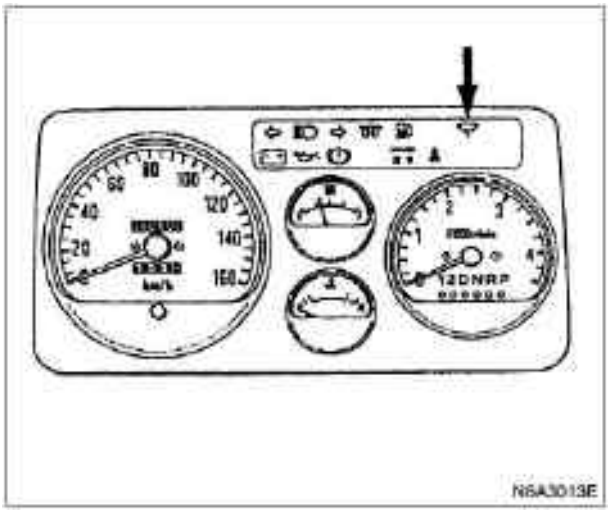
Caution

Strongly recommend the use of original Isuzu fuel filter.

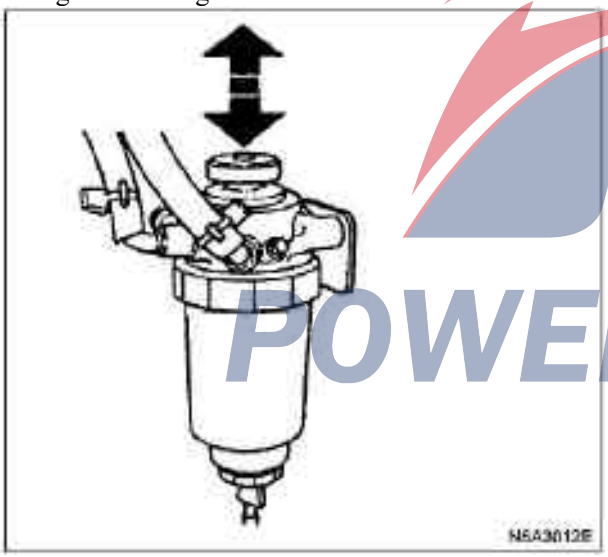
Drainage procedure of fuel filter

When the water surface of the oil-water separator exceeds the specified value, the indicator light will be on.

In accordance with the following procedures, water and foreign objects are discharged from the oil-water separator.



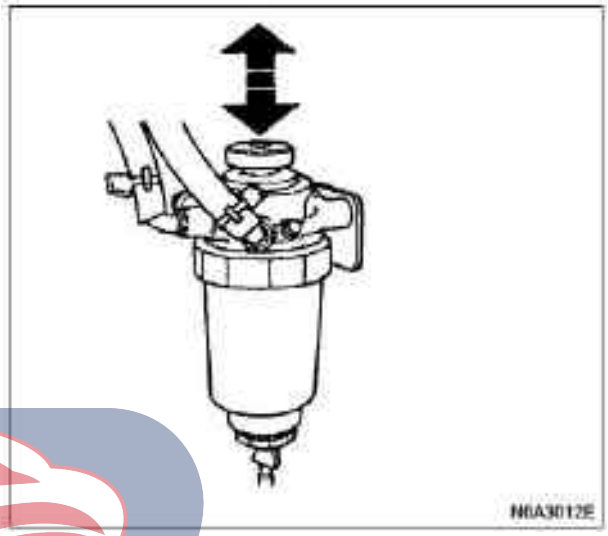
1. Find a safe place to park.
2. Open the engine hood and put a container (with about 0.2 liters of capacity) at the end of the ethylene hose under the water drain plug of the oil separator.
3. Open the water drain plug (about 5 circles) in the counter clockwise direction and press the hand oil pump up and down about 10 times until 0.1 liter of sewage is discharged.



4. After drainage, tighten the slug in clockwise direction and press the hand oil pump several times with the hand up and down.
5. After starting the engine, see if the plug has a leakage of fuel. And check whether the indicator of the fuel filter has been off.

Exhaust

1. Release the relief plug on the overflow valve of the fuel injection pump.
2.Press the hand oil pump until the mixed foam in the fuel is out of the vent plug.
3. Tighten the relief plug.
4. Press the hand oil pump several times to check for fuel leakage.



Outgassing of fuel injection pump (only for 4KH1-TC)

In order to start the engine, the fuel injection pump must be deflated as follows:

- The fuel has been consumed (fuel depleted)
- The fuel filter has been replaced.
- The fuel injection pump has been replaced.

Caution

If the fuel injection pump has been replaced, the outgassing process will take more time and energy (because there is no fuel in the fuel injection pump).

1. Undo the outgassing nut on the hand oil pump plunger (at the top of fuel filter).
2. Press the manual oil pump till feeling strong resistance (about 15 times).
3. Stop pressing and tighten nuts.
4. Wait for 1min.
5. Re-unscrew the bleeder nut on the plunger of the manual oil pump.
6. Press the manual oil pump till feeling strong resistance (about 10 times).
7. Stop pressing and tighten nuts.
8. Wait for 1min.
9. Re-unscrew the bleeder nut on the plunger of the manual oil pump.
10. Press the hand oil pump up and down until it feels strong resistance (about 5 times).
11. Stop pressing and tightening the outgassing nut.

12. Always step on the accelerator and clutch pedal, do not let go. Turn the ignition switch to the "ON" position. Wait until the preheating indicator lights up and goes out.

Caution

If the engine is cold, the preheating indicator will be lit for 4-7 seconds before it is extinguished.

However, if the engine is hot, the light will not be illuminated.

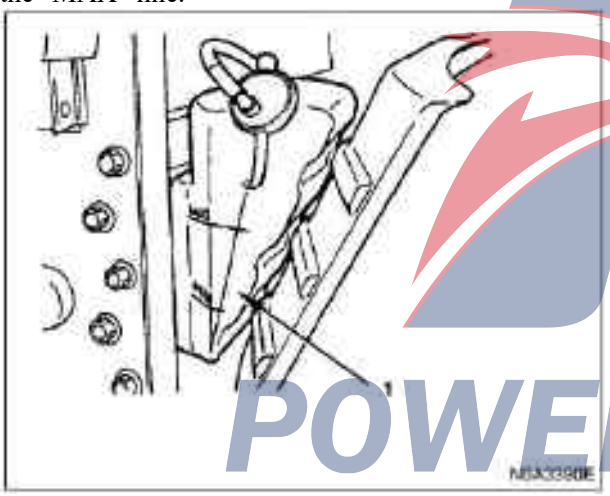
13. Switch the ignition switch to the "(START)" position and start the ignition (not more than 10 seconds). If the engine is not started, Step 9-13 should be repeated.

14. Let the engine idle for 5 minutes.

Cooling System

Coolant level

Check the coolant level. If necessary, the radiator tank should be added. If the coolant level is lower than the "MIN" line, check the leakage of the cooling system carefully. Then, add enough coolant to reach the "MAX" line.



Legend

1. Water tank

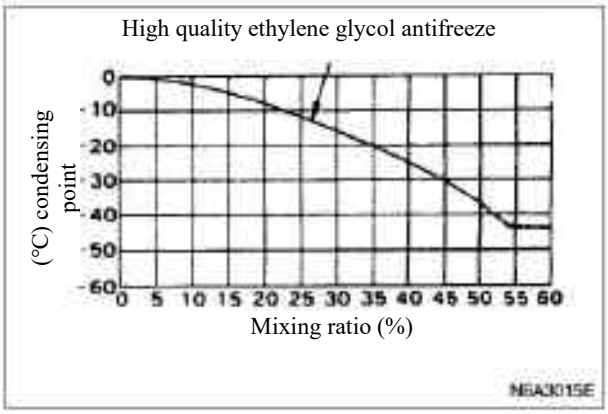
Engine coolant replacement procedure

1. When replacing the engine coolant, it is necessary to ensure that the engine is cold.

Warning:

Do not unscrew or open the radiator cover in case of reaching high coolant temperature. Otherwise, you may be scalded by vapor or boiling water. Before opening the radiator cover, place a piece of thick cloth on the cover and then slowly unscrew the cover so as to reduce the pressure during cooling of coolants.

2. Open the radiator cover, unscrew the radiator and the drain valve on the cylinder, to drain the sewage from the cooling system



Caution

In order to ensure the best cooling effect, it is recommended that the engine cooling system be cleaned at least once a year. Before using antifreeze, it is recommended that the interior of cooling system be cleaned, including the radiator.

A broken rubber hose should also be replaced if the antifreeze may leak, even there are tiny cracks.

It is recommended that cooling system should adopt original Isuzu antifreeze (vinyl alcohol based) or equivalent, do not add any additives or inhibitors.

Caution

When the coolant is replaced or injected in the cooling system of the engine improperly, sometimes the coolant will overflow from the neck of the filling even before the engine and radiator are full.

If the engine operates in this case, the lack of coolant may cause the engine to overheat. In order to avoid this kind of fault, attention should be paid to the following conditions when adding the coolant.

3. When re-injecting coolant, use the filler hose whose nozzle neck diameter should be smaller.

Otherwise, the air between the injection neck and the injection hose will block the entrance and prevent the cooling system from filling.

4. Keep the speed of filling coolant (less than 9 L / min). It is possible to bring the air in the engine and the radiator when the filling speed is over the maximum speed. It will also increase the flow rate of the coolant, and it is difficult to judge whether the cooling system is filled.

5. When the cooling system is filled, take out the filling hose and see if the trapped air in the system is discharged, and the cooling level is reduced. If the coolant level drops, the filling process should be repeated until the coolant level is no longer reduced.

6. When the radiator is filled directly, the water tank should be added to the highest level.
7. Install and tighten the radiator cover to start the engine. After 2-3 minutes at the idle speed, the engine is extinguished and the radiator lid is reopened. If the water level is reduced, it should be supplemented.

Warning:

Do not unscrew or open the radiator cover in case of reaching high coolant temperature. Otherwise, you may be scalded by vapor or boiling water. Before opening the radiator cover, place a piece of thick cloth on the cover and then slowly unscrew the cover so as to reduce the pressure during cooling of coolants.

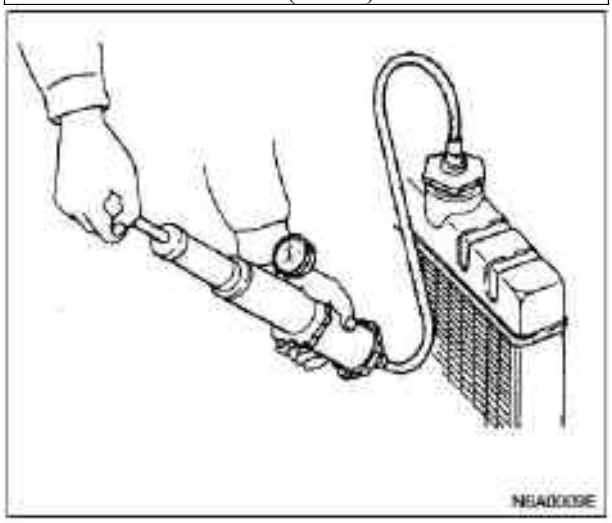
8. After tightening the radiator cap, the engine is preheated to the speed of 2000r/min. Adjust the heater, and set up as the maximum temperature, so that the coolant is circulated to the heater water supply system.
9. Check whether the thermostat has been opened. According to the water thermometer pointer position, operate for 5 minutes at the idle speed, the engine goes out.
10. When the engine is cooled, check whether the water surface of the injection mouth drops, and if necessary, it should be refilled. If the coolant is found to be seriously inadequate, check the leakage of the cooling system and the water tank hose.
11. Pour the coolant into the water tank until it reaches the "MAX" line.

Cooling system check

Install a filler cap tester on the radiator. Apply the test pressure to the cooling system to see if there is any leakage.

The test pressure must be greater than the specified pressure.

Test pressure	kPa (kg/cm2/psi)
147 (1.5/21)	



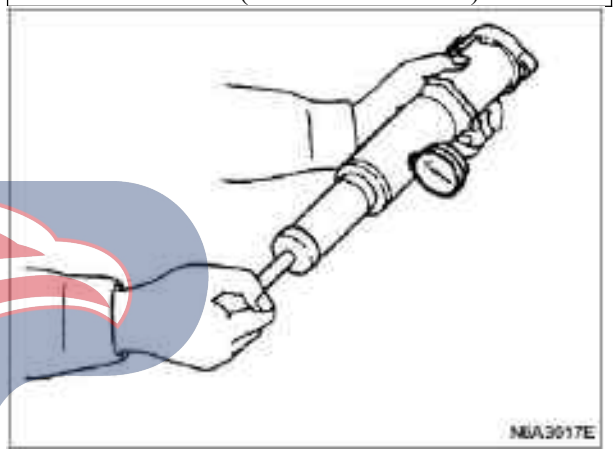
Inspection of radiator cap

According to the design, the filling port cap of the radiator can make the coolant pressure in the cooling System 2 keep 1.05 kg/cm (15 psi /103 kPa). Use the radiator filling port cap tester, and check the radiator filling port cap. During the test, if the filling port cap of radiator can not maintain a specified pressure, it is necessary to replace the filling port cap.

Pressure of radiator filling port cap

Pressure valve	kPa (kg/cm^2/psi)
88-118 (0.9-1.2/12.8-17.1)	

Negative pressure valve (Reference)	kPa (kg/cm^2/psi)
1.0-13.9 (0.01-0.04/0.14-0.57)	



Running test of thermostat

1. Fully immerse the thermostat in the water.
2. Heat the water.

In order to prevent direct heating, a block of wood (2) is placed between the thermostat and the container to prevent direct heating by using a suitable wood stick (1).

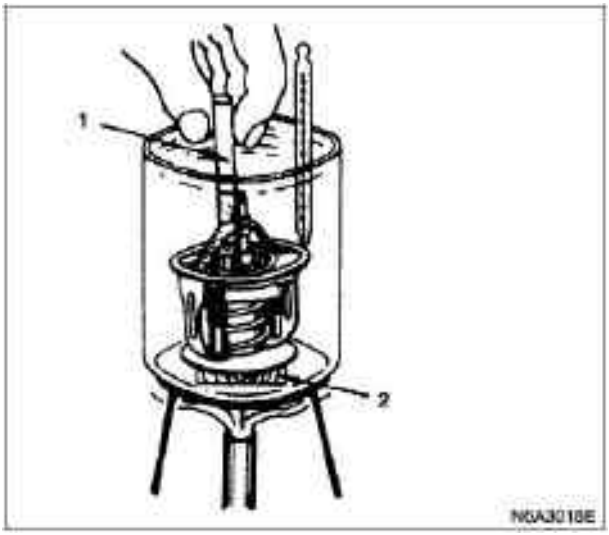
3.Check the initial temperature of the thermostat

Initial temperature of thermostat	°C (°F)
82 (180)	

4. Check the temperature of fully opening the thermostat.

Temperature of fully opening the thermostat	°C (°F)
95 (203)	

Valve lift in full open position	mm(in)
10 (0.39)	



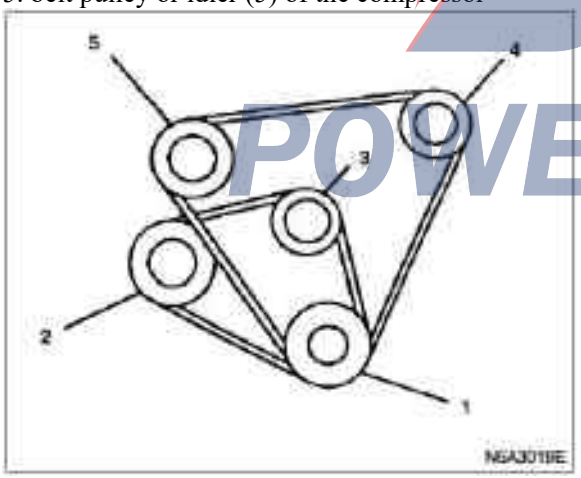
Drive belt adjustment

Exert 98 N (10 kg / 22 lb) force to the middle of the drive belt.

Standard deflection of drive belt	mm(in)
8-12 (0.32-0.47)	

Check whether there is fracture and other damage on drive belt.

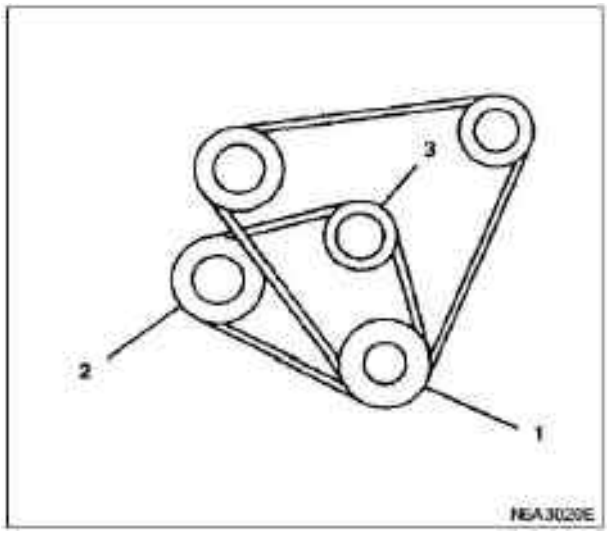
1. Crankshaft belt pulley (1)
2. Generator pulley (2)
3. Cooling fan pulley (3)
4. belt pulley or idler (4) of the fuel pump
5. belt pulley or idler (5) of the compressor



Drive belt of cooling fan pulley

Move the generator to adjust the tension of the fan belt. Exert 98 N (10 kg / 22 lb) force to the middle of the drive belt.

1. Crankshaft belt pulley (1)
2. Generator pulley (2)



Drive belt of compressor pulley

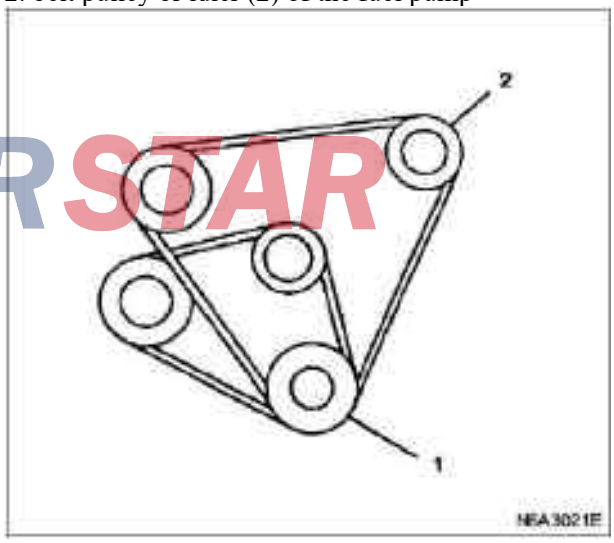
Move the idle wheel according to the requirement in order to adjust the tension of the compressor belt.

If the vehicle is equipped with a power steering device, the fuel pump should be moved as required.

Exert 98N (22.05lb / 22lb) force to the middle of the drive belt.

Standard deflection of drive belt	mm (in)
8 - 1 2 (0.32 - 0.47)	

1. Crankshaft belt pulley (1)
2. belt pulley or idler (2) of the fuel pump



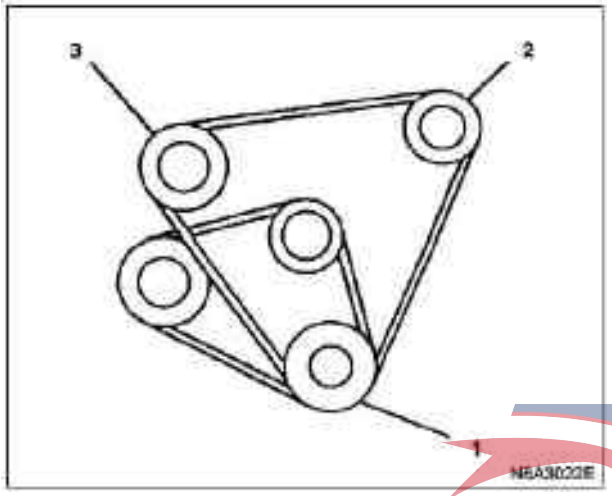
Drive belt of oil pump pulley of power steering device

Move the fuel pump as required in order to adjust the tension of the drive belt of the fuel pump.

Exert 98N (22.05lb / 22lb) force to the middle of the drive belt.

Standard deflection of drive belt	mm(in)
8-12(0.32-0.47)	

1. Crankshaft belt pulley (1)
2. Fuel pump pulley (2)
3. belt pulley or idler (3) of the compressor



Engine control

Idle speed check

1. Pull the handbrake to stop driving wheel.
2. Switch the gear into the neutral position.
3.Start the engine to make it preheated.
4. Disconnect the engine control cable on the control lever.
5. Install a tachometer on the engine.
6.Check engine idle speed

If the engine idling exceeds the specified range, the idle speed must be adjusted.

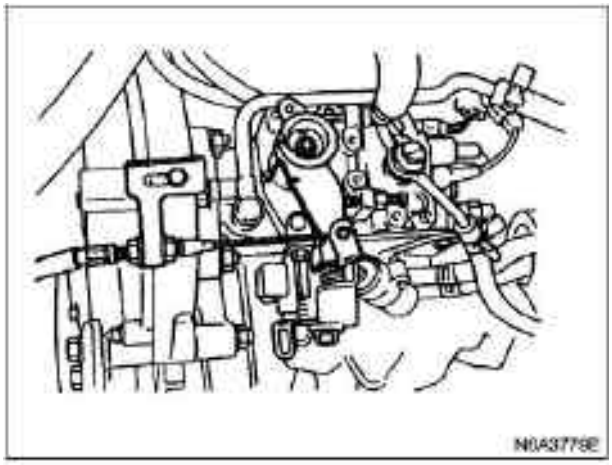
Engine idle speed	r/min
4JB1 / 4JB1-TC	750-790
4J G2	700-740
4KH1-TC	675-725

Idle speed adjustment

(applicable to only 4JB1/4JB1-TC/4JG2)

1. Unscrew the lock nut on the idle speed adjustment bolt of the injection pump.
2. Turn the idle speed adjustment bolt, and adjust the idle speed within the specified range.
3. Adjust the lock nut of the bolt to tighten the idle speed adjustment bolt with the idle speed.

4. Check if the idle control cable is tightened (no gap). If necessary, the gap should be removed from the cable.



Adjustment of throttle control cable

(applicable to only 4JB1/4JB1-TC/4JG2)

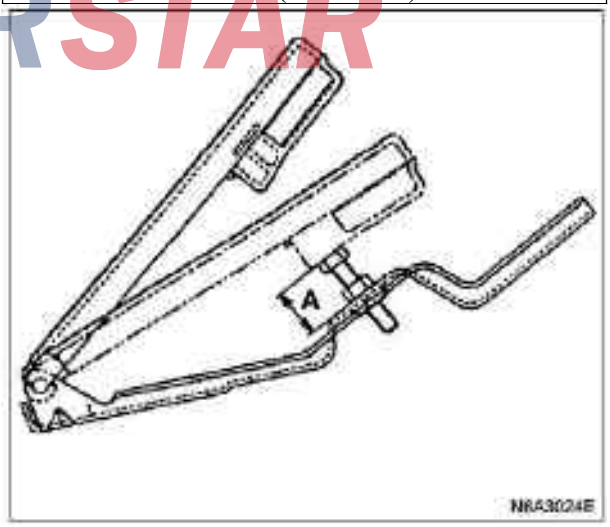
1. Unscrew the clamping bolt of the throttle control cable.
2. Check whether the idling control knob on the dashboard is in the engine idle position.
3. The throttle linkage is in the fully closed position, and the control cable is tightened in the direction of the arrow, without leaving any gaps.

Adjustment of accelerator pedal

Left-placing steering wheel

1. Unscrew the lock nut.
2. Adjust the height of the bolt to the floor.

Adjust the height of the bolt (A)	mm(in)
18 - 28 (0.71 - 1.1)	

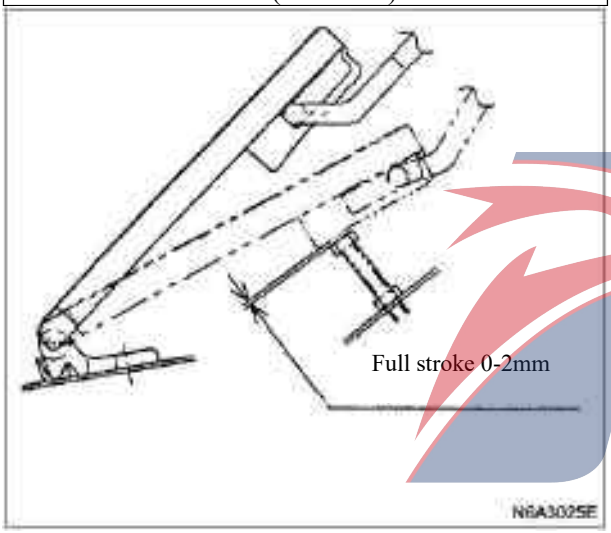


3. Check whether the accelerator pedal clearance is within the range of 5-10mm.
4. Depress the accelerator pedal to bottom and check whether the engine runs smoothly at the highest speed during each time of connection
5. Operating levers can favorably return their respective original position within the working range of the accelerator pedal and fuel injection pump.

Right-placing steering wheel

1. Use the hand to hold the accelerator pedal to make it reach the full stroke.
2. Adjust the blocking bolt to make the gap between the blocking bolt and the back of the pad to reach the specified length.

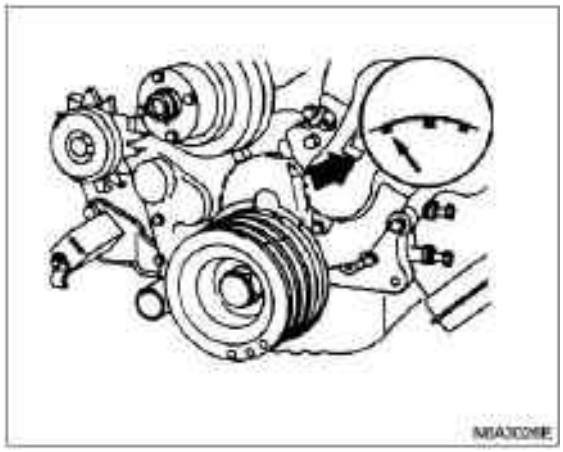
mm (in)
0 - 2 (0 - 0.079)



3. Check whether the accelerator pedal clearance is within the range of 5-10mm.
4. Depress the accelerator pedal to bottom and check whether the engine runs smoothly at the highest speed during each time of connection
5. Operating levers can favorably return their respective original position within the working range of the accelerator pedal and fuel injection pump.

Valve clearance adjustment

1.Turn the crankshaft until the TDC line of the crankshaft pulley is aligned to the positive point, so that the piston of the first or the fourth cylinder reaches the top stop.

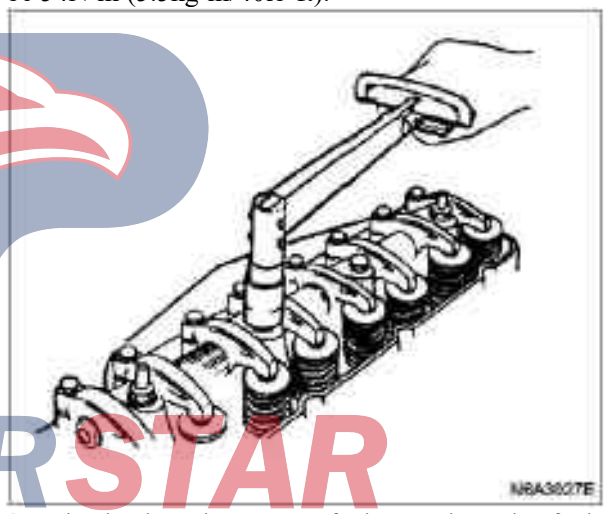


2. Check whether the rockshaft bracket nut is loose.

Before adjusting the valve gap, the rocker shaft support nut should be tightened.

Tightening torque:

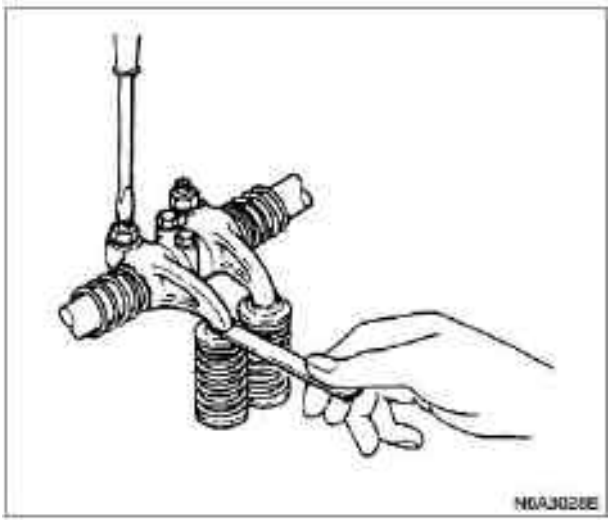
·Tighten the torque of the rocker shaft support nut to be 54N-m (5.5kg-m/40lb-ft).



3. Check the clearance of the push rod of the induction and exhaust valves of the first cylinder.

If the push rod of the intake and exhaust valves of the first cylinder has clearance, the piston of the first cylinder is located at the TDC of the compression stroke.

If the push rod of the intake and exhaust valves of the first cylinder has no clearance, the piston of the fourth cylinder is located at the TDC of the compression stroke.

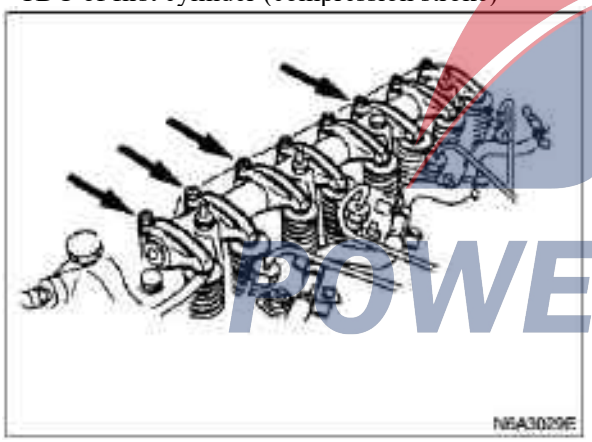


The valve clearance of each cylinder shall be adjusted when the first cylinder or the fourth cylinder is located at the TDC (Top Dead Center) of the compression stroke.

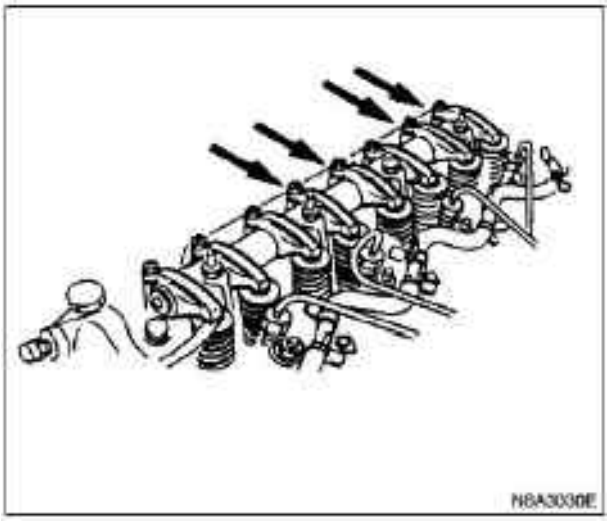
Valve gap (cold state)	mm (in)
0 . 4 (0 . 0 1 6)	

4. Unscrew all the adjustment screws of valve clearance according to the diagram.

• TDC of first cylinder (compression stroke)



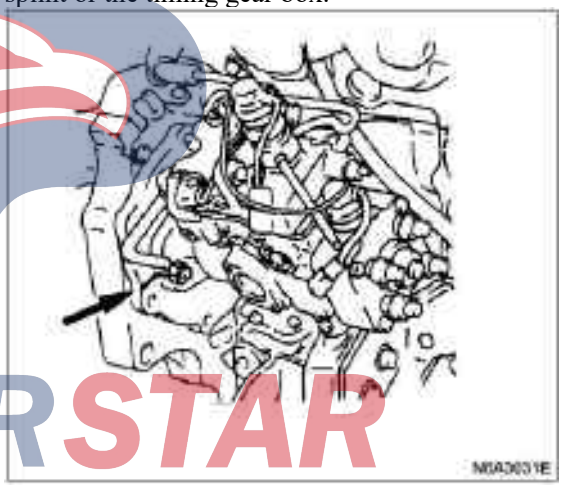
5. Between the rocker arm and the end of the valve rod, insert the feeler gauge with appropriate thickness.
6. Turn the valve clearance to adjust the screw until the feeler gauge has slight resistance.
7. Tighten the locknut.
8. Turn the crankshaft to 360 °.
9. Use the timing point to re-check the cut line of the crankshaft pulley on the TDC.
10. Adjust the clearance of residual valves as shown in the figure.



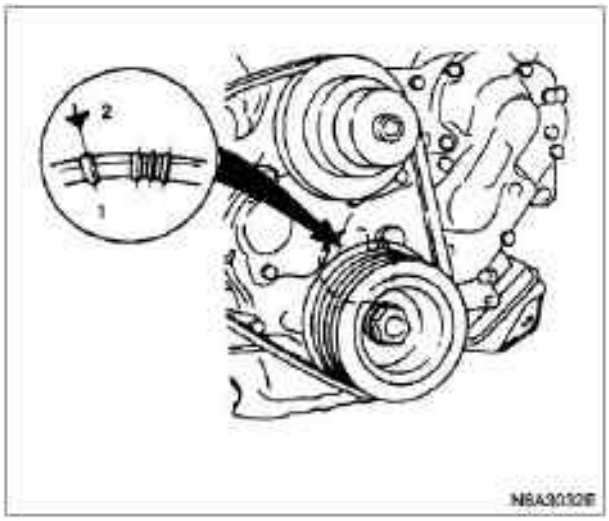
Timing adjustment of fuel injection

(applicable to only 4JB1/4JB1-TC/4JG2)

1. Check whether the cut line on the injection pump flange is aligned with the incisional line of the front splint or the timing gear box.

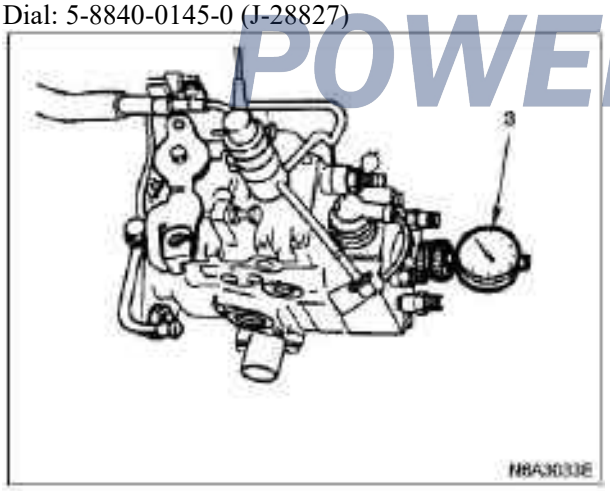


2. Turn the crankshaft until the point line of the crankshaft pulley is aligned with the timing mark (2), so that the piston of the first cylinder reaches TDC1 on the compression stroke.

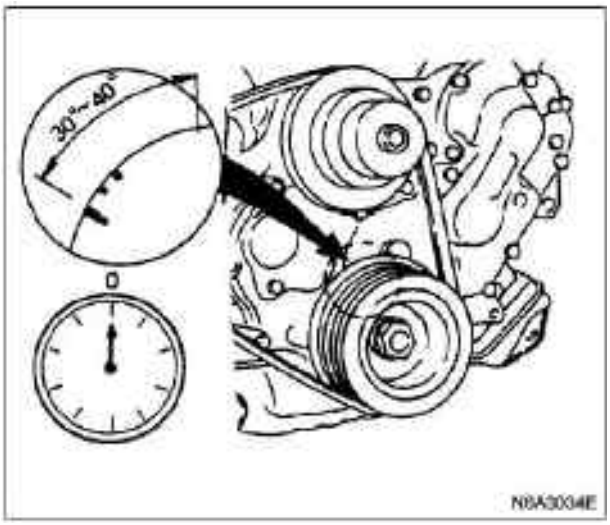


Caution
Check the gap between the intake and exhaust valve push rod of first cylinder.
If the push rod of the intake and exhaust valves of the first cylinder has clearance, the piston of the first cylinder is located at the TDC of the compression stroke.

3. Disconnect the injection pipe of the injection pump.
4. Disassemble a bolt on the top of the distributor.
5. Insert a screwdriver into the hole on the fast idle lever to remove the cold start function (if it is equipped).
6.Install micrometer (3).
Micrometer probe should be pressed inwardly into 2 mm (0.079 in).
Dial: 5-8840-0145-0 (J-28827)



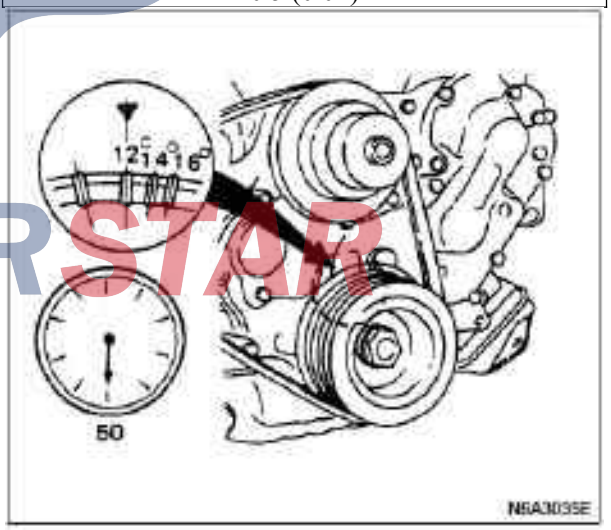
7. Turn the crankshaft a little bit, so that the piston of the first cylinder reaches 30-40°(BTCP).
8. The pointer of the timing meter is set to 0.



10. When the timing mark of the crankshaft pulley is aligned with the indicator, the crankshaft should be rotated clockwise and read.

4J B1	B top dead center 14°
4JB1-TC	B top dead center 4°
4J G2	A TDC 2°

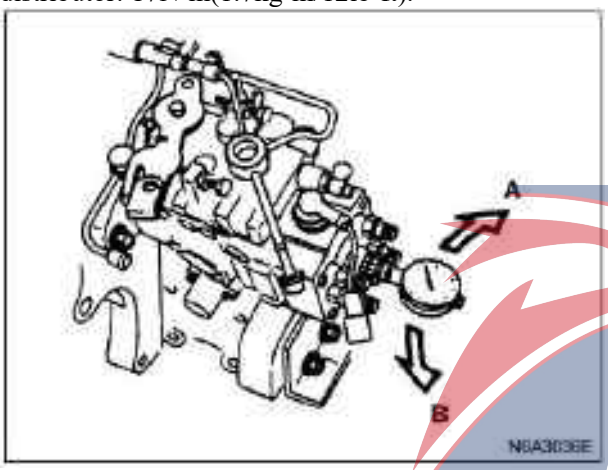
Standard readings (initial timing)	mm(in)
0.5 (0.02)	



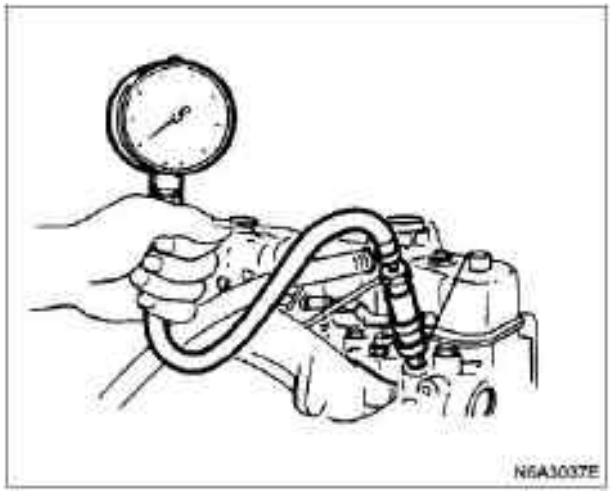
If the injection time exceeds the specified scope, the following steps should be taken.
11. Unscrew the fixed nut and support bolt of the injection pump.
12. Adjust the installation angle of injection pump.

	Greater than standard value	Smaller than standard value
Gear drive	A	B

A: Move the fuel injection pump to the engine.
B: Remove the fuel injection pump from the engine.
Tighten the fixed nut of the fuel injection pump and adjust the bolt and the plug at the top of the injection pump distributor to the specified torque.
Tightening torque:
• Fixed bolt torque of the injection pump: 24N· m(2.4kgm/17lb·ft).
·Adjust the bolt torque to19N· m(1.9kg· m/14lb·ft).
• Torque of the top plug of the fuel injection pump distributor: 17N·m(1.7kg·m/12lb·ft).

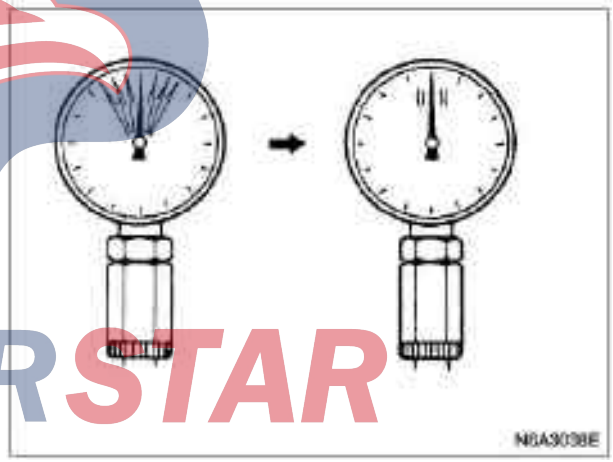


Legend
A. Ahead of time
B. Delay
Caution
When installing the plug on the top of the distributor, it is necessary to ensure the use of new copper gaskets.
Compression pressure measurement
1. Start the engine to make it idle until the temperature of the coolant reaches 70-80°C (158-176°F).
2. Remove the following parts.
·Glow plug
·Oil broken solenoid valve connector
·Quick on start (QOS) fuse on the connector.
3. The connector tube and pressure gauge are installed in the glow plug hole of the first cylinder.
Pressure meter (with connector tube):5-8840-2008-0 (J-29762)
Connector tube: 5-8531-7001-0



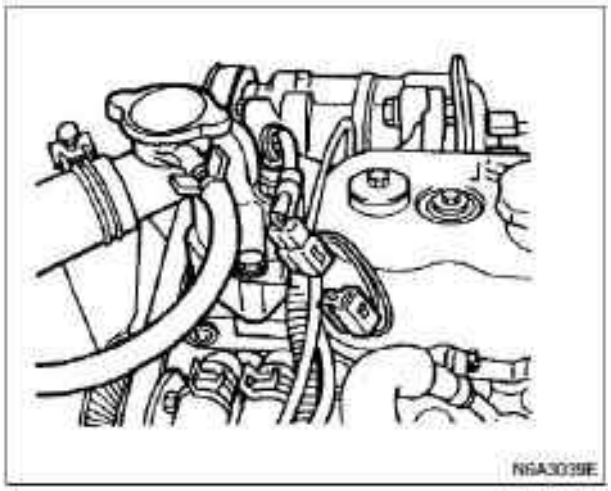
4. Use the starting motor to start the engine, and read the value of the pressure gauge.
Compression pressure kPa (kg/cm /psi) when the speed is 200r/min

	Standard value	Limit value
4J B1	3,038 (31/441)	2,157 (22/313)
4J G2	3,334 (34/484)	2,452 (25/356)



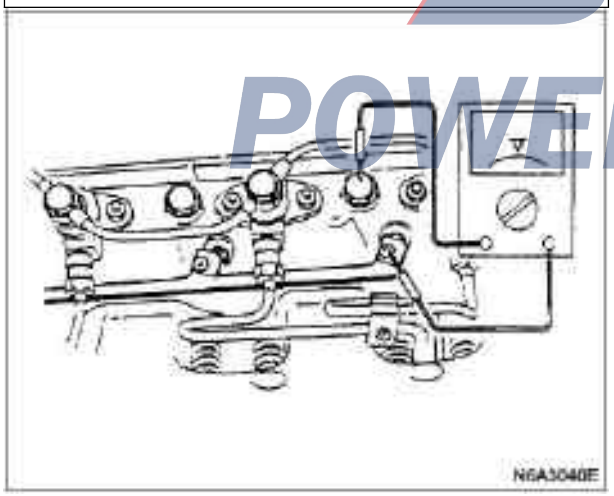
5. For the remaining cylinders, the above procedures should be repeated (Step 3 and Step 4).
If the measured value is less than the specified limit, see the "Find Out Fault" section of this manual.

Quick starting II system (applicable to only 4JB1 / 4JB1-TC / 4KH1-TC)
quick starting system check procedure
1. Disconnect the temperature-sensitive component on the outlet pipe of the thermostat.

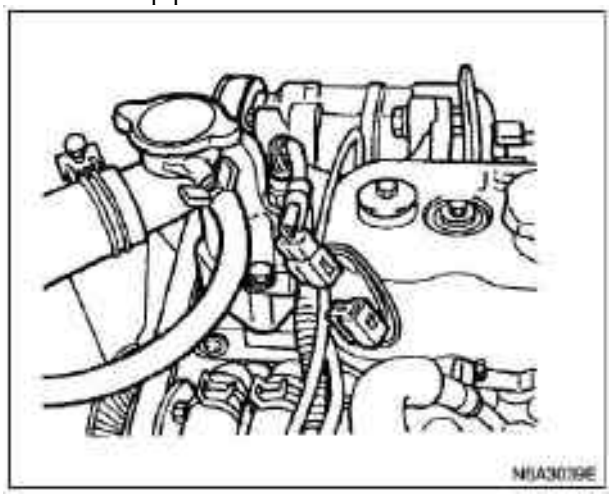


2. Turn the starting switch to “ON” position.
If the QOS II system runs normally, the preheating relay will send out the clad within 15 seconds after opening the starting switch.
3. After turning the starting switch to “ON” position, immediately measure the glow plug terminal voltage using the circuit tester.

Glow plug terminal voltage	V
About11	



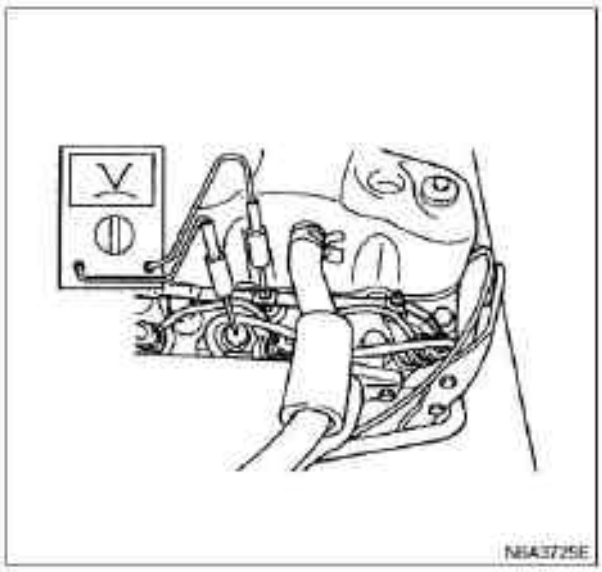
Quick starting III system (applicable to only 4JG2)
quick starting system check procedure
1. Disconnect the temperature-sensitive component on the outlet pipe of the thermostat.



2. Turn the starting switch to “ON” position. If the QOS III system runs normally, the preheating relay will send out the clad within 7 seconds after opening the starting switch.
3. After turning the starting switch to “ON” position, immediately measure the glow plug terminal voltage using the circuit tester.

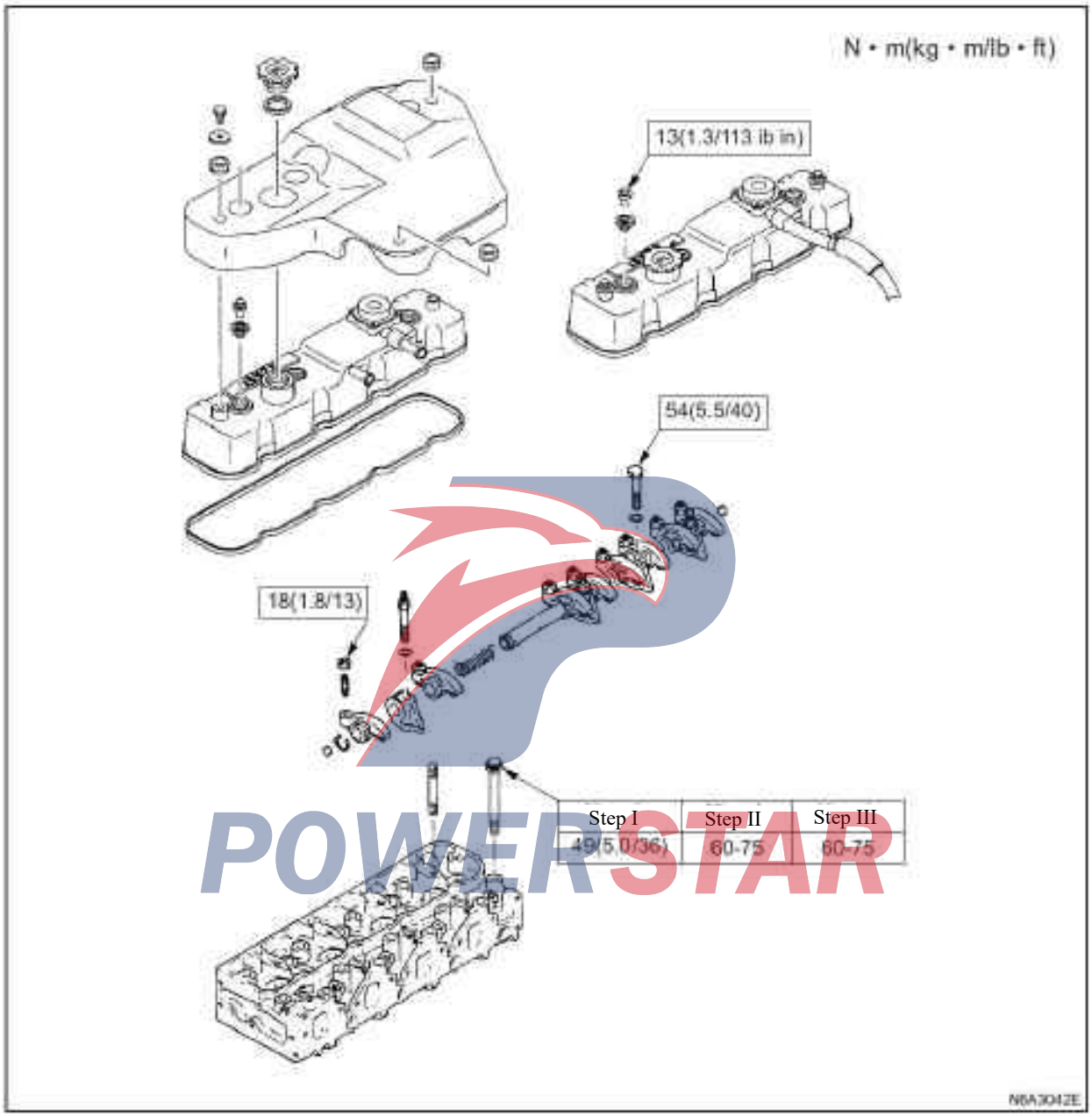
Glow plug terminal voltage	V
8—9	

Caution
When the starting switch is kept in the "ON" position for 20 seconds, the power of the QOS system will be cut off.
Turn the starting switch to the "OFF" position and then turn back to the "ON" position.
This can make the QOS III system reset.

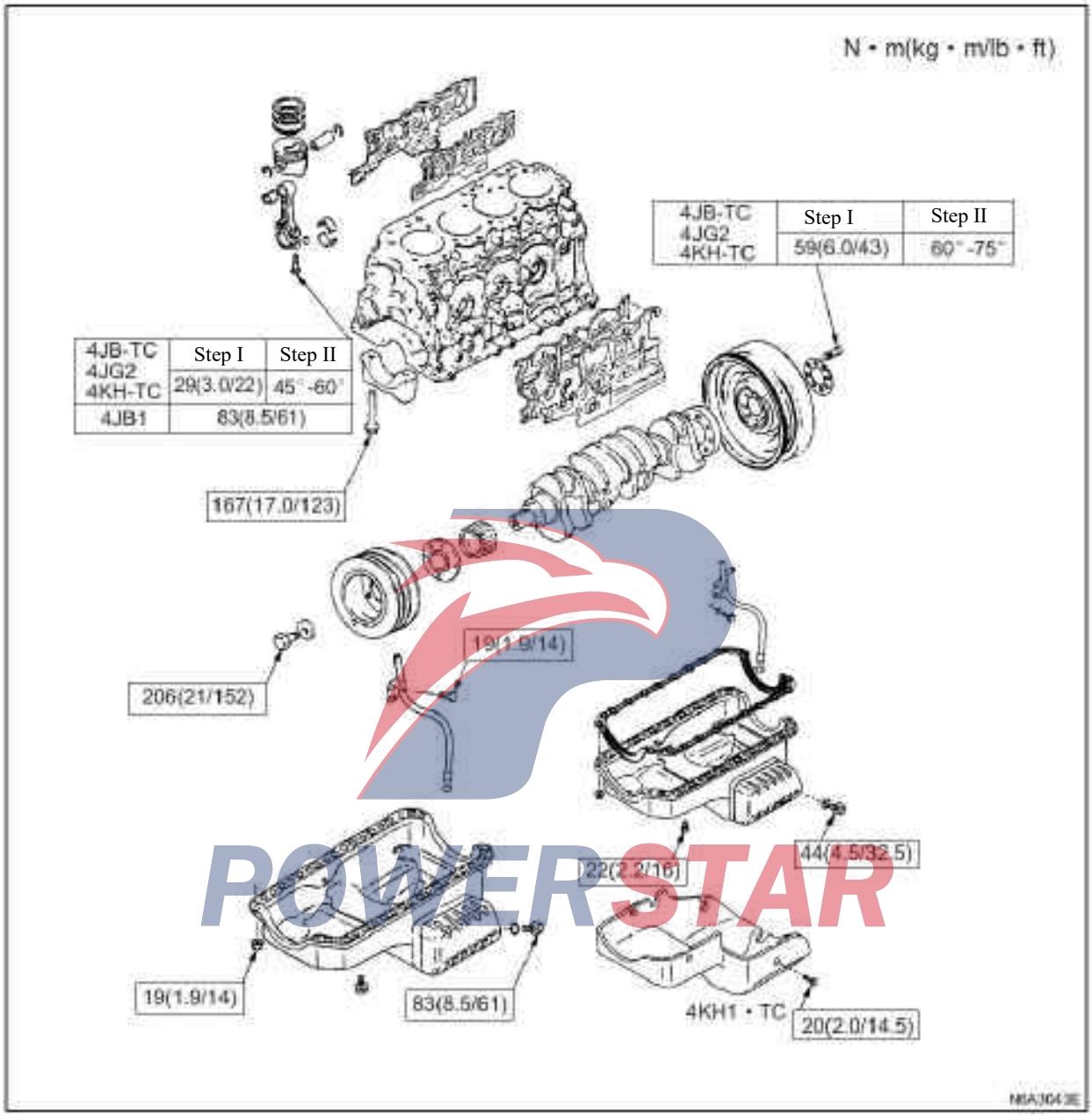


Tightening torque

Front cylinder head, cylinder head rocker arm, and shaft brake

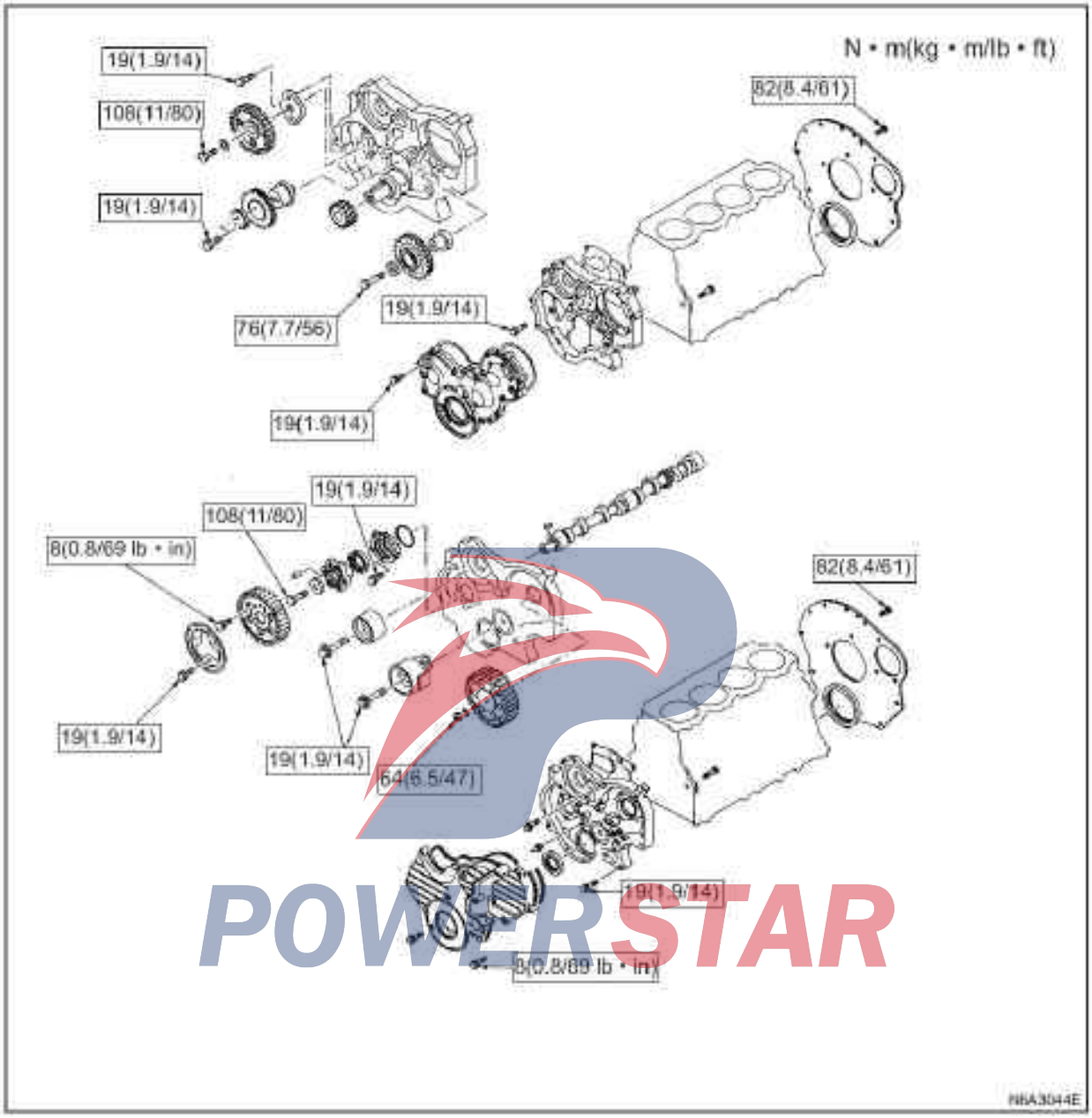


Crankshaft, bearing cap, connecting rod bearing cap, crankshaft belt pulley, flywheel, oil sump

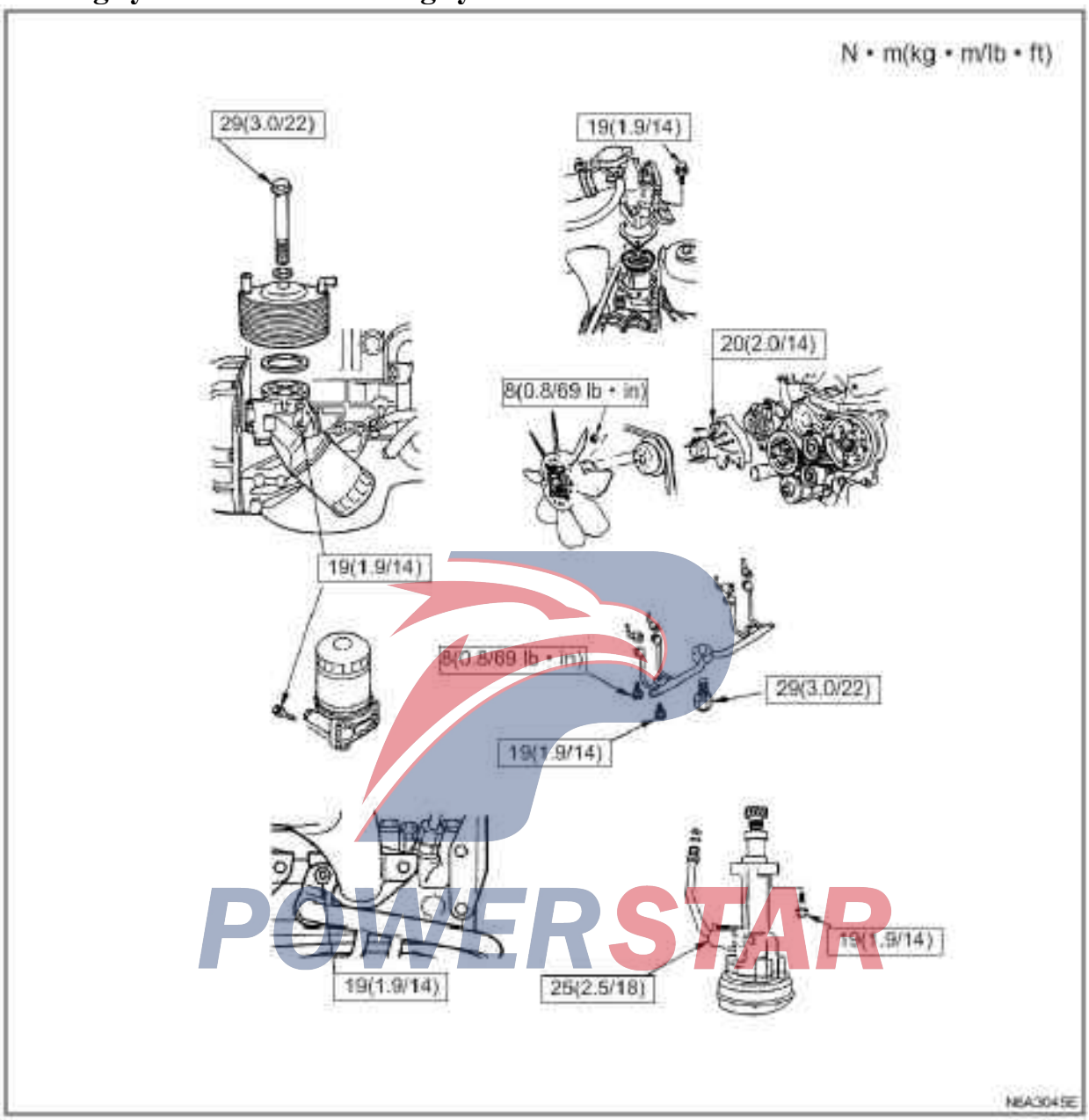


Legend

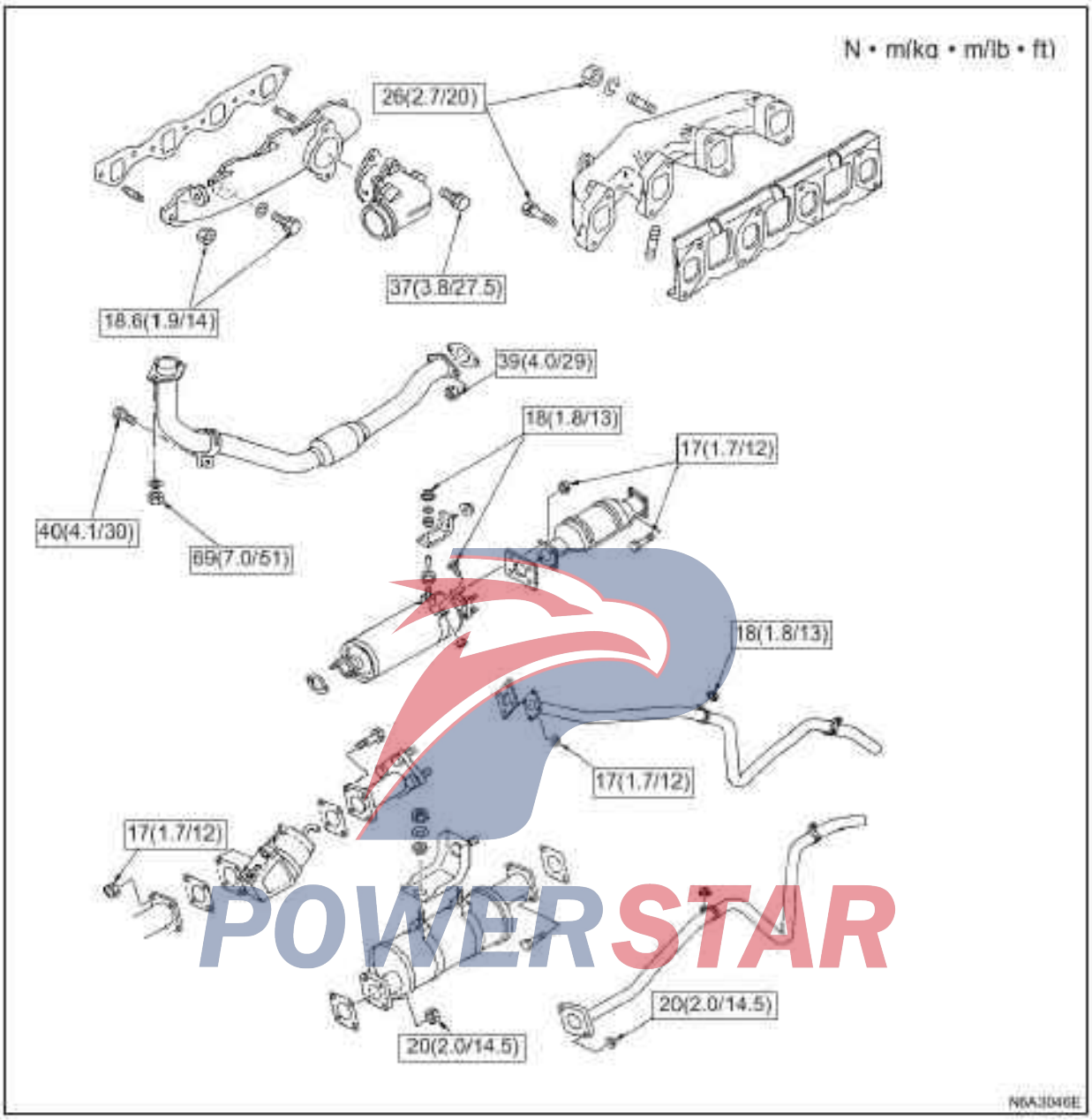
Timing pulley casing, timing pulley, timing gear, camshaft oil seal ring

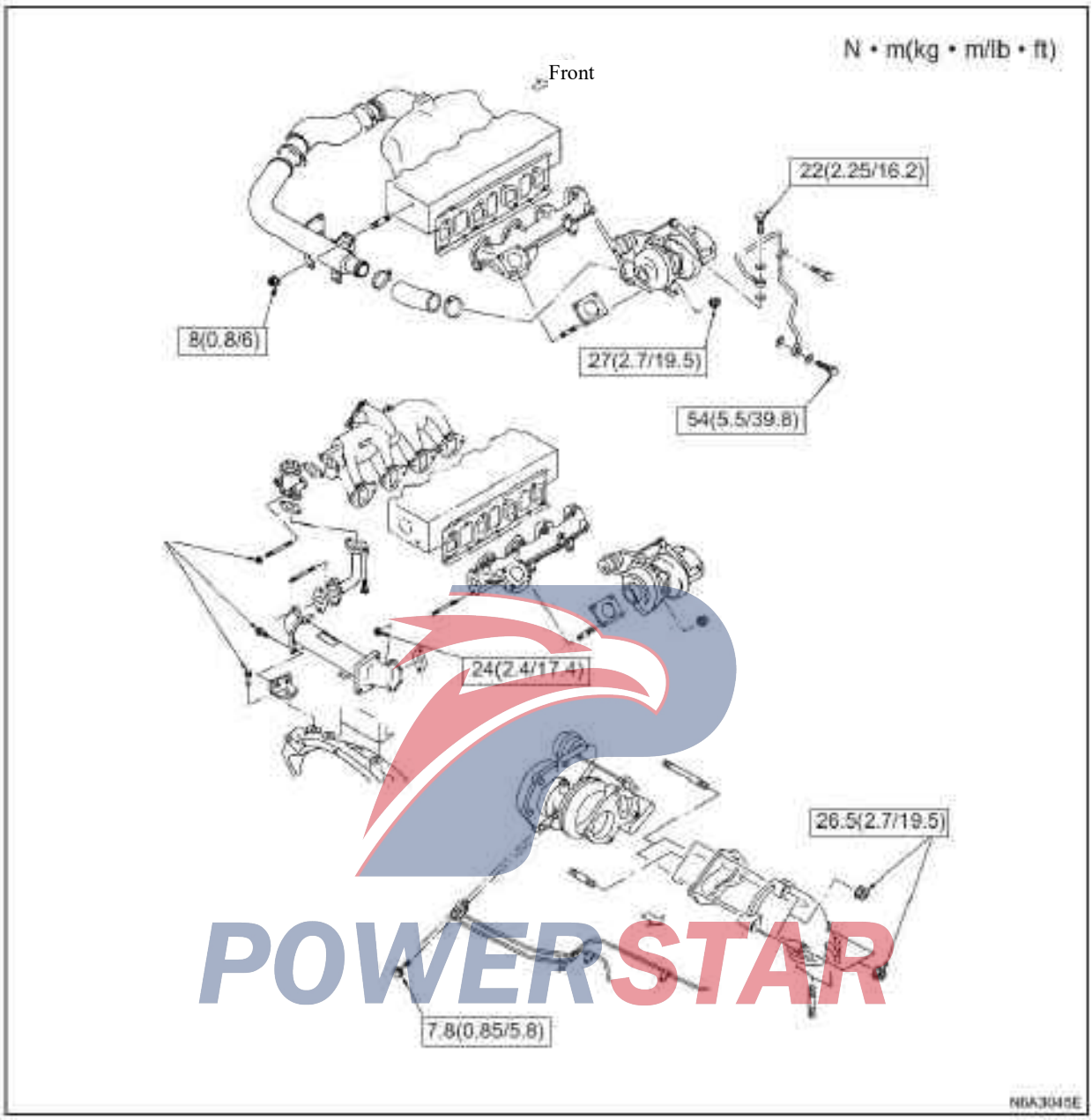


Cooling system and lubricating system

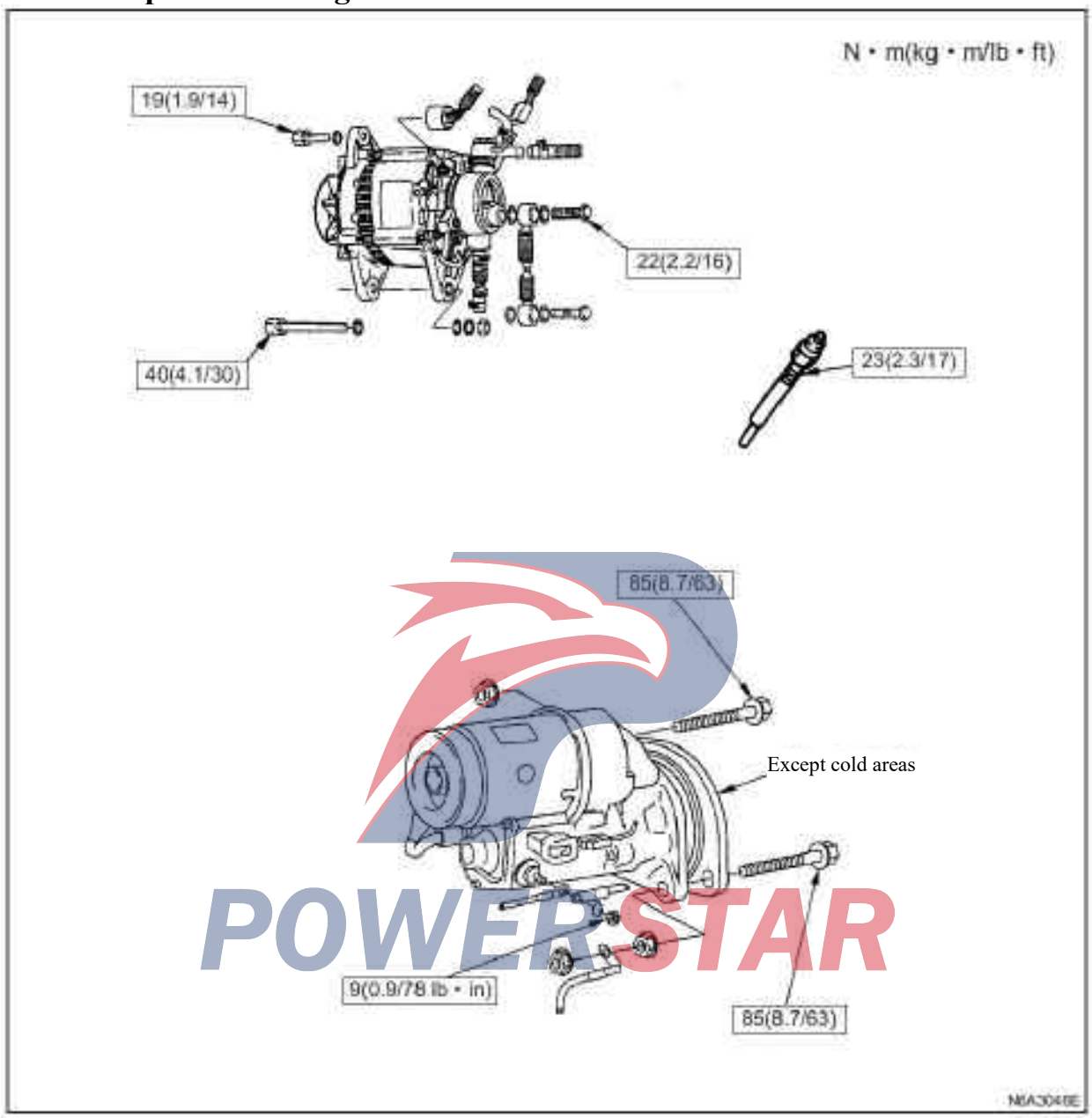


Intake manifold, exhaust manifold, and exhaust pipeline

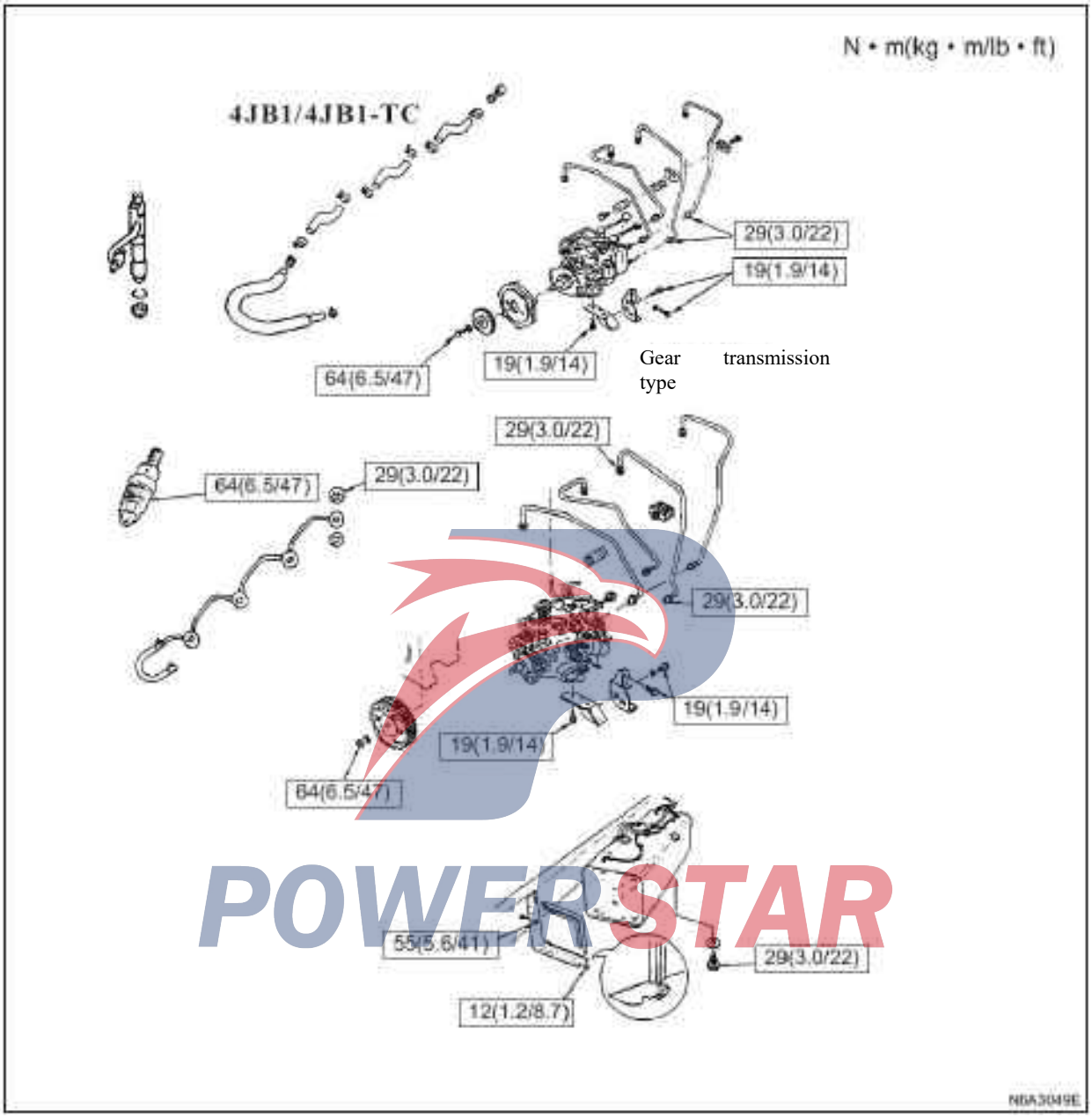


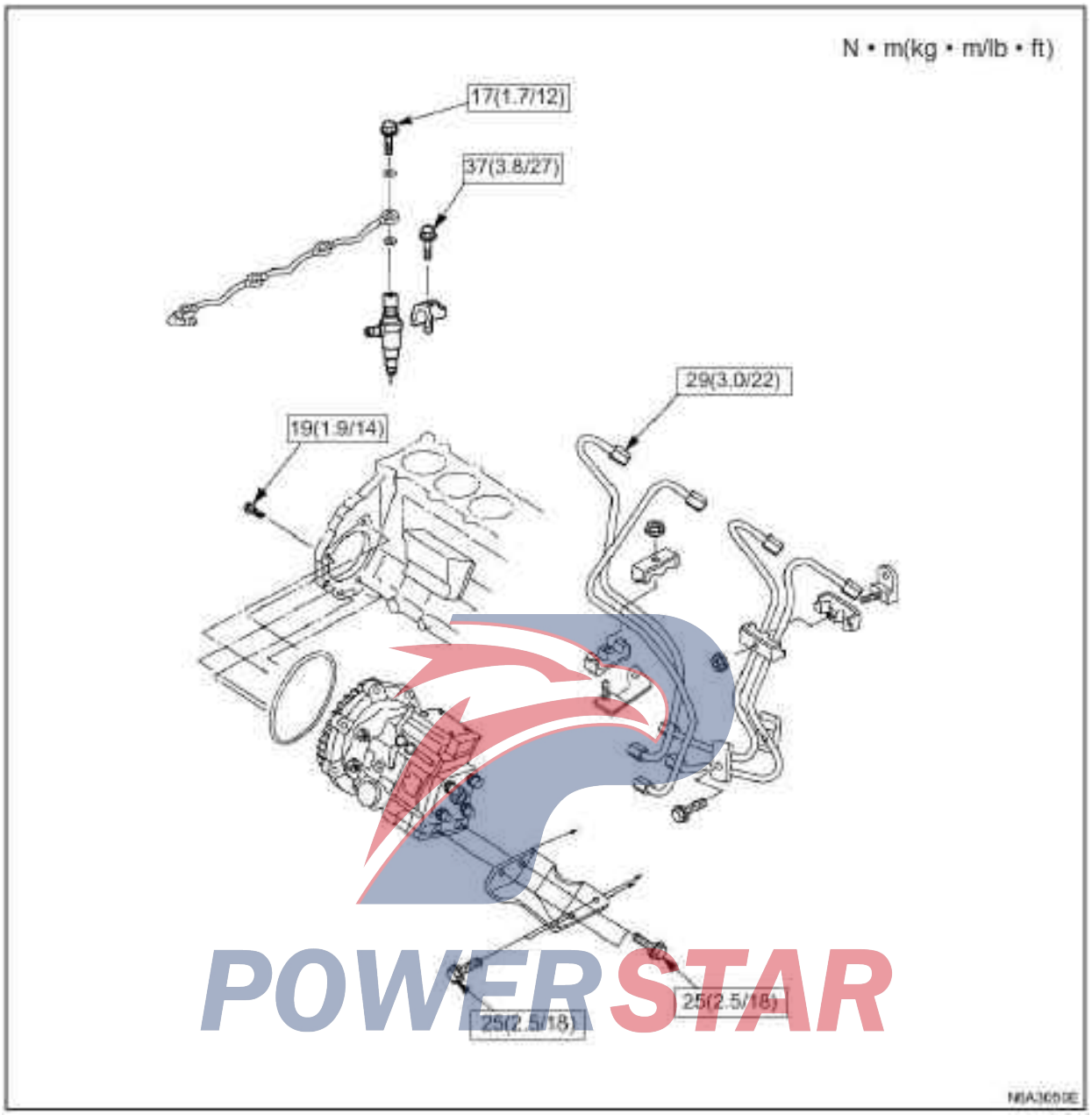

N • m(kg • m/lb • ft)
Front
22(2.25/16.2)
8(0.8/6)
27(2.7/19.5)
54(5.5/39.8)
24(2.4/17.4)
26.5(2.7/19.5)
7.8(0.85/5.8)
NBA3045E

Electrical part of the engine

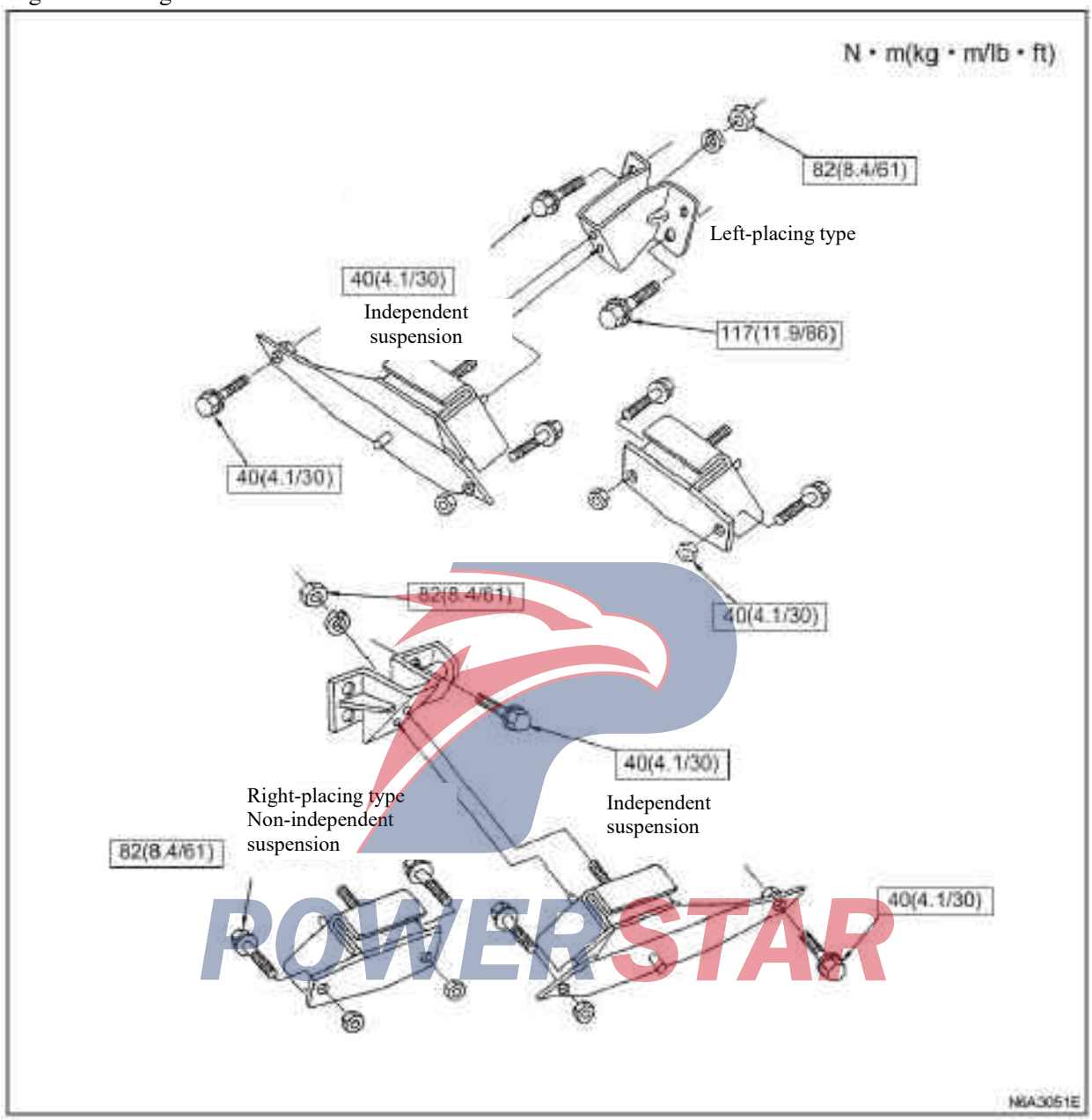


Engine fuel system
Except 4KH1-TC

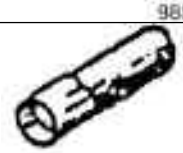


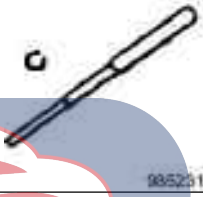
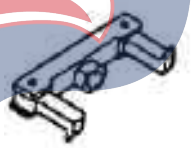
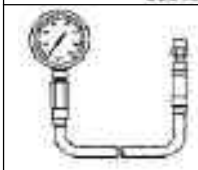

N • m(kg • m/lb • ft)
17(1.7/12)
37(3.8/27)
29(3.0/22)
19(1.9/14)
25(2.5/18)
25(2.5/18)
NBA365E

Engine mounting bracket

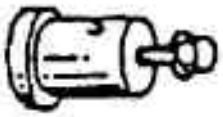
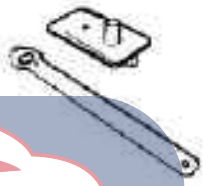
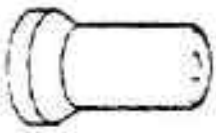


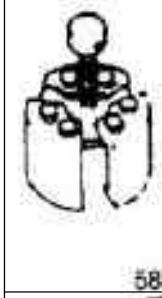
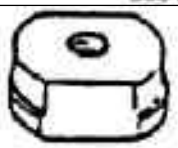
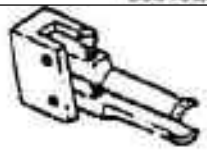
Special tools

Legend	Tool No./description /remarks
 5884020350	5-8840-2035-0 / Crankshaft timing pulley (applicable to only 4JG2 belt drive)
 5884002000	5-8840-0200-0 / Engine oil filter wrench (89.0 mm/3.5 in)
 5884002020	5-8840-0202-0 / Engine oil filter wrench (106.0 mm/4.2 in)
 5884022090	5-8840-2209-0 / Engine oil filter wrench (100.6 mm/4.0 in)
 9852314230	9-8523-1423-0 (J-29760) / Valve spring compressor
 5884020330	5-8840-2033-0 / Oil seal installer

Legend	Tool No./description /remarks
 5884090180	5-8840-9018-0 / Piston ring compressor
 5884020930	5-8840-2093-0 / Tachometer
 9852312120	9-8523-1212-0 / Valve guide replacer
 5884000860	5-8840-0086-0/ Camshaft timing pulley puller (applicable to only 4JG2 belt drive)
 5884001990	5-8840-0199-0 / Rubber hardness tester
 5884026750	5-8840-2675-0 / Pressure gauge

Legend	Tool No./description /remarks
 5853170010	5-8531-7001-0 / Instrument connector tube
 5853170020	5-8531-7002-0 / Pressure gauge joint
 5884001450	5-8840-0145-0 / Measuring instrument
 -1	Installation of crankshaft timing pulley Device (only suitable for belt drive of 4JG2)
 5884002660	5-8840-0266-0 / Goniometer
 5884090160	5-8840-9016-0 / Fuel injector tester
 5884020340	5-8840-2034-0 / Injector body puller (applicable to only 4JB1)

Legend	Tool No./description /remarks
 5884020380	5-8840-2038-0 / Camshaft bearing converter
 5884020360	5-8840-2036-0 / Front shaft oil seal installer (only applicable to belt drive of 4JB1 and 4JG2)
 5867391490	Base 5-86739-149-0 / Leveraged 5-86739-150-0 / Shear gear installation tool
 5884002590	5-8840-0259-0 / Injector seat wrench (applicable to only 4JG2)
 5884002530	5-8840-0253-0 / (J-22700) Fuel filter wrench
 5884023620	5-8840-2362-0 / Front axle oil seal puller (applicable to only 4JG2 belt drive)
 5884023610	5-8840-2361-0 / Front shaft oil seal installer (applicable to only 4JG2 belt drive)

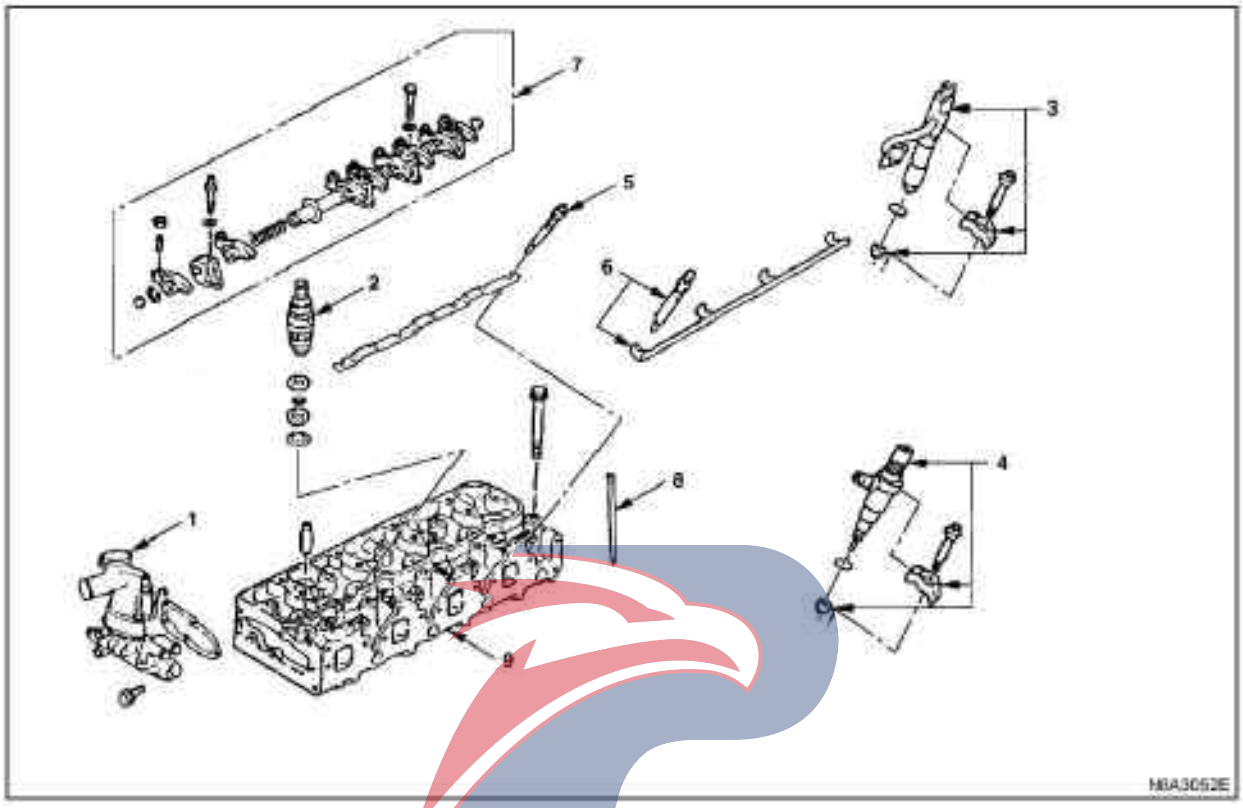
Legend	Tool No./description /remarks
 5884023600	5-8840-2360-0 / Rear oil seal puller
 5884023590	5-8840-2359-0 / Rear oil seal installer
 5884020400	5-8840-2040-0 / cylinder liner installer (applicable to only 4JB1)
 5884023130	5-8840-2313-0 / cylinder liner installer (applicable to only 4JG2)
 5884020390	5-8840-2039-0 / Cylinder liner puller (applicable to only 4JB1)
 5884023040	5-8840-2304-0 / Cylinder sleeve puller (applicable to only 4JG2)
 5884020000	5-8840-2000-0 / The first axle front of the transmission Bearing remover

Legend	Tool No./description /remarks
 5884000180	5-8840-0019-0 / Slide hammer
 5852200240	5-8522-0024-0 / Bearing installer before the first axle of the transmission

4J Series engine
Section 6A
Mechanical system of engine
Table of Contents

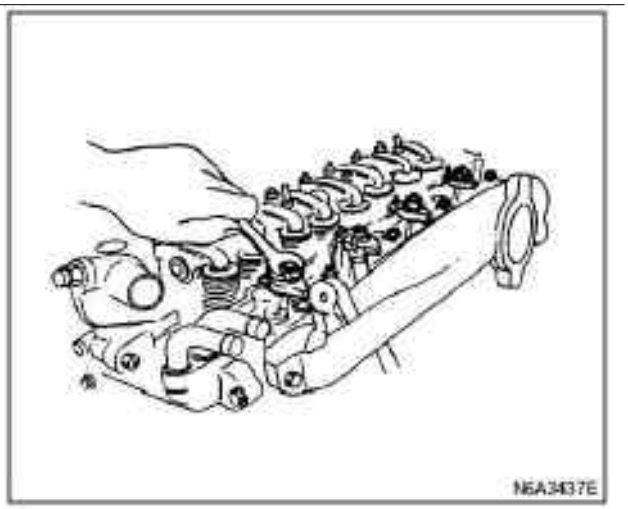
Cylinder head

Part



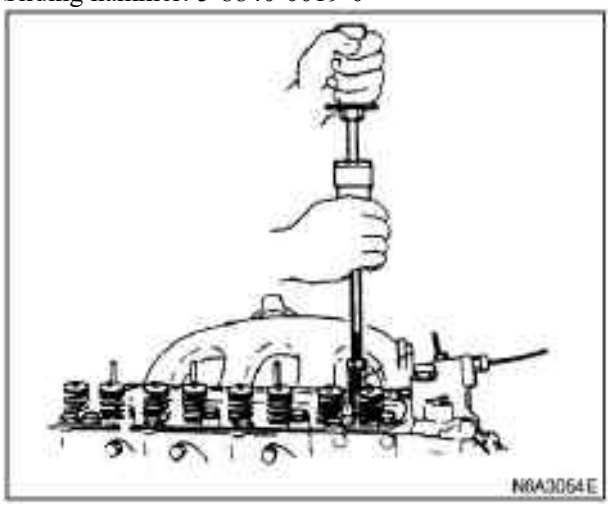
Legend
1. Thermostat housing assembly
2. Fuel injector body (4JG2)
3. Fuel injector body (4JB1, 4JB1-TC)
4. Fuel injector body (4KH1-TC)
5. Glow plug and glow plug connector (4JG2)
6. Glow plug and glow plug connector (4JB1, 4JB1-TC)
7. Rockshaft and rocker arm
8. Push rod
9. Cylinder head

Caution:
• When dismantling, ensure that the valve body components are kept together and easy to be identified so that they can be reinstalled to the right place.
·The compression test is carried out before the cylinder head is removed from the engine and the valve mechanism is dismantled and the test results are recorded.

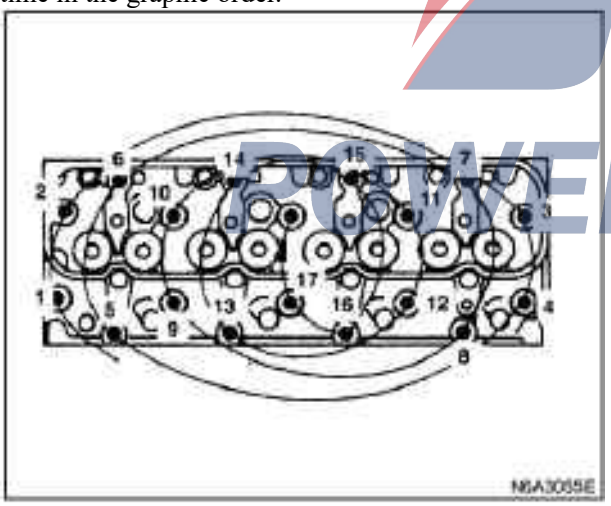


Dismantling
1. Thermostat housing assembly
2. Fuel injector body (4JG2)
3. Fuel injector body (4JB1, 4JB1-TC)
4. Fuel injector body (4KH1-TC)
1) Disassemble the bracket nut of the injector body.

2) The injector body and the support are dismantled with the injector body disassembly tool and the sliding hammer.
Disassembly tool for injector body: 5-8840-2034-0
Sliding hammer: 5-8840-0019-0



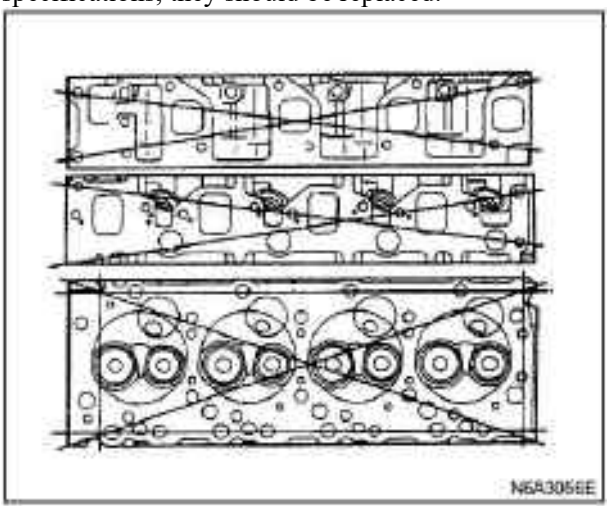
5. Glow plug and glow plug connector (4JG2)
6. Glow plug and Glow plug connector (4JB1, 4JB1-TC, 4KH1-TC)
7. Rockshaft and rocker arm
8. Push rod
9. Cylinder head
• The cylinder head bolts are loosened a little each time in the graphic order.



Caution:
If the cylinder head bolts are loosened each time a little in the graphic order, it will have a harmful effect on the surface of the cylinder head.

Cleaning
·Cylinder head bolts
Cylinder head
Carefully remove the varnish, soot and carbon to expose the metal surface, and do not use a mobile wire brush on the gasket sealing surface.

Repair
During inspection, if serious wear or damage is found, necessary adjustment, maintenance and replacement of parts should be carried out.
·Leakage, corrosion and blowby of the cylinder head pad and joint surface. If the cylinder cover pad is invalid, the reasons should be found.
- Improper installation
- Looseness or warp of the cylinder head
- Insufficient torque of cylinder head bolts
- Warpage of cylinder surface
1. Check whether the screw thread of the cylinder head is damaged or lengthened and damage the cylinder head because of the improper use of the tool.
Be careful:
Be sure to replace unreliable bolts.
2. Cracks in the cylinder head, especially there are cracks between the valve seat and the vent.
3. The cover plate of the cylinder head is corroded and the cylinder head has sand and hole.
Be careful:
The cylinder head should not be welded, and the cylinder head should be replaced.
4. Evenness of coordination surface of cylinder cover plate, intake and exhaust manifold
These surfaces can be repaired by grinding (except for the lower surface of the cylinder head). If these surface roughness exceeds the specified specifications, they should be grinded according to the specifications. If the limit values exceed the specifications, they should be replaced.

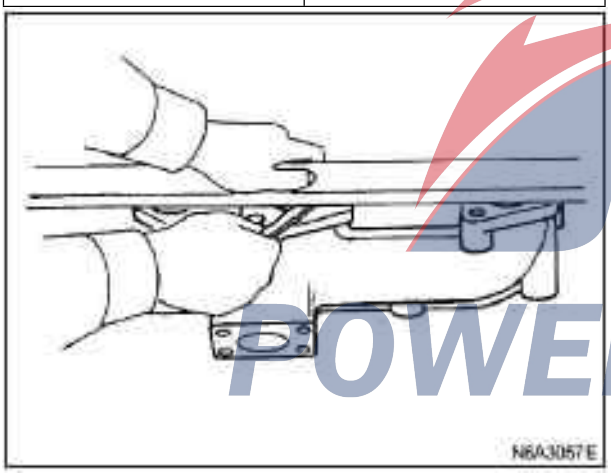


Caution:
The lower surface of the cylinder head can not be regrinded.
mm(in)

	Criterion	Limit value
Lower surface deflection of cylinder head	0.05 (0.002) or below	0.20 (0.0079)
Cylinder head height	92 (3.622)	91.55 (3.6043)

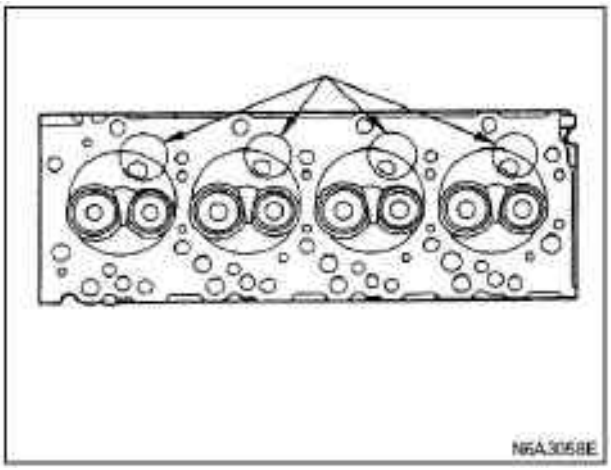
5. Support surface of water jacket sealing plug.
6. Use the ruler and the feeler to measure the warpage of cylinder cover and exhaust manifold. If the measured value is between the specified limit value and standard, it is necessary to re-grind the surface of the exhaust manifold and cylinder head.
If the measured value exceeds the specified limit value, the manifold must be replaced.

Warpage of exhaust manifold	mm(in)
Criterion	Limit value
0.05 (0.002) or less than	0.20 (0.0079)

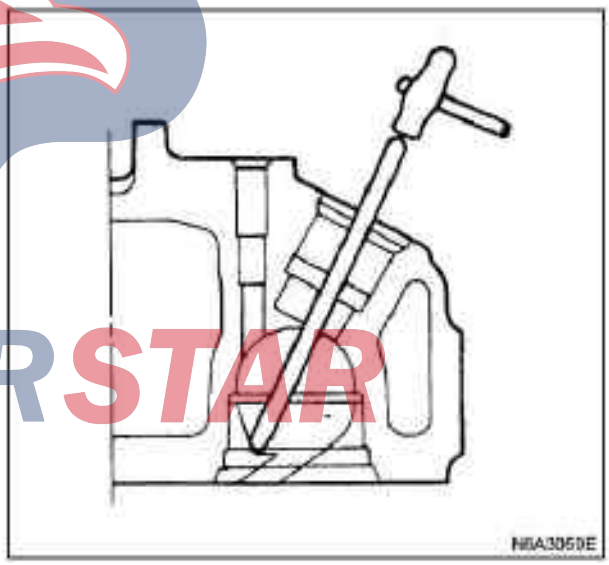


Sinkage of the combustion chamber insert (only 4JG2)
1. When cleaning the lower side of the cylinder head, be careful not to damage the surface of the combustor.
2. Use ruler and feeler to measure the sinkage of insert 1to 4. Be sure to replace the combustion chamber block if the measured value exceeds the limit value.

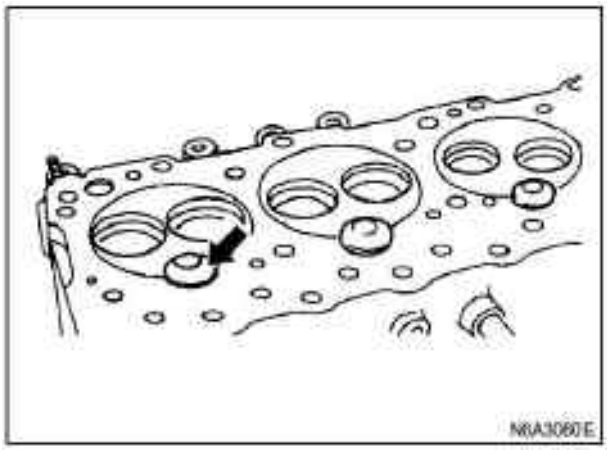
Press-in limit	mm(in)
0.02(0.0008)	



Combustor insert disassembly (only 4JG2)
1. Insert a rod with a diameter of 3 - 5 (0.12 0.20) into the injector installation hole to make contact with the combustion chamber insert.
2. Use a hammer to tap, make the insert in combustor loose.
Be sure to replace the combustion chamber block if the measured value exceeds the limit value.



Combustor test (only 4JG2)
1. Remove the carbon attached to the surface of the combustor, and be careful not to damage the assembly position of the combustor.



2. Check the surface of the combustor to see if there is any crack or other damage on the machined surface. If there is a crack or other damage, the cylinder head must be replaced.

Caution:

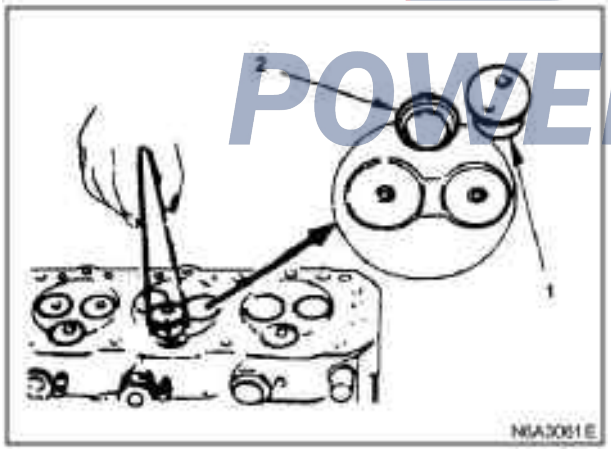
After installation, it ensures that there is no scratch or bulge on the combustor surface in contact with the combustor insert so as not to affect the correct positioning of the combustor.

Inspection of combustor insert

There are no excessive wear and other damage to the combustor insert. If there are two cases, the combustor should be replaced.

Installation of combustor insert (only 4JG2)

1.The spherical positioning surface (1) of combustor insert is aligned with the head groove (2) and tapped for preliminary positioning with a plastic hammer.



2. A metal plate (3) with proper thickness is placed on the surface of the combustor insert (4).

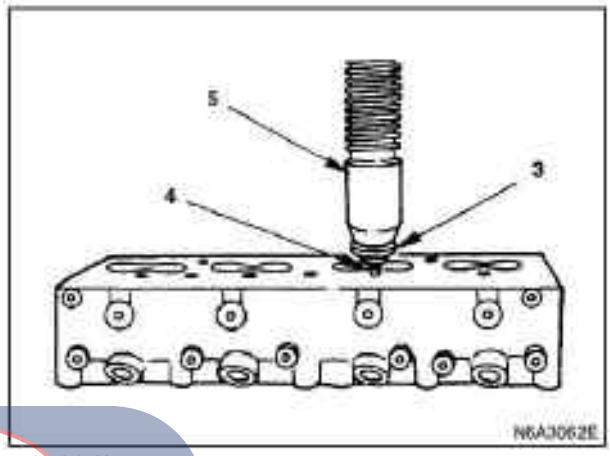
3. The pressure of 44130 - 53937N (4500 - 5500kg/9923 - 12128 pounds) is applied to the metal plate covering the upper surface of the combustor with pressing ring (5) to position the combustor insert in place.

4. Gently tap the combustor insert to ensure its reliable positioning.

5. For the rest of the combustor insert, Step 1-4 can be repeated.

Be careful:

The pressure used should not be greater than the specified value so as not to damage the cylinder head.



N6A3062E

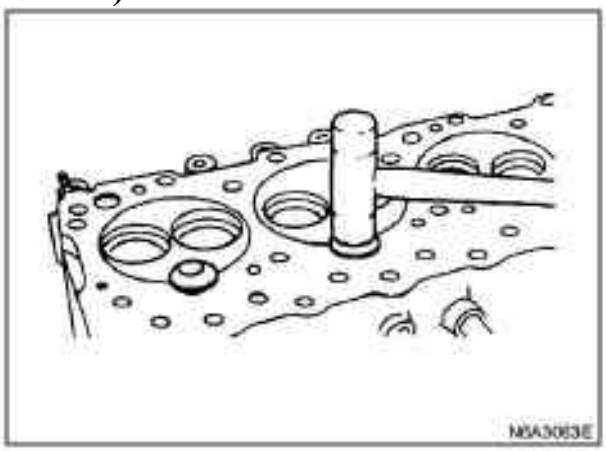
6. Use a plane grinder to remove the convex tumor of the surface.

The combustor insert must be completely flat with the cylinder head.

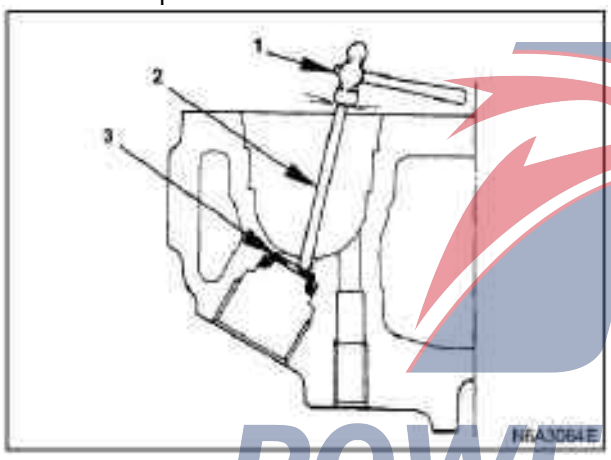
7. After grinding, there is no bump on the surface of the combustor. There must be no subsidence on the surface of the insert.

Again tap the combustor insert to ensure its reliable positioning.

Disassembly of heat shield cover (only 4 J G 2)



Remove the combustor insert, and use a hammer (1) and copper (2) to tap the lower side of heat shield (3) to make it drop off.



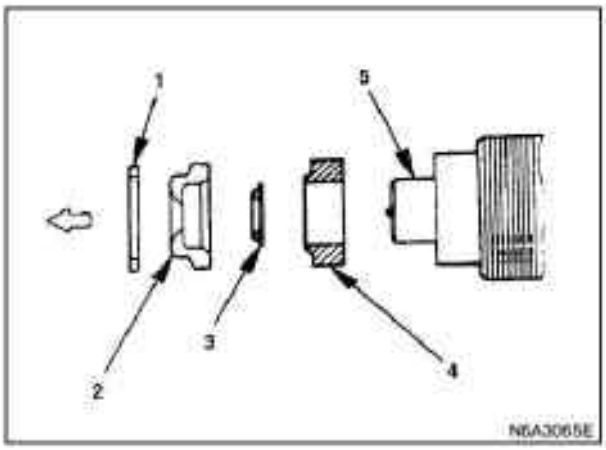
Installation of heat shield (only 4JG2)

The heat shield and its gasket ring are mounted to the cylinder head from the injector body mounting hole side.

Use a copper strip to tap the edge to be in place and its heat shield flange must be upwards.

Caution:

The heat shield can not be reused.



Legend

1. Gasket
2. Heat shield of fuel injector
3. Liner
4. Gasket heat shield
5. Fuel injector

Reassemble

Cylinder head

1. Combustor insert

According to the cylinder order, install the spherical locating surface in the positioning groove of the cylinder head surface, and use a plastic hammer tap.

Caution:

After the cylinder head is pressed into the cylinder head, the combustor inserts are grinded in plane. Accordingly, there are differences in the specifications, and do not confuse the order of the cylinder.

When replacing the new combustor insert:

·When assembling the combustor inserts, according to the cylinder order, install the spherical locating surface in the positioning groove of the cylinder head surface, and use a plastic hammer tap until the combustor insert is positioned reliably.

Cover the combustor with a cover plate to avoid damage and press it in with the force of 4.5-5.5t.

After pressing combustor inserts, the surface should be in contact with the cylinder head.

Finally, use a plastic hammer to tap the combustor insert, and check the presence of excessive subsidence, bulge or gap.

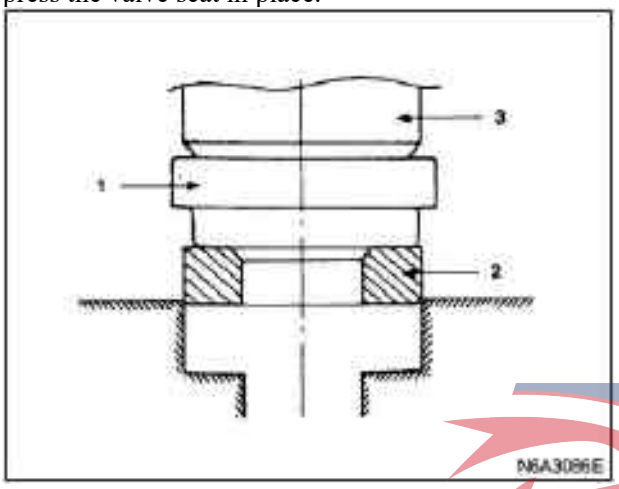
2. Installation of valve seat ring

1) Carefully place the accessory (1) (the outer diameter is slightly less than the outer diameter of valve seat) on the valve seat (2).

Caution:

The optical slide surface of the accessory must be connected to the valve seat.

Press the accessory with the desktop press (3) and press the valve seat in place.

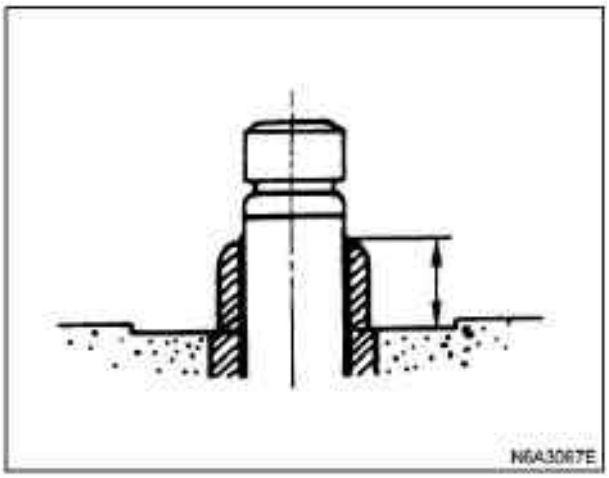


Caution:

The pressure of the desktop press can not be too large, otherwise, it will damage the valve seat.

Cylinder head. Measure the upper end height of the valve tube from the cylinder head.

The upper end height of the valve	(H) (Reference) mm(in)
13 (0.51)	



Caution:

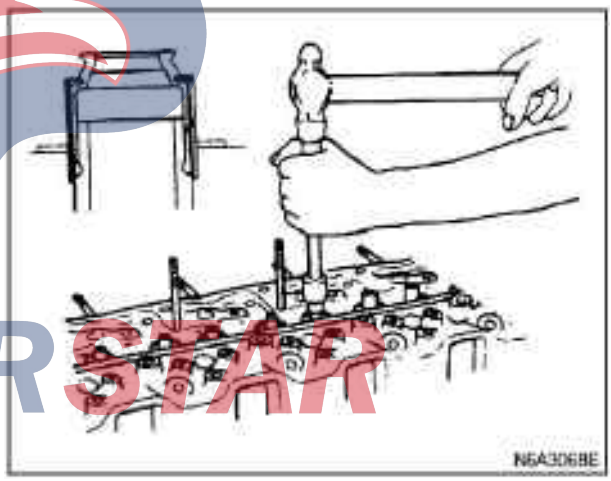
If the valve guide is dismantled, the valve and valve guide must be replaced together.

2) spring lower seat

3) Valve stem oil seal

·Install the new oil seal into the valve.

·Import oil seal installer with special tool: 5-8840-2003-0



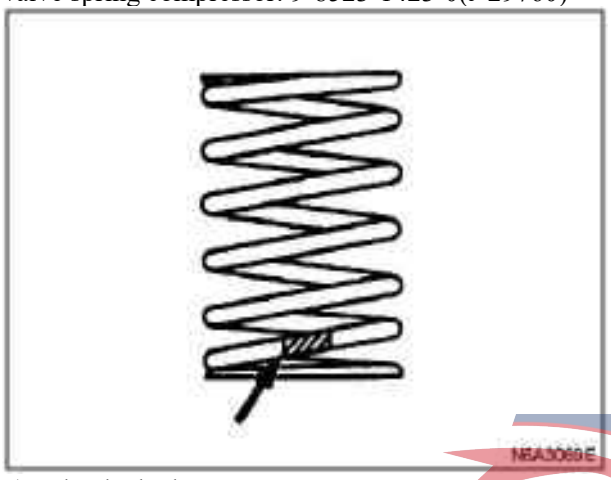
5) valve

• Apply the oil film on the outer surface of the valve rod before installation.

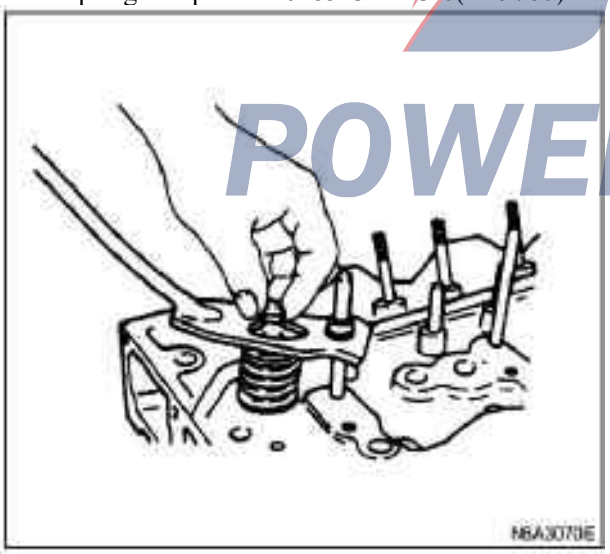
6) Valve spring

• Put the valve spring on the upper spring seat.

Be careful:
·The paint area of valve spring should face the bottom.
·Pass into the compressed air from the preheating plug hole to cylinder, and make the valve positioned.
·Install valve collet with special tools.
valve spring compressor: 9-8523-1423-0(J-29760)

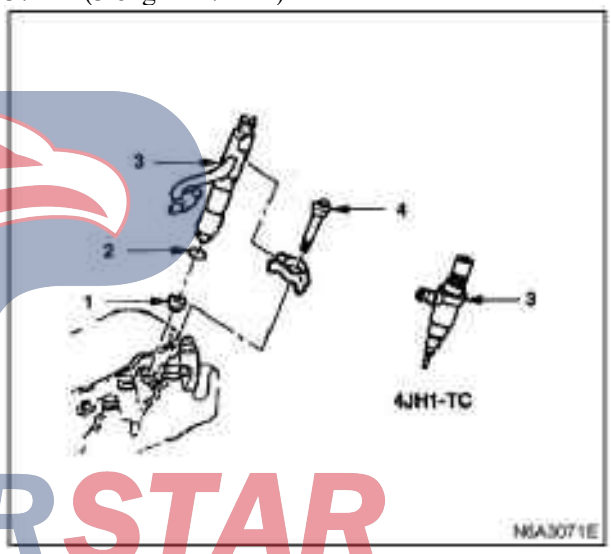


7) Valve lock clamp
·Use the spring compressor to push the valve spring into the position.
·Install spring seat and valve collet.
·Use a rubber pad hammer to tap the collet and make it positioned.
valve spring compressor: 9-8523-1423-0(J-29760)

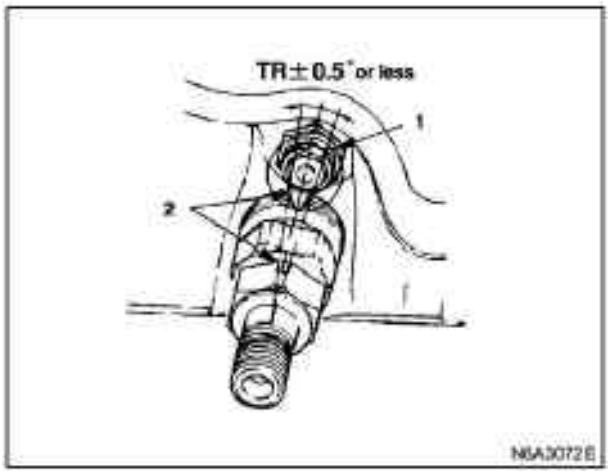


3. Push rod
4. Rockshaft and rocker arm

Tightening:
·Fixed bolt of rocker shaft reaches up to 54 N· m (5.5 kg m/401b. Ft)
5. Glow plug and its connector (4JB1/4JB1-TC/4KH1-TC)
Tightening:
The glow plug reach 23 N·m(2.3kg·m/171b·ft)
6. Fuel ejector body (only 4JB1/4JB1-TC)
7.Fuel ejector body (only 4KH1-TC)
1) The seal ring (1) and the O ring (2) of fuel injector are installed on the fuel ejector body (3) to ensure that the O ring fits properly in the fuel injector slot.
2) Applied the oil film on the body hole of the cylinder head injector.
3) Install the fuel injector body and the injector body support (4) on the cylinder head.
Tightening:
37N·m(3.8kg·m/271b.ft)



8. Fuel injector (only 4JG2)
·The injector body nut is tightened gently to the specified torque so that the injector is rotated one by one.
·According to the retaining lug of cylinder head surface, set locating confirmation hole ((ō2), and the rotation angle of injector body is ±5°.



Legend
1. Glow plug
2. Retaining lug

·As shown in the diagram, the wrench should be applied and a special tool should be used to tighten the seat nut according to the specified torque.

Be careful:

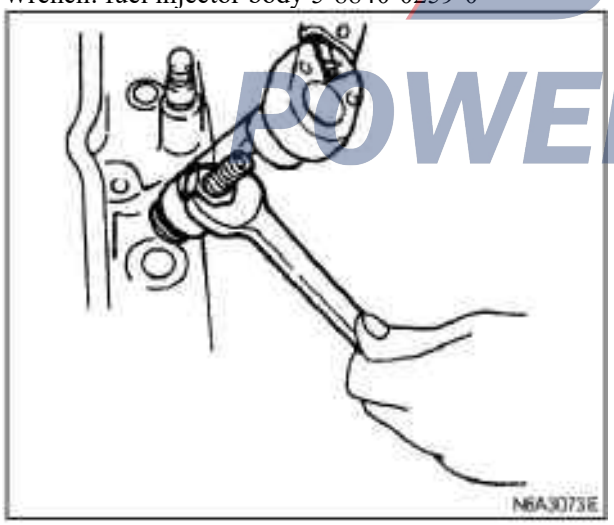
·When the nut is tightened, ensure that the drill and the retaining lugs of the cylinder head surface keep ±5°or less.

·When installing oil pipes, injectors and pipelines, the air is wiped in order to prevent dust from entering.

Tightening:

Fixed torque of the injector: 64N m (6.5kg · ·m/471b·ft)

Wrench: fuel injector body 5-8840-0259-0



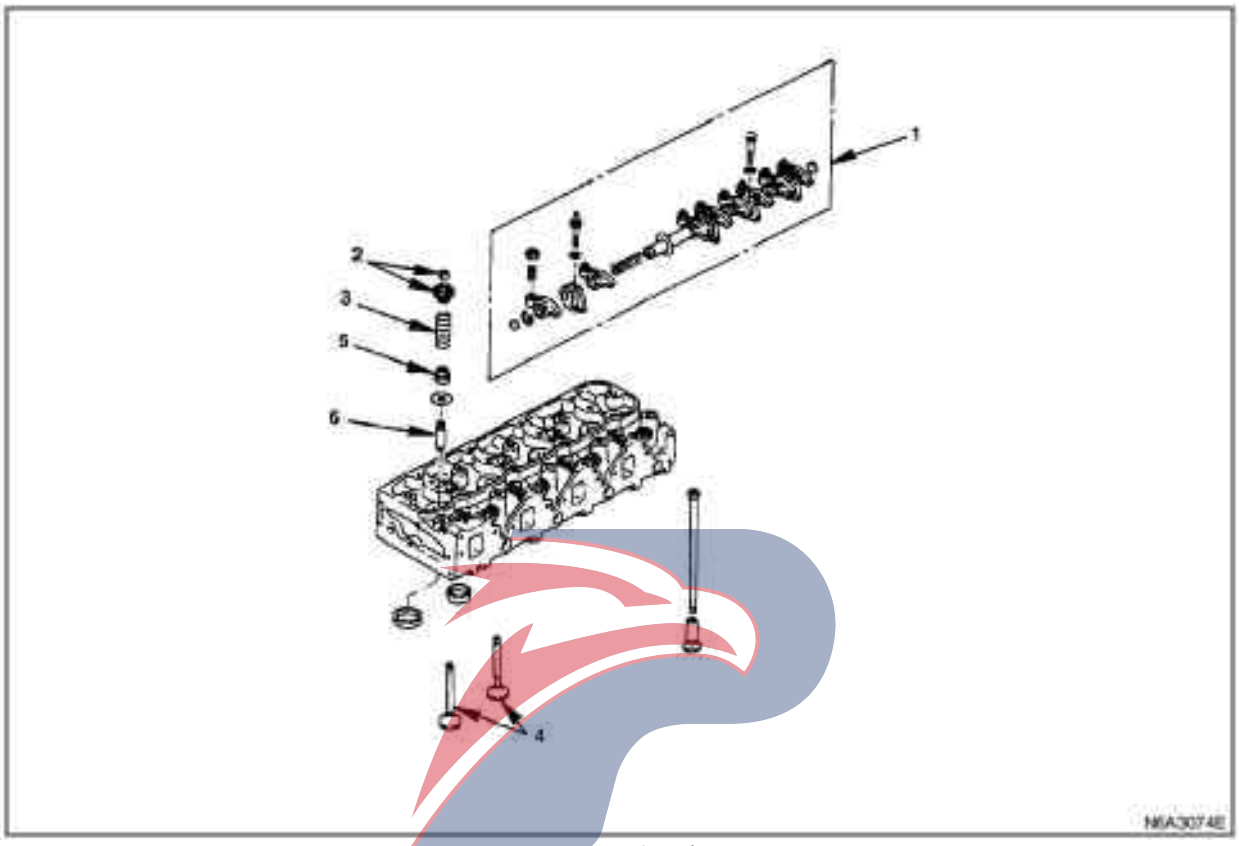
9. Thermostat housing assembly

Tightening:

Torque of fixed bolt for the thermostat shell assembly: 19N m(1.9kgm/141b·ft)

Valve spring, valve tube oil seal, valve tube, push rod

Part



Legend

1. Rocker arm assembly
2. Valve lock clamp
3. Valve spring
4. valve
5. valve guide oil seal
6. valve guide

Dismantling

1. Rocker arm assembly
2. Valve lock clamp

The valve spring is compressed with a special tool.
Valve spring compressor: 9-8523-1423-0 (J-29760)

3. Valve spring
4. valve

5. valve guide oil seal
6. valve guide
Valve guide replacer: 9-8523-1212-0

Repair

In the case of excessive wear or damage, the necessary adjustment, repair and replacement of parts should be carried out.

Air valve spring

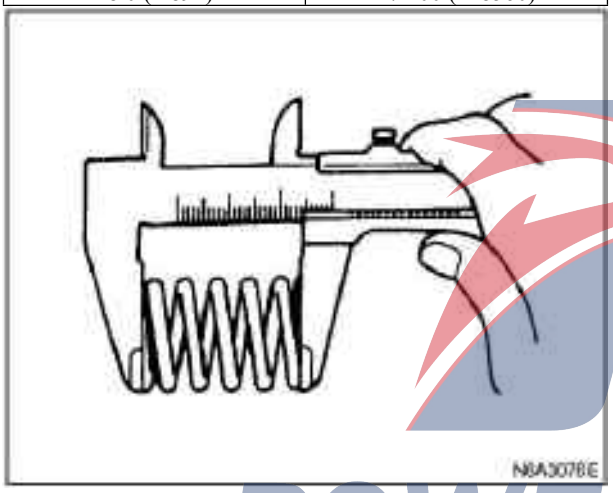
Be careful:

Visually inspect valve springs. If there is damage or abnormal wear, it should be replaced.

1. Free height

·Measure the free height of the spring. If the height is lower than the specified limit, the spring must be replaced.

Free height	mm(in)
Criterion	Limit value
48.0 (1.891)	47.100 (1 .8560)

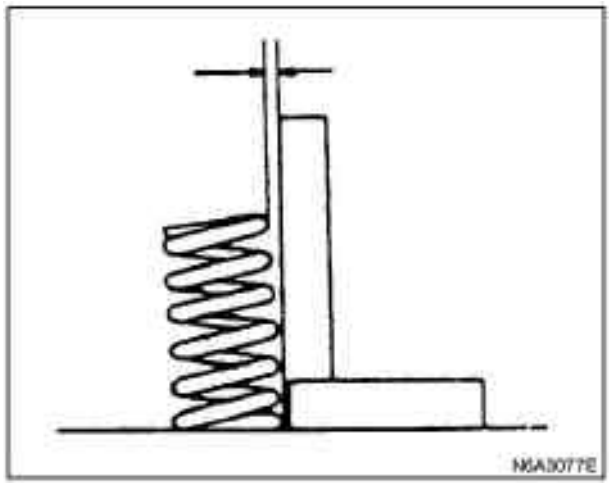


2. perpendicularity

Use the angle steel ruler to measure the verticality of valve spring.

If the measured value exceeds the specified limit value, the valve spring is replaced.

Limit value	mm(in)
1.7 (0.067)	

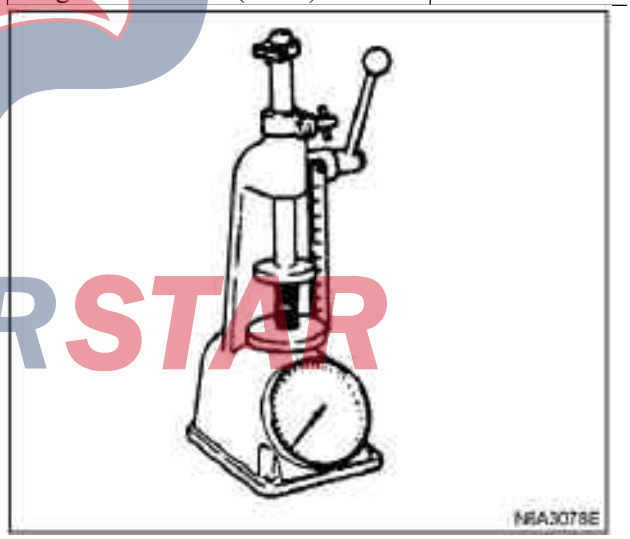


3. Spring tensity

The spring tester is used to compress the spring to the installation height and to measure the tensity of the compressed spring.

If the measured tensity is lower than the specified limit value, the spring is replaced.

Tightness	
According to the installation height of 38.9 mm (1.5 in)	Criterion
	296.2 (30.2/66.6)



Valve guide

Be careful:

When removing carbon adhering to the valve head, be careful not to damage the contact surface of valve seat. Carefully check whether there is any scratch or abnormal wear on the valve rod. If there is any scratch or wear, the valve and valve guide must be replaced.

1. Valve guide clearance

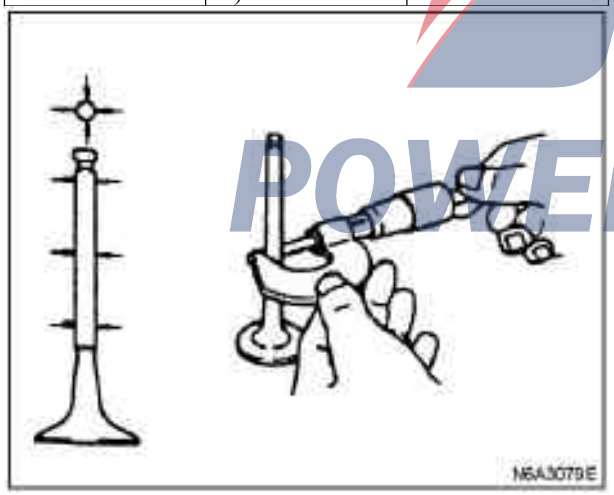
·The diameter of the valve rod is measured with a micrometer. If the diameter of the valve rod is less than the limit value, the valve and valve guide must be replaced in a complete set.

mm(in)			
		Criterion	Limit value
Valve rod diameter	Intake	7.946-7.961 (0.3128-0.3134)	7.880 (0.310.2)
	Exhaust	7.921-7.936 (0.3118-0.3124)	7.850(0.3091)

·Measure the diameter of the valve guide by a micrometer.

·Minus the outer diameter of the valve rod from the measured internal diameter of valve guide. If the value exceeds the specified limit value, the valve and valve guide must be replaced in complete set.

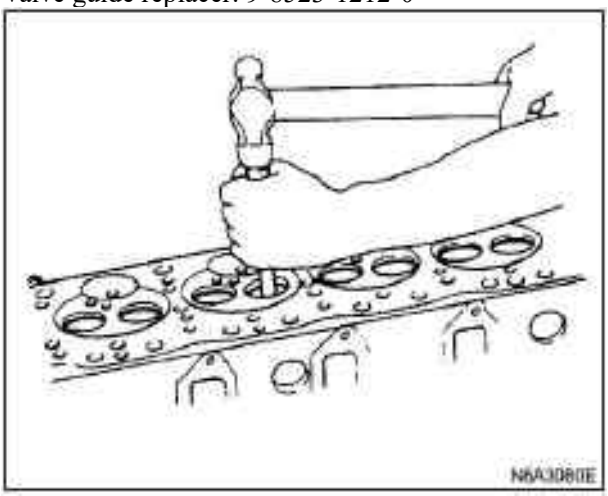
Valve guide clearance		mm(in)
	Criterion	Limit value
Intake clearance	0.039-0.069 (0.0015-0.0027)	0.200 (0.0079)
Exhaust clearance	0.064-0.096 (0.0025-0.0038)	0.250 (0.0098)



Replacement of valve tube

1. Use a special tool to disassemble the valve guide from the side of the combustor.

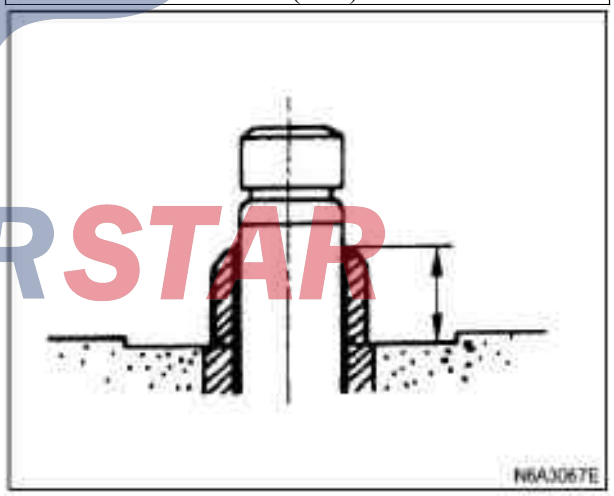
Valve guide replacer: 9-8523-1212-0



2. Apply the oil film on the outer surface of the valve guide, and use a special tool to install a new valve guide from the cylinder head and check the height of the valve guide.

Valve guide replacer: 9-8523-1212-0

Height	mm(in)
13 (0.51)	



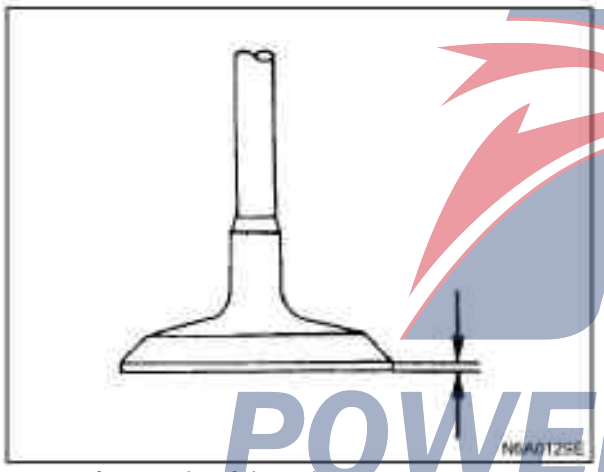
Caution:

If the valve guide is dismantled, the valve and valve guide must be replaced together.

Valve thickness

1. Measure the valve thickness.
2. If the measured value is less than the specified limit value, the valve and valve guide should be replaced in a complete set.

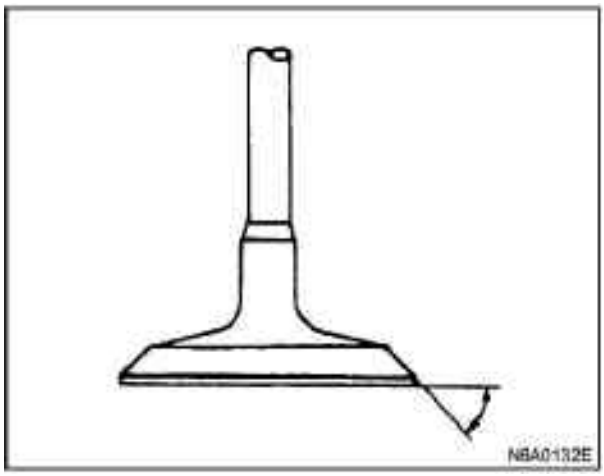
Valve thickness			mm(in)
	Criterion		Limit value
4J B1 4JB1-TC	Air Intake valve	1.79(0.0705)	1.5 (0.06)
	Exhaust valve	1.83(0.0720)	
4J G2	Air Intake valve	1.41(0.0555)	1.1 (0.043)
	Exhaust valve	1.39(0.0547)	
4KH1-TC	Air Intake valve	1.41(0.0555)	1.1 (0.043)
	Exhaust valve	1.38(0.0543)	



Contact face angle of the valve seat.

1. Measure the contact face angle of the valve seat.
2. If the measured value exceeds the specified limit value, the valve guide and valve seat should be replaced in a complete set.

Criterion	Degree
	45°

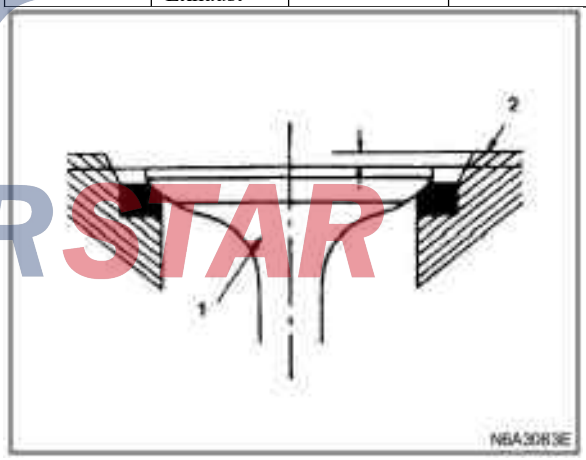


Sinkage of valve

1. The valve (1) is installed on the cylinder head (2).
2. Use the depth meter or the steel plate and ruler to measure the valve sinkage from the bottom of the cylinder head.

If the measured value exceeds the specified limit value, the valve seat must be replaced.

Sinkage of valve		mm(in)	
	Criterion		Limit value
4J B1 4JB1-TC	Intake air	0.73(0.029)	1.28(0.050)
	Exhaust	0.70(0.028)	1.2(0.047)
4J G2 4KH1-TC	Intake air	1.1(0.043)	1.6(0.063)
	Exhaust		

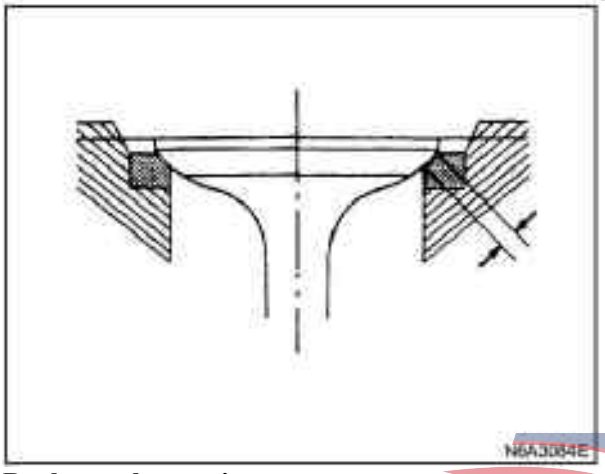


Contact width of valve

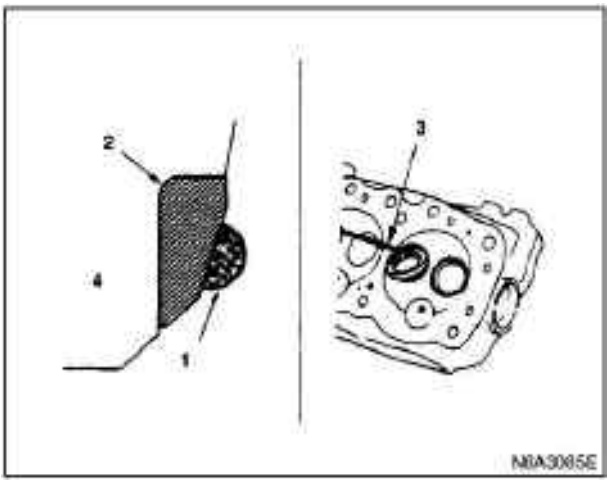
1. Check the roughness and unevenness of the valve contact surface, so that the contact surface of the valve is smooth.

2. Measure the contact face angle of the valve.
If the measured value exceeds the specified limit value, the valve seat must be replaced.

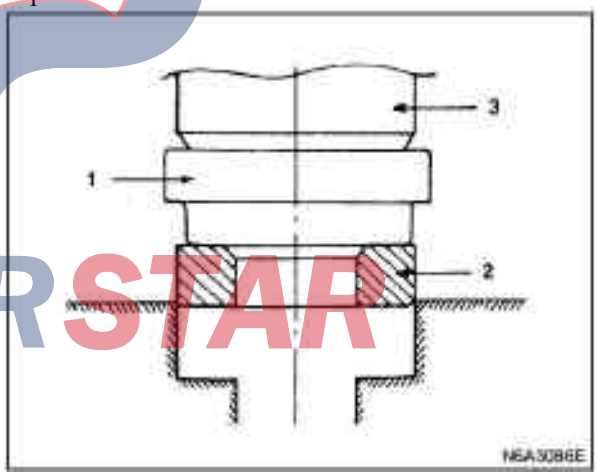
Contact width		mm(in)
	Criterion	Limit value
Intake air	1.7(0.0670)	2.2(0.0866)
Exhaust	2.0(0.0788)	2.5(0.0984)



Replace valve retainer
1.The inner circumference (1) of the valve retainer (2) is subject to arc welding.
2. Let the valve seat cool for a few minutes
This can cause contraction, so that the removal of the valve seat ring is easier.
3. Shed the valve retainer with a screwdriver (3).
Take care not to damage the cylinder head (4).
4. Carefully remove the carbon and other foreign objects in the valve retainer installation hole of the cylinder head.



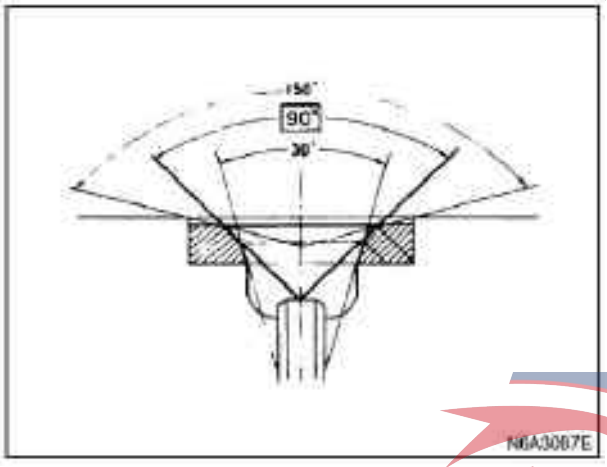
Installation of valve seat ring
1. Carefully place the accessory (1) (the outer diameter is less than the valve seat) on the valve retainer (2).
Caution:
The smooth surface of accessories must be in contact with the valve seat ring.
2. Use the desktop press (3) to gradually apply pressure to the accessories, so that the valve retainer is positioned.



Caution:
The pressure exerted by a bench press shall not be too large so as to avoid damaging the valve seat ring.
Correction of valve retainer
1. Remove the carbon on the valve seat ring surface.

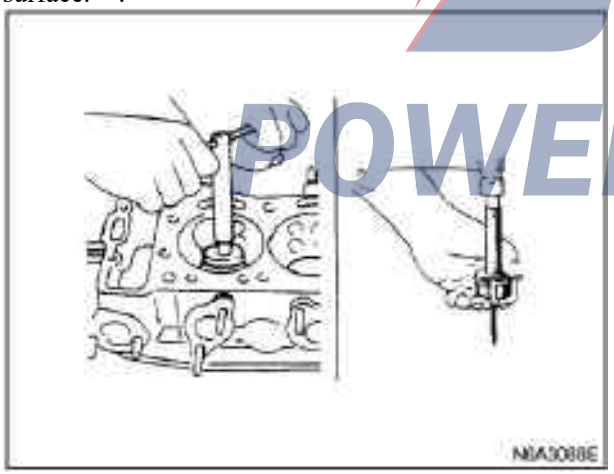
2. Use valve cutter ((15°, 45°, 75° blades) for processing to reduce scratches and other rough areas, so that the contact width can be restored to standard value. Only scratches and rough areas can be removed, and too much cutting can not be done. Be careful not to damage the normal area on the surface of the valve retainer.

Angle of valve retainer	Degree
45°	

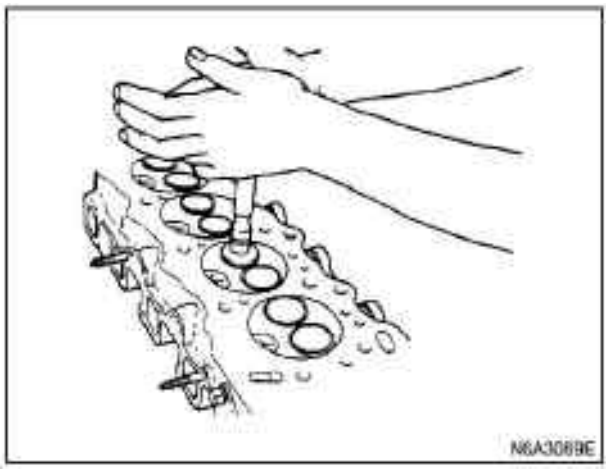


Caution:
Use adjustable valve cutter pilots.
Do not cause the valve cutter pilot to waggle in the valve guide.

3. Apply grinding agents to the valve seat ring surface. .



4. Insert the valve into the valve guide.
5. Rotate the valve and lightly knock it so that it cooperates with the valve seat ring.



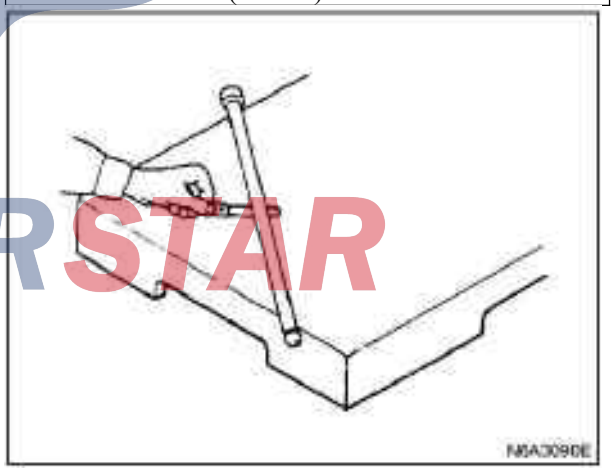
6. Check whether the valve contact width is correct.
7. Check whether the valve retainer is contacted with the whole circle of the valve.

Bending degree of push rod

1. Place the push rod onto the flat plate.
2 .Roll the rod along the panel, and use a feeler to measure the bending degree of push rod.

Be sure to replace the push rod if the measured value exceeds the specified limit value.

Limit bending degree of push rod	mm(in)
0.4 (0.0157) or below	



3. Visually inspect whether the two ends of the push rod are overly worn and damaged. If this situation is found, the push rod must be replaced.

Reassemble

1. Valve guide

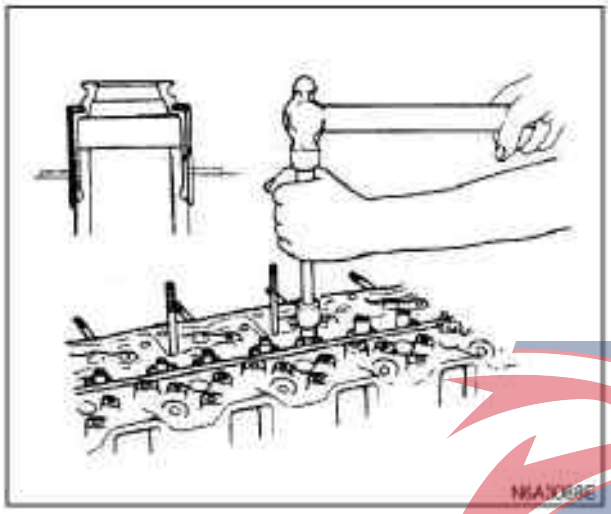
·Applied the oil film outside the valve guide.

Use a special tool to install the new valve guide from the shaft of the rocker arm.

Valve guide replacer: 9-8523-1212-0

2. Valve guide oil seal

·Use special tools to install new oil seals, use special tools of oil seal to install new oil seals. Tools for installing oil seal: 5-8840-2033-0

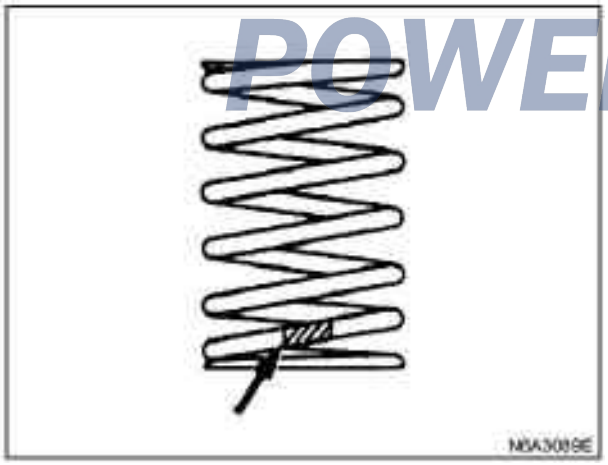


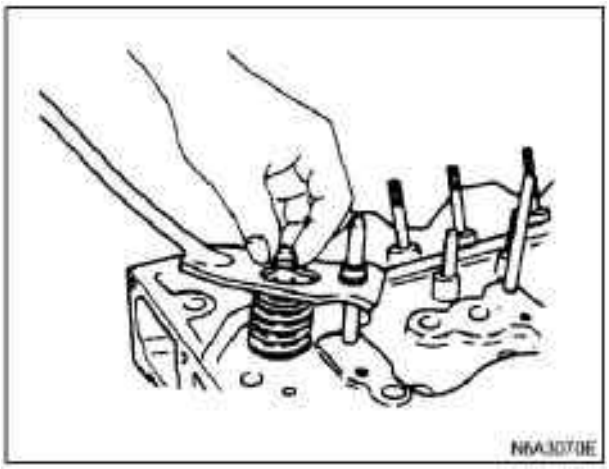
3. Valve

·Apply the oil film on the outer surface of the valve rod.

4. Valve spring

·Install the valve seat on the upper spring seat, so that the paint area of the valve spring is facing down.

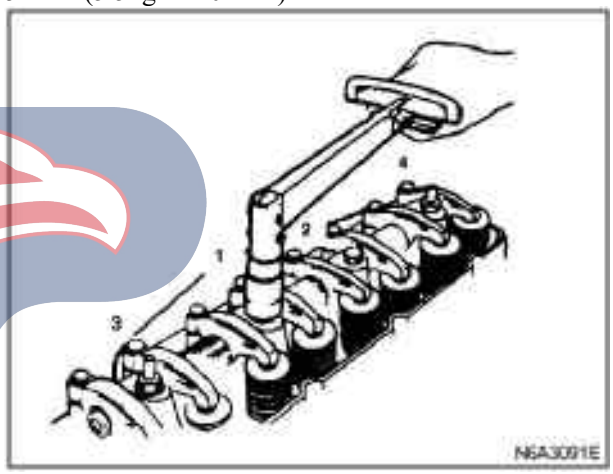




6. Rocker arm assembly

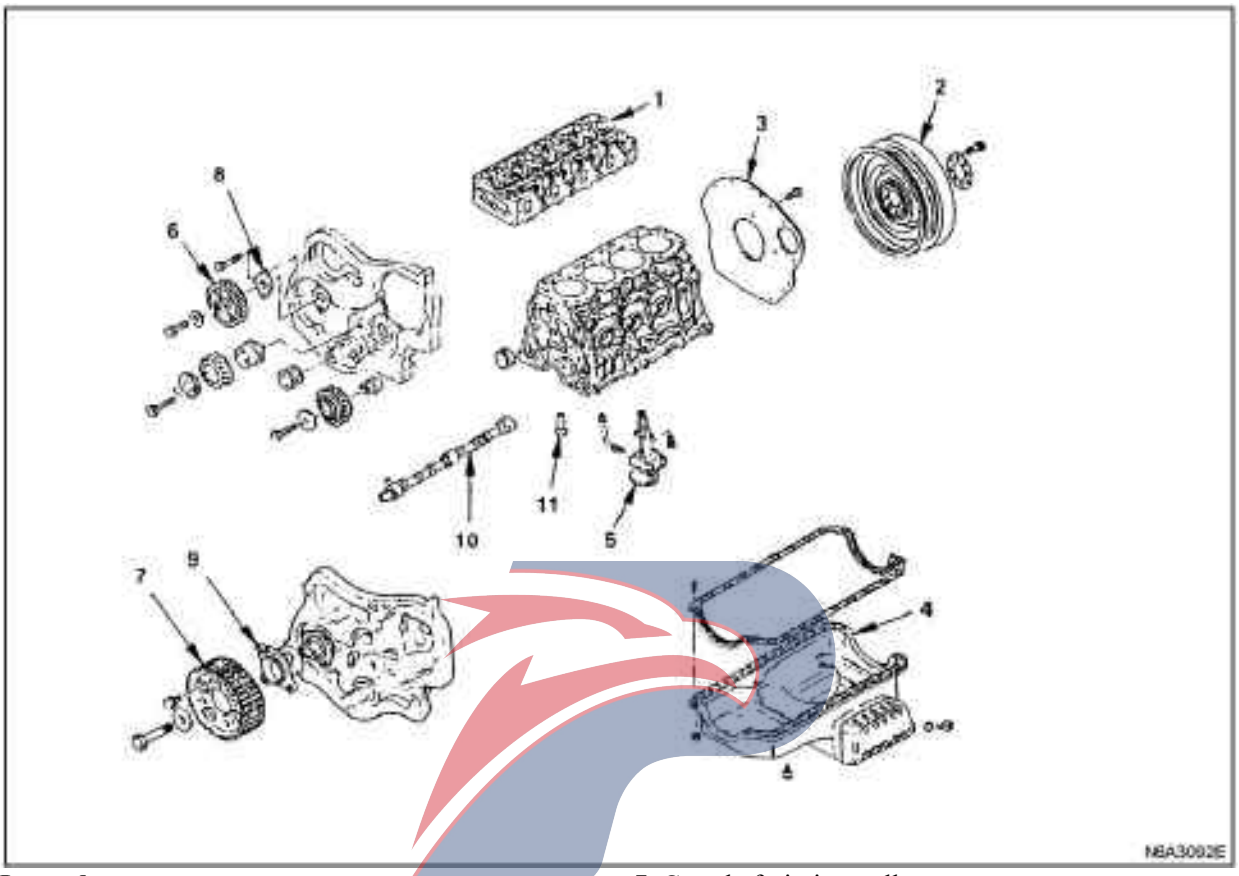
Tightening:

54N·m(5.5kg·m/401b·ft)



Camshaft, tappet

Part



Legend

1. Cylinder head assembly
2. Flywheel
3. Cylinder body rear plate
4. Oil sump assembly
5. Engine oil pump assembly
6. Timing gear of camshaft
7. Camshaft timing pulley
8. Camshaft thrust plate
9. Camshaft belt pulley center flange plate
10. Camshaft
11. valve lifter

Dismantling

1. Cylinder head assembly
2. Flywheel
3. Cylinder body rear plate
4. Oil sump assembly
5. Engine oil pump assembly
6. Camshaft timing gear (gear drive type)

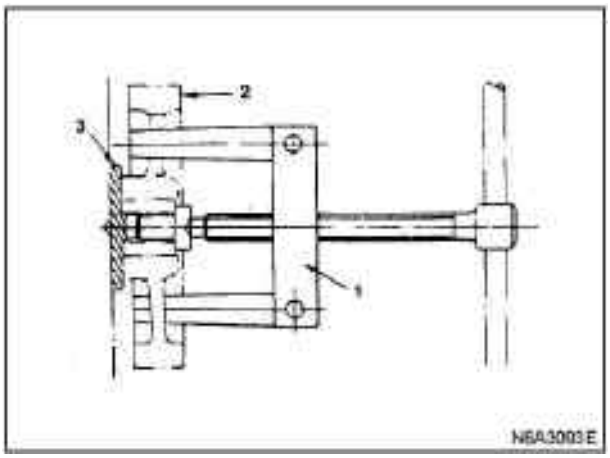
·Remove the camshaft timing gear from the camshaft.

Caution:

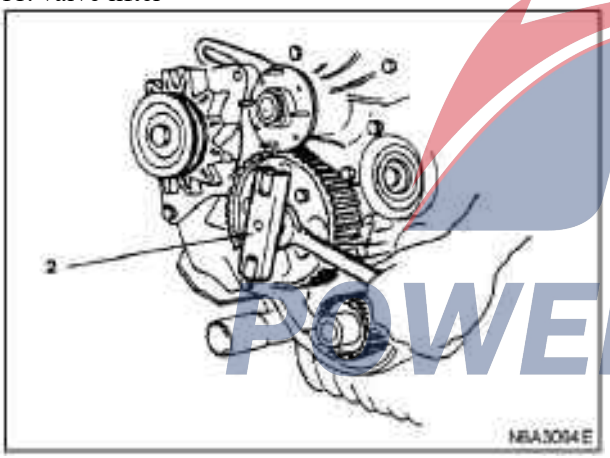
The camshaft is fixed to prevent the camshaft from turning.

·Use the universal pulling force(1) to pull out the camshaft timing gear (2).

• Universal pulling force: 5-8521-0002-0 dismantling and thrust plate (3).



7. Timing belt pulley of camshaft (belt drive type)
·Use the pulling force (2) of timing pulley to remove the pulley.
Pulling force of timing pulley: 5-8840-0086-0
·Remove the catch bolt.
8. Camshaft thrust plate (gear drive type)
9. Center flange plate of camshaft pulley (belt drive type)
10. Camshaft
11. valve lifter

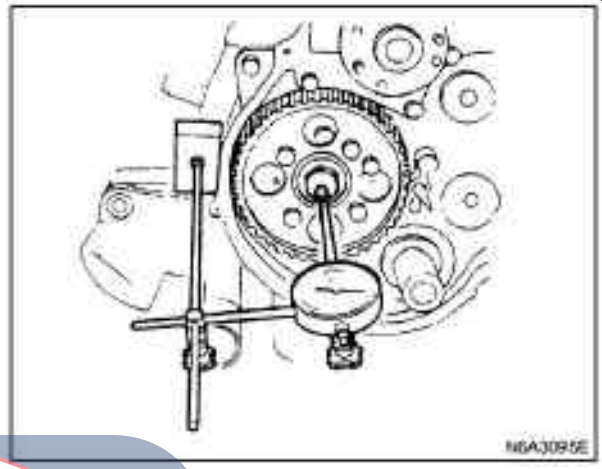


Repair

In the case of excessive wear or damage, the necessary adjustment, repair or replacement of parts should be carried out.
1. Measure the thrust clearance on the camshaft.
·The axial clearance of camshaft is measured by dial indicator before removing the camshaft gear.

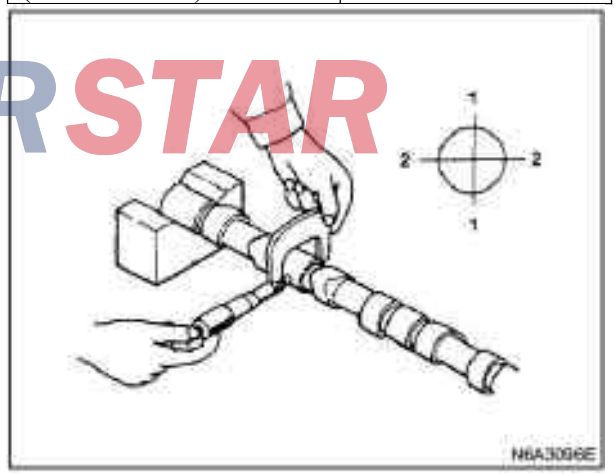
If the axial clearance of the camshaft exceeds the specified limit value, the thrust plate must be replaced.

Axial clearance of camshaft	mm(in)
Criterion	Limit value
0.08 (0.0031)	0.2 (0.0079)



2. camshaft journal diameter
·Measure the diameter of the camshaft journal in two directions (1) and (2) with a micrometer. If the measured value is less than the specified limit value, the camshaft must be replaced.

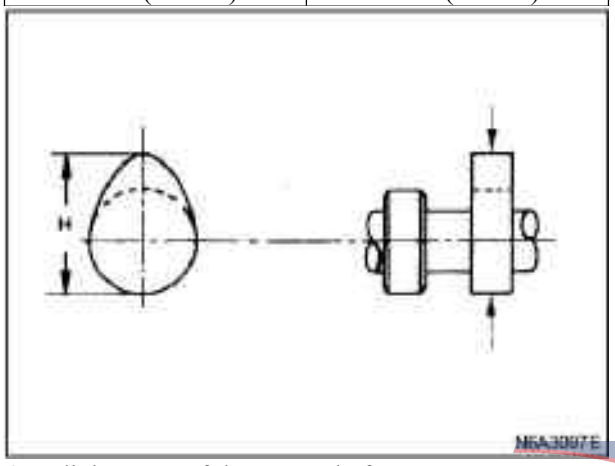
Journal diameter	mm(in)
Criterion	Limit value
49.945-49.975 (1.9663-1.9675)	49.60 (1.9528)



3. Cam height

·Measure cam height with a micrometer. If the measured value is less than the limit value, the camshaft must be replaced.

Cam height	mm(in)
Criterion	Limit value
42.02 (1.6543)	41.65 (1.6398)

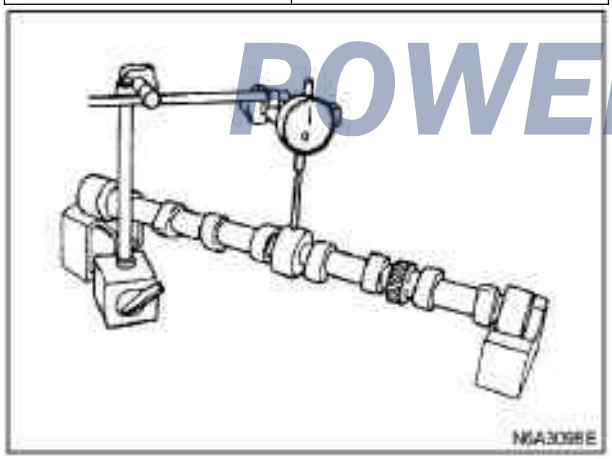


4.Radial runout of the camshaft

· The camshaft is installed in the V-shape groove on the iron block.

· Use the dial indicator to measure radial runout. If the measured value exceeds the limit value, the camshaft should be replaced.

Radial runout	mm(in)
Criterion	Limit value
0.02 (0.008) or less than	0.10(0.0039)



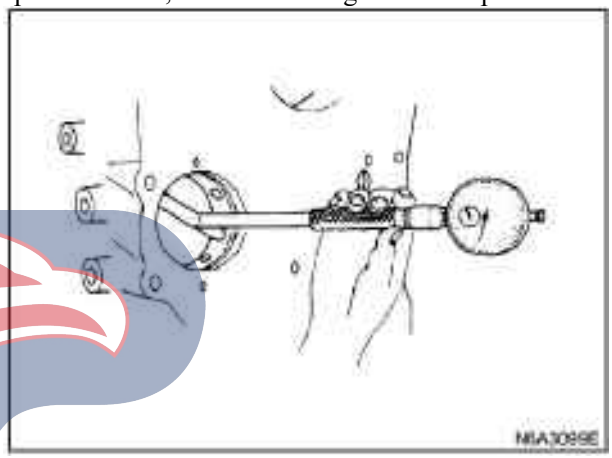
5. Clearance between camshaft and cam bearing

·Use inner dial indicator to measure cam bearing diameter.

Cam bearing ID
Criterion
50.00-50.03(1.9685-1.9696)

Cam bearing clearance	mm(in)
Criterion	Limit value
0.025-0.085(0.0010-0.0033)	0.12 (0.005)

·If the clearance between the inner diameter of the cam bearing and the shaft journal exceeds the specified limit, the cam bearing must be replaced.



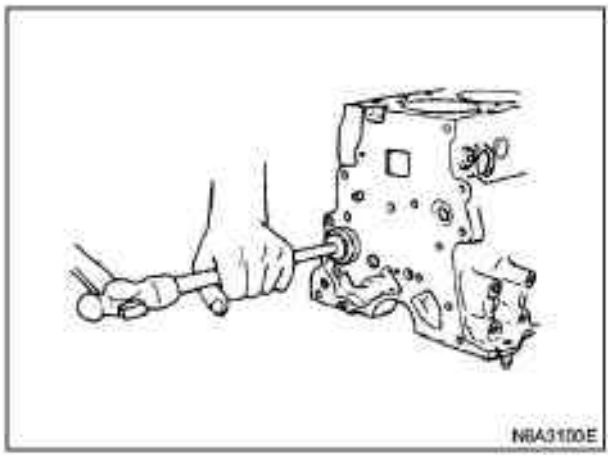
Replace cam bearing

Dismantle cam bearing

1.Remove the cylinder block.

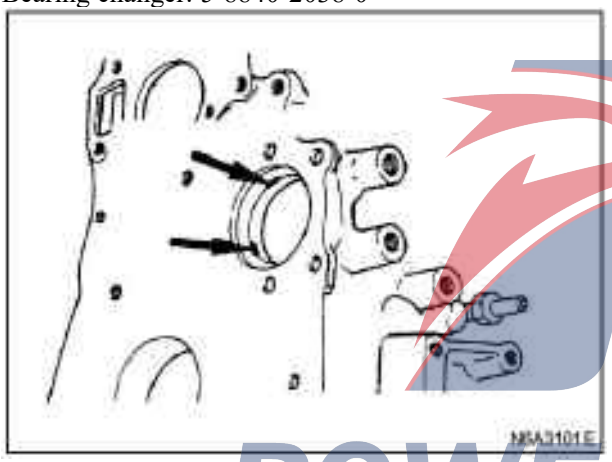
2. Remove the cam bearing with the bearing converter.

Bearing changer: 5-8840-2038-0



Installation of camshaft bearing

1. Align the bearing oil holes with the cylinder oil holes.
2. Install the camshaft bearing using a replacer. Bearing changer: 5-8840-2038-0



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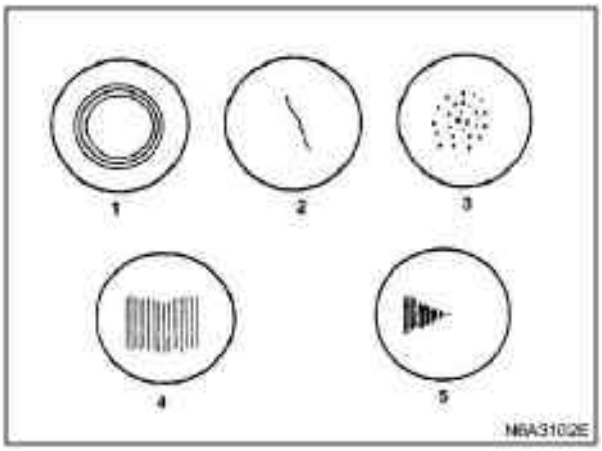
Valve tappet

There is no spot corrosion, crack and other abnormal conditions on the contact surface of the valve tappet camshaft by visual inspection. If these phenomena occur, the valve tappet must be replaced.



Legend

1. Normal contact
2. Crack
3. Pitting corrosion
4. abnormal contact
5. abnormal contact

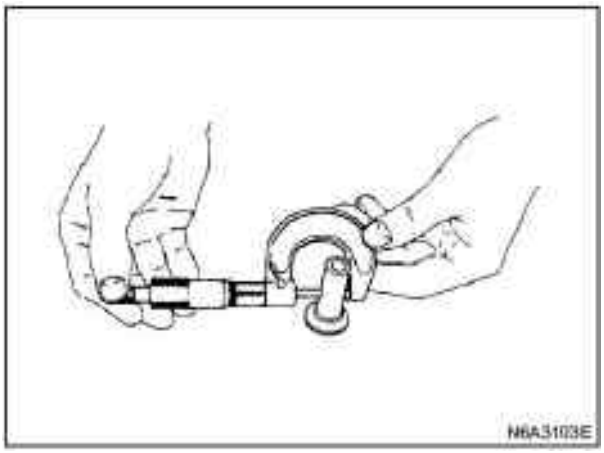
Caution:

Because the valve tappet surface is spherical, do not use oil stone or similar tools to repair the valve tappet. If the valve tappet is damaged, it must be replaced.

Valve lifer OD

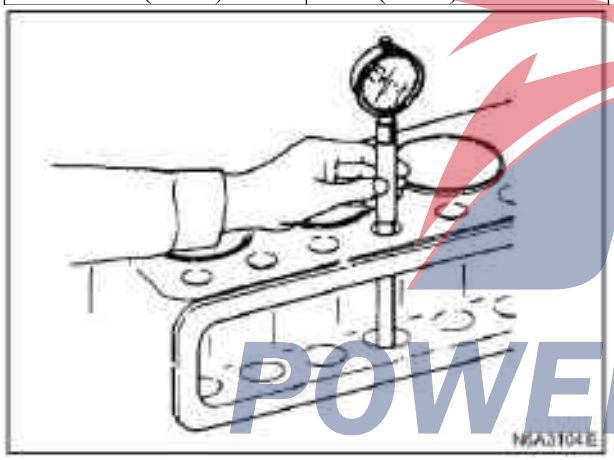
1. Measure the outer diameter of the valve tappet with a micrometer. If the measured value is less than the limit value, the valve tappet must be replaced.

Valve lifer OD	mm(in)
Criterion	Limit value
12.97-12.99(0.510-0.511)	12.95(0.509)



2. Measure the inner diameter of the valve tappet on the cylinder and calculate the clearance. If the clearance exceeds the limit value, replace the valve tappet and / or the cylinder.

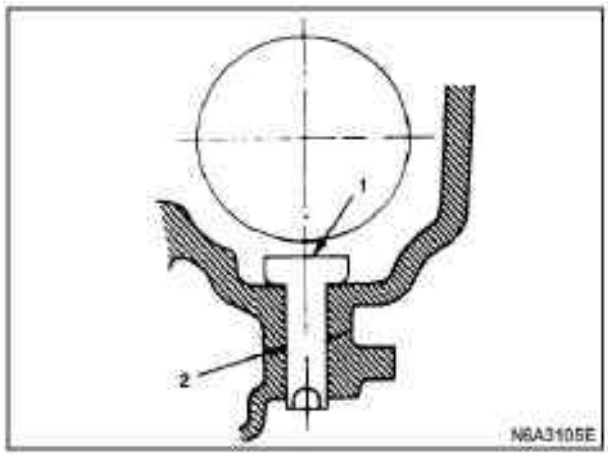
Clearance of valve tappet or cylinder body	mm(in)
Criterion	Limit value
0.03 (0.001)	0.10 (0.004)



Reassemble

1. valve lifter

1) The oil film is applied on the valve tappet (1) and the cylinder valve tappet installation hole (2).



2) Determine the position of the mark on the disassembly (if the valve tappet is not reused).

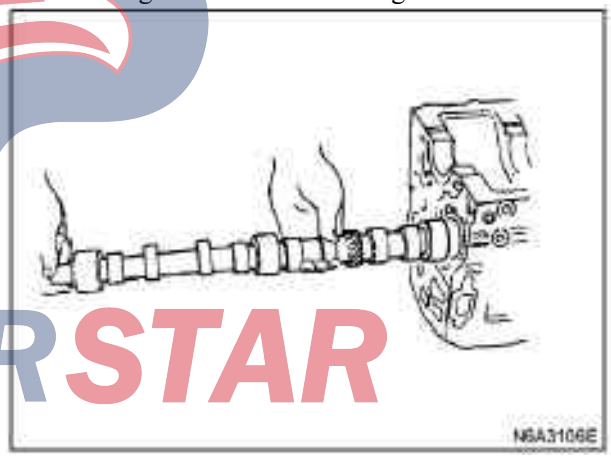
Caution:

The valve tappet is installed before the camshaft.

2. Camshaft

1) A layer of oil film is applied on the camshaft and camshaft bearings.

2) Install the camshaft on the cylinder, and be careful not to damage the camshaft bearing.



3. Center flange of camshaft timing pulley (belt drive type)

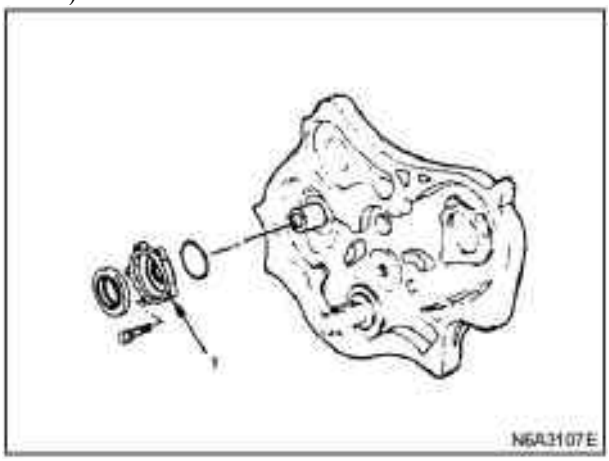
·Apply the oil film on the lip of the oil seal bearing.

·Use recommended liquid sealant or its similar bearing.

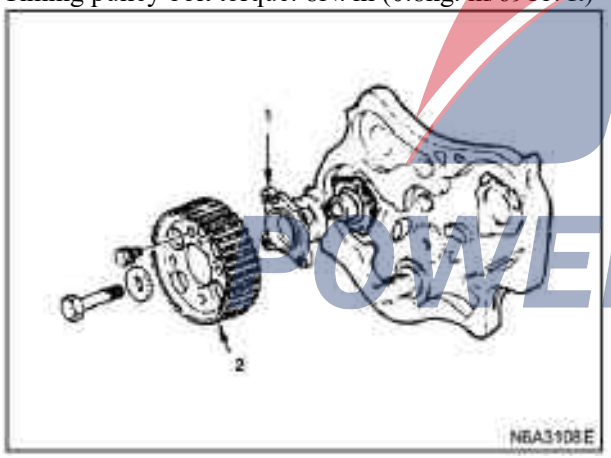
·Install oil seal support in the cylinder block.

• Tighten the catch bolt according to the specified torque.

Tightening:
N6A3107E
Torque of oil seal support bolt: 19N m (1.9kg m/14 1b. Ft)

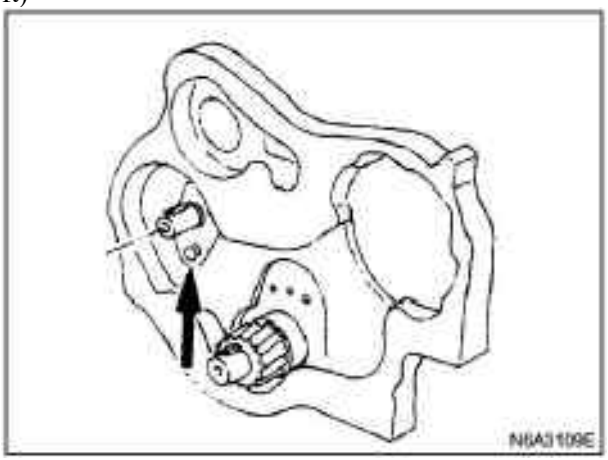


Legend
1. oil seal pedestal
·The center flange of the camshaft timing pulley is aligned with the camshaft key.
• Tighten the timing pulley according to the specified torque.
Tightening:
Timing pulley bolt torque: 8N. m (0.8kg. m/691b. ft)

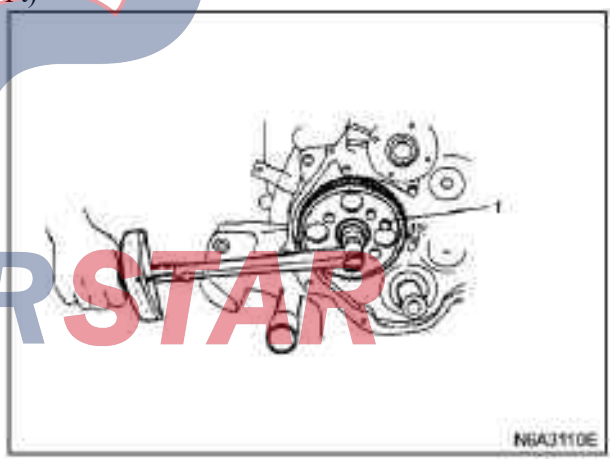


Legend
1. Timing belt pulley center flange plate
2. Timing belt pulley
4. Camshaft thrust plate (gear drive type). Install the thrust plate on the cylinder, and tighten the bolts of the thrust plate according to the specified torque.

Tightening:
Torque of thrust plate bolt: 18N. m (1.8kg. m/131b. ft)

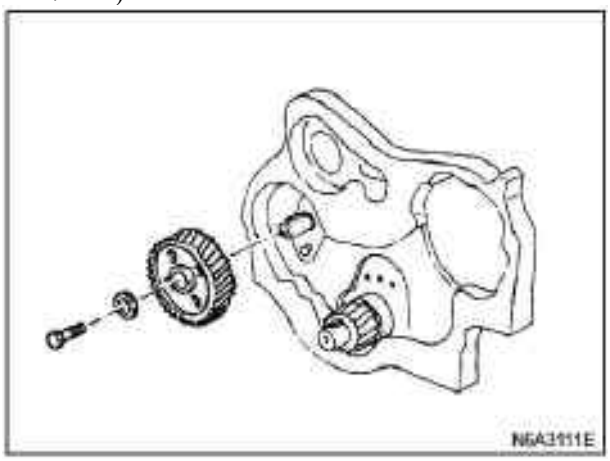


5. Timing belt pulley of camshaft (belt drive type)
·Prevent the camshaft from turning when the center flange bolt is tightened.
·Tighten the central flange of the timing pulley according to the specified torque.
Tightening:
Torque of center flange bolt: 64N. M (6.5kg. M/471b. Ft)

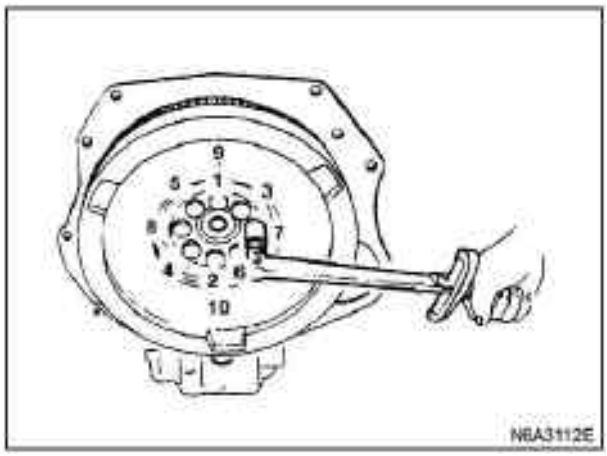


Legend
1. Lock bolt
6. Camshaft timing gear (gear drive type)
1) Install the camshaft timing gear onto the camshaft. The timing gear mark ("Y - Y") must be outward.
2) Tighten the timing gear according to the specified torque.

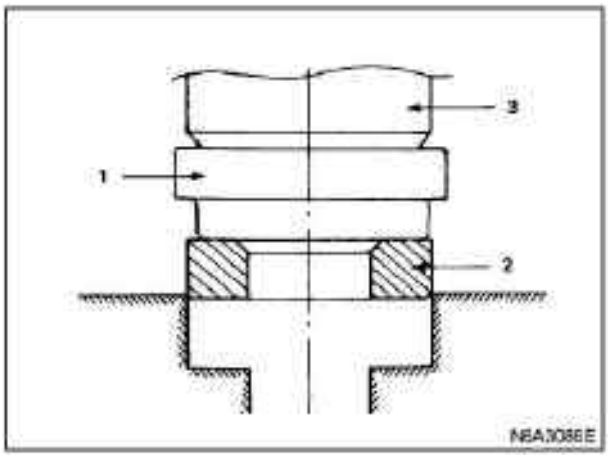
Tightening:
Torque of timing gear bolt: 64N. M (6.5kg. M/471b.ft)



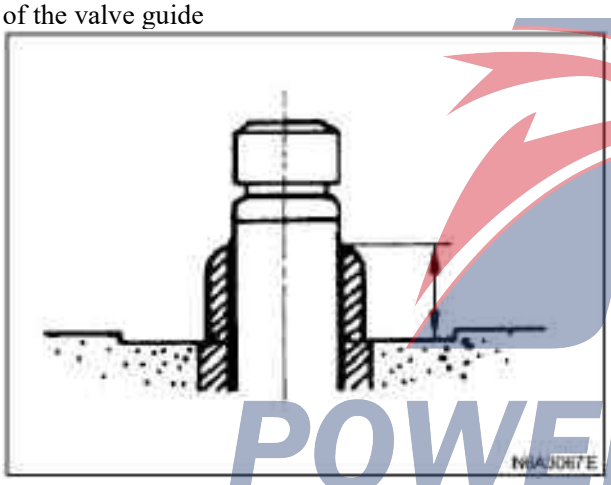
7. Engine oil pump assembly
8. Oil sump assembly
For the above work, see the section of "Oil Pump" in this manual.
9. Cylinder body rear plate
·Tighten bolts on the back plate of the cylinder body according to the specified torque.
Tightening:
Torque of rear plate bolt: 82N. M (8.4kg. M/61 1b. Ft)
10. Flywheel
• Apply the oil film on the fixed bolt.
• Use angle tightening method to tighten the flywheel bolts in two steps according to the specified torque.
Tightening:
·Flywheel bolt torque:
Step 1(initial torque): 59N. M (6.0kg. M/43 1b. Ft)
Step 2(final torque): 60°— 9 0°



11. Cylinder head assembly
1) Combustor insert
·According to the cylinder order, the spherical positioning surface of the insert is installed into the positioning groove of the cylinder head, and use a plastic hammer to tap.
Caution:
After the cylinder is pressed into the cylinder, the combustor insert is grinded in plane.
Accordingly, the specifications are different, and be careful not to confuse the order of the cylinders.
When replacing new combustor inserts,
When assembling the new combustor insert, the spherical positioning surface is pressed into the positioning groove of cylinder cover, and tapped by a plastic hammer until the combustor insert is positioned reliably.
Place the cover plate on the combustor insert to prevent damage. It is pressed into it with the force of 4.5 to 5.5 ton.
2) Installation of valve retainer
·Carefully install the accessory (1) on the valve retainer (2).
Caution:
The surface of the accessories must be exposed to the valve retainer.
• Use the desktop press-fit machine (3) to gradually apply pressure to the accessories and press the valve retainer into place.



Caution:
The pressure exerted by a bench press shall not be too large so as to avoid damaging the valve seat ring. Measure the height of the upper end of the valve guide from the cylinder head.
The height (H) (Reference) mm (in) of the upper end of the valve guide

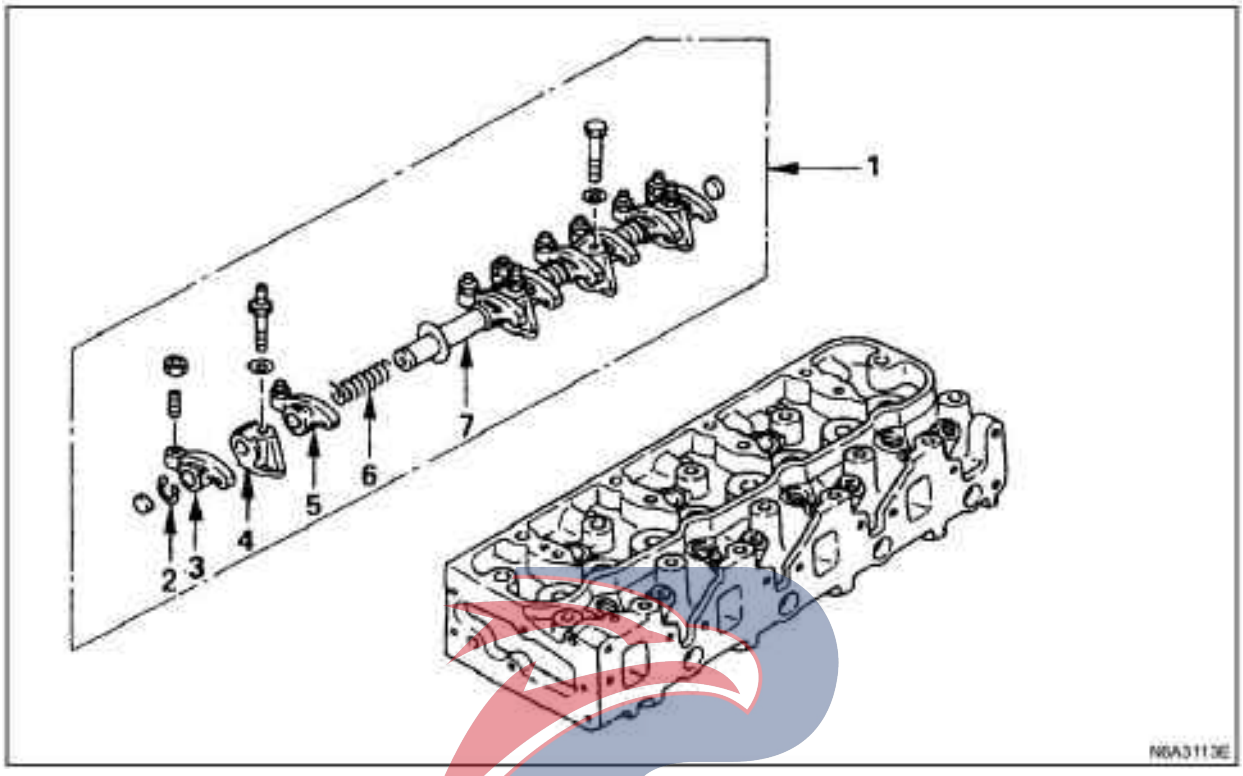


Caution:
If the valve guide is dismantled, the valve and valve guide must be replaced together.

3) spring lower seat
4) Valve stem oil seal
5) valve
6) Valve spring
7) Valve lock clamp
The above work can be shown in the "Valve" section of this manual.

Rocker arm assembly

Part



Legend
1. Rockshaft assembly
2. Rockshaft snap ring
3. Rocker arm
4. Rockshaft pedestal
5. Rocker arm
6. Rockshaft spring
7. Rockshaft

Dismantling
1. Rockshaft assembly
2. Rockshaft snap ring
3. Rocker arm
4. Rockshaft pedestal
5. Rocker arm
6. Rockshaft spring
7. Rockshaft

Repair

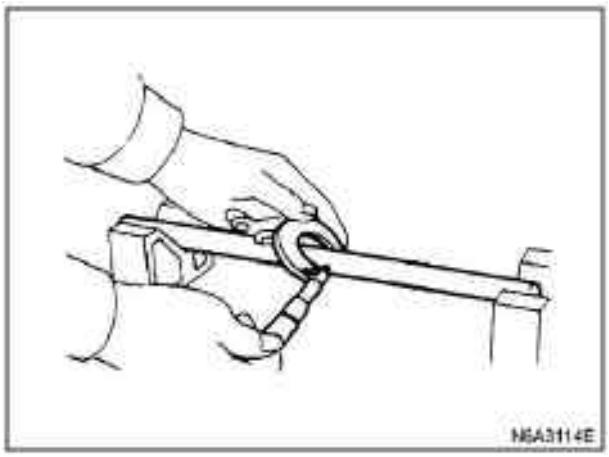
When overhauling, it is necessary to adjust, repair and replace the parts if they are found to be overly worn or damaged.

According to the point that the rocker arm moves on the rocker shaft, the outer diameter of the rocker shaft is measured with a micrometer.

If the diameter exceeds the specified limit value, the rocker shaft should be replaced.

mm(in)

Criterion	Limit value
18.98-19.00 (0.7472-0.7480)	18.9 (0.744)



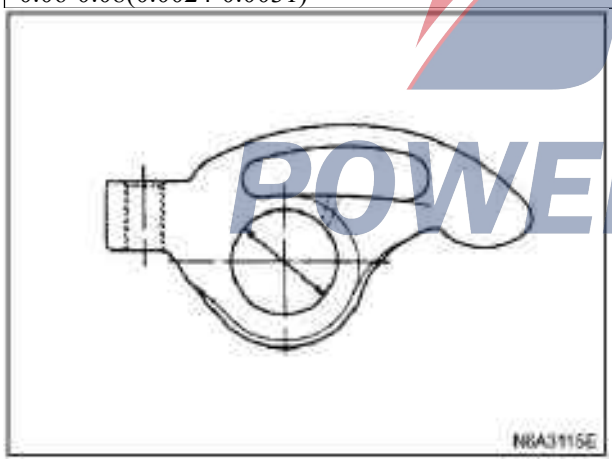
oil clearance

1. Use vernier caliper or micrometer to measure internal diameter of rocker arm.

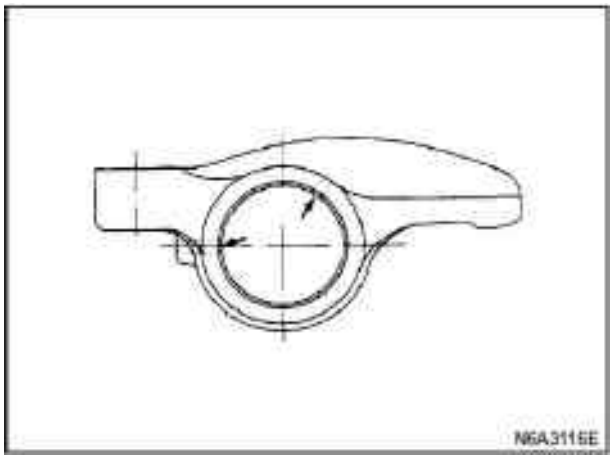
Rocker arm ID	mm(in)
Criterion	Limit value
19.036-19.060 (0.7494-0.7503)	19.100 (0.7519)

2. Measure the outer diameter of the rocker arm shaft. If the measured value exceeds the prescribed limit value, the rocker arm or the rocker arm shaft should be replaced.

Clearance rocker arm and rocker shaft mm(in)
Criterion
0.06-0.08(0.0024-0.0031)



3. Check whether the rocker arm oil hole is blocked. When necessary, use compressed air to clean the oil hole of the rocker arm for correction

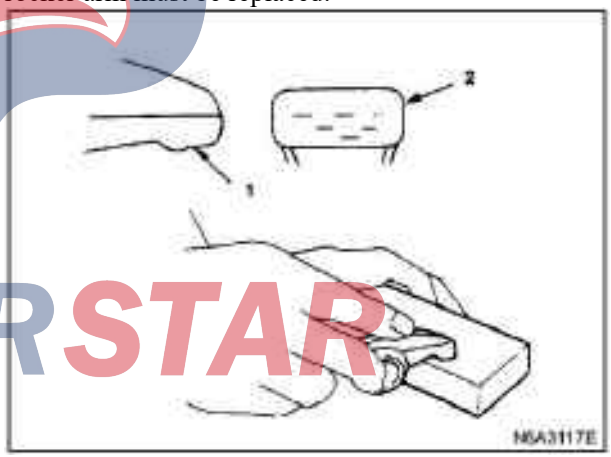


Rocker calibration

Check whether there is ladder-like wear (1) and scratch (2) on the contact face of the rocker valve.

If there is a slight ladder-like wear or scratch on the contact surface, it can be grinded with oil stone.

If there is a serious ladder-like wear or scratch, the rocker arm must be replaced.



Radial runout of rockshaft

1. The rocker shaft is arranged on the iron block in V groove.

2. Use a micrometer to measure the radial runout of center flange plate of rocker shaft. If the radial runout is very small, the radial runout is corrected with a desktop press, and the rocker arm must be in a cold state.

If the measured radial runout of rocker shaft exceeds the specified limit, the rocker shaft must be replaced.

Radial runout of rockshaft	mm(in)
	Limit value
4JB1 / 4JB1-TC	0.2 (0.008)
4KH1-TC	

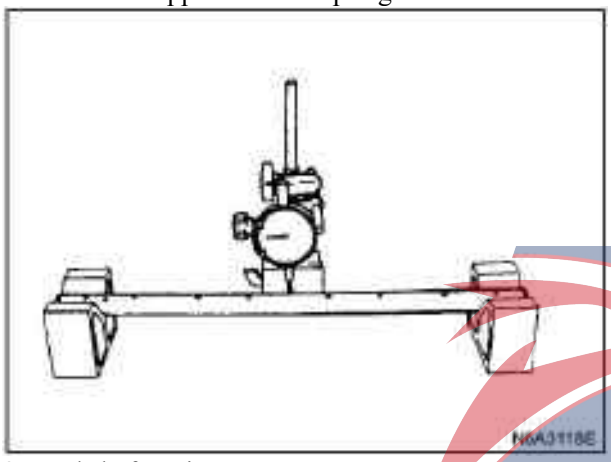
Reassemble

1. Rockshaft

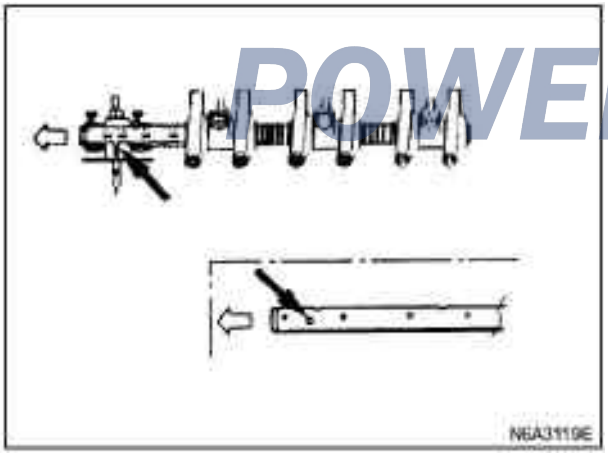
·Apply an oil film on the rocker shaft.

·The rocker shaft is positioned, and the big hole (Φ4) face to the front of engine.

·Install the rocker shaft with the rocker arm, the rocker shaft support and the spring.



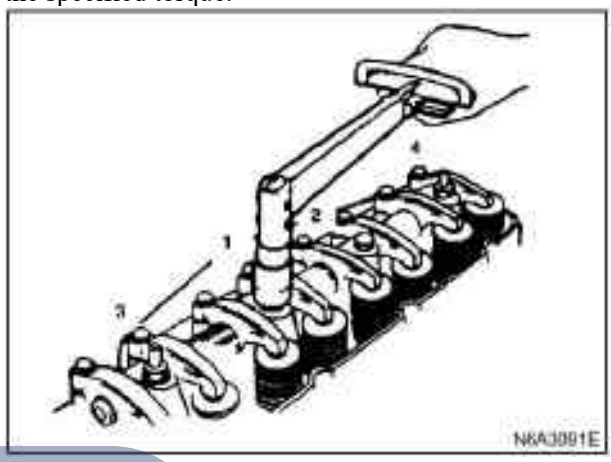
2. Rockshaft spring
3. Rocker arm
4. Rockshaft pedestal
5. Rocker arm



6. Rockshaft snap ring
7. Rockshaft assembly

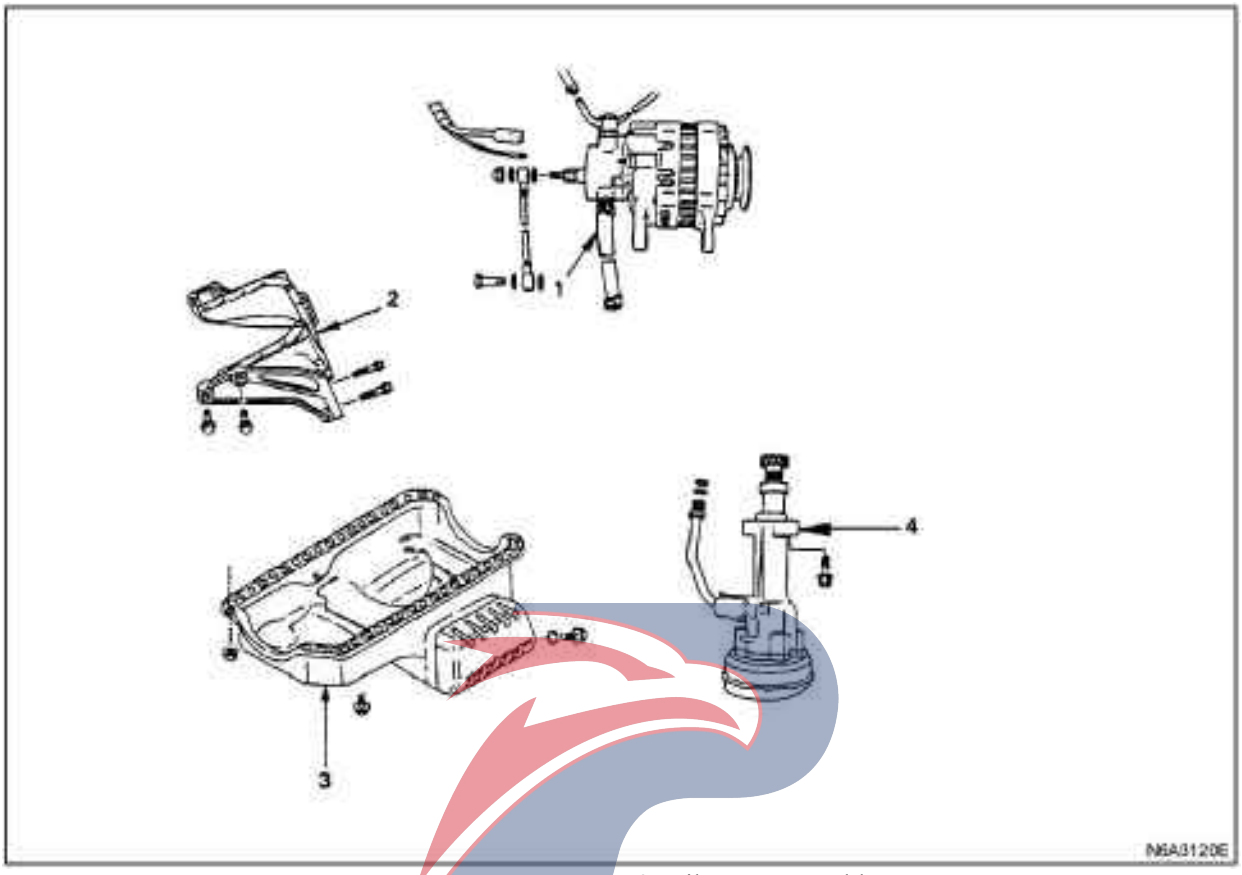
•The rocker bearing assembly is mounted on the cylinder head.

• Tighten the fixed bolt of rocker shaft according to the specified torque.



Engine oil pump

Part



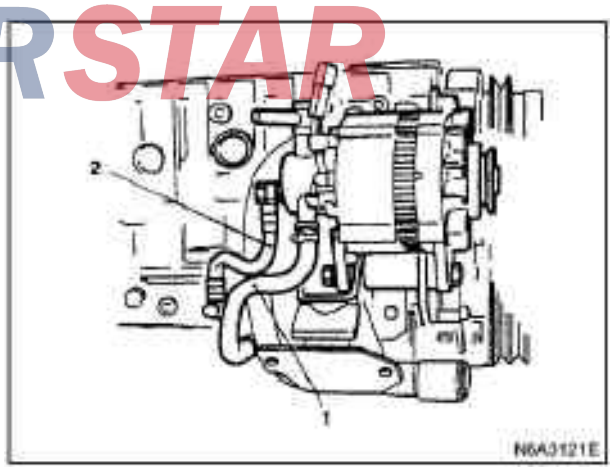
Legend

1. Vacuum pump oil pipe
2. Reinforcement and rubber pads
3. Oil sump assembly
4. Engine oil pump assembly

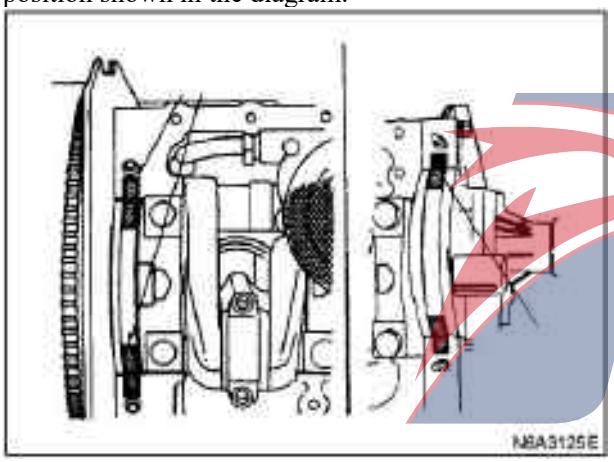
Dismantling

1. Vacuum pump oil pipe

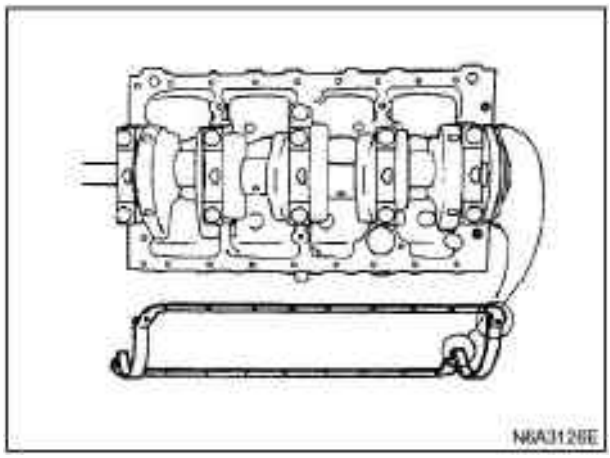
·Remove the oil pipe from the oil pan (1).



2. Reinforcement and spaced rubber pads
·Remove the reinforcement from the left and right sides of the oil pan.
·Remove the spaced rubber pad.
3. Oil sump assembly
4. Engine oil pump assembly
Install
1. Engine oil pump assembly
·Apply the molybdenum oil on the driven gear and camshaft transmission of the oil pump.
·Tighten the fixed bolt of the oil pump according to the specified torque.
Tightening:
19N m(1.9kg·m/14 1b·ft)
2. Oil sump assembly
·Apply the recommended liquid sealant or its analogues in the fifth arched area according to the position shown in the diagram.



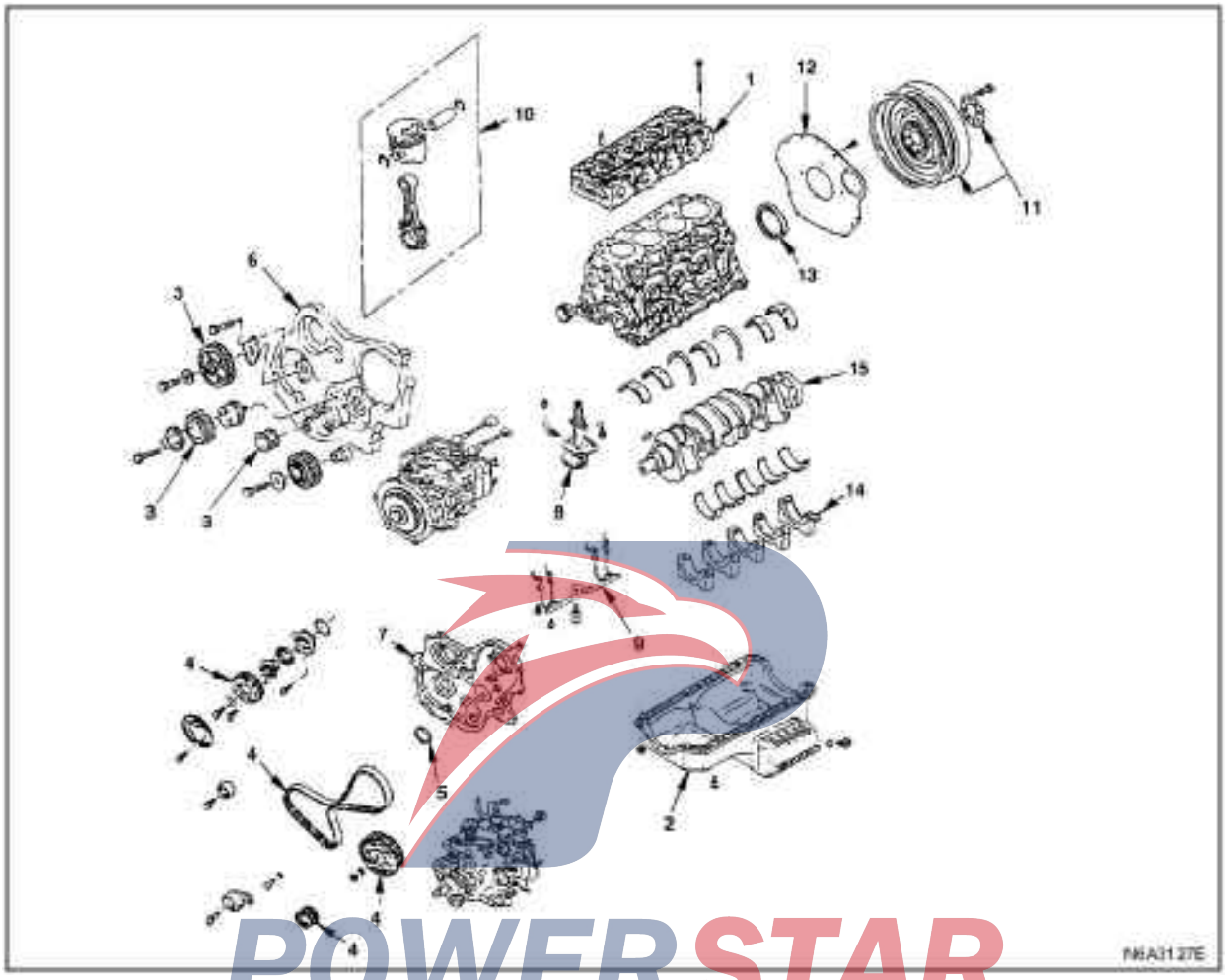
·The back lip of the sealant is partially applied into the fifth bearing groove.



·Absolutely ensure that the lip part is pressed into the slot.
·Install the oil sump on the cylinder.
·Tighten the oil sump bolt according to the specified torque.
Tightening:
Torque of oil sump bolt: 19N·m(1.9kg·m/14 1b·ft)
3. Reinforcement and spaced rubber cushion mats
·Install spaced rubber pad.
·Install the reinforcement according to the specified torque.
Tightening:
•Torque of engine: 37N·m(3.8kg·m/27 1b·ft)
•Torque of clutch hull body:78 N·m(8.0kg·m/58 1b·ft)
4. Vacuum pump oil pipe
·Install the oil tube to the oil sump.

Crankshaft

Part



Legend

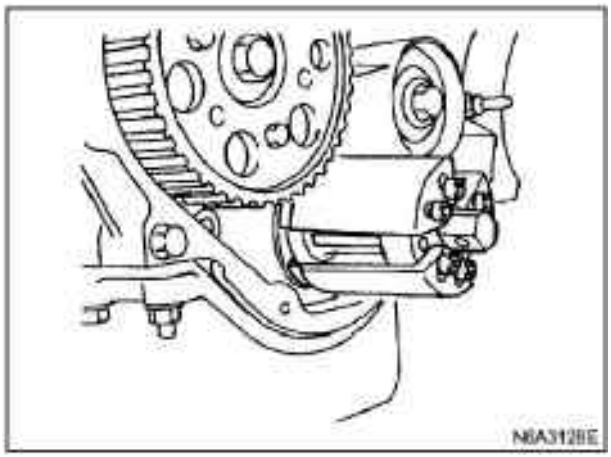
1. Cylinder head assembly and cylinder gasket
2. Oil sump assembly
3. Timing gear
4. Timing belt and belt pulley
5. Front oil seal
6. Timing gear cover
7. Timing belt pulley housing
8. Engine oil pump assembly
9. Piston cooling oil pipe
10. Piston and **connecting rod**
11. Flywheel
12. Cylinder body rear plate
13. Crankshaft rear oil seal
14. Main bearing cover
15. **Crankshaft**

Dismantling

1. Cylinder head assembly and cylinder gasket
2. Oil sump assembly
3. Timing gear (gear drive type)
4. Timing belt and pulley (belt drive type)

5. Front oil seal

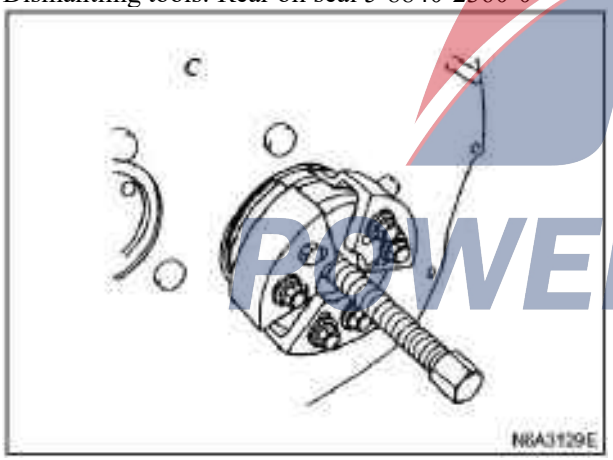
·Push the oil seal deeply and dismantle the oil seal using special tools as shown in the figure. Dismantling tools: 5-8840-2362-0



6. Timing gear housing
7. Timing belt pulley housing
8. Engine oil pump assembly
9. Piston cooling oil pipe
10. Piston and **connecting rod**
11. Flywheel
12. Cylinder body rear plate
13. Crankshaft rear oil seal 1 (gear and belt drive type)

·Push the oil seal deeply and dismantle the oil seal using special tools as shown in the figure.

Dismantling tools: Rear oil seal 5-8840-2360-0



Caution:

When the oil seal is removed, be careful not to damage the seal face of the back plate and the crankshaft.

14. Main bearing cover
15. **Crankshaft**

Repair

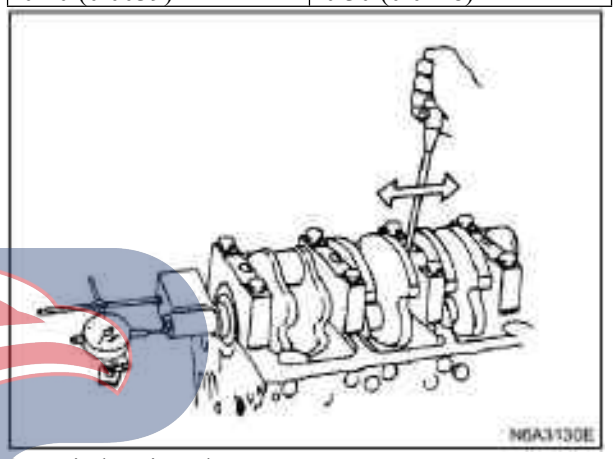
In the case of overhaul, the necessary adjustment, repair and replacement of parts should be carried out if it is found to be overly worn or damaged.

1. **Crankshaft**

Thrust clearance

As shown in the figure, the micrometer is used to measure the crankshaft thrust clearance. If the thrust clearance exceeds the specified limit value, the thrust bearing should be replaced in a complete set.

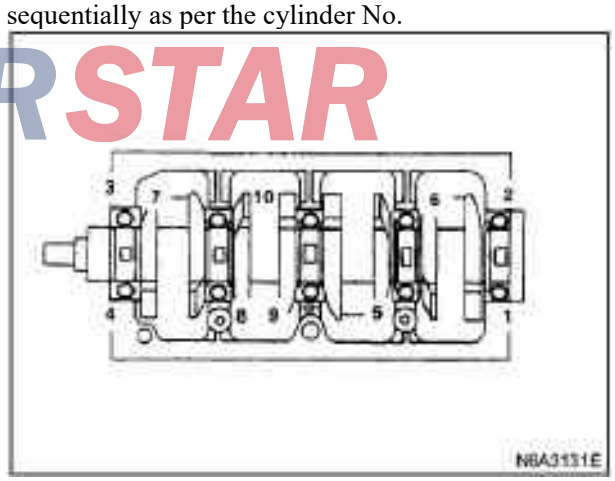
Thrust clearance	mm(in)
Criterion	Limit value
0.10 (0.0039)	0.30 (0.0118)



2. Main bearing clearance

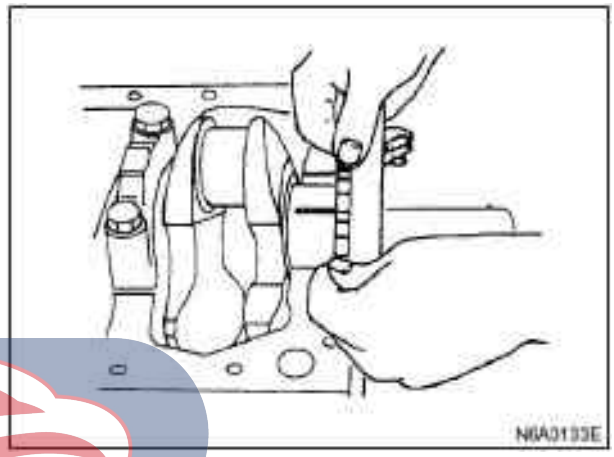
1) The main bearing cover is disassembled in the graphic sequence.

Arrange the dismantled main bearing covers sequentially as per the cylinder No.



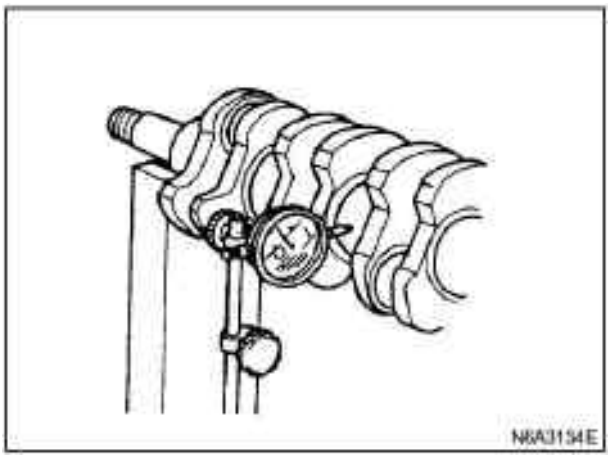
2) Disassemble the crankshaft and the main bearing.
3) Clean the upper and lower bearing and crankshaft spindle journal.
4) Check whether there is excessive wear or damage on the bearing. In the case of inspection, if the damage or excessive wear is found, a complete replacement of the bearing must be made.
5) Put the bearings and thrust washer back where they are, and carefully install the crankshaft.
6) Put the lower bearing back in the bearing cover.
7) As shown in the figure, the plastic clearance measurement sheet is applied to the crankshaft journal.
8) The main bearing cover is installed, and the oil film is applied on the screw thread and the seat.
Tightening:
167N m(17kg · ·m/123 1b·ft)
Caution:
Do not cause the crankshaft to rotate.
9) Disassemble the main bearing cover.
10) Measure the width of the plastic clearance measurement sheet and measure the oil film clearance. If the oil film clearance exceeds the specified limit value, the main bearing and / or the crankshaft should be changed.
11)Remove the plastic clearance measurement film from the bearing and the crankshaft.
12) Remove the crankshaft and bearing.

oil clearance		mm(in)
	Criterion	Limit value
4J B1 4JB1-TC	0.035—0.080 (0.0014—0.0036)	0.11(0.0043)
4J G2	0.031—0.063 (0.0012—0.0025)	
4KH1-TC	0.037—0.068 (0.0015—0.0027)	



3. Radial runout
1) Carefully install the crankshaft on the iron block in the V groove, slowly rotate the crankshaft and measure the radial runout.
If the crankshaft's radial runout exceeds the specified limit, the crankshaft must be replaced.

Radial runout	mm(in)
Criterion	Limit value
0.05 (0.0020) or below	0.08(0.0031)



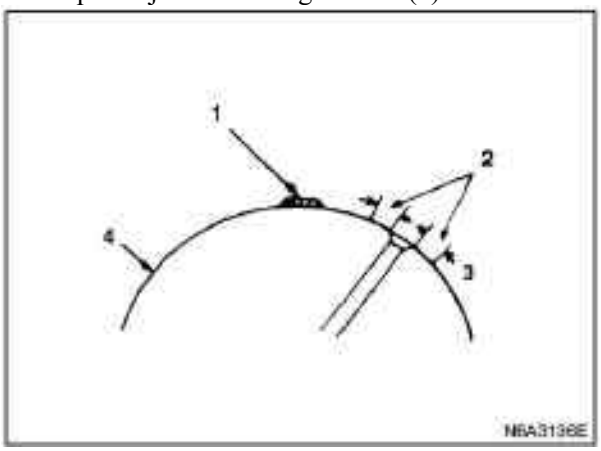
Measure the diameter and non-uniform degree of wear of the main journal and crank pin.
If the crankshaft is worn over the specified limit, the crankshaft must be replaced.

mm(in)

	Criterion	Limit value
Main journal diameter	69.917 — 69.932 (2.7526 — 2.7532)	69.91(2.7524)
Crank pin diameter	52.915 — 52.930 (2.0833)	52.90(2.0843)
Uneven wear limit	0.05 (0.0020) or below	0.08(0.0031)

Crankshaft inspection
Check for excessive wear or damage of the crankshaft journal and crank pin surface.
Check whether the assembly surface of the oil seal is overly worn and damaged.
Check whether the oil hole is blocked.

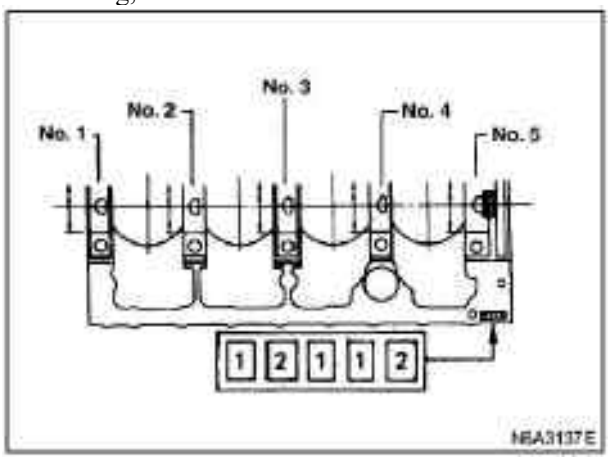
Crankshaft testing with the nitriding method
The test part must maintain even without solution flow (1).
The solution can not be used within 10mm(0.39in) (3) around the oil hole (2).
Crank pin or journal sliding surface (4).

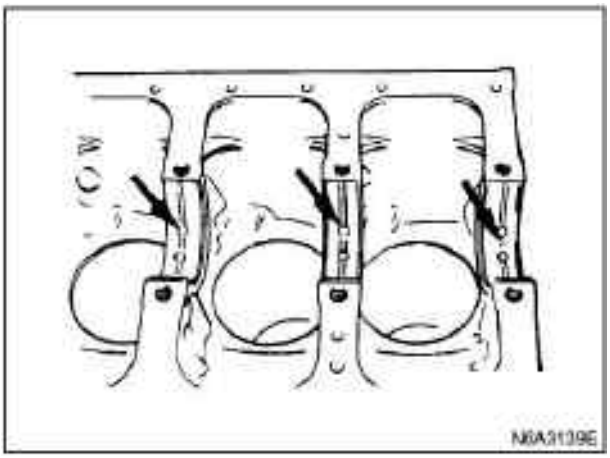


Caution:
In order to increase the strength of the crankshaft, the soft nitriding method is adopted. Therefore, the crankshaft surface can not be regrinded.
1. The organic cleaner are used to clean crankshaft, and inspected surface must not have oil.
2. The 5 - 10% ammonium chloride solution (dissolved in distilled water) is prepared.
3. Apply the solution to the tested surface with a syringe.
Keep the test surface evenly to avoid solution to flow.
Caution:
The solution is not allowed to contact the oil hole and its surrounding area.
Test
1. Wait for 30~40 seconds.
After 30~40 seconds, the crankshaft is available if there is no discoloration.
If the color changes (the test surface becomes coppery), the crankshaft must be replaced.
2. Clean the crankshaft surface with steam immediately upon experiment completion.
Caution:
The copper chloride solution has a very strong corrosiveness. After the test, the tested surface must be cleaned immediately.

Crankshaft bearing selection

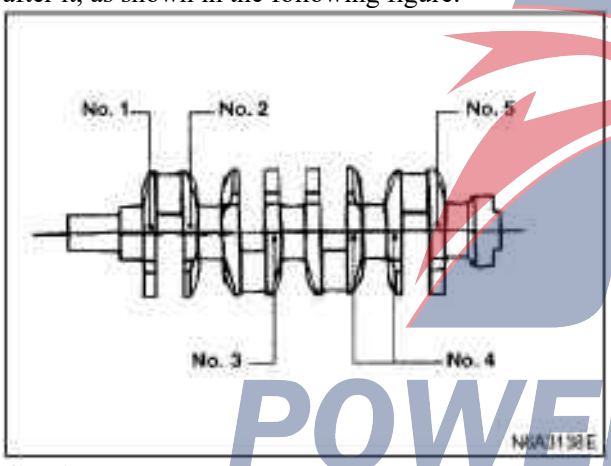
When installing new crankshaft bearings or replacing old bearing, see the selection table.





Caution:

Some No. 4 crankshaft journals produced in a limited period of production are numbered (No.4) before and after it, as shown in the following figure.



Caution:

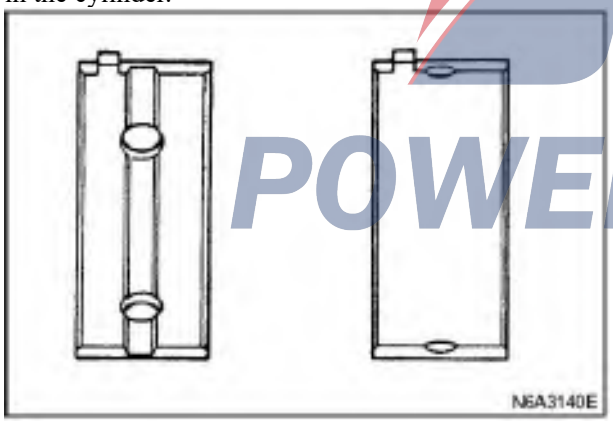
Although all upper journal bearings (cylinder face) have oil grooves and oil holes, the lower bearing (bearing cover surface) has no oil slots and oil holes. Pay special attention to the difference when installing.

mm(in)				
Outer diameter of main bearing		Diameter of main bearing journal		Specification code of crankshaft bearing
grade mark	Diameter	grade mark	Diameter	
1	73.992 — 74.000 (2.9131 —2.9134)	1 或	69.927 — 69.932 —2.7532)	4
		2or…	69.922 — 69.927 (2.7528 — 2.7530)	
		3or…	69.917 — 69.922 (2.7556 — 2.7528)	5
2	73.983 — 73.992 (2.9127 — 2.9131)	1 or -	69.927 — 69.932 (2.7530 — 2.7532)	2
		2 or--	69.922 — 69.927 (2.7528 — 2.7530)	3
		3or…	69.917 — 69.922 (2.7556 — 2.7528)	4
3	73.975 — 73.983 (2.9124 — 2.9127)	1 or -	69.927 — 69.932 (2.7530 — 2.7532)	1
		2 or--	69.922 — 69.927 (2.7528 — 2.7530)	2
		3 or--	69.917 — 69.922 (2.7526 — 2.7528)	

Reassemble

1. **Crankshaft**

·Install the main bearing and the main bearing cover in the cylinder.



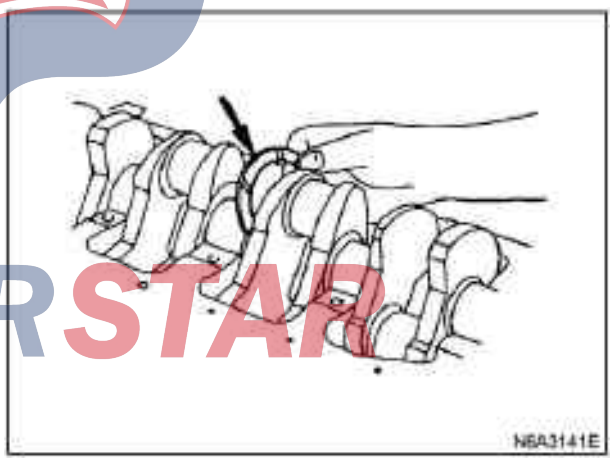
·Make sure that it is in the right position.

·Apply the oil film on the upper and lower main bearing surface.

·Carefully install the crankshaft.

·Apply the oil film on the thrust washer.

·Install the thrust washer on No. 3 main bearing journal, and the oil groove must face the crankshaft.

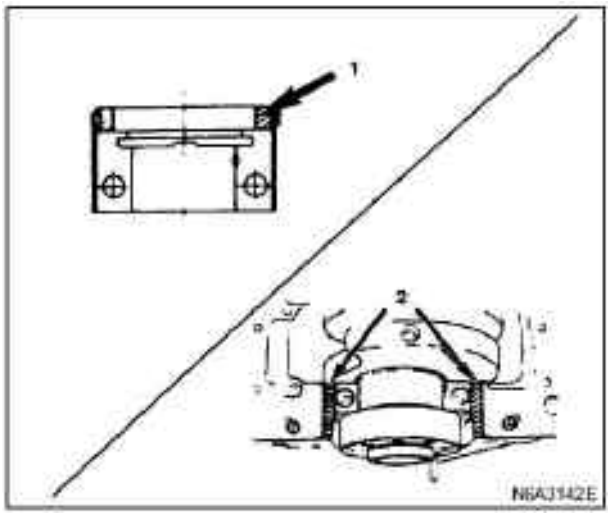


2. Main bearing cover

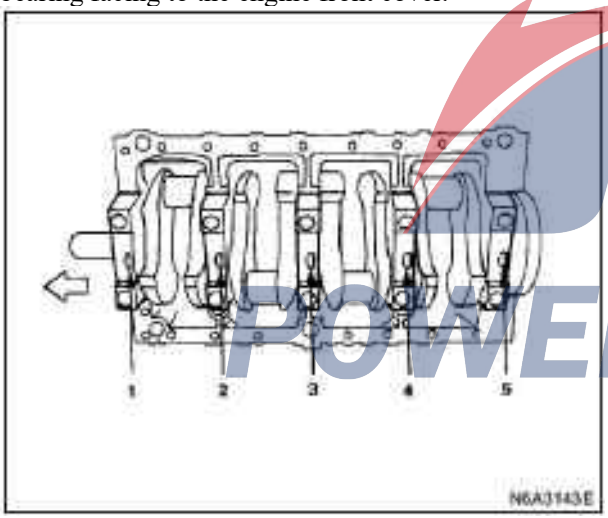
·As shown in the diagram, the recommended liquid sealant or its similar sealant is applied to No. 5 crankshaft bearing cover (1).

·The arched sealant (2) is mounted on the No. 5 bearing cover.

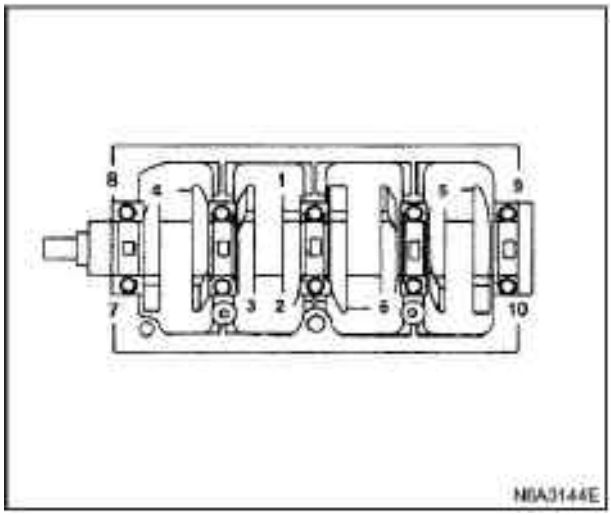
·Use the finger to push the arched sealant into the bearing cap groove.



Caution:
Before the application of liquid sealant, ensure that there is no oil stain on the assembly surface of bearing cover.
The sealant shall not block the screw hole and bearing of the cylinder head.
·Install the bearing cover, with the arrow marking of bearing facing to the engine front cover.

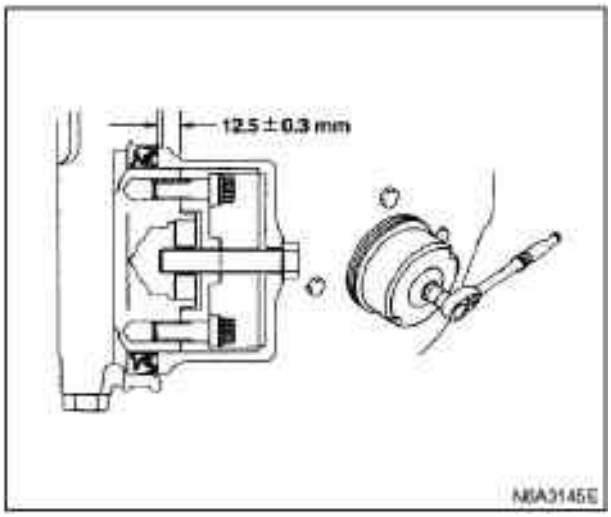


·Apply the oil film on the bearing cover bolts.
·Tighten the crankshaft bearing cover bolts each time according to the specified torque, as shown in the graphic sequence.
Tightening:
167N m(17kg·m/123 1b·ft)

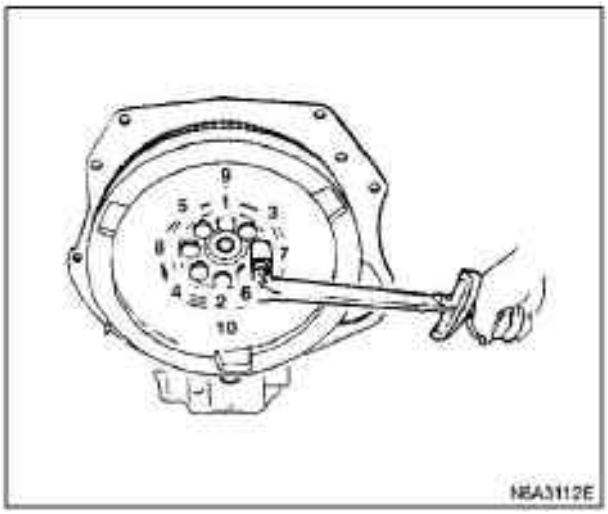


Caution:
Rotate the crankshaft by hand to check its flexible operation.
3. Rear oil seal of crankshaft (gear and belt drive type). Use oil seal assembly tool to install oil seal on the cylinder body.
Installation tool: Rear oil seal 5-8840-2359-0
Caution:
Rust and debris are removed from the pressed parts of the oil seal.
Pay attention to the pressing-in direction of the oil seal.
1) Use two bolts to install the special tool joint to the rear end of the crankshaft.
2) Install the oil seal to the outer circle of the joint.
3) Insert the subordinate part into the joint part and tighten it with a bolt (M12 x 1.75L-70) until the joint cross section contacts the subordinate part.
4) Remove the joint and subordinate parts.
5) After the oil seal is installed, the size of the oil seal is checked.

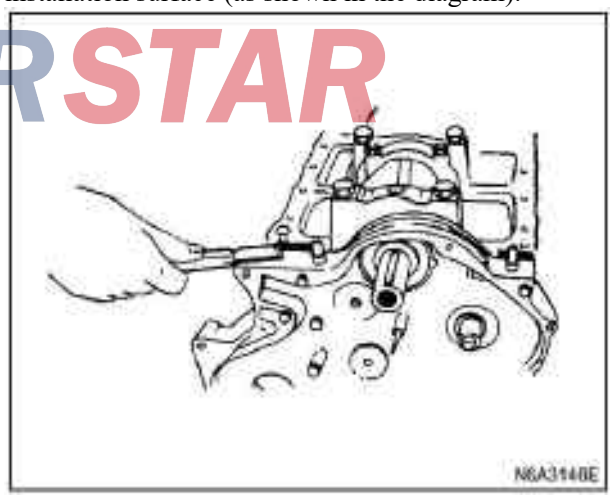
Criterion	mm(in)
12.2 — 12.8 (0.48 — 0.50)	



4. Cylinder body rear plate
The rear plate is aligned with the dowel pin of cylinder block, and the rear plate is tightened according to the specified torque.
Tightening:
82N·m (8.4kg· m / 61 Lb· ft)
5. Flywheel
1) Thoroughly remove the oil retain of crankshaft thread.
2)Install the flywheel on the crankshaft and then install the washer.
3)Apply a layer of oil film on the flywheel bolt.
4) Align the flywheel with the crankshaft dowel pin.
5) Use the angle tightening method to tighten the flywheel bolts in two steps according to the specified torque.
Follow the following sequence of illustrations.
Tightening:
·Flywheel bolt torque:
Step I: 59N·m(6.0kg·m/43 1b·ft)
Step II: 60°— 90°



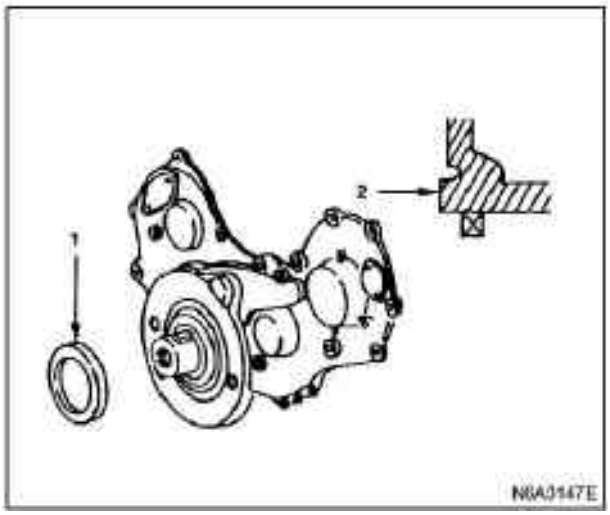
6. Piston and connecting rod assembly
7. Piston cooling oil pipe
8. Engine oil pump assembly
The above work can be seen in the section "Piston and Connecting rod" in this manual.
9. Timing belt pulley housing
1)The timing pulley shell is mounted on the cylinder block.
Caution:
Be careful not to distort the front oil seal.
2) Tighten the timing pulley shell bolt and the timing pulley washer according to the specified torque.
Tightening:
19N·m(1.9kg·m/14 1b·ft)
3) Cut off the protruding parts of the sealant installation surface (as shown in the diagram).



10. Timing gear housing

11.Front oil seal (gear drive type)

·Install the oil seal using special tools. Installation tool: 5-8840-2061-0



Legend

1. Oil seal
2. Timing belt pulley housing
12. Front oil seal (belt drive type)

·Install the oil seal using special tools.
Installation tool: 5-8840-2361-0

Caution:

Clean up the rust and debris on the pressed part of the oil seal.

Pay attention to the pressing-in direction of the oil seal.

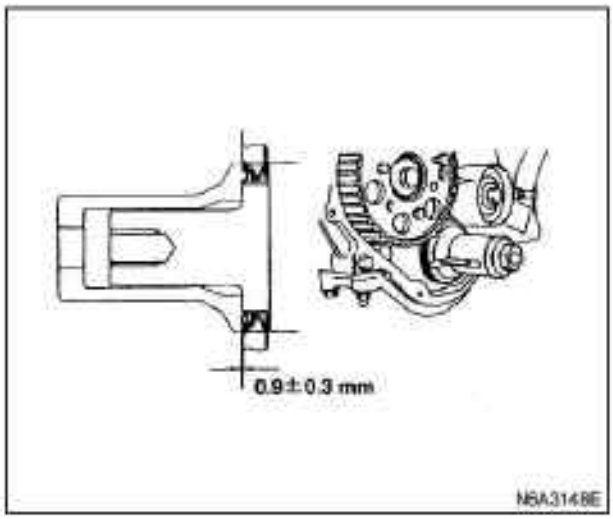
1) Encapsulate the oil seal on the bushing and press it into the front of the crankshaft.

2) Attach the edge of the oil seal reliably to the crankshaft and tighten it with the center flange bolt until the bushing is dependable on the base face of the front end of the crankshaft.

3) Remove the bushing.

4) After pressing into the oil seal, check the size of the oil seal.

Criterion	mm(in)
0.6 — 1.2 (0.024 — 0.047)	



13. Camshaft timing pulley (belt drive type)

1) Apply the oil seal on the oil seal lip of the oil seal bearing.

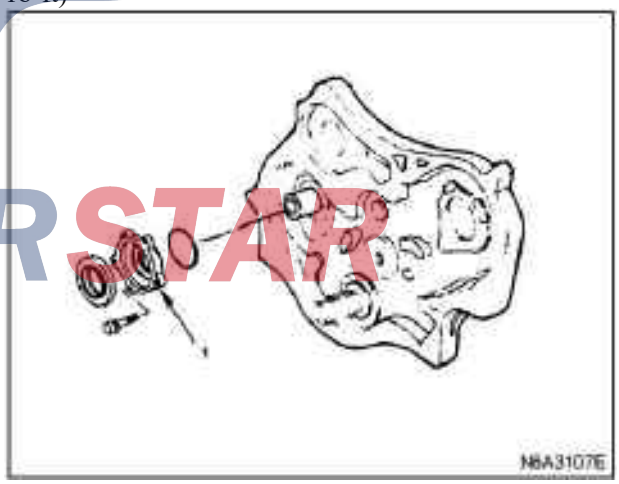
2) Install the recommended liquid sealant or similar sealant in the oil seal bearing.

3) Install the oil seal bearing on the cylinder block.

4) Tighten the oil seal support bolt according to the specified torque

Tightening:

Torque of oil seal support bolt: 19N·m(1.9kg·m/14 1b·ft)



Legend

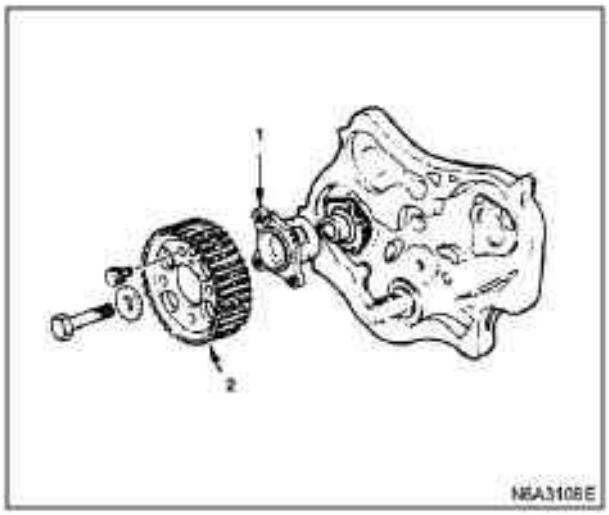
1. oil seal pedestal

5) The center flange of the camshaft timing pulley is aligned with the camshaft key.

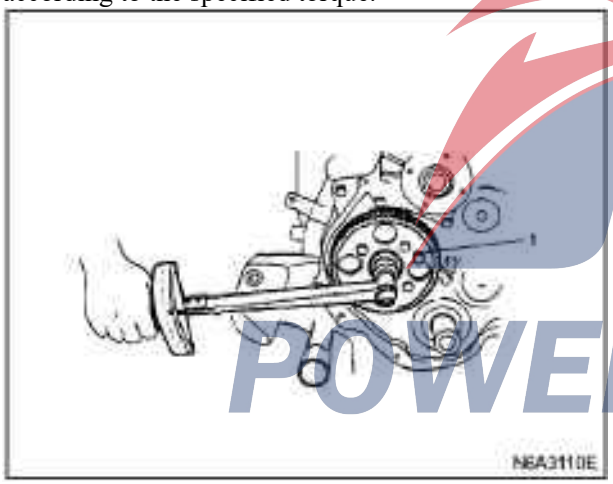
6) Tighten the timing pulley bolts according to the specified torque.

Tightening:

Torque of timing pulley: 8N·m(0.8kg·m/69 1b·ft)

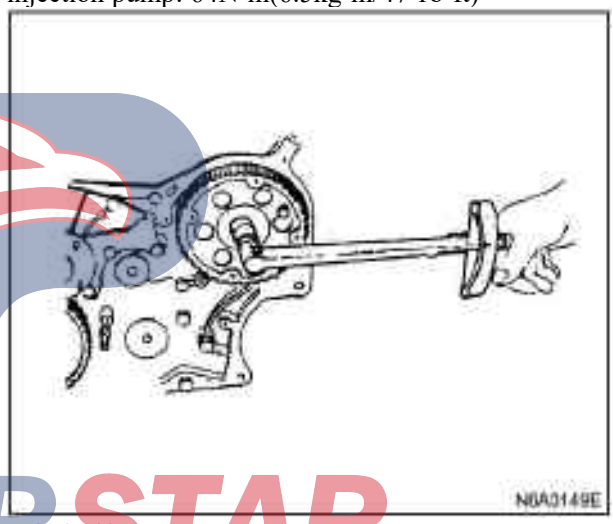


Legend
1. Timing belt pulley center flange plate
2. Timing belt pulley
7) When tightening the center flange bolt of the timing pulley, avoid the camshaft to rotate.
8) Tighten the center flange bolt of the timing pulley according to the specified torque.

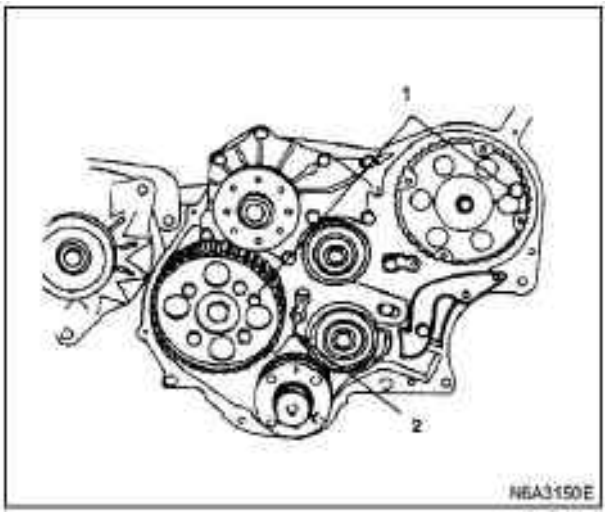


Tightening:
Torque of center flange bolt: 64N m(6.5kg m/47 1b·ft)

Legend
1. Lock bolt
9) Install the crankshaft belt pulley.
10) Install the tension belt pulley and the tension wheel.
Tightening:
76N·m(7.8kg·m/56 1b·ft)
11) Install the fuel pump assembly and the timing pulley.
12) Align the timing belt pulley with the pump shaft key.
13) Install the catch bolt on the timing belt pulley to avoid the timing belt pulley to move.
14) Tighten the nuts of timing belt pulley according to the specified torque.
Tightening:
The torque of the timing belt pulley nut of the oil injection pump: 64N·m(6.5kg·m/47 1b·ft)

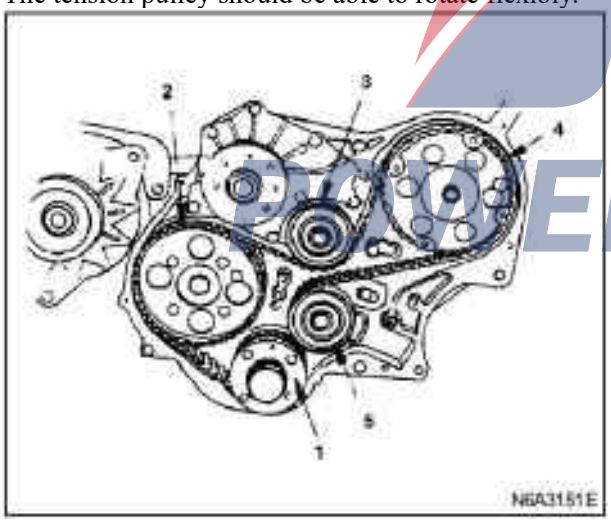


N6A3149E
15)Remove the catch bolt from the timing belt pulley of the oil injection.
14. Timing belt (belt drive type)
Caution:
·When the timing belt is removed, make sure that the new one is replaced.
·The tension of the timing belt is affected by the temperature change and it must be installed after the engine is cooled.
·When the timing belt is forced to be bent, the broken line will appear so that the belt will be lowered and the belt is not bent when unnecessary.
1) Check whether the catch bolt is properly installed on the camshaft timing belt pulley and the spray machine oil pump.
2) Check whether the mark of the timing pulley shell is aligned with the crankshaft timing pulley, and the first cylinder should be at the TDC of the compression stroke.
Rotate the crankshaft damping pulley in clockwise direction so that it is aligned with the mark.



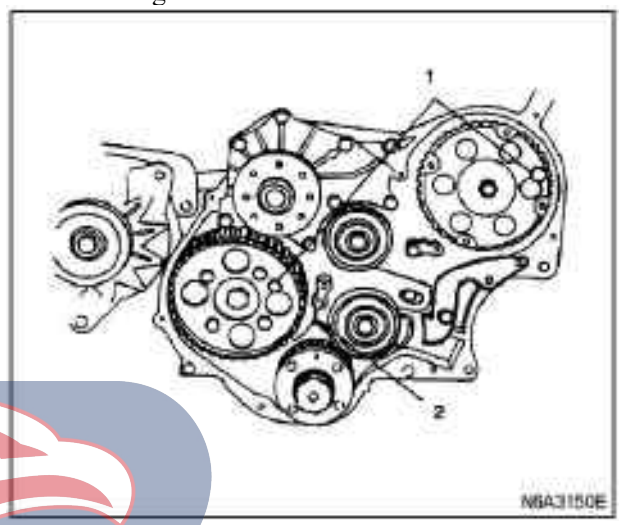
Legend
1. Lock bolt
2. Adjustment mark

3) The timing belt is installed on the crankshaft timing pulley (1), the camshaft timing pulley (2), the tension pulley (3) and the injection timing pulley (4). Follow the order number.
4) The timing belt tension pulley (5) is installed on the timing pulley shell.
5) Temporarily tighten the tension belt.
The tension pulley should be able to rotate flexibly.



Caution:
It is easy to damage the timing belt and should be careful.

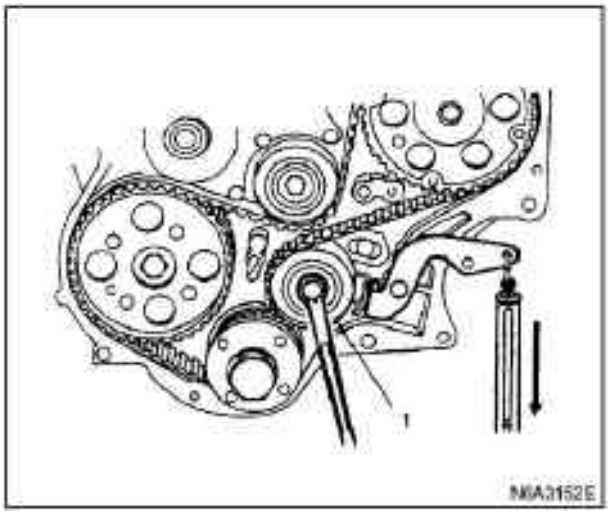
Caution:
Be careful:
After completing the installation of the timing belt, check whether the alignment mark of the crankshaft timing pulley is consistent with the alignment mark on the shell.
•If the alignment marks are different from each other, they should be adjusted and the timing belt should be reinstalled together.



Legend
1. Lock bolt
2. Adjustment mark

6) Adjust the adjusting rod of the tension pulley to the timing pulley shell.
7)Remove the catch bolt from the timing pulley of the camshaft and the oil pump of the oil injection pump.
8) Add a spring scale.
9) Use the prescribed force to pull down directly on the spring scale and adjust the tightness of the belt.

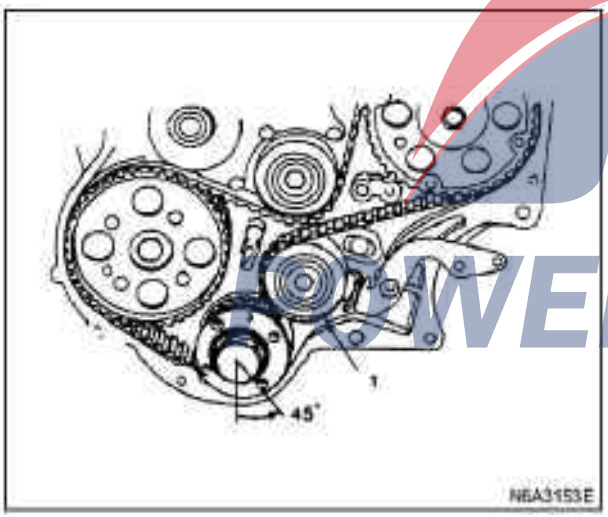
Tension force of adjusting rod	N(kg/lb)
98 — 118 (10 — 12/22 — 26)	



Legend
1. Tensioning wheel

Caution:
The tightness of the timing belt must be adjusted.
If the tightness of the timing belt is not adjusted well, the timing belt will be damaged.

10) Tighten the tighten bolt.
11)Turn the crankshaft 45 degrees in counter clockwise direction.

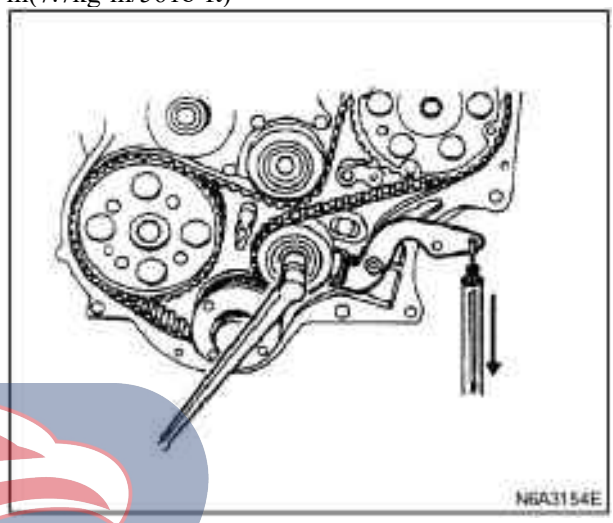


Legend
1. Tensioning wheel

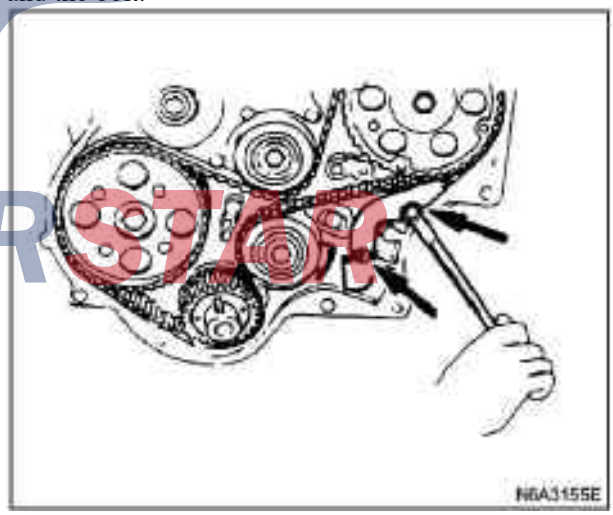
Caution:
Do not rotate the crankshaft in clockwise direction when adjusting the timing belt.

12) Adjust the tightness of the timing belt.
See Step 9.
In this way, the tightness of the rest of the belt can be eliminated.
13) Tighten the tensioning wheel bolt according to the specified torque.

Tightening:
Torque of tension pulley bolt: 76N m(7.7kg·m/561b·ft)



14) Strengthen the tightness and adjust the rod nut and the bolt.



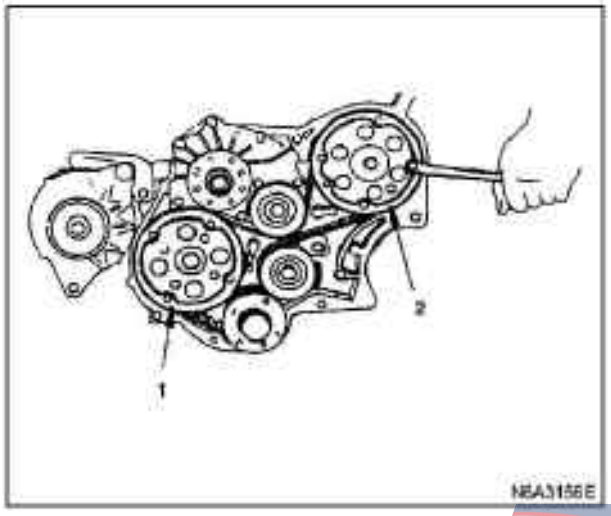
Caution:
Do not turn the crankshaft when changing the timing belt of the vehicle.
If the crankshaft is rotated, the piston and the valve will be damaged.

15. Flange: Camshaft pulley (belt drive type)
16. Flange: Injection pump pulley(belt drive type)
1) The timing pulley flange is installed on the camshaft and the timing pulley of the injection pump.

2) Tighten the timing pulley flange bolt according to the specified torque.

Tightening:

Torque of timing pulley flange bolt:
19N·m(1.9kg·m/14 1b·ft)

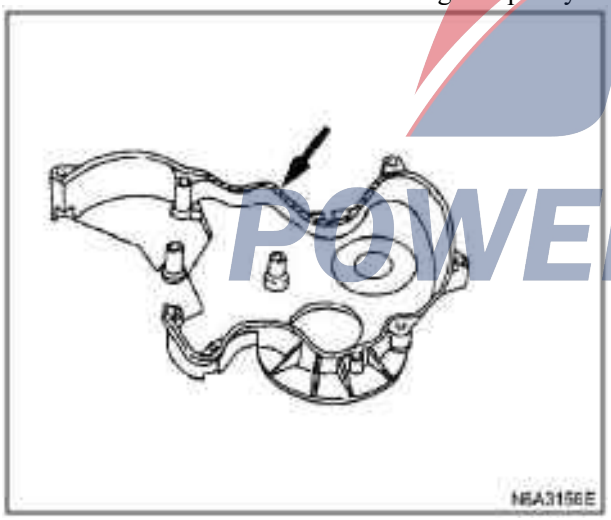


Legend

1. Camshaft pulley
2. Injection pump pulley

17. Lower cover of timing belt pulley(belt drive type)

1) The recommended liquid sealant or similar sealant is used for the lower cover of the timing belt pulley.



2) The lower cover is installed on the timing pulley shell.

3) Avoid the loss of liquid sealant with the guide bolt of the lower cover.

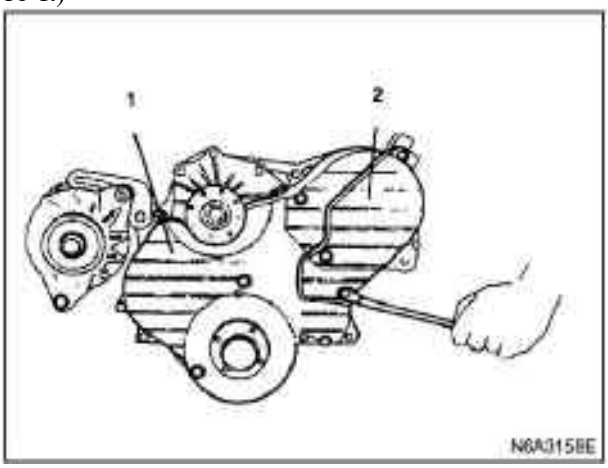
18. Upper cover of timing pulley (belt drive type)

1) Install the upper cover on the lower cover and the pulley shell

2) Tighten the bolt of timing belt pulley cover at the specified torque one point and one point.

Tightening:

Bolt of timing belt pulley cover: 8N·m(0.81kg·m/6 1b·ft)



Legend

1. Lower cover
2. Upper cover

3) Remove the guide pin of lower cover.

Tightening:

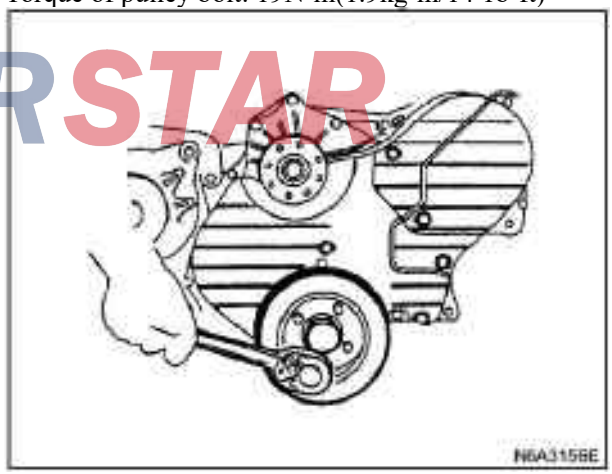
Torque of center bolt of crankshaft pulley: 206N·m(21kg·m/152 1b·ft)

19. Crankshaft damping pulley (belt drive type)

1) Install the damping pulley and tighten the bolt according to the specified torque.

Tightening:

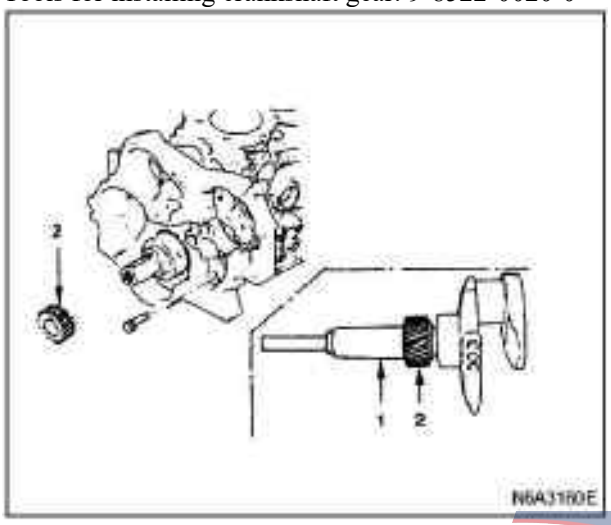
Torque of pulley bolt: 19N·m(1.9kg·m/14 1b·ft)



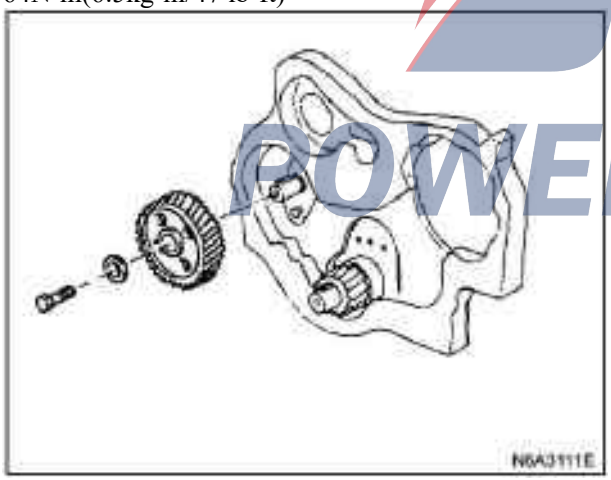
20. Crankshaft gear (gear drive type)

1) Install the crankshaft gear.

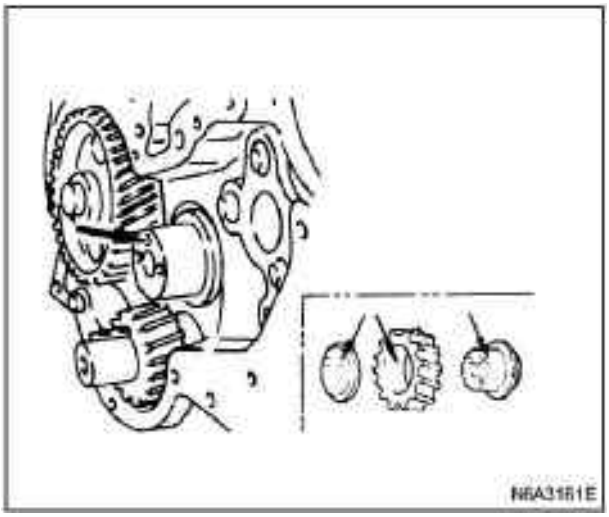
2)The crankshaft gear (2) is installed with the tool used for installing crankshaft gear (1).
The timing mark of the crankshaft gear ("X - X") or (~ ~ ~ ~ ~ ~ (~ ~ ~)) face outwards.
Tools for installing crankshaft gear: 9-8522-0020-0



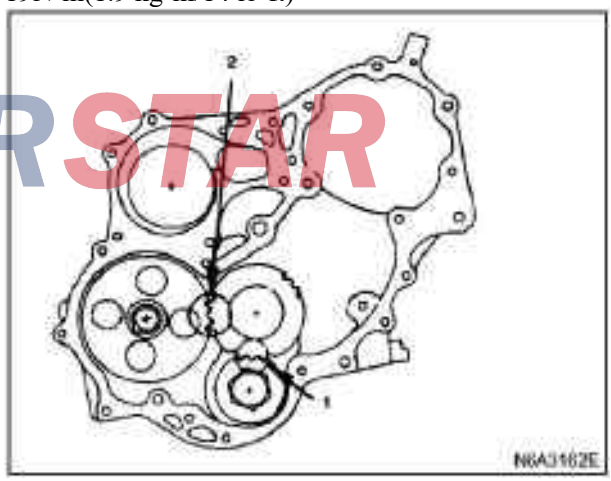
21.Crankshaft timing gear (gear drive type)
1) Install the camshaft timing gear onto the camshaft.
The timing gear marks ("Y - Y") or (~ ~ ~ ~ ~ ~ ~ ~ ~) must be outward.
2) Tighten the timing gear in accordance with the specified torque.
Tightening:
64N·m(6.5kg·m/47 lb·ft)



22.Tension pulley (gear drive type)
1) Apply oil films to the tensioning wheel and tensioning wheel shaft.
The oil hole of the tension axle must be upwards.
2) The positioning adjustment mark "X" or "~" of tension pulley and "Y" or "~ ~" positioning should be upwards when installing.



3) The "X" or "~" adjustment marks of the tension pulley are aligned with the mark "X - X" or "~ ~ ~"of crankshaft timing gear (1).
4) The "Y" adjustment mark of the tension pulley is aligned with the "Y - Y" or "~ ~ ~ ~ ~" mark of camshaft timing gear (1).
5) Install the thrust ring and bolt through the shaft to the cylinder body.
The oil hole of thrust ring must be upwards, and the chamfer of thrust ring must be outwards.
6) Tighten the tension pulley according to the specified torque.
Tightening:
19N·m(1.9 kg·m/14 lb·ft)

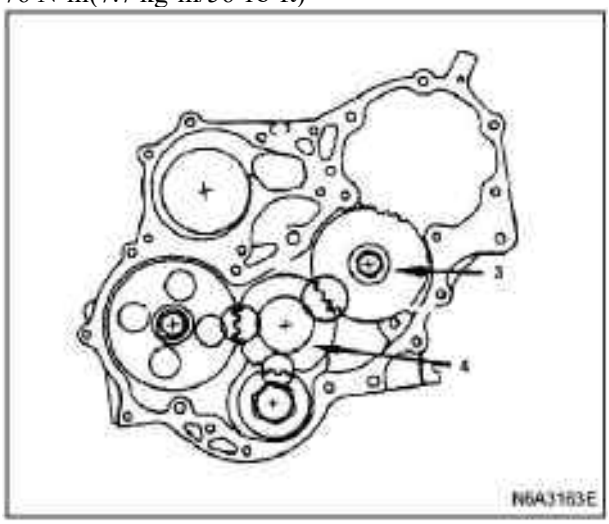


23. Tension pulley "B" and shaft (gear drive type)
1) Apply oil films to the tensioning wheel and tensioning wheel shaft.
2) Align the adjustment mark "Z" or "~" of tension pulley "B" (3) with the adjustment mark "Z - Z" or ": ~ ~ ~:" of tension pulley "A" (4).

3) Tighten the tensioning wheel bolt according to the specified torque.

Tightening:

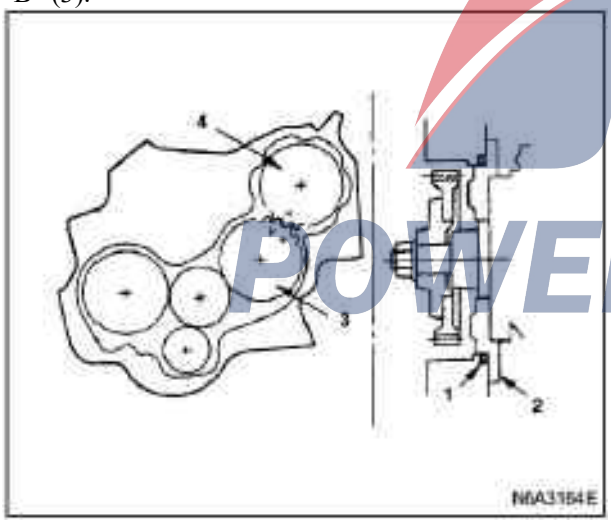
76 N·m(7.7 kg·m/56 1b·ft)



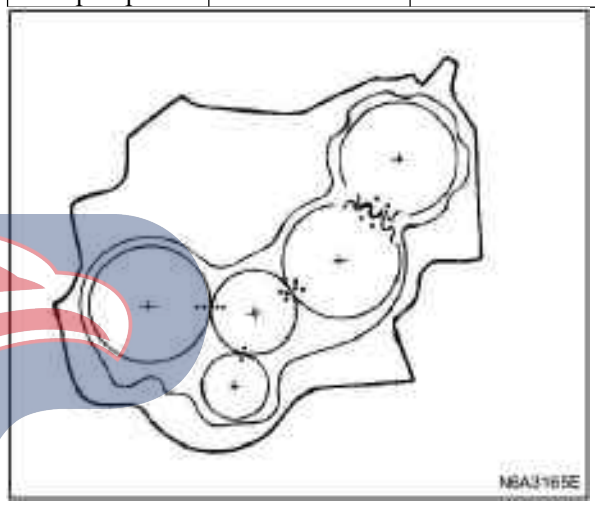
24. Injection pump (gear drive type)

1) Install the O- ring (1) on the injection pump flange (2).

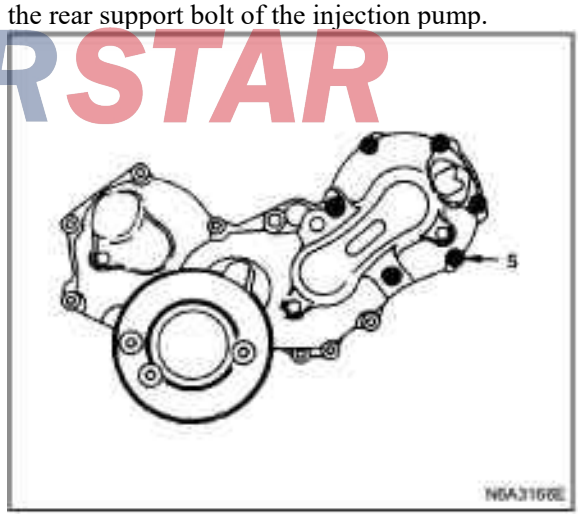
2) Install the injection pump to the timing gear cover. Align the mark "V - V" or ":: -:" of the tension pulley "B" (3).



Gear	4JB1-TC 4J G2	4KH1-TC
Crankshaft gear tension pulley "A"	X — X	·—·
Tension pulley "A" - cam gear	Y — Y	··—··
Tension pulley "A" – tension pulley "B"	Z — Z	:·—·:
Tension pulley "B" – injection pump	V — V	:—:

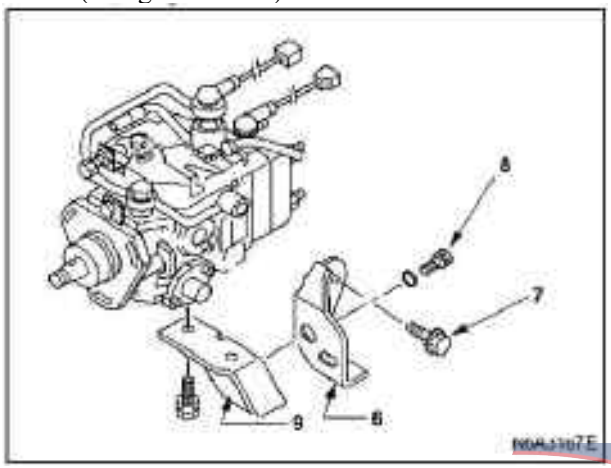


3) Temporarily tighten 6 injection pump bolts (5). The bolt of the injection pump is finally tightened on the rear support bolt of the injection pump.

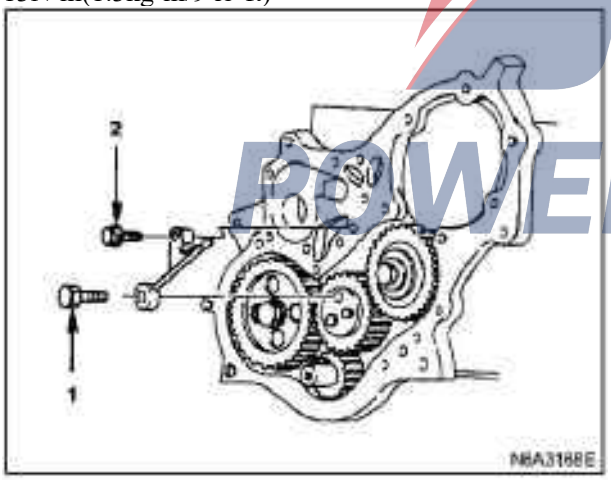


4)The rear support (6) and rear support bolt (7) of the injection pump are installed on the cylinder block.

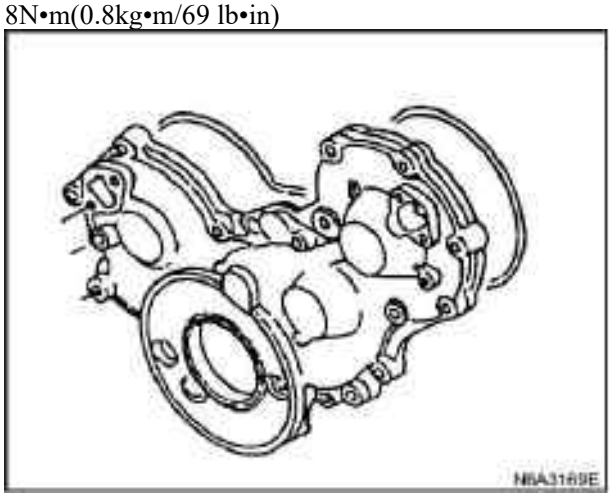
5) The rear seat bolt (8) is installed on the injection pump seat (9).
Don't tighten the bolts.
Finally, the rear seat bolts (7) and (8) are tightened according to the specified torque.
Tightening:
19N m(1.9kg·m/14 lb·ft)



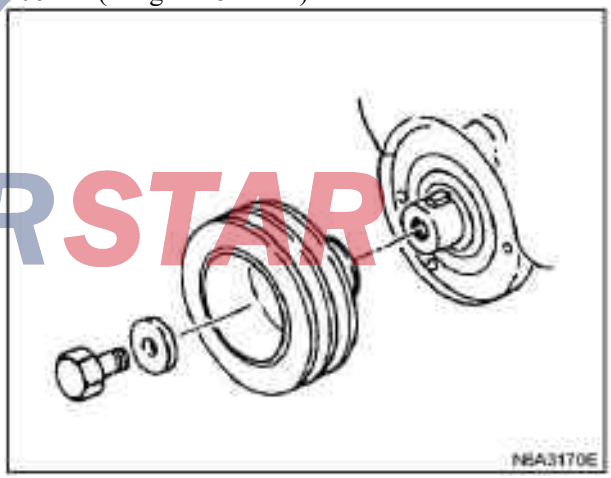
25. Oil pipe of timing gear (gear drive type)
1)Install the oil pipe on the timing gear cover and the tension pulley "A".
2) Tighten the eye bolt (1) and bolt (2) of oil pipe according to the specified torque.
Tightening:
13N·m(1.3kg·m/9 lb·ft)



26. Timing gear cover (gear drive type)
1) The gear cover is aligned with the dowel pin of timing gear cover, and then the timing gear cover is installed.
2) Tighten the bolts of gear cover according to the specified torque.
Tightening:
8N•m(0.8kg•m/69 lb•in)



27. Crankshaft damping pulley (gear drive type)
Tighten the crankshaft damping pulley bolt according to the specified torque.
Caution:
When the damping belt pulley is tightened, the gear ring of the flywheel is unmovable in order to prevent the crankshaft from turning.
Tightening:
206N·m(21kg·m/152 lb·ft)



28. Cooling fan assembly (gear drive type)
1) The fan pulley, the spacer and the cooling fan (in this order) are installed on the pump, and tightened according to the specified torque.

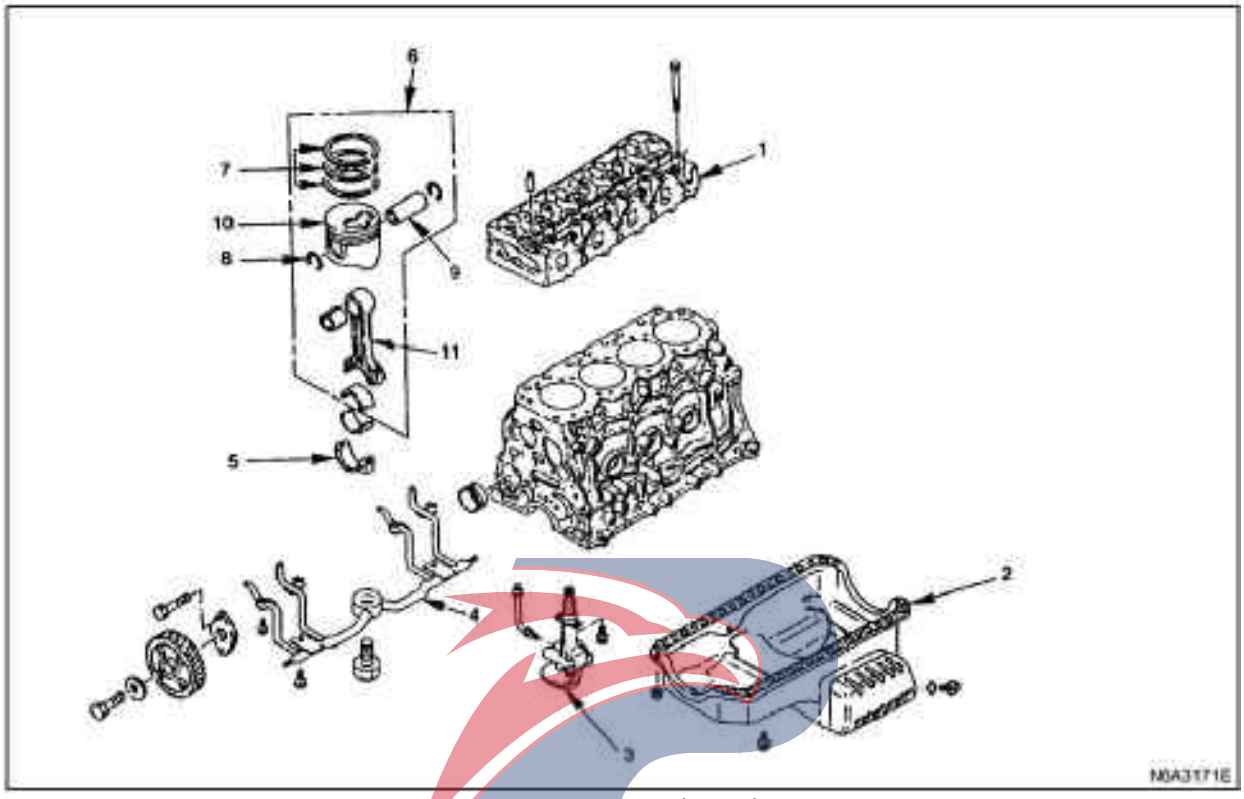
Tightening:
8N•m(0.8kg•m/69 lb•in)
29. Drive belt of AC generator and power steering pump (gear drive type)
1) Install the drive belt of AC generator and power steering pump, and adjust the tightness of the belt.
2)Use the force of 98 N (10kg/22 lb) to press central drive belt.

drive belt deflection	mm(in)
8 (0.31) — 12 (0.47)	

3) Tighten the lock nut of tension pulley according to the specified torque.
Tightening:
27 N·m(2.8 kg·m/20 1b·ft)
30. Fan wind scooper (gear drive type)
1) Install the fan wind scooper and the water tank hose.
2) Inject coolant
3) Start the engine and check the leakage of the coolant.
31. Oil sump assembly
For the above work, refer to the Section “Engine Oil Pump” in the Manual.
32. Cylinder head assembly and sealant
·Injection measurement point at the top of piston
·Cylinder head assembly
·Pushing rod
·Rockshaft ass
Valve clearance adjustment
For the above work, refer to the Section “Cylinder Body” in the Manual.

Piston and connecting rod

Part



Legend

1. Cylinder head assembly
2. Oil sump assembly
3. Engine oil pump assembly
4. Piston cooling oil pipe
5. Connecting rod bearing cover
6. Piston and **connecting rod**
7. Piston ring
8. Piston pin retainer
9. **Piston pin**
10. Piston
11. Connecting rod

Dismantling

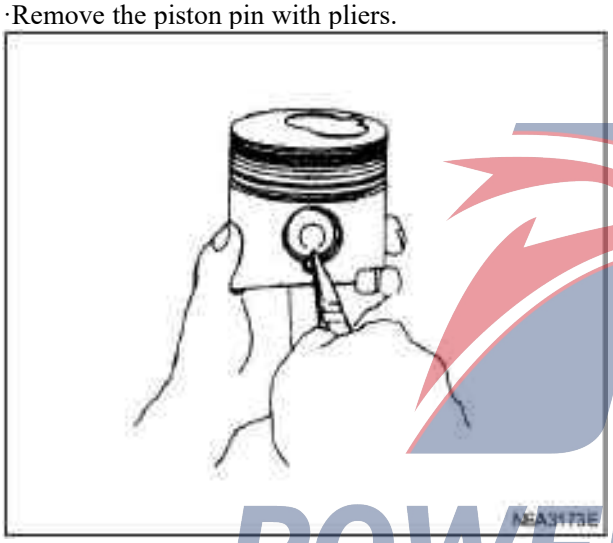
1. Cylinder head assembly
2. Oil sump assembly
3. Engine oil pump assembly
4. Piston cooling oil pipe
5. Connecting rod bearing cover
6. Piston and **connecting rod**

·Before removing the piston and connecting rod, remove carbon from the upper cylinder wall with a scraper

7. Piston ring

Remove the piston ring with the piston expander ring.
Remove piston ring in the cylinder order.

8. Piston pin retainer
·Remove the piston pin with pliers.



9. **Piston pin**

Caution:

The dismantled parts should be separated from each cylinder, and all the parts must be reinstalled to the original site.

10. Piston

11. **Connecting rod**

Repair

Piston and piston ring

Piston

Carefully clean up the carbon deposited on the piston top and the piston ring groove.

Caution:

Never clean the piston with steel brushes to avoid damaging the piston.

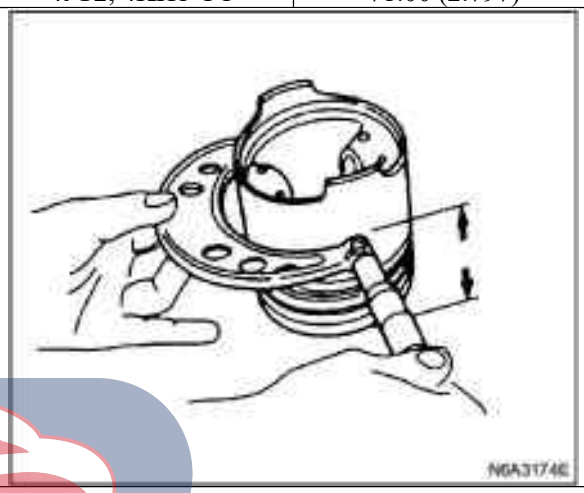
Visually inspect whether each piston has signs of cracks, bruises and other excessive wear.

Be sure to replace the piston if the above cases occur.

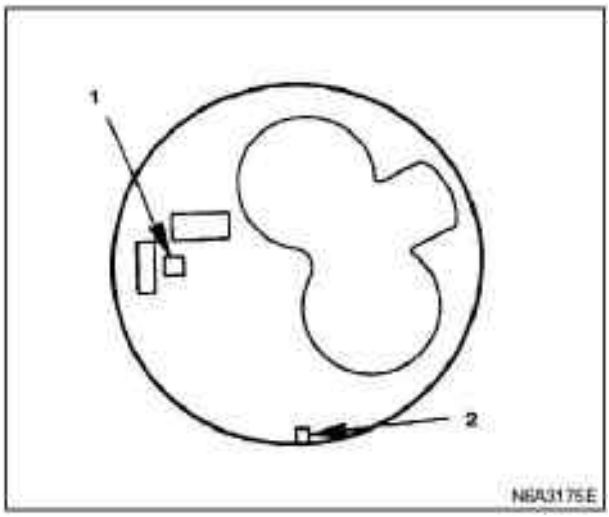
Piston diameter

1. Measure the outer diameter of piston at the piston grading position with a micrometer.

Piston grading position	mm(in)
4JB1 / 4JB1-TC	74 (2.913)
4JG2, 4KH1-TC	71.00 (2.797)



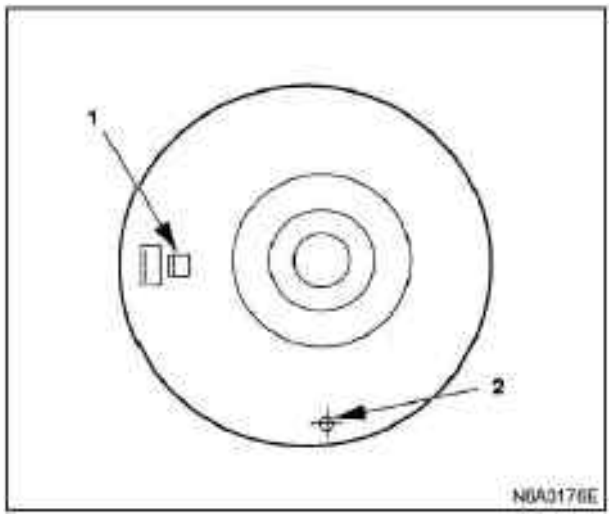
4JB1 / 4JB1-TC mm(in)	
Specification and marking	Outer diameter
A	92.985 —92.994(3.6608 —3.661 2)
B	92.995 —93.004(3.6612 —3.6616)
C	93.005 —93.014(3.6616 —3.6620)
D	93.015 —93.024(3.6620 —3.6624)



Legend
1. Specification and marking
2. Front mark

4J G2	mm(in)
Specification and marking	Outer diameter
A	95.365 —95.374(3.7545 —3.7549)
B	95.375 —95.384(3.7549 —3.7553)
C	95.385 —95.394(3.7553 —3.7557)
D	95.395 —95.404(3.7557 —3.7561)

4KH1-TC	mm(in)
Specification and marking	Outer diameter
A	95.355 —95.364(37.5413 —37.5449)
B	95.365 —95.374(37.5453 —37.5488)
C	95.375 —95.384(37.5492 —37.5528)
D	95.385 —95.394(37.5531 —37.5567)



Legend
1. Specification and marking
2. Front mark

The grade position of the outer diameter of the piston is represented by the 'G' as shown in the diagram.
The inner diameter of the cylinder is measured (see this section "Cylinder Body Inspection"). Be sure to replace the piston and/or the cylinder liner if the piston clearance is not in line with the specified value.

piston clearance	mm(in)
4JB1 / 4JB1-TC	0.061 (0.0024)
4J G2	0.066 (0.0026)
4KH1-TC	0.057 — 0.075 (0.0022 —0.0029)

The selection method of piston grading for maintenance and use of components.
If Grade A piston is found from the piston mark or the measurement result of the piston outer diameter, AX can be selected as the maintenance piston grade.
The stamping piston grade on the top of the piston.

Grade of repaired piston	
Piston specification mark	Grade of repaired parts
A	AX
B	AX
C	CX
D	CX

Diameter of repaired piston	mm(in)
Piston grade	4JB1 / 4JB1-TC
AX	92.989—93.004(3.6610—3.6616)
CX	93.005—93.020(3.6616—3.6622)

Piston grade	4J G2
AX	95.369—95.384(3.7547—3.7553)
CX	95.385—95.400(3.7553—3.7559)

Piston grade	4KH1-TC
AX	95.359—95.374(3.7543—3.7549)
CX	95.375—95.390(3.7549—3.7555)

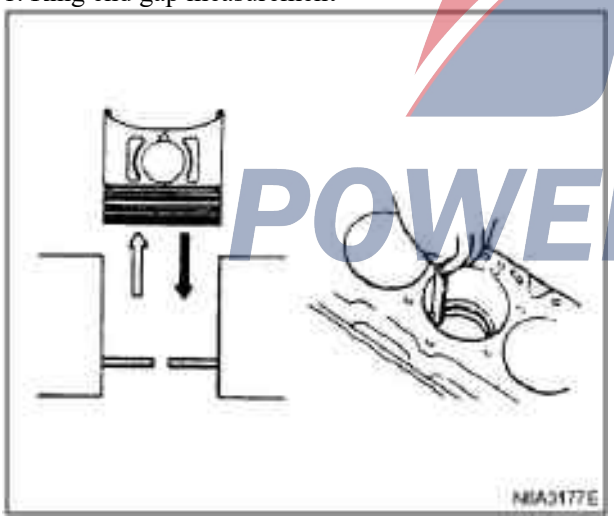
Caution:

It is very important to use the correct piston grade. If you don't choose the correct piston grade, it will damage the engine. The cylinder bore should be measured at any time and the correct piston grade should be selected.

Piston ring

In case of finding worn or damaged components during engine repair, they must be replaced with new ones.

1. Ring end gap measurement



·Insert the piston ring into the hole.

·Use the piston to push the ring at the right angle perpendicular to the wall to the tip ring at the smallest hole in the cylinder.

·The mark on the top piston ring is as shown in the figure.

Legend

1.N marker (the first gas ring.) (the second ring) (4JB1)

2.1N marker (the first gas ring.) 2N marker (the second ring) (4JG2)

3.R marker (the first gas ring.) (the second ring) (4KH-TC)

4JB1 / 4JB1-TC			mm(in)
		Criterion	Limit value
Compression ring	The first	0.20—0.40 (0.0079—0.0157)	1.5 (0.059)
	The second	0.20—0.40 (0.0079—0.0157)	
Oil ring		0.10—0.30 (0.0039—0.0118)	

4J G2			mm(in)
		Criterion	Limit value
Compression ring	The first	0.20—0.35 (0.0079—0.0138)	1.5 (0.059)
	The second	0.37—0.52 (0.0146—0.0205)	
Oil ring		0.20—0.40 (0.0079—0.0157)	

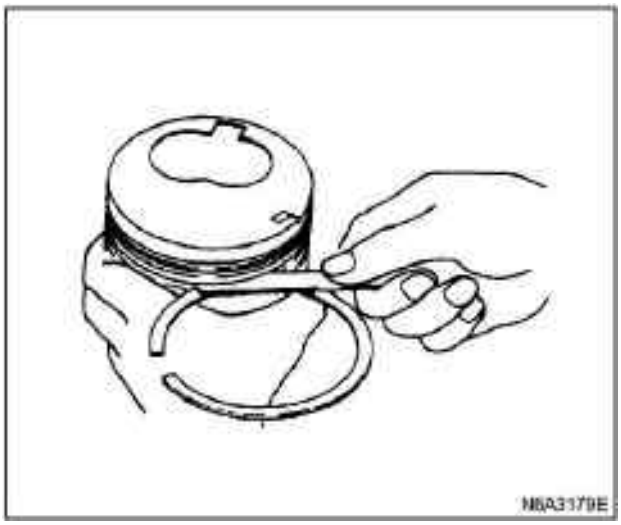
4KH1-TC			mm(in)
		Criterion	Limit value
Compression ring	The first	0.30—0.50 (0.0118—0.0197)	1.5 (0.059)
	The second	0.30—0.50 (0.0118—0.0197)	
Oil ring		0.25—0.45 (0.0098—0.0117)	

2. Use the feeler to measure the gap between piston ring groove and the piston ring. If the gap exceeds the specified limit value, the piston must be replaced.

4JB1 / 4JB1-TC			mm(in)
		Criterion	Limit value
Compression ring	The first	0.090—0.125 (0.0035—0.0049)	1.5 (0.059)
	The second	0.050—0.075 (0.0020—0.0030)	
Oil ring		0.03—0.07 (0.0012—0.0028)	

4J G2			mm(in)
		Criterion	Limit value
Compression ring	The first	0.09—0.13 (0.0035—0.0051)	1.5 (0.059)
	The second	0.05—0.07 (0.0020—0.0028)	
Oil ring		0.20—0.40 (0.0012—0.0028)	

4KH1-TC			mm(in)
		Criterion	Limit value
Compression ring	The first	0.09—0.13 (0.0035—0.0051)	1.5 (0.059)
	The second	0.05—0.09 (0.0002—0.0035)	
Oil ring		0.03—0.07 (0.00118—0.0028)	

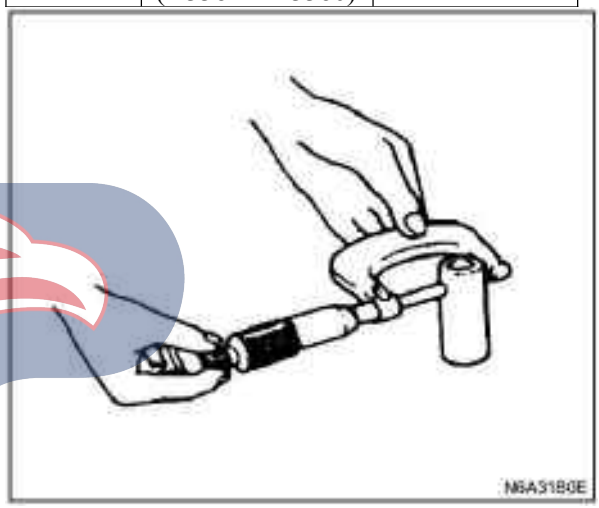


Piston pin

Visually check for crack, defect and other damage of the piston pin. Replace it if necessary.

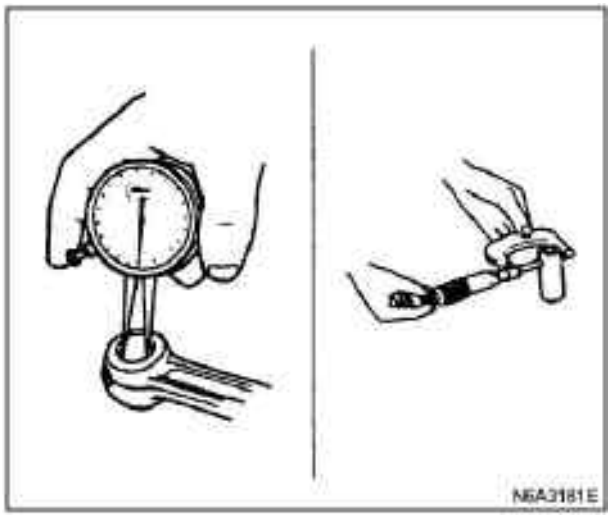
1. Measure the outer diameter of the piston pin in two directions in 3 positions with the micrometer. If the measured value exceeds the specified limit value, the piston pin must be replaced.

Piston pin OD		mm(in)
	Criterion	Limit value
4J B 1 4JB1-TC 4KH 1-TC	30.995—31.000 (1.2202—1.2204)	30.970(1.2190)
4J G2	33.995—34.000 (1.3384—1.3386)	33.970(1.3374)



2. Measure the inner diameter of the small end of connecting rod. If the gap between the small end and the pin is not consistent with the specified value, the connecting rod or bushing and pin must be replaced.

		mm(in)
	Criterion	Limit value
Gap	0.008 — 0.020 (0.0003 — 0.0008)	0.05(0.0020)



3. The piston pin is inserted into the piston and rotated. If the piston pin rotates smoothly without gaps, the gap is normal. If there is a gap or roughness, the gap should be measured. If the gap exceeds the specified limit value, the piston and piston pin must be replaced.

		mm(in)
	Criterion	Limit value
Gap	0.002—0.004 (0.00008—0.00016)	0.04(0.0016)

Replace bushing

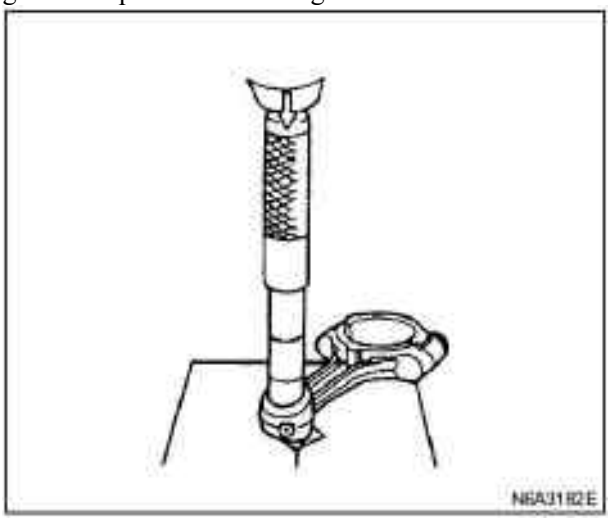
Disassembly: Use the suitable bar and desktop press-fit machine or hammer.

Installation: Use suitable bar and desktop press-fit machine.

Caution:

The bushing is aligned with the oil hole of connecting rod.

After installing the new bushings, use the pin hole grinder to polish the bushing.

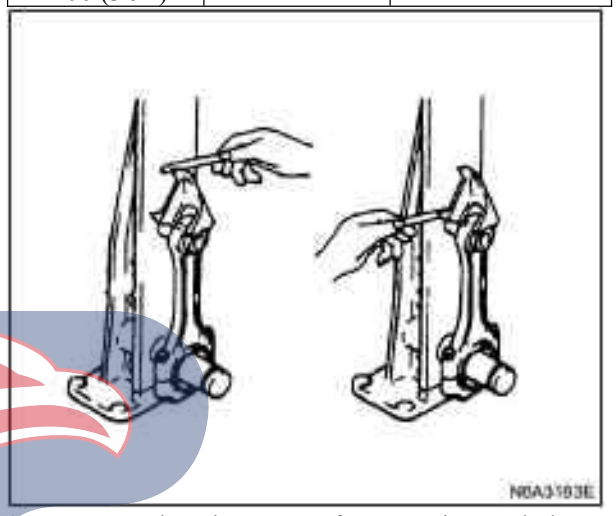


Connecting rod

1. Use the connecting rod calibrator to check the error of double hole axis of connecting rod.

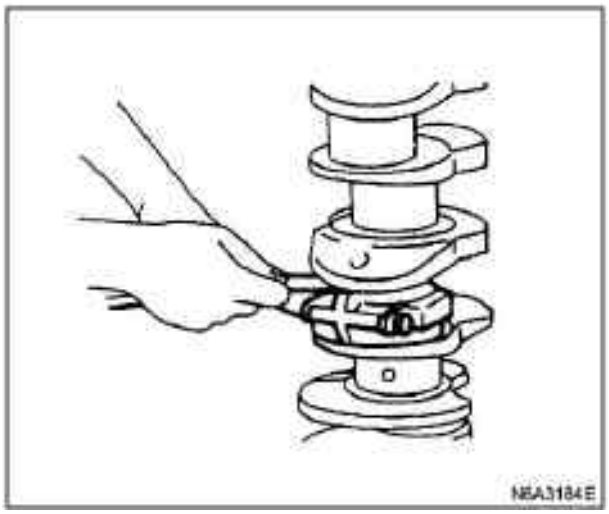
If the curvature or distortion exceeds the specified limit value, the connecting rod must be replaced.

		mm(in)
	Criterion	Limit value
Curvature /100 (3.94)	0.08 (0.0031) or below	0.20(0.0079)
Distortion /100 (3.94)	0.05 (0.0020) or below	0.15(0.0059)



2. Measure the clearance of connecting rod thrust. Use the feller to measure the thrust clearance at big end of the connecting. If the clearance exceeds the limit value, the connecting rod must be replaced.

Thrust clearance	mm(in)
Criterion	Limit value
0.230 (0.0091)	0.350 (0.0138)



3. The method of measuring the oil film clearance between the connecting rod and the crankshaft is below:

1) Remove the connecting rod cover nut and the connecting rod cover.

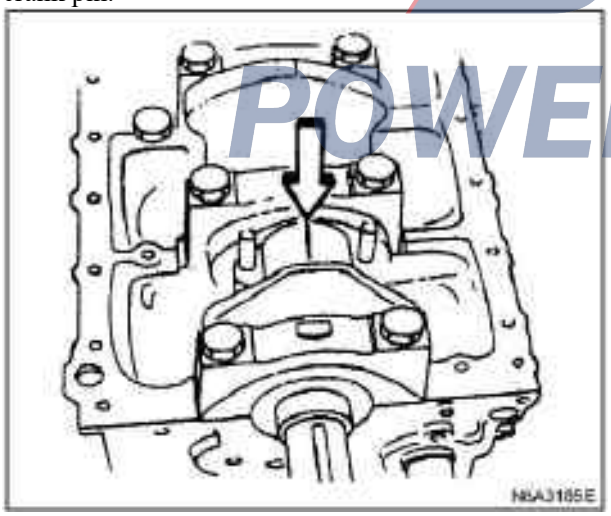
The disassembled connecting rod cover is arranged in the order of engine.

2) Clean the connecting rod bearing and crank pin.

3) Check the connecting rod bearing carefully.

Even if a bearing is found to be damaged or seriously worn, the whole assembly of the bearing must be replaced in a complete set, and the bearing is reinstalled at the original position.

Put the plastic clearance measurement sheet on the crank pin.



4) Put the plastic clearance measurement sheet and reinstall the connecting rod cover in the original position.

5) According to the following specifications, the cap nut is tightened in two steps with angle method.

(4JG2, 4JH1-TC, 4JB1-TC)

Tightening:

·4KH1-TC,4JB1-TC，4JG2

Step I: 29 N·m(3 kg·m/22 1b·ft)

Step II: 45°— 6 0°

·4JB1 83 N·m (8.5 kg·m/61 1b·ft)

Caution:

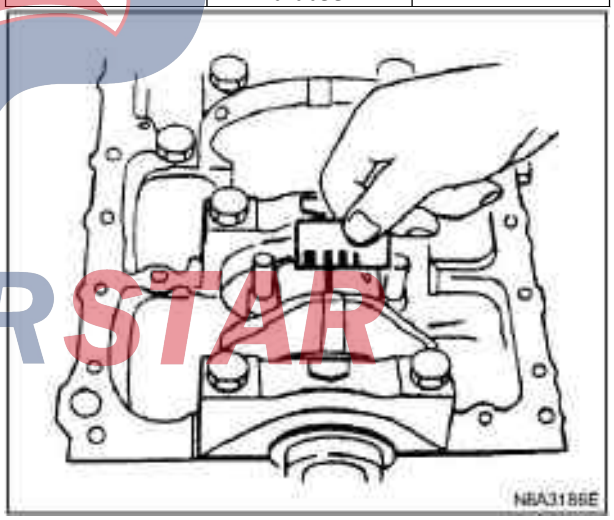
Do not cause the crankshaft to rotate.

6) Remove the cover of the connecting rod.

7) Measure the width of the plastic clearance measurement sheet and determine the gap of the oil film. If the oil film gap exceeds the limit, the connecting rod bearing is replaced in a complete set.

8) Remove the plastic clearance measurement film from the bearing and the crank pin.

Clearance between crankshaft bearing journal and bearing mm(in)		
	Criterion	Limit value
4JB1 / 4JB1-TC	0.029— 0.066 (0.0011— 0.0026)	0.100 (0.0039)
4JG24KH1-TC	0.029— 0.083(0.0011— 0.0033	



Reassemble

1. **Connecting rod**
2. Piston
3. **Piston pin**

Apply a layer of oil film on the piston pin and the piston pin hole.

4. Piston pin retainer

A thin layer of oil film is applied on the piston pin, and the piston pin is inserted into the piston pin hole with normal finger pressure.

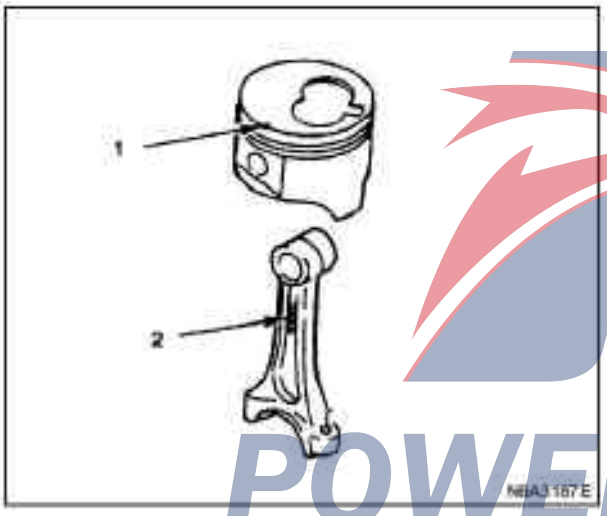
For the weight of each piston and connecting rod assembly, choose the combination of the piston and the connecting rod, and the variation of the weight of the different combinations should not exceed the limit value.

	K (ounce)
Weight variation after assembling	Less than 3 (0.1058)

Caution:

Do not change the piston/piston pin combination while replacing the piston/connecting rod combination.

·Install the piston on the connecting rod. The front piston mark and the connecting rod ISUZU mark should be on the same side.

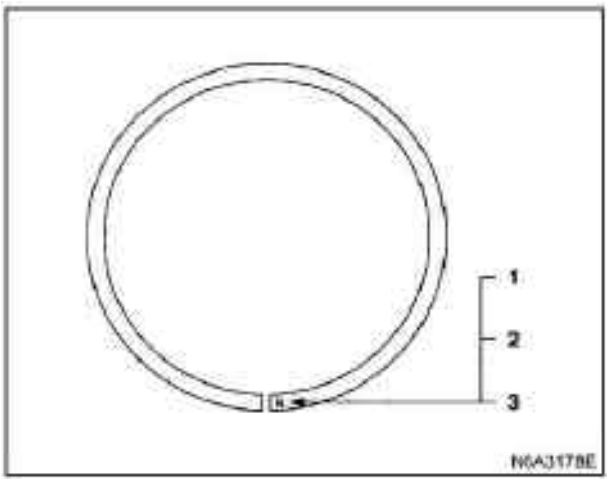


Legend

1. Front mark
2. ISUZU mark
5. Piston ring

·Install the piston ring with a piston ring expander. For the installation of the air ring, Mark N must be upwards.

·The location of the distinguishing mark is as shown in the figure.



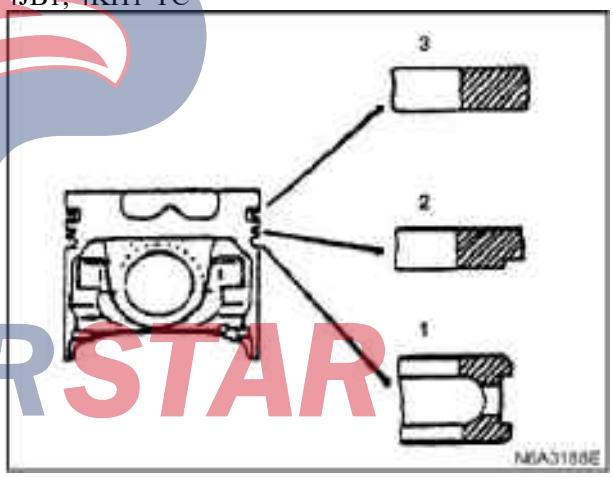
Legend

1. N mark (the first ring) (the second ring) (4JB1)
2. 1N mark (the first ring) 2N mark (the second ring) (4JG2)
3. R mark (the first ring) (the second ring) (4KH-TC)

• The piston rings are installed in the following order:

1) Oil ring

4JB1, 4KH1-TC



Legend

1. Oil ring
2. The second gas ring
3. The first gas ring

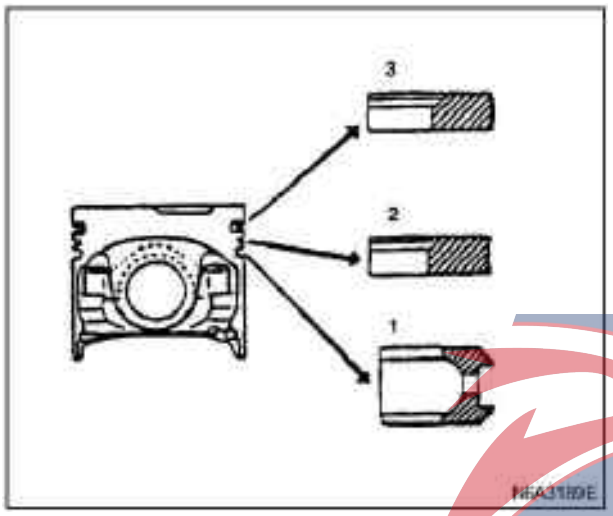
2) The second gas ring

3) The first gas ring

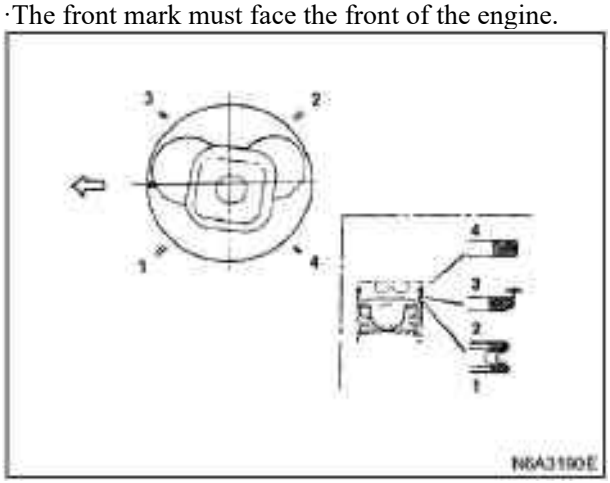
·The installation of the air ring must keep Mark 1N or 2N (4JG2) to face upwards.

• The first gas ring: 1N (4JG2), N (4JB1), R (4KH1-TC)

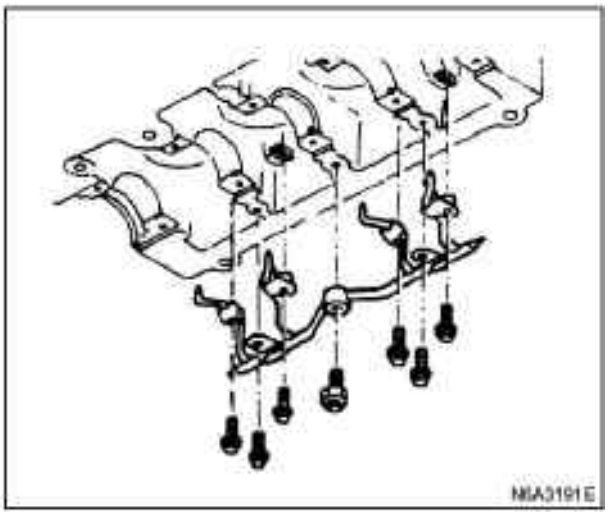
·The second gas rings: 2N (4JG2), N (4JB1), R (4KH1-TC)
·After installation, the oil film is coated on the whole circle of the piston ring.
·Insert the bearing into the connecting rod and the connecting rod cover.
The new oil film is coated on the bearing surface. There is no oil hole in the side bearing. The connecting rod side bearing should be aligned with the oil hole on the connecting rod.
4J G2



Legend
1. Oil ring
2.2 The second air ring
3. The first gas ring
6. Piston and **connecting rod**
·Apply oil film on cylinder bore, connecting rod bearing and crankpin.
·Check whether the end clearance of the piston ring is accurate.
·Piston / connecting rod assembly is inserted into each cylinder with a piston compressor.
·The front mark must face the front of the engine.



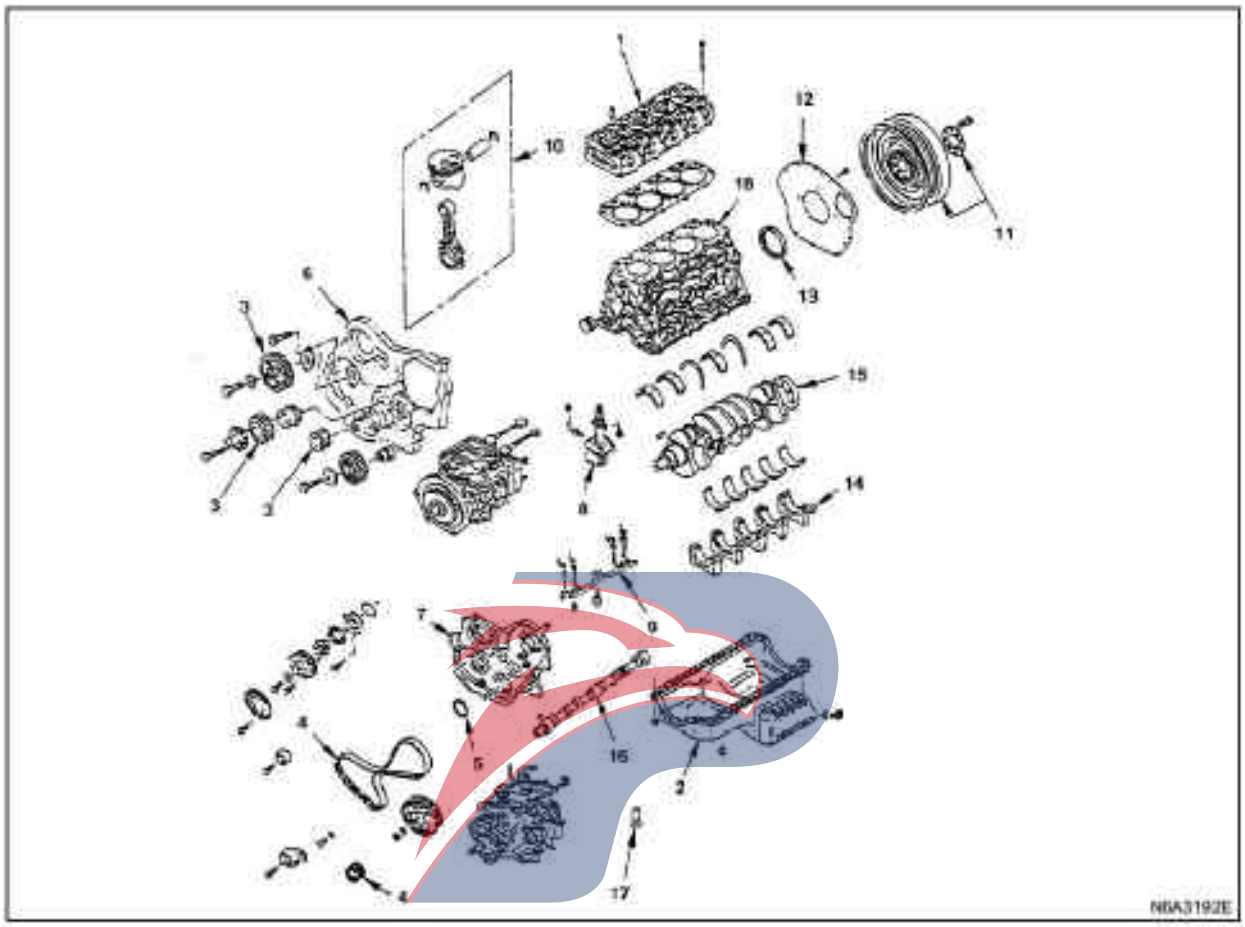
Legend
1. Oil ring
2. Oil ring
3. The first gas ring
4. The second gas ring
7. Connecting rod bearing cover
• Tighten the cap nut in two steps with the angle as shown in the following specifications.
Tightening:
4KH1-TC, 4JB1-TC to
· Step 1: 29 N·m(3.0 kg·m/22 1b·ft)
·Step2 : 45°— 6 0°
4JB1 to 83 N·m (8.5 kg·m/61 1b·ft)
When the nut is tightened, check the crankshaft to rotate smoothly.
8. Piston cooling oil pipe
·Install the piston cooling oil pipe on the cylinder.
·Tighten the oil pipe bolts and limit pressure valves according to the specified torque.
Tightening:
Torque of oil pipe bolt:
·M8 × 1.25: 19 N·m(1.9 kg·m/14 1b·ft)
·M6 × 1.00: 8 N·m(0.8 kg·m/69 lb·in)
·M16 ×1.5: 29 N·m(3.0 kg·m/22 1b·ft)
Torque of oil pressure regulating valve:



Caution:
Turn the crankshaft slowly and check whether there is interference between the piston and the injection pipe.
9. Engine oil pump assembly
10. Oil sump assembly
The above work is referred to as the "Oil Pump" section of this manual.
11. Cylinder head assembly
·Protruding measurement point on the top of piston
·Cylinder head
·Pushing rod
·Rockshaft ass
Valve clearance adjustment
For the above work, refer to the Section “Cylinder Body” in the Manual.

Cylinder block

N6A3192E



Legend

Part

1. Cylinder head assembly and cylinder gasket
2. Oil sump assembly
3. Timing gear
4. Timing belt and belt pulley
5. Front oil seal (belt drive type)
6. Timing gear housing
7. Timing belt pulley housing
8. Engine oil pump assembly
9. Piston cooling oil pipe
10. Piston and **connecting rod**
11. Flywheel
12. Cylinder body rear plate
13. Crankshaft rear oil seal
14. Main bearing cover
15. **Crankshaft**
16. Camshaft
17. Tappet rod
18. Cylinder body

Dismantling

1. Cylinder head assembly and cylinder gasket
2. Oil sump assembly
3. Timing gear
4. Timing belt and belt pulley
5. Front oil seal (belt drive type)
6. Timing gear housing
7. Timing belt pulley housing

8. Engine oil pump assembly
9. Piston cooling oil pipe
10. Piston and **connecting rod**
11. Flywheel
12. Cylinder body rear plate
13. Crankshaft rear oil seal
14. Main bearing cover
15. **Crankshaft**
16. Camshaft
17. Tappet rod
18. Cylinder body

Repair

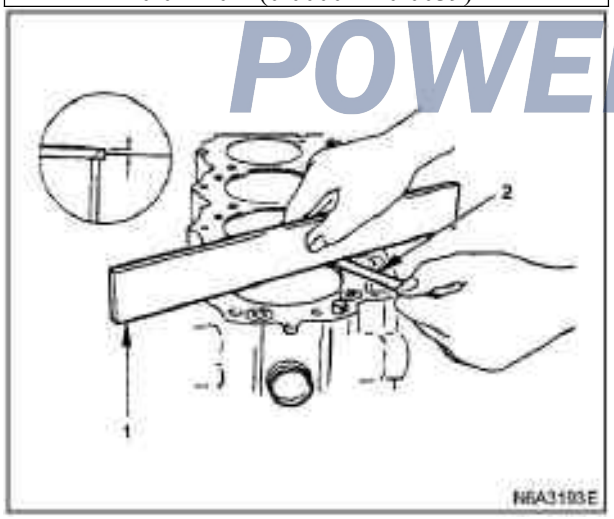
During the inspection period, if excessive wear or damage is found, necessary adjustment, maintenance and replacement of parts should be carried out.

1. Cylinder block. Remove the cylinder pad and other materials attached to the surface of the cylinder. Be careful not to accidentally drop any object into the cylinder. Be careful not to scratch the cylinder.
2. Carefully remove the seal components on the installation surface of oil pump, the rear sealing seat and the oil sump .
3. Clean the cylinder.

Bulge test of cylinder sleeve

1. Use a ruler (1) to measure along the top of the cylinder sleeve.
2. Use the feeler (2) to measure the bulge of each cylinder. The bulge height difference of two adjacent cylinders should not exceed 0.03mm (0.0012 inches).

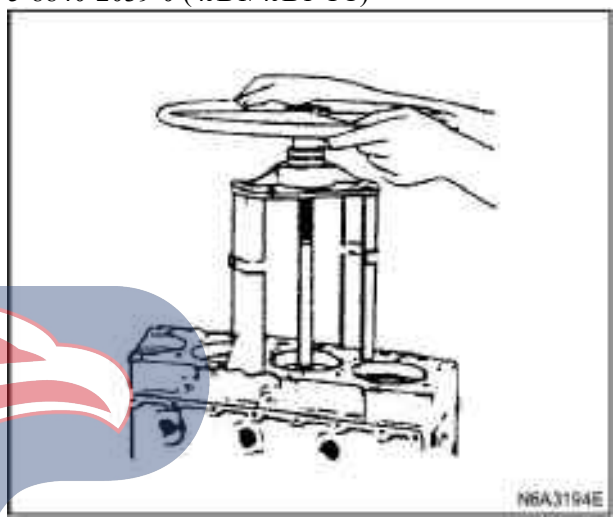
Criterion	mm(in)
0.0 — 0.1 (0.0000 — 0.0039)	



Flatness

1. Dismantle cylinder pin
2. Place the cylinder liner remover onto the cylinder liner.
3. Whether the angle between the shaft of the dismantling device is reliable to clamp the bottom of the cylinder sleeve.
4. Rotate in the clockwise direction and slowly turn the cylinder sleeve of dismantling device shaft.

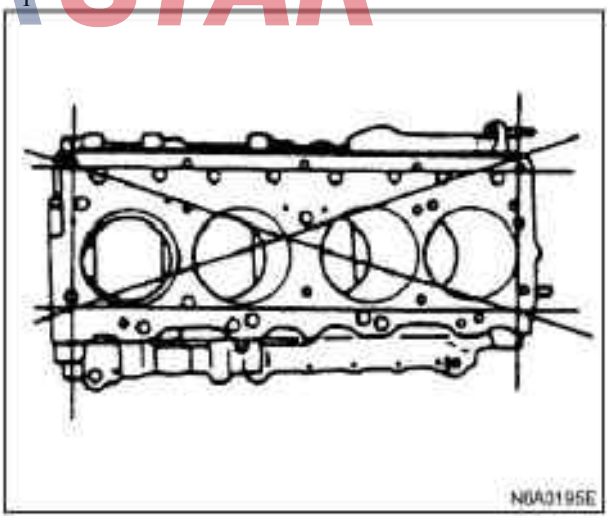
Device for dismantling cylinder liner:
5-8840-2304-0 (4JG2/4JH1-TC)
5-8840-2039-0 (4JB1/4JB1-TC)



Caution:

When the cylinder sleeve is removed, be careful not to damage the upper part of the cylinder.

5. Use the ruler and the feeler to measure 4 sides and two diagonals of cylinder. If the measured value exceeds the limit value, the cylinder body must be replaced.

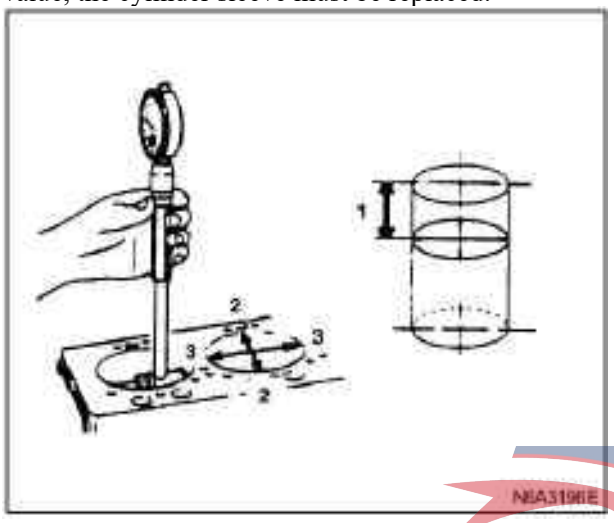


Cylinder liner hole diameter measurement

Use the measuring point (1)of inner diameter for dial indicator along the direction of the thrust (2) - (2) and (3) axial direction to measure cylinder diameter.

Measuring point (1) 20mm (0.79 in)

If the measured value exceeds the specified limit value, the cylinder sleeve must be replaced.

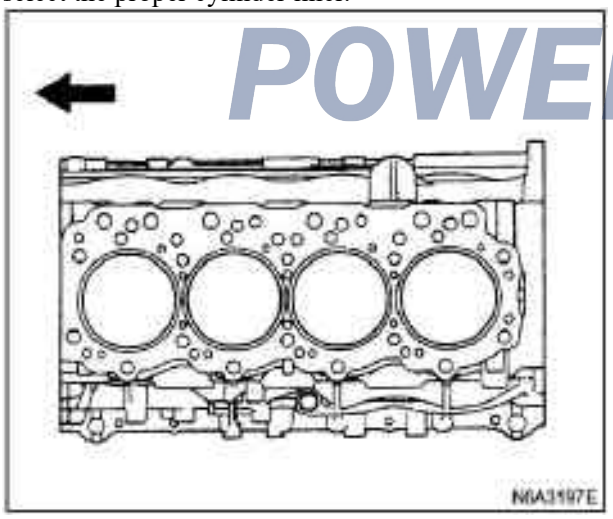


Caution:

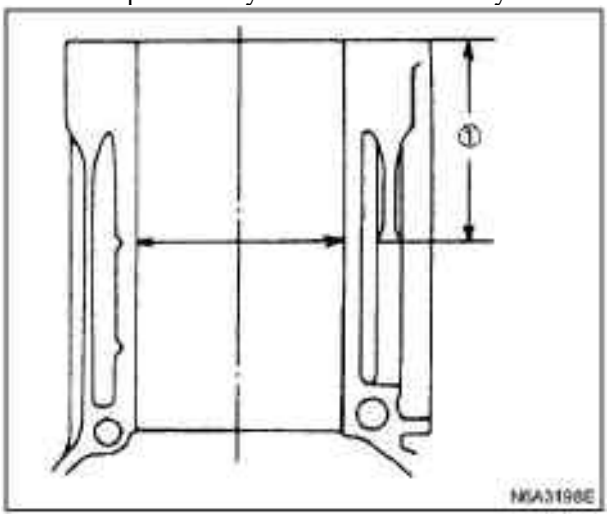
The inner side of a dry cylinder liner is chrome plated surface, which cannot be bored or ground again.

If the inner side of the cylinder liner has scratches or burns, it must be replaced. cylinder liner grade selection

Measure the inner diameter of cylinder bore and select the proper cylinder liner.



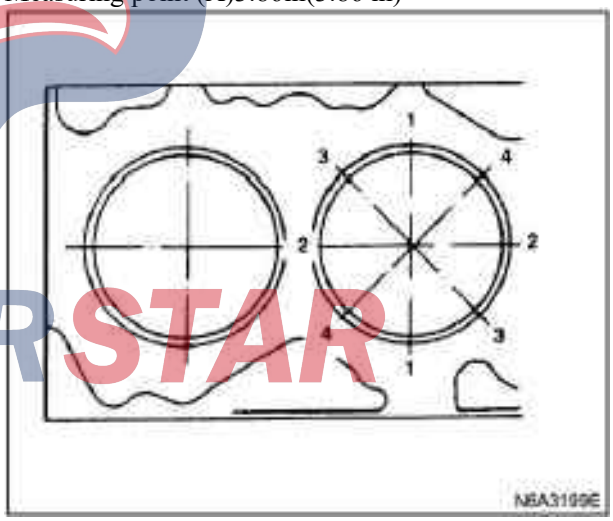
If the interference fit (1) of cylinder sleeve is too small, it will affect the engine cooling efficiency. If the interference fit of cylinder sleeve is too large, it is difficult to press the cylinder liner into the cylinder.

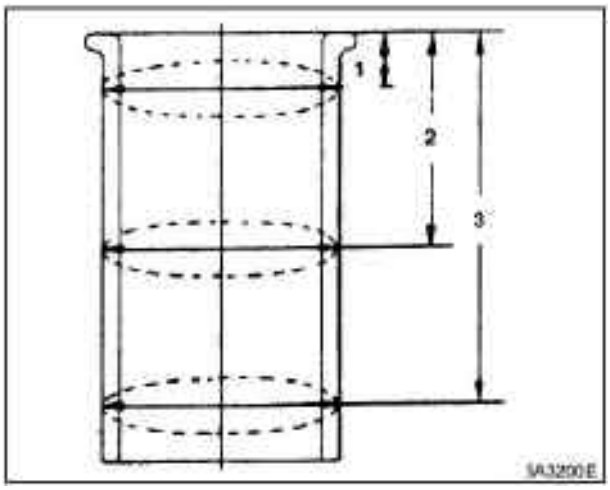


Measure cylinder bore diameter

1. Measure at the measuring points in the positions (1) - (1) - (1), (2) - (2), (3) - (3) and (4) - (4).

Measuring point (A)3.86in(3.86 in)





2. Calculate the average value of 4 measured values and determine the appropriate cylinder grade.
3. According to the average value of the following table, select the suitable cylinder liner.
Selection method for cylinder liner and piston grade
In the production line, the cylinder liner grade and the outer diameter grade 1, 2, 3 and 4 of cylinder sleeve are printed on the top of the cylinder block.
If you find the outer diameter grade of the cylinder liner is grade 1 and the outer diameter of the cylinder B or the measurement result of the maintenance piece on the cylinder block, you can choose the Grade AX of service parts and the Grade AX of piston for the cylinder liner 1.
The grade code on the maintenance parts:
The cylinder liner grade is printed on the outer side of the cylinder sleeve.
Piston grade printed on the piston top

4JB1 / 4JB1-TC mm(in)

Sleeve outer side grade	Average diameter of cylinder hole	Sleeve OD	Sleeve hole diameter grade	Cylinder liner hole diameter measurement
1	95.001—95.010 (3.7402—3.7406)	95.011—95.020 (3.7406—3.7409)	AX	93.035(3.6628)—93.050(3.6634)
			CX	93.051(3.6634)—93.066(3.6640)
2	95.011—95.020 (3.7406—3.7409)	95.021—95.030 (3.7410—3.7413)	AX	93.035(3.6628)—93.050(3.6634)
			CX	93.051(3.6634)—93.066(3.6640)
3	95.021—95.030 (3.7410—3.7413)	95.031—95.040 (3.7414—3.7417)	AX	93.035(3.6628)—93.050(3.6634)
			CX	93.051(3.6634)—93.066(3.6640)
4	95.031—95.040 (3.7414—3.7417)	95.041—95.050 (3.7418—3.7421)	AX	93.035(3.6628)—93.050(3.6634)
			CX	93.051(3.6634)—93.066(3.6640)

4JG2 / 4KH1-TC mm(in)

Sleeve outer side grade	Average diameter of cylinder hole	Sleeve OD	Sleeve hole diameter grade	Cylinder liner hole diameter measurement
1	97.001—97.010 (3.8189—3.8193)	97.011—97.020 (3.8193—3.81 97)	AX	95.435(3.7573)-95.450(3.7579)
			CX	95.451(3.7579)-95.466(3.7585)
2	97.011—97.020 (3.8193—3.8197)	97.021—97.030 (3.8197—3.8201)	AX	95.435(3.7573)-95.450(3.7579)
			CX	95.451(3.7579)-95.466(3.7585)
3	97.021—97.030 (3.8197—3.8201)	97.031—97.040 (3.8201—3.8205)	AX	95.435(3.7573)-95.450(3.7579)
			CX	95.451(3.7579)-95.466(3.7585)
4	97.031—97.040 (3.8201—3.8205)	97.041—97.050 (3.8205—3.8209)	AX	95.435(3.7573)-95.450(3.7579)
			CX	95.451(3.7579)-95.466(3.7585)

Caution:
It is very important to use the correct piston grade. Improper selection of piston grade will damage the engine. The cylinder bore diameter should be measured regularly and the correct piston grade should be selected.

The cylinder sleeve assembly has gaps. The installation procedure of cylinder liner may cause the cylinder sleeve clearance to slightly sink. After installation, the cylinder liner clearance should be measured at any time to ensure that it is correct.

Cylinder liner installation

1. Use special tools to install the cylinder sleeve.

1) Clean the cylinder and cylinder holes with new kerosene or diesel oil.

2) Dry the cylinder sleeve and the cylinder hole surface with compressed air.

Cylinder liner installation tools:

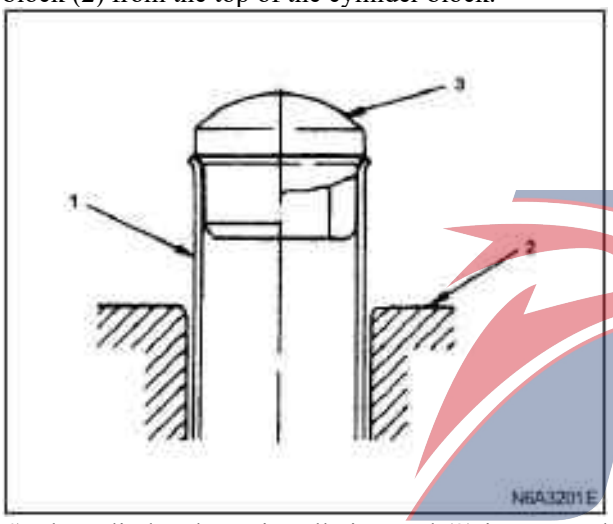
:5-8840-2313-0 (4JG2 / 4KH1-TC)

:5-8840-2040-0 (4JB1 / 4JB1-TC)

Caution:

Before installation, the foreign objects on the cylinder liner and the cylinder bore must be carefully removed.

3) The cylinder liner (1) is inserted into the cylinder block (2) from the top of the cylinder block.

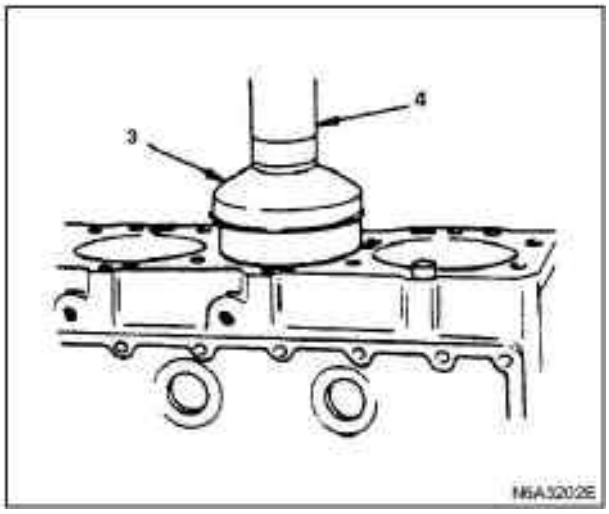


4) The cylinder sleeve installation tool (3) is mounted on the top of the cylinder sleeve. The cylinder block is positioned so that the center flange of the installation tool is placed under the center flange of the desktop press-fit machine (4).

Cylinder liner installation tools:

:5-8840-2313-0 (4JG2 / 4KH1-TC)

:5-8840-2040-0 (4JB1 / 4JB1-TC)



Caution:

Check whether the cylinder sleeve is perpendicular to the desktop press-fit machine without shake.

5) The predetermined position force of 500 kg (1102.5 lb/4900 N) is applied to the cylinder sleeve by a desktop press-fit machine.

6) The force of 2500 kg (5512.5 lb/24500 N) is applied, so that the cylinder sleeve is fully positioned.

7) Measure the convex value of the cylinder liner after installing it.

8) Measure the convex value of the cylinder liner after installing it.

See the "Bulge" test of the cylinder sleeve of this section.

Measure the inner diameter of the cylinder bore and select the proper piston grade.

Reassemble

1. Cylinder body
2. Tappet rod
3. Camshaft

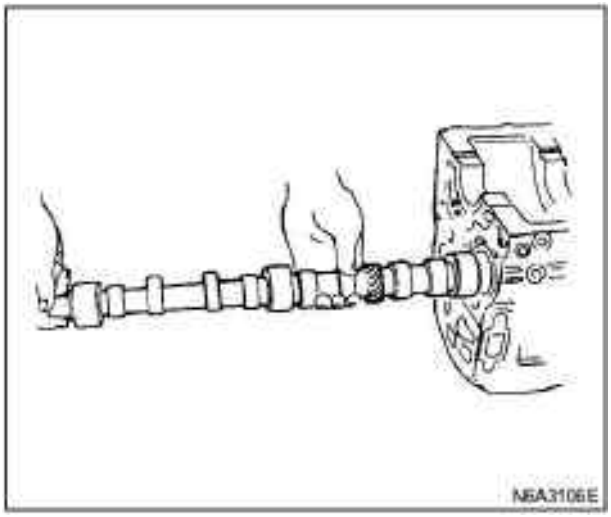
·Apply an oil film on the valve tappet and the valve tappet installation hole of the cylinder body.

·Locate the location mark used when dismantling (if the valve tappet is reused).

·Apply an oil film on the camshaft and camshaft bearings.

·Install the camshaft to the cylinder and be careful not to damage the camshaft bearing.

4. **Crankshaft**



5. Main bearing cover
6. Crankshaft rear oil seal
7. Cylinder body rear plate
8. Flywheel

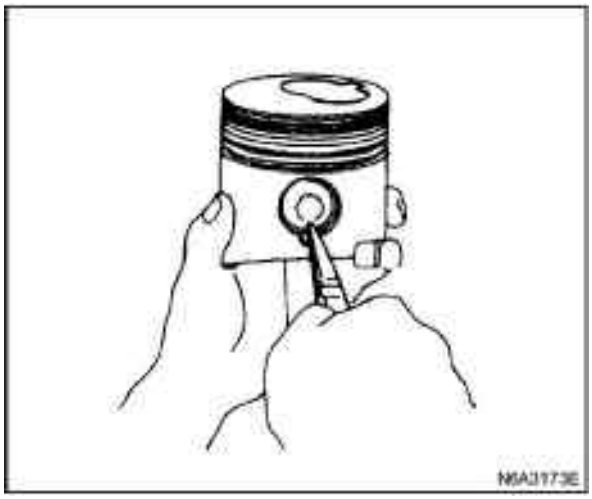
For the above work, refer to the Section “Crankshaft” in the Manual.

9. Piston and **connecting rod**

1) Insert the piston pin into its hole with normal finger pressure. Weigh the weight of the assembly of each piston and the connecting rod.
The combination of piston and connecting rod is selected to control the weight difference of different assembly to be within the limit range.

	K (ounce)
Weight variation after assembling	Less than 3 (0.1058)

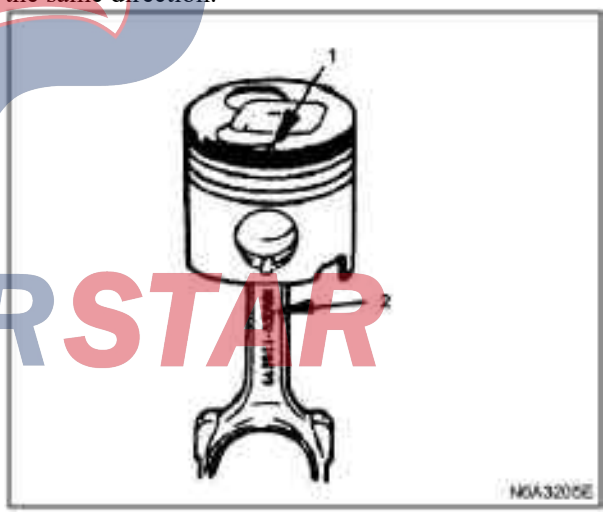
2) Clamp the connecting rod with a vise.
Be careful not to damage the connecting rod.
3) Install the piston pin retainer on the piston with the pliers.



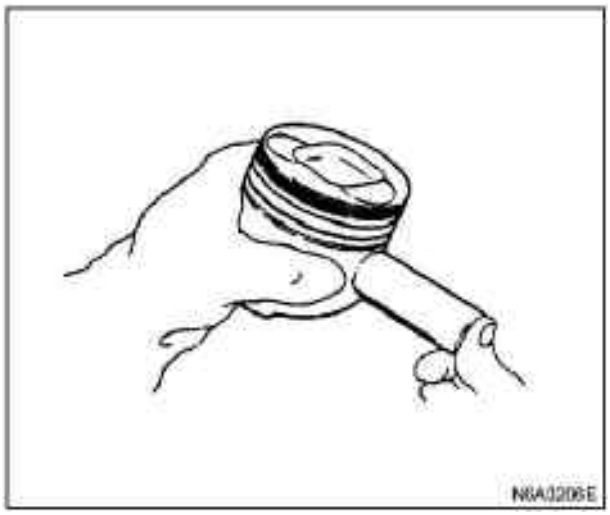
Caution:

When replacing the piston / connecting rod combination, do not change the piston / piston pin combination.

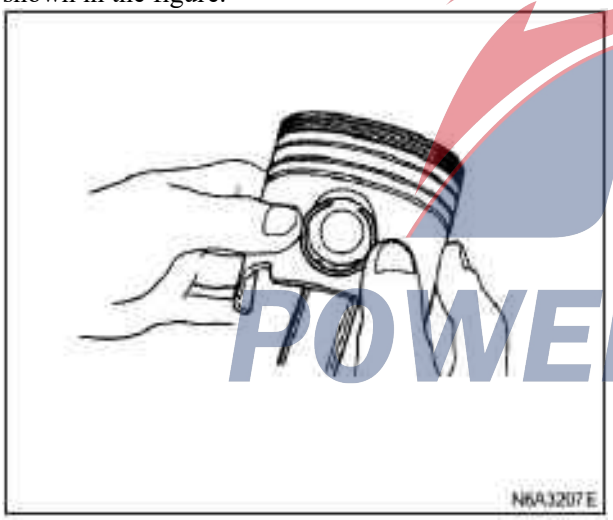
4) The piston is mounted on the connecting rod, and the front mark (1) on the top of piston and the "ISUZU" casting mark of connecting rod must be in the same direction.

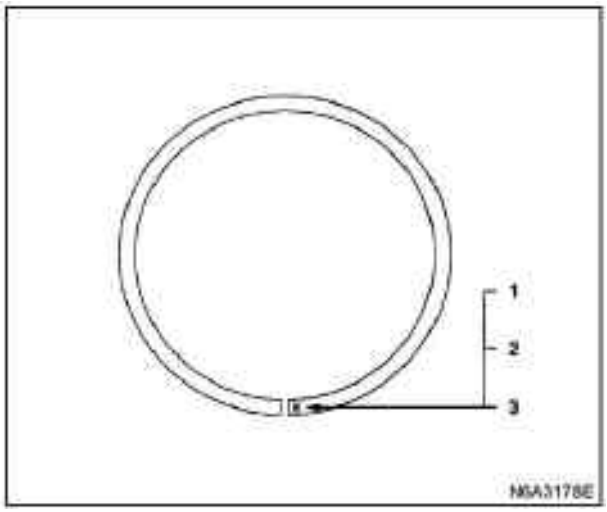


5) Apply a layer of oil film on the piston pin and the piston pin hole.
Use the finger to put the piston pin into the piston until it contacts with the clip.



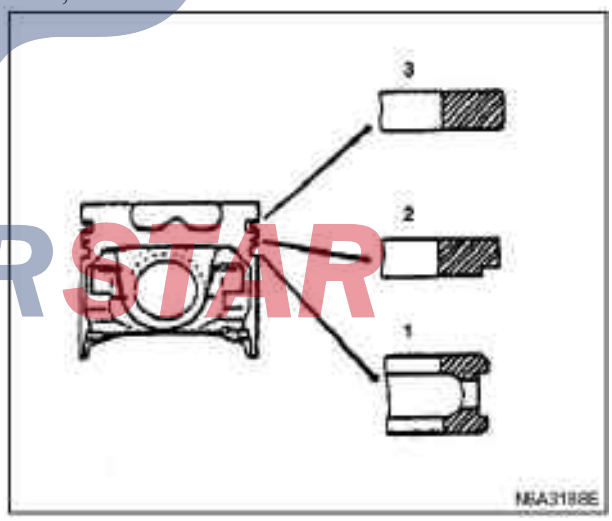
6) The piston pin retainer is pressed into the clip groove with the finger.
Check whether the connecting rod can rotate flexibly on the piston pin.
7)Install piston ring by piston ring expander.
Installation of the air ring. The Mark 1N and 2N (4JG2) keep upwards. The distinguishing mark is as shown in the figure.





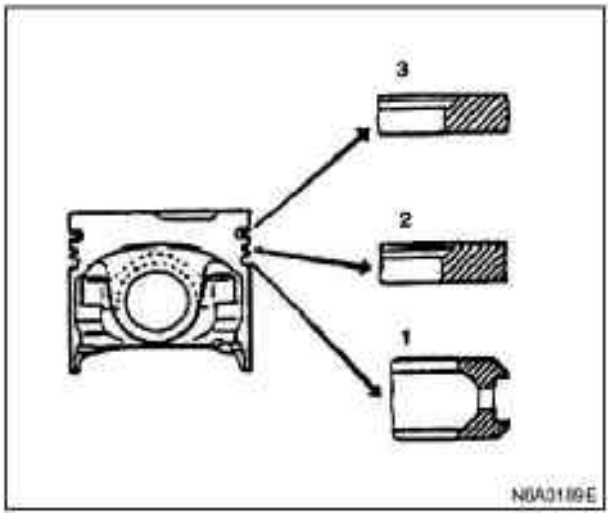
Legend
1. N mark (the first ring) (the second ring) (4JB1)
2. 1N mark (the first ring) 2N mark (the second ring) (4JG2)
3. R mark (the first ring) (the second ring) (4KH-TC)

8) 3 piston rings are installed with the piston ring converter.
Piston ring converter:
Install the piston ring in the graphic order.
4JB1, 4KH1-TC



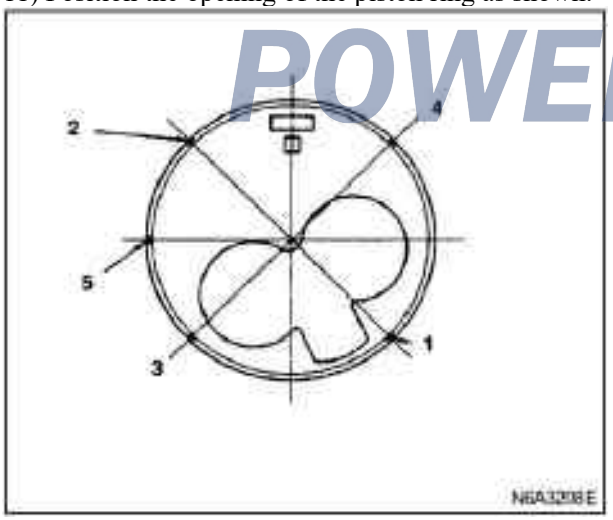
Legend
1. Oil ring
2. The second gas ring
3. The first gas ring

4J G2



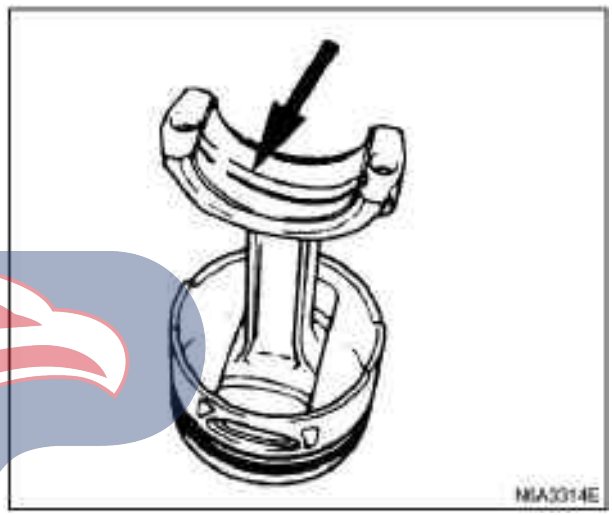
Legend
1. Oil ring
2. The second gas ring
3. The first gas ring

Caution:
The air ring is installed and the stamping surface is facing up.
Before installing oil ring, the expander ring is inserted into the oil ring groove to ensure there is no gap on one side of expander ring.
9) Apply a lay of oil film on the surface of the piston ring.
10) Check whether the piston ring rotate smoothly in the piston ring groove.
11) Position the opening of the piston ring as shown.

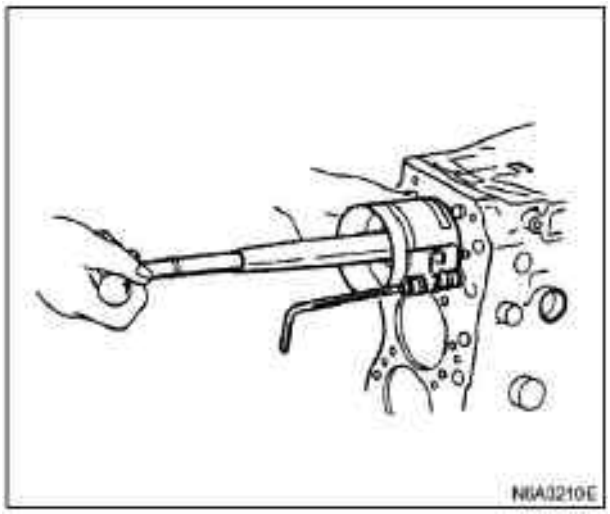


Legend
1. The first gas ring
2. The second gas ring
3. Oil ring
4. Expanding ring
5. Front mark

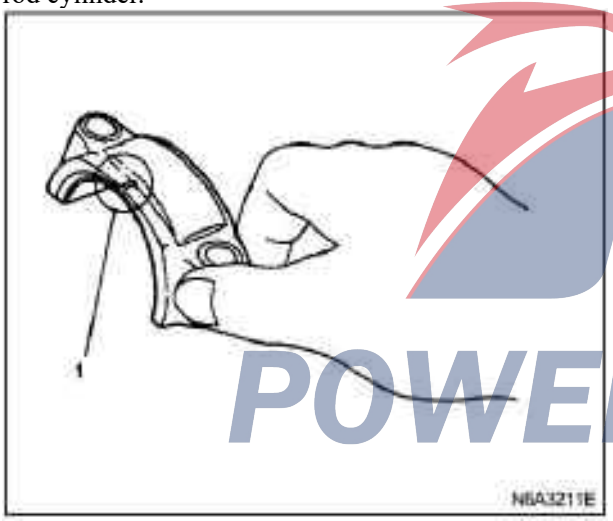
12)Carefully clean the oil dirt or other foreign objects on the back of the connecting rod bearing and the assembly surface of the connecting rod bearing.
13) Apply a layer of oil film on the upper bearing surface.
Apply a layer of oil film on the wall of the cylinder liner.



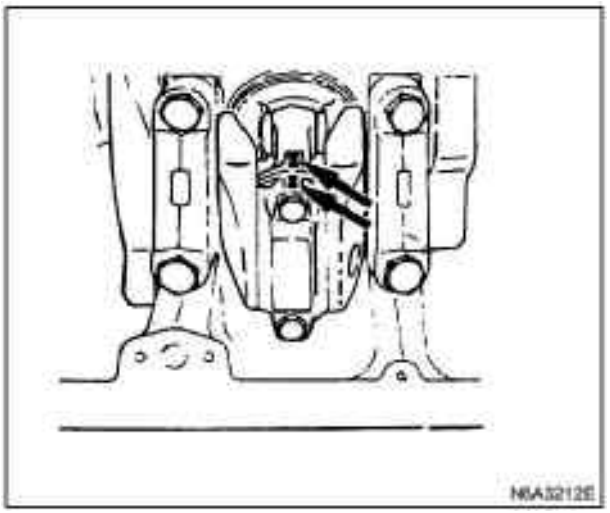
14) Position the piston top according to the mark, so that it is facing the front of the engine.
The piston ring is compressed with a piston compressor.
Piston ring compressor: 5-8840-9018-0 (J-8037)
15) Use a hammer to push into the piston until connecting rod and crank pin contact.
At the same time, the crankshaft is rotated until the crank pin is at the BDP.



16) Position the front mark of the bearing cover to make it face the front of the engine.
17) Install the connecting rod bearing cover, and align the numbering mark of the bearing cover cylinder and the numbering mark of the connecting rod cylinder.



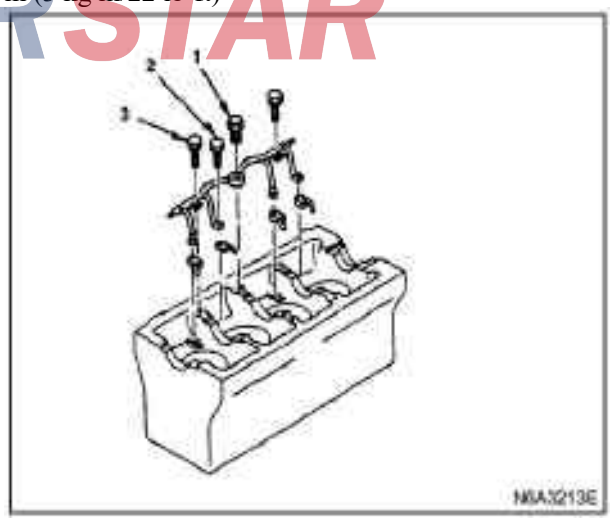
Legend
1. Front mark
18) Apply a layer of oil film on the screw and assembly surface of each connecting rod.
19) Use the angle method to tighten the connecting rod bearing cover bolts in two steps according to the specified torque.
Tightening:
Torque of connecting rod bearing cover bolt:
• 4JB1-TC, 4KH1-TC, 4JG2
Step 1: 29 N·m (3.0 kg m/22 lb·ft)
Step 2: 45° to 60°
·4JB1: 83 N·m(8.5 kg·m/61 lb·ft)



Caution:
Rotate the crankshaft by hand to check whether the crankshaft is flexible.
10. Piston cooling oil pipe
Tightening:

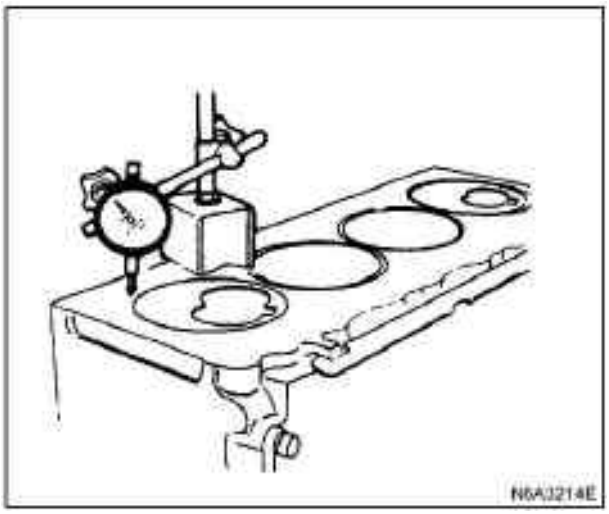
1) The injection pipe and the dowel pin are installed on the cylinder.
2)The piston cooling oil pipe is installed on the cylinder, and the pressure limiting valve (1) and the 4 connecting bolts (2) are tightened on the specified torque.

Torque of oil pipe fixed bolt:
M8: 19 N·m(1.9 kg·m/14 lb·ft)
M6: 8 N•m(0.8 kg·m/69 lb·in)
• Torque of fixed bolt of pressure limiting valve: 29 N m (3 kg m/22 lb·ft)

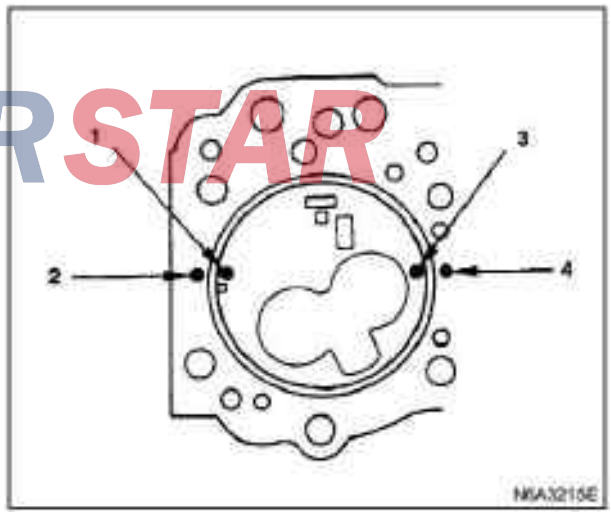


Caution:
When the piston assembly is installed, the crankshaft is rotated slowly to check whether the gap between the piston and the injection pipe is interfered.

11. Engine oil pump assembly
For the above work, refer to the Section “Engine Oil Pump” in the Manual.
12. Timing belt pulley housing
13. Timing gear housing
14. Front oil seal (belt drive type)
15. Timing belt and belt pulley
1) Camshaft timing belt pulley
2) Timing belt
3) Flange: camshaft pulley
4) Lower cover of timing belt pulley
5) Upper cover of timing belt pulley
6) Belt pulley of crankshaft damper
16. Timing gear (gear drive type)
1) Crankshaft gear
2) Crankshaft timing gear
3)Tension pulley
4) Tension pulley "B" and the shaft
5)Oil injection pump
6) Timing oil pipe
7) Timing gear housing cover
8) belt pulley of crankshaft damper
9) Cooling fan assembly
10) Drive belt of AC generator and power steering pump
11)Fan wind scooper
For the above work, refer to the Section “Crankshaft” in the Manual.
Oil pump assembly
For the above work, see the "Oil Pump" section of this manual.
Cylinder head assembly and cylinder head gasket
1)In order to improve the engine performance, the cylinder head gasket should be determined according to the bulge of the piston top on the upper surface of the cylinder body.
There are three cylinder head gaskets with different thickness. The proper head gasket should be selected from three different levels of cylinder head gasket according to the following procedures.
Before measuring, remove the carbon from the surface of the piston top and cylinder, and clean the place where the cylinder is installed.



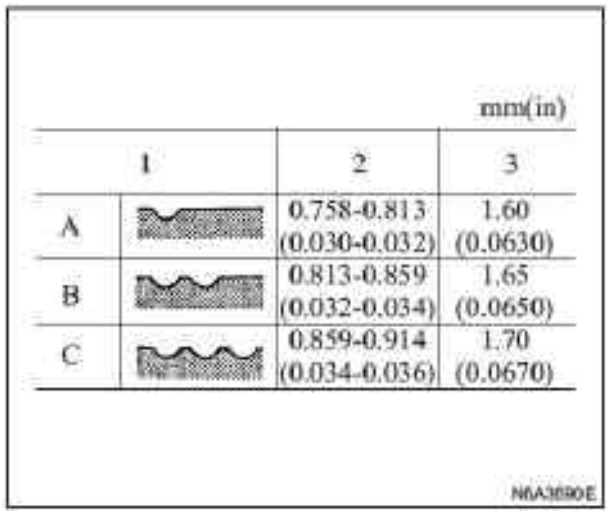
Measuring point of bulge of piston top
2) Use a dial indicator to measure the bulge of piston.
3) The measuring position of the outer bulge of the piston top is shown in the picture.
All measuring positions should be as close to the cylinder liner as possible.
4) Measure point (1) (2) (3) (3) (4) and obtain two differences on each cylinder (1) - (2) and (3) - (4).
Calculate the average value of the bulge of each cylinder piston top.
5) Calculate the maximum value of the 4 cylinders.
6) According to the following table, the cylinder head gasket level required for the above maximum value is determined.



4JB1 / 4JB1-TC
Cylinder head gasket thickness

mm(in)

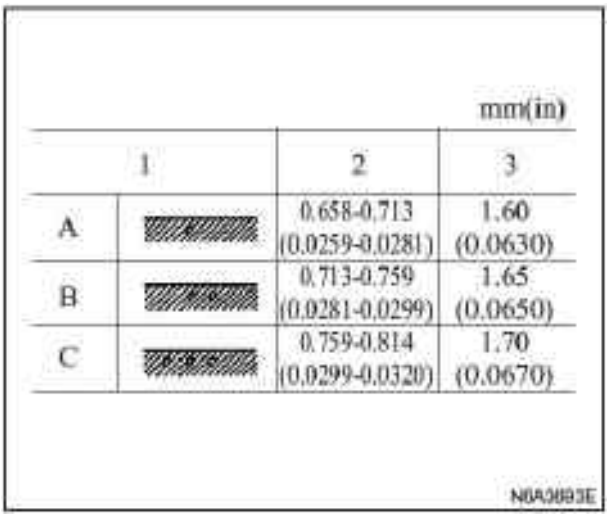
1		2	3
A		0.758-0.813 (0.030-0.032)	1.60 (0.0630)
B		0.813-0.859 (0.032-0.034)	1.65 (0.0650)
C		0.859-0.914 (0.034-0.036)	1.70 (0.0670)



Legend
1. Cylinder head gasket grade mark
2. External bulge of piston
3. Thickness of cylinder head gasket (Reference)

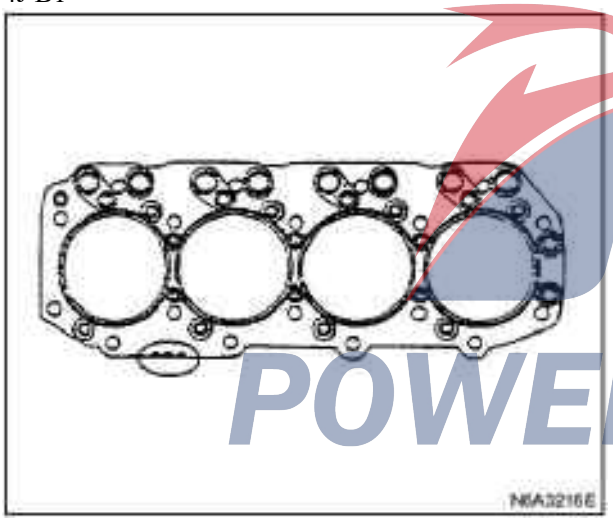
mm(in)

1		2	3
A		0.658-0.713 (0.0259-0.0281)	1.60 (0.0630)
B		0.713-0.759 (0.0281-0.0299)	1.65 (0.0650)
C		0.759-0.814 (0.0299-0.0320)	1.70 (0.0670)



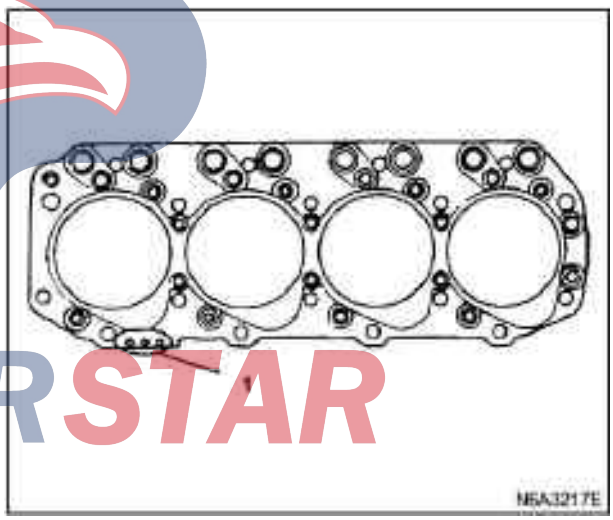
Legend
1. Cylinder marks
2. Average piston bulge
3. Thickness of cylinder head gasket

4J B1



Caution:
The difference between the measured maximum piston top convex value and minimum one shall not exceed 1.0mm(0.039in).

4J G2



Legend
1. Grade mark

4KH 1-TC
cylinder head gasket thickness

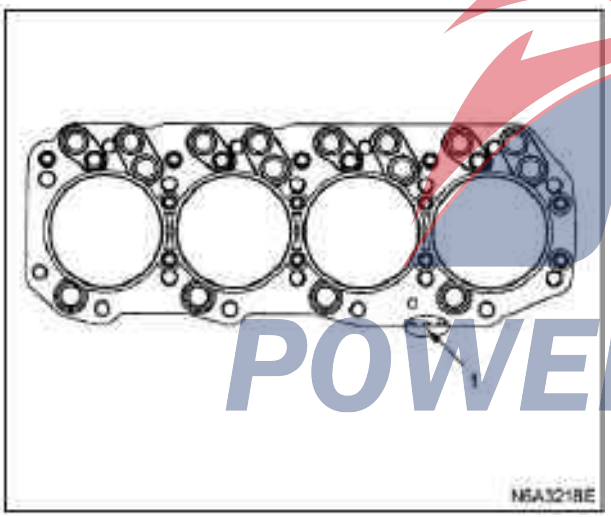
mm(in)

	1	2	3
A		0.215-0.265 (0.0085-0.0104)	1.30 (0.5118)
B		0.265-0.315 (0.0104-0.0124)	1.35 (0.5315)
C		0.315-0.365 (0.0124-0.0144)	1.4 (0.5512)

N6A3891E

Legend
1. Cylinder grade mark
2. Piston bulge
3. Sealant thickness (Reference)

4KH1-TC

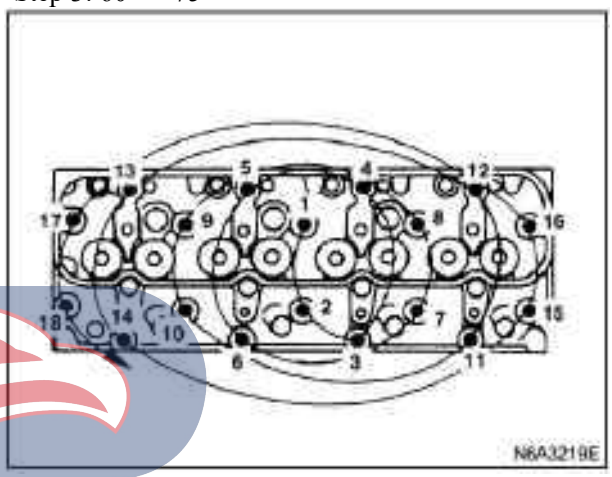


Legend
1. Grade mark

Caution:
The difference between the measured maximum piston top convex value and minimum one shall not exceed 1.0mm(0.039in).

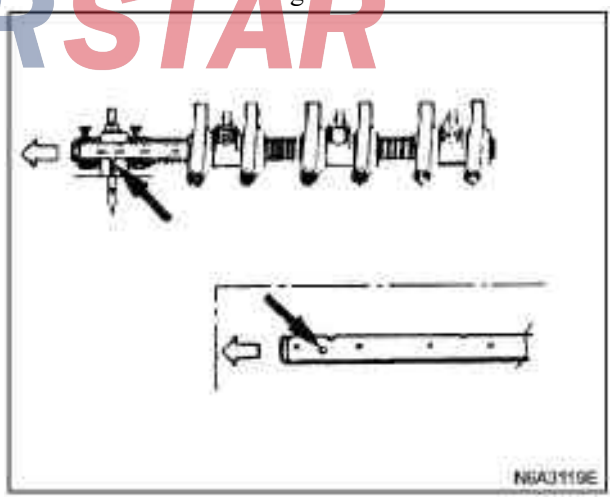
Cylinder head assembly
1. Put the pin into the cylinder.
2. Install the cylinder head gasket with the mark on the top being upwards.
3. Clean the lower surface of the cylinder head and the upper surface of the cylinder body.
4. Install the cylinder head carefully.
5. Smear the grease of molybdenum disulfide on the thread and the fit surface of the cylinder head bolts.
6. Tighten the cylinder head bolts according to the specified torque in the following three steps.

Tightening:
Torque of cylinder head bolt:
· Step 1 : 49 N m(5 kg·m/36 1b·ft)
·Step 2 : 60°—75°
·Step 3: 60°— 75 °



Push rod
·Apply the oil film on the push rod and install the cylinder head.

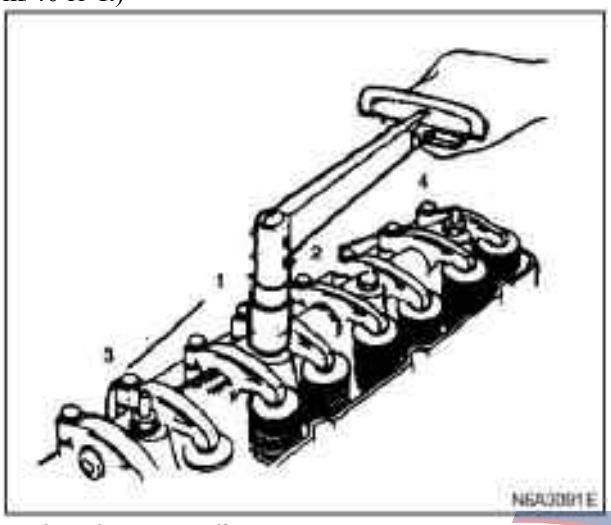
Rocker arm shaft assembly
1. Loosen all the adjusting bolts
2. Install rocker shaft, with the big hole (phi 4) being toward the front of the engine.



3. Tighten the support bolt of rocker shaft according to the specified torque in the graphic order.

Tightening:

Torque of rocker shaft support bolt: 54 N ·m(5.5kg m/40 lb·ft)



·Valve clearance adjustment

4J series engine

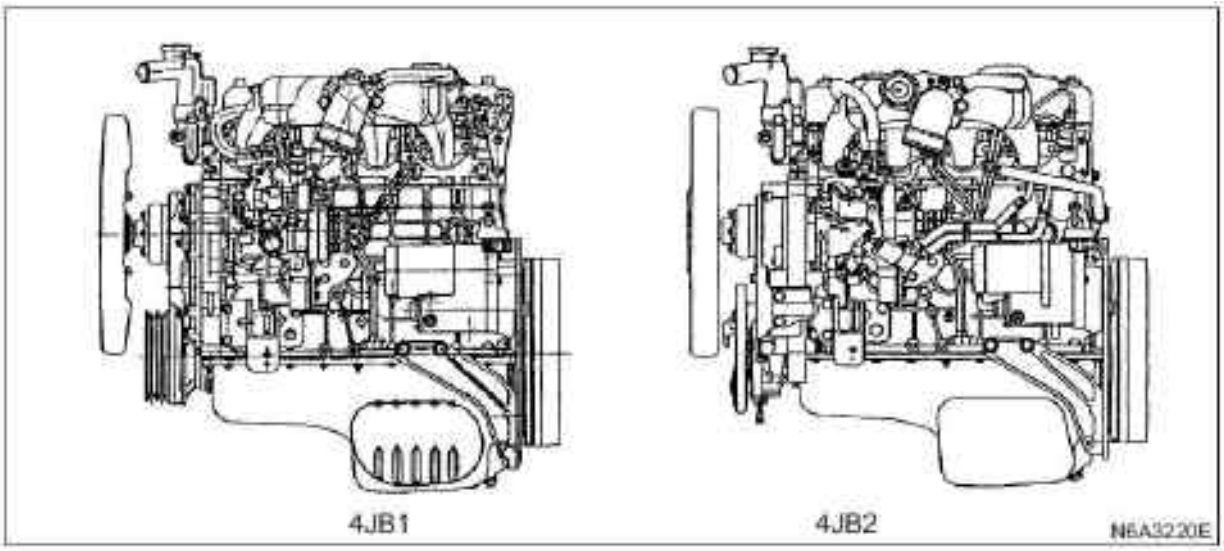
Section 6A1

Engine: 4JB1/4JB1-TC/4JG2/4KH1-TC

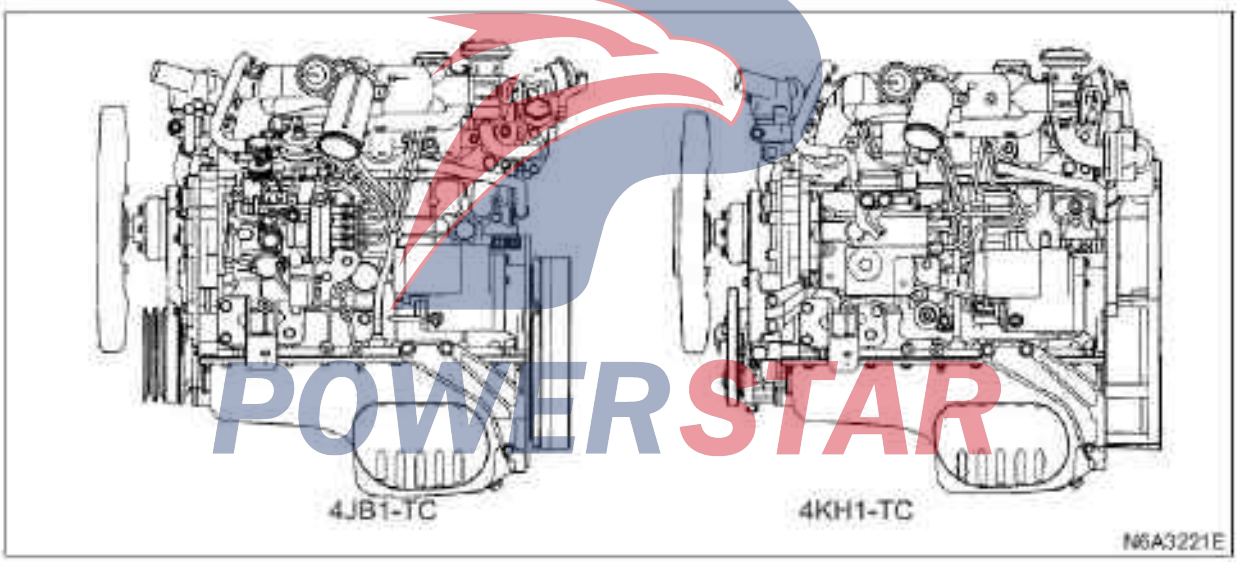
Table of Contents

Overview

4JB1 and 4JG2



4JB1-TC and 4KH1-TC



The 4JB1 engine adopts a square-ring combustor and is equipped with a protective cover. It is designed with superior oil saving, saving oil even under various driving conditions.

The 4JG2 engine adopts RECARD Comet V swirl combustion chamber with superior driving performance, fuel saving and silent combustion characteristics under various driving conditions.

Laminated steel plate is used as the steel plate of the cylinder pad.

According to the difference in the protruding part of the piston top from the gas cylinder cover, three levels of the cylinder pad can be used to minimize the fluctuation range of the engine compression ratio.

Fixing bolts of cylinder covers, connecting rods and flywheels are fastened by angle fastening.

Chromium plated steel dry cylinder sleeve has very strong wear resistance.

The car thermal compensated piston with cast steel support is used to reduce thermal expansion and engine noise when the engine is cooled, and the crankshaft after soft nitriding has long service life. Because of soft nitriding, it cannot be grinded again.

The main and connecting rod bearings of the crankshaft are made of aluminum alloy. For foreign objects such as metal chips, such bearings are particularly vulnerable. The oil inlet and other surface should be kept clean and free of foreign objects.

In order to increase the strength of the crankshaft, the soft nitriding treatment (nitriding) of the crankshaft should be able to avoid repeated grinding of the crankshaft pin and the journal.

The lubricating oil circuit is equipped with the injection device used by the cooling piston. The lubricating oil comes from the oil duct of the cylinder and injects the oil to the piston through a one-way valve.

Do not damage the injection device when the piston and connecting rod assembly are disassembled or installed. 4JG2 adopts a single spring hole nozzle.

The 4JB1 engine adopts a direct jet engine with a four-hole nozzle to make the incoming air and fuel injection up to excellent mixing ratio.

The 4JB1-TC engine has two spring nozzles to effectively control the oil quantity.

The turbocharger increases the intake efficiency, enhances engine power, reduces fuel consumption and minimizes the noise.

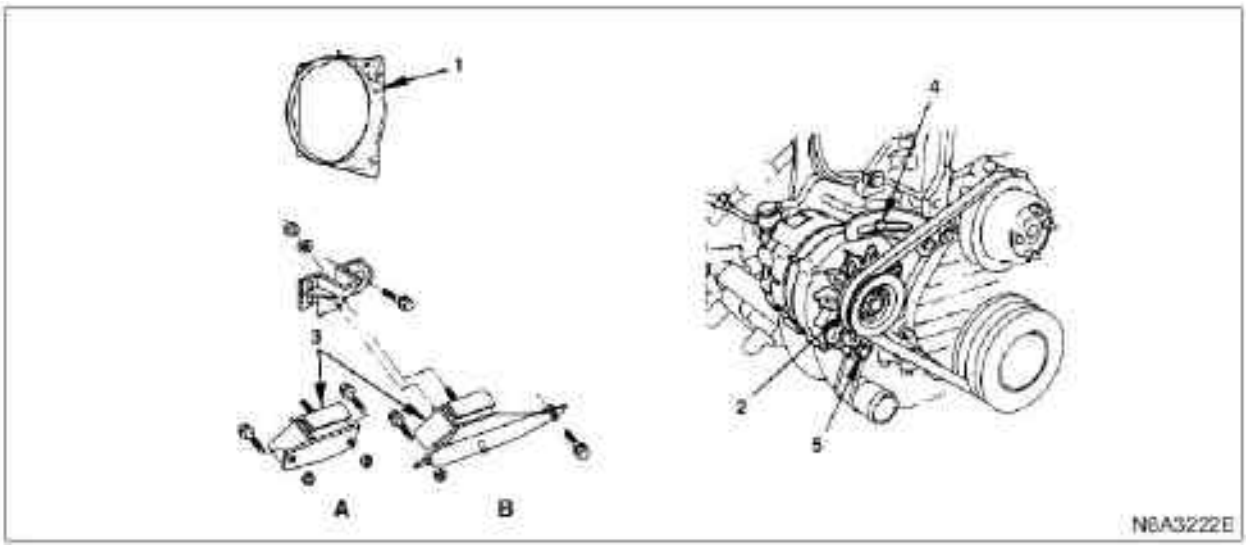
The rotating parts of the turbocharger operate at a very high speed and temperature. The part materials are carefully selected and processed to very high precision. The 4JB1 engine adopts the QOS II preheating system with rapid ignition speed, the controllable ignition time and preheating time by a thermometer.

4JG2 adopts QOS III system. The system can change the condition of ignition with the engine water temperature after starting the engine to achieve the best ignition time.

The belt driven timing belt of the 4JG2 engine is a very important part and should be maintained as required.

Engine bracket (right)

Parts



Legend

A. rigid suspension
B. independent suspension
1. Fan wind scooper
2. Fan belt
3. Supporting rubber block
4. Lock bolt
5. AC generator fixing bolt

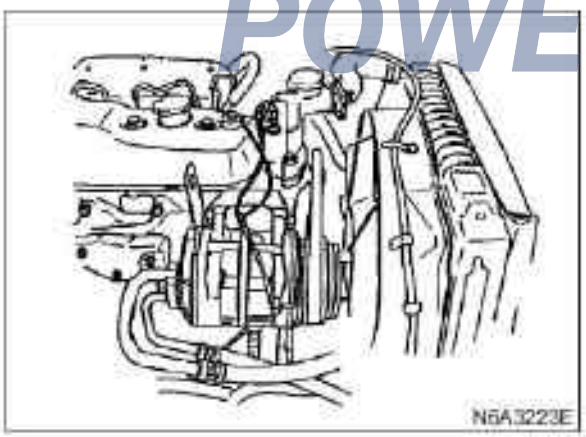
Dismantling

Preparation

• Disconnect the grounding wire of the battery.

1. Fan wind scooper

• Disassemble the water tank hose and fan guide cover



2. Fan belt

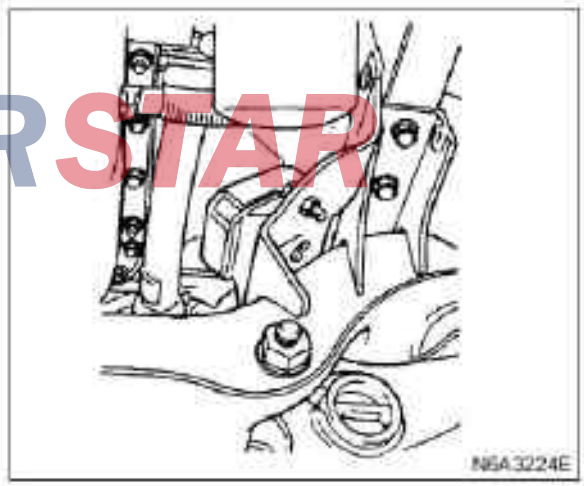
• Disassemble the lock bolt for the adjustment plate.

• Unscrew the generator fixing bolt and disassemble the fan belt.

3. Supporting rubber block

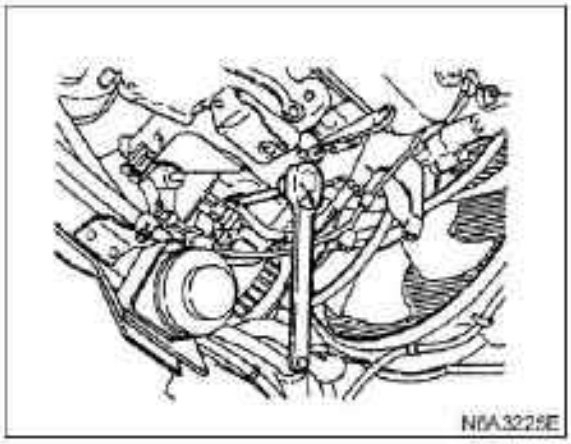
• Disassemble two fixing nuts on the beam

• Disassemble the generator from the engine.



• Disassemble the support rubber brick nut on the engine support.

• Lift the engine and disassemble the support glue.



Legend

1. Drive belt of the A/C compressor
2. Drive belt of power steering oil pump

---

3. Fan wind scooper

Install the fan guide cover and tighten the water tank hose.

Install

1. Supporting rubber block

· Lift the engine and install the support glue.

· Tighten the locking nut to the specified torque.

Tightening

· 82 N.m (8.4 kg. m/61 lb. ft) for engine support

· 40 N. m (4.1 kg. m/30 lb. ft) for beam

2. Fan belt

· Install the fan belt.

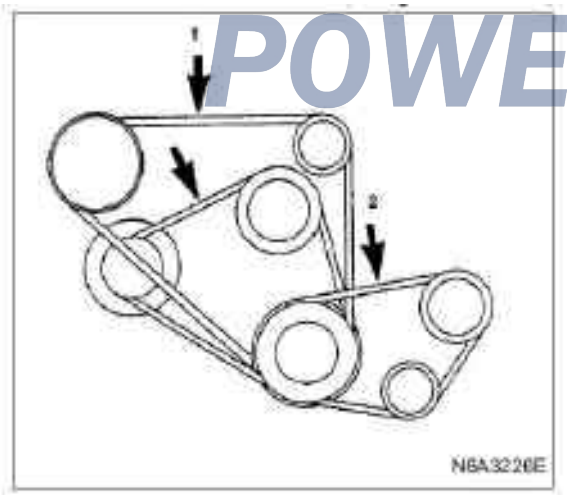
· Apply the force of 98 N (10 kg/ 22 lb) to the central position of the fan belt.

· Tighten the fixing bolt to the specified torque.

Tightening

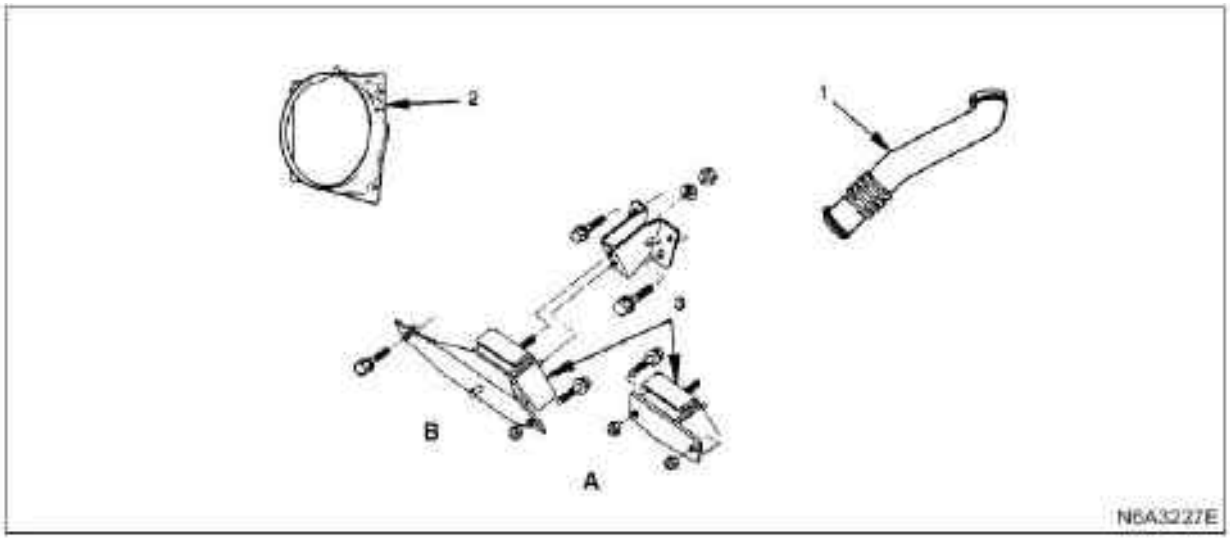
· 19 N·m (1.9 kg·m/14 lb·ft) for adjusting plate locking bolt

· 40 N·m (4.1 kg·m/30 lb·ft) for fixing bolt of generator



Engine bracket (left)

Parts



Legend

A. rigid suspension
B. independent suspension
1. Intake pipe
2. Fan wind scooper
3. Supporting rubber block

Dismantling

Preparation

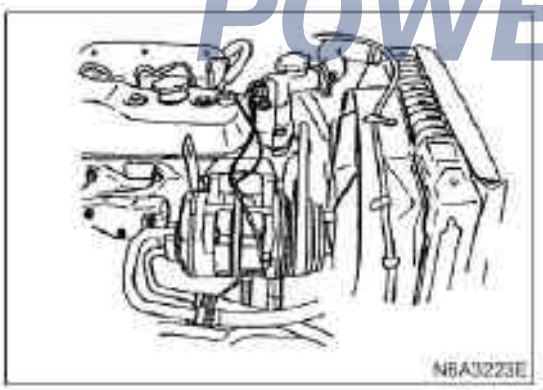
Disconnect the grounding wire of the battery.

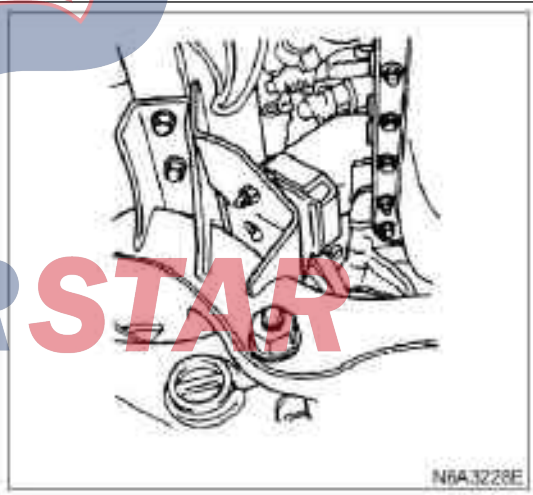
1. Intake pipe

· Disassemble the intake pipe

2. Fan wind scooper

· Disassemble the water tank hose and fan guide cover



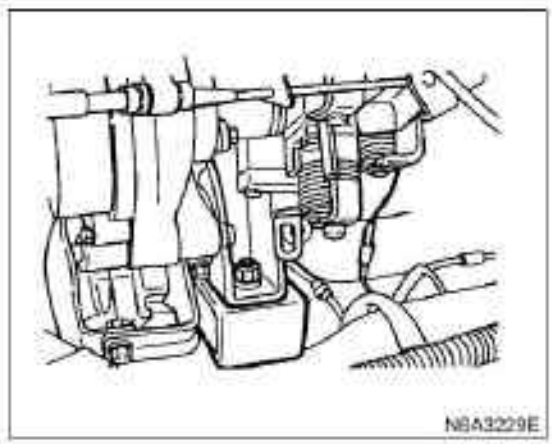


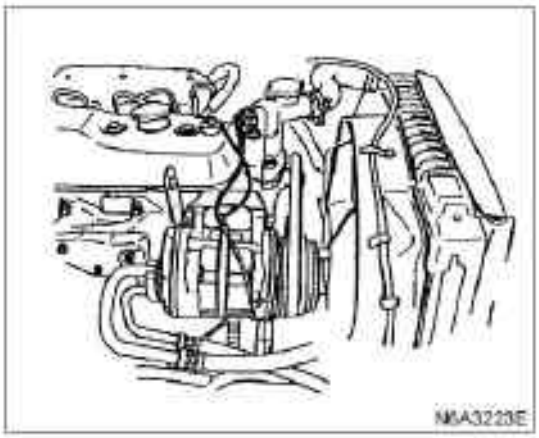
· Disassemble the support rubber brick nut on the engine support.

· Lift up the engine and disassemble the support glue.

3. Supporting rubber block

· Disassemble two fixing nuts on the beam.





Install

1. Supporting rubber block

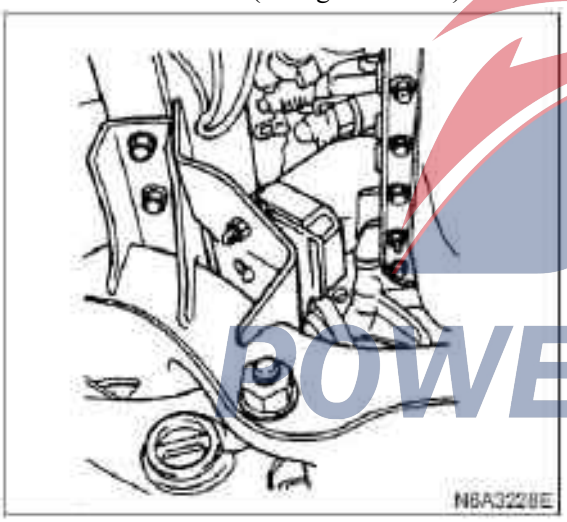
· Lift the engine and install the support glue.

· Tighten the fixing nut to the specified torque.

Tightening

·Engine bracket to 82 N·m(8.4 kg·m/61 lb·ft)

·Cross beam to 40 N·m(4.1 kg·m/30 lb·ft)



2. Fan wind scooper

· Install the fan guide cover and tighten the water tank hose.

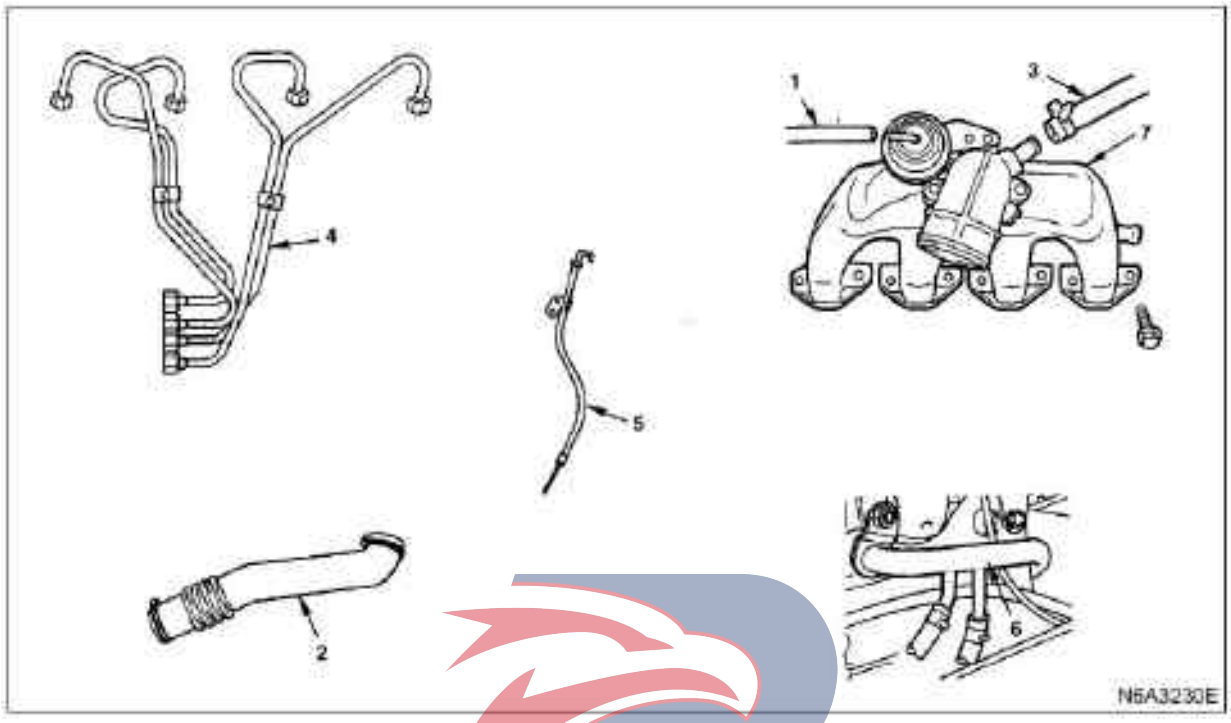
3. Intake pipe

· Installation of the intake pipe

· Connect the grounding wire of the storage battery

Intake manifold

Parts



Legend

1. Vacuum tube
2. Intake pipe
3. Crankcase ventilation (PCV) hose
4. High pressure oil pipe
5. Oil scale
6. Engine oil cooler water pipe (engine oil cooler type)
7. Intake manifold

Dismantling

Preparation

·Disconnect the grounding wire of the storage battery

· Discharge coolant.

1. Vacuum tube

2. Intake pipe

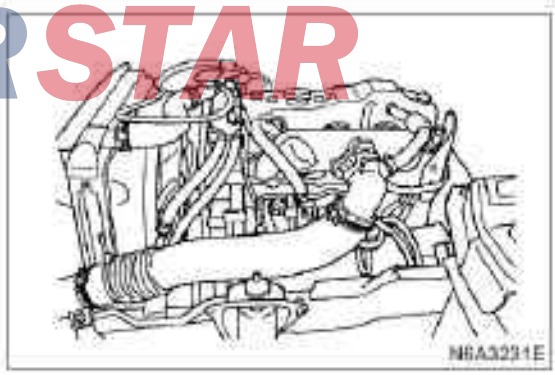
3. PCV Hose

4. High pressure oil pipe

· Release the hoop of the high pressure oil pipe.

· Release the flared nut on the injection pump.

·Release the flared nut on the fuel injector, disassemble the pipe and put it aside.



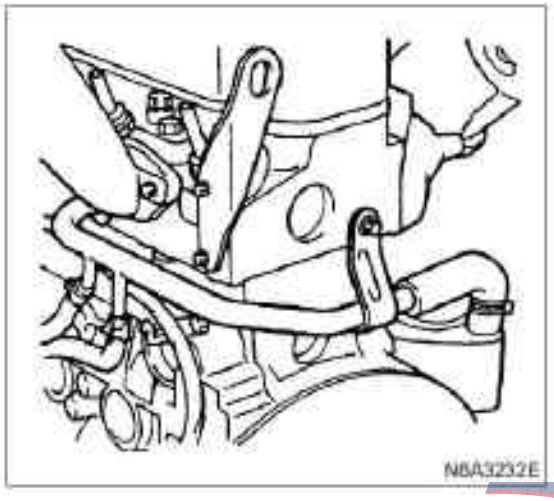
5. Engine oil dipstick guide

· Disassemble the fixing bolt and the oil scale tube.

6. Engine oil cooler water pipe (engine oil cooler type)

· Disassemble the bolt of the pipe support.

· Disassemble the intake manifold fixing nut.



7. Intake manifold

· Disassemble the fixing bolts and nuts of the manifold.

Install

1. Intake manifold

· Tighten the fixing bolt and nut to the specified torque.

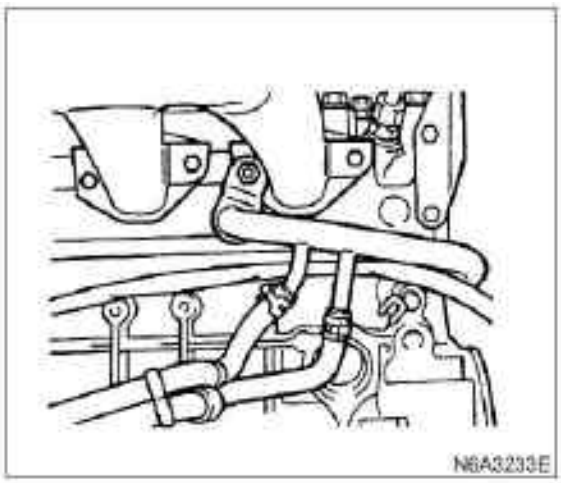
Tightening

· 19 N·m (1.9 kg·m/14 lb·ft) for bolts and nuts

2. Engine oil cooler water pipe (engine oil cooler type)

· Install the pipe and tighten the manifold and water pipe together.

· Tighten the pipe support bolts on the back of the cylinder cover.



3. Engine oil dipstick guide

· Install the catheter, fasten the manifold and the catheter.

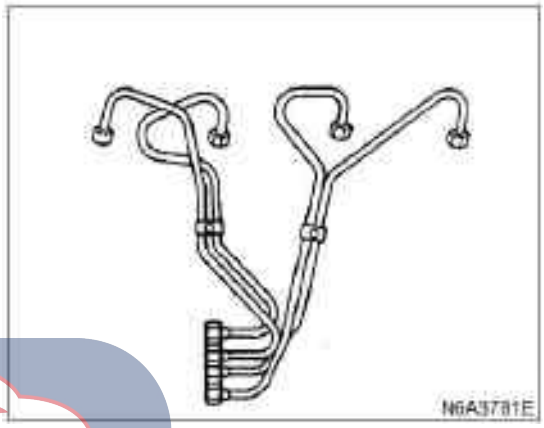
4. High pressure oil pipe

· Connect the high pressure oil pipe, tighten the flared nut to the specified torque.

Tightening

· 29 N·m (3.0 kg·m/22 lb·ft) for flared nuts.

· Install the pipe hoop in the original position.



5. PCV Hose

6. Intake pipe

7. Vacuum tube

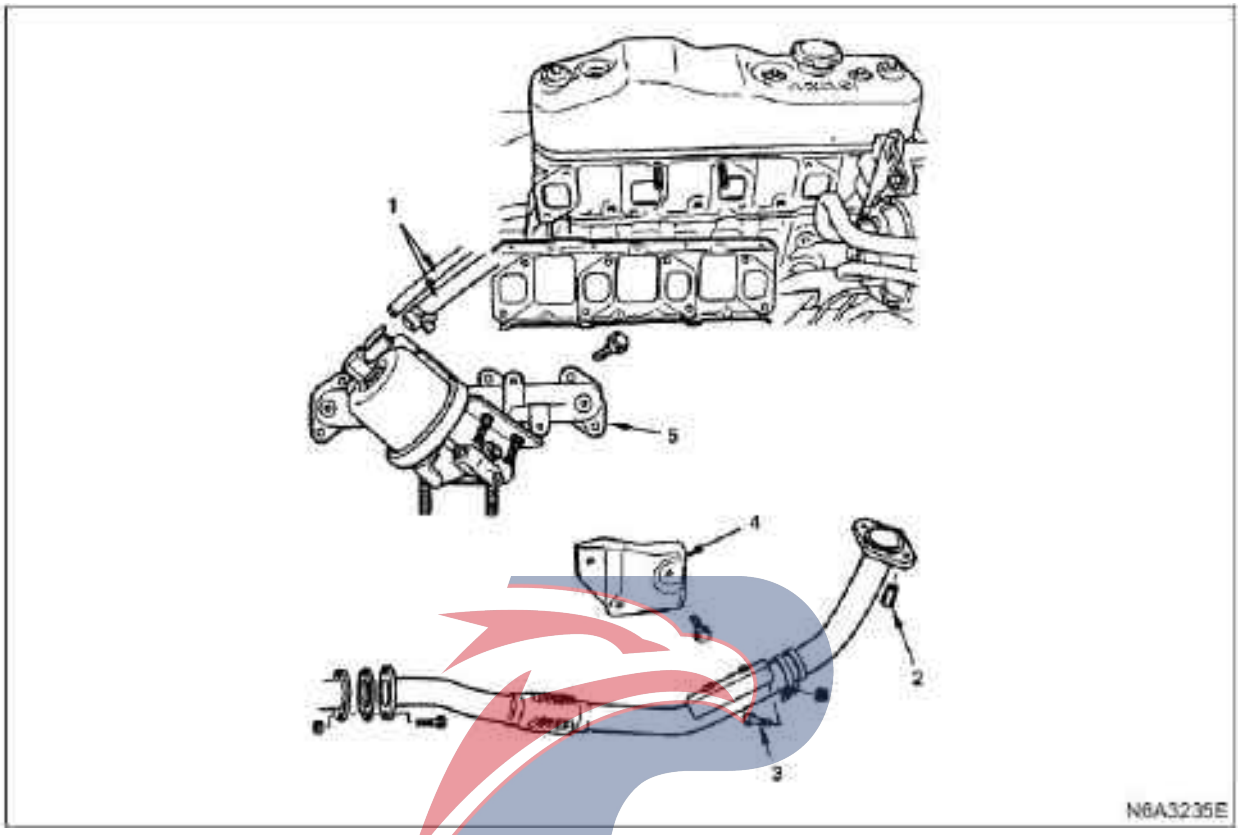
· Connect the grounding wire of the storage battery

· Pour into the coolant

· Start the engine and check the leakage of the coolant

Exhaust manifold

Parts



Legend

l. Vacuum tube
2. Front exhaust pipe nut
3. Front exhaust pipe bracket bolts
4. Heat shield
5. Exhaust manifold

Dismantling

Preparation

· Disconnect the grounding wire of the storage battery

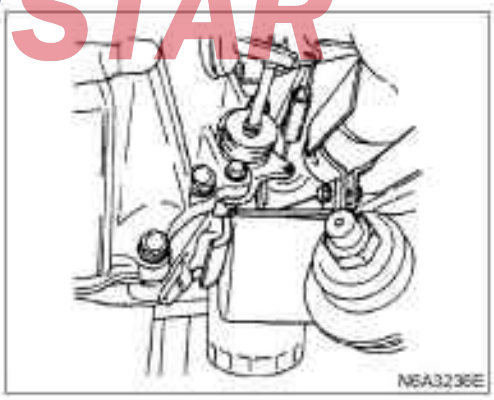
1. Vacuum tube (exhaust brake type)

· Disassemble the vacuum adjuster hose

2. Front exhaust pipe bolt

· Disassemble the fixing nut of the exhaust manifold.

3. Front exhaust pipe bracket bolts



4. Heat shield

5. Exhaust manifold

· Disassemble the manifold bolts and manifold and liner.

Install

1. Exhaust manifold

· Tighten the fixing bolt and nut to the specified torque.

Tightening

· 29 N·m (2.7 kg·m/20 lb·ft) for manifold nuts.

2. Heat shield

· Tighten the hot plate to the specified torque.

Tightening

· 19 N·m (1.9 kg·m/14 lb. ft) for nuts of hot plate

3. Front exhaust pipe bracket bolts

· Tighten the fixing nut to the specified torque.

Tightening

· 40 N·m (4.1 kg·m/30 lb·ft) for support bolts

4. Front exhaust pipe nut

· Tighten the fixing bolt to the specified torque.

Tightening

· If not with exhaust brake, tighten to 69 N·m (1.9 kg·m/4 lb·ft)

· If with exhaust brake, tighten to 69 N·m (7 kg·m/51 lb·ft)

5. Vacuum tube (exhaust brake type)

· Install two hoses to the vacuum adjuster

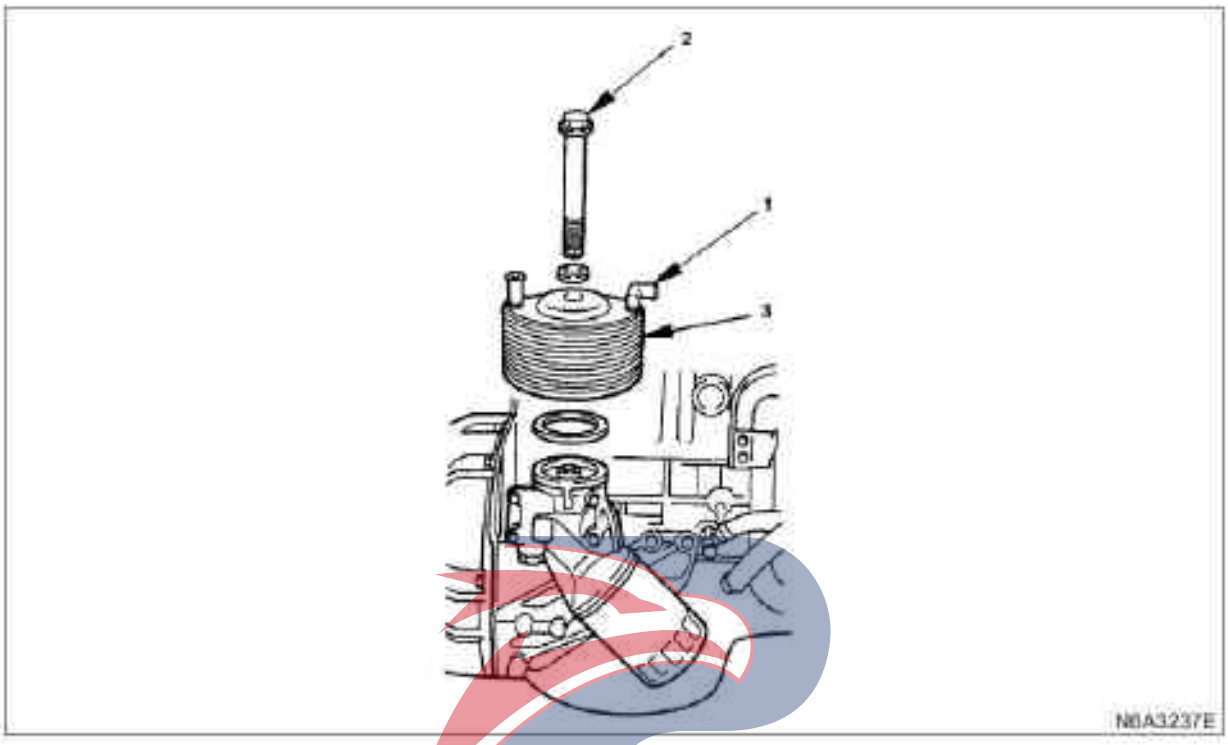
· Connect the grounding wire of the storage battery

· Start the engine and check the leakage of the coolant

Oil cooler (oil cooler type)

Parts

4JG2. 4JB1. 4JB1-TC and 4KH1-TC



Legend

1. Water pipe
2. Fixing bolt of the engine oil cooler
3. Engine oil cooler

Dismantling

Preparation

· Disconnect the grounding wire of the storage battery

· Discharge coolant.

· Put a piece of cloth in the lower part of the oil cooler to prevent oil leakage.

1. Water pipe

· Disassemble the water inlet and outlet pipes.

2. Fixing bolt of the engine oil cooler

3. Engine oil cooler

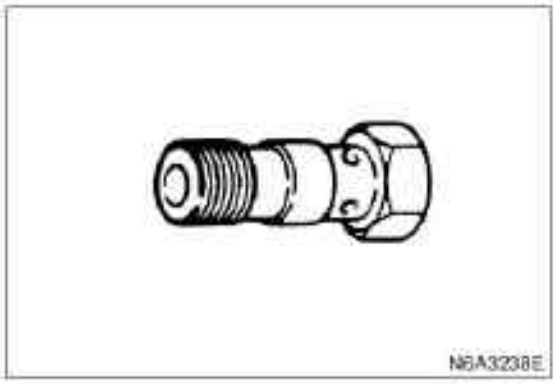
Inspection

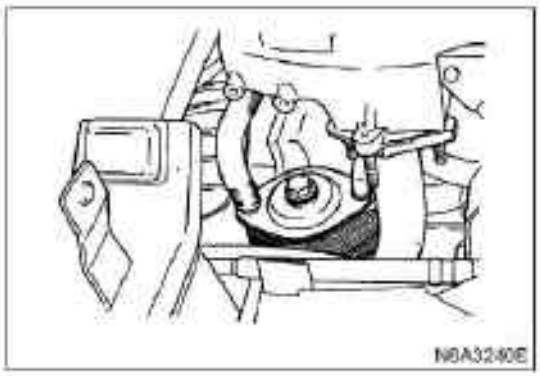
Safety valve

1. Install an oil pressure gauge at the oil pipe near the engine oil filter.

2. Start the engine and check the opening pressure of the safety valve.

Opening pressure of safety valve	kPa (kg/cm^2/psi)
Type 1	559—618(5.7—6.3/81.0—89.6)





Engine oil cooler

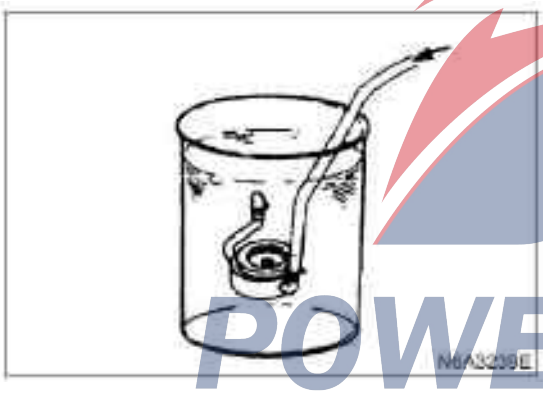
Check whether the water pipe leaks.

1. Plug one end of the water pipe of the engine oil cooler.

2. Immerse the engine oil cooler into water.

3. Exert compressed air (2 kg/cm2(28.5 psi/196.0 kPa)) to the other end of the engine oil cooler water pipe.

If the water meter has bubbles, there is water leakage in the water pipe.



Install

1. Engine oil cooler

· Install the O ring on the oil filter and place the oil cooler.

2. Fixing bolt of the engine oil cooler

Tightening

· 29 N·m (3.0 kg·m/22 lb·ft) for oil cooler bolts

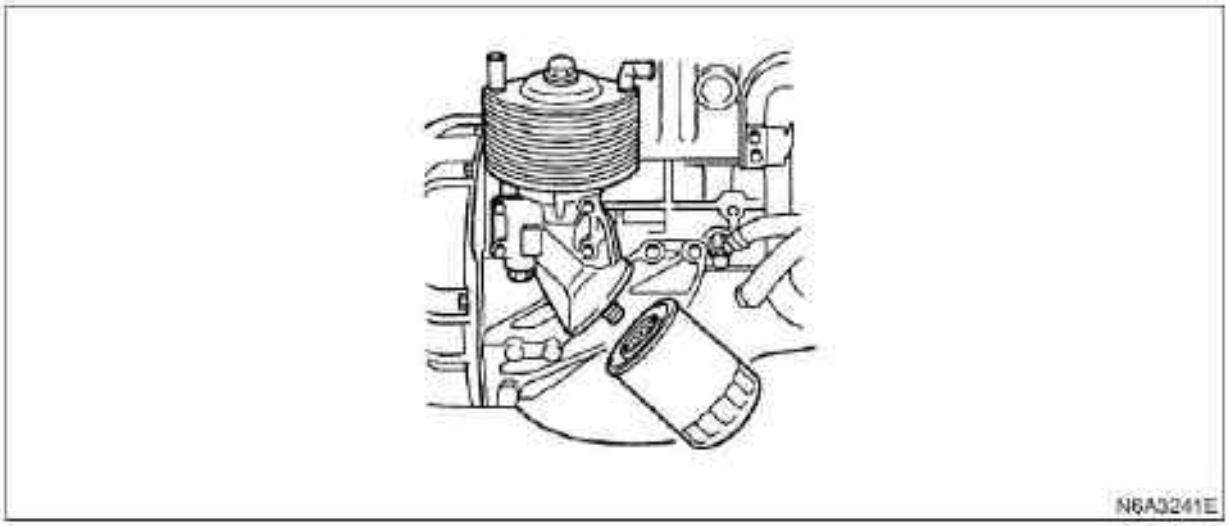
3. Water pipe

· Connect the water pipe

Engine oil filter element

Parts

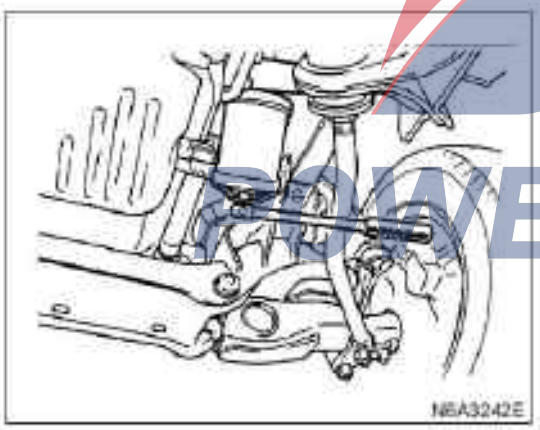
4JG2. 4JB1. 4JB1-TC and 4KH1-TC



Dismantling

Place a container under the oil filter to hold the discharged oil.

· Use the oil filter to disassemble the wrench and disassemble the filter cartridge. Oil filter disassembly wrench: 5-8840-0200-0



Install

· Install the O ring of the filter cartridge of the oil filter.

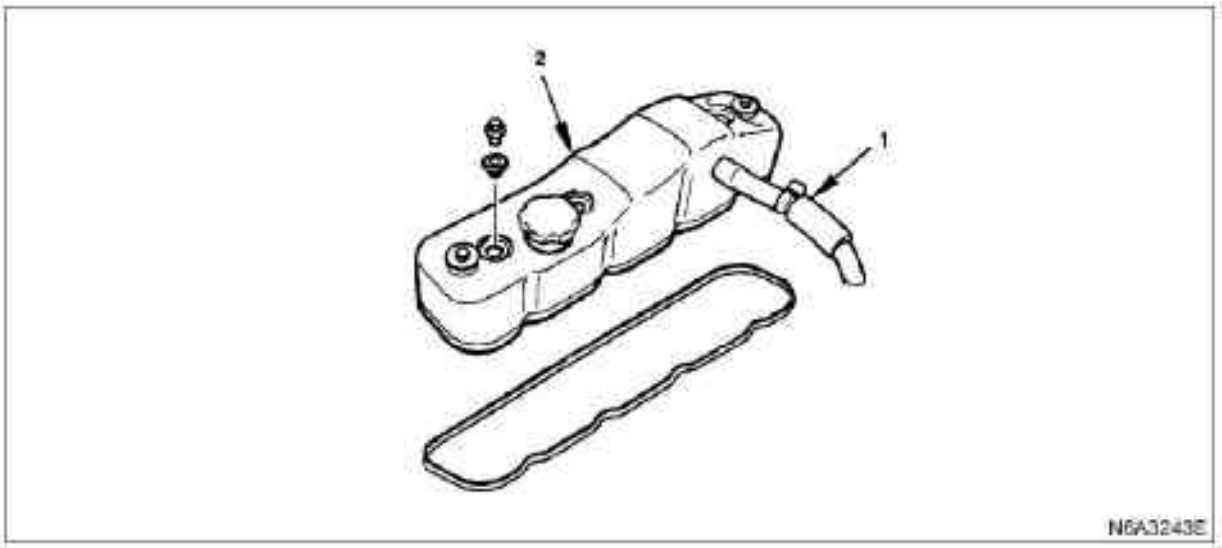
· Screw the new filter cartridge with hand until the sealing surface is attached to the O ring.

·Screw the oil filter with the oil filter disassembly wrench, and after tightening, screw 1.1/8 turn again.

· Turn on the engine and check if the oil filter is leaking.

Cylinder head cover

Parts



Legend

1. PCV hose
2. Cylinder Cover

Dismantling

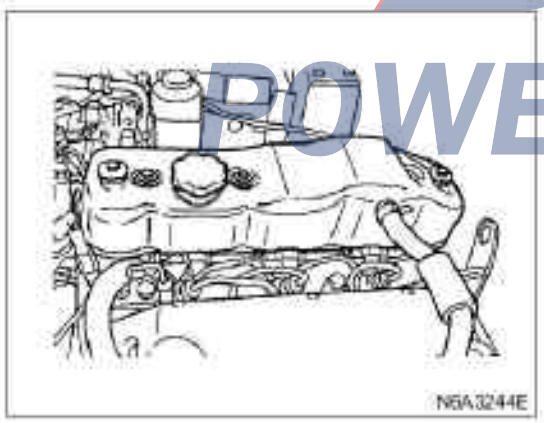
Preparation

· Disconnect the grounding wire of the storage battery

1. PCV Hose

· Disconnect the PCV hose with the intake pipe.

2. Cylinder head cover



Install

1. Cylinder head cover

· Apply the engine oil on the rocker arm and the valve spring.

· Mount the cylinder cover liner on the cover of the cylinder cover.

· The liner should be smooth and undamaged.

· Tighten the cylinder cover to the specified torque.

Tightening

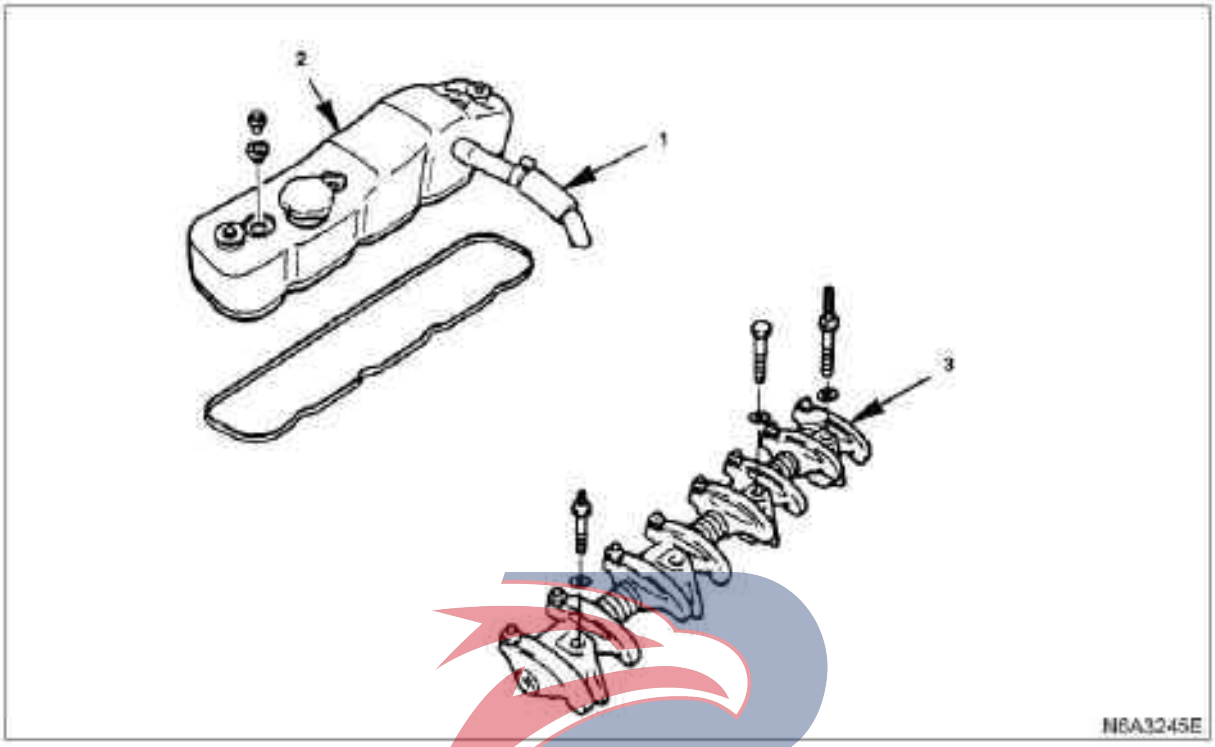
2. PCV Hose

· Connect the PCV hose to the intake pipe.

· Connect the grounding wire of the storage battery

Rocker arm shaft assembly

Parts



Legend

1. PCV Hose
2. Cylinder head cover
3. Rockshaft assembly

Dismantling

Preparation

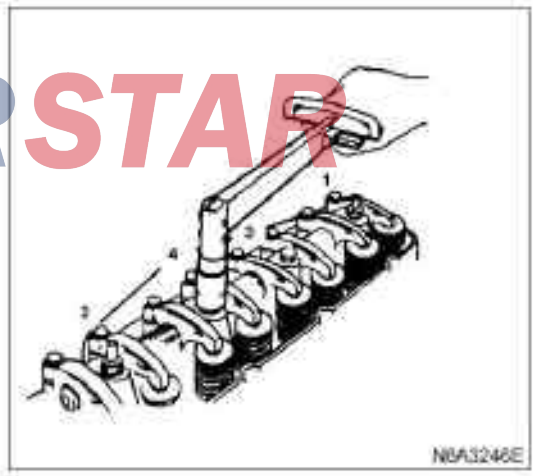
· Disconnect the grounding wire of the storage battery

1. PCV Hose

2. Cylinder head cover

3. Rockshaft assembly

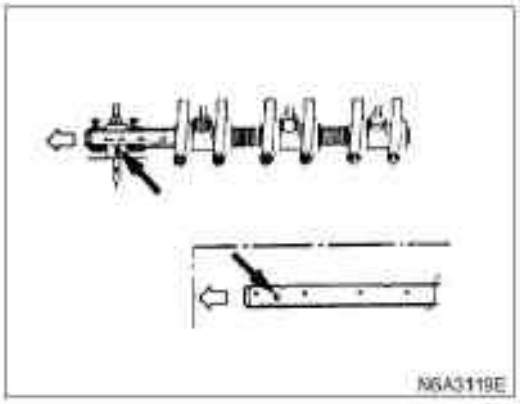
Unscrew the bolts and nuts of the rocker shaft support and disassemble the shaft assembly of the rocker arm.



Install

1. Rockshaft assembly

· Install rocker shaft to allow the oil hole (Ø4) of the mainframe to be located in front of the engine.



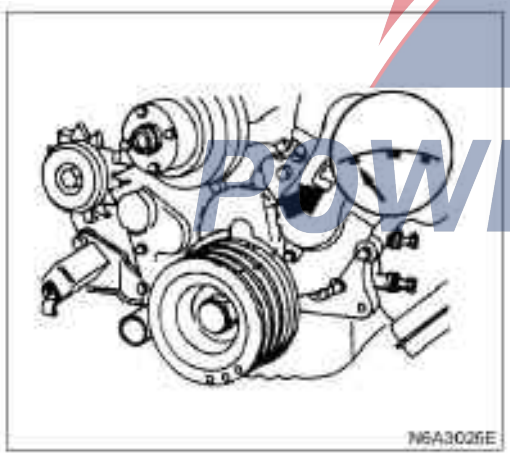
· Align the fixing bolt with the rocker shaft nut and tighten the fixing bolt to the specified torque.

Tightening

· 54 N·m (5.5kg·M/40 lb·ft) for rocker shaft support nut

2. Valve clearance adjustment

1) Place the piston of Cylinder 1 or 4 at the top dead center of the compression stroke by rotating the crankshaft, and align the TDC line of the crankshaft buffer pulley with the timing pointer.

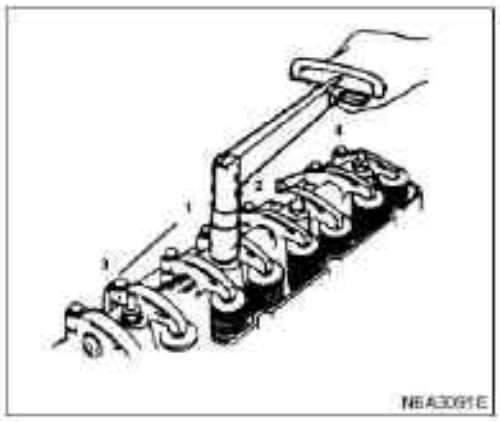


2) Check whether the rocker shaft support nut is loose.

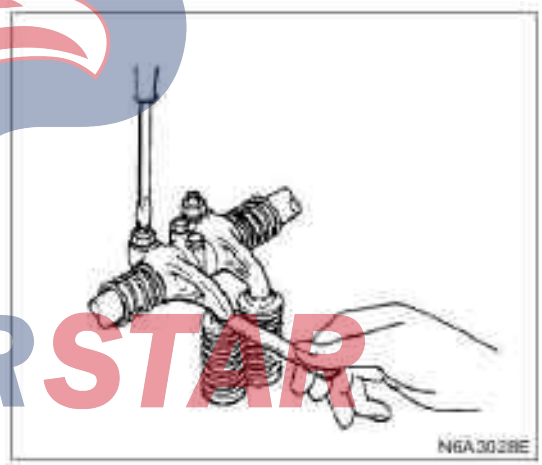
Before adjusting the valve gap, tighten the loose support nuts of all the rocker shafts.

Tightening

• 54 N·m(5.5kg·m/40 lb·ft) for rocker shaft bearing nut



3) Check the gap between the first cylinder intake and the exhaust tappet. If there is a gap between the first cylinder intake and the exhaust tappet, the piston of Cylinder 1 should be at the top dead center of the compression stroke. If the inlet and outlet doors of Cylinder 1 are too tight, the piston of Cylinder 4 should be located at the top dead center of the compression stroke.

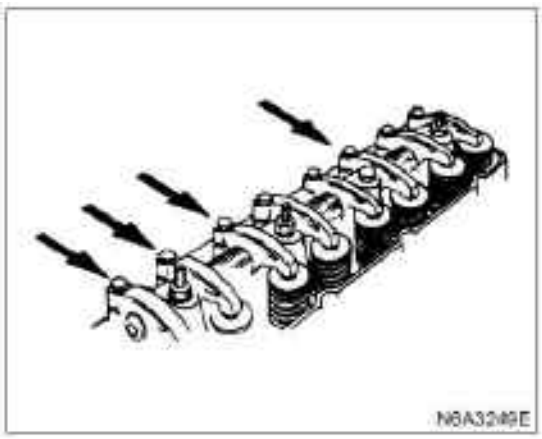


If Cylinder 1 and 4 are located at the top dead center of the compression stroke, the valve gap on it should be adjusted.

Valve gap (cold state)	mm (in)
0.4 (0.016)	

4) Unscrew the adjusting screws for all valve gaps according to the illustrated instructions.

Top dead center of Cylinder 1 (compression stroke)



5) Insert a feeler gauge with suitable thickness in between the ends of the rocker arm and the valve rod.

6) Rotate the valve gap adjusting screw until some small resistance exists on the feeler gauge.

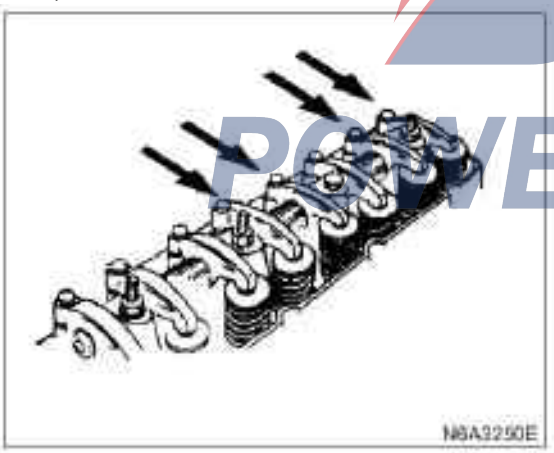
7) Fasten the locking nut.

8) Rotate the crankshaft 360 degrees.

9) Align the notch line of the crankshaft shock absorber pulley TDC with the timing pointer again.

10) Adjust the gap between other valves as shown in the illustration.

Top dead center of Cylinder 4 (compression stroke)



3. Cylinder head cover

· Install the Cylinder Cover and tighten the bolt to the specified torque.

Tightening

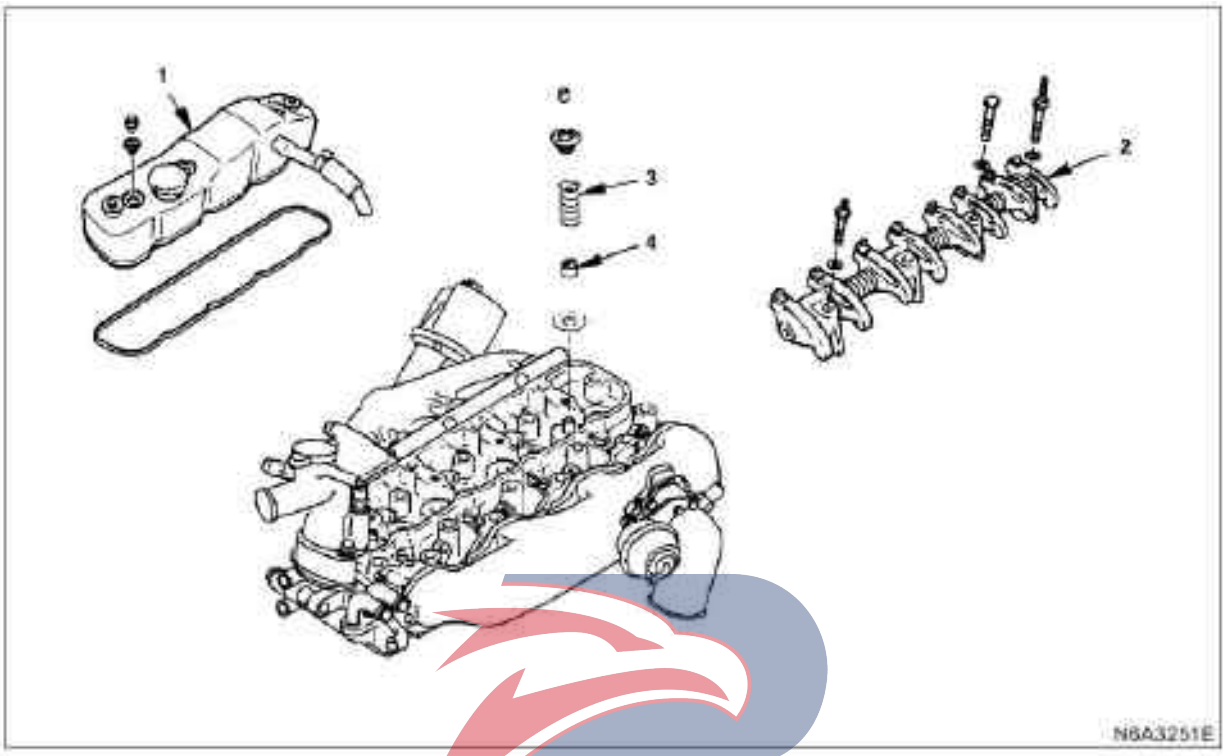
• 13 N·m(1.3 kg·m/113 lb·in)

4. PCV Hose

· Connect the grounding wire of the storage battery.

Valve stem oil seal and valve spring

Parts



Legend

1. Cylinder head cover
2. Rockshaft assembly
3. Valve spring
4. Valve stem oil seal

Dismantling

Preparation

· Disconnect the grounding wire of the storage battery

1. Cylinder head cover

2. Rockshaft assembly

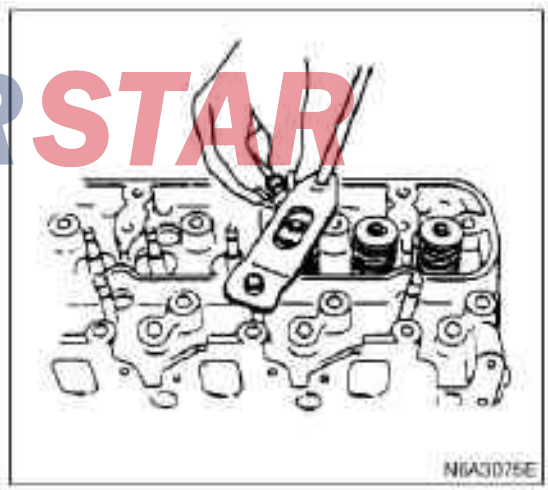
· Unscrew the bolts and nuts of the rocker shaft support and disassemble the shaft assembly of the rocker arm.

3. Valve spring

· Inject compressed air from the preheating plug hole into the cylinder, and keep the valve in the normal position.

· Disassemblevalve lock clamp with special tools and compression valve spring.

valve spring compressor 9-8523-1423-0(J-29760)

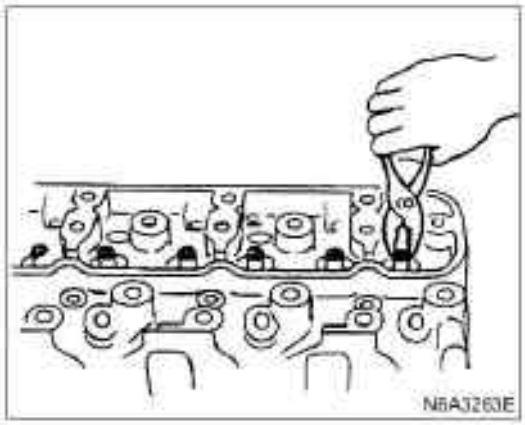


Tips:

Keep the disassembled valve spring according to the number of the cylinder.

4. Valve rod oil seal

· Disassemble the valve rod oil seal with pliers.



Tips:

Do not reuse the dismantled oil seal.

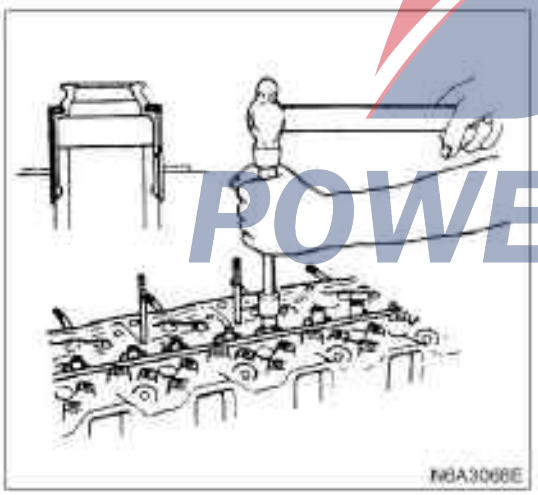
Install

1. Valve stem oil seal

· Install a new valve rod oil seal on the valve.

· Use special tools as the guide.

Special tool 5-8840-2033-0

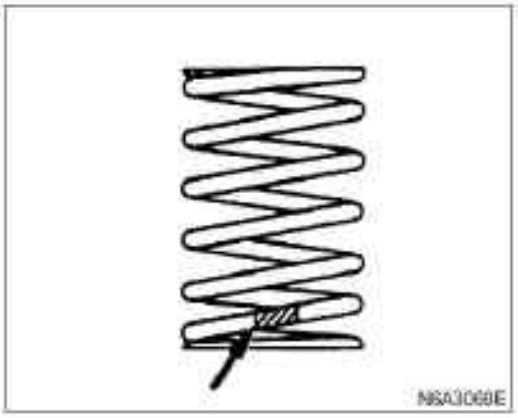


2. Valve spring

· Place the valve spring on the valve spring.

Tips:

· The coating of the valve spring should be facing down.



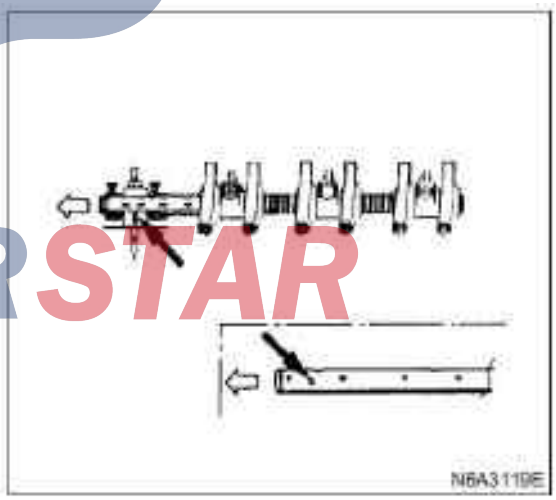
· Inject compressed air from the preheating plug hole into the cylinder, and keep the valve in the normal position.

· Install valve lock with special tools.

valve spring compressor 9-8523-1423-0(J-29760)

3. Rockshaft assembly

· Install rocker shaft to allow the oil hole (Ø4) of the mainframe to be located in front of the engine.



· Align the fixing bolt with the rocker shaft nut and tighten the fixing bolt to the specified torque.

Tightening

• 54 N·m(5.5 kg·m/40 lb·ft)

· Valve gap adjustment

4. Valve clearance adjustment

Please refer to the “Rocker Shaft Assembly" Chapter of this Manual.

5. Cylinder head cover

· Apply the engine oil on the rocker arm and the valve spring.

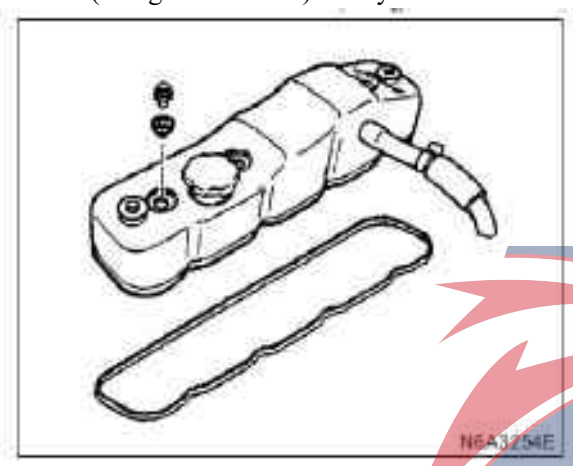
· Mount the cylinder cover liner on the cover of the cylinder cover.

The liner should be very smooth without loose area.

· Install the Cylinder Cover and tighten the bolt to the specified torque.

Tightening

· 13N·m(1.3kg·m/113 lb·in) for Cylinder Cover bolts

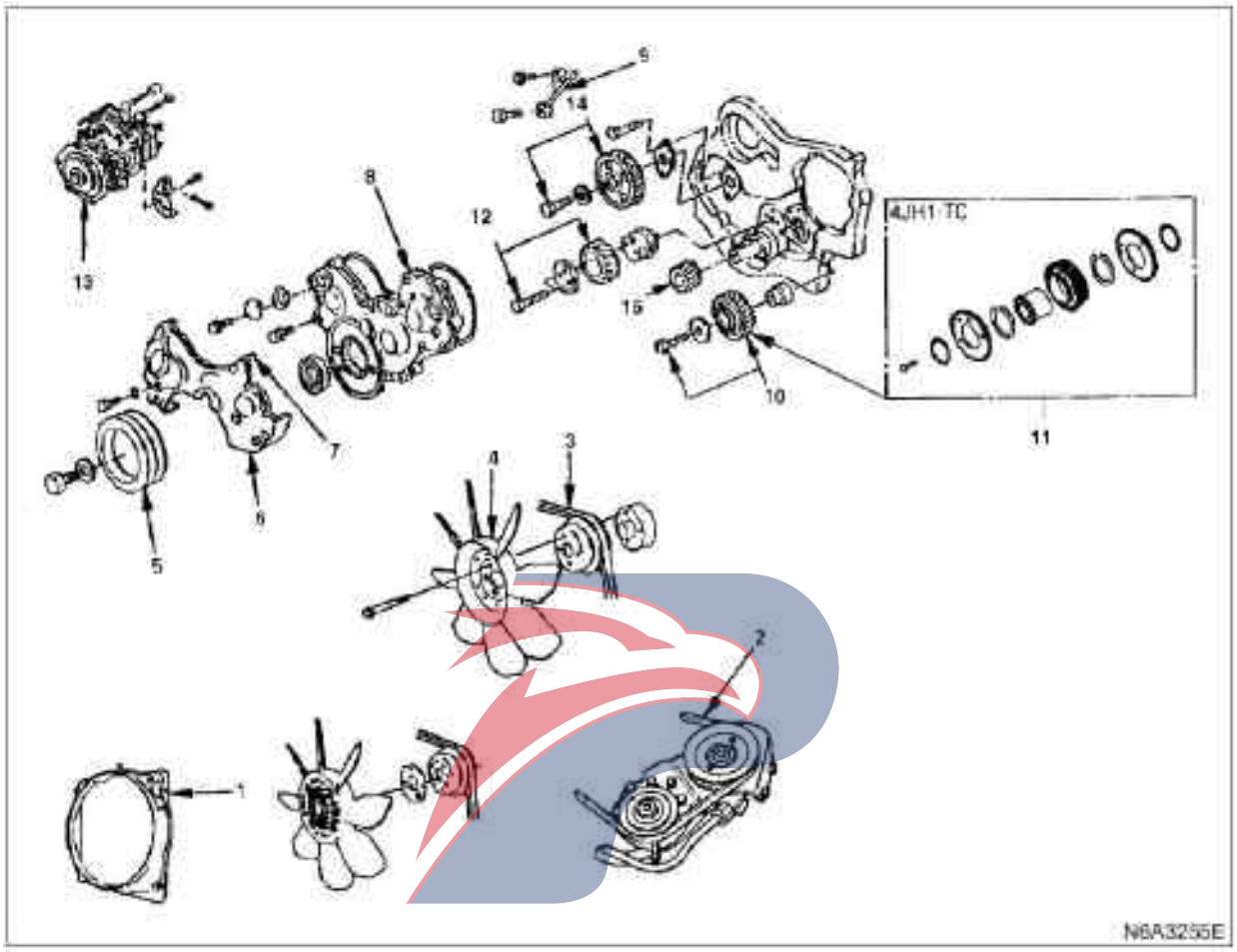


· Connect PCV hose

· Connect the grounding wire of the storage battery

Timing gear (4JB1.4JB1-TC, 4KH1-TC gear types)

Parts



Legend

1. Fan wind scooper
2 . Drive belt of power steering pump
3. drive belt of the AC generator.
4. Cooling fan assembly
5. belt pulley of crankshaft damper
6. Acoustic enclosure
7. Acoustic enclosure gasket
8. Timing gear chamber cover
9. Engine oil pipe
10 . Idler
11. Idler "B"
12 . Idler
13. Fuel injection pump
14. Crankshaft timing gear
15. Crankshaft gear

Dismantling

Preparation

· Disconnect the grounding wire of the storage battery

· Discharge coolant.

1. Fan wind scooper

2. Drive belt (P/S type) of power steering pump

Unscrew the mounting bolts and adjusting bolts of the power steering pump and disassemble the transmission belt.

3. drive belt of the AC generator.

· Unscrew the mounting bolt (side lower part) and the locking bolt of the adjusting plate of the alternator, and disassemble the transmission belt.

4. Cooling fan assembly

· Disassemble fastening nut and cooling fan assembly, long distance pipe and fan pulley.

5. belt pulley of crankshaft damper

6. Acoustic enclosure

7. Acoustic enclosure gasket

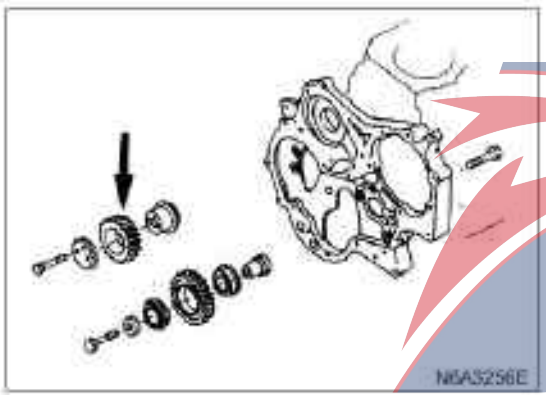
8. Timing gear chamber cover

9. Engine oil pipe

10. Idler

1) Before dismantling the idler, measure the gap of the crankshaft timing gear and the camshaft timing gear.

2) Before dismantling the idler, measure the axial gap of the inert wheel.



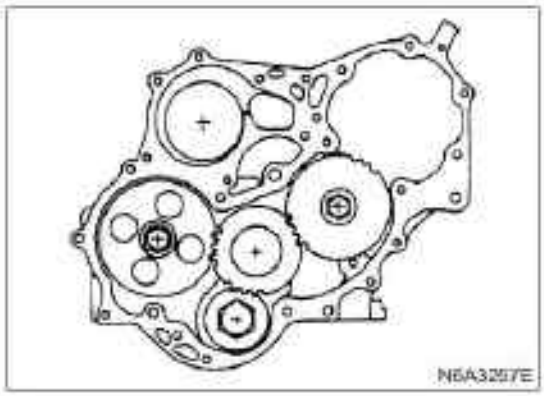
Caution:

Please refer to the following measuring procedure for backlash and axial clearance.

11. Backlash measurement of timing gear

1) Install the micrometer gauge measuring timing gear.

While checking the gear, the adjacent gear should be kept still.



2) Move the gear to the left and right and check it.

Read the reading on the micrometer gauge.

If the measured value exceeds the specified limit, the timing gear should be replaced.

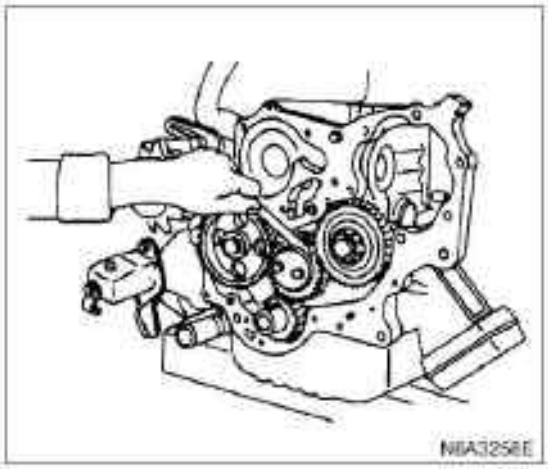
Timing gear backlash	mm(in)
Standard	Limit
0.10—0.17(0.0039—0.0067)	0.30(0.012)

12. Measurement of the axial gap of inert "A"

Insert a micrometer between the inert and the thrust ring to measure the gap value and determine the axial gap of the inert wheel.

If the measured value exceeds the specified limit, the thrust ring should be replaced.

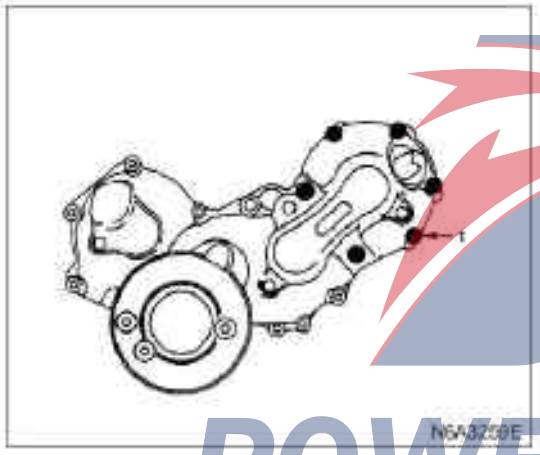
Axial gap of "A" in inert wheel	mm(in)
Standard	Limit
0.07(0.0028)	0.20(0.0079)



13. Idler

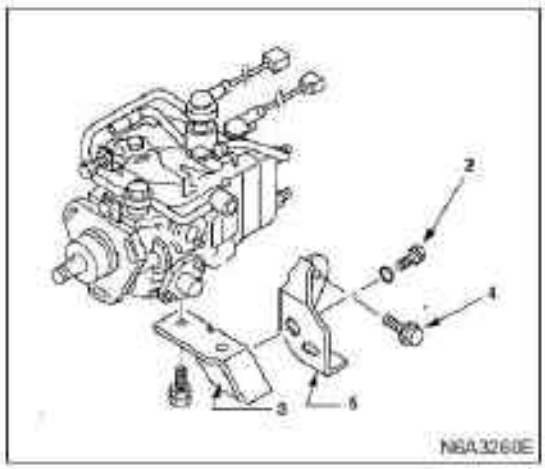
14. injection pump

1) Disassemble 6 fuel injection pump support bolts (1) from the timing gear chamber.



2) Disassemble the bolt (2) from the fuel injection pump bracket (3).

3) Disassemble the rear support bolt (4) and fuel injection pump bracket (5) from the cylinder block.



4) Drag out the injection pump and the timing gear of the fuel injection pump to the rear of the engine.

Caution:

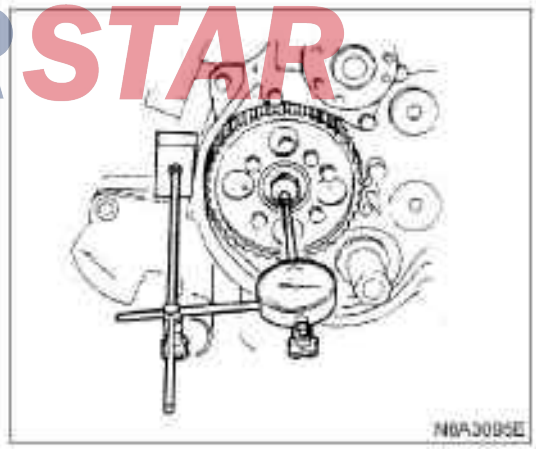
Plug the hole of the oil pump out of the oil valve with the cover (or other similar objects) to prevent the foreign object from entering.

15. Timing gear of camshaft

1) Measure camshaft axial gap with micrometer gauge. The measurement shall be performed before dismantling the gear of the camshaft.

If the measured value exceeds the specified limit, the thrust plate should be replaced.

Camshaft gap	mm(in)
Standard	Limit
0.050—0.114 (0.002—0.0044)	0.2(0.008)



2) Disassemble the camshaft timing gear bolts from the camshaft.

Caution:

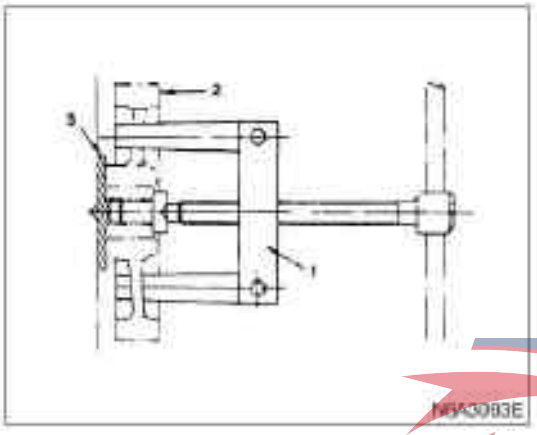
Keep the camshaft still to prevent the camshaft from rotating.

3) Use the universal puller (1),

Pull out the camshaft timing gear (2).

Universal puller 5-8521-0002-0

4) Disassemble the thrust plate (3)



16. Crankshaft gear

Install

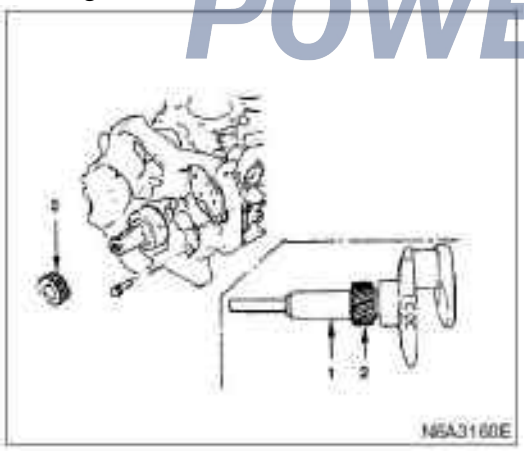
1. Crankshaft gear

1) Install the crankshaft gear

2) Install the crankshaft gear (2) with the crankshaft gear erector (1).

The crankshaft timing gear mark ("X - X") or ("· — ·") should be facing out.

crankshaft gear installer: 9-8522-0020-0



2. Timing gear of camshaft

1) Install the thrust plate to the cylinder block.

2) Tighten the thrust plate bolts to the specified torque.

Tightening

• 18 N·m(1.8 kg·m/13 lb·ft)

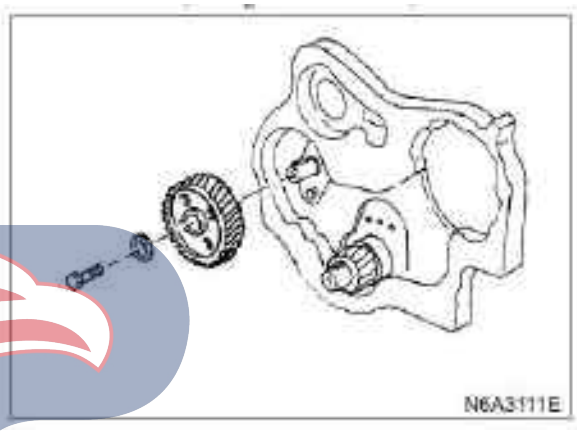
3) Install the crankshaft timing gear on the camshaft.

The camshaft timing gear mark ("Y - Y") or ("·· — ··") should be facing out.

4) Tighten the timing gear to the specified torque.

Tightening

• 4 N·m(6.5 kg·m/47 lb·ft)

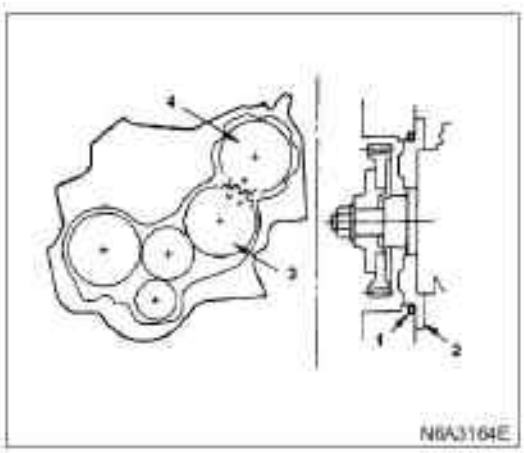


3. injection pump

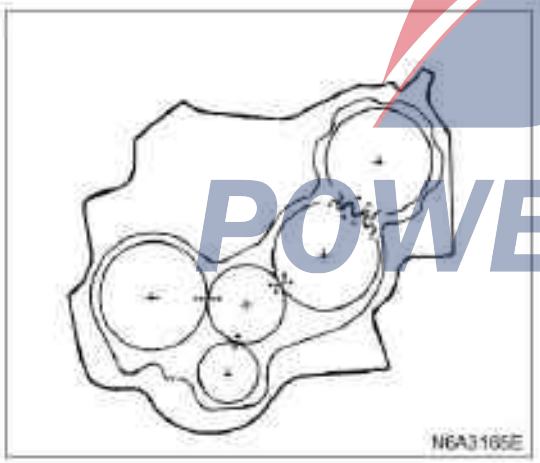
1) Install the O ring (1) on the fuel injection pump flange (2).

2) Install the fuel injection pump on the timing gear chamber.

Align the "B" (3) "V - V" or ": -:" mark of the idler with the "V" or ":" mark of the injection pump timing gear (4).

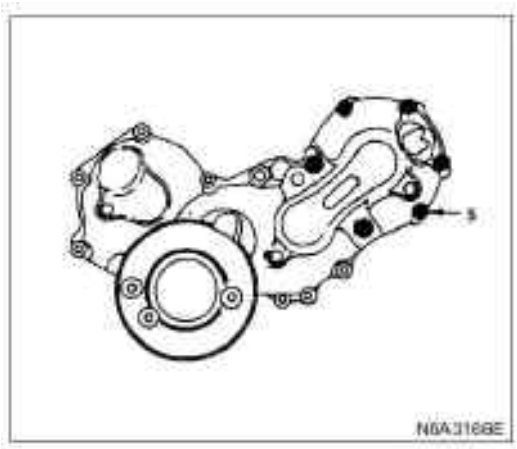


Gear	4JB1-TC,4JG2	4KH1TC
Crank gear - Idler "A"	X — X	
Idler "A" - cam gear	Y — Y	
Idler “A--- Idler “B”	Z — Z	
Idler "B" - fuel injection pump	V — V	



Fasten 6 fuel injection pump bolts (5) temporarily.

Tighten the fuel injection pump bolts after fastening the rear support bolts of the fuel injection pump.

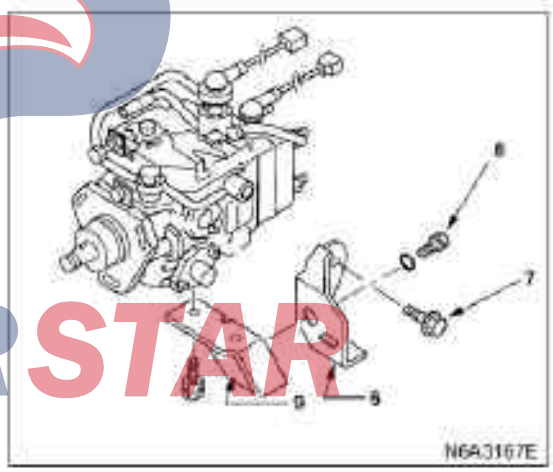


4) Install the fuel injection pump bracket (6) and the rear support bolt (7) on the cylinder block.

5) Install the rear support bolt (8) on the fuel injection pump bracket (9).

Do not tighten the bolts.

After tightening the oil pump nut, tighten the rear support bolts (7) and (8) to the specified torque.



6) Tighten the fuel pump nut to the specified torque.

Tightening

- 19 N·m (1.9 kg·m/14 lb·ft)

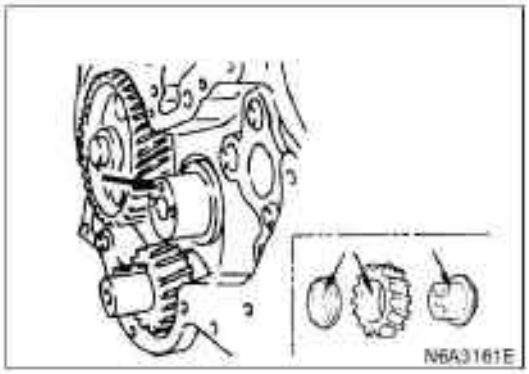
7) Tighten the fuel pump support bolt to the specified torque.

Tightening

- 19 N·m (1.9 kg·m/14 lb·ft)

4. Idler

1) Apply engine oil onto the idler and idler shaft.



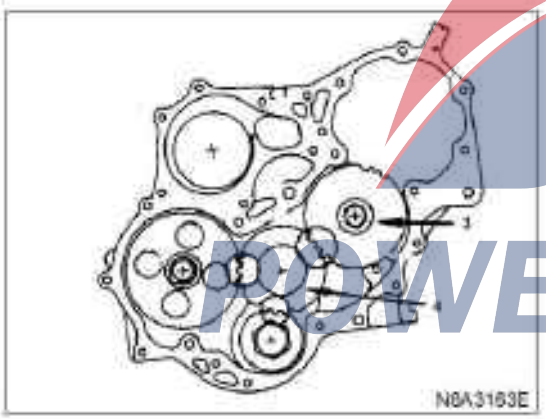
The oil hole of the idler shaft shall face upward.

2) Make the idler positioning mark "X" or "·" and "Y" or "· ·" to align them to the front of the engine.

.

3) Align the positioning mark "X" or "·" of the idler with "X - X" or "· - ·" of the timing gear of the crankshaft (1).

4) Align the positioning mark "Y" or "·" of the idler with "Y - Y" or "··— ··" on the camshaft timing gear (2).



5) Install the thrust ring and bolt through the shaft to the cylinder block. The oil hole of the thrust ring should be upwards and the thrust ring of the chamfer should be outward.

6) Tighten the idler bolt of the idle wheel to the specified torque.

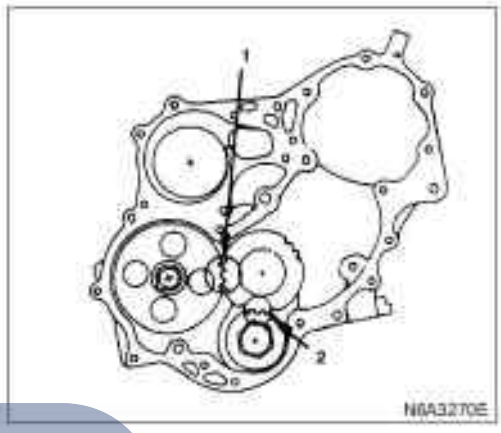
Tightening

• 19 N·m (1.9 kg·m/14 lb·ft)

5. Idler

1) Apply engine oil onto the idler and idler shaft.

2) Align the positioning mark "B" (3) "Z" or "·" on the idler with "A" (4) "Z - Z" or ":-:" of the idler. Positioning mark



3) Tighten the idler bolt of the idle wheel to the specified torque.

Tightening

• 76 N·m (7.7 kg·m /56 lb·ft)

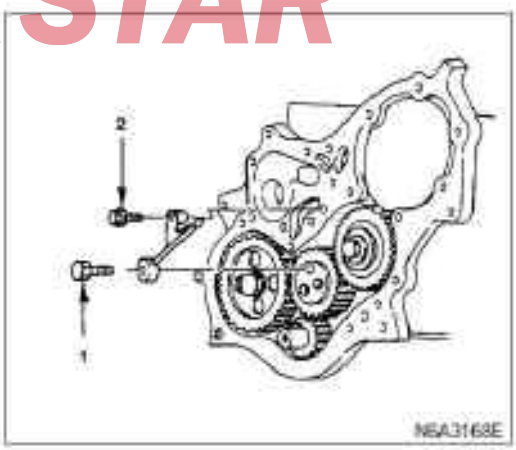
6. Engine oil pipe

1) Install the oil pipe to the timing gear chamber and the idler "A".

2) Tighten the eye-bolt (1) and the bolt (2) of the oil pipe to the specified torque.

Tightening

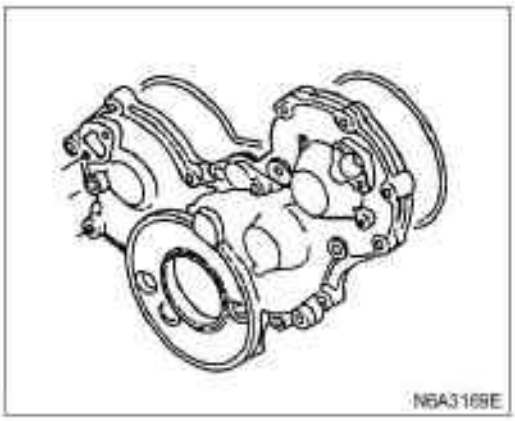
• 13 N·m (1.3 kg·m /9 lb·ft)



7. Timing gear chamber cover

1) Align the timing gear chamber with the positioning pin, and install the timing gear chamber cover.

2) Tighten the gear chamber cover bolt to the specified torque.



8. Acoustic enclosure gasket

9. Acoustic enclosure

10. belt pulley of crankshaft damper

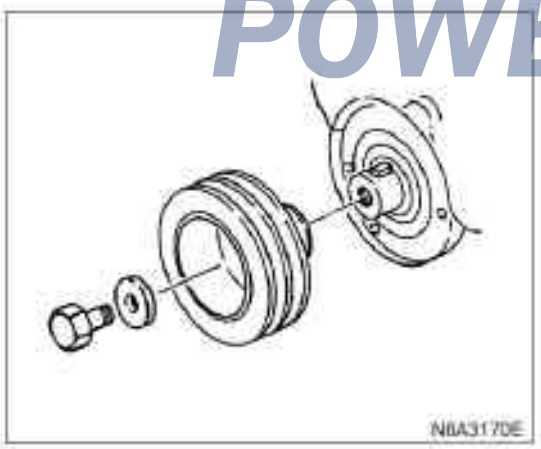
Tighten the bolt of the crankshaft damper belt pulley to the specified torque.

Caution:

The flywheel is made to be in static state so as to prevent crankshaft rotation while tightening the damper belt pulley.

Tightening

· 206 N·m (21 kg·m/152 lb·ft) for pulley flange bolts.



11. Cooling fan assembly

· Install the fan belt, septum and cooling fan assembly on the pump in order and tighten them to the specified torque.

Tightening

• 8 N·m (0.8 kg·m /69 lb·in)

12. drive belt of the AC generator.

· Install the transmission belt of the alternator and adjust the tightness of the belt.

· Apply the force of 98 N (10 kg/22 lb) to the central position of the transmission belt.

drive belt deflection	mm (in)
8 (0.31) — 12 (0.47)	

· Tighten the idler locking nut to the specified torque.

Tightening

· 27 N·m (2.8 kg·m/20 lb·ft) for idler locking nuts

13. Drive belt (P/S type) of power steering pump

· Install the transmission belt of the power steering pump and adjust the tightness of the belt.

· Apply the force of 98 N (10 kg/22 lb) to the central position of the transmission belt.

drive belt deflection	mm (in)
8 (0.31) — 12 (0.47)	

· Tighten the idler locking nut to the specified torque.

Tightening

• 27 N·m (2.8 kg·m /20 lb·ft)

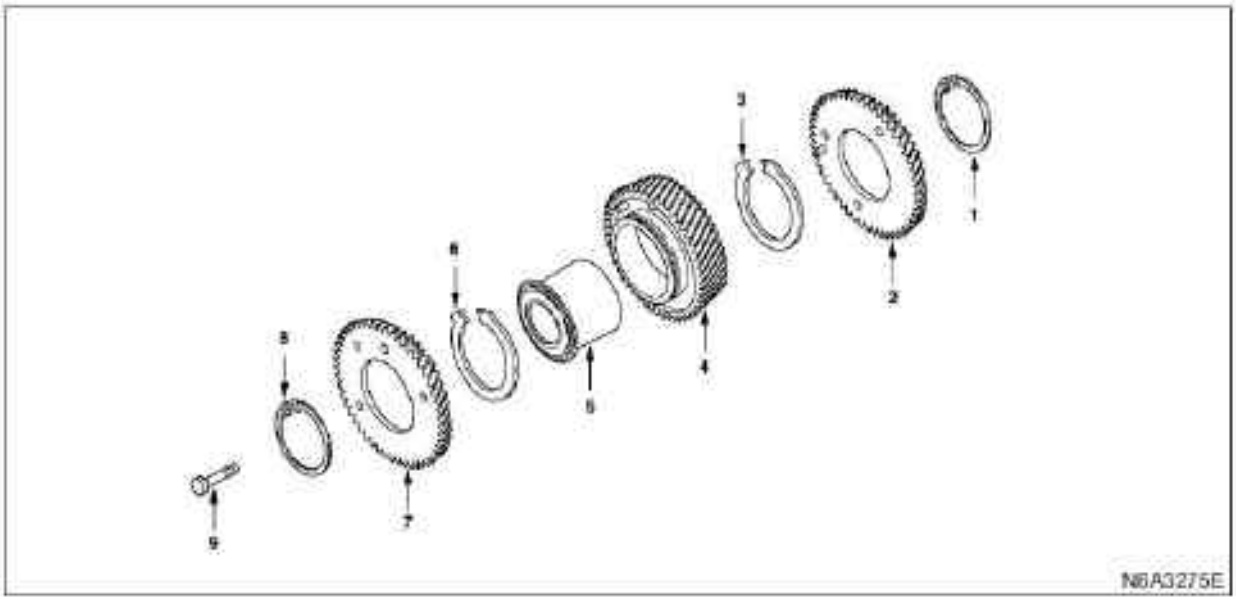
14. Fan wind scooper

· Install the fan guide cover and the water tank hose.

· Pour into the coolant

· Start the engine and check the leakage of the coolant

Inert "B" (4KH1-TC shear gear)

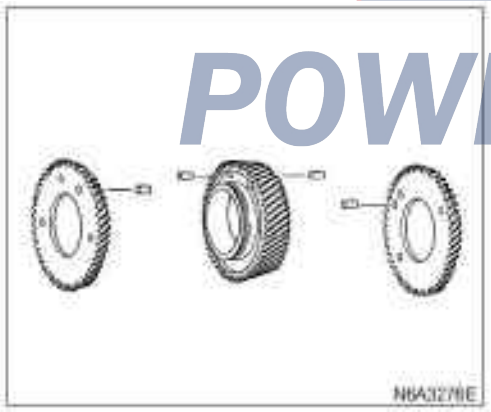


Legend

1. Stop ring
2 . Rear gear
3 . spring
4. bull gear
5. bearing
6 . spring
7. Front gear
8. Stop ring
9. Lock bolt

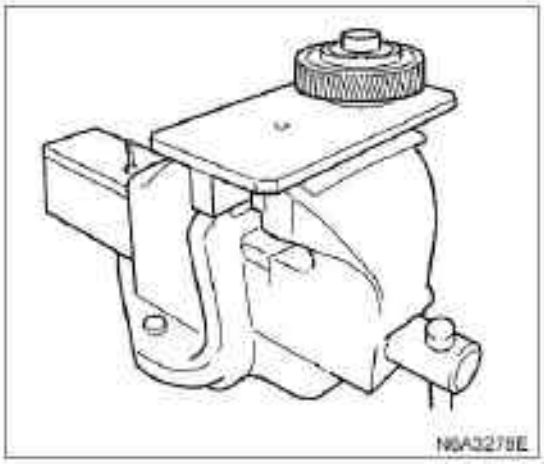
Assembling

1. Insert the pin into the main gear, the front gear and the rear gear.

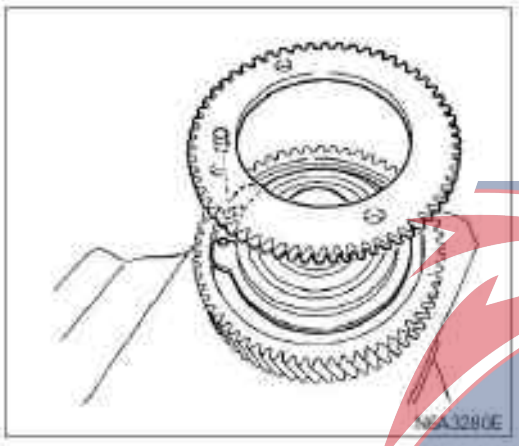


2. Exert force from the front of the main gear (on the side with the slot) to the main gear bearing.

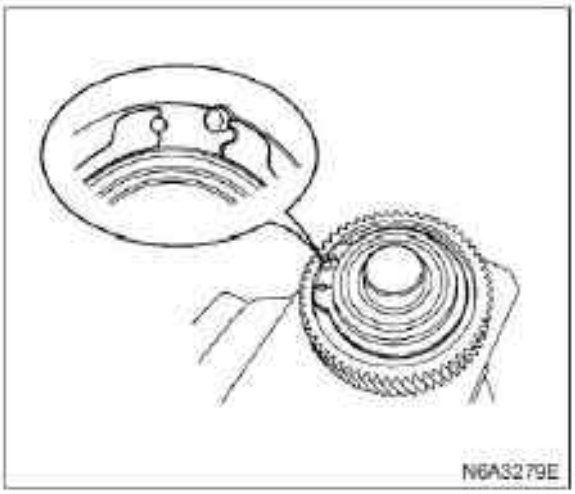
3. Place special tools on the bench clamp to facilitate turning back the main gear.
Shear gear installation tool
Support 5-8673 9-14 9-0



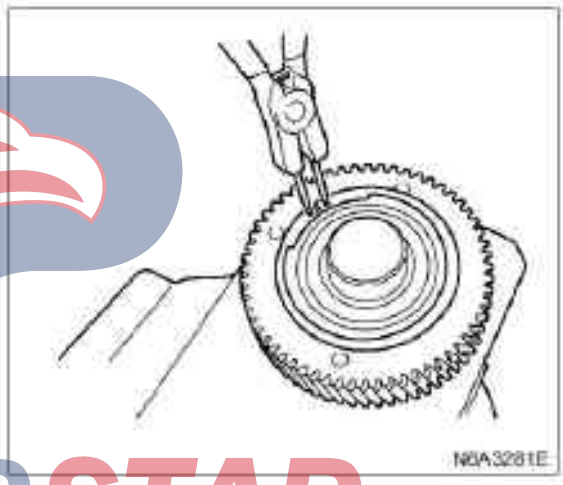
4. Install the spring with reference to the illustration.



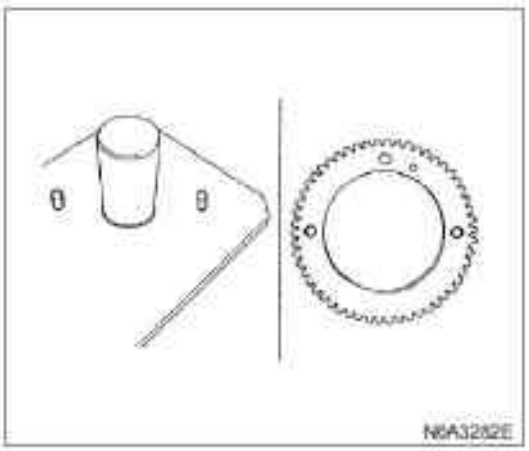
5. Place the rear gear correctly to align the pin with the receiving end of the spring.

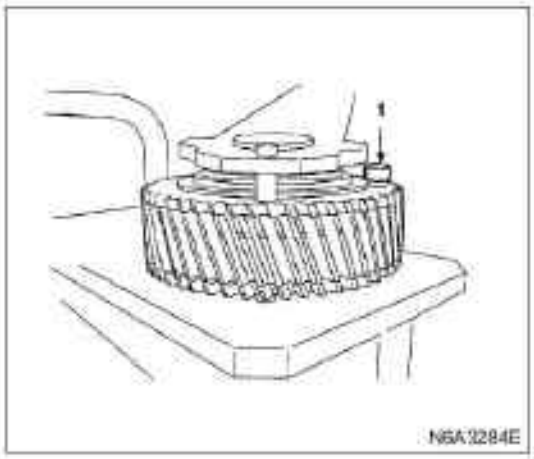


6. Install the check ring to the main gear slot.

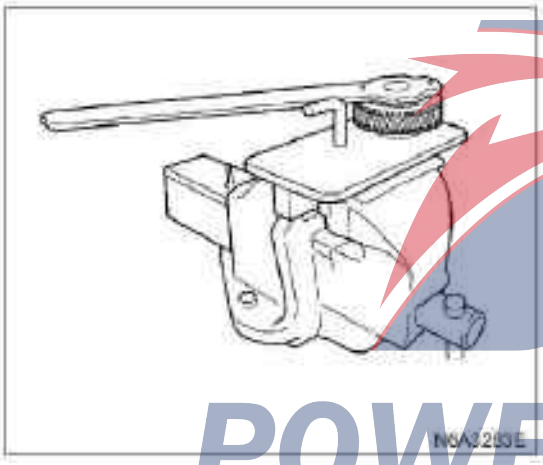


7. Insert the rear gear into the special tool shaft.



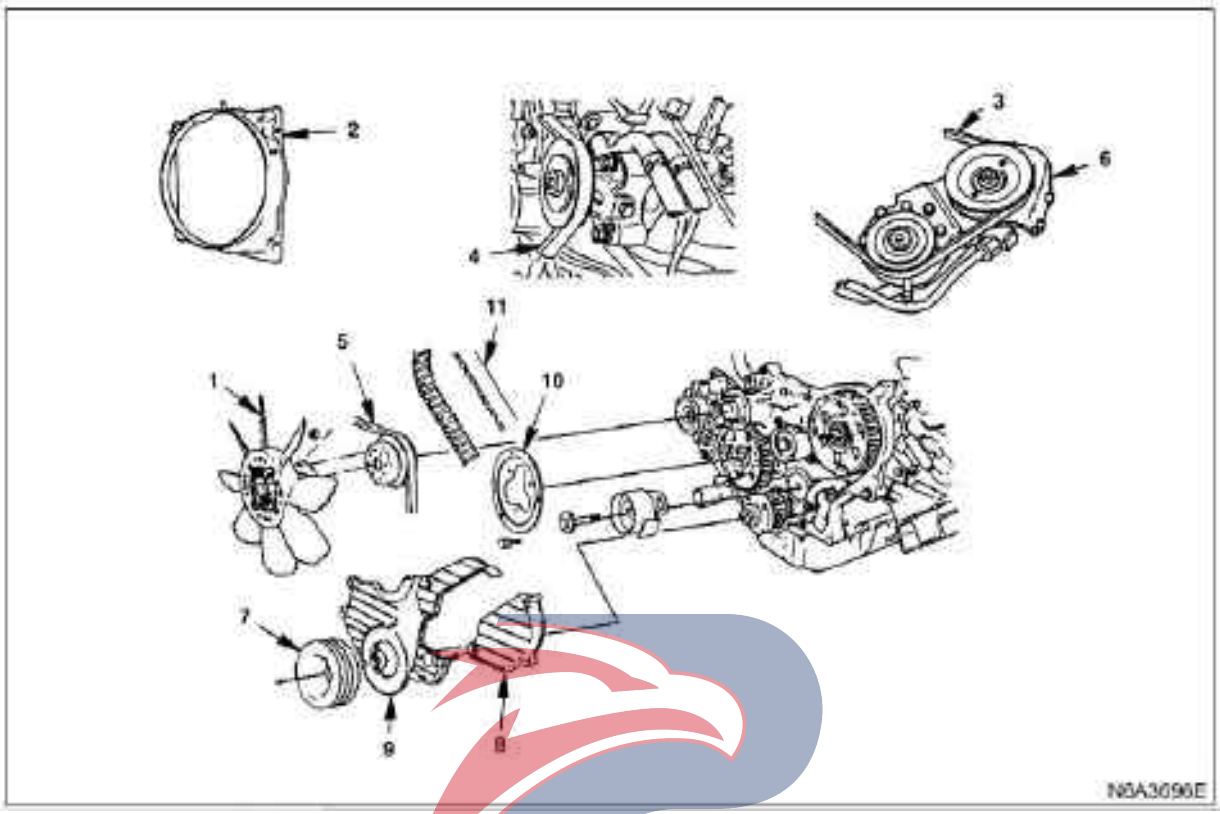


8. Place the special tools on the bench clamp to facilitate turning the main gear forward.
9. Repeat steps 3, 4 and 5.
10. Mutually mesh the teeth of the front gear, bull gear and rear gear using special tools.



11. Insert a locking bolt (M6 × 1.00 L = 30) (1) to the shear gear to prevent the rotation of the shear gear.
Shear gear mounting tool bar: 5-8 6 7 3 9-1 5 0-0

Timing belt pulley (4JG2 belt type)



Legend

1. Cooling fan assembly
2. Fan wind scooper
3 .Drive belt of power steering pump
4. Drive belt of the A/C compressor
5. Drive belt of the AC generator.
6. Power steering pump and bracket assembly
7. Belt pulley of crankshaft damper
8. Upper cover of timing belt pulley
9. Lower cover of timing belt pulley
10. Flange and camshaft belt
11. Timing belt pulley

Dismantling

Preparation

· Disconnect the grounding wire of the storage battery

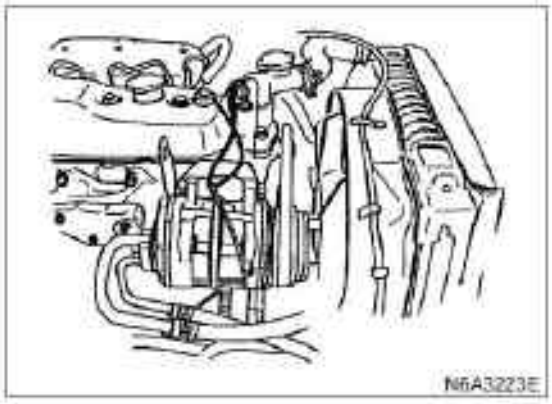
· Discharge coolant.

1. Cooling fan assembly

· Disassemble fastening nut and cooling fan assembly, long distance pipe and fan pulley.

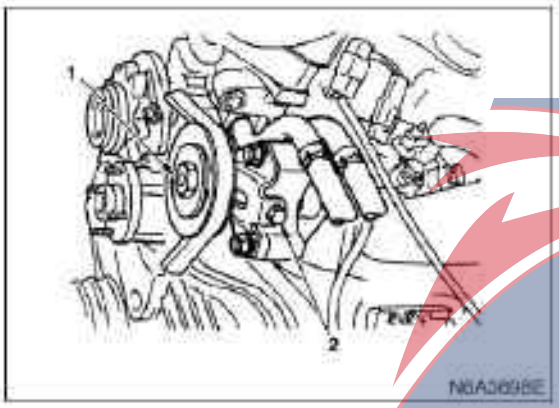
2. Fan wind scooper

· Disassemble the water tank hose and fan guide cover



3. Drive belt (P/S type) of power steering pump

·Unscrew the power steering pump to adjust the wheel locking nut and the adjusting bolt and disassemble the transmission belt.

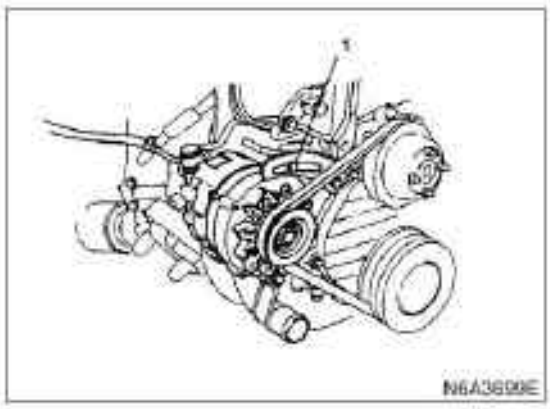


4. Drive belt (A/C type) of the A/C compressor

· Unscrew the locking nut (1) and adjusting belt (2) of the adjusting wheel of air conditioner compressor, and disassemble the transmission belt.

5. drive belt of the AC generator.

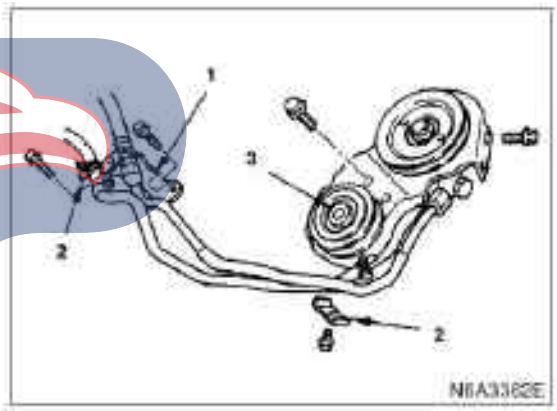
·Unscrew the fixing bolt (side lower part) and the locking bolt (1) of the adjusting plate of the alternator, and disassemble the transmission belt.



6. Power steering pump and bracket assembly (P/S type)

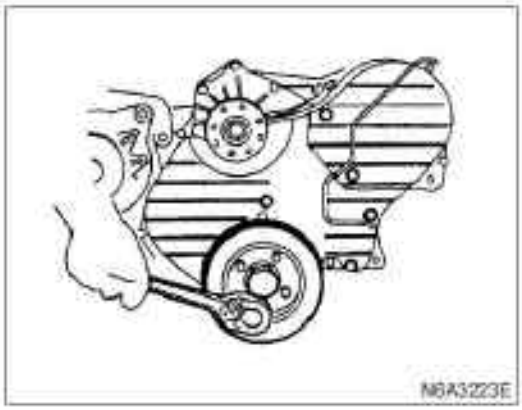
· Unscrew the support (1) and the clamp (2) of the power steering pump.

· Disassemble and hang the support assembly of the power steering pump.

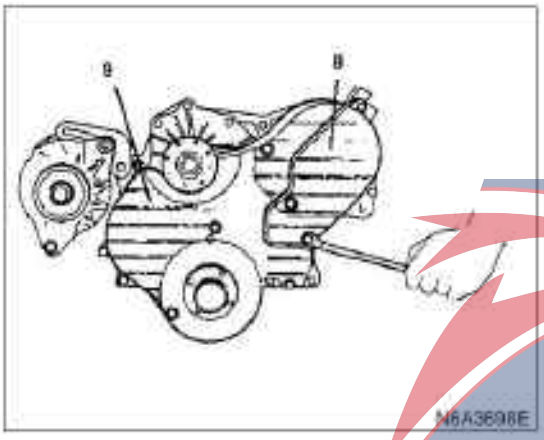


Legend

1. Pipe support
2. Hoop
3. Locking nut
7. belt pulley of crankshaft damper



8. Upper cover of timing belt pulley
9. Lower cover of timing belt pulley

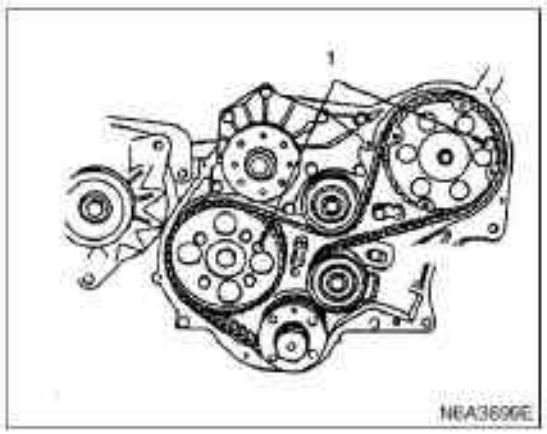


10. Flange and camshaft belt
11. Timing belt pulley

· Prepare a fixing bolt (M8 × 40, P = 1.25).

· Rotate the camshaft timing pulley in the direction of normal operation until the mark on the pulley is aligned with that of the timing belt chamber.

· Ensure that the bolt holes of the camshaft pulley and the timing pulley are matched. Then screw in the mounting bolt (1) and tighten it gently.

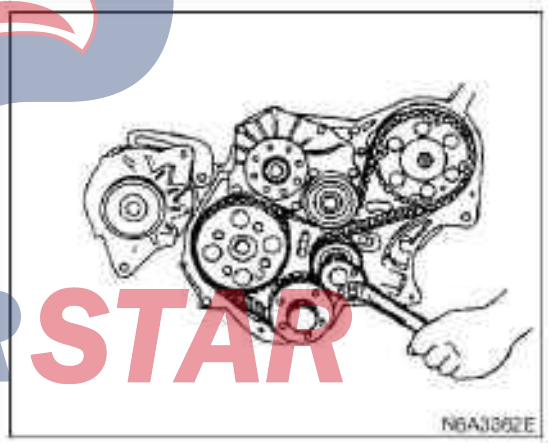


· Cylinder 1 should be located at the top dead center. If the fixing bolt hole is not aligned (Cylinder 4 is located at the top dead center), turn one more circle.

· Disassemble the tensioner and the timing pulley

Warning:

If the crankshaft and camshaft are rotating when there is no timing belt, the piston and the valve will interfere with each other. Therefore, the crankshaft and the camshaft should not be rotated at this time.



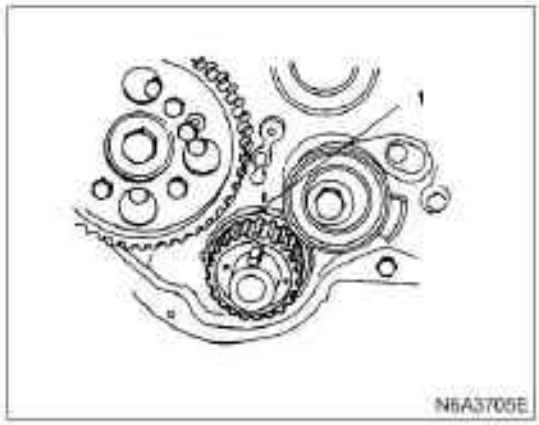
Install

1. Timing belt pulley

· When the belt is disassembled, ensure the marks on the bolt fixed camshaft, the jet pulley and the crankshaft timing pulley are aligned with each other (1).

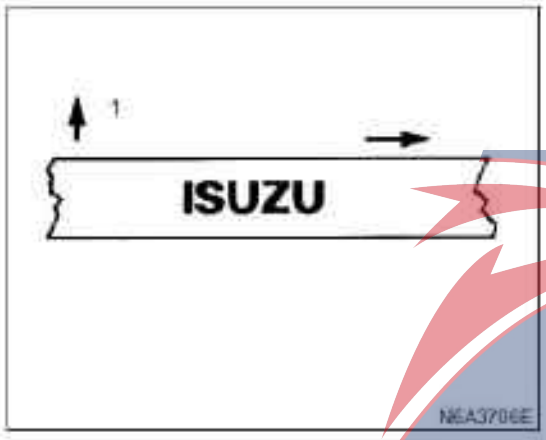
Tips:

Do not turn the crankshaft, because the piston and the valve may interfere with each other.



Tips:

In order to assemble preciously, be sure to install the belt in the direction as stated in the text on the belt.

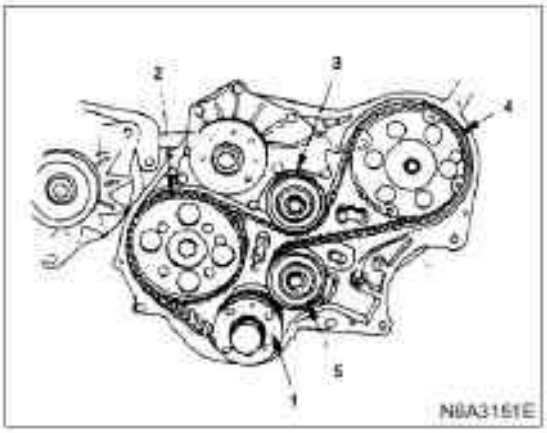


Legend

1. Cylinder cover side

· Follow the following steps to install a new timing belt on the pulley.

Crankshaft timing pulley (1) → camshaft timing pulley (2) → inert wheel (3) → oil injection pump pulley (4) → tension pulley (5)



· Install the belt on the timing pulley of the crankshaft and hold it with one hand.

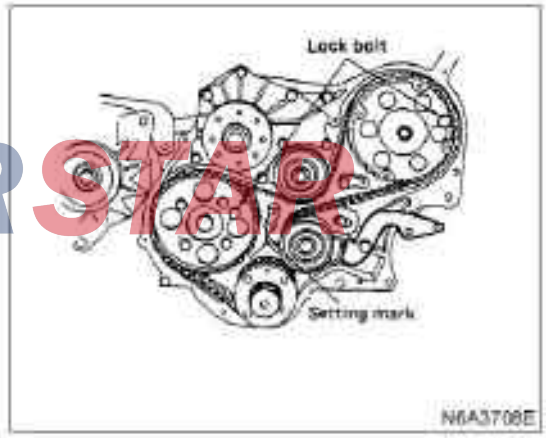
· Stretch the belt and wind it on each pulley with the other hand.

· After winding the belt on the injection pump pulley, install tension pulley and be careful not to loosen the belt.

Tips:

· After winding the belt, ensure the alignment of the positioning mark on the timing pulley of the crankshaft.

· If unmarked and unaligned, readjust the mark and re-wind the belt.

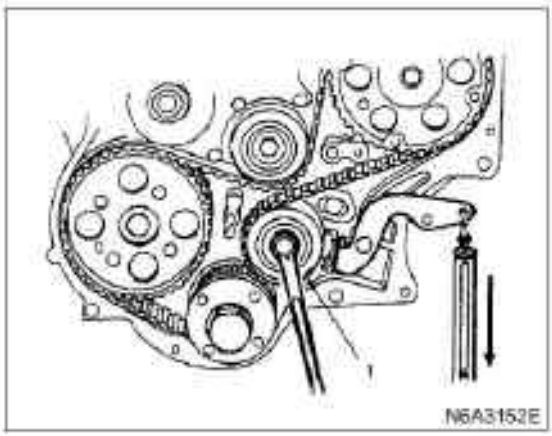


Legend

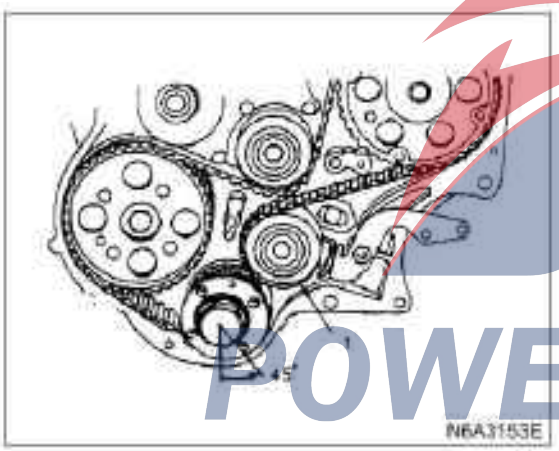
1. Lock bolt
2. Positioning mark

· Disassemble the fixing bolt of the tightness adjustment lever and unscrew the support bolt until the rod can be disassembled.

· Hang a spring balance on the tail hole of the tensioner adjustment lever. When hanging the spring with the force if 9kg, screw down the fixing bolt of the tensioner (1), and then tighten the bolt again.



·Rotate the crankshaft 45 degrees in the counter clockwise direction to eliminate the relaxation of the belt with the tension pulley.



· Hang a spring scale on the tail hole of the tensioner adjustment lever again, and lift the spring scale with the specified force. In this case, unscrew the bolt to absorb the relaxation of the belt and re-tighten it to the specified torque.

Belt	N·(kg/lb)
Tightness	98—118(10—12/22—26)

Tightening

· 76 N·m (7.8 kg·m/56 lb·ft) for bolts

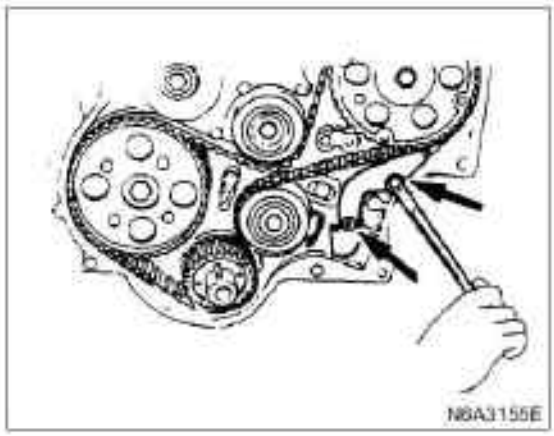
· Install adjusting rod of the tensioner

Tips:

· If the timing belt is replaced according to the warning light, the back switch of the instrument should be replaced to extinguish the indicator light.

· Please refer to Chapter 8 “Chassis and Wiring”

· Tighten the tightness adjustment rod nuts and bolts.

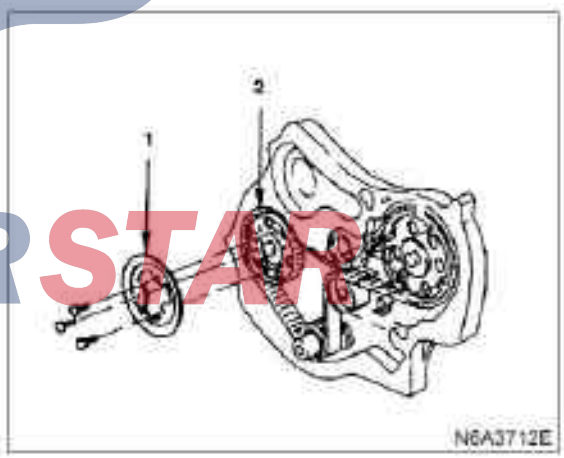


2. Flange and camshaft belt

· Install timing wheel flange (1) on the timing pulley (2) of the cam.

Tightening

· 19 N·m (1.9 kg·m/14 lb·ft) for flange bolts



3. Lower cover of timing belt pulley

· Install the lower cover of the timing pulley and screw the cover the specified torque.

Tightening

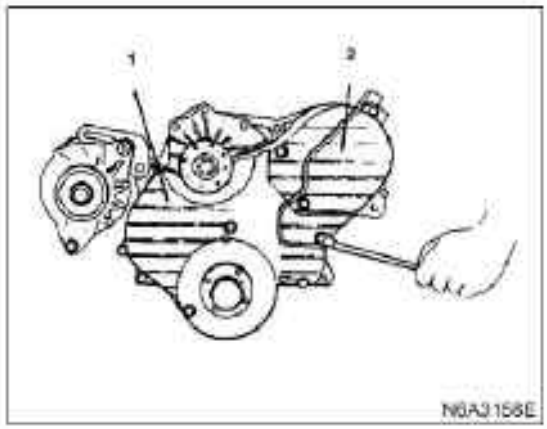
· 8 N·m (0.8 kg·m/69 lb·ft) for bolts of pulley head cover.

4. Upper cover of timing belt pulley

· Install the upper cover of the timing pulley and screw the bolt to the specified torque.

Tightening

· 8 N·m (0.8 kg·m/69 lb·ft) for pulley head.



Legend

1. Lower cover
2. Upper cover

5. belt pulley of crankshaft damper

· Install the crankshaft shock absorber pulley and tighten the bolt to the specified torque.

Tightening

?9 N•M(1.9 kg•m/14 lb•ft)

7. Power steering pump and bracket assembly (P/S type)

· Install the pipe supports and hoops and tighten the bolts to the specified torque.

Tightening

· 19 N·m (1.9 kg·m/14 lb·ft) for pipe support bolts.

· 10 N·m (1.0 kg·m/87 lb·ft) for pulley hoop bolts.

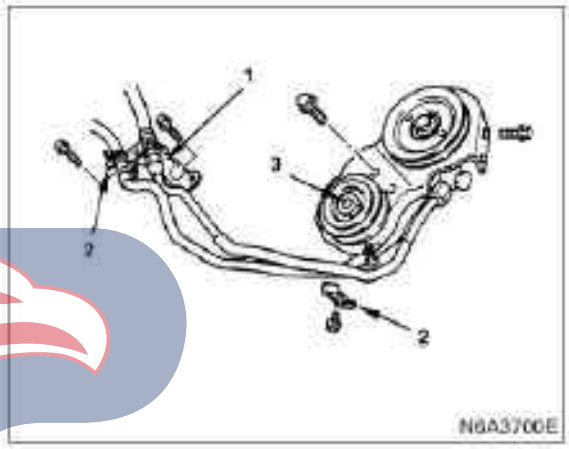
· Install power steering pump and support assembly.

Tightening

·M10 bolt to 40 N·m(4.1 kg·m/30 lb·ft)

·M8 bolt to 19 N·m(1.9 kg·m/14 lb·ft)

· 27 N·m(2.8 kg·m/20 lb·ft) for locking nuts



Legend

1. Pipe support
2. Hoop
3. Locking nut

7. drive belt of the AC generator.

· Install the transmission belt of the alternator and adjust the tightness of the belt.

· Apply the force of 98 N (10 kg/ 22 lb) to the central position of the transmission belt.

drive belt deflection	mm (in)
8(0.31)— 12(0.47)	

· Install the fixing bolt and tighten the bolt to the specified torque.

Tightening

· 40 N·m (4.1 kg·m/30 lb·ft) for fixing bolt of generator

· 19 N. m (1.9 kg. m/14 lb. ft) for adjusting plate fixing bolt

8. Drive belt (A/C type) of the A/C compressor

· Install the transmission belt of the air condition compressor and adjust the tightness of the belt.

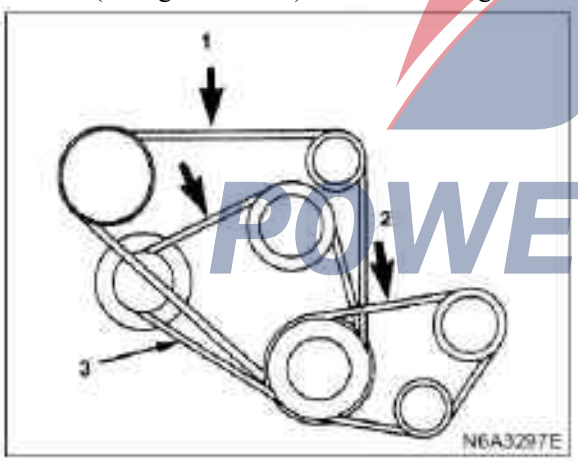
· Apply the force of 98 N (10 kg/ 22 lb) to the central position of the transmission belt.

drive belt deflection	mm (in)
8(0.31)— 12(0.47)	

· Tighten the idler locking nut to the specified torque.

Tightening

· 27 N·m (2.8 kg·m/20 lb·ft) for idler locking nuts



Legend

1. Drive belt of the A/C compressor
2 . Drive belt of power steering pump
3. Alternator and fan pulley

---

9. Drive belt (power steering pump type) of power steering pump

· Install the transmission belt of the power steering pump and adjust the tightness of the belt.

· Apply the force of 98 N (10 kg/22 lb) to the central position of the transmission belt.

drive belt deflection	mm (in)
8(0.31)— 12(0.47)	

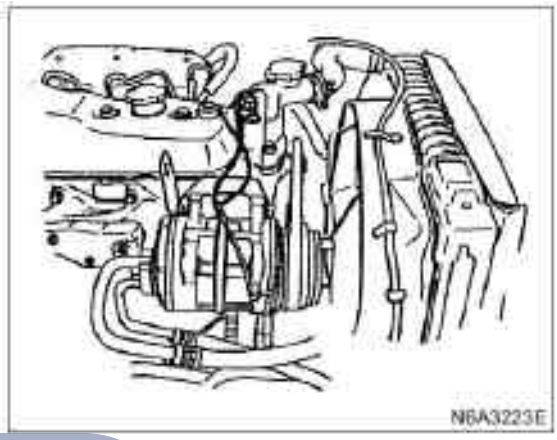
· Tighten the idler locking nut to the specified torque.

Tightening

· 27 N·m (2.8 kg·m/20 lb·ft) for idler locking nuts

10. Fan wind scooper

· Install the fan guide cover and the water tank hose.



11. Cooling fan assembly

· Install the fan belt, septum and cooling fan assembly on the pump in order and tighten them to the specified torque.

Tightening

· 8 N·m(0.8 kg·m/69 lb·ft) for nuts

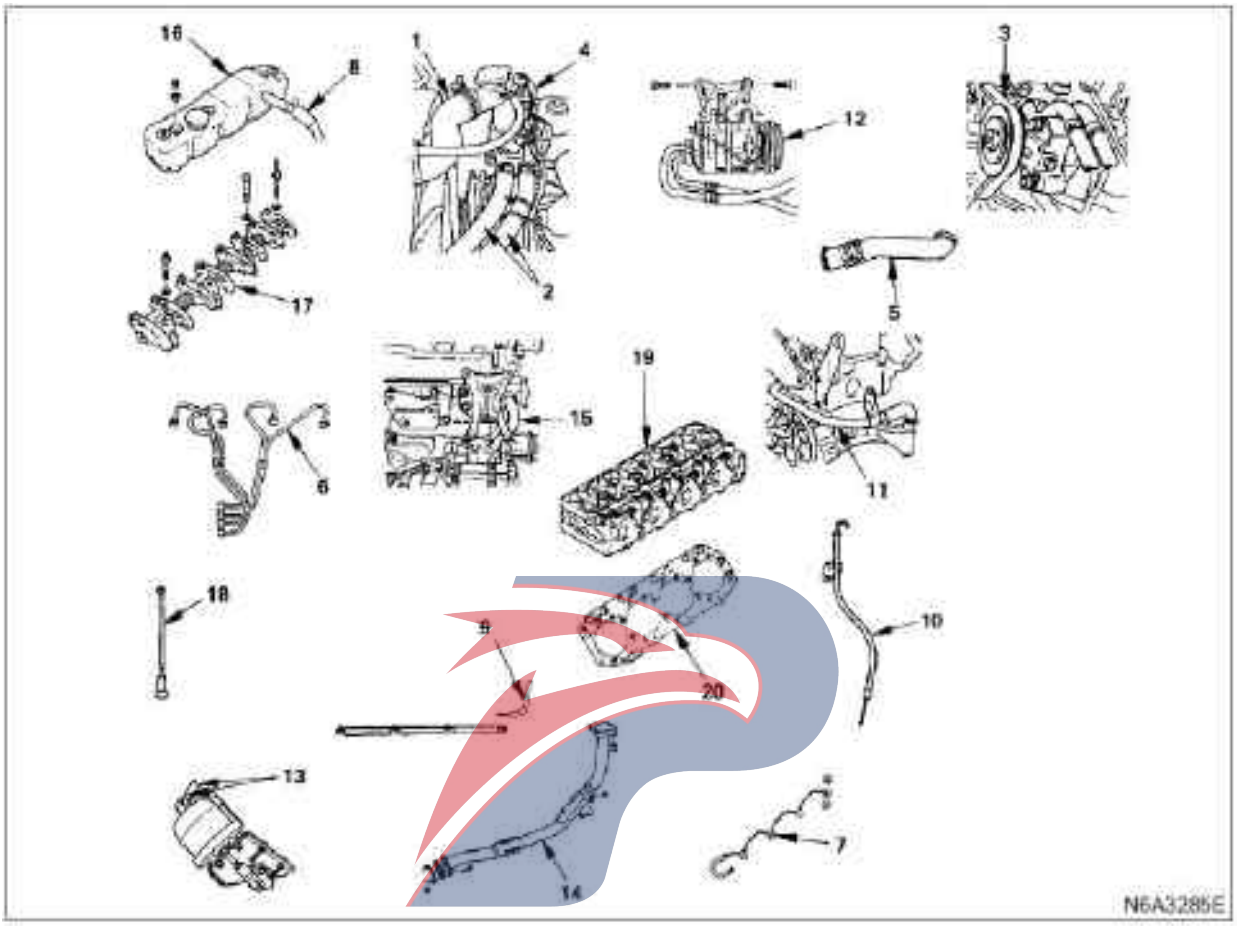
· Connect the grounding wire of the storage battery

· Pour into the coolant

· Start the engine and check the leakage of the coolant

Cylinder head assembly and gasket

Parts



Legend

1. Upper radiator hose
2. Heater hose
3. Drive belt of the A/C compressor
4. Engine harness
5. Intake pipe
6. High pressure oil pipe
7. Return oil pipe
8. PCV Hose
9. Glow plug harness
10. Engine oil dipstick guide
11. Oil cooler pipe
12. A/C compressor assembly
13. Vacuum adjuster hose
14. Front exhaust pipe
15. bypass hose
16. Cylinder head cover
17. Rockshaft
18. Tappet
19. Cylinder cover assembly
20. Cylinder head gasket

Dismantling

Preparation

·Disconnect the grounding wire of the storage battery.

·Disassemble the coolant in the radiator and the engine.

1. Upper radiator hose

· Disassemble the upper hose of the radiator from the side of the engine.

2. Heater hose

· Disassemble the heater hose from the heater tube.

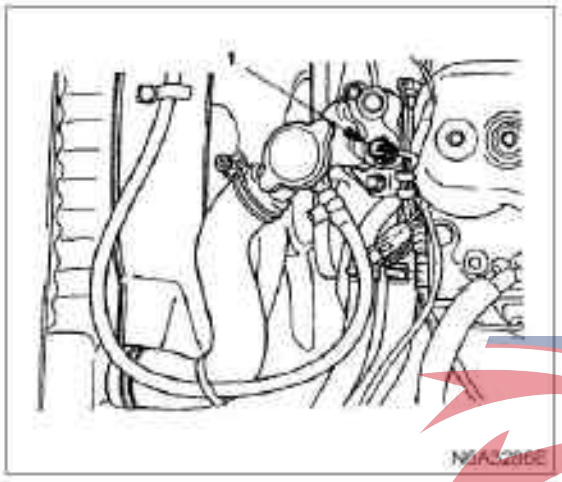
3. AC compressor transmission belt

· Unscrew idler locking nut

· Unscrew the adjusting bolt and disassemble the transmission belt.

4. Engine harness

· Disassemble the wire harness connector from the part on the thermostat housing.



Legend

1. Temperature sensor

---

5. Intake pipe

· Disassemble the hoop and intake pipe.

6. High pressure oil pipe

· Disassemble the hoop of the high pressure oil pipe.

· Disassemble the flared nut of the oil pump.

· Disassemble the flared nut and oil pipe of the fuel injector.

Caution:

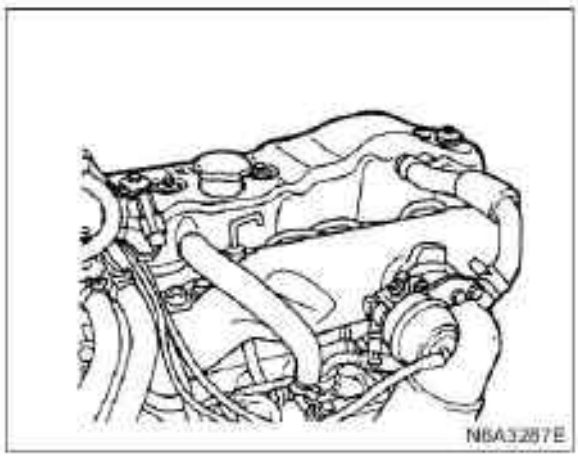
Plug the nozzle of the fuel injector body and the oil outlet valve to prevent the foreign objects from entering.

7. Return oil hose

Disassemble the fuel return hose

8. PCV Hose

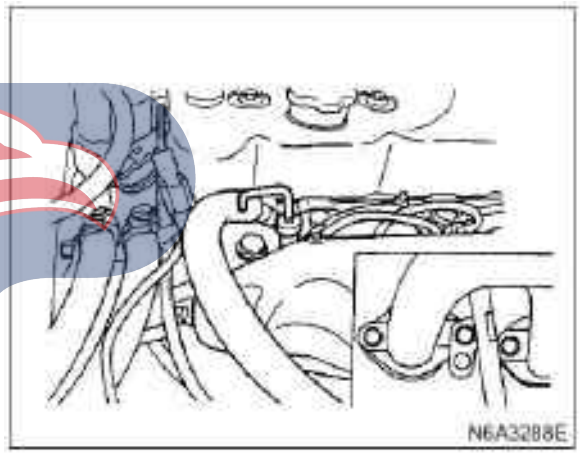
· Disassemble the PCV hose from the intake pipe.



9. Glow plug harness

10. Engine oil dipstick guide

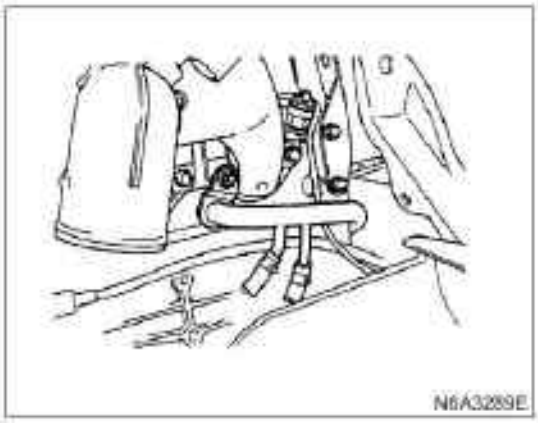
· Disassemble the duct from the cylinder cover.



11. Engine oil cooler water pipe (engine oil cooler type)

· Disassemble the pipe fixing bolt on the back side of the cylinder cover.

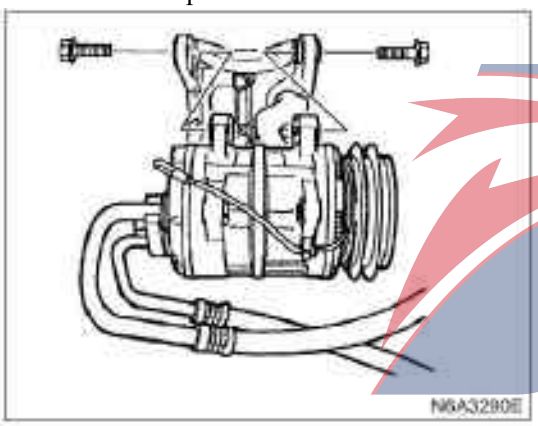
· Disassemble the fixing nut of the oil cooler pipe from the intake manifold.



12. A/C compressor assembly (A/C type)

· Disassemble the clutch wire connector.

· Disassemble the fixing bolt of the air conditioner compressor, and temporarily use the wire to fix the air conditioner compressor to the bottom.



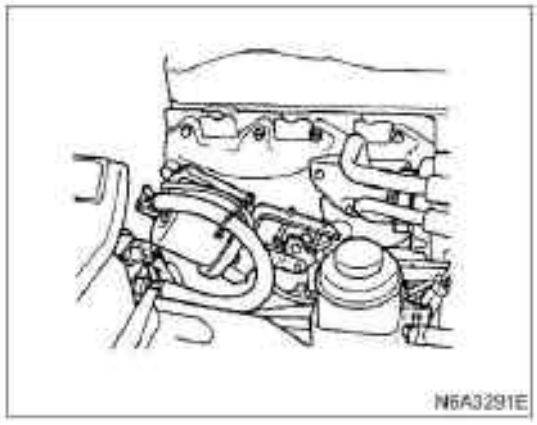
14. Front exhaust pipe

· Disassemble the exhaust pipe fixing bolt from the exhaust manifold.

· Disassemble the exhaust pipe support bolts.

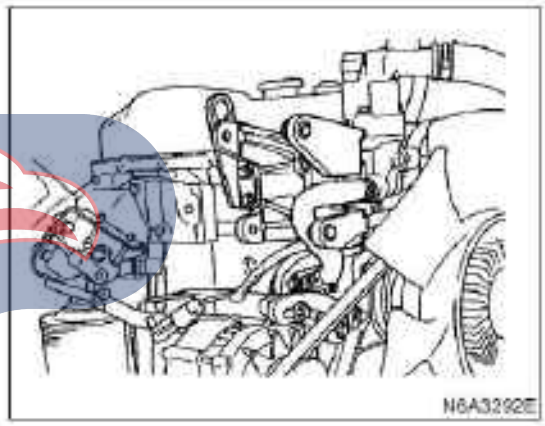
15. bypass hose

16. Cylinder head cover



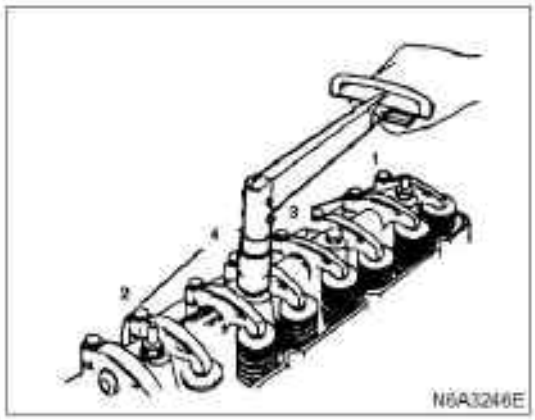
13. Vacuum regulator hose (exhaust brake type)

· Disassemble the vacuum hose from the vacuum adjuster.



17. Rockshaft

· Unscrew the rocker shaft support bolt according to the numerical order shown in the illustration.



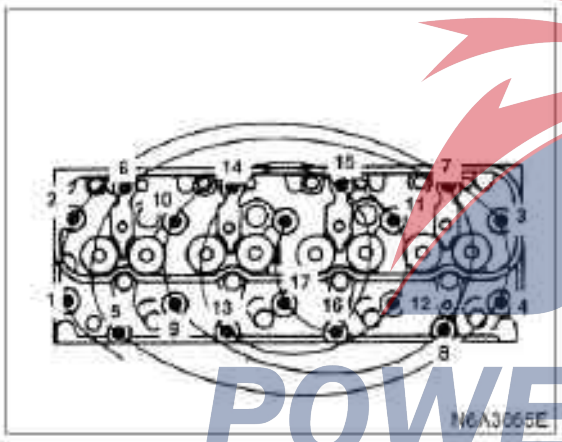
Caution:

Failure to unscrew the rocker shaft support bolts in the numerical order of the illustrations will bring adverse effects on the use of the rocker shaft.

18. Tappet

19. Cylinder head assembly

· Unscrew the rocker shaft support bolt according to the numerical order shown in the illustration.



Caution:

Failure to unscrew the cylinder cover bolts in the numerical order of the illustrations will bring adverse effects on the lower surface of the cylinder cover.

20. Cylinder head gasket

· Disassemble the seal gasket and positioning pin of the cylinder cover.

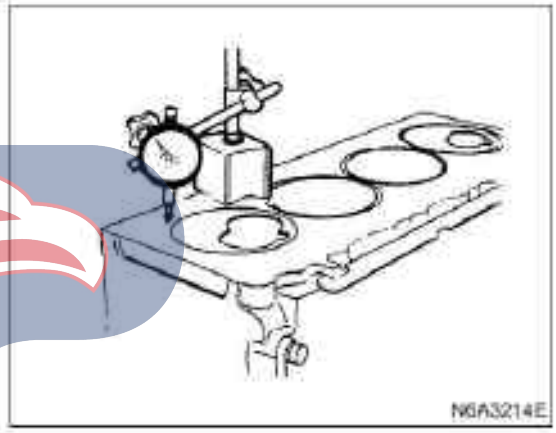
Install

1. Cylinder head gasket

The sealing gasket of the cylinder cover is determined by the protruding part of the piston top relative to the upper surface of the cylinder block to improve the engine performance. According to the thickness, three types of sealing gaskets can be used. According to the above methods, select the most suitable one from the three types of sealing gaskets. Before measuring, clean the carbon deposited on the top of the piston top and the upper surface of the cylinder and the installation position of the sealing gaskets.

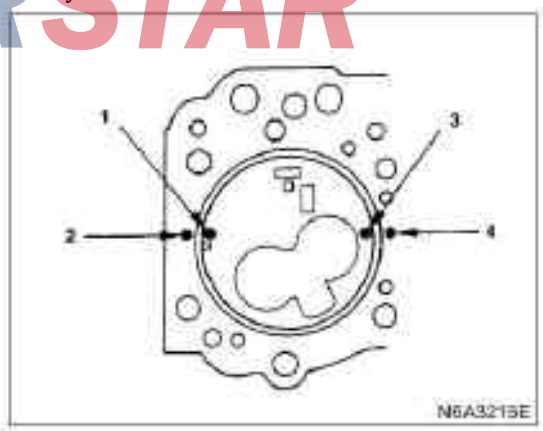
Measuring point of the bulge of piston top

1) Measure the piston protrusion with a micrometer gauge.



2) Please refer to the measurement position of the piston top protruding part in the illustration.

All measuring positions shall be as close as possible to the cylinder liner.



3) Measure Points (1), (2), (3) and (4) to obtain two difference values on each cylinder, that is, the difference values between (1) - (2) and between (3) - (4). Calculate the average value of the protruding part of the piston top on each cylinder.

4) Obtain the maximum value of the four cylinders.

5) According to the provisions of the following table, determine the corresponding grade of sealing gaskets.

4JB1

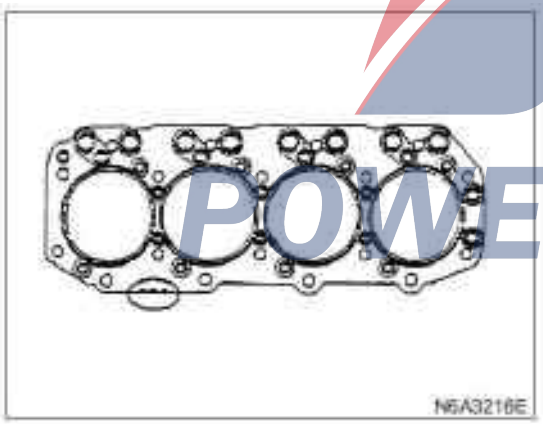
mm (in)

	1	2	3
A		0.758 - 0.813 (0.030 - 0.032)	1.60 (0.0630)
B		0.813 - 0.859 (0.032 - 0.034)	1.65 (0.0650)
C		0.859 - 0.914 (0.034 - 0.036)	1.70 (0.0670)

N6A3699E

Caution:

The difference between the measured maximum piston top convex value and minimum one shall not exceed 1.0 mm(0.039 in).



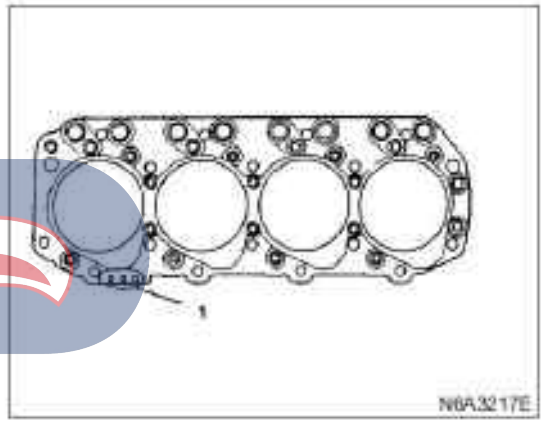
N6A3216E

4JG2

mm (in)

	1	2	3
A		0.858-0.713 (0.0259-0.0281)	1.60 (0.0630)
B		0.713-0.759 (0.0281-0.0299)	1.65 (0.0650)
C		0.759-0.814 (0.0299-0.0320)	1.70 (0.0670)

N6A3693E

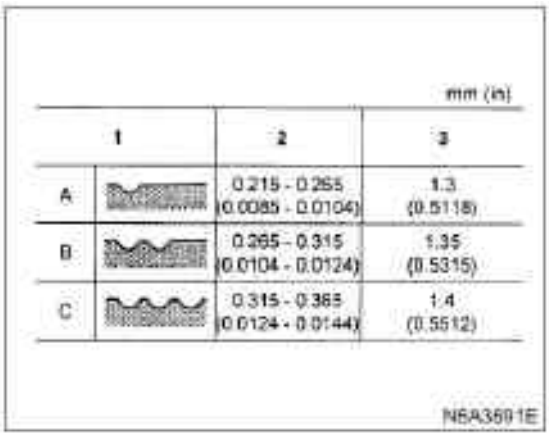


N6A3217E

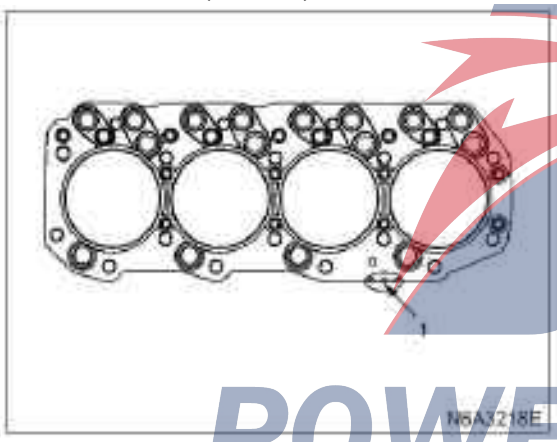
Legend

1. Grade symbol

4K H1-TC



Caution:
The difference between the measured maximum piston top convex value and minimum one shall not exceed 1.0 mm(0.039 in).



Legend

1. Grade symbol

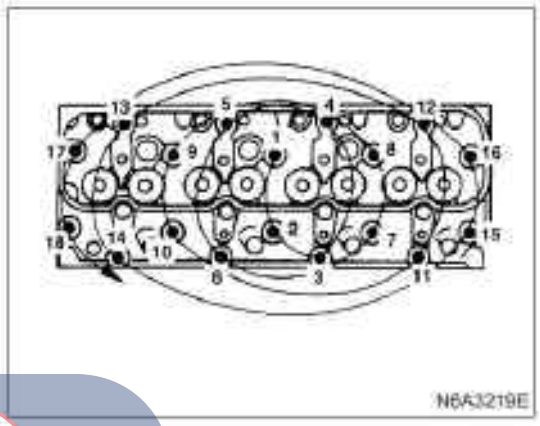
---

2. Cylinder head assembly

1) Install the positioning pin on the cylinder block.
2) Install the sealing gasket of the cylinder cover to keep the mark upwards.
3) Clean the lower surface of the cylinder cover and the upper surface of the cylinder block.
4) Install cylinder cover cautiously and carefully.
5) Apply the engine oil to the bolt screw thread and the cylinder seat surface.
6) Tighten the cylinder cover bolts to the specified torque in 3 steps according to the numerical order in the figure.

Tightening

Cylinder cover bolt
Step 1: to 49 N·m(5kg·m/36 lb·ft)
·Step 2: 60°— 7 5°
·Step 3: 60°— 7 5°

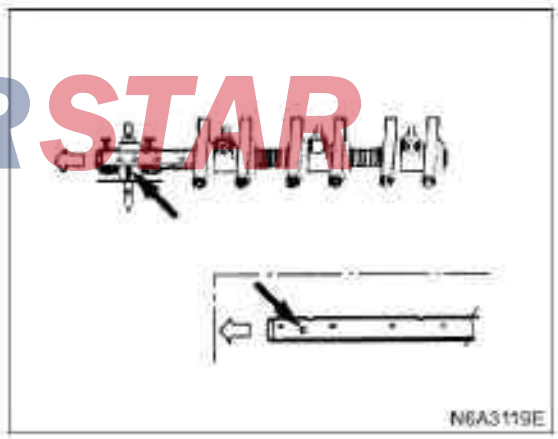


3. Tappet

· Apply the engine oil to the tappet and the cylinder cover.

4. Rockshaft

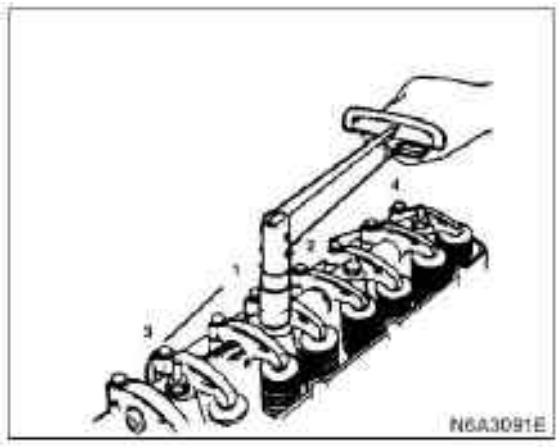
1) Unscrew all the adjusting screws.
2) Align rocker shaft oil hole (4) toward the front of the engine.



3) Tighten the rocker shaft support bolt to the specified torque according to the numerical order shown in the illustration.

Tightening

· 54 N·m (5.5kg·m/40 lb·ft) for rocker shaft support nuts



· Valve gap adjustment

For the above operations, please refer to the "Rocker Shaft Assembly" Chapter of this Manual.

5. Cylinder head cover

· Apply the engine oil on the rocker arm and the valve spring.

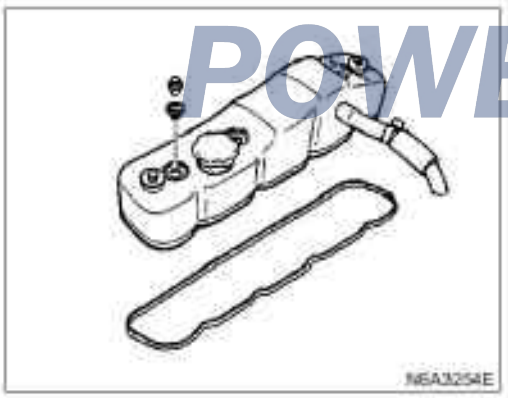
· Mount the cylinder cover liner on the cover of the cylinder cover.

· The liner should be smooth and undamaged.

· Tighten the Cylinder Cover nut to the specified torque according to the numerical order shown in the illustration.

Tightening

· 13 N·m (1.3 kg·m/113 lb·in) for Cylinder Cover



6. bypass hose

7. Front exhaust pipe

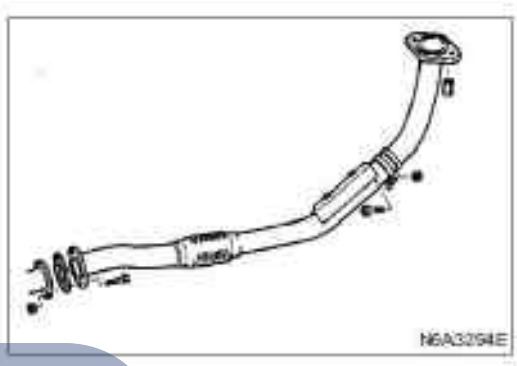
· Install the pipe onto the manifold and tighten the bolts and nuts to the specified torque.

Tightening

· If with exhaust brake, tighten the manifold nut to 37 N·m (3.8 kg·m/27 lb·ft)

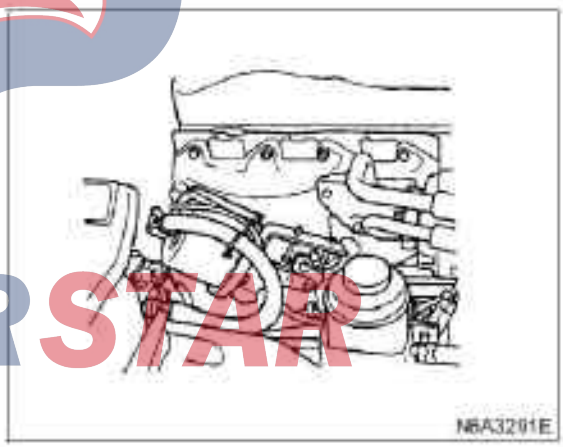
· If not with exhaust brake, tighten the manifold nut to 40 N·m (4.1 kg·m/30 lb·ft)

· 40 N·m (4.1 kg·m/30 lb·ft) for pipe support bolt



8. Vacuum regulator hose (exhaust brake type)

· Install the vacuum tube on the vacuum adjuster

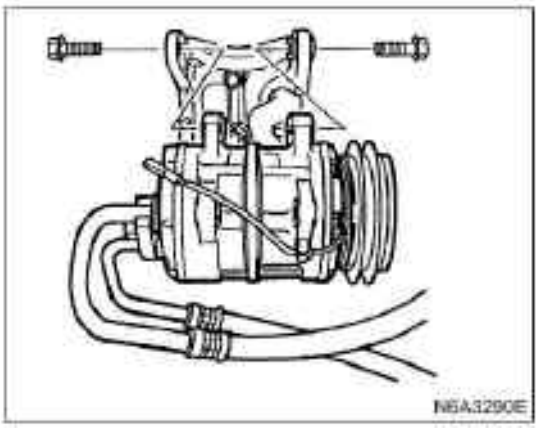


9. A/C compressor assembly (A/C type)

· Install the fixing bolt of the air conditioner compressor and tighten it to the specified torque.

Tightening

· 37 N·m (3.8 kg·m/27 lb·ft) for compressor bolts



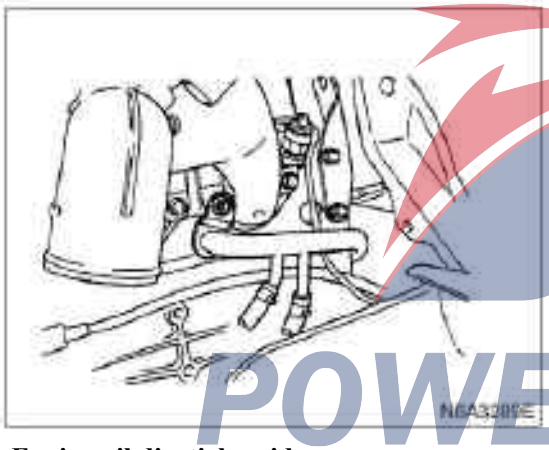
10. Engine oil cooler water pipe (engine oil cooler type)

· Install the pipe bolt and tighten the bolt to the specified torque.

Tightening

· 19 N·m (1.9 kg·m/14 lb·ft) for pipe bolts

· 40 N·m (4.1 kg·m/30 lb·ft) for pipe support bolt

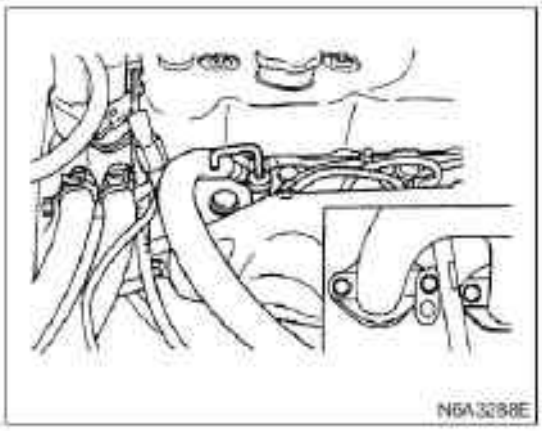


11. Engine oil dipstick guide

· Install the duct bolt and tighten the bolt to the specified torque.

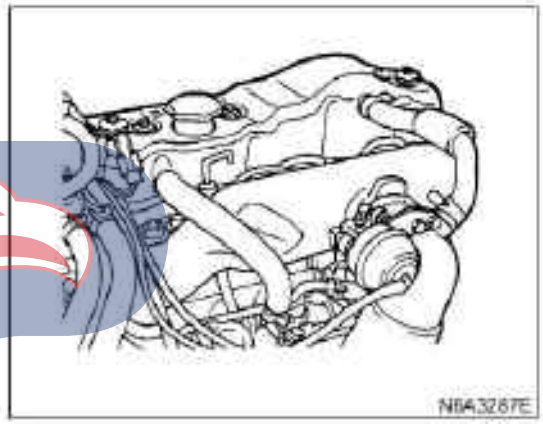
Tightening

· 19 N·m (1.9 kg·m/14 lb·ft) for duct bolts.



12. Glow plug harness

13. PCV Hose



14. Return oil hose

· Install with a new copper seal.

15. High pressure oil pipe

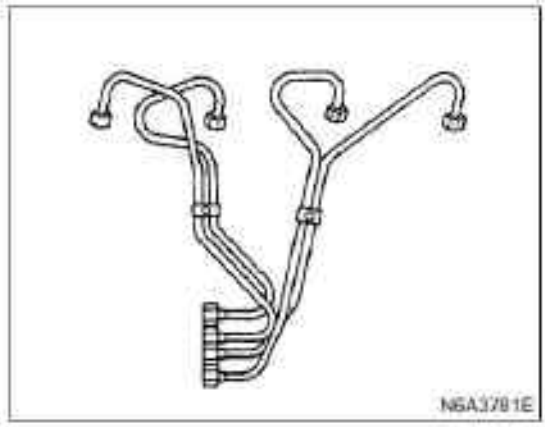
· Install the flared nut on the fuel injection pump.

· Install the flared nut on the fuel injector side.

· Tighten the flared nut to the specified torque.

Tightening

· 29 N·m (3.0 kg·m/22 lb·ft) for flared nuts.



· Install the pipe hoop at the specified torque.

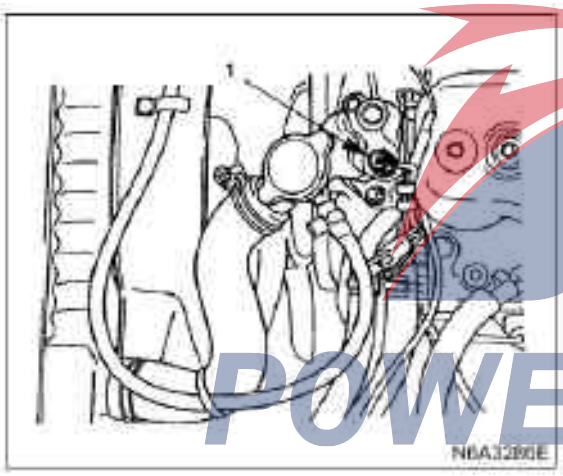
Tightening

· 29 N·m (3 kg. m/22 lb. ft) for sleeve nuts.

16. Intake pipe

17. Engine harness

· Connect the temperature sensor wire harness to the thermometer wire harness.



1. Temperature sensor

---

18. Drive belt (A/C type) of the A/C compressor

Check for wear of the drive belt. Replace immediately as necessary. Check for the tightness of the belt. Adjust if necessary.

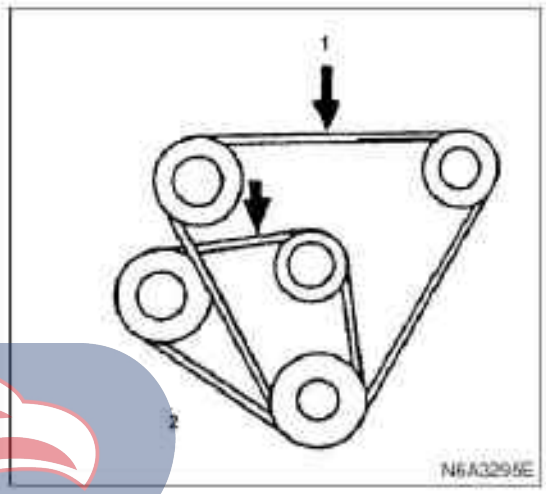
· Check the tightness of the transmission belt.

· Apply the force of 10 kg in the middle of the belt and check the deflection of each belt.

· Standard deflection

	mm (in)
	Initial tightness
Drive belt of AC generator and fan belt pulley	8 — 12(0.31— 0.47)
Drive belt of the A/C compressor	
Drive belt of power steering pump	

4JB1



Legend

1. Drive belt of the A/C compressor and drive belt of the power steering pump
2. Drive belt of AC generator and fan belt pulley

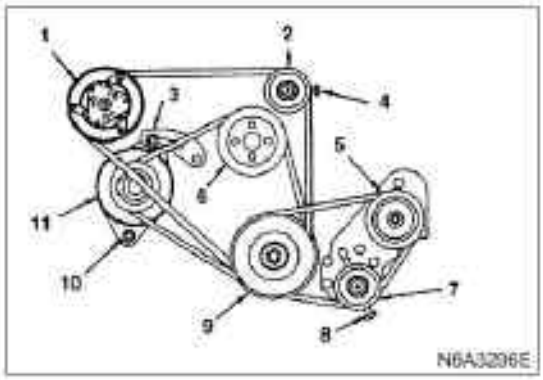
Tightness adjustment

Power steering pump and A/C compressor pulley

· If the locking nut is loose for the power steering pump, adjust the tightness of the nut with the adjusting belt.

Cooling fan pulley

If the mounting nut and locking nut of the alternator are loose, adjust the tightness of the belt with the adjusting bolt.



Legend

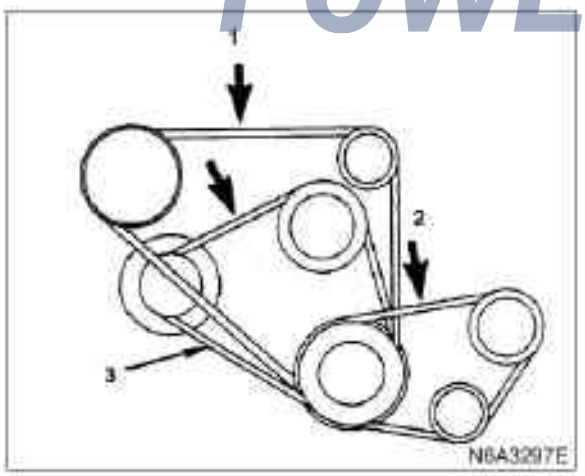
1. A/C compressor
2. Idler
3. Adjusting plate
4. adjusting bolt
5. Power steering pump pulley
6. Fan belt pulley
7. Idler pulley
8. adjusting bolt
9. Crankshaft pulley
10. Alternator bolts
11. AC generator

Tightening

· 40 N·m (4.1 kg·m/30 lb·ft) for fixing bolt of alternator

· 19 N. m (1.9 kg. m/14 lb. ft) for adjusting plate fixing bolt

· 19 N. m (1.9 kg. m/14 lb. ft) for adjusting plate locking bolt



Legend

1. Drive belt of the A/C compressor
2 . Drive belt of power steering pump
3. Alternator fan pulley

---

19. Heater core

· Connect the heater hose and tighten the hoop.

20. Radiator hose

· Connect the heater hose and tighten the hoop.

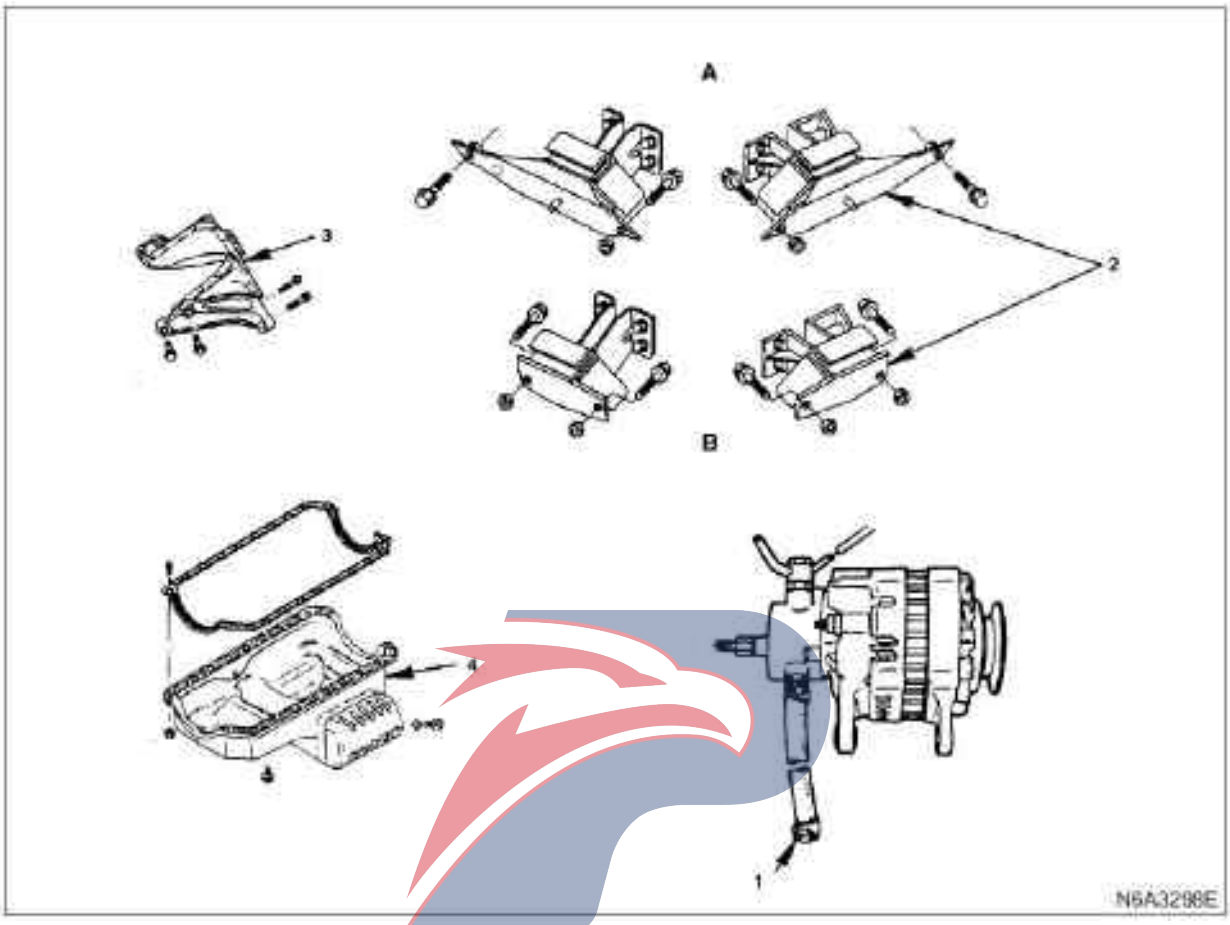
· Pour into the coolant

· Connect the grounding wire of the storage battery

· Start the engine and check the leakage of the coolant

Oil sump

Parts



Legend

A. Independent suspension (4 × 2)
B. Rigid suspension (4 ×2)
1. Vacuum pump oil pipe
2. Engine bracket bolt
3. Reinforcement and rubber cushion
4. Oil sump assembly

Dismantling

Preparation

· Disconnect the grounding wire of the storage battery
· Raise the car.
· Discharge engine oil.

Caution:

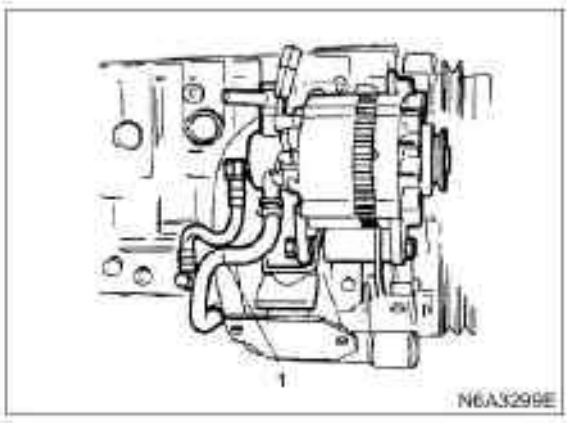
Install the oil drain plug with new gaskets.

Tightening

• 44 N. m (4.5 kg·m /33 lb·ft)

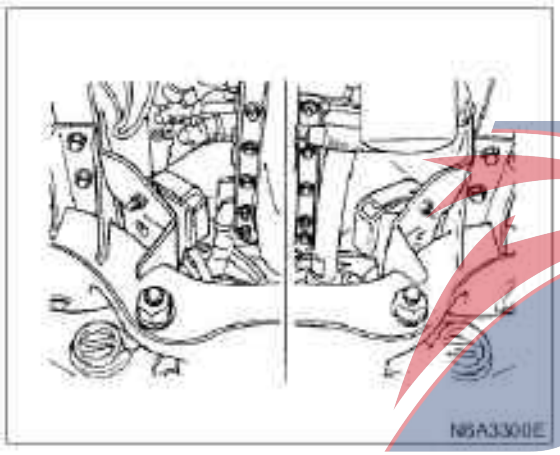
1. Vacuum pump oil pipe

· Disassemble the oil pipe (1) from the oil pan.



2. Engine bracket bolt

· Disassemble the left and right support bolts of the engine.

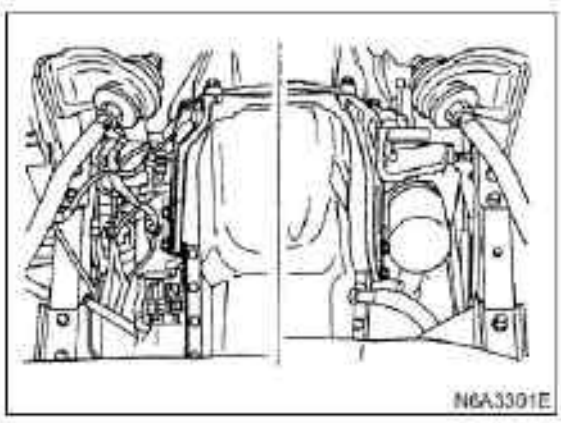


3. Reinforcement and rubber cushion

· Disassemble the exhaust pipe support.

· Disassemble the stiffeners from the left and right sides of the oil pan.

· Take out the rubber pad.



4. Oil sump assembly

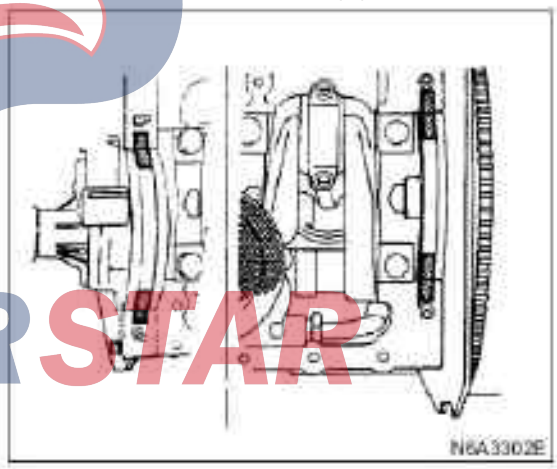
· Raise the engine by about 50mm.

· Disassemble the oil pan from the cylinder block.

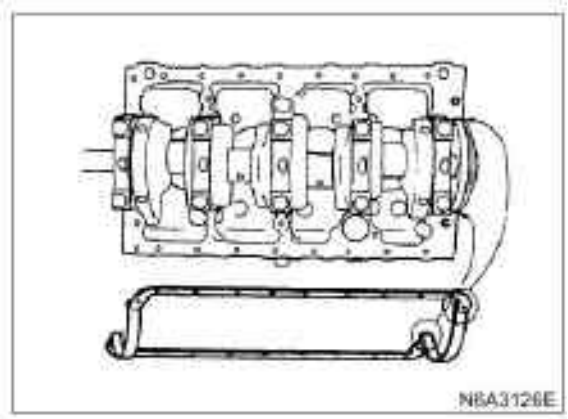
Install

1. Oil sump assembly

· According to the position in the illustration, apply the recommended liquid sealant or its similar products to the arch cover and trough of Bearing 5, and the arched area of the timing gear chamber.



· Place the lip on the back of the sealing gasket into Slot 5.



· Ensure that the lip is just slipping into the groove.
· Install the oil pan on the cylinder block.
· Tighten the oil pan bolt to the specified torque.

Tightening

· 19 N·m (1.9 kg·m/14 lb·ft) for oil pan bolts

2. Reinforcement and rubber cushion

· Install rubber pad
· Install the stiffeners on both sides and tighten the bolts to the specified torque.

Tightening

· 37 N.m (3.8 kg. m/27 lb. ft) for engine shell
· 78 N·m (8.0 kg·m/58 lb·ft) for clutch sheave
· Install the exhaust pipe support.

3. Engine bracket bolt

· Install the fixing bolt and tighten the bolt to the specified torque.

Tightening

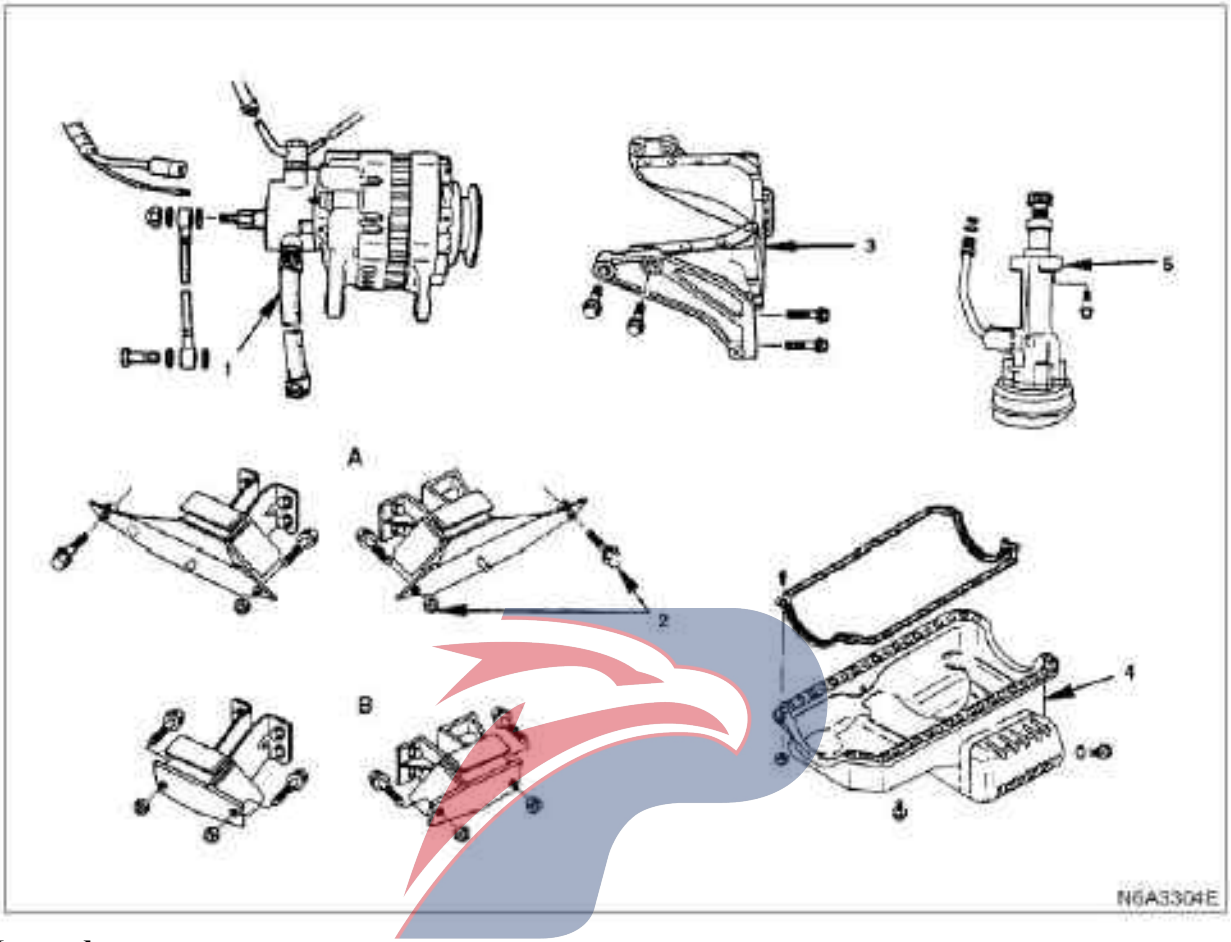
· Install bolts to 40 N·m (4.1 kg·M/30 lb·ft)
· Install the oil pipe to the oil pan.

4. Vacuum pump oil pipe

· Pour the engine oil
· Connect the grounding wire of the storage battery
· Start the engine and check the leakage of the coolant

Oil pump assembly

Parts



Legend

A. Independent suspension (4 × 2)
B. Rigid suspension (4 × 2)
1. Vacuum pump oil pipe
2. Engine bracket bolt
3. Reinforcement and rubber cushion
4. Oil sump assembly
5. Engine oil pump assembly

Dismantling

Preparation

· Disconnect the grounding wire of the storage battery
· Raise the car.
· Discharge engine oil.

Caution:

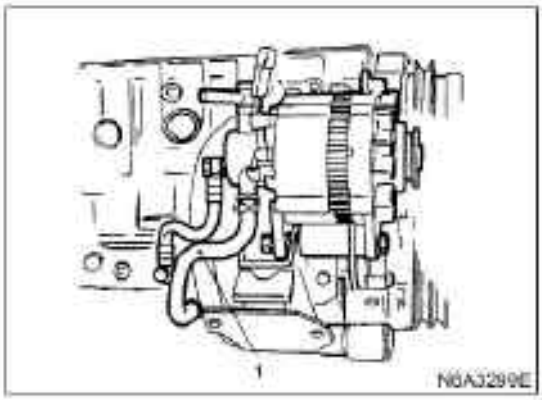
Install the oil drain plug with new gaskets.

Tightening

• 44 N·m(4.5 kg·m/33 lb·ft)

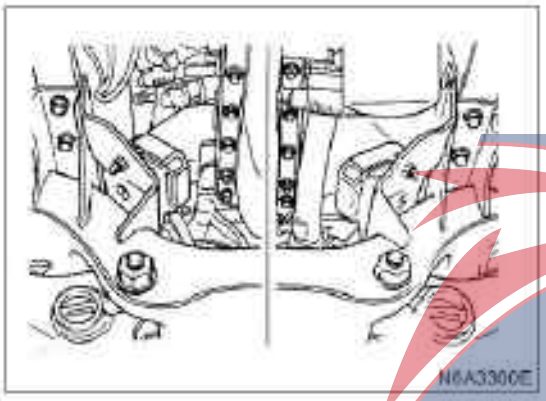
1. Vacuum pump oil pipe

· Disassemble the oil pipe (1) from the oil pan.



2. Engine bracket bolt

· Disassemble the left and right support bolts of the engine.

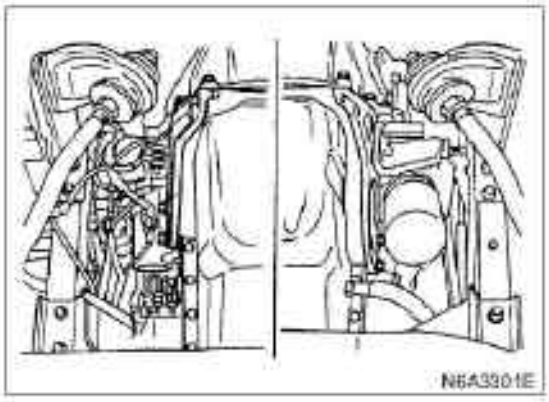


3. Reinforcement and rubber cushion

· Disassemble the exhaust pipe support.

· Disassemble the stiffeners from the left and right sides of the oil pan.

· Take out the rubber pad.



4. Oil sump assembly

· Raise the engine by about 50mm.

· Disassemble the oil pan from the cylinder seat.

5. Engine oil pump assembly

· Disassemble the oil pan from the cylinder block.

Install

· Prepare a mixture of 80% engine oil and 20% molybdenum disulfide

· Apply the mixture to the pinion rack of the oil pump.

1. Engine oil pump assembly

· Apply the engine oil to the O ring of the oil pipe and place the O ring in the O-ring groove of the cylinder block.

· Install the oil pump assembly together with the oil pipe on the cylinder block and tighten the fixing bolt to the specified torque.

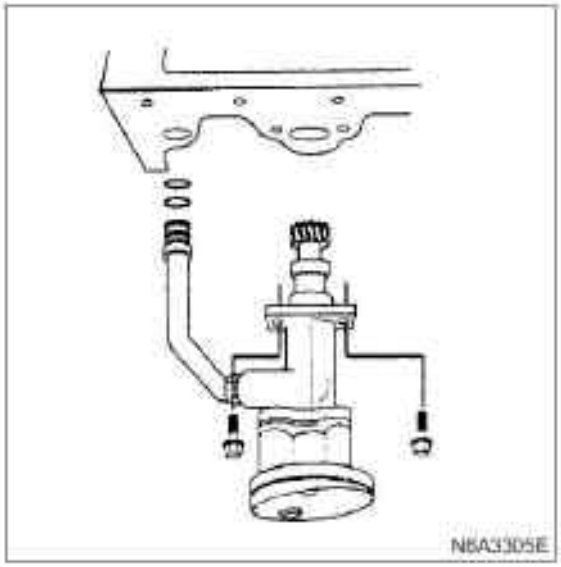
Tightening

• 19 N·m(1.9 kg·m/14 lb·ft)

· Tighten the sleeve nut to the specified torque.

Tightening

• 25 N·m(2.5 kg·m/18 lb·ft)

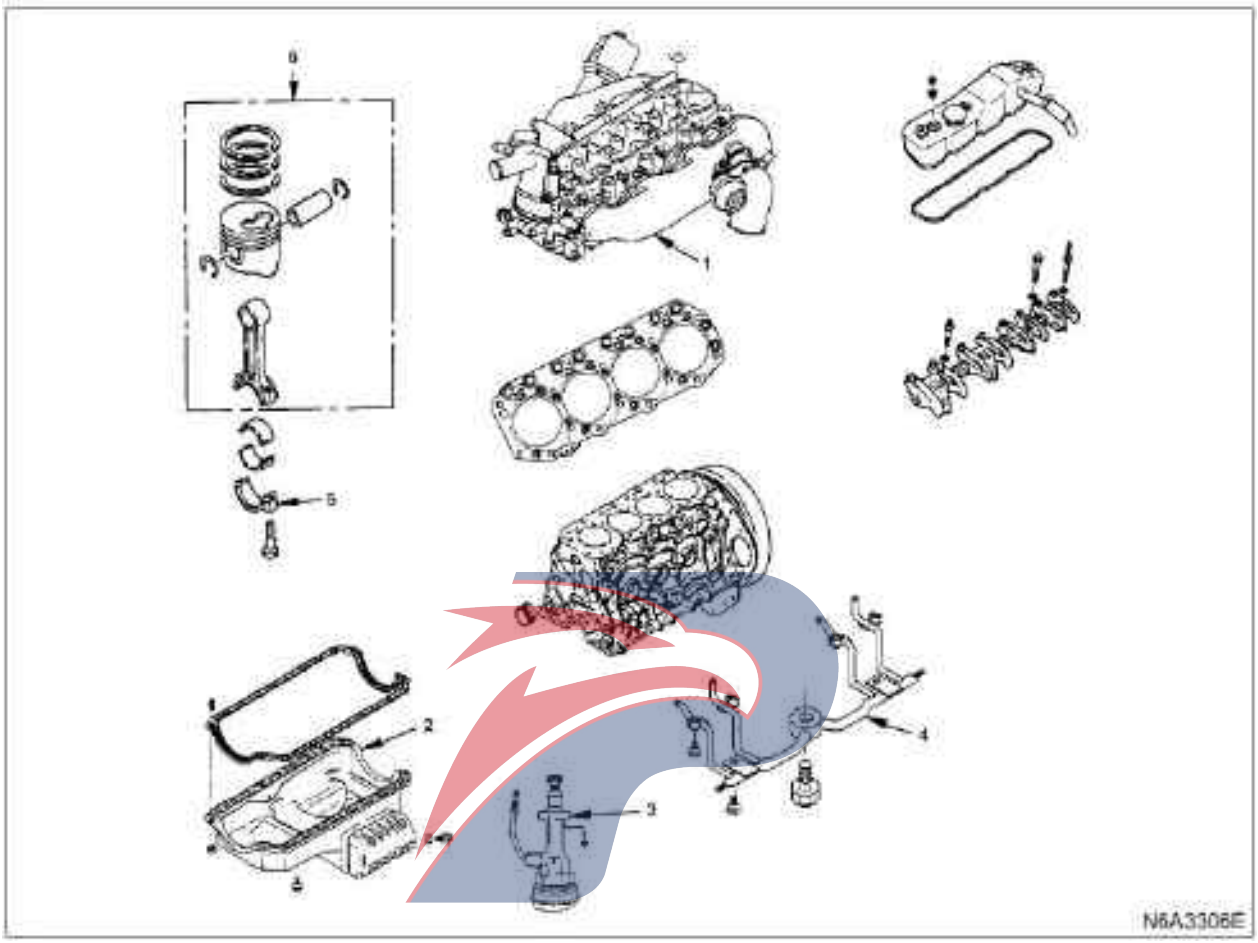


2. Oil sump assembly
3. Reinforcement and rubber cushion
4. Engine bracket bolt
5. Vacuum pump oil pipe

For the above operations, please refer to the "Oil Pan" Chapter in this Manual.

Piston, piston ring, and connecting rod

Parts



Legend

1. Cylinder head assembly
2. Oil sump assembly
3. Engine oil pump assembly
4. Piston cooling oil pipe
5. Connecting rod bearing cover
6. Piston and connecting rod assembly

Dismantling

Preparation

· Disconnect the grounding wire of the storage battery
· Discharge coolant.
· Discharge engine oil.

Caution:

Install the oil drain plug with new gaskets.

Tightening

• 44 N·m(4.5 kg·m/33 lb·ft)

1. Cylinder head assembly

1) Upper radiator hose
2) Heater hose
3) Transmission belt of air conditioner compressor
4) Engine harness
5) Intake pipe
6) High pressure oil pipe
7) Return oil pipe
8) PCV hose
9) Glow plug harness

10) Engine oil dipstick guide
11) A/C compressor assembly (A/C type)
13) Vacuum regulator hose (exhaust brake type)
14) Front exhaust pipe
15) bypass hose
16) Cylinder head cover
17) Rockshaft
18) Tappet
19) Cylinder head assembly
20) Cylinder head gasket

For the above operations, please refer to the "Cylinder Cover Assembly and Gasket" Chapter of this Manual.

2. Oil sump assembly

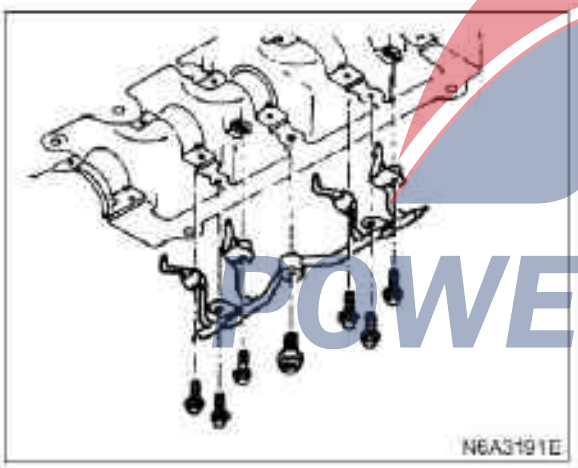
1) Vacuum pump oil pipe
2) Engine support bolt
3) Reinforcing parts and rubber pads
4) Oil pan

For the above operations, please refer to the "Oil Pan" Chapter of this Manual.

3. Engine oil pump assembly

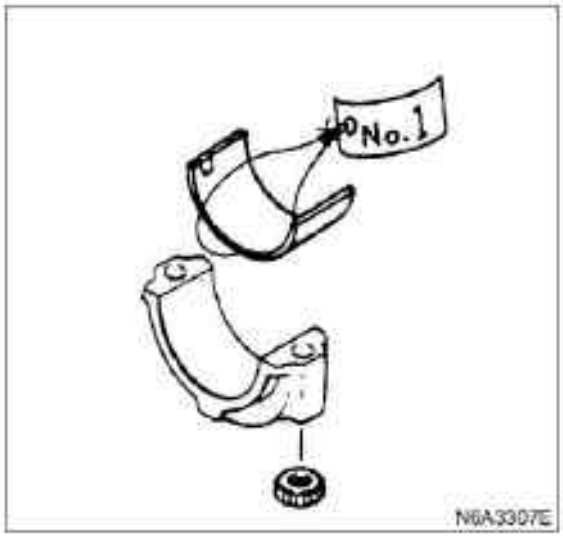
4. Piston cooling oil pipe

· Disassemble safety valves and oil pipe.



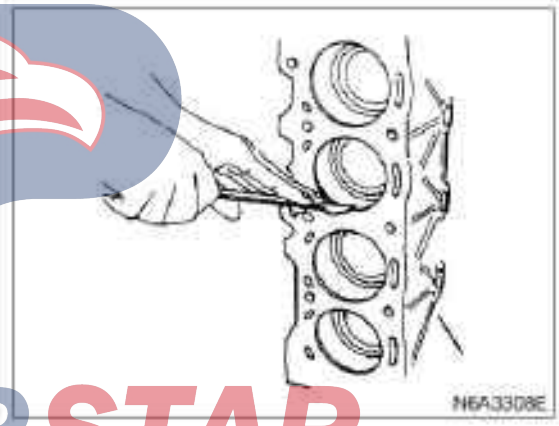
5. Connecting rod bearing cover

If the lower bearing of the connecting rod needs to be reinstalled, the installation marks should be made on each bearing to mark the serial number and installation position of the cylinder when dismantling.

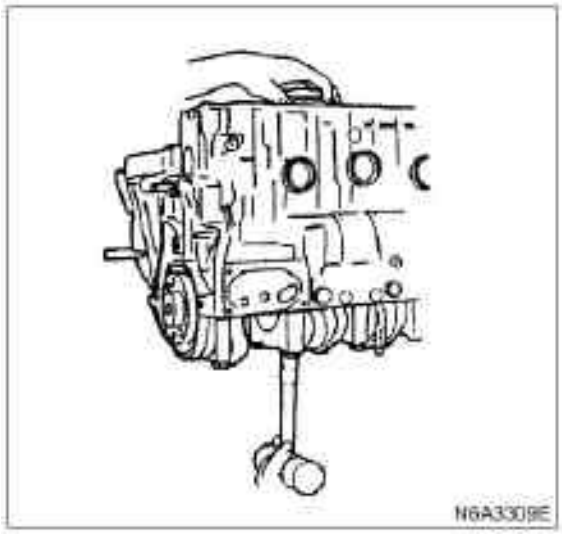


6. Piston and connecting rod assembly

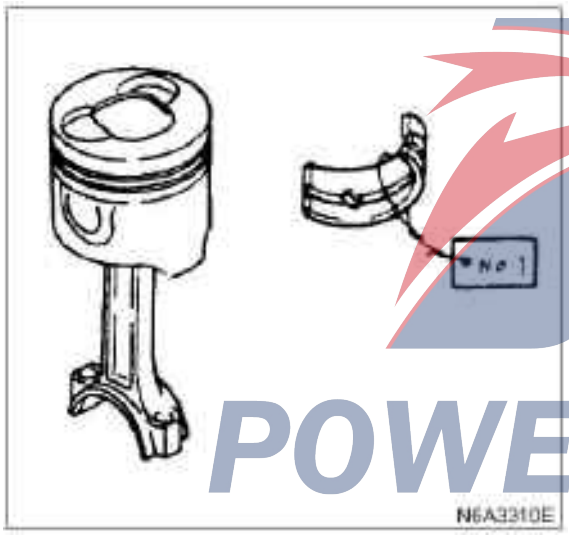
1) Before removing the piston and connecting rod, disassemble the carbon deposited on the top of the cylinder wall with a scraper.



2) Move the piston to the top of the cylinder and push down the lower side of the connecting rod to the lower part of the connecting rod with the hammer, and take out the piston and the connecting rod.



If the lower bearing of the connecting rod needs to be installed, the mounting mark and cylinder numbering should be made on each bearing.



4) Clamp the connecting rod tightly using a bench clamp.

Take care not to damage the connecting rod.

Dismantle the piston ring with a piston ring replacer.

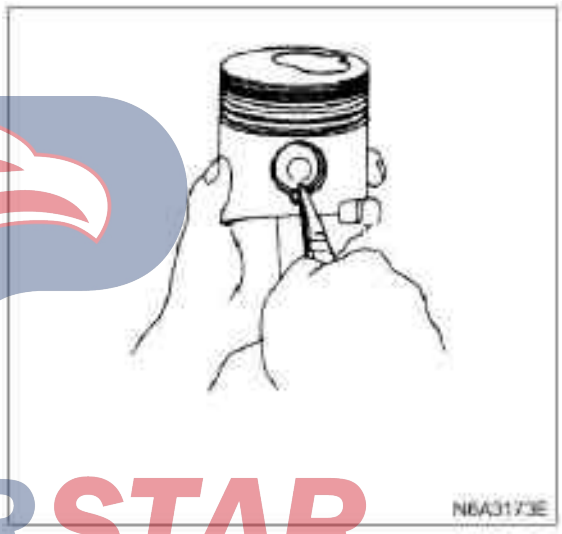
piston ring remover and installer

Do not use other tools to disassemble the piston ring.

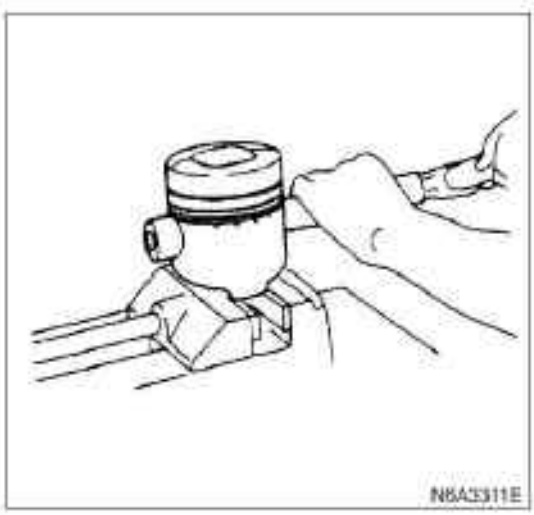
Tensile piston ring

Reduce elastic force of the piston ring.

5) Disassemble the piston pin with a pair of pliers.



6) Pry out piston pin with a hammer and brass rod if the piston and piston pin need to be reinstalled, the mounting marks should be made on each piston and the cylinder should be numbered on the piston pin.



Install

1. Piston and connecting rod assembly

1) Push the piston pin into the piston pin hole with normal finger pressure.

Weigh each piston and connecting rod assembly.

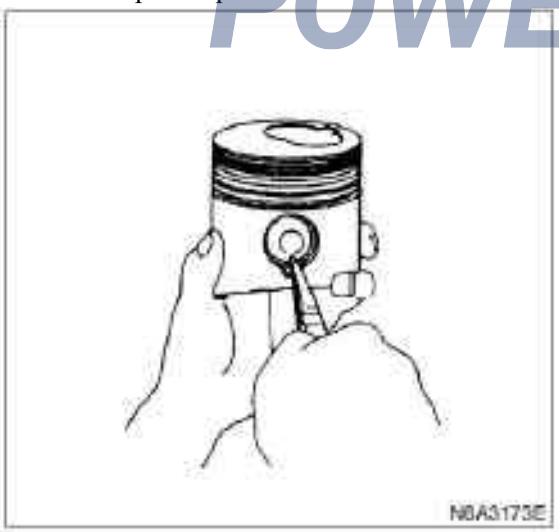
The piston and the connecting rod are combined to keep the weight difference of different assemblies within the specified limit.

	g (oz)
Weight difference	Less than
Weight after assembly	3(0.1058)

2) Clamp the connecting rod tightly using a bench clamp.

Take care not to damage the connecting rod.

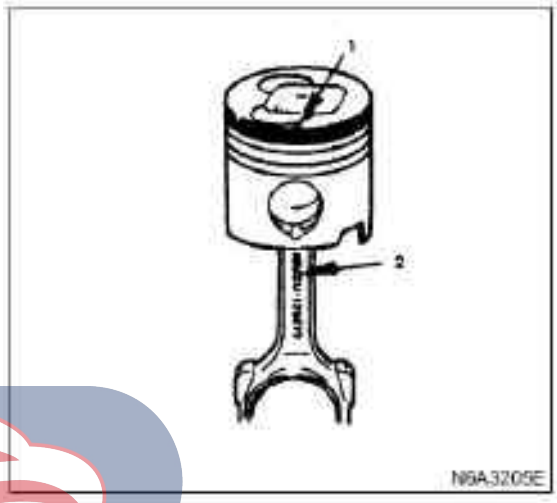
3) Install the piston pin retaining ring on the piston with a pair of pliers.



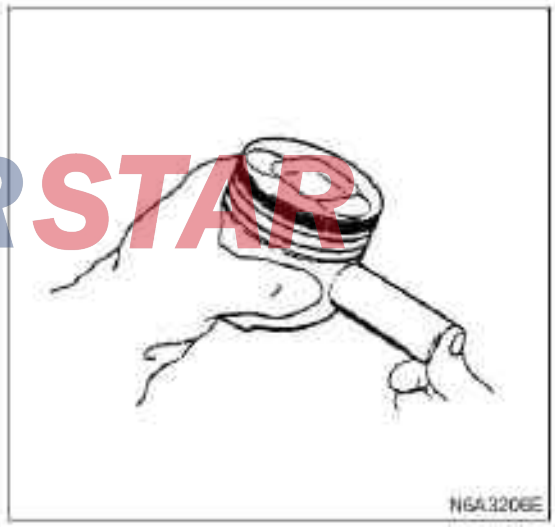
Caution:

If the piston / connecting rod combination is changed, do not change the piston / piston pin combination.

4) Install the piston on the connecting rod. The piston top mark (1) and the "ISUZU" casting mark (2) on the connecting rod should be facing to the same direction.

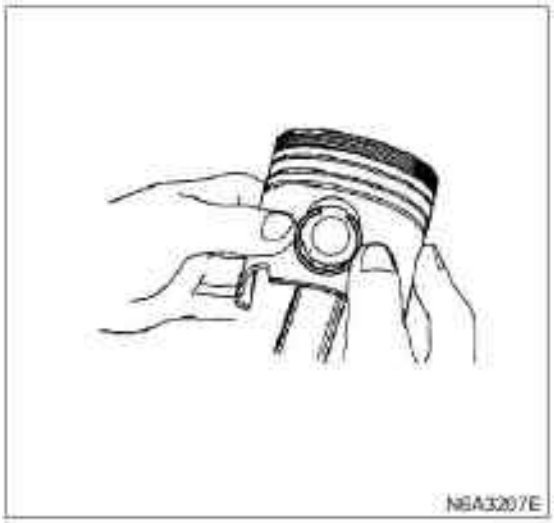


5) Apply the engine oil to the surface of the piston pin and the piston pin hole. Put the piston pin into the piston with the hand until it touches the stop ring.

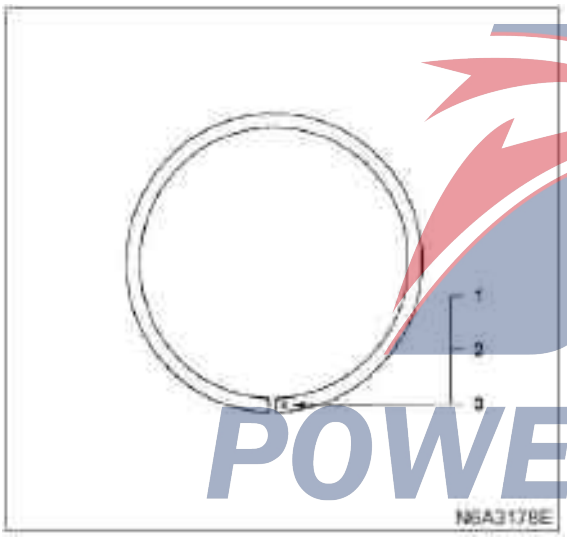


6) Put the piston pin into the piston with the finger until it touches the stop slot of the piston.

Check whether the connecting rod can move very flexibly in the piston pin.



7) Install the piston ring with piston ring expander.
The air ring should be marked with 1N, 2N and R, and facing upwards.
Make identification mark as shown in the illustration.



Legend
1. N mark (Ring 1), (Ring 2) (4JB1)
2.1N mark (Ring 1)2N mark (Ring 2)(4JG2)
3.R mark (Ring 1)、(Ring 2) (4KH1-TC)

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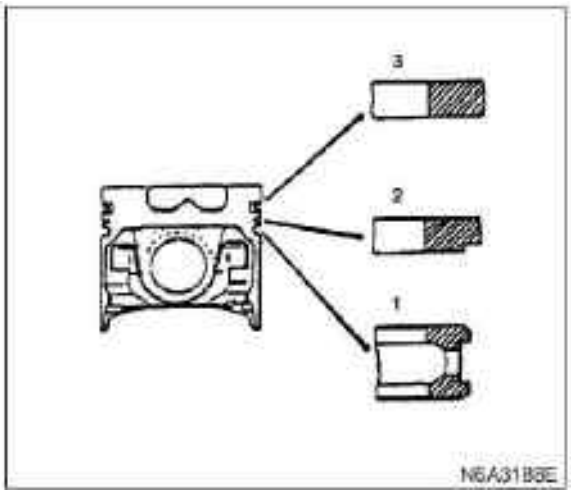
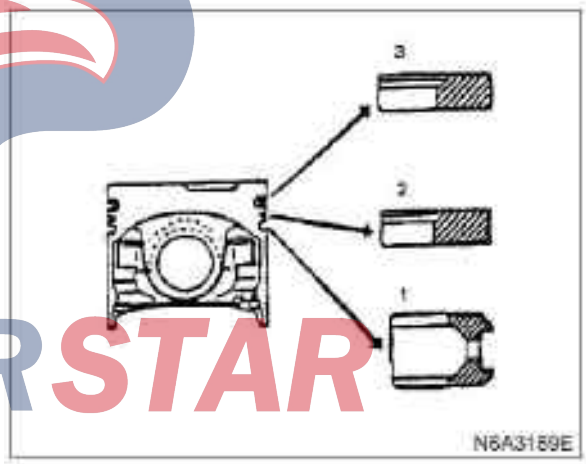
8) Install the piston ring with the piston ring replacer.
piston ring remover and installer
Install the piston ring in the numerical order shown in the illustration.

4JB1-TC and 4JB1



Legend
1. Oil ring
2. The second gas ring
3. The first gas ring

4JG2



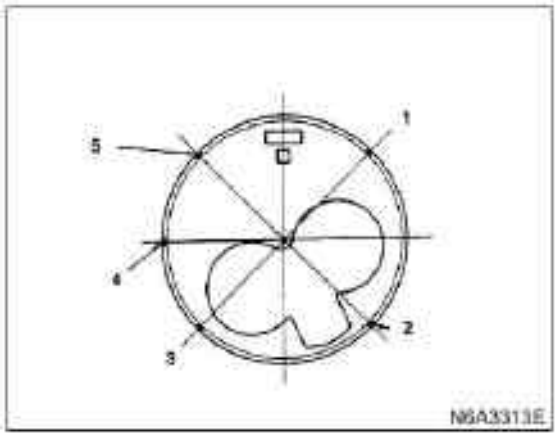
Legend
1. Oil ring
2. The second gas ring
3. The first gas ring

Caution:
When installing the gas ring, face the chamfering upwards.
Insert the expander coil into oil ring slot to allow no gap on both sides of the expander before installing the oil ring.

9) Apply the engine oil to the surface of the piston ring.

10) Check whether the piston ring can rotate smoothly in the piston ring slot.

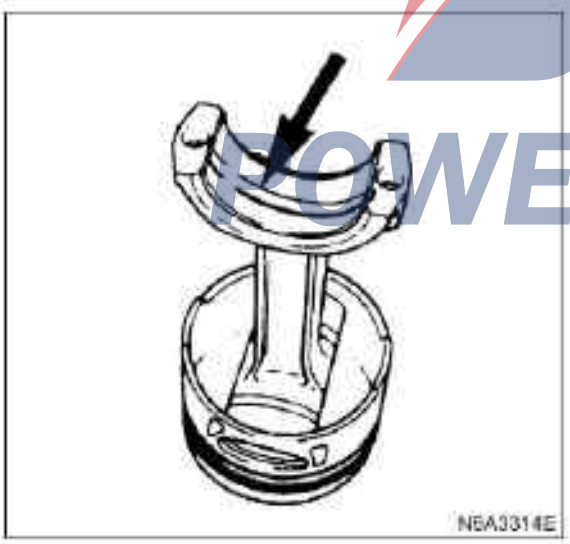
11) Correctly locate the opening position of the piston ring according to the illustration.



Legend

1. Expanding ring
2. The second gas ring
3. Oil ring
4. Front mark
5. The second gas ring

12) Carefully scavenge oil or other foreign objects on the back of the connecting rod bearing and the connecting rod bearing surface.



13) Apply the engine oil to the upper surface of the bearing.

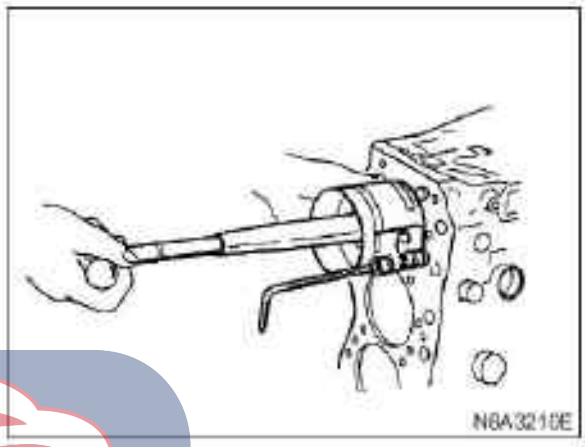
Apply the engine oil to the cylinder wall.

14) Correctly position the piston head mark to make it towards the engine front end.

Compress the piston ring with a piston ring compressor.

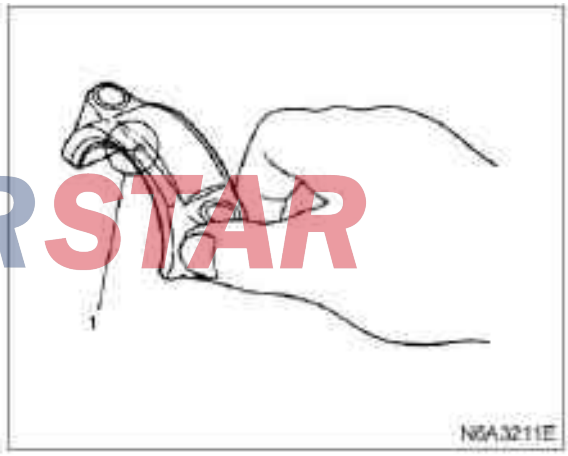
Piston ring compressor 5-8840-9018-0 (J-8037)

15) Push the piston with the hammer until the connecting rod touches the crankpin. At the same time, rotate the crankshaft until the crankpin is located at the lower dead center.



2. Connecting rod bearing cover

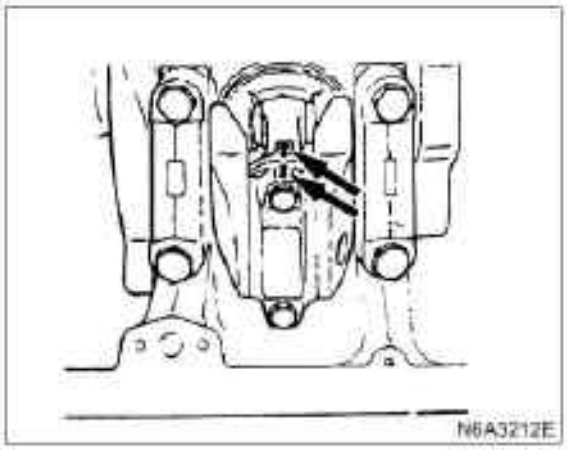
1) Correctly position the piston head mark (1) to make it towards the engine front end.



2) Install the connecting rod bearing cover

Check the numbering mark of the bearing cover cylinder and the serial number mark on the connecting rod.

3) Apply the engine oil to the screw and each connecting rod cover bolt on the installation surface.



4) Tighten the connecting rod bearing cover bolt in two steps with the angle fastening method to the specified torque.

Tightening

·4JB1-TC, 4JG2 and 4KH1-TC

Tighten the connecting rod bearing cover bolts to the torque value in Step 1: 29 N ·m(3.0 kg·m/ 22 lb·ft) and the torque value in Step 2:

45°— 6 0°

·4JB1

83 N ·m(8.5 kg ·m/ 61 lb·ft) for connecting rod bearing cover bolts.

Caution:

Please check whether the crankshaft can rotate smoothly by hand.

3. Piston cooler oil pipe

1) Install the piston chiller oil pipe on the cylinder block.

2) Tighten the oil pan bolts and the safety valve to the specified torque.

Tightening

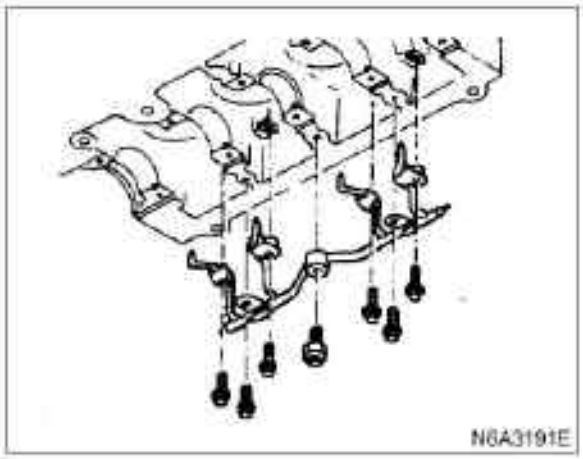
· For oil pipe bolts

M8×1.25:19 N·m(1.9 kg·m/14 lb·ft)

M6×1.00:8 N·m(0.8 kg·m /69 lb·in)

· For oil pressure regulating valve

M6×1.5:29 N·m(3.0 kg·m/22 lb·ft)



Caution:

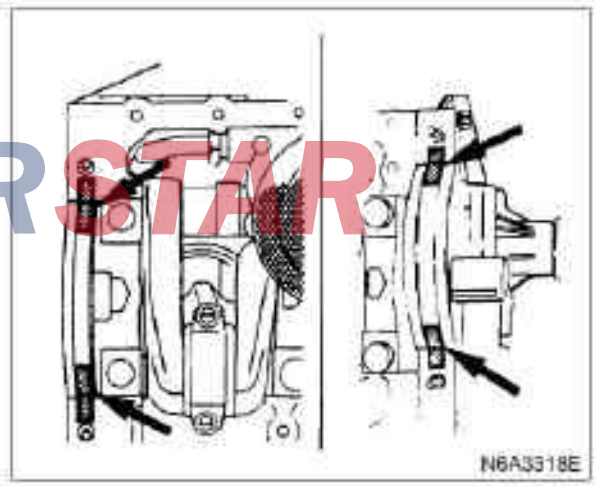
Check to ensure no interference between the piston and the high-pressure oil pipe when the crankshaft is slowly rotating.

4. Oil pump assembly

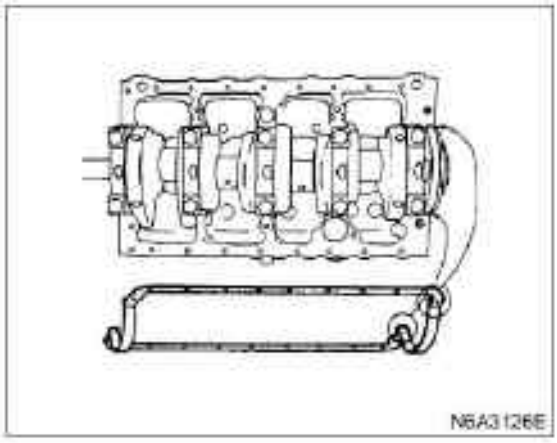
For the above operations, please refer to the "Oil Pump" Chapter in this Manual.

5. Oil sump assembly

1) According to the position in the illustration, apply the recommended liquid sealant or its similar products to the arch cover and trough of Bearing 5, and the arched area of the timing gear chamber.



2)· Embed the lip on the back of the sealing gasket into Slot 5. Ensure that the lip just slips into the slot.



3) Install the oil pan on the cylinder block.

· Tighten the oil pan bolt to the specified torque.

Tightening

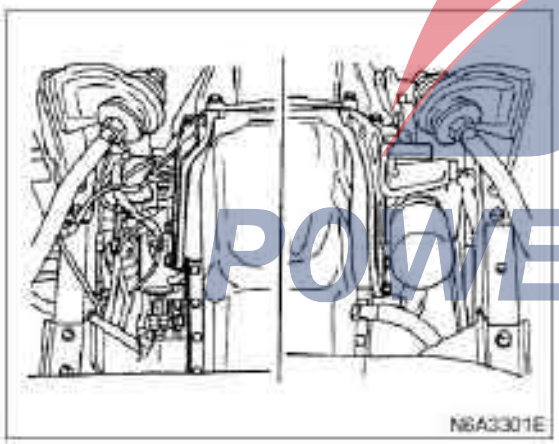
· 19 N·m (1.9 kg·m/14 lb·ft) for oil pan bolts

4) Install the rubber pad and stiffener (both sides) and tighten the bolt to the specified torque.

Tightening

· 37 N ·m(3.8 kg·m/27 lb·ft) for bolt of the stiffener of the engine shell.

· 78 N ·m(8.0 kg·m/58 lb·ft) for the stiffener bolts on the clutch side.

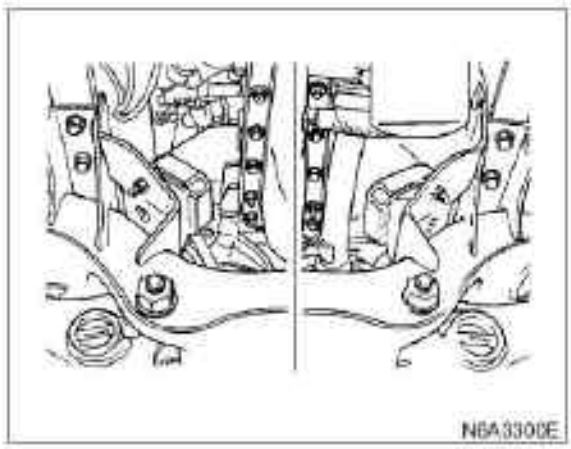


5) Install the exhaust pipe support.

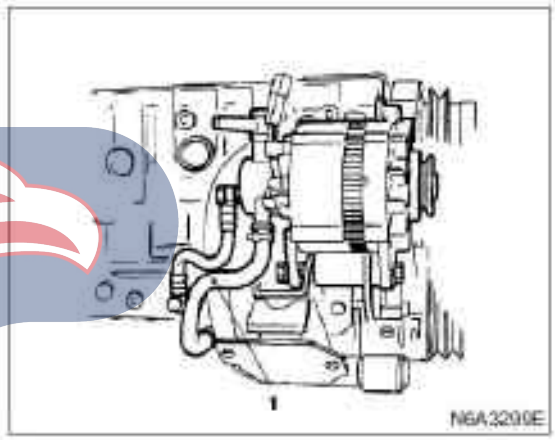
6) Install the support glue block and tighten the nut to the specified torque.

Tightening

· 40 N·m(4.1 kg·m/30 lb·ft) for the support rubber brick nut.



7) Install the vacuum pump oil pipe (1) on the oil pan.



6. Cylinder cover assembly

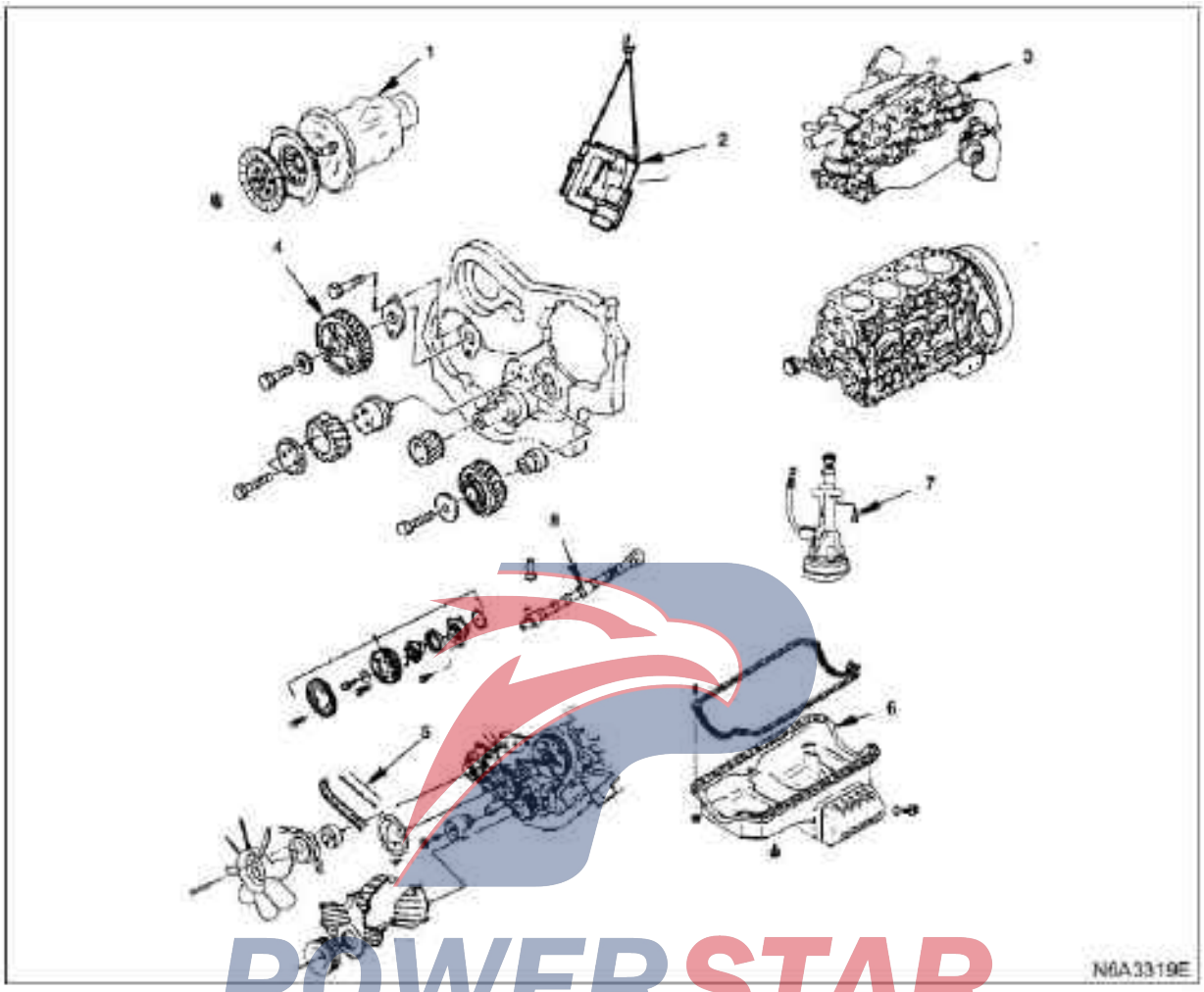
1) Cylinder head gasket
2) Cylinder head assembly
3) Tappet
4) Rockshaft
5) Cylinder head cover
6) bypass hose
7) Front exhaust pipe
8) Vacuum regulator hose (exhaust brake type)
9) A/C compressor assembly (A/C type)
10) Engine oil cooler water pipe (engine oil cooler type)
11) Engine oil dipstick guide
12) Glow plug harness
13) PCV hose
14) Return oil pipe
15) High pressure oil pipe
16) Intake pipe

17) Engine harness
18) Transmission belt of A/C compressor (air conditioning type)
19) Heating hose
20) Upper radiator hose

For the above operations, please refer to the “Cylinder Cover Assembly and Gasket” Chapter of this Manual.

Camshaft and tappet

Parts



Legend

1. Transmission and clutch assembly
2. Engine assembly
3. Cylinder cover assembly and sealing gasket
4. Timing gear (gear drive type)
5. Timing belt (belt drive type)
6. Oil sump
7. Engine oil pump
8. Camshaft and tappet

Dismantling

Preparation

· Disconnect the grounding wire of the storage battery

· Discharge coolant.

· Discharge engine oil.

Caution:

Install the oil drain plug with new gaskets.

Tightening

· 83 N·m(8.5 kg·m/61 lb·ft) for oil plugs

1. Transmission and clutch assembly

1) Transmission

2) Clutch

2. Engine assembly

1) Radiator assembly

2) Intake pipe

3) Heater hose

4) Engine control line
5) Glow plug harness
6) Fuel pipe
7) Oil pressure witch harness
8) A/C compressor assembly (A/C type)
9) Power steering pump and bracket assembly (power steering type)
10) Booster vacuum hose (exhaust brake type)
11) Vacuum pump hose (exhaust brake type)
12) Front exhaust pipe
13) Supporting rubber block
14) Engine assembly
For the above operation, refer to the chapter “engine assembly” in the manual.

3. Cylinder head assembly and gasket

1) High pressure oil pipe
2) Return oil pipe
3) PCV hose
4) Glow plug harness
5) Engine oil dipstick guide
6) Engine oil cooler water pipe (engine oil cooler type)
7) bypass hose
8) Cylinder head cover
9) Rockshaft
10) Tappet
11) Cylinder head assembly
12) Cylinder head gasket
For the above operations, please refer to the “Cylinder Cover Assembly and Gasket” Chapter of this Manual.

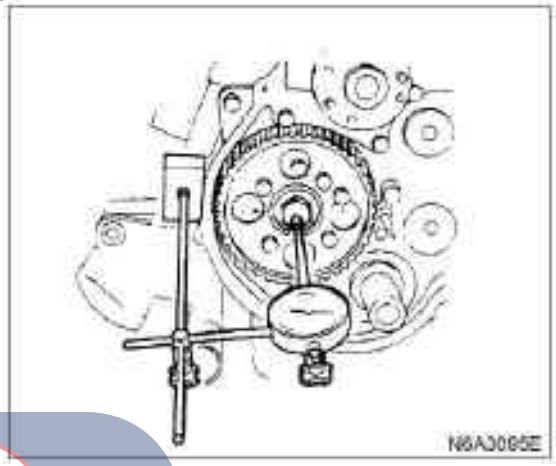
4. Timing gear (gear drive type)

1) Cooling fan assembly
2) belt pulley of crankshaft damper
3) Acoustic enclosure
4) Acoustic enclosure gasket
5) Timing gear chamber cover
6) Camshaft timing gear
For the above operations, refer to the "Timing Gear (Gear Type)” Chapter of this Manual.

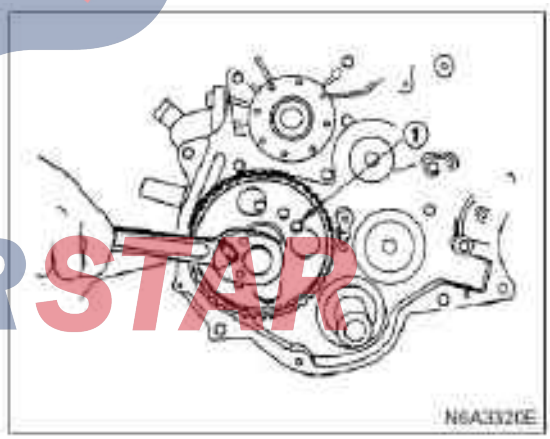
5. Timing gear (belt drive type)

1) Cooling fan assembly
2) belt pulley of crankshaft damper
3) Upper cover of timing belt pulley
4) Lower cover of timing belt pulley
5) Flange: camshaft belt pulley
6) Flange: fuel injection pump belt pulley
7) Timing belt
For the above operations, refer to the "Timing Belt (Belt Type)” Chapter of this Manual.
8) camshaft timing belt pulley
· Measure crankshaft gap with micrometer gauge.
The measurement should be carried out before removing the oil pump.
If the axial clearance of camshaft exceeds the specified limit, then the camshaft and/or the drive gear should be replaced.

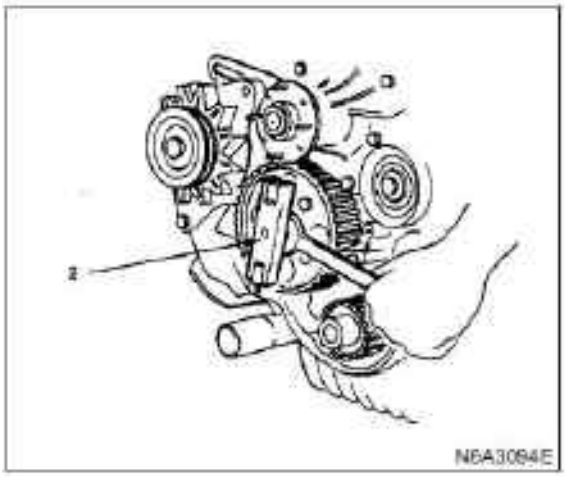
Axial clearance of camshaft	mm (in)
Standard	Limit
0.08(0.003)	0.20(0.008)



· Install the stop bolt (1) on the timing pulley to prevent the pulley from rotating.
· Unscrew the center bolt.

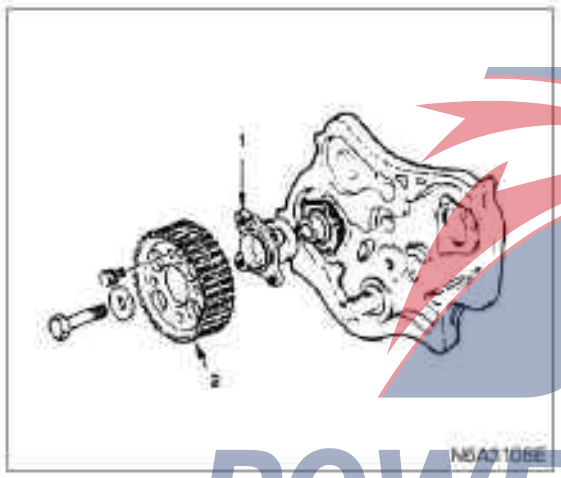


· Disassemble the pulley with the timing pulley replacer (2).
Timing pulley replacer 5-8840-0086-0

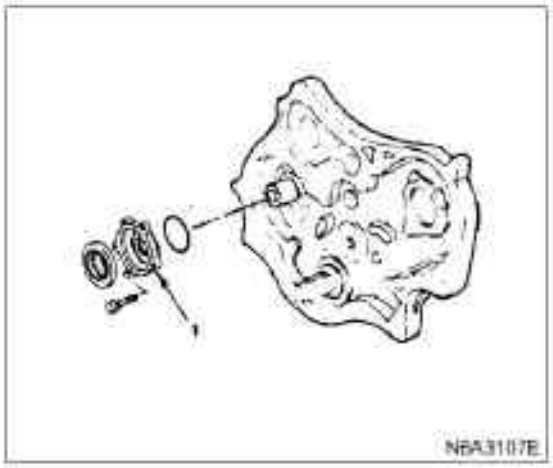


· Disassemble the catch bolt.

· Disassemble the center bolt and the timing pulley (2) equipped with the pulley center flange (1).

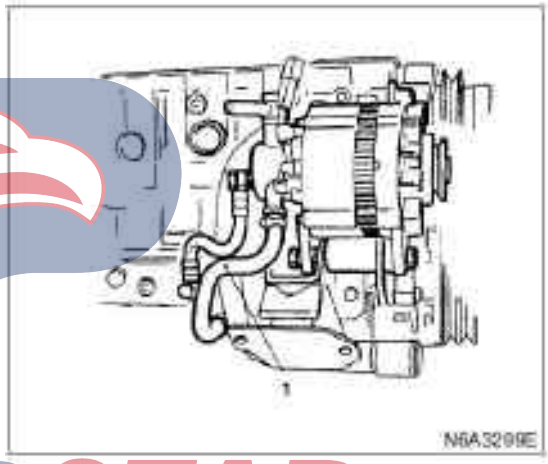


· Disassemble the oil seal bearing (1).

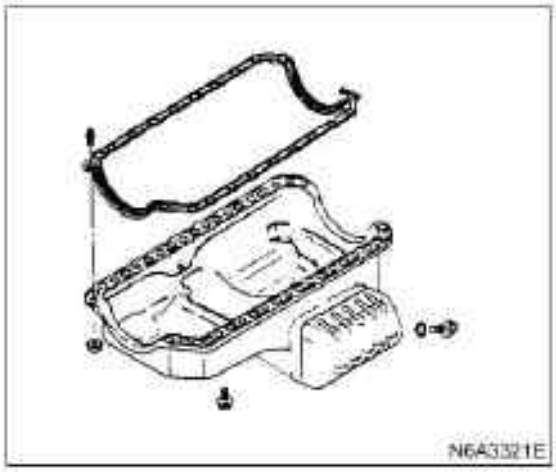


6. Oil sump assembly

· Disassemble the vacuum pump oil pipe (1) from the oil pan.



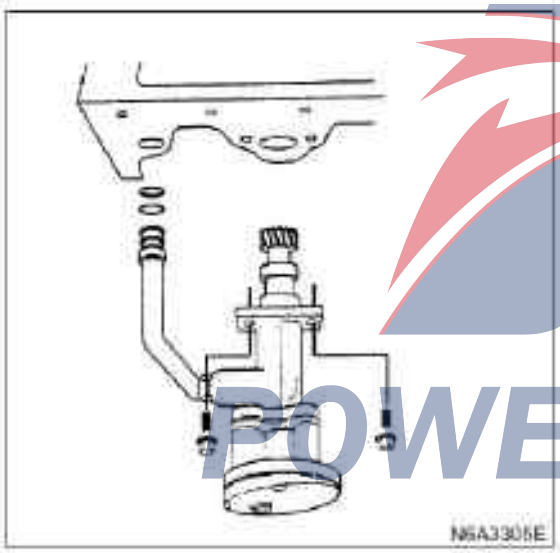
· Disassemble the stiffeners and pads from both sides of the oil pan.



· Disassemble the oil pan from the cylinder block after dismantling the oil pan bolts.

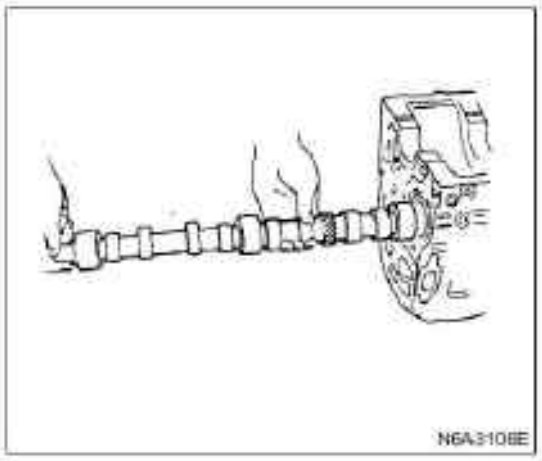
7. Engine oil pump assembly

· Disassemble the oil pump assembly from the cylinder.



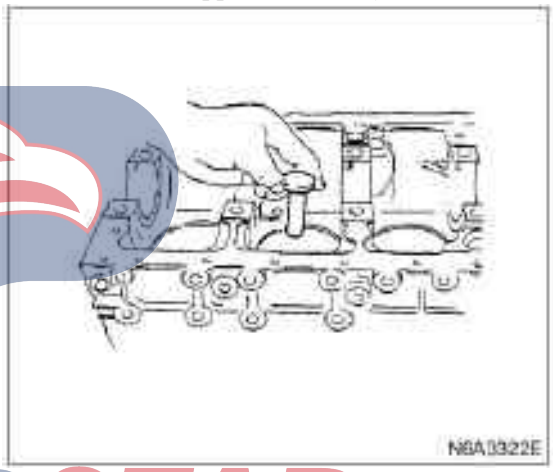
8. Camshaft and tappet

· Disassemble the camshaft from the cylinder.



· Be cautious and careful not to damage the camshaft bearing.

· Disassemble the tappet from the cylinder.



Install

1. Camshaft and tappet

· Apply the engine oil on the tappet and cylinder tappet insertion hole.

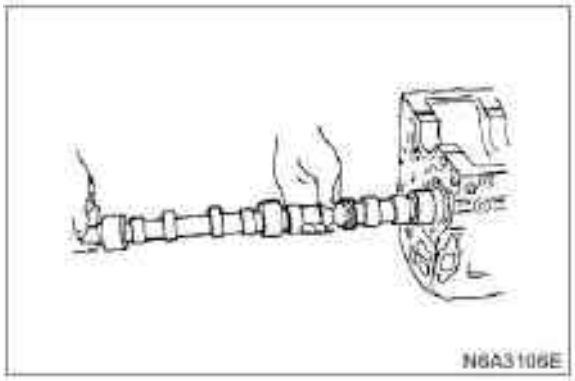
· Please install (if the tappet is reused) according to the position mark in the disassembly.

Caution:

The tappet shall be installed before the camshaft.

· Apply the engine oil to the camshaft and camshaft bearings.

· Install the camshaft to the cylinder. Be cautious and careful not to damage the camshaft bearing.



2. Engine oil pump assembly

· Prepare a mixture of 80% engine oil and 20% molybdenum disulfide

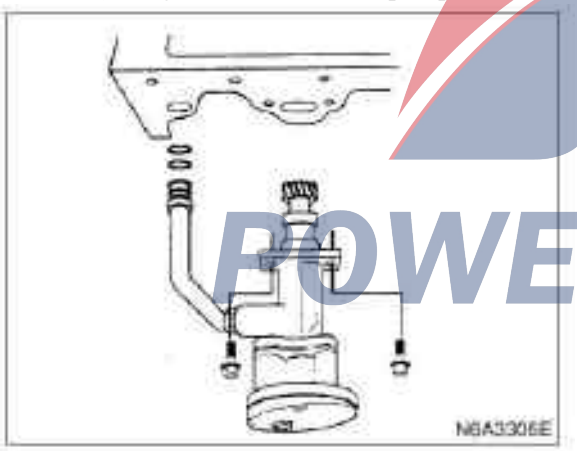
· Apply the mixture to the pinion rack of the oil pump.

· Apply the engine oil to the O ring of the oil pipe and place the O ring in the O-ring adaptor of the cylinder block.

· Install the oil pump assembly together with the oil pipe on the cylinder block and tighten the fixing bolt to the specified torque.

Tightening

· 19 N·m (1.9 kg·m/14 lb·ft) for oil pump bolts



· Tighten the sleeve nut to the specified torque.

Tightening

· 25 N·m(2.5 kg·m/18 lb·ft) for sleeve nuts

3. Oil sump assembly

For the above operations, please refer to the "Oil Pan" Chapter in this Manual.

4. Timing belt

1) camshaft timing belt pulley
2) Timing belt
3) Flange: fuel injection pump belt pulley
4) Flange: camshaft belt pulley
5) Lower cover of timing belt pulley
6) Upper cover of timing belt pulley
7) belt pulley of crankshaft damper
8) Cooling fan assembly

For the above operations, refer to the "Timing Belt (Belt Type)" Chapter of this Manual.

5. Timing gear (gear type)

1) Crankshaft timing gear
2) Timing gear chamber cover
3) Acoustic enclosure gasket
4) Acoustic enclosure
5) belt pulley of crankshaft damper
6) Cooling fan assembly

For the above operations, refer to the "Timing Gear (Gear Type)" Chapter of this Manual.

6. Cylinder head assembly and gasket

1) Cylinder head gasket

Measuring point of the bulge of piston top

2) Cylinder cover assembly
3) Tappet
4) Rockshaft

Valve clearance adjustment

5) Cylinder head cover
6) Branch pipe
7) Engine oil cooler water pipe (engine oil cooler type)
8) Engine oil dipstick guide
9) Glow plug harness
10) PCV hose
11) Return oil pipe
12) High pressure oil pipe

For the above operations, please refer to the "Cylinder Cover Assembly and Gasket" Chapter of this Manual.

7. Engine assembly

1) Engine assembly
2) Supporting rubber block
3) Front exhaust pipe
4) Vacuum pump hose

5) Booster vacuum hose
6) Power steering pump and bracket assembly (power steering type)
7) A/C compressor assembly (A/C type)
8) Oil pressure witch harness
9) Fuel pipe
10) Glow plug harness
11) Engine control line
12) Heater hose
13) Intake pipe
14) Radiator assembly

8. Transmission and clutch assembly

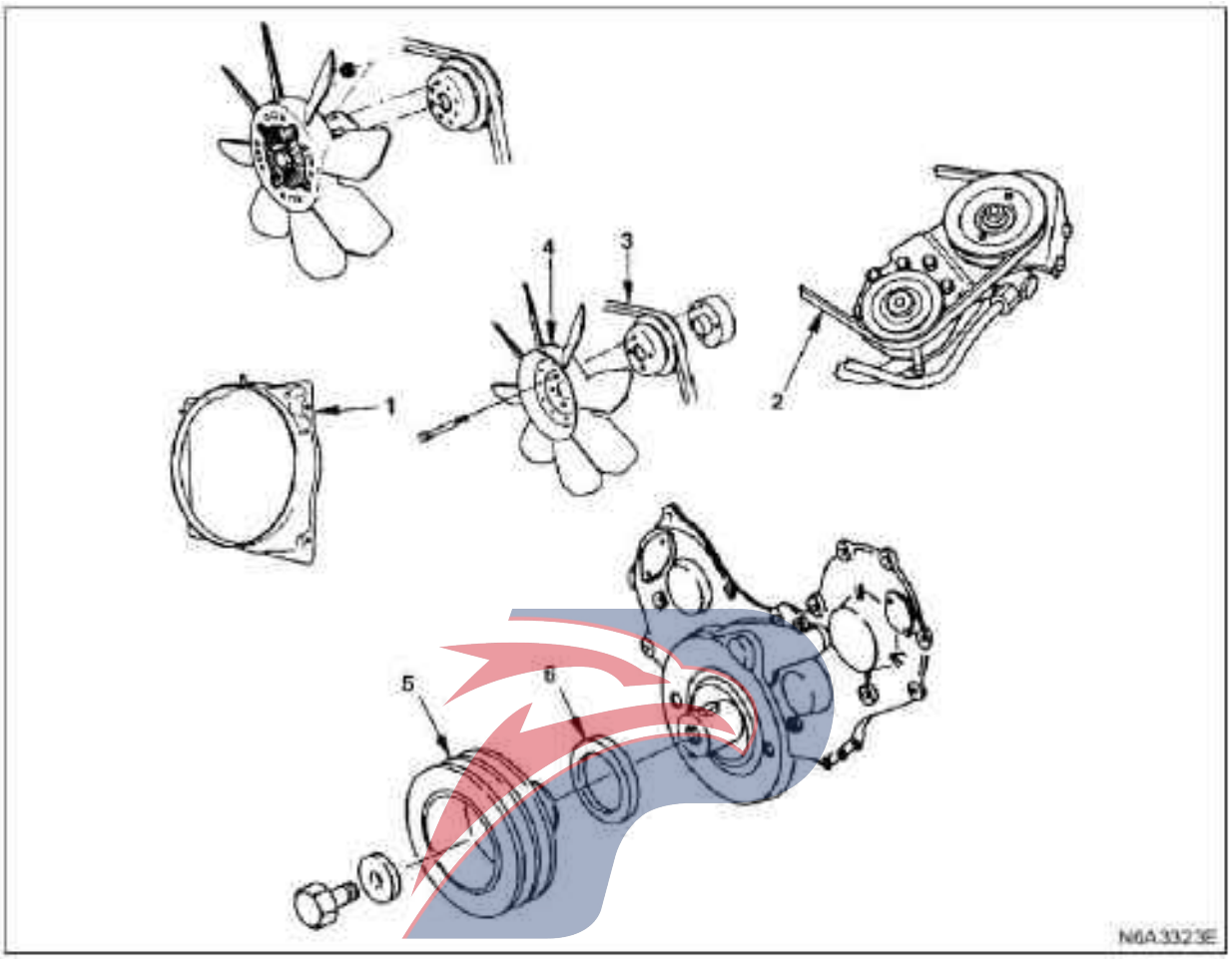
1) Clutch
2) Transmission

For the above operations, please refer to the "Engine Assembly" Chapter in this Manual.

· Connect the grounding wire of the storage battery
· Pour into the coolant
· Pour the engine oil
· Start the engine and check the leakage of the coolant

Crankshaft front oil seal (gear drive type)

Parts



Legend

1. Fan wind scooper
2 . Drive belt of power steering pump
3. drive belt of the AC generator.
4. Cooling fan assembly
5. belt pulley of crankshaft damper
6. Front oil seal

Dismantling

Preparation

· Disconnect the grounding wire of the storage battery

· Discharge coolant.

1. Fan wind scooper

2 . Drive belt of power steering pump

Unscrew the mounting bolts and adjusting bolts of the power steering pump and disassemble the transmission belt.

3. drive belt of the AC generator.

· Unscrew the fixing bolt (side lower part) and the locking bolt of the adjusting plate of the alternator, and disassemble the transmission belt.

4. Cooling fan assembly

· Disassemble fastening nut and cooling fan assembly, long distance pipe and fan pulley.

5. belt pulley of crankshaft damper

6. Front oil seal

· Pry up the oil seal and disassemble it from the concave of the gear box with a plastic hammer and a screwdriver.

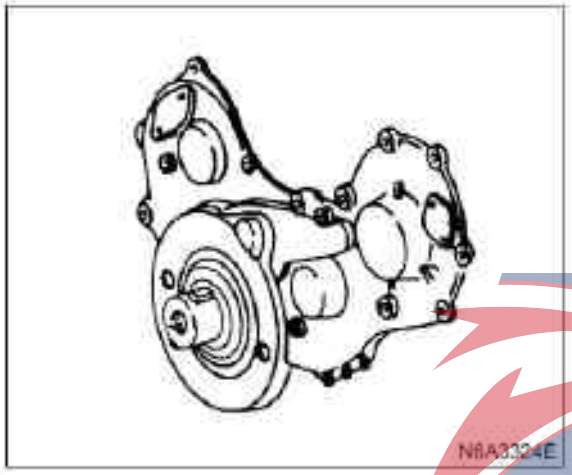
Please be careful not to damage the mounting surface of the oil seal.

Caution:

The flywheel is made to be in static state so as to prevent crankshaft rotation while tightening the damper belt pulley.

Tightening

· 206 N·m (21 kg·m/152 lb·ft) for pulley flange bolts.



Install

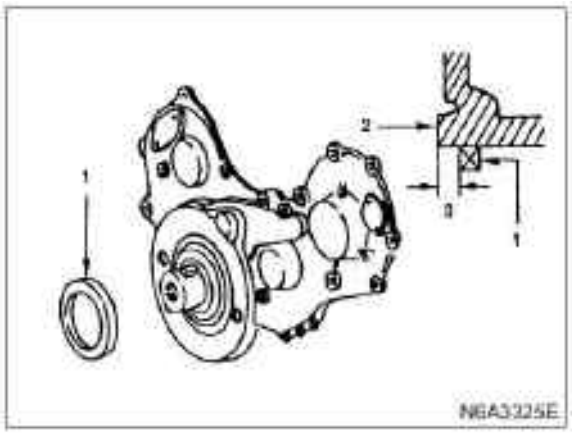
1. Front oil seal

· Install the front oil seal (1) on the gear chamber cover (2) with the erector.

Oil seal installer 5-8840-2061-0

Pay attention to the installation of the oil seal installation depth (3) as shown in the illustration.

Depth (3) =1 mm (0.039 in.)



2. belt pulley of crankshaft damper

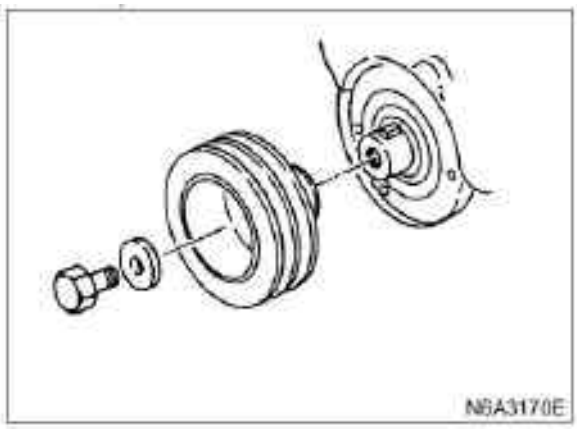
Tighten the bolt of the crankshaft damper belt pulley to the specified torque.

Caution:

The flywheel is made to be in static state so as to prevent crankshaft rotation while tightening the damper belt pulley.

Tightening

• 206 N m(21 kg m/152 lb·ft) for pulley flange bolts.



3. Cooling fan assembly

· Install the fan belt, septum and cooling fan assembly on the pump in order and tighten them to the specified torque.

Tightening

· 8 N·m (0.8 kg·m/69 lb·in) for pulley flange bolts.

4. drive belt of the AC generator.

· Install the transmission belt of the alternator and adjust the tightness of the belt.

· Please refer to the “transmission skin” Section of this chapter

5 . Drive belt of power steering pump

· Install the transmission belt of the power steering pump and adjust the tightness of the belt.

· Please refer to the “transmission skin” Section of this chapter

6. Fan wind scooper

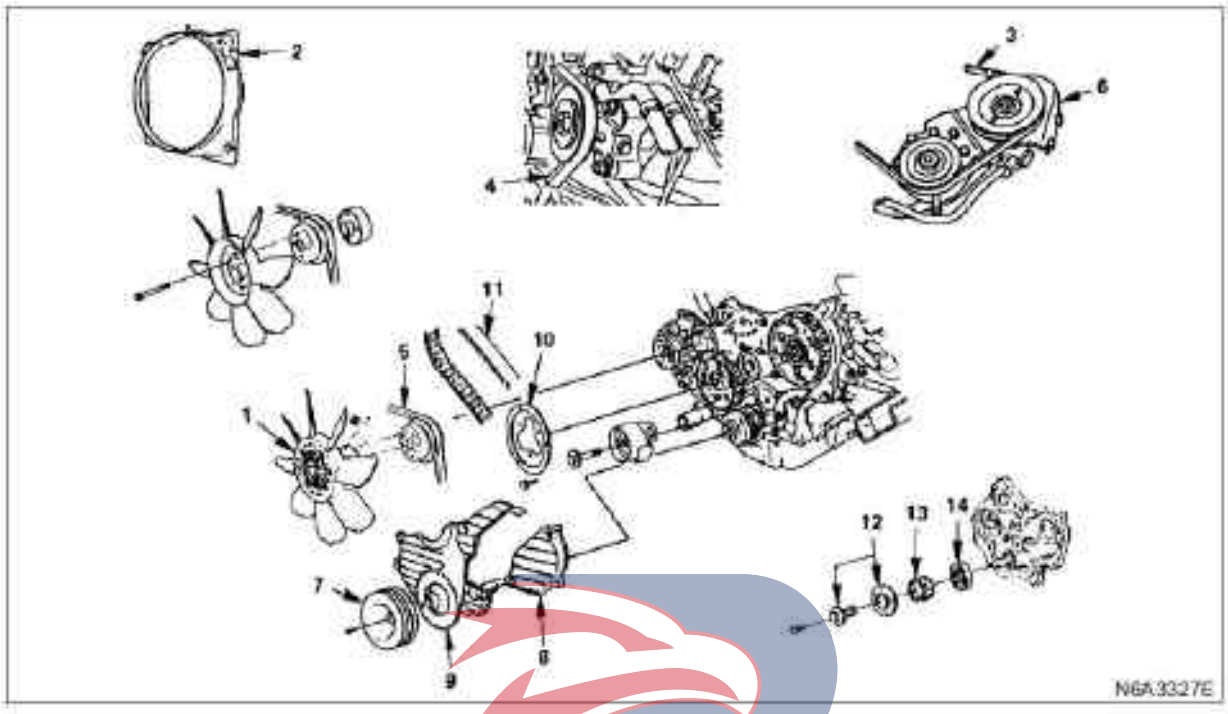
· Install the fan guide cover and the water tank hose.

· Pour into the coolant

· Start the engine and check the leakage of the coolant

Crankshaft front oil seal (belt drive type)

Parts



Legend

1. Cooling fan assembly
2. Fan wind scooper
3 . Drive belt of power steering pump
4. Drive belt of the A/C compressor
5. drive belt of the AC generator.
6. Power steering pump and bracket assembly
7. belt pulley of crankshaft damper
8. Upper cover of timing belt pulley
9. Lower cover of timing belt pulley
10. Flange and camshaft belt pulley
11. Timing belt
12. Camshaft belt pulley center flange plate
13. crankshaft timing pulley
14. Front oil seal

Dismantling

Preparation

· Disconnect the grounding wire of the storage battery

· Discharge coolant.

1. Cooling fan assembly

2. Fan wind scooper

3. Drive belt (P/S type) of power steering pump

4. Drive belt (A/C type) of the A/C compressor

5. drive belt of the AC generator.

6. Power steering pump and bracket assembly (P/S type)

7. Belt pulley of crankshaft damper

8. Upper cover of timing belt pulley

9. Lower cover of timing belt pulley

10. Flange and camshaft belt pulley

11. Timing belt pulley

For the above operations, please refer to the "Timing Belt (Belt Type)" Chapter of this Manual.

12. Camshaft belt pulley center flange plate

· Disassemble the center of the pulley with special tools.

Replacer: 5-8840-0161-0

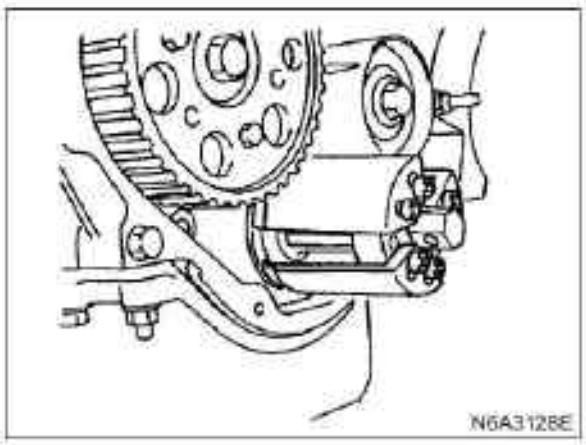
13. crankshaft timing pulley

14. Front oil seal

· Disassemble oil seals with special tools.

· While pushing forward the oil seal, disassemble the oil seal with special tool in accordance with the illustrations.

Front oil seal remover 5-8840-2362-0



Caution:

When removing oil seals, please be careful and cautious not to damage the oil seal surface of the front baffles and crankshafts.

.

Install

1. Front oil seal

· Install oil seals with special tools.

Erector: front oil seal: 5-8840-2361-0

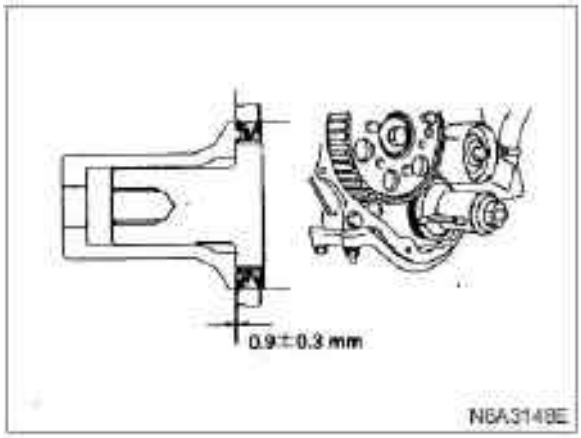
1) Place the shaft sleeve with oil seal into the front of the crankshaft.

2) When the edge of the oil seal is attached to the crankshaft, tighten it with the center bolt until the sleeve can completely touch the base face of the front end of the crankshaft.

3) Remove the shaft sleeve.

4) Measure the dimension of the oil seal after tightly pressing it.

Standard	mm (in)
0.6 — 1.2 (0.024 — 0.047)	



Caution:

· After installing the timing belt wheel chamber, install the oil seal.

· Apply oil on the lip of the oil seal.

· Pay attention to the pressing direction of the oil seal.

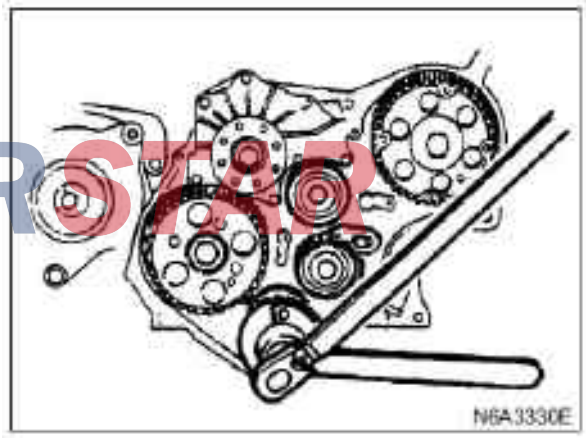
2. Crankshaft timing pulley

3. Camshaft belt pulley center flange plate

· Install the center flange of the timing pulley and tighten the bolt to the specified torque.

Tightening

· 206 N·m (21 kg·m/152 lb·ft) for center bolts of the pulley.



4. Timing belt pulley

5. Flange and camshaft belt pulley

6. Lower cover of timing belt pulley

7. Upper cover of timing belt pulley

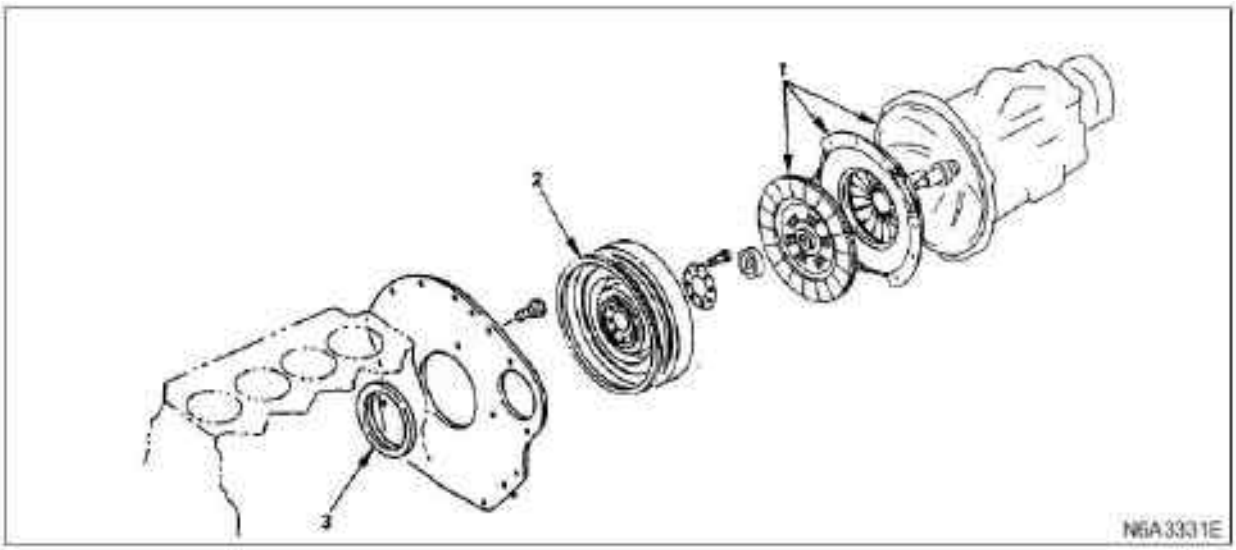
8. Belt pulley of crankshaft damper

9. Power steering pump and bracket assembly (P/S type)

10. drive belt of the AC generator.
11. Drive belt (A/C type) of the A/C compressor
12. Drive belt (power steering pump type) of power steering pump
13. Fan wind scooper
14. Cooling fan assembly
For the above operations, please refer to the "Timing Belt (Belt Type)" Chapter of this Manual.

Crankshaft rear oil seal (gear and belt drive type)

Parts



Legend

1. Transmission and clutch assembly
2. Flywheel
3. Rear oil seal

Dismantling

Preparation

· Disconnect the grounding wire of the storage battery

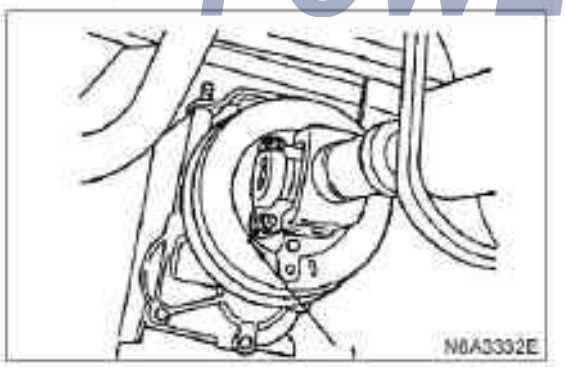
1. Transmission and clutch assembly

· Raise the car and support it safely.

1) Transmission

(i) Transmission

· Mark the mark (1) in advance on the car brake drum and the flange fork.



· Disconnect the drive shaft on the flange

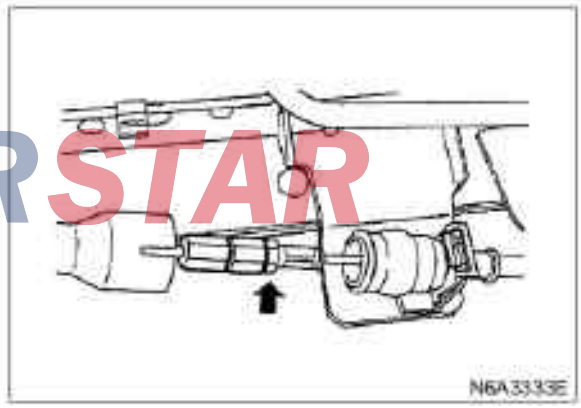
· Place the drive shaft separately and tie it on the frame so that it will not affect the normal operation of the maintenance.

(ii) Brake pull wire

· Disassemble the joint cover.

· Disassemble the connecting bolt.

· Disassemble the hoop and disassemble the wire.

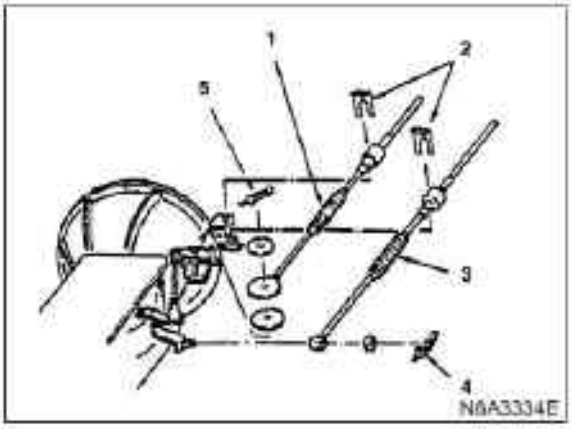


(iii) The connector of the wire

· Disassemble the automobile speed sensor, the neutral switch and the wire connector on the back-up lamp switch.

(iv) Shift cable and selector cable

· Disconnect the shift cable and the selector cable on the transmission.

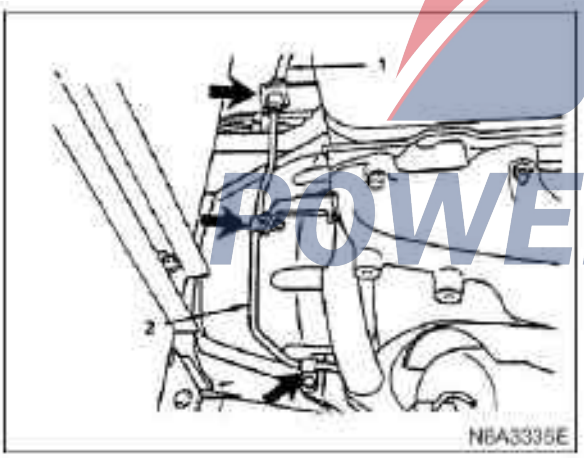


Legend

1. shift cable
2. Hoop
3. Shift selection cable
4. Cotter pin
5. Cotter pin

(v) Clutch wheel cylinder

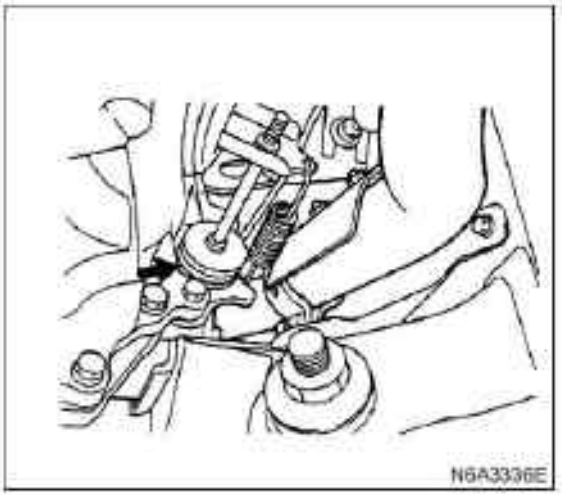
· Disassemble clamps and supports of clutch pipes (only on the right).



Legend

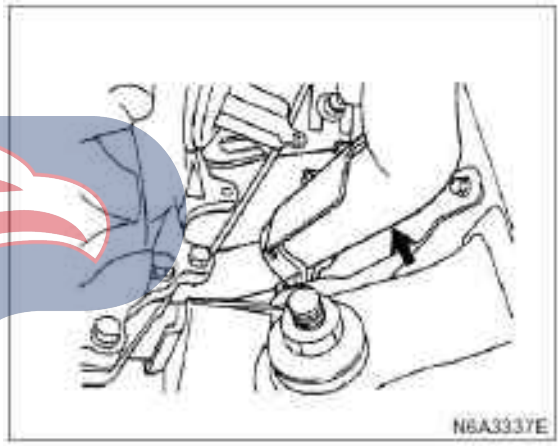
1. Flexible hose
2. Clutch pipe

·Disassemble the clutch wheel cylinder assembly with flexible hose and fasten it on the car frame so that it will not interfere with the normal maintenance.



(vi) Exhaust brake assembly

(vii) Front exhaust pipe



(viii) Transmission assembly

Caution:

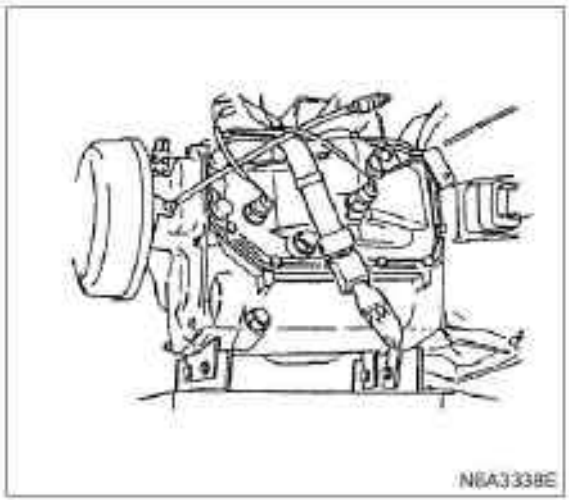
Possible wrong installation position of exhaust pipe bracket, gear control bracket and hoop sometimes, or direction error In order to avoid wrong installation of the above components, installation marks shall be made on them.

· Support the transmission with the jack.

Tips:

To prevent the transmission from toppling, it shall be firmly tied onto a jack using chains or belts.

Do not allow the transmission in the air suspension state of the clutch to avoid damage to the clutch.



· Disassemble the nut of the transmission mounting bracket on the frame cross beam.

· Be sure to adjust the angle of the engine and the transmission to facilitate disassembling.

· Support the rear of the engine with the jack or lifting device.

Tips:

While raising the engine with a jack, use wooden blocks as cushions to avoid damaging the oil sump.

· Support the rear of the engine with the jack or lifting device.

· Drag back the transmission assembly.

(ix) Clutch installing support

· Raise the car and support it safely.

Tips:

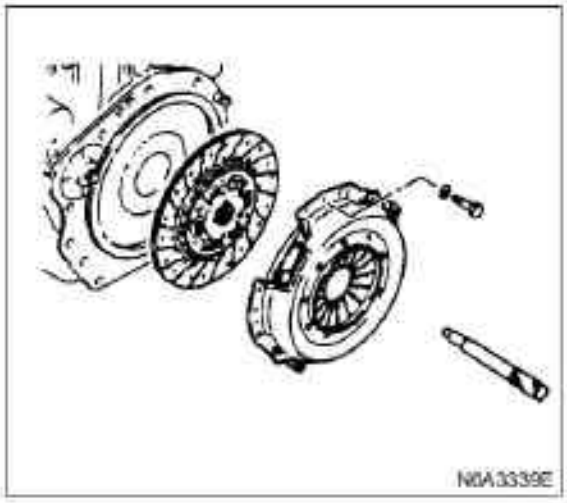
Never allow clutch fluid to remain on the engine surface, which shall be immediately washed away.

(x) Pressure plate assembly

(xi) Driven disc assembly

· Prevent the movement of the driven disc assembly with the guide positioner.

Guide positioner 5-5825-3001-0



· When installing, the flying wheel and pressure plate should be marked for accurate calibration.

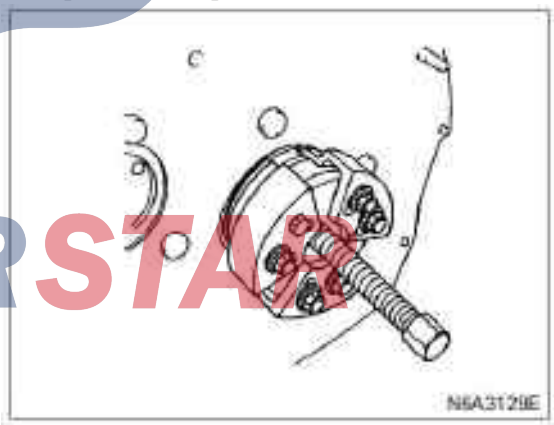
· Unscrew the pressure plate assembly fixing bolts.

2. Flywheel

3. Rear oil seal

· While pushing forward the oil seal, install the oil seal with special tools in accordance with the illustrations.

· The replacer of the post oil seal: 5-8840-2360-0



Caution:

When removing the oil seal, be cautious and careful, and do not damage the crankshaft or oil seal plug.

Install

1. Rear oil seal

· Install the oil seal on the cylinder with the oil seal erector

Post oil seal erector: 5-8840-2359-0

Caution:

Disassemble rust and debris at the installation location of oil seals.

1) Pay attention to the pressing direction of the oil seal.

2) Install a special tool connector at the back end of the crankshaft with two bolts.

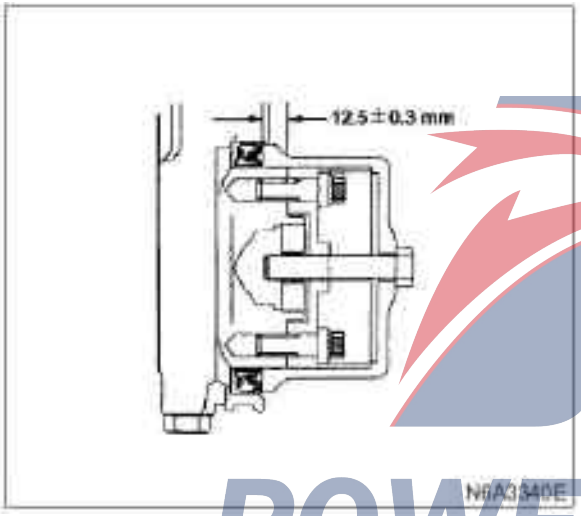
3) Install the oil seal to the outer edge of the adapter.

4) Insert the sleeve into the adapter interface and tighten the bolt (M12×1.75, Length = 70), until the adapter touches the sleeve.

5) Disassemble the adapter and sleeve.

6) Measure the dimension of the oil seal after installing it.

Standard	mm (in)
12.2 — 12.8 (0.48 — 0.5)	



2. Flywheel

· Apply the engine oil to the fixing bolt.

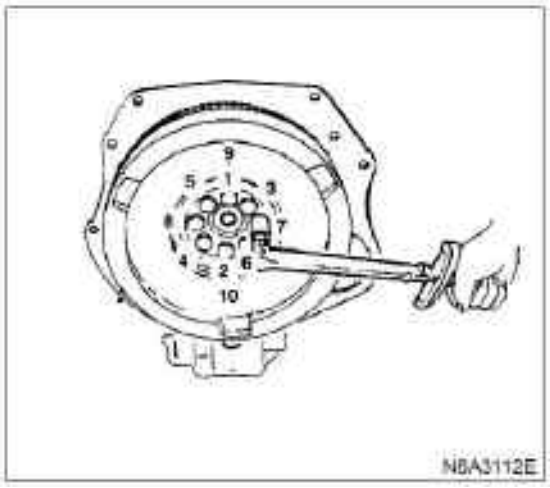
·Tighten the flywheel bots to the specified torque by two steps by means of angle tightening. Operate according to the number sequence shown in the illustration.

Tightening

· For flywheel bolts

Step 1: 59 N m(6.0 kg m/43 lb ft) and the torque value of Step 2: 60°— 90 °

Standard	mm (in)
12.2 — 12.8 (0.48 — 0.50)	



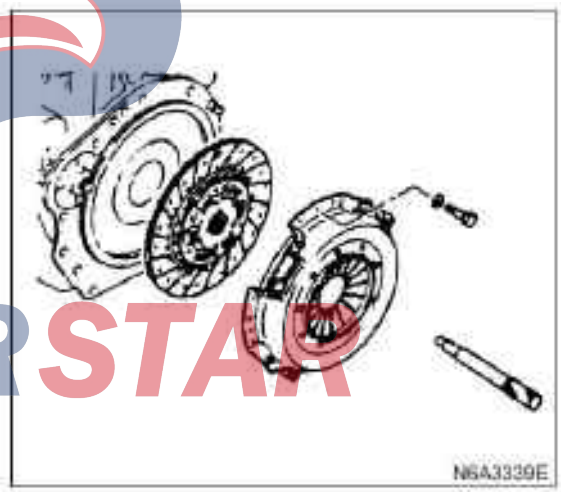
3. Gearbox and clutch assembly

1) Driven disc assembly

· Apply the molybdenum disulfide lubricating oil to the spline bushing of the driven disc.

· Install the driven disc assembly with the guide positioner.

Guide positioner: 5-5825-3001-0

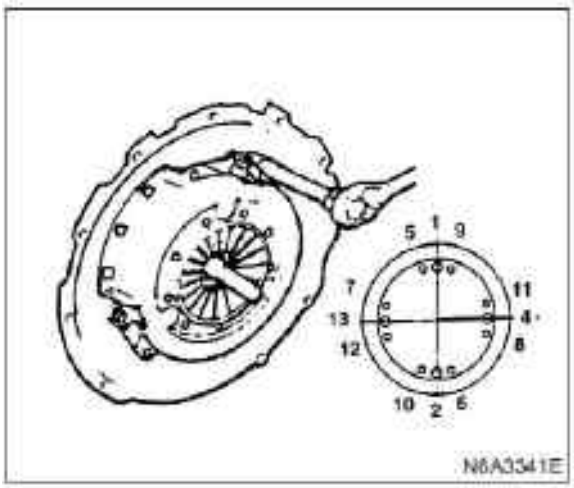


2) Pressure plate assembly

·Tighten the fixing bolts of the pressure plate assembly according to the number sequence.

Tightening

· 18 N·m (1.3 kg·m/13 lb·ft) for pressure plate fixing bolts.



· Disassemble the guide positioner.

Caution:

If a new pressure plate assembly is installed, be sure to dismantle the electric wire after tightening the pressure plate to the specified torque so as to protect the diaphragm spring.

3) Installation bracket

Tightening

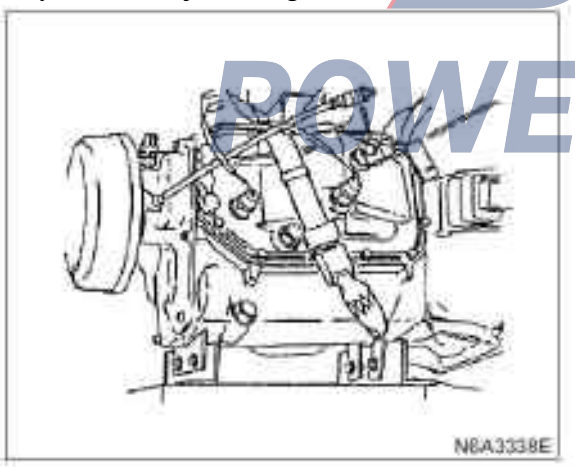
· Install the support nut to 69 N·m (7.0 kg·m/51 lb·ft)

4) Transmission assembly

· Support the transmission with the jack.

Tips:

To prevent the transmission from toppling, it shall be firmly tied onto a jack using chains or belts.



· Convert the transmission to high gear.

· Allow the transmission to be connected with the engine on the same line.

· Turn the output end of the parking brake drum to facilitate the clutch spline meshing.

Tightening

· Torque of wheel shell bolt

M10:46 N·m (4.7 kg·m/34 lb·ft)

M12:91 N·m (9.3 kg·m/67 lb·ft)

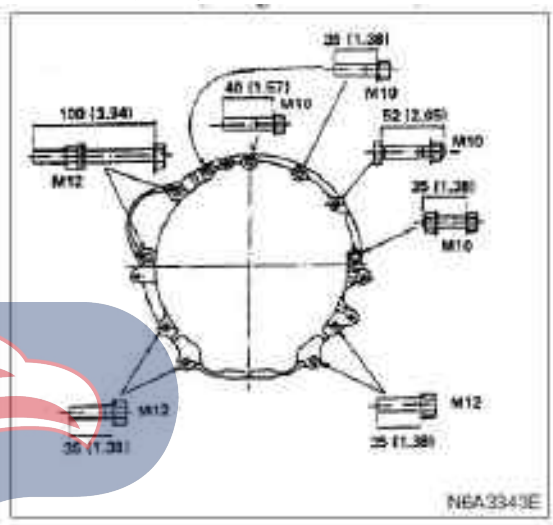
· Raise the engine and transmission and place the transmission rear transmission frame.

Tightening

· For engine rear mounting nuts and bolts

M10:40 N·m (4.1 kg·m/30 lb·ft)

M12:69 N•M(7.0 kg·m/51 lb·ft)



5) Front exhaust pipe

Tightening

· 37 N·m (3.8 kg·m/27 lb·ft) for front exhaust pipe bolts.

6) Exhaust brake assembly

Tightening

· Tighten the exhaust brake bolts to 17 N·m (1.9 kg·m/12 lb·ft)

7) clutch cylinder

Tightening

· 19 N·m (1.9 kg·m/14 lb·ft) for wheel cylinder bolts

· Before installing the return spring, the wheel cylinder should be adjusted.

a. Unscrew the locking nut of the push rod.

b. Rotate the adjustment nut till it contacts the release fork.

c. Return the adjusting nut by 1.5 circles.

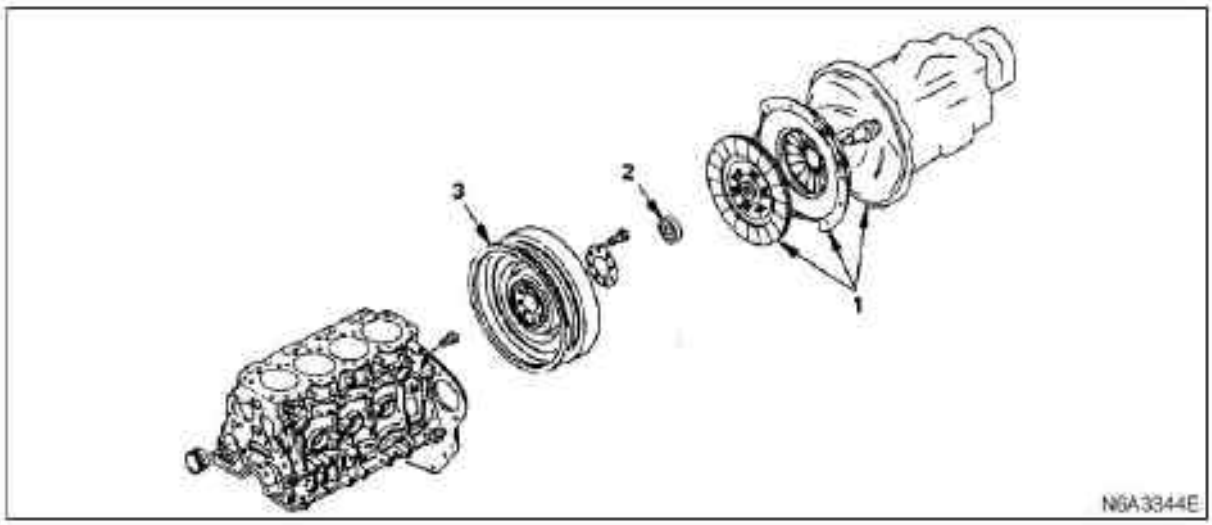
(release fork play about 2 mm / 0.1 in)

d. Tighten the locknut.

Tightening
· 16 N·m(1.6 kg·m/12 lb·ft) for push rod locking nuts
8) Shifting cable and shift selection cable
9) Wire connector
· Connector color
Reversing light switch: brown
Neutral line switch: grey
10) Parking brake
11) Transmission shaft
· Align all the marks
Tightening
· 66 N·m (6.7 kg·m/48 lb·ft) for drive shaft nut
· Connect the grounding wire of the storage battery

First axle bearing of flywheel and transmission

Parts



Legend

1. Transmission and clutch assembly
2. Flywheel and transmission first axle front bearing
3. Flywheel

Dismantling

Preparation

· Disconnect the grounding wire of the storage battery

1. Transmission and clutch assembly

1) Transmission

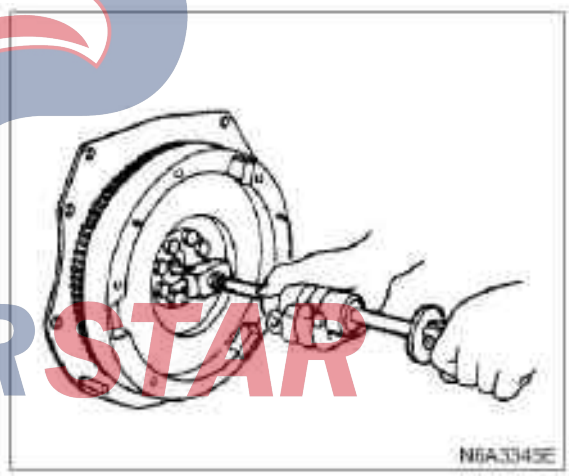
2) Clutch

For the above operation, refer to the chapter “engine assembly” in the manual.

2. Front bearing of the transmission input shaft

· Disassemble the front bearing of the first axle of the transmission with the replacer. First axle bearing tractor of transmission: 5-8840-2000-0

Sliding hammer: 5-8840-0019-0



3. Flywheel

· Install the flywheel plug.

· Release the flywheel fixing bolt and disassemble the flywheel.

Install

1. Flywheel

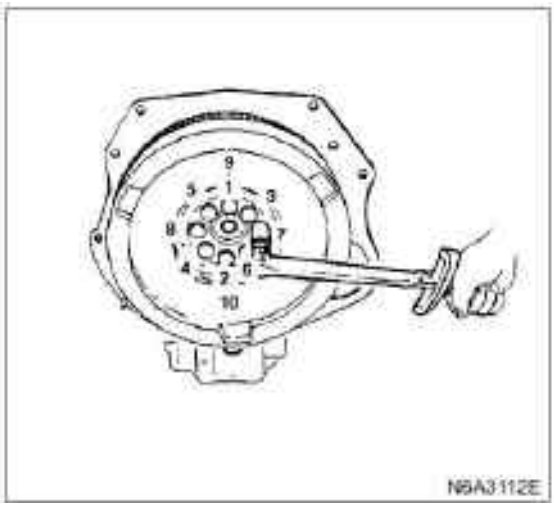
· Apply the engine oil to the fixing bolt.

·Tighten the flywheel bolts to the specified torque in two steps using the angle fastening method. Operate according to the number sequence shown in the illustration.

Tightening

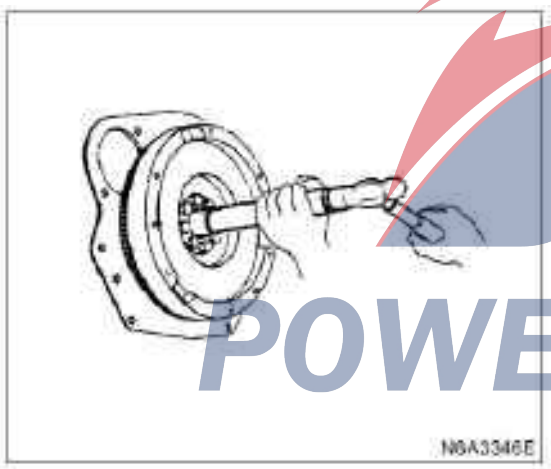
· For flywheel bolts

Step 1: 59 N·m(6.0 kg·m/43 lb·ft) and the torque value of Step 2 60°— 90 °



2. Front bearing of the transmission input shaft

· Install the first axle front bearing of the transmission with the erector. First axle bearing erector of transmission: 5-8522-0024-0



3. Transmission and clutch assembly

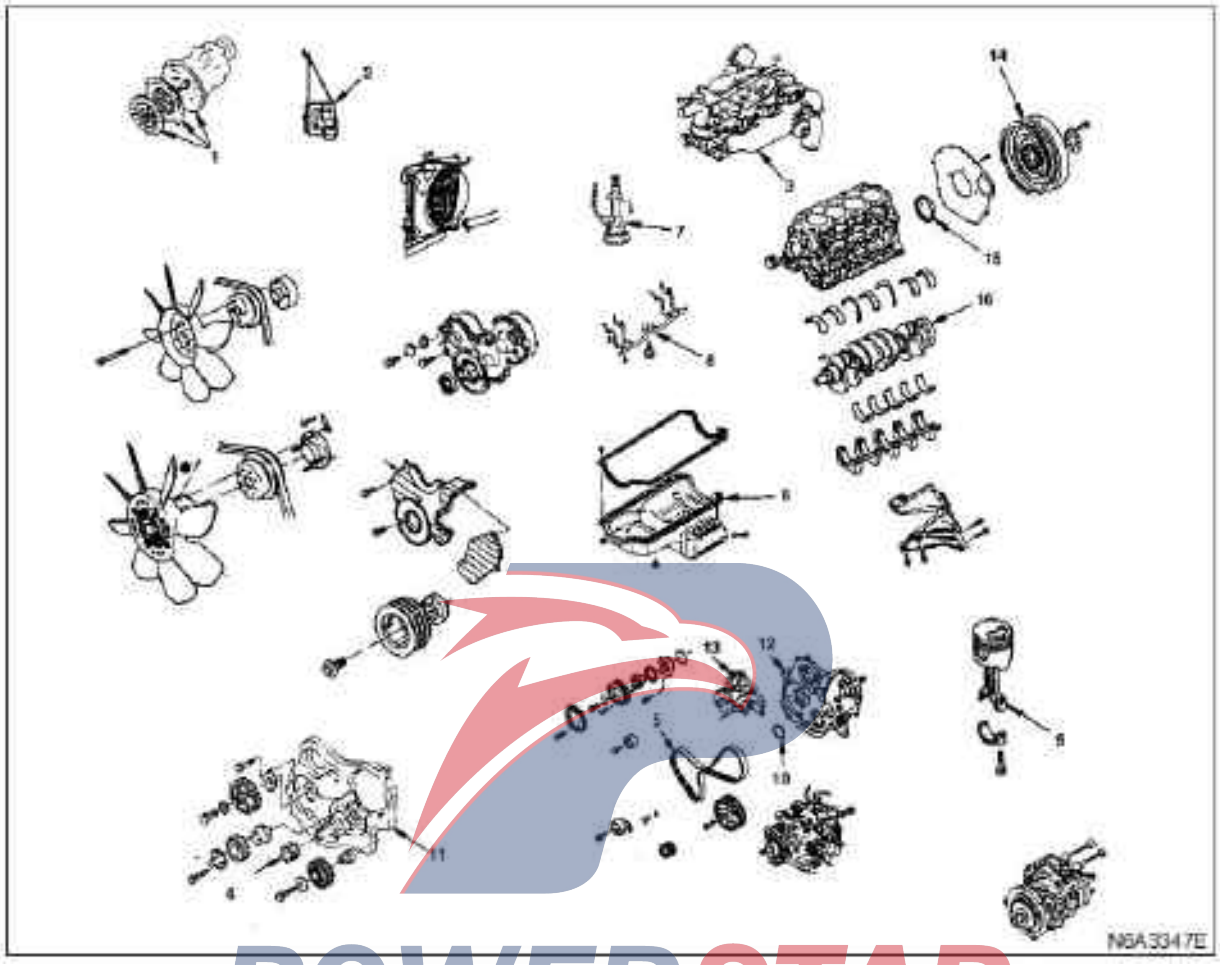
1) Clutch

2) Transmission

For the above operations, please refer to the "Engine Assembly" Chapter in this Manual.

Crankshaft and main bearing

Parts



Legend

1. Transmission and clutch assembly
2. Engine assembly
3. Cylinder head assembly and gasket
4. Timing gear (gear drive type)
5. Timing gear (belt drive type)
6. Oil sump assembly
7. Engine oil pump assembly
8. Engine oil cooling pipe of piston
9. Piston and connecting rod assembly
10. Front oil seal
11. Timing gear chamber
12. Timing belt pulley chamber
13. Water pump assembly
14. Flywheel and rear plate
15. Rear oil seal
16. Crankshaft and main bearing

Dismantling

Preparation

· Disconnect the grounding wire of the storage battery

· Discharge coolant in the radiator and the engine

1. Transmission and clutch assembly

1) Transmission

2) Clutch

For the above operations, please refer to the "Engine Assembly" Chapter in this Manual.

2. Engine assembly

1) Radiator assembly

2) Intake pipe
3) Heater hose
4) Engine control line
5) Glow plug harness
6) Fuel pipe
7) Engine oil pressure switch harness
8) Compressor assembly of the air conditioner
9) Support assembly of power steering pump (power steering type)
10) Adjuster vacuum hose (exhaust brake type)
11) Vacuum pump hose (exhaust brake type)
12) Front exhaust pipe
13) Supporting rubber block
14) Engine assembly

For the above operations, please refer to the "Engine Assembly" Chapter in this Manual.

3. Cylinder head assembly and gasket

1) High pressure oil pipe
2) Return oil pipe
3) PCV hose
4) Glow plug harness
5) Engine oil dipstick guide
6) Engine oil cooler water pipe (engine oil cooler type)
7) bypass hose
8) Cylinder head cover
9) Rockshaft
10) Tappet
11) Cylinder head assembly
12) Cylinder head gasket

For the above operations, please refer to the "Cylinder cover Assembly and Gasket" Chapter of this Manual.

.

4. Timing gear (gear drive type)

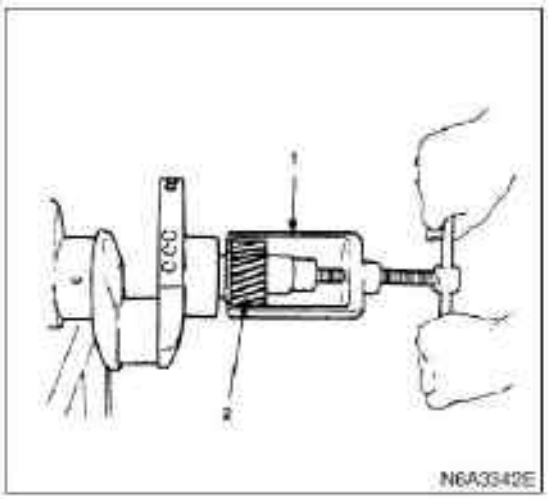
1) Cooling fan assembly
2) belt pulley of crankshaft damper
3) Acoustic enclosure
4) Acoustic enclosure gasket
5) Timing gear chamber cover
6) Oil pump
7) Idler
8) Idler "B" and shaft
9) injection pump
10) Crankshaft timing gear

For the above operations, please refer to the "Timing Gear (Gear Type)" Chapter of this Manual.

11) Crankshaft gear

· Disassemble the crankshaft gear (2) with the crankshaft gear replacer (1).

Crankshaft timing gear replacer 5-8840-2057-0



5. Timing belt (belt drive type)

1) Cooling fan assembly
2) belt pulley of crankshaft damper
3) Upper cover of timing belt pulley
4) Lower cover of timing belt pulley
5) Flange: camshaft belt pulley
6) Flange: injection pump pulley 7) Timing pulley

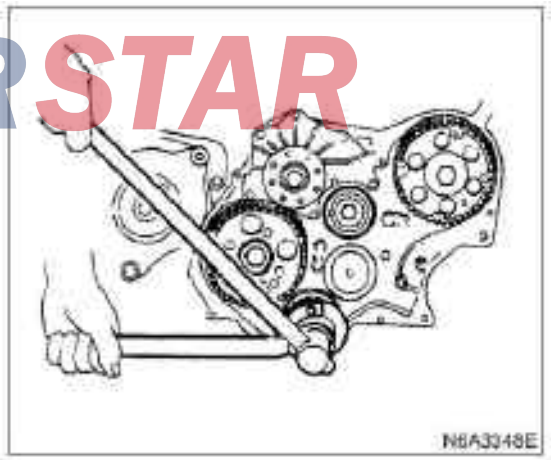
For the above operations, please refer to the "Timing Belt (belt type)" Chapter of this Manual.

8) Crankshaft timing belt pulley center flange plate

· Prevent crankshaft rotation with a fixed wrench.

non-adjustable wrench: 5-8840-0161-0

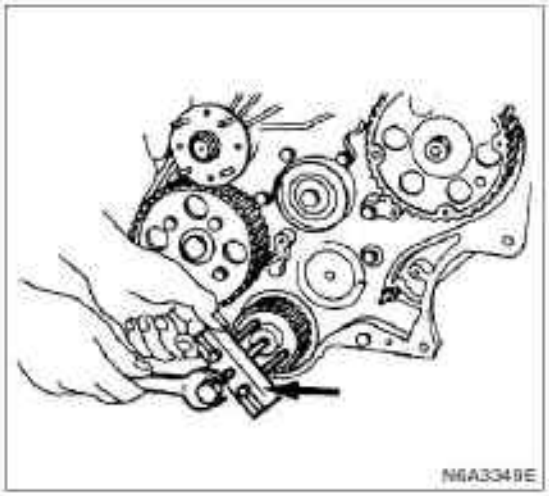
· Disassemble the central flange of the timing pulley from the crankshaft



9) crankshaft timing pulley

· Block the crankshaft with hardwood blocks to prevent the crankshaft from rotating.

· Disassemble the timing pulley with the crankshaft timing pulley replacer.



crankshaft timing pulley remover and installer: 5-8840-2035-0

10) Timing belt pulley of fuel injection pump

11) injection pump

For the above operations, please refer to the "Cylinder Block Assembly" Chapter in this Manual.

12) camshaft timing belt pulley

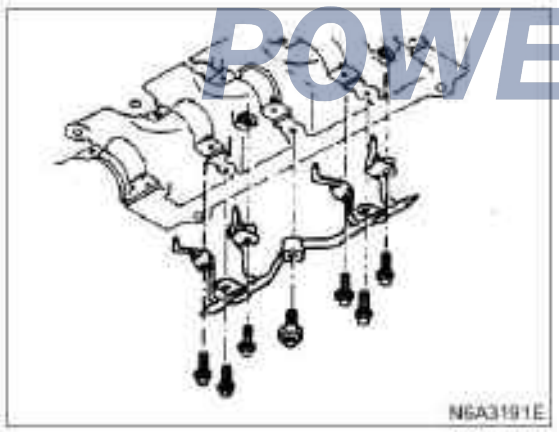
6. Oil sump assembly

7. Engine oil pump assembly

For the above operations, please refer to the "Camshaft and Tappet." Chapter in this Manual.

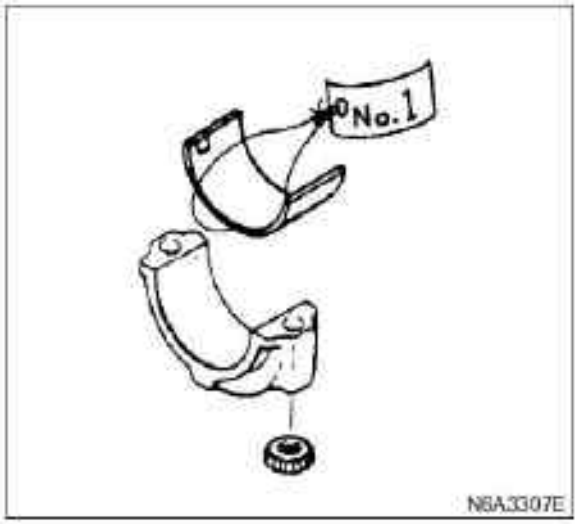
8. Engine oil cooling pipe of piston

· Disassemble the oil pipe from the cylinder block.



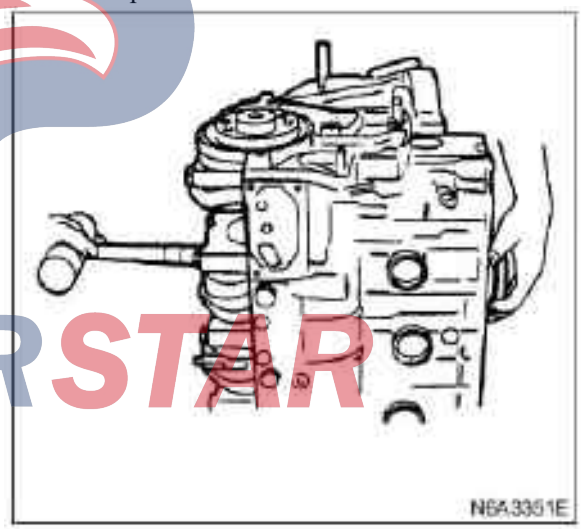
9. Piston and connecting rod assembly

· If the lower bearing of the connecting rod needs to be installed, the mounting mark and cylinder numbering should be made on each bearing.

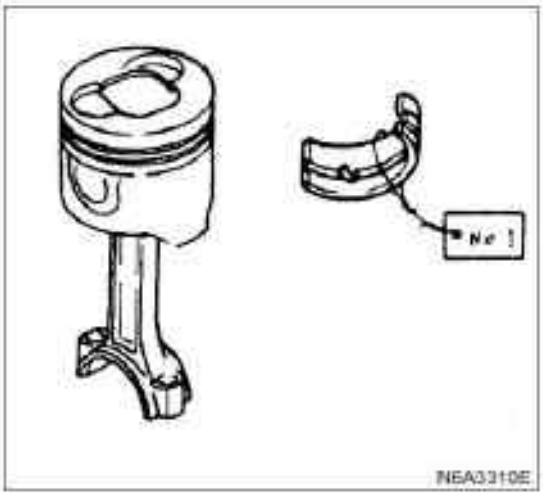


· Before removing the piston and connecting rod, disassemble the carbon deposited on the surface of the cylinder wall with a scraper.

Move the piston to the top of the cylinder and eject lower side of the piston with the hammer holder, and take out the piston.



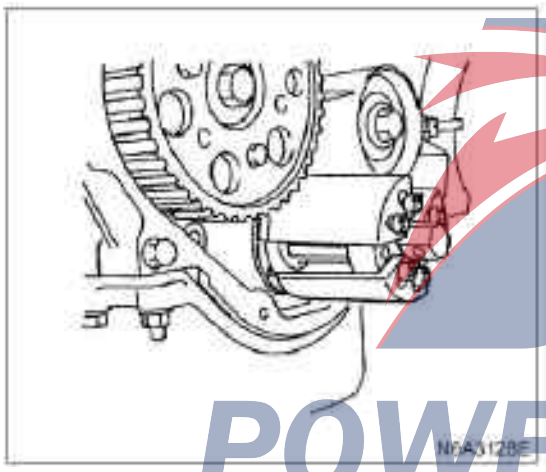
· If the lower bearing of the connecting rod needs to be installed, the mounting mark and cylinder numbering should be made on each bearing.



10. Front oil seal (belt drive type)

· While pushing forward the oil seal, disassemble the oil seal with special tools in accordance with the illustrations.

Front oil seal remover 5-8840-2362-0



11. Timing gear chamber

12. Timing belt pulley chamber

13. Water pump assembly

14. Flywheel and cylinder rear plate

· Install the flywheel plug.

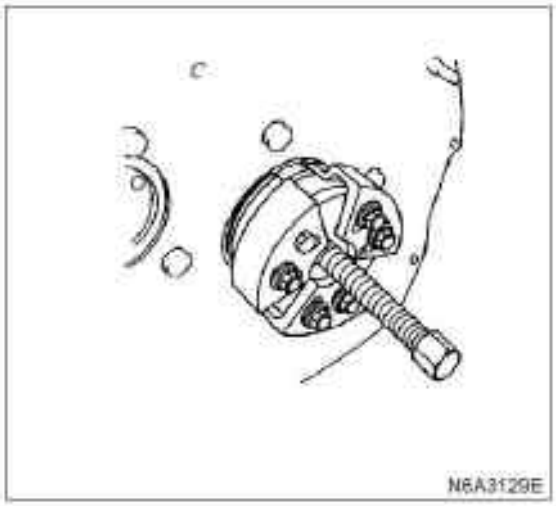
· Unscrew the flywheel fixing bolt and disassemble the flywheel.

· Disassemble the rear plate of the cylinder.

15. Rear oil seal (gear and belt drive type)

· While pushing forward the oil seal, disassemble the oil seal with special tools in accordance with the illustrations.

The replacer of the post oil seal: 5-8840-2360-0

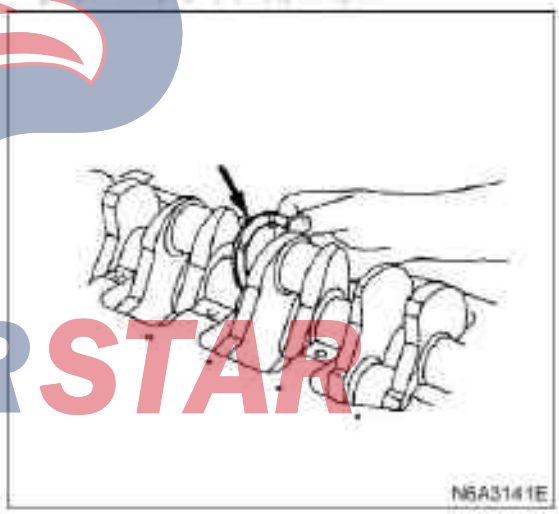


Caution:

When removing oil seals, please be careful and cautious not to damage the oil seal surface of front baffles and crankshafts.

16. Crankshaft and main bearing

1) Disassemble the main bearing cover and thrust seal.



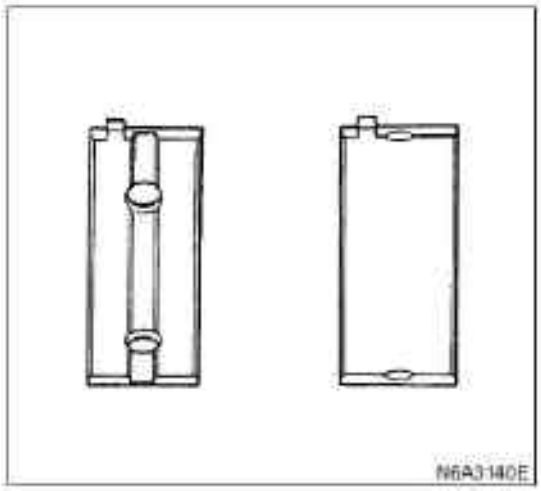
2) Carefully disassemble the crankshaft.

3) Disassemble the bearing on the crankshaft.

Install

1. Crankshaft and main bearing

· The upper bearing of the crankshaft has an oil hole and an oil tank. The lower bearings have no oil holes and oil grooves.



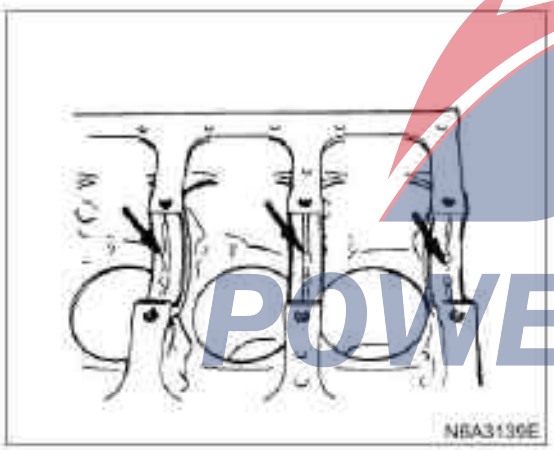
· Install the main bearing and the main bearing cover on the cylinder block, respectively.

· Apply the new engine oil to the upper and lower main shafts.

· Ensure the correct position of the main shafts.

· Cautiously and carefully wipe away the foreign objects on the main axis.

· Install the main shaft on the cylinder block and the main shaft cover.



Caution:

Do not apply the engine oil to the back of the main bearing and the mounting surface of the cylinder bearing.

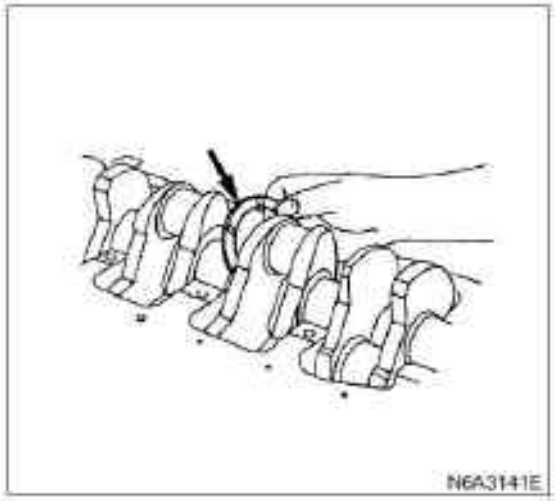
· Ensure that they are in the right place.

· Apply the new engine oil to the upper and lower main shaft surfaces.

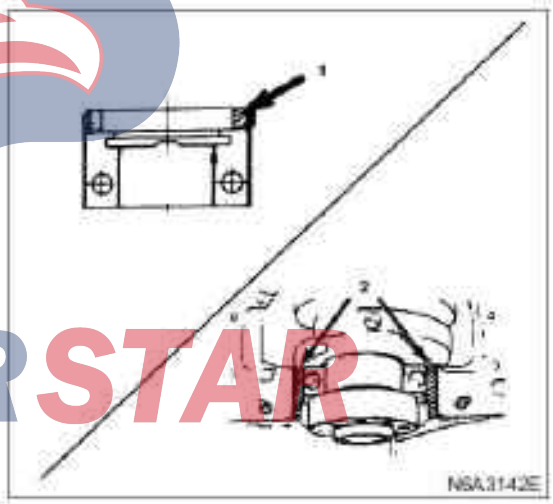
· Install the crankshaft cautiously.

· Apply the new engine oil to the thrust gasket.

· Install the thrust gasket on the third main journal. The oil ditch on the thrust seal should be facing to the crankshaft.



· Apply the recommended liquid sealant or its similar products on the mounting surface of the cylinder of the Bearing 5 arch cover according to the position in the illustration.



Caution:

Ensure there is no oil on the surface of the bearing cover before using the liquid sealant.

Do not allow the liquid sealant to obstruct the hole and bearing on the cylinder cover.

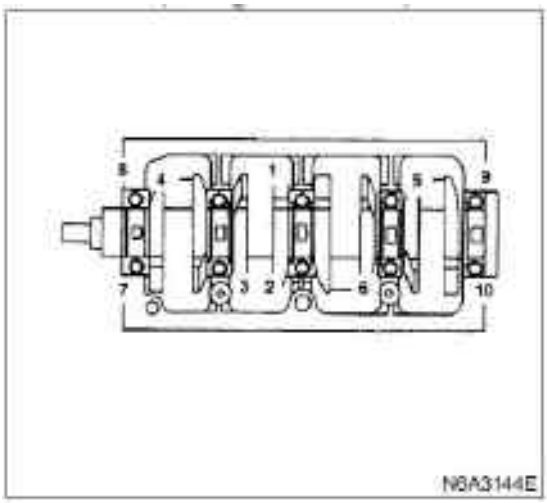
· When installing the bearing cover, the arrowhead mark of the bearing cover should be facing to the front of the engine.

· Apply the engine oil to the front of the engine.

· Slowly tighten the crankshaft bearing cover bolts to the specified torque in the order shown in the illustrations.

Tightening:

• 167 N•M(17.0 kg•m/123 lb•ft)



Caution:

Please check whether the crankshaft can rotate smoothly by hand.

2. Crankshaft rear oil seal

Install the oil seal on the cylinder with the oil seal erector

Post oil seal erector: 5-8840-2361-0

Caution:

Remove the rust and detritus on the pressed part of a clean oil seal.

Pay attention to the pressing-in direction of the oil seal.

1) Install the special tool to the rear end of the crankshaft with two bolts at the back end of the crankshaft.

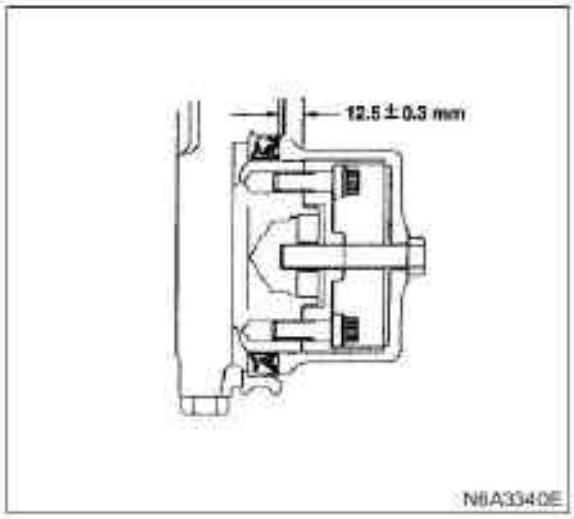
2) Install the oil seal to the outer edge of the adapter.

3) Insert the attachment into the adapter interface and tighten the bolt (M12 * 1.75 length = 70) until the adapter touches the attachment.

4) Disassemble the adapter and attachments.

5) Measure the dimension of the oil seal after installing it.

Standard	mm (in)
12.2 — 12.8 (0.48 — 0.50)	



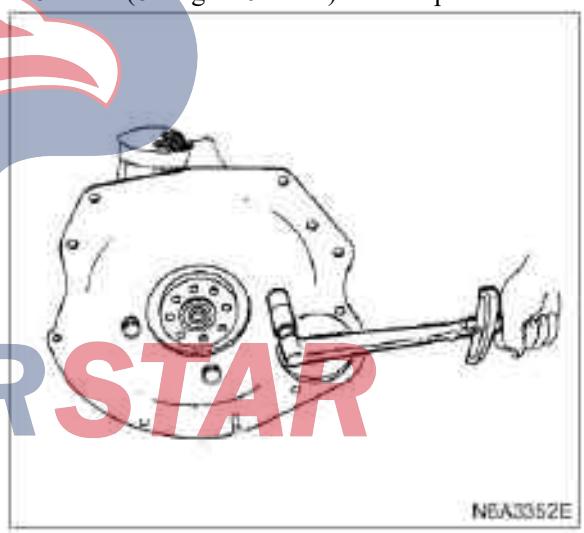
3. Flywheel and cylinder rear plate

· Aligning the rear plate with the cylinder block.

· Tighten the rear plate to the specified torque.

Tightening:

· 82 N·m (8.4 kg·m/61 lb·ft) for rear plate bolts



· Block the crankshaft with a hardwood block to prevent the rotation of the flywheel.

· Apply a layer of engine oil on the thread of the flywheel bolt.

· Align the flywheel with the crankshaft positioning pin.

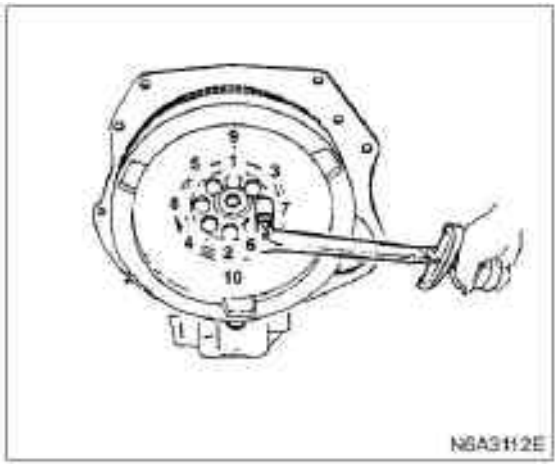
· Tighten the flywheel bolts to the specified torque in two steps using the angle fastening method.

· Operate in the numerical order shown in the illustration.

Tightening:

· For flywheel bolts

Step 1: 59 N· m(6.0 kg·m/43 lb·ft) and the torque value of Step 2: 60°— 90 °



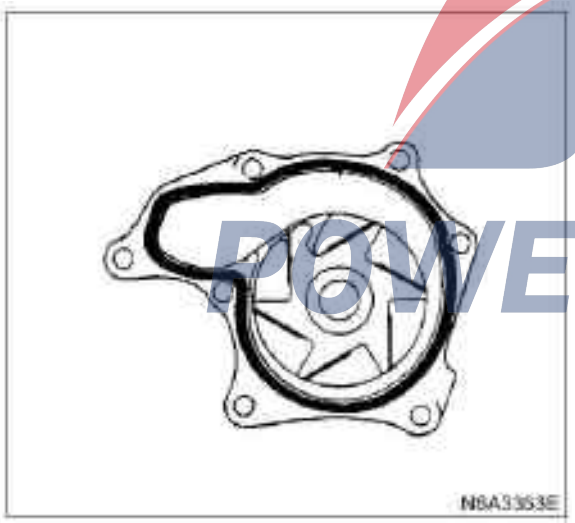
4. Water pump assembly

· Install the O ring on the pump.

· Install the pump assembly and tighten the bolt to the specified torque.

Tightening:

· 20 N·m (2.0 kg·m/14 lb·ft) for water pump bolts



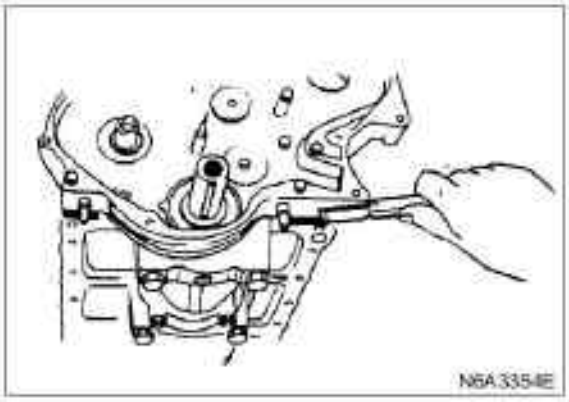
5. Timing belt pulley chamber

· Install the timing belt pulley on the cylinder block. Please be cautious and careful not to distort the front oil seal.

· Tighten the timing pulley and sealing gasket to the specified torque.

Tightening:

· 19 N·m (1.9 kg·m/152 lb·ft) for timing pulley chamber bolts



· Disassemble the sharp edges of the gasket.

6. Timing gear chamber

· Install the timing gear chamber on the cylinder block.

· Tighten the timing gear chamber and the sealing gasket to the specified torque.

Tightening:

· 19 N·m (1.9 kg·m/14 lb·ft) for bolts in the timing gear chamber

· Disassemble the sharp edges of the gasket.

7. Front oil seal (belt drive type)

· Install oil seals with special tools.

Oil seal installer 5-8840-2361-0

Caution:

Remove the rust and detritus on the pressed part of a clean oil seal.

Pay attention to the pressing-in direction of the oil seal.

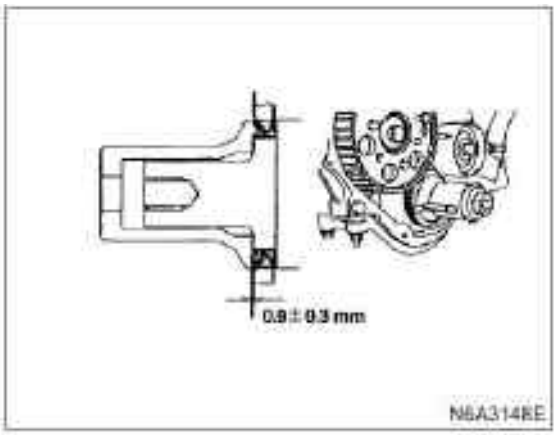
1) Place the shaft sleeve with oil seal into the front of the crankshaft.

2) When the edge of the oil seal is attached to the crankshaft, tighten it with the center bolt until the shaft sleeve can completely touch the base face of the front end of the crankshaft.

3) Remove the shaft sleeve.

4) Measure the dimension of the oil seal after tightly pressing it.

Standard	mm (in)
0.6 — 1.2 (0.024 — 0.047)	



8. Piston and connecting rod assembly

9. Engine oil cooling pipe of piston

For the above operations, please refer to the "Piston Assembly" Chapter in this Manual.

10. Oil pump assembly

11. Oil sump assembly

For the above operations, please refer to the "Oil Pump and Pan" Chapter in this Manual.

12. Timing belt (belt drive type)

1) camshaft timing belt pulley

For the above operations, please refer to the "Camshaft and Tappet" Chapter in this Manual.

2) injection pump

3) Timing belt pulley of fuel injection pump

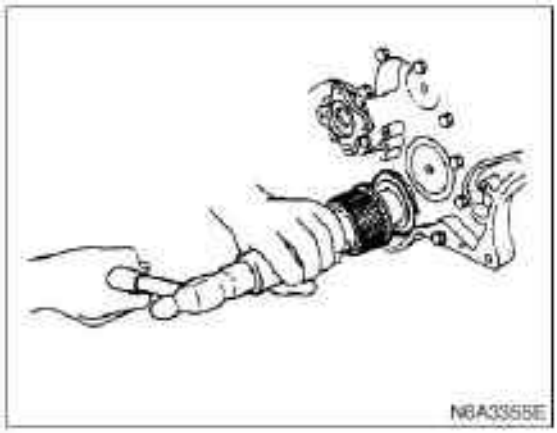
For the above operations, please refer to the "Cylinder Block Assembly" Chapter in this Manual.

4) crankshaft timing pulley

· Install the timing pulley with the crankshaft timing pulley replacer.

· The positive timing pulley flange should be facing to the cylinder block.

crankshaft timing pulley remover and installer: 5-8522-0020-0



5) Crankshaft timing belt pulley center flange plate

· Install the center distance of the crankshaft pulley.

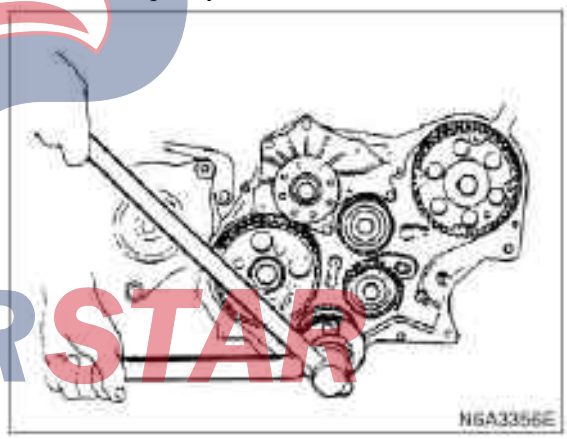
· Prevent crankshaft rotation with a fixed wrench.

non-adjustable wrench: 5-8840-0161-0

· Tighten the crankshaft pulley center bolts to the specified torque.

Tightening:

· 206 N·m (21 kg·m/152 lb·ft) for center bolts of the crankshaft pulley.



6) Timing belt

7) Flange: camshaft belt pulley

8) Flange: fuel injection pump belt pulley

9) Lower cover of timing belt pulley

10) Upper cover of timing belt pulley

11) belt pulley of crankshaft damper

12) Cooling fan assembly

For the above operations, please refer to the "Timing Gear (Pulley Type)" Chapter of this Manual.

13. Timing gear (gear drive type)

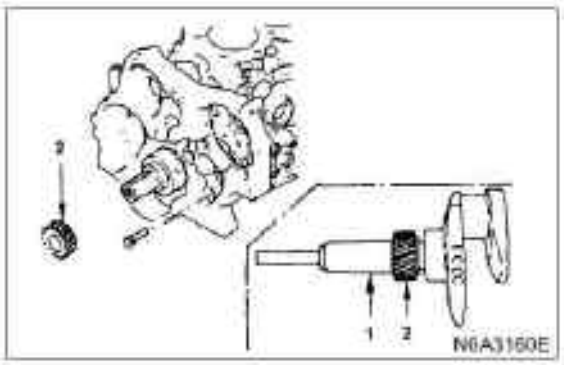
1) Crankshaft gear

· Install the crankshaft gear

· Install the crankshaft gear (2) with the crankshaft gear erector (1).

· The crankshaft gear timing mark ("X - X") or ("· — ·") should be facing out.

crankshaft gear installer: 9-8522-0020-0



2) Crankshaft timing gear

3) injection pump

4) Idler “B”and shaft

5) Idler

6) Timing gear oil pipe

7) Timing gear chamber cover

8) Soundproof cushion cover

9) Acoustic enclosure

10) belt pulley of crankshaft damper

11) Cooling fan assembly

For the above operations, please refer to the "Timing Gear (Gear Type) Chapter of this Manual.

14. Cylinder head assembly and gasket

1) Cylinder head gasket

2) Cylinder head assembly

3) Tappet

4) Rocker shaft assembly

Valve clearance adjustment

5) Cylinder head cover

6) bypass hose

7) Engine oil cooler water pipe (engine oil cooler type)

8) Engine oil dipstick guide

9) Preheating plug wire harness connector

10) PCV hose

11) Return oil pipe

12) High pressure oil pipe

For the above operations, please refer to the “Cylinder Cover Assembly and Gasket” Chapter of this Manual.

15. Engine assembly

1) Supporting rubber block

2) Front exhaust pipe

3) Vacuum pump hose

4) Vacuum regulator hose (exhaust brake type)

5) Power steering pump and bracket assembly (power steering type)

6) A/C compressor assembly (A/C type)

7) Engine oil pressure switch harness

8) Fuel pipe

9) Glow plug harness

10) Engine control line

11) Heater hose

12) Intake pipe

13) Radiator assembly

For the following operations, please refer to the "Engine Assembly” Chapter in this Manual.

16. Transmission and clutch assembly

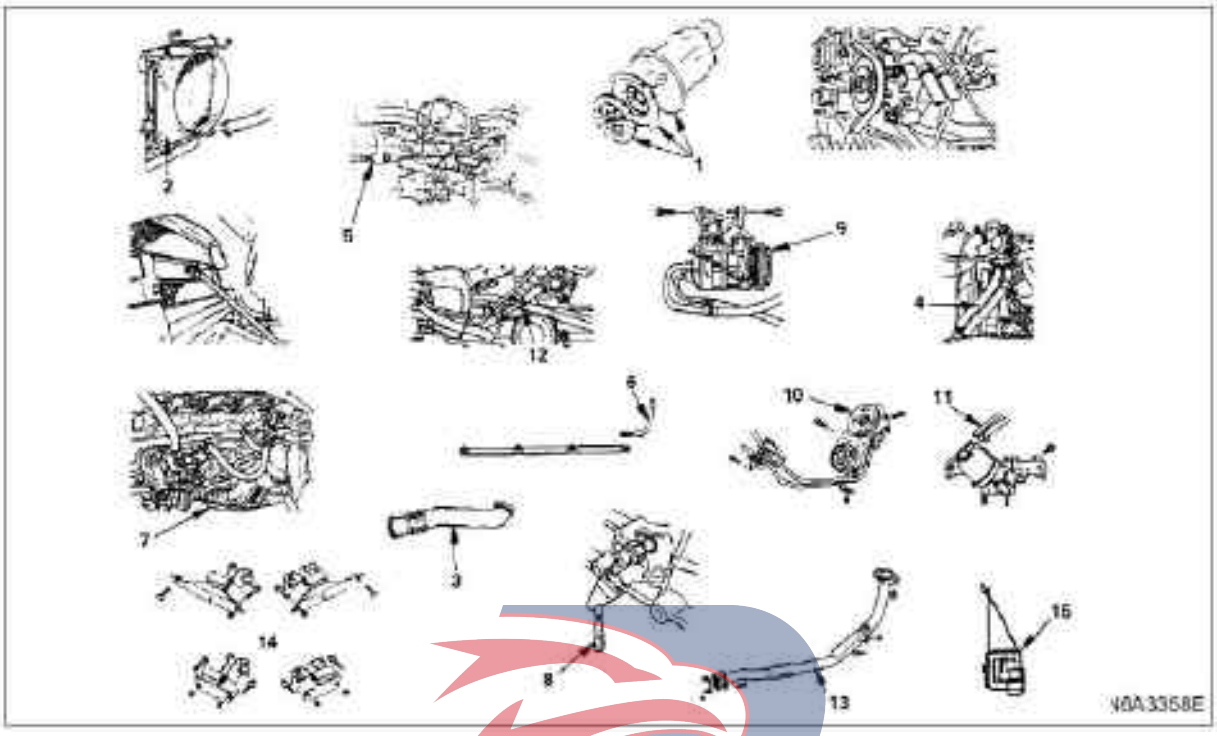
1) Clutch

2) Transmission

For the following operations, please refer to the "Engine Assembly” Chapter in this Manual.

Engine assembly

Parts



Legend

1. Transmission and clutch assembly
2. Radiator assembly
3. Intake pipe
4. Heater hose
5. Engine control line
6. Glow plug harness
7. Fuel pipe
8. Engine oil pressure switch harness
9. A/C compressor assembly (A/C type)
10. Power steering pump and bracket assembly (power steering type)
11. Vacuum regulator hose (exhaust brake type)
12. Vacuum pump hose
13. Front exhaust pipe
14. Supporting rubber block
15. Engine assembly

Dismantling

Preparation

· Disconnect the grounding wire of the storage battery

· Discharge coolant.

1. Transmission and clutch assembly

· Raise the car and support it safely.

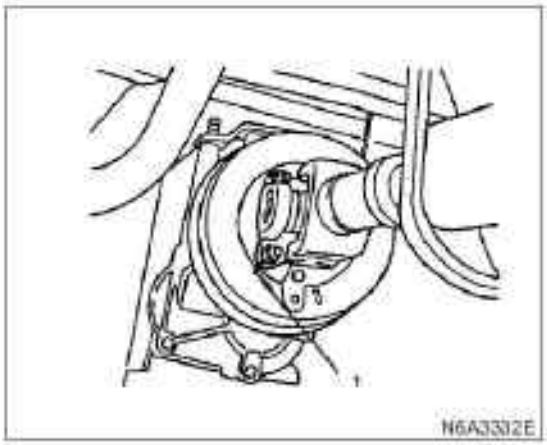
1) Transmission

(1) Transmission

· Mark the mark in advance on the car brake drum and the flange fork.

· Disconnect the drive shaft on the flange

· Place the drive shaft separately and tie it on the frame so that it will not affect the normal operation of the maintenance.



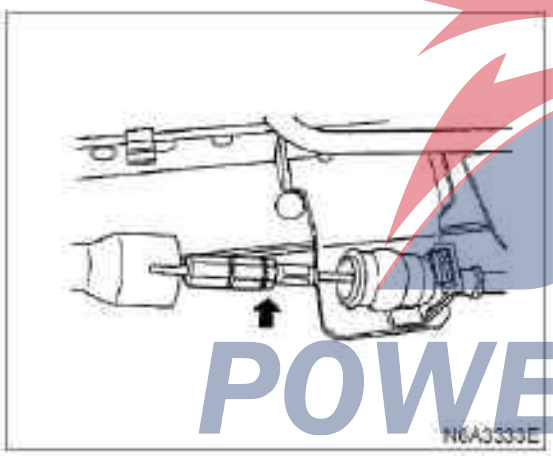
Legend

1. Reference mark

(ii) Brake pull wire

· Disassemble the joint bolt.

· Disassemble the hoop and separate the wire from the bracket.

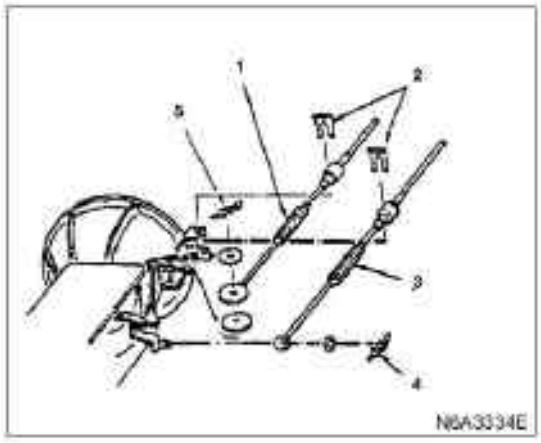


(iii) The connector of the wire

· Disassemble the automobile speed sensor, the neutral switch and the wire connector on the back-up lamp switch.

(iv) Shift cable and selector cable

· Disconnect the shift cable and the selector cable on the transmission.

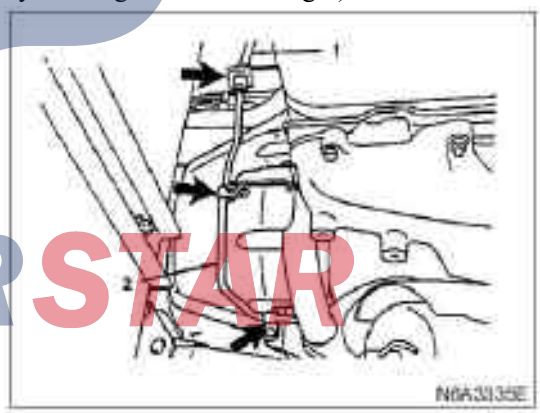


Legend

1. shift cable
2. Hoop
3. Shift selection cable
4. Cotter pin
5. Cotter pin

(v) Clutch wheel cylinder

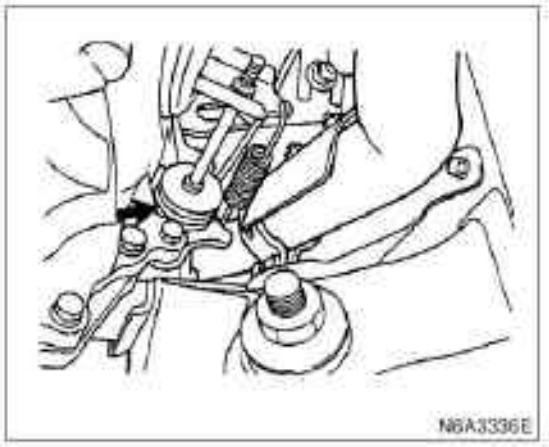
· Disassemble clamps and supports of clutch pipes (only steering wheel on the right)..



Legend

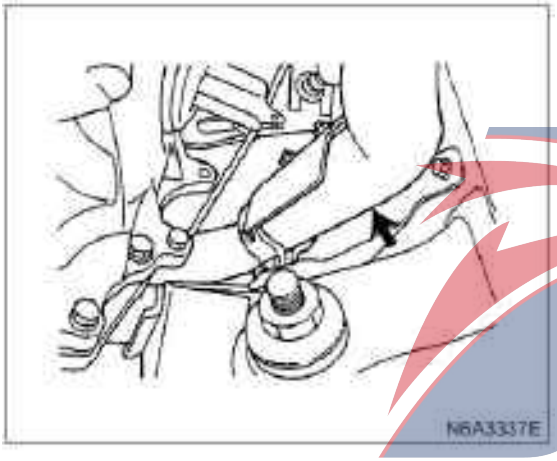
1. Flexible hose
2. Clutch pipe

· Disassemble the clutch pump assembly and the flexible hose attached, and tie it on the car frame so that it will not affect the maintenance.



(vi) Exhaust brake assembly

(vii) Front exhaust pipe



(viii) Transmission assembly

Caution:

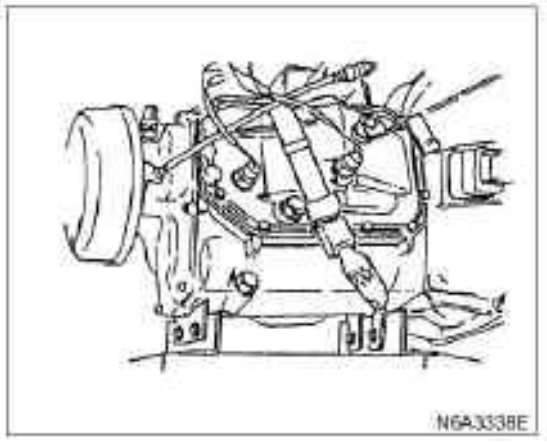
Possible wrong installation position of exhaust pipe bracket, gear control bracket and hoop sometimes, or direction error In order to avoid wrong installation of the above components, installation marks shall be made on them.

· Support the transmission with the jack.

Tips:

In order to prevent the failure of the transmission system, apply the chain or belt to the jack.

Do not allow the transmission in an unsupported state. If the clutch assembly is damaged, it may lead to:



· Disassemble the nut of the transmission mounting bracket on the frame cross beam.

· When dismantling, adjust the angle of the engine and the transmission to facilitate the disassembly.

· Support the rear of the engine with the jack or lifting device.

Tips:

While raising the engine with a jack, use wooden blocks as cushions to avoid damaging the oil sump.

· Support the rear of the engine with the jack or lifting device.

· Drag back the transmission assembly.

(ix) Install Clutch

2) Clutch

· Raise the car and support it safely.

Tips:

Never allow clutch fluid to remain on the engine surface, which shall be immediately washed away.

(i) Pressure plate assembly

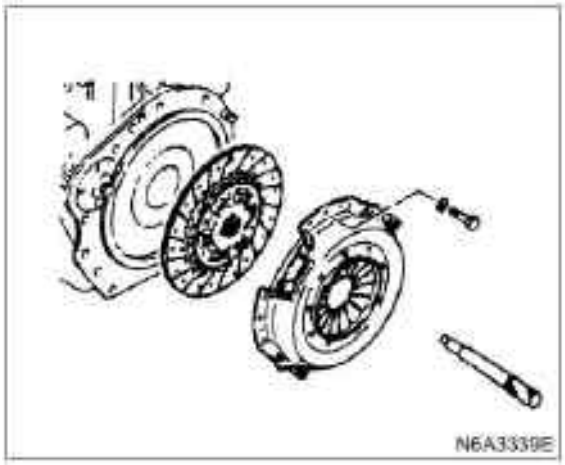
(ii) Driven disc assembly

· Prevent the dropping of the driven disc assembly with the guide positioner.

Guide positioner: 5-5825-3001-0

· When installing, the flying wheel and pressure plate flange should be marked for accurate alignment.

· Unscrew the pressure plate assembly fixing bolts.



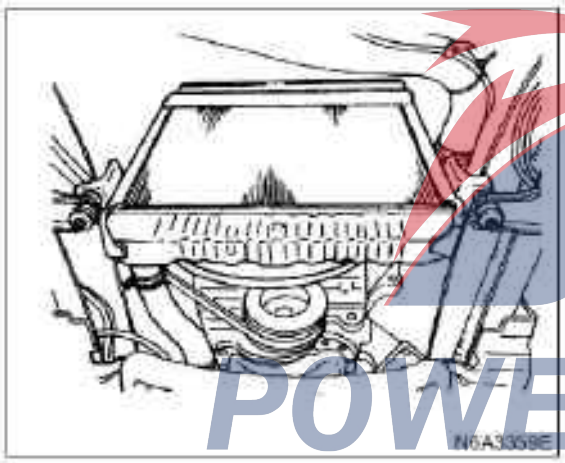
2. Radiator assembly

1) Disassemble the upper and lower hoses of the radiator.

2) Disassemble the hose of the water tank.

3) Dismantle the rubber ring from the two sides.

4) Dismantle the radiator bracket.



3. Intake pipe

4. Heater hose

5. Engine control line

· Unscrew the locking nut on the bracket and disconnect the fuel pump control rod and the accelerator pedal cable.

6. Glow plug harness

7. Fuel pipe

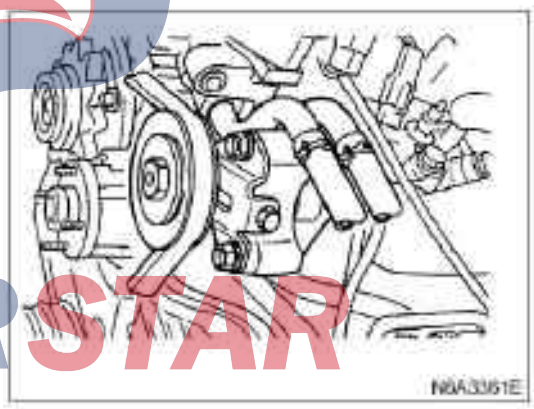
· Disassemble fuel inlet pipe and fuel oil return pipe.

8. Engine oil pressure switch harness

9. A/C compressor assembly

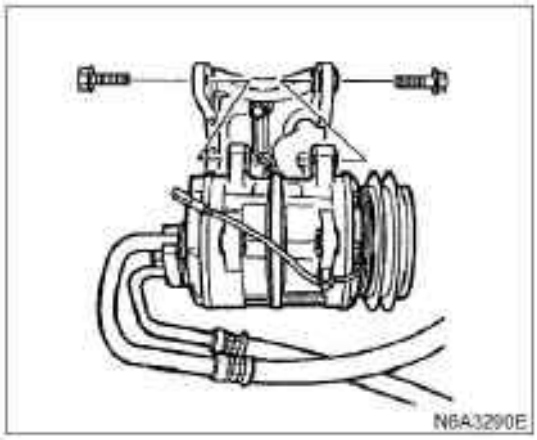
· Unscrew idler locking nut

· Unscrew the adjusting bolt and disassemble the transmission belt.



· Disassemble the electromagnetic clutch wire harness connector.

· Disassemble the fixing bolt of the air conditioner compressor, and temporarily use the wire to fix the air conditioner compressor to the bottom.



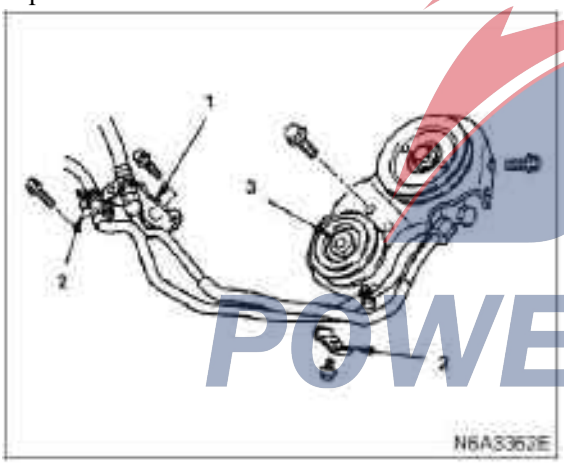
10. Power steering pump and bracket assembly (power steering type)

1) Loosen the locking nut of the idler

2) Unscrew the adjusting bolt and disassemble the transmission belt.

3) Disassemble the fixing bolt and hoop of the pipe support.

4) Disassemble the fixing bolt of the power steering pump.

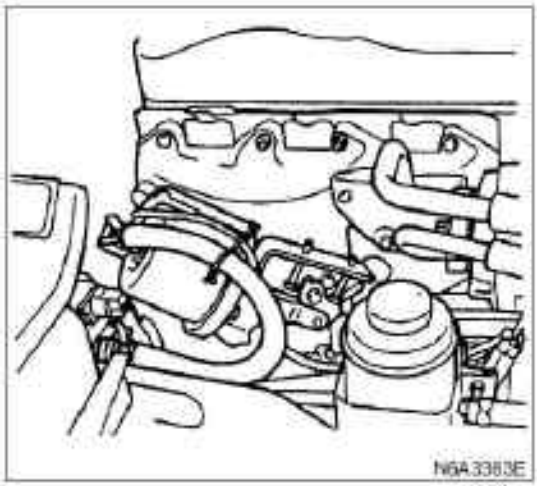


Legend

1. Support
2. Hoop
3. Locking nut

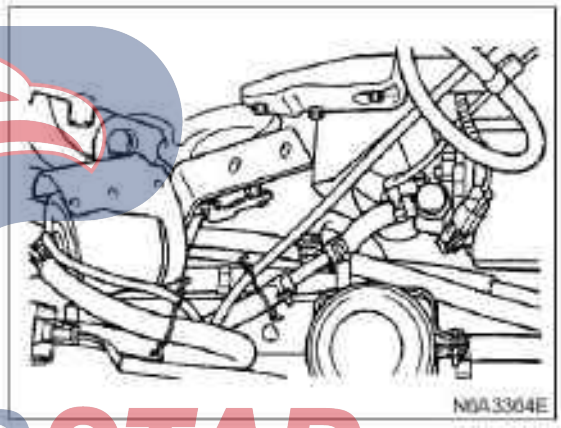
11. Vacuum regulator hose (exhaust brake type)

· Disconnect the connection between the vacuum tube and the booster.



12. Vacuum pump hose (exhaust brake type)

· Disconnect the connection between the vacuum tube and the vacuum tank as well as the solenoid valve.

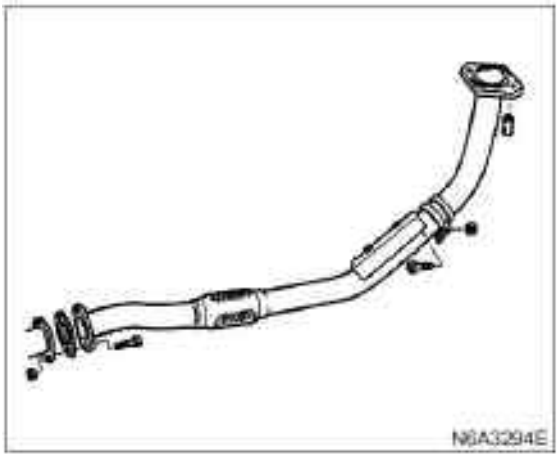


13. Front exhaust pipe

· Disassemble the exhaust pipe fixing bolt from the exhaust manifold.

· Disassemble the exhaust pipe support bolts.

· Disassemblefixing nut on the front tube.



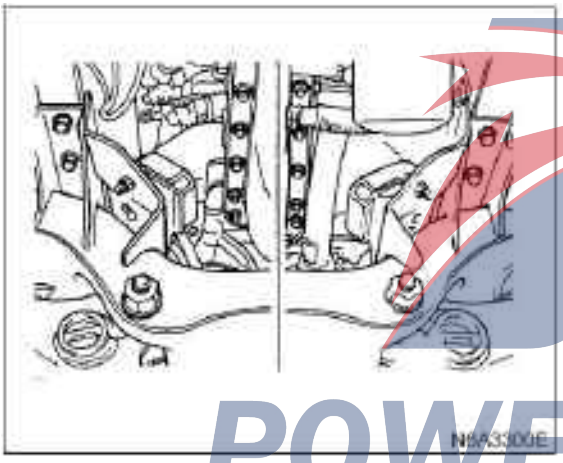
14. Supporting rubber block

1) Right-mounted

· Disassemble two fixing nuts on the beam.

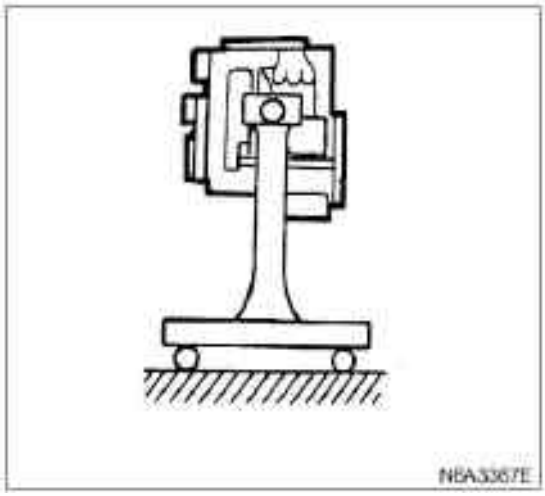
2) Left-mounted

· Disassemble two fixing nuts on the beam.



15. Engine assembly

1) Raise the engine with a lifting device.



2) The rising elevation is appropriate with the front of the engine higher than the rear.

3) When taking out the engine assembly, all the pipes and brake pipes should not be damaged.

Install

1. Engine assembly

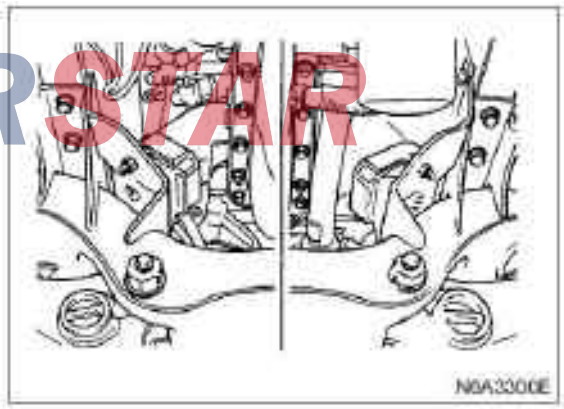
· Fix the engine in a proper position with the lifting device.

2. Supporting rubber block

· After inserting all the fixing bolts (two bolts on left and right side) into each hole, tighten the fixing bolt to the specified torque.

Tightening:

· 40 N•M(4.1 kg·m/30 lb·ft)



3. Front exhaust pipe

· Connect the exhaust pipe and tighten the flared nut to the specified torque.

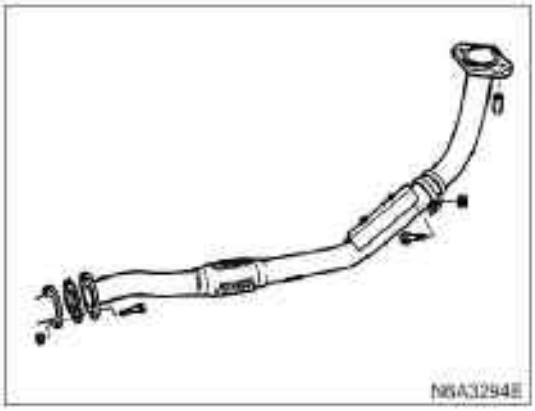
Tightening:

· 69 N·m (7.0 kg·m/51 lb·ft) for exhaust pipe nuts

· Install the exhaust pipe support and tighten the nuts to the specified torque.

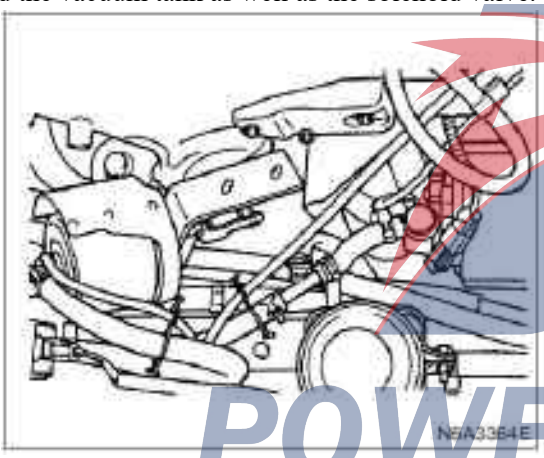
Tightening:

· 40 N·m (4.1 kg·m/30 lb·ft) for support bolts



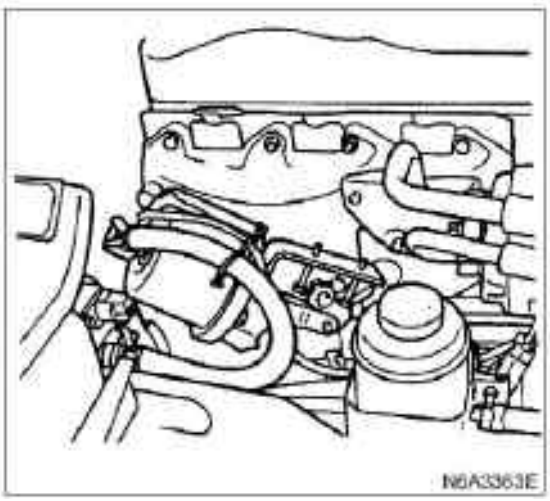
4. Vacuum pump hose (exhaust brake type)

· Connect the connection between the vacuum tube and the vacuum tank as well as the solenoid valve.



5. Vacuum regulator hose (exhaust brake type)

· Connect the vacuum tube and vacuum adjuster.



6. Power steering pump and bracket assembly (power steering type)

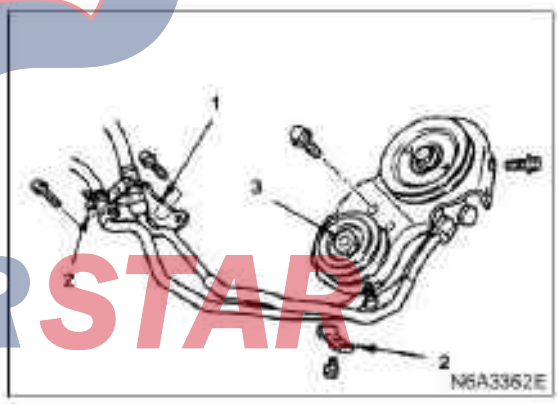
· Install the power steering pump and the pipe support, and tighten the bolt to the specified torque.

Tightening:

· 19 N·m (1.9 kg·m/14 lb·ft) for pump bolts

· 19 N·m (1.9 kg·m/14 lb·ft) for pipe support bolts

· 10 N·m (1.0 kg·m/87 lb·ft) for pulley hoop bolts



Legend

1. Support
2. Hoop
3. Locking nut

· Install the transmission belt of the power steering pump (1) and adjust the tightness of the belt.

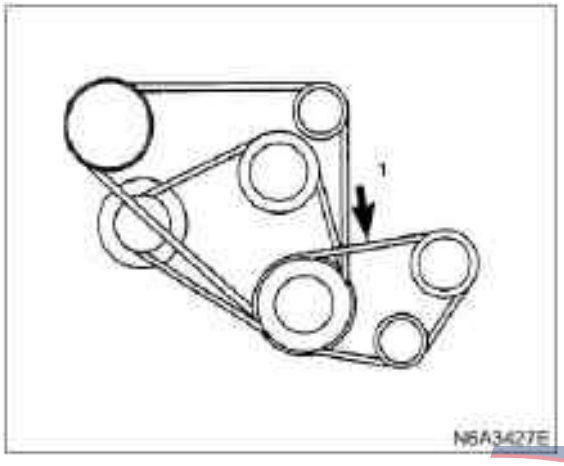
Check for wear of the drive belt. Replace immediately as necessary.

Check for the tightness of the belt. Adjust if necessary.

· Apply the force of 10kg in the middle of the belt and check the deflection of each belt.

· Standard deflection

	mm (in)
	Initial tightness
Drive belt of power steering pump	8—12(0.31—0.47)

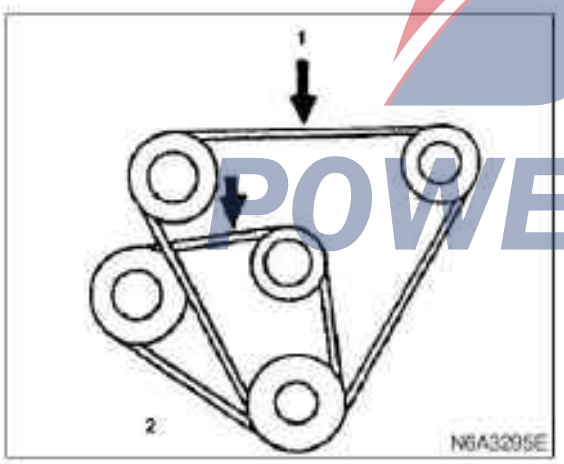


· If the locking nut is loose for the power steering pump, adjust the tightness of the nut with the adjusting belt.

Tightening:

· 27 N·m (2.8 kg·m/20 lb·ft) for idler locking nuts

4JB1



Legend

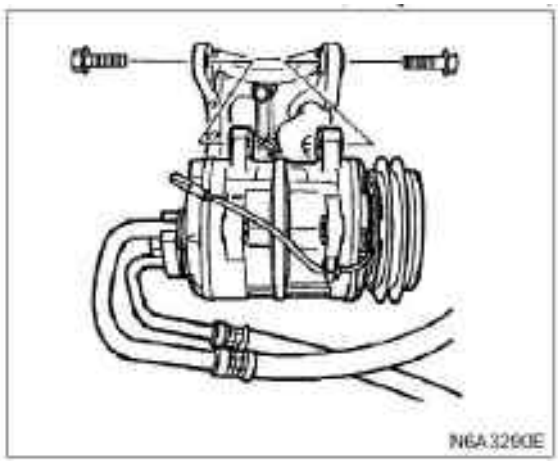
1. Drive belt of the A/C compressor and drive belt of the power steering pump
2. Drive belt of AC generator and fan belt pulley

7. A/C compressor assembly (A/C type)

· Install the fixing bolt of the air conditioner compressor and tighten it to the specified torque.

Tightening:

· 37 N·m (3.8 kg·m/27 lb·ft) for compressor fixing bolts



· Disassemble the electromagnetic clutch wire connector.

· Install the transmission belt of the air condition compressor (1) and adjust the tightness of the belt.

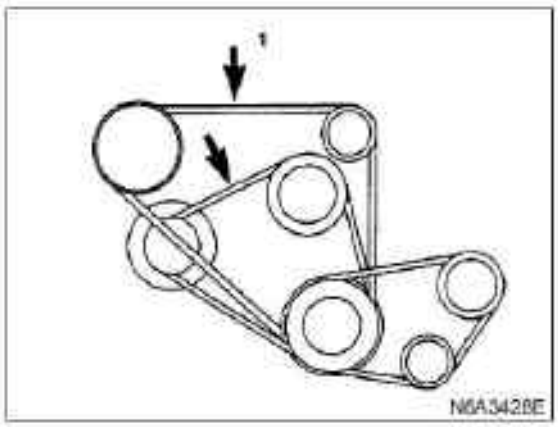
Check for wear of the drive belt. Replace immediately as necessary. Check for the tightness of the belt. Adjust if necessary.

· Apply the force of 10kg in the middle of the belt and check the deflection of each belt.

· Standard deflection

	mm (in)
	Initial tightness
Drive belt of the A/C compressor	8—12(0.31—.47)

4JG2



· If the pulley of the air conditioner compressor is loose, please adjust the tightness of the belt with the adjusting nut.

Tightening:

· 27 N·m (2.8 kg·m/20 lb·ft) for idler locking nuts

8. Engine oil pressure switch harness

· Connect the wiring harness of the oil pressure switch.

9. Fuel pipe

· Connect into the oil pipe and the oil pipe, and fasten the hoop.

10. Glow plug harness

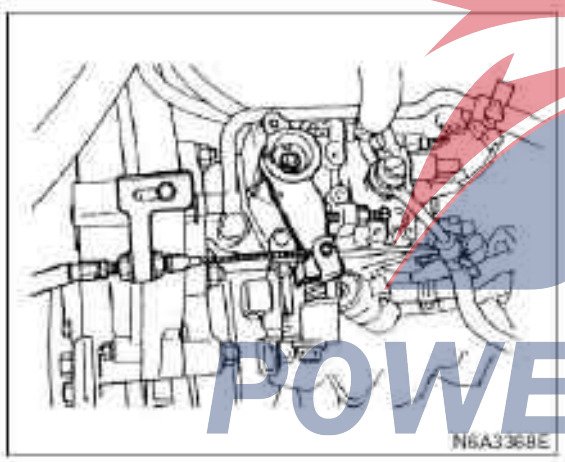
· Install the wire harness connector and tighten the bolt.

11. Engine control line

1) Install the control line on the engine control lever.

2) Completely close the accelerator rod and stretch the cable in the direction shown in the arrow to tighten it.

3) Tighten the accelerator cable support bolt.

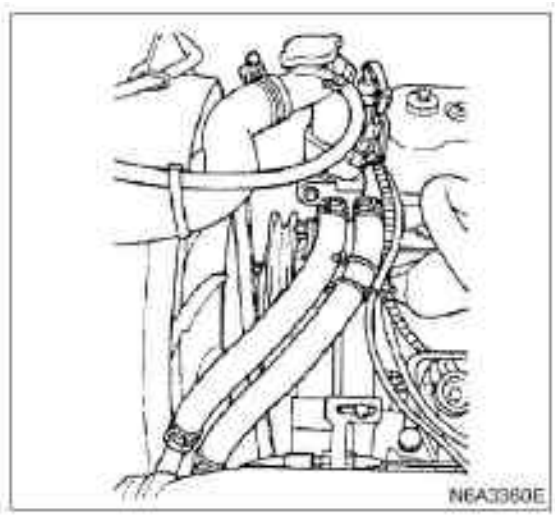


12. Heater hose

· Connect the heater hose and tighten the hoop.

13. Intake pipe

· Connect the air passage and tighten the clamp.



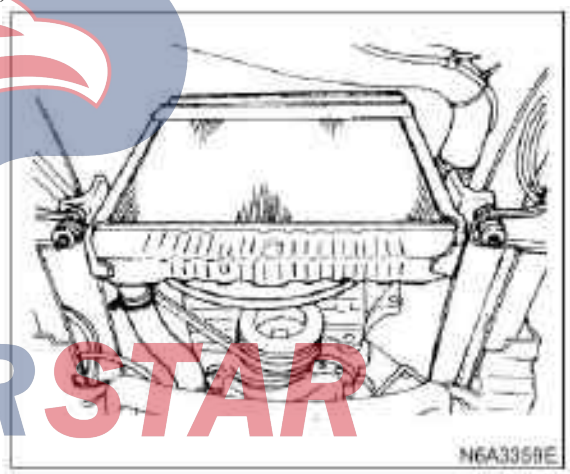
14. Radiator assembly

1) Dismantle the rubber ring from the two sides.

2) Dismantle the radiator bracket.

3) Connect the upper and lower hoses of the radiator.

4) Connect the water tank hose.



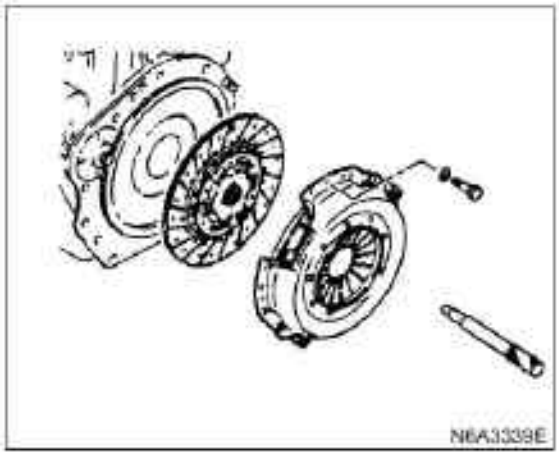
15. Transmission and clutch assembly

1) Driven disc assembly

· Apply the molybdenum disulfide lubricating oil to the inner surface of the spline bushing of the driven disc.

· Install the driven disc assembly with the driving positioner.

Guide positioner: 5-5825-3001-0

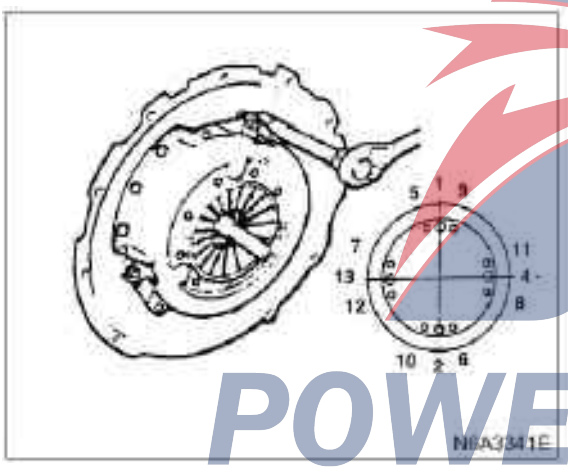


Pressure plate assembly

·Tighten the fixing bolts of the pressure plate assembly according to the number sequence.

Tightening:

· 18 N·m (1.8 kg·m/13 lb·ft) for pressure plate fixing bolts.



· Disassemble the guide positioner.

Caution:

If a new pressure plate assembly is installed, be sure to dismantle the electric wire after tightening the pressure plate to the specified torque so as to protect the diaphragm spring.

3) Installation bracket

Tightening:

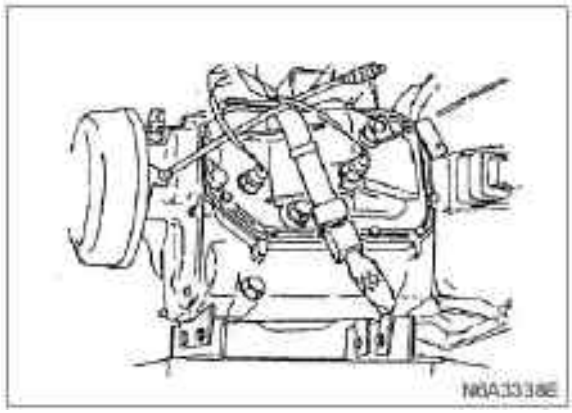
· Install the support nut to 69 N·m (7.0 kg·m/51 lb·ft)

4) Transmission assembly

· Support the transmission with the jack.

Tips:

To prevent the transmission from toppling, it shall be firmly tied onto a jack using chains or belts.



· Convert the transmission to high gear.

· Allow the transmission to be connected with the engine on the same line.

· Turn the output end of the parking brake drum to facilitate the clutch spline meshing.

Tightening:

· Torque of flywheel shell bolt

M10:46 N·m(4.7 kg·m/34 lb·ft)

M12:91 N·m(9.3 kg·m/67 lb·ft)

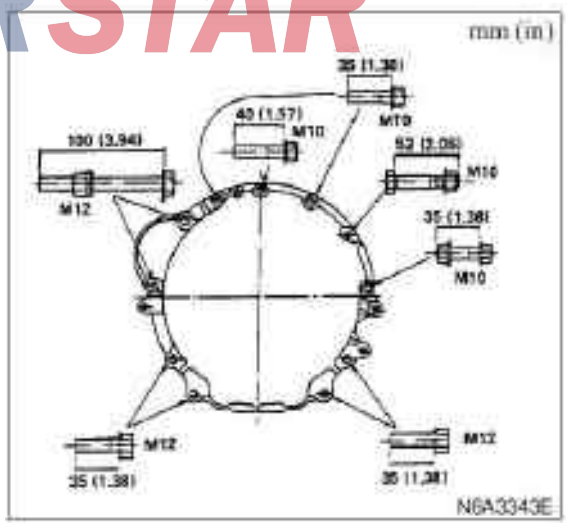
· Raise the engine and transmission and place them on the power the transmission rear transmission frame.

Tightening:

· Engine rear mounting nuts and bolts

M10:40 N·m(4.1 kg·m/30 lb·ft)

M12:69 N·m(7.0 kg·m/51 lb·ft)



5) Front exhaust pipe

Tightening:

· 37 N·m (3.8 kg·m/27 lb·ft) for front exhaust pipe bolts.

6) Exhaust brake assembly

Tightening:

· Tighten the exhaust brake bolts to 17 N·m (1.8 kg·m/12 lb·ft)

7) clutch cylinder

Tightening:

· 19 N·m (1.9 kg·m/14 lb·ft) for wheel cylinder bolts

·Before installing the return spring, the wheel cylinder should be adjusted.

a. Unscrew the locking nut of the tappet.

b. Rotate the adjustment nut till it contacts the release fork.

c. Return the adjusting nut by 1.5 circles.

(release fork play about 2 mm / 0.1 in)

d. Tighten the locknut.

Tightening:

· 16 N·m(1.6 kg·m/12 lb·ft) for tappet locking nuts

8) Shifting cable and shift selection cable

9) Wire connector

· Connector color:

Reversing light switch: brown

Neutral switch: gray

10) Parking brake

11) Transmission shaft

· Align all the marks.

Tightening:

· 66 N·m (6.7 kg·m/48 lb·ft) for drive shaft nut

· Connect the grounding wire of the storage battery

· Pour into the coolant

·Start the engine and check the leakage of the coolant

4J series engine

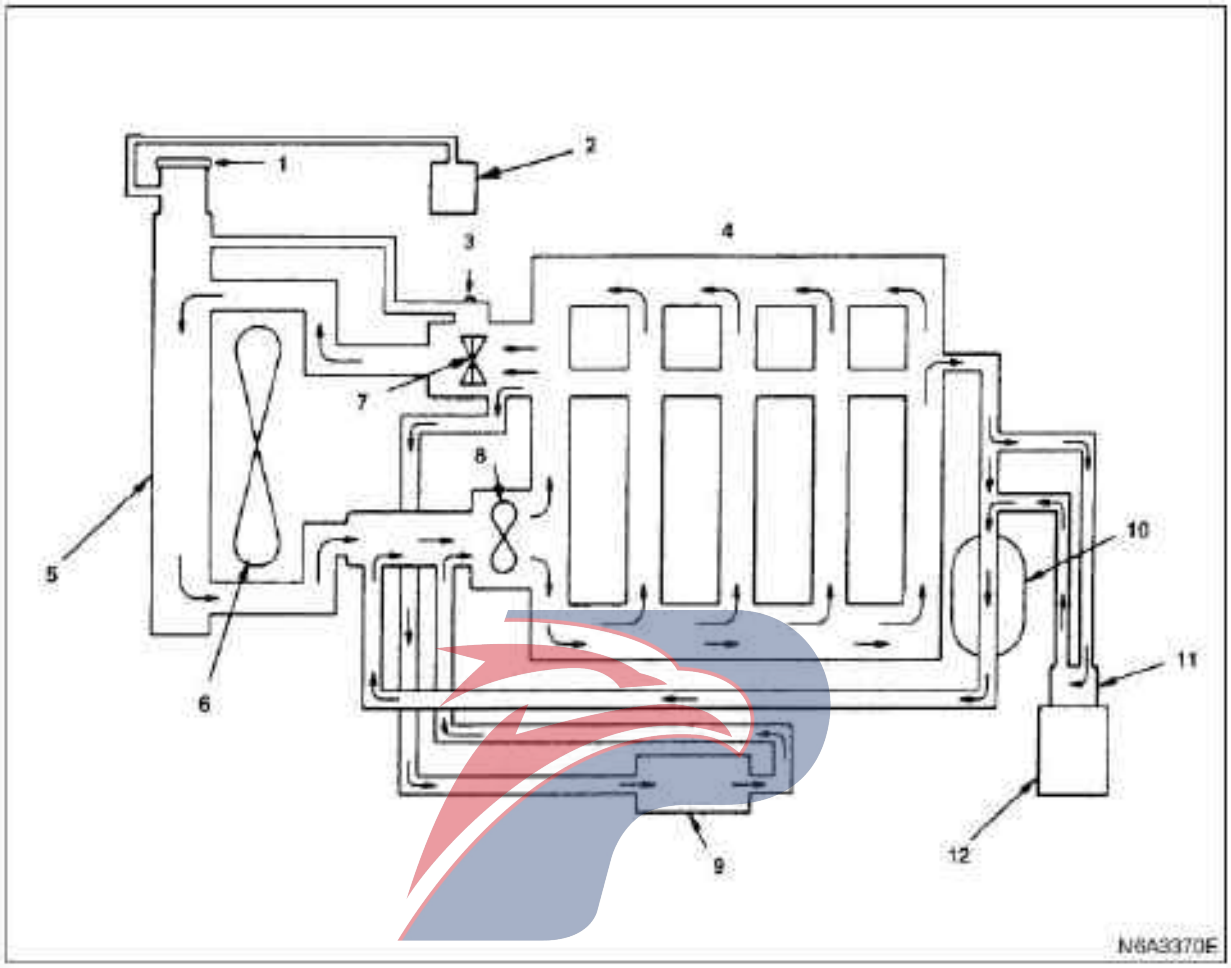
Section 6B

Engine cooling system

Table of Contents

Overview

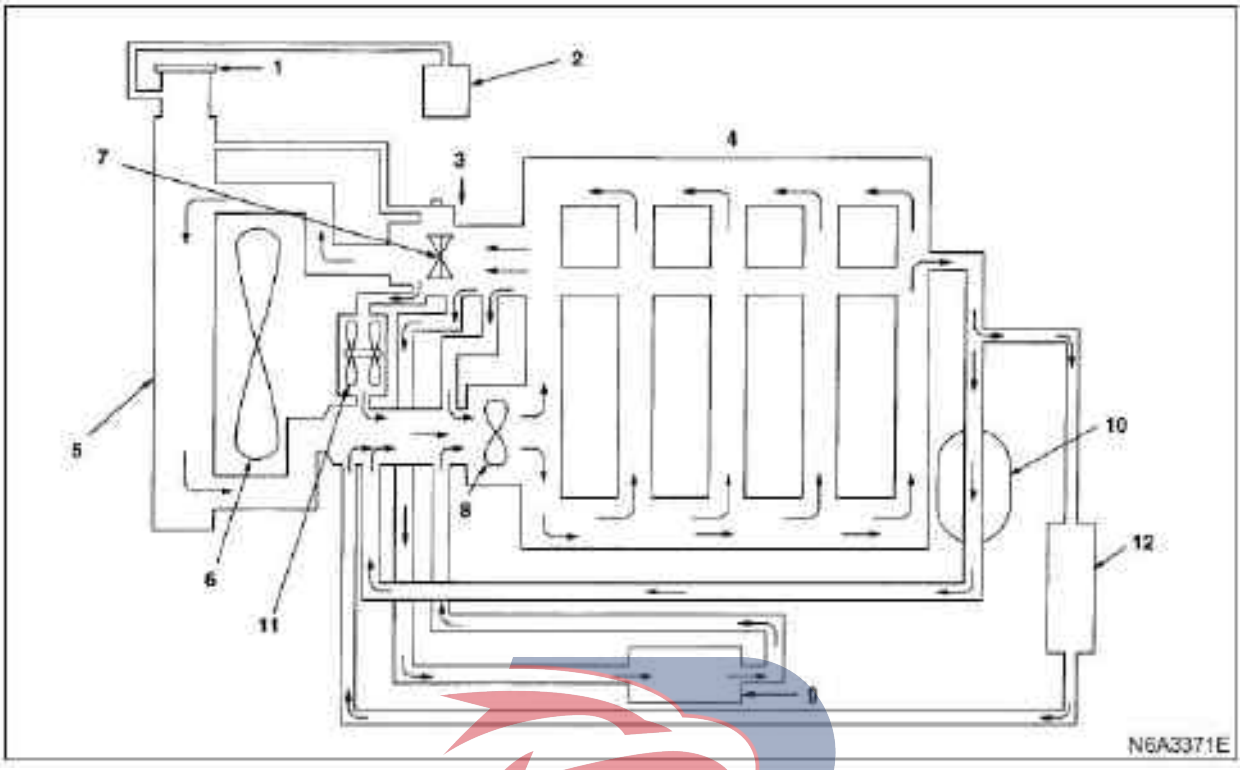
Florchart for coolant of parts



Legend

1. Radiator cover
2. Water tank
3. Exhaust plug
4. Cylinder head
5. Radiator
6. Cooling fan
7. Thermostat
8. Water pump
9. Vehicle heater
10. Engine oil cooler
11. Cold starter
12. Injection pump

Flowchart of coolant (4KH1-TC)



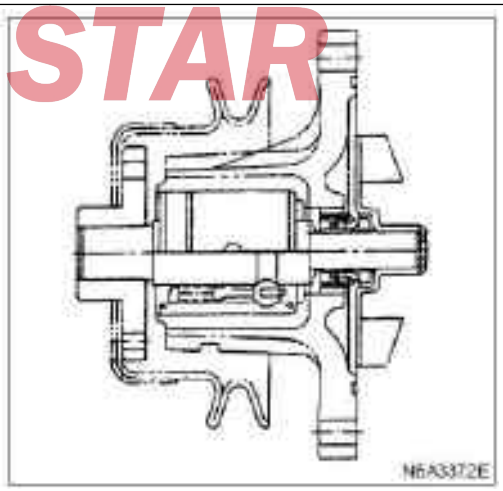
Legend

1. Radiator cover
2. Water tank
3. Exhaust plug
4. Cylinder head
5. Radiator
6. cooling fan
7. Thermostat
8. Water pump
9. Vehicle heater
10. Engine oil cooler
11. Turbocharger
12. EGR cooler

The cooling system is a pressurized forced coolant circulation system, including a pump, a thermostat cooling fan, a radiator and other parts. The circulating coolant can cool the lubricating oil in the oil cooler and the turbocharger.

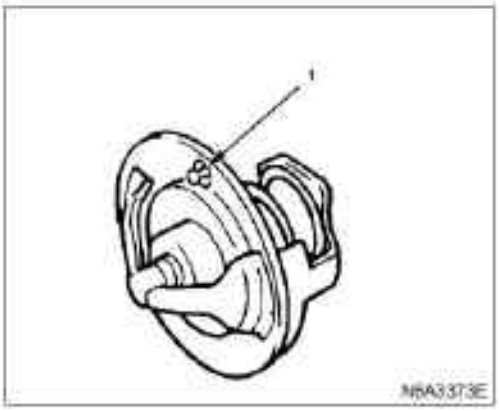
Water pump

The coolant pump is a centrifugal impeller pump driven by a triangular transmission belt. Do not break down the pump assembly.



Thermostat

Install the thermostat in the thermostat housing.



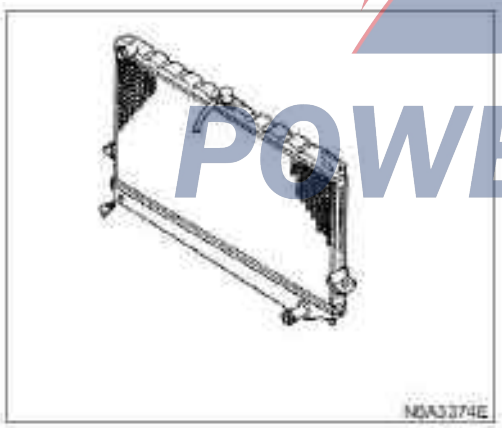
Legend

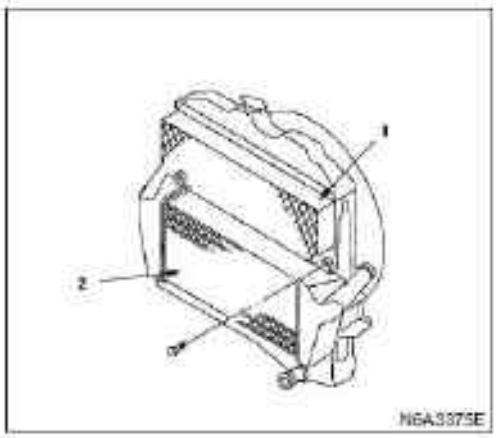
1. Rocking valve

Radiators

The radiator is a tubular radiator with corrugated radiator. In order to increase the boiling point of coolant, the pressure inside the radiator should be adjusted, that is, install a vacuum valve in the upper slot of the cooling liquid to keep the pressure range between 93 and 123 kPa (0.95 1.25kg/cm2). The cover installed on the thermostat housing of the cylinder cover has only the function of water supply.

The 4KH1-TC engine is equipped with an intercooler.





Legend

1. Radiator
2. Intercooler

Engine coolant replacement procedure

1. Before replacing the engine coolant, make sure that the engine is in the cooling state.

Warning:

Be sure not to loosen or dismantle the radiator cover in case of reaching high coolant temperature. Otherwise, this may cause operating personnel to be scalded by vapor or boiling water. Before opening the radiator cover, place a piece of thick cloth on the cover and then slowly unscrew the cover so as to reduce the pressure during gradual cooling of coolants.

2. Open the lid of the coolant and release the gas in the cooling system by loosing the exhaust valve on the radiator and the cylinder.

Caution:

For the best effect of the cooling system, it is suggested that the engine cooling system should be cleaned at least once a year. Before using the prescribed coolant, it is best to clean the interior of the cooling system, including the radiator. In accordance with the requirements of the engine coolant, replace the damaged rubber hose. The coolant may leak even for small cracks. For cooling system, Qingling Company recommends to use authentic cooling fluid or the same cooling fluid. Meanwhile, do not add any inhibitors or additives.

Tips:

If it is unable for replacement of the engine cooling system or there is too much coolant for replacement, the coolant will overflow from the nozzle before the engine and radiator have been fully filled with coolant.

If running in this condition, the engine may be overheated due to the lack of cooling fluid. To avoid this situation, the following measures should be taken:

.

3. When re-adding coolant to the engine, pour the coolant through the hose with outer diameter smaller than the nozzle. Otherwise, the air between the nozzle and the hose may prevent the entry of the coolant and the coolant will not fully fill the cooling system.

4. The coolant should be added at a speed of 9 liters or less per minute. If the adding speed exceeds the above maximum, the air will enter the engine and the radiator. Also, it is difficult to determine whether the coolant system is fully filled if the flow velocity of the coolant is accelerated.

5. After the system is filled up, pull out the input hose of the coolant to check whether the air in the system has been discharged and whether the level of the liquid drops. If the level drops, please add the coolant again to the maximum.

6. After adding the coolant to the radiator, add it to the water tank to the highest position.

7. Install and tighten the radiator cover and start the engine. After running for 2 to 3 minutes at idle speed, stop the engine and reopen the radiator cover. If the water level drops, add water again.

Warning:

Be sure not to loosen or dismantle the radiator cover in case of reaching high coolant temperature. Otherwise, this may cause operating personnel to be scalded by vapor or boiling water. Before opening the radiator cover, place a piece of thick cloth on the cover and then slowly unscrew the cover so as to reduce the pressure during gradual cooling of coolants.

8. After tightening the radiator cover, preheat the engine at the speed of 2000 rpm. Adjust the heater to the highest temperature position to allow the coolant to flow into the heater's hot water system.

9. Check whether the thermostat has been opened and passed the tip of the water thermometer, and then stop the engine after 5 minutes of idle running.

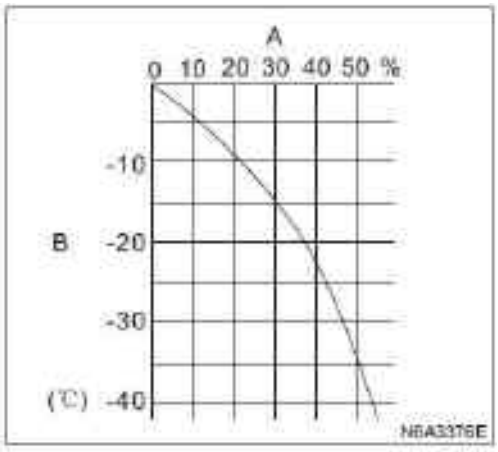
10. After cooling the engine, check the water level of the nozzle. If necessary, water can be added again. If the coolant is found insufficient, check the leakage of the coolant system and the hose of the water tank.

11. Add the coolant to the water tank until the highest position.

Designated coolant

· Relationship between the mixing ratio and the solidification temperature The solidification temperature of the engine coolant depends on the dissolution rate of the coolant in the water.

Please determine the mixing ratio with reference to the chart. To enhance the cooling effect, do not use inhibitors or additives not recommended by Qingling Company.



Legend

A. Mixing ratio

B. Solidification temperature

· Calculation method of mixing ratio

$$\text{Mixing ratio} = \frac{\text{Specified coolant (L/qt.)}}{\text{Specified coolant (L/qt.) + water (L/qt.)}}$$

Caution:

Specified coolant + water =10 liters (total cooling system volume)

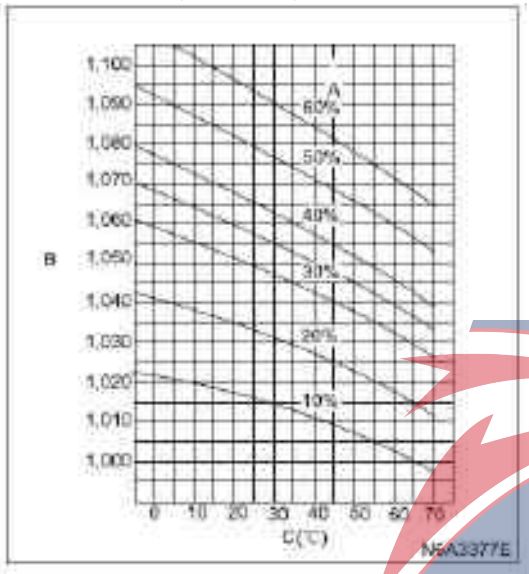
If the total volume of the cooling system is 6.8 liters

Mixing ratio(%)	Designated coolant L(qt. UK /qt. US)		Water L(qt. UK /qt. US)	
0	0	0	10	(8.80/10.57)
5	0.5	(0.44/0.53)	9.5	(8.36/1 0.04)
10	1.0	(0.88/1.06)	9.0	(7.92/9.51)
15	1.5	(1.32/1.59)	8.5	(7.48/8.98)
20	2.0	(1.76/2.11)	8.0	(7.04/8.45)
25	2.5	(2.20/2.64)	7.5	(6.60/7.93)
30	3.0	(2.64/3.17)	7.0	(6.16/7.40)
35	3.5	(3.08/3.70)	6.5	(5.72/6.87)
40	4.0	(3.52/4.23)	6.0	(5.28/6.34)
45	4.5	(3.96/4.76)	5.5	(4.84/5.81)

Mixing ratio(%)	Designated coolant L(qt. UK /qt. US)	Water L(qt. UK /qt. US)
50	5.0 (4.40/5.28)	5.0 (4.40/5.28)

Mixing ratio

Measure the specific gravity of engine coolant in the cooling system under the temperature of 0-50 °C by suction hydrometer. Then determine the mixing ratio of coolant according to the regulations in the table.

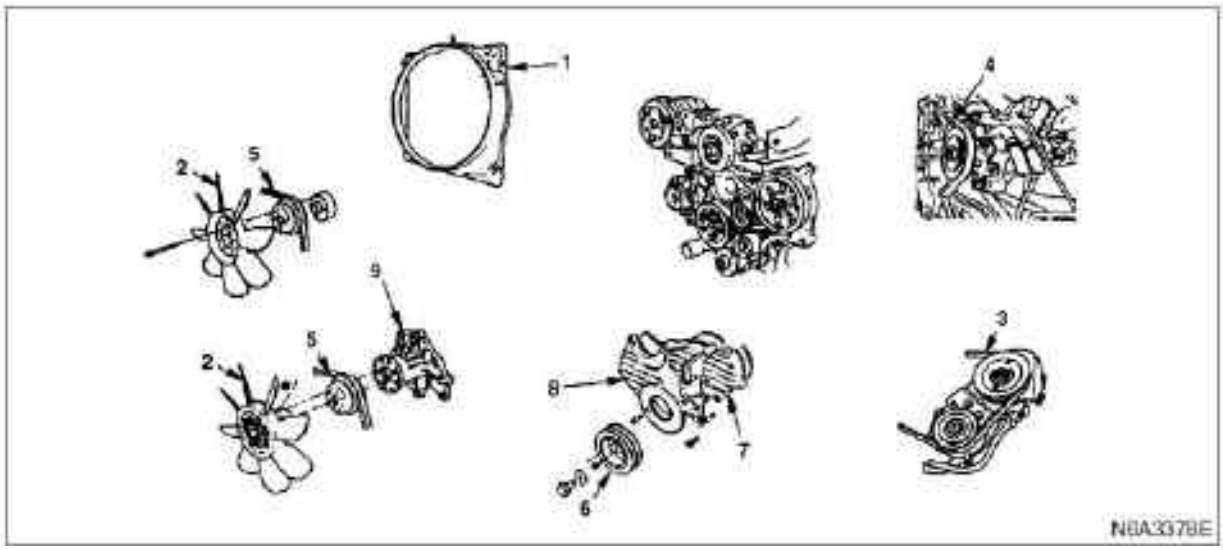


Legend

A. Mixing ratio
B. Specific gravity
C. Coolant temperature

Water pump

Parts



Legend

1.
2. Cooling fan assembly
3 . Drive belt of power steering pump
4. Drive belt of the A/C compressor
5. Drive belt of the AC generator.
6. Belt pulley of crankshaft damper
7. Upper cover of timing belt pulley
8. Lower cover of timing belt pulley
9. Water pump assembly

Dismantling

Preparation

· Disconnect the grounding wire of the storage battery.

· Discharge coolant.

1. Fan wind scooper

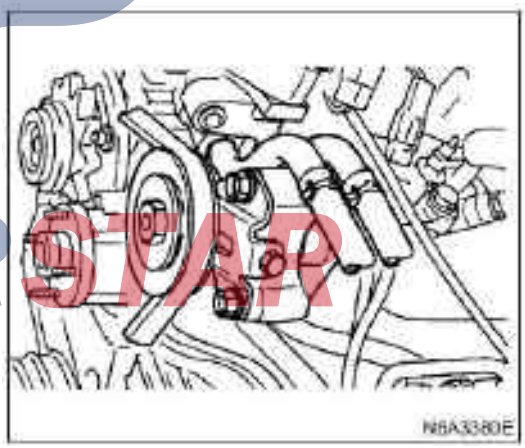
· Disassemble the water tank hose, branch hose and fan guide cover.

2. Cooling fan assembly

· Disassemble the locking nut and take out the cooling fan assembly.

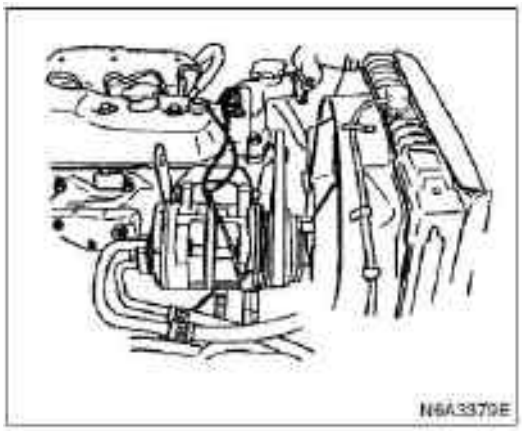
3 . Drive belt of power steering pump

· Unscrew the idler locking nut and adjusting belt, and disassemble the transmission belt.



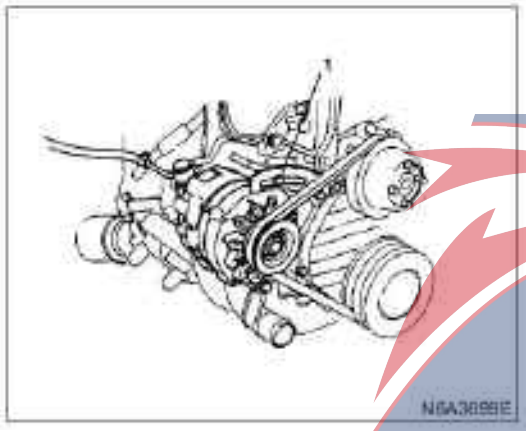
4. Drive belt of the A/C compressor

Unlock the locking nut and adjusting bolt of the compressor and disassemble the transmission belt.



5. drive belt of the AC generator.

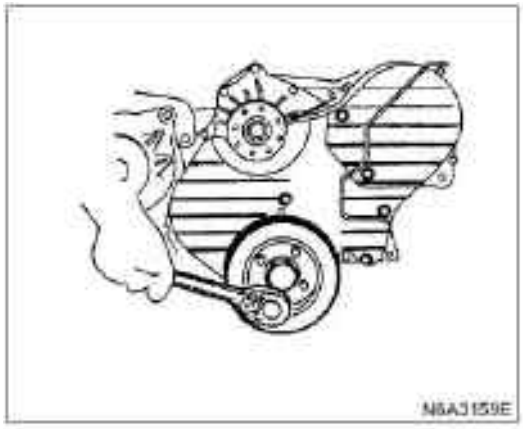
· Unscrew the fixing bolt (side lower part) and the locking bolt of the adjusting plate of the alternator, and disassemble the transmission belt.



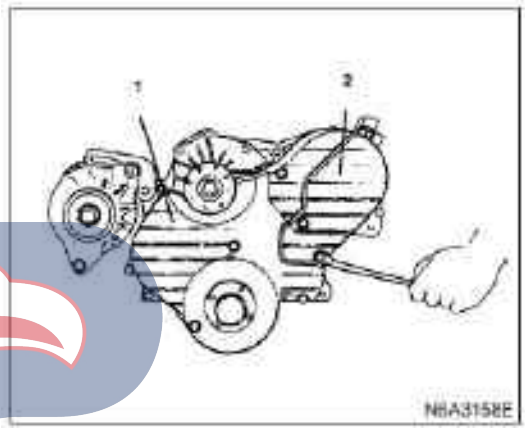
Legend

1. Lock bolt

6. belt pulley of crankshaft damper



7. Timing belt wheel upper cover



Legend

1. Lower cover
2. Upper cover

8. Lower cover of timing belt pulley

9. Water pump assembly

Disassemble O ring

Inspection

In case of finding excessive wear or damage of parts during checking, please replace them in time.In case of the following problems, the whole pump should be replaced.

· There is a crack on the water pump

· The coolant leaks from the water seal

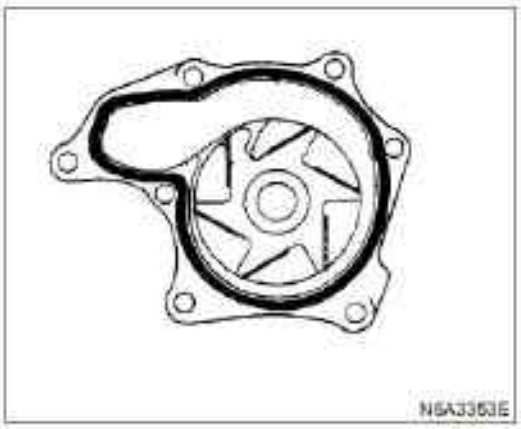
· There is gap or abnormal sound on the bearing

· There is crack or rust on the impeller

Install

1. Water pump assembly

· Place the O ring in the grooves of the pump body



· Install the pump assembly and tighten to the specified torque.

Tightening

Fastening torque of the pump: 20 N ·m(2 kg·m/14 lb·ft)

2. Lower cover of timing belt pulley

· Install the lower cover of the timing pulley and screw the cover the specified torque.

Tightening

Cover tightening torque:8 N·m(0.8 kg·m/69 lb·in)

3. Lower cover of timing belt pulley

· Install the lower cover of the timing pulley and tighten to the specified torque.

Tightening

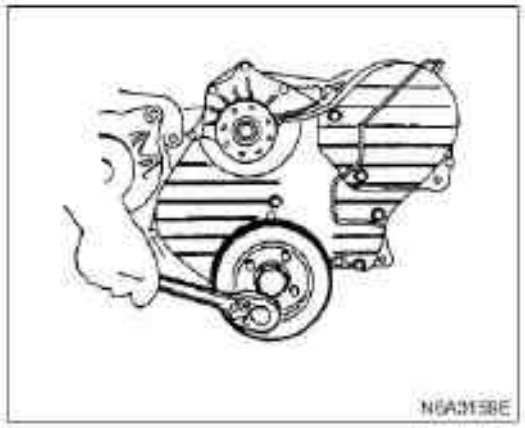
Cover tightening torque:8 N·m(0.8 kg·m/69 lb·in)

4. belt pulley of crankshaft damper

· Install the crankshaft shock absorber pulley and tighten to the specified torque.

Tightening

Fastening torque of the pump: 19 N ·m(1.9 kg·m/14 lb·ft)



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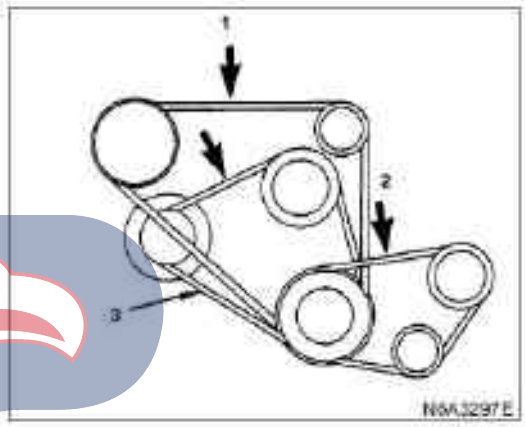


Legend

1. Drive belt of the A/C compressor
2 . Drive belt of power steering pump
3. Drive belt of AC generator and cooling fan

5. drive belt of the AC generator.

6. Drive belt of the A/C compressor

7 . Drive belt of power steering pump

· Install the transmission belt and the adjusting belt

Check for wear of the drive belt. Replace immediately as necessary. Check for the tightness of the belt. Adjust if necessary.

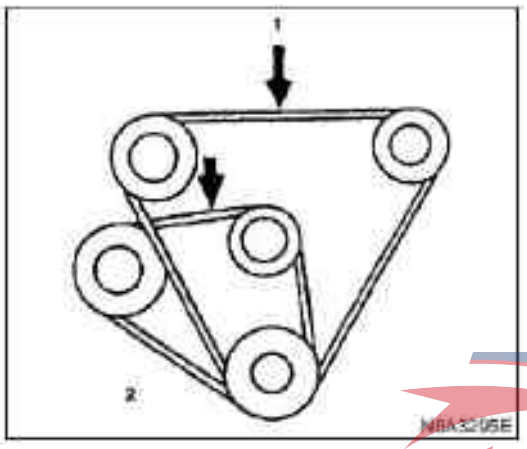
· Apply the force of 98 N (10 kg/ 22 lb) in the middle of the belt check the deflection of each belt.

· Standard deflection

Legend

	mm (in)
	Initial tightness
Drive belt of the AC generator. Drive belt of the A/C compressor Drive belt of power steering pump	8—12(0.31—0.47)

4JB2



1. Drive belt of the A/C compressor and drive belt of the power steering pump
2. Alternator and fan pulley transmission belt

Tightening

· 40 N·m (4.1 kg·m/30 lb·ft) for generator transmission belt

· 19 N. m (1.9 kg. m/14 lb. ft) for adjusting plate fixing bolt

· 27 N·m (2.8 kg·m/20 lb·ft) for air conditioner idler locking nuts

· 27 N·m (2.8 kg·m/20 lb·ft) for power steering pump idler locking nuts

· Cooling fan assembly

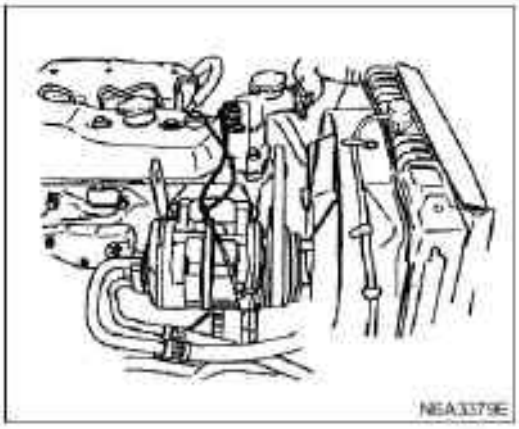
· Install the fan belt and cooling fan assembly on the pump and tighten them to the specified torque.

Tightening

·8 N·m(0.8 kg·m/69 lb·ft) for fan belt nuts

9. Fan wind scooper

· Install the fan guide cover,water tank hoses and the branch hose



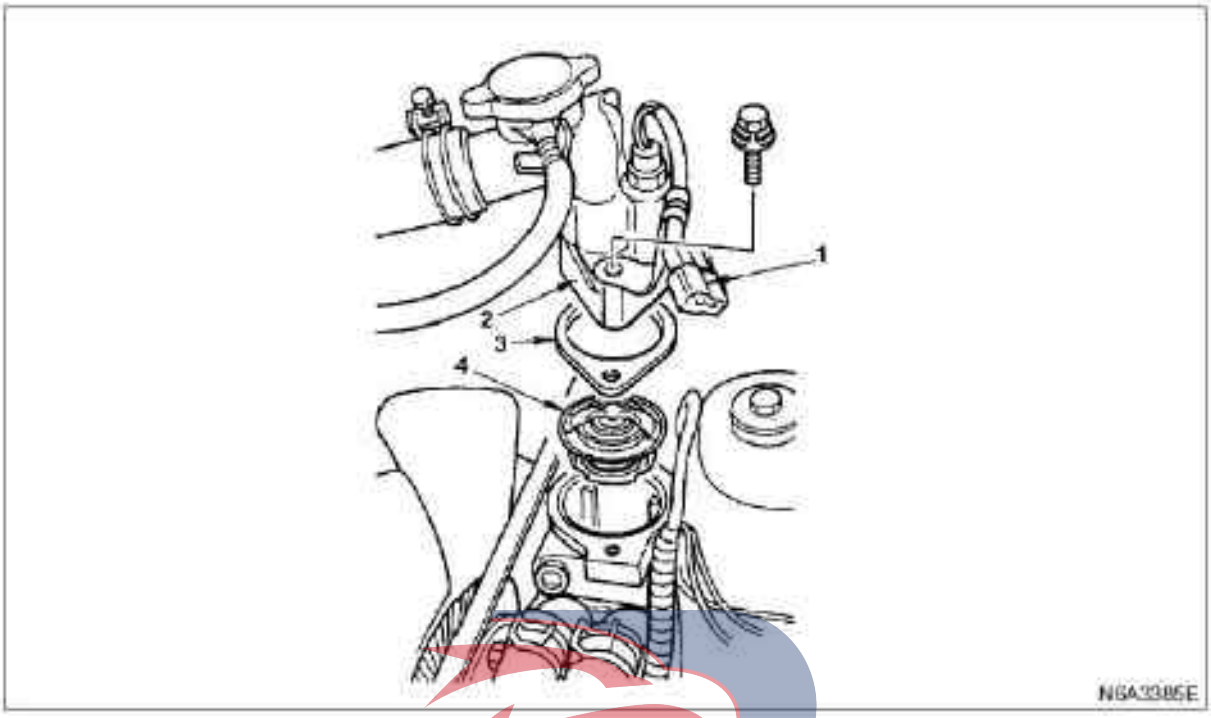
· Connect the grounding wire of the storage battery;

· Inject the coolant;

· Start the engine and check the leakage of the coolant

Thermostat

Parts



Legend

1. Switch harness
2. Outlet pipe
3. Seal gasket
4. Thermostat

Dismantling

Preparation

· Disconnect the grounding wire of the storage battery

· Discharge coolant in the radiator and the engine

1. Switch harness

2. Outlet pipe

· Disassemblefixing bolt, outlet pipe and radiator hose.

3. Seal gasket

4. Thermostat

Inspection

Immerse the thermostat assembly into the water.

Place a wood block at the bottom of the water container.

Do not heat the thermostat directly.

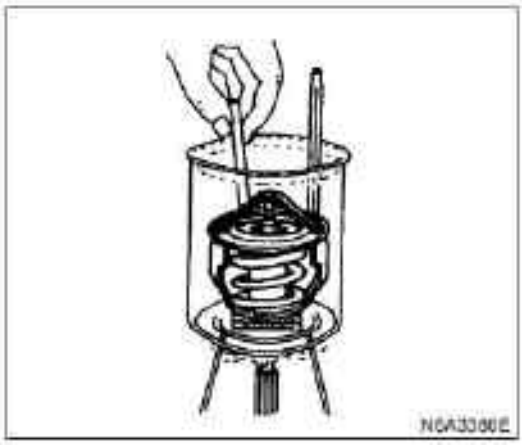
The temperature of the thermostat increases slowly. Stir the water to allow the temperature of the whole water to become uniform.

· Make sure that the main valve is opened at the specified temperature.

Main valve opening temperature	° C(°F)
82(180)	

· Make sure that all second valves are open at the specified temperature

Full open temperature of valve	° C(°F)
95(203)	



In case of finding excessive wear or damage of parts during checking, please replace them in time.

Install

1. Thermostat

2. Seal gasket

3. Outlet pipe

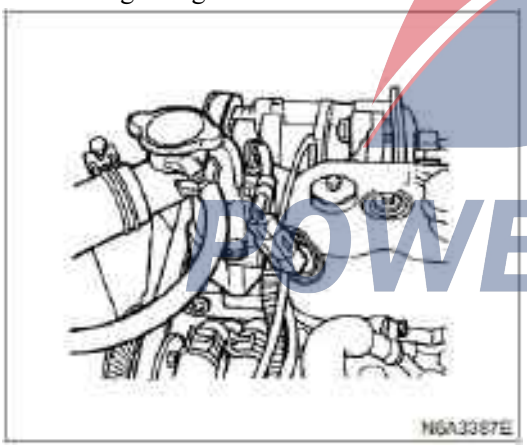
· Connect the outlet pipe and tighten the bolt to the specified torque.

Tightening

19 N•m (1.9 kg•m/14 lb•ft)

4. Switch harness

· Install the beginning harness



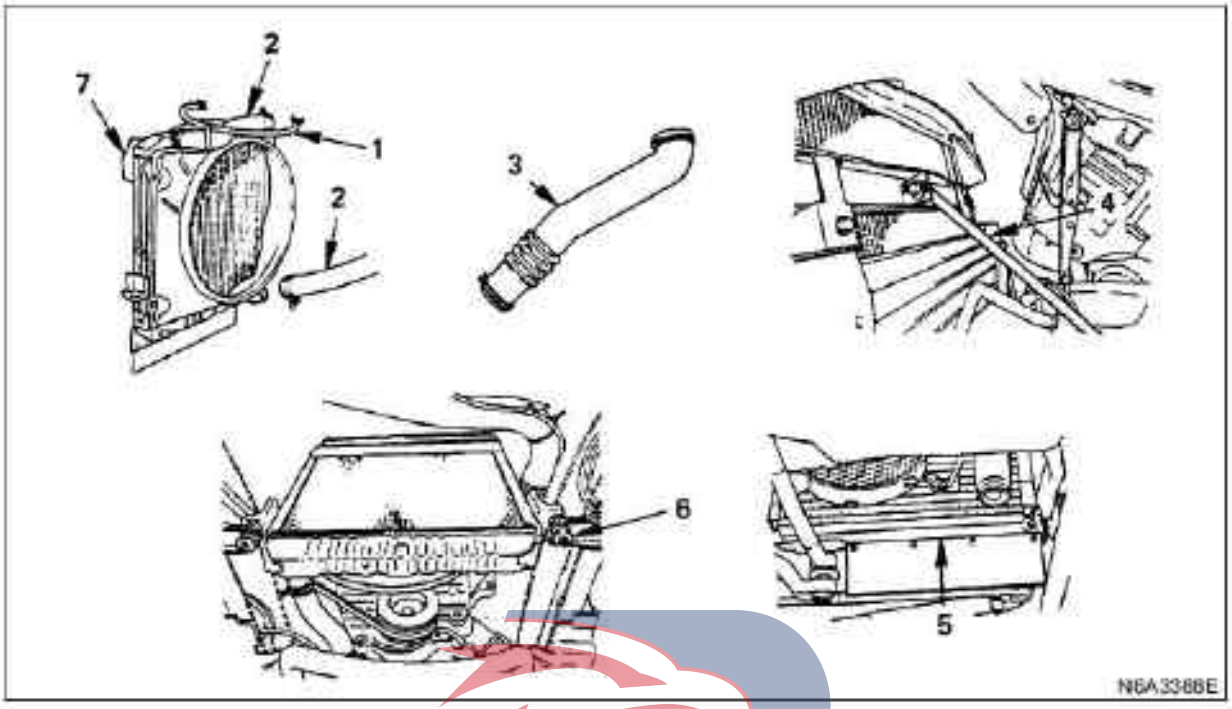
· Install the grounding wire of the storage battery

· Pour into the coolant

· Start the engine and check the leakage of the coolant

Radiators

Parts



Legend

1. Water tank hose and branch hose
2. Radiator hose
3. Air intake pipe
4. Radiator support
5. Condenser
6. Buffer rubber pad
7. Radiator assembly

Dismantling

Preparation

· Disconnect the grounding wire of the storage battery

· Unscrew the coolant drain plug to discharge the coolant

1. Liquid storage tank hose and branch hose

· Disconnect the radiator hose

2. Radiator hose

· Disconnect the upper and lower hoses of the engine

3. Air intake pipe

4. Radiator support

5. Condenser

· Disassemble the condenser from the radiator and temporarily tighten the condenser to the front of the body with the wire.

6. Buffer rubber pad

· Disassemble the cushion rubber pad from both sides of the bottom

7. Radiator assembly

· Disassemble the radiator assembly with hose upwards, and do not allow the radiator core to be damaged by the fan blade.

Check the cover of the radiator

· Test the opening of the pressure valve with radiator cap tester. If radiator opening vacuum valve's opening pressure exceeds standard value, please replace a new radiator cap.

Opening pressure of valve	kPa (kg/cm2 /psi)
93—123 (0.95—1.25/1 3.5—17.8)	

· Disassemble the cover of the radiator and check whether the vacuum valve is in the center of the seat. If the vacuum valve is not working properly, please clean or replace the radiator cover.

Tightening

· 6 N·m (0.6 kg·m/4 lb·ft) for radiator cover

· After reinstalling the radiator cover, check the leakage of the cooling system.

Radiator core

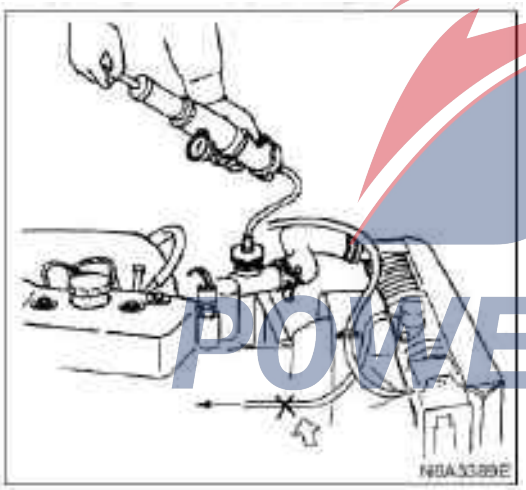
· The deformed radiators may lead to the radiation effect and then overheating. Straighten the radiator. In this process, do not damage the root of the radiator fin.

· Disassemble dust and other foreign objects. Clean the radiator.

· Clean the inner and coolant channels of the radiator with water and neutral detergent. Disassemble rust and dust.

Check whether there is leakage of coolant

· Install the water tank hose carefully and add the compressed air of 147 kPa (1.5 kg/cm2/21 psi) from the neck of the liquid inlet into the radiator, and check the leakage of the cooling system.



.

· Since there is a valve on the top of the radiator, the range of pressure cannot exceed the pressure with opening valve unless the hose is blocked.

Install

1. Radiator assembly

· Install the radiator.

2. Buffer rubber pad

· Install buffer rubber pads on both sides of the bottom of the radiator.

· Install the radiator assembly with hose upwards, and do not allow the radiator core to be damaged by the fan blade.

3. Condenser

4. Radiator support

5. Air intake pipe

· Connect the air passage and tighten the clamp.

6. Radiator hose

· Connect the inlet pipe and the outlet pipe to the engine.

· Connect the grounding wire of the storage battery

· Pour the coolant into the liquid inlet of the radiator to the maximum scale of the tank.

7. Water tank hose and branch hose

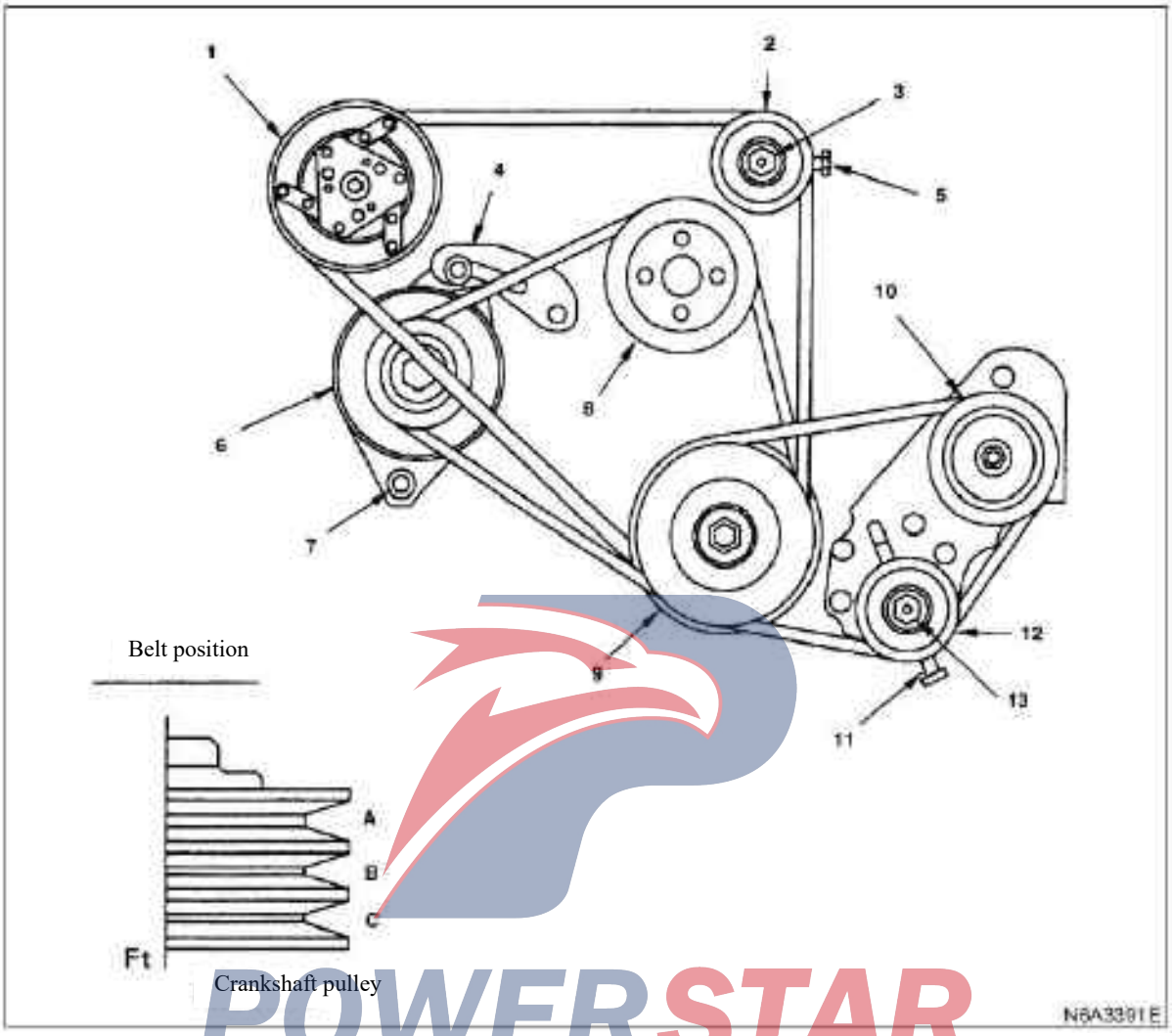
· Start the engine for preheating and check whether there is leakage of the coolant.

Legend

1. Water tank

Drive belt adjustment

Parts



Legend

A. Alternator cooling fan
B. A/C compressor and power steering pump A/C compressor
1.
2. Idler
3. Adjusting locking nuts
4. Adjusting plate
5. adjusting bolt
6. AC generator
7. AC generator fixing bolt
C. A/C compressor steering pump
8. Cooling fan pulley
9. Crankshaft pulley
10. Power steering pump
11. adjusting bolt
12. Idler
13. Locking nut

Inspection

Check for wear of the drive belt. Replace immediately as necessary. Check for the tightness of the belt. Adjust if necessary.

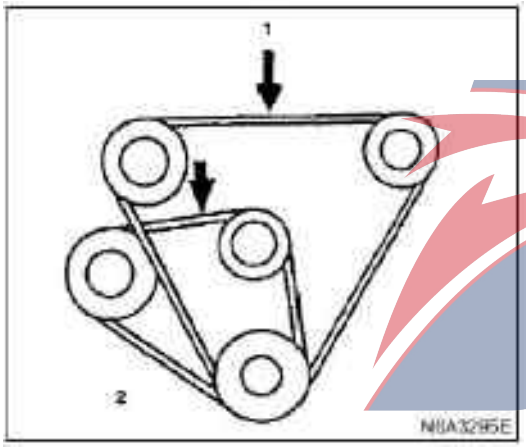
· Check the tightness of the transmission belt.

· Apply the force of 98 N (10 kg/ 22 lb) in the middle of the belt and check the deflection of each belt.

· Standard deflection

	mm (in)
	Initial tightness
Drive belt of AC generator and fan belt pulley AC compressor transmission belt Drive belt of power steering pump	8—12(0.31—0.47)

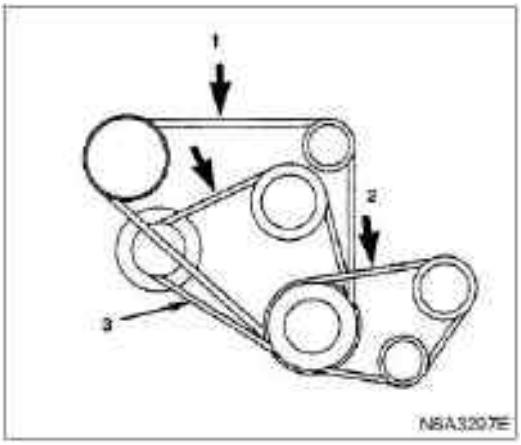
4JB1



Legend

1. Drive belt of the A/C compressor and drive belt of the power steering pump
2. Alternator and fan pulley transmission belt

4JG2



Legend

1. Drive belt of the A/C compressor
2 . Drive belt of power steering pump
3. Drive belt of AC generator and cooling fan

Tightness adjustment

1. Cooling fan transmission belt

· Release the mounting and locking nuts of the alternator, and adjust the tightness of the belt to the bolt with the adjusting bolt. Tighten the bolt to the specified torque.

Tightening

· 40 N·m (4.1 kg·m/30 lb·ft) for fixing bolt of generator

· 19 N. m (1.9 kg. m/14 lb. ft) for adjusting plate fixing bolt

2. Power steering pump and A/C compressor pulley

· Unscrew the locking nut of the power steering pump and adjust the tightness of the nut with the adjusting belt.

Tighten the locking nut to the specified torque.

Tightening

· Locking nut torque: 27 N·m(0.6 kg·m/4 lb·ft)

4J series engine

Section 6C

Engine fuel system

Table of Contents

Overview

The following precautions must be kept in mind in the maintenance of the fuel system.

· Whenever maintaining the fuel system, except for the tests applying storage battery voltage, the negative cable of the storage battery should be disconnected in other cases.

· Regularly place a dry chemical fire extinguisher (Grade B) next to the working area.

· The tube and joint of the same size should be used to replace all disassembled pipes and joints.

Clean and detect O ring. Replace any O ring requiring replacement.

· The oil pipe pressure should be released before repairing any parts of the fuel system.

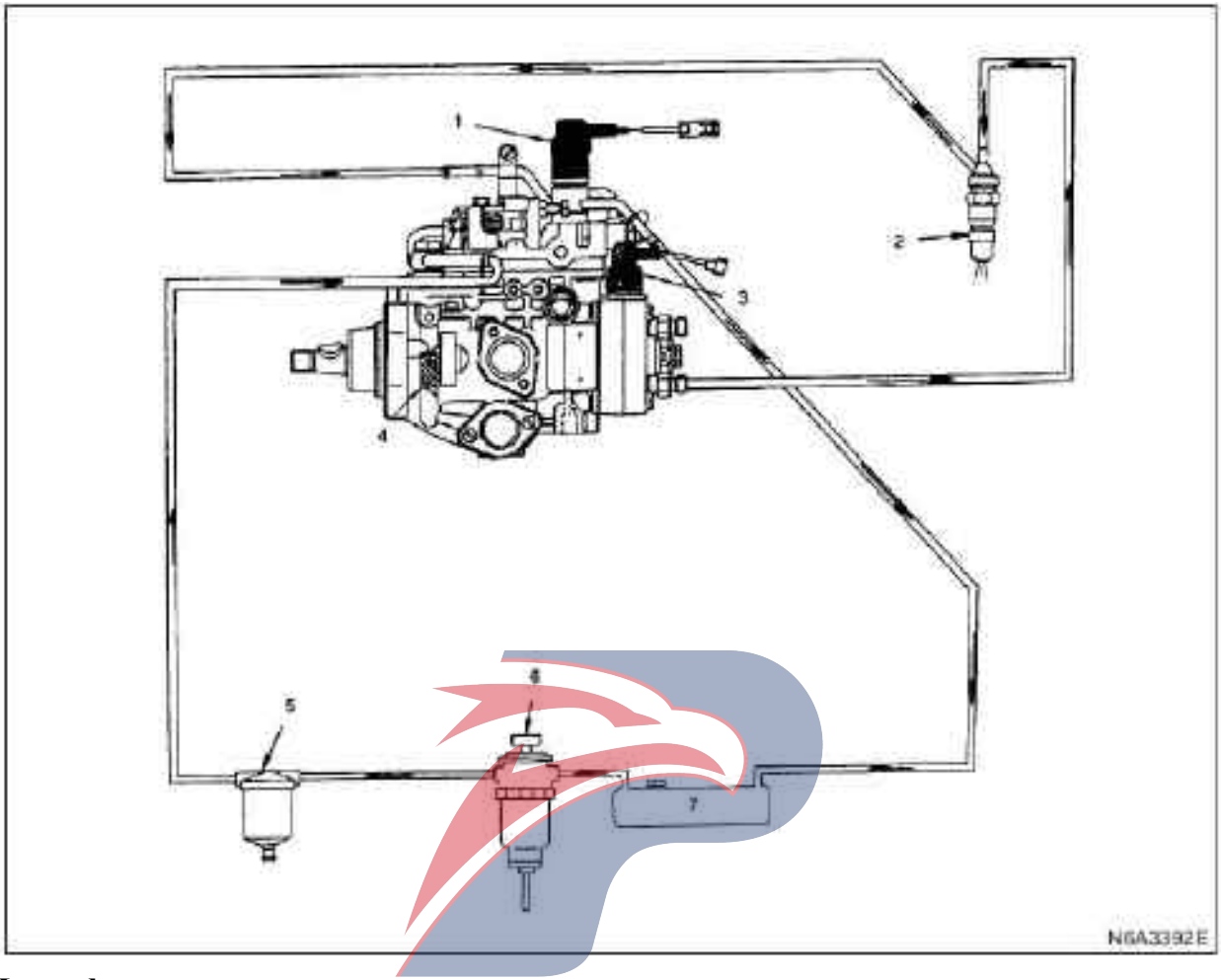
· Please do not try to repair the fuel system before reading the relevant instructions in detail and check the pictures associated with the maintenance.

· The 4KH1-TC engine is equipped with an electronic control fuel injection system.

· For the information related to fuel injection pump maintenance and/or parts replacement, please contact the Bosch Automotive System Co., Ltd.

· For more information related to the maintenance of the 4KH1-TC engine fuel injector, please contact the Bosch Automotive System Co., Ltd.

Fuel oil line



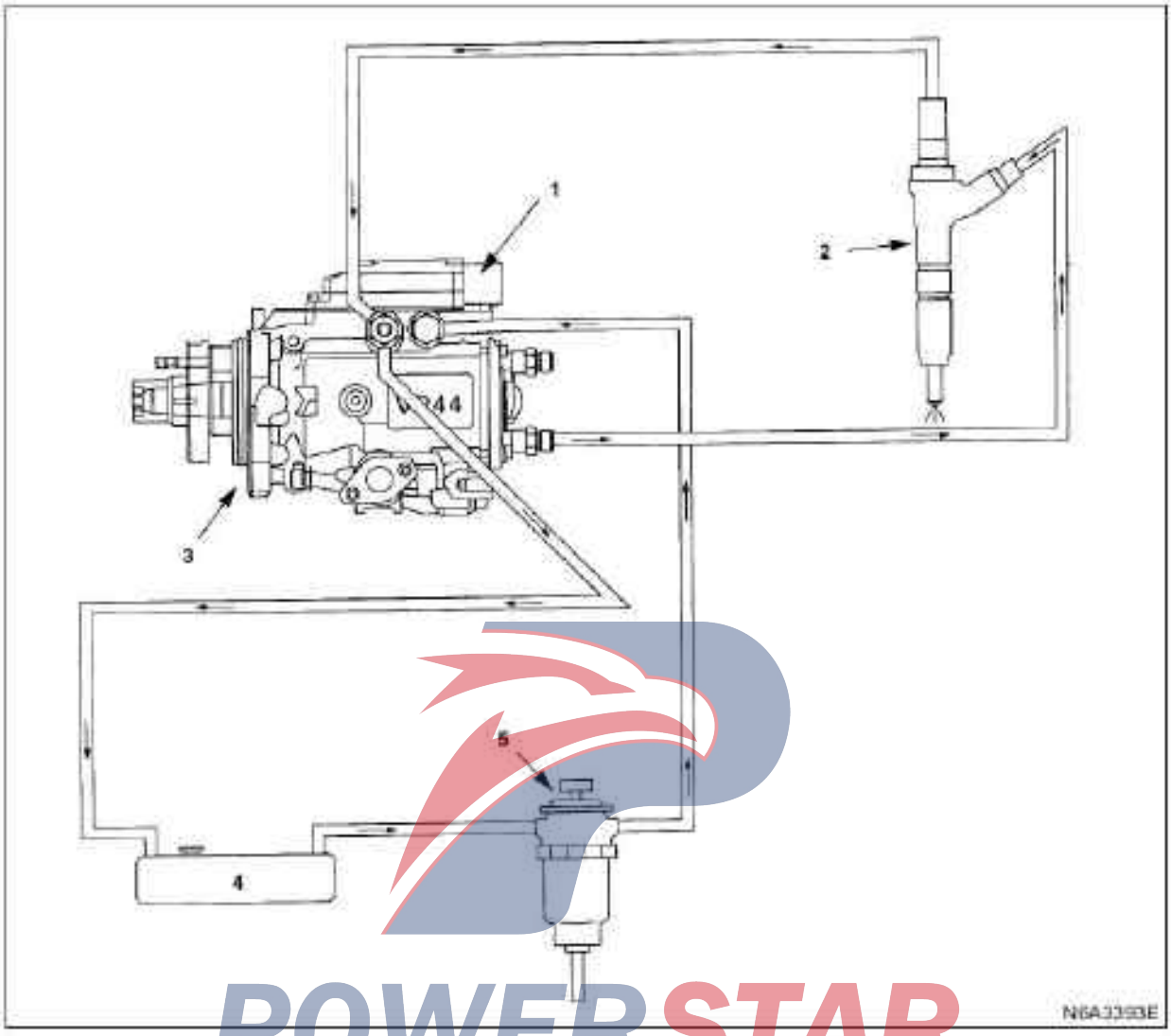
Legend

1. Cold starting solenoid valve
2. Fuel injector
3. Fuel solenoid dump valve
4. Distributive fuel injection pump
5. Fuel filter
6. Oil-water separator
7. Fuel tank

The fuel system includes a fuel tank, a water separator, a fuel filter, a fuel injection pump, and a fuel injector. The fuel from the fuel tank passes through the water separator and the fuel filter. The moisture content and its impurities are disassembled from the fuel.

In order to enable the engine to work efficiently, the fuel supplied by the fuel injection pump is supplied to the fuel injector with standard oil quantity at the most suitable time.

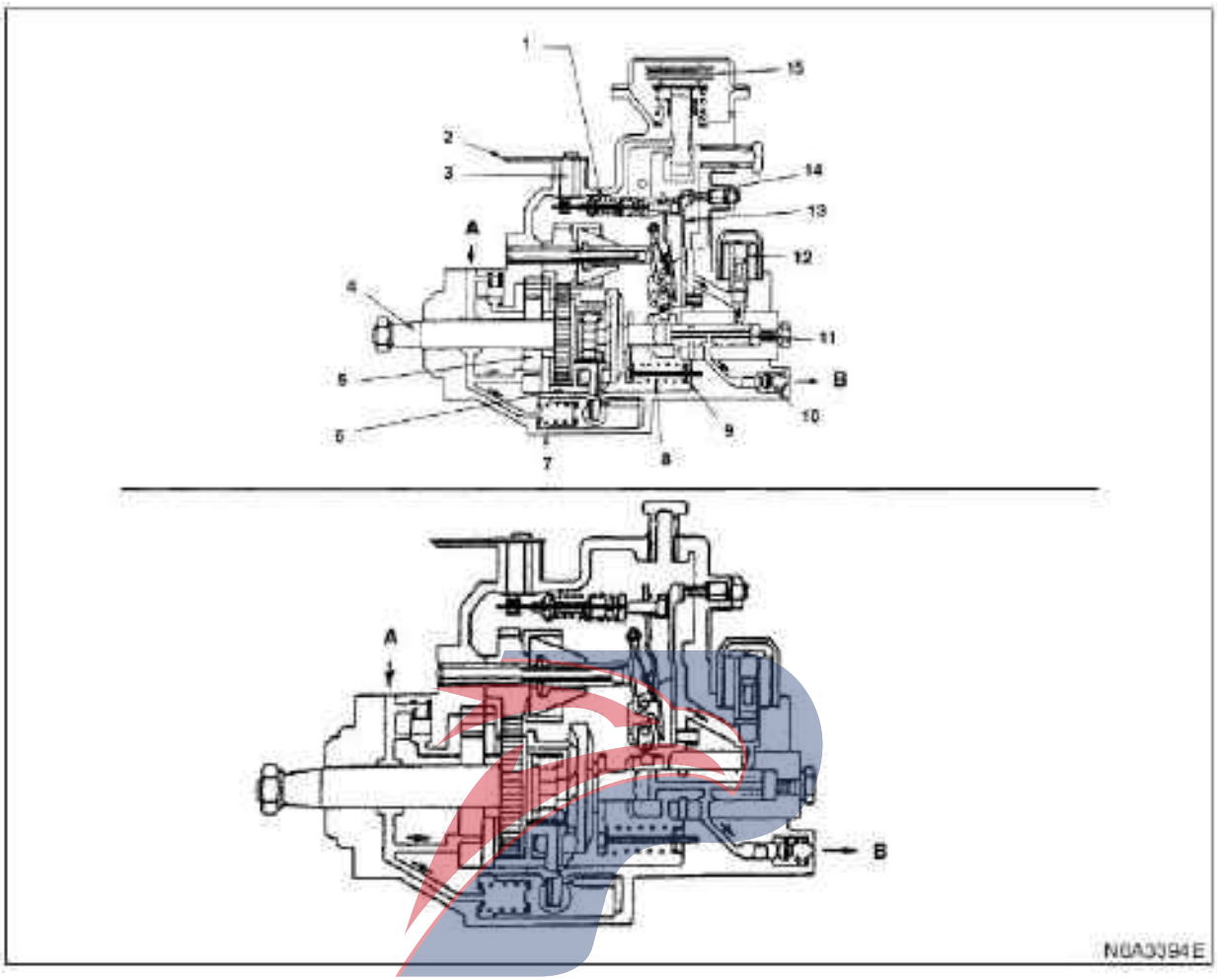
Fuel oil line (4KH1-TC)



Legend

1. Electronic drive module
2. Fuel injector
3. Fuel injection pump
4. Fuel oil tank
5. Fuel filter

Fuel injection pump



Legend

A. From the fuel filter
B. To the fuel injector
1. Governor spring
2. Control rod
3. Control rod shaft
4. Driving shaft
5. Oil pump gear
6. Driven disk
7. Timer
8. Plunger spring
9. Control sleeve
10. Oil outlet valve
11. Plunger
12. Fuel cutoff solenoid valve
13. Tensioning rods
14. Connection handle
15. Non-liquid compensator

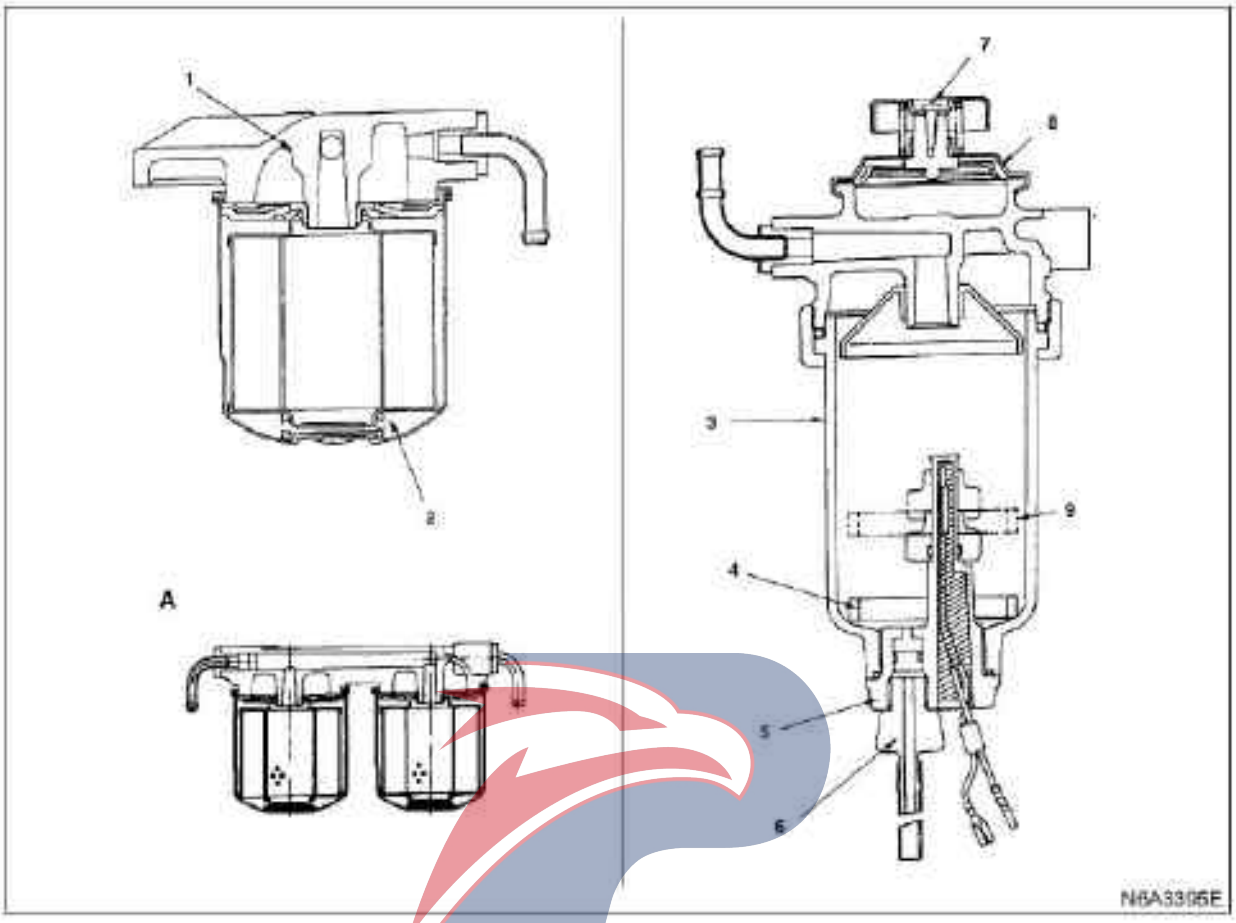
The system adopts the distribution type fuel injection pump of Bosch. Regardless of the specific number of the engine cylinders, a separate reciprocating/rotating plunger evenly supplies fuel to the fuel injector.

Governor, injection timer, and fuel pump are included in the fuel injection pump shell.

The fuel injection pump is compact in structure, light in quality and reliable in high speed operation.

There is a non-liquid compensator for vehicles running at high altitudes. The compensator regulates the air fuel ratio.

Fuel filter and water separator



Legend

A. Consolidation type
1. Filter housing assembly
2. Filter element
3. Filter shell
4. Float
5. Oil level sensor
6. Drain plug
7. Hand pump
8. Filter housing assembly
9. Drainage water level

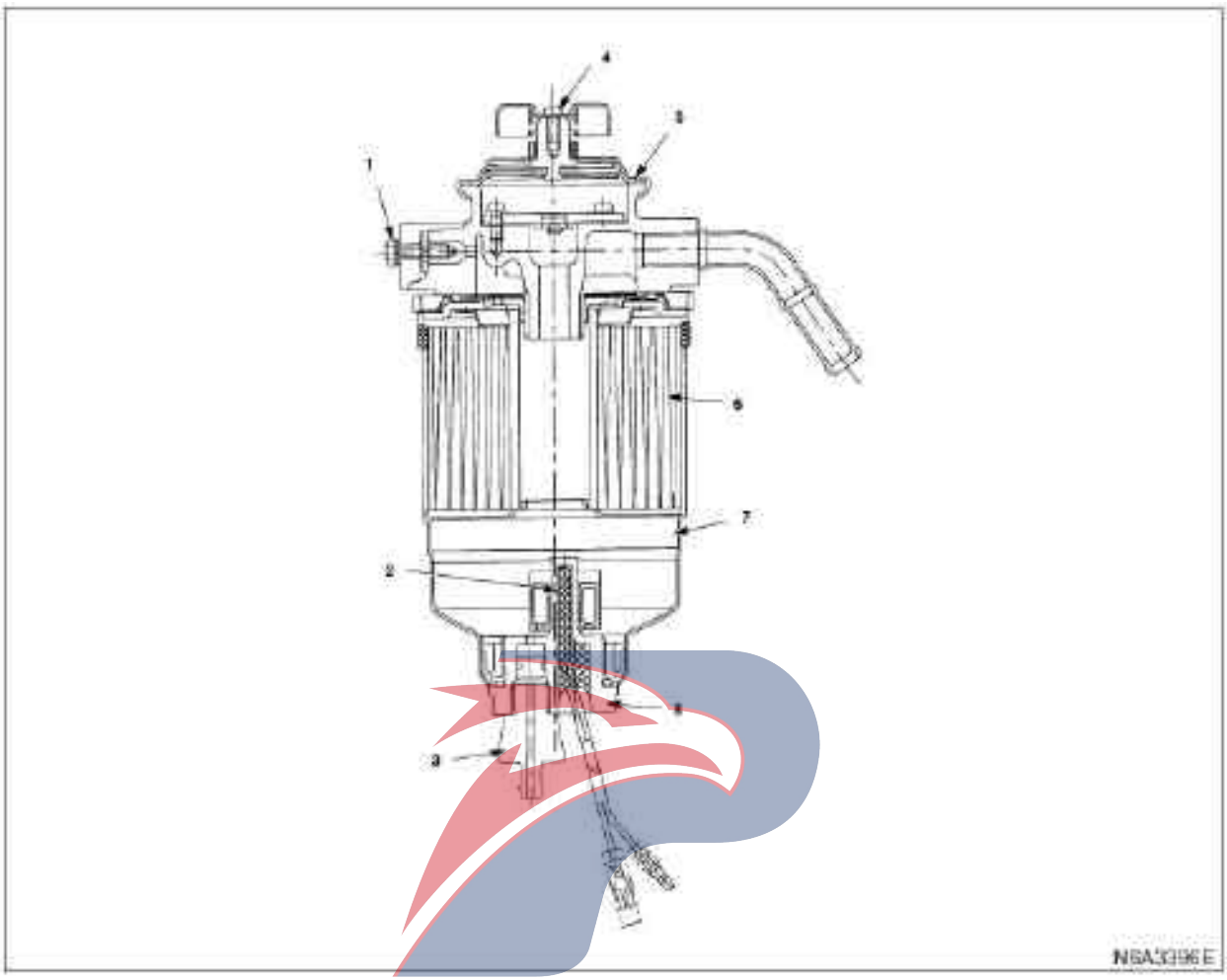
The cylinder fuel filter and water separator are used in conjunction with the distributive fuel injection pump.

The inside of the filter pump is lubricated with fuel, so fuel must be very clean. Before fuel reaches the fuel injection pump, the water and other external matters in fuel are separated by the fuel filter and water separator.

There is a float in the water separator. When the float reaches the predetermined position, the warning light will be on. Remind you to discharge the water from the water separator.

There is a diaphragm hand pump installed at the top of the water separator. This hand pump will be used in the process of drainage and air exhaust.

Fuel filter (4KH1-TC) with a built-in water separator



Legend

1. Exhaust plug
2. Float
3. Drain plug
4. Hand pump
5. Filter assembly
6. Filter element
7. Filter shell
8. Water level sensor assembly

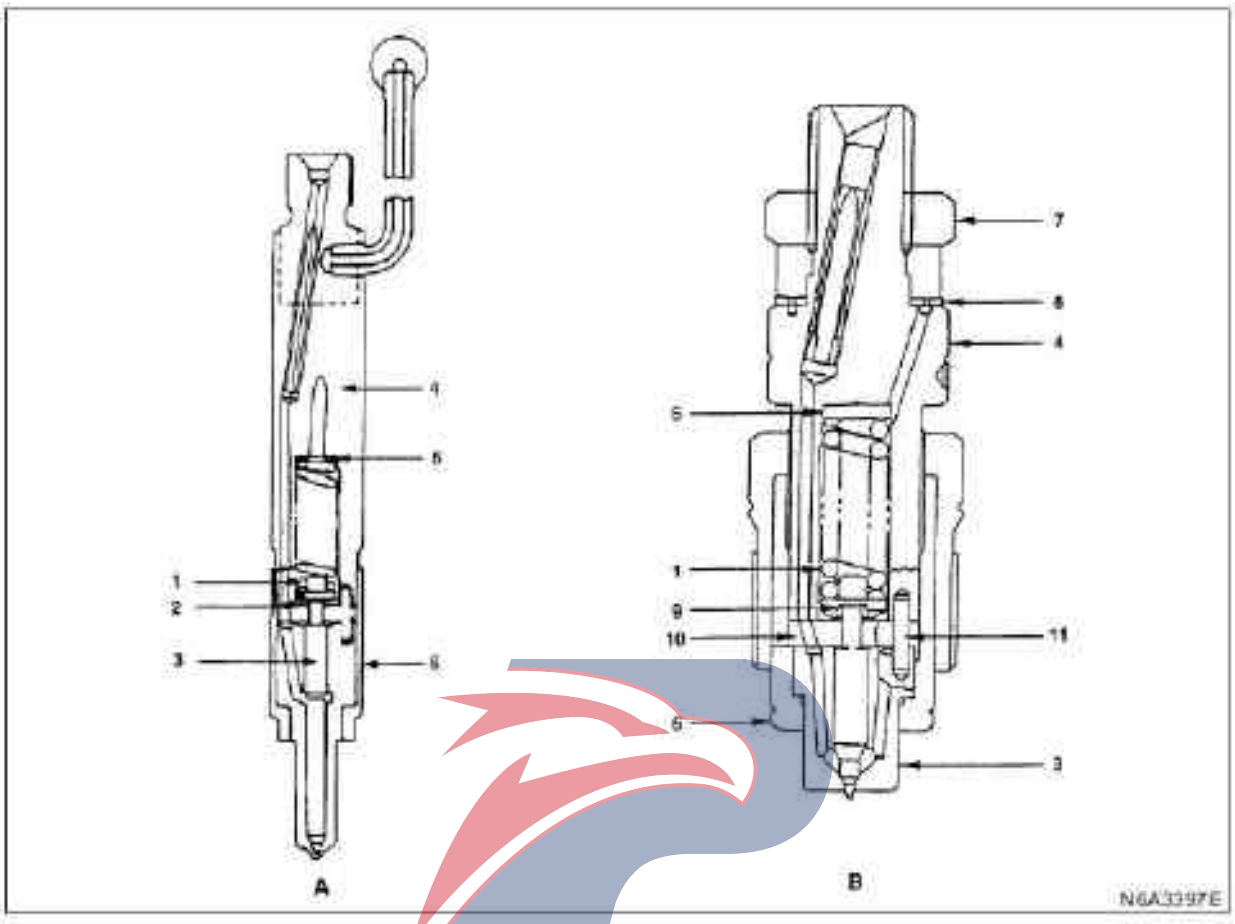
The fuel filter with a built-in water separator is used in conjunction with the distributive type fuel injection pump.

The inside of the filter pump is lubricated with fuel, so fuel must be very clean. Before fuel reaches the fuel injection pump, the water and other external matters in fuel are separated by the fuel filter and water separator.

There is a float in the water separator. When the float reaches the predetermined position, the warning light will be on. Remind you to discharge the water from the water separator.

There is a diaphragm hand pump installed at the top of the water separator. This hand pump will be used in the process of drainage and air exhaust.

Fuel injector



Legend

A. Direct fuel injector
B. Indirect fuel injector
1 . spring
2. Spring seat
3. Fuel injector
4. Fuel injector body
5. Adjusting gasket
6. Fuel injector fixing nut
7. Nut
8. Gasket
9. Push rod
10. Spacer block
11. Locating pin

For 4J series diesel engines, there are two types of perforated fuel injectors. Direct jet engine (4JB1) and indirect jet engine (4JG2). Therefore, the fuel injectors will depend on the type of engine and the difference of the combustion chamber.

The compressed fuel from the fuel injection pump is injected into the combustion chamber via the small hole on the fuel injector.

The fuel injector used by the 4JB1 engine is a hole type fuel injector with four small holes. The fuel injector is made up of anfuel injector body and a needle valve assembly.

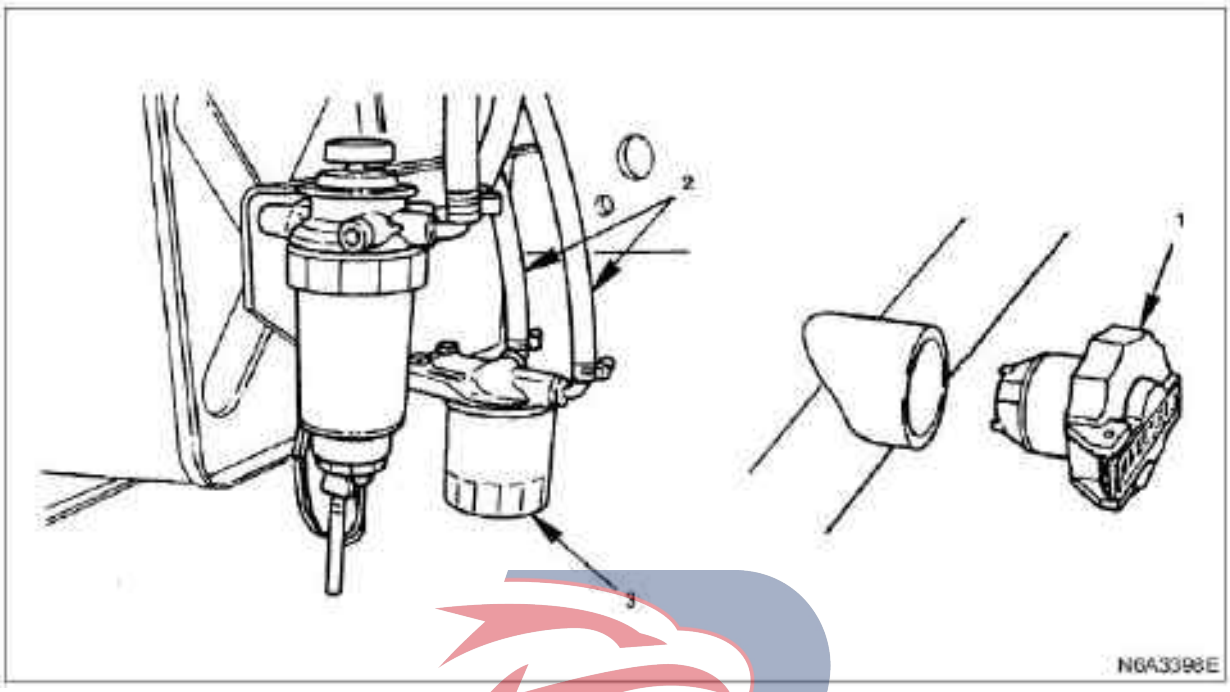
The compressed fuel from the fuel injection pump is injected into the combustion chamber via the small hole on the fuel injector.

4JB1-TC engine

In order to reduce the content of nitrogen and oxygen compounds and other particles from the exhaust of a direct injection diesel engine, a dual-springfuel injector has been developed.

Fuel filter assembly

Parts



Legend

1. Fuel filter cover
2. Fuel hose
3. Fuel filter assembly

Dismantling

Preparation

· Disconnect the earthing cable of the storage battery.

1. Fuel filter cover

2. Fuel hose

· Disassemble the fuel hose from the fuel filter. Plug the end of the hose to prevent the fuel from spilling.

3. Fuel filter assembly

· Disassemble the fixing bolts on the fuel filter bracket.

Install

1. Fuel filter assembly

· Install the fuel filter bracket first, and then fasten the fixing bolt.

2. Fuel hose

· Connect the fuel hose to the fuel filter.

3. Fuel filter cover

· Connect the grounding cable of the storage battery.

· Inject the fuel into the fuel pump by hand pressure, and exhaust the air in the fuel system.

Fuel filter element

Dismantling

· Disassemble the filter cartridge of the fuel filter with filter wrench. The number of the filter wrench is:

5-8840-0253-0 (J-22700)

Install

· Clean the installation surface of the fuel filter to ensure the safety of the filter cartridge.

· Coat a thin layer of engine oil on the O ring of the new filter cartridge.

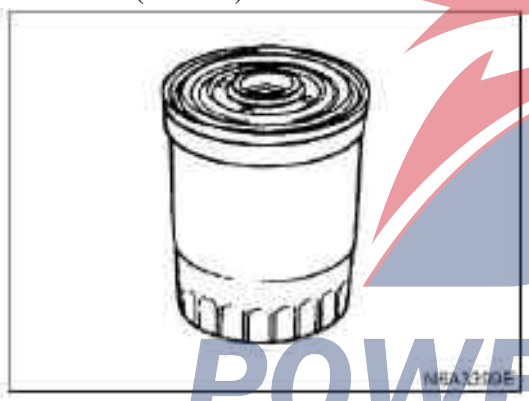
· In order to facilitate the exhaust of air, inject the fuel into the new filter cartridge and fill it with light oil.

· Tighten the filter cartridge until the O ring is tightly attached to the sealing surface. Be careful not to spill light oil.

· Re-tighten 1/3 - 2/3 of the filter cartridge with a fuel filter wrench.

Fuel filter wrench No.:

5-8840-0253-0 (J-22700).



Exhaust the air

· Send the air in the fuel system to the fuel injection pump by operating the hand pump.

· Release the air plug of the fuel injection pump, and then continue to operate the hand pump until there is no bubble.

· Tighten the air plug.

· Start the engine. If the engine does not start successfully for 10 seconds or less, repeat the above operation to eliminate the air in the fuel system.

· Please confirm that there is no fuel leakage and then tighten the hand pump.

Drainage:

·When the water in the precipitator reaches the predetermined amount, the warning lamp will be lit. In this case, please follow the following steps to discharge the water.

· Attach an ethylene hose to the drain plug.

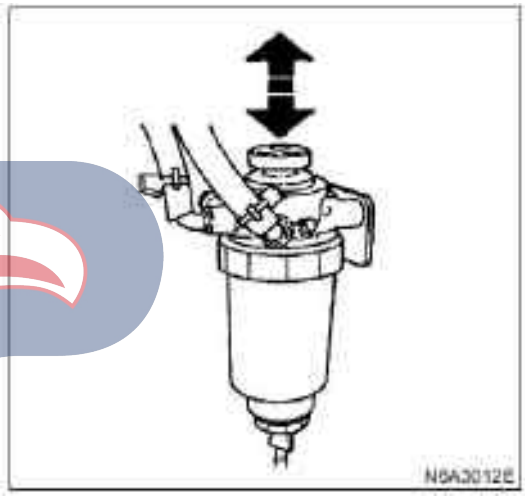
· Release the drain plug.

· In order to discharge the water, please operate the hand pump several times.

· After the water is drained, fasten the drain plug.

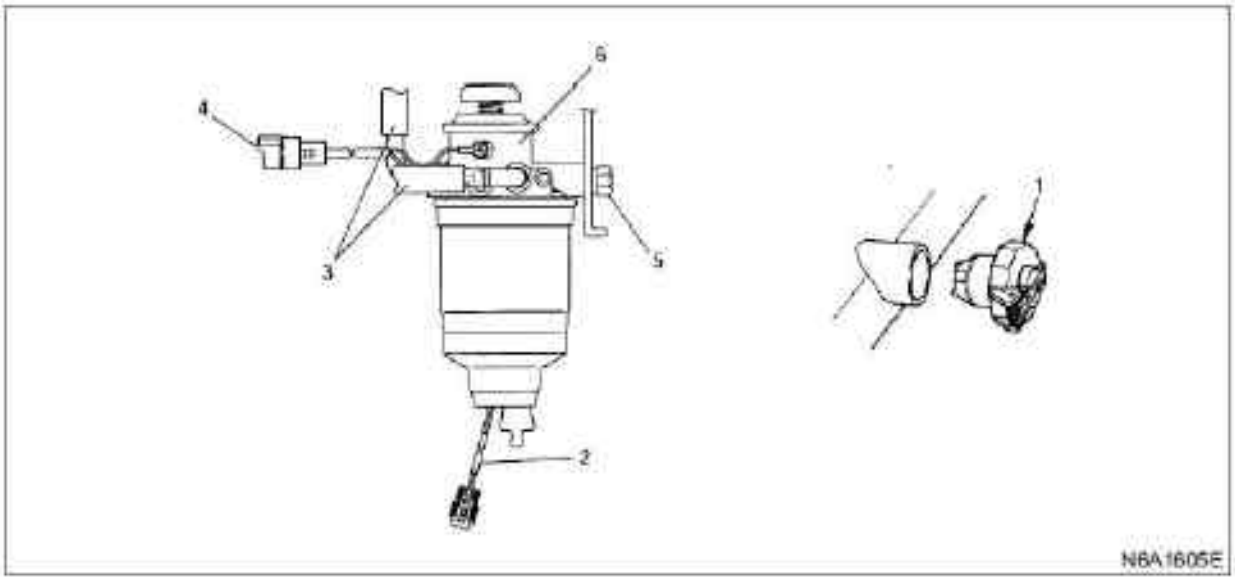
· Operate the hand pump several times to detect the leakage of fuel.

· Check whether the water level warning light is closed.



Fuel filter assembly (4KH1-TC)

Parts



Legend

1. Fuel filter cover
2. Connector of fuel precipitator
3. Fuel hose
4. Fuel heater connecting head
5. Bolt
6. Fuel filter assembly

Dismantling

Step 1. Please disassemble the fuel filter cover.

2. Disassemble the connector of the fuel precipitator and of the fuel heater.

3. Disassemble the fuel oil supply hose and fuel return hose from the fuel filter and plug the hose to prevent fuel leakage.

4. Disassemble the fixing bolt from the fuel filter.

5. Dismantle the fuel filter assembly.

Install

1. Install the fuel filter assembly.

2. Install the fixing bolt to fix the fuel filter.

3. Install the fuel oil supply pipe and oil return pipe.

Install the fuel precipitator and the fuel heater connector.

4. Install the fuel filter cover.

5. Discharge air.

· Please refer to "Fuel Filter Cartridge (4KH1-TC)".

Fuel filter element (4KH1-TC)

Dismantling

1. Disassemble the filter cartridge of the fuel filter with a fuel filter wrench. The number of the fuel filter wrench is: J-22700

2. Disassemble the precipitator sensor

Legend

1. O ring
2. Fuel filter cartridge.
3. Precipitator sensor
4. Fuel heater connecting head

Install

1. Assemble the precipitator sensor into the new fuel filter cartridge.

Clean the mounting surface of the fuel filter cartridge in the fuel filter so that the filter cartridge can be safely fixed.

2. Coat a thin layer of engine oil on the O ring of the new filter cartridge.

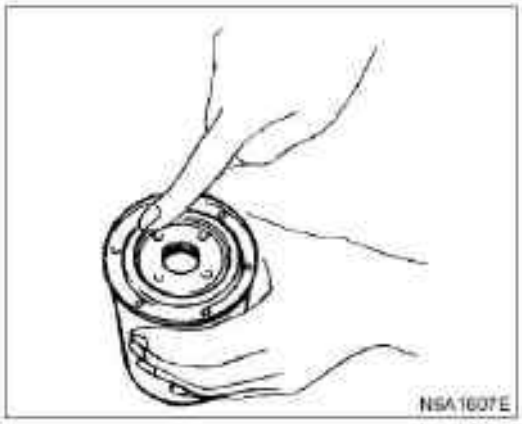
3. Fill the new filter cartridge with light oil to facilitate air discharging.

4. After contacting with the sealing surface of the O ring, fasten the filter cartridge.

When fastening, be careful not to spill light oil in the filter cartridge.

5. Re-tighten 1/3 - 2/3 of the filter cartridge with a fuel filter wrench.

Fuel filter wrench No.:J-22700



Exhaust air from the fuel injection pump (4KH1-TC)

When the following situations occur, in order to start the engine, the air in the fuel injection pump must be exhausted.

· The fuel tank has been used up (the fuel has been used out).

· The fuel filter has been replaced

· The fuel injection pump has been replaced

Caution:

If the fuel injection pump has been replaced, more time and efforts will be needed to complete the exhaust of air. (This is because there is no fuel in the pump)

1. Release the air exhaust nut on the plunger of the hand pump (at the top of the fuel filter).

2. Move the pump plunger up and down (about 15 times) until feeling strong resistance.

3. Stop operating the hand pump, and then tighten the exhaust air nut.

4. Wait for 1min.

5. Re-loosen the exhaust air nut on the plunger of the hand pump (at the top of the fuel filter).

6. Move the hand pump plunger up and down again (about 10 times) till feeling very strong resistance.

7. Stop operating the hand pump, and then tighten the exhaust air nut.

8. Wait for 1min.

9. Re-loosen the exhaust air nut on the plunger of the hand pump (at the top of the fuel filter).

10. Move the hand pump plunger up and down again (about 5 times) till feeling very strong resistance.

11. Stop operating the hand pump, and then tighten the exhaust air nut.

12. Step on the accelerator pedal and clutch pedal towards the floor from beginning to end, and keep them low. Rotate the ignition switch to the ON position. Wait until the light is turned on and off.

Caution:

If the engine is cold, the light will remain open for about 4 to 7 seconds before it is extinguished.

However, if the engine is hot, the light will not be lit.

13. Turn the ignition switch to the starting position to start the engine (not more than 10 seconds).

If the engine is not able to start, repeat the above Step 9 to 13.

14. Allow the engine to be at idle for 5 minutes.

Special basis

Schematic diagram	Schematic tool number / description
	J—22700 Fuel filter wrench

Discharge water

If the water level in the precipitator exceeds the predetermined position, the warning lamp will be lit. In this case, please follow the following steps to drain the water.

· Place a container at the end of the plastic hose

· Release the drain plug

· Operate the hand pump several times to release more water.

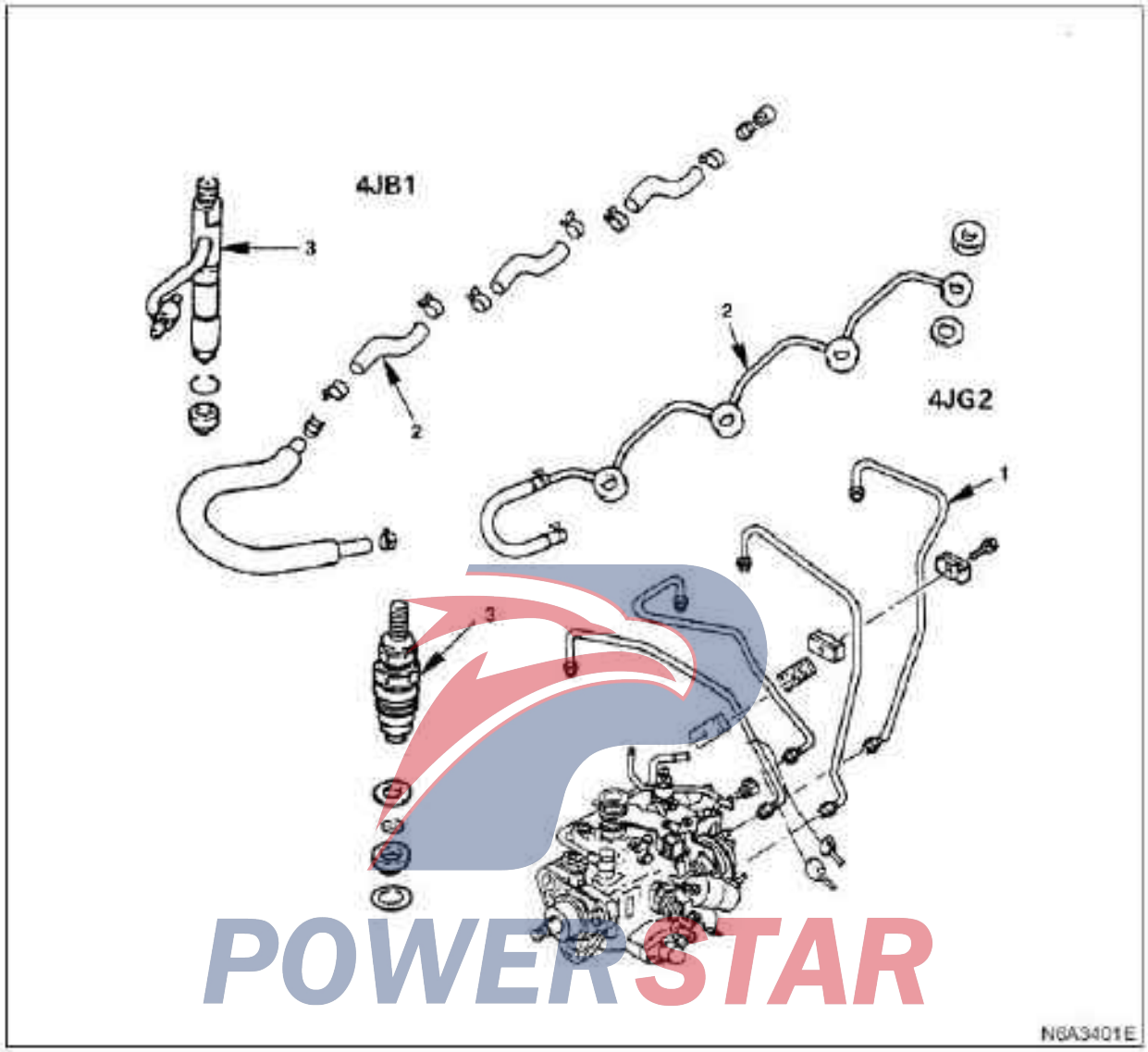
· After releasing water, tighten the plug.

· Operate the hand pump several times to detect whether there is fuel leakage.

· Check and confirm whether the indicator in the combination instrument is extinguished.

Fuel injector

Parts 4JB1 / 4JG2



Legend

1. High pressure oil pipe
2. Return oil pipe
3. Fuel injector

Dismantling

Preparation:

· Disconnect the connection of the earthing cable of the storage battery.

1. High pressure oil pipe

· Release high pressure pipe clamp.

· Unscrew the cone nut on the side of the fuel injection pump.

·Unscrew the cone nut on the side of the fuel injection pump, then disconnect the high pressure oil pipe and place it away.

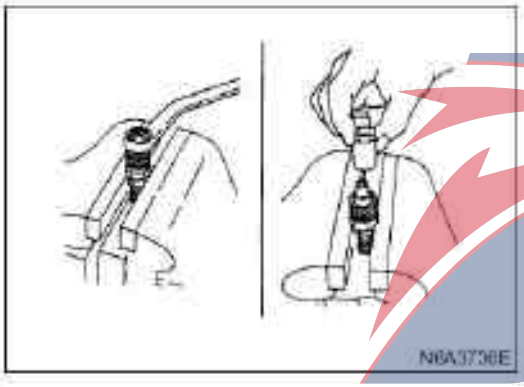
2. Return oil pipe

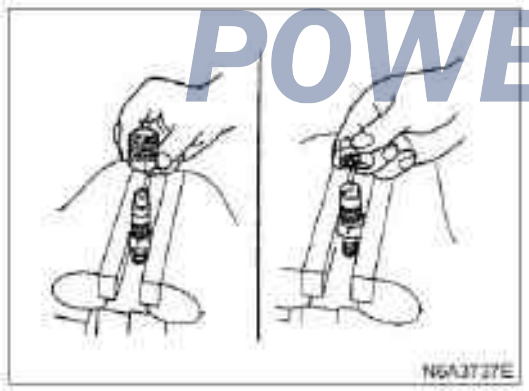
3. Fuel injector

Disassembling (4JG2 engine)

· Clamp the fuel injector body tightly with the pincer pliers, unlock the nut and break down.

· Release the fixing nut of the fuel injector and disassemble the nozzle matching parts.



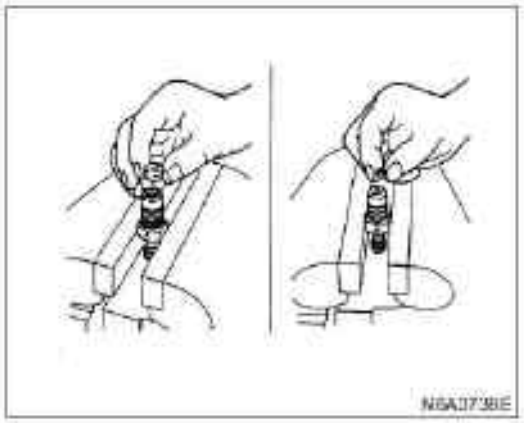


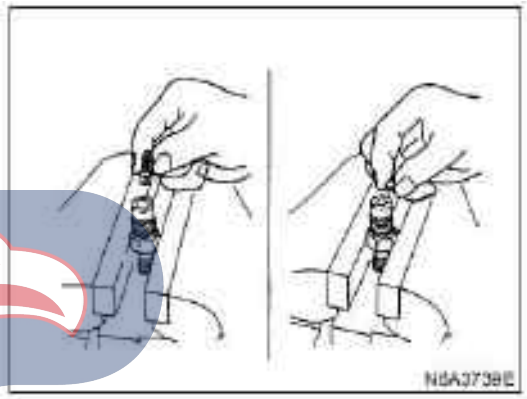
Caution:

· Please be careful not to damage the needle valve.

· Disassemble the interval block, the locating pin and the push rod.

· Disassemble the spring and adjusting gasket.





Caution:

· Clean all the disassembled parts and carefully place the parts by the cylinder number. Please be careful not to confuse these parts.

· Place the fuel injector assembly in a part container with light oil.

· Please be careful not to miss any of the used gaskets.

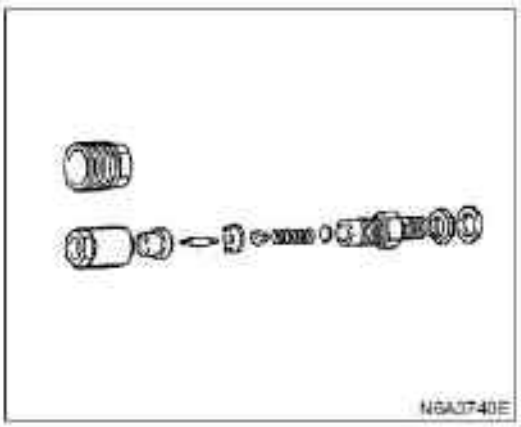
Testing (4JG2 engine)

Nozzle matching parts

· Place the remaining oil nozzle couplings in the light oil, and carefully clean the needle valve and needle valve, respectively, and carefully check the smoothness of the needle valve in the needle valve body.

Caution:

· If the needle valve cannot slide smoothly in the needle valve body, please repair or replace with a new needle valve assembly.

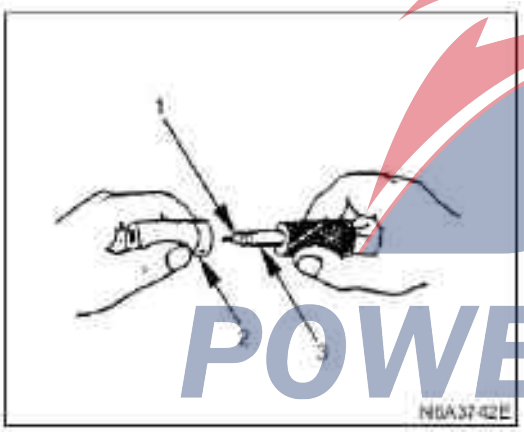


Grinding process of injection nozzle matching parts

· Apply a thin layer of grinding paste (mixed with chromium oxide with animal oil) on a needle valve seat and a sleeve.

Caution:

· The excess abrasive paste may accelerate the wear of the needle valve, so be sure to clean the extra grinding paste after assembling the needle valve.



Legend

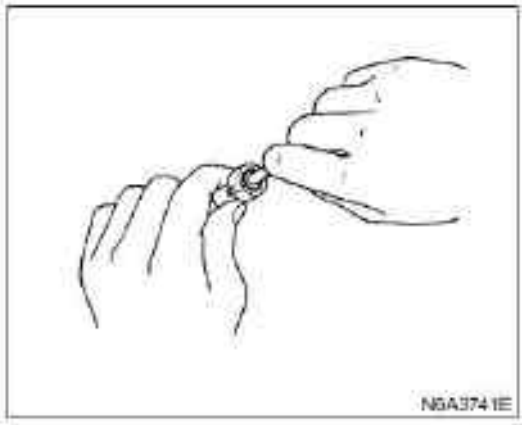
1. Grinding paste
2. Needle valve body
3. Needle valve

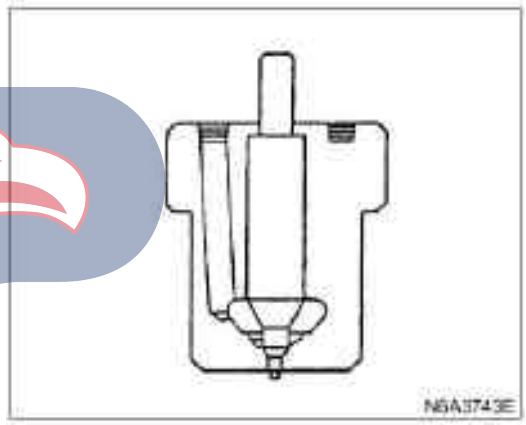
Needle valve body and needle valve

· Test the body and head of the fuel injector to check the hairpin phenomenon. If the hairpin is obvious, replace one of the nozzle pairs. Also, if the end of the needle valve has been deformed or stuck, please replace the entire nozzle pair.

Caution:

· If the needle valve body and needle valve have been defective, then a new nozzle pair must be replaced.



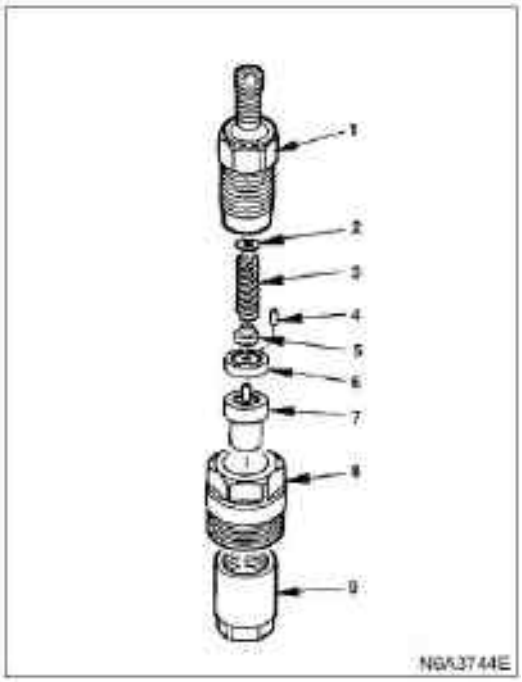


Reassemble (4JG2 engine)

In order to reassemble the fuel injector, follow the reverse order of the disassembly step. In order to assemble well, please pay attention to the following items:

Caution:

· Be careful to assemble the spacer because the pin will get through it.



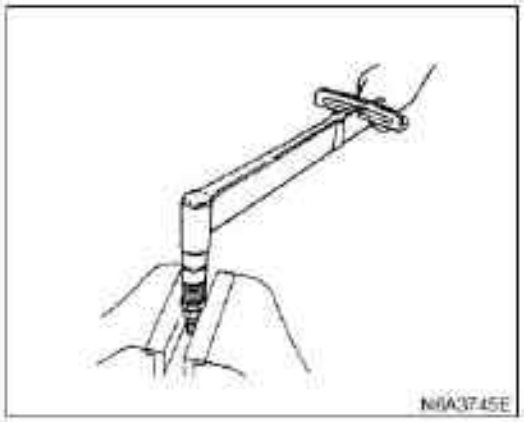
Legend:

1. Fuel injector body
2. Adjusting gasket
3. Fuel injector surge spring
4. Locating pin
5. Push rod
6. Spacer block
7. Fuel injection nozzle mate parts
8. Fuel injector body nut
9. Fuel injector fixing nut

· Install the fixing nut of the fuel injector. Then tighten the nut with the set torque.

Tightening torque:

The tightening torque of the nut is 39N ·m (4.0 kg·m/32 lb·ft)

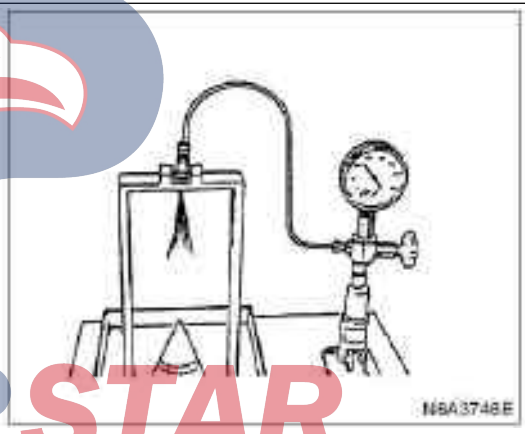


Regulating fuel jet pressure (4JG2 engine)

· Install a fuel injector assembly in a fuel injector tester.

· Apply the hydraulic pressure onto the fuel injector through the handle of the tester and confirm that the fuel can be ejected under the pressure below.

kPa (kgf / cm2 / lb·ft)
14710 (150/2133)



Caution:

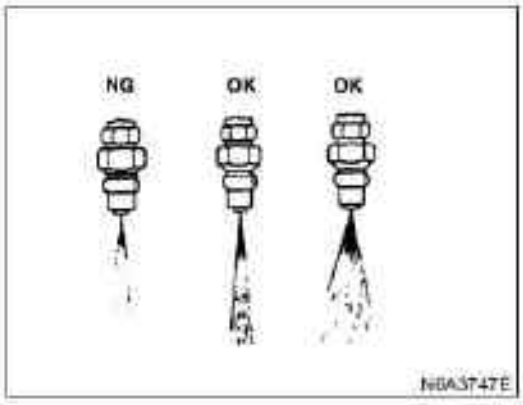
· If the fuel in the fuel injector is not ejected under the set pressure, adjust the adjusting gasket of the adjuster. The selectable type of adjustable cushion includes the thickness range of the gasket from 1 to 1.75 mm (0.039 - 0.069 in).

· The fuel injector has no problem unless a very unshaped spray is visible.

Caution:

· The dual jet fuel injector is qualified when the fog shape fuel is sprayed using the nozzle.

Install (4JG2 engine)

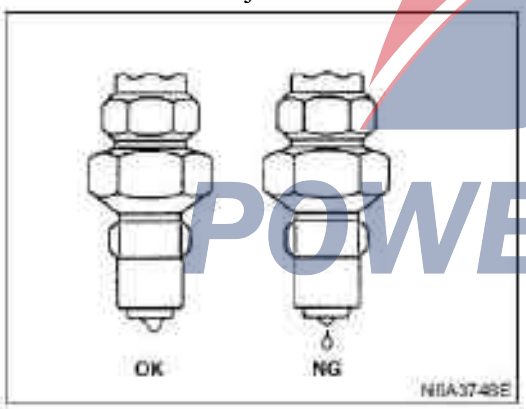


Oil seal test (4JG2 engine)

1) After adjusting the jet pressure, the light oil at the top of the fuel injector should be wiped up.

2) When loading is less than 1,961 kPa of oil pressure than 20 kgf/ cm2 / 284 lb / ft, check whether there is oil droplet flow after 10 seconds of loading.)

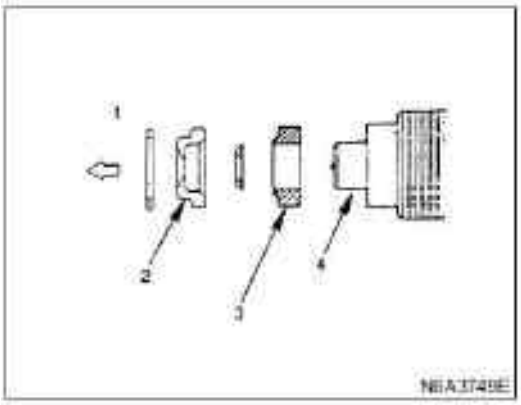
3) In case of oil dripping, please clean the fuel injector completely. Then reassemble it and check if there is oil dropping. If the oil is still dripping, only replace with a new fuel injector.



Caution:

· The fuel injector must be reassembled according to the following schematic.

· New heat insulated pads and new corrugated packing rings should be used.



Legend:

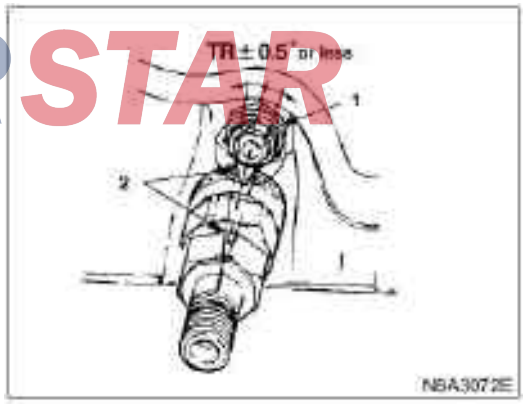
1. Cylinder head side
2. Fuel injector heat insulation pad
3. Heat insulation washer
4. Fuel injector

---

1. Fuel injector (only for 4JG2 engine)

· Gently fasten the fuel injector body nut to a certain length so that the fuel injector body can be adjusted per graduation.

· Install the positioning confirmation hole in ±5 degree rotation angle of the positioning bush of the fuel injector relative to the cylinder cover side.



Legend:

1. Glow plug
2. Positioning bush

· Fasten the fuel injector body nut to the set torque with a wrench and a special tool as shown in the pictures.

Caution:

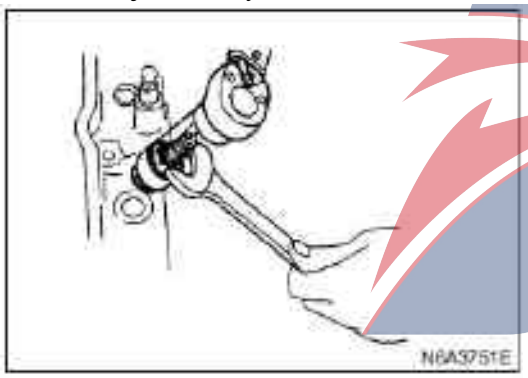
· After fastening the nut of the fuel injector body, please confirm that the angle deviation of the hole of the drill is ±5° or smaller than the locating bush on the side of the cylinder cover.

· When installing the leakage oil return pipe, the fuel injector and the piping, clean the parts with compressed air to prevent the dust from entering inside.

Tightening torque:

· 64 N·m (6.5 kg·m/47 lb·ft) for fuel injectorfixing nuts.

Wrench: fuel injector body 5-8840-0259-0



2. Return oil pipe

· Install with a new copper gasket.

· Fasten the nut to the set torque.

Tightening torque:

· 29 N·m (3.0 kg·m/22 lb·ft) for pipe nuts.

3. High pressure oil pipe

· Connect the high pressure oil pipe with the fuel injector body.

· Fasten the connection on the side of the fuel injection pump.

Tightening torque:

· 29 N·m(3.0 kg·m/22 lb·ft) for sleeve nuts

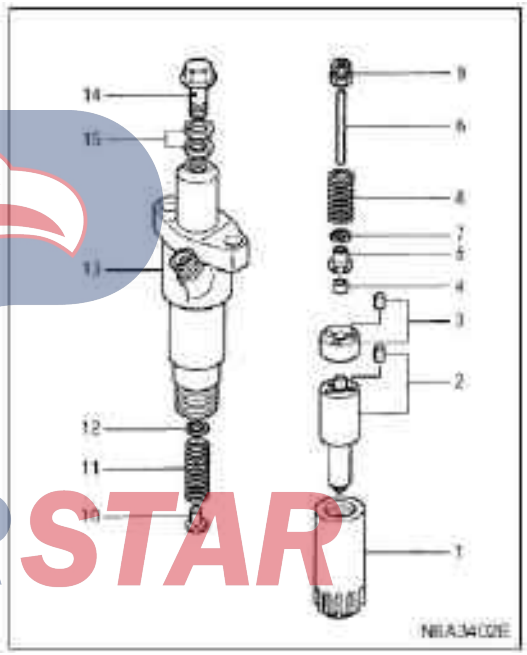
· Install the pipe clamp to the specified position.

4-1 fuel injector (dual-springfuel injector body) (4JB1-TC)

In order to reduce the content of the nitrogen and oxygen compounds and other particles in the exhaust gas of the direct injection diesel engine, the dual spring fuel injector body has been developed.

Decomposition:

1. Fuel injectorfixing nuts (1)
2. Nozzle matching parts (2)
3. Spacer block and pin (3)
4. Lifting block (4)
5. spring seat (5)
6. Push rod (6)
7. Gasket (Stage 2 jet pressure regulation) (7)
8. Stage 2 Spring (8)
9. Collar (9)
10. spring seat (10)
11. Stage 1 spring (11)
12. Gasket (Stage 1 jet pressure regulation) (12)
13. Fuel injector body (13)
14. Eye bolts (14)
15. Washer (15)



1) Before reassembling, disassemble the accumulated carbon in the peripheral of the fuel injector and the fuel injector assembly with a wire brush.

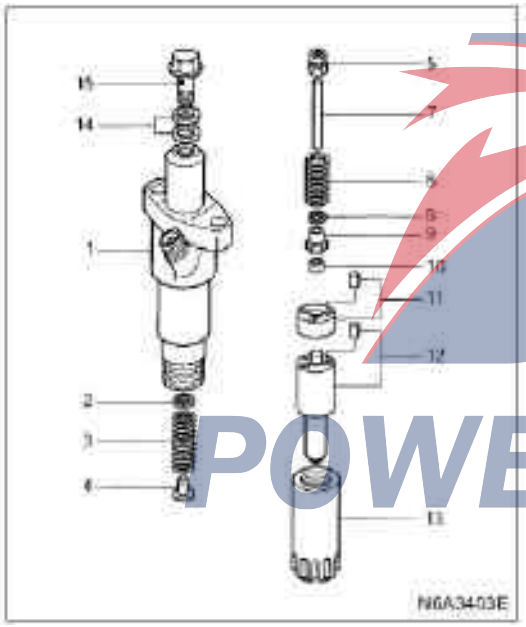
Caution:

During washing, please do not contact the nozzle of the fuel injector.

2) Decompose the fuel injector assembly in the numerical order.

Reassemble the fuel injector and adjust the jet pressure of the fuel injector (4JB1-TC)

1. Fuel injector body
2. Gasket (Stage 1 jet pressure regulation)
3. Primary spring
4. Spring seat
5. Shaft collar
6. Secondary spring
7. Push rod
8. Gasket (Stage 2 jet pressure regulation) (7)
9. Spring seat
10. Lifting block
11. Spacer block and pin
12. Fuel injection nozzle mate parts
13. Fuel injector fastening nuts
14. Gasket
15. Eye bolts



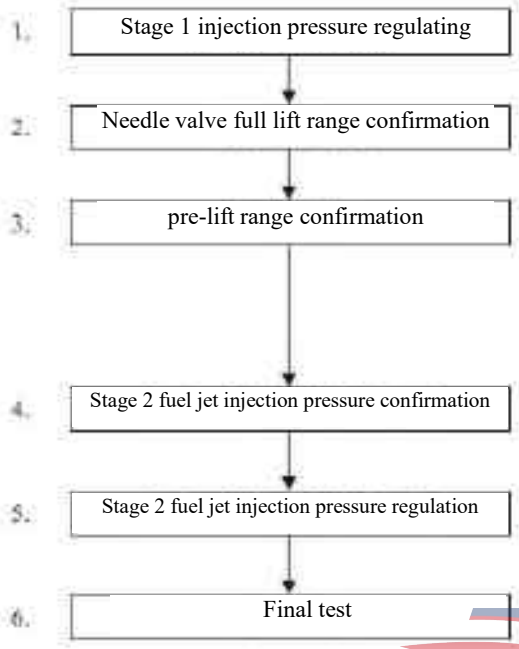
The fuel injector body is adjusted when the fuel injector body is reassembled in the above order.

The two-spring fuel injector body is adjusted by taking “silk” as the unit, so all parts shall be cleaned in light oil so as to clear any dirt and foreign matters.

The fuel injector body is adjusted when the fuel injector body is reassembled in the above order.

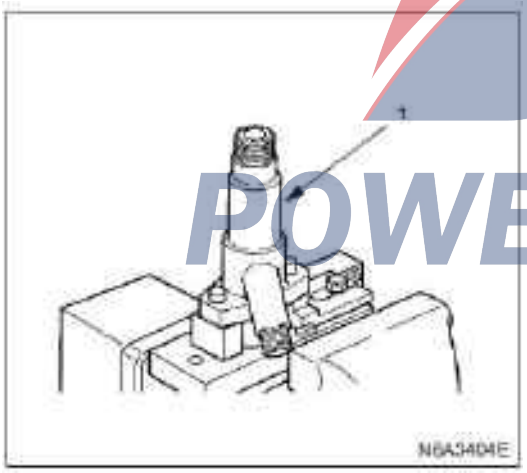
. The two-spring fuel injector body is adjusted by taking “silk” as the unit, so all parts shall be cleaned in light oil so as to clear any dirt and foreign matters.

Reassemble and adjust the flow of the fuel injector body



Injection pressure regulation of Stage 1 fuel injector

1. Plate the body of the fuel injector between the pincer pliers



Legend

1. Fuel injector body

---

2. Install the gasket, Stage 1 spring and the spring seat in the fuel injector body.

Adjust the jet pressure of the first stage fuel injector with a regulating gasket

Confirm the whole lifting range of the needle valve is consistent with the feedback method

Confirm the pre-lifting is consistent with the feedback method

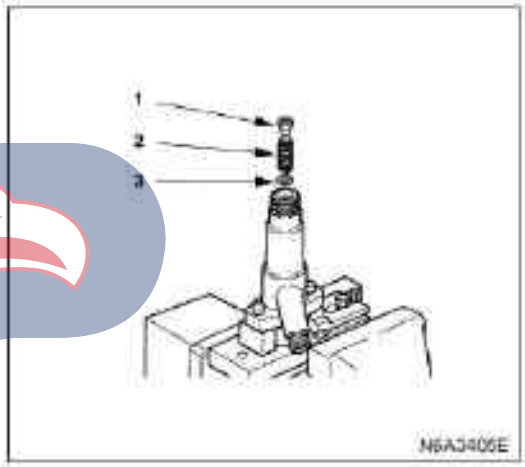
Caution:

If the pre-lifting is not consistent with the specified value, replace the fuel injector assembly, lifting block, pin and interval block with the fuel injector tool.

Confirm Stage 2 injection pressure is consistent with the feedback method

Adjust the second injection pressure with the gasket

Confirm fuel injection conditions with fuel injector and fuel injector assembly

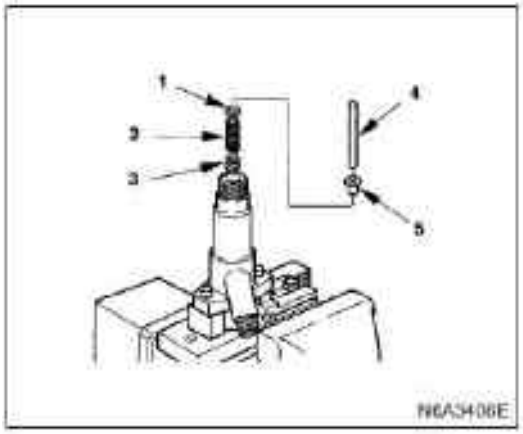


Legend:

1. Spring seat
2. Primary spring
3. Stage 1 injection pressure regulating gasket

---

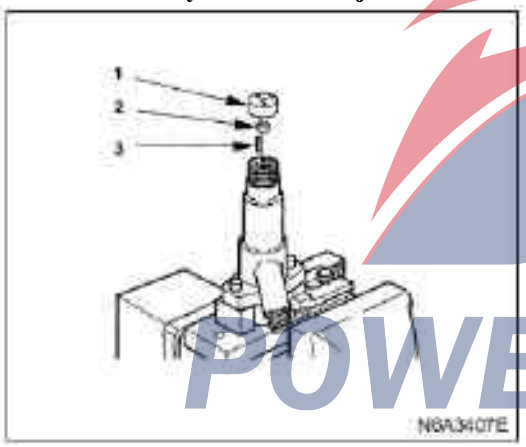
3. Install the collar, Stage 2 spring, gasket, in spring seat and push rod in the fuel injector body.



Legend

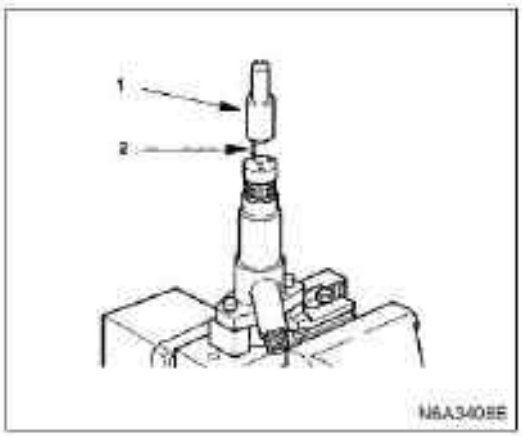
1. Grade II injection oil pressure adjusting gasket
2. Secondary spring
3. Shaft collar
4. Push rod
5. Spring seat

4. The pin (3), lifting block (2) and spacer (1) installed in the body of the fuel injector.



5. The pin (2) installed on a spacer block.

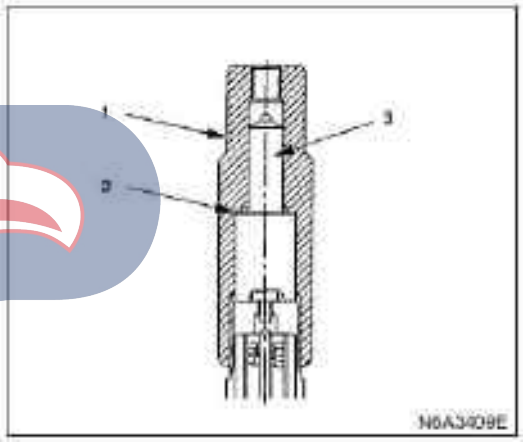
6. The nozzle pair (1) installed on the interval block.



7. Fasten the adjusting stop nut and gasket to the fuel injector body by hand.

Stop nut: 5-8677-7140-0

Washer: 5-8677-7139-0



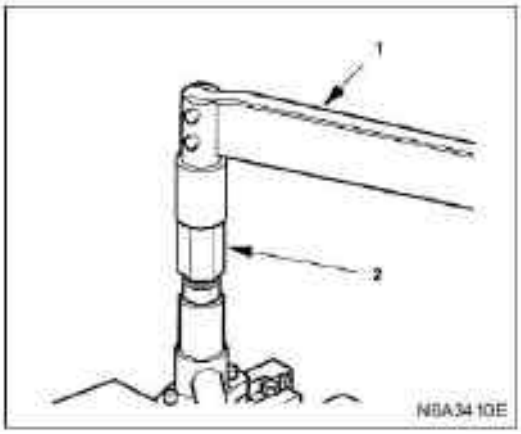
Legend

1. Locknut (special tools)
2. Gasket (special tool)
3. Injector

8. Tighten the fuel injector adjusting stop nut to the specified torque.

Tightening torque:

The torque of the fuel injector stop nut is 29 — 39 N·m (3.0 — 4.0 kg·m)



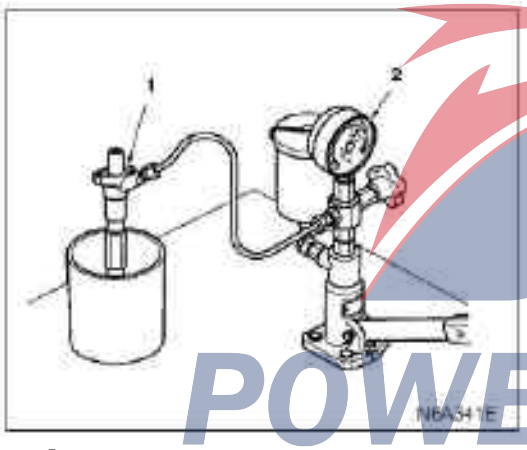
Legend:

1. Torque wrench
2. Locknut (special tools)

---

9. Install the fuel injector body onto the fuel injector test stand.

10. Operate the fuel injector test equipment and test the first stage injection pressure.



Legend

1. Fuel injector body
2. Fuel injector tester

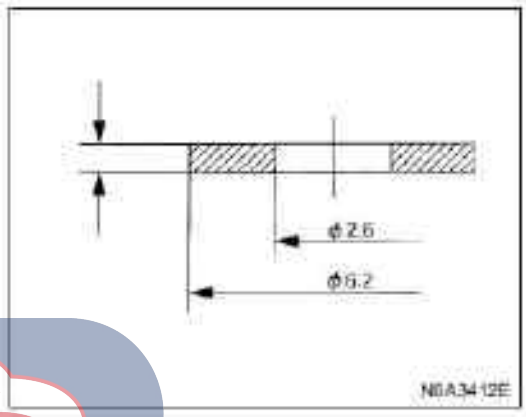
---

11. If the injection pressure of the fuel injector does not meet the specified value, disassemble the fuel injector body and replace the gasket until the injection pressure meets the specifications.

Caution:

Use a micrometer to measure the thickness of the gasket.

Part number	Thickness (mm)
1-1534-9042-0	0.40
1-1534-9043-0	0.50
1-1534-9044-0	0.52
1-1534-9045-0	0.54
1-1534-9046-0	0.56
1-1534-9047-0	0.58
1-1534-9048-0	0.60
1-1534-9049-0	0.70

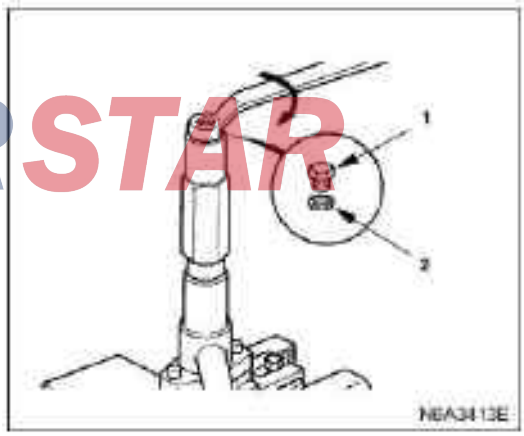


Needle valve full lift range confirmation

1. Install and adjust the washer (2) and plug (1) of the fixing nut of fuel injector.

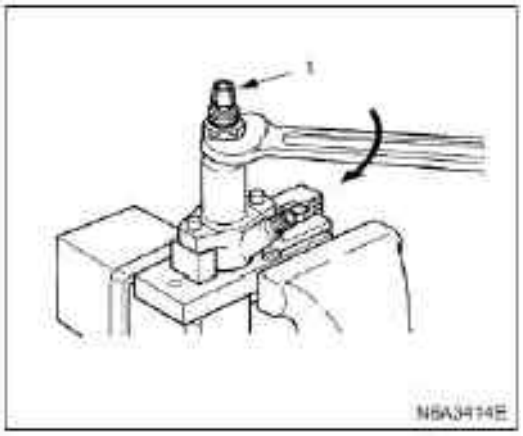
Washer: 8-9722-7602-0

Plug: 5-8677-7141-0



2. Position the fuel injector body with the fuel injector facing down and install the dial gauge body on the fuel injector body.

Dial gauge body: 5-8677-7142-0

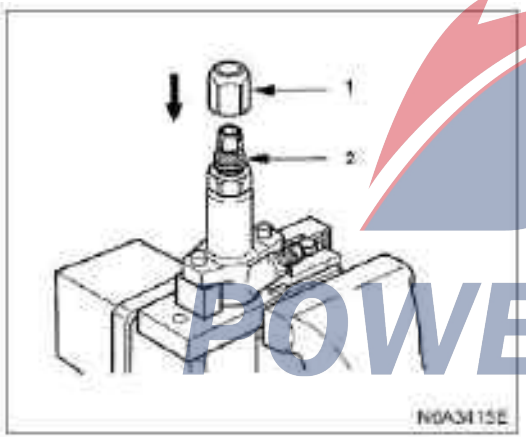


Legend

1. Micrometer gauge holder (special tools)

3. Install the nut (1) on the micrometer gauge holder (2).

Nut: 5-8677-7143-0



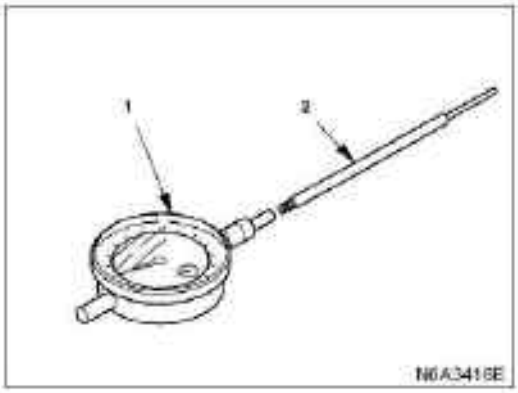
4. Install the pin (2) on the dial gauge holder (1).

Caution:

The length of the pin does not include the thread part.

Pin (length = 100 mm): 5-8677-7144-0

Dial scale: 1-8531-7015-0

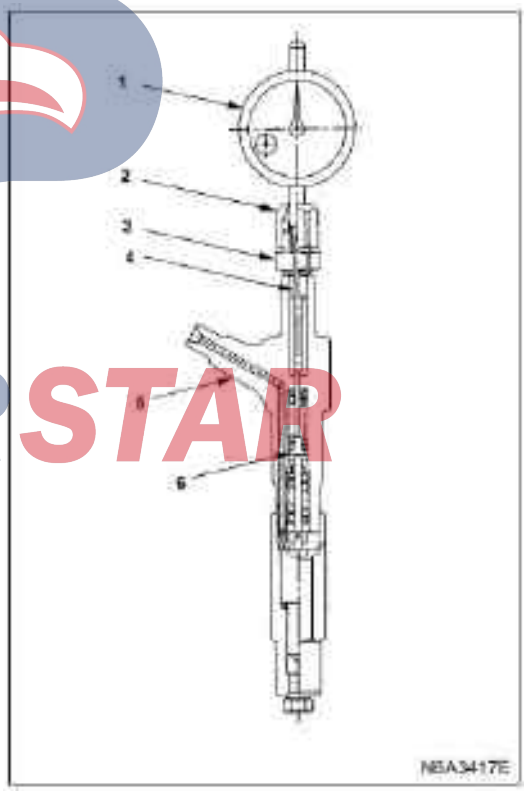


5.Use a nut to ensure that the dial gauge is well connected to the fuel injector body so that the pin can contact the first stage spring seat.

Caution:

·Protect the micrometer gauge so that this gauge can measure 2mm of travel.

· Do not over-tighten the nut as the dial shaft may become clogged.(Make sure the shaft can move smoothly by using a micrometer gauge.)



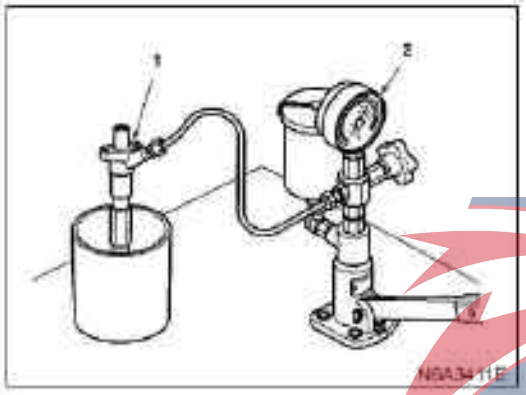
Legend

1. Dial gauge
2. Nut
3. Fastening device
4. Pin
5. Fuel injector body
6. The first stage spring seat

---

6. Install the fuel injector body (1) onto the fuel injector tester (2), and set the needle valve on the micrometer gauge to 0.

7. Operate the fuel injector tester (2), to release air from the fuel injector fixing nut and verify that no fuel has been leaked.

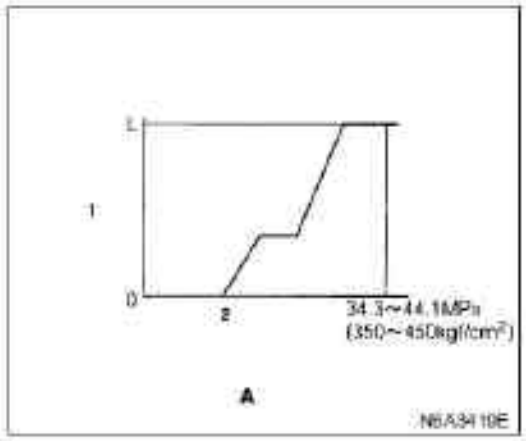


8. Operate the fuel injector tester and increase the rail pressure to 34.3-44.1 MPa (350-450 kgf / cm2) so that the needle valve of the fuel injector can wholely experience the full lift of its nozzle.

Record full lift "L" (read micrometer gauge)

Caution:

The above operation is used to determine whether the fuel injector seat is damaged, and whether the fuel injector assembly is in good condition.

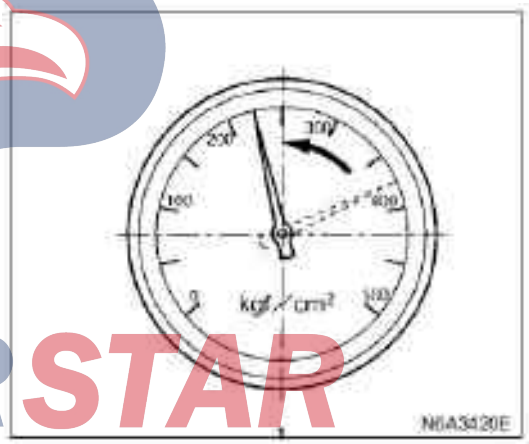


Legend:

A. Oil pressure of oil pipe
1. Needle valve lift
2. Stage I injection oil pressure

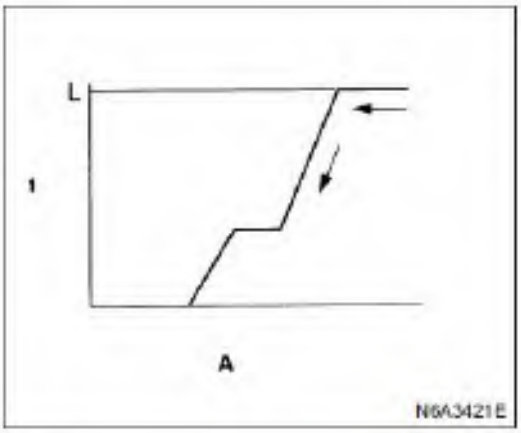
Pre-lift range confirmation

1. When the needle valve is in full lift, release the handle of the fuel injector tester.



Legend

1. Pressure gauge



Legend

A. Oil pressure of oil pipe
1. Needle valve lift

Caution:

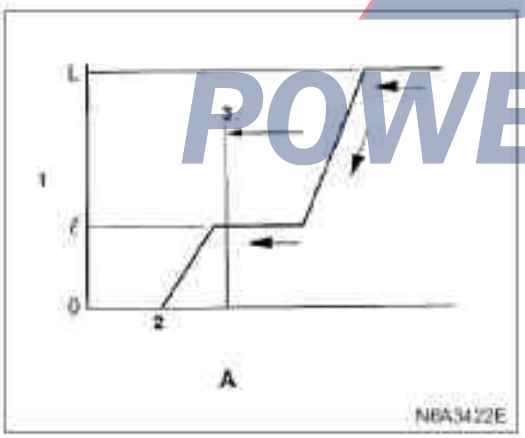
The oil pipe pressure will be reduced, and the needle valve lift (as shown on the micrometer gauge) will also be reduced a little.

2. Read the “L” value of needle valve lift from the micrometer gauge (when the second stage spring has ceased to operate and the needle has dropped).

For more information about "L", please see pre-lift measurement point.

Pre-lift measurement point:

Read the first stage injection pressure 1 MPa (10 kgf / cm^2) on the micrometer gauge.



Legend

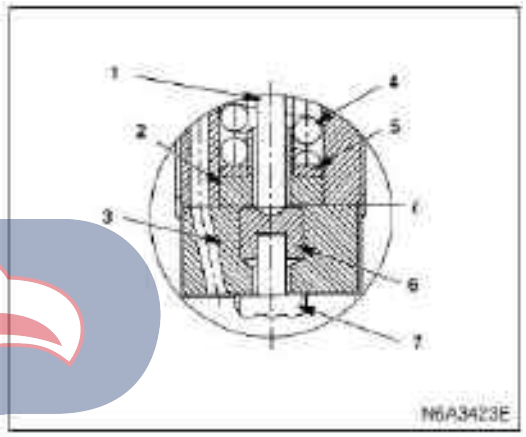
A. Oil pressure of oil pipe
1. Needle valve lift
2. Stage I injection oil pressure
3. Pre-lift measurement point

Caution:

When the oil pressure is decreasing, this point can be found.

3. Confirm that the pre-lift "L" is consistent with that is specified.

Pre-lift	mm (in)
0.04(0.002)	



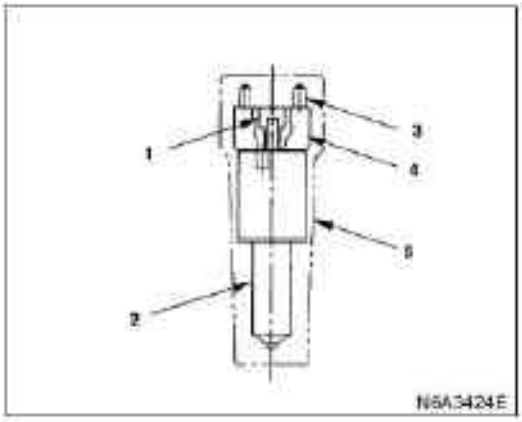
Legend

1. Push rod
2. Spring seat
3. Spacer block
4. Secondary spring
5. Adjusting gasket
6. Lifting block
7. Needle valve

---

4. If the pre-lift is inconsistent with the specified value, then use service tools to replace the pin, lift block, spacer, and fuel injector assembly.

Service tools: 8-9720-3470-1

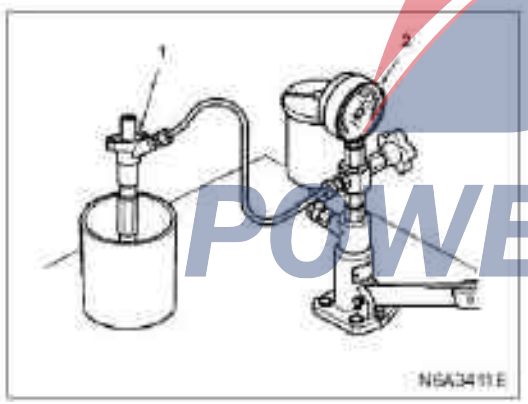


Legend

1. Lifting block
2. Fuel injector assembly
3. Pin
4. Spacer block
5. Outer tube

The second stage injection pressure confirmation

1. After completing the pre-lift confirmation, operate the fuel injector tester to increase oil pipe pressure to 34.3 - 44.1 MPa (350 - 450 kgf / cm2),so that the needle valve can move within its full stroke.

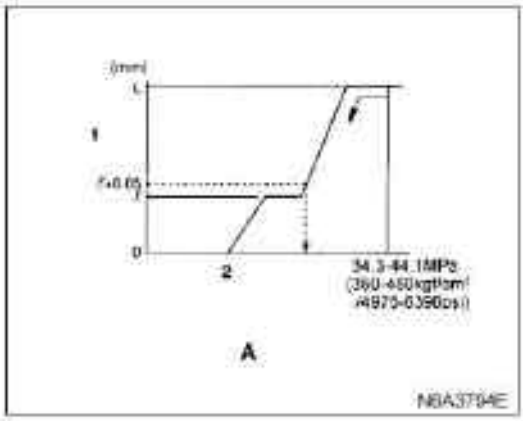


Legend

1. Needle valve body
2. Needle valve tester

---

2. Release the handle of the fuel injector tester to reduce oil pipe pressure.



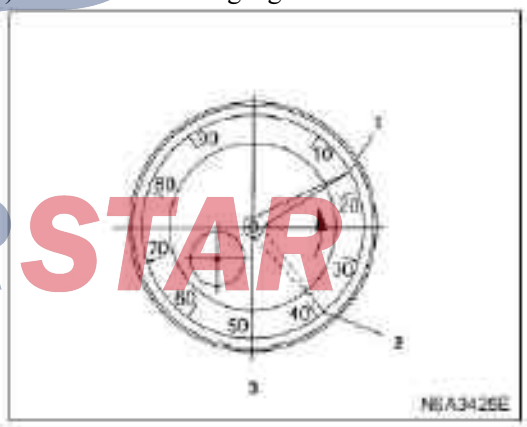
Legend:

A. Oil pressure of oil pipe
1. Needle valve
2. The second stage of injection pressure

Caution:

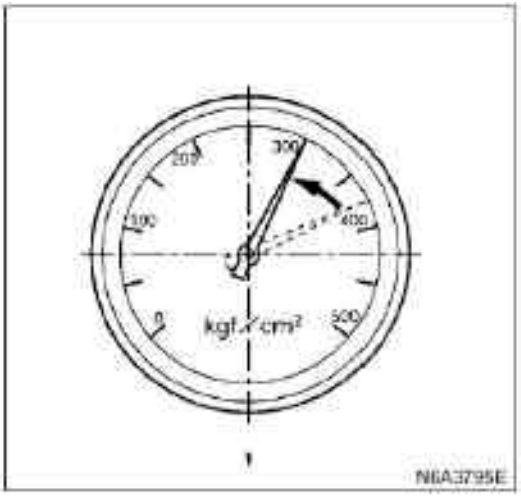
Oil pipe pressure will be reduced, and needle valve lift(as shown in the micrometer gauge) will also be reduced a little.

3. Then, read out the value of the pressure gauge(the second injection pressure) indicated by the specified needle valve lift(normally the pre-lift value plus 0.05 mm) in the micrometer gauge.



Legend

1. When needle valve lift is L+0.05 mm.
2. Full lift of the needle valve
3. Dial gauge



Legend

1. Oil pressure gauge

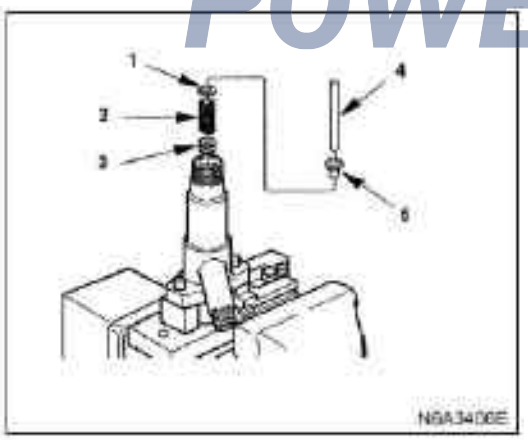
The second stage injection pressure adjustment

If the second stage injection pressure differs from the specified value, then please disassemble the fuel injector from the fuel injector body and replace the gasket until the injection pressure reaches the set value.

Caution:

·Since the second stage injection pressure changes as the first stage injection pressure changes, the second stage injection pressure must be re-adjusted after the first stage injection pressure is changed.

·Use a micrometer to measure the thickness of the gasket.

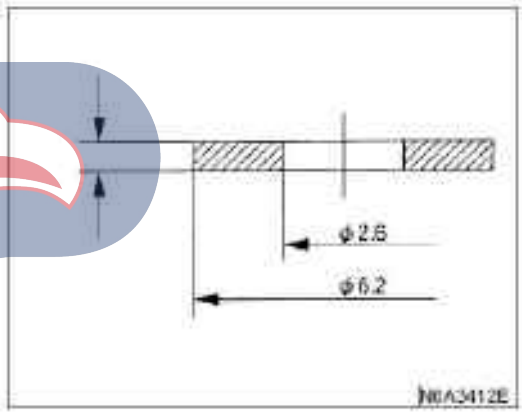


Legend

1. Grade II injection oil pressure adjusting gasket
2. Secondary spring
3. Shaft collar
4. Push rod
5. Spring seat

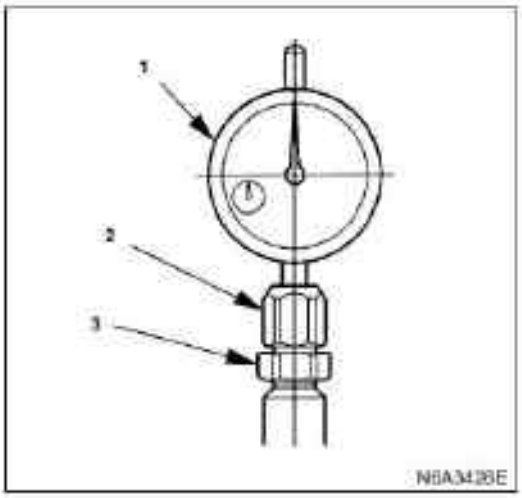
· Pressure adjusting gasket of the second stage injection

Part Number	Thickness
8-9711-6034-0	0.40
8-9711-6035-0	0.50
8-9711-6037-0	0.52
8-9711-6039-0	0.54
8-9711-6041-0	0.56
8-9711-6043-0	0.58
8-9711-6044-0	0.59



Final detection

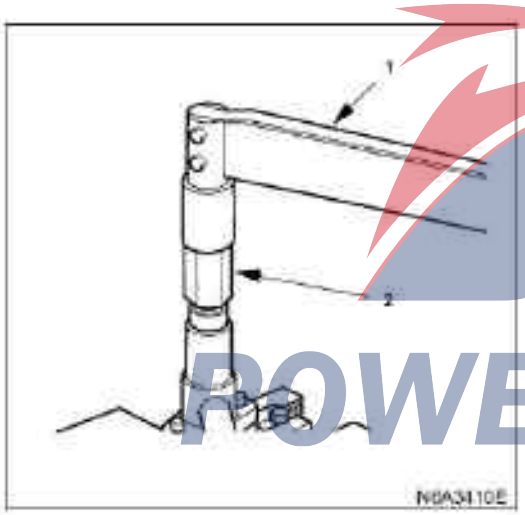
1. Disassemblemicrometer gauge (1), nut (2) and dial holder (3).



2. Disassemble adjustment stop nut and washer.

3. Install the original fuel injector stop nut, confirm that the pin has been fully plugded into the fuel injector, and tighten the stop nut with hands. Then tighten this stop nut to the specified torque.

Torque: 59-79 N•m (6.0 -8.0 kg•m / 43.5 -58.2 lb • ft)

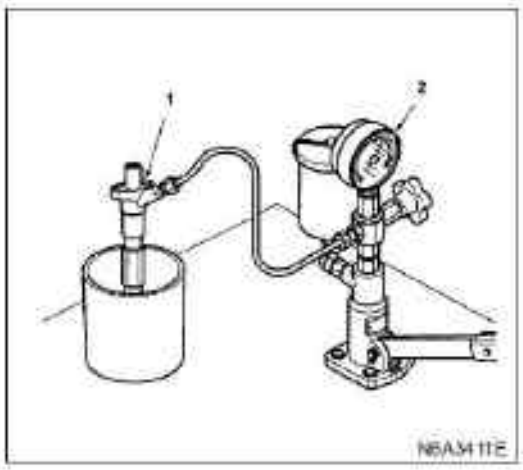


Legend

1. Torque wrench
2. Locknut (special tools)

---

4. Install the fuel injector body onto the fuel injector tester, and check the first stage injection pressure, spray condition, seat oil seal, and whether there is oil leak for each part.



Legend

1. Fuel injector body
2. Fuel injector tester

5.When replacing the fuel injector, please replace the nozzle coupling, lifting block, pin, and spacer block together as a whole, and replace with fuel injector service tools.

Caution:

If only nozzle coupling is replaced, the pre-lift will be inconsistent with the specified value.

Disassembling (4JB1 engine)

1. Stop nut (1)

2. Fuel injection nozzle coupling(2)

1) Disassemble the fuel injector assembly from the fuel injector.

Label the fuel injector assembly and the fuel injector body to ensure that they can be installed in their original position when re-installing.

Please do not exchange different pairs of fuel injector assemblies and fuel injector bodies.

2) Soak the fuel injector in a tool plate with clean diesel to prevent the fuel injector from sticking to the dust.

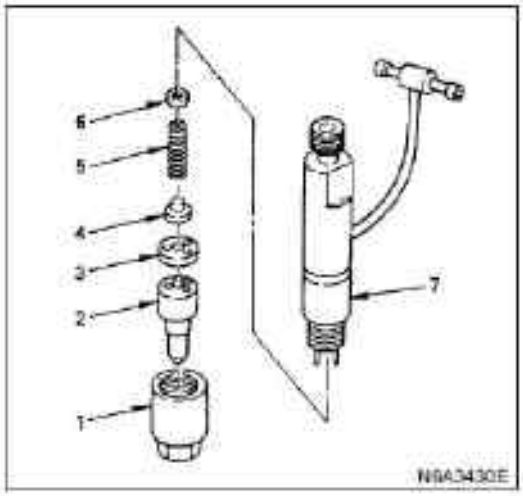
3. Spacer block (3)

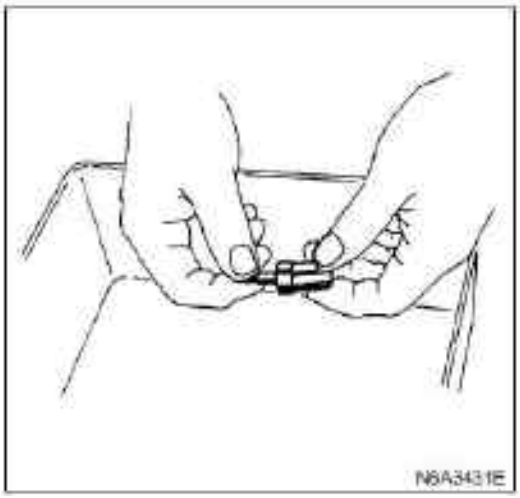
4. spring seat (4)

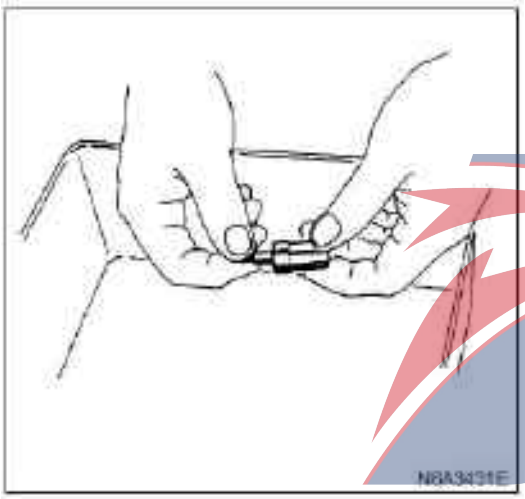
5. Spring (5)

6. Adjusting gasket (6)

7. Fuel injector body (7)







Detection and repair(4JB1 engine)

If the part has been found excessively worn or damaged during detection, then it should be adjusted, repaired, and replaced necessarily.

Detection of fuel injector needle valve

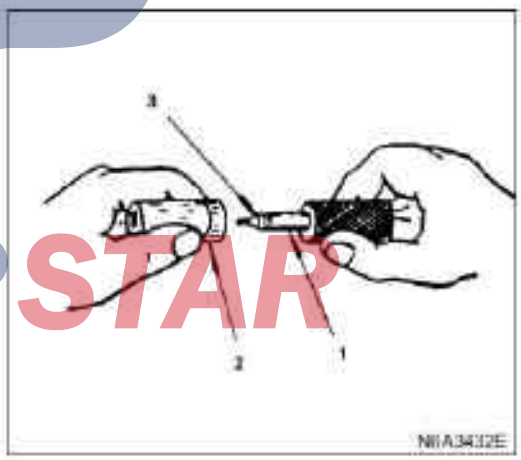
1. Disassemble the needle valve from the fuel injector needle valve body.
2. Please carefully clean the fuel injector needle valve and the injection needle valve body in clean diesel.
3. Check whether the nozzle needle valve can slide smoothly inside the needle valve body, if it cannot, then the needle valve must be repaired(see"Nozzle coupling grinding process").

Nozzle grinding process:

1. Grind nozzle needle valve(1) and needle valve body (2) by using abrasive paste of chrome oxide and animal oil (3)

Caution:

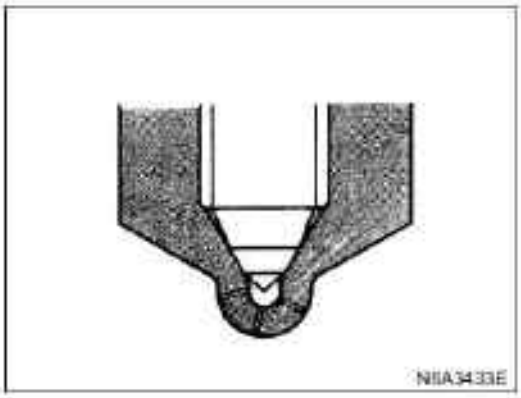
Do not use too much abrasive paste of chrome oxide and animal oil in the area of nozzle needle valve seat. Otherwise it will cause over-wear on the conical surfaces of the nozzle needle valve and hole of the needle valve body.



2. After the grinding is completed, the needle valve and needle valve body should be carefully cleaned in clean diesel.

Needle valve body of fuel injector and needle valve detection

Please carefully check whether there is damage or deformation for the needle valve body and the needle valve. If one of them is found damaged during the detection, the needle valve and the needle valve coupling must be replaced at the same time.

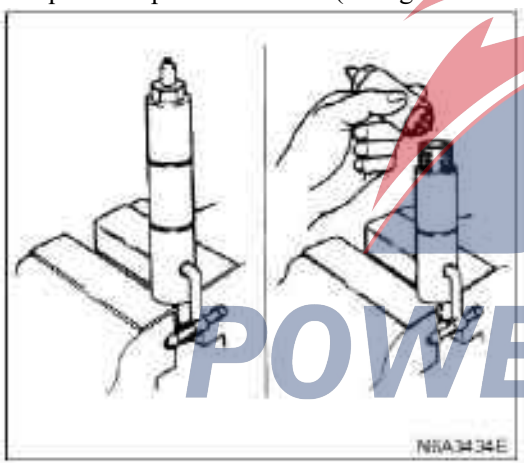


Reassemble

1. Fuel injector body
2. Adjusting gasket
3 . spring
4. Spring seat
5. Spacer block
6. Fuel injector
7. Stop nut

Tightening torque:

The torque of stop nut is 34 N·m (3.5 kg·m / 25 lb·ft)

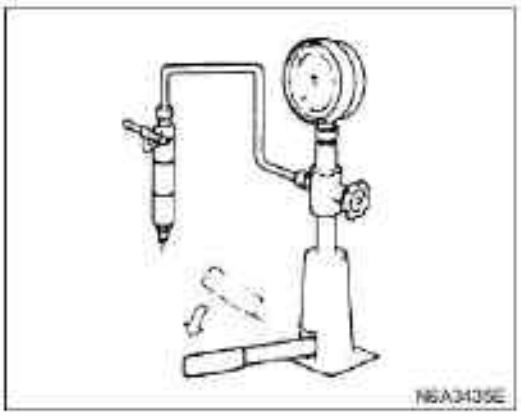


Fuel injector adjustment

1. Install the fuel injector body on the fuel injector tester.

2. Apply pressure to the fuel injector tester to check whether the fuel injector opens under specified pressure.

kPa (kgf / cm2 / lb·ft)
18142(185/2630)



If the fuel injector does not inject oil under specified pressure, appropriate number of adjusting gaskets should be installed or disassembled to adjust the opening pressure of the fuel injector.

Applicability of the adjusting gasket	mm (in)
Range of thickness	0.50 — 1.50 (0.02 — 0.06)
Grading thickness	0.025 (0.001)
Total number of gasket	40

Each reduction or addition of a gasket will increase or decrease injection pressure of the fuel injector approximately 369.46kPa(3.77kgf/cm2/53.6psi).

Warning:

The test liquid coming out of the fuel injector is injected under high pressure. The liquid can easily penetrate human skin. Please remember to keep your hands away from the fuel injector tester all the times.

Install (4JB1/4KH1-TC engine)

1. Fuel injector

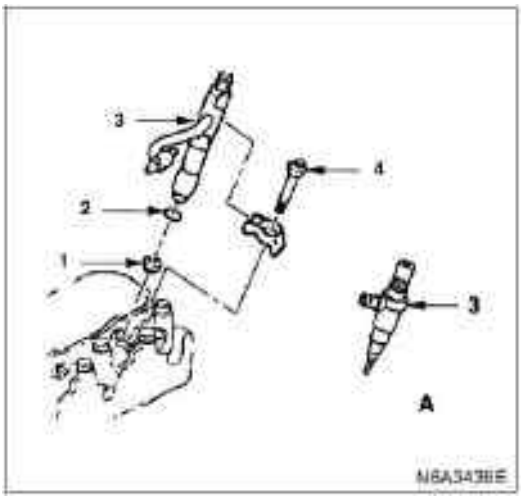
Install the fuel injector gasket (1) and O-ring (2) on the fuel injector body (3).

Make sure that the O-ring is completely installed in the groove of the fuel injector.

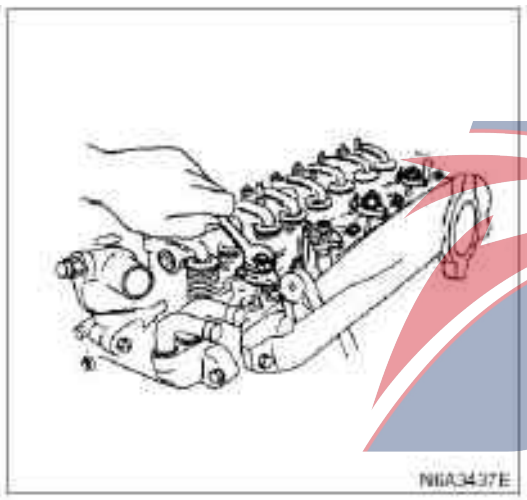
1) Apply engine oil to the hole of fuel injector body on engine cylinder cover.

2) Install the fuel injector body together with its bracket to the cylinder cover.

Tightening torque: 37 N·m (3.8 kg·m/27 lb·ft)



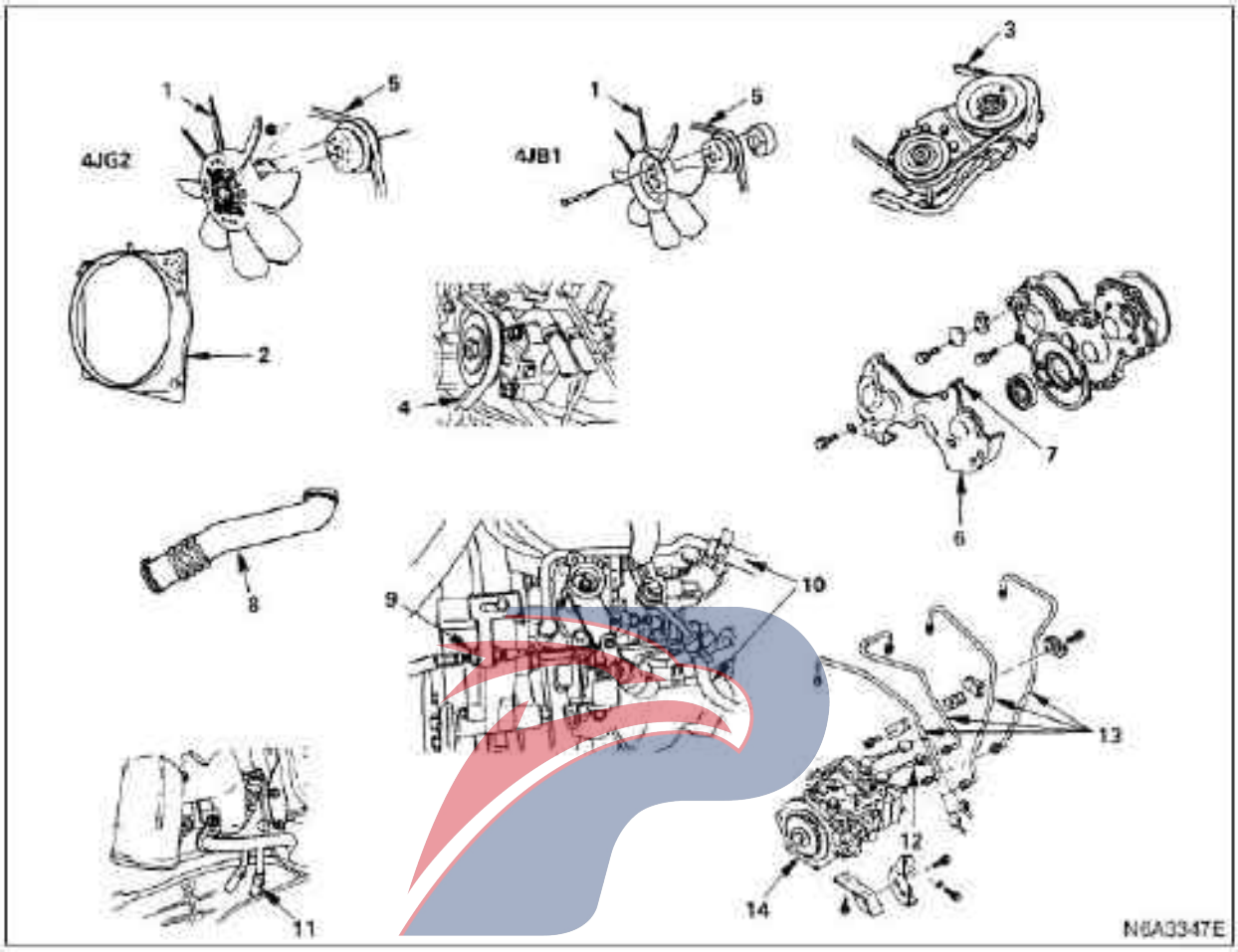
Legend
A. 4KH1-TC



2. Return oil pipe
3. High pressure oil pipe

Fuel injection pump assembly (4JB1/4JG2, gear drive type)

Parts 4JB1 / 4JG2



Legend

1. Cooling fan assembly
2. Fan wind scooper
3 . Drive belt of power steering pump
4. Drive belt of the A/C compressor
5. Drive belt of the AC generator.
6. Noise cover
7. Noise cover pad
8. Intake pipe
9. Fuel injection pump control cable
10. Fuel hose
11. Water pipe of cold starting device
12. Fuel injection pump harness
13. High pressure oil pipe
14. Fuel injection pump assembly

Dismantling

Preparation:

·Disconnect the grounding wire of the storage battery

·Discharge coolant

1. Cooling fan assembly

·Disassemble the clamping nut, and also disassemble the cooling fan assembly, the distal tube, and the fan pulley.

2. Fan wind scooper

3. Transmission belt of the power steering pump(P/S power steering type)

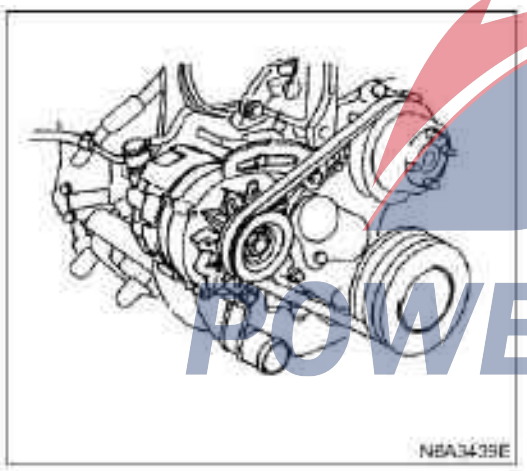
·Loosen the mounting bolt and adjusting bolt of the power steering pump, then disassemble the transmission belt.

4. Transmission belt of A/C compressor (A/C air conditioning type)

·Loosen the mounting bolt and adjusting bolt of the A/C compressor, then disassemble the transmission belt.

5. drive belt of the AC generator.

·Loosen the mounting bolt and the adjusting plate lock bolt of the power steering pump, then disassemble the transmission belt.



6. Noise cover

7. Noise cover pad

8. Intake pipe

9. Fuel injection pump control cable

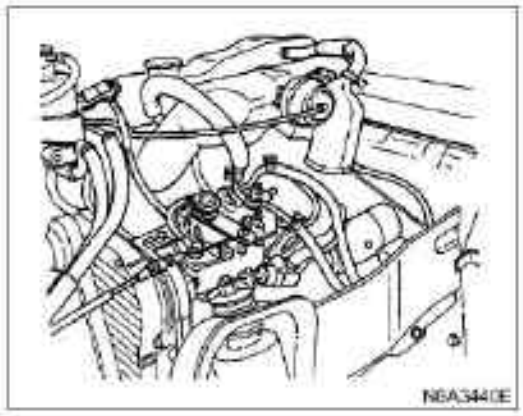
·Disassemblecontrol wire bracket bolt and control wire.

10. Fuel hose

· Disconnect the fuel supply hoses and the fuel return hoses.

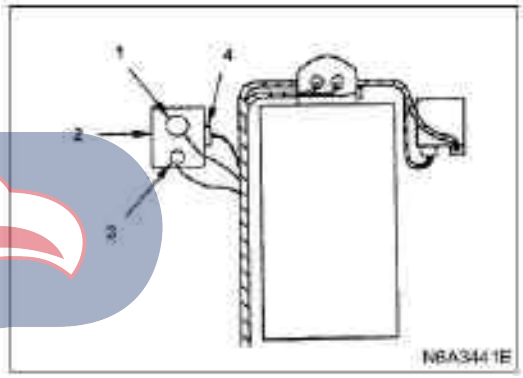
11. Water pipe of cold starting device

·Disconnect the water tube from side of the fuel injection pump.



12. Fuel injection pump harness

·Disassemble tachometer sensor(with tachometer), cold start electromagnetic valve, fuel cut-off electromagnetic valve.



Legend

1. Cold starter electromagnetic valve
2. Fuel injection pump
3. Fuel cutoff solenoid valve
4. Tachometer sensor

13. High pressure oil pipe

·Loosen the pipe clamp

·Disassemble the cone nut on pump side

·Disassemble the cone nut on the fuel injector side, and disassemble the high-pressure tube

Caution:

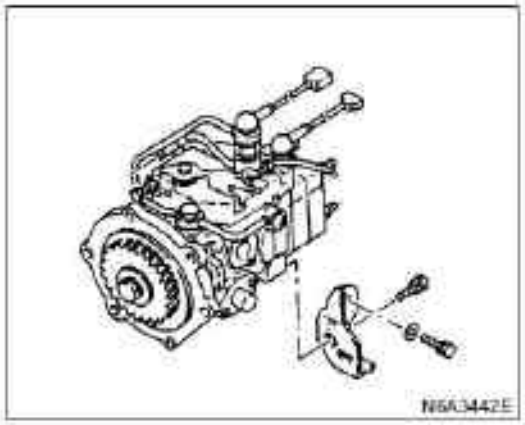
·Make sure that the fuel injector body and the fuel tube are blocked to prevent other substances from entering.

14. Fuel injection pump assembly

·Disassemble the mounting nut of the fuel injection pump

·Loosen the lock bolt of the rear bracket adjuster of the fuel injection pump.

·Disassemble the mounting bolt on the engine side, and disassemble the pump from the engine.



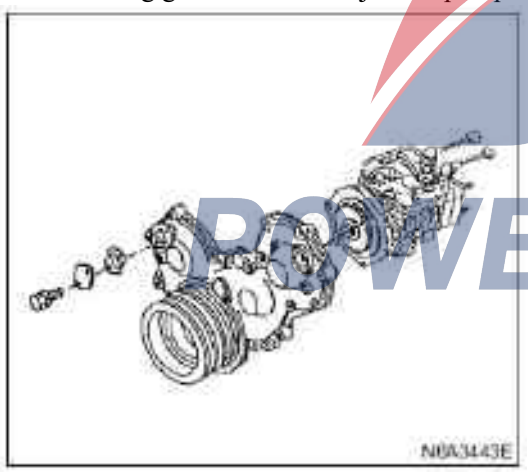
Caution:

Use a boat-shaped cover(or equivalent) to block the holes in the fuel injection pump body to prevent other substances from entering.

Install

1. Fuel injection pump assembly

1) Install the inspection hole cover on side of the timing gear of camshaft of the timing gear body and side of the timing gear of the fuel injection pump.



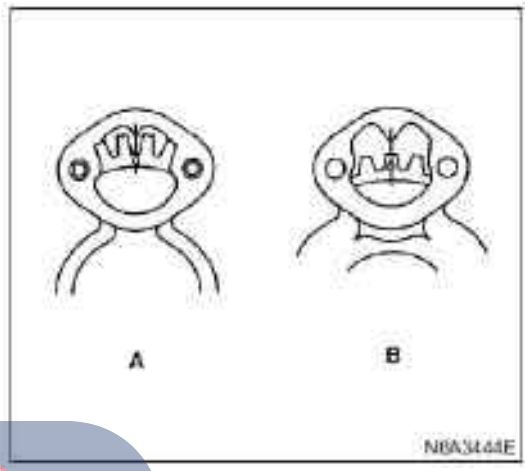
2) Rotate the crankshaft clockwise to the indicator to check whether the top dead center mark of the crankshaft pulley is aligned with the pointer. And continue to rotate the crankshaft to make the first cylinder piston stay at the top dead center of the compression stroke.

3) Under the above condition,at the same time, align the engraved line marked "O" of the fuel injection pump gear with the pointer on the inspection hole and install the fuel injection pump assembly.

·Install the fixing bolt of fuel injection pump and fasten them to the specified torque.

Tightening torque:

Pump bolt to 15 N•m (1.5 kg•m / 11 lb • ft)



Legend

A. Camshaft gear

B. Fuel injection pump gear

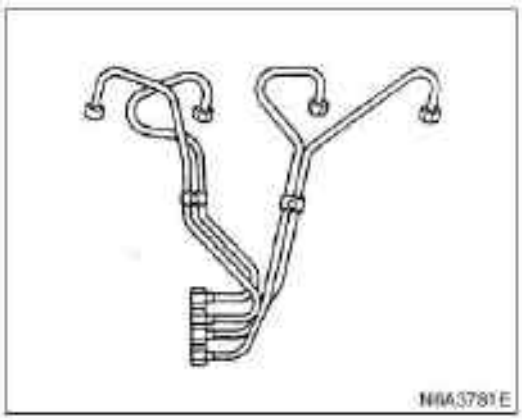
2. High pressure oil pipe

·Connect the oil pipe on the pump side and fuel injector side respectively, and tighten these tubes firmly.

·Install the oil pipe clamp in the previous position.

Tightening torque:

The torque of the sleeve nut is 29 N•m (3.0 kg•m / 22 lb • ft)

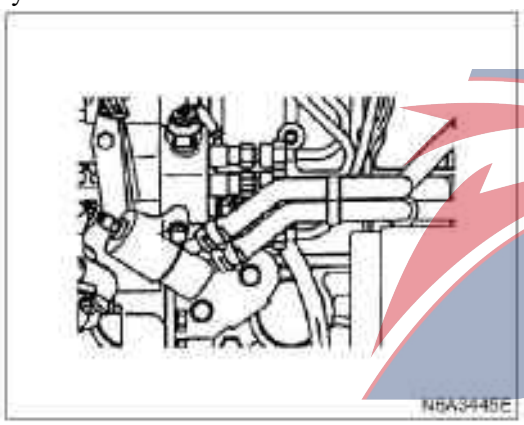


3. Fuel injection pump harness

·Install the fuel injection pump harness and connect it to the corresponding switch.

4. CSD cold start device water pipe

·Connect the water pipe and fasten the pipe clamp safely.



5. Fuel hose

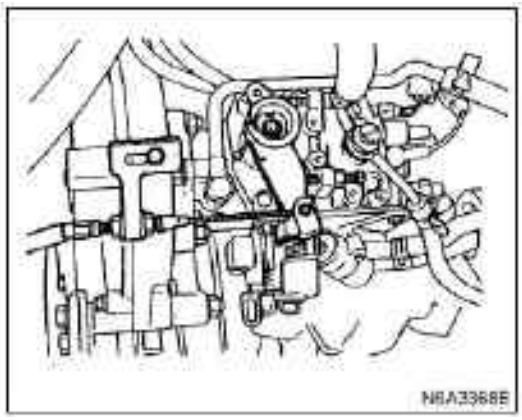
·Connect oil supply hose and oil return hose

·Connect the oil return hose

6. Fuel injection pump control cable

1) Install the control wire to the engine control lever. Hold the accelerator lever in a fully closed position and strain the control wire in the direction indicated by the arrow to eliminate any slack in the cable.

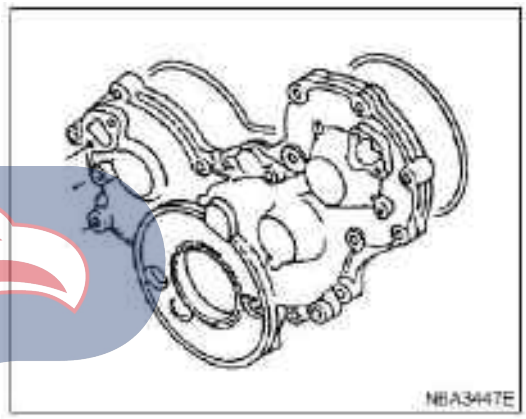
2) Fasten the bolt of the accelerator cable bracket.



7. Air intake pipe

8. Noise cover pad

9. Noise cover



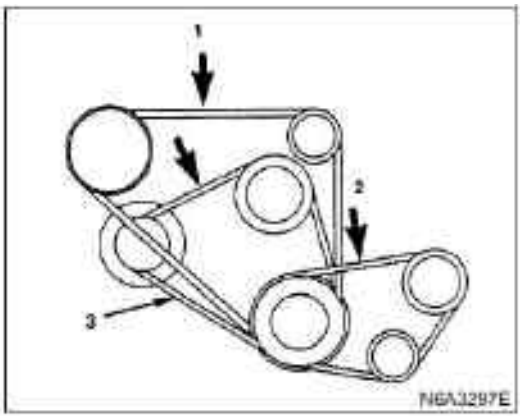
10. drive belt of the AC generator.

·Install the transmission belt and accessories of the alternator and adjust its tension.

·Press in the middle of the transmission belt with a pressure of 96 N (10 kg / 22 lb).

drive belt deflection	mm (in)
8(0.31)— 12(0.47)	

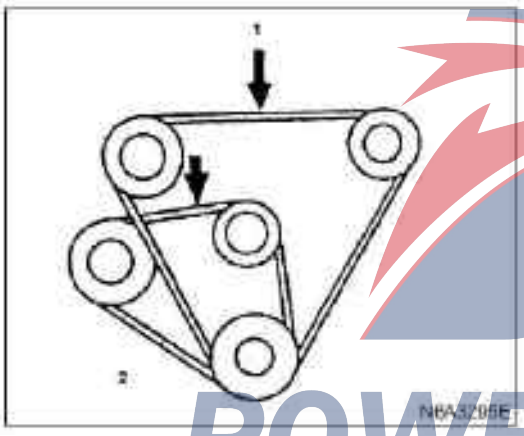
4JG2



Legend

1. Drive belt of the A/C compressor
2. Drive belt of power steering oil pump
3. Drive belt of AC generator and fan belt pulley

4JB1



Legend

1. Drive belt of the A/C compressor and drive belt of the power steering oil pump
2. Drive belt of AC generator and fan belt pulley

·Install the fixing bolts and fasten these bolts to the specified torque.

Tightening torque:

·The torque of Generator fixing bolt is 40 N•m (4.1 kg•m / 30 lb • ft)

·The torque of the adjusting plate fixing bolt is 19 N•m (1.9 kg•m / 14 lb • ft)

11. Drive belt (A/C mode) of the A/C compressor

·Install the A/C compressor transmission belt and adjust the belt tension.

·Press the middle of the transmission belt with a pressure of 98 N (10 kg / 22 lb).

drive belt deflection	mm (in)
8(0.31)— 12(0.47)	

·Fasten the fastening nut of the idler to the specified torque.

Tightening torque:

12. Transmission belt of the power steering pump (power steering type)

· Install the transmission belt of the power steering pump and adjust the belt tension.

·Press the middle of the transmission belt with a pressure of 98 N (10 kg / 22 lb).

Drive belt deflection	mm (in)
8(0.31)— 12(0.47)	

·Fasten the fastening nut of the idler to the specified torque.

Tightening torque:

27 N·m (2.8 kg·m/ 20 lb·ft)

13. Fan wind scooper

·Install fan shroud and fuel tank hose

14. Cooling fan assembly

·Install the fan pulley, crossbar, and cooling fan assembly(in sequence) onto the pump, and fasten these parts to the specified torque.

Tightening torque:

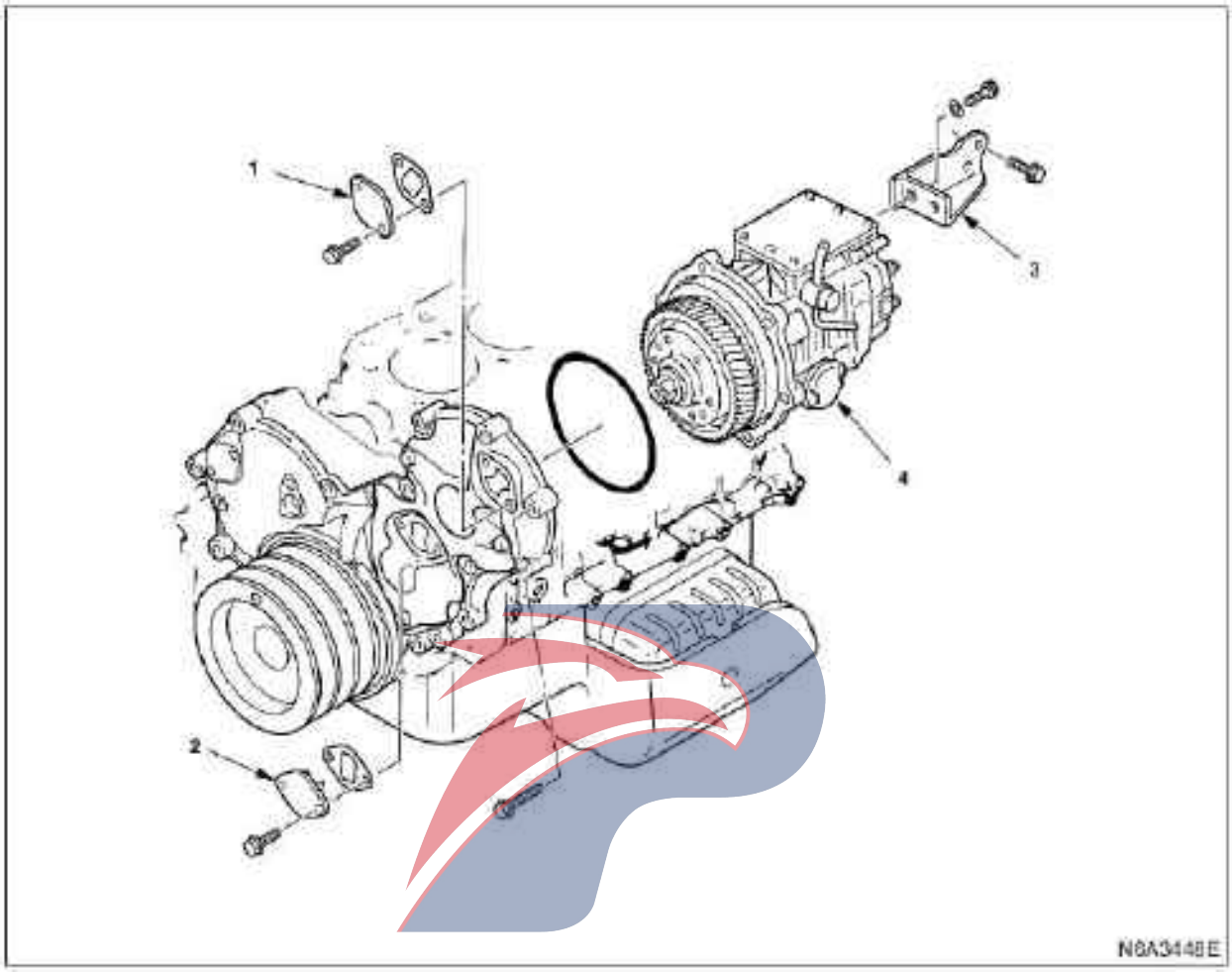
8 N·m (0.8 kg·m/ 69 lb·ft)

·Connect the grounding wire of the storage battery

·Inject coolant

Fuel injection pump assembly (4KH1-TC)

Parts



Legend

1. Inspection hole cover: fuel injection pump gear
2. Inspection hole cover: shear gear
3. Fuel injection pump bracket
4. Fuel injection pump assembly

Dismantling

Preparation

Disassemble fuel pipe and high pressure oil pipe

1. Inspection hole cover: fuel injection pump gear

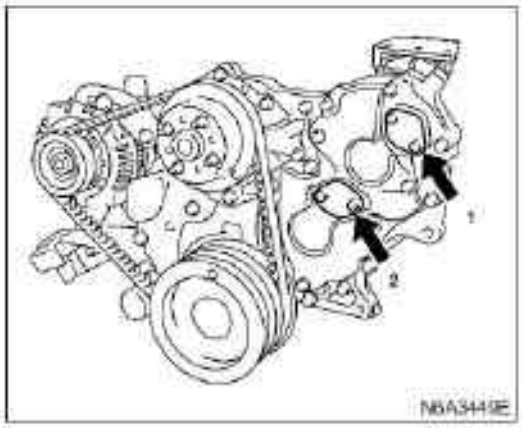
Inspection hole cover: Shear gear (1)

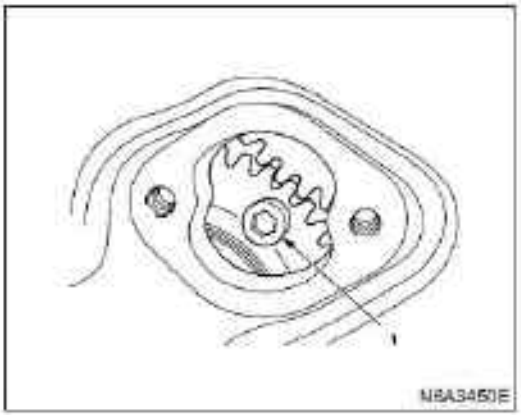
2. Inspection hole cover: shear gear

·Disassemble the inspection hole cover (2)

·Rotate the crankshaft pulley until the hole that was used to install the scissors gear (this hole extending from the inspection hole cover) can be seen again.

·Install the lock bolt in the hole of the shear gear

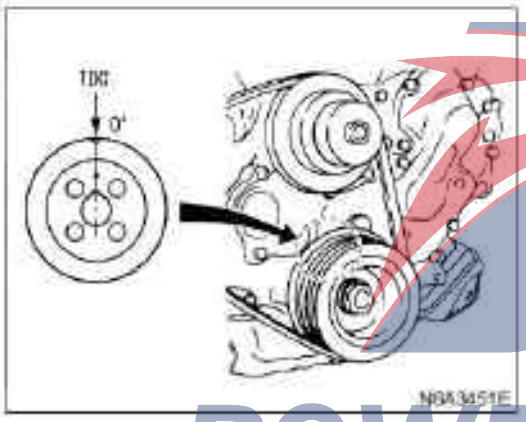




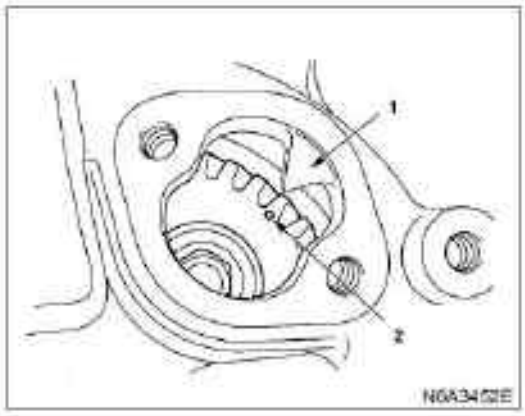
Legend

1. Lock bolt

·Rotate the crankshaft pulley to align the point on the pulley with the top dead center mark of the crankshaft.



·Check whether the fuel injection pump is aligned with the arrow marks. If the marks are not aligned, rotate the crankshaft pulley for another round.



Legend

1. Arrow mark

2. Mark point

Caution:

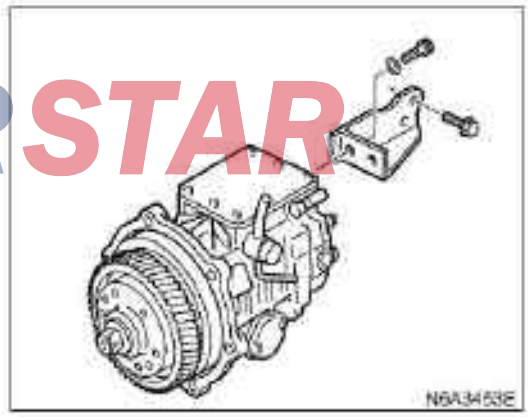
This crankshaft pulley and the shear gear lock bolt can be rotated to appropriate position when the shear gear and inspection hole cover are not installed.

3. Fuel injection pump bracket

Disassemble the fixing bolt of this bracket at the rear of the fuel injection pump

4. Inspection pump assembly

Loosen six bolts that fix the fuel injection pump assembly



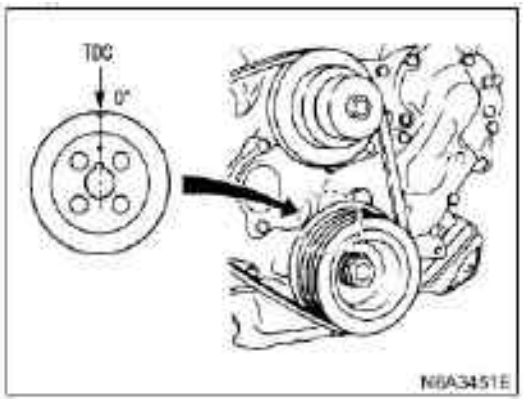
Caution:

Use a boat cap(or something similar) to block the outlet valve hole of the open fuel injection pump to prevent other substances from entering.

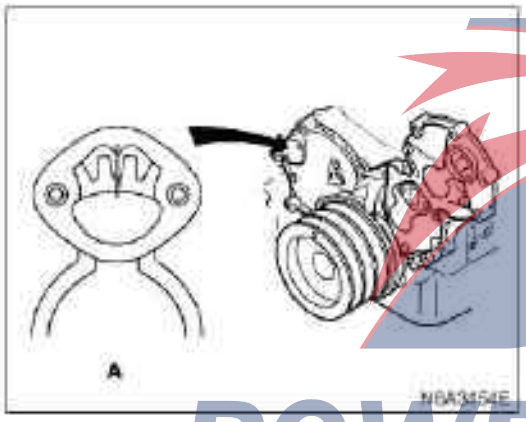
Install

1. Fuel injection pump assembly

·Check whether the pulley alignment mark is aligned with the top dead center mark of the crankshaft.



·Disassemble the inspection hole cover of the crankshaft gear and check whether the crankshaft gear marks are aligned.

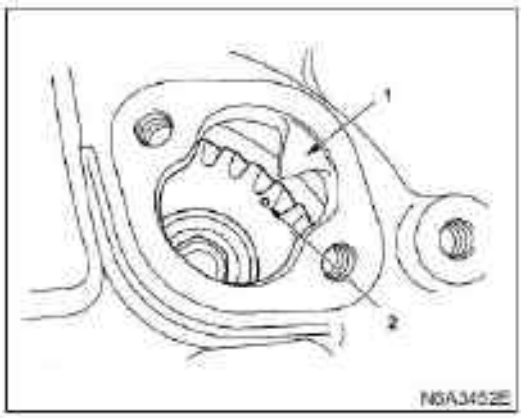


Legend

A. Crankshaft gear

·Install the O-ring

·Install the fuel injection pump assembly. During installation, make sure to align the mark of fuel injection pump gear with the arrow(observe through the inspection hole).



Legend

1. Arrow mark
2. Mark

·Tighten the fuel injection pump bolt to the specified torque

Tightening torque:

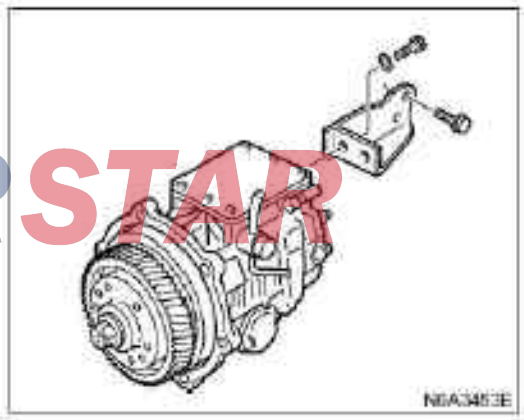
The pump bolt is 15 N•m (1.5 kg•m / 11 lb • ft)

2. Fuel injection pump bracket

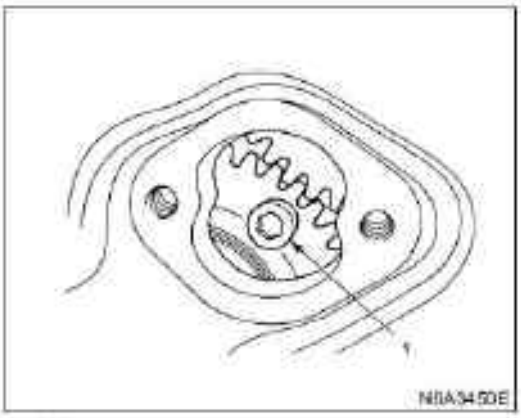
·Install the bracket of the fuel injection pump to the gear of the fuel injection pump, and tighten the bolt to the specified torque.

Tightening torque:

Bracket bolt is 25 N•m (2.5 kg•m / 18 lb • ft)



·Rotate the crankshaft pulley until the shear gear lock bolt can be seen through the inspection hole, and disassemble the bolt.



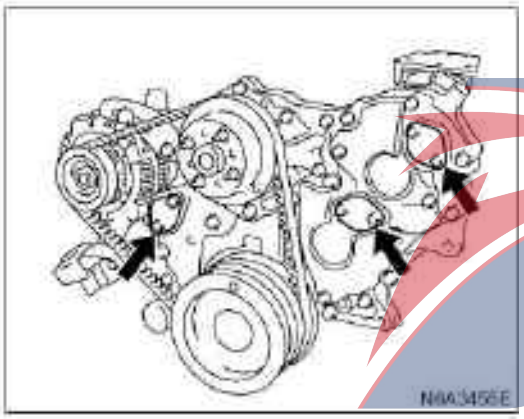
Legend

1. Lock bolt

---

3. Check the hole cover: scissors gear

4. Check the hole cover: fuel injection pump



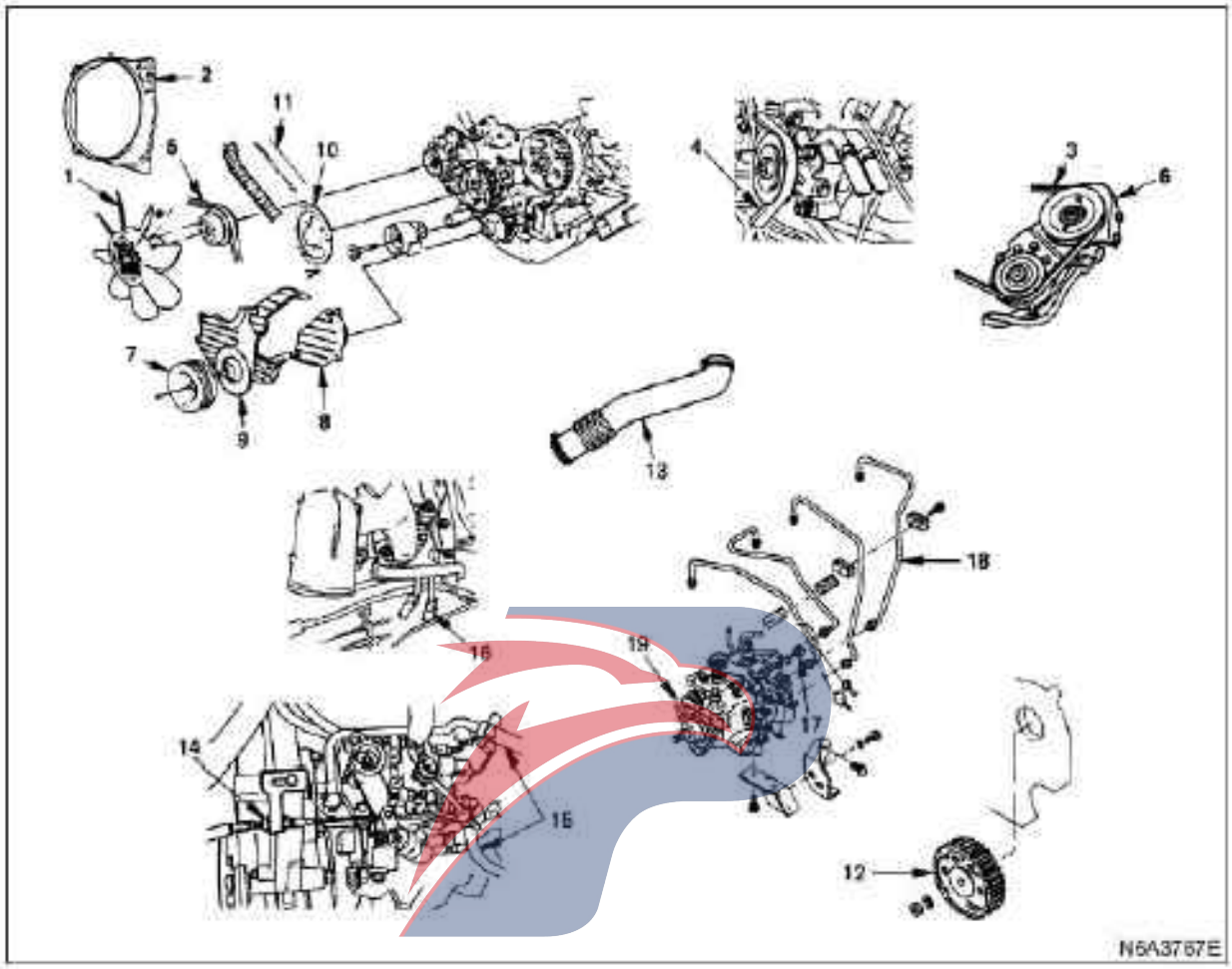
Caution:

Install inspection hole cover.

·Rotate the crankshaft pulley for 2 rounds, and confirm that the lock bolt has been disassembled(if the bolt were forgotten to be disassembled, this bolt would hit the guide hole of the inspection hole and the crankshaft pulley would not be able to rotate).

Fuel injection pump assembly (4JG2 belt drive type)

Parts



Legend

1. Cooling fan assembly
2. Fan wind scooper
3 . Drive belt of power steering pump
4. Drive belt of the A/C compressor
5. drive belt of the AC generator.
6. Power steering pump and bracket assembly
7. Belt pulley of crankshaft damper
8. Upper cover of the timing pulley
9. Lower cover of the timing pulley
10. Flange and camshaft belt pulley
11. Timing belt
12.Fuel pump timing pulley
13. Air intake pipe
14. Fuel pump control wire
15. Fuel hose
16. Water pipe of cold starting device
17. Fuel injection pump harness
18. High pressure oil pipe
19. Fuel pump assembly

Dismantling

Preparation:

·Disconnect the grounding wire of the storage battery

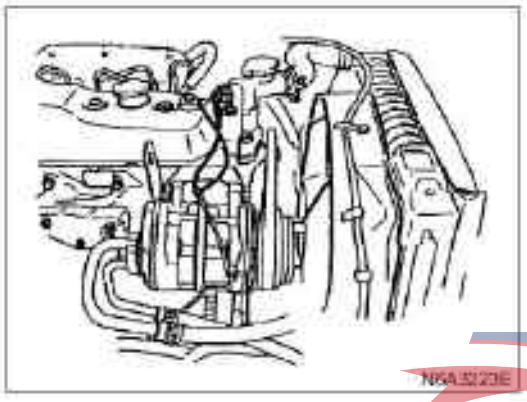
·Discharge coolant

1. Cooling fan assembly

·Disassemble the clamping nut, and disassemble the cooling fan assembly, the distal tube, and the fan pulley.

2. Fan wind scooper

·Disassemble the tank hose and fan shroud.

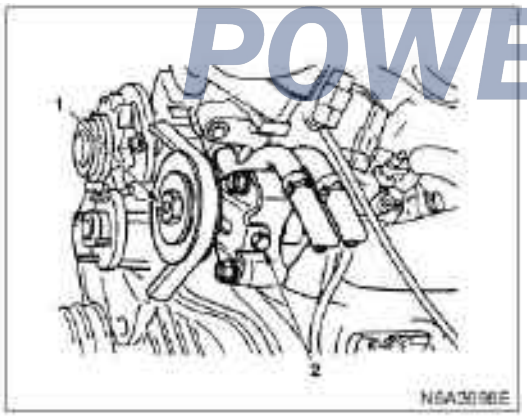


3. Power steering transmission belt(power steering type)

·Loosen the locking nut of idler of the power steering pump and adjusting bolt, and disassemble the transmission belt.

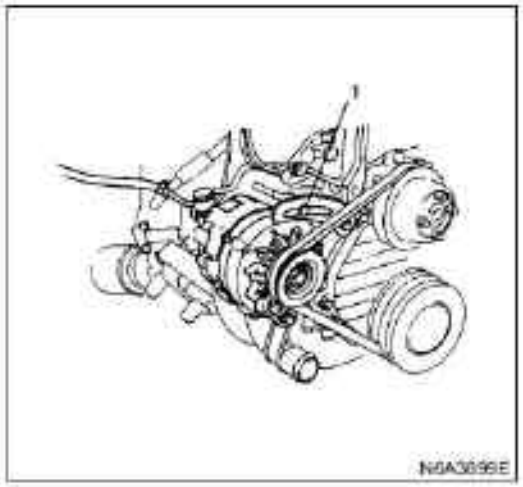
4. Drive belt (A/C mode) of the A/C compressor

·Loosen the locking nut(1)of idler of the A/C compressor, adjust the bolt(2), and disassemble the transmission belt.



5. drive belt of the AC generator.

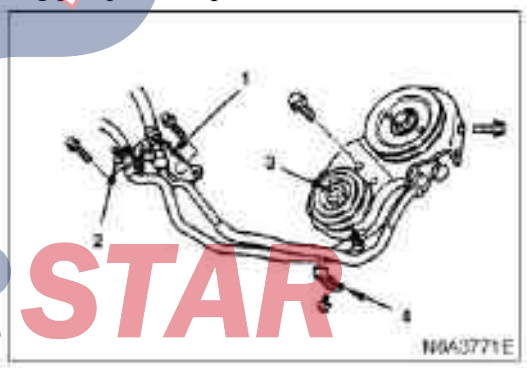
·Loosen the fastening bolt of the alternator(on the lower side), adjust the lock bolt(1) of the plate, and disassemble the drive bolt.



6. Power steering pump and bracket assembly (power steering mode)

·Loosen the power steering tube bracket(1) and oil pipe clamp(2).

·Disassemble the bracket assembly of the power steering pump and suspend it.

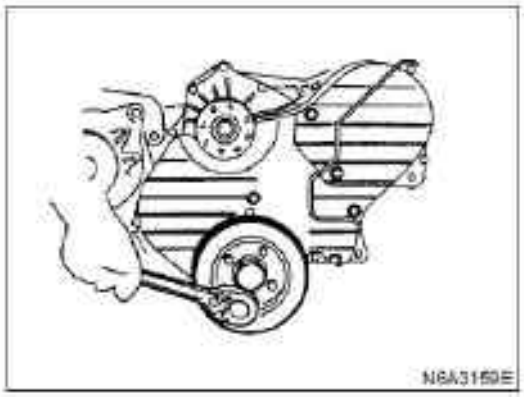


Legend

1. Support
2. Clamp
3. Locking nut
4. Bracket of the power steering pump

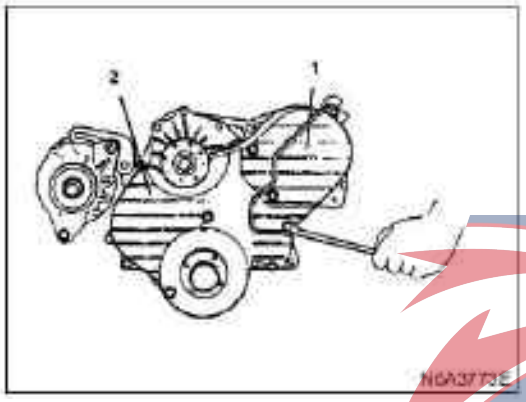
---

7. belt pulley of crankshaft damper

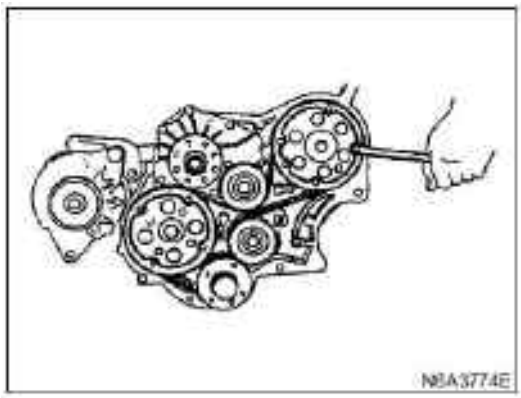


8. Upper cover (1) of timing belt pulley

9. Upper cover (2) of timing belt pulley



10. Flange and camshaft belt pulley

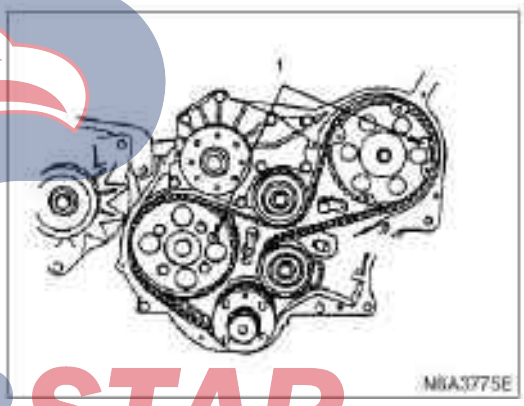


11. Timing belt

·Prepare a fixing bolt (M8 × 40, P = 1.25).

·Rotate the crankshaft timing pulley so that the mark on the pulley side aligns with the mark on the side of shell of the timing pulley in normal direction.

·Make sure that the camshaft pulley and the fixing bolt holes of the timing pulley of the fuel injection are aligned, and then install the fixing bolt, and tighten lightly.



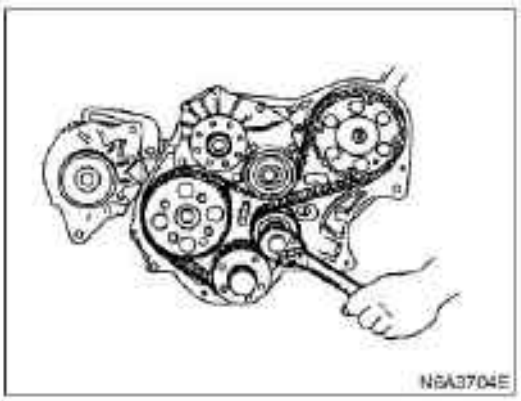
·The first cylinder piston should be at top dead center.

·If the fixing bolt holes are not yet aligned with each other(i.e., the fourth cylinder piston is at top dead center), then rotate the crankshaft for another round.

·Disassemble the tension pulley and the timing belt.

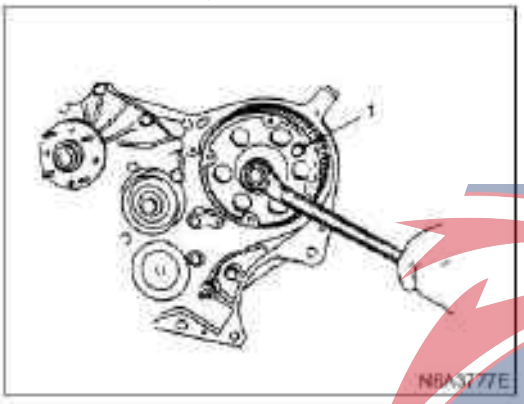
Warning:

·If rotate the crankshaft and camshaft while the timing belt is not installed well, the piston and the valve will interfere, therefore the crankshaft and camshaft should not be rotated.



12. Timing belt pulley of fuel ejection pump

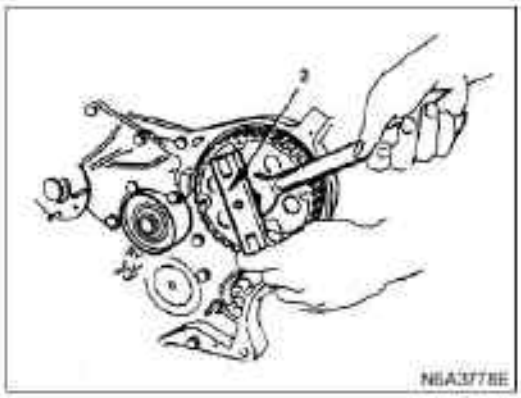
·Install the stop bolt(1) on the timing pulley to prevent it from rotating.



·Use the timing pulley puller to disassemble the timing pulley of the fuel injection pump.

Timing pulley puller:

·Disassemble the stop bolt



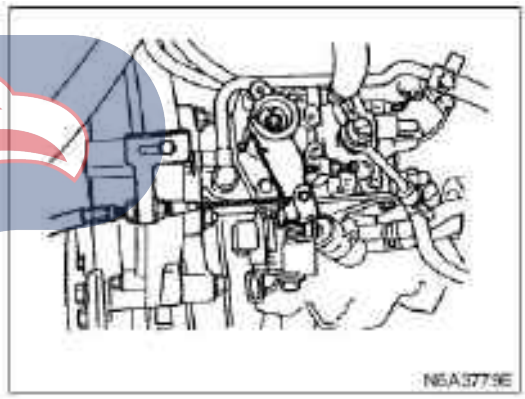
13. Air intake pipe

14. Fuel injection pump control cable

·Disassemble the bolt of the control wire bracket, and disassemble the control wire from the side of control lever.

15. Fuel hose

·Disconnect the fuel supply hose and return hose.



16. Water pipe of cold starting device

17. Fuel injection pump harness

18. High pressure oil pipe

19. Fuel injection pump assembly

·Disassemble the bolt of the pump bracket on the side of the engine

·Disassemble the adjustment lock bolt

·Disassemble the fixing bolt of the fuel injection pump and the fuel injection pump

Install

1. Fuel injection pump assembly

·Align the installation mark on the side of the timing pulley body with it is on the side of the fuel injection pump, and tighten them temporarily.

·After adjusting the fuel injection timing, re-tighten them.

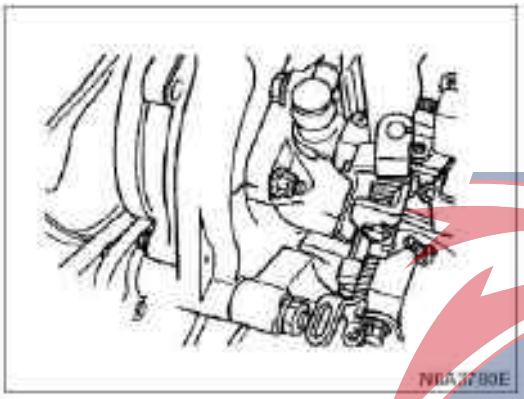
·Install the rear bracket on the cylinder, and tighten to the specified torque

Tightening torque:

The torque of bracket on the cylinder is 19 N•m (1.9 kg•m / 14 lb • ft

·Install the adjustment lock bolt, and tighten it lightly.

·After adjusting the fuel injection timing, re-tighten this bolt.



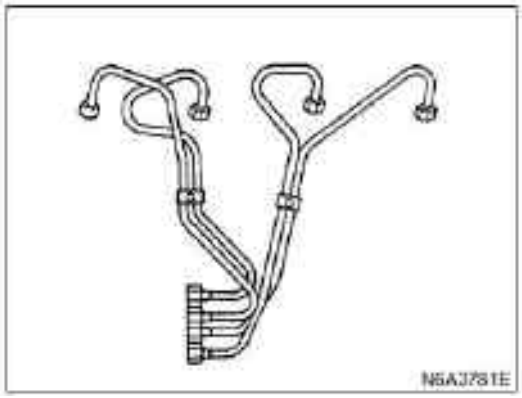
2. Injection tube

·Connect the tube on the pump side and on the fuel injector side, and tighten firmly.

· Install the oil pipe clamp in its original place.

Tightening torque:

29 N•m for sleeve nut (3.0 kg•m / 22 lb • ft)

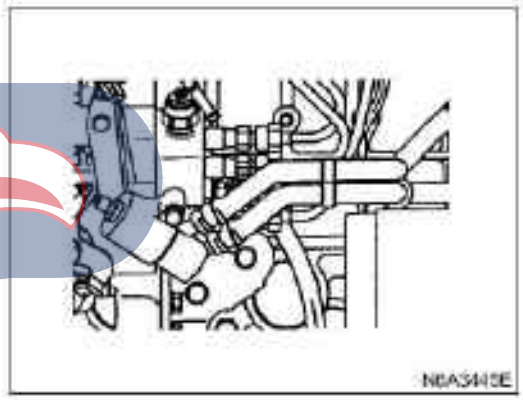


3. Injection pump harness

·Install the harness of the injection pump and connect to the switch.

4. Cold starter tube

·Connect the water pipe and tighten the pipe clamp firmly.



5. Fuel hose

·Connect fuel supply hose and fuel return hose

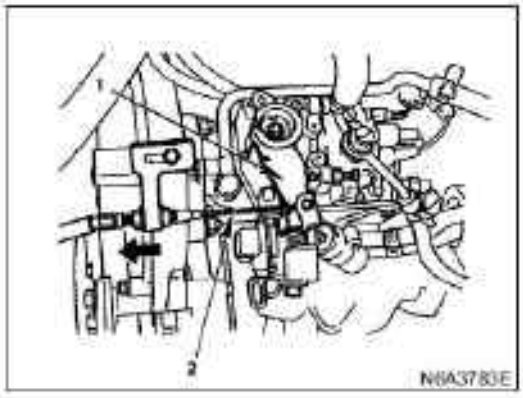
·Connect the return hose

6. Fuel injection pump control cable

1) Install the control wire to the control lever of the engine.

2) Keep the accelerator lever(1) at fully closed position, and stain the control wire(2) in the direction indicated by the arrow to eliminate loose cables.

3) Tighten the accelerator cable support bolt.



7. Air intake pipe

·Connect the air intake pipe and tighten the pipe clamp securely.

8. Timing belt pulley of fuel ejection pump

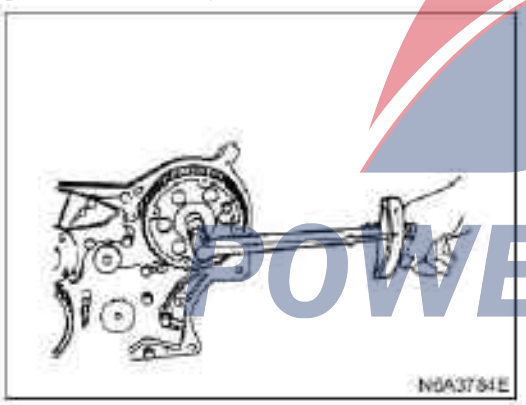
·Align the timing pulley with the key of the pump shaft.

·Install the stop bolt on the timing pulley which should prevent the timing pulley from rotating.

·Tighten the nut of the timing pulley to the specified torque.

Tightening torque:

The nut of the timing pulley of the fuel injection pump is 64 N·m (6.5kg·m/47 lb·ft)



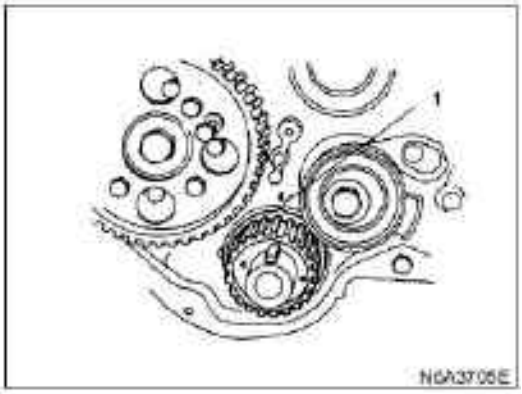
·Disassemble the stop bolt from the timing pulley of.the fuel injection.

9. Timing belt

·When disassemble the belt, make sure that the mark on the bolt-fixed camshaft, the mark on the pulley of the fuel injection pump, and the mark on the timing pulley of the crankshaft are all aligned with each other.

Caution:

·Please do not rotate the crankshaft, otherwise the piston and the valve will interfere with each other.

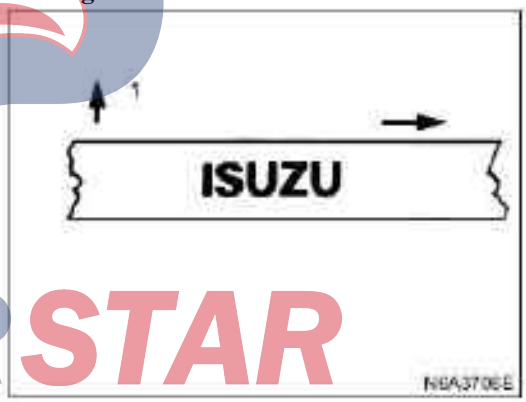


Legend

1. Positioning mark

Caution:

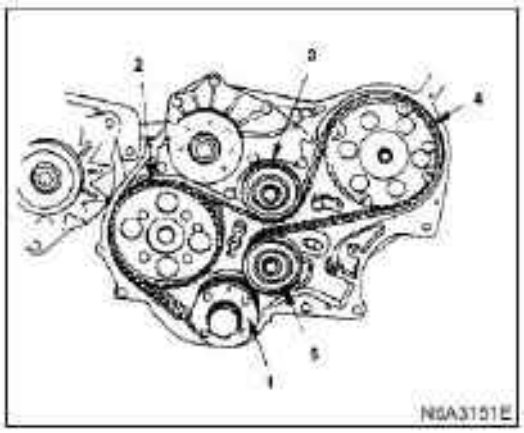
· In order to install to the exact place accuratly, please make sure that the mounting bolt should be in the direction that you might see the text on the belt during installation.



Legend

1. Cylinder head side

·Install a new timing belt on the pulley in following order: crankshaft timing pulley(1), camshaft timing pulley(2), idler pulley(3), fuel injection pump pulley(4), and tension pulley(5).



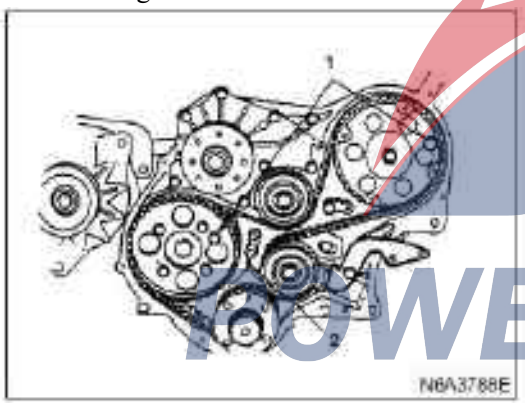
·Install the belt on the crankshaft timing pulley and hold it tight with one hand.

·Use the other hand to stretch the belt and wind it around each pulley.

·After winding the fuel injection pump pulley, start to install the tension pulley, but be careful not to let the belt slack

Caution:

·After completing winding the belt, please make sure that the positioning mark on the timing pulley of the crankshaft is aligned.



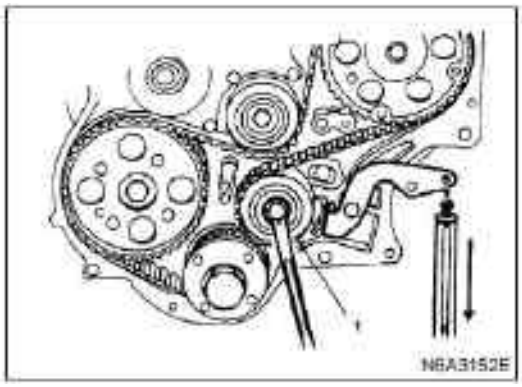
Legend

1. Lock bolt
2. Positioning mark

·If misaligned, please re-align this mark and re-wind the belt.

·Disassemble the tension adjuster, the mounting bolt of the lever and loosen the fulcrum bolt of the lever to some extent so that the lever can be moved.

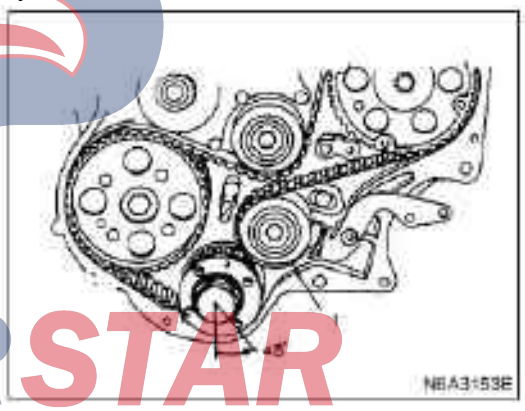
·Hang a spring balance on the end hole of the tension adjuster lever and pull down it with a force of 88 N. Loosen the mounting bolt of the tension pulley once, and then tighten this bolt again.



Legend

1. Tensioning wheel

·Rotate the crankshaft 45 degrees counterclockwise to change the relaxation of the belt on the tension pulley.



Legend

1. Tensioning wheel

·Hang a spring balance on the end hole of the tension adjuster lever again, and pull down it with a specified force. In this case, loosen the mounting bolt of the tension pulley to eliminate the relaxation of the belt, and re-tighten this bolt to the specified torque.

Belt tensioning force	N(kg/lb)
98—118(10—12/22—26)	

Tightening torque:

Bolts 76 N ·m(7.8 kg·m / 56 lb·ft)

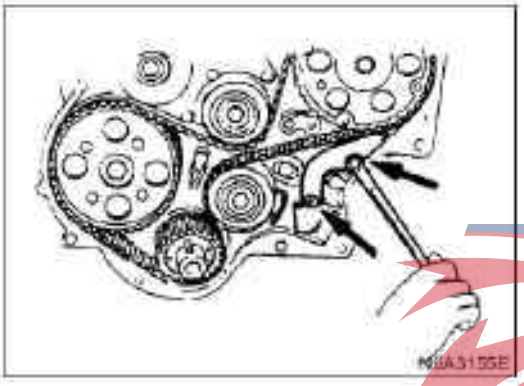
·Install tensioning lever

Caution:

·If the timing belt is replaced due to a caution light alarm, rotate the switch on the back of the meter in the opposite direction and turn this light off.

·Refer to Section 8 "Chassis Electrical System" for related information.

·Tighten the nut and bolt of the tensioning lever.



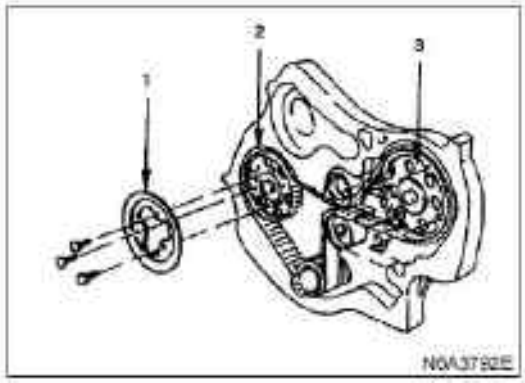
10. Flange and camshaft belt pulley

·Install the timing pulley flange(1) on the camshaft(2).

·Tighten the bolt of the timing pulley flange to the specified torque.

Tightening torque:

19 N•m (1.9 kg•m/14 lb•ft)



11. Timing belt under the hood

·Install the lower cover of the timing belt, and tighten the bolt to the specified torque.

Tightening torque:

Bolts 8 N ·m(0.8 kg·m / 69 lb·ft)

12. Upper cover of the timing belt

·Install the upper cover of the timing belt, and tighten the bolt to the specified torque.

Tightening torque:

Bolts 8 N ·m(0.8 kg·m / 69 lb·ft)

13. belt pulley of crankshaft damper

·Install the pulley of the crankshaft damper, and fasten the bolt to the specified torque.

Tightening torque:

Bolts 19 N ·m(1.9 kg·m / 14 lb·ft)

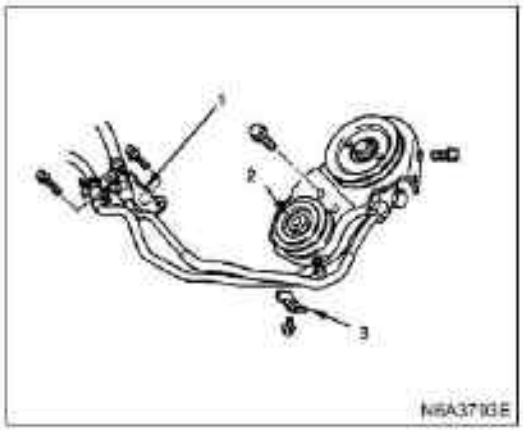
14. Power steering pump and bracket assembly (power steering mode)

· Install the oil pipe holder, oil pipe clamp, and tighten the bolt to the specified torque.

Tightening torque:

19 N•m for the bolt of the oil pipe bracket (1.9 kg•m / 14 lb • ft)

10 N•m for the bolt of the oil pipe clamp (1.0 kg•m / 7 lb • ft)



Legend

1. Oil pipe bracket
2. Lock bolt
3.Oil pipe clamp

· Install the power steering pump and the bracket assembly

Tightening torque:

·40 N•m for M10 Bolt (4.1 kg•m / 30 lb • ft)

·19 N•m for M8 Bolt (1.9 kg•m / 14 lb • ft)

·27 N•m for locking nut (2.8 kg•m / 20 lb • ft)

15. drive belt of the AC generator.

·Install the transmission belt of alternator and adjust the tension of the belt.

·Press the middle of the transmission belt with a force of 98 N (10 kg / 22 lb).

drive belt deflection	mm (in)
8(0.31)— 12(0.47)	

·Install the fixing bolt and tighten the bolt to the specified torque.

Tightening torque:

·40 N•m for the fixing bolt of generator (4.1 kg•m / 30 lb • ft)

·19 N•m for the fixing bolt of the adjustment plate (1.9 kg•m / 14 lb • ft)

16. Drive belt (A/C mode) of the A/C compressor

·Install the transmission belt of the A/C compressor and adjust the tension of the belt.

·Press the middle of the transmission belt with a force of 98 N (10 kg / 22 lb).

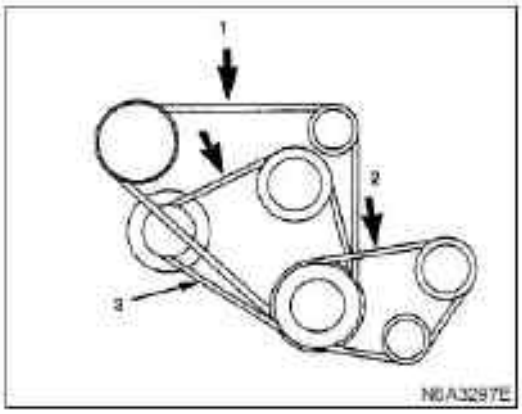
drive belt deflection	mm (in)
8(0.31)— 12(0.47)	

·Tighten the locking nut of the idler to the specified torque

Tightening torque:

27 N•m for the locking nut of the idler (2.8 kg•m / 20 lb • ft)

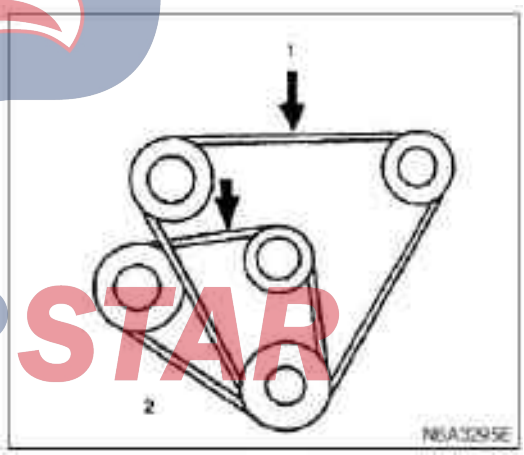
4JG2



Legend

1. Drive belt of the A/C compressor
2. Drive belt of power steering oil pump
3. Drive belt of AC generator and fan belt pulley

4JB1



Legend

1. Drive belt of the A/C compressor and drive belt of the power steering oil pump

---

2. Drive belt of AC generator and fan belt pulley
17. Transmission belt of the power steering pump (power steering type)

·Install the transmission belt of the power steering pump, and adjust the tension of the belt.

·Press the middle of the transmission belt with a force of 98 N (10 kgf / 22 lb).

drive belt deflection	mm (in)
8(0.31)— 12(0.47)	

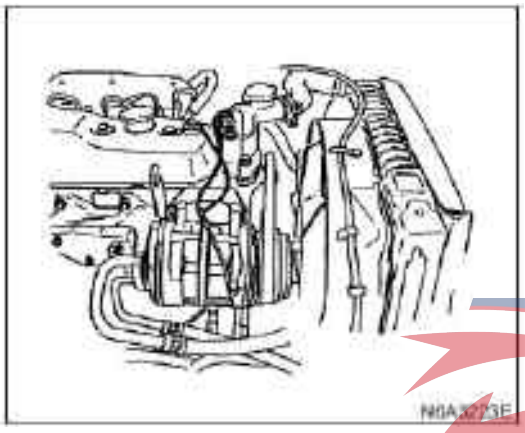
·Tighten the locking nut of the idler to the specified torque.

Tightening torque:

27 N ·m (2.8kg·m/20 lb·ft) Tighten the locking nut of the idler to 27 N•m (2.8 kg•m / 20 lb • ft)

18. Fan wind scooper

·Install the fan shroud and the water tank hose.



19. Cooling fan assembly

·Install the fan pulley, spacer block, and cooling fan assembly(in this order) on the water pump, and tighten to the specified torque.

Tightening torque:

Nut to 8 N•m (0.8 kg•m / 69 lb • ft)

·Connect the grounding wire of the storage battery

·Discharge coolant

·Start the engine and check the leakage of the coolant.

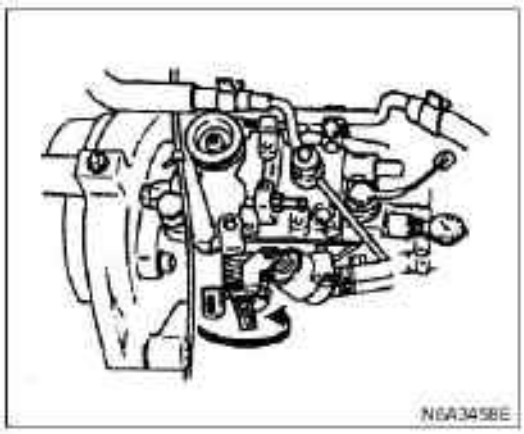
Fuel injection timing adjustment

· Set the first cylinder piston at the position of top dead center.

·Disassemble the blockage inside the dispenser-head of the fuel injection pump.

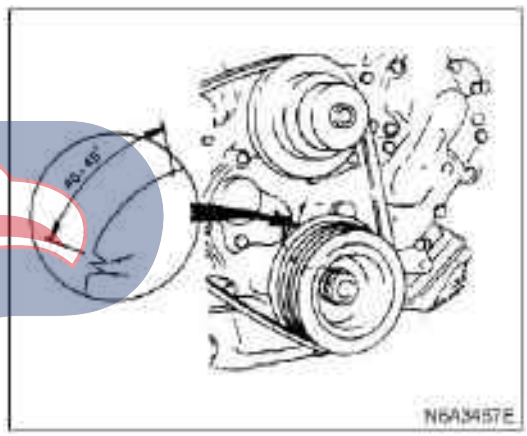
·Scrape the waxy cold starter mark with a screwdriver handle.

·Install a micrometer gauge and set the lift to 2mm.



Measuring equipment: 5-8840-0145-0

·Position the top dead center mark of the crankshaft damper pulley 45 degrees approximately before the pointer.

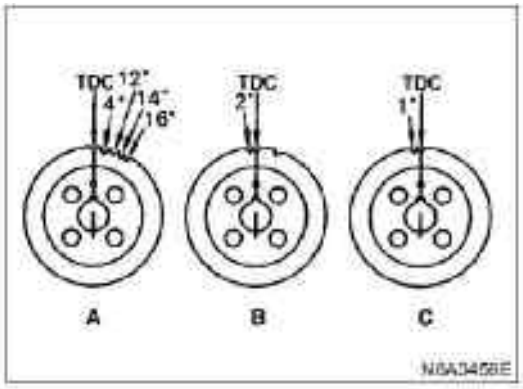


·Install the micrometer gauge at "0" position.

·Rotate the crankshaft clockwise slightly, then rotate the crankshaft slightly counterclockwise, to check whether this indicator is stable at position "0".

·Rotate the crankshaft in the normal direction, and read out the value of the test equipment as indicated below.

4JB1	14° before the top dead center
4JB1-TC	4° before the top dead center
4JG2 (belt drive type)	1° after the top dead center
4JG2 (gear drive type)	2° after the top dead center



Legend

A. 4JB1

B. 4JG2 G gear drive type

C. 4JG2 belt drive type

Micrometer gauge readings	mm (in)
Standard	0.5(0.0197)

·If the value read out is abnormal, loosen the fixing nut of the fuel injection pump and the adjusting bolt of the pump bracket, and adjust by changing the installation angle of the pump. When the value read out by the micrometer gauge is specified value, tighten the nut and the bolt to the specified value .

Tightening torque:

·The fixing nut of the pump is 24 N•m (2.4 kg•m / 17 lb • ft)

·The adjusting bolt is19 N•m (1.9 kg•m / 14 lb • ft)

·Disassemble the measuring device and tighten the blockage of the fuel dispenser-head to the specified torque.

Tightening torque:

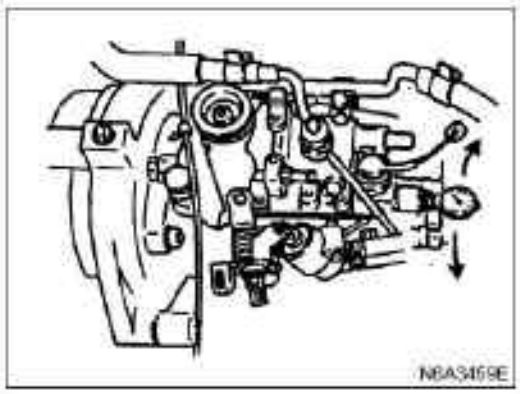
17 N •m (1.7 kg•m/12 lb•ft)

Caution:

·Make sure to use a new copper washer when installing the blockage of the fuel dispenser-head.

·Connect the high pressure oil pipe.

·Install the oil pipe clamp at the specified position.



Adjust idle speed

1. Pull up the handbrake and lock the vehicle drive wheel.

2. Set the gear of the gearbox to neutral position.

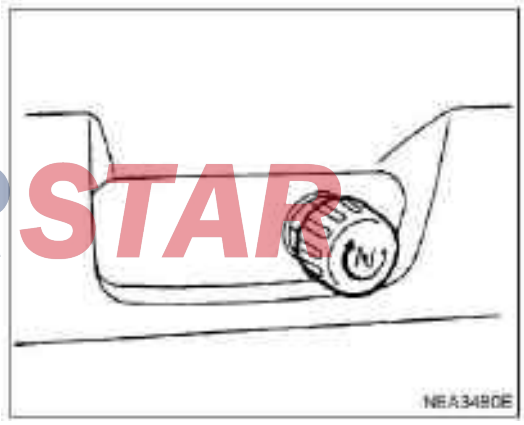
3. Start the engine and set the vehicle to idle status before the water temperature reaches 70 to 80 degrees Celsius (158 to 176 degrees Fahrenheit).

4. Turn the idle speed control off and disassemble the control wire from the control lever(fuel injection pump).

5. Install the engine tachometer

6. Check the rotational speed of the idling speed

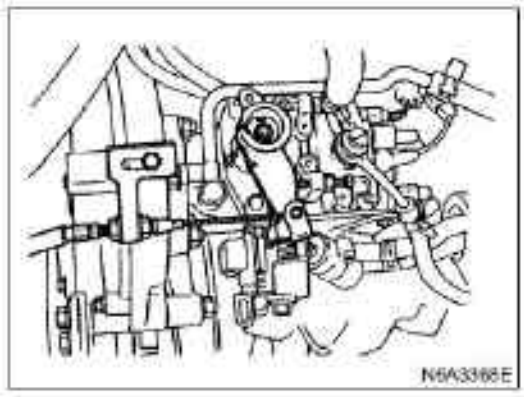
When the rotational speed at the idle speed exceeds the specified range, please adjust the speed to the specified range(r/min).



1) Loosen the locking nut of the setting bolt at the idle speed.

2) Loosen the setting bolt at the idle speed to set the rotational speed at the idle speed to the specified value.

3) Tighten the locking nut to lock this mounting bolt.
4) Check the tension of the control wire and eliminate any slack part as needed.



Fuel injection pump data

Test conditions

Test name	Condition		
Engine type	4JB1 (gear drive type)	4JG2 (Belt Drive Type)(for '91/542B) meets the Euro II emission standards	4JB1 (Gear Drive Type)(Applicable to '91/542A) meets the Euro I emission standards
Fuel injector			
ZEXEL part No.	105780-0000	105780-0000	
No. of Bosch parts	DN12SD12T	DN12SD12	
Fuel injector body			
ZEXEL part No.	105780-2080	105780-2080	
No. of Bosch parts	EF8511/9	EF8511/9	
Injection oil pressure of fuel injector MPa (kg/ cm2/ psi)	14.7 (150/ 2,133)		13.0 (133 / 1,891)
High pressure oil pipe diameter mm(in)			
Inner diameter of oil pipe	2 (0.079)		
Outer diameter of oil pipe	6 (0.236)		
Length	840 (33.1)		450 (17.7)
Fuel supply pressure kPa (kg /cm2/psi)	20 (0.2 / 2.84)		
Test fuel	Society of Automotive Engineers Standard of testing diesel (Society of Automotive Engineers 967D) ISO Standard Test Diesel Oil (ISO 4113)		
Test diesel oil temperature. °C(°F)	48 - 52 (118-126)		
ID number	104746-1230 104746-1240 104746-1250 104746-1260 104746-1270 104746-1280 104746-1290 104746-1370	196000-1 042	104742-1451 104742-1461 104742-1471 104742-1480 104742-1490

Caution:

′ 91/542A; Meets the Euro I emission standards

′ 91/542B; Meets the Euro II emission standards

Test name	Condition
Engine type	4JB1-TC
Fuel injector	
ZEXEL part No.	105780-0060
No. of Bosch parts	
Fuel injector body	
ZEXEL part No.	105780-2150
No. of Bosch parts	—
Injection oil pressure of fuel injector	13.0 (133 / 1,891)
MPa (kg/ cm2/ psi)	
High pressure oil pipe diameter mm(in)	
Inner diameter of oil pipe	2 (0.079)
Outer diameter of oil pipe	6 (0.236)
Length	450 (17.7)
Fuel supply pressure kPa (kg /cm2/psi)	20 (0.2 / 2.84)
Test fuel	American Automobile Association Standard of testing diesel (American Automobile Association 967D) ISO Standard Test Diesel Oil (ISO 4113)
Test diesel oil temperature. °C(°F)	48 — 52 (118 — 126)
ID number	1 04746-6601
	1 04766-6620

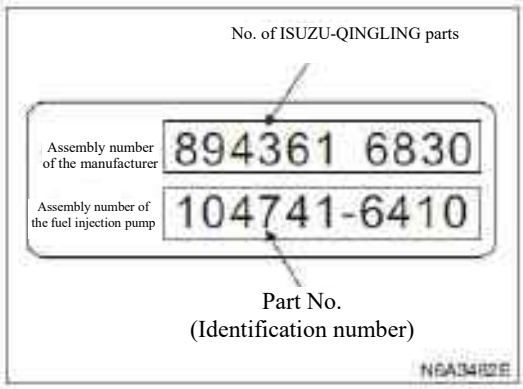
Caution:

'91/542A; Meets the Euro I emission standards

'91/542B; Meets the Euro II emission standards

Nameplate and identification number

Use the following data of the identification number of the fuel injection pump to adjust the injection quantity.



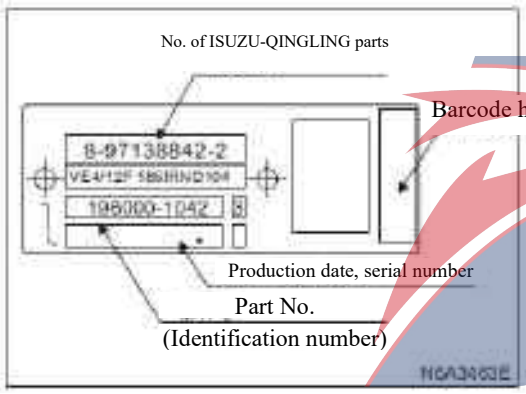


Chart of fuel injection quantity and speed regulator performance

Speed regulator performance chart

Engine; 4JB1

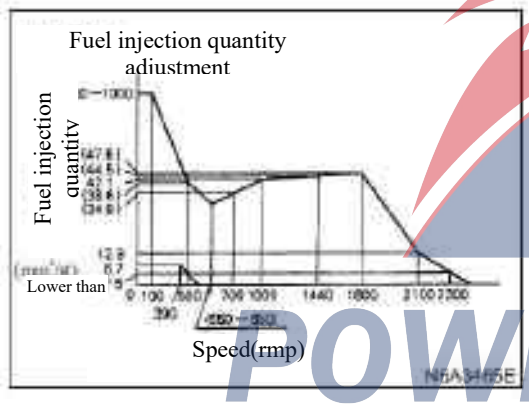
Fuel injection pump assembly No.;

8943616830(104741-6410)

8943616850(104741-6430)

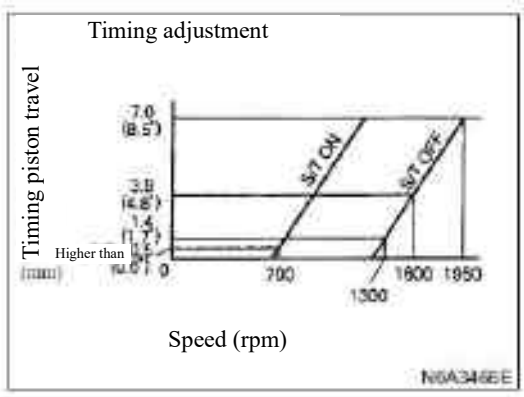
Specification of regulating the fuel injection quantity

The rotational speed of the oil pump (r/min)	Average fuel injection quantity (mm^3/st)	Amplitude of fluctuation (mm3/ st)	Engine oil temperature (℃)	Remarks
500	(38.6)	—	48±2	
700	34.9±2.5	—	50±2	
1000	42.1±1.0	4.0	50±2	Standard
1450	44.5±2.5	—	50±2	
1800	47.6±3.0	—	60±2	
2100	12.9±3.0	4.0	52±2	
390	6.7±3.0	2.0	48±2	
100	60 -100	—	48±2	



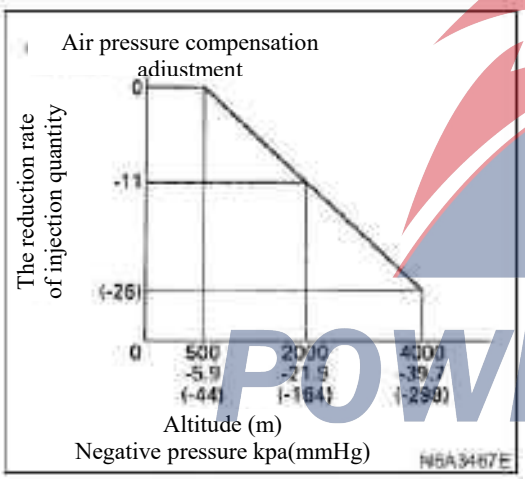
The automatic advance of oil supply

Pump speed (r/min)	The piston stroke of the automatic advance of oil supply (mm)		air pressure of pump (kPa (kg/ cm^2))		remarks
	Solenoid valve timing device		Solenoid valve timing device		
	On	Closure	On	Closure	
700	More than 0.5	—	—	—	
1300	—	1.4±0.4	—	—	
1600	—	3.9±2	—	490±20 (5.0±0.2)	Standard
1950	—	7.0 + 0.4-0.3	—	—	



Regulation specification for non-hydraulic compensator

Pump speed	Altitude	Air pressure difference	Decrement	Reduction rate
(r/min)	(m)	(kPa (mmHg))	(mm^3/st)	(%)
1000	0	0	0	0
	(500)	-5.9±3.3 (-44±3)	Expansion point	Expansion point
	2000	-21.9 (-164)	-4.6±1	-11±3

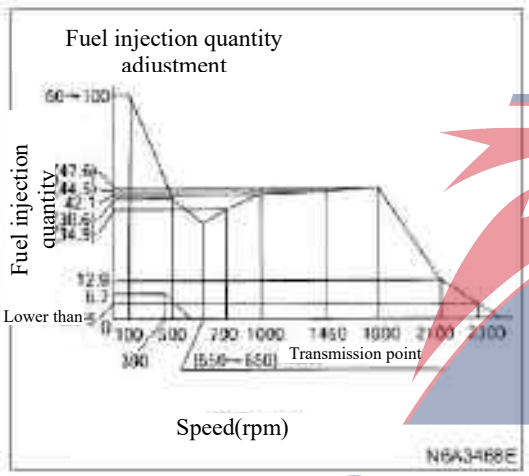


Engine: 4JB1

Fuel injection pump identification number; 104746-1230, 1240, 1250, 1260, 1280, 1290, 1370

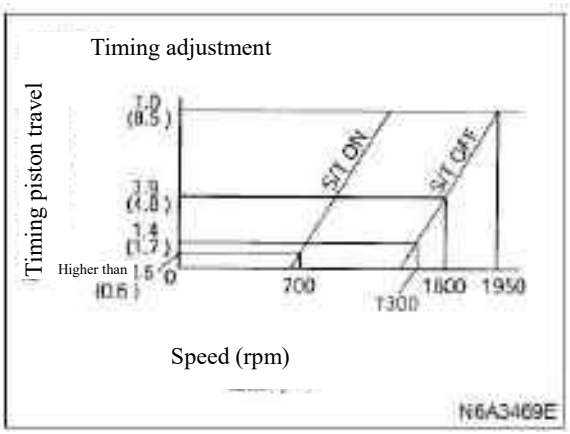
Specification of regulating the fuel injection quantity

Pump speed (r/min)	Average fuel injection quantity (mm^3/st)	Amplitude of fluctuation (mm^3/ st)	Engine oil temperature (℃)	Remarks
500	(38.6)	—	48±2	
700	34.9±2.5	—	50±2	
1000	42.1±1.0	4.0	50±2	
1450	44.5±2.5	—	50±2	Standard
1800	47.6±3.0	—	60±2	
2100	12.9±3.0	4.0	52±2	
390	6.7±3.0	2.0	48±2	
100	60 -100	—	48±2	



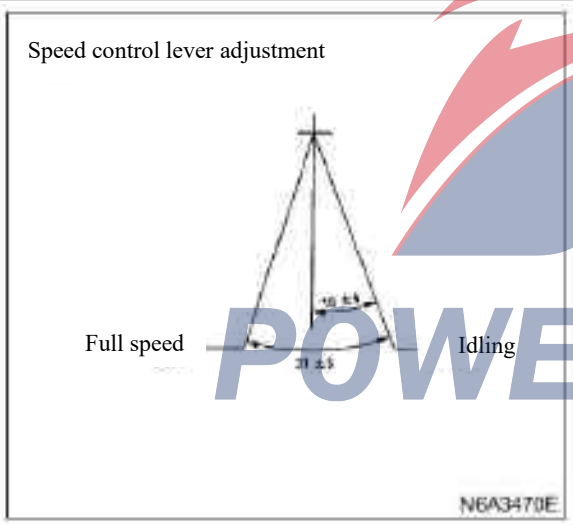
Adjustment specification for timing device and pump housing pressure

Pump speed (r/min)	Timing device piston stroke (mm)		Air pressure of pump (MPa (kg/ cm^2))		remarks
	Solenoid valve timing device		Solenoid valve timing device		
	On	Closure	On	Closure	
700	More than 0.5	—	—	—	
1300	—	1.4±0.4	—	—	
1600	—	3.9±2	—	490±20 (5.0±0.2)	Standard
1950	—	7.0	—	—	



Regulation specification for non-hydraulic compensator

Pump speed	Altitude	Air pressure difference	Decrement	Reduction rate
(r/min)	(m)	(kPa (mmHg))	(mm^3/st)	(%)
1000	0	0	0	0
	(500)	-5.9±3.3 (-44±3)	Expansion point	Expansion point
	2000	-21.9 (-164)	-4.6±1	-11±3

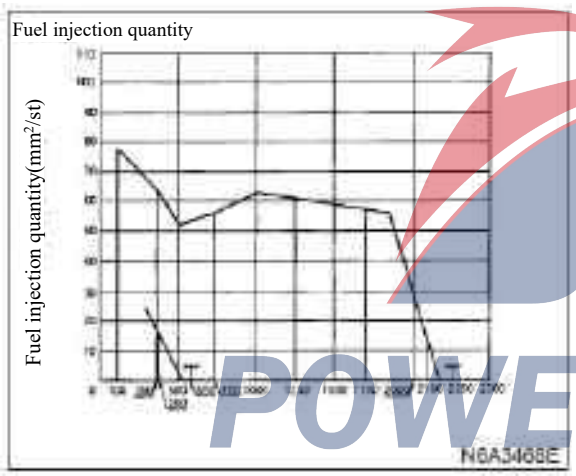


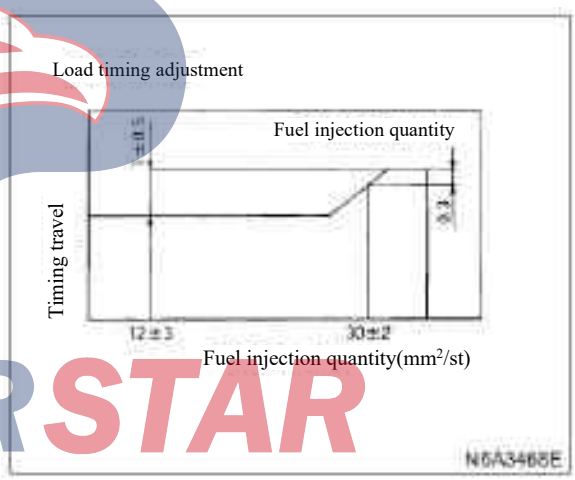
Engine; 4JG2 (for '91/542B)(belt drive type)

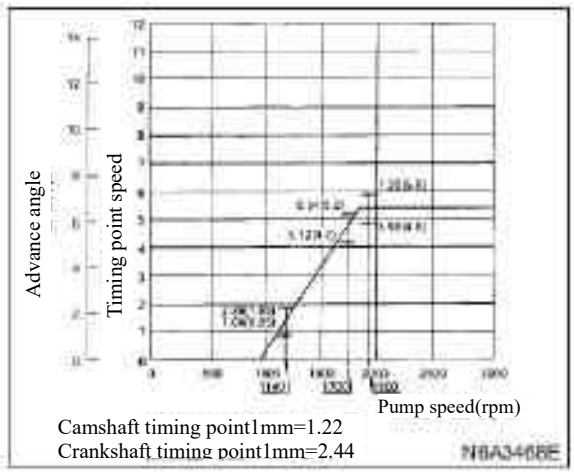
Fuel injection pump assembly No.; 897138-8422 (196000-1042)

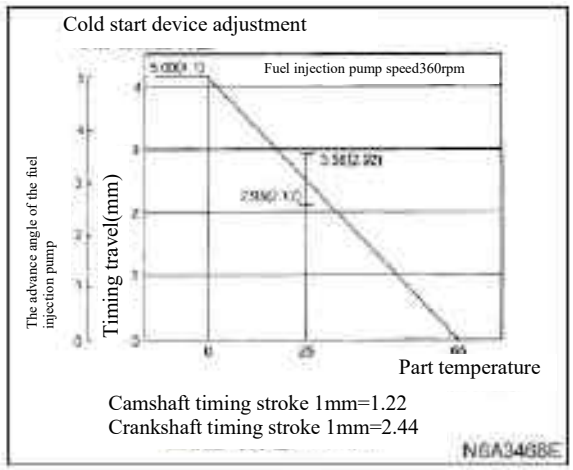
Fuel injection quantity adjusting specification

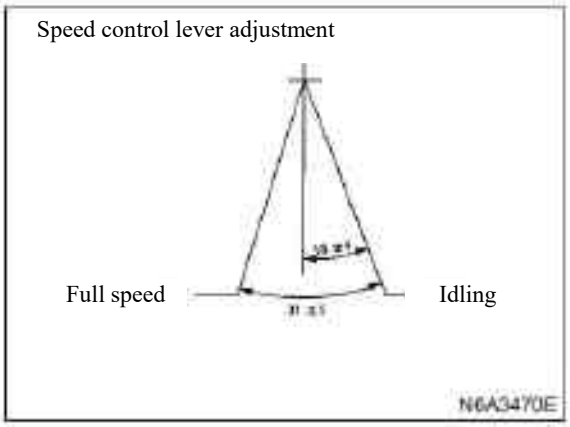
Pump speed (r/min)	Average fuel injection quantity (mm^3/st)	Amplitude of fluctuation (mm^3/ st)	Remarks
100	78±12	—	
350	64±6.0	—	
500	52±3.0	—	
720	55.9±3.4	—	
1000	62.6±1.0	4.0	
1250	60.9±3.5	—	
1700	574±3.5	4.0	
2100	13±5.0	—	
2250	Lower than 5.0	—	
360	15.9±3.0	2.5	
550	Lower than 3.0	—	





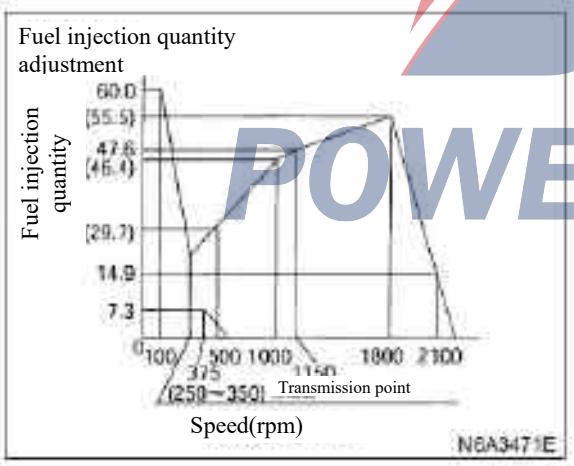






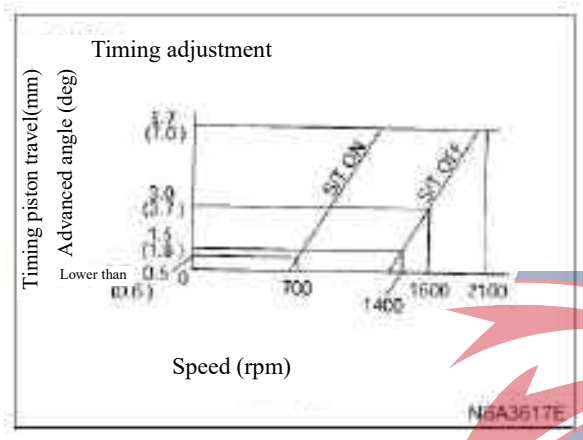
Engine; 4JB1 (For c91/542A)(gear drive type)
Fuel injection pump identification number; 104742-1451, 1461, 1471
Fuel injection quantity adjusting specification

Pump speed (r/min)	Average fuel injection quantity (mm^3/st)	Amplitude of fluctuation (mm^3/ st)	Engine oil temperature (℃)	Remarks
500	(29.7±4.5)	—	48±2	
1000	(46.4±3.5)	—	50±2	
1150	47.6±1.0	3.5	50±2	Standard
1800	(55.5 $^{+0.4}_{-4.0}$)	4.0	50±2	
2100	14.9±3.0	2.0	52±2	Standard
375	7.3±2.0	—	48±2	Standard



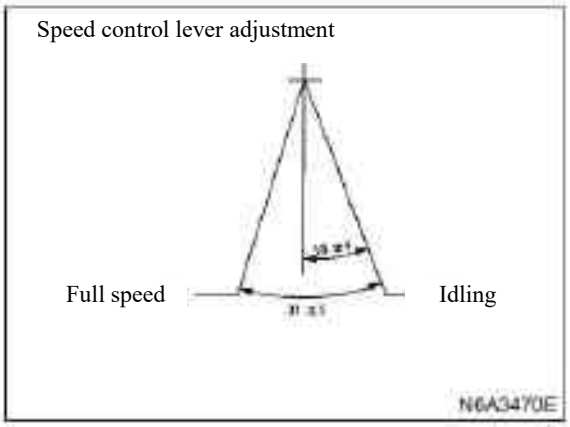
Adjustment specification for timing device and pump housing pressure

Pump speed (r/min)	Timing device piston stroke (mm)		Air pressure of pump (MPa (kg/cm^2))		remarks
	Solenoid valve timing device		Solenoid valve timing device		
	On	Closure	On	Closure	
700	More than 0.5	—	—	—	
1300	—	1.5±0.4	—	—	
1600	—	3.0±0.2	—	0.53±0.02 (5.4±0.2)	Standard
1950	—	[illegible]	—	—	



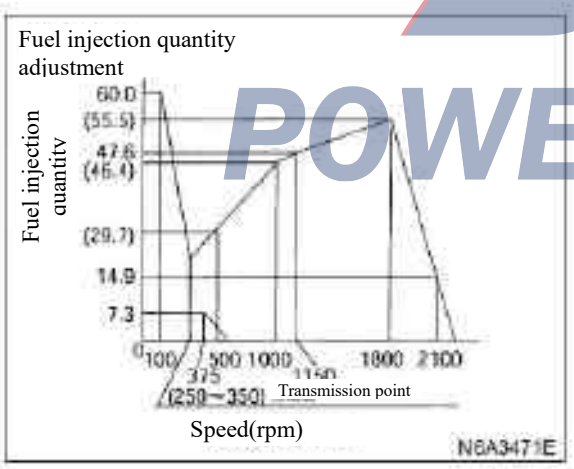
Regulation specification for non-hydraulic compensator

Pump speed	Altitude	Air pressure difference	Decrement	Reduction rate
(r/min)	(m)	(kPa (mmHg))	(mm^3/st)	(%)
1150	0	0	0	0
	(500)	-5.9±3.3 (-44±3)	Expansion point	Expansion point
	2000	-21.9 (-164)	-4.6±1	-11±3



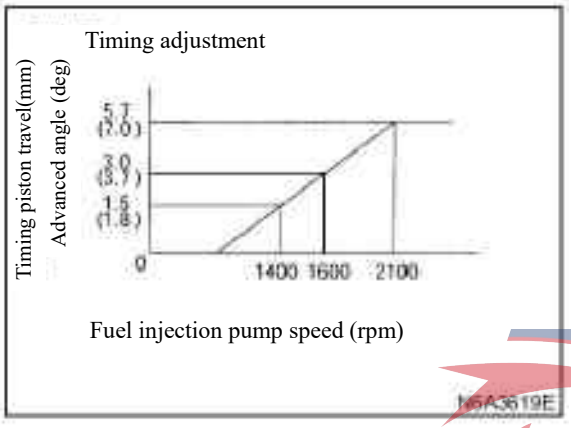
Engine; 4JB1(For '91/542A)(gear drive type)
Fuel injection pump identification number; 104742-1480,1490
Fuel injection quantity adjusting specification

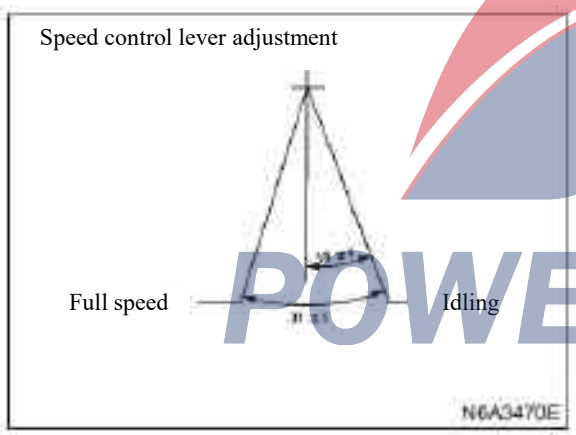
Pump speed (r/min)	Average fuel injection quantity (mm^3/st)	Amplitude of fluctuation (mm^3/ st)	Engine oil temperature (℃)	Remarks
500	(29.7±4.5)	—	48±2	
1000	(46.4±3.5)	—	50±2	
1150	47.6±1.0	3.5	50±2	Standard
1800	(55.5 $^{+0.4}_{-4.0}$)		50±2	
2100	14.9±3.0	4.0	52±2	Standard
375	7.3±2.0	2.0	48±2	Standard
100	(60-100)	—	48±2	Standard



Adjustment specification for timing device and pump housing pressure

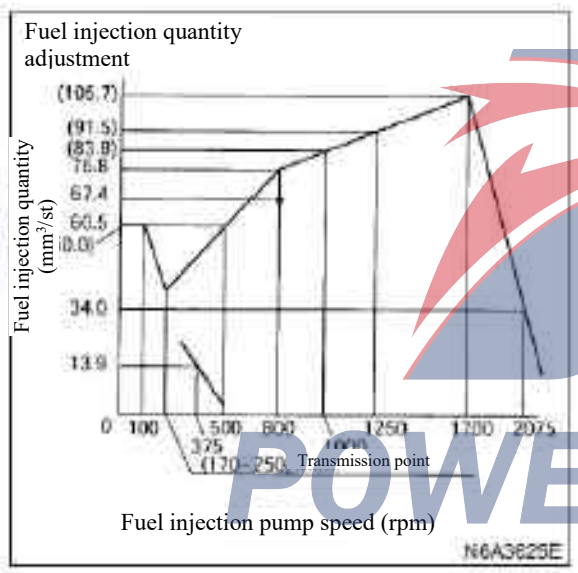
Pump speed (r/min)	Timing device piston stroke (mm)	Air pressure of pump (MPa (kg/ cm^2))	remarks
1400	1.5±0.4	—	
1600	3.0±0.2	0.53±0.02 (5.4±0.2)	Standard
2100	$5.7^{+0.4}_{-0.3}$	—	





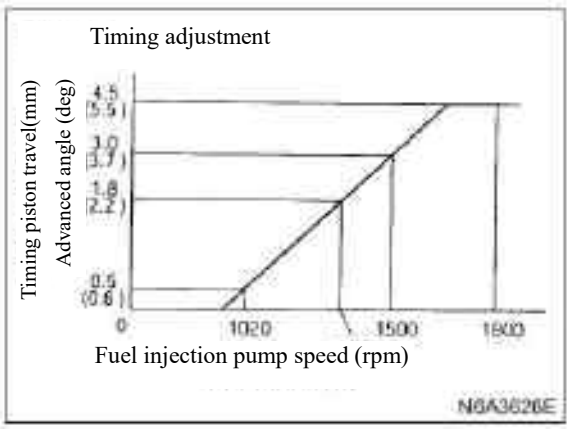
Engine; 4JB1-TC
Fuel injection pump identification number; 104746-6601
Specification of regulating the fuel injection quantity

Pump speed (r/min)	Average fuel injection quantity (mm^3/st)	Amplitude of fluctuation (mm^3/ st)	Engine oil temperature (℃)	Remarks
500	60.5±1.0	5.0	0	Standard
800	67.4±1.0	5.5	52.0 (0.531)	Standard
800	76.8±1.0	6.0	80.0 (0.821)	Standard
1000	(83.8±6.5)		80.0 (0.821)	
1250	(91 .5±6.5)		80.0 (0.821)	
1700	(105.7±6.5)		80.0 (0.821)	Standard
2075	34.0±3.0	7.0	80.0 (0.821)	Standard
375	13.9±2.0	2.0	0	
100	60 $+_{40-0}$		0	



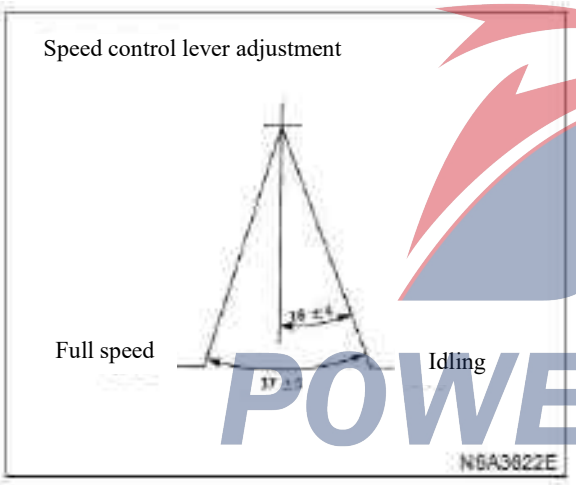
Adjustment specification for timing device and pump housing pressure

Pump speed	Timing device piston stroke	Air pressure of pump	Pushing-in pressure	Remarks
(r/min)	(mm)	(Mpa (kg/ cm^2))	(kpa (kg/ cm^2))	
1020	Less than 0.5		80.0 (0.82)	
1350	1.8±0.2	471±29 (4.8±0.3)	80.0 (0.82)	Standard
1500	(3.0±0.4)		80.0 (0.82)	
1800	4.5 $^{+0.4}_{-0.3}$		80.0 (0.82)	



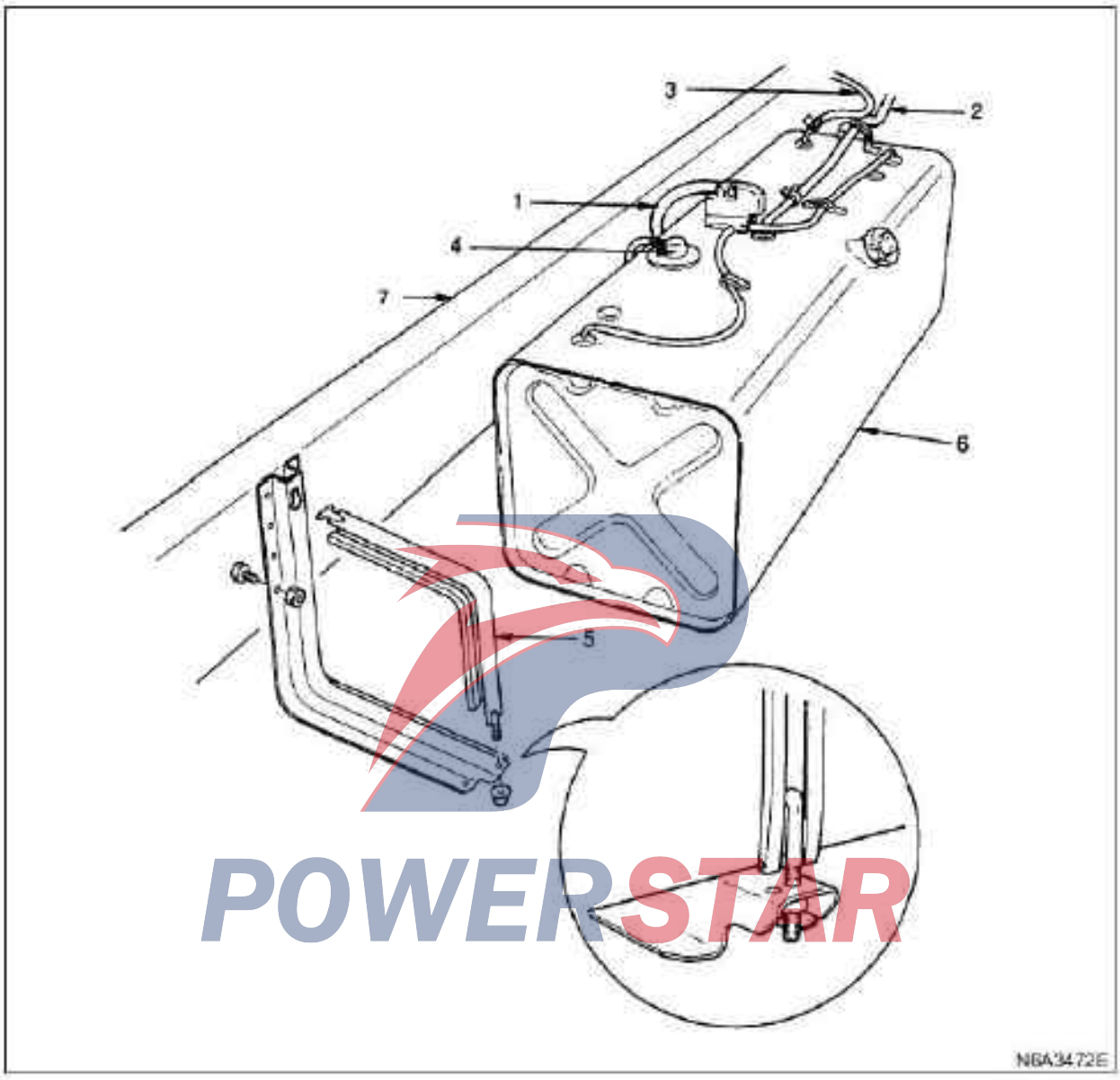
Voltmeter adjustment

Pump speed (r/min)	Voltage output (V)	Average fuel injection quantity (mm^3/st)	Pushing-in pressure (kPa(kg/cm^2))	Remarks
1080	3.56±0.03	27.5±2.0	0	Standard
375	(0.93±0.45)	13.9±2.0	0	Standard



Fuel tank

Parts



Legend

1. Fuel evaporation hose
2. Fuel supply hose
3. Fuel return hose
4. fuel sensor joint
5. Strap
6. Fuel tank
7. Frame

Dismantling

Preparation:

·Disconnect the grounding wire of the storage battery

·Loosen the cover of the fuel filler

·Discharge fuel from the drain plug

·After draining the fuel, tighten the drain plug to the specified torque.

Tightening torque:

1. Fuel evaporation hose

2. Fuel supply hose

3. Fuel return hose

·Block the fuel hose to prevent fuel splashes and tie the blocked tube to the frame.

4. Fuel connector of the sensor

·Disassemble theconnector of the fuel sensor.

5. Strap

·Disassemble the nut of the fixing hoop of the fuel tank, and disassemble the end of the hoop on the frame side.

6. Fuel tank

·Pull the fuel tank out.

Caution:

When it is not possible to disassemble the fuel tank, move away the bracket of the fuel tank and disassemble the fuel tank downwards.

Installation

1. Fuel oil tank

Caution:

When moving away the tank bracket to disassemble the fuel tank, install the bracket to the frame and tighten to the specified torque.

Tightening torque: 55 N·m(5.6 kg·m/41 lb·ft)

When installing the fuel tank on the bracket, make sure to place tank liner on the bracket.

2. Strap

·Tighten the hoop to the specified torque.

Tightening torque: 12 N·m(1.2 kg·m/104 lb·ft)

3. fuel sensor joint

·Please connect the fuel sensor connector well.

4. Fuel return hose

5. Fuel supply hose

·25mm(0.98 in).

Install the oil return hose to the oil pipe at a depth larger than 25 mm (0.98 in).

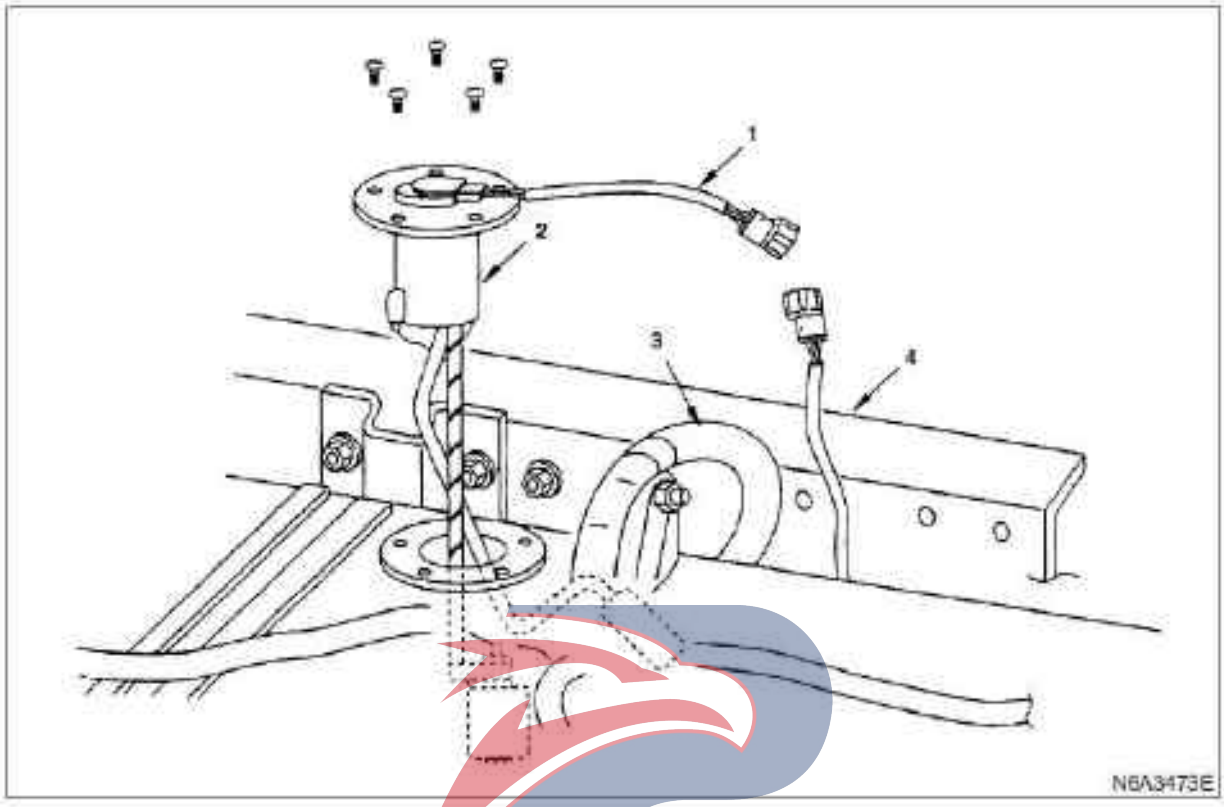
6. Fuel evaporation hose.

·Fill the fuel to the oil tank.

·Connect the grounding wire of the storage battery.

Fuel sensor

Parts



Legend

1. fuel sensor joint
2. Fuel sensor
3. Fuel evaporation hose
4. Frame

Preparation for disassembly:

·Disconnect the grounding wire of the storage battery

1. fuel sensor joint

·Disconnect the fuel sensor connector from the fuel sensor side.

2. Fuel sensor

· Disassemble the fixing screw of the fuel sensor and the fuel sensor.

Caution:

·After removing the fuel sensor, cover the fuel tank opening with cloth or plastic paper to prevent other debris from entering.

Install

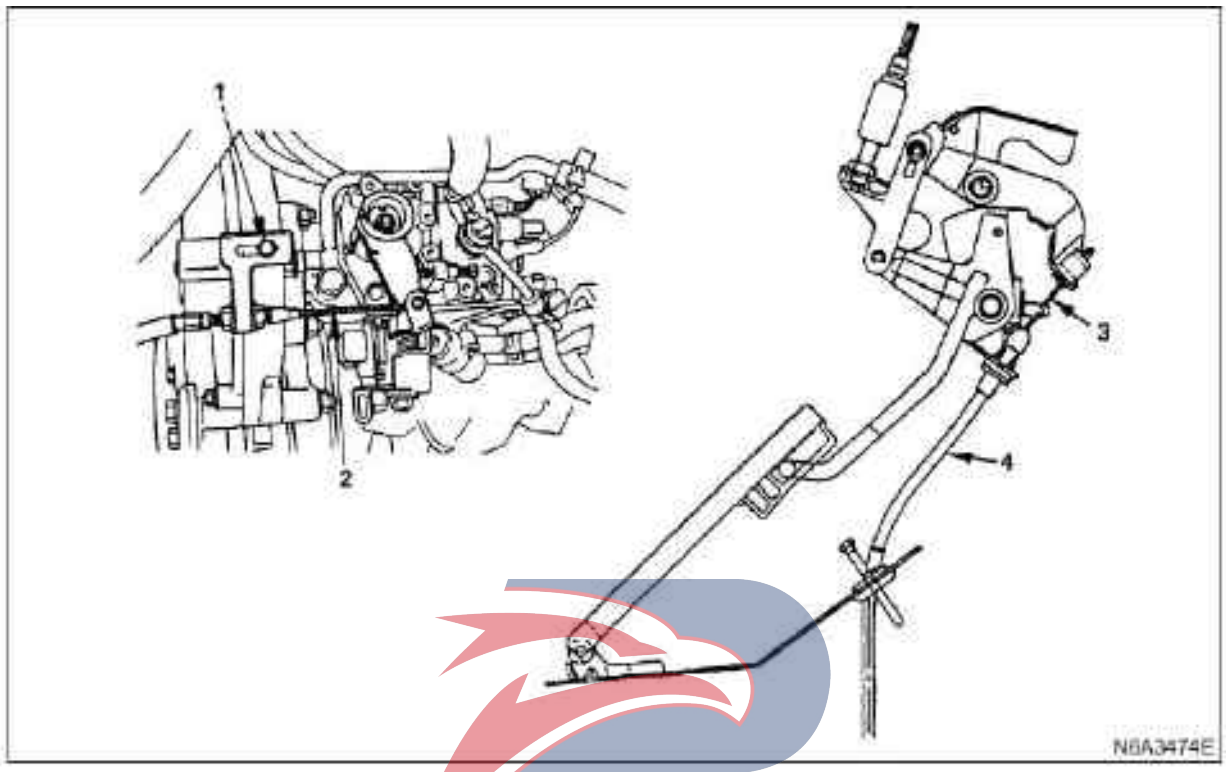
1. Fuel sensor

2. fuel sensor joint

·Connect the wire connector to the fuel sensor connector.

Accelerator pedal control conductor

Parts



Legend

1. Adjusting nut
2. accelerator pedal control lead (fuel injection pump side)
3. accelerator pedal control lead (accelerator pedal side)
4. Accelerator pedal control cable

Dismantling

1. Adjusting nut

·Loosen the adjusting nut of the wire bracket mounted on the intake manifold.

2. accelerator pedal control lead (fuel injection pump side)

·Disassemble the control wire from the control lever of the fuel injection pump.

3. accelerator pedal control lead (accelerator pedal side)

· Disassemble the control wire of the accelerator pedal from the accelerator pedal.

4. Accelerator pedal control cable

· Disassemble the cable clamp from the intake manifold.

·Disassemble the cable clamp from the chassis frame.

·Pull the wire through the grommet hole of the chassis of vehicle body to the chassis side, and disassemble the control wire.

Testing

Check the contents below, and if any unusual situations are found, please replace the control wire.

·Control wireshould be flexible to move.

· Control wire cannot be bent or twisted.

·Control wires cannot be damaged and corroded.

Install

1. Accelerator pedal control cable

·Be careful not to damage or distort the core wire of the cable.

·Pull the cable through the grommet hole of the chassis of vehicle body from the chassis bottom.

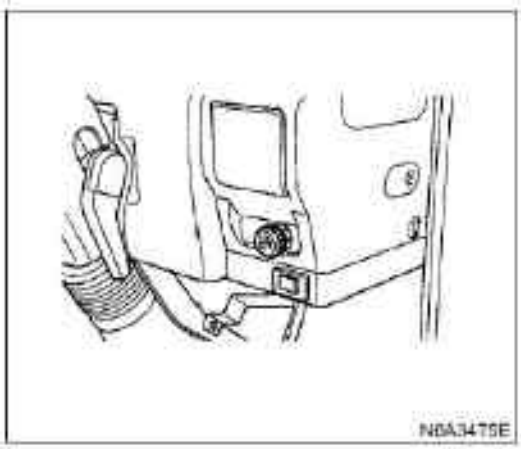
·Install the groove of the grommet hole into the chassis of vehicle body safely.

·Lower the vehicle body

2. accelerator pedal control lead (accelerator pedal side)

·Connect the control wire of the accelerator pedal to the accelerator pedal.

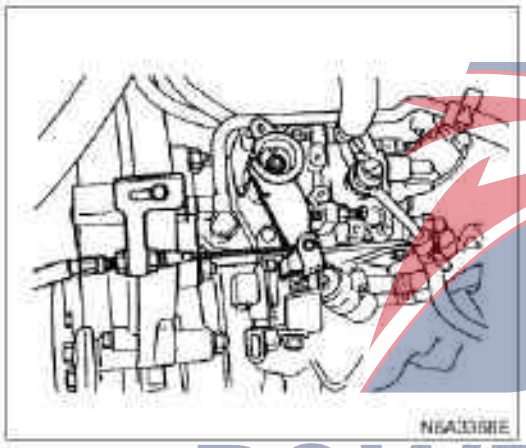
·Check whether the control knob at the idle speed is fully turned to the left.



·Tilt the vehicle body

3. accelerator pedal control lead (fuel injection pump side)

·Install the top of the wire to the control lever of the engine.



4. Lock bolt

·Pull the control lever of the accelerator to the stop bolt, pull the cable toward the front of the shaft gently, and fix the cable bracket with the lock bolt.

·Check whether the lever of the fuel injection pump is at idle speed position(lever in contact with stop bolt)

·Connect the grounding wire of the storage battery.

·Lower the vehicle body.

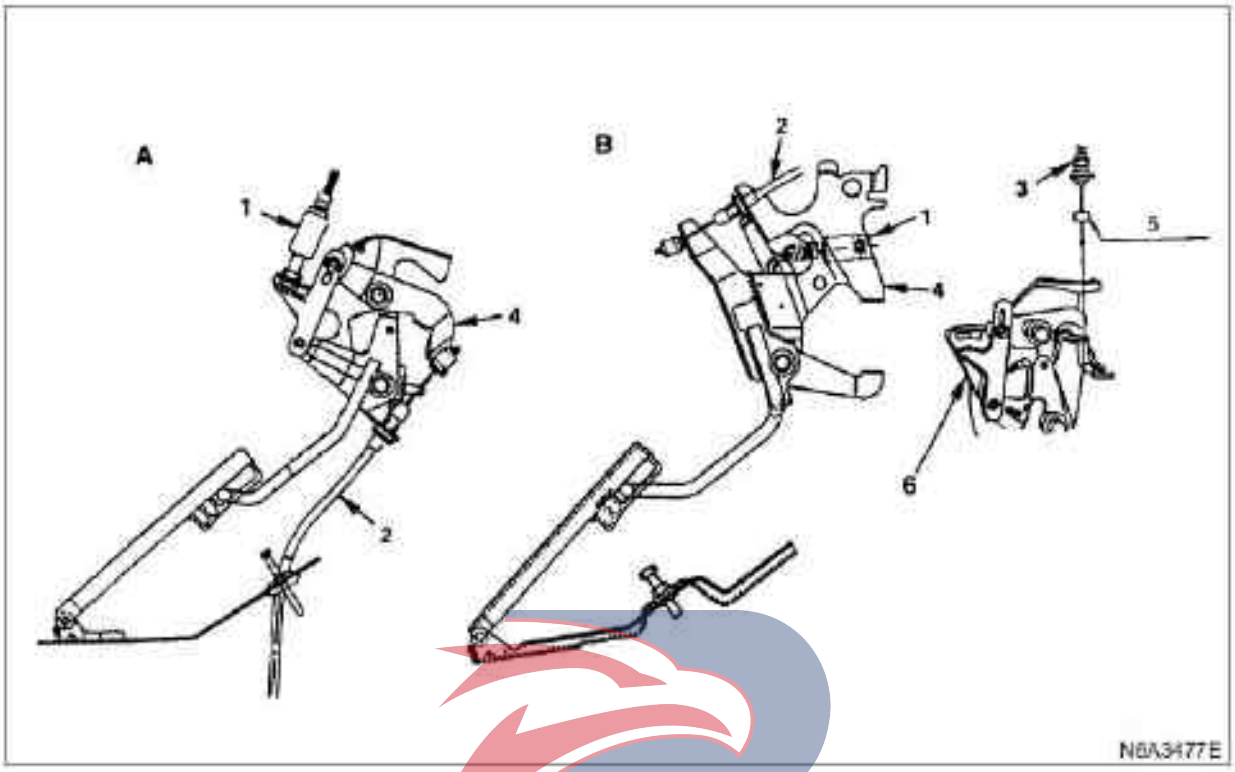
·Check whether the accelerator pedal moves within the range of 5 to 10 mm above the pedal pad.

·Fully depress the accelerator pedal, and check whether the connection is operating smoothly when the engine is running at maximum speed.

·Check whether the accelerator pedal and the lever of the fuel injection pumb are able to return to their original positions successfully within the operating range of the accelerator pedal.

Accelerator pedal

Parts



Legend

A. Right seat driving
B.Left seat driving
1. Idle switch joint
2. Accelerator pedal control cable
3. idle speed control cable
4. Accelerator pedal assembly
5. Wire sheath
6. Accelerator pedal bracket

Dismantling

1. Idle switch joint

2. Accelerator pedal control cable

·Disassemble the control wire from the bracket of the accelerator pedal.

3. idle speed control cable

·Disassemble the control wire from the bracket of the accelerator pedal.

4. Accelerator pedal assembly

·Disassemble the accelerator pedal assembly from the bracket of the brake pedal.

Install

1. Accelerator pedal assembly

· Install the grease-lubricated slider to the bracket of the brake pedal.

2. idle speed control cable

·Install the cable to the lever of the bracket of the accelerator pedal.

3. Accelerator pedal control cable

·After confirming that the control knob at the idle speed has fully rotated to the left, install the control wire of the accelerator pedal.

4. Idle switch joint

Adjust the amount of depression of the accelerator pedal

·After each cable is installed, make the accelerator pedal to move at full stroke once when manually pushing the accelerator pedal base.

·Adjust the stop bolt so that the clearance between the stop bolt of the pedal base and the back of the base becomes 0 - 2 mm (0 - 0.079 in.), and tighten the stop nut with the specified torque.

Tightening torque:

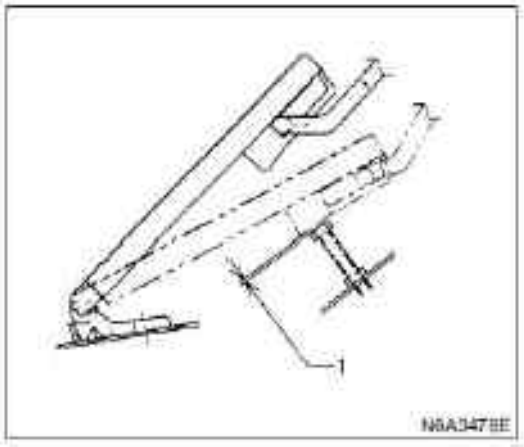
7.4 N·m(0.75 kg·m / 65 lb·ft)

·Check whether the accelerator pedal is operating within the rage of 5 - 10 mm (0.2 - 0.4 in) above the pedal base.

·Fully depress the accelerator pedal and check whether the engine is running smoothly at maximum engine speed.

·Check whether the accelerator pedal and the lever of the fuel injection pump are able to return to their original positions within the operating range of the accelerator pedal.

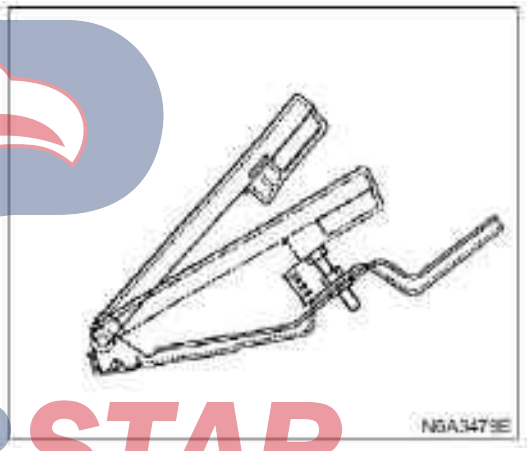
Right seat driving



Legend

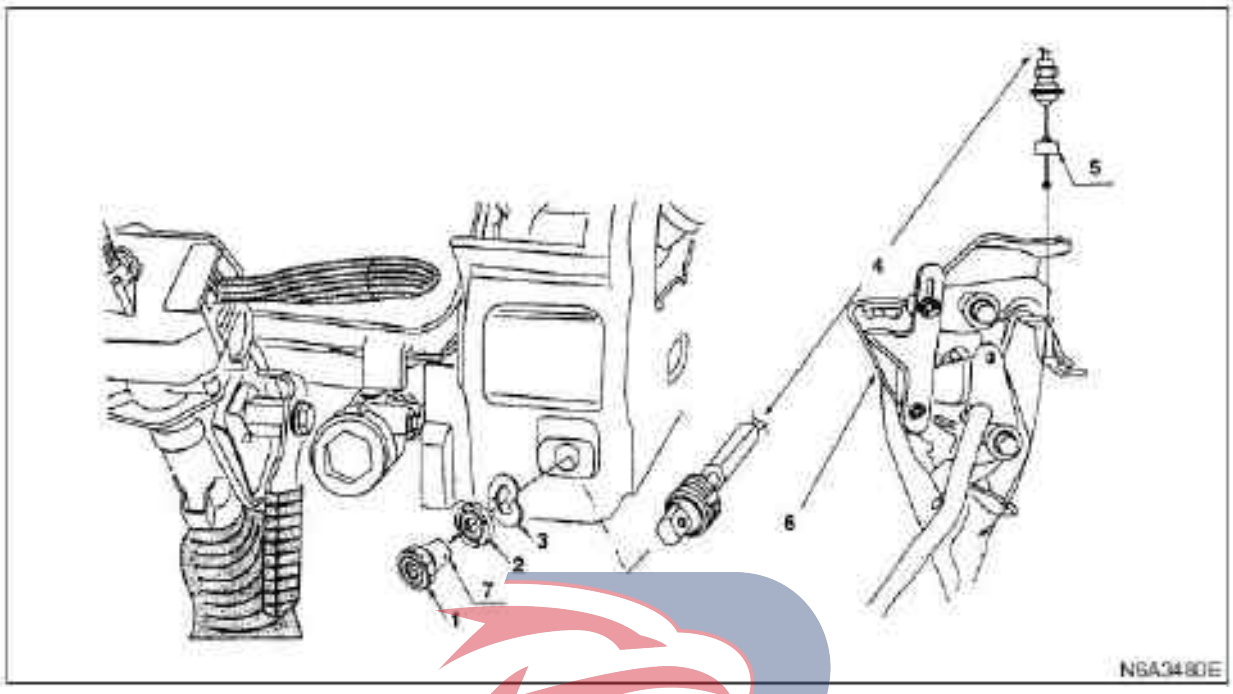
1. Full stroke 0 - 2 mm

Left seat driving



Idle speed control cable

Parts



Legend

1. Idle control knob
2. The control wire nut at the idle speed
3. wave washer
4. idle speed control cable
5. Cable sheath
6. Accelerator pedal bracket
7. Screw

Removal

1. The control knob at the idle speed

·Loosen the control knob screw at the idle speed and disassemble the knob from the cable.

2. The control wire nut 2 of at the idle speed.

3. wave washer

4. idle speed control cable

·Disassemble the control wire from the bracket of the accelerator pedal.

Testing

·Check whether the the lever of the fuel injection pump is at idle speed position(with the lever in contact with the stop bolt) without using the control knob at the idle speed.

·Turn the control knob at the idle speed fully to the right and check whether the idle speed of the engine reaches 1500 or higher.

Installation

1. idle speed control cable

·Install the control wire to the bracket of the accelerator pedal.

2. wave washer

3. The control wire nut at the idle speed

·Plug the control wireat the idle speed into the specified dashboard hole.

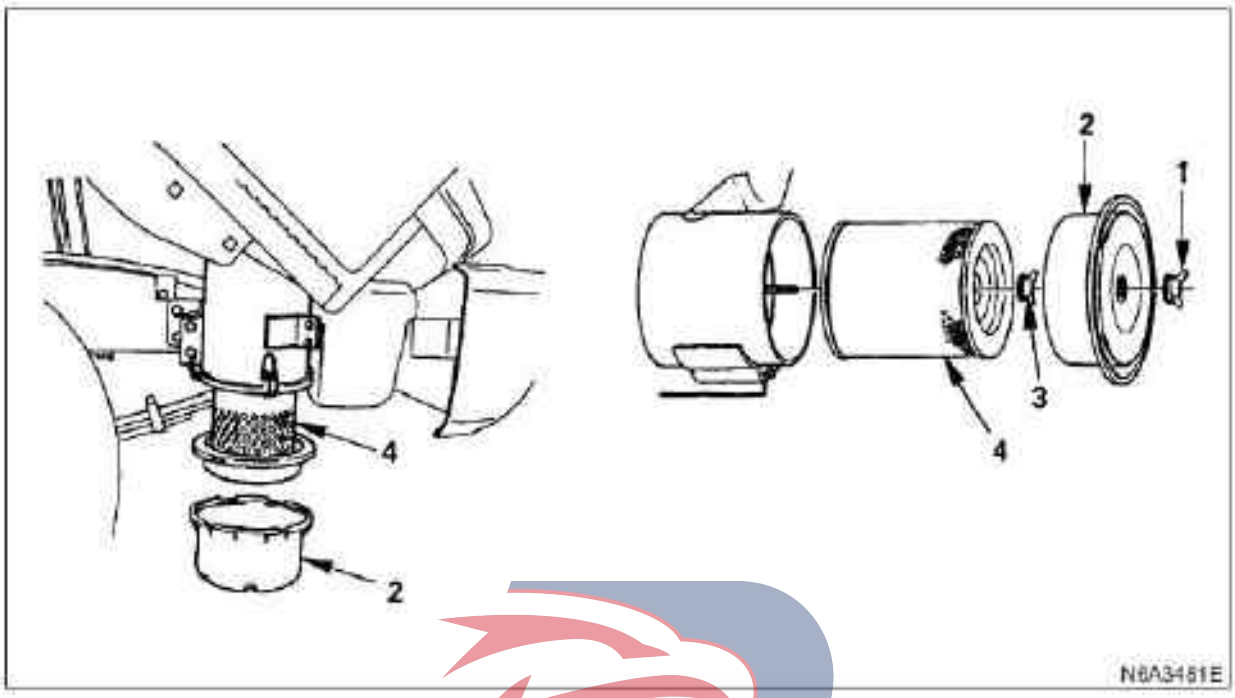
·Install the washer in the cable and tighten with the nut.

4. Idle control knob

·Plug the control knob at the idle speed into the cable and tighten with the screw.

Air filter element

Parts



Legend

1. Wing nut
2. End cover
3. Filter element and wing nut
4. Filter element of the air filter

Dismantling

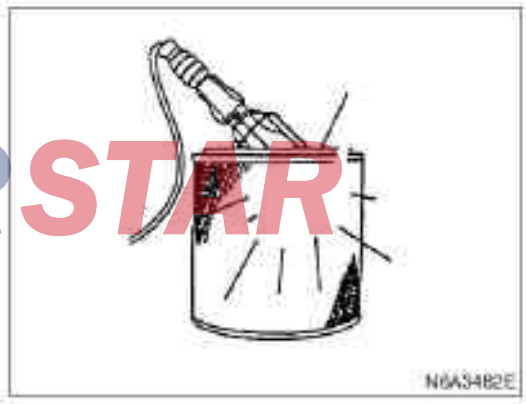
1. Wing nut
2. Filter cover
3. Filter element and wing nut
4. Filter element of the air filter

Cleaning

·Clean the interior of the air filter assembly.
·Clean the filter cover

Testing

·Use a light to check whether there are broken or small holes for the air filter.



Cleaning method

Dust-polluted filter element

When using compressed air to clean the interior of the filter, rotate the filter by hands. This method should be able to blow the dust out.

Compressed air pressure	KPa(kg/cm^2/psi)
392-490(4-5/57-71)	

Caution:

When cleaning, you cannot tap the filter with other objects to prevent damage to the filter.

Coke and dust polluted filter

1. Prepare Isleep's original filter cleaning liquid(Donaldson D1400) which is diluted with water.
2. Soak the filter element in the liquid for 20 minutes.

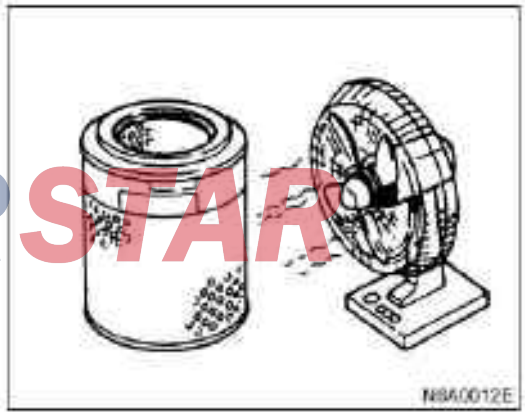
3. Disassemble the filter from the liquid and clean it with running water.

Water pressure must not exceed 274 kPa (2.8 kg / cm2 / 40 psi).

4. Dry the filter in a well-ventilated environment. Use a hair dryer to speed up drying filter.

Caution:

Do not use compressed air or open flame to quickly dry the filter. This will damage the filter. It usually takes two to three days to dry the filter. Therefore, a good solution is to prepare a spare filter for temporary use.



Install

1. Filter element of the air filter
2. Filter element and wing nut
3. End cover
4. Wing nut of the end cover

4J series engine

Section 6D

Electrical system of engine

Table of Contents

Crankshaft and main bearing

Overview

There are six storage battery charge caps on the top of the storage battery, covered with paper label.

Besides the six small vent holes on the side, the storage battery is completely sealed.

In comparison with conventional batteries, this battery has several advantages as follows.

These small vent holes discharge a small amount of gas generated by the storage battery.

1. There is no need to fill water for the entire service life of the storage battery

2.The storage battery has overcharge self-protection function, which can refuse overcharge. (Conventional storage battery can accept overcharge, resulting in liquid gasification and depletion for the storage battery.)

3. Compared with conventional storage battery, this type of storage battery will not easily discharge itself.

Fault diagnosis

1. Visual inspection

Check whether there is any obvious damage for the storage battery, such as crevice or crack that may cause electrolyte loss.

If there is obvious damage, replace the storage battery.

Check whether there is any other damage and repair as needed.

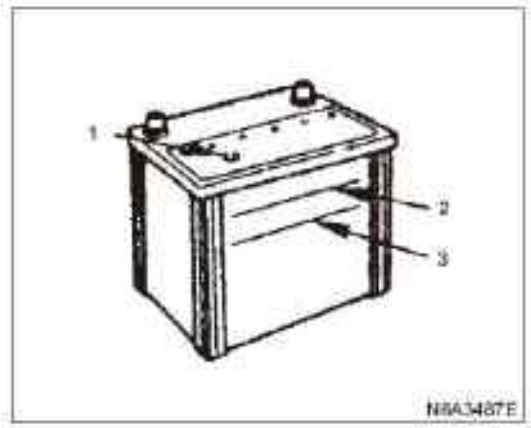
If no, go to step 2.

2. Electrolyte level check

The electrolyte level should be between the upper level line and the lower level line indicated on the storage battery side.

a. Correct electrolyte level: charge

b. Below the lower level line: replace the storage battery



Legend

1. Charging test indicator
2. Upper liquid level
3. Lower liquid level

---

3. Voltage check

1) Connect the voltmeter test wire to the storage battery terminals

a. If the voltage is 12.4 volts or above, the storage battery is in good condition.

b. When it is below 12.4 volts, proceed to step two.

2) Determine the rapid charging amperage quickly according to the parameters(see the main data and parameters described in this section)

Fast charge for storage battery for 30 minutes, and the amperes should not be higher than the specified value.

Record the voltage and amperage after charging.

a. If it is less than 1/3 amps and the voltage is 16V above, replace the storage battery.

b. If it is more than 1/3 amperes and the voltage is 16V above, lower the charging voltage to 15V and charge for 10-15 minutes.

C. If the voltage is between 12V and 16V, continue to charge for 3-3.5 hours at the same rate.

d. Voltage is lower than 12V, replace the storage battery

4. Load test

1) Connect the voltmeter and storage battery load tester to the storage battery terminal.

2) Use 300 amps for 15 seconds to disassemble the surface charge of the storage battery.

3) Wait 15 seconds for the storage battery to recover. Then use the specified load according to the specification(see the main data and parameters described in this section). Measure the voltage after 15 seconds and then disassemble the load.

A. The voltage drop is not lower than the minimum value listed in the following table; Which indicates that the storage battery is normal and may continue to be used.

B. If the voltage is lower than the minimum value listed, replace the storage battery.

Measure the temperature		Minimum voltage
°F	°C	Limit value
70	21	9.6
60	16	9.5
50	10	9.4
40	4	9.3
30	-1	9.1
20	-7	8.9
10	-12	8.7
0	-18	8.5
The storage battery temperature must be determined based on the ambient temperature and outdoor temperature(the storage battery has been put outdoors previously for a few hours.)		

Battery charging

The following safety precautions should be followed when charging:

1. Do not charge if the liquid level of the storage battery is lower than the lower liquid level indicated on the storage battery side. In this case, the storage battery must be replaced.

2. Pay close attention to the storage battery status when charging. If the storage battery touchs overheating, should stop charging or reduce the charging rate.

If the storage battery begins to generate gas or discharge electrolyte from the vent hole, stop charging or reduce the charging rate.

3.. In order to observe the blue point or ring mark of the liquid hydrometer, shake or tilt the storage battery slightly.

4. Storage battery temperature has a great influence on storage battery charging ability.

5. The enclosed storage battery used in this vehicle can be charged quickly or slowly by using the same method as other batteries.

Regardless of method, itshould ensure that the storage battery is fully charged instead of partially charged.

Jump start

Use auxiliary(assistive) storage battery for jump-start

Caution

Do not attempt to push or drag the vehicle for starting, otherwishe it may cause serious damage to the exhaust and other components.

When using jump wire, use the discharged storage battery and auxiliary storage battery particularly carefully. Follow the jump-start procedure carefully, and be careful all the time to avoid sparking.

Warning:

Failing to follow the jump-start procedure may result in the following problems:

1. Serious body injury, especially to the eyes.

2. Property damage caused by storage battery explosion, storage battery acid or electric fire.

3. Particularly the damage to the vehicle electrical components.

Do not bring the storage battery close to open flames or sparks. Gas from the storage battery may cause fire or explosion.

Before working around the storage battery, take off the ring, watch or other jewelry. Wear approved goggles.

Do not allow storage battery liquid to contact with eyes or skin.

Do not allow storage battery liuid contact with the fabric or paint surface. Storage battery liquid is a highly corrosive material that, if exposed to the skin, eyes, fabric or painted surfaces, wash immediately with clean running water.

Do not allow metal tool or jump wire to reach the storage battery's positive terminal or any other metal surface of the vehicle to prevent short circuit.

The storage batteryshould be placed out of the reach of the children.

Jump-start procedure

Pull up the handbrake of the vehicle to make the vehicle at parking status.

1. If the vehicle is automatic, place the selector lever at"Parking" position.

If the vehicle is manually shifted, set the shift lever at"Neutral" position. Turn off the ignition.

Turn off all lights and any other accessories that require electricity.

2. Observe the built-in liquid gravitometer.

If the built-in hydrometer display area is completely clear, do not attempt to jump-start.

3. Connect the other end of a cable with the positive terminal (+) of the discharged battery.

Connect the other end of the jump wire to the positive terminal of the auxiliary storage battery.

Do not make vehicle touch each other, otherwise it will cause grounding, thus cannot be charged.

Make sure the rating of the auxiliary storage battery is at 12 volts.

4. Connect one end of the other cable to the negative terminal of the auxiliary storage battery.

Connect the other end of the same cable to the fixed ground(such as the A/C compressor bay or generator installation bracket) of the vehicle engine which already equipped with rechargeable storage battery, this ground must be at least 450mm away from the storage battery which being charged.

Caution:

Never connect jump wire terminal directly to the negative terminal of non-rechargeable storage battery.

5. Start the engine with a good storage battery.

Be sure to turn off all unnecessary electrical accessories.

6. Start the vehicle engine which has run out of rechargeable storage battery.

7. When removing the jump wire, proceed as described above in the reverse order.

Make sure to disconnect the negative cable of a vehicle of non-rechargeable storage battery first.

Battery dismantling and installation

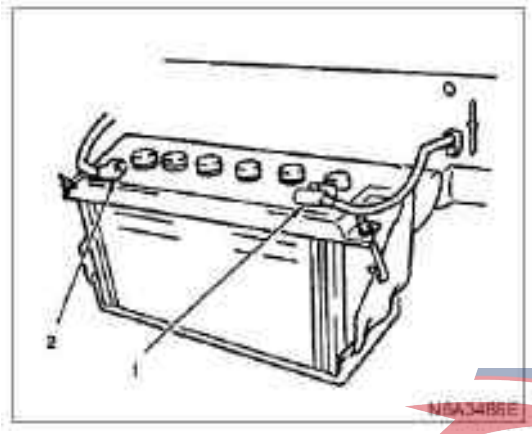
Dismantling

1. All switches should be at"off" position

2. Disconnect the grounding wire of the storage battery

3. Disconnect the positive cable of the storage battery

4. Disconnect the battery cable.



Caution:

Disconnect the grounding wire of the storage battery first.

To disconnect the positive cable first will cause a short circuit.

Install

When installing the storage battery, proceed the disassembly procedure in reverse order,

Note the following:

1. Be sure to hang the pull rod onto the body side.

Main data and parameters

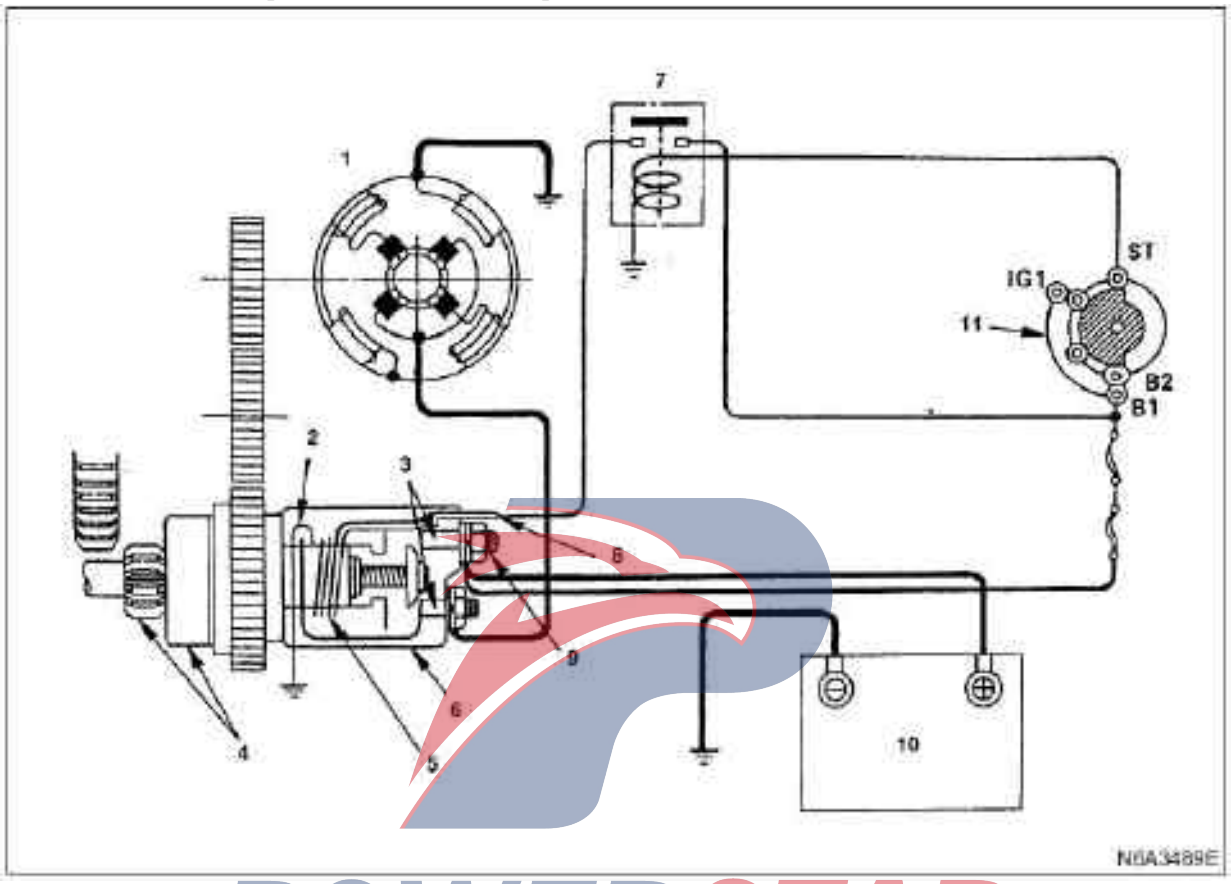
Model	(JIS)	115E41R-MF	130E41R-MF	95D31R-MF	80D26R-MF
Voltage	(V)	12	12	12	12
Cold starting performance	(Amp)	651	799	622	582
Backup power	(Min)	212	229	159	133
Load test	(Amp)	325	400	310	290
Fast charging maximum amps	(Amp)	20	20	20	20
Identification code of the storage battery charging indicator		-	-	27	24
Length × width × height overall dimensions	(mm)	410×178×213	410×178×213	-	-

Starting system

Overview

Starting line

Starting system consists of storage battery, starting motor, starting switch, starting relay, etc., and the connection of main components as shown in the pictures.



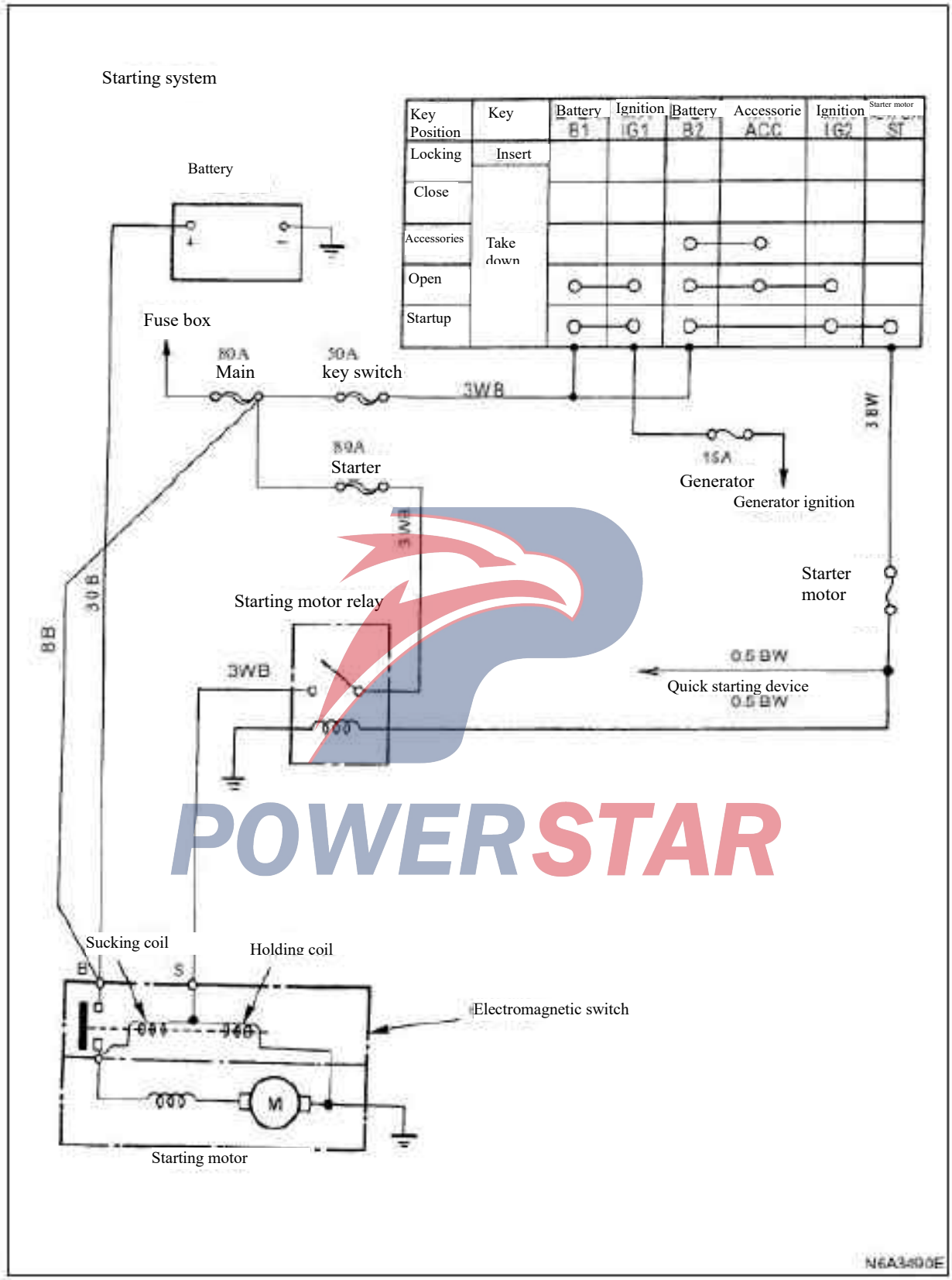
Legend

1. Starter motor
2. Suction coil
3. Contact
4. Driving gear clutch
5. Suction force coil
6. Magnetic switch
7. Starting motor relay
8. Terminal"50"
9. Terminal"30"
10. Accumulator
11. Starting switch

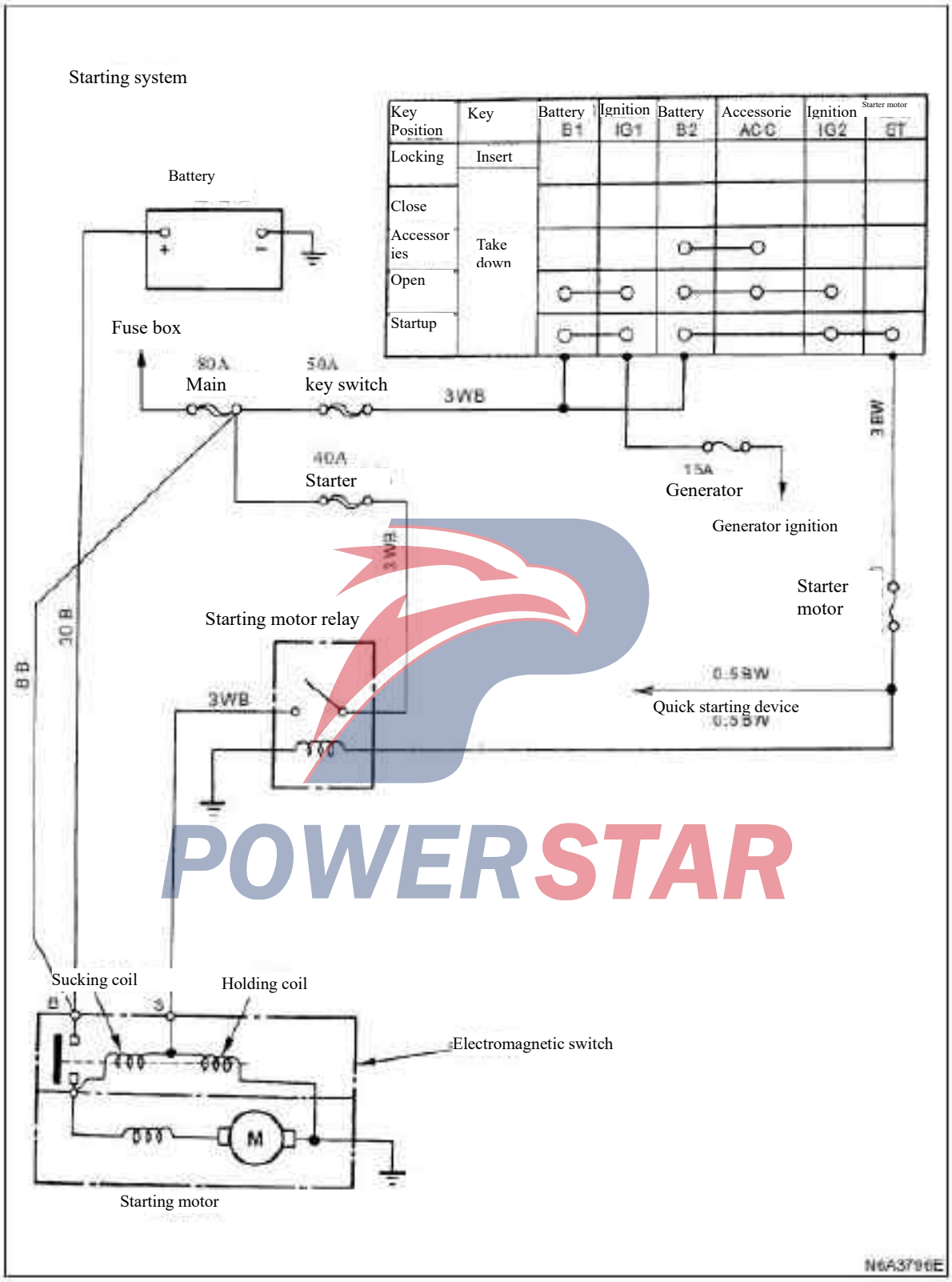
Starter motor

The starting system adopts a electromagnetic-type starting motor, whose motor shaft is also used as a drive gear. When the starting switch is turned on, the contact of the magnetic switch is closed and the armature rotates. At the same time, the movable iron core suctions, lever push the drive gear forward to mesh with the ring gear, and then the ring gear rotates to start the engine. When the engine starts, the starting switch is closed, the movable iron core returns, the drive gear detaches from the ring gear, and the armature stops rotating. When the engine speed is higher than the drive gear, the pinion idles to prevent the armature from being driven.

4JB1, 4JB1-TC starting line

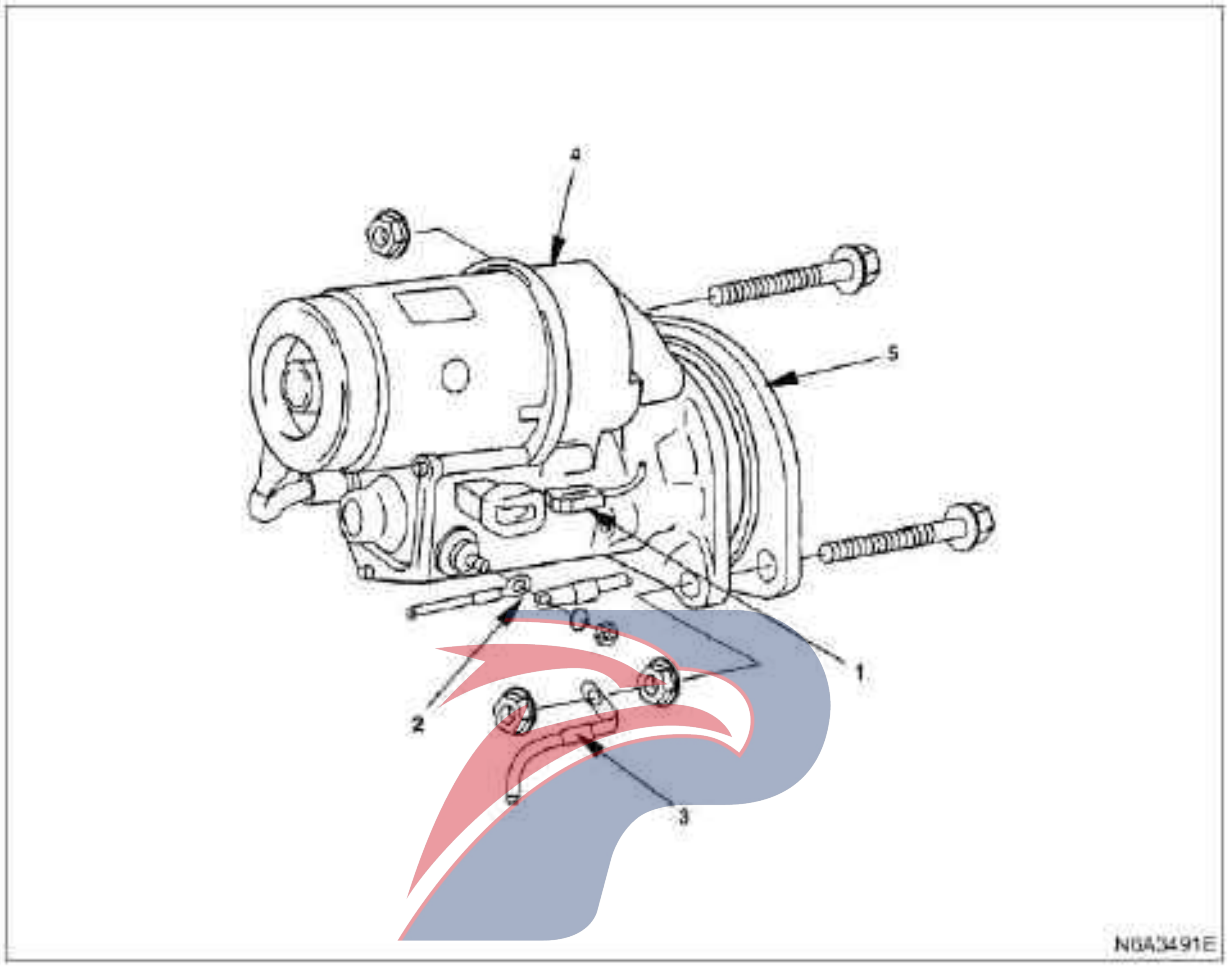


Starting line 4KH1-TC



Onboard maintenance

Starter motor



Legend

1. Terminal
2. Terminal
3. Grounding wire terminal
4. Starting motor assembly
5. Isolation pad (4JB2, except the cold area)

Dismantling

Preparation

·Disconnect the grounding wire of the storage battery

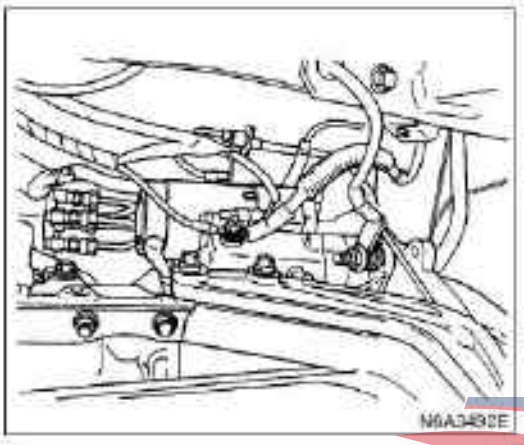
1. Terminal "50"

2. Terminal"30"

3. Grounding wire terminal

4. Starting motor assembly

5. Isolation pad (4JB2, except the cold area)



Install

1. Washer(4JB1, except for cold area)

2. Starting motor assembly

Tighten the fixing bolt and nut to the specified torque

Tightening

The torque of the bolt and nut of the starting motor is 81N • m(8.3 kg • m/60 lb • ft)

3. Grounding wire terminal

·Connect the ground terminal

4. Terminal"30"

·Connect the harness connector

5. Terminal "50"

·Connect the terminal of the cable of the storage battery to the terminal of switch harness of the starting motor, and tighten the nut to the specified torque.

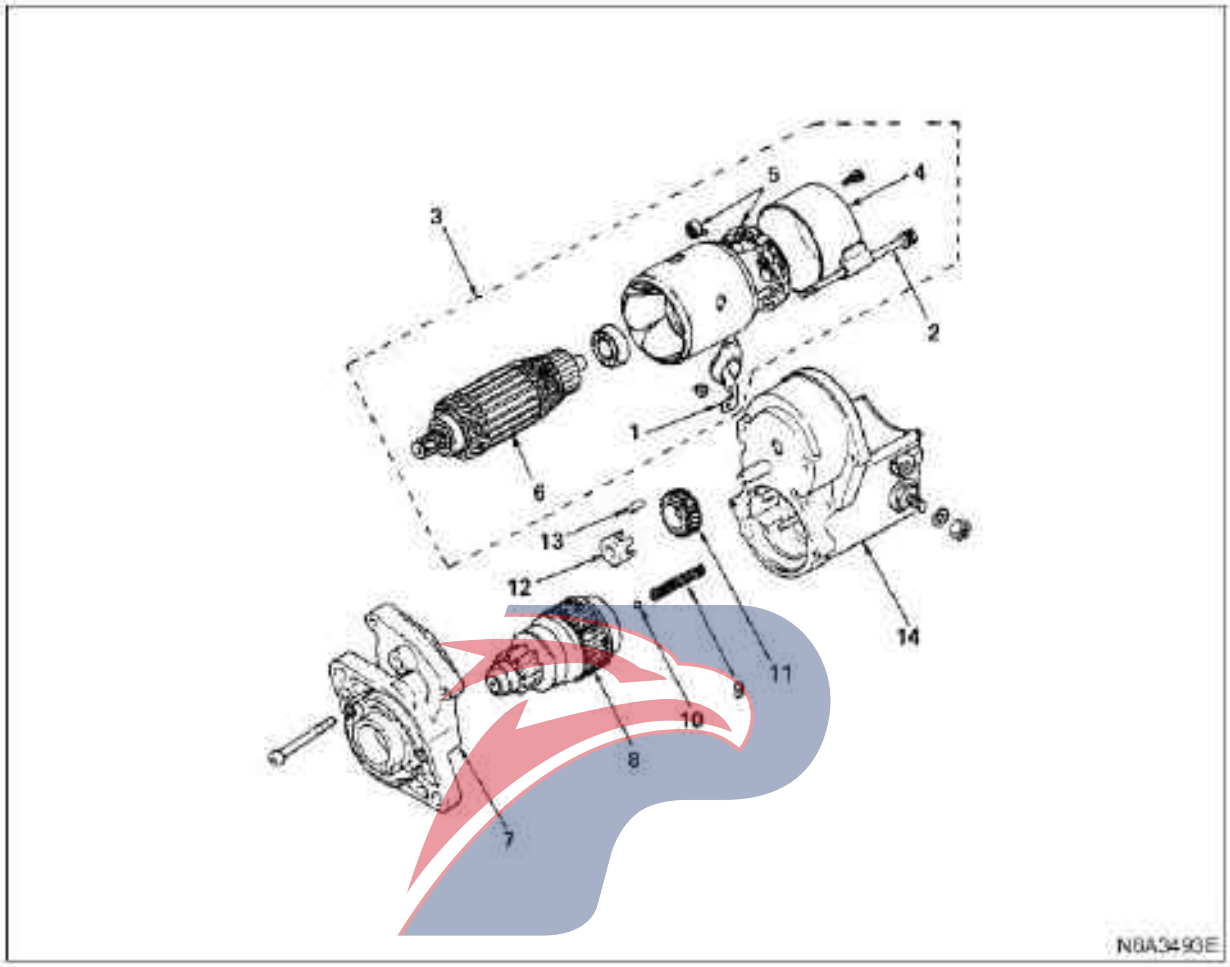
Tightening

9 N•m for the torque of the fixing nut (0.9 kg•m / 78 lb • in)

·Connect the cable of the storage battery

Single piece maintenance

Part



Legend

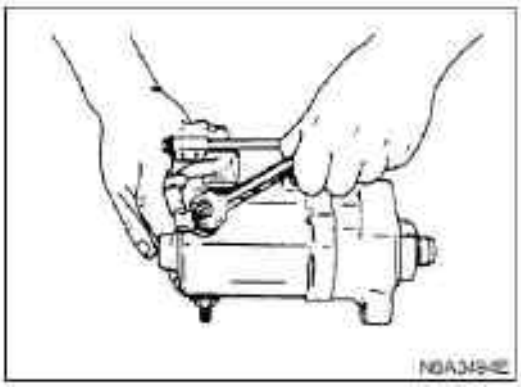
Single piece maintenance

1. Lead
2. through bolt
3. Magnetic yoke assembly
4. Cover
5. Electric brush and electric brush holder
6. armature
7. Drive side end cover
8. Overrun clutch
9. Return spring
10. Steel ball
11. Driven pinion
12. Holder
13. Roller
14. Magnetic switch

Dismantling

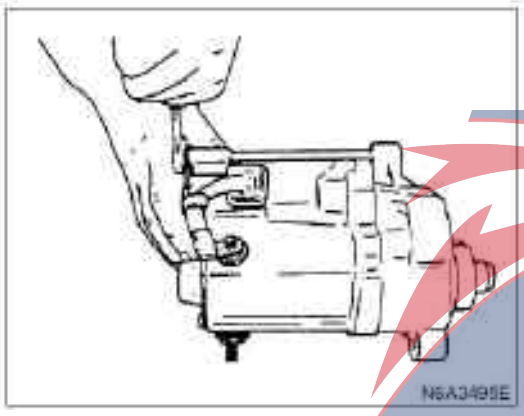
1. Lead

Disconnect the magnetic switch wire:



2. through bolt

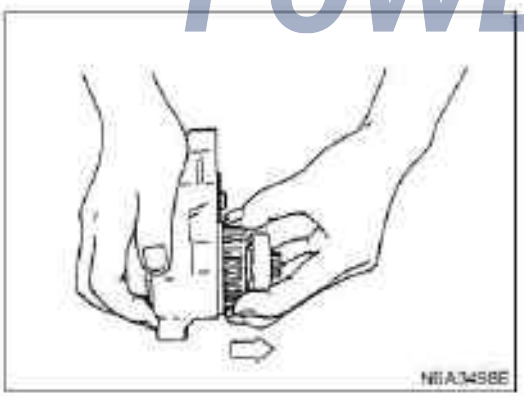
Disassemble the through bolt from the yoke

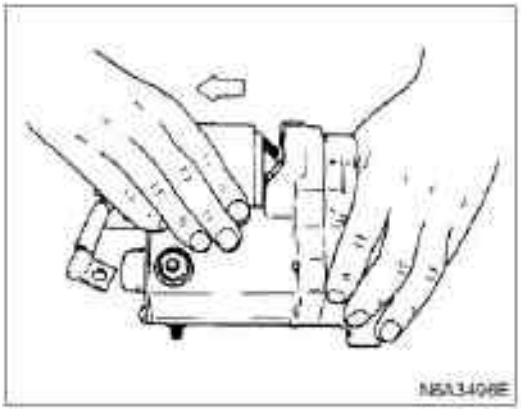


3. Magnetic yoke assembly

Disassemble the yoke from the electromagnetic switch

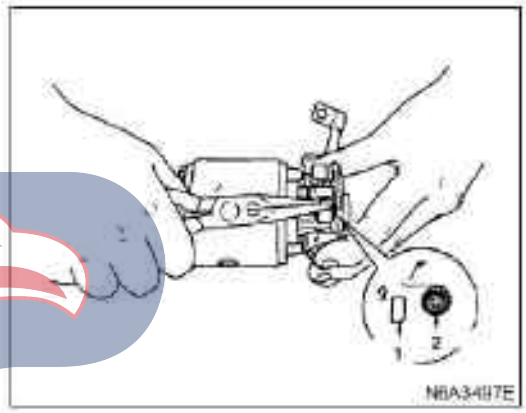
4. Yoke cover





5. Electric brush and electric brush holder

Use long nose plier to disassemble(pull out the brush and brush holder) from the armature.



Legend

1. Electric brush
2 . spring

Armature

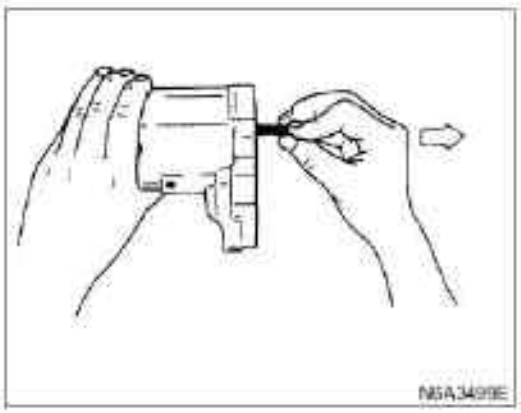
6. Drive side end cover

7. Overrun clutch

8. Disassemble the overrunning clutch from the shell.

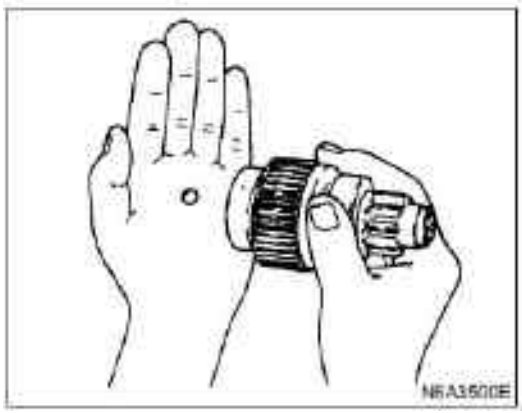
9. Return spring

Disassemble the return spring from the magnetic switch.



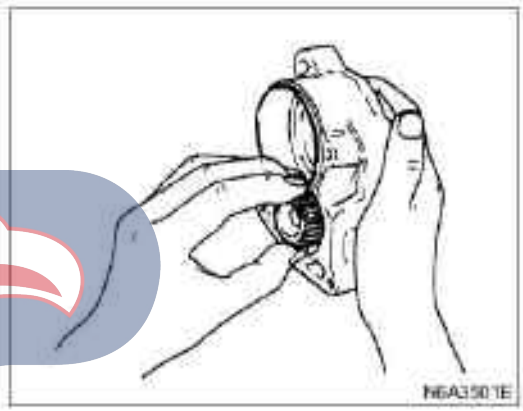
10. Steel ball

Disassemble the steel ball from the overrunning clutch.



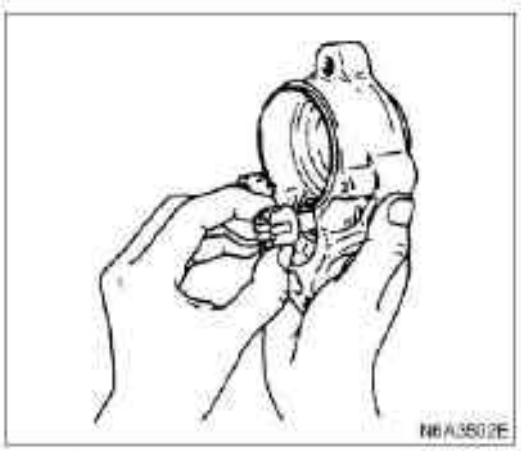
11. Driven pinion

Disassemble the driven pinion from the shell.



12. Holder

13. Disassemble the cage from the shell



13. Roller

14. Magnetic switch

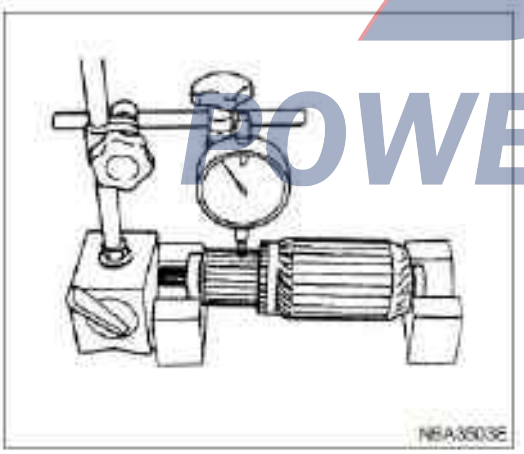
Inspection and repair

If there is any wear, damage or other unusual situations when inspecting, make necessary repair or replace the parts.

Armature

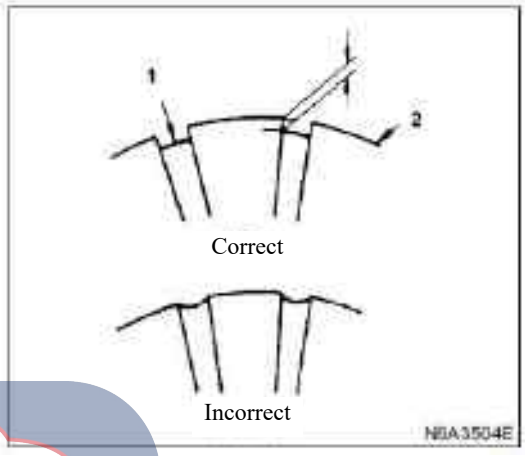
Check the radial runout of the armature commutator and replace if exceeds the limit value.

Wear detection		mm (in)
kw	Standard	Limit value
2.2	0.02 (0.0008)	0.05(0.0020)
2.0		



Check the wear and tear situation of the mica sheet.

Mica sheet thickness		mm (in)
kw	Standard	Limit value
2.2	0.7—0.9(0.028—0.035)	0.20(0.008)
2.0		

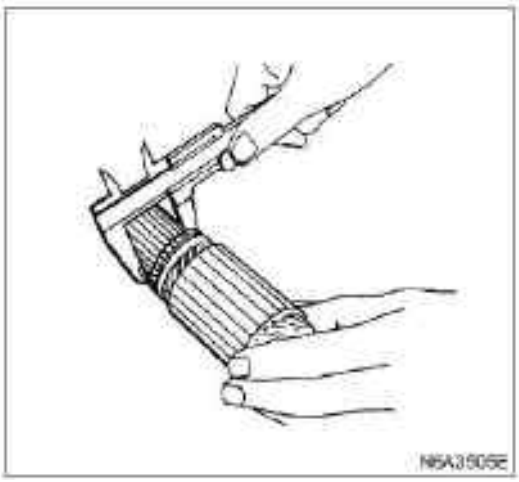


Legend

1. Insulator
2. Commutator

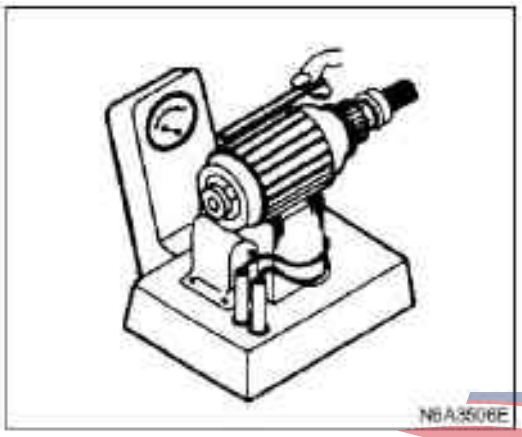
Check the outer diameter of commutator

Outer diameter of commutator		mm (in)
kw	Standard	Limit value
2.2	35.00(1.378)	34.00(1.339)
2.0		



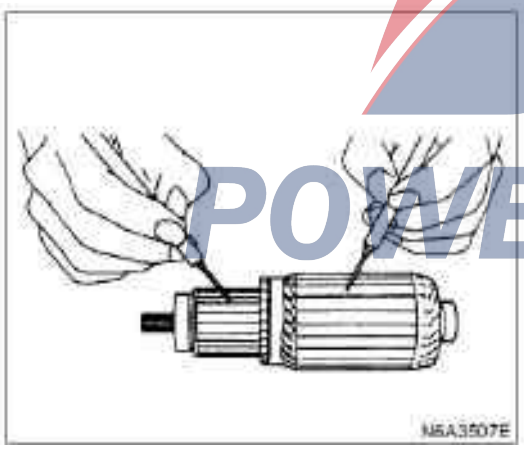
Armature short-circuit test

Place the armature on short-circuit coil tester to check for short circuit. Place one blade on the armature iron core, rotate the armature slowly. If the armature becomes short-circuited, the saw blade should vibrate and should be attracted to the iron core. In this case, it indicates that the armature is short-circuited and must be replaced.



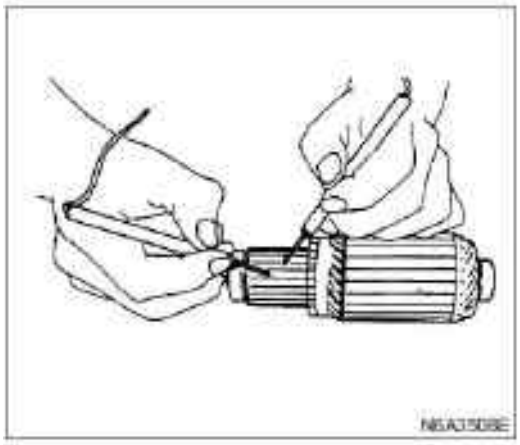
Armature grounding test

Place one probe of the line tester on the commutator, and the other probe on the armature iron core. There should be no access. Otherwise, it indicates that the armature grounds and should be replaced.



Armature access test

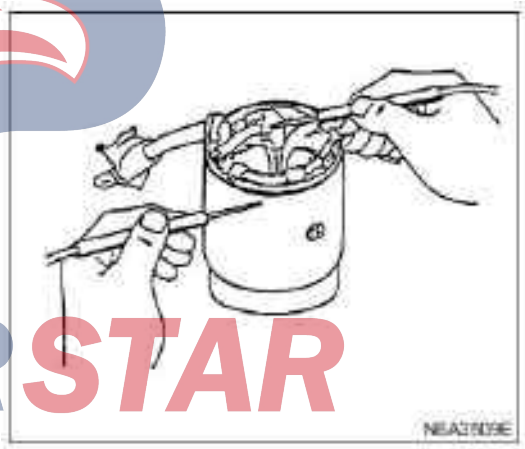
Connect the probe of the line tester to two armatures, and there should be no open at any point. Otherwise, the armature should be replaced.



Yoke

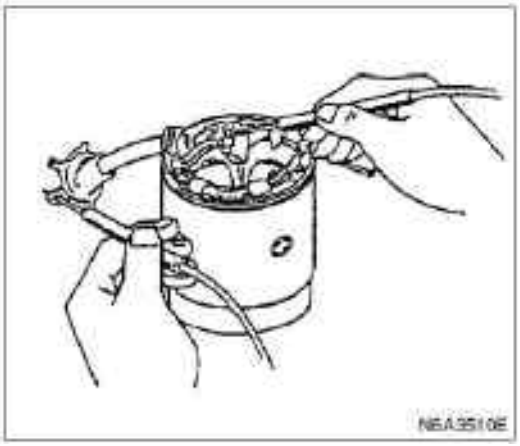
Magnet excitation coil grounding test

Place a probe on the end of the magnet exciting coil or brush, and place the other probe on the exposed surface of the yoke by using a line tester. There should be no access. Otherwise, it indicates that the magnet excitation coil grounds, and the yoke assembly should be replaced.



Magnet excitation coil access test

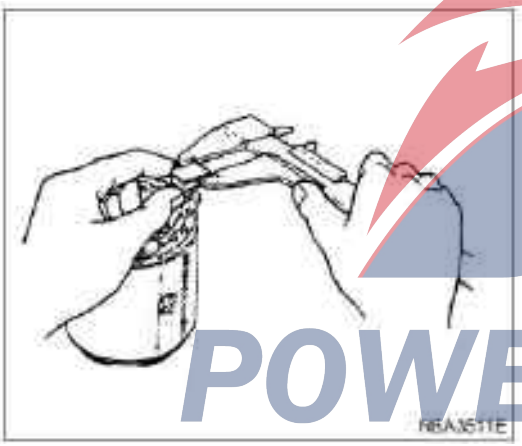
Place a probe on "C" terminal wire and the other probe contacting the brush by using a line tester, and there should be access. Otherwise, the yoke should be replaced.



Electric brush and electric brush holder

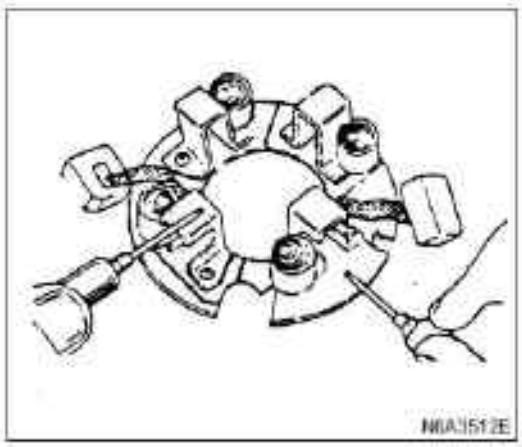
Measure the length of the brush, and replace it if the amount of wear exceeds the service limit value.

Electric brush length		mm (in)
kw	Standard	Limit value
2.2	14.5(0.57)	10(0.39)
2.0	16(0.63)	



Electric brush holder insulation test

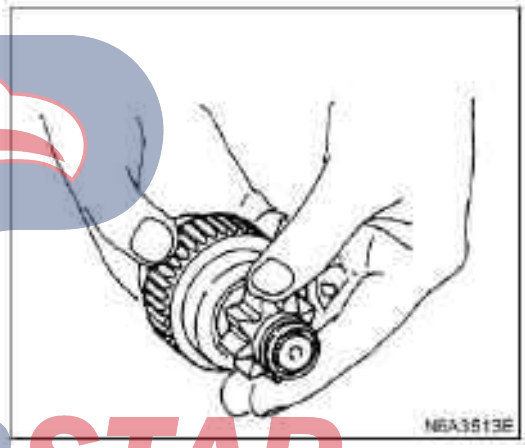
Inspect the insulation of the brush holder by using a line tester. Place a probe on the brush holder plate and connect the other probe to the positive brush holder. There should be no access.



Overrunning clutch

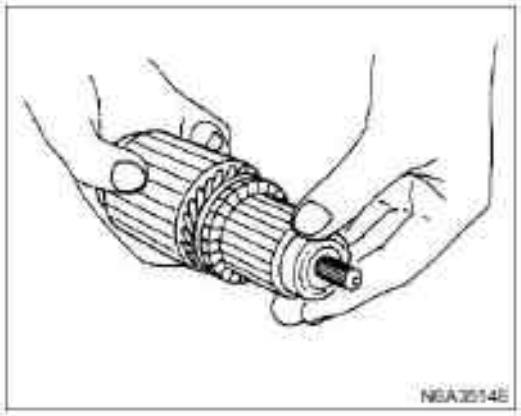
Check the wear and damage situation for the drive gear. If damaged, it should be replaced.

Rotate the drive gear in the direction of rotation(clockwise). It should rotate smooth, but it should not rotate in the opposite direction.



Bearing

Check the wear and damage situation for the bearing. If the bearing makes noise during operation, it should be replaced.



Reassemble

When installing, proceed the disassembly steps in the reverse order, and pay attentions to the followings:

·Magnetic switch

·Tension pulley

·Clutch assembly

·Shell

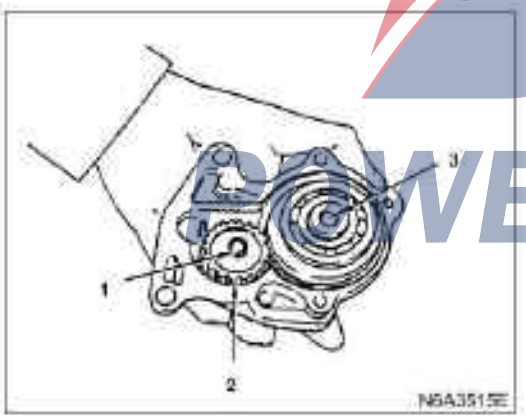
1. Install the clutch assembly onto the magnetic switch.

2. Install the tension pulley and the shell

Caution:

Take care to install steel ball and spring between the clutch and the magnetic switch.

First of all, install the roller to the tension pulley.



Legend:

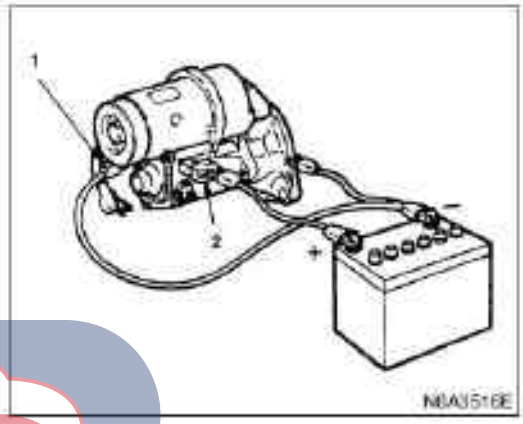
1. Roller
2. Tensioning wheel
3. Steel ball

Magnetic switch

Temporarily connect the electromagnetic switch between the clutch and the shell, and perform the following tests: Each test should be completed in 3 to 5 seconds.

1. Attraction test

Connect the negative terminal of the storage battery to the electromagnetic switch shell and the terminal M. When the positive terminal of the storage battery applies current to terminal 50, the drive gear should vibrate.



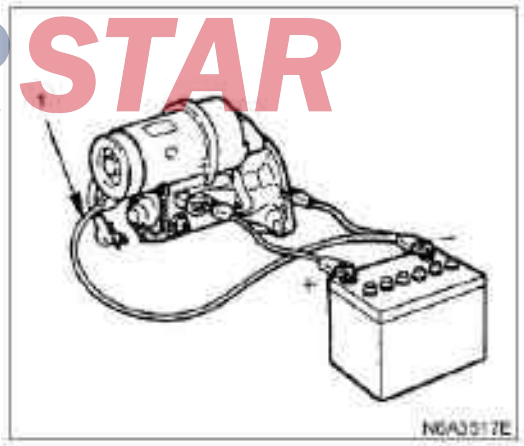
Legend

1. M terminal
2. Terminal 2.50

---

2. Hold-in test

Disconnect the wire at terminal M and the drive gear should continue to vibrate.



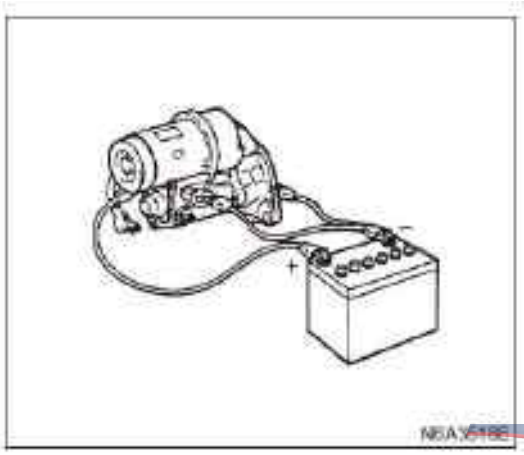
Legend

1. Disconnection

---

3. Return test

Connect the negative terminal of the storage battery to terminal 50and the shell, the positive terminal of the storage battery to terminal M, and the drive gear should vibrate. After disconnecting the wire from terminal 50, the drive gear should be reset immediately.



4. Current value

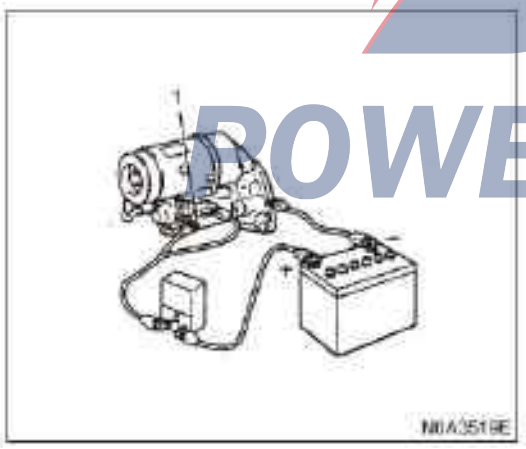
Connect as shown in the pictures to measure the current value.

Standard: 120A or smaller

Caution:

Make sure to use fully charged storage battery.

Use thick wire since the current is large.



Legend

1. Terminal 30

Charging system

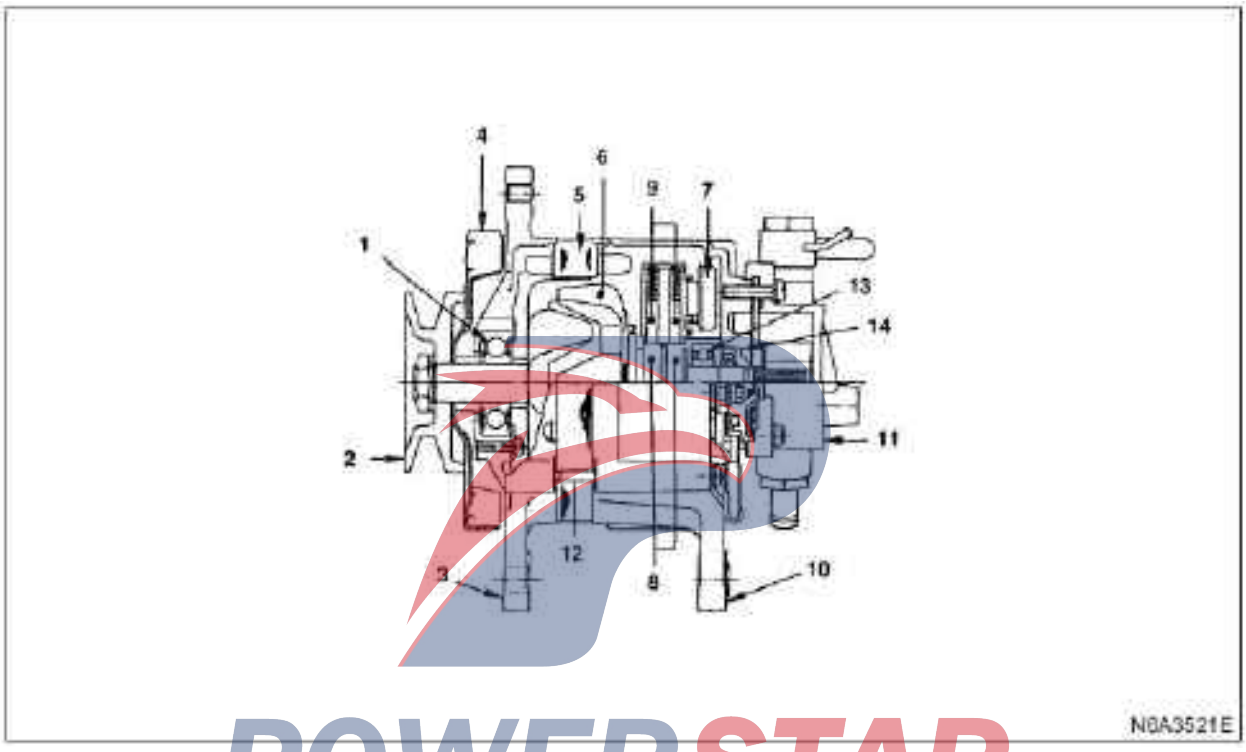
Overview

The charging system is the integrated circuit interal regulation charging system, and the connection of its main components as shown in the pictures.

The interal adjuster and the brush holder assembly are installed inside the generator, which is mounted on the rear end cover.

The generator does not require special maintenance like the voltage regulation. There is six diodes for the rectifier which installed on the stator coil,which convert AC voltage to DC voltage. The DC voltage is connected to the output terminal of the generator.

Generator(12V-50A)



Legend

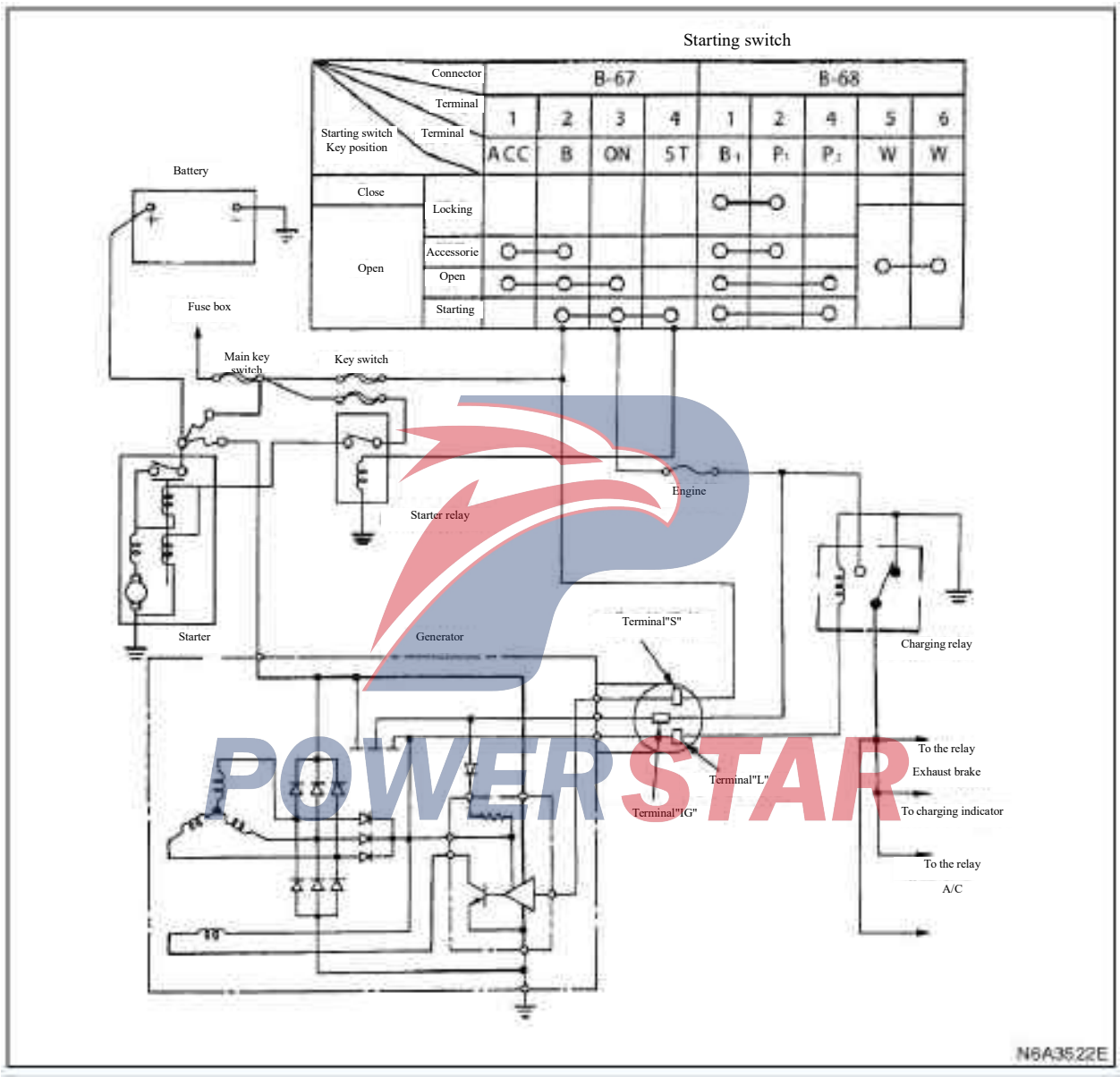
1. Ball bearing
2. Belt pulley
3. Front cover
4. Fan
5. Stator
6. Rotor
7.(Integrated circuit) adjuster
8. Slip Ring
9. Electric brush
10. Rear cover
11. Vacuum pump
12. Through bolt
13. Ball bearing
14. Oil seal

Fault diagnosis

General on-vehicle inspection

The charging indicator light shows the working state of the charging system. When the starting switch is at"on" position, the caution light should be on.If the warning light is off after the engine is started, this indicates that the discharging system works normally. If the caution light behaves abnormal or the storage battery might be undercharged or overcharged, check as per following steps to diagnose.

4JB1, 4JB1-TC charging circuit



1. Visual inspect the belt and wire connector to make terminal "L" on one side of the connector ground.

2. Set the starting switch when the engine is shut down.

At"on" position, observe the caution light.

· If the light is on, repair or replace the generator.

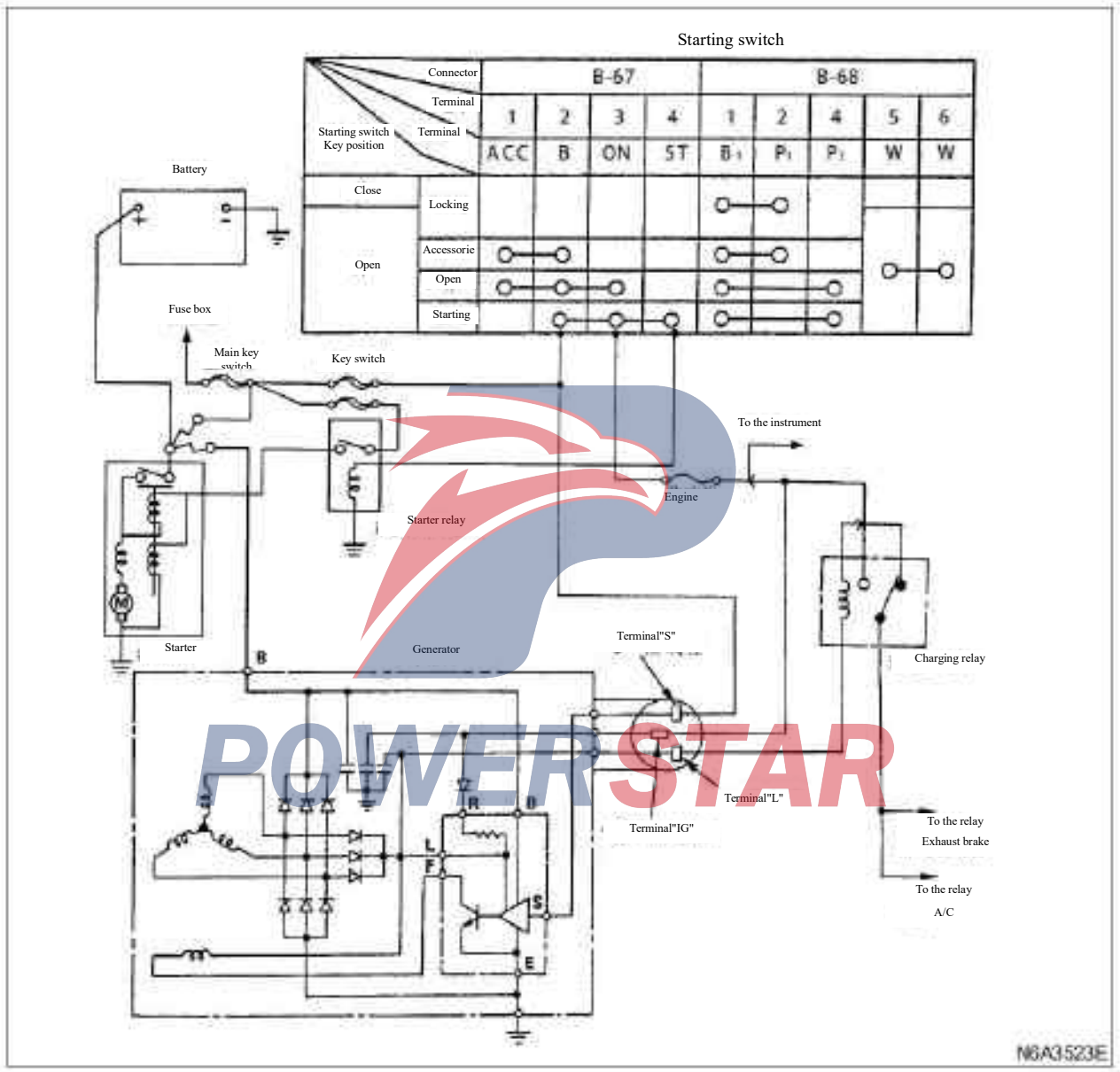
·If the light is off, disconnect the cable connector from the generator,

Fault diagnosis

General on-vehicle inspection

The charging indicator light shows the working state of the charging system. When the starting switch is at“on" position, the caution light should be on. If the warning light is off after the engine is started, this indicates that the discharging system works normally. If the caution light behaves abnormal or the storage battery might be undercharged or overcharged, check as per following steps to diagnose.

4KH1 charging circuit



1. Visual inspection for the belt and wire connector
2. Set the starting switch when the engine is shut down.

At"on" position, observe the caution light.

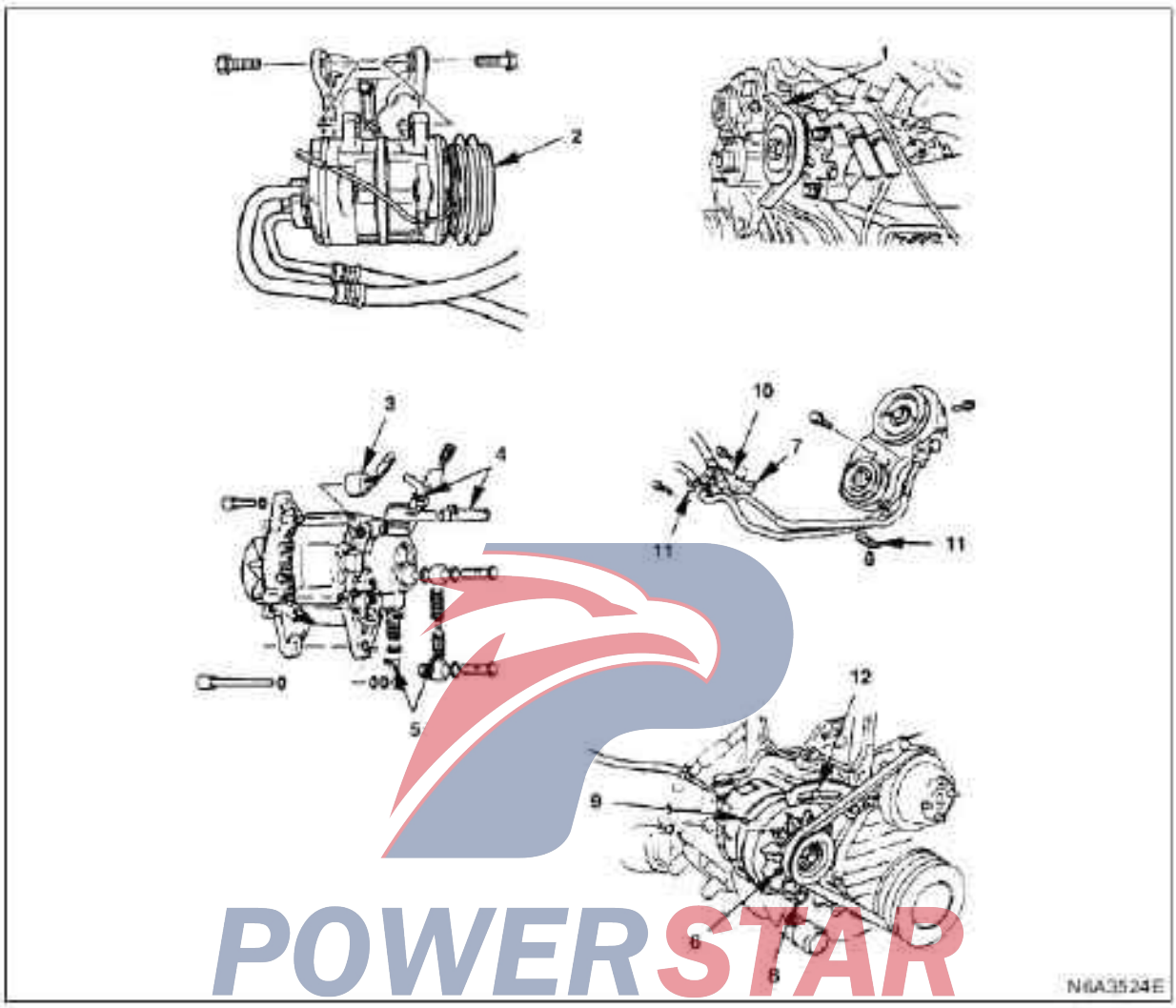
If the light is off, disconnect the wire connector from the generator and make terminal "L" on one side of the connector ground.

·If the light is on, repair or replace the generator.

Onboard maintenance

Part

Generator



Legend

1. Drive belt of the A/C compressor
2. A/C compressor
3. Harness connector
4. Vacuum hose
5. Engine oil hose
6. Drive belt of the AC generator.
7. The bracket of oil hose of the power steering
8. AC generator fixing bolt
9. AC generator assembly
10. Bracket
11. Clamp
12. Stop bolt

Dismantling

Preparation

·Disassemble the grounding wire of the storage battery

1. Drive belt (A/C type) of the A/C compressor

·Loosen the locking nut of the idler pulley

·Loosen the adjusting bolt and disassemble the transmission belt

2. A/C compressor assembly (A/C type)

·Disconnect the harness connector of the clutch

·Disassemble the fixing bolt of the A/C compressor, and temporarily fasten the A/C compressor to the frame with metal wires.

3. Harness connector (A/C type)

·Disconnect terminal"L", "S" and"IG".

·Terminal"B"

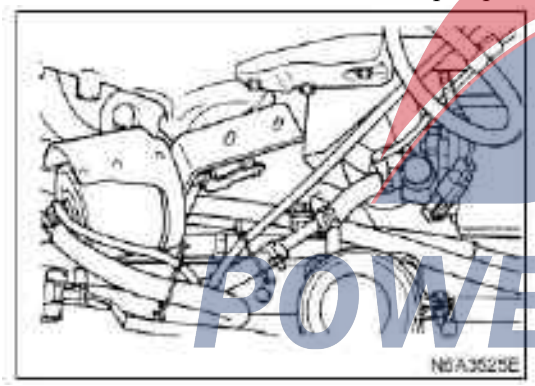
4. Vacuum hose (exhaust brake type)

·Disassemble the vacuum hose to the vacuum tank and the exhaust adjuster

5. Engine oil hose

· Disassemble the oil hose from the oil plate

·Disassemble the oil hose on the vacuum pump side



6. drive belt of the AC generator.

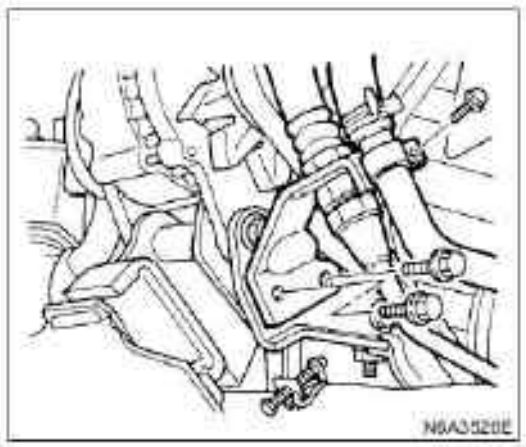
·Loosen the fixing bolt of the adjusting plate

·Disassemble the adjusting bolt

·Loosen the fixting bolt of the alternator and disassemble the fan belt.

7. Branket of the power steering tube(P/S power steering)

·Disassemble the the fixting bolt and clamping bolt of the pressure tube bracket. Disasemble clamping bolt of the suction



8. AC generator fixing bolt

9. AC generator assembly

Install

1. AC generator assembly

·Install alternator

2. AC generator fixing bolt

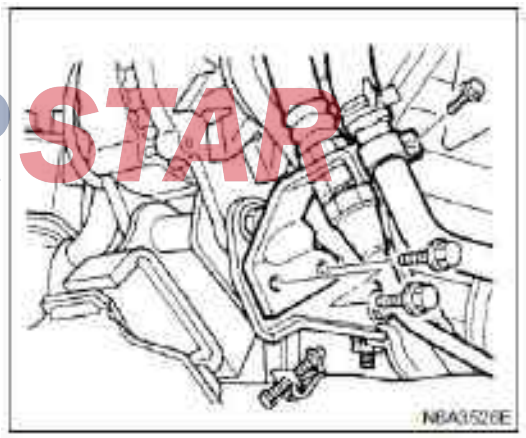
·Temporarily install the fixing bolt of the alternator

3. Bracket of the power steering tube(power steering type)

·Install the tube bracket and tighten to the specified torque.

Tightening:

19 N•m for the bolt of the bracket (1.9 kg•m / 14 lb • ft)



·Install clamping bolt of the suction and tighten the bolt to the specified torque.

Tightening:

Pipe clamp bolt torque: 10N·m(1 kg·m/87 lb·in)

·Install the clamping bolt of pressure pipe and suction pipe and tighten to the specified torque.

Tightening:

Pipe clamp bolt torque: 10 N·m(1 kg·m/87 lb·in)

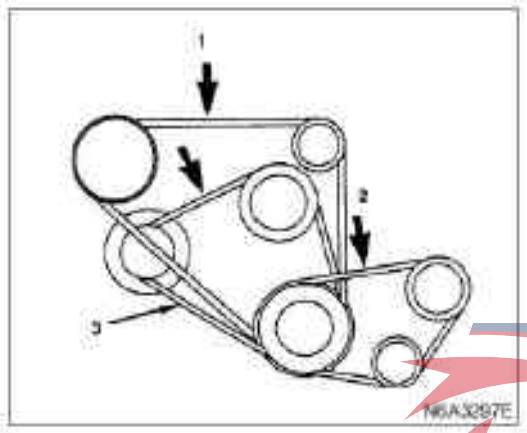
4. drive belt of the AC generator.

·Install the alternator transmission belt and adjust the belt tension.

·Press the middle transmission belt with a force of 98 N (10 kg / 22 lb).

drive belt deflection	mm (in)
8(0.31)— 12(0.47)	

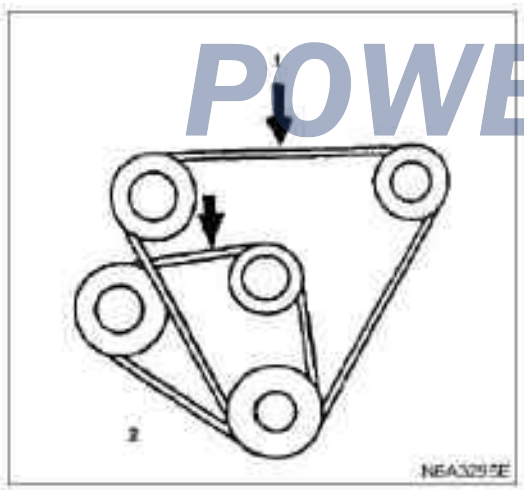
4JG2



Legend:

1. Drive belt of the A/C compressor
2. Drive belt of power steering oil pump
3. Drive belt of AC generator and fan belt pulley

4JB1



Legend

1. Drive belt of the A/C compressor and drive belt of the power steering pump
2. Drive belt of AC generator and fan belt pulley

·Install the fixing bolt and tighten to the specified torque.

Tightening:

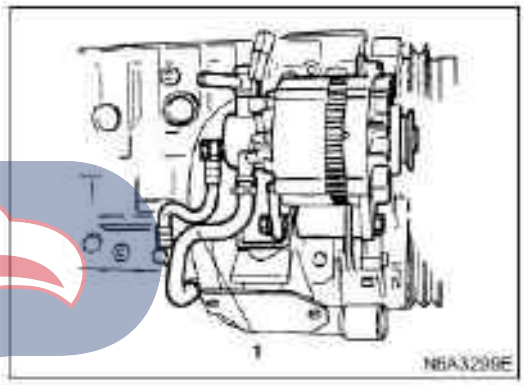
·40 N•m for the fixing bolt of the generator (4.1 / kg•m / 30 lb • ft)

·19 N•m for the fixing bolt of the adjusting plate (1.9 kg•m / 14 lb • ft)

5. Engine oil hose

· Install the oil hose(1) to the vacuum pump.

· Install the oil hose(2) to oil plate.



6. Vacuum hose (exhaust brake type)

·Install the vacuum hose to the vacuum tank and the exhaust adjuster

7. Harness connector (A/C type)

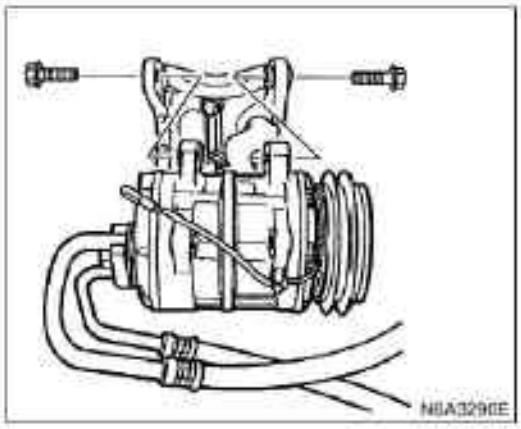
· Connect connectors of terminal"L", "S" and"IG", and "B".

8. A/C compressor assembly (A/C type)

· Install the compressor assembly and tighten the bolt to the specified torque.

Tightening:

19 N•m for the bolt of the compressor (1.9 kg•m / 14 lb • ft)



·Connect the harness connector of the magnetic switch

9. Drive belt (A/C type) of the A/C compressor

·Install the transmission belt of the A/C compressor and adjust the belt tension.

· Use a force of 98N (10 kg / 22 lb) to depress the middle section of the transmission belt.

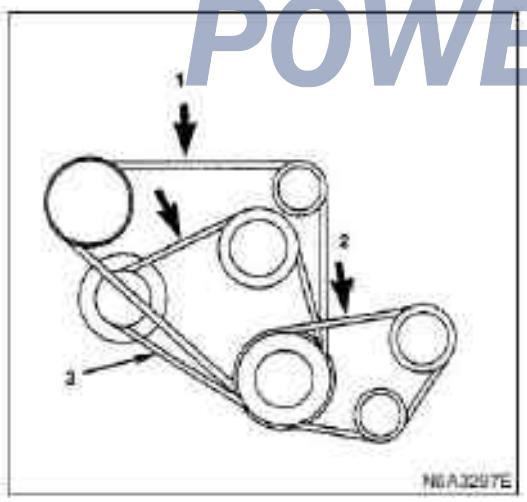
drive belt deflection	mm (in)
New 7-8(0.2—0.31) Check 12-14(0.47—0.55)	

·Tighten the locking nut of the tension pulley to the specified torque.

Tightening:

The torque of the locking nut of the tension pulley is 27 N·m(2.8 kg·m/20 lb·ft)

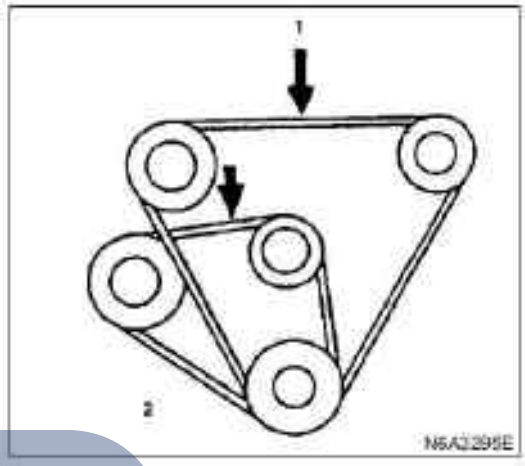
4JG2



Legend

1. Drive belt of the A/C compressor
2. Drive belt of power steering oil pump
3. Drive belt of AC generator and fan belt pulley

4JB1



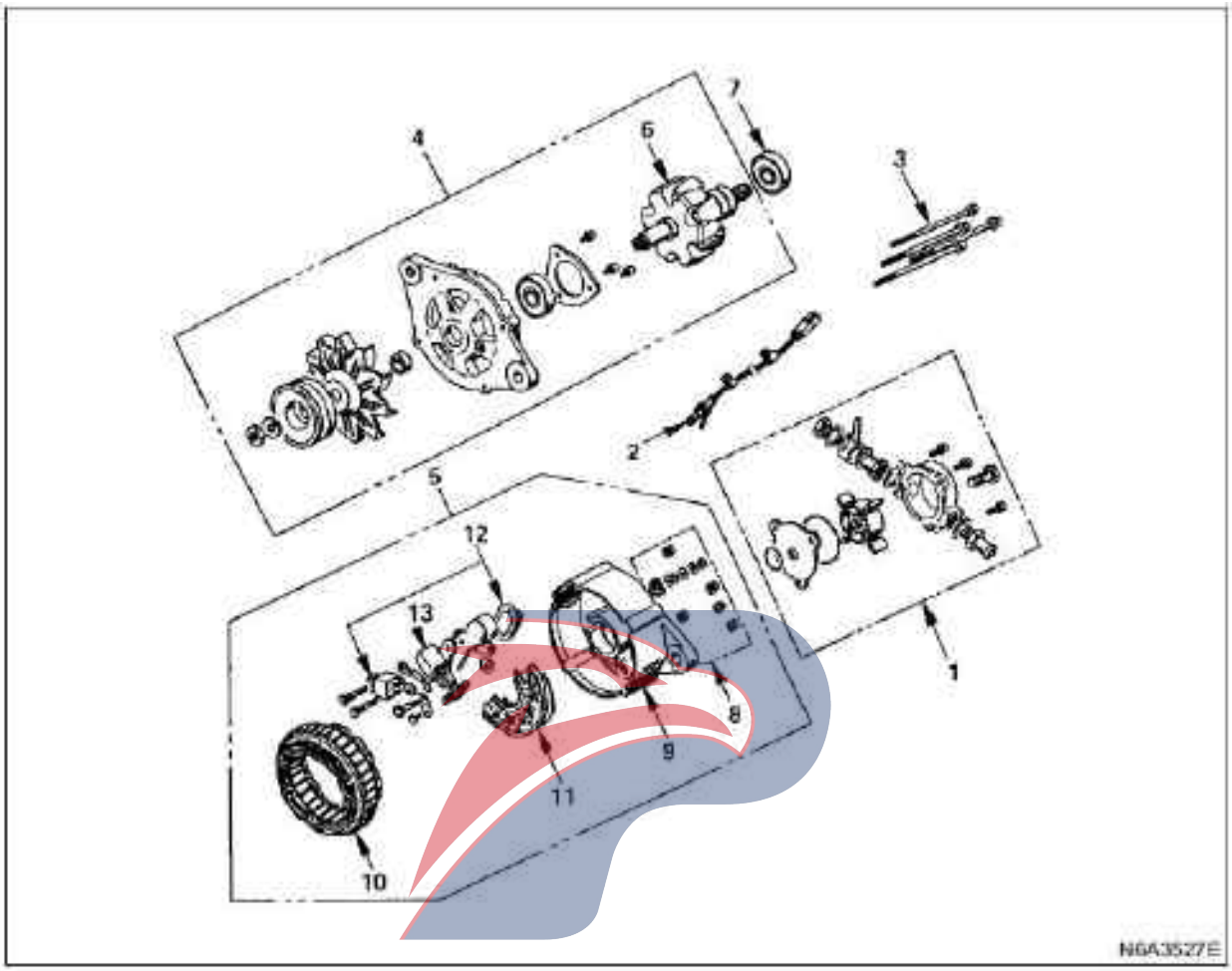
Legend

1. Drive belt of the A/C compressor and drive belt of the power steering pump
2. Drive belt of AC generator and fan belt pulley

·Connect the grounding wire of the storage battery.

Single piece maintenance

Parts 12V-50A



Legend

1. Vacuum pump
2. Lead
3. through bolt
4. Rotor and front cover assembly
5. Stator and rear cover assembly
6. rotor
7. Rear bearing
8. Terminal bolt and nut
9. Rear cover
10. stator
11. Diode
12. Integrated circuit regulator assembly
13. brush holder

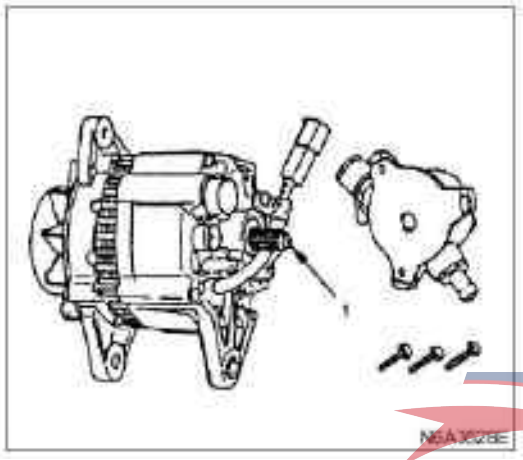
Dismantling

1. Vacuum pump

Discharge liquid from vent hole. Disassemble the fixing bolt of the vacuum pump. Hold the center plate, and disassemble the vacuum pump horizontally along the rotor axis.

2. Lead

3. through bolt



Legend

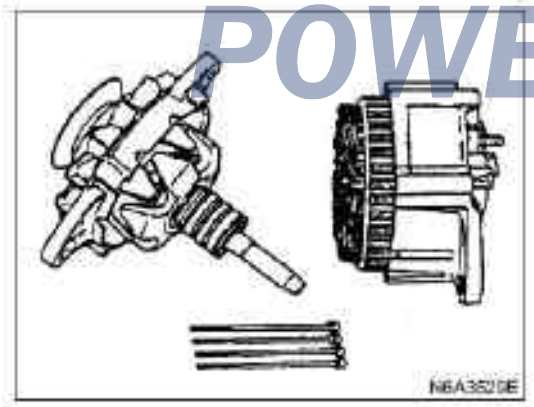
1. Oil seal protector

---

4. Rotor and front cover assembly

5. Stator and rear cover assembly

·Insert the screwdriver into the gap between the front cover and the stator iron core to disassemble the assembly.

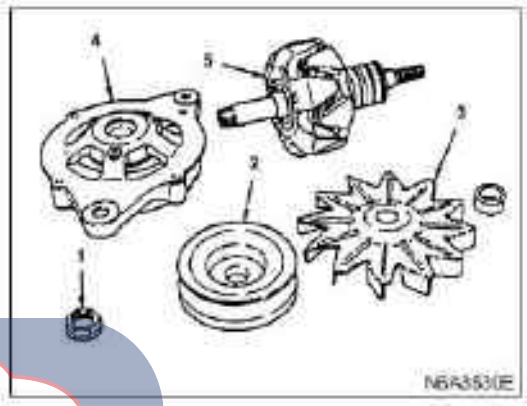


Caution:

Be careful not to damage the stator coil with the screwdriver. If the assembly cannot be disassembled, hold the back cover downward and tap the end surface of the shaft with a plastic hammer gently to disassemble it.

6. rotor

·• Clamp the stator with a vise, disassemble the nut of the pulley(1), then disassemble the pulley(2), fan(3), front cover(4), and rotor(5).



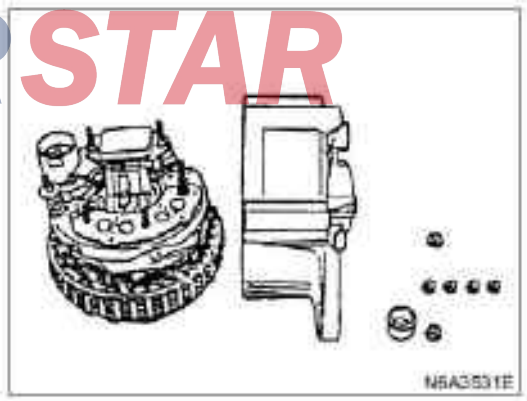
7. Rear bearing

8. Terminal bolt and nut

9. Rear cover

· Disassemble the bolt that fix terminal B and the diode bracket. Separate the stator and the back cover.

Pay attention to the position of the insulation washer and make sure to install it back to its original position.



10. stator

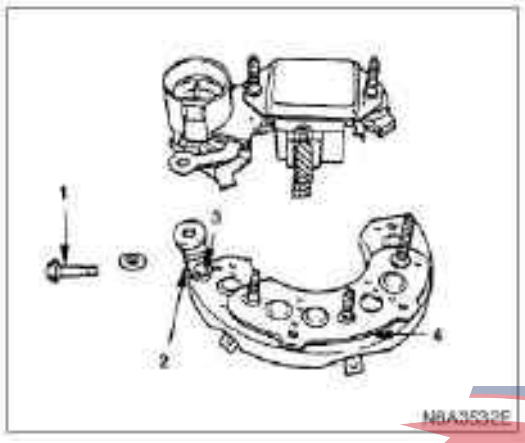
11. Diode

·Melt the solder on the stator coil and diode, and disassemble the diode from the stator.

When melting the solder, use a long nose plier to clamp the wire to prevent heat transferring to the diode.

12. Integrated circuit regulator assembly

·Melt the solder on the integrated circuit adjuster bracket, detaching the integrated circuit adjuster from the diode, and disassemble the bolt.



Legend

1. Terminal bolt
2. Terminal board
3. Rivet
4. Diode

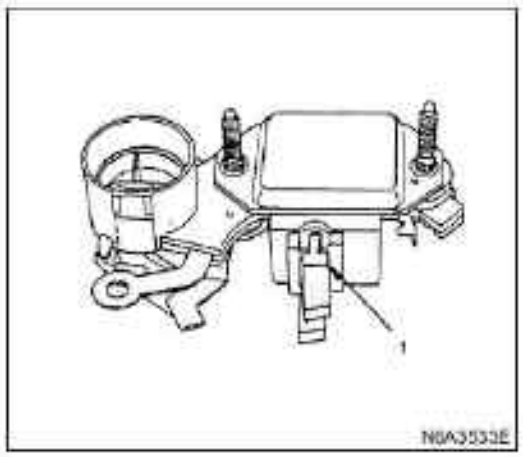
---

13. brush holder

·Disassemble the jagged bolt to melt the solder on the IC adjuster.

·Disassemble jagged bolt when replacing brush or capacitor.

Install in reverse order of disassembly steps.



Legend

1. Wear limit

Inspection and repair

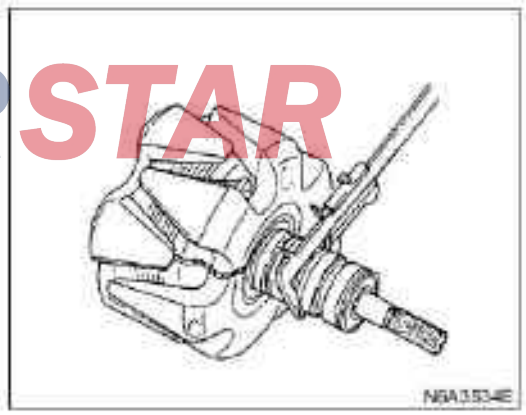
If any part is found worn or damaged when inspection, it should be repaired or replaced.

rotor

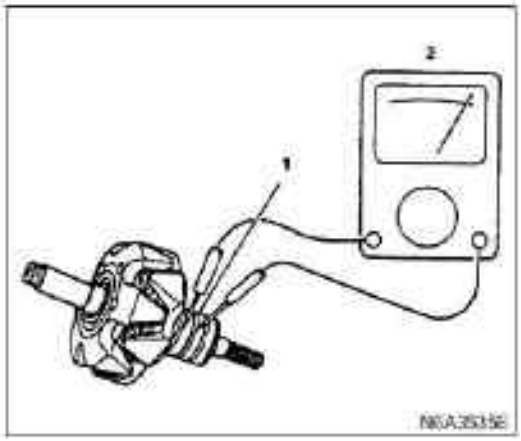
1. Check whether there is contamination and rough situation for the surface of slip ring of the rotor, if rough, grind with sandpaper # 500 - 600.

2. Measure the diameter of the slip ring and replace it if it exceeds the limit value.

	mm (in)
Limit	Standard
34.6(1.36)	33.6(1.32)

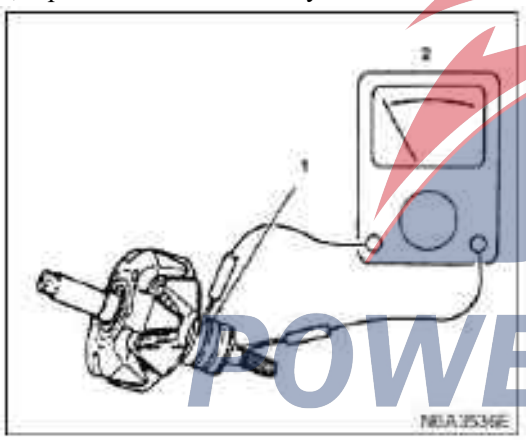


3. Check whether there is access between the slip rings, if it is open circuit, the rings should be replaced.



Legend
1. Slip Ring
2. Tester

4. Check whether there is access between the slip ring and rotor iron core or between the slip ring and rotor shaft.
If so, replace the rotor assembly.



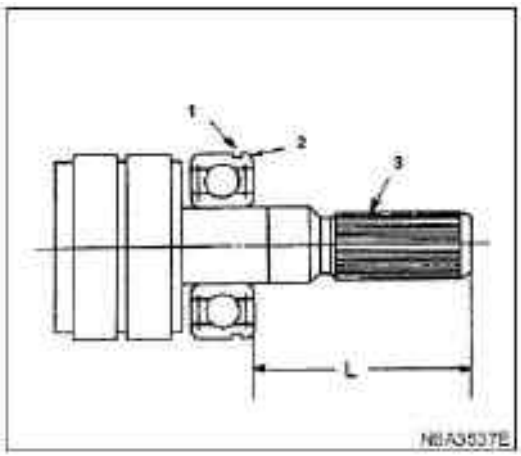
Legend
1. Slip Ring
2. Tester

Rear ball bearing

check whether the spherical bearing runs smoothly without noise.

If the rotation is not smooth, and with noise, it should be replaced. When install the bearing, the retaining ring should face toward the spline shaft and push the inner race of the bearing to press it in.

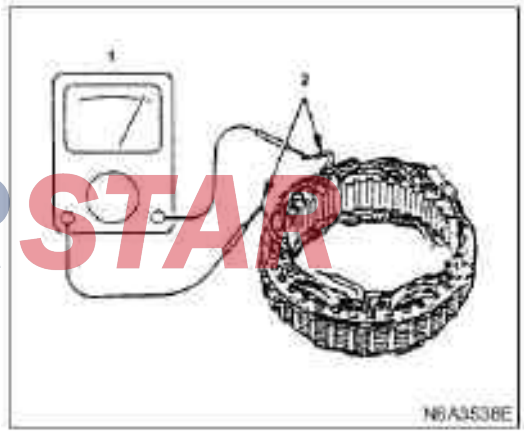
Pressure measurement for bearing L	
Standard	41.8 — 42.0(1.64 — 1.65)



Legend
1. Stop ring
2. Ball bearing
3. Spline shaft

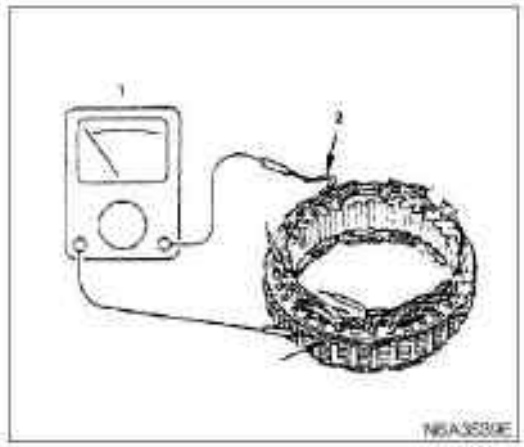
Stator coil

1. Check whether there is access between each status.
If it is open circuit, replace the stator



Legend
1. Tester
2. Lead

2. Check whether there is access between the stator coil and stator core, if it is open circuit, replace the coil.



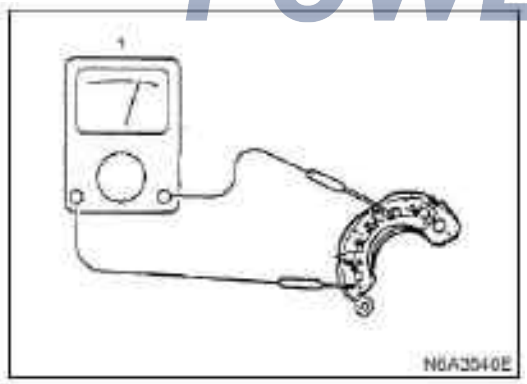
Legend

1. Tester
2. Lead

Diode

1. Check whether there is access between terminals(for example: BAT and U), if there is, the diode should be in good condition. If it is open circuit, there should be problems with the diode.
2. Switch polarity to test. If it is open circuit, the diode should be normal; If at any point of the circuit is closed, then there should be problems with the diode, and replace the diode.

The auxiliary diode is not fit for terminals and the circuit test should be conducted from the normal diode terminals.

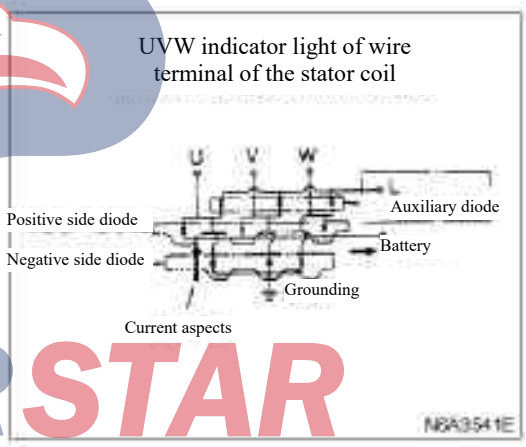


Legend

1. Tester

Inspection for negative side diode			
		BAT (positive(+) diode)	
	Tester connector	Positive pole side	negative pole side
U.V.W	Positive side		open circuit
	Negative side	passage	

Inspection for positive side diode			
		E(negative side(-) diode)	
	Tester connector	Positive pole side	negative pole side
U.V.W	Positive side		passage
	Negative side	open circuit	



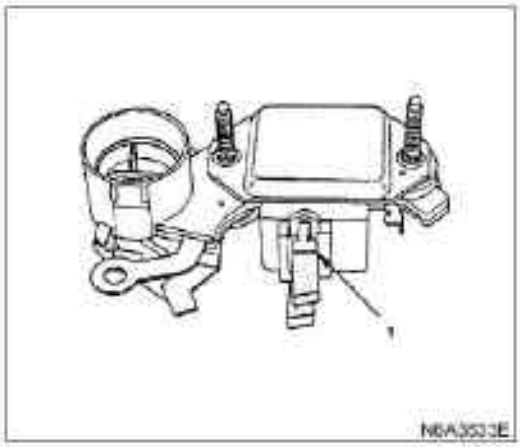
Electric brush

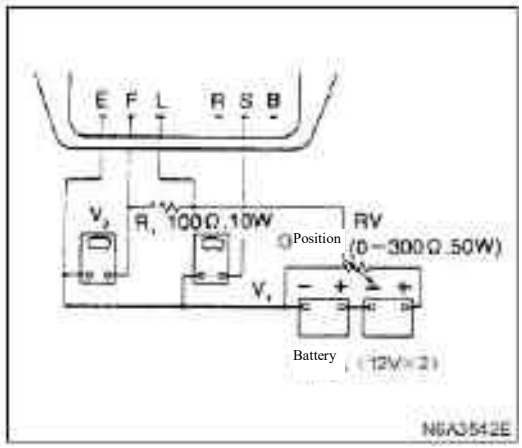
Measurement for the length of the brush

Brush length (L)

mm (in)	
Limit	Standard
20(0.79)	8(0.24)

The mark line on the brush indicates the limit value for use.





Legend

1. Wear limit

IC adjuster

There is a need for measuring instruments.

Make the following measurements and connect the instrument as shown in the picture below.

Voltage of V1 battery 1	V
Standard	10 — 13

Voltage V2 F-E	V
Standard	Limit value
2 or below	2 or over

V3 Measure the voltage of storage battery 1 and storage battery 2.	V
Standard	20 — 26

·Change the resistance from zero gradually by using a variable resistor and measure the voltage of E-F.

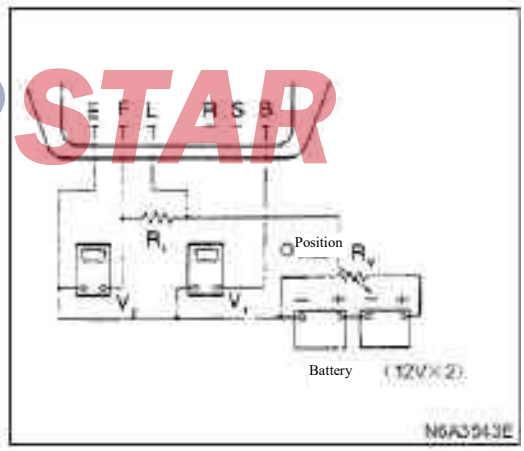
Then check for voltage rise from 2V to 10-13V.

If the voltage increase is blocked at any point, replace the adjuster

·V4 Measure the voltage at the middle tap on the variable resistor and the terminal "E" without changing the resistance.

	V
Standard voltage(68° F)	14.0 — 14.9

If the measured value does not match the standard, replace the adjuster.



Check the following, the connection for meter as shown in the pictures.

Use a variable resistor RV to raise the voltage gradually and measure the voltage at terminal B-E.

Check whether the voltage is less than 2V~10-13V.

If the voltage does not change, there should be problems with the adjuster, then replace it.

Check the voltage at the middle tap of the variable resistor and terminal E Without changing the resistance.

	V
Standard voltage20℃(68° F)	14.5 — 16.9

If the measured voltage value does not match the standard, replace the adjuster.

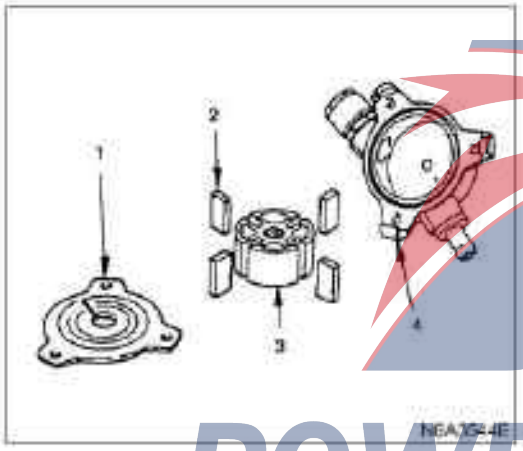
Vacuum pump

Visual inspection

·Check whether there is wear, damage or other unusual situations for the following parts.

Vacuum pump removal

·Center plate, rotor and blade.



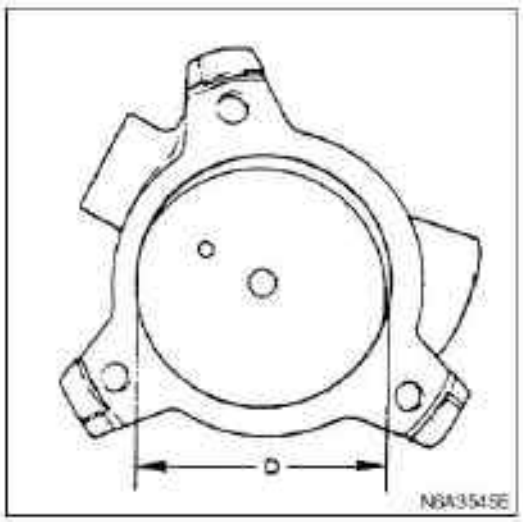
Legend

1. Center plate
2. Blade
3. rotor
4. Housing

Housing

·Measure the inner diameter of the shell and replace if it exceeds the standard.

	mm(in)
Standard	57.0 — 57.1 (2.244 — 2.248)



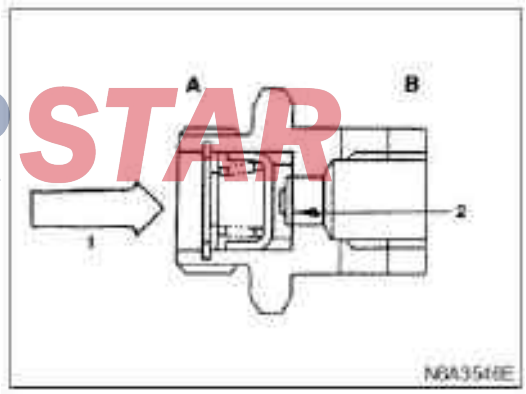
Blade

Measure the blade length

	mm(in)
Standard	12.5 — 13.5 (0.492 — 0.531)

Check valve

1. Check whether the valve operates well by using a screwdriver to press the side"B"of the valve gently.
2. Check whether there is gas leakage by appling compressed air 100 - 500 kPa (1 - 5 kg / cm2 / 14.5 - 72.5 psi) on the side "A" of the valve.



Legend

1. Compressed air
2. Advance

Reassemble

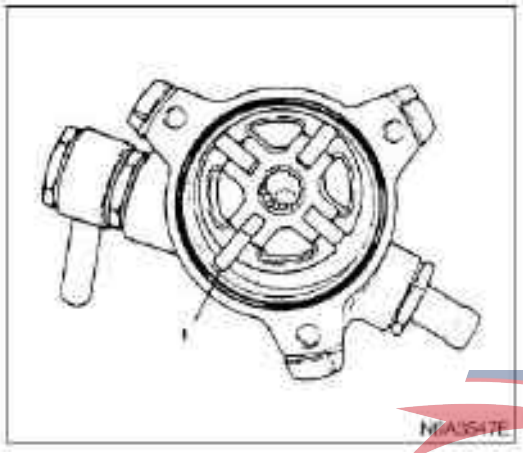
1. Place the rotor on the center plate and the shell with jagged protrusions upwards.

Align the holes of the center plate with the rotor.

2. Insert the blade into the slot in the rotor.

When installing the blade, make its chamfer side facing outwards.

3. Install O-ring and center plate



Legend

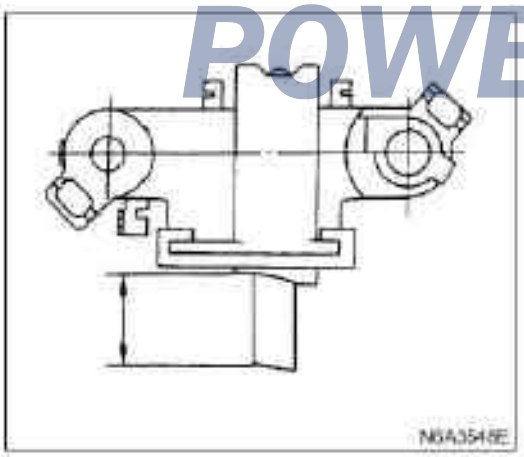
1. Chamfer side

Assembly

1. brush holder

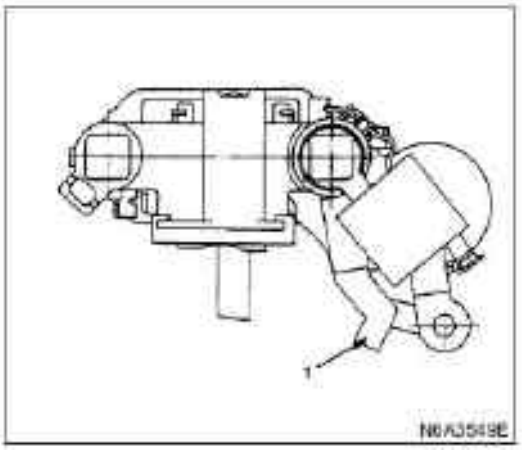
2. Integrated circuit regulator assembly

·Place the brush in the bracket as shown in the pictures and solder the wire with solder.



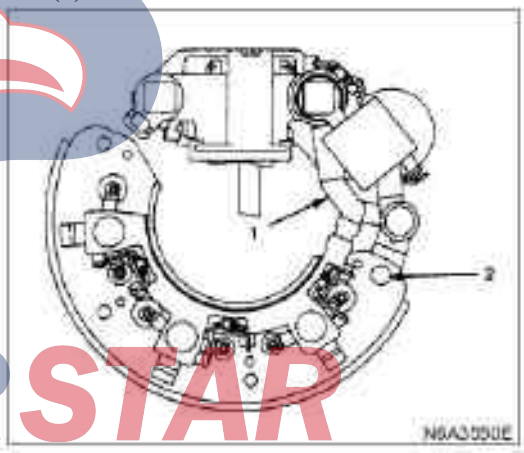
·Place the IC adjuster on the brush bracket and press in the bolt.

When pressing bolt, bushing and connecting plate must be installed.



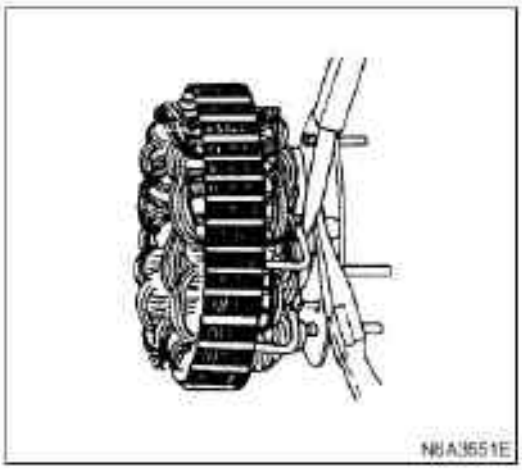
3. Diode

·Using rivets at position(1), solder the terminal at position(2) and connect the terminal.



4. stator

·When soldering wire of the stator coil and diode wire, use a long nose plier and complete as soon as possible to prevent heat from transferring to the diode.



5. Rear cover

6. Terminal bolt and nut

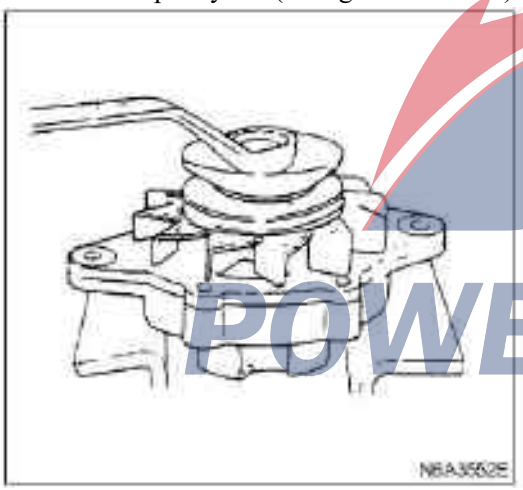
7. Rear bearing

8. rotor

Use a copper pad on the vise, clamp the rotor and tighten the bolt to the specified torque.

Tightening

90 N•m for the pulley nut (9.2 kg•m / 67 lb • ft)



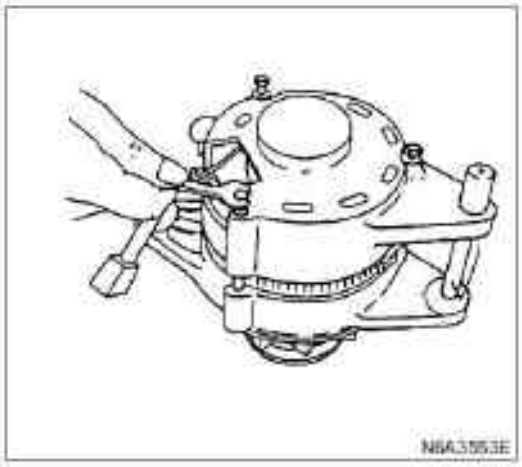
9. Stator and back cover assembly

10. Rotor and front cover assembly

11. through bolt

·Align the hole that the guide lever plugged into the front cover and the flange of the rear cover, and install the through bolt.

• Tighten the through bolts according to the specified torque



12. Lead

13. Vacuum pump

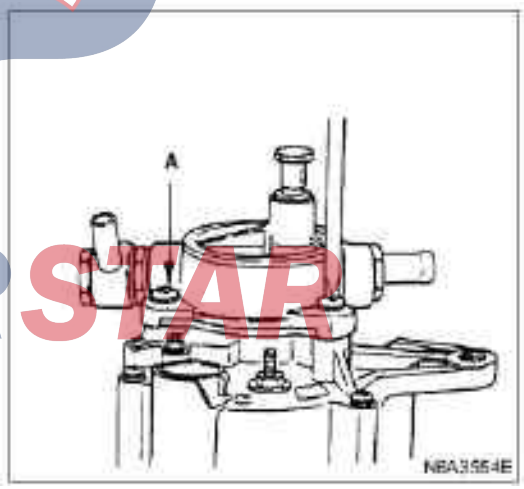
·Use three bolts to install the shell on the generator.

·Add oil (5cc) through the fill port and check whether the generator pulley is free to rotate by hand.

·Tighten the fixing bolt(A) of the pump to the specified torque.

Tightening:

3.5 N•m for through bolt (0.36 kg•m / 31 lb • in)



·Add oil(5 cc) through the fill port and check whether the pulley rotates smoothly.

QOS II preheating system(only applicable to 4JB1/4JB1-TC/4KH1-TC)

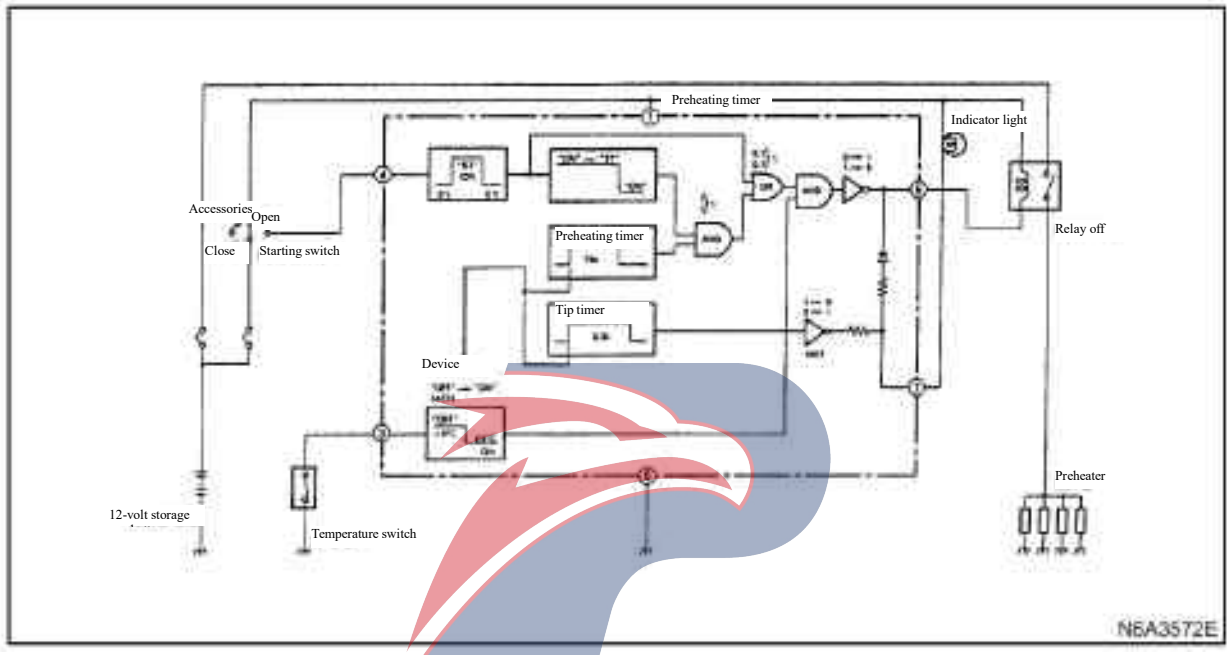
Overview

The feature of the QOS II preheating system is to use fast preheating plug, preheating time thermometer control and post- preheating time functions.

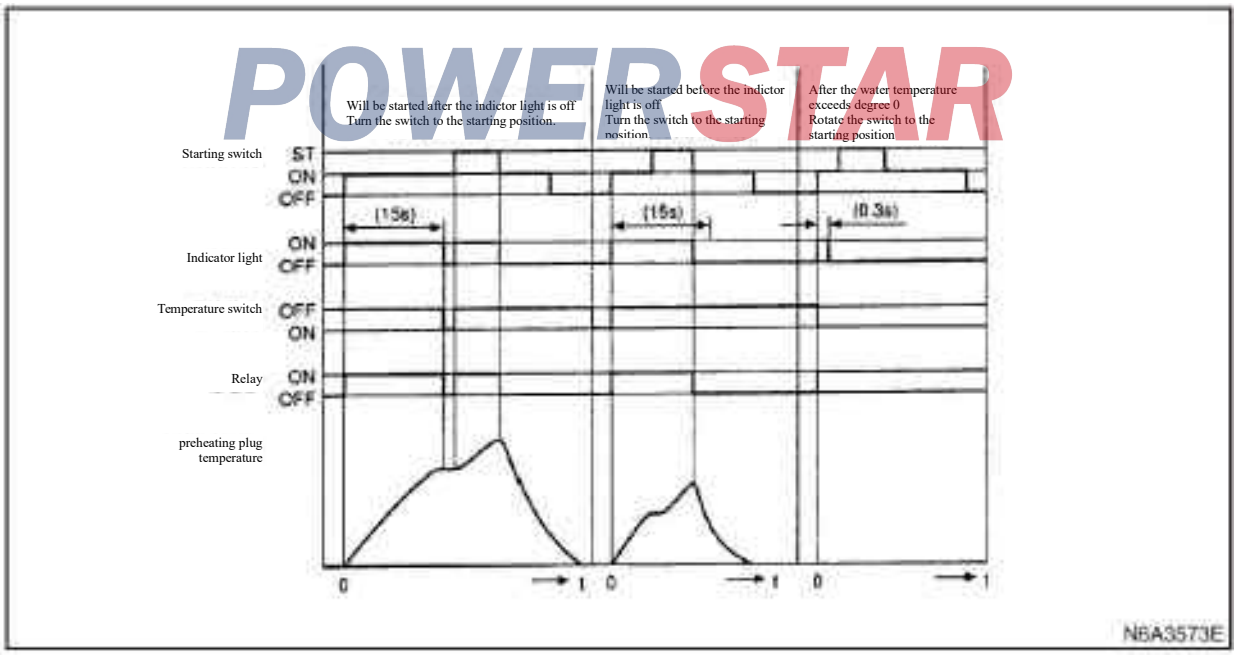
The system includes control, LED, temperature switch, relay and preheating plugs(4 pieces)

When using the temperature switch, the preheating time changes according to the coolant temperature of the engine to obtain the best starting condition.

System diagram



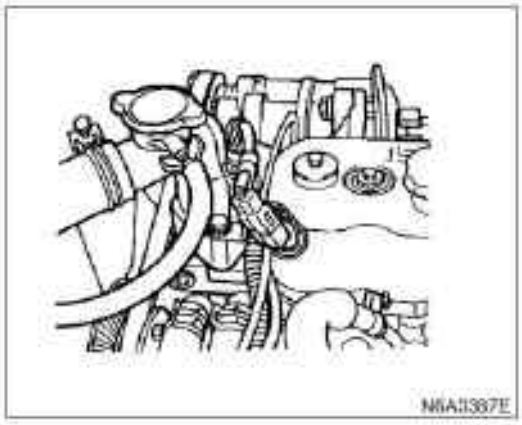
QOS Ⅱ timing diagram



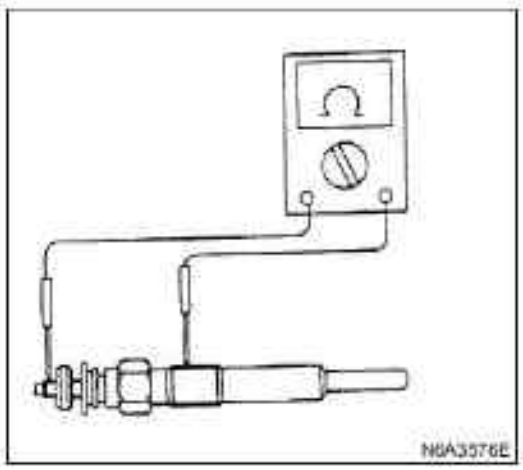
Check QOSII system operation

Temperature switch

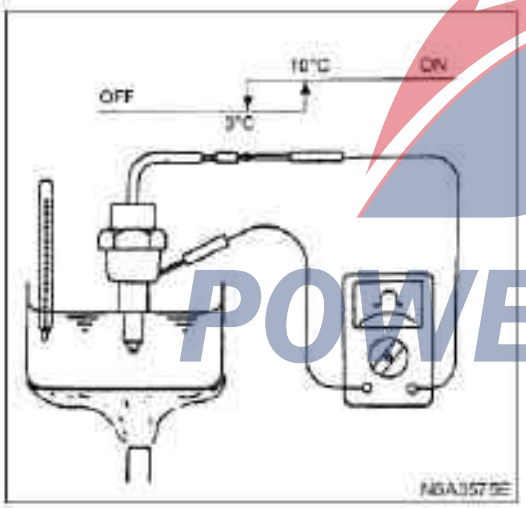
Temperature switch locates above the water outlet pipe.



Use line tester to check whether the temperature switch is on.



Off → On: 7 - 13 ° C
On → off: below 3 ℃

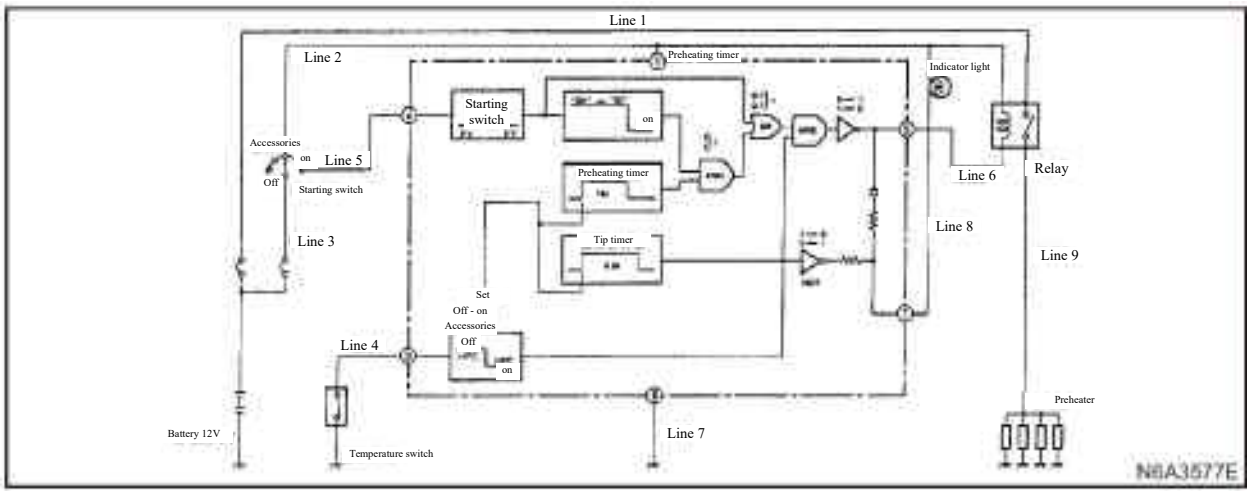


Glow plug

Use line tester to test whether the preheating plug is on.

Preheating plug resistance(standard)	Ω
Normal type	About 1.5
Quick starting type	About 0.9

QOSII system fault check and troubleshooting



1. Problems when the water temperature of the engine is below 0 ℃

Problem	Causes	Line
Preheating plug relay does not start	Poor fuse connection between storage battery and starting motor. Poor or broken circuit connection for the switch of the starting motor Poor or broken connection for the SBF8 fuse. Other lines fail at the same time Poor quality of the starting generator switch. Poor connection of the terminal of the preheating plug relay The excitation coil of the preheating plug relay breaks off The timing line of the preheating plug relay breaks off Poor quality of the preheating plug(the main contact is off power) Poor connection of the timer Poor timer quality Poor connection of grounding line of the timer Poor quality of the temperature switch(still at connected status when the water temperature is below 0 ° C) Temperature switch is shorted to ground.	3 2 1 6 7 7
Although the preheating plug relay is on, it is not preheated.	Poor connection of fuse between the storage battery and the preheating plug relay. Poor or broken connection for main contact terminal of the preheating circuit relay. Poor connection between the preheating plug connector and the preheating circuit.	1 9
Preheating plug relay is connected, but cannot be turned off	Poor timer quality 5 Poor connection or shorted circuit for the wire between the terminal 5and the preheating plug relay. Poor quality of the preheating relay	6
The indicator light is not on.	Poor timer quality Bulb burns out	8

Caution:

See the preheating chart for line numbers.

2. Problems when water temperature of the engine is 0 °C or above

Problem	Causes	Line
The indicator light is not on.	Poor timer quality 8 Bulb burns out	8
Preheating relay connected	Poor quality of the temperature switch or open circuit for switch. (Indicator lights for 3.5 seconds) Poor timer quality Poor timer quality Short circuit or short grounding between terminal 5 and preheating relay.	4

Caution:

The line number is shown in the preheating chart above.

3. Preheating plug burns out

When only one wire burns out, it does not afftect the starting of the engine. Even if one line burns out, judge according to the characteristic of the preheating plug, the applied voltage should only change slightly.

Therefore, it is not possible to judge by normal test method after the preheating plug is installed. Disassemble the preheating plug from the connector and check their continuity respectively in order to check whether the line has broken off or burned out.

QOS III preheating system (only applicable for 4JG2)

Overview

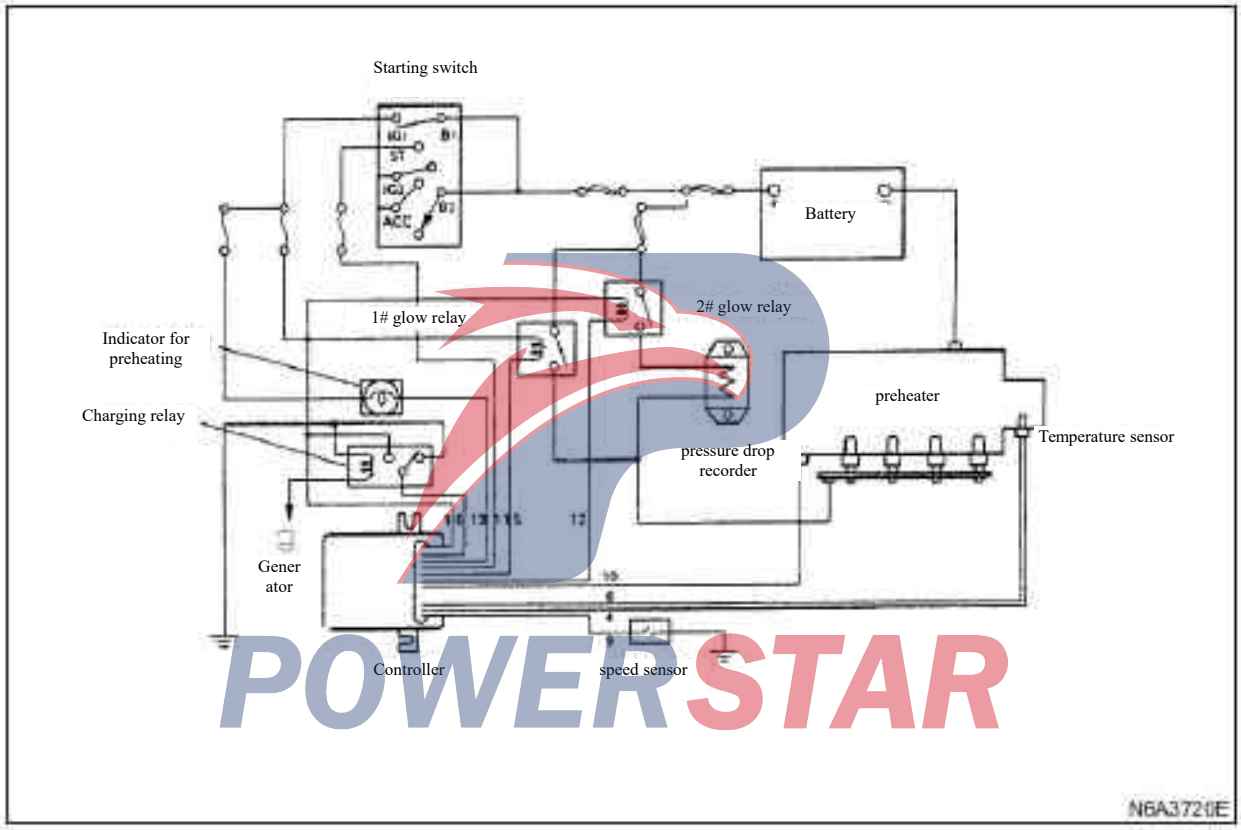
The QOS III preheating system adopts quick preheating plug, preheating time controller control and post-heat time function.

The system includes a controller, LED, vehicle speed sensor, pressure reducing resistor, relays(2), temperature-self controlled preheating plugs(4)

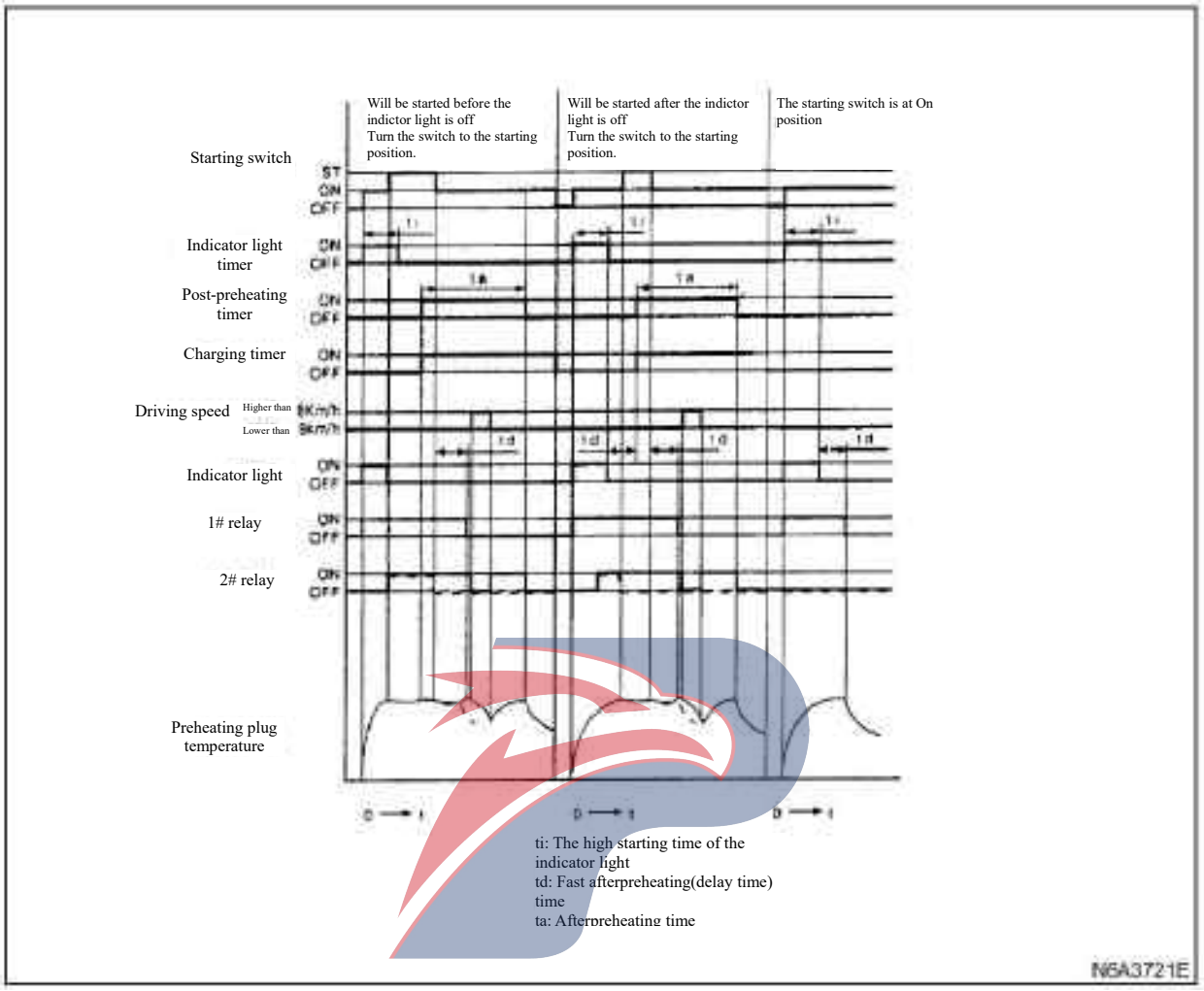
Use the temperature switch, change preheating time according to the coolant temperature of the engine to obtain the best starting condition.

The post-thermal time function is controlled by the temperature sensor, vehicle speed sensor and engine stall sensor(charging relay).

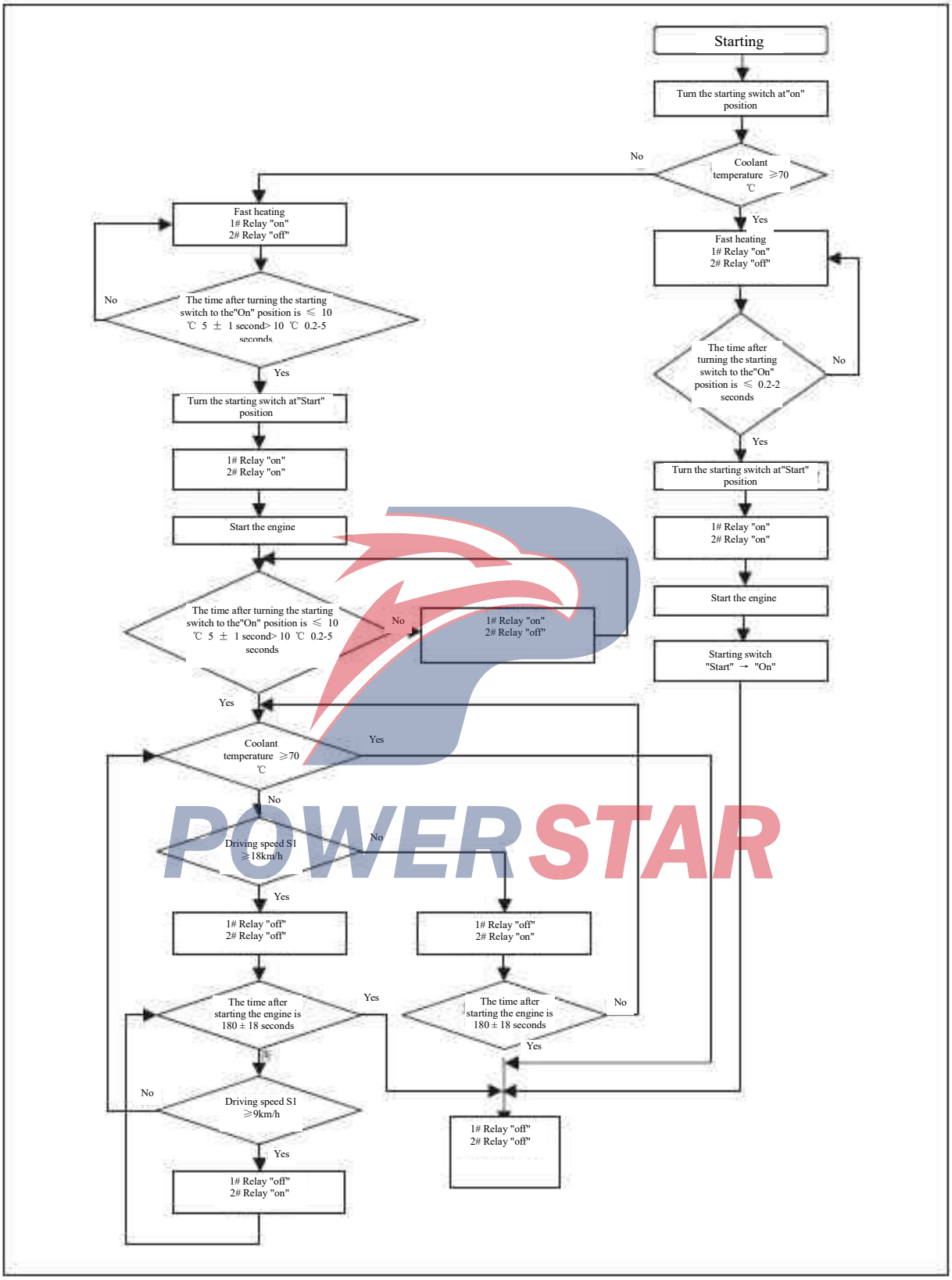
Electrical schematic diagram



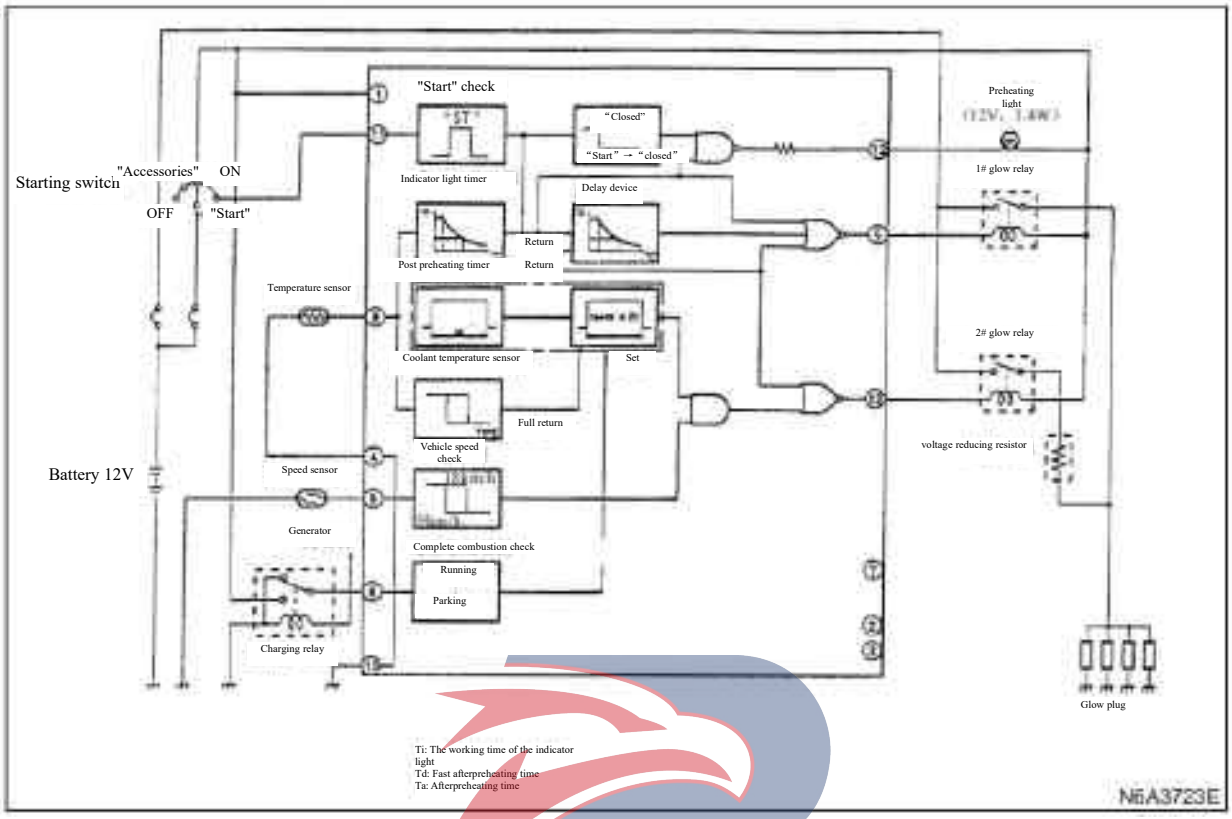
Electrical schematic diagram



QOS III timing diagram



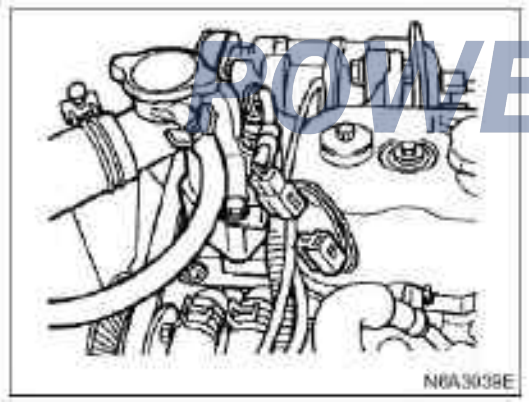
QOS III timing diagram



QOS III system operation check

Fast heating operation check

1. Disconnect the temperature sensor on the thermostat shell.



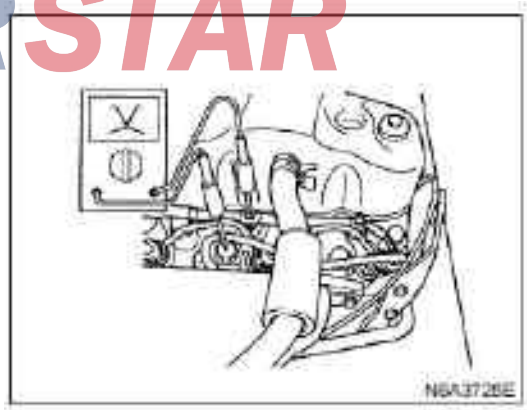
2. Connect the line tester between the glow plug and engine GND.

3. Check the following items, the starting motor switch is set at"On" position(but do not start the engine).

1) Preheating indicator light is on for 1-6 seconds.

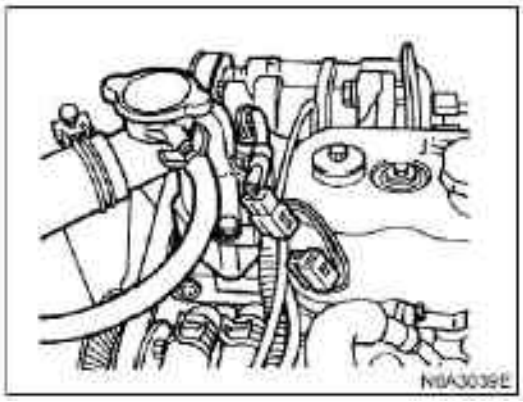
2) The line tester shows the power supply voltage for 9-13 seconds.

·If the above requirements cannot be met, check wiring, preheating relay and temperature sensor. If it is good, check the preheating plug.



Check quick preheating operation

1. Disconnect the temperature sensor from the thermostat shell.



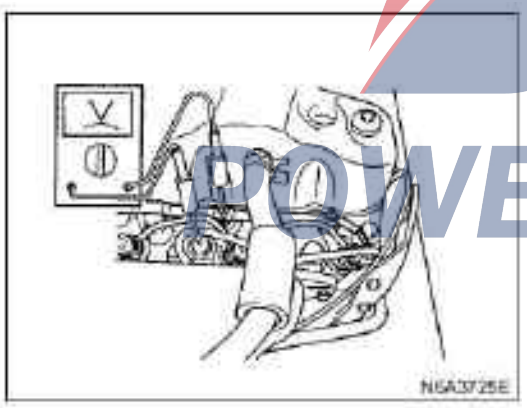
2. Connect the line tester between the glow plug and engine GND.

3. Start the engine and check the following items:

1) The line tester shows the power voltage for about 5 seconds.

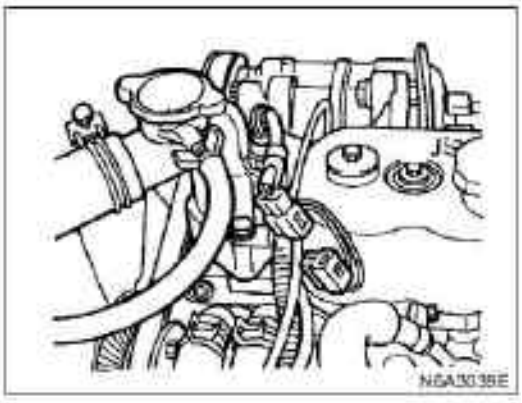
· If the above requirements are not met, check the storage battery voltage, engine ground, wiring and "Start"signal from starting switch to the control device.

If there is no problem, check wiring, engine ground and starting switch.



Check whether it runs after the preheating.

1. Disconnect the temperature sensor from the thermostat.

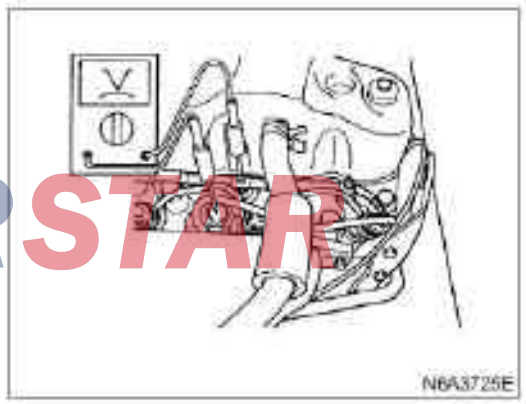


2. Connect the line tester between the glow plug and engine GND.

3. Start the engine and check the following items:

1) The voltage displayed on the line tester 360 seconds after the engine is started is approximately 7 volts.

· If the above requirements cannot be met, check storage battery voltage, engine ground, wiring, preheating plug, pressure relief resistor, relay No. 2, and charging relay.

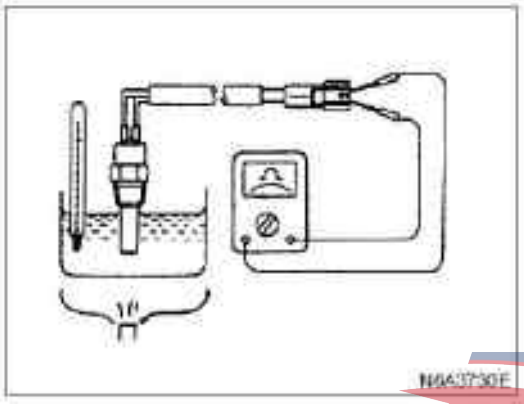


Temperature sensor

Measurement the resistance according to the water temperature, as the left number shows.

(Measuring range: 10 ℃ - 50 ℃)

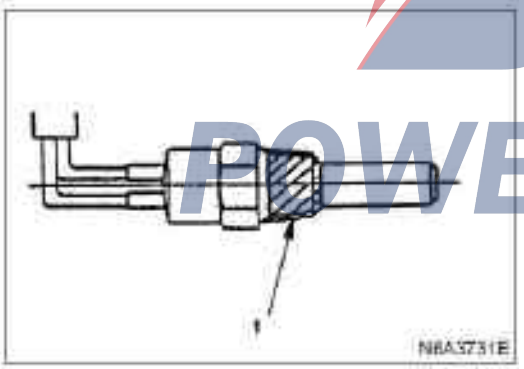
Temperature	Current (mA)	Resistance (KΩ)
20±1	1.0	2.0 - 3.0
50±1	1.0	0.68 - 1.0



When installing the temperature sensor, use a sealant(Loctite # 262 or the like) in the gap to prevent water leakage.

Tightening:

8 N•m for the temperature sensor (0.8 kg•m / 69 lb • in)



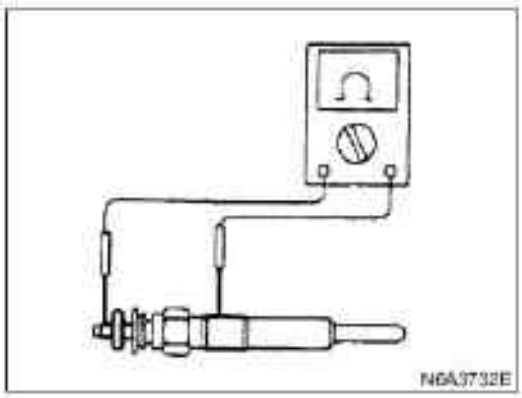
Glow plug

Check the resistance.

Resistance at room temperature	Ω
0.8 — 1.0	

Tightening

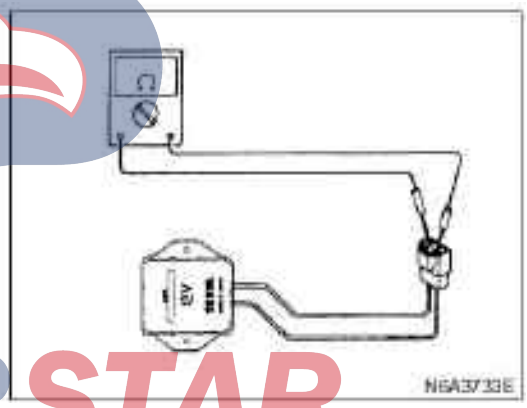
23 N•m for the preheating plug (2.3 kg•m / 17 lb • ft)



Voltage reducing resistor

Check the resistance.

Resistance at normal ambient temperature	Ω
225 — 255	



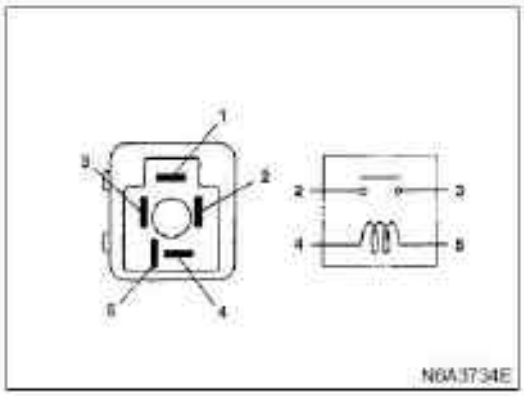
Glow plug relay

Check for connection.

2 — 3	open circuit

If the storage battery voltage is applied to terminals between 4-5,

2 — 3	passage



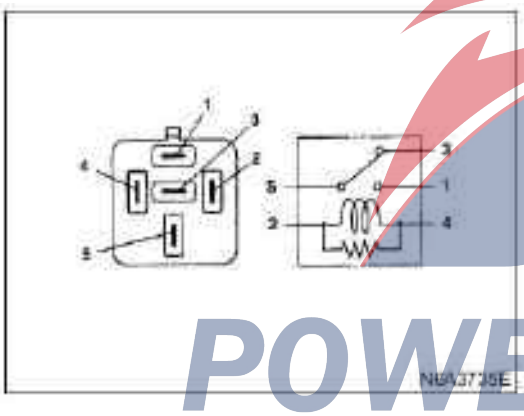
Charging relay

Check for connection.

3 — 5	passage
1 — 5	open circuit

If storage battery voltage is applied to terminals between 2-4.

3 — 5	passage
1 — 5	open circuit



4J series engine
Section 6E
Exhaust gas recirculation(EGR) system

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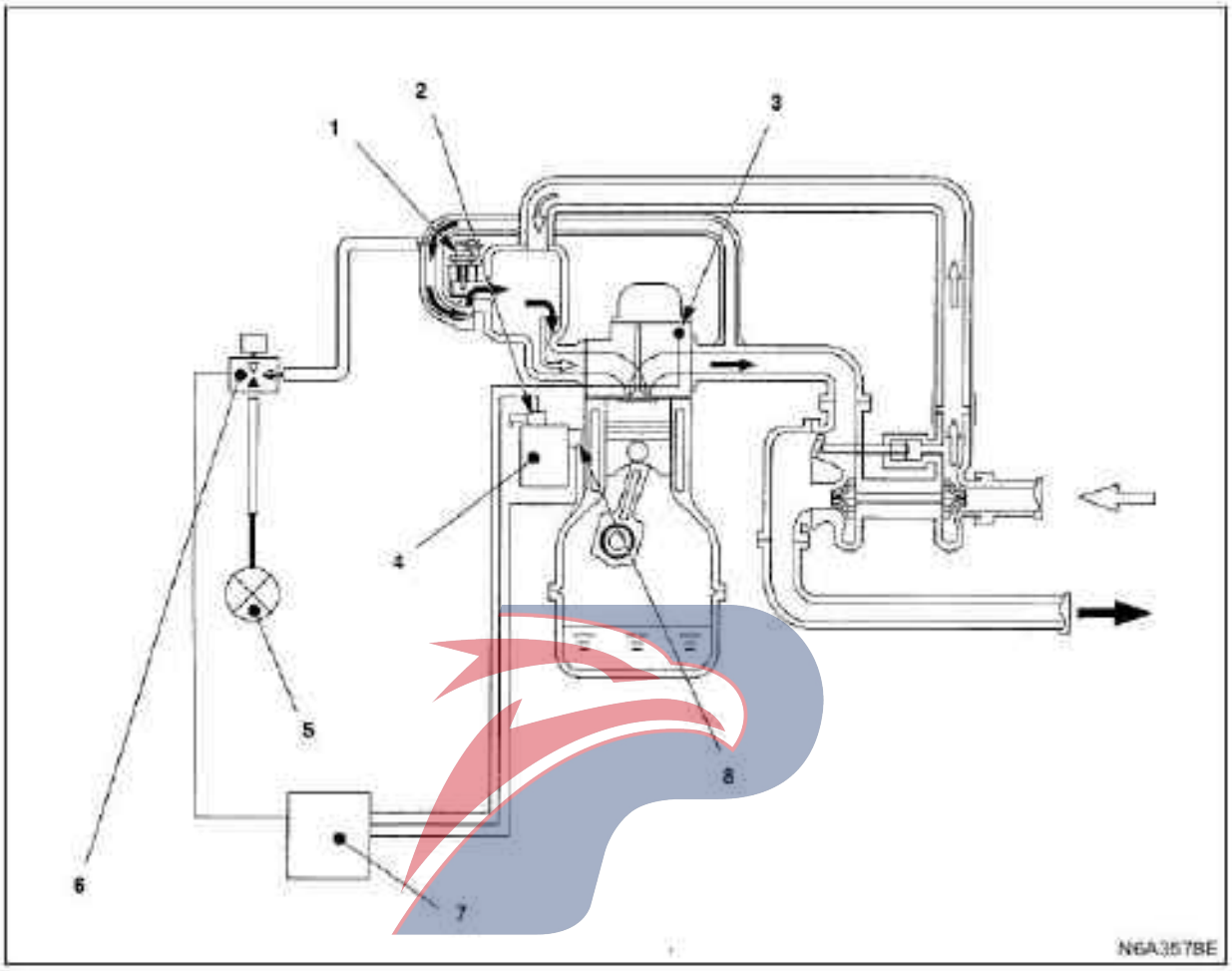
Pages

Overview

4JB1-TC



Legend

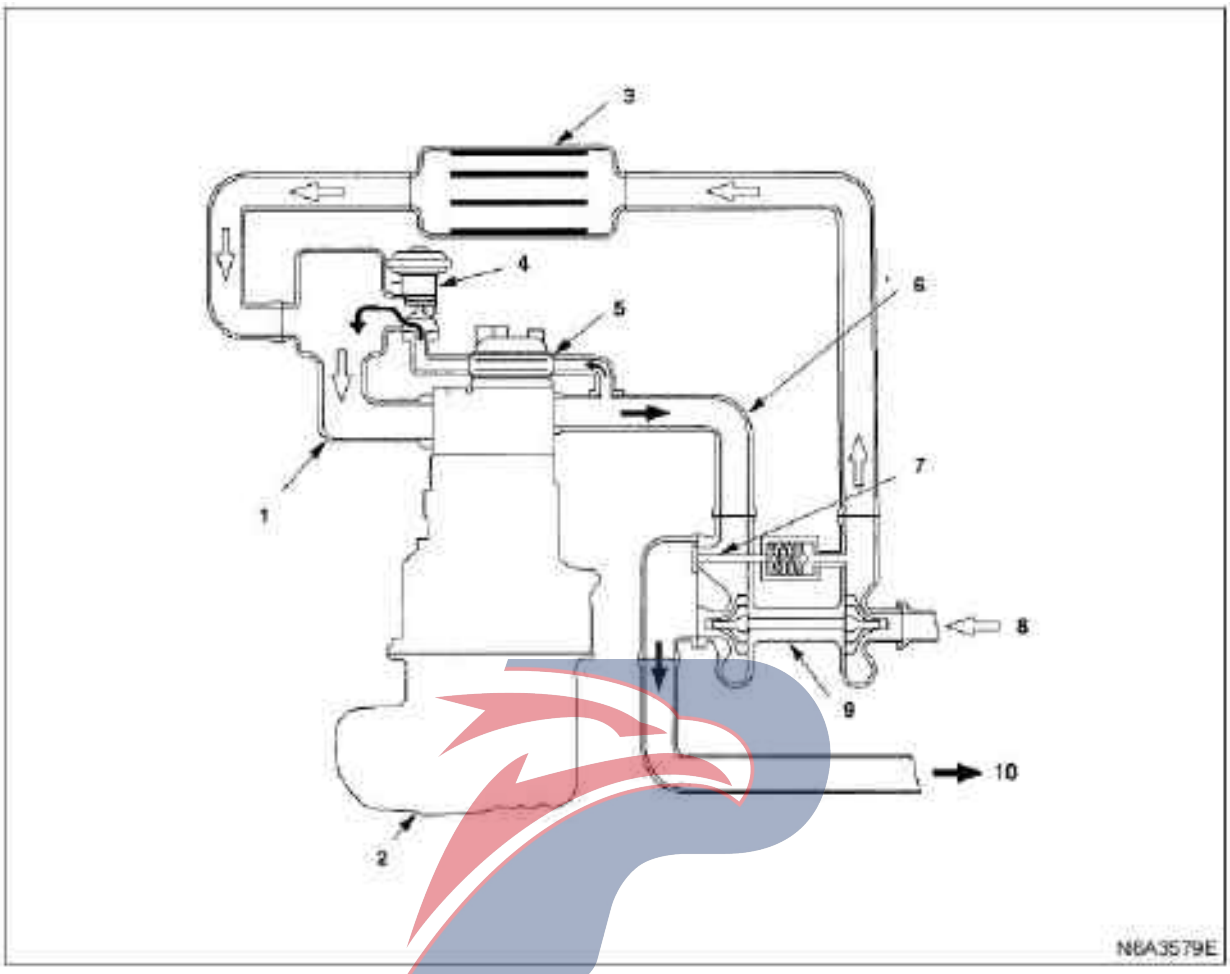
1. EGR valve
2. Potentiometer
3. Thermal switch
4. injection pump
5. Vacuum pump
6. Vacuum switch valve
7. EGR controller
8. Engine speed sensor

Through the intake manifold, the EGR system recirculates the exhaust gases into the combustion chamber, which reduces the emission of the nitrogen oxide gas.

The vacuum switch valve controls the EGR valve, and the EGR controller also controls the vacuum switch valve accordingly to signals from the engine speed sensor gauge and potentiometer.

The rotational rounds of engine and the“On” number of accelerator determine the amount of EGR gas.

4KH1-TC



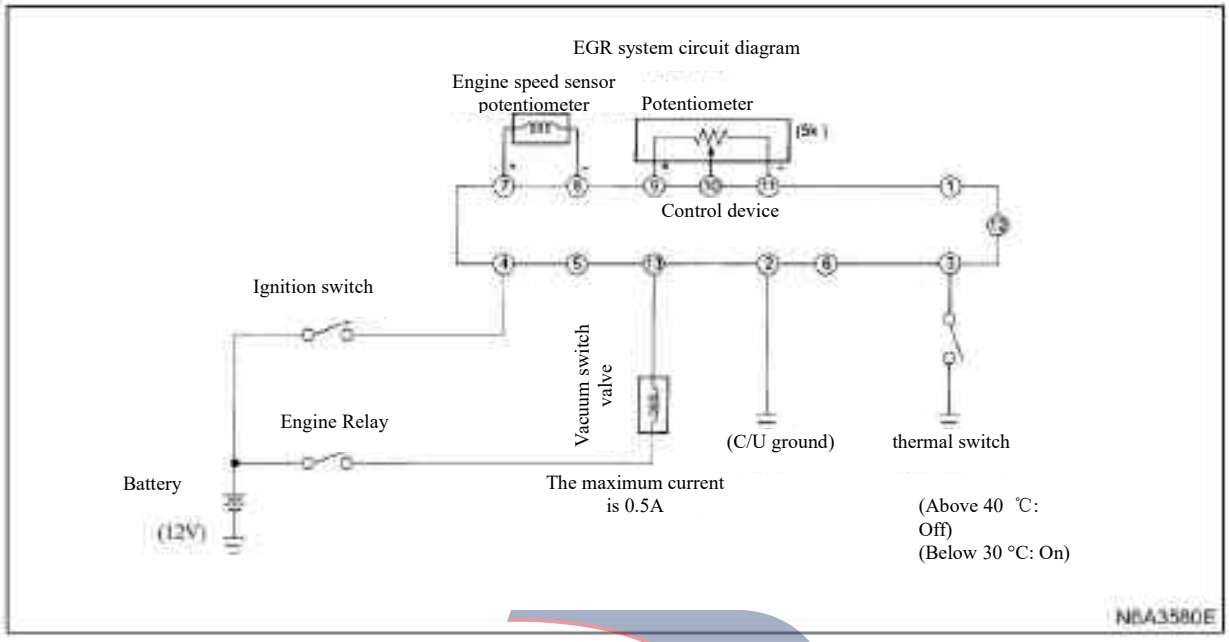
Legend

1. Intake manifold
2. Oil sump
3. Intercooler
4. Exhaust gas recirculation (EGR) valve
5. EGR cooler
6. Exhaust manifold
7. Waste gas bypass valve
8. Fresh air
9. Turbocharger
10. Exhaust

The 4KH1-TC engine is equipped with an EGR cooler.The EGR cooler can reduce the temperature of the air drawn into the engine as well as the combustion temperature. Therefore it reduces the emission of the nitrogen oxide gas.

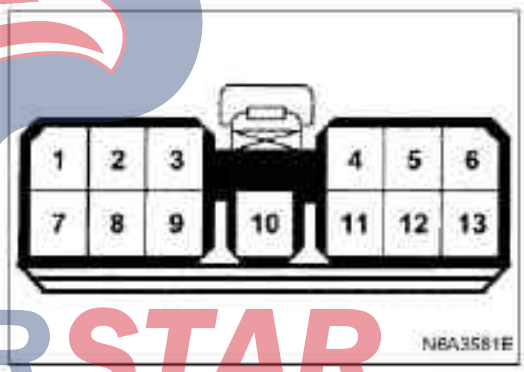
EGR system circuit diagram

Applicable for 4JB1-TC / 4JG2



1. Connector pins distribution

Number	Connector name
1	-
2	Storage battery (-)C/U Ground
3	Thermal switch
4	Battery (+)
5	-
6	-
7	Engine speed signal (+)
8	Engine speed signal (-)
9	Potentiometer (+)
10	Potentiometer
11	Potentiometer (-)
12	-
13	Vacuum switching valve (VSV)



EGR system running

1. At the input side of the engine speed, provide a hysteresis speed of 50 rpm toward the rising side of the speed.
2. The EGR system does not start running until 70 seconds after engine starts.
3. The EGR system does not operate while the water temperature switch is On (≤30 ° C).
4. When the engine speed drops from 3800 rpm or higher, the EGR system should stop for 25 seconds.

Exhaust gas recirculation (EGR) system check

Step	Operating steps	Rated value	Yes	No
1	Check if theEGR valve is loose. Is the ERG valve loose?	-	Go to step 2	Go to step 3
2	Fixed ERG valve Is it to be fixed?	-	Repair	-
3	1. The engine is "Off" 2. Ignition switch is "On" 3. Use a grounding test light to check the ERG valve and ignition EGR harness between power supply circuit. Is the test light turned on?	-	Go to step 5	Go to step 4
4	Repair the ignition power supply circuit of the EGR harness. Is the fault removed?	-	Repair	Go to step 5
5	1. Disassemble the ERG valve 2. Conduct visual and physical inspection of EGR valve stem, valve channel, and adapter to see if there is excessive sediment, clogging or throttling problems. Is there any sediment, blocking or throttling problems for ERG valve?	-	Go to step 6	Go to step 7
6	Clean or replace the EGR system parts as necessary. Is the fault removed?	-	Repair	Go to step 7
7	1. Disassemble the EGR inlet & outlet pipe from the intake & exhaust manifolds. 2. Conduct visual and physical inspection of manifold EGR outlet and EGR intake & exhaust pipe to see if the pipe is clogged or throttled due to excess sediment or other damage. Is there any excess sediment, obstruction, or throttling problems for the manifold EGR outlet or EGR inlet & exhaust pipe?	-	Go to step 8	EGR system runs normally and no fault has been found.
8	Clean or replace the EGR system parts as necessary. Whether to clean or replace?	-	Repair	-

Check

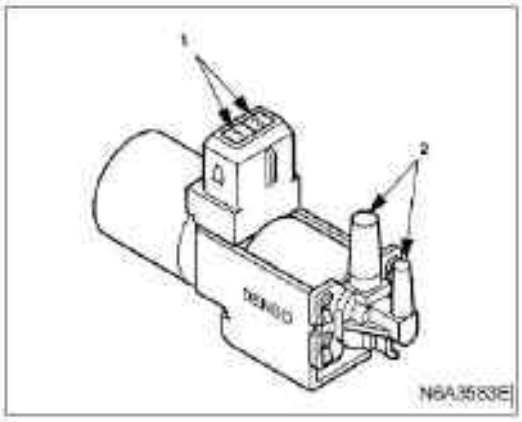
Vacuum switching valve (VSV)

Use a circuit tester to check the resistance between the VSV terminals.

Cold resistance: 37 - 44 (Ω) (for 12V)

Connect the storage battery voltage between the VSV terminals to ensure the continuity of the outlet.

Legend	Tool No./description /remarks
	5-8840-0366-0 / High impedance multimeter (Digital Voltmeter-DVM)
	5-8840-0279-0 / Vacuum pump with meter



Legend

1.2 pin

2. Outlet

EGR valve

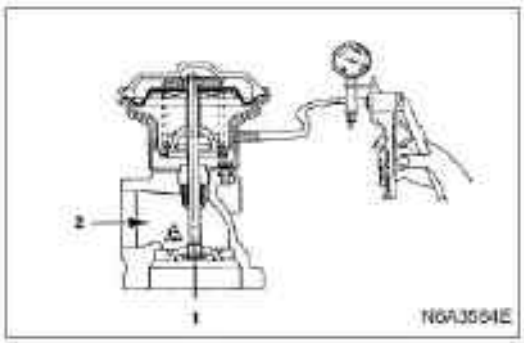
Negative pressure is applied to the diaphragm chamber to ensure that the EGR valve can be driven smoothly to vent between (1) and (2).

Starting pressure: -18.66 ± 2.67 kPa (-140 ± 20 mmHg) or so

Check whether the EGR valve is driven normally under the following conditions:

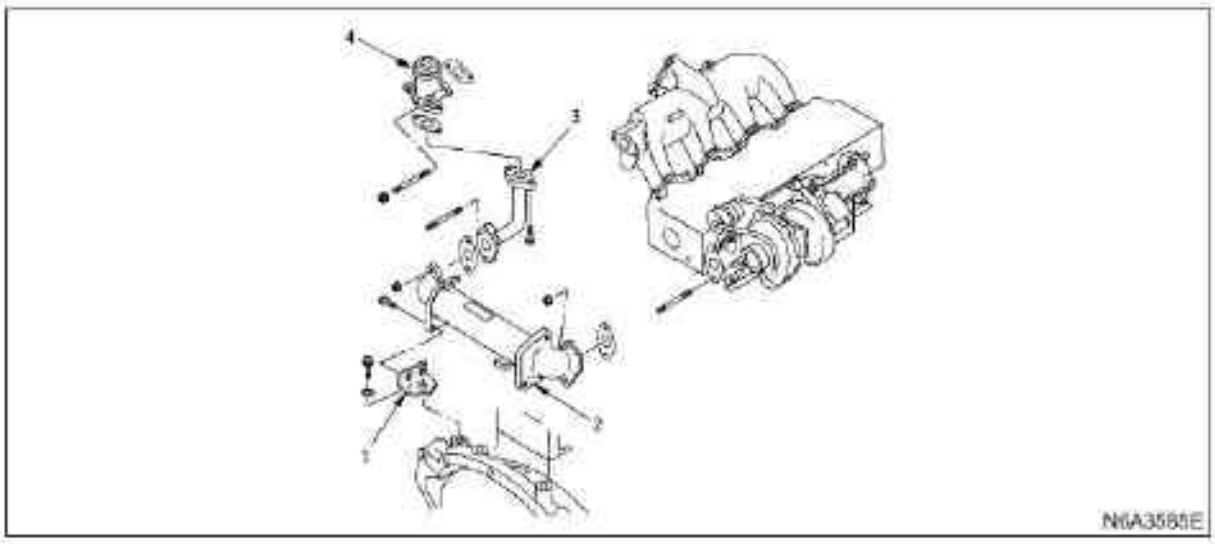
(After preheating) QWS is off

Engine coolant temperature: ≥80 ℃



EGR cooler

Parts



Legend

1. EGR cooler bracket
2. EGR cooler
3. EGR pipe
4. EGR valve

Dismantling

Preparation

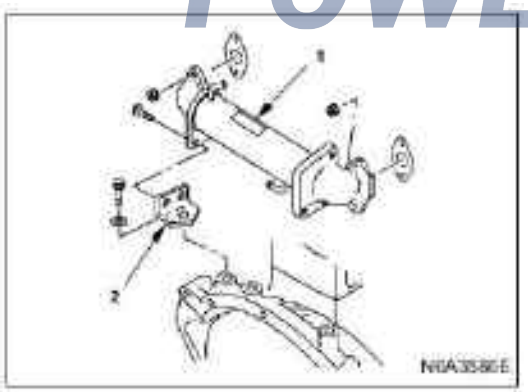
·Disconnect the grounding wire of the storage battery.
·Discharge coolant.
·Disassemble the water inlet hose.

1. EGR cooler bracket

Disassemble the bracket from the flywheel shell.

2. EGR cooler

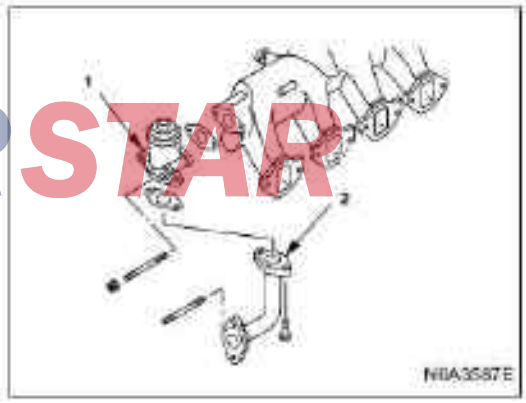
Unscrew the fixing nut of the EGR cooler. Disassemble the cooler together with the gasket.



Legend

1. EGR cooler
2. EGR cooler bracket

3. EGR pipe
4. EGR valve



Legend

1. EGR valve
2. EGR pipe

Install

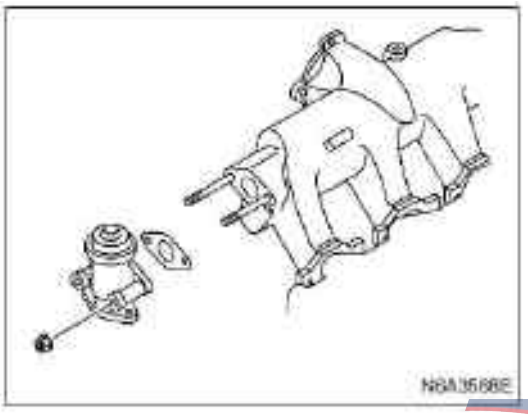
1. EGR valve

·Install the gasket on the intake manifold.

·Install the EGR valve and tighten the nut to the specified torque.

Tightening torque:

• 24 N·m (2.4 kg·m/17 lb·ft)



2. EGR pipe

·Install the gasket on the EGR valve.

·Install the EGR tube and tighten the bolt to the specified torque.

Tightening torque:

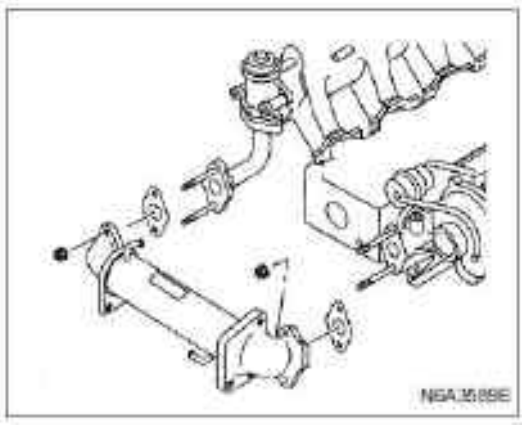
• 19 N·m (1.9 kg·m/14 lb·ft)

3. EGR cooler

·Install the gasket on the EGR pipe and exhaust manifold.

·Install the EGR cooler.

· Tighten the nut properly(but do not screw them dead).

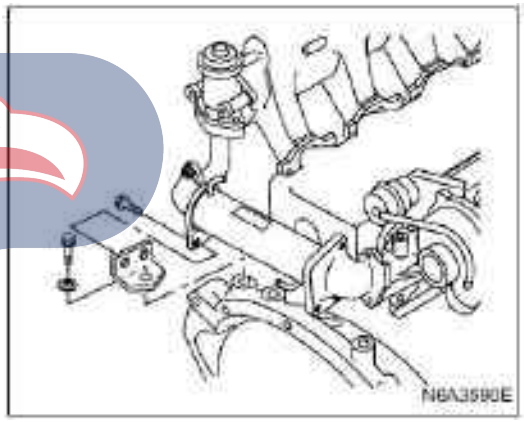


4. EGR cooler bracket

·Install the bracket on the EGR cooler.

·Install the gasket on the side of the flywheel shell

·Tighten the nut properly (but do not screw them dead).

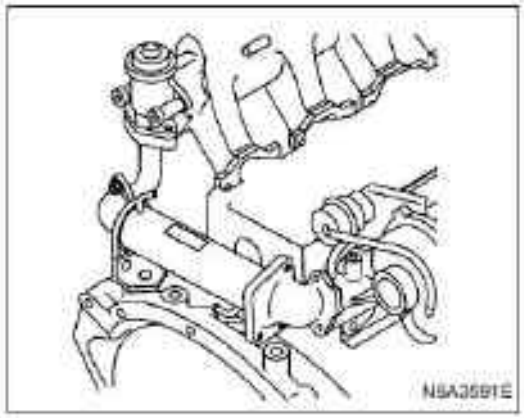


Tighten the nut and bolt to the specified torque in the order showing below.

Tightening torque:

·Nut torque: 24 N·m (2.4 kg·m / 17 lb·ft)

·Nut torque: 19 N·m (1.9 kg·m/14 lb·ft)



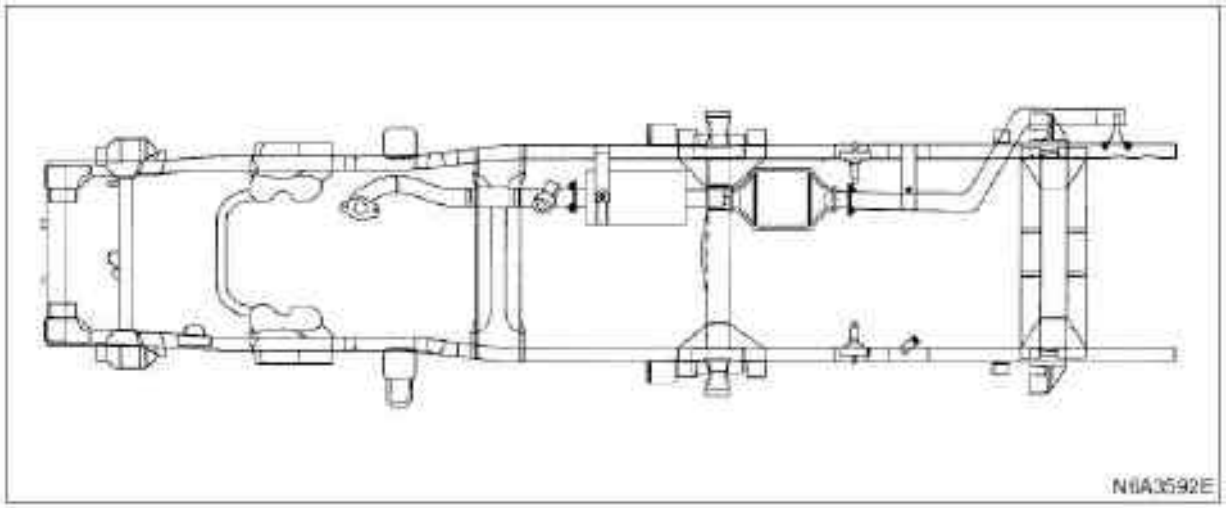
4JS eries engine
Section 6F
Exhaust system of engine

Table of Contents

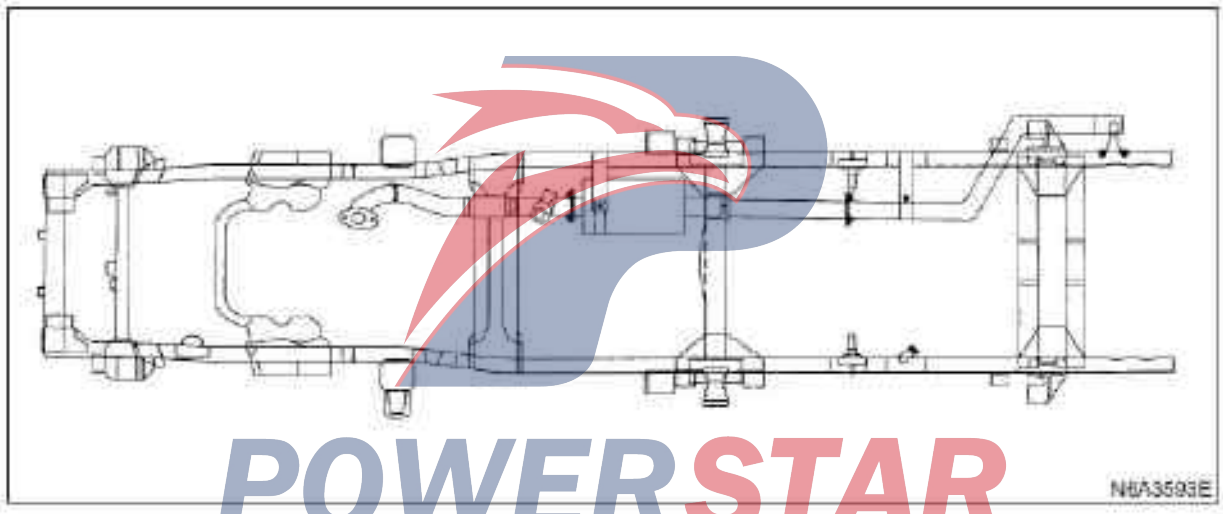
Caution:
The exhaust system components must keep a distance from the vehicle body base to prevent overheating of the vehicle bottom floor or damage to the passenger compartment, insulation and decorative materials.

Overview

Three-way catalytic converter is available



Three-way catalytic converter is unavailable.

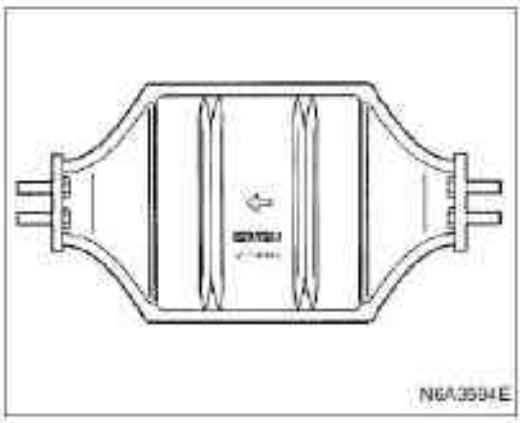


When inspecting or replacing the exhaust system components, make sure that sufficient clearance is maintained between each service and the vehicle body base to prevent overheating of the vehicle floor, or damage to passenger compartments, insulation and decorative materials.

Check the entire exhaust system and bod part nearby as well as the rear compartment to check whether there is any damage, loss or misalignment of components, crack, opening, unfirm connection or other problems that may cause quality defect situation such as the exhaust fumes enter into the rear or passenger compartment. If there is dust in the rear compartment, there should be a problem with a certain part. Any fault parts should be repaired immediately.

Three-way catalytic converter

A three-way catalytic converter is an emission control device which is installed on the exhaust system to reduce pollutions in exhaust emission.



Caution

Catalytic converters can only use lead free fuel.

Regular maintenance for the exhaust system is not required. If it requires to raise the vehicle body to carry out other repairs, the entire exhaust system can be inspected.

Twin-bed catalytic converter with the three-way catalytic converter used together.

Catalyst Type:

Ternary (reduction / oxidation) catalyst

The catalyst coating in the ternary (reduction) converter contains platinum and rhodium, which can reduce the nitrogen oxides(NOx), the hydrocarbon(CH) and carbon monoxide(Co) contents.

Onboard maintenance

The squawking, noise and vibration of the exhaust system are usually caused due to misalignment of the components. When adjusting the exhaust system, loosen all bolts and nuts, adjust all the parts, and tighten, and adjust from front to back.

1. Check whether the connector is loose or damaged, in particular check for the presence of exhaust leakage.

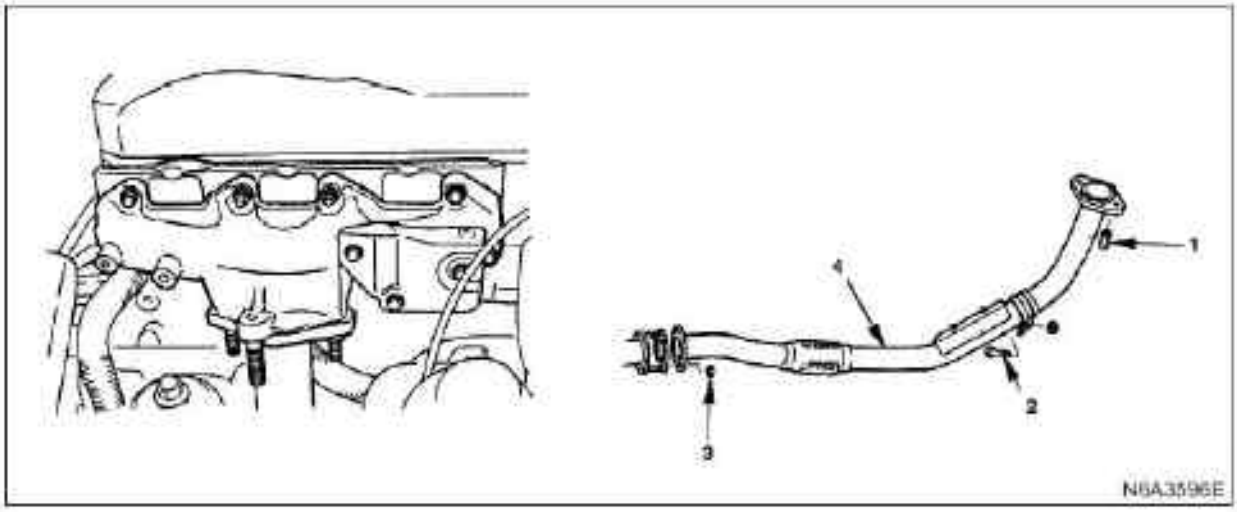
2. Check whether the chuck and rubber parts are aging, cracking or damaged.

3. If the converter heat shield is damaged or recessed and contacted with catalyst, repair or replace it.

4. Check whether there is any sunken, damag, crack or cracking hole due to corrosion.

Front Exhaust

Part



Legend

1. The fixing washer and nut of the exhaust manifold
2. The fixing nut to install bracket of the front exhaust pipe
3. The fixing nut of the front exhaust pipe
4. Front row

Dismantling

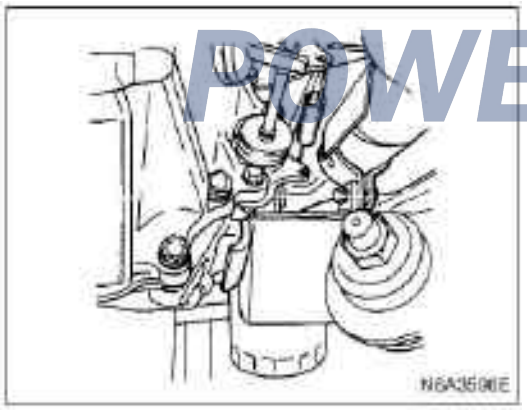
Preparation

·Disconnect the grounding wire of the storage battery

1. Fixing nut of the exhaust manifold

·Disassemble the two fixing nuts from the exhaust manifold and the front exhaust pipe

2. The fixing nut and bolt to install the bracket of the front exhaust pipe



3. The fixing nut and bolt of the front exhaust pipe

·Disassemble the two bolts from the front exhaust pipe and the center pipe

4. Front exhaust pipe

·Fold the exhaust pipe to the other side

Install

1. Front exhaust pipe

2. The fixing nut and bolt of the front exhaust pipe

·Tighten the fixing nut to the specified torque

Tightening

• 50 N·m (5.1 kg·m/37 lb·ft)

3. The fixing nut and bolt to install the bracket of the front exhaust pipe

·Tighten the fixing bolt to the specified torque

Tightening

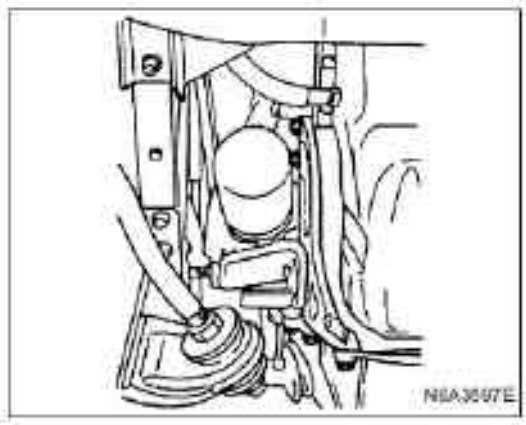
• 40 N·m (4.1 kg·m/30 lb·ft)

4. Fixing nut of the exhaust manifold

·Tighten the nut to the specified torque

Tightening

• 69 N·m (7 kg·m/51 lb·ft)



· Connect the grounding wire of the storage battery

·After all parts have been assembled, start the engine and check whether there is any gas leakage for all connectors.

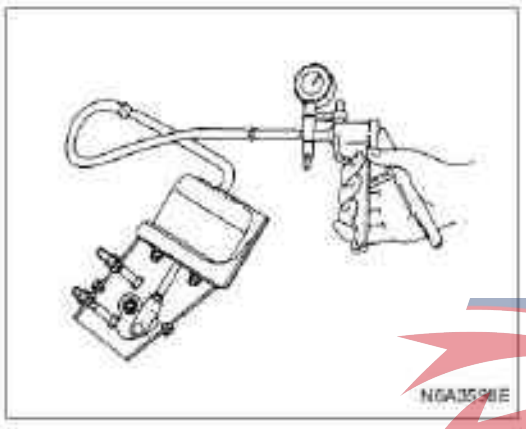
Exhaust brake

Check

Operation inspection

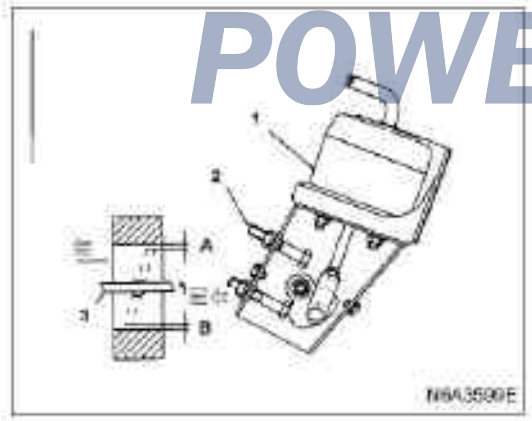
·While the engine is idling, operate the exhaust brake to check whether there is noise due to the valve striking the plug.

·When the vacuum pump applies negative pressure to the power chamber(400 mmHg - 700 mmHg), check whether the exhaust valve is opened and closed normally.



When the vacuum pump applies negative pressure to the power chamber, check whether the valve clearance is within the range of 0.1 mm - 0.2 mm(at minimum of 0.1 mm) and average the measured values between point "A" and "B".

·If the gap is beyond this range, use adjusting bolt to adjust.



4J Series engine
Section 6G
Turbocharger
Table of Contents

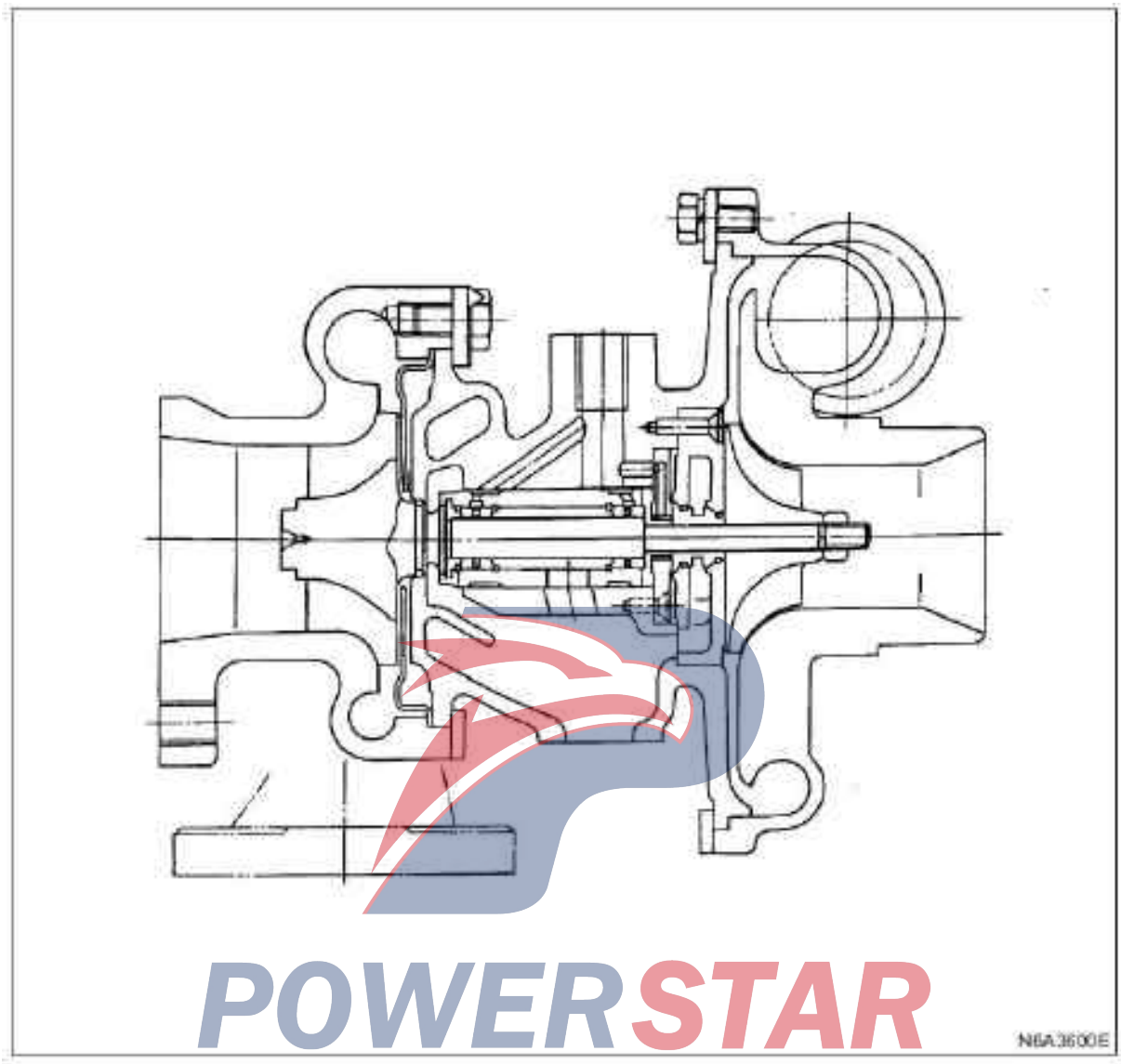
Turbocharger

Main data and parameters

Model		IHI RHF 4H	IHI RHB 5
Turbine type		Mixed flow	Radial
Compressor type		Centrifugal	
The maximum allowable speed	r/min	180,000	
Waste gas bypass valve opening pressure	kPa (mmHg)	109 ± 4.4 (815 ± 33)	120 ± 4.8 (898 ± 36)
Weight	N (kg/lb)	41 (4.2/9.3)	45 (4.6/10.1)

IHI Corporation
China Jiangsu Ishikawajima Supercharger Co., Ltd.

Overview



The internal devices of the turbocharger include turbine impeller, compressor impeller and radial bearing. These parts are supported by the bearing shell.

The external devices of the turbocharger include air intake of compressor cylinder and exhaust of turbine shell.

Turbocharger can improve the intake efficiency. Thus it increases engine power, reducing fuel consumption, and minimizing engine noise.

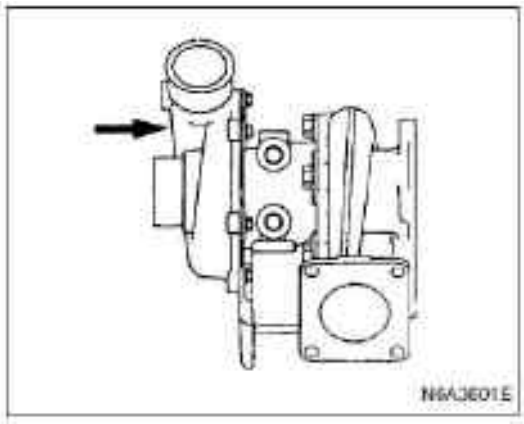
Turbocharger operates at high speed and under high temperature. Part material has been selected carefully and processed precisely.

Professional personnel shall be very careful while doing the turbocharger maintenance work.

If the performance has been found decreased, check whether there is any damage or wear for the engine. If there is no obvious damage or wear to the engine, it means the turbocharger has fault.

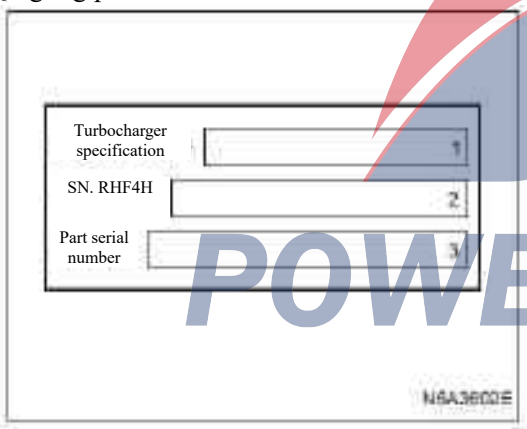
Component mark

The nameplate of the turbocharger indicates the production date and other important information that is necessary to identify the component during service inquirie.



The nameplate is printed with the following information:

1. Turbocharger specifications number and year of production
2. Production date and serial number
3. Qingling parts number



Turbocharger maintenance

1. Refer to the repair section of this Manual to determine whether it requires any repair or overhaul for the turbocharger.

2. To determine whether it requires any repair or overhaul for the turbocharger(whether the supercharger is disassembled from the vehicle or not, but do not disassemble the supercharger), the the following steps should be taken:

Visual inspection

·Pitch measurement

·End clearance measurement

See "Repair" section

3. The pressure blower and turbine shell can be disassembled from the intermediate shell and the rotating assembly for further visual inspection.

See the "Disassembly and Reorganization" section

Preventive measures

Professional personnel shall be very careful while doing the turbocharger maintenance work.

Wrong turbocharger repair procedures can severely damage the piston, valve, cylinder liner, and other important engine components.

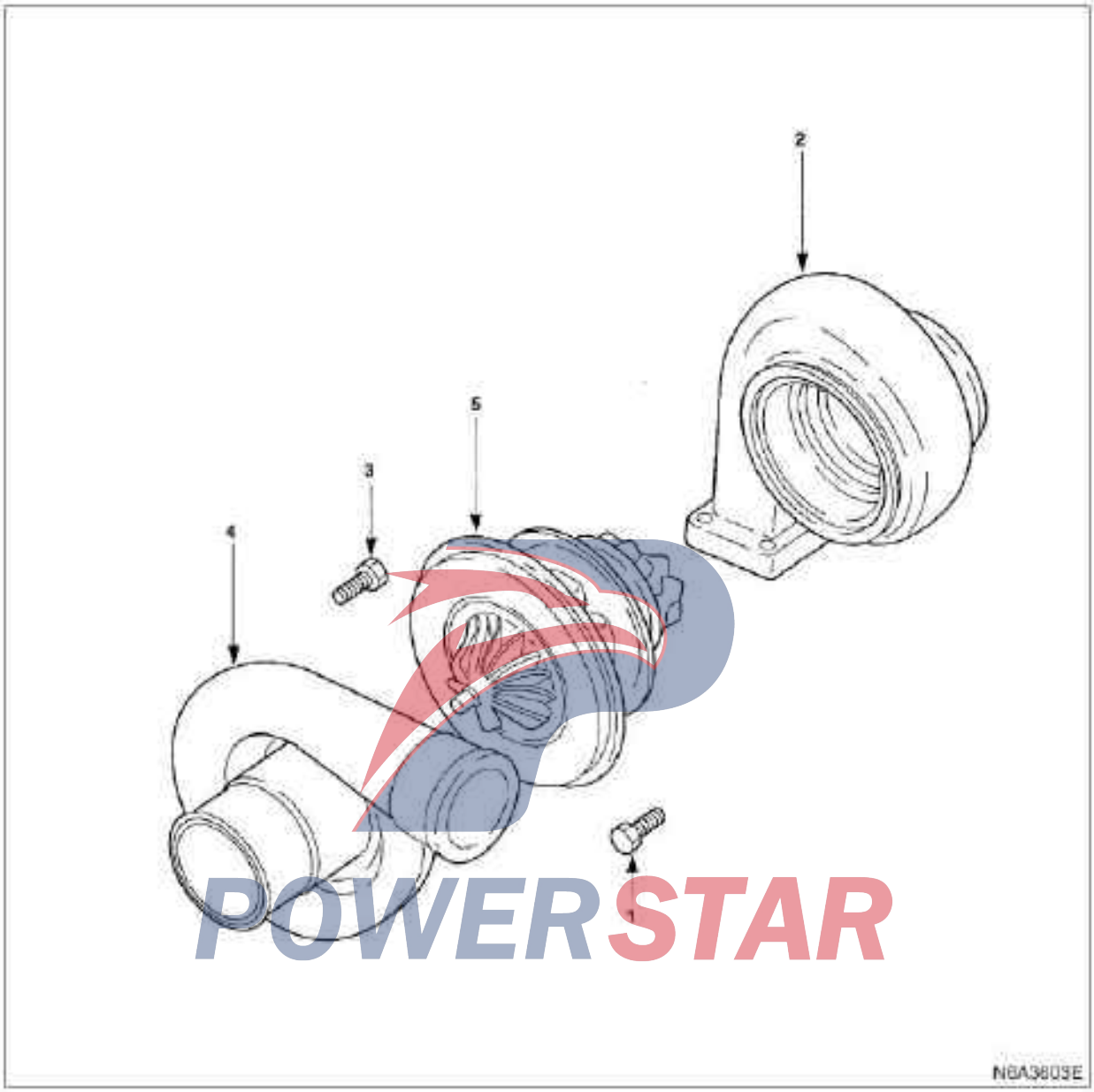
Qingling recommends that do not use any repair procedures which are not specified in this Manual.

Please contact your nearest IHI service facility for repair or overhaul of the turbocharger assembly.

Service facilities should require sign and assembly number.

Disassembling

Part



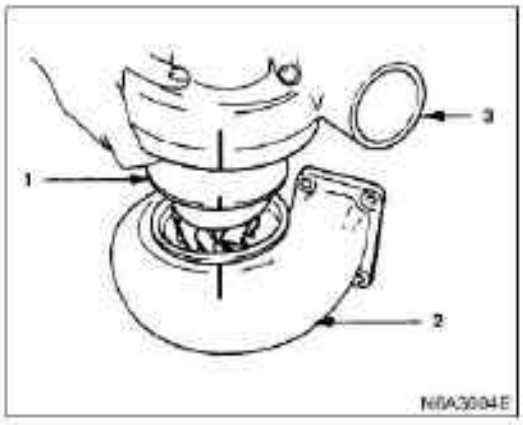
Legend

1. Bolt
2. Turbine housing
3. Bolt
4. Compressor housing
5. Intermediate housing and rotary assembly

Disassembling steps

1. Bolt

Positioning marks are used on the intermediate shell and the rotation assembly(1), the turbine shell(2) and the compressor shell(3).



2. Turbine housing

3. Bolt

4. Compressor housing

5. Intermediate housing and rotary assembly

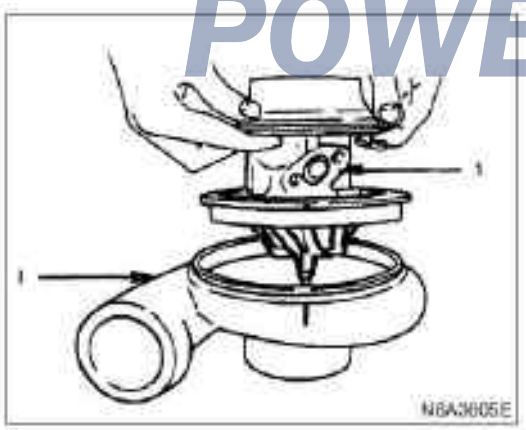
1) Loosen the bolt.

2) Disassemble the part.

Treat the part careful, and take and put gently. Special care must be taken in order not to damage the turbine blade and compressor blade. Be careful not to allow foreign objects entering into the intermediate shell.

Caution:

It is recommended not to disassemble and repair the intermediate shell and the rotatation assembly.



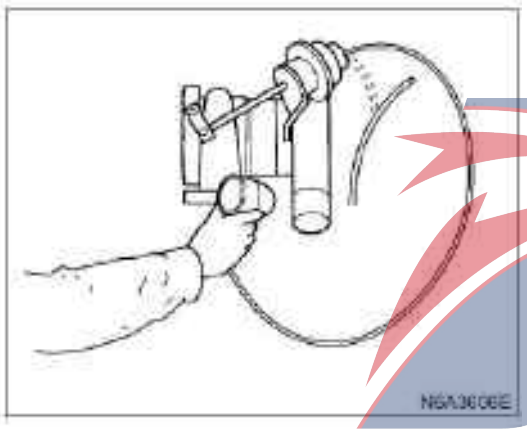
Repair

During the inspection, if the turbocharger is found over worn, necessary adjustment, repair and replacement of parts should be made. This chapter defines the minor maintenance procedures. For overhaul and maintenance, please contact the nearest IHI service facility.

Turbocharger pressure check

1. Disassemble connecting pipe of the control room of the waste gas bypass valve
2. Connect the manometer.
3. Start the engine and gradually increase the retating rounds of the engine(the vehicle must be stationary and no load applied to the engine).
4. Check whether the turbocharger pressure raises to about 500 mmHg.

Manometer: 5-8840-0075-0

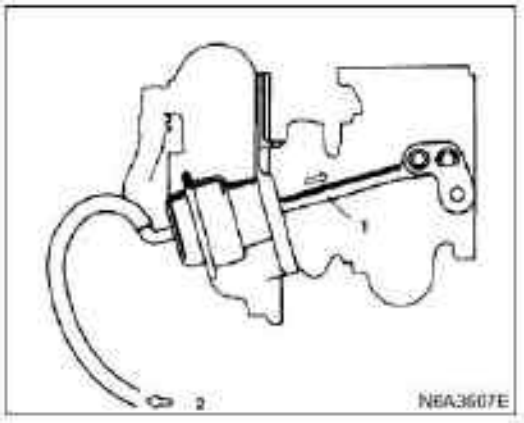


Waste gas bypass valve operation check

1. Disassemble the hose between control room of the waste gas bypass valve and the intake pipe.
2. Connect the manometer.
3. When the pressure of the control room of the waste gas bypass valve reaches about 665 mmHg, check whether the control lever begins to move.

Caution:

During the inspection, the pressure the waste gas bypass valve should not exceed 1467 mmHg(196 kPa).

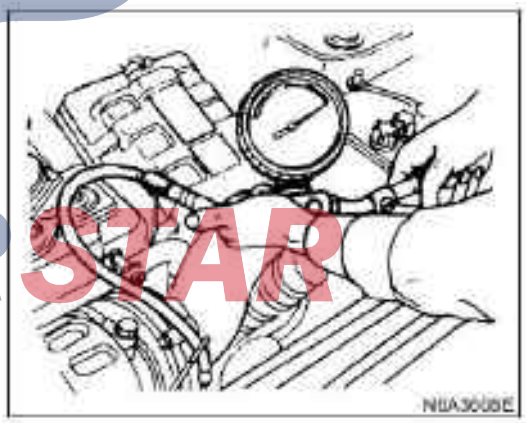


Legend

1. Control rod
2. Pressure

4. Check whether the pressure that can make the control lever to move 2 mm is within the following limited range.

The working pressure of the control lever	kPa (mmHg)
4JB1-TC (IHI RHF4)	109 ± 4.4 (815 ± 33)

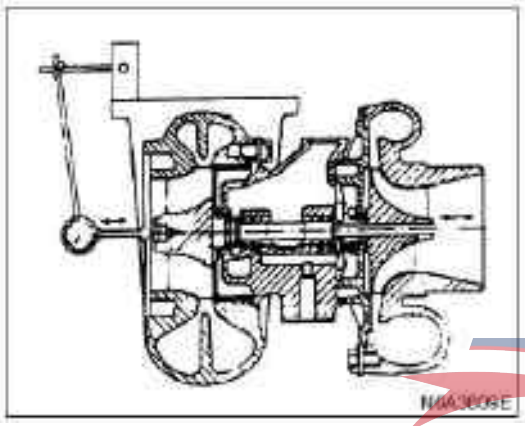


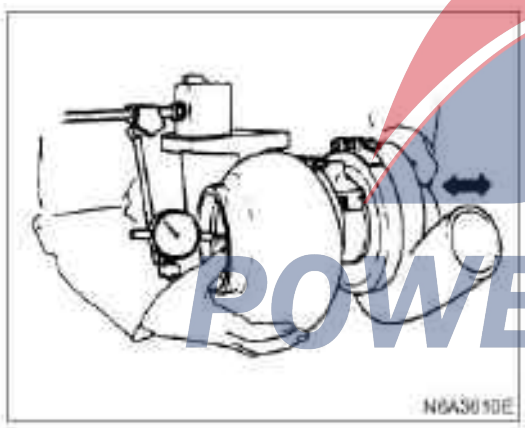
The standard value and limit value for impeller shaft and bearinrg clearances are provided below.

Impeller shaft end clearance

Use micrometer gauge to measure impeller shaft end clearance. Apply a force of 1.2 kg (2.6 lb / 11.8 N) to the compressor impeller end and the turbine impeller end alternately.

Impeller shaft end clearance	mm (in)
Standard	Limit
0.02— 0.08 (0.0008—0.0031)	0.09(0.0035)

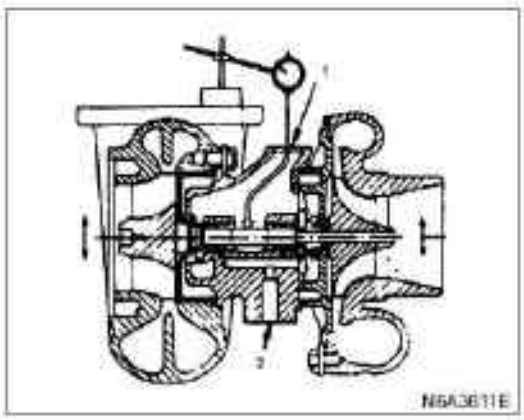




Clearance between impeller shaft and bearing

Use micrometer gauge to measure impeller shaft and bearing clearance.

Clearance between impeller shaft and bearing	mm (in)
Standard	Limit
0.07— 0.12 (0.0028—0.0047)	0.16 (0.0063)



Legend

1. Oil return hole
2. Oil inlet hole

Install

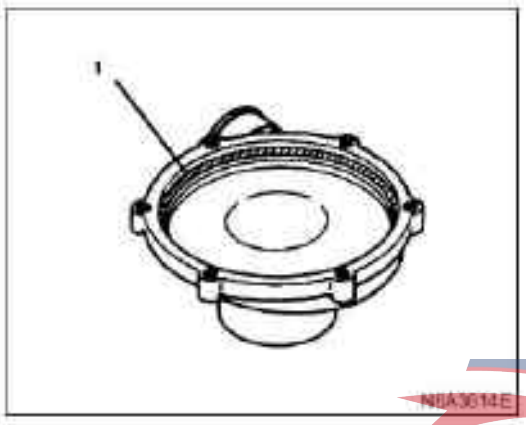
Installation steps

1. Intermediate housing and rotary assembly

2. Compressor housing

3. Bolt

1) The flange surface of the compressor housing shown in the figure adopts Threebond 1215(1) or equivalent material.



2) Align the positioning mark(mark for removal) on the intermediate shell, the rotation assembly, and the compressor shell.

Gently handle the parts to avoid damaging the compressor blade.

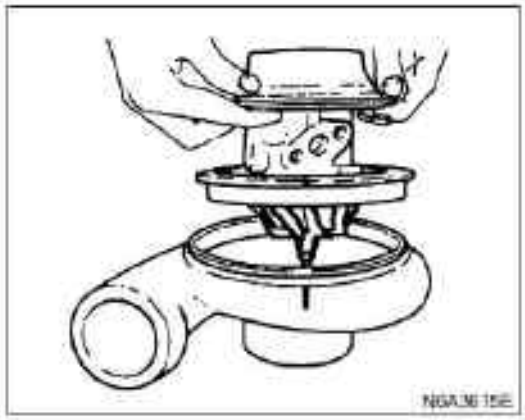
3) Apply anti-seizure agents (Loctite anti-seizure lubricants or other equivalents) to new bolts.

4) Install the new bolt on the compressor shell.

5) Tighten bolts according to the specified torque.

Tightening torque:

Tighten the bolt to the specified torque: 4.7 N·m (0.5 kg·m/3.5 lb·ft)



4. Turbine housing

5. Lock plate and bolt

1) Intermediate shell

Gently handle the parts to avoid damaging the compressor blade.

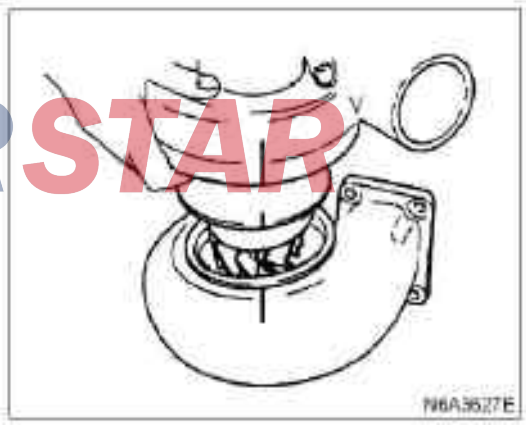
2) Apply anti-seizure agents (Loctite anti-seizure lubricants or other equivalents) to new bolts.

3) Tighten bolts according to the specified torque.

Tightening torque:

The torque of the tightening bolt of the compressor shell is 28.0 N·m (0.5 kg·m/3.5 lb·ft)

4) Check whether the rotation assembly runs smoothly.



4. J series engine
Section 6E1

Engine control system (4KH1-TC)

Table of contents

Specification

Temperature and resistance comparison table

Comparison Table of Engine Coolant Temperature and Resistance

℃	°F	
Comparison table of temperature and resistance rating (approx. rated value)		
120	248	120
110	230	160
100	212	200
90	194	260
80	176	350
70	158	470
60	140	640
50	122	880
40	104	1250
30	86	1800
20	68	2650
10	50	4000
0	32	6180
-10	14	9810
-20	-4	16000
-30	-22	27000

Intake air temperature and pressure

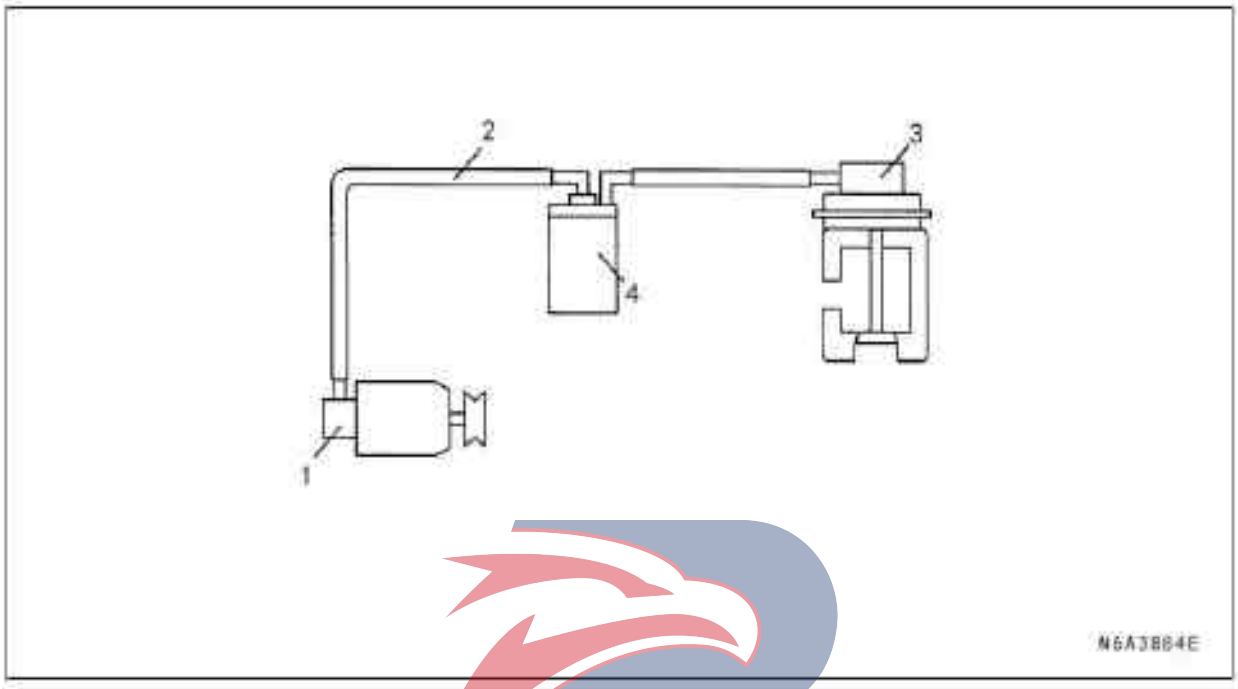
℃	°F	
Temperature Pressure (approximate rated value)		
100	212	190
90	194	240
80	176	320
70	158	430
60	140	590
50	122	810
40	104	1150
30	86	1650
25	77	2000
20	68	2430
10	50	3660
0	32	5650
-10	14	8970
-20	-4	14700

Comparison table of altitude and atmospheric pressure

Altitude measured (m)	Altitude measured (ft)	Atmospheric pressure measured (kPa)
Altitude Understood via the local Weather Bureau or other channels		
4267	14000	56-64
3962	13000	58-66
3658	12000	61-69
3353	11000	64-72
3048	10000	66-74
2743	9000	69-77
2438	8000	71-79
2134	7000	74-82
1829	6000	77-85
1524	5000	80-88
1219	4000	83-91
914	3000	87-98
610	2000	90-98
305	1000	94-102
0	0 Sea Level	96-104
-305	-1000	101-105

Diagram and Rute Map

Vacuum Hose Circuit Diagram

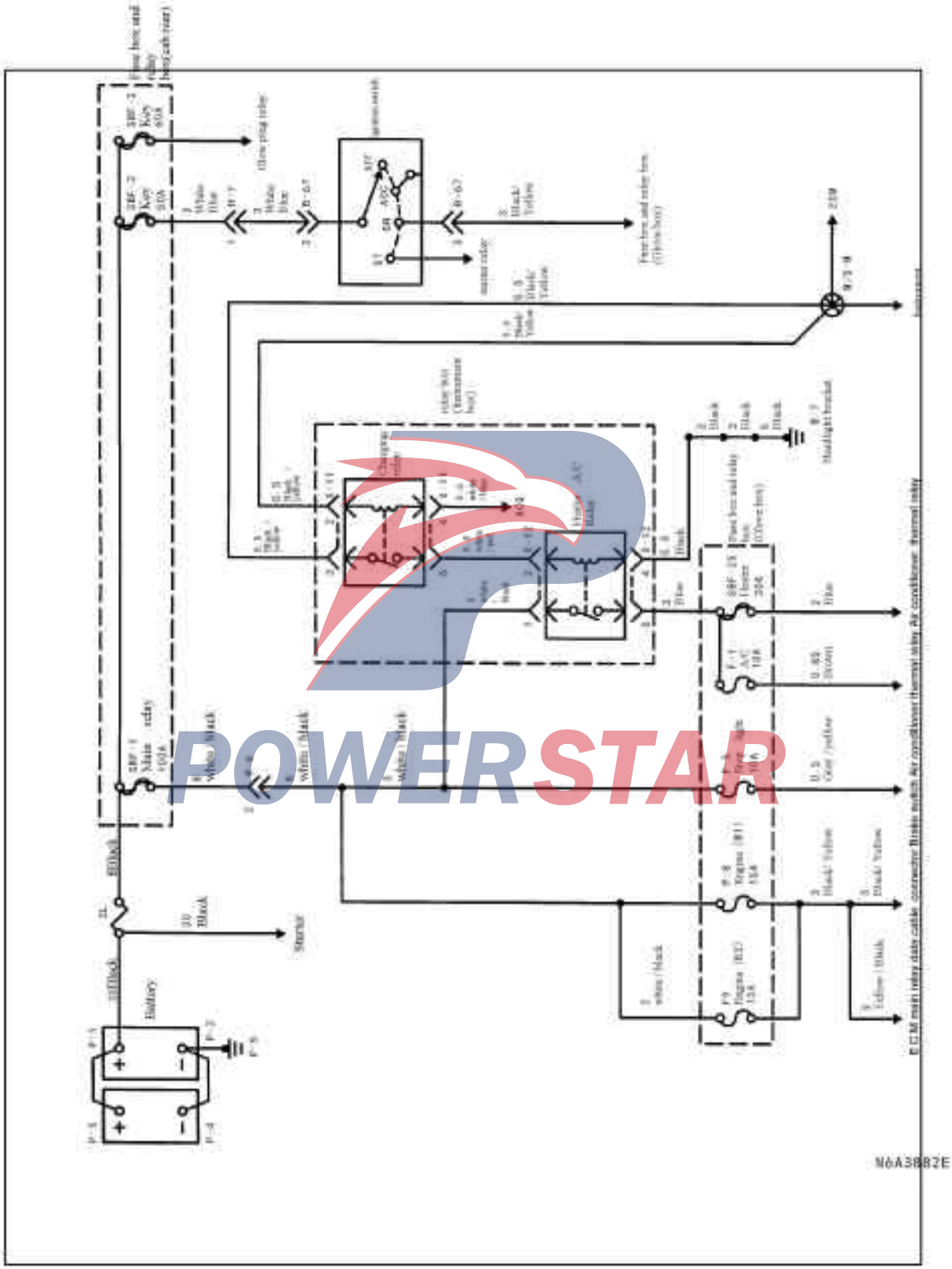


Legend

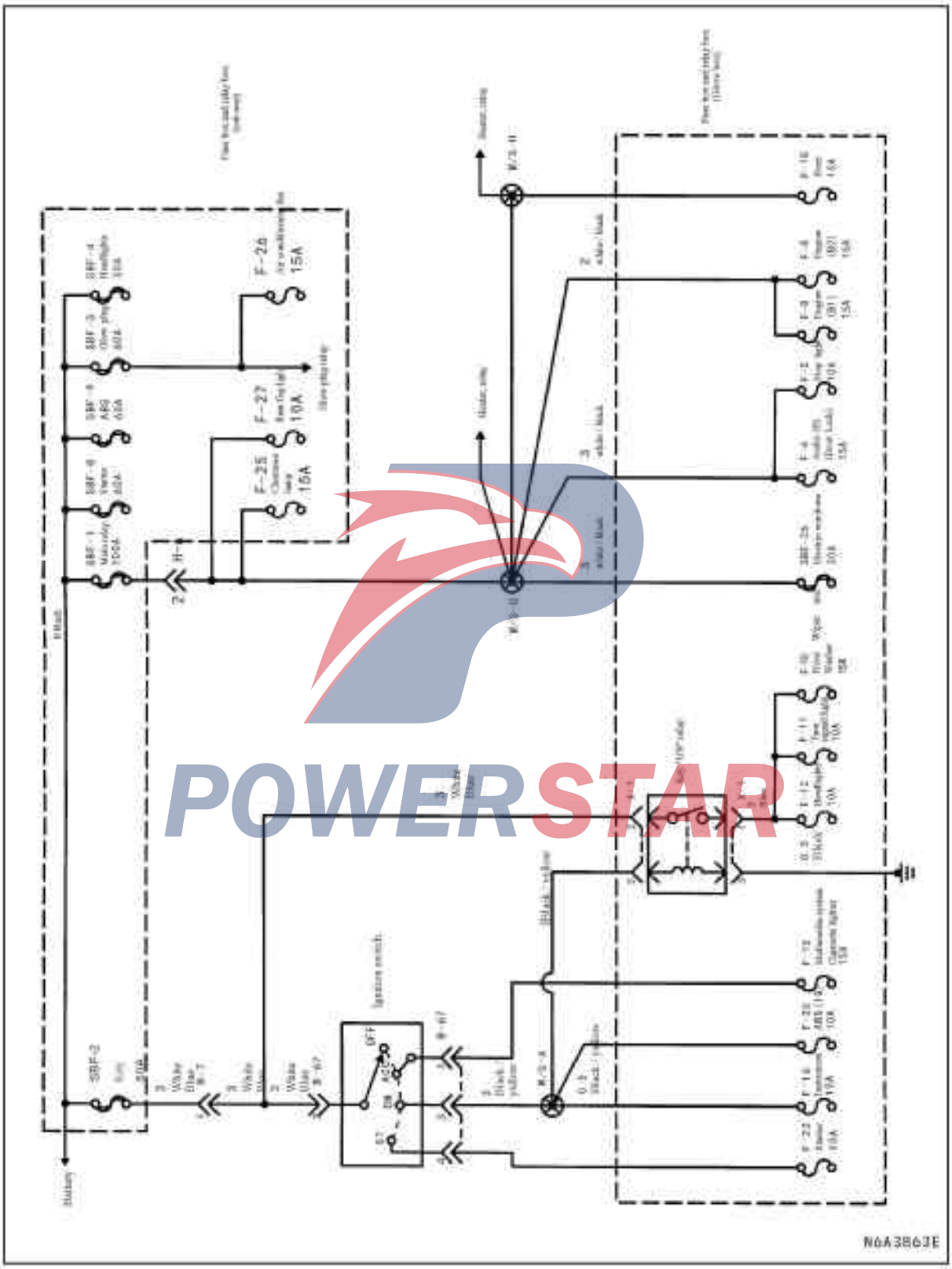
1. Vacuum pump (ACG AC generator part)
2. Vacuum hose
3. EGR valve
4. EEG solenoid valve

Engine control sketch

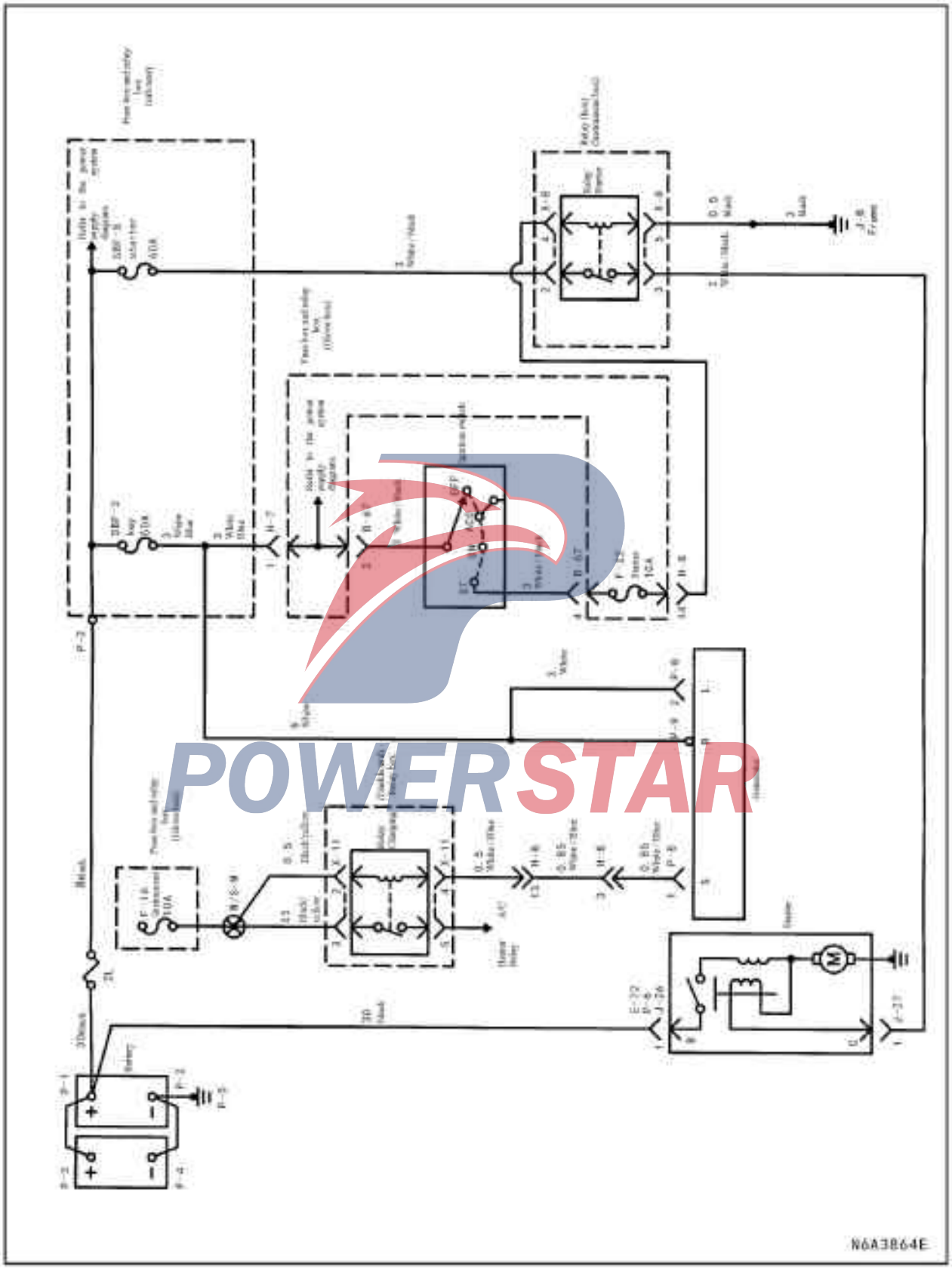
(1) Electrical system



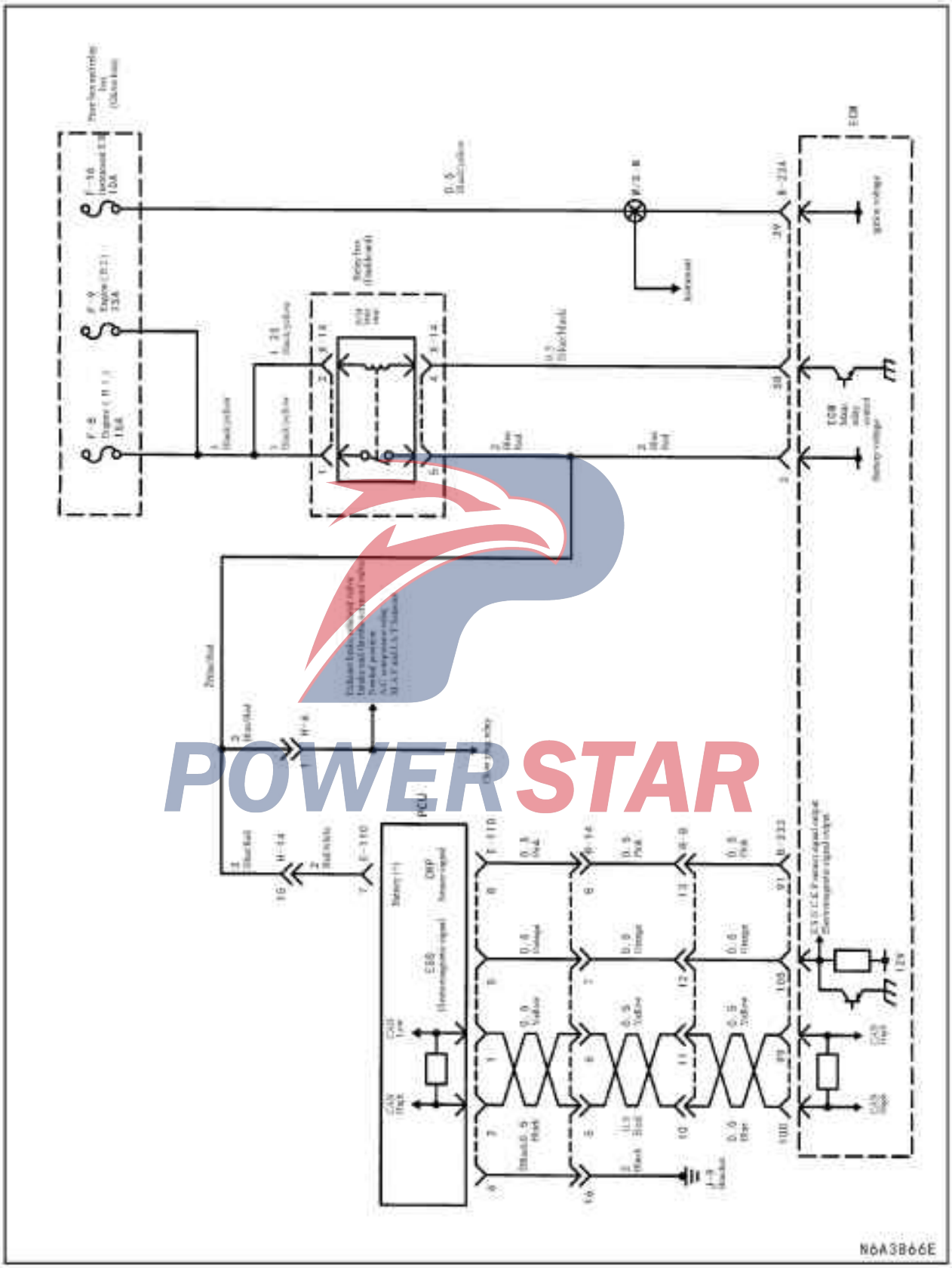
(2) Electrical system



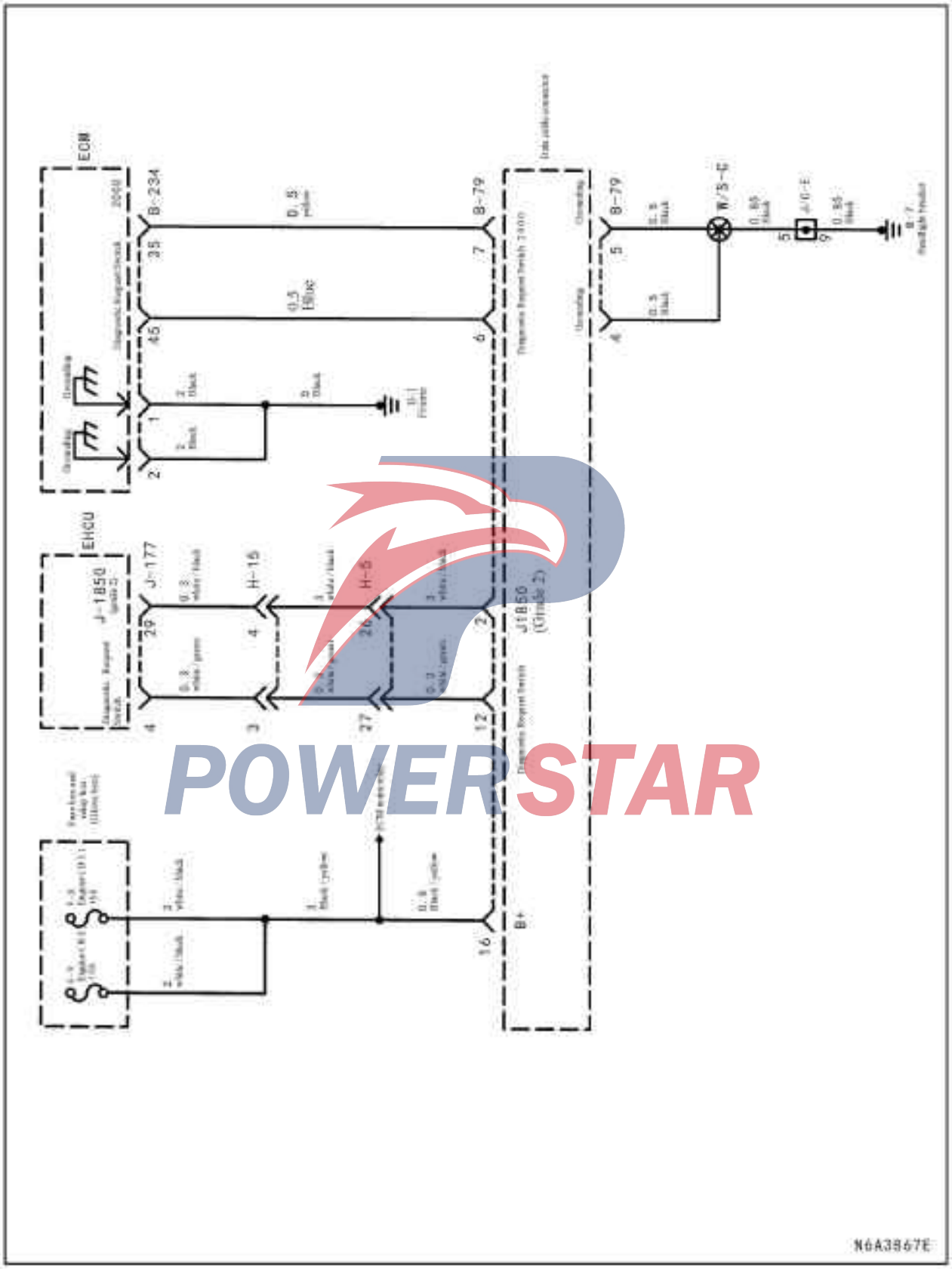
Starting and Charging System



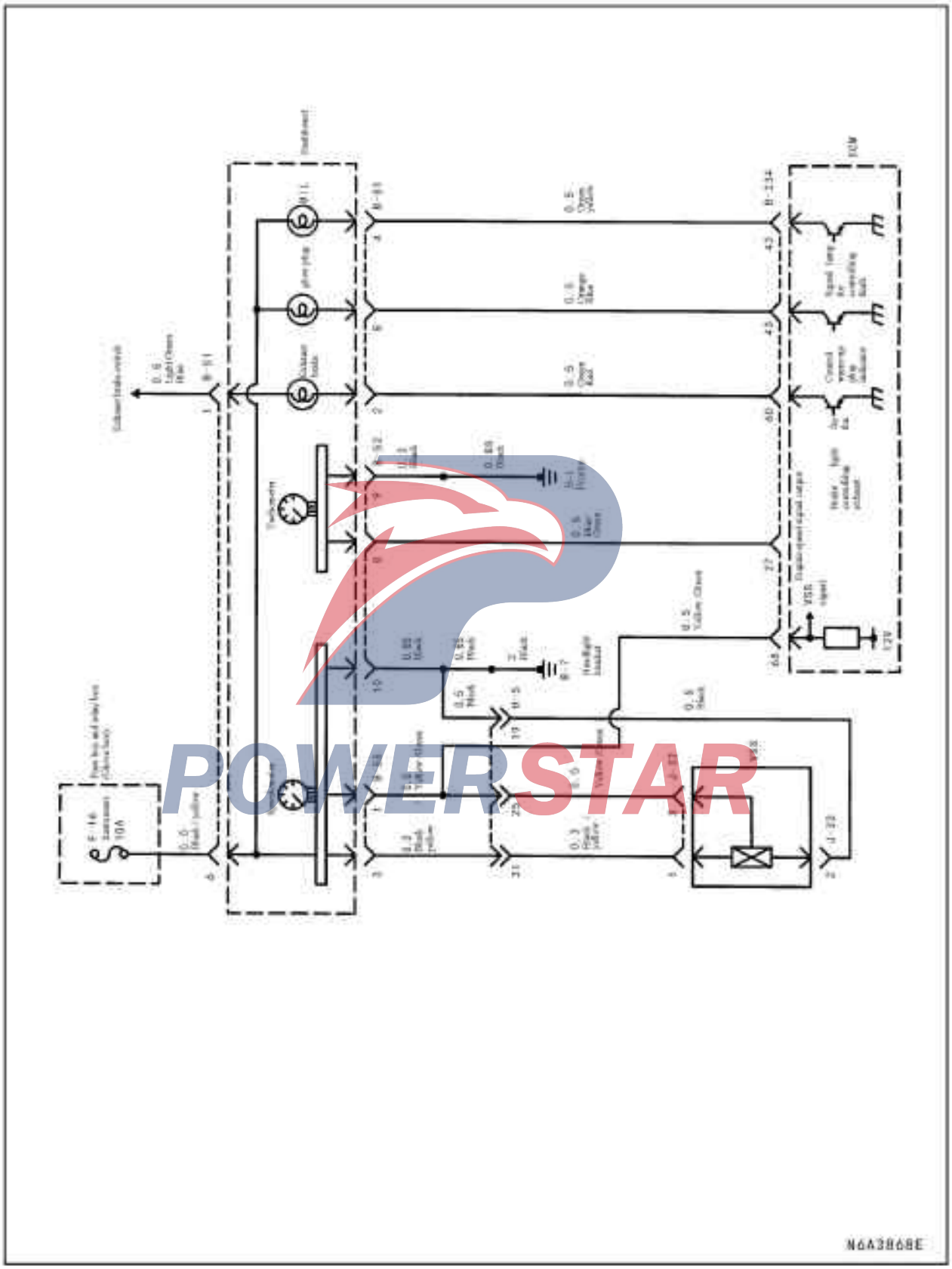
Engine Control Module Engine Control Module Power vs.PCU



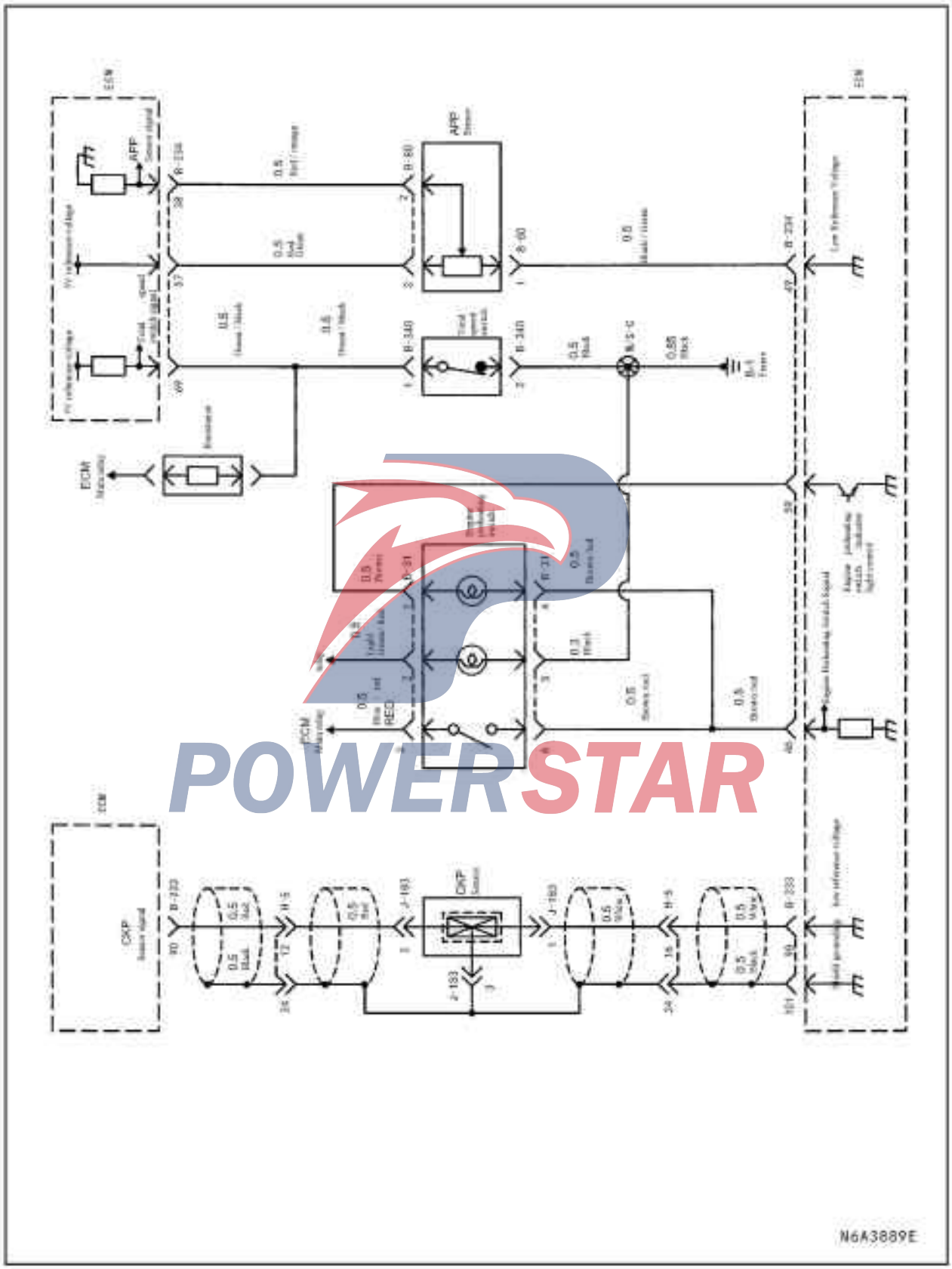
ECM grounding, electric heating catalyst unit and fault diagnosis connector



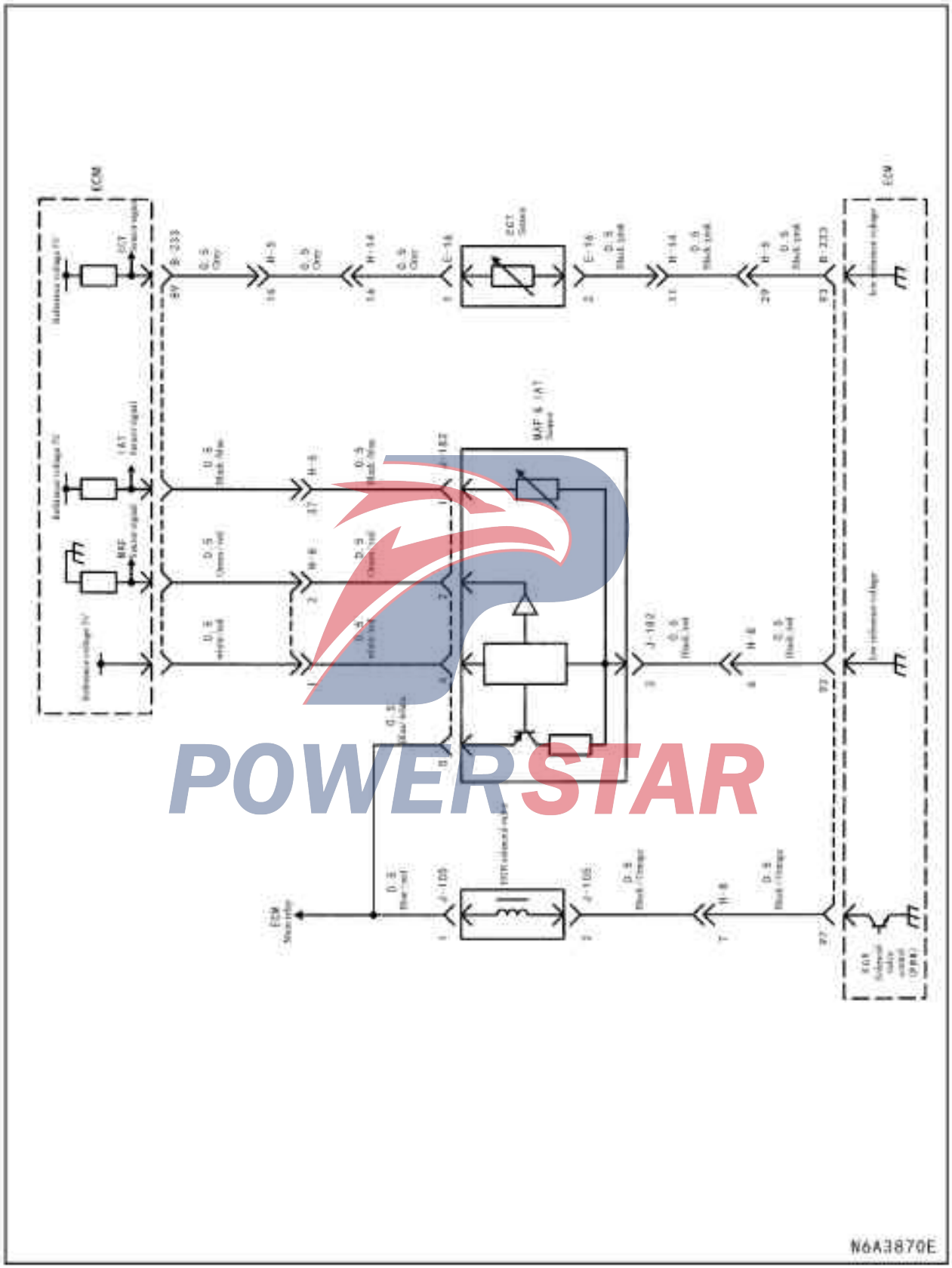
Combined instrument and warning light



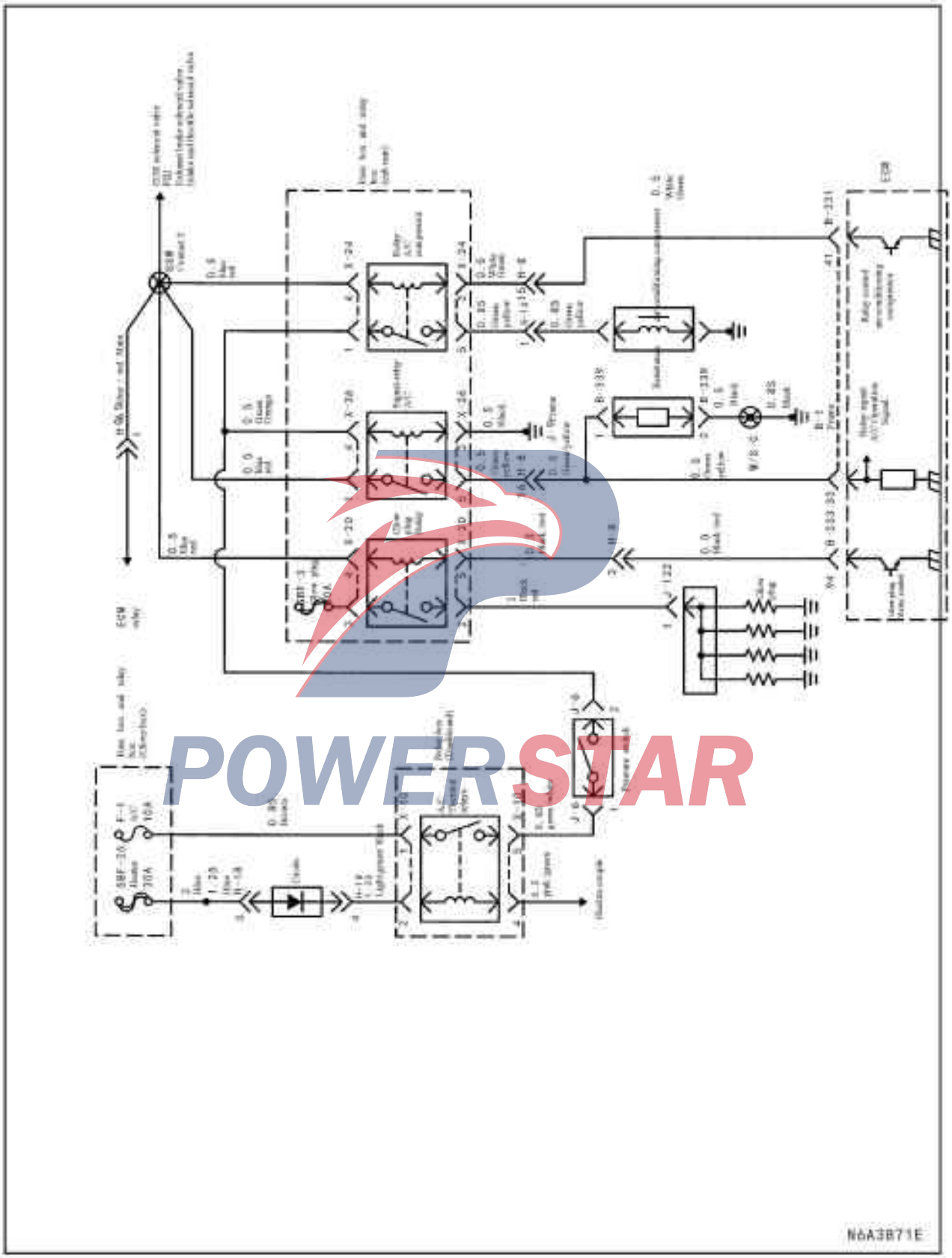
Crankshaft Position Sensor, Engine Warm Up Switch, and Accelerator Pedal Position Sensor



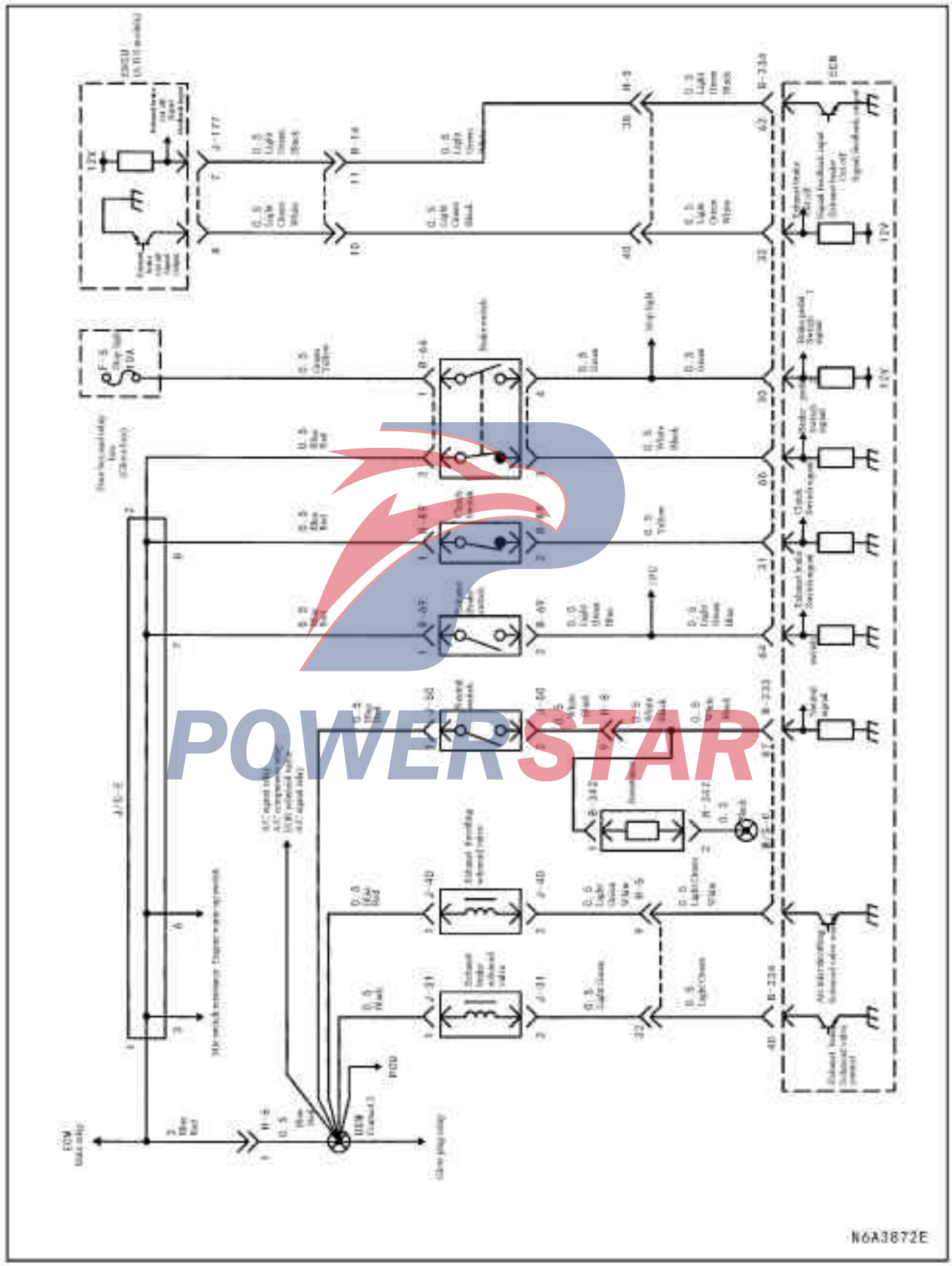
Air flow, intake air temperature, and engine coolant temperature sensor



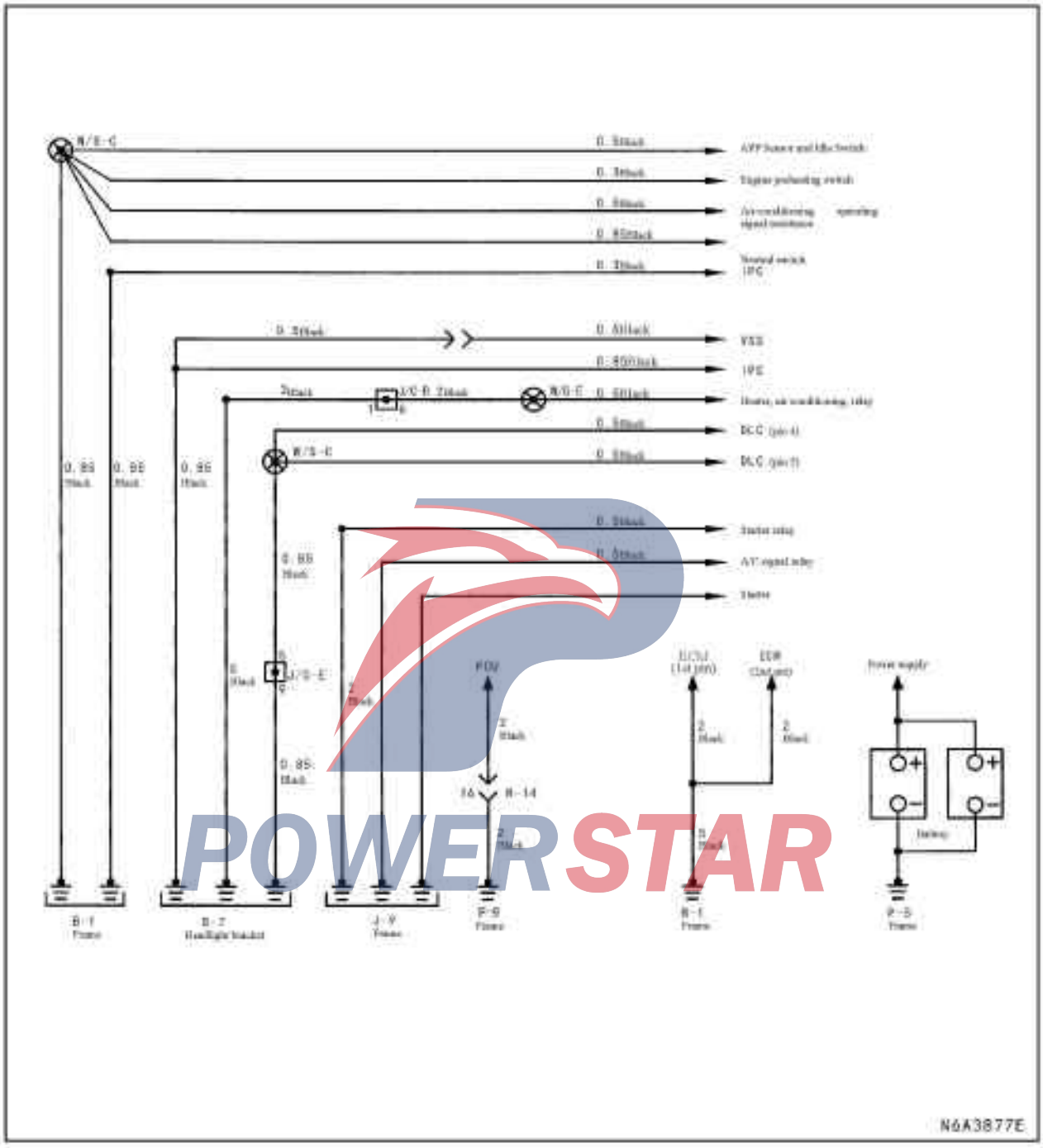
Air conditioning and preheating relay



E G R solenoid valve, exhaust valve brake solenoid valve, air intake throttle solenoid valve, exhaust brake switch



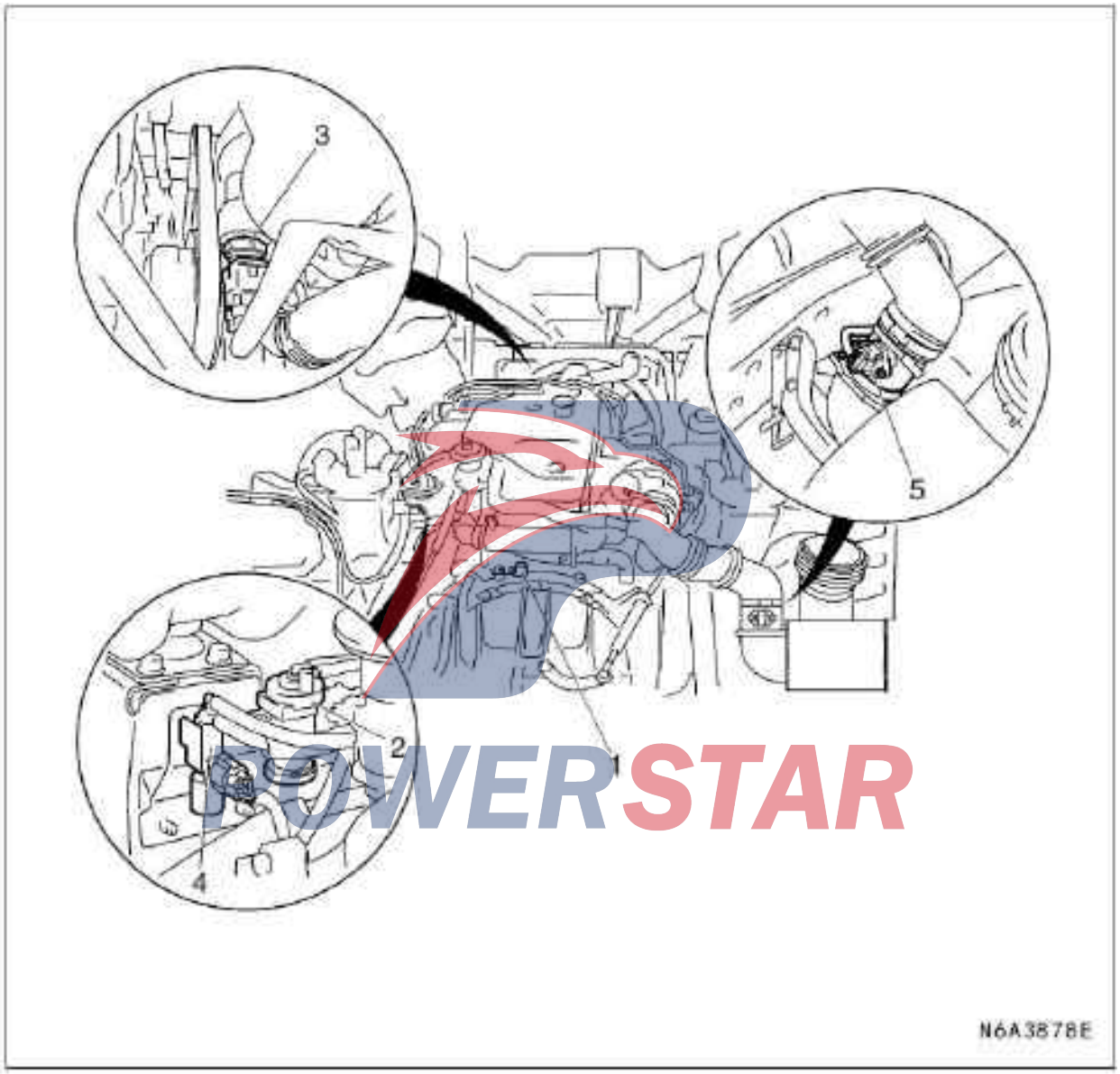
Distribution diagram of GND points



Part positioner

Engine control component diagram

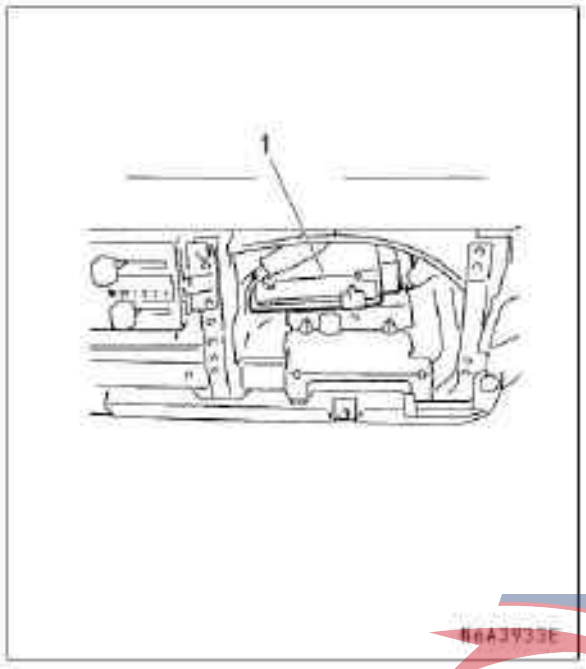
Crankshaft Position Sensor, E G R Solenoid Valve, Engine Coolant Temperature Sensor, Intake Throttle Solenoid, Air Flow/ Intake Temperature Sensor



Legend

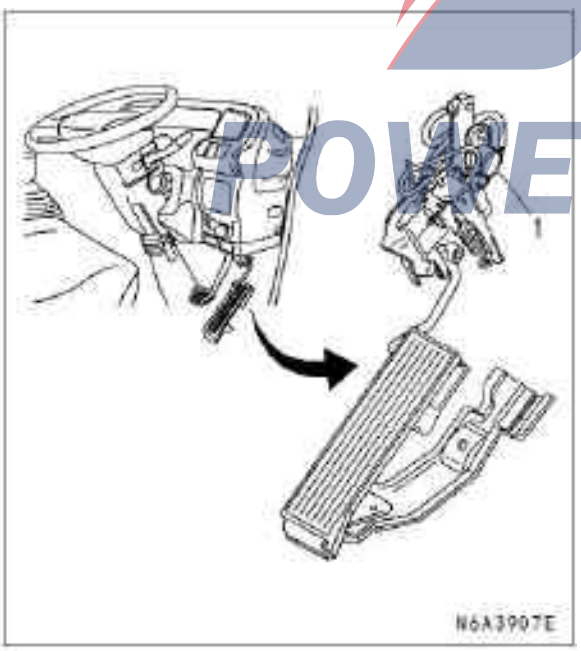
1. Crankshaft position sensor
2. EEG solenoid valve
3. Engine coolant temperature sensor
4. Intake throttle solenoid valve
5. Mass air flow/ intake air temperature sensor

Engine Control Module



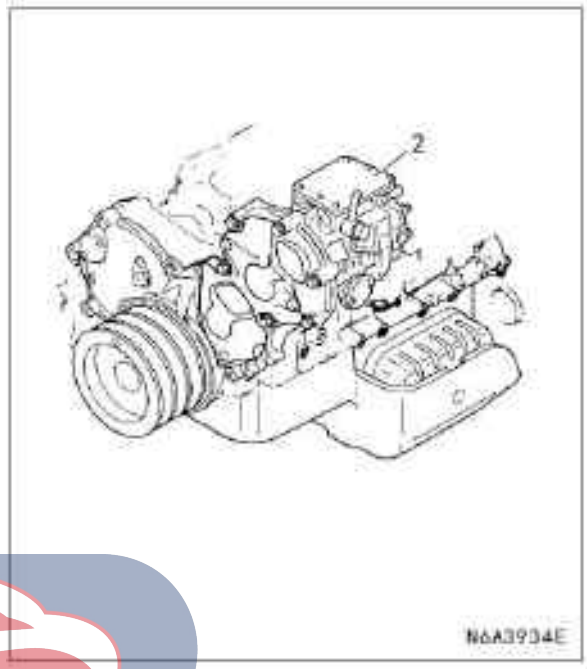
Legend
1. Engine control module (ECM)

Accelerator Pedal Position (APP) sensor



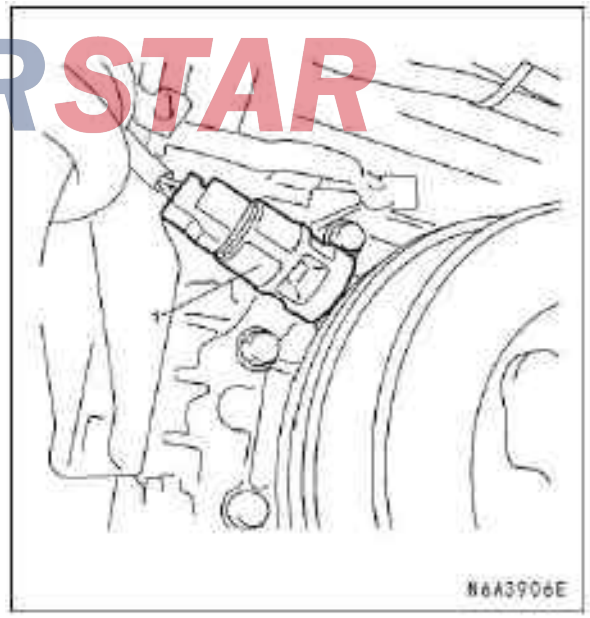
Legend
1. Accelerator Pedal Position Sensor

Fuel Injection Pump and Pump Control device



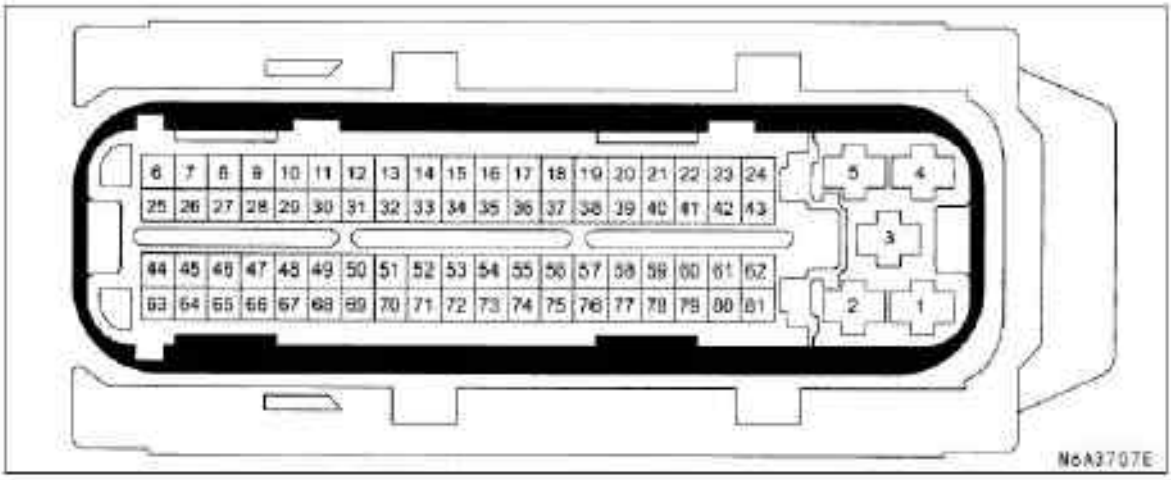
Legend
1. injection pump
2. Pump control unit (ACU)

Vehicle Speed Sensor



Legend
1. Vehicle Speed Sensor (VSS)

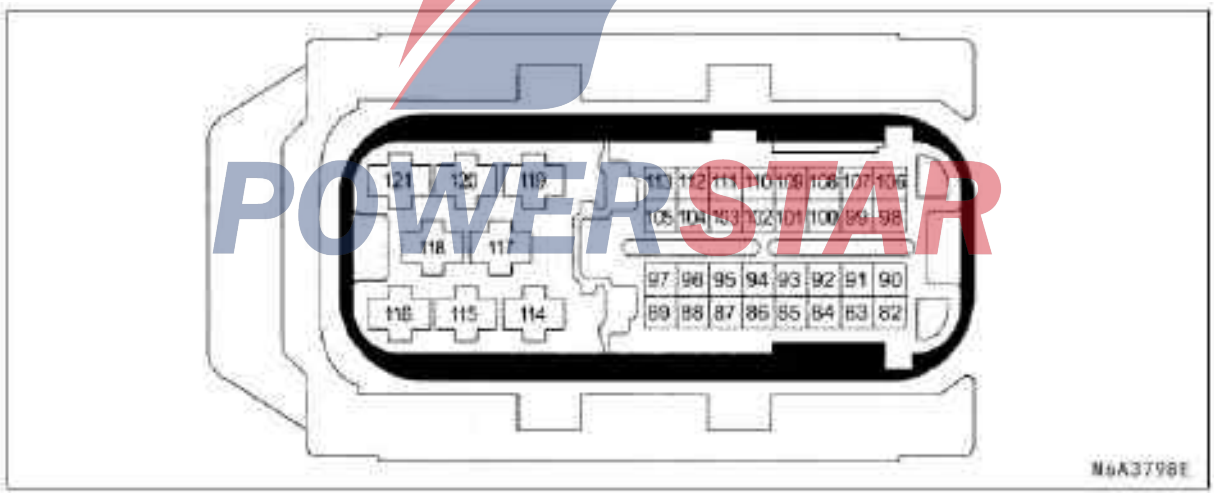
View of the Engine Control Module (E C M) Connector



Joint No.		B-234
Joint color		Black
Test connector No.		J-35616-4A (Pin 1-5) J-35616-64A (Pin 6-81)
Contact pin	Wiring color	Connector pin function
1	Black	Engine Control Module Grounding
2	Black	Engine Control Module Grounding
3	Blue / red	Engine Control Module battery voltage
4	—	Useless
5	—	Useless
6-24	—	Useless
25	—	Useless
26	—	Useless
27	Blue / green	Engine speed signal to tachometer
28	—	Useless
29	—	Useless
30	Green	Brake pedal switch signal
31	Yellow	clutch pedal switch
32	Light green /white	Exhaust brake disconnect signal output from EHCU (anti-lock system module)
33	Green /yellow	Air conditioner Disconnecting Signal Relay Input
34	—	Useless
35	Yellow	To pin 7 of the data transmission connector
36	—	Useless
37	—	Useless
38	Green / Orange	Accelerator pedal position sensor signal
39	white	Ignition voltage power supply

Joint No.		B-234
Joint color		Black
Test connector No.		J-35616-4A (Pin 1 - 5) J-35616-64A(Pin6-81)
Contact pin	Wiring color	Connector pin function
40	Light green	Exhaust brake solenoid valve
41	white / green	A/C compressor relay control
42	Green /yellow	Fault indicator control
43	Orange/Blue	Glow indicator light control
44	—	Useless
45	Blue	To pin 6 of the data transmission connector
46	Brown / red	Engine heating switch input
47	—	Useless
48	—	Useless
49	Black / green	Accelerator Pedal Position Sensor Grounding
50	—	Useless
51	—	Useless
52	—	Useless
53	—	Useless
54	—	Useless
55	—	Useless
56	—	Useless
57	Red /green	Accelerator Pedal Sensor 5V Flag
58	Blue / black	Engine control module (ECM)Relay Control
59	Brown	Engine Heating Indicator Lamp Control
60	Green /red	Exhaust brake lamp control
61	—	Useless

Joint No.		B-234
Joint color		Black
Test connector No.		J-35616-4A (Pin 1 - 5) J-35616-64A (Pin 6 - 81)
Contact pin	Wiring color	Connector pin function
62	Light green/ black	Exhaust brake disconnecting signal output to EHCU (anti-lock module)
63	—	Useless
64	Light green/ blue	Exhaust brake switch signal
65	white / black	Brake pedal 2 switch signal
66	—	Useless
67	—	Useless
68	Yellow / green	vehicle speed sensor signal
69	Green /black	Idle switch signal
70	—	Useless
71	—	Useless
72	—	Useless
73	—	Useless
77	—	Useless
78	—	Useless
79	—	Useless
80	—	Useless
81	—	Useless

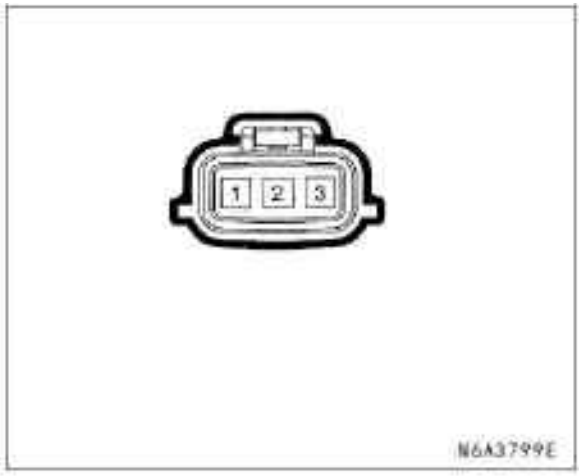


Joint No.		B-233
Joint color		Black
Test connector No.		J-3561 6-64A
Contact pin	Wiring color	Connector pin function
82	—	Useless
83	white / red	Air Flow Sensor 5V Flag

Joint No.		B-233
Joint color		Black
Test connector No.		J-3561 6-64A
Contact pin	Wiring color	Connector pin function
84	Black/blue	intake air temperature sensor signal
85	—	Useless

Joint No.		B-233
Joint color		black
Test connector No.		J-3561 6-64A
Contact pin	Wiring color	Connector pin function
86	-	Useless
87	Black / white	Neutral switch input
88	Green /red	MAF sensor signal
89	Grey	Engine coolant temperature ensor signal
90	Red	Crankshaft position sensor signal
91	Pink	Crankshaft Position Sensor Signal Output
92	Black / red	Mass air flow sensor and inlet air temperature sensor grounding
93	Black / pink	Engine Coolant Temperature sensor are Grounded
94	Black / red	Glow relay control
95	Light green /white	Intake throttling solenoid valve control
96		Useless
97	Black / Orange	EGR solenoid valve control
98	white	Low level mark of crankshaft position sensor
99	Blue	CAN low level signal
100	Yellow	CAN high level signal
101	Black	protective grounding of crankshaft position sensor
102		Useless
102		Useless
103	—	Useless
105	Orange	Engine Shutdown Solenoid Control Signal Output
106-121	—	Useless

Side view of engine control connector Accelerator Pedal Position (APP) sensor

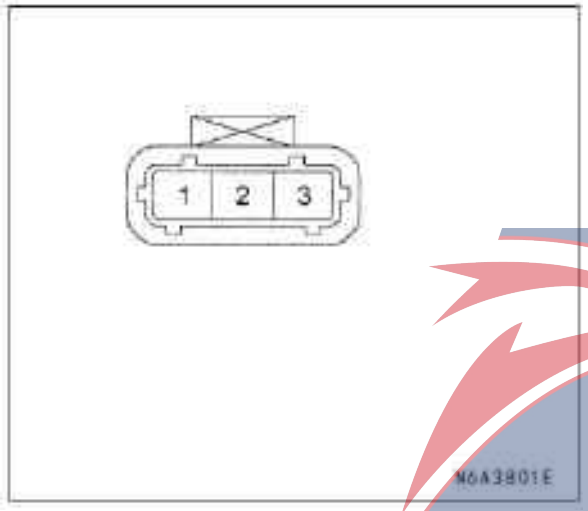


Joint No.		B-80
Joint color		Grey
Test connector No.		J-35616-33
Contact pin	Wiring color	Connector pin function
1	Black / green	Accelerator Pedal Position Sensor Low Mark
2	Green / Orange	Accelerator Pedal Position Sensor Signal
3	Red /green	Accelerator Pedal Position Sensor 5V mark

Brake switch

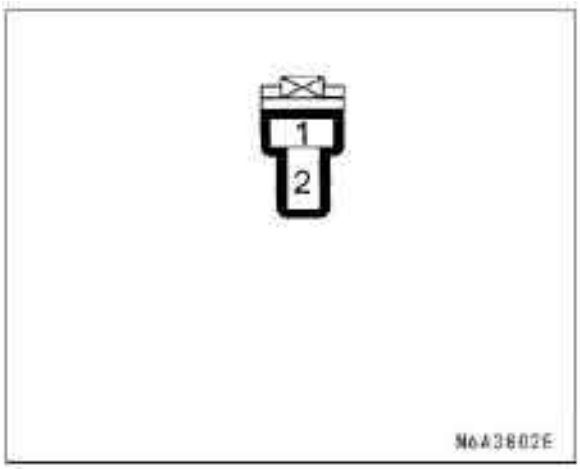
Joint No.		B-66
Joint color		Brown
Test connector No.		J-35616-42
Contact pin	Wiring color	Connector pin function
1	Green /yellow	Brake pedal switch (brake lamp pedal switch) 12V power supply
2	Blue /red	Brake Pedal 2 Switch Ignition Voltage
3	white / black	Brake pedal 2 switch signal
4	GRN green	Brake Pedal 1 Switch (Brake Lamp Pedal Switch) Signal

Crankshaft position sensor



Joint No.		J-183
Joint color		Black
Test connector No.		J-3561 6-4A
Contact pin	Wiring color	Connector pin function
1	White	Low level mark of crankshaft position sensor
2	Red	Crankshaft position sensor signal
3	Black	protective grounding of crankshaft position sensor

Clutch switch



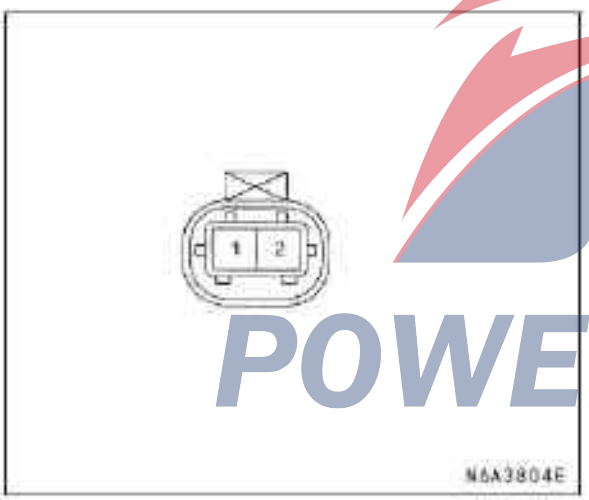
Joint No.		B-89
Joint color		White
Test connector No.		J-35616-42
Contact pin	Wiring color	Connector pin function
1	Blue /red	Clutch Pedal Switch Ignition Voltage
2	Yellow	Clutch Pedal Switch signal

Data Link Connector

Joint No.		B-79
Joint color		black
Test connector No.		J-35616-2A
Contact pin	Wiring color	Connector pin function
1	—	Useless
2	white / black	J1850 (Class 2)

Joint No.		B-79
Joint color		Black
Test connector No.		J-3561 6-2A
Contact pin	Wiring color	Connector pin function
3	—	Useless
4	Black	Grounding
5	Black	Connected
6	Blue	Diagnostic Requirements Switch (Engine Control Module)
7	Yellow / blue	Key words 2000
8	—	Useless
9	—	Useless
10	—	Useless
11	—	Useless
12	white / green	Diagnostic Requirements Switch (EHCU Anti-lock System Module)
13	—	Useless
14	—	Useless
15	—	Useless
16	Black / yellow	Power supply

EEG solenoid valve

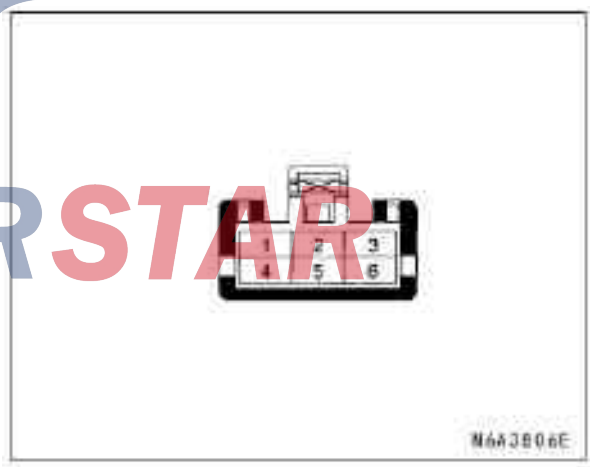


Joint No.		J-105
Joint color		Black
Test connector No.		J-3561 6-4A
Contact pin	Wiring color	Connector pin function
1	Blue /red	Solenoid 12V power supply
2	Black / Orange	Solenoid valve control

Engine Cooling Temperature Sensor

Joint No.		E-16
Joint color		Grey
Test connector No.		J-35616-4A
Contact pin	Wiring color	Connector pin function
1	Grey	Engine Coolant Temperature Sensor Signal
2	Black / pink	Engine Coolant Temperature Sensor Low level Mark

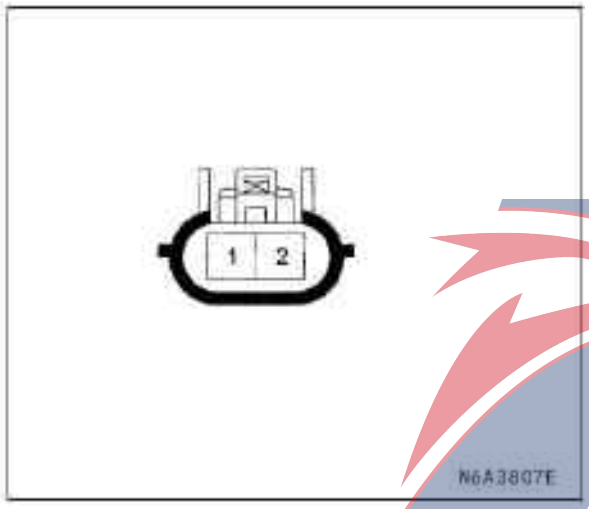
Engine heating switch



Joint No.		B-31
Joint color		Grey
Test connector No.		J-35616-42
Contact pin	Wiring color	Connector pin function
1	Brown	Indicator light control
2	Green / red	Lighting 12V power supply

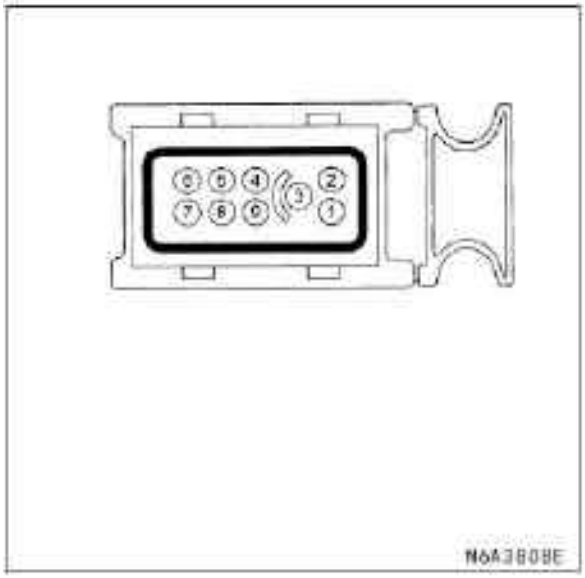
Joint No.		B-31
Joint color		Grey
Test connector No.		J-35616-42
Contact pin	Wiring color	Connector pin function
3	Blue / red	Engine heating switch 12V power supply
4	Orange / red	Indicator voltage power supply from switch signal
5	Black	Light grounding
6	Orange / red	Engine heating switch signal

Exhaust brake solenoid valve



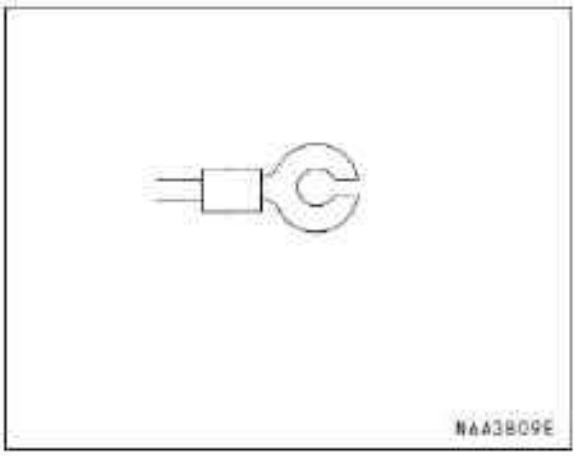
Joint No.		J-31
Joint color		Black
Test connector No.		J-35616-33
Contact pin	Wiring color	Connector pin function
1	Black	Ignition voltage
2	Light green	Exhaust brake solenoid valve control

Fuel injection pump control device



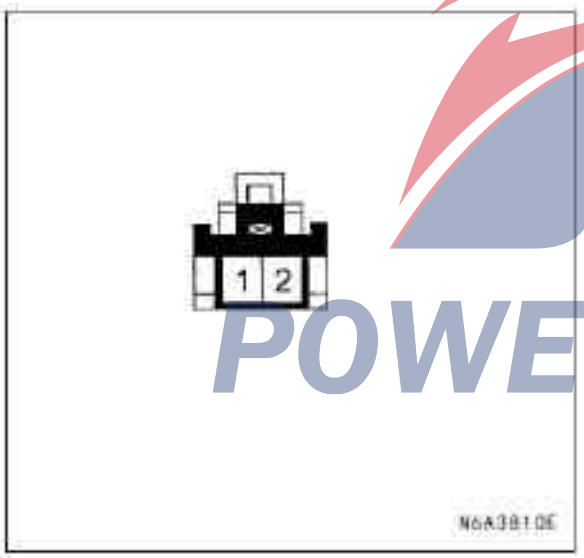
Joint No.		E-110
Joint color		Black
Test connector No.		J-35616-8
Contact pin	Wiring color	Connector pin function
1	Blue	CAN low level signal
2	Yellow	CAN high level signal
3	—	Useless
4	—	Useless
5	Orange	Engine Shutdown Solenoid Control Signal Input
6	Black	Grounding
7	Red /white	Battery Voltage
8	Pink	Crankshaft sensor signal input
9	—	Useless

Glow plug



Joint No.		J-122
Joint color		Silver
Contact pin	Wiring color	Connector pin function
1	Black / yellow	Power supply

Idle switch

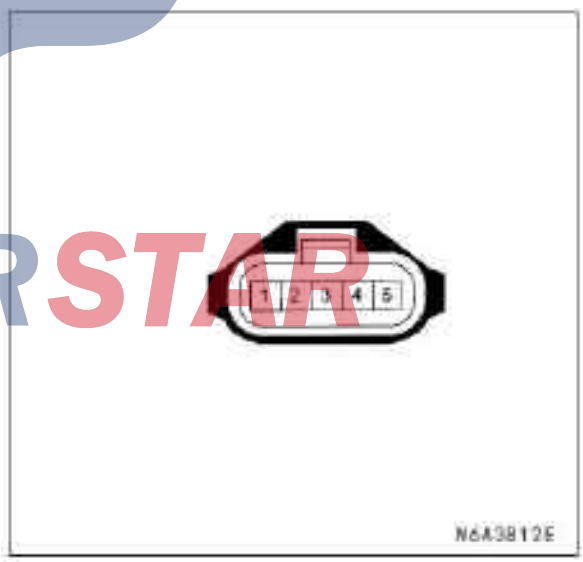


Joint No.		B-340
Joint color		Black
Test connector No.		J-35616
Contact pin	Wiring color	Connector pin function
1	Green / black	Idle switch signal
2	Black	Idle switch grounded

Intake throttle solenoid

Joint No.		J-40
Joint color		Brown
Test connector No.		J-35616-4A
Contact pin	Wiring color	Connector pin function
1	Blue / red	Ignition voltage
2	Light green/ white	Intake throttling solenoid valve control

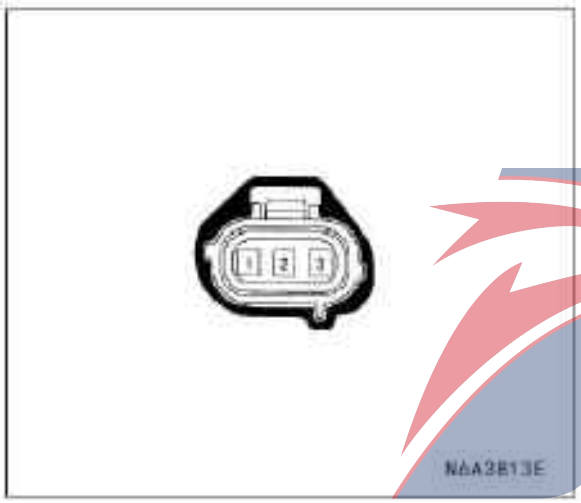
Mass air flow intake air temperature sensor



Joint No.		J-182
Joint color		Black
Test connector No.		J-35616-4A
Contact pin	Wiring color	Connector pin function
1	Black / blue	IAT sensor signal

Joint No.		J-182
Joint color		Black
Test connector No.		J-3561 6-4A
Contact pin	Wiring color	Connector pin function
2	Blue / red	Mass Air Flow Sensor Ignition Voltage Supply
3	Black /red	Mass Air Flow Sensor – Air Inlet Temperature Low level Mark
4	white /red	Mass Air Flow Sensor 5V
5	Green / red	MAF sensor signal

Vehicle speed sensor (VSS)



Joint No.		J-32
Joint color		Grey
Test connector No.		J-3561 6-64A
Contact pin	Wiring color	Connector pin function
1	Black / yellow	Speed sensor 12V power supply
2	Black	Vehicle speed sensor low level mark
3	Yellow /Green	vehicle speed sensor signal

Diagnosis information and procedure

General maintenance information

Components of non-original equipment manufacturer

All on-board diagnostics are corrected by the original equipment manufacturer's components. Therefore, if a commercially available sensor or switch is installed, the diagnosis is incorrect and the fault indicating lamp is on. If the supporting electronic components such as mobile phones, stereo devices and anti-theft devices are improperly installed, they may cause electromagnetic interference to the control unit. This will cause the sensor reading to be inaccurate, and the fault indicator lamp lights up.

Improper maintenance to vehicle

If the vehicle is not properly maintained, the sensitivity of the on-board diagnostic device will make the fault indicator lamp light up. If the oil filter and the fuel filter are plugged and the crankshaft generates carbon because the engine oil is not changed or the viscosity is not proper, the actual vehicle fault that cannot be detected before on-board diagnostic device will be caused. Improper vehicle maintenance shall not be considered as" non-vehicle fault ", but according to the sensitivity of on-board diagnosis, the vehicle maintenance plan must be strictly observed.

Visual/ Actual Engine Room Check

The engine compartment shall be carefully inspected and physically checked when any diagnostic procedure is carried out or the cause of the emission test failure is diagnosed. This tends to solve problems, without further processes. In case of appearance and actual inspection, the following guidance methods shall be adopted:

· Check that all vacuum hoses are perforated, cut, disconnected, and whether the lines are correct.

· Check the hoses that are difficultly seen behind other parts.

· Check whether all wirings of the engine room are connected correctly, whether there are burnt or broken parts and extruded wiring, and whether the wires have contacted with sharp edge or hot exhaust manifold or pipe.

Basic knowledge of required tools

To diagnose without basic knowledge of the power train may result in incorrect diagnosis or damage to the power train components. If without basic knowledge of the power train, it is not possible to attempt to diagnose the problem. It is necessary to have a basic understanding of the start-up of the manual tools in order to effectively use the instructions in this section in the Service Manual.

Malfunction indicator light (MIL)

Generally speaking, the fault indicator lamp lights when the control module detects a Diagnostic Trouble Code that affects the emission of the vehicle. The Diagnostic System must be checked if the fault indicator lamp lights when the engine is in operation or due to the driving performance or the emission problem that may cause fault. The inspection procedures are shown in the description of the control part of engine in Diagnostic System Check.

Diagnostic Trouble Code Type

Features of the code

· Related to non-emission

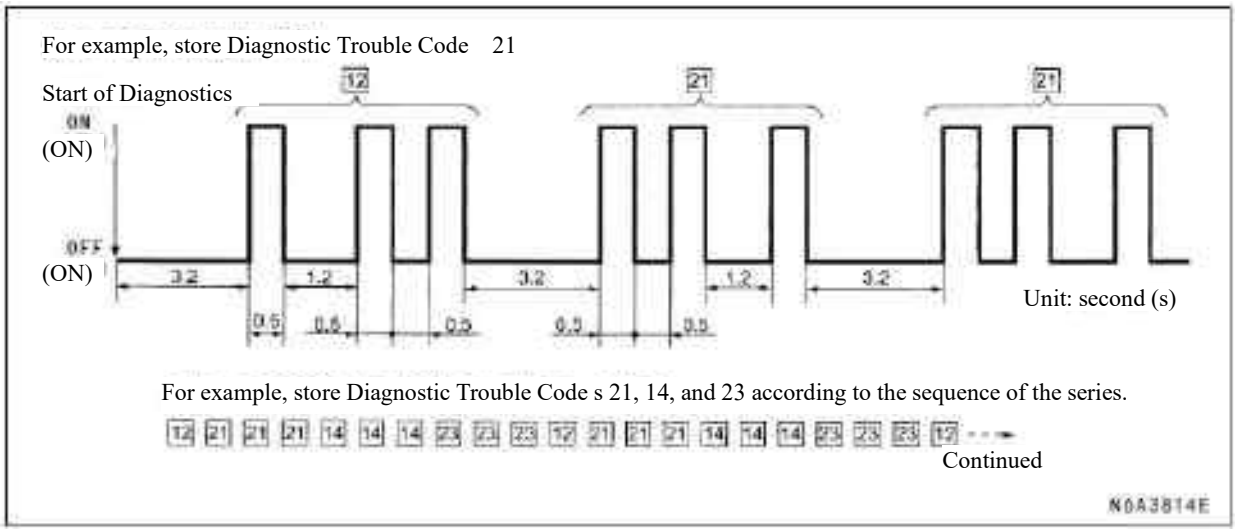
· No lighting lamps required

· Fault occurs when the first trip is saved.

Readout Quick Diagnostic Trouble Code

A device fault connector that communicates with the ECM. The Diagnostic Trouble Code stored in the engine control module can be read by using a handheld diagnostic scanner, such as the Tech2 inserted in the fault diagnostic connector or when DLC diagnostic test terminal is grounded by means of the flickering times of the fault indicator lamp. The fault diagnosis connector terminal "6" (diagnostic requirement switch) is connected to terminal "4" of the fault diagnosis connector, which is set in the "Low" (grounding) position and the terminal "4" is a grounding wire.

When terminal "4" is connected to terminal "6", the ignition switch must be set to the "ON" position and the engine is not running. The fault indicator lamp flashes 12 times, first, then flashes the first stored Diagnostic Trouble Code for 3 times, and the second stored diagnostic trouble code for 3 times, and so on. All stored diagnostic trouble codes flash and then return to 12 to continue flashing. If there is no diagnostic fault code, the fault indicator flashes continuously 12. As long as the fault diagnosis connector is shorted, the Diagnostic Trouble Code display will flash continuously



Reading-type Diagnostic fault code with Tech2

Use Diagnostic Trouble Code s to read the procedure through diagnostic Tech2. When reading the Diagnostic Trouble Code , use Tech2 to read the Diagnostic Trouble Code information stored by the ECM

Use or do not use T e c h 2 to, clear the Diagnostic Trouble Code.

Do not remove Diagnostic Trouble Code s unless they are required by the service information provided by each diagnostic procedure. When the Diagnostic Trouble Code is cleared, use Tech2 "Clear Diagnostic Trouble Code Information". If Tech2 process record is not available, the diagnostic trouble code is cleared after 40 cycles of fault-free continuous running

Tech2 diagnostic apparatus

Qingling Company recommends to use Tech2 . Refer to the instructions for the correct starting procedure in the Tech2 user guide.

Operation Procedures

1. 1 Touch input start screen
2. Select diagnose >appropriate normal vehicle mark >power drive system > 4KH1-TC.
3. The function menu that should be used is shown in the following table

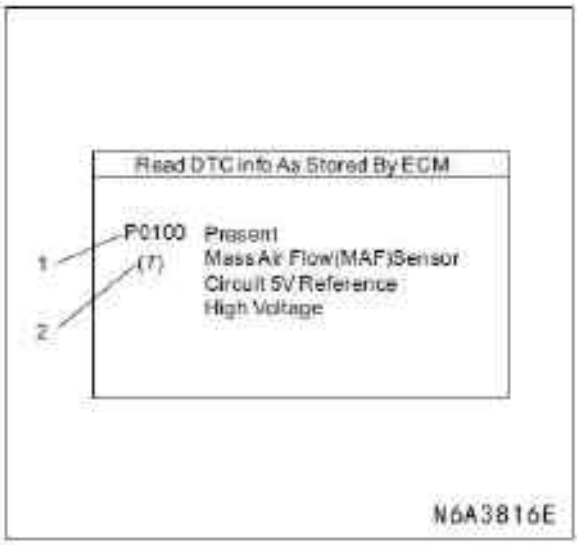
F0: Diagnostic Trouble Code F0: Read the Diagnostic Trouble Code stored in the engine control module (Diagnostic Trouble Code) F1: Clear diagnostic trouble code information F1: Data Display F2: Extraction point printing F3: Other Tests F0: Luminaire F0: Fault indicator F1: Indicator for preheating Relay F0: Warm-up display F1: Solenoid valve F0: EGR solenoid valve F2: Engine speed control F3: Program control F0: Vehicle Identification Code Procedure F1: Lock Spray ECU

F0: Diagnostic Trouble Code

The purpose of this mode is to display the fault codes that are stored in the engine control module. When the Clear Diagnostic Trouble Code message is selected, the Clear Diagnostic Trouble Code message appears. This message indicates that all diagnostic trouble messages stored in the engine control module will be cleared if the diagnostic trouble code is cleared.

Fault symptom code

The fault symptom code is located in the diagnostic trouble code column. The additional letter or number represents the fault identification code. Each Diagnostic Trouble Code includes a single symptom, such as the Diagnostic Trouble Code P 0 1 0 0 has, four fault symptoms (7), (9), (B), and (C). The Diagnostic Trouble Code chart is classified accordingly



Legend
1. Diagnostic Trouble Code
2. Fault symptom code

F1: Data Display
The purpose of this mode is to continuously detect data parameters. Actual number ratings of all important sensors and signals in the current system are shown in this mode.

F2: Quick diagnosis device
F3: The quick diagnosis device is not required to consult all the data when it expects fault, but try to make the condition happens. The quick diagnostic device can collect parameter information around the selected trigger point. Refer to Tech2 User's Manual for a detailed description.

F4: Multiple Tests
The purpose of this mode is to check whether the electronic system actuator is operating correctly. Using a variety of test menus can test the status of each of the actuators and associated sensors. In particular, the fault line can be diagnosed when the Diagnostic Trouble Code cannot be detected. Even if the Diagnostic Trouble Code is detected, using these menu test lines can determine whether the fault is a mechanical problem or an electronic fault. Refer to the description of the Tech @ output control in this section.

F5: program control
The purpose of this mode is to program the VIN to the ECM and lock the programmed VIN. Refer to the instructions in this section for the replacement of the ECM.

Tech2 Data, Sheet
The Tech2 data sheet lists all parameters that are owned by Tech2. Use the Tech2 data sheet after you have determined the following.
· Diagnostic System Check that Engine Control is completed
· No diagnostic trouble code (DTC) display
· On-board diagnosis device operates normally.
The rated value of Tech2 number of the normal running engine can be used for comparing with the engine being diagnosed. The Tech2 data list lists the data that can be seen on the normal running engine.

Important notes:
Tech2 that displays error data shall not be used, the fault of Tech 2 shall be informed to the manufacturer. Using a faulty Tech2 can cause diagnostic errors and unnecessary component replacement. Only the following parameters in Service Manual can be used when diagnosing.

Tech2 parameter	Display unit	Nominal rating of engine idling	Standard fixed value at 2000rpm
Operating conditions: engine idling or 2000 rpm/ engine coolant temperature 75-85 ° C (167-185 ° F)/ accelerator pedal constant/ parking or neutral/ attachment off/ vehicle on flat			
Ignition switch	On/off	On	off
System voltage	V	11.0-15.0	11.0-15.0
ECM main relay	On/off	On	On
Engine speed	a. Speed in revolutions per minute	650-750	1950-2050
Desired Idle	a. Speed in revolutions per minute	700	700
Fuel injection pump speed	a. Speed in revolutions per minute	325-375	975- 1025
Accelerator Pedal Position	%	0.0	19.0-23.0
Idle speed switch	On/off	On	bur
off			
Intake air temperature (IAT)	°C/°F	20-40°C/68-104°F	20 - 40°C / 68 -104°F
Engine coolant temperature (ECT)	°C/°F	75-85°C/167 -185°F	75 - 85°C/167-185°F

Tech2 parameter	Display unit	Nominal rating of engine idling	Standard fixed value at 2000rpm
Fuel temperature	°C/°F	20 - 60°C / 68 - 140°F	20 - 60°C / 68 - 140°F
atmospheric pressure	hPa	At sea level nearly 1010hpa	Altitude: near 1010hpa
EGR electromagnetic control	%	Almost 70%	Almost 30%
MAF sensor	mg/strk	Greater than 480 mg/strk in case of sea level	Greater than 480 mg/strk in case of sea level
Expected fuel injection volume	mg/strk	Greater than 480 mg/strk in case of sea level	Greater than 1200 mg/strk in case of sea level
Actual injection quantity	mg/strk	7.0 - 10.0	8.0-12.0
Expected fuel injection volume	mg/strk	7.0 - 10.0	8.0-12.0
Actual ignition timing	°CA	3.0-5.0	5.0-7.0
Expected fuel injection timing	°CA	3.0-5.0	5.0-7.0
Neutral switch	On/off	On	On
Brake pedal 1 switch	Press/ release	Release	Release
Brake pedal 2 switch	Press/ release	Release	Release
clutch pedal switch	Press/ release	Release	Release
Engine heating switch	On/off	off	off
Exhaust brake switch	On/off	off	off
Intake throttling solenoid valve control	On/off	off	off
Exhaust brake electromagnetic control	On/off	off	off
Anti-lock device signal	On/off	off	off
anti-lock output signal	On/off	off	off
Vehicle speed	km/h/MPH	0	0
Glow relay control	On/off	off	off
Glow indicator light control	On/off	off	off
MIL control	On/off	off	off
Air conditioning requirements signal	On/off	off	off
A/C relay control	On/off	off	off

Tech2 Data, Definitions

The contents of each message shown on Tech 2 are, described in the engine control. This information helps to discharge or operate performance issues. These indications can be seen in the vehicle driving. Diagnostic System Check shall be performed frequently-first engine control. The check of the diagnostic system can ensure proper functioning of the system.

Ignition switch

This parameter displays the status of the ignition switch to the ECM terminals (Pin 39). The Tech2 display s On/Off . The ON indicates that the ignition switch is set to the connecting position.

System voltage

This parameter displays the system voltage measured at the engine control module terminal (pin 3) at the ECM main relay voltage supply.

ECM main relay

This parameter displays the control status of the engine control module main relay control line (pin 58). The Tech2 displays ON/OFF. The ON indicates that the main relay control circuit of the engine control module is grounded by the ECM, providing voltage to the other circuits of the engine control module; the OFF indicates that the main relay is not controlled

Engine speed
This parameter displays the crankshaft speed calculated by the ECM according to the input of the crankshaft position (CKP) sensor or camshaft position sensor (CMP).
Desired Idle Speed
This parameter displays the idle speed required by the engine control module. The ECM compensates for various engine loads depending on the engine coolant temperature (ECT) and the condition of the air conditioning unit. If the air conditioner is disconnected, the engine control module is set at a speed greater than the normal idle speed by 50RPM
Fuel injection pump speed
This parameter displays the injection pump speed calculated by the fuel pump control (HFID) from the input of the fuel injection pump crankshaft position (CMP) sensor. Tech 2 shows the unit of revolutions per minute in RPM.
This parameter displays the accelerator angle calculated by the ECM using the acceleration pedal position (APP) sensor. The accelerator pedal position indication angle is a range of ratings that indicates a lower percentage when the accelerator pedal is depressed and the high percentage when the accelerator pedal is fully depressed.
Idle switch
This parameter displays the input status of the idle switch to the ECM terminal (pin 69). Tech displays ON/OFF. The ON indicates that the accelerator pedal is not depressed. The OFF indicates that the accelerator pedal is depressed.
Intake air temperature (IAT)
This parameter displays the inlet air temperature from the voltage input to the IAT sensor connected to the ECM. When the signal voltage is high Tech 2 shows low temperature, and the high temperature is displayed when the signal voltage is low. Note that the intake sensor is located in the Mass Air Flow (MAF) sensor and the mass air flow sensor is heated.
Engine coolant temperature (ECT)
This parameter displays the engine coolant (ECT) temperature measured according to the engine coolant (ECT) sensor to the voltage input of the ECM. If the signal voltage is high , Tech 2 shows low temperature, if the signal voltage is low, TECH displays high temperature
Fuel temperature
This parameter displays the temperature calculated by the fuel injection pump control unit (PCU) by using the signal from fuel temperature sensor that is built in PCU.
Atmospheric pressure
This parameter displays the atmospheric pressure calculated by the ECM according to the signal from the atmospheric pressure (BARO) sensor inside.
Exhaust gas recirculation system (E G R) electromagnetic control
This parameter displays the ECM control load ratio measured by the ECM terminals (pin 97) based on the engine speed, the amount of injection, and the input of various sensors. If the load ratio is small, the control EGR valve is closed, if the load ratio is large, and the control EGR valve is disconnected.
MAF sensor
This parameter displays the air flow entering the engine calculated by the engine module according to the input of the mass air flow (MAF) sensor. When the engine is in high speed, Tech2 shows a rated value; while the engine is idling, Tech2 shows a low rated value. This parameter can be compared with the mass air flow in order to determine the accuracy of the MAF sensor, the fault of the exhaust gas recirculation system or the fault of the air inlet . Note that the MAF on Tech2 can only be updated when the engine is running.
The Desired Mass Air Flow
This parameter displays the mass air flow required for the engine control module according to the current driving conditions.
Actual injection quantity
This parameter displays the amount of injection for the pump control unit calculated according to the time for which the fuel injection solenoid valve has been switched on, this switching-on time is compensated from the position of the timing device to the input of fuel temperature. This parameter can be compared with the desired amount of injection in order to determine the fault of the fuel system.
Expected fuel injection volume
This parameter displays the amount of injection required for the engine control module to use the target ignition atlas according to the current driving conditions.
Actual injection timing
This parameter displays the injection time calculated by PCU according to the position of the timing device measured by the crankshaft position sensor and the cam position sensor.
Expected fuel injection timing
This parameter displays the injection timing desired by the engine control module according to the current driving conditions and by using the target injection timing atlas. This timing is compensated by the engine coolant temperature etc.
Neutral switch
This parameter displays the injection timing desired by the engine control module according to the current driving conditions and by using the target injection timing atlas. This timing is compensated by the engine coolant temperature etc.

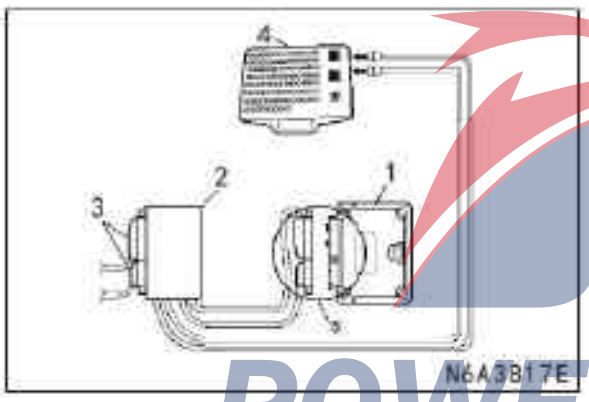
Brake Pedal 1 Switch
This pedal displays the brake pedal status determined by the ECM terminal (pin 30) according to the input of the brake pedal 1 switch. This switch turns on the brake light when the brake pedal is depressed. Tech 2 displays pressing when the brake pedal is depressed.
Brake pedal 2 switch
This parameter displays the brake pedal 2 switch determined by the ECM terminal (pin 65). Tech 2 shows release or pressurization. Releasing indicates that the brake pedal is not pressurized and pressing shows that the brake switch is depressed.
Clutch switch
This parameter indicates the clutch pedal status determined by the ECM terminal (pin 31) according to the input of the clutch pedal switch.
Tech2 shows RELEASE or PRESSURIZATION.The releasing indicates that the clutch is not pressurized and the pressing indicates that the clutch is depressed.
Engine heating switch
This parameter displays the input status of the engine heating switch to the ECM terminal (pin 46). Tech2 shows ON or OFF. The releasing indicates that the clutch is not pressurized and the pressing indicates that the clutch is depressed.
Exhaust brake switch
This parameter displays the input status of the exhaust brake switch to the ECM (pin 64). Tech 2 displays ON or OFF. The ON indicates that the exhaust brake switch is switching off the exhaust brake request circuit to the ECM and brakes the intake throttle solenoid and the exhaust brake solenoid valve according to the driving conditions. The OFF indicates that the exhaust brake switch is disconnected and the exhaust brake does not operate
Intake throttling solenoid valve control
This parameter displays the control status of the inlet air throttle(IAT)solenoid control circuit (pin 95). Tech 2 displays ON or OFF. The ON indicates that the ECM is activating the air inlet throttle solenoid circuit; the OFF indicates that the ECM does not control the inlet throttle solenoid.
Exhaust brake solenoid valve control
This parameter displays the control status of the exhaust brake solenoid circuit (pin 40). Tech 2 displays ON or OFF. The ON indicates that the ECM is activating the exhaust brake solenoid circuit; the OFF indicates that the engine control module (ECM) does not control the exhaust brake solenoid.
Anti-lock input signal
This parameter displays the status of the request input for exhaust brake disconnecting from the (anti-lock device) to the engine control module terminal (pin 32). Tech 2 displays ON or OFF. The ON indicates that the EHCU sends a command to release the exhaust brake to the ECM; the OFF indicates that the EUCH is not being controlled.
Anti-lock output signal
This parameter displays the feedback (output) signal of exhaust brake disconnecting request from the engine control module terminal (pin 62) to the EHCU (anti-lock device). The ON indicates that the engine module sends the feedback signal back to the EHCU. The OFF indicates that the engine control module is not being controlled.
Vehicle speed
This parameter indicates the vehicle speed calculated by the ECM according to the input of the speed sensor (VSS). At high speed, Tech 2 displays high rated value, and at low speed ratings it displays low number rated value.
Glow relay control
This parameter displays the control status of the glow relay control circuit (pin 94). Tech 2 shows ON or OFF, and the ON indicates that the glow plug relay control circuit is grounded by the ECM, causing the glow plug to produce voltage. The OFF indicates that the ECM does not control the glow plug relay.
Glow indicator light control
This parameter displays the control status of the glow indicator lamp control circuit (pin 43). When Tech 2 shows ON, the warm-up indicator should be on; when Tech 2 shows OFF, that the warm-up indicator lamp should turn off .
Malfunction Indicator Lamp (MIL) Control
This parameter displays the control status of the malfunction indicator lamp (MIL) control circuit (pin 42). When Tech 2 shows ON, the MIL shall be on, and when Tech 2 shows OFF, the MIL should turn off. When the engine is turned on, the ignition device is switched on, the engine control module controls the MIL for a certain time to check the bulb.
Signal required by Air-conditioning (A/ C)
This parameter displays the input status required by the air conditioning (A/ C) to the heating, ventilation, and air conditioning (HVAC) control terminal (pin 33). Tech 2 indicates ON or OFF. The ON indicates that the requirement of AC compressor relay control circuit of the HAVC system is accepted and the AC compressor clutch is engaged. The OFF indicates that the Engine Control Module (ECM) does not accept the HAVC requirements.
A/C relay control
This parameter displays the control status of the AC compressor relay control circuit (pin 41). Tech 2 displays ON or OFF. The ON indicates the ECM is grounded, AC compressor relay controls the circuit, so the AC compressor clutch is energized; the OFF indicates that the ECM does not control the AC compressor relay.

Intermediate signal check Tech2 output control

Tech2 output control	Additional Menu Selection	Notes
EEG solenoid valve	solenoid valve	The purpose of this test is to check whether the EGR valve can act correctly according to the command. If the mass air flow (MAF) sensor receives the command of ON or OFF, and does not change, the effects of external substances on valve action, excessive crud, vacuum hose line failure, EGR valve or EGR solenoid valve failure shall be considered.
Engine Speed (RPM) Control	–	The purpose of this test is to check whether the actual engine idle speed can change or not and whether it matches the desired speed (RPM).
Warm-up indicator	Light	The purpose of this test is to check whether the warm-up indicator can act when it receives the ON command. If the switch is required to turn on, but it does not act, the circuit fault or the bulb short circuit shall be considered.
Glow relay	Relay	The purpose of this test is to check whether the preheater can act after it receives the command for ON. If the preheater does not act, the circuit fault or preheater failure shall be considered.
malfunction indicator light (MIL)	Light	The purpose of this test is to check whether the malfunction indicator lamp (MIL) can act after receiving the ON command. If not, the circuit fault or the bulb circuit shall be considered.

Circuit breaker box

Circuit Breaker box connection type A

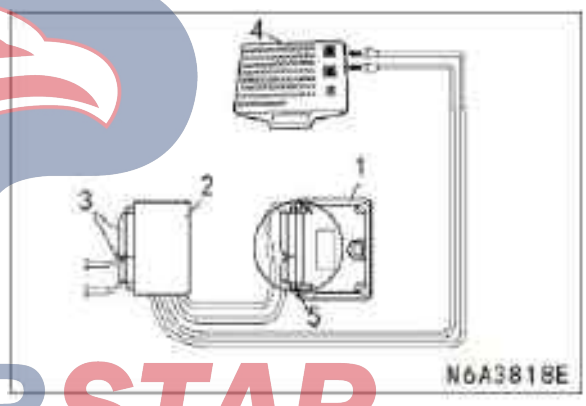


Legend

1. Engine control module (ECM)
2. Harness joint
3. ECM - harness connector
4. circuit breaker box
5. Engine control module disconnected

Although the detection connector can detect the engine control module harness connector, the breaker box connection type A is suitable for preventing damage to detection errors and internal terminals when an open or short circuit is detected for grounding between the ECM and the electrical components, because the terminals are set together and the ECM harness connectors at these terminals are very thin.

Circuit Breaker box connection type B



Legend

1. engine control module (ECM)
2. Harness joint
3. ECM - harness connector
4. circuit breaker box
5. Engine Control Module Connections

The ECM and other connectors are provided with waterproof terminals that cannot be used to support the detection head. The breaker connection type B is suitable for short-circuit or engine control module (E C M) and electrical components of the detection voltage line.

Engine control system check list

Engine control system check list			**Name of the inspector**	
User's Name			Model and vehicle model, year	
Name of driver			Chassis number	
Vehicle inspection date			Engine number	
License No.			Milestone reading	Km/miles
Fault	The engine is not running	Engine does not start No Starting Ignition No complete combustion		
	Difficult starting	Engine starts slow Other ( )		
	Idle is abnormal.	Idle is abnormal. High idle speed Low idle speed Idle and jitter Other ( )		
	Poor driving performance	The reaction is slow, weak, intermittent surge, deflagration shutdown, fire breaking, Insufficient power, stagnation, pedal soft other( )		
	Engine is shutdown	Starting soon after After pressing the accelerator pedal During air conditioning operation After releasing the accelerator pedal Neutral to Forward Shift Other ( )		
	Other	Black smoke White smoke Poor fuel economy Fuel deflagration, combustion noise Other ( )		
Fault occurrence Date				
Fault frequency		Constant Discontinuity (time/ month) One time only Other ( )		
Fault	Weather	Sunlight Cloudy Rainy Snowy Various/ Others ( )		
	Atmospheric Temperature	Hot (Approx) warm Cool Cold (Approx) Any temp.		
	Starting point	Expressway Suburb City Uphill downhill uneven road Other ( )		
	Load conditions	Greater than (approx. t) Others (approx. t) No Load		
	Engine temp.	Cold Heating After heating Any temp. Other ( )		
	Engine running	Startup After starting (min) Idling High speed operation Driving Constant Acceleration Deceleration Air-conditioning switch ON/ OFF Other ( )		
	Fuel quantity	Full Above 1/ 2 Below 1/ 2 near-empty		
	Fuel brand			
Fault indicator condition			Keep ON Interrupted-on cannot be switched on	
Diagnostic Trouble Code (DTC) or Flash Code	current fault code		No Current fault code and fault symptom code Number ( )	
	history fault code		No Current fault code and fault symptom code Number ( )	
Additional Conditions attached				

Diagnostic Starting Point-Engine Control

Use Diagnostic System for Checking-Engine Control begins system diagnosing Diagnostic System Check-The ECM provides the following:

· Control module identification of the control system

· Ability to connect between the control module and the serial data line

· Identification and its status of any stored diagnostic trouble code (DTC)

Use the Diagnostic System for Checking-ECM can identify the correct procedure and the position of the procedure of the diagnostic system.

Important note:

The engine control system check list must be used to verify the problem of the user. It is necessary to understand the correct operating method of the system and verify that the user's problem is a valid system failure.

Diagnostic System Check-Engine Controls

Notes

Diagnostic System Check- It is an organized exploration that the engine control device identifies the condition causing the faults in electronic engine control system. The Diagnostic System Check must be the starting point for attention to any driving performance. The Diagnostic System Check can guide the maintenance technician to take the next reasonable step to diagnose the problem that is concerned. Understanding and correct use of the diagnostic tables can reduce the diagnostic time and prevent the replacement of normal components.

Test Description

The following numbers indicate the step numbers in the diagnostic table.

2. If key word 2000 serial data line partly or completely malfunctions, the communication will not be smooth. Special conditions shall be determined according to the specified procedure.

11. If there are other modules with diagnostic trouble codes, refer to the Diagnostic Trouble Code Catalogue. The diagnostic trouble code catalogue can give the correct diagnostic procedure. If the control module stores multiple diagnostic trouble codes, the diagnostic trouble code (DTC) shall be conducted according to the following order

· Component-level diagnostic trouble codes such as sensor diagnostic trouble codes, solenoid diagnostic trouble codes, brake diagnostic trouble codes, and relay diagnostic trouble codes. In this category, a multi-Diagnostic Trouble Code is diagnosed in a numerical sequence. Begin with the diagnosis fault code of the minimum number, unless otherwise specified in the diagnostic table.

Diagnostic System Check-Engine Controls

Important note:

If there is no problem in driving performance, do not perform this diagnosis unless another procedure is required for this diagnosis.

Before diagnosis, the vehicle shall be visually inspected and enquired about repairing.

· Do not clear diagnostic trouble codes unless the requirement by the diagnostic procedure.

If the starting system has some conditions, refer to the instructions for the starting system in the engine mechanical description.

· Ensure that the battery is fully charged.

· Ensure that the battery cable (+) (-) is clean and secure.

Make sure that the engine control module is grounded and the position is correct.

Make sure that the harness connector of the engine control module is clean and the connection is correct.

· Ensure that the ECM terminals are clean and correctly mated.

· Ensure that the fuel injection pump control unit (PCU) is grounded clean and tight and positioned correctly.

Make sure that the PCU harness connector is clean and connected correctly.

· Make sure the PCU terminals are clean and matched properly.

· Make sure that the vehicles have been repaired sufficiently

Step	Method	Fixed value(S)	Yes	No
1	Install Tech2 Is Tech2 ON?	—	Go to step 2	Go to Techno 2, Power is not Transmitted
2	1. Switch on ignition device, and the engine is switched off 2.Attempt to establish Communication Engine Control Module for the Engine Communication Module ? Does Tech2 communicate with the engine module control?	—	Go to step 3	Go to ECM, and Communication is lost

Step	Method	Fixed value	Yes	No
3	Try to start the engine. Does the engine start or idle?	—	Go to step 4	Use the engine for start-up but the engine does not run
4	Select the diagnostic trouble code display function of the engine control module Does Tech2 display any diagnostic trouble codes?	—	Go to step 5	Go to step 12
5	1. 30s 2. Start the engine 3. Detect diagnostic trouble information with Tech2. Is this method completed?		Go to step	
6	Does Tech2 display engine control module diagnostic trouble code P06022?	—	Use applicable diagnostic trouble codes	Go to step 7
7	Does Tech2 display engine control module diagnostic trouble code P0251 (fault symptom code 9 or, A), P0606 (fault symptom code A or B) or P1605 (fault symptom code C, D or E)?		Use applicable diagnostic trouble codes	Go to step 8
8	Does Tech2 display engine control module (ECM) diagnostic trouble code P0560 (fault symptom code 1, 2 or, A)?	—	Use applicable diagnostic trouble codes	Go to step 9
9	Does Tech2 display engine control module (ECM) diagnostic trouble code P0561 (fault symptom code A or B) or P1625 (fault symptom code A or B)?	—	Use applicable diagnostic trouble codes	Go to step 10
10	Does Tech2 display engine control module (ECM) diagnostic trouble code P1650 (fault symptom code A or B) or P1651 (fault symptom code A or B)?	—	Use applicable diagnostic trouble codes	Go to step 11
11	Is there any other code in any controller that is not diagnosed?	—	Use applicable diagnostic trouble codes	Go to step 12
12	1. Check the following symptoms 2. Check the following used symptom diagnostic tables · The operation is unstable, unstable, or idle speed is incorrect and stopped · Surge/ deflagration · Insufficient power, stagnation, or soft pedal · The reaction is slow, weak and intermittent · Fuel deflagration/ combustion noise · Poor Fuel Economy · Excessive smoke (black smoke) · Excessive smoke (white smoke) · Has it been found and corrected for the condition?		System normal	Procedure for using intermittent condition faults

Tech 2 not powered

Circuit instructions

The fault diagnostic connector (DLC) is a standard 16 cavity connector. The design and location of the connector shall be in accordance with the industry standard, and the following shall be provided:

Battery Positive pole voltage at Tech 2 energizing terminal 16

· Grounding of battery at Tech 2 energizing terminal 2

· Common signal grounding at terminal 5

Tech 2 is charged after the ignition device is turned off. However, some modules cannot communicate unless the ignition device is on.

Tech 2 does not energize

Mark of Schematic Diagram: engine control schematic diagram

Mark of Side view of connector: Side view of the engine connector

Step	Method	Fixed value	Yes	No
1	Important Ensure that Tech 2 can operate normally on another vehicle before this form is used. 1. Turn off electric fire 2. Check the ENG (B1) (B2) fuse in the glove box fuse box. Are ENG (B1) (B2) (15A) fuse (F-8 & F-9) disconnected?		Go to step 2	Go to step 3
2	Replace the fuse (F-8, F-9) of the engine (B1) (B2) (15A) . If the fuse is still disconnected, repair the grounding from the circuit that is powered by the engine (B1) (B2) (15A) or replace the short circuit accessories powered by Short circuit accessories. Are the repairs completed?		Go to step 7	
3	1.Check each line of the fault diagnostic connector (DLC) (B-79 connector) for exiting, loosing, or terminal missing. 2. Repair the terminals as required and is the terminal found and has it been repaired?		Go to step 7	Go to step 4
4	Does one detection lamp light connected between B + circuit (pin 16 of B-79 connector) at DLC and a known grounded place?	—	Go to step 6	Go to step 5
5	Repair the open circuit from the battery voltage circuit to the DLC. Is this repair completed?	—	Go to step 7	—
6	1.Check all ground circuits at DLC (pins 4 and 5 on B-79 connector) for an open or high resistance. 2. Repair the circuit as required.		Go to step 7	Turn to disconnecting condition
7	1. Connect Tech2 to DLC 2. Attempt to turn on Tech 2. Does Tech 2 turn ON?		System normal	Go to step 1

Lost Communication with Engine Control Module (E C M)

Description of the Circuit

The Engine Control Module (ECM) communicates with Tech 2 through the keyword 2000 series data link. However, the mutual communication between the engine control module and the fuel injection pump control (PCU) is performed via the control area network (CAN) chain. The CAN chain does not communicate with Tech2, it is shared with PCU only by ECM.

Diagnostic assistant

The following conditions cause the keyword 2000 series data communication to be lost between Tech 2 and any control module:

· Key words 2000 series data line is disconnected.

· Key words 2000 series data line grounded.

· Key words 2000 series data circuit short-circuited.

· The internal condition on the module or the connector on key words 2000 series data line causes short-circuit or grounding of key words 2000 series data lines.

· Open grounding line (pin 5)at DLC

Lost communication with the Engine Control Module (ECM).

Schematic mark: engine schematic

Mark of side view of the connector: side view of the control connector or the side view of the engine control module (ECM) connector

Step	Method	Fixed value	Yes	No
1	Is the Diagnostic System Checked-Engine Controlled?	—	Go to step 2	Go to diagnostic system check – engine control
2	Attempt to establish the communication between the Engine Control Module (ECM) and Tech 2 Does the ECM communicate with Tech 2?		Go to step 3	Go to step 4
3	Test the keyword 2000 series data line for intermittent grounding or intermittent short-circuit Did you find and correct the positive conditions?		Go to step 17	System normal
4	Check whether the connectors for the engine control module B-234 and B-233 are not well connected. Found and corrected?		Go to step 17	Go to step 5
5	1.Switch on the ignition device when the engine is off 2.Check main relay (100A) (SBF-1), key (50A) (SBF-2) and engine (B1) (B2) (15A) fuse (F-8 and F-9). If the disconnect is disconnected or re-detected. If the fuse continues disconnecting, check that all circuits supplied by the fuse are grounded or not. 3.Turn off the ignition device. 4.Disconnect the connector of the engine control module B-234 harness. 5.The ignition is switched on when the engine is off. 6.Connect the detection lamp to the ground contact and check the ignition voltage at the ECM (Pin 39 at connector B-234) Check if there is voltage in the power supply line. Does the detection light On?		Go to step 6	Go to step 14
6	Check the ground circuit of the fault diagnosis connector (DLC) at terminal 5 for a disconnected line or a poor connection. Found and corrected?		Go to step 17	Go to step 7

Step	Method	Fixed value	Yes	No
7	Check whether there is grounding or short-circuit of the keyword 2000 series data circuit between the engine control module (connector B-234 pin 35) and DLC (connector B-79 pin) . Found and corrected?		Go to step 17	Go to step 8
8	**Important notes:** **The ground line disconnection at the ECM does not cause a communication interrupt.** 1. Inspect the ECM ground lead for corrosion or poor tightening. 2. Clean or tighten the ground lead as required. Found and corrected?		Go to step 17	Go to step 9
9	1. Turn off the ignition device. 2. Reconnect the ECM harness connector, if it was disconnected 3. Switch on the ignition device when the engine is off. 4. Replace the main relay with the horn relay or a normal relay. 5. Try to establish the communication between Tech2 and ECM. Does the ECM communicate with Tech 2?		Go to step 15	Go to step 10
10	1. Turn off the ignition device. 2. Remove the main relay of the engine control module 3. Switch on the ignition device when the engine is off. 4. Using a test light to check the battery voltage, supply circuit to the ECM main relay (X-14 connector, pins 1 and 2 Battery voltage 5. Repair the open circuit of the circuit as needed. Found and corrected?		Go to step 17	Go to step 11
11	1. Reinstall the main relay of the engine control module . 2. The ECM will turn off the ignition device ; at the same time listen or feel whether the main relay of the engine control module clicks. Pause for 2 seconds between switching. Does the engine main relay click when the ignition device is ON or OFF?		Go to step 13	Go to step 12
12	Correct the following conditions for the main relay control line of the engine control module (ECM) between the ECM main relay (X-14 connector, pin 4) and the ECM (connector B-234 pin 58): • Open circuit • Short circuit of battery or ignition voltage • The resistance of ECM and ECM main relay is high or is not well connected. Found and corrected?		Go to step 17	Go to step 16

Step	Method	Fixed value	Yes	No
13	Check the following conditions of ECM main relay power line from ECM main relay (X-14) connector, pin 5 and the ECM (connector B-234 pin 3) to ECM: • Open circuit • The resistance of ECM and ECM main relay is high or is not well connected. Repair the circuit as required Did you find and correct it?		Go to step 17	Go to step 16
14	Repair the power circuit of the ignition device to the engine control module Has the circuit repaired?		Go to step 17	—
15	Replace the ECM main relay Have you finished the replacement?		Go to step 17	—
16	**Important note:** **The replacement of the ECM must be programmed.** Replace ECM. Refer to the description of replacement of the engine control module in this section. Have you finished the replacement?		Go to step 17	
17	1. Switch off the ignition. 2. Reconnect all disconnected connectors. 3. Switch on the ignition device when the engine is switched-off. 4. Try to establish the communication between Tech2 and ECM. Has Tech 2 communicated with the engine module?		System normal	Go to step 3

The engine is started but doesn't run.

Notes

The engine starts but does not run the diagnostic table is a systematic discussion that determines the condition causing the engine not to start. This diagnostic table directs the service personnel to perform the correct system diagnosis. The diagnostic table assumes that the following conditions are met:

·The battery is fully charged and the terminal is clean and tight.

· The starting speed of the engine is normal.

Engine Cranks but Does Not Run.

· There is enough fuel in the fuel tank.

· There is no leakage in the fuel line.

· There is no air in the fuel line.

The filter (air, fuel) is clean.

The fuse and the slow- fusing fuse are normal.

Diagnostic assistant

If an intermittent condition is suspected, refer to the description of this section for discontinuities.

Step	Method	Fixed value	Yes	No
1	Has the Diagnostic System Check-Engine Control been conducted?		Go to step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install Tech 2. 2. Switch off the ignition device for 30 seconds. Start the engine for a positive time. 3. Use Tech 2 to detect Diagnostic Trouble Code s. 4. Does Tech 2 display any Diagnostic Trouble Code s for a failed ignition ?	15 seconds	Go to Diagnostic Trouble Code Catalogue	Go to step 3
3	1. Check whether the following input and output readings are correct or not: refer to Tech2 data directory or good vehicle to determine the normal number rating. • System voltage • Engine coolant temperature (ECT) • Intake air temperature (IAT) • Mass air flow sensor (MAF) • Atmospheric pressure 2. Repair or replace as required. Found and corrected?		Go to step 10	Go to step 4

Step	Method	Fixed value	Yes	No
4	1. Check the high-pressure side between the fuel injection pump and the fuel injector for leakage of oil. The following components may have external leakage: • Fuel injection pump • Fuel injection pump control unit (PCU) • Fuel injection solenoid • Timing control valve (TCV) • Constant pressure valve (CPV) • Fuel lines between fuel injection pump and fuel injector • All fuel pipe fitting nuts • Each fuel pipe fitting • Each gasket **Note:** **The fuel will leak from the fuel injection pump into the engine. In this case, the engine oil level will rise. Check for any fuel leaking into the engine oil.** 2. Is there any problem found and has it been corrected as needed to repair the fuel system leak fault?		Go to step 10	Go to step 5
5	1. Switch off ignition 2. Check whether the fuel system line connections between the fuel tank and the fuel injection pump are tight and whether all fuel lines are cut and cracked and the pipe clamps are properly used or not. 3. Press the start pump on the fuel filter until it is stable. If there is leakage on the suction side of the fuel system between the start pump and the fuel injection pump, the start pump will not have sufficient stability, and fuel leakage will occur. Did you repair or replace and handle the found problem as needed?		Go to step 10	Go to step 6
6	1. Remove the fuel hose that is connected to the suction side of the fuel injection pump. 2. Remove the fuel pipe fitting that is connected to the suction side of the fuel injection pump 3. Check the lifting eye bolts of all limiting conditions or blasting mesh filters. **Note:** **If any current limiting condition is found, check the conditions that cause fuel pollution, such as: the user uses the fuel filter not specified Qingling or does not maintain the filter regularly. Check whether the type of fuel used is incorrect in winter or the wax or ice is separated out because the water enters the fuel system.** 4. Did you repair or replace and correct the found condition as needed ?		Go to step 10	Go to step 7

Step	Method	Fixed value	Yes	No
7	1. Disconnect the fuel hoses that are connected to the suction side of the fuel injection pump. In order to measure the amount of fuel injected, place the hose in the bottle or container. 2. Press the start pump on the fuel filter. **Note:** **If there is a leak in the suction side of the fuel system, the fuel will not flow enough from the disconnected hose, and fuel leaks. Also, if the fuel system suction side has limited flow, the fuel does not flow enough from the disconnected hose , the maximum possibility is that the fuel filter is plugged or the fuel hose or tube is deformed.** 3. Take fuel from the fuel line to the fuel suction line as close as possible to the fuel box in order to ensure that the clean fuel can flow (using hand-held vacuum pump 5-8840-0279-0/ J-23738-A and a clean hose or equivalent) so that the fuel suction line does not break and bring the air into the fuel line. Eliminate the fuel system leakage and flow- limiting faults as required Did you find and correct the problem?		Go to step 10	Go to step 8
8	1. Other causes that may cause no start-up: • Incorrect mechanical timing of the fuel injection pump. • The flywheel is installed incorrectly , so timing of the crankshaft (CKP) sensor is not accurate to the engine. Disconnect the sensor and try to start the engine for determination. • Inlet, exhaust flow is severely limited or the catalyst converter is blocked by solid. • Poor engine compression • If water enters in the fuel or gasoline is polluted, the fuel or gasoline shall be repaired or replaced as required. Did you find and correct the problem?		Go to step 10	Go to step 9
9	**Important note:** **The fuel injection pump must be inconsistent with the engine timing.** Replace the fuel injection pump. Refer to the Description of the Fuel Injection Pump Replacement in Engine Mechanical Section Have you finished the replacement?		Go to step 10	
10	1. Reconnect the previously disconnected harness connector 2. Switch off the ignition for 30 seconds 3. Attempt to start the engine Did the engine start and run continuously?		Go to step 11	Go to step 2
11	Using Tech 2 to observe the diagnostic fault code information. Is there any non-diagnosed DTC?		Go to Diagnostic Trouble Code (DTC) Catalogue	System normal

Diagnostic trouble code (DTC) catalog

DTC (trouble symptom code)	Flash code	MIL state	Name of the diagnostic trouble code on Tech2	DTC running conditions	DTC setting conditions	Probable causes
P01 00 (7)	**65**	On	Mass Air Flow (MAF) Sensor Line 5V Standard High Voltage	• Ignition switch ON	• The ECM detects that the MAF sensor 5V standard circuit voltage is above 5.2 V 0.5 seconds.	• The sensor 5V standard circuit is shorted to battery or ignition voltage. • Sensor 5V standard circuit shorted to sensor ignition voltage circuit • MAF sensor malfunction • Engine control module faulty.
P0100 (9)	**65**	On	Mass Air Flow (MAF) Sensor Voltage 5V Standard Circuit Low Voltage	• Ignition switch ON	• The ECM detects that the MAF sensor 5V standard circuit voltage is less than 4.6 V for 0.5 seconds.	• The sensor 5V standard circuit is grounded. • The sensor standard circuit is shorted to the low standard circuit. • MAF sensor malfunction • Engine control module faulty
P0100 (B)	**65**	On	Mass Air Flow (MAF) Sensor Circuit Low Voltage	• Ignition switch ON • Engine running	• The ECM calculates the MAF lower than-18.6 kg/ h for 5 seconds.	• The sensor ignition voltage supply circuit is open or its resistance is high. • Sensor 5V standard circuit open, high resistance, grounded or short to low standard circuit. • The sensor signal circuit is open, high resistance, grounded or short to the low standard circuit. • Poor wiring harness connection • Sensor installation failure • MAF sensor malfunction • Engine control module faulty
P0100 (C)	65	On	Mass Air Flow (MAF) Sensor Circuit is in high Voltage	• Ignition switch ON • Engine running	• The ECM calculates MAF above 806 kg/ h for 10 seconds.	• The sensor signal circuit is shorted to all 5V standard circuits and is shorted to the battery or the ignition voltage circuit. • Sensor low standard circuit open or high resistance. • Poor connection of harness connector • MAF sensor malfunction • Engine control module faulty

DTC (trouble symptom code)	Flash code	MIL state	Name of the diagnostic trouble code on Tech2	DTC running conditions	DTC setting conditions	Probable causes
P0110(1)	**23**	On	Intake Air Temperature (IAT) Sensor Circuit is in high Voltage	• Ignition switch ON.	• The ECM detects that the IAT signal voltage is greater than 4.7 V for 3 seconds.	• The sensor signal is open, high resistance, short to any 5V standard circuit, shorted to battery or ignition voltage. • Sensor low standard circuit open or high resistance. • Poor connection of harness connector. • Intake air temperature sensor faulty • Engine control module faulty
P0110(2)	**23**	On	Intake Air (IAT) Sensor Circuit Low Voltage	• Ignition switch ON.	• The ECM detects that the IAT sensor signal voltage is less than 0.3 V for 3 seconds.	• The sensor signal circuit is grounded or shorted to a low standard circuit. • IAT sensor malfunction • Engine control module faulty
P0115(1)	**14**	On	Engine Coolant Temperature (ECT) Sensor Circuit High Voltage	• Ignition switch ON.	• The ECM detects that the ECT sensor signal voltage is greater than 4.7 V for 3 seconds.	• Sensor signal is open, high resistance, short circuit to any 5V standard circuit, short circuit to battery or ignition voltage. • Sensor low standard circuit is open or in high voltage. • Poor connection of harness connector. • ECT sensor malfunction • Failure of the engine control module
P0115(2)	**14**	On	Engine Coolant Temperature (ECT) Sensor Circuit Low Voltage	• Ignition switch ON.	• The ECM detects that the ECT sensor signal voltage is less than 0.3 V seconds.	• The sensor signal circuit is grounded or shorted to the standard circuit. • The ECT sensor has failed. • Faulty engine control module sensor.
P0180(B)	**15**	On	Fuel temperature sensor circuit	• Ignition switch ON.	• Full throttle fully open (FT) sensor output below -40 ° C (-40. F) for 3 seconds or above 150 ° C (302 ° F) for 3 seconds.	Failure of PCU

Diagnostic trouble code	Flash code	MIL state	Name of the diagnostic trouble code on Tech2	DTC running conditions	DTC setting conditions	Probable causes
P02 15(A)	**52**	Switch on in the next ignition cycle	Engine Shutdown (ESO) Solenoid Control Circuit Failure	• Ignition switch off • Engine speed below 1500RPM • Vehicle speed is less than 1.5 km/ h (1MPH).	• After 2 seconds of diagnostic trouble code operation, the engine speed is above 200RPM when the ESO solenoid is commanded to be disconnected from the PCU	• Fuel injection pump failure
P02 15(B)	**52**	On	Engine is shutdown (ESO)and Solenoid controls Circuit High Input	• Ignition switch ON.	• When the ECM does not command to switch off, PCU detects that the high voltage condition for ESO solenoid to control the circuit is longer than 1 second.	• The ESO solenoid control circuit is shorted to the battery or ignition voltage. • PCU faulty • Engine control module faulty
P02 15(C)	**52**	On	The engine shutdown (ESO) solenoid control circuit is active	• Ignition switched off • Engine speed below 1500RPM • Vehicle speed is less than 1.5 km/ h (1MPH).	• When the diagnostic trouble code operating conditions are reached, the engine speed is greater than 200RPM within two seconds.	• The ESO solenoid control circuit is open, high resistance, or ground. • PCU faulty • Engine control module faulty
P0215(D)	**52**	On	Engine Shutdown (ESO) Solenoid Control Circuit Failure	• Ignition switch off	• The ECM detects that the built-in CAN controller cannot be adjusted to the bus shutdown mode.	• Engine control module faulty
P0216(A)	**54**	On	Failure of control circuit of injection timing	• Engine speed above 700RPM • Oil injection volume greater than 4mg/ strk	• Actual fuel injection timing of PCU is 3 ° CA earlier than the expected, longer than 12 seconds or 6 ° CA delayed than the expected, longer than 12 seconds.	• Excessive air in the fuel system. • Fuel loss • The fuel suction port is loose, bent or blocked. • Failure or blockage of the fuel filter • Fuel contamination • Fault in the timing device • Fuel injection pump CMP sensor malfunction

Diagnostic Trouble Code (symptom code)	Flash code	MIL state	Name of the diagnostic trouble code on Tech2	DTC running conditions	DTC setting conditions	Possible Causes
P0216(B)	**54**	On	Fuel injection timing control circuit failure	• The engine speed is higher than 2014RPM.	The actual fuel injection timing monitored by the CU is higher than the expected rated value ± 5.2 ° CA	• Excessive air in the fuel system • Fuel loss • Loose, bent or blocked fuel suction opening • Failure or blockage of the fuel filter • Fuel contamination • Failure of the timing device • Failure of the fuel injection pump CM sensor
P0251(6)	**53**	On	Injection pump fuel metering control	• The fuel injection pump CMP sensor signal occurs • The CAN communication between the ECM and the TECU is OK.	• When the expected fuel injection volume is controlled to 0 mg,/ strk, PCU detects that the fuel injection solenoid is acting.	• Fuel injection pump faulty • PCU faulty
P0251(7)	**53**	On	Injection pump fuel metering control	• The fuel injection pump CMP sensor signal occurs • Crankshaft position sensor signal occurs • Engine speed above 500RPM	• The HFID detects that the dual fuel injection pump speed is below the engine speed of 800RPM, longer than 0.2 seconds.	• CKP sensor signal failure • Fuel injection pump CMP sensor signal fault • Electronic interference • Magnetic Interference • PCU faulty
P0251(9)	**53**	On	Injection pump fuel metering control	• Ignition switch ON	The CU detects that the built-in fuel injection pump control atlas is not programmed in the self-diagnosis process.	• PCU faulty
P0251(A)	**53**	On	Injection pump fuel metering control	• Ignition switch ON	• PCU detects that EEPROM or A/ D converter fails during self-diagnosis .	• PCU faulty

Diagnostic trouble code	Flash code	MIL state	Name of the diagnostic trouble code on Tech2	DTC running conditions	DTC setting conditions	Probable causes
P0251(B)	**53**	On	Fuel injection pump fuel metering control	• Turn on the ignition switch.	• PCU detects that the drive circuit of fuel injection solenoid fails during self-diagnosis.	• Fuel injection pump failure • PCU faulty
P0251(D)	**53**	On	Fuel injection pump fuel metering control	• Turn on the ignition switch.	• PCU detects that the voltage of the drive circuit of fuel injection solenoid is not normal during self-diagnosis.	•Injection pump fuel metering control • PCU faulty
P0251(E)	**53**	On	Injection pump fuel metering control	• Turn on the ignition switch.	• The ECM detects that there communication instructions from PCU has not been received for more than 1 second.	• The CAN high circuit is open, high resistance, grounded, or short circuit to battery or ignition device voltage. • The CAN low circuit is open, high resistance, grounded, or short circuit to battery or ignition device voltage. • Electronic interference • Magnetic Interference • PCU fault • Engine control module faulty
P0335(B)	**43**	On	Crankshaft Position (CKP) Sensor Circuit	• Turn on the ignition switch. • Engine speed above 665RPM	• ECM detects excessive or lost signals of CKP sensor while the engine is running.	The sensor signal circuit is open, high resistance, grounded, short circuit to battery or ignition device voltage. • Sensor low standard circuit open, high resistance, grounded, short circuit to battery or ignition device voltage. • Sensor protection grounding is in open circuit, high resistance, grounded, short circuit to battery or ignition device voltage. • CKP sensor malfunction • Engine control module faulty • Electronic interference • Magnetic Interference • Sensor installation failure • Flywheel circumference failure

Diagnostic trouble code (symptom code)	Flash code	MIL state	Name of the diagnostic trouble code on Tech2	DTC running conditions	DTC setting conditions	Probable causes
P0335(D)	**43**	On	Crankshaft position (CKP) sensor circuit	• Diagnostic trouble code P0335 (fault symptom code B) is not set • Ignition switch ON • The fuel injection pump CMP sensor signal occurs. • The CAN communication between the ECM and the TECU is OK.	• The ECM detects that the CKP sensor signal is not generated when the dual fuel injection pump speed is above 50RPM.	• Sensor signal circuit is open, high resistance, grounded, shorted to battery or to ignition device • Sensor low standard circuit open, high resistance, grounded, shorted to battery or to ignition device. • Sensor protection grounding is open, high resistance, grounded, shorted to battery or ignition device. • CKP sensor malfunction • Engine control module faulty • Electronic interference • Magnetic Interference • Sensor installation failure • Flywheel circumference failure
P0335(E)	**43**	On	Crankshaft position (CKP) sensor circuit	• Ignition switch ON	• ECM detects engine speed above 5700RPM for 0.2 seconds	• Engine overspeed • CKP sensor malfunction • Engine control module faulty • Electronic interference • Magnetic Interference Flywheel circle fault
P0380(4)	**66**	On	Glow Plug Relay Control Circuit Low Voltage	• Ignition switch ON	• When the ECM detects that the relay command is OFF, a low voltage condition is generated on the glow relay control circuit for more than 3 seconds.	• The coil side glow relay voltage ,supply circuit is open or has high resistance. • The glow relay control circuit is open, high resistance, and grounded. • Preheating relay fault • Engine control module faulty
P0380(8)	**66**	On	Glow Plug Relay Control Circuit Low Voltage	• Ignition switch ON	• When the ECM detects that the relay command is ON, a high voltage condition is generated on the glow relay control circuit for more than 1 second.	• The glow relay control circuit is shorted to the battery or ignition switch. • Preheating relay fault • Engine control module faulty

Diagnostic trouble code (symptom code)	Flash code	MIL state	Name of the diagnostic trouble code on Tech2	DTC running conditions	DTC setting conditions	Probable causes
P0381(4)	**67**	On	Glow Plug Indicator Circuit is in Low Voltage	• Ignition switch ON	• Low voltage is generated on the warm-up indicator when the ECM detects that the indicator is turned off.	• The meter (10A) fuse (F-16) disconnects the glow indicator voltage supply circuit , which is open, intermediate or high resistance. The glow indicator control circuit is open, high resistance or grounded. • Poor connection of harness connector • Preheating indicates that the bulb is burned. • Instrument Panel Cluster Failure (Metering Table Assembly) • Engine control module faulty
P0381(8)	**67**	On	Glow Plug Indicator Circuit is in high Voltage	• Ignition switch ON	• When the ECM detects that the indicator lamp command is ON, a high voltage is generated on the glow indicator lamp control circuit for more than 1 second.	The glow indicator lamp control circuit is shorted to the battery or the ignition device voltage circuit. • Instrument Panel Cluster Failure (Metering Table Assembly) • Engine control module faulty
P0400(3)	**32**	On	Exhaust Gas Recirculation (EGR) Performance	• Ignition switch ON • Engine rotation • BARO is between 880 hPa and 1100 hPa. • IAT is at 16°C (61°F) and 34°C (93 °F). • ECT is between 70°C (158°F) and 100°C (212°F).	• The ECM detects that the MAF is less than the expected by150 mg/ strk, for 60 seconds.	The MAF sensor circuit is high resistance. The MAF sensor signal is shorted to the IAT sensor signal circuit. • Air Intake leakage • Air Inlet opens • Air intake system blocked • Turbine charger failure • Exhaust system failure • EGR valve vacuum control system malfunction • EGR valve failure • EGR solenoid failure • Solenoid vacuum hose line failure • MAF sensor malfunction

Diagnostic trouble code (symptom code)	Flash code	MIL state	Name of the diagnostic trouble code on Tech2	DTC running conditions	Diagnostic Trouble Code Setting Conditions	Probable causes
P0400(4)	**32**	On	Exhaust Gas Recirculation (EGR) Solenoid Circuit Low Voltage	• Ignition switch ON	• When ECM detects that the solenoid command is OFF, a low voltage is generated on the EGR solenoid control circuit for more than 3 seconds.	• The EGR solenoid ignition voltage supply circuit is open or high. • The EGR solenoid control circuit is open, high resistance, or grounded. • Poor connection of harness connector • EGR solenoid failure • Engine control module faulty
P0400(5)	**32**	On	Exhaust Gas Recirculation System (EGR) Performance	• Ignition switch ON. • Engine running • BARO is between 880hPa and 1100hPa. • IAT is between 16 °C (61 °F) and 34 °C (93 °). • ECT is located at 70 °C (158. Between 1 °C and 100°C (212 °F).	• The ECM detects that the MAF is higher the expected by150 mg/ strk, for 60 seconds.	• The resistance of MAF sensor low standard circuit is high. • EGR valve vacuum control system malfunction • EGR valve failure • Vacuum pump failure • EGR solenoid failure •Faulty EGR solenoid EGR Solenoid valve vacuum hose circuit fault • MAF sensor malfunction • Engine control module faulty
P0400(8)	**32**	On	Exhaust Gas Recirculation (EGR) Solenoid High Voltage	• Ignition switch ON.	• When the ECM detects that the solenoid is ON, a high voltage is generated on EGR solenoid control circuit for more than 3 seconds.	• The EGR solenoid control circuit is shorted to battery or ignition voltage circuit. • EGR solenoid failure • Engine control module faulty
P0500(1)	**24**	Off	Vehicle Speed Sensor (VSS) Circuit high Input	• Ignition switch ON.	• The ECM detects a vehicle speed greater than 190km/ h (119MPH) for 5 seconds.	• High speed • Electronic interference • Magnetic Interference • VSS fault • Engine control module faulty

Diagnostic trouble code (symptom code)	Flash code	MIL state	Name of the diagnostic trouble code on Tech2	DTC running conditions	DTC setting conditions	Probable causes
P0500(A)	**24**	Off	Vehicle Speed Sensor (VSS) Circuit Input frequency is too high	• Ignition switch ON.	• The ECM detects that the speed sensor signal frequency is too high for 0.6 seconds.	• Electronic interference • Magnetic Interference • VSS fault • Engine control module faulty
P0500(B)	**24**	Off	Vehicle Speed Sensor (VSS) Circuit Signal Error	• Ignition switch ON • Engine speed above 3600 RPM • Fuel injection volume greater than 41 mg/ strk thermostat	• The ECM detects a vehicle speed of less than 1.5 km/ h (1 MPH) for 60 seconds.	• Gauge(10A) fuse (F-16) is disconnected. • The sensor ignition voltage circuit is open or high. • Sensor signal circuit is open, high resistance, grounded, shorted to battery or ignition voltage. • Sensor low standard circuit open or high resistance. • Poor connection of harness connector. • Instrument Panel combination (Gauge Assembly) Fault • VSS fault • Engine control module faulty
P0560(1)	**35**	Off	System Voltage High	-	• ECM detects that the battery voltage supply circuit voltage is greater than 20V	• "Sudden starting" incorrect • Charging system failure • Engine control module faulty
P0560(2)	**35**	Off	System voltage input is too low	-	• ECM detects that the battery voltage supply circuit voltage is less than 7V	• Charging system failure • Battery voltage supply circuit resistance is high • Engine control module faulty
P0560(A)	**35**	Off	System voltage function failure	-	• The voltage of PCU Battery voltage supply circuit voltage is less than 4.5 V or greater than 27V.	• "Sudden starting" incorrect • Charging system failure • The resistance of battery power or grounded circuit is high • PCU faulty

Diagnostic trouble code (symptom code)	Flash code	MIL state	Name of the diagnostic trouble code on Tech2	DTC running conditions	DTC setting conditions	Probable causes
P0561(A)	**18**	Off	The function of the ignition switch circuit fails.	-	• The engine control module detects that the ignition voltage is changed from switching-on to switching-off at the start of the ignition.	• The main relay of engine control module is grounded. • The ignition voltage supply circuit is intermittently open or high. • Ignition switch malfunction
P0561(B)	**18**	Off	Failure of the ignition switch circuit function	-	• The ECM detects the failure of the ignition voltage supply circuit after the initial start-up.	• Engine control module faulty
P0602(25)	_	On	Control Module is Not Programmed	-	• VIN in the engine control module is not programmed .	• VIN is not programmed
P0606(A)	**28**	On	Failure of internal performance of control module	-	• The ECM detects no response of the internal CPU.	• Engine control module faulty
P0606(B)	**28**	On	Failure of internal performance of control module	• Accelerator pedal position is less than 1%. • Expected fuel injection volume is 0 mg/ strk	• Engine control module detects the engine speed above 2000 RPM	• Engine control module faulty
P0645 (4)	**46**	On	The voltage of AC Clutch Relay Control Circuit is Low	• The ignition switch is ON. • A/ C compressor relay is commanded ON once.	• When the ECM detects that the relay command is OFF, a low voltage is generated on A/C compressor control circuit for more than 3 seconds.	• The coil side A/ C compressor relay ignition voltage supply circuit is open or its resistance is high . • A/ C compressor relay control circuit is open, high resistance, or grounded. • Poor installation of A/ C compressor relay. • A/ C compressor relay faulty. • Engine control module faulty.

Diagnostic trouble code (symptom code)	Flash code	MIL state	Name of the diagnostic trouble code on Tech2	DTC running conditions	DTC setting conditions	Probable causes
P0645(8)	**46**	On	AC Clutch Relay Control Circuit High Voltage	• Ignition switch ON. • A/ C compressor relay is commanded ON once.	• When the ECM detects that the relay command is ON, a high voltage is generated on A/C compressor control circuit for more than 3 seconds.	• A/ C compressor relay control circuit is shorted to battery or ignition voltage circuit. • A/ C compressor relay fault. • Engine control module faulty.
P0703(A)	**25**	On	Brake switch circuit failure	• Ignition switch ON. • Engine speed above 1500RPM. . Throttle pedal position is greater than 10% • Vehicle speed greater than 15km/ h (9MPH)	• When the engine control module detects that after the ignition switch is switched on, in possible condition, and the brake pedal has been switched off (released) for more than 30 seconds, the brake pedal 1 switch is switched on (pressing).	• Parking (15A) fuse (F-5) OFF • The brake pedal 1 switch voltage supply circuit is open or its resistance is high. • The brake pedal 1 switch signal circuit is open, high resistance, and is shorted to battery or ignition voltage. • Brake pedal 2 switch ignition voltages is open or its resistance is high. • Brake pedal 2 switch signal is open, high resistance, and is shorted to battery or ignition voltage. • Brake pedal switch adjustment offset. • Poor connection of the brake pedal switch. • Brake pedal switch failure. • Engine control module faulty.
P0703(B)	**25**	On	Brake switch circuit failure	• Ignition switch ON. • Engine speed above 500RPM. • Throttle pedal position is greater than 10%. • Vehicle speed greater than 15 km/ h (9MPH)	• When the engine control module detects that the brake pedal 2 switch is switched on(pressing) for more than 30 seconds, the brake pedal 1 switch is closed (released).	• Brake (15A) fuse broken (F-5) Disconnect. • The brake pedal 1 switch battery voltage supply circuit is open or its resistance is high. • The brake pedal 1 switch signal circuit is open, high resistance, shorted to battery or ignition voltage. • The brake pedal 2 switch ignition voltage supply circuit is open or its resistance is high. • Brake pedal 2 switch signal open, high resistance, shorted to battery or ignition voltage. • Brake pedal is maladjustment • Poor connection of the brake pedal switch. • Brake pedal switch failure. • Engine control module failure

Diagnostic trouble code (symptom code)	Flash code	MIL state	Name of the diagnostic trouble code on Tech2	DTC running conditions	DTC setting conditions	Probable causes
P0704(6)	**57**	On	Clutch switch input circuit failure	• Ignition switch ON.	• When the engine control module detects a change in speed between 5km/ h (3MPH) and 80km/ h (50MPH), the clutch pedal switch signal does not change.	• The clutch pedal switch ignition voltage supply circuit is open or the resistance is off. • The clutch switch signal circuit is open, high resistance, shorted to battery or ignition voltage. • Clutch pedal maladjustment • Poor connection of clutch switch. • Clutch pedal switch failure. • Engine control module faulty.
P1105(2)	**86**	On	The voltage of air pressure Sensor Circuit is High	• Ignition switch ON.	• The ECM detects that the pressure sensor signal voltage is greater than 4.4 V for 1 second.	• Engine control module faulty.
P1105(2)	**86**	On	The voltage of the air pressure sensor circuit is low.	• Ignition switch ON.	• The ECM detects that the pressure sensor signal voltage is less than 1.5 V for 1 second.	• Engine control module faulty.
P1110(4)	**72**	On	The voltage of solenoid circuit for the air inlet throttle is low.	• Ignition switch ON.	• When the ECM detects that the solenoid is OFF, a low voltage is generated on air inlet throttle solenoid control circuit for more than 3 seconds.	• The IAT solenoid ignition voltage supply circuit is open or the voltage is high. • The IAT solenoid control circuit is open, high resistance, or grounded. • Poor connection of harness connector. • The air inlet throttle solenoid is faulty. • Engine control module faulty.
P1110(8)	**72**	On	The solenoid circuit of the air inlet throttle is high.	• Ignition switch ON.	• When the ECM detects that the solenoid is ON, high voltage is generated on the control circuit of the inlet throttle solenoid for more than 3 seconds.	• The IAT solenoid control circuit is shorted to the battery or the ignition voltage circuit. • The air inlet throttle solenoid is faulty. • Engine control module faulty.

Diagnostic trouble code (symptom code)	Flash code	MIL state	Name of the diagnostic trouble code on Tech2	DTC running conditions	DTC setting conditions	Probable causes
P1120(1)	**21**	On	Throttle Pedal Position (APP) Sensor Circuit High Voltage	• Ignition switch ON	• The ECM detects that the APP sensor signal voltage is greater than 4.9 V for 0.5 seconds.	• The sensor 5V standard circuit is shorted to battery or ignition voltage. • The sensor 4V standard circuit is grounded or shorted to a low standard circuit. • The sensor signal is shorted to any 5 V standard circuits, shorted to battery or ignition voltage. • The sensor low standard circuit is open or the resistance is high. • Poor connection of harness connector. • APP sensor failure. • Engine control module faulty.
P1120(2)	**21**	On	The accelerator Pedal Position (APP) sensor circuit voltage is low.	• Ignition switch ON	• The ECM detects that the APP sensor signal voltage is less than 0.3 V for 0.5 seconds.	• Sensor 5V standard circuit open, high resistance, or short to low standard circuit. • Sensor signal is open, high resistance, grounded or shored to low standard circuit. • Poor connection of harness connector. • APP sensor failure. • Engine control module faulty.
P1120(7)	**21**	On	The Throttle Pedal Position (APP) sensor 5V standard circuit voltage is high.	• Ignition switch ON	• The ECM detects that the APP sensor supply circuit is greater than 5.2 V for 0.5 seconds.	• The sensor 5V standard circuit is shorted to the battery or the ignition voltage circuit. • Engine control module faulty.
P1120(9)	**21**	On	The throttle pedal position sensor 5V standard circuit voltage is low.	• Ignition switch ON	• The ECM detects that the APP sensor supply circuit is less than 4.6 V for 0.5 seconds.	• The sensor 5V standard circuit is grounded or shorted to a low standard circuit. • APP sensor failure. • Engine control module fault.

Diagnostic trouble code (symptom code)	Flash code	MIL state	Name of the diagnostic trouble code on Tech2	DTC running conditions	DTC setting conditions	Probable causes
P1120 (D)	21	On	Accelerator Pedal Position (APP) sensor brake switch fault	● Turn on the ignition switch. ● The engine speed is more than 1700RPM; ● The vehicle speed is above 1.5km/h (1MPH).	● ECM detects that APP sensor angle is stabilized at more than 18% and the brake pedal is applied for more than 2s.	● The signal circuit of brake pedal 1 is open circuit; the resistance is high and is short circuit to the battery or the ignition switch. ● The accelerator pedal is stuck. ● The intake throttle is stuck. ● The intake throttle control cable is damaged, stuck or gapless. ● APP sensor is out of adjustment. ● APP sensor is faulty. ● The brake pedal switch is out of adjustment. ● The brake pedal switch is faulty. ● Engine control module (ECM)
P1120 (E)	21	On	Accelerator Pedal Position (APP) sensor brake switch fault	● Turn on the ignition switch.	● ECM detects that APP sensor angle is > 18% and the idling switch is on for more than 0.6s.	● APP sensor low-voltage circuit high has high resistance. ● The idling switch signal circuit is grounded. ● Poor connection of harness connector ● APP sensor failure ● The idling switch is faulty. ● Engine control module (ECM)
P1173 (3)	22	Off	Fuel injection quantity reduction	● Turn on the ignition switch.	● ECM detects that the coolant temperature is too high for 30s.	● The engine is overheated. ● The engine cooling system is faulty. ● ECT sensor is faulty.
P1173 (7)	22	Off	Fuel injection quantity reduction	● Turn on the ignition switch.	● ECM detects that FT is too high for 30s.	● PCU failure
P1173 (A)	22	Off	Fuel injection quantity reduction	● Turn on the ignition switch.	● ECM detects that FT is too low for 30s.	● PCU failure
P1335 (A)	43	On	Crankshaft position (CKP) sensor circuit is faulty	● Turn on the ignition switch.	● PCU detects that CKP sensor signal from ECM is faulty.	● CKP sensor signal output circuit is open circuit, grounded or short circuit to the battery or the ignition switch. ● The wiring harness connector is not connected properly. ● PCU failure ● ECM failure

Diagnostic trouble code (symptom code)	Flash code	MIL state	Name of the diagnostic trouble code on Tech2	DTC running conditions	DTC setting conditions	Probable causes
P1345 (A)	41	On	Correlation of the crankshaft position (CKP) to the cam position (CMP)		● PCU receives the wrong fuel injection pump CMP sensor signal for 1s.	● Fuel injection pump fault ● PCU failure
P1520 (A)	47	On	The parking/neutral position switch is faulty	● Turn on the ignition switch. ● The engine speed is higher than 1500RPM. ● The vehicle speed is higher than 64km/h (40MPH). ● Release the clutch pedal.	● ECM detects that the neutral switch signal is continuously on (neutral) during three consecutive driving cycles.	● The neutral switch signal circuit is short circuit to the battery or the ignition switch. ● Neutral switch fault ● ECM failure
P1520 (B)	47	On	The parking/neutral position switch can not turned off normally	● Turn on the ignition switch. ● The engine speed is higher than 665RPM. ● The speed is less than 2km/h (3MPH) after it is applied and released.	● ECM detects that the neutral switch signal is continuously off (instead of neutral position) during three successive drive cycles.	● The neutral ignition voltage supply circuit is open circuit or its resistance is too high. ● The neutral switch signal circuit is open circuit or its resistance is too high. The wiring harness connector is not connected properly. ● Neutral switch fault ● ECM failure
P1576 (4)	71	On	The exhaust brake solenoid circuit voltage is too low	● Turn on the ignition switch.	● When ECM detects that the solenoid command is off, the exhaust brake solenoid valve circuit generates a low voltage for more than 3s.	● The exhaust brake solenoid ignition voltage supply circuit is open circuit or the resistance is too high. ● The exhaust brake solenoid control circuit is open circuit; the resistance is too high or grounded. ● Poor connection of harness connector ● Exhaust brake solenoid valve fault

Diagnostic trouble code (symptom code)	Flash code	MIL state	Name of the diagnostic trouble code on Tech2	DTC running conditions	DTC setting conditions	Probable causes
P1576 (8)	71	On	The exhaust brake solenoid circuit voltage is too high	● Turn on the ignition switch.	● When ECM detects that the solenoid valve command is ON, the exhaust brake solenoid valve generates a high voltage for more than 3s.	● The exhaust brake solenoid control circuit is short circuit to the battery or the circuit voltage. ● Exhaust brake solenoid valve fault ● ECM failure
P1605 (C)	55	On	Control module internal performance failure		● ECM detects that the internal or major document in EEPROM data is damaged.	● ECM failure
P1605 (D)	55	On	Control module internal performance failure	—	● ECM detects that the reading or message from EEPROM data is faulty during the initial start-up.	● ECM failure
P1605 (E)	55	On	Control module internal performance failure		● ECM detects that the total number of EEPROM data differs from the recording count value during the initial start-up.	● ECM failure
P1625 (A)	76	Off	ECM main relay switch is turned off in advance	—	● ECM detects that ECM main relay command is turned off in advance.	● ECM main control relay circuit is open circuit or the resistance is too high. ● ECM battery voltage supply circuit is open circuit or the resistance is too high. ● ECM main relay is faulty.

Diagnostic trouble code (symptom code)	Flash code	MIL state	Name of the diagnostic trouble code on Tech2	DTC running conditions	DTC setting conditions	Probable causes
P1625 (B)	76	Off	ECM main relay switch is turned off delay.	● Ignition switch OFF	● ECM detects that ECM main relay is turned on for 2s.	● ECM main relay control circuit is grounded. ● ECM battery voltage circuit is short circuit to the battery. ● ECM failure ● The main relay is faulty. ● ECM failure
P1630 (A)	51	On	Fuel injection pump fuel metering control failure		● ECM detects that the fuel injection solenoid valve control current monitored by PCU is too high.	● Fuel injection pump fault ● PCU failure
P1630 (B)	51	On	Fuel injection pump fuel metering control failure		● ECM detects that PCU continuously delivers the control current to the fuel injection solenoid valve.	● Fuel injection pump fault ● PCU failure
P1650(八)	44	On	CAN unit is not connected		● ECM detects that PCU receives the controller back-up or bus offline message from CAN.	● CAN HV circuit opening, high resistance, grounding, shorting with battery or ignition voltage ● CAN low voltage circuit is open circuit, high resistance, grounded, or shorted to the battery or the ignition switch. ● Electronic interference ● Magnetic interference ● PCU failure ● ECM failure
P1650 (B)	44	On	CAN unit is not returned		● ECM detects no response from internal CAN controller.	● ECM failure

Diagnostic trouble code (symptom code)	Flash code	MIL state	Name of the diagnostic trouble code on Tech2	DTC running conditions	DTC setting conditions	Probable causes
P1651 (A)	45	On	CAN failure		● ECM detects that PCU does not receive CAN message from ECM.	● CAN HV circuit opening, high resistance, grounding, shorting with battery or ignition voltage ● Electronic interference ● Magnetic interference ● PCU failure ● ECM failure
P1651 (B)	45	On	CAN failure		● ECM does not receive the message from PCU.	● CAN HV circuit opening, high resistance, grounding, shorting with battery or ignition voltage ● CAN low voltage circuit is open circuit, high resistance, grounded, or shorted to the battery or the ignition switch. ● Electronic interference ● Magnetic interference ● PCU failure ● ECM failure
P1690 (4)	77	Off	The fault LED (MIL) control circuit has a low voltage.	● Turn on the ignition switch.	● ECM detects a low voltage on MIL control circuit for more than 3s when MIL command is turned off.	● The meter (10A) fuse (F-16) is blown. ● MIL ignition voltage supply circuit is open circuit or high resistance. ● MIL control circuit is open circuit, high resistance or grounded. ● Poor connection of harness connector ● MIL bulb is burned out. ● The dashboard assembly (instrument cluster) is faulty. ● ECM failure
P1690 (8)	77	Off	MIL circuit has a high voltage	● Turn on the ignition switch.	● When ECM detects a high voltage on MIL control circuit for more than 1s when MIL command is connected.	● MIL circuit is shorted to the battery or the ignition switch. ● The dashboard is faulty. ● ECM failure

P0100 (Trouble symptom code 7) (flash code 65)

Circuit instructions

The air flow sensor is an instrument used to determine the air flow into the engine. Install it in the middle between the filter and the turbocharger. The air flow entering the engine is difficult to indicate that the engine is under acceleration or idle status. Large air flow rate entering the engine indicates that the engine is in acceleration state or large load state. The air flow sensor is fitted with the following circuits:

- Ignition voltage circuit
- 5V reference circuit
- LV reference circuit
- ECM can provide 5V reference voltage for the air flow sensor via the reference circuit.

The ECM can monitor the 5V reference voltage.

If ECM detects an excessive air flow sensor 5V reference voltage, DTC will be reset.

DTC running conditions

- The ignition switch is on.

DTC setting conditions

- ECM detects that the air flow sensor 5V reference voltage is greater than 5.2V in 0.5s.

DTC resetting method:

- When the diagnosis fails, ECM will flash MIL as an indicator.
- ECM uses a 1600mg/strk air flow as an alternative for engine control.
- ECM uses 10% exhaust recirculation solenoid valve as an alternative.
- MIL/DTC clearing conditions:
- When the diagnosis fails, ECM will shut down MIL.
- The historical record of DTC will be cleared after 40 circles of continuous failure-free operation. Or clear using Tech2 scanning tool.
- **Diagnostic aid**
- If there is an operation breakage, please see “Operation Breakage” in this section.
- **Caution:**
- The parameters of the air flow sensor on Tech2 are updated only when the engine is running.

Test description

The following serial numbers refer to step serial numbers in the diagnosis table.

If the air flow sensor 5V reference voltage between ECM and the sensor is normal, the sensor signal voltage will be too low and DTCP0100 (TSC B) will be reset.

DTC P0100 (TSC 7)

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition device for 30s. 3. Starting engine 4. Monitor the DTC information using Tech2 scanning tool. Does DTC ignition fail?	—	Go to step 3	Go to the diagnostic aid procedure
3	1. Turn off the ignition device. 2. Disconnect the air flow sensor joint. 3. Start the engine and run it idly for 30s. 4. Monitor the DTC information using Tech2 scanning tool. 5. Is DTCP 0100 (TSC B) reset, but is DTCP0100 (TSC 7) not reset?	—	Go to step 5	Go to step 4

Step	Measure	Rated value	Yes	No
4	1. Test the following state of the 5V reference circuit between the ECM (B-233 joint pin 83) and the air flow sensor (J-182 joint pin 4): ● Battery or ignition voltage short circuit ● The sensor voltage is short-circuit Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 7	Go to step 6
5	Replace the air flow sensor. Please refer to the contents of "air flow sensor replacement" in the chapter. Has the replacement been completed?	—	Go to step 7	—
6	**Key attentions:** **Replace ECM with the procedures.** Replace the engine control module (ECM). Refer to the contents of "ECM replacement" in this chapter. Has the replacement been completed?	—	Go to step 7	—
7	1. Connect all the previously disconnected joints. 2. Clear the DTC using Tech2 scanning tool. 3. Turn off the ignition device for 30s. 4. Starting engine 5. Monitor the DTC information using Tech2 scanning tool. 6. Does the DTC show ignition failure?	—	Go to step 3	Go to step 8
8	Observe the DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	See "DTC Directory"	System normal

P0100 (Trouble symptom code9) (flash code 65)

Circuit instructions

The air flow sensor refers to the instrument used to measure the air flow rate entering the engine. Install it in the middle between the filter and the turbocharger. Small air flow rate entering the engine indicates that the engine is in deceleration state or idle state. Large air flow rate entering the engine indicates that the engine is in acceleration state or large load state. The air flow sensor is fitted with the following circuits:

• Ignition voltage circuit
• 5V reference circuit
• LV reference circuit
• Air flow sensor signal circuit

ECM provides a 5V reference voltage to the air flow sensor via the reference circuit.

The ECM can monitor the 5V reference voltage.

If ECM detects a low air flow sensor 5V reference voltage, DTC will be reset.

DTC running conditions

• The ignition switch is on.

Set DTC conditions.

• ECM detects that the airflow sensor 5V reference voltage is less than 4.6V in 0.5s.

DTC resetting method:

• When the diagnosis fails, ECM MIL will flash as an indicator.

• ECM uses a 1600mg/strk air flow as an alternative for engine control.
• The ECM uses 10% EGR solenoid valve control for replacement.

Clear the conditions of the MIL/DTC (diagnostic trouble code):

• The engine control module turns off the malfunction indicator light in case of diagnosis failure.
• The historical record of DTC will be cleared after 40 circles of continuous failure-free operation. Or clear using Tech2 scanning tool.

Diagnostic aid

• If there is an operation breakage, please see “Operation Breakage” in this section.

Caution:

• The parameters of the air flow sensor on Tech2 are updated only when the engine is running.

Test description

The following serial numbers refer to step serial numbers in the diagnosis table.

3. If the air flow sensor 5V reference voltage between ECM and the sensor is normal, the sensor signal voltage will be too low and DTC P0100 (TSC B) will be reset.

DTC P0100 (TSC 9) (FC 65)

Graphic reference: engine control illustration

Joint end face view reference: engine control joint end

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition device for 30s. 3. Starting engine 4. Monitor the DTC information using Tech2 scanning tool. 5. Does the DTC show ignition failure?	—	Go to step 3	Go to the diagnostic aid procedure

Step	Measure	Rated value	Yes	No
3	1. Turn off the ignition device. 2. Disconnect the air flow sensor joint. 3. Start the engine and run it idly for 30s. 4. Monitor the DTC information using Tech2 scanning tool. Is DTC P0100 (TSC B) reset? DTC P0100 (TSC 9) is not reset.	—	Go to step 5	Go to step 4
4	1. Test the following state of the 5V reference circuit between the ECM (B-233 joint pin 83) and the air flow sensor (J-182 joint pin 4): • The grounding line is short circuit • Low reference voltage circuit 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 7	Go to step 6
5	Replace the air flow sensor. Please refer to the contents of “air flow sensor replacement” in the chapter. Has the replacement been completed?	—	Go to step 7	—
6	**Key attentions:** **The engine control module (ECM) shall be replaced as per the procedures.** Replace the engine control module (ECM). Refer to the contents of “ECM replacement” in this chapter. Has the replacement been completed?	—	Go to step 7	—
7	1. Connect all the previously disconnected joints. 2. Clear the DTC using Tech2 scanning tool. 3. Turn off the ignition device for 30s. 4. Starting engine 5. Monitor the DTC information using Tech2 scanning tool. Does DTC ignition fail?	—	Go to step 3	Go to step 8
8	Observe the DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P0100 (TSC B) (FC 65)

Circuit instructions

The air flow sensor refers to the instrument used to measure the air flow rate entering the engine. Install it in the middle between the filter and the turbocharger. Small air flow rate entering the engine indicates that the engine is in deceleration state or idle state. Large air flow rate entering the engine indicates that the engine is in acceleration state or large load state. The air flow sensor is fitted with the following circuits:

• Ignition voltage circuit
• 5V reference circuit
• LV reference circuit
• Air flow sensor signal circuit

ECM is mainly used to monitor the sensor signals outside the normal range of the air flow sensor. If ECM detects a too low air flow sensor signal voltage, DTC will be reset.

DTC running conditions

• The ignition switch is on.
• The engine is running.

Set DTC conditions.

• ECM detects that the air flow is less than -18.6kg/h in 5s. This indicates that ECM detects that the air flow sensor signal voltage is less than a predetermined range when the engine is operated.

DTC resetting method:

• When the diagnosis fails, ECM MIL will flash as an indicator.
• The ECM uses 1,600mg/strk air flow for displacing so as to control the engine.
• The ECM uses 10% EGR solenoid valve control for replacement.

Clear the conditions of the MIL/DTC (diagnostic trouble code):

• When the diagnosis is normal, ECM will turn off MIL.
• The historical record of DTC will be cleared after 40 circles of continuous failure-free operation. Or clear using Tech2 scanning tool.

Diagnostic aid

• If there is an operation breakage, please see “Operation Breakage” in this section.

Caution:

• The incorrect installation orientation of the air flow sensor will cause the reset of DTC.
• A contaminated or restricted air flow sensor will cause the reset of DTC.
• The parameters of the air flow sensor on Tech2 are updated only when the engine is running.

Test description

The following serial numbers refer to step serial numbers in the diagnosis table.

5. If the air flow signal circuit between ECM and the sensor is grounded or the low reference circuit is short circuit, the low sensor 5V reference voltage DTC P0100 (TSC 9) will be reset.
6. If the air flow sensor signal circuit between ECM and the sensor is normal, the sensor signal voltage will be too high and DTC P0100 (TSC C) will be reset.

DTC P0100 (TSC (FC 65)

Graphic reference: engine control illustration

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition device for 30s. 3. Start the engine and run it idly for 30s. 4. Monitor the DTC information using Tech2 scanning tool. Does DTC ignition fail?	—	Go to step 3	Go to the diagnostic aid procedure

Step	Measure	Rated value	Yes	No
3	1. Turn off the ignition device. 2. Disconnect the air flow sensor joint. 3. Connect the test lamp between the ignition voltage supply circuit on the air flow sensor (Pin 2 of Connector J-182) and the effective grounding line. 4. Turn off the ignition device and stop the engine. Is the test lamp turned on?	—	Go to step 4	Go to step 7
4	1. Turn on the ignition device and stop the engine. 2. Connect the diagnosis and maintenance monitor to the wiring harness between 5V reference on the air flow sensor (Pin 4 of Connector J-182) and the effective grounding line. Is the diagnosis and maintenance monitor (DMM) voltage greater than the specified value?	4.7V	Go to step 5	Go to step 8
5	1. Turn off the ignition device. 2. 3A jumper between 2.5V reference circuit and the signal circuit on the air flow sensor (Pins 4 and 5 of Connector J-182) is disconnected. 3. Turn off the ignition device and stop the engine. Do not start the engine. 4. Monitor the DTC information using Tech2 scanning tool. Is DTC P0100 (TSC 9) reset: DTC P0100 (TSC B) is not reset.	—	Go to step 9	Go to step 6
6	1. Connect the fused 3A jumper. 2. Start the engine and run it idly for 30s. Is DTC P0100 (TSC C) reset? DTC P0100 (TSC B) is not reset.	—	Go to step 11	Go to step 10
7	Repair the open circuit or high resistance on the ignition power supply circuit between the main relay (Pin 5 of Connector X-14) and the air flow sensor (Pin 2 of Connector J-182) of ECM. Has the maintenance been completed?	—	Go to step 15	—

Step	Measure	Rated value	Yes	No
8	1. Test the following state of the 5V reference circuit between the ECM (B-233 joint pin 83) and the air flow sensor (J-182 joint pin 4): • Open circuit • Grounding wire short circuit • Low reference voltage circuit • High resistance 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 15	Go to step 12
9	1. Check the signal circuit between ECM (Pin 88 of Connector B-233) and the air flow sensor (Pin 5 of Connector J-182) for the followings: • Grounding wire short circuit • Low reference voltage circuit 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 15	Go to step 14
10	1. Check the signal circuit between ECM (Pin 88 of Connector B-233) and the air flow sensor (Pin 5 of Connector J-182) for open circuit or high resistance: 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 15	Go to step 12
11	1. Turn off the ignition device. 2. Check the air flow sensor connector (Pins 2, 4 and 5 of Connector J-182) for disconnection or poor connection. 3. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 15	Go to step 13
12	1. Turn off the ignition device. 2. Disconnect the ECM joint. 3. Check the air flow sensor circuit at ECM connector (Pins 83 and 88 of Connector B-233) for disconnection or poor connection. 4. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 15	Go to step 14

Step	Measure	Rated value	Yes	No
13	Replace the air flow sensor. Please refer to the contents of “air flow sensor replacement” in the chapter. Has the replacement been completed?	—	Go to step 15	—
14	**Key attentions:** **The engine control module (ECM) shall be replaced as per the procedures.** Replace the engine control module (ECM). Refer to the contents of “ECM replacement” in this chapter.	—	Go to step 15	—
15	1. Connect all the previously disconnected joints. 2. Clear the DTC using Tech2 scanning tool. 3. Turn off the ignition device for 30s. 4. Starting engine 5. Accelerate the engine multiple times alternately in idle state and full valve opening state (accelerator pedal full-range) while observing the DTC information using Tech2 scanning tool. Does DTC ignition fail?	—	Go to step 3	Go to step 16
16	Observe the DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P0100 (TSC C) (FC 65)

Circuit instructions

The air flow sensor refers to the instrument used to measure the air flow rate entering the engine. Install it in the middle between the filter and the turbocharger. Small air flow rate entering the engine indicates that the engine is in deceleration state or idle state. Large air flow rate entering the engine indicates that the engine is in acceleration state or large load state. The air flow sensor is fitted with the following circuits:

• Ignition voltage circuit
• 5V reference circuit
• LV reference circuit
• Air flow sensor signal circuit

ECM is mainly used to monitor the voltage signals outside the normal range of the air flow sensor. If the ECM detects too high air flow sensor signal voltage, the DTC will be re-set.

DTC running conditions

• The ignition switch is on.
• The engine is running.

Set DTC conditions.

• ECM detects that the air flow is higher than 806kg/h in 10s. This indicates that ECM detects that the air flow sensor signal voltage is greater than the predetermined range when the engine is operated.

DTC resetting method:

• When the diagnosis fails, ECM MIL will flash as an indicator.
• The ECM uses 1,600mg/strk air flow for displacing so as to control the engine.
• The ECM uses 10% EGR solenoid valve control for replacement.

Clear the conditions of the MIL/DTC (diagnostic trouble code):

• The engine control module turns off the malfunction indicator light in case of diagnosis failure.
• The historical record of DTC will be cleared after 40 circles of continuous failure-free operation. Or clear using Tech2 scanning tool.

Diagnostic aid

• If there is an operation breakage, please see “Operation Breakage” in this section.

Caution:

• The parameters of the air flow sensor on Tech2 are updated only when the engine is running.

Test description

The following serial numbers refer to step serial numbers in the diagnosis table.

3. If the air flow sensor signal circuit between ECM and the sensor is normal, the sensor signal voltage will be too low and DTC P0100 (TSC B) (FC 65) will be reset.

Graphic reference: engine control illustration

Joint end face view reference: engine control joint end

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition device for 30s. 3. Start the engine and run it idly for 30s. 4. Monitor the DTC information using Tech2 scanning tool. Does DTC ignition fail?	—	Go to step 3	Go to the diagnostic aid procedure

Step	Measure	Rated value	Yes	No
3	1. Turn off the ignition device. 2. Disconnect the air flow sensor joint. 3. Start the engine and run it idly for 30s. 4. Monitor the DTC information using Tech2 scanning tool. Is DTC P0100 (TSC B) is reset? DTC P0100 (TSC C) is not reset.	—	Go to step 4	Go to step 5
4	1. Turn off the ignition device. 2. Connect the test lamp between the low reference circuit on the air flow sensor (Pin 3 of Connector J-182) and the battery voltage. Is the test light on?	—	Go to step 7	Go to step 6
5	**Key attentions:** **If a voltage source in the sensor signal circuit is short-circuit, the air flow sensor may be damaged.** Check the signal circuit between ECM (Pin 88 of Connector B-233) and the air flow sensor (Pin 5 of Connector J-182) for the followings: • Battery or ignition voltage short circuit • 5V reference voltage short circuit Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 11	Go to step 10
6	Check the low reference circuit between ECM (Pin 92 of Connector B-233) and the air flow sensor (Pin 3 on Connector J-182) for open circuit or high resistance: 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 11	Go to step 8
7	Turn off the ignition device. Check the air flow sensor connector (Pin 3 of Connector J-182) for disconnection or poor connection. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 11	Go to step 9

Step	Measure	Rated value	Yes	No
8	1. Turn off the ignition device. 2. Disconnect the ECM joint. 3. Check the air flow sensor circuit at ECM connector (Pin 92 of Connector B-233) for disconnection or poor connection. 4. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 11	Go to step 10
9	Replace the air flow sensor. Please refer to the contents of "air flow sensor replacement" in the chapter. Has the replacement been completed?	—	Go to step 11	—
10	**Key attentions:** **The engine control module (ECM) shall be replaced as per the procedures.** Replace the engine control module (ECM). Refer to the contents of "ECM replacement" in this chapter. Has the replacement been completed?	—	Go to step 11	—
11	1. Connect all the previously disconnected joints. 2. Clear the DTC using Tech2 scanning tool. 3. Turn off the ignition device for 30s. 4. Starting engine 5. Accelerate the engine multiple times alternately in idle state and full valve opening state (accelerator pedal full-range) while observing the DTC information using Tech2 scanning tool. Does DTC ignition fail?	—	Go to step 3	Go to step 12
12	Observe the DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the "Diagnostic Trouble Code (DTC) Catalog".	System normal

P0110 (Trouble symptom code1) (flash code 23)
Circuit instructions
Install the IAT sensor between the filter and the turbocharger. The IAT sensor is located in the air flow sensor. The IAT sensor is a variable resistor. The IAT sensor is fitted with signal circuit and low reference circuit. The IAT sensor can measure the temperature of the air entering the engine. The ECM provides 5V voltage to the intake air temperature signal circuit and grounding wire to the low intake air temperature reference circuit. The sensor resistance will rise when the intake air temperature sensor becomes cold. When the air temperature rises, the sensor resistance will decrease. If the sensor resistance is high, the ECM can detect the high voltage of the IAT signal circuit. If the sensor resistance is low, the ECM can detect the low voltage of the IAT signal circuit. If the ECM detects too high air flow sensor signal voltage, the DTC will be re-set.
DTC running conditions
• The ignition switch is on.
Set DTC conditions.
• ECM detects that the intake temperature sensor signal voltage is greater than 4.7V in 3s.
DTC resetting method:
• When the diagnosis fails, ECM MIL will flash as an indicator.
• The ECM uses 1,600mg/strk air flow for displacing so as to control the engine.
• ECM uses the exhaust recirculation solenoid valve to control 10% of displacement.
Clear the conditions of the MIL/DTC (diagnostic trouble code):
• The engine control module turns off the malfunction indicator light in case of diagnosis failure.
• The historical record of DTC will be cleared after 40 circles of continuous failure-free operation. Or clear using Tech2 scanning tool.
Diagnostic aid
• If there is an operation breakage, please see “Operation Breakage” in this section.
• According to the temperature and resistance comparison table, test the IAT senor under different temperature conditions so as to evaluate whether a deflection sensor can be used. Sensor deflection may lead to the consequence of a poor driving performance.
Caution:
• Heated air flow sensor Result: when the ignition switch is on, the IAT sensor may detect the rated temperature value which may be higher than ordinary intake air temperature.
Diagnostic Trouble CodeP0110 (Trouble symptom code1) (flash code 23)
Graphic reference: engine control illustration
Joint end face view reference: engine control joint end

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition device and stop the engine. 3. Observe the IAT sensor parameter using Tech2. Is the IAT sensor parameter larger than the specified rated value?	-38°C (-36°F)	Go to step 3	Go to the diagnostic aid procedure

Step	Measure	Rated value	Yes	No
3	1. Turn off the ignition device. 2. Disconnect the joint of the air flow sensor joint or the intake air temperature sensor. 3. Connect the diagnosis and maintenance monitor to the wiring harness between the signal circuit on the intake temperature sensor (Pin 1 of Connector J-182) and the effective grounding line. 4. Turn off the ignition device and stop the engine. Is the diagnostic maintenance monitor voltage larger than the specified rated value?	5.3V	Go to step 4	Go to step 5
4	**Key attentions:** **If a voltage source in the sensor signal circuit is short circuit, the intake temperature sensor may be damaged.** 1. Check the signal circuit between ECM (Pin 84 of Connector B-233) and the intake temperature sensor (Pin 1 of Connector J-182) for short circuit to the battery or the ignition switch. 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 14	Go to step 13
5	1. Turn off the ignition device. 2. Connect the fused 3A jumper between the signal circuit and the low reference circuit on the intake temperature sensor wiring harness (Pins 1 and 3 of Connector J-182). 3. Turn off the ignition device and stop the engine. 4. Use Tech2 scanning tool to observe the inlet temperature parameters. Is the IAT sensor parameter larger than the specified rated value?	110°C (230°F)	Go to step 9	Go to step 6
6	1. Turn off the ignition device. 2. Connect the fused 3A jumper between the signal circuit on the intake temperature sensor (Pin 1 of Connector T-182) and the effective grounding line. 3. Turn off the ignition device and stop the engine. 4. Observe the DTC information using Tech2 scanning tool. Is the IAT sensor parameter larger than the specified rated value?	110°C (230°F)	Go to step 8	Go to step 7
7	1. Check the signal circuit between ECM (Pin 84 of Connector B-233) and the intake temperature sensor (Pin 1 of Connector J-182) for open circuit or high resistance. 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 14	Go to step 11

Step	Measure	Rated value	Yes	No
8	1. Check the low reference circuit between ECM (Pin 92 of Connector B-233) and the intake temperature sensor (Pin 3 of Connector J-182) for open circuit or high resistance. 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 14	Go to step 11
9	1. Check the signal circuit between ECM (Pin 84 of Connector B-233) and the intake temperature sensor (Pin 1 of Connector J-182) for short circuit to 5V reference circuit. 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 14	Go to step 10
10	1. Turn off the ignition device. 2. Check the intake temperature sensor connector (Pin 3 of Connector J-182) for disconnection or poor connection. 3. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 14	Go to step 12
11	1. Turn off the ignition device. 2. Disconnect the ECM joint. 3. Check the intake temperature sensor circuit at ECM connector (Pins 84 and 92 of Connector B-233) for disconnection or poor connection. 4. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 14	Go to step 13
12	Replace the intake air temperature sensor. Please refer to the contents of “air flow sensor replacement” in the chapter. Place the IAT sensor inside the air flow sensor. Has the replacement been completed?	—	Go to step 14	—
13	**Key attentions:** **The engine control module (ECM) shall be replaced as per the procedures.** Replace the engine control module (ECM). Please refer to the contents of “ECM replacement” in this chapter. Has the replacement been completed?	—	Go to step 14	—

Step	Measure	Rated value	Yes	No
14	1. Connect all the previously disconnected joints. 2. Clear the DTC using Tech2 scanning tool. 3. Turn off the ignition device for 30s. 4. Starting engine 5. Monitor the DTC information using Tech2 scanning tool. Does DTC ignition fail?	—	Go to step 2	Go to step 15
15	Observe the DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P0110 (Trouble symptom code2) (flash code 23)

Circuit instructions

Install the IAT sensor between the filter and the turbocharger. The IAT sensor is located in the air flow sensor. The IAT sensor is a variable resistor. The IAT sensor is fitted with signal circuit and low reference circuit. The IAT sensor can measure the temperature of the air entering the engine. The ECM provides 5V voltage to the intake air temperature signal circuit and grounding wire to the low intake air temperature reference circuit. The sensor resistance will rise when the intake air temperature sensor becomes cold. When the air temperature rises, the sensor resistance will decrease. If the sensor resistance is high, the ECM can detect the high voltage of the IAT signal circuit. If the sensor resistance is low, the ECM can detect the low voltage of the IAT signal circuit. If the engine control module detects a too low inlet air temperature signal voltage, the trouble code is reset.

DTC running conditions

• The ignition switch is on.

Set DTC conditions.

• ECM detects that the intake temperature sensor signal voltage is less than 0.3V in 3s.

DTC resetting method:

• When the diagnosis fails, ECM MIL will flash as an indicator.

• ECM uses the air flow at 0°C (32°F) for replacement, for engine control.

Clear the conditions of the MIL/DTC (diagnostic trouble code):

• The engine control module turns off the malfunction indicator light in case of diagnosis failure.

• The historical record of DTC will be cleared after 40 circles of continuous failure-free operation. Or clear using Tech2 scanning tool.

Diagnostic aid

• If there is an operation breakage, please see “Operation Breakage” in this section.

• According to the temperature and resistance comparison table, test the IAT senor under different temperature conditions so as to evaluate whether a deflection sensor can be used. Sensor deflection may lead to the consequence of a poor driving performance.

Caution:

• Heated air flow sensor Result: when the ignition switch is on, the IAT sensor may detect the rated temperature value which may be higher than ordinary intake air temperature.

Diagnostic Trouble CodeP0110 (Trouble symptom code2) (flash code 23)

Graphic reference: engine control illustration

Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Measure	Rated value	Yes	No
1	Is the diagnosis system test for ECM completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition device and stop the engine. 3. Observe the IAT sensor parameter using Tech2. Is the IAT sensor parameter larger than the specified rated value?	110°C (230°F)	Go to step 3	Go to the diagnostic aid procedure
3	1. Turn off the ignition device. 2. Disconnect the joint of the air flow sensor joint or the intake air temperature sensor. 3. Turn off the ignition device and stop the engine. 4. Observe the DTC information using Tech2 scanning tool. Is the IAT sensor parameter larger than the specified rated value?	-38°C (-36°F)	Go to step 5	Go to step 4

Step	Measure	Rated value	Yes	No
4	1. Check the signal circuit between ECM (Pin 84 of Connector B-233) and the intake temperature sensor (Pin 1 of Connector J-182) for the followings: • Grounding wire short circuit • Low reference voltage circuit 2. Repair the circuit as necessary. Has the case been found and corrected?		Go to step 8	Go to step 6
5	Replace the intake air temperature sensor. Please refer to the contents of "air flow sensor replacement" in the chapter. Place the IAT sensor inside the air flow sensor. Has the replacement been completed?		Go to step 8	
6	1. Turn off the ignition device. 2. Disconnect the ECM joint. 3. Check the intake temperature sensor circuit at ECM connector (Pins 84 and 92 of Connector B-233) for connection corrosion. 4. Repair or clean up the connection as necessary. Has the case been found and corrected?		Go to step 8	Go to step 7
7	**Key attentions:** **The engine control module (ECM) shall be replaced as per the procedures.** Replace the engine control module (ECM).Please see ECM contents in this section. Has the replacement been completed?		Go to step 8	
8	1. Connect all the previously disconnected joints. 2. Clear the DTC using Tech2 scanning tool. 3. Turn off the ignition device for 30s. 4. Starting engine 5. Monitor the DTC information using Tech2 scanning tool. Does DTC ignition fail?		Go to step 2	Go to step 9
9	Observe the DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?		Refer to the "Diagnostic Trouble Code (DTC) Catalog".	System normal

P0115 (Trouble symptom code1) (flash code 14)

Circuit instructions

The engine coolant temperature sensor is installed on the thermostat sleeve. The ECT sensor is a variable resistor. The IAT sensor is fitted with signal circuit and low reference circuit. The ECT sensor is used to measure the ECT. The ECM provides 5V voltage to the ECT signal circuit and grounding wire to the low ECT reference circuit. The sensor resistance will rise when the ECT sensor becomes cold. When the ECT rises, the sensor resistance will decrease. If the sensor resistance is high, the ECM can detect the high voltage of the ECT signal circuit. If the sensor resistance is low, the ECM can detect the low voltage of the ECT signal circuit. If ECM detects an excessive ECT sensor signal voltage, DTC will be reset.

DTC running conditions

• The ignition switch is on.

Set DTC conditions.

• ECM detects that ECT signal voltage is greater than 4.7V in 3s.

DTC resetting method:

• When the diagnosis fails, ECM MIL will flash as an indicator.

• ECM uses ECT instead of the fuel temperature, for engine control.

• The ECM uses 1,600mg/strk air flow for displacing so as to control the engine.

• ECM uses ECT at -25℃ (-13℉) as an alternative for thermal control.

Clear the conditions of the MIL/DTC (diagnostic trouble code):

• The engine control module turns off the malfunction indicator light in case of diagnosis failure.

• The historical record of DTC will be cleared after 40 circles of continuous failure-free operation. Or clear using Tech2 scanning tool.

Diagnostic aid

• If there is an operation breakage, please see “Operation Breakage” in this section.

• After starting the engine, the ECT shall rise stably till reaching about 80°C-85°C(176°F-185°F); it is in stable state only when the thermostat is turned on.

• According to the temperature and resistance comparison table, test the ECT senor under different temperature conditions so as to evaluate whether a deflection sensor can be used. Sensor deflection may lead to the consequence of a poor driving performance.

Diagnostic Trouble CodeP0115 (Trouble symptom code1) (flash code 14)

Graphic reference: engine control illustration

Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition device and stop the engine. 3. Observe the ECT parameter using Tech2. Is the ECT parameter larger than the specified rated value?	-35°C (-31°F)	Go to step 3	Go to the diagnostic aid procedure

Step	Measure	Rated value	Yes	No
3	1. Turn off the ignition device. 2. Disconnect the ECT sensor joint. 3. Connect the diagnosis and maintenance monitor to the wiring harness between the signal circuit on ECT sensor (Pin 1 of Connector E-16) and the effective grounding line. 4. Turn off the ignition device and stop the engine. Is the diagnostic maintenance monitor voltage larger than the specified rated value?	5.3V	Go to step 4	Go to step 5
4	**Key attentions:** If a voltage source in the sensor signal circuit is short-circuit, ECT sensor may be damaged. 1. Check the signal circuit between ECM (Pin 89 of Connector B-233) and ECT sensor (Pin 1 of Connector E-16) for short circuit to the battery or the ignition switch. 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 14	Go to step 13
5	1. Turn off the ignition device. 2. Connect the fused 3A jumper between the signal circuit and the low reference circuit on ECT sensor wire (Pins 1 and 2 of Connector E-16). 3. Turn off the ignition device and stop the engine. 4. Observe the ECT parameter using Tech2 scanning tool. Is the ECT parameter larger than the specified rated value?	135°C (275°F)	Go to step 9	Go to step 6
6	1. Turn off the ignition device. 2. Connect the fused 3A jumper between the signal circuit on ECT sensor (Pin 1 of Connector E-16) and the effective grounding line. 3. Turn off the ignition device and stop the engine. 4. Use Tech2 scanning tool to observe ECT. Is the ECT parameter larger than the specified rated value?	135°C (275°F)	Go to step 8	Go to step 7

Step	Measure	Rated value	Yes	No
7	1. Check the signal circuit between ECM (Pin 89 of Connector B-233) and ECT sensor (Pin 1 of Connector E-16) for open circuit or high resistance. 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 14	Go to step 11
8	1. Check the low reference circuit between ECM (Pin 93 of Connector B-233) and ECT sensor (Pin 2 of Connector E-16) for open circuit or high resistance. 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 14	Go to step 11
9	1. Check the signal circuit between ECM (Pin 89 of Connector B-233) and ECT sensor (Pin 1 of Connector E-16) for short circuit to 5V reference circuit. 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 14	Go to step 10
10	1. Turn off the ignition device. 2. Check the connector of ECT sensor (Pins 1 and 2 of Connector E-16) for disconnection or poor connection. 3. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 14	Go to step 12
11	1. Turn off the ignition device. 2. Disconnect the ECM joint. 3. Check ECT sensor circuit at ECM connector (Pins 89 and 93 of Connector B-233) for disconnection or poor connection. 4. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 14	Go to step 13

Step	Measure	Rated value	Yes	No
12	Replace the engine coolant temperature (ECT) sensor. Please refer to the contents of "ECT sensor replacement" in the chapter. Has the replacement been completed?	—	Go to step 14	—
13	**Key attentions:** **The engine control module (ECM) shall be replaced as per the procedures.** Replace the engine control module (ECM). Please refer to the contents of "ECM replacement" in this chapter. Has the replacement been completed?	—	Go to step 14	—
14	1. Connect all the previously disconnected joints. 2. Clear the DTC using Tech2 scanning tool. 3. Turn off the ignition device for 30s. 4. Starting engine 5. Monitor the DTC information using Tech2 scanning tool. Does DTC ignition fail?	—	Go to step 2	Go to step 15
15	Observe the DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the "Diagnostic Trouble Code (DTC) Catalog".	System normal

P0115 (Trouble symptom code2) (flash code 14)

Circuit instructions

The engine coolant temperature sensor is installed on the thermostat sleeve. The ECT sensor is a variable resistor. The IAT sensor is fitted with signal circuit and low reference circuit. The ECT sensor is used to measure the ECT. The ECM provides 5V voltage to the ECT signal circuit and grounding wire to the low ECT reference circuit. The sensor resistance will rise when the ECT sensor becomes cold. When the ECT rises, the sensor resistance will decrease. If the sensor resistance is high, the ECM can detect the high voltage of the ECT signal circuit. If the sensor resistance is low, the ECM can detect the low voltage of the ECT signal circuit. If ECM detects a too low coolant temperature (ECT) signal voltage, DTC will be reset.

DTC running conditions

• The ignition switch is on.

Set DTC conditions.

• ECM detects that ECT sensor signal voltage is less than 0.3V in 3s.

DTC resetting method:

• When the diagnosis fails, ECM MIL will flash as an indicator.

• ECM uses ECT instead of the fuel temperature for engine control.

• The ECM uses 60(120°F) engine coolant temperature (ECT) for replacement so as to carry out timed control of fuel injection.

• ECM uses ECT at -25°C (-13°F) as an alternative for thermal control.

Clear the conditions of the MIL/DTC (diagnostic trouble code):

• The engine control module turns off the malfunction indicator light in case of diagnosis failure.

• The historical record of DTC will be cleared after 40 circles of continuous failure-free operation. Or clear using Tech2 scanning tool.

Diagnostic aid

• If there is an operation breakage, please see “Operation Breakage” in this section.

• After starting the engine, the ECT shall rise stably till reaching about 80°C-85°C(176°F-185°F); it is in stable state only when the thermostat is turned on.

• According to the temperature and resistance comparison table, test the ECT senor under different temperature conditions so as to evaluate whether a deflection sensor can be used. Sensor deflection may lead to the consequence of a poor driving performance.

Diagnostic Trouble CodeP0115 (Trouble symptom code2) (flash code 14)

Graphic reference: engine control illustration

Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Test the engine control diagnosis system.
2	1. Install Tech2 scanning tool. 2. Turn off the ignition device and stop the engine. 3. Observe the ECT parameter using Tech2. Is the ECT parameter larger than the specified rated value?	135°C (275°F)	Go to step 3	Go to the diagnostic aid procedure

Step	Measure	Rated value	Yes	No
3	1. Turn off the ignition device. 2. Disconnect the ECT sensor joint. 3. Turn off the ignition device and stop the engine. 4. Observe the ECT parameter using Tech2 scanning tool. Is ECT parameter less than the specified value?	-35°C (-31°F)	Go to step 5	Go to step 4
4	1. Check the signal circuit between ECM (Pin 89 of Connector B-233) and ECT sensor (Pin 1 of Connector E-16) for the followings: • Grounding wire short circuit • Low reference voltage circuit 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 8	Go to step 6
5	Replace the engine coolant temperature (ECT) sensor. Please refer to the contents of "ECT sensor replacement" in the chapter. Has the replacement been completed?	—	Go to step 8	—
6	1. Turn off the ignition device. 2. Disconnect the ECM joint. 3. Check ECT sensor circuit at ECM connector (Pins 89 and 93 of Connector B-233) for connection corrosion. 4. Repair or clean up the connection as necessary. Has the case been found and corrected?	—	Go to step 8	Go to step 7
7	**Key attentions:** **The engine control module (ECM) shall be replaced as per the procedures.** Replace the engine control module (ECM). Please refer to the contents of "ECM replacement" in this chapter. Has the replacement been completed?	—	Go to step 8	v

Step	Measure	Rated value	Yes	No
8	1. Connect all the previously disconnected joints. 2. Clear the DTC using Tech2 scanning tool. 3. Turn off the ignition device for 30s. 4. Starting engine 5. Monitor the DTC information using Tech2 scanning tool. Does DTC ignition fail?	—	Go to step 2	Go to step 9
9	Observe the DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P0180 (TSC B) (FC 15)

Circuit instructions

The fuel temperature sensor is located in the fuel injection pump control unit and is used to detect the fuel temperature in the fuel injection pump. ECM and the fuel injection pump control unit exchange the information via a controller area network (CAN) connection. If the fuel temperature sensor in the fuel injection pump control unit is too high or too low, DTC will be reset.

DTC running conditions

• The ignition switch is ON.

Set DTC conditions.

• If the fuel temperature sensor in the fuel injection pump control unit is below 40℃ (-40℉) for more than 3s or above 150℃ (302℉).

DTC resetting method:

• When the diagnosis fails, MIL of ECM will flash as an indicator.

• ECM uses the default fuel temperature as an alternative, for engine control.

Clear the conditions of the MIL/DTC (diagnostic trouble code):

• When the diagnosis fails, ECM will turn off MIL.

• The history record of DTCs will be cleared after 40 cycles of consecutive trouble-free operations. Or clear using Tech2 scanning tool.

Diagnostic aid

• If there is an operation shutdown, please see the shutdown conditions in this section.

Caution:

• The fuel temperature sensor is located in the fuel injection pump control unit and is a part of the fuel injection pump assembly.

DTC P0180 (TSC B) (FC 15)

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition device for 30s. 3. Starting engine 4. Monitor the DTC information using Tech2 scanning tool. Is DTC the ignition fault?	—	Go to step 3	Go to step 4
3	**Key attentions:** The fuel injection pump shall be synchronous with the engine. Replace the fuel injection pump. Please refer to the contents of "fuel injection pump replacement" in the chapter "engine machinery". The fuel temperature sensor is located within the fuel injection fuel injection pump control unit and is a part of the fuel injection pump assembly. Has the replacement been completed?	—	Go to step 4	—
4	1. Clear the DTC using Tech2 scanning tool. 2. Turn off the ignition device for 30s. 3. Starting engine 4. Monitor the DTC information using Tech2 scanning tool. Does DTC ignition fail?	—	Go to step 3	Go to step 5
5	Observe the DTC information using Tech2 scanning tool. Is there still undiagnosed DTC?	—	Refer to the "Diagnostic Trouble Code (DTC) Catalog".	System normal

P0215 (Trouble symptom codeA) (flash code 52)

Circuit instructions

The ECM calculates the needed fuel injection quantity and the data from different sensors. These requested data are sent to the fuel injection pump control device through the CAN transmission line, and the fuel injection pump control device also receives relevant signals from internal input: the pump camshaft position sensor placed in the fuel injection pump determines the angle of rotation of the cam ring and the speed of the fuel injection pump. The fuel temperature sensor is in the fuel injection pump control device. The above rated value is used to compare the required rated value transmitted by the ECM; then the fuel injection pump control device decides the contact pin position of the fuel injection timer and the fuel injection quantity; according the control diagram on the fuel injection pump control device, the timing control valve and fuel injection solenoid valve are controlled.

Install the fuel injection solenoid valve on the rear side of the fuel injection pump. Fuel injection events are controlled by the ON/OFF command of the solenoid valve. After the fuel injection pump control device sends out a closing command to the engine shutdown solenoid valve, the fuel injection solenoid valve cuts off fuel supply. The fuel injection solenoid valve and the engine cutoff solenoid valve are the same component. When fuel is intercepted, the engine will be called to cut off the solenoid valve. When the ignition switch is turned off or a fail-safety command is received, the engine cutoff solenoid valve is turned off as required so as to shut down the engine. If the ECM detects that the engine is still running when the ignition switch is OFF, the DTC will be re-set.

DTC running conditions

• The ignition switch is off.

DTC P0215 (TSC A) (FC 52)

The engine speed is below 1500RPM.

• Vehicle speed lower than 1. 5km/h (1MPH)

Set DTC conditions.

• After a DTC is operated for 2s in this conditions, the engine speed will be up to above 200 RPM; at this time, the engine will cut off the solenoid valve closing command receives from the fuel injection pump control unit. This indicates that the fuel injection pump control unit makes a response to the command issued from ECM, but the engine cutoff solenoid valve does not response to the command from the fuel injection pump control unit, so the fuel supply is not disconnected.

DTC resetting method:

• ECM will turn on MIL on the next ignition cycle.

• The ECM cuts off fuel injection.

Clear the conditions of the MIL/DTC (diagnostic trouble code):

• The engine control module turns off the malfunction indicator light in case of diagnosis failure.

• The historical record of DTC will be cleared after 40 circles of continuous failure-free operation. Or clear using Tech2 scanning tool.

Diagnostic aid

• If there is an operation breakage, please see “Operation Breakage” in this section.

Caution:

• The fuel injection solenoid valve is placed in the fuel injection pump assy.

• The fuel injection pump control device is part of the fuel injection pump assy.

Step	Measure	Rated value	Yes	No
—	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Carry out engine control. Diagnosis system inspection
—	1. Install Tech2 scanning tool. 2. Turn off the ignition device for 30s. 3. Start the engine and run it idly for 30s. 4. Monitor the DTC information using Tech2 scanning tool. 5. Shut down the engine. Does the DTC ignition fail before turning off the ECM?	—	Go to step 3	Go to step 4

Step	Measure	Rated value	Yes	No
3	**Key attentions:** The fuel injection pump shall be synchronous with the engine. Replace the fuel injection pump. Please refer to the contents of “fuel injection pump replacement” in the chapter “engine machinery”. Has the replacement been completed?	—	Go to step 4	—
4	1. Clear the DTC using Tech2 scanning tool. 2. Turn off the ignition device for 30s. 3. Starting engine 4. Monitor the DTC information using Tech2 scanning tool. 5. Shut down the engine. Does the DTC ignition fail before turning off the ECM?	—	Go to step 3	Go to step 5
5	Observe the DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P0215 (Trouble symptom codeB) (flash code 52)

Circuit instructions

The ECM calculates the needed fuel injection quantity and the data from different sensors. These requested data are sent to the fuel injection pump control device through the CAN transmission line, and the fuel injection pump control device also receives relevant signals from internal input: the pump camshaft position sensor placed in the fuel injection pump determines the angle of rotation of the cam ring and the speed of the fuel injection pump. The fuel temperature sensor is in the fuel injection pump control device. The above rated value is used to compare the required rated value transmitted by the ECM; then the fuel injection pump control device decides the contact pin position of the fuel injection timer and the fuel injection quantity; according the control diagram on the fuel injection pump control device, the timing control valve and fuel injection solenoid valve are controlled.

Install the fuel injection solenoid valve on the rear side of the fuel injection pump. Fuel injection events are controlled by the ON/OFF command of the solenoid valve. After the fuel injection pump control device sends out a closing command to the engine shutdown solenoid valve, the fuel injection solenoid valve cuts off fuel supply. The fuel injection solenoid valve and the engine cutoff solenoid valve are the same component. When fuel is intercepted, the engine will be called to cut off the solenoid valve. When the ignition switch is turned off or a fail-safety command is received, the engine cutoff solenoid valve is turned off as required so as to shut down the engine. If the fuel injection pump control unit detects that the engine cut-off solenoid valve control circuit voltage from ECM to the fuel injection pump control unit is too high, DTC will be reset.

DTC running conditions

• The ignition switch is on.

Set DTC conditions.

• ECM will not issue a closing command when the fuel injection pump control unit detects a high voltage in the engine cutoff solenoid valve control circuit for more than 1s.

DTC resetting method:

• When the diagnosis fails, ECM MIL will flash as an indicator.

Clear the conditions of the MIL/DTC (diagnostic trouble code):

• The engine control module turns off the malfunction indicator light in case of diagnosis failure.

• The historical record of DTC will be cleared after 40 circles of continuous failure-free operation. Or clear using Tech2 scanning tool.

Diagnostic aid

• If there is an operation breakage, please see “Operation Breakage” in this section.

Caution:

• The fuel injection solenoid valve is placed in the fuel injection pump assy.

• The fuel injection pump control device is part of the fuel injection pump assy.

• If this DTC is present, the engine will not be started.

P0215 (Trouble symptom codeB) (flash code 52)

Graphic reference: engine control illustration

Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition device for 30s. 3. Starting engine Start the engine if it is not started. 4. Monitor the DTC information using Tech2 scanning tool. Does DTC ignition fail?	—	Go to step 3	Go to the diagnostic aid procedure
3	1. Turn off the ignition device. 2. Disconnect the joint of the fuel injection pump control device. 3. Connect the testing light to the engine cutoff solenoid valve control signal circuit (pin 5 of joint E-110) and grounding wire with good effect. 4. Turn off the ignition device and stop the engine. Is the test light on?	—	Go to step 5	Go to step 4

Step	Measure	Rated value	Yes	No
4	1. Turn off the ignition device. 2. Reconnect the fuel injection pump control unit connector. 3. Disconnect ECM Connector B-233 and maintain the connection of Connector B-234. 4. Connect the test lamp between the engine cutoff solenoid valve control valve signal circuit (Pin 105 of Connector B-233) and the effective grounding line. 5. Turn on the ignition device and stop the engine. Is the test light on?	—	Go to step 6	Go to the diagnostic aid procedure
5	1. Test whether the engine cutoff solenoid valve control signal circuit between the ECM (joint B-233 pin 105) and the fuel injection pump control device (joint E-110 pin 5) has phenomena such as battery short circuit or ignition voltage short circuit. 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 8	Go to step 7
6	**Key attentions:** The fuel injection pump shall be synchronous with the engine. Replace the fuel injection pump. Please refer to the contents of “fuel injection pump replacement” in the chapter “engine machinery”. Has the replacement been completed?	—	Go to step 8	—
7	**Key attentions:** **The engine control module (ECM) shall be replaced as per the procedures.** Replace the engine control module (ECM). Please refer to the contents of “ECM replacement” in this chapter. Has the replacement been completed?	—	Go to step 8	—
8	1. Connect all the previously disconnected joints. 2. Clear the DTC using Tech2 scanning tool. 3. Turn off the ignition device for 30s. 4. Starting engine 5. Monitor the DTC information using Tech2 scanning tool. Does DTC ignition fail?	—	Go to step 3	Go to step 9
9	Observe the DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	See “DTC Directory”	System normal

P0215 (Trouble symptom codeA) (flash code 52)

Circuit instructions

The ECM calculates the needed fuel injection quantity and the data from different sensors. These requested data are sent to the fuel injection pump control device through the CAN transmission line, and the fuel injection pump control device also receives relevant signals from internal input: the pump camshaft position sensor placed in the fuel injection pump determines the angle of rotation of the cam ring and the speed of the fuel injection pump. The fuel temperature sensor is in the fuel injection pump control device. The above rated value is used to compare the required rated value transmitted by the ECM; then the fuel injection pump control device decides the contact pin position of the fuel injection timer and the fuel injection quantity; according the control diagram on the fuel injection pump control device, the timing control valve and fuel injection solenoid valve are controlled.

Install the fuel injection solenoid valve on the rear side of the fuel injection pump. Fuel injection events are controlled by the ON/OFF command of the solenoid valve. After the fuel injection pump control device sends out a closing command to the engine shutdown solenoid valve, the fuel injection solenoid valve cuts off fuel supply. The fuel injection solenoid valve and the engine cutoff solenoid valve are the same component. When fuel is intercepted, the engine will be called to cut off the solenoid valve. When the ignition switch is turned off or a fail-safety command is received, the engine cutoff solenoid valve is cut off so as to shut down the engine. If the ECM detects that the engine is still running when the ignition switch is OFF, the DTC will be re-set.

DTC running conditions

• The ignition switch is off.

• The engine speed is below 1500 RPM.

• Vehicle speed lower than 1. 5km/h (1MPH)

Set DTC conditions.

• The engine speed is greater than 200 RPM in 2s after the conditions to start DTC are achieved. This indicates that the fuel injection pump control unit does not response to this command from ECM and the fuel supply can not be cut off.

DTC resetting method:

• When the diagnosis fails, ECM MIL will flash as an indicator.

• The ECM cuts off fuel injection.

Clear the conditions of the MIL/DTC (diagnostic trouble code):

• The engine control module turns off the malfunction indicator light in case of diagnosis failure.

• The historical record of DTC will be cleared after 40 circles of continuous failure-free operation. Or clear using Tech2 scanning tool.

Diagnostic aid

• If there is an operation breakage, please see “Operation Breakage” in this section.

Caution:

• The fuel injection solenoid valve is placed in the fuel injection pump assy.

• The fuel injection pump control device is part of the fuel injection pump assy.

DTC P0215 (TSC C) (FC 52)

Graphic reference: engine control illustration

Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition device for 30s. 3. Start the engine and run it idly for 30s. 4. Monitor the DTC information using Tech2 scanning tool. 5. Shut down the engine. Does the DTC ignition fail before turning off the ECM?	—	Go to step 3	Go to the diagnostic aid procedure

Step	Measure	Rated value	Yes	No
3	1. Turn off the ignition device. 2. Disconnect the joint of the fuel injection pump control device. 3. Connect the testing light to the engine cutoff solenoid valve control signal circuit (pin 5 of joint E-110) and grounding wire with good effect. 4. Turn on the ignition device and stop the engine. Is the test light on?	—	Go to step 5	Go to step 4
4	1. Turn off the ignition device. 2. Connect the digital multimeter between the engine cutoff solenoid valve control signal circuit (Pin 5 of Connector E-110) and the effective grounding line. 3. Turn on the ignition device and stop the engine. Is the diagnostic maintenance monitor voltage larger than the specified rated value?	10V	Go to step 7	Go to step 6
5	1. Test whether the engine cutoff solenoid valve control signal circuit between the ECM (joint B-233 pin 105) and the fuel injection pump control device (joint E-110 pin 5) has phenomena such as battery short circuit or ignition voltage short circuit. 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 11	Go to step 10
6	1. Check the engine cutoff solenoid control signal circuit between ECM (Pin 105 of Connector B-233) and the fuel injection pump control unit (Pin 5 of Connector E-110) for open circuit or high resistance. 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 11	Go to step 8
7	1. Turn off the ignition device. 2. Check the engine cutoff solenoid valve control signal circuit at the fuel injection pump control unit connector (Pin 5 of Connector E-110) for disconnection, poor connection or corrosion. 3. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 11	Go to step 9
8	1. Turn off the ignition device. 2. Disconnect the ECM joint. 3. Check the engine cutoff solenoid valve control signal circuit at ECM connector (Pin 105 of Connector B-233) for disconnection or poor connection. 4. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 11	Go to step 10
9	**Key attentions:** The fuel injection pump should be synchronized with the engine operation. Replace the fuel injection pump. Please refer to the contents of “fuel injection pump replacement” in the chapter “engine machinery”. Has the replacement been completed?	—	Go to step 11	—

Step	Measure	Rated value	Yes	No
10	**Key attentions:** **The engine control module (ECM) shall be replaced as per the procedures.** Replace the engine control module (ECM). Please refer to the contents of "ECM replacement" in this chapter. Has the replacement been completed?	—	Go to step 11	—
11	1. Connect all the previously disconnected joints. 2. Clear the DTC using Tech2 scanning tool. 3. Turn off the ignition device for 30s. 4. Starting engine 5. Monitor the DTC information using Tech2 scanning tool. 6. Shut down the engine. Does the DTC ignition fail before turning off the ECM?	—	Go to step 3	Go to step 12
12	Use Tech2 scanning tool to observe DTC message. Is there any DTC which has not been diagnosed yet?	—	Refer to the "Diagnostic Trouble Code (DTC) Catalog".	System normal

P0215 (TSC D) (FC 52)

Circuit instructions

The ECM calculates the needed fuel injection quantity and the data from different sensors. These requested data are sent to the fuel injection pump control device through the CAN transmission line, and the fuel injection pump control device also receives relevant signals from internal input: the pump camshaft position sensor placed in the fuel injection pump determines the angle of rotation of the cam ring and the speed of the fuel injection pump. The fuel temperature sensor is in the fuel injection pump control device. The above rated value is used to compare the required rated value transmitted by the ECM; then the fuel injection pump control device decides the contact pin position of the fuel injection timer and the fuel injection quantity; according the control diagram on the fuel injection pump control device, the timing control valve and fuel injection solenoid valve are controlled.

The ECM monitors the network (CAN) running state of the controller area so as to transmit the information from the fuel injection pump control device continuously. If ECM detects that CAN controller is not turned off when the ignition switch is turned off, DTC will be reset.

DTC running conditions

• The ignition switch is in OFF status

DTC P0215 (TSC D) (FC 52)

Set DTC conditions.

• ECM detects that CAN controller is not in OFF status.

DTC resetting method:

• When the diagnosis fails, ECM MIL will flash as an indicator.

Clear the conditions of the MIL/DTC (diagnostic trouble code):

• When the diagnosis fails, ECM will turn off MIL.

• The history record of DTC will be cleared after 40 cycles of consecutive trouble-free operations. Or clear using Tech2 scanning tool.

Diagnostic aid

• If there is an operation breakage, please see “Operation Breakage” in this section.

Caution:

• CAN controller is located in ECM.

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Carry out engine control. Diagnosis system inspection
2	1. Install Tech2 scanning tool. 2. Turn off the ignition device for 30s. 3. Start the engine and run it idly for 30s. 4. Monitor the DTC information using Tech2 scanning tool. 5. Shut down the engine. Does the DTC ignition fail before turning off the ECM?	—	Go to step 3	Go to step 4
3	**Key attentions:** **The engine control module (ECM) shall be replaced as per the procedures.** Replace the engine control module (ECM). Please refer to the contents of “ECM replacement” in this chapter. Has the replacement been completed?	—	Go to step 4	—

Step	Measure	Rated value	Yes	No
4	1. Clear the DTC using Tech2 scanning tool. 2. Turn off the ignition device for 30s. 3. Start the engine and run it idly for 30s. 4. Monitor the DTC information using Tech2 scanning tool. 5. Shut down the engine. Does the DTC ignition fail before turning off the ECM?	—	Go to step 3	Go to step 5
5	Observe the DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P0216 (Trouble symptom codeA and B) (flash code 54)

Circuit instructions

The ECM calculates the needed fuel injection quantity and the data from different sensors. These requested data are sent to the fuel injection pump control device through the CAN transmission line, and the fuel injection pump control device also receives relevant signals from internal input: the pump camshaft position sensor placed in the fuel injection pump determines the angle of rotation of the cam ring and the speed of the fuel injection pump. The fuel temperature sensor is in the fuel injection pump control device. The above rated value is used to compare the required rated value transmitted by the ECM; then the fuel injection pump control device decides the contact pin position of the fuel injection timer and the fuel injection quantity; according the control diagram on the fuel injection pump control device, the timing control valve and fuel injection solenoid valve are controlled.

The timing device is used to set the optimal injection time based on different engine status. It can be used to adjust the fuel pressure fed from the feed pump to suit the timing punch of fuel pressure controlled by TCV. TCV is mounted to the rear of the fuel injection pump and controlled with the duty cycle of the fuel injection pump control unit. Connect the timing punch to the cam ring through the ball pin. The axial movement of the timing punch is transmitted to the cam ring in a rotational manner, to improve the injection timing for movement on the right of the timing punch. If the fuel injection pump control unit detects that the actual injection timing is too different from the ideal timing, DTC will be reset.

DTC running conditions

Trouble symptom code A

• The engine speed is more than 700RPM.

• fuel injection quantity more than 4mg/strk

Trouble symptom code B

• The engine speed is more than 2014RPM.

Set DTC conditions.

Trouble symptom code A

• The vibration amplitude of actual fuel injection time monitored by the fuel injection pump control unit is 3°CA above predicted value and the actual fuel injection time lasts over 12s or the vibration amplitude is 6°CA above the predicted value and the actual fuel injection time lasts lasts over 12s.

Trouble symptom code B

DTC P0216 (TSCs A and B) (FC 54)

• The vibration amplitude of the actual fuel injection time monitored by the fuel injection pump control unit is 5.2°CA above the predicted value.

DTC resetting method:

• When the diagnosis fails, ECM MIL will flash as an indicator.

• The ECM limits fuel injection quantity.

Clear the conditions of the MIL/DTC (diagnostic trouble code):

• The engine control module turns off the malfunction indicator light in case of diagnosis failure.

• The historical record of DTC will be cleared after 40 circles of continuous failure-free operation. Or clear using Tech2 scanning tool.

Diagnostic aid

• If there is an operation breakage, please see “Operation Breakage” in this section.

Caution:

• Incorrect mechanical timing of the fuel injection pump may cause DTC to be reset.

• DTC shows the fuel pressure loss relative to the fuel line on a large extent. Check the fuel line between the fuel injection pump and the fuel tank.

• The fuel system from the fuel tank to the fuel injection pump is under a slight vacuum status when the engine is operated. As a result, the air may enter the fuel system if the connection is loosened or any fuel tube is cracked, resulting in pressure fluctuation in the fuel injection pump, especially at high engine speeds and high loads and DTC to be reset.

• Any improper use of fuel can also cause DTC to be reset. Check fuel waxing or icing caused by improper use of fuel or water entering the fuel system in the winter.

• Any contaminated fuel can also cause DTC to be reset. Check the pipe fitting fixing bolts (eyebolts) on the suction side of the fuel injection pump.

Key attentions:

Allow the air to enter the fuel system if the fuel in the fuel tank is exhausted or nearly exhausted. As there is the air contained in the fuel system, a resistance may be encountered when the fuel enters the injection pump, at this time, DTC may be reset.

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition device for 30s. 3. Start the engine and run it idly for 30s. Use Tech2 scanning tool to monitor DTC information. Is DTC P0335 (TSC B or D), P1335 (TSC A), or P1345 (TSC A) reset?	—	Perform applicable DTC.	Go to step 3
3	1. Shut down the engine. 2. Set the transmission in neutral position and set the brakes. 3. Start the engine and keep it in idling state for 30s while observing the actual fuel injection timing parameter using Tech2. 4. Accelerate the engine and keep its speed at 20000RPM while observing the actual fuel injection timing parameter using Tech2. 5. Accelerate the engine and keep its speed at 30000RPM while observing the actual fuel injection timing parameter using Tech2. Does the actual fuel injection timing parameter conform to the required fuel injection timing range 2°CA during running at each engine speed?	—	Go to the diagnostic aid procedure	Go to step 4
4	1. Turn off the ignition device. 2. Check the fuel system line connections between the fuel tank and fuel injection pump for tightness and any fuel lines for cuts, cracks and clamps. **Caution:** The fuel system from the fuel tank to the fuel injection pump is under micro vacuum when the engine is operated. As a result, the air may enter the fuel system if the connections are poorly sealed. The air in the fuel system may cause the pressure fluctuation in the fuel injection pump, especially at engine speeds and heavy loads, which will cause DTC to be reset. 3. Use the liquid pump on the fuel filter to absorb moisture until it becomes solid. If there is a leakage at the fuel system suction port between the fluid pump and the fuel injection pump, the fluid pump will not become solid and there may be fuel leakage. 4. Repair or replace as necessary. Has the case been found and corrected?	—	Go to step 9	Go to step 5

Step	Measure	Rated value	Yes	No
5	1. Dismantle the fuel pipe connected with the suction port of the fuel injection pump. 2. Dismantle the fuel pipe joint connected with the suction port of the fuel injection pump. 3. Check the eyebolt for any restriction or shrinking mesh filter. **Caution:** If there is any restriction, please check the causes of fuel contamination, for example, the customer uses the old fuel filter or the maintenance period is too long. Also, check fuel waxing or icing due to improper use of fuel or water entering the fuel system in the winter. 4. Repair or replace as necessary. Has the case been found and corrected?	—	Go to step 9	Go to step 6
6	1. Dismantle the fuel pipe connected with the suction port of the fuel injection pump. To determine the amount of fuel discharged, place the hose in the bottle or container. 2. Use the liquid pump on the fuel filter for moisture absorption. **Caution:** If there is a leakage at the suction port of the fuel system, the fuel flow out of the removed hose will not be discharged completely and there may be a fuel leakage. In the meantime, if there is a restriction on the suction port of the fuel system, the fuel flow out of the removed tube will not be discharged completely, which may result in blockage of the fuel filter or kinking of the fuel hose. 3. Drain the fuel from the fuel tank through the fuel hose (as close as possible to the fuel tank), into the fuel storage hose, to determine whether it is clean (with a hand-held vacuum pump with a cleaning hose or similar devices 5-8840-0279-0/J-23738-A). This will ensure that the fuel storage tube will not be broken, i.e., the air will not be absorbed into the fuel hose. 4. If necessary, repair leakages and restrictions in the fuel system. Has the case been found and corrected?	—	Go to step 9	Go to step 7

Step	Measure	Rated value	Yes	No
7	1. Dismantle the fuel pipe joint connected with the suction port of the fuel injection pump. 2. Dismantle the fuel pipe connected with the suction port of the fuel injection pump. 3. Replace it with a clean hose. **Caution:** Clean the hose. 4. Connect the clean hose to the fuel injection pump. 5. Open the fuel system. See Diagnosis Helps. 6. Allow engine to be operated at idle for at least 2min. 7. Accelerate the engine in several times between the idle and the throttle full-opening status (apply fully the accelerator pedal) and check the clean hose. **Caution:** If there are air bubbles on the fuel surface, check the fuel system connections between the fuel tank and the fuel injection pump for tightness and all fuel lines for cuts, cracks and clamps. 8. If necessary, repair the fuel system. Has the case been found and corrected?	—	Go to step 9	Go to step 8
8	**Key attentions:** The fuel injection pump shall be synchronous with the engine. Replace the fuel injection pump. Please refer to the contents of “fuel injection pump replacement” in the chapter “engine machinery”. Has the replacement been completed?	—	Go to step 9	—
9	1. Clear the DTC using Tech2 scanning tool. 2. Turn off the ignition device for 30s. 3. Place the transmission in neutral position and apply the brakes. 4. Start the engine and keep it in idling state for 30s while observing the actual fuel injection timing parameter using Tech2. 5. Accelerate the engine and keep its speed at 20000RPM while observing the actual fuel injection timing parameter using Tech2. 6. Accelerate the engine and keep its speed at 30000RPM while observing the actual fuel injection timing parameter using Tech2. Does the actual fuel injection timing parameter conform to the required fuel injection timing range 2°CA during running at each engine speed?	—	Go to step 10	Go to step 2
10	Observe the DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P0251 (Trouble symptom code6) (flash code 53)

Circuit instructions

The ECM calculates the needed fuel injection quantity and the data from different sensors. These requested data are sent to the fuel injection pump control device through the CAN transmission line, and the fuel injection pump control device also receives relevant signals from internal input: the pump camshaft position sensor placed in the fuel injection pump determines the angle of rotation of the cam ring and the speed of the fuel injection pump. The fuel temperature sensor is in the fuel injection pump control device. The above rated value is used to compare the required rated value transmitted by the ECM; then the fuel injection pump control device decides the contact pin position of the fuel injection timer and the fuel injection quantity; according the control diagram on the fuel injection pump control device, the timing control valve and fuel injection solenoid valve are controlled.

Install the fuel injection solenoid valve on the rear side of the fuel injection pump. Fuel injection events are controlled by the ON/OFF command of the solenoid valve. After the fuel injection pump control device sends out a closing command to the engine shutdown solenoid valve, the fuel injection solenoid valve cuts off fuel supply. The fuel injection solenoid valve and the engine intercepting solenoid valve are the same component. When fuel is intercepted, the engine will be called to cut off the solenoid valve. When the ignition switch is turned off or a fail-safety command is received, the engine cutoff solenoid valve is cut off so as to shut down the engine. If the fuel injection pump control units detects that the estimated fuel injection from ECM is 0 mg/strk and the fuel injection solenoid valve is in operation, DTC will be reset.

Diagnostic Trouble CodeP0251 (Trouble symptom code6) (flash code 53)

DTC running conditions

• Fuel injection pump CMP sensor signals are generated.

• The network communication in the controller area between the ECM and the fuel injection pump control device is normal.

Set DTC conditions.

• The fuel injection pump control unit detects that the fuel injection solenoid valve is in operation when the estimated fuel injection amount is 0 mg/strk.

DTC resetting method:

• When the diagnosis fails, ECM MIL will flash as an indicator.

• The ECM cuts off fuel injection.

Clear the conditions of the MIL/DTC (diagnostic trouble code):

• The engine control module turns off the malfunction indicator light in case of diagnosis failure.

• The historical record of DTC will be cleared after 40 circles of continuous failure-free operation. Or clear using Tech2 scanning tool.

Diagnostic aid

• If there is an operation breakage, please see “Operation Breakage” in this section.

Caution:

• The fuel injection solenoid valve is placed in the fuel injection pump assy.

• The fuel injection pump control device is part of the fuel injection pump assy.

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition device for 30s. 3. Start the engine and run it idly for 30s. 4. Accelerate the engine multiple times alternately in idle state and full valve opening state (accelerator pedal full-range) while observing the DTC information using Tech2 scanning tool. Does DTC ignition fail?	—	Go to step 3	Go to step 4
3	**Key attentions:** The fuel injection pump shall be synchronous with the engine. Replace the fuel injection pump. Please refer to the contents of “fuel injection pump replacement” in the chapter “engine machinery”. Has the replacement been completed?	—	Go to step 4	—

Step	Measure	Rated value	Yes	No
4	1. Clear the DTC using Tech2 scanning tool. 2. Turn off the ignition device for 30s. 3. Start the engine and run it idly for 30s. 4. Accelerate the engine multiple times alternately in idle state and full valve opening state (accelerator pedal full-range) while observing the DTC information using Tech2 scanning tool. Does DTC ignition fail?	—	Go to step 3	Go to step 5
5	Observe the DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P0251 (Trouble symptom code7) (flash code 53)

Circuit instructions

The ECM calculates the needed fuel injection quantity and the data from different sensors. These requested data are sent to the fuel injection pump control device through the CAN transmission line, and the fuel injection pump control device also receives relevant signals from internal input: the pump camshaft position sensor placed in the fuel injection pump determines the angle of rotation of the cam ring and the speed of the fuel injection pump. The fuel temperature sensor is in the fuel injection pump control device. The above rated value is used to compare the required rated value transmitted by the ECM; then the fuel injection pump control device decides the contact pin position of the fuel injection timer and the fuel injection quantity; according the control diagram on the fuel injection pump control device, the timing control valve and fuel injection solenoid valve are controlled. The fuel injection pump control unit compares the engine speed signal from ECM with the fuel injection pump speed. If the fuel injection pump control unit detects that the speed of the dual fuel injection pump is significantly less than the engine speed, DTC will be reset.

DTC running conditions

• Fuel injection pump CMP sensor signals are generated.

• Generate a crankshaft position sensor signal.

• The engine speed is more than 500RPM.

Set DTC conditions.

• The fuel injection pump control unit detects the dual fuel injection pump speed is 800 RPM less than the engine speed within 0.2s.

DTC resetting method:

• When the diagnosis fails, ECM MIL will flash as an indicator.

• The ECM cuts off fuel injection.

Clear the conditions of the MIL/DTC (diagnostic trouble code):

• The engine control module turns off the malfunction indicator light in case of diagnosis failure.

• The historical record of DTC will be cleared after 40 circles of continuous failure-free operation. Or clear using Tech2 scanning tool.

Diagnostic aid

• Electronic or magnetic interference may affect interruption conditions.

• If there is an operation breakage, please see “Operation Breakage” in this section.

Caution:

• The fuel injection pump CMP is placed in the fuel injection pump assembly.

• The fuel injection pump control device is part of the fuel injection pump assy.

Diagnostic Trouble CodeP0251 (Trouble symptom code7) (flash code 53)

Graphic reference: engine control illustration

Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition device for 30s. 3. Starting engine Start the engine if it is not started. 4. Monitor the DTC information using Tech2 scanning tool. Is DTC P0335 (TSC B, D or E), P1335 (TSC A), or P1345 (TSC A) reset?	—	Perform applicable DTC.	Go to step 3
3	1. Starting engine 2. Monitor the DTC information using Tech2 scanning tool. 3. Accelerate the engine in several times between the idle and throttle full-opening status (fully apply the accelerator pedal). Does DTC ignition fail?	—	Go to step 4	Go to the diagnostic aid procedure

Step	Measure	Rated value	Yes	No
4	1. Observe the engine speed parameter using Tech2 scanning tool. 2. Accelerate the engine while observing Tech2 multiple times alternately in idle state and full valve opening state (accelerator pedal full-range). Does the engine speed parameter reflect the correct engine speed?	—	Go to step 9	Go to step 5
5	1. Check the crankshaft position sensor for tensioning. 2. Dismantle the crankshaft position sensor, and check for its damage, existence of metal particles on the magnet, and flywheel appearance damage. Has the case been found and corrected?	—	Go to step 10	Go to step 6
6	1. Turn off the ignition device. 2. Disconnect the crankshaft position sensor joint. 3. Check the crankshaft position sensor connector (Pins 1, 2, and 3 of Connector J-183) for disconnection, poor connection, or corrosion. 4. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 10	Go to step 7
7	1. Turn off the ignition device. 2. Disconnect the fuel injection pump control unit connector. 3. Check the crankshaft position sensor signal input at the fuel injection pump control unit connector (Pin 8 of Connector E-110) for disconnection, poor connection, or corrosion. 4. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 10	Go to step 8
8	1. Turn off the ignition device. 2. Disconnect the ECM joint. 3. Check ECM connector (Pins 90, 91, 98, and 101 of Connector B-233) for disconnection, poor connection, or corrosion. 4. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 10	Go to step 9
9	**Key attentions:** The fuel injection pump shall be synchronous with the engine. Replace the fuel injection pump. Please refer to the contents of “fuel injection pump replacement” in the chapter “engine machinery”. Has the replacement been completed?	—	Go to step 10	—

Step	Measure	Rated value	Yes	No
10	1. Connect all the previously disconnected joints. 2. Clear the DTC using Tech2 scanning tool. 3. Turn off the ignition device for 30s. 4. Starting engine 5. Accelerate the engine multiple times alternately in idle state and full valve opening state (accelerator pedal full-range) while observing the DTC information using Tech2 scanning tool. Does DTC ignition fail?	—	Go to step 2	Go to step 11
11	Observe the DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P0251 (Trouble symptom code9、A、B and D) (flash code 53)

Circuit instructions

The ECM calculates the needed fuel injection quantity and the data from different sensors. These requested data are sent to the fuel injection pump control device through the CAN transmission line, and the fuel injection pump control device also receives relevant signals from internal input: the pump camshaft position sensor placed in the fuel injection pump determines the angle of rotation of the cam ring and the speed of the fuel injection pump. The fuel temperature sensor is in the fuel injection pump control device. The above rated value is used to compare the required rated value transmitted by the ECM; then the fuel injection pump control device decides the contact pin position of the fuel injection timer and the fuel injection quantity; according the control diagram on the fuel injection pump control device, the timing control valve and fuel injection solenoid valve are controlled.

Install the fuel injection solenoid valve on the rear side of the fuel injection pump. Fuel injection events are controlled by the ON/OFF command of the solenoid valve. After the fuel injection pump control device sends out a closing command to the engine shutdown solenoid valve, the fuel injection solenoid valve cuts off fuel supply. The fuel injection solenoid valve and the engine intercepting solenoid valve are the same component. When the fuel flow is cut off, it will call the engine cutoff solenoid valve. When the ignition switch is turned off or a fail-safety command is received, the engine cutoff solenoid valve is cut off so as to shut down the engine.

DTC running conditions

• The ignition switch is on.

Set DTC conditions.

• The fuel injection pump control unit detects that the internal fuel injection pump control chart is not programmed during the self-test.
(Trouble symptom code 9)

Diagnostic Trouble CodeP0251 (Trouble symptom code9、A、B and D) (flash code 53)

• The fuel injection pump control unit detects that the internal EEPROM or AC/DC converter operation fails during self-test. (Trouble symptom code A)

• The fuel injection pump control unit detects that the fuel injection solenoid valve drive circuit fails during the self-test.
(Trouble symptom code B)

• The fuel injection pump control unit detects that the voltage on the fuel injection solenoid valve drive circuit is abnormal during self-test. (Trouble symptom code D)

DTC resetting method:

• When the diagnosis fails, ECM MIL will flash as an indicator.

• The ECM cuts off fuel injection. (Trouble symptom code 9)

• The ECM limits fuel injection quantity. (Trouble symptom code A)

Clear the conditions of the MIL/DTC (diagnostic trouble code):

• The engine control module turns off the malfunction indicator light in case of diagnosis failure.

• The historical record of DTC will be cleared after 40 circles of continuous failure-free operation. Or clear using Tech2 scanning tool.

Diagnostic aid

• If there is an operation breakage, please see “Operation Breakage” in this section.

Caution:

• The fuel injection solenoid valve is placed in the fuel injection pump assy.

• The fuel injection pump control device is part of the fuel injection pump assy.

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition device for 30s. 3. Turn on the ignition device and stop the engine. 4. Monitor the DTC information using Tech2 scanning tool. Does DTC ignition fail?	—	Go to step 3	Go to step 4
3	**Key attentions:** The fuel injection pump shall be synchronous with the engine. Replace the fuel injection pump. Please refer to the contents of “fuel injection pump replacement” in the chapter “engine machinery”. Has the replacement been completed?	—	Go to step 4	—

Step	Measure	Rated value	Yes	No
4	1. Clear the DTC using Tech2 scanning tool. 2. Turn off the ignition device for 30s. 3. Turn on the ignition device and stop the engine. 4. Monitor the DTC information using Tech2 scanning tool. Does DTC ignition fail?	—	Go to step 3	Go to step 5
5	Observe the DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P0251 (Trouble symptom codeE) (flash code 53)

Circuit instructions

The ECM calculates the needed fuel injection quantity and the data from different sensors. The requested data are sent to the fuel injection fuel injection pump control unit via CAN transmission line and the fuel injection pump control unit receives the relative signals from the internal input: the rotation angle of the cam ring and the speed of the fuel injection pump determined via the pump camshaft position sensor located in the fuel injection pump. The fuel temperature sensor is in the fuel injection pump control device. The above rated value is used to compare the required rated value transmitted by the ECM; then the fuel injection pump control device decides the contact pin position of the fuel injection timer and the fuel injection quantity; according the control diagram on the fuel injection pump control device, the timing control valve and fuel injection solenoid valve are controlled.

The ECM monitors the network (CAN) running state of the controller area so as to transmit the information from the fuel injection pump control device continuously. If ECM detects that the communication from the fuel injection pump control unit is not received, DTC will be reset.

DTC conditions in operation

• The ignition switch is ON.

Diagnostic Trouble CodeP0251 (Trouble symptom codeE) (flash code 53)

Set DTC conditions.

• ECM detects that the communication from the fuel injection pump control unit is not received in more than 1s.

DTC resetting method:

· When the diagnosis fails, MIL on ECM will flash as an indicator.

• ECM cuts off the fuel injection.

Clear the conditions of the MIL/DTC (diagnostic trouble code):

• When the diagnosis fails, ECM will turn off MIL.

• The history record of DTCs will be cleared after 40 cycles of consecutive trouble-free operations. Or clear using Tech2 scanning tool.

Diagnostic aid

• If there is an operation breakage, please see “Operation Breakage” in this section.

Caution:

• The fuel injection pump control unit is a part of the fuel injection pump assembly.

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition device for 30s. 3. Starting engine Start the engine if it is not started. 4. Monitor the DTC information using Tech2 scanning tool. Is DTC P1650 (TSC A or B) or P1651 (TSC A or B) reset?	—	Perform applicable DTC.	Go to step 3
3	1. Turn on the ignition device and stop the engine. 2. Monitor the DTC information using Tech2 scanning tool. Does DTC ignition fail?	—	Go to step 4	Go to step 5
4	**Key attentions:** Replace ECM with the procedural steps. Replace the engine control module (ECM). Please refer to the contents of “ECM replacement” in this chapter. Has the replacement been completed?	—	Go to step 5	—

Step	Measure	Rated value	Yes	No
5	1. Clear the DTC using Tech2 scanning tool. 2. Turn off the ignition device for 30s. 3. Turn on the ignition device and stop the engine. 4. Monitor the DTC information using Tech2 scanning tool. Does DTC ignition fail?	—	Go to step 2	Go to step 6
6	Observe the DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P0335 (Trouble symptom code B and D) (flash code 43)

Circuit instructions

The crankshaft position sensor is located at the top of the flywheel housing. There are 4 equidistant seams on the flywheel circumference, with the interval of 90°. The crankshaft position sensor is a magnetic coil sensor that generates AC signal voltage based on the crankshaft rotation speed. ECM can monitor the signals from the crankshaft position sensor and the fuel injection pump camshaft position sensor to ensure their relations.

If ECM receives redundant or misrecognized crankshaft position sensor signal pulses, DTC will be reset. (Trouble symptom code B)

If ECM receives a certain amount of injection pump crankshaft position sensor signal pulses but does not receive the crankshaft position sensor signals, DTC will be reset. (Trouble symptom code D)

DTC running conditions

Trouble symptom code B

• The ignition switch is on.

• The engine speed is more than 665RPM.

Trouble symptom code D

•Diagnostic Trouble CodeP0335 (Trouble symptom codeB) Not reset.

• The ignition switch is on.

• Fuel injection pump CMP sensor signals are generated.

• The network communication in the controller area between the ECM and the fuel injection pump control device is normal.

DTC setting conditions - TSC B

• ECM detects redundant or missing crankshaft position sensor signals while the engine is operated.

Trouble symptom code D

• ECM detects that no crankshaft position sensor signal is generated when the dual fuel injection pump speed is above 50 RPM.

DTC resetting method:

• When the diagnosis fails, ECM MIL will flash as an indicator. ECM uses the engine speed instead of the dual fuel injection pump speed for engine control.

Clear the conditions of the MIL/DTC (diagnostic trouble code):

• The engine control module turns off the malfunction indicator light in case of diagnosis failure.

• The historical record of DTC will be cleared after 40 circles of continuous failure-free operation. Or clear using Tech2 scanning tool.

Diagnostic aid

• If there is an operation breakage, please see “Operation Breakage” in this section.

• Ensure that the tightness of the sensor is good and the flywheel surface is not damaged.

Diagnostic Trouble Code P0335 (Trouble symptom code B and D) (flash code 43)

Graphic reference: engine control illustration

Joint end face view reference: engine control joint end

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition device for 30s. 3. Start the engine (Note: there may be a slight start delay.) 4. Monitor the DTC information using Tech2 scanning tool. Is DTC the ignition fault?	—	Go to step 3	Go to the diagnostic aid procedure

Step	Measure	Rated value	Yes	No
3	1. Turn off the ignition device. 2. Disconnect the crankshaft position sensor joint. 3. Connect the diagnosis and maintenance monitor to the crankshaft position sensor connector (Pins 1 and 2 of Connector J-183). 4. Measure the resistance of the crankshaft position sensor. Is the resistance of the crankshaft position sensor within the specified range?	870930 Ω	Go to step 4	Go to step 20
4	1. Connect the diagnosis and maintenance monitor to the connector of the crankshaft position sensor (measure the output voltage of the sensor) 2. Install the diagnosis and maintenance monitor on AC voltage meter. 3. Starting engine 4. Accelerate the engine between the idle and the throttle full opening status (fully apply the accelerator pedal) and monitor the diagnosis and maintenance monitor. Does the diagnosis maintenance monitor show that AC voltage increases with the engine speed (within the range of 0.7V ~ 1.4V)?	—	Go to step 5	Go to step 19
5	1. Turn on the ignition device and stop the engine. 2. Connect the test lamp between the low reference circuit on the crankshaft position sensor wiring harness (Pin 1 of Connector J-183) and the effective grounding line. Is the test light on?	—	Go to step 11	Go to step 6
6	1. Turn on the ignition device and stop the engine. 2. Connect the test lamp between the low reference circuit on the air flow sensor (Pin 1 of Connector J-183) and the battery voltage. Is the test light on?	—	Go to step 7	Go to step 12
7	1. Turn on the ignition device and stop the engine. 2. Connect the test lamp between the shielded grounding circuit on the crankshaft position sensor wiring harness (Pin 3 of Connector J-183) and the effective grounding line. Is the test light on?	—	Go to step 13	Go to step 8
8	1. Turn on the ignition device and stop the engine. 2. Connect the test lamp between the shield grounding circuit on the crankshaft position sensor wiring harness (Pin 1 of Connector J-183) and the battery voltage. Is the test light on?	—	Go to step 9	Go to step 14

Step	Measure	Rated value	Yes	No
9	1. Turn on the ignition device and stop the engine. 2. Connect the test lamp between the signal circuit on the crankshaft position sensor wiring harness (Pin 2 of Connector J-183) and the battery voltage. Is the test light on?	—	Go to step 15	Go to step 10
10	1. Turn on the ignition device and stop the engine. 2. Connect the diagnosis and maintenance monitor (DMM) between the signal circuit on the crankshaft position sensor (Pin 2 of Connector J-183) and the effective grounding line. Is the diagnostic maintenance monitor voltage larger than the specified rated value?	IV	Go to step 16	Go to step 17
11	**Key attentions:** If a voltage source of the sensor's low reference circuit is short-circuit, ECM may be damaged. 1. Check the low reference circuit between ECM (Pin 98 of Connector B-233) and the crankshaft position sensor (Pin 1 of Connector J-183) for short circuit to the battery or ignition voltage. 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 22	Go to step 21
12	1. Check the low reference circuit between ECM (Pin 98 of Connector B-233) and the crankshaft position sensor (Pin 1 of Connector J-183) for open circuit or high resistance. 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 22	Go to step 18
13	**Key attentions:** If a voltage source of the shielded grounding circuit is short-circuit, ECM may be damaged. 1. Check the shielded grounding circuit between ECM (Pin 101 of Connector B-233) and the crankshaft position sensor (Pin 3 of Connector J-183) for short circuit to the battery or the ignition switch. 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 22	Go to step 21

Step	Measure	Rated value	Yes	No
14	1. Check the shielded grounding circuit between ECM (Pin 101 of Connector B-233) and the crankshaft position sensor (Pin 3 of Connector J-183) for open circuit or high resistance. 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 22	Go to step 18
15	1. Test the following state of the signal circuit between the ECM (B-233 joint pin 90) and the crankshaft position sensor (J-183 joint pin 2): • Grounded short circuit • Low reference voltage short circuit. • Shield grounding wire short circuit 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 22	Go to step 21
16	**Key attentions:** If a voltage source in the sensor signal circuit is short-circuit, the crankshaft position sensor may be damaged. 1. Test the following state of the signal circuit between the ECM (B-233 joint pin 90) and the crankshaft position sensor (J-183 joint pin 2): • Battery or ignition voltage short circuit • 5V reference voltage short circuit 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 22	Go to step 21
17	1. Turn off the ignition device. 2. Check the crankshaft position sensor connector (Pins 1, 2 and 3 of Connector J-183) for disconnection or poor connection. 3. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 22	Go to step 20
18	1. Turn off the ignition device. 2. Disconnect the ECM joint. 3. Check the crankshaft position sensor circuit at ECM connector (Pins 90, 98, and 101 of Connector B-233) for disconnection or poor connection. 4. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 22	Go to step 21

Step	Measure	Rated value	Yes	No
19	1. Check the crankshaft position sensor for tensioning. If the sensor is loosened, please readjust it. 2. Dismantle the crankshaft position sensor, and check for its damage, existence of metal particles on the magnet, and flywheel appearance damage. Has the case been found and corrected?	—	Go to step 22	Go to step 20
20	Crankshaft position sensor replacement. Please refer to the contents of “crankshaft position sensor replacement” in the chapter. Has the replacement been completed?	—	Go to step 22	—
21	**Key attentions:** **The engine control module (ECM) shall be replaced as per the procedures.** Replace the engine control module (ECM). Please refer to the contents of “ECM replacement” in this chapter. Has the replacement been completed?	—	Go to step 22	—
22	1. Connect all the previously disconnected joints. 2. Clear the DTC using Tech2 scanning tool. 3. Turn off the ignition device for 30s. 4. Starting engine 5. Monitor the DTC information using Tech2 scanning tool. Does DTC ignition fail?	—	Go to step 3	Go to step 23
23	Observe the DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P0335 (Trouble symptom codeE) (flash code 43)

Circuit instructions

The crankshaft position sensor is located at the top of the flywheel housing. Based on the signal from the crankshaft position sensor, ECM measures the engine speed and the exact position of the crankshaft. If ECM detects the engine overspeed, DTC will be reset.

DTC running conditions

• The ignition switch is on.

Set DTC conditions.

• ECM detects that the engine speed is above 5700 RPM within 0.2s.

DTC resetting method:

• When the diagnosis fails, ECM MIL will flash as an indicator.

Diagnostic Trouble Code P0335 (Trouble symptom codeE) (flash code 43)

• The ECM cuts off fuel injection.

Clear the conditions of the MIL/DTC (diagnostic trouble code):

• The engine control module turns off the malfunction indicator light in case of diagnosis failure.

• The historical record of DTC will be cleared after 40 circles of continuous failure-free operation. Or clear using Tech2 scanning tool.

Diagnostic aid

• Ensure that the tightness of the sensor is good and the flywheel surface is not damaged.

Caution:

• DTC is caused by the engine overspeed due to the driver's disoperation (eg, shift the low-speed gear in the manual transmission on a steep slope), to ensure that there is no damage on the engine appearance. Excessive engine speed may cause the damage to internal parts.

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Starting engine 3. Observe the engine speed parameter using Tech2 scanning tool. 4. Accelerate the engine while observing Tech2 multiple times alternately in idle state and full valve opening state (accelerator pedal full-range). Is the engine speed parameter larger than the specified rated value?	5000RPM	Go to step 4	Go to step 3
3	Consult the driver about overspeed causes in gear disengagement, shift error, or high speed on downhill and ECT. If the engine is overspeeded, must check it and repair it as necessary. Is the operation completed?	—	Go to step 7	—
4	1. Remove the crankshaft position sensor. Please refer to the contents of “crankshaft position sensor replacement” in the chapter. 2. Measure the crankshaft position sensor for the followings: • Appearance damage • Occurrence of loosening • Improper installation Has the case been found and corrected?	—	Go to step 7	Go to step 5
5	Visually check the flywheel appearance for damage? Is any damage found and repaired?	—	Go to step 7	Go to step 6

Step	Measure	Rated value	Yes	No
6	**Key attentions:** **The engine control module (ECM) shall be replaced as per the procedures.** Replace the engine control module (ECM). Please refer to the contents of "ECM replacement" in this chapter. Has the replacement been completed?	—	Go to step 7	—
7	1. Connect all previously disconnected connectors. 2. Clear the DTC using Tech2 scanning tool. 3. Turn off the ignition device for 30s. 4. Starting engine 5. Use Tech2 scanning tool to observe the engine speed parameters. 6. Accelerate the engine in several times between idle and throttle full opening status (fully apply the accelerator pedal), while observe Tech2 scanning tool. Is the engine speed parameter larger than the specified rated value?	5000RPM	Go to step 4	Go to step 8
8	Observe the DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the "Diagnostic Trouble Code (DTC) Catalog".	System normal

P0380 (Trouble symptom code4) (flash code 66)

Circuit instructions

The ECM controls the glow indicator to supply power to the glow plug according to the ECT. The glow indicator light doesn't flash in the afterglow stage, but the glow plug can still run for a certain period of time. If ECM detects that the preheater indicator control circuit is open circuit or short circuit to the ground, DTC will be reset.

DTC running conditions

• The ignition switch is ON.

Set DTC conditions.

• If ECM detects a low voltage on the preheater indicator control circuit and lasts for more than 3s, the relay will be turned off.

DTC resetting method:

·When the diagnosis fails, MIL on ECM will flash as an indicator.

Clear the conditions of the MIL/DTC (diagnostic trouble code):

• When the diagnosis fails, ECM will turn off MIL.

• The history record of DTCs will be cleared after 40 cycles of consecutive trouble-free operations. Or clear using Tech2 scanning tool.

Caution:

• When the preheater indicator is OFF, the ignition device is ON and the engine is shutdown. At this point, the ECT is up to 30°C(86°F).

• When the preheater indicator is OFF, and the engine is operated, ECT is up to 30°C (86°F).

Diagnostic Trouble CodeP0380 (Trouble symptom code4) (flash code 66)

Graphic reference: engine control illustration

Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Measure	Rated value	Yes	No
1	Are the systematic tests on the engine control unit completed?	—	Go to step 2	Perform the systematic tests for diagnosis engine control unit.
2	1. Tech2 scanning tool. 2. Turn on the ignition device and stop the engine. 3. Use Tech2 scan tool to complete the preheater indicator test. 4. Turn on the glow indicator using Tech2 scanning tool. Does the glow indicator make ticking sound when turned on using Tech2 scanning tool?	—	Go to the diagnostic aid procedure	Go to step 3
3	1. Ignition device 2. Replace the preheater indicator with the relay or other relays with better performances. 3. Turn on the ignition device and stop the engine. 4. Turn on the glow indicator using Tech2 scanning tool. Does the preheater indicator send a “Tick” sound when the preheater indicator is opened with TeCh2 scanning tool?	—	Go to step 10	Go to step 4
4	1. Ignition device 2. Preheater indicator. 3. Connect the test lamp between the power supply circuit on the preheater indicator coil (Pin 4 of Connector X-20) and the effective grounding line. 4. Turn on the ignition device and stop the engine. Is the test light on?	—	Go to step 5	Go to step 7

Step	Measure	Rated value	Yes or no	
5	1. Ignition device 2. Connect the test lamp between the control circuit of the preheater indicator (Pin 5 of Connector X-20) and the battery voltage. 3. Turn on the ignition device and stop the engine. Does the test lamp flash (if ECT is below 30°C [86°F], does the test lamp flash and is OFF normally)?	—	Go to step 8	Go to step 6
6	1. Ensure the test lamp is connected properly. 2. Turn on the glow indicator using Tech2 scanning tool. Is the test light on when turned on using Tech2 scanning tool?	—	Go to step 10	Go to step 9
7	Repair the power supply circuit with open circuit or high resistance between ECM main relay (Pin 5 of Connector X-14) and the preheater indicator (Pin 4 of Connector X-20). Has the maintenance been completed?	—	Go to step 14	—
8	1. Check the preheater indicator control circuit between ECM (Pin 94 of Connector B-233) and the preheater indicator (Pin 5 of Connector X-233) for short circuit to the ground? 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 14	Go to step 13
9	1. Check the preheater indicator control circuit between ECM (Pin 94 of Connector B-233) and the preheater indicator (Pin 5 of Connector X-20) for open circuit or high resistance. 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 14	Go to step 11
10	1. Turn off the ignition device. 2. Check the preheater indicator connector (Pins 4 and 5 of Connector X-20) for disconnection or poor connection. 3. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 14	Go to step 12
11	1. Turn off the ignition device. 2. Disconnect the ECM joint. 3. Check the preheater indicator control circuit at ECM connector (Pin 94 of Connector B-233) for disconnection or poor connection. 4. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 14	Go to step 13

Step	Measure	Rated value	Yes	No
12	Dismantle the glow indicator. Has the replacement been completed?	_	Go to step 14	—
13	**Key attentions:** **The engine control module (ECM) shall be replaced as per the procedures.** Replace the engine control module (ECM). Please refer to the contents of "ECM replacement" in this chapter. Has the replacement been completed?	—	Go to step 14	—
14	1. Connect any previously disconnected relay or connector. 2. Clear the DTC using Tech2 scanning tool. 3. Turn off the ignition device for 30s. 4 Start and preheat the engine (allow ECT up to at least 35℃ [95℉]). 5. Use Tech2 scanning too to monitor DTC information. Does DTC ignition fail?	—	Go to step 2	Go to step 15
15	Observe the DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the "Diagnostic Trouble Code (DTC) Catalog".	System normal

P0380 (Trouble symptom code8) (flash code 66)

Circuit instructions

The ECM controls the glow indicator to supply power to the glow plug according to the ECT. The glow indicator light doesn't flash in the afterglow stage, but the glow plug can still run for a certain period of time. If ECM detects that the preheater indicator control circuit is short circuit to the battery or the ignition switch, DTC will be reset.

DTC running conditions

• The ignition switch is on.

Set DTC conditions.

• If ECM detects that the high voltage on the preheater indicator control circuit lasts for more than 1s, the relay will be opened.

DTC resetting method:

• When the diagnosis fails, ECM MIL will flash as an indicator.

Clear the conditions of the MIL/DTC (diagnostic trouble code):

• The engine control module turns off the malfunction indicator light in case of diagnosis failure.

• The historical record of DTC will be cleared after 40 circles of continuous failure-free operation. Or clear using Tech2 scanning tool.

Caution:

• When the preheater indicator is OFF, the ignition device is ON and the engine is shutdown. At this point, the ECT is up to 30°C(86°F).

• When the preheater indicator is OFF, the engine is operated, and the engine coolant temperature is up to 30°C (86°F).

Diagnostic Trouble CodeP0380 (Trouble symptom code8) (flash code 66)

Graphic reference: engine control illustration

Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn on the ignition device and stop the engine. 3. Complete the glow indictor test using Tech2 scanning tool. 4. Turn on the glow indicator using Tech2 scanning tool. Does the glow indicator make ticking sound when turned on using Tech2 scanning tool?	—	Go to the diagnostic aid procedure	Go to step 3
3	1. Turn off the ignition device. 2. Replace the preheater indicator with a starter relay or other relay with better performances. 3. Turn on the ignition device and stop the engine. 4. Turn on the glow indicator using Tech2 scanning tool. Does the glow indicator make ticking sound when turned on using Tech2 scanning tool?	—	Go to step 5	Go to step 4

Step	Measure	Rated value	Yes	No
4	1. Check the preheater indicator control circuit between ECM (Pin 94 of Connector B-233) and the preheater indicator (Pin 5 of Connector X-20) for short circuit to the battery or the ignition switch. 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 7	Go to step 6
5	Dismantle the glow indicator. Has the replacement been completed?	—	Go to step 7	—
6	**Key attentions:** **The engine control module (ECM) shall be replaced as per the procedures.** Replace the engine control module (ECM). Please refer to the contents of "ECM replacement" in this chapter. Has the replacement been completed?	—	Go to step 7	—
7	1. Connect all the previously disconnected relays or joints. 2. Clear the DTC using Tech2 scanning tool. 3. Turn off the ignition device for 30s. 4. If necessary, cool the engine and preheat (the ECT is allowed to reach at least 25℃ [77℉]). 5. Starting engine 6. Monitor the DTC information using Tech2 scanning tool. Does DTC ignition fail?	—	Go to step 2	Go to step 8
8	Observe the DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the "Diagnostic Trouble Code (DTC) Catalog".	System normal

P0381 (Trouble symptom code4) (flash code 67)

Circuit instructions

The glow indicator light is installed on the dashboard. When the ECT is low so as to facilitate engine starting, the preheating control system can be used. When the ECT is low, if the ignition switch is ON, the ECM will turn on the glow indicator light and glow plug. The ECM will turn off the glow indicator light and glow plug after a certain period of time. The ECM monitors the control circuit of the glow indicator light and thus decides the existence of improper operation or not according to the command state. If ECM detects that the preheater indicator control circuit is open circuit or short circuit to the ground, DTC will be reset.

DTC running conditions

• The ignition switch is on.

Set DTC conditions.

• If ECM detects that the low voltage on the preheater indicator control circuit lasts for more than 3s, the indicator will be turned off.

DTC resetting method:

• When the diagnosis fails, ECM MIL will flash as an indicator.

Clear the conditions of the MIL/DTC (diagnostic trouble code):

• The engine control module turns off the malfunction indicator light in case of diagnosis failure.

• The historical record of DTC will be cleared after 40 circles of continuous failure-free operation. Or clear using Tech2 scanning tool.

Diagnostic aid

• If there is an operation breakage, please see “Operation Breakage” in this section.

Caution:

• When the glow indictor light is turned off, the ignition device is on and the engine is off. At this point, the ECT is up to 30°C(86°F).

Diagnostic Trouble CodeP0381 (Trouble symptom code4) (flash code 67)

Graphic reference: engine control illustration

Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn on the ignition device and stop the engine. 3. Complete the glow indictor test using Tech2 scanning tool. 4. Turn on the glow indicator using Tech2 scanning tool. Is the glow indicator light in ON state when turned on using Tech2 scanning tool?	—	Go to step 3	Go to step 4
3	Use Tech2 scanning tool to turn off the preheater indicator. Is the flow indicator light off?	—	Go to step 17	Go to step 10
4	1. Turn off the ignition device. 2. Check the instrument (10A) fuse (F-16) on the glove fuse box. Is the meter (10A) fuse (F-16) open?	—	Go to step 5	Go to step 6

Step	Measure	Rated value	Yes	No
5	Replace the instrument (10A) fuse (F-16). If the fuse is always in ON state, repair for the short circuit of a circuit grounding wire connected with the instrument (10A) fuse (F-16) or replace the component shorted and connected with the instrument (10A) fuse (F-16). Has the maintenance been completed?	—	Go to step 19	—
6	1. Turn off the ignition device. 2. Disconnect the ECM joint. 3. Turn on the ignition device and stop the engine. 4. Connect the fused 3A jumper between the preheater indicator control circuit on ECM connector (Pin 43 of Connector B-234) and the effective grounding line. Is the flow indicator light off?	—	Go to step 11	Go to step 7
7	1. Turn off the ignition device. 2. Remove the dashboard. 3. Remove the preheat indicator bulb from the dashboard. Is the preheater indicator turned off?	—	Go to step 15	Go to step 8
8	1. Disconnect the joint B-51 on the dashboard. 2. Connect the test lamp between the power supply circuit on the preheater indicator (Pin 8 of Connector B-51) and the effective grounding line. 3. Turn on the ignition device and stop the engine. Is the test light on?	—	Go to step 9	Go to step 12
9	1. Turn off the ignition device. 2. Reconnect ECM connector. 3. Connect the test lamp between the power supply circuit and the control circuit of the preheater indicator (Pins 6 and 8 of Connector B-51). 4. Turn on the ignition device and stop the engine. 5. Complete the glow indictor test using Tech2 scanning tool. 6. Turn on the glow indicator using Tech2 scanning tool. Is the test lamp turned on when the preheater indicator is turned on with Tech2 scanning tool?	—	Go to step 14	Go to step 13
10	1. Check the preheater indicator control circuit between ECM (Pin 43 of Connector B-234) and the dashboard for short circuit to the ground. 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 19	Go to step 18

Step	Measure	Rated value	Yes	No
11	1. Turn off the ignition device. 2. Disconnect the ECM joint. 3. Check the preheater indicator control circuit at ECM connector (Pin 43 of Connector B-234) for disconnection or poor connection. 4. Repair the connection as necessary. Has the case been found and corrected?	—	Go to step 19	Go to step 18
12	Repair the open circuit or high resistance on the power supply circuit between the dashboard (Pin 8 of Connector B-51) and instrument fuse (10A) fuse (F-16). Has the maintenance been completed?	—	Go to step 19	—
13	1. Repair the open circuit or high resistance on the preheater indicator between ECM (Pin 43 of Connector B-234) and the dashboard (Pin 6 of Connector B-51). 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 19	—
14	1. Turn off the ignition device. 2. Check the preheat indicator supply circuit on the dashboard (Pins 6 and 8 of Connector B-51) for disconnection or poor connection. 3. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 19	Go to step 16
15	Replace the preheater indicator bulb. Has the replacement been completed?	—	Go to step 19	—
16	Repair or replace the dashboard (instrument assembly. Has the replacement been completed?	—	Go to step 19	—
17	1. Turn off the ignition device for 30s. 2. Turn on the ignition device for 30s and stop the engine. 3. Monitor the DTC information using Tech2 scanning tool. Does DTC ignition fail?	—	Go to step 18	Go to the diagnostic aid procedure
18	**Key attentions:** **The engine control module (ECM) shall be replaced as per the procedures.** Replace the engine control module (ECM). Please refer to the contents of “ECM replacement” in this chapter. Has the replacement been completed?	—	Go to step 19	—

Step	Measure	Rated value	Yes	No
19	1. Connect all the previously disconnected relays or joints. 2. Clear the DTC using Tech2 scanning tool. 3. Turn off the ignition device for 30s. 4. Starting engine 5. Monitor the DTC information using Tech2 scanning tool. Does DTC ignition fail?	—	Go to step 2	Go to step 20
20	Observe the DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the "Diagnostic Trouble Code (DTC) Catalog".	System normal

P0381 (Trouble symptom code8) (flash code 67)

Circuit instructions

The glow indicator light is installed on the dashboard. When the ECT is low so as to facilitate engine starting, the preheating control system can be used. When the ECT is low, if the ignition switch is ON, the ECM will turn on the glow indicator light and glow plug. The ECM will turn off the glow indicator light and glow plug after a certain period of time. The ECM monitors the control circuit of the glow indicator light and thus decides the existence of improper operation or not according to the command state. If ECM detects that the preheater relay control circuit is short circuit to the battery or the ignition switch, DTC will be reset.

DTC running conditions

• The ignition switch is on.

Set DTC conditions.

• If ECM detects that the high voltage on the preheater indicator control circuit lasts for more than 1s, the indicator will be turned on.

DTC resetting method:

• When the diagnosis fails, ECM MIL will flash as an indicator.

Clear the conditions of the MIL/DTC (diagnostic trouble code):

• The engine control module turns off the malfunction indicator light in case of diagnosis failure.

• The historical record of DTC will be cleared after 40 circles of continuous failure-free operation. Or clear using Tech2 scanning tool.

Diagnostic aid

• If there is an operation breakage, please see “Operation Breakage” in this section.

Caution:

• When the glow indictor light is turned off, the ignition device is on and the engine is off. At this point, the ECT is up to 30°C(86°F).

Test description

The following serial numbers refer to step serial numbers in the diagnosis table.

3. If the preheater indicator control circuit between ECM and the dashboard is in normal condition but the control circuit voltage is low, DTCP0381 (TSC 4) will be reset.

Diagnostic Trouble CodeP0381 (Trouble symptom code8) (flash code 67)

Graphic reference: engine control illustration

Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn on the ignition device and stop the engine. 3. Use Tech2 scan tool to complete the preheater relay test. 4. Turn on the glow indicator using Tech2 scanning tool. Is the glow indicator light in ON state when turned on using Tech2 scanning tool?	—	Go to the diagnostic aid procedure	Go to step 3
3	1. Turn off the ignition device. 2. Remove the dashboard to disconnect the dashboard connector B-51. 3. Disconnect the joint B-51 on the dashboard. 4. Turn on the ignition device for 30s and stop the engine. 5. Monitor the DTC information using Tech2 scanning tool. Is DTC P0381 (TSC 4) reset, but is DTC P0381 (TSC 8) not reset?	—	Go to step 5	Go to step 4

Step	Measure	Rated value	Yes	No
4	1. Check the preheater indicator control circuit between ECM (Pin 43 of Connector B-234) and the dashboard (Pin 6 of Connector B-51) for short circuit to the battery or the ignition switch. 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 7	Go to step 6
5	Repair or replace the dashboard (instrument assembly. If the repair or replacement completed?	—	Go to step 7	—
6	**Key attentions:** **The engine control module (ECM) shall be replaced as per the procedures.** Replace the engine control module (ECM). Please refer to the contents of "ECM replacement" in this chapter. Has the replacement been completed?	—	Go to step 7	—
7	1. Connect all the previously disconnected joints. 2. Clear the DTC using Tech2 scanning tool. 3. Turn off the ignition device for 30s. 4. If necessary, cool the engine and preheat (the ECT is allowed to reach at least 25℃ [77℉]). 5. Turn on the ignition device and stop the engine. 6. Monitor the DTC information using Tech2 scanning tool. Does DTC ignition fail?	—	Go to step 2	Go to step 8
8	Observe the DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the "Diagnostic Trouble Code (DTC) Catalog".	System normal

P0400 (Trouble symptom code3) (flash code 32)

Circuit instructions

The ECM controls EGR flow rate according to engine speed, ECT), intake air temperature, air pressure and fuel injection quantity. The ECM controls the EGR valve by controlling the EGR solenoid valve. The air flow sensor monitors the EGR flow rate. When the engine is in running state, test whether the air flow rate is up to the predetermined rated value. If ECM detects that the actual air flow is below the predicted value, DTC will be reset. This indicates too large EGR gas flow rate.

DTC running conditions

• The ignition switch is on.
• The engine is running.
• The air pressure range is from 880hPa to 1100hPa.
• The IAT range is 16°C(61°F)~34°C(93°F).
• The ECT range is 70(158°F)~100(211°F).

Set DTC conditions.

• ECM detects that the actual air flow is 150 mg/strk below the predicted value and lasts over 60s. This indicates too large EGR gas flow rate.

DTC resetting method:

• When the diagnosis fails, ECM MIL will flash as an indicator.
• The ECM limits fuel injection quantity.

Clear the conditions of the MIL/DTC (diagnostic trouble code):

• The engine control module turns off the malfunction indicator light in case of diagnosis failure.
• The historical record of DTC will be cleared after 40 circles of continuous failure-free operation. Or clear using Tech2 scanning tool.

Diagnostic aid

• If there is an operation breakage, please see “Operation Breakage” in this section.
• If the exhaust recirculation valve has stickiness or its stickiness is instable, this may also lead to re-setting of DTC.
• The vacuum tube with improper pathway may also lead to re-setting of DTC.

Diagnostic Trouble CodeP0400 (Trouble symptom code3) (flash code 32)

Graphic reference: engine control illustration

Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition device for 30s. 3. Start the engine and run it idly for 30s. 4. Use Tech2 scanning tool to monitor DTC information. Is DTC P0100 (TSC 7, 9, B or C) or TO400 (TSC 4 or 8) reset?	—	Perform applicable DTC.	Go to step 3
3	1. Install Tech2 scanning tool. 2. Turn off the ignition device for 30s. 3. Start the engine and preheat (the ECT is allowed to reach at least 75℃ [167°F]). 4. Complete the EGR solenoid valve test using Tech2 scanning tool. 5. Send out the commands of opening and closing the EGR solenoid valve using Tech2 while observing the air flow sensor parameter. Will the air flow sensor parameter decrease by 200mg/srtk within 2s when the EGR solenoid valve receives an opening command?	—	Go to the diagnostic aid procedure	Go to step 4

Step	Measure	Rated value	Yes	No
4	1. Turn off the ignition device. 2. Check the following: • Check the exhaust recirculation valve control vacuum hose for damage or kinking. • Check the exhaust recirculation solenoid valve vacuum hose and vent hose for damage or kinking. • Check the exhaust recirculation valve for opening. • Check the exhaust system for any restriction. • Check the air flow sensor for leakage or the sensor housing for any build-ups. • Check the intake hose between the air flow sensor and the intake manifold for leakage. • Check whether the turbocharger turbine shaft rotation speed is too low caused by the shaft twisting. See the turbocharger diagnosis in the engine mechanical section. • Check the air hose between air filter elements, air filter or turbocharger for restriction or shrinkage. • The air flow sensor signal is inaccurate as the air pipeline contains oil. When there is oil sludge in the pipeline, it is needed to wipe the intercooler and turbocharger. • Contaminated, deflected or slow air flow sensor. 3. Repair or replace as necessary. Has the case been found and corrected?	—	Go to step 10	Go to step 5
5	1. Turn off the ignition device. 2. Dismantle the control vacuum pipe from the EGR valve. 3. Connect the handheld vacuum pump (5-8840-0279-0/J-23738-A) onto the disconnected vacuum tube. 4. Start the engine and run it idly. 5. Complete the EGR solenoid valve test using Tech2 scanning tool. 6. Complete the EGR solenoid valve opening/closing command using Tech2 scanning tool. Does the handheld vacuum pump show “>50cmHg(20inHg)” when the command is ON. Does the handheld vacuum pump show “<10cmHg(20inHg)” when the command is OFF?	—	Go to step 6	Go to step 9

Step	Measure	Rated value	Yes	No
6	1. Turn off the ignition device. 2. Disconnect hand-held vacuum pump and vacuum tube. 3. Connect the handheld vacuum pump to the vacuum inlet of the EGR valve. 4. Start the engine and run it idly. 5. Apply the vacuum pressure to the exhaust recirculation valve and observe the air flow sensor parameters. Does the air flow sensor parameter decrease by at least 200mg/strk after exerting vacuum pressure?	—	Go to the diagnostic aid procedure	Go to step 7
7	1. Turn off the ignition device. 2. Disconnect the air flow sensor joint. 3. Check the air flow sensor connector (Pins 2, 4 and 5 of Connector J-182) for disconnection or poor connections. 4. Disconnect the ECM joint. 5. Check the air flow sensor circuit at ECM connector (Pins 83 and 88 of Connector B-233) for disconnection or poor connection. 6. Test whether the air flow sensor circuit has high resistance. 7. Check the intake temperature sensor on the air flow sensor signal circuit for short circuit. 8. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 10	Go to step 8
8	Replace the EGR valve. Please refer to the contents of “EGR valve replacement” in the chapter “engine machinery”. Has the replacement been completed?	—	Go to step 10	—
9	Replace the EGR solenoid valve. Please refer to the contents of “EGR solenoid valve replacement” in the chapter. Has the replacement been completed?	—	Go to step 10	—
10	1. Connect all the previously disconnected joints. 2. Clear the DTC using Tech2 scanning tool. 3. Turn off the ignition device for 30s. 4. Start and preheat the engine (allow ECT up to at least 75℃ [187℉]) and observe the air flow parameters with Tech2 scanning tool. Is the air flow sensor parameter in line with the predicted rated value, i.e. within the range of ≤50mg/strk?	—	Go to step 11	Go to step 2
11	Observe the DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P0400 (Trouble symptom code4) (flash code 32)

Circuit instructions

The ECM controls EGR flow rate according to engine speed, ECT), intake air temperature, air pressure and fuel injection quantity. The ECM controls the EGR valve by controlling the EGR solenoid valve. The air flow sensor monitors the EGR flow rate. When the engine is in running state, test whether the air flow rate is up to the predetermined rated value. If ECM detects that the exhaust recirculation solenoid valve control circuit is open circuit or short circuit to the ground, DTC will be reset.

DTC running conditions

• The ignition switch is on.

Set DTC conditions.

• If ECM detects that the low voltage on the exhaust recirculation solenoid valve control circuit lasts for more than 3s, the indicator will be turned off.

DTC resetting method:

• When the diagnosis fails, ECM MIL will flash as an indicator.

• The ECM limits fuel injection quantity.

Clear the conditions of the MIL/DTC (diagnostic trouble code):

• The engine control module turns off the malfunction indicator light in case of diagnosis failure.

• The historical record of DTC will be cleared after 40 circles of continuous failure-free operation. Or clear using Tech2 scanning tool.

Diagnostic aid

• If there is an operation breakage, please see “Operation Breakage” in this section.

Diagnostic Trouble CodeP0400 (Trouble symptom code4) (flash code 32)

Graphic reference: engine control illustration

Joint end face view reference: engine control joint end

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition device for 30s. 3. Starting engine 4. Monitor the DTC information using Tech2 scanning tool. Does DTC ignition fail?	—	Go to step 3	Go to the diagnostic aid procedure
3	1. Turn off the ignition device. 2. Dismantle the EGR control solenoid valve joint. 3. Connect the test lamp between the voltage supply circuit of the exhaust recirculation control solenoid valve wiring harness (Pin 1 of Connector J-105) and the effective grounding line. 4. Turn on the ignition device and stop the engine. Is the test light on?	—	Go to step 4	Go to step 6
4	1. Connect the test lamp between the control circuit of the exhaust recirculation solenoid valve wiring harness (Pin 2 of Connector J-105) and the battery voltage. 2. Use Tedi2 scanning tool to complete the exhaust recirculation solenoid valve test. 3. Use Tech2 scanning tool to open the exhaust recirculation solenoid valve. Is the test light on when turned on using Tech2 scanning tool?	—	Go to step 5	Go to step 7

Step	Measure	Rated value	Yes	No
5	Use Tech2 scanning tool to close the exhaust recirculation solenoid valve. When it is closed with Tech2 scanning tool, the test lamp will flash continuously as in Step 4 (the test lamp will flash slightly when the close command is received and the circuit is normal).	—	Go to step 8	Go to step 9
6	Repair the open circuit or high resistance on the power supply circuit between ECM main relay (Pin 5 of Connector X-14) and the exhaust recirculation solenoid valve (Pin 1 of Connector J-105). Have you completed maintenance?	—	Go to step 13	—
7	1. Check the control circuit between ECM (Pin 97 of Connector B-233) and the exhaust recirculation solenoid valve (Pin 2 of Connector J-105) for open circuit or high resistance. 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 13	Go to step 10
8	1. Check the control circuit between ECM (Pin 97 of Connector B-233) and the exhaust recirculation solenoid valve (Pin 2 of Connector J-105) for short circuit to the ground. 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 13	Go to step 12
9	1. Turn off the ignition device. 2. Dismantle the EGR control solenoid valve joint. 3. Check the exhaust recirculation control solenoid valve connector (Pins 1 and 2 of Connector J-105) for disconnection or poor connection. 4. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 13	Go to step 11
10	1. Turn off the ignition device. 2. Disconnect the ECM joint. 3. Check the exhaust recirculation solenoid valve control circuit at ECM connector (Pin 97 of Connector B-233) for disconnection or poor connection. 4. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 13	Go to step 12

Step	Measure	Rated value	Yes	No
11	Replace the EGR solenoid valve. Please refer to the contents of “EGR solenoid valve replacement” in the chapter. Has the replacement been completed?	—	Go to step 13	—
12	**Key attentions:** **The engine control module (ECM) shall be replaced as per the procedures.** Replace the engine control module (ECM). Please refer to the contents of “ECM replacement” in this chapter. Has the replacement been completed?	—	Go to step 13	—
13	1. Connect all the previously disconnected joints. 2. Clear the DTC using Tech2 scanning tool. 3. Turn off the ignition device for 30s. 4. Starting engine 5. Monitor the DTC information using Tech2 scanning tool. Does DTC ignition fail?	—	Go to step 3	Go to step 14
14	Observe the DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P0400 (Trouble symptom code5) (flash code 32)

Circuit instructions

The ECM controls EGR flow rate according to engine speed, ECT), intake air temperature, air pressure and fuel injection quantity. The ECM controls the EGR valve by controlling the EGR solenoid valve. The air flow sensor monitors the EGR flow rate. When the engine is in running state, test whether the air flow rate is up to the predetermined rated value. If ECM detects that the actual air flow is above its predicted value, DTC will be reset. This indicates too small EGR gas flow rate.

DTC running conditions

• The ignition switch is on.
• The engine is running.
• The air pressure range is from 880hPa to 1100hPa.
• The IAT range is 16°C(61°F)~34°C(93°F).
• The ECT range is 70(158°F)~100(211°F).

Set DTC conditions.

• ECM detects that the air flow is 150 mg/strk above the predicted value and lasts longer than 60s. This indicates too small EGR gas flow rate.

DTC resetting method:

• When the diagnosis fails, ECM MIL will flash as an indicator.
• The ECM limits fuel injection quantity.

Clear the conditions of the MIL/DTC (diagnostic trouble code):

• The engine control module turns off the malfunction indicator light in case of diagnosis failure.
• The historical record of DTC will be cleared after 40 circles of continuous failure-free operation. Or clear using Tech2 scanning tool.

Diagnostic aid

• If there is an operation breakage, please see “Operation Breakage” in this section.
• If the exhaust recirculation valve has stickiness or its stickiness is instable, this may also lead to re-setting of DTC.
• The vacuum tube with improper pathway may also lead to re-setting of DTC.
• The vacuum tube fault can also cause DTC to be reset.

Diagnostic Trouble CodeP0400 (Trouble symptom code5) (flash code 32)

Graphic reference: engine control illustration

Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Perform the diagnosis system test for the engine control unit
2	1. Install Tech2 scanning tool. 2. Turn off the ignition device for 30s. 3. Start the engine and run it idly for 30s. 4. Monitor the DTC information using Tech2 scanning tool. Is DTC P0100 (TSC 7, 9, B or C) or P0400 (TSC 4 or 8) reset?	—	Perform applicable DTC.	Go to step 3
3	1. Install Tech2 scanning tool. 2. Turn off the ignition device for 30s. 3. Start the engine and preheat (the ECT is allowed to reach at least 75℃ [167℉]). 4. Complete the EGR solenoid valve test using Tech2 scanning tool. 5. Send out the commands of opening and closing the EGR solenoid valve using Tech2 while observing the air flow sensor parameter. Will the air flow sensor parameter decrease by 200mg/srtk within 2s when the EGR solenoid valve receives an opening command?	—	Go to the diagnostic aid procedure	Go to step 4

Step	Measure	Rated value	Yes	No
4	1. Turn off the ignition device. 2. Check the following: • Check the exhaust recirculation valve control vacuum tube for damage or kinking. • Check the exhaust recirculation solenoid valve control vacuum tube and vent tube for damage or kinking. • Check the exhaust recirculation valve for closing. • Check the exhaust recirculation passage between the exhaust manifold and the exhaust recirculation valve for restriction or shrinkage. • Check the vacuum tube of the vacuum pump for damage or kinking. • Check the vacuum pump for damage. • The air flow sensor signal is inaccurate as the air pipeline contains oil. When there is oil sludge in the pipeline, it is needed to wipe the intercooler and turbocharger. • Contaminated or deflected air flow sensor. 3. Repair or replace as necessary. Has the case been found and corrected?	—	Go to step 10	Go to step 5
5	1. Turn off the ignition device. 2. Dismantle the control vacuum pipe from the EGR valve. 3. Connect the handheld vacuum pump (5-8840-0279-0/J-23738-A) onto the disconnected vacuum tube. 4. Start the engine and run it idly. 5. Complete the EGR solenoid valve test using Tech2 scanning tool. 6. Complete the EGR solenoid valve opening/closing command using Tech2 scanning tool. Does the handheld vacuum pump show “>50cmHg(20inHg)” when the command is ON. Does the handheld vacuum pump show “<10cmHg(20inHg)” when the command is OFF?	—	Go to step 6	Go to step 9
6	1. Turn off the ignition device. 2. Disconnect the vacuum tube from the handheld vacuum pump. 3. Connect the handheld vacuum pump to the vacuum inlet of the EGR valve. 4. Start the engine and run it idly. 5. Apply the vacuum pressure to the exhaust recirculation valve and observe the intake flow sensor parameters. Does the air flow sensor parameter decrease by at least 200mg/strk after exerting vacuum pressure?	—	Go to the diagnostic aid procedure	Go to step 7

Step	Measure	Rated value	Yes	No
7	1. Turn off the ignition device. 2. Disconnect the air flow sensor joint. 3. Check the air flow sensor connector (Pin 3 of Connector J-182) for disconnection or poor connection. 4. Disconnect the ECM joint. 5. Check the air flow sensor circuit at ECM connector (Pin 92 of Connector B-233) for disconnection or poor connection. 6. Test whether the air flow sensor circuit has high resistance. 7. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 10	Go to step 8
8	Replace the EGR valve. Please refer to the contents of "EGR valve replacement" in the chapter "engine machinery". Has the replacement been completed?	—	Go to step 10	—
9	Replace the EGR solenoid valve. Please refer to the contents of "EGR solenoid valve replacement" in the chapter. Has the replacement been completed?	—	Go to step 10	—
10	1. Connect all the previously disconnected joints. 2. Clear the DTC using Tech2 scanning tool. 3. Turn off the ignition device for 30s. 4. Start and preheat the engine (allow ECT up to at least 75°C [167°F]) and observe the air flow sensor parameters with Tech2 scanning tool. Is the air flow sensor parameter in line with the predicted rated value, i.e. within the range of ≤50mg/strk?	—	Go to step 11	Go to step 2
11	Observe the DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the "Diagnostic Trouble Code (DTC) Catalog".	System normal

P0400 (Trouble symptom code8) (flash code 32)

Circuit instructions

The ECM controls EGR flow rate according to engine speed, ECT), intake air temperature, air pressure and fuel injection quantity. The ECM controls the EGR valve by controlling the EGR solenoid valve. The air flow sensor monitors the EGR flow rate. When the engine is in running state, test whether the air flow rate is up to the predetermined rated value. If ECM detects that the exhaust recirculation solenoid valve control circuit is short circuit to the voltage or the ignition voltage, DTC will be reset.

DTC running conditions

• The ignition switch is on.

Set DTC conditions.

• If ECM detects that the high voltage on the exhaust recirculation solenoid valve control circuit lasts for more than 3s, the solenoid valve will be turned off.

DTC resetting method:

• When the diagnosis fails, ECM MIL will flash as an indicator.

• The ECM limits fuel injection quantity.

Clear the conditions of the MIL/DTC (diagnostic trouble code):

• The engine control module turns off the malfunction indicator light in case of diagnosis failure.

• The historical record of DTC will be cleared after 40 circles of continuous failure-free operation. Or clear using Tech2 scanning tool.

Diagnostic aid

• If there is an operation breakage, please see “Operation Breakage” in this section.

Test description

The following serial numbers refer to step serial numbers in the diagnosis table.

3. If the exhaust recirculation solenoid valve control circuit between ECM and the solenoid valve is in normal condition and the control circuit voltage is low, DTCP0400 will be reset.

Diagnostic Trouble CodeP0400 (Trouble symptom code8) (flash code 32)

Graphic reference: engine control illustration

Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition device for 30s. 3. Start the engine and preheat (the ECT is allowed to reach at least 75℃ [167℉]). 4. Monitor the DTC information using Tech2 scanning tool. Does DTC ignition fail?	—	Go to step 3	Go to the diagnostic aid procedure
3	1. Turn off the ignition device. 2. Dismantle the EGR control solenoid valve joint. 3. Starting engine 4. Monitor the DTC information using Tech2 scanning tool. Is DTC P0400 (TSC 4) reset, but is DTC P0400 (TSC 8) not reset?	—	Go to step 5	Go to step 4

Step	Measure	Rated value	Yes	No
4	1. Check the control circuit between ECM (Pin 97 of Connector B-233) and the exhaust recirculation solenoid valve (Pin 2 of Connector J-105) for short circuit to the battery or the ignition switch. 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 7	Go to step 6
5	Replace the EGR solenoid valve. Please refer to the contents of “EGR solenoid valve replacement” in the chapter. Has the replacement been completed?	—	Go to step 7	—
6	**Key attentions:** **The engine control module (ECM) shall be replaced as per the procedures.** Replace the engine control module (ECM). Please refer to the contents of “ECM replacement” in this chapter. Has the replacement been completed?	—	Go to step 7	—
7	1. Connect all the previously disconnected joints. 2. Clear the DTC using Tech2 scanning tool. 3. Turn off the ignition device for 30s. 4. Start the engine and preheat (the ECT is allowed to reach at least 75℃ [167℉]). 5. Monitor the DTC information using Tech2 scanning tool. Does DTC ignition fail?	—	Go to step 3	Go to step 8
8	Observe the DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P0500 (TSC 1 and A) (FC 24)

Circuit instructions

The vehicle speed sensor is used for the ECM and speedometer, and the ECM and speedometer generate the speed signals from the transmission output shaft. The vehicle speed sensor is fitted with the following circuits:

• Ignition voltage supply circuit
• Vehicle speed sensor signal circuit
• Vehicle speed sensor low reference circuit

The vehicle speed sensor has a Hall effect component. It interacts with the magnetic field of a rotary magnet to generate rectangular wave pulse signals. The ECM calculates the vehicle driving speed via the vehicle speed sensor. If ECM detects that the vehicle speed sensor signal frequency is high, DTC will be reset.

DTC running conditions

• The ignition switch is on.

Set DTC conditions.

ECM detects that the engine speed is above 190km/h (119MPH) with 5s.
(Trouble symptom code 1)

• ECM detects that the vehicle speed sensor signal frequency is too high in 0.6s.Trouble symptom code A

DTC resetting method:

• The engine control module will not turn on the malfunction indicator light in case of diagnosis failure.
• ECM uses a 5km/h (3MPH) vehicle speed as an alternative for engine control.

Clear the conditions of the DTC (diagnostic trouble code).

• The historical record of DTC will be cleared after 40 circles of continuous failure-free operation. Or clear using Tech2 scanning tool.

Diagnostic aid

• Electronic or magnetic interference may affect interruption conditions.
• If there is an operation breakage, please see “Operation Breakage” in this section.

DTC P0500 (TSCs 1 and A) (FC 24)

Graphic reference: engine control illustration

Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Check all circuits connected to the vehicle speed sensor the followings: • Too close to the fuel injection solenoid valve or the element. • Too close to the fitting on electrical equipment. • Too close to the solenoid, relay and motor. 2. If the connection path is wrong, please correct it. Has the case been found and corrected?	—	Go to step 7	Go to step 3
3	1. Turn off the ignition device. 2. Disconnect the vehicle speed sensor joint. 3. Check for disconnection or poor connection at the joint of the vehicle speed sensor (pins 1, 2 and 3 of joint j-32). 4. Repair the connection as necessary. Has the case been found and corrected?	—	Go to step 7	Go to step 4

Step	Measure	Rated value	Yes	No
4	1. Turn off the ignition device. 2. Disconnect the ECM joint. 3. Check the vehicle speed sensor circuit at ECM connector (Pin 68 of Connector B-234) for disconnection or poor connection. 4. Repair the connection as necessary. Has the case been found and corrected?	—	Go to step 7	Go to step 5
5	1. Dismantle the vehicle speed sensor. Please refer to the contents of “vehicle speed sensor replacement” in the chapter. 2. Visually inspect the vehicle speed sensor and check the following: • Appearance damage • Occurrence of loosening • Improper installation 3. The following conditions may cause DTC to be reset: • Electromagnetic interference on the vehicle speed sensor circuit 4. Repair or replace as necessary. Has the case been found and corrected?	—	Go to step 7	Go to step 6
6	Replace the vehicle speed sensor. Please refer to the contents of “vehicle speed sensor replacement” in the chapter. Has the replacement been completed?	—	Go to step 7	—
7	1. Connect all the previously disconnected joints. 2. Clear the DTC using Tech2 scanning tool. 3. Turn off the ignition device for 30s. 4. Drive the vehicle. 5. Observe the vehicle speed sensor parameter using Tech2 scanning tool. Does the vehicle speed parameter reflect accurate vehicle speed?	—	Go to step 8	Go to step 2
8	Observe the DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P0500 (Trouble symptom codeB) (flash code 24)

Circuit instructions

The vehicle speed sensor is used for the ECM and speedometer, and the ECM and speedometer generate the speed signals from the transmission output shaft. The vehicle speed sensor is fitted with the following circuits:

• Ignition voltage supply circuit
• Vehicle speed sensor signal circuit
• Vehicle speed Sensor Low reference circuit

The vehicle speed sensor has a Hall-effect component. It interacts with the magnetic field of a rotary magnet to generate rectangular wave pulse signals. The ECM calculates the vehicle driving speed via the vehicle speed sensor. If ECM detects that no vehicle speed sensor signal is generated, DTC will be reset.

DTC running conditions

• The ignition switch is on.
• The engine speed is more than 3600RPM.
• fuel injection quantity more than 0.00oz/strk

Set DTC conditions.

• ECM detects that the vehicle speed is below 1.5km/h (1MPH) and lasts for 60s.

DTC resetting method:

• The engine control module will not turn on the malfunction indicator light in case of diagnosis failure.

Clear the conditions of the DTC (diagnostic trouble code).

• The historical record of DTC will be cleared after 40 circles of continuous failure-free operation. Or clear using Tech2 scanning tool.

Diagnostic aid

• Electronic or magnetic interference may affect interruption conditions.
• If there is an operation breakage, please see “Operation Breakage” in this section.

Diagnostic Trouble CodeP0500 (Trouble symptom codeB) (flash code 24)

Graphic reference: engine control illustration

Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Drive the vehicle. 3. Observe the vehicle speed sensor parameter using Tech2 scanning tool. Does the vehicle speed parameter reflect accurate vehicle speed?	—	Go to the diagnostic aid procedure	Go to step 3
3	1. Turn off the ignition device. 2. Check the instrument (10A) fuse (F-16) on the glove fuse box. Replace the instrument (10A) fuse (F-16).	—	Go to step 4	Go to step 5
4	Replace the instrument (10A) fuse (F-16). If the fuse is always in ON state, repair for the short circuit of a circuit grounding wire connected with the instrument (10A) fuse (F-16) or replace the component shorted and connected with the instrument (10A) fuse (F-16). Has the maintenance been completed?	—	Go to step 18	—

Step	Measure	Rated value	Yes	No
5	1. Dismantle the vehicle speed sensor. Please refer to the contents of "vehicle speed sensor replacement" in the chapter. 2. Visually inspect the vehicle speed sensor and check the following: • Appearance damage • Occurrence of loosening • Improper installation • Transmission output shaft gear rack damage 3. Repair or replace as necessary. Has the case been found and corrected?	—	Go to step 18	Go to step 6
6	1. Turn off the ignition device. 2. Disconnect the vehicle speed sensor joint. 3. Connect the test lamp between the ignition voltage supply circuit on the vehicle speed sensor (Pin 1 of Connector J-32) and the effective grounding line. 4. Turn off the ignition device and stop the engine.	—	Go to step 7	Go to step 9
7	1. Turn on the ignition switch. 2. Connect the test lamp between the ignition voltage supply circuit and the low reference voltage on the vehicle speed sensor wiring harness (Pins 1 and 2 of Connector J-32) Is the test light on?	—	Go to step 8	Go to step 10
8	1. Turn off the ignition device and stop the engine. 2. Connect the signal circuit of the vehicle speed sensor (Pin 3 of Connector J-32) intermittently and connect the test lamp on the sensor to the effective grounding line, and use Tedi2 scanning tool to monitor vehicle speed parameters. Is the vehicle speed shown on Tech2 scanning tool when the circuit falls to the ground from time to time?	—	Go to step 12	Go to step 11
9	1. Check the ignition voltage supply circuit between the vehicle speed sensor (Pin 1 of Connector J-32) and the dashboard (Pin 3 of Connector B-55) for open circuit or high resistance and check the circuit between the dashboard (Pin 8 of Connector B-51) the and instrument (10A) fuse (F-16) for open circuit or high resistance. 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 18	Go to step 13
10	Repair the open circuit or high resistance on the low reference circuit between the vehicle speed sensor (Pin 2 of Connector J-32) and the grounded terminal (Port B-7). Have you completed maintenance?	—	Go to step 18	—

Step	Measure	Rated value	Yes	No
11	1. Check the vehicle speed sensor signal circuit between ECM (Pin 68 of Connector B-234) and the intake temperature sensor (Pin 3 of Connector J-32) for the followings. • Open circuit • Grounded short circuit • Battery or ignition voltage short circuit • High resistance 2. Repair the circuit as necessary. Has the case been found and corrected?	—	Go to step 18	Go to step 14
12	1. Turn off the ignition device. 2. Disconnect the vehicle speed sensor joint. 3. Check for disconnection or poor connection at the joint of the vehicle speed sensor (pins 1, 2 and 3 of joint j-32). 4. Repair the connection as necessary. Has the case been found and corrected?	—	Go to step 18	Go to step 15
13	1. Turn off the ignition device. 2. Disconnect Connectors B-51 and B-55 on dashboard. 3. Check the dashboard connector (Pin 8 of Connector B-51) for disconnection or poor connection. 4. Repair the connection as necessary. Has the case been found and corrected?	—	Go to step 18	Go to step 16
14	1. Turn off the ignition device. 2. Disconnect the ECM joint. 3. Check the air flow sensor circuit at ECM connector (Pin 68 of Connector B-233) for disconnection or poor connection. 4. Repair the connection as necessary. Has the case been found and corrected?	—	Go to step 18	Go to step 17
15	Replace the vehicle speed sensor. Please refer to the contents of “vehicle speed sensor replacement” in the chapter. Has the replacement been completed?	—	Go to step 18	—
16	Repair or replace the dashboard (instrument assembly. Please see the instrument replacement in the electrical section. Has the replacement been completed?	—	Go to step 18	—
17	**Key attentions:** **The engine control module (ECM) shall be replaced as per the procedures.** Replace the engine control module (ECM). Please refer to the contents of “ECM replacement” in this chapter. Has the replacement been completed?	—	Go to step 18	—

Step	Measure	Rated value	Yes	No
18	1. Connect all the previously disconnected relays or joints. 2. Clear the DTC using Tech2 scanning tool. 3. Turn off the ignition device for 30s. 4. Drive the vehicle. 5. Observe the vehicle speed sensor parameter using Tech2 scanning tool. Does the vehicle speed parameter reflect accurate vehicle speed?	—	Go to step 19	Go to step 3
19	Observe the DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the "Diagnostic Trouble Code (DTC) Catalog".	System normal

P0560 (Trouble symptom code1) (flash code 35)

Circuit instructions

The ECM monitors the system voltage on the main relay load power supply port and controls the voltage to be within the reasonable range. If ECM detects that the system voltage is too high, DTC will be reset.

Set DTC conditions.

• ECM detects that the battery circuit voltage is greater than 20V.

DTC resetting method:

• The engine control module will not turn on the malfunction indicator light in case of diagnosis failure.

Clear the conditions of the DTC (diagnostic trouble code).

• The historical record of DTC will be cleared after 40 circles of continuous failure-free operation. Or clear using Tech2 scanning tool.

Diagnostic aid

• Charging system failure may lead to re-setting of DTC.

• Starting the vehicle or installing the battery charger may lead to re-setting of DTC.

Diagnostic Trouble CodeP0560 (Trouble symptom code1) (flash code 35)

Graphic reference: engine control diagram, and starting and charging diagram

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition device for 30s. 3. Starting engine 4. Monitor the DTC information using Tech2 scanning tool. Does DTC ignition fail?	—	Go to step 3	Go to the diagnostic aid procedure
3	Is the system voltage up to 24V when the vehicle is started?	—	Go to step 8	Go to step 4
4	1. Start the engine and run it idly for 30s. 2. Observe the DTC information using Tech2 scanning tool. Is the system voltage parameter less than the specified rated value?	16V	Go to the diagnostic aid procedure	Go to step 5
5	Test the charging system. Refer to the contents of “charging system diagnosis” in the chapter “charging system”. Is any charging system fault identified?	—	Go to step 6	Go to step 7
6	Repair the charging system. Refer to the contents of “charging system diagnosis” in the chapter “charging system”. Have you completed maintenance?	—	Go to step 8	—
7	**Key attentions:** Replace ECM with the procedural steps. Replace the engine control module (ECM). Please refer to the contents of “ECM replacement” in this chapter. Has the replacement been completed?	—	Go to step 8	—

Step	Measure	Rated value	Yes	No
8	1. Connect all the previously disconnected joints. 2. Clear the DTC using Tech2 scanning tool. 3. Turn off the ignition device for 30s. 4. Starting engine 5. Observe the DTC information using Tech2 scanning tool. Is the system voltage parameter less than the specified rated value?	16V	Go to step 9	Go to step 5
9	Observe the DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P0560 (Trouble symptom code2) (flash code 35)

Circuit instructions

The ECM monitors the system voltage on the main relay load power supply port and controls the voltage to be within the reasonable range. If ECM detects that the system voltage is too low, DTC will be reset.

Set DTC conditions.

• ECM detects that the battery circuit voltage is less than 7V.

DTC resetting method:

• The engine control module will not turn on the malfunction indicator light in case of diagnosis failure.

Clear the conditions of the DTC (diagnostic trouble code).

• The historical record of DTC will be cleared after 40 circles of continuous failure-free operation. Or clear using Tech2 scanning tool.

Diagnostic aid

• If there is an operation breakage, please see "Operation Breakage" in this section.

• Charging system failure may lead to re-setting of DTC.

Diagnostic Trouble CodeP0560 (Trouble symptom code2) (flash code 35)

Graphic reference: engine control diagram, and starting and charging diagram

Connector end view reference: ECM connector end view

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition device for 30s. 3. Starting engine 4. Monitor the DTC information using Tech2 scanning tool. Does DTC ignition fail?	—	Go to step 3	Go to the diagnostic aid procedure
3	1. Start the engine and run it idly for 30s. 2. Load the circuit system by turning on headlights, A/C, etc. 3. Observe the DTC information using Tech2 scanning tool. Is the system voltage parameter more than the specified rated value?	10V	Go to the diagnostic aid procedure	Go to step 4
4	Test the charging system. Refer to the contents of "charging system diagnosis" in the chapter "charging system". Is any charging system fault identified?	—	Go to step 5	Go to step 6
5	Repair the charging system. Refer to the contents of "charging system diagnosis" in the chapter "charging system". Have you completed maintenance?	—	Go to step 8	—
6	1. Turn off the ignition device. 2. Disconnect the ECM joint. 3. Check the battery power circuit at ECM connector (Pin 3 of Connector B-234) for disconnection, poor connection, or corrosion. 4. Repair or clean up the connection as necessary. Has the case been found and corrected?	—	Go to step 8	Go to step 7

Step	Measure	Rated value	Yes	No
7	**Key attentions:** **The engine control module (ECM) shall be replaced as per the procedures.** Replace the engine control module (ECM). Please refer to the contents of "ECM replacement" in this chapter. Has the replacement been completed?	—	Go to step 8	—
8	1. Connect all the previously disconnected joints. 2. Clear the DTC using Tech2 scanning tool. 3. Turn off the ignition device for 30s. 4. Starting engine 5. Load the circuit system by turning on headlights, A/C, etc. 6. Observe the DTC information using Tech2 scanning tool. Is the system voltage parameter more than the specified rated value?	10V	Go to step 9	Go to step 4
9	Observe the DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the "Diagnostic Trouble Code (DTC) Catalog".	System normal

DTC P0560 (TSC A) (FC 35)

Circuit instructions

The fuel injection pump control unit is used to monitor the system voltage on the main relay load voltage port of ECM within a reasonable range. If ECM detects that the system voltage is too high or low, DTC will be reset.

Set DTC conditions.

• The fuel injection pump control unit detects that the battery supply circuit voltage is less than 4.5V or greater than 27V.

DTC resetting method:

• The engine control module will not turn on the malfunction indicator light in case of diagnosis failure.

Clear the conditions of the DTC (diagnostic trouble code).

• The historical record of DTC will be cleared after 40 circles of continuous failure-free operation. Or clear using Tech2 scanning tool.

Diagnostic aid

• If there is an operation breakage, please see "Operation Breakage" in this section.

• Charging system failure may lead to re-setting of DTC.

• Starting the vehicle or installing the battery charger may lead to re-setting of DTC.

Caution:

• The fuel injection pump control device is part of the fuel injection pump assy.

DTC P0560 (TSC A) (FC 35)

Graphic reference: engine control diagram, and starting and charging diagram

Joint end face view reference: engine control joint end face view

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition device for 30s. 3. Starting engine 4. Monitor the DTC information using Tech2 scanning tool. Is DTC P0560 (TSC 1 or 2) reset?	—	Perform applicable DTC.	Go to step 3
3	1. Start the engine and run it idly for 30s. 2. Monitor the DTC information using Tech2 scanning tool. Does DTC ignition fail?	—	Go to step 4	Go to the diagnostic aid procedure
4	1. Turn off the ignition device. 2. Disconnect the fuel injection pump control unit connector. 3. Check the supply voltage circuit at the fuel injection pump control unit connector (Pins 6 and 7 of Connector E-110) or grounding line for disconnection, poor connection or corrosion. 4. Repair or clean up the connection as necessary. Has the case been found and corrected?	—	Go to step 6	Go to step 5

Step	Measure	Rated value	Yes	No
5	**Key attentions:** The fuel injection pump shall be synchronous with the engine. Replace the fuel injection pump. Please refer to the contents of “fuel injection pump replacement” in the chapter “engine machinery”. Has the replacement been completed?	—	Go to step 6	—
6	1. Connect all the previously disconnected joints. 2. Clear the DTC using Tech2 scanning tool. 3. Turn off the ignition device for 30s. 4. Start the engine and run it idly for 30s. 5. Monitor the DTC information using Tech2 scanning tool. Does DTC ignition fail?	—	Go to step 2	Go to step 7
7	Observe the DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P0561 (TSC A) (FC 18)

Circuit instructions

ECM main relay is energized when ECM receives "ON" signal of the ignition voltage switch. The ECM main relay is powered off after the ignition is OFF for a certain period of time. During power-on, DTC will be reset if ECM detects that the ignition voltage switch signal is changed to "OFF".

Set DTC conditions.

• During initialization, ECM detects that the ignition voltage circuit is changed from ON to OFF.

Operation steps performed while setting DTC

• ECM does not turn on MIL when diagnosis operation fails.

• After 1s from the fault identification, if the ignition voltage circuit is in "OFF" condition, ECM will be turned off.

• After 1s from the fault identification, if the ignition voltage circuit is returned in "ON" condition, ECM will limit the fuel injection amount.

Clear DTC conditions

• Clear the original DTC after performing continuously 40 times of transmission cycles favorably. Or clear DTC using Tech2 scanning tool.

Diagnostic aid

• If there is a gap, see "Gap Conditions" in this section.

• In the event of ECM main relay fault or contact sticking, DTC can be set.

Caution:

• If the ignition switch is changed quickly and continuously between "ON" and "OFF", DTC will be reset.

Test description

For the following numbers, please refer to step serial numbers in the diagnosis table.

2. If DTCP1625 (TSC B) appears when the ignition switch is turned off, Tech2 scanning tool can signal ECM.

DTCP0561 (TSC A) (FC 18)

Graphic reference: engine control illustration

Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. Monitor DTC information using Tech2 scanning tool. Is DTCP1625 set (TSC B)?	—	Perform applicable DTC.	Go to step 3
3	1. Turn off the ignition switch 2. Disconnect the wiring harness connector (B-67) from the ignition switch (located behind the steering column). 3. Check the ignition switch wiring harness connector (Pins 2 and 3 of Connector B-67) for gap, poor contact, and corrosion. 4. Repair the junction as necessary. Have the above cases been found and corrected?	—	Go to step 6	Go to step 4

Step	Measure	Rated value	Yes	No
4	1. Turn off the ignition switch 2. Disconnect the ECM joint. 3. Check the ignition power supply circuit of ECM wiring harness connector (Pin 39 of Connector B-234) for gap, poor contact, and corrosion. 4. Check the ignition power supply circuit for high resistance. 5. If necessary, repair the connector or wiring harness. Have the above cases been found and corrected?	—	Go to step 6	Go to step 5
5	Replace the ignition switch. Has the replacement work been completed?	—	Go to step 6	—
6	1. Reconnect the disconnected connector. 2. Clear DTC using Tech2 scanning tool. 3. Turn off the ignition switch for 30s. 4. Starting engine 5. Monitor DTC information using Tech2 scanning tool. 6. Turn off the ignition switch Does DTC ignition fail before ECM is turned off?	—	Go to step 2	Go to step 7
7	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P0561 (TSC B) (FC 18)

Circuit instructions

ECM main relay will be energized when ECM receives “ON” signal of the ignition voltage switch. After a period of time since the ignition switch is OFF, ECM main relay is in the release period. DTC will be set if ECM detects that the ignition voltage switch signal is changed to “OFF” during power-on.

Set DTC conditions.

• During initialization, ECM detects that the ignition voltage circuit is changed from “ON” to “OFF”

DTCP0561 (TSC B) (FC 18)

Operation steps performed while setting DTC

• ECM will not turn on MIL when the diagnosis operation fails.

• Turn off ECM.

Clear DTC conditions

• Clear the original DTC after performing continuously 40 times of transmission cycles favorably. Or clear DTC using Tech2 scanning tool.

Diagnostic aid

• If there may be a gap, see “Gap Conditions” in this section.

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. The engine flames out. Turn on the ignition switch. 4. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to step 4
3	**Key points:** ECM replacement must be programmed. Replace the ECM. See “ECM Replacement” in this section. Has the replacement work been completed?	—	Go to step 4	—
4	1. Clear DTC using Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. Starting engine 4. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to step 5
5	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P0602
Notes
If ECM detects a non-programmed VIN, ECM can set a DTC.
Diagnostic aid

Caution:
• Unless the calibration software is updated, do not require software programming when ECM is replaced in the production and use. DTC indicates that VIN is not programmized for ECM production or use.
DTCP0602

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. The engine flames out. Turn on the ignition switch. 4. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to step 6
3	**Key points:** The blank ECM must be programmed. For ECM programming, see “ECM Replacement” in this section. Is the programming completed?	—	Go to step 4	—
4	1. Clear DTC using Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. The engine flames out. Turn on the ignition switch. 4. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 5	Go to step 7
5	**Key points:** ECM replacement must be programmed. Replace the ECM. See “ECM Replacement” in this section. Has the replacement work been completed?	—	Go to step 6	—
6	1. Clear DTC using Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. Starting engine 4. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to step 7
7	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P0606 (Trouble symptom code A and B) (flash code 28)
Notes
This diagnosis applies to the complete internal microprocessor in ECM.
DTC running conditions
Trouble symptom code B
• The accelerator pedal position is less than 1°%.
• The expected fuel injection amount is 0 mg/strk.
Set DTC conditions.
Trouble symptom code A
• ECM detects that there is no response in the internal CPU.

DTCP0606 (Trouble symptom code A and B) (flash code 28)
Trouble symptom code B
• ECM detects that the engine speed is greater than 2000rpm.
Operation steps performed while setting DTC
• ECM will turn on MIL when diagnosis operation fails.
• ECM cuts off fuel injection.
Clear MIL/DTC conditions
• The ECM turns off the malfunction indicator light in case of favorable diagnosis operation.
• Clear the original DTC after performing continuously 40 times of transmission cycles favorably. Or clear DTC using Tech2 scanning tool.

Step	Operating steps	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. Starting engine 4. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to step 4
3	**Key points:** ECM replacement must be programmed. Replace the ECM. See “ECM Replacement” in this section. Has the replacement work been completed?	—	Go to step 4	—
4	1. Clear DTC using Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. Starting engine 4. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to step 5
5	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P0645 (Trouble symptom code4) (flash code 46)

Circuit instructions

The ECU controls the relay of the A/C compressor; power is supplied to the A/C compressor clutch according to the input voltage needed by the ECM for the HVAC control device. The ECM orders the A/C compressor relay to be turned on when the engine is running. If ECM detects that the control circuit of the air conditioning compressor relay is open circuit or short circuit, DTC will be set.

DTC running conditions

• Ignition switch ON

• The air conditioning compressor relay is opened after a command is received.

Set DTC conditions.

• When the air conditioning compressor relay is closed with a command, ECM detects that there is still a low voltage current on the relay control circuit for more than 3s.

Operation steps performed while setting DTC

• The ECM turns on the malfunction indicator light in case of diagnosis operation failure.

Clear MIL/DTC conditions

• The ECM turns off the malfunction indicator light in case of favorable diagnosis operation.

• Clear the original DTC after performing continuously 40 times of transmission cycles favorably. Or clear DTC using Tech2 scanning tool.

Diagnostic aid

• If there may be a gap, see “Gap Conditions” in this section.

Caution:

• When the ECT is up to around 115(239°F) and the A/C compressor relay is ordered to restart at lower than 110°C(230°F), the relay is ordered to shut down.

DTCP0645 (trouble symptom code 4) (flash code 46)

Illustration reference: Engine control unit chart

Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Operating steps	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. Starting engine 4. Turn on the blower motor switch and A/C compressor switch. 5. Turn off the A/C compressor switch. 6. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to the diagnostic aid procedure
3	1. Turn off the ignition switch 2. Replace the A/C compressor relay with a marker lamp relay or a relay with good performance. 3. Start the engine and run it idly. 4. Turn on the blower motor switch and A/C compressor switch. 5. Turn off the A/C compressor switch. 6. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 4	Go to step 12

Step	Operating steps	Rated value	Yes	No
4	1. Turn off the ignition switch 2. Remove the air conditioning compressor relay. 3. Connect the test lamp to the power supply circuit at the air conditioning compressor relay coil side (Pin 4 of Connector X-24) and the effective grounding line. 4. The engine flames out. Turn on the ignition switch. Is the test light on?	—	Go to step 5	Go to step 7
5	1. Turn off the ignition switch 2. Connect the test lamp between the air conditioning compressor relay control circuit (Pin 2 of Connector X-24) and the battery power supply. 3. The engine flames out. Turn on the ignition switch. Is the test light turned on?	—	Go to step 8	Go to step 6
6	1. Power on the test lamp. 2. Starting engine 3. Turn on the blower motor switch and A/C compressor switch. Is the test lamp turned on when the air conditioning compressor relay is turned on?	—	Go to step 10	Go to step 9
7	Repair the open circuit or high resistance on the power supply circuit between ECM main relay (Pin 5 of Connector X-14) and the air conditioning compressor relay (Pin 4 of Connector X-24). Has the maintenance work been completed?	—	Go to step 14	—
8	1. Check the control circuit between ECM (Pin 41 of Connector B-234) and the air conditioning compressor relay (Pin 2 of Connector X-24) for short circuit to the ground. 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 14	Go to step 13
9	1. Check the control circuit between ECM (Pin 41 of Connector B-234) and the air conditioning compressor relay (Pin 2 of Connector X-24) for open circuit or high resistance. 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 14	Go to step 11
10	1. Turn off the ignition switch 2. Check the air conditioning compressor relay wiring terminals (Pins 2 and 4 of Connector X-24) for any gap or poor contact. 3. Repair the junction as necessary. Have the above cases been found and corrected?	—	Go to step 14	Go to step 12

Step	Operating steps	Rated value	Yes	No
11	1. Turn off the ignition switch 2. Disconnect the ECM joint. 3. Check the air conditioning compressor relay control circuit at ECM connector (Pin 41 of Connector B-234) for any gap or poor contact. 4. Repair the junction as necessary. Have the above cases been found and corrected?		Go to step 14	Go to step 13
12	Replace the A/C compressor. Has the replacement work been completed?	—	Go to step 14	—
13	**Key points:** ECM replacement must be programmed. Replace the ECM. See “ECM Replacement” in this section. Has the replacement work been completed?	—	Go to step 14	—
14	1. Reconnect the previously disconnected fuse, relay, or connector. 2. Clear DTC using Tech2 scanning tool. 3. Turn off the ignition switch for 30s. 4. Start the engine and run it idly. 5. Turn on the blower motor switch and A/C compressor switch. 6. Turn off the A/C compressor switch. 7. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to step 15
15	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P0645 (Trouble symptom code8) (flash code 46)

Circuit instructions

The ECU controls the relay of the A/C compressor; power is supplied to the A/C compressor clutch according to the input voltage needed by the ECM for the HVAC control device. The ECM orders the A/C compressor relay to be turned on when the engine is running. If ECM detects that the air conditioning compressor relay control circuit is short circuit to the battery or the ignition switch, DTC will be set.

DTC running conditions

• Ignition switch ON

• The air conditioning compressor relay is turned on with a command.

Set DTC conditions.

• When the air conditioning compressor relay is turned on with a command, ECM detects that there is a high voltage current on the relay control circuit for more than 3s.

Operation steps performed while setting DTC

• The ECM turns on the malfunction indicator light in case of diagnosis operation failure.

Clear MIL/DTC conditions

• The ECM turns off the malfunction indicator light in case of favorable diagnosis operation.

• Clear the original DTC after performing continuously 40 times of transmission cycles favorably. Or clear DTC using Tech2 scanning tool.

Diagnostic aid

• If there may be a gap, see “Gap Conditions” in this section.

Caution:

• When the ECT is up to around 115(239°F) and the A/C compressor relay is ordered to restart at lower than 110°C(230°F), the relay is ordered to shut down.

DTCP0645 (trouble symptom code 8) (flash code 46)

Graphic reference: engine control illustration

Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Operating steps	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. Starting engine 4. Turn on the blower motor switch and A/C compressor switch. 5. Monitor DTC information using Tech2 scanning tool when the A/C relay command parameter shows “ON”. DTC ignition failure?	—	Go to step 3	Go to the diagnostic aid procedure
3	1. Turn off the ignition switch 2. Replace the A/C compressor relay with a marker lamp relay or a relay with good performance. 3. Starting engine 4. Turn on the blower motor switch and A/C compressor switch. 5. Monitor DTC information using Tech2 scanning tool when the A/C relay command parameter shows “ON”. DTC ignition failure?	—	Go to step 4	Go to step 5

Step	Operating steps	Rated value	Yes	No
4	1. Check the control circuit between ECM (Pin 41 of Connector B-234) and the air conditioning compressor relay (Pin 2 of Connector X-24) for short circuit to the battery or the ignition switch. 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 7	Go to step 6
5	Replace the A/C compressor. Has the replacement work been completed?	—	Go to step 7	—
6	**Key points:** ECM replacement must be programmed. Replace the ECM. See “ECM Replacement” in this section. Has the replacement work been completed?	—	Go to step 7	—
7	1. Re-connect the previously disconnected relays or joints. 2. Clear DTC using Tech2 scanning tool. 3. Turn off the ignition switch for 30s. 4. Starting engine 5. Turn on the blower motor switch and A/C compressor switch. 6. Monitor DTC information using Tech2 scanning tool when the A/C relay command parameter shows “ON”. DTC ignition failure?	—	Go to step 3	Go to step 8
8	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P0703 (Trouble symptom codeA and B) (flash code 25)

Circuit instructions

The brake pedal switch is installed on the brake pedal bracket. Brake pedal 1 switch is a normally open switch, and brake pedal 2 switch is a normally close switch. While depressing the brake pedal, the ECM will receive the signal from the brake pedal 1 switch , and turn on the stop light. Afterwards, the signal (low voltage) transmitted by the brake pedal switch 2 to the ECM is stopped. If ECM detects that there is no correlation among the brake switch signals, DTC will be set.

DTC running conditions

• Ignition switch ON
• The engine speed is over 1500rpm.
• The accelerator pedal position exceeds 10 °%.
• The vehicle peed is over 15km/h (9MPH).

Set DTC conditions.

• After the ignition switch is turned on, ECM detects that there is a signal switching error between the brake pedal 1 switch (normally opened switch) and the brake pedal 2 switch (normally closed switch) for more than 30s under practicable conditions. (Trouble symptom code A)
• ECM detects that there is signal switching error of more than 30s between the brake pedal 1 switch (normally opened switch) and the brake pedal 2 switch (normally closed switch). (Trouble symptom code B)

Operation steps performed while setting DTC

• The ECM turns on the malfunction indicator light in case of diagnosis operation failure.

Clear MIL/DTC conditions

• The ECM turns off the malfunction indicator light in case of favorable diagnosis operation.
• Clear the original DTC after performing continuously 40 times of transmission cycles favorably. Or clear DTC using Tech2 scanning tool.

Diagnostic aid

• If there may be a gap, see “Gap Conditions” in this section.
• If the brake pedal switch is not properly adjusted, DTC will be set.

DTCP0703 (Trouble symptom codeA and B) (flash code 25)

Graphic reference: engine control illustration

Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Operating steps	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. The engine flames out. Turn on the ignition switch. 3. Use Tech2 scanning tool to monitor the brake pedal 1 switch parameters when the brake pedal is applied and then released. Are “Apply” and “Release” shown separately on Tech2 scanning tool when the brake pedal is applied and then released?	—	Go to step 10	Go to step 3
3	1. Check the brake pedal switch and ensure correct adjustment. When the brake pedal is released, the plunger should always be maintained inside, but should not obstruct the return stroke. 2. Adjust the brake pedal switch as needed. Have the above cases been found and corrected?	—	Go to step 20	Go to step 4
4	1. Turn off the ignition switch 2. Check the parking light (10A) fuse (F-5) in glove compartment fuse box. Is the parking light (10A) fuse (F-5) blown?	—	Go to step 5	Go to step 6

Step	Operating steps	Rated value	Yes	No
5	Replace the parking light (10A) fuse (F-5). If the fuse is still blown, repair the shorted parking light (10A) fuse (F-5) wiring, or replace the shorted parking light (10A) fuse (F-5) accessories. Has the maintenance work been completed?	—	Go to step 20	—
6	1. Turn off the ignition switch 2. Disconnect the joint of the brake pedal switch. 3. Connect the test lamp between the power supply circuit of the brake pedal 1 switch wiring harness (Pin 1 of Connector B-66) and the effective grounding line. Is the test light turned on?	—	Go to step 7	Go to step 8
7	1. The engine flames out. Turn on the ignition switch. 2. The 3A safety jumper temporarily bridge-connects the brake pedal 1 switch joint between pins 1 and 4 of B-66 joint; in addition, the parameter of the brake pedal 1 switch is monitored using Tech2 scanning tool. Are “Apply” and “Release” shown on Tech2 scanning tool respectively when the circuit is jumpered and not jumpered?	—	Go to step 16	Go to step 9
8	Repair the short circuit or high-resistance of the power supply circuit between the parking light (10A) fuse (F-5) and the brake pedal 1 switch (Pin of Connector B-66). Has the maintenance work been completed?	—	Go to step 20	—
9	1. Check brake pedal 1 switch signal circuit between ECM (Pin 30 of Connector B-234) and brake pedal 1 switch (Pin 4 of Connector B-66) for the followings: • Open circuit • Shorting of battery or ignition switch • High resistance 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 20	Go to step 17
10	Apply the brake pedal to the end and release it and use Tech2 scanning tool to monitor the brake pedal 2 switch parameters. Are “Apply” and “Release” shown on Tech2 scanning tool respectively when the brake pedal is applied and released?	—	Go to the diagnostic aid procedure	Go to step 11
11	1. Check the brake pedal switch and ensure correct adjustment. When the brake pedal is released, the plunger should always be maintained inside, but should not obstruct the return stroke. 2. Adjust the brake pedal switch as needed. Have the above cases been found and corrected?	—	Go to step 20	Go to step 12

Step	Operating steps	Rated value	Yes	No
12	1. Turn off the ignition switch 2. Disconnect the joint of the brake pedal switch. 3. The engine flames out. Turn on the ignition switch. 4. Connect the test lamp between the power supply circuit of the brake pedal 2 switch wiring harness (Pin 2 of Connector B-66) and the effective grounding line. Is the test light turned on?	—	Go to step 13	Go to step 14
13	1. The engine flames out. Turn on the ignition switch. 2. The 3A safety jumper temporarily bridge-connects the brake pedal 2 switch joint between pins 2 and 3 of B-66 joint; in addition, the parameter of the brake pedal 2 switch is monitored using Tech2 scanning tool. Are “Apply” and “Release” shown on Tech2 scanning tool respectively when the circuit is jumpered and not jumpered?	—	Go to step 16	Go to step 15
14	Repair the open circuit or high resistance on the power supply circuit between ECM main relay (Pin 5 of Connector X-14) and the brake pedal 2 switch (Pin 2 of Connector B-66). Has the maintenance work been completed?	—	Go to step 20	—
15	1. Check the brake pedal 2 switch signal circuit between ECM (Pin 65 of Connector B-234) and the brake pedal 2 switch (Pin 3 of Connector B-66) for the followings: • Open circuit • Shorting of battery or ignition switch • High resistance 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 20	Go to step 17
16	1. Turn off the ignition switch 2. Disconnect the joint of the brake pedal switch. 3. Check the brake pedal switch connector (Pins 1, 2, 3, 4 of Connector B-66) for any gap and poor contact. 4. Repair the junction as necessary. Have the above cases been found and corrected?	—	Go to step 20	Go to step 18
17	1. Turn off the ignition switch 2. Disconnect the ECM joint. 3. Check the brake switch circuit of ECM connector (Pins 30 and 65 of Connector B-234) for any gap and poor contact. 4. Repair the junction as necessary. Have the above cases been found and corrected?	—	Go to step 20	Go to step 19
18	Replace the brake pedal switch. See “Brake Switch Replacement” in this section. Has the replacement work been completed?	—	Go to step 20	—

Step	Operating steps	Rated value	Yes	No
19	**Key points:** Replace ECM with programmed steps. Replace the ECM. See “ECM Replacement” in this section. Has the replacement work been completed?	—	Go to step 20	—
20	1. Re-connect the previously disconnected fuses or joints. 2. Clear DTC using Tech2 scanning tool. 3. The engine flames out. Turn on the ignition switch. 4. Apply the brake pedal to the end and release it and use Tech2 scanning tool to monitor the brake pedal 1 switch and the brake pedal 2 switch. Are “Apply” and “Release” shown on Tech2 scanning tool respectively when the brake pedal is applied and released?	—	Go to step 21	Go to step 2
21	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P0704 (Trouble symptom code6) (flash code 57)

Circuit instructions

The clutch pedal switch is mounted on the clutch pedal bracket and it is a normally closed switch. When the clutch pedal is applied, the clutch pedal switch signal to ECM will stop (low pressure). If ECM detects that the clutch pedal switch signal is not changed within the predetermined speed range, DTC will be set. DTC runs only once each time of ignition cycle under feasible conditions.

DTC running conditions

• The ignition switch is "ON".

Set DTC conditions.

• The vehicle speed is changed within the range of 5km/h (3MPH) ~ 80km/h (50MPH), and ECM detects that the clutch pedal switch signal is not changed. DTC runs only once each time of ignition cycle under feasible conditions.

Operation steps performed while setting DTC

• The ECM turns on the malfunction indicator light in case of diagnosis operation failure.

Clear MIL/DTC conditions

• The ECM turns off the malfunction indicator light in case of favorable diagnosis operation.

• Clear the original DTC after performing continuously 40 times of transmission cycles favorably. Or clear DTC using Tech2 scanning tool.

Diagnostic aid

• If there may be a gap, see "Gap Conditions" in this section.

• Any improper adjustment of the brake pedal switch will cause DTC to be set.

DTCP0704 (Trouble symptom code6) (flash code 57)

Graphic reference: engine control illustration

Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Operating steps	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. The engine flames out. Turn on the ignition switch. 3. Apply the clutch pedal to the end and release it and use Tech2 scanning tool to monitor the clutch pedal switch parameters. Are "Apply" and "Release" shown on Tech2 scanning tool respectively when the brake pedal is applied and released?	—	Go to the diagnostic aid procedure	Go to step 3
3	1. Check the clutch pedal switch to ensure that it is properly adjusted. When the clutch pedal is release, the plunger should always be maintained inside, but should not obstruct the pedal return stroke. 2. If necessary, adjust the clutch pedal switch. Have the above cases been found and corrected?	—	Go to step 14	Go to step 4
4	1. Turn off the ignition switch 2. Disconnect the clutch pedal switch connector. 3. The engine flames out. Turn on the ignition switch. 4. Temporarily bridge the clutch pedal switch connector between Pins 1 and 2 of Connector B-89 and use Tech1 scanning tool to monitor the clutch pedal switch parameters. Are "Apply" and "Release" shown on Tech2 scanning tool respectively when the the circuit is jumpered and not jumpered?	—	Go to step 10	Go to step 5

Step	Operating steps	Rated value	Yes	No
5	1. Connect the test lamp between the power supply circuit of the clutch pedal switch wiring harness (Pin 1 of Connector B-89) and the effective grounding line. 2. The engine flames out. Turn on the ignition switch. Is the test light turned on?	—	Go to step 6	Go to step 7
6	1. Connect the test lamp between the signal circuit of the clutch pedal switch wiring harness (Pin 2 of Connector B-89) and the effective grounding line. 2. The engine flames out. Turn on the ignition switch. Is the test light turned on?	—	Go to step 8	Go to step 9
7	Repair the open circuit or high-resistance in the power supply circuit between ECM main relay (Pin 5 of Connector X-14) and the clutch pedal switch (Pin 2 of Connector B-89). Has the maintenance work been completed?	—	Go to step 14	—
8	1. Check the signal circuit between ECM (Pin 31 of Connector B-234) and the clutch pedal switch (Pin 2 of Connector B-89) for short circuit to the battery or the ignition switch. 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 14	Go to step 13
9	1. Check the signal circuit between ECM (Pin 31 of Connector B-234) and the clutch pedal switch (Pin 2 of Connector B-89) for open circuit or high resistance. 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 14	Go to step 11
10	1. Turn off the ignition switch 2. Check the wiring harness connector of the clutch pedal switch (Pins 1 and 2 of Connector B-89) for any gap and poor contact. 3. Repair the junction as necessary. Have the above cases been found and corrected?	—	Go to step 14	Go to step 12
11	1. Turn off the ignition switch 2. Disconnect the ECM harness joint. 3. Check the clutch pedal switch circuit at ECM wiring harness connector (Pin 31 of Connector B-234) for any gap and poor contact. 4. Repair the junction as necessary. Have the above cases been found and corrected?	—	Go to step 14	Go to step 13

Step	Operating steps	Rated value	Yes	No
12	Replace the clutch pedal switch.See “Clutch Pedal Switch Replacement” in this section. Has the replacement work been completed?	—	Go to step 14	—
13	**Key points:** ECM replacement must be programmed. Replace the ECM. See “ECM Replacement” in this section. Has the replacement work been completed?	—	Go to step 14	—
14	1. Re-connect the previously disconnected fuses or joints. 2. Clear DTC using Tech2 scanning tool. 3. The engine flames out. Turn on the ignition switch. 4. Apply the clutch pedal to the end and release it and use Tech2 scanning tool to monitor the clutch pedal switch parameters. Are “Apply” and “Release” shown on Tech2 scanning tool respectively when the brake pedal is applied and released?	—	Go to step 15	Go to step 3
15	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P1105 (Trouble symptom code1) (flash code 86)

Circuit instructions

The barometric pressure (BARO) sensor is mounted in ECM to convert the air pressure into the voltage signal. The ECM uses the voltage signal to calibrate the fuel injection quantity and fuel injection time limit. If ECM detects that BARO sensor signal voltage is too high, DTC will be set.

DTC running conditions

• Ignition switch (ON)

DTCP1105(trouble symptom code 1) (flash code 86)

Set DTC conditions.

• ECM finds that the signal voltage of the baroreceptor is over 4.4v, with the duration of 1s.

Operation steps performed while setting DTC

• The ECM turns on the malfunction indicator light in case of diagnosis operation failure.

• ECM uses 1013hPa air pressure for replacement.

Clear MIL/DTC conditions

• The ECM turns off the malfunction indicator light in case of favorable diagnosis operation.

• Clear the original DTC after performing continuously 40 times of transmission cycles favorably. Or clear DTC using Tech2 scanning tool.

Step	Operating steps	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. Starting engine 4. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to step 4
3	**Key points:** ECM replacement must be programmed. Replace the ECM. See “ECM Replacement” in this section. Has the replacement work been completed?	—	Go to step 4	—
4	1. Clear DTC using Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. Starting engine 4. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to step 5
5	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P1105 (Trouble symptom code2) (flash code 86)
Circuit instructions
The barometric pressure (BARO) sensor is mounted in ECM to convert the air pressure into the voltage signal. The ECM uses the voltage signal to calibrate the fuel injection quantity and fuel injection time limit. The ECM will set the DTC in case of finding too low signal voltage of the air pressure sensor through detection.
DTC running conditions
• Ignition switch (ON).
DTCP1105(trouble symptom code 2) (flash code 86)
Set DTC conditions.
• ECM finds that the signal voltage of the baroreceptor is over 1.5v, with the duration of 1s.
Operation steps performed while setting DTC
• The ECM turns on the malfunction indicator light in case of diagnosis operation failure.
• ECM uses 1013hPa air pressure for replacement.
Clear MIL/DTC conditions
• The ECM turns off the malfunction indicator light in case of favorable diagnosis operation.
• Clear the original DTC after performing continuously 40 times of transmission cycles favorably. Or clear DTC using Tech2 scanning tool.

Step	Operating steps	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. Starting engine 4. Use Tech2 scanning tool to monitor DTC information. DTC ignition failure?	—	Go to step 3	Go to step 4
3	**Key points:** ECM replacement must be programmed. Replace the ECM. See “ECM Replacement” in this section. Has the replacement work been completed?	—	Go to step 4	—
4	1. Clear DTC using Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. Starting engine 4. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to step 5
5	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P1110 (Trouble symptom code4) (flash code 72)
Circuit instructions
The ECM controls the exhaust brake. The brake excites the intake throttling solenoid valve and exhaust brake solenoid valve according to vehicle running situation. The ECM orders each solenoid valve to close all throttling valves as per vacuum pressure. The ECM will set the DTC in case of finding opening or grounded shorting of the control circuit of the intake throttling solenoid valve through detection.
DTC running conditions
• Ignition switch (ON). **Set DTC conditions.**
• When the intake throttle solenoid valve is closed with a command, ECM detects there is a low voltage current on the solenoid valve control circuit for more than 3s.
Operation steps performed while setting DTC
• The ECM turns on the malfunction indicator light in case of diagnosis operation failure.
Clear MIL/DTC conditions
• The ECM turns off the malfunction indicator light in case of favorable diagnosis operation.
• Clear the original DTC after performing continuously 40 times of transmission cycles favorably. Or clear DTC using Tech2 scanning tool.

Diagnostic aid
• If there may be a gap, see “Gap Conditions” in this section.
Test description
For the following numbers, please refer to step serial numbers in the diagnosis table.
5. If the solenoid valve control circuit between ECM and the intake throttle solenoid valve is normal, DTCP1110 (TSC 8) will be set.
DTCP1110(trouble symptom code 4) (flash code 72)
Graphic reference: engine control illustration
Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Operating steps	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. Starting engine 4. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to the diagnostic aid procedure
3	1. Turn off the ignition switch 2. Disconnect the intake air throttling solenoid valve harness joint. 3. Connect the test lamp between the power supply circuit of the intake throttle solenoid valve wiring harness (Pin 1 of Connector J-40) and the effective grounding line. Is the test light turned on?	—	Go to step 4	Go to step 6
4	1. Turn off the ignition switch 2. Connect the test lamp between the control circuits of the intake throttle solenoid valve wiring harness (Pin 2 of Connector J-40) with the battery voltage. 3. The engine flames out. Turn on the ignition switch. Is the test light turned on?	—	Go to step 8	Go to step 5

Step	Operating steps	Rated value	Yes	No
5	1. Use a 3A safety jumper to connect the intake throttle solenoid valve wiring harness connector between Pins 1 and 2 of Connector J-40. 2. Raise the driving wheel or drive the vehicle. 3. Use Tech2 scanning tool to monitor the intake throttle solenoid valve command parameters and allowing the vehicle in running, so as to apply the exhaust brake. Is DTCP1110 (TSC 8) set, instead of DTCP1110 (TSC 4) when applying the exhaust brake?	—	Go to step 9	Go to step 7
6	Repair the open circuit or high resistance on the power supply circuit between ECM main relay (Pin 14 of Connector X-14) and the intake throttle solenoid valve (Pin 1 of Connector J-40). Has the maintenance work been completed?	—	Go to step 13	—
7	1. Check the control circuit between ECM (Pin 95 of Connector B-233) and the intake throttle solenoid valve (Pin 2 of Connector J-40) for open circuit or high resistance. 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 13	Go to step 10
8	1. Check the control circuit between ECM (Pin 95 of Connector B-233) and the intake throttle solenoid valve (Pin 2 of Connector J-40) for short circuit to the ground. 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 13	Go to step 12
9	1. Turn off the ignition switch 2. Disconnect the intake air throttling solenoid valve harness joint. 3. Check the intake throttle solenoid valve wiring harness connector (Pins 1 and 2 of Connector J-40) for any gap and poor contact. 4. Repair the junction as necessary. Have the above cases been found and corrected?	—	Go to step 13	Go to step 11
10	1. Turn off the ignition switch 2. Disconnect the ECM harness joint. 3. Check the control circuit of the intake throttle solenoid valve on ECM connector (Pin 95 of Connector B-233) for any gap or poor contact. 4. Repair the junction as necessary. Have the above cases been found and corrected?	—	Go to step 13	Go to step 12

Step	Operating steps	Rated value	Yes	No
11	Replace the intake throttling solenoid valve. See “Intake Throttle Solenoid Valve Replacement” in this section. Has the replacement work been completed?	—	Go to step 13	—
12	**Key points:** ECM replacement must be programmed. Replace the ECM. Refer to the contents of “ECM replacement”. Has the replacement work been completed?	—	Go to step 13	—
13	Re-connect the previously disconnected harness joints. Clear DTC using Tech2 scanning tool. Turn off the ignition switch and last for 30s. Start the engine. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to step 14
14	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P1110 (Trouble symptom code8) (flash code 72)

Circuit instructions

The ECM controls the exhaust brake. The brake excites the intake throttling solenoid valve and exhaust brake solenoid valve according to vehicle running situation. The ECM orders each solenoid valve to close all throttling valves as per vacuum pressure. If ECM detects that the intake throttle solenoid valve control circuit is short circuit to the battery or the ignition switch, DTC will be set.

DTC running conditions

• Ignition switch (ON). **Set DTC conditions.**

• When the intake throttle solenoid valve is opened with a command, ECM detects that there is a high pressure on the solenoid valve control circuit for more than 3s.

Operation steps performed while setting DTC

• The ECM turns on the malfunction indicator light in case of diagnosis operation failure.

Clear MIL/DTC conditions

• The ECM turns off the malfunction indicator light in case of favorable diagnosis operation.

• Clear the original DTC after performing continuously 40 times of transmission cycles favorably. Or clear DTC using Tech2 scanning tool.

Diagnostic aid

• If there may be a gap, see “Gap Conditions” in this section.

Test description

For the following numbers, please refer to step serial numbers in the diagnosis table.

3. If the solenoid valve control circuit between ECM and the intake throttle solenoid valve is normal, a low-voltage DTCP1110 (TSC 4) will be set.

DTCP1110(trouble symptom code 8) (flash code 72)

Graphic reference: engine control illustration

Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Operating steps	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. Raise the driving wheel or drive the vehicle. 4. Monitor intake air throttling electromagnetic commands using Tech2 scanning tool while running the vehicle so as to carry out exhaust braking. DTC ignition failure during exhaust braking?	—	Go to step 3	Go to the diagnostic aid procedure
3	1. Turn off the ignition switch 2. Disconnect the intake throttle solenoid valve wiring harness connector. 3. Starting engine 4. Monitor DTC information using Tech2 scanning tool. Is DTCP1110C (TSC 4) set, instead of DTCP1110 (TSC 8)?	—	Go to step 5	Go to step 4
4	1. Check the control circuit between ECM (Pin 95 of Connector B-233) and the intake throttle solenoid valve (Pin 2 of Connector J-40) for short circuit to the battery or the ignition switch. 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 7	Go to step 6
5	Replace the intake throttling solenoid valve. See “Intake Throttle Solenoid Valve Replacement” in this section. Has the replacement work been completed?	—	Go to step 7	—

Step	Operating steps	Rated value	Yes	No
6	**Key points:** ECM replacement must be programmed. Replace the ECM. Refer to the contents of "ECM replacement". Has the replacement work been completed?	—	Go to step 7	—
7	1. Re-connect the previously disconnected harness joints. 2. Clear DTC using Tech2 scanning tool. 3. Turn off the ignition switch for 30s. 4. Raise the driving wheel or drive the vehicle. 5. Monitor intake air throttling electromagnetic commands using Tech2 scanning tool while running the vehicle so as to carry out exhaust braking. DTC ignition failure during exhaust braking?	—	Go to step 3	Go to step 8
8	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the "Diagnostic Trouble Code (DTC) Catalog".	System normal

P1120 (Trouble symptom code1) (flash code 21)

Circuit instructions

The accelerator pedal position (APP) sensor is mounted on the accelerator pedal bracket.The driver accelerates or decelerates via fuel injection; the ECM uses the APP sensor to decide the expected degree of acceleration nor deceleration. The driver accelerates or decelerates via fuel injection; the ECM uses the APP sensor to decide the expected degree of acceleration nor deceleration. APP sensor includes the following circuits.

• 5V reference circuit
• LV reference circuit
• APP sensor signal circuit

The ECM provides 5V voltage to the APP sensor via the 5V reference circuit. The ECM also causes LV reference circuit grounding. The APP sensor provides a signal to the ECM via the APP sensor signal circuit, and the signal is related to the variation of the accelerator pedal angle position. The ECM monitors whether the voltage of the APP sensor signal exceeds the normal range of the APP sensor. If ECM detects that APP sensor signal voltage is too high, DTC will be set.

DTC running conditions

• Ignition switch (ON).

Set DTC conditions.

• ECM detects that APP sensor signal voltage exceeds 4.9V and lasts for 0.5s.

Operation steps performed while setting DTC

• The ECM turns on the malfunction indicator light in case of diagnosis operation failure.
• ECM uses the 1400rpm engine for replacement.

Clear MIL/DTC conditions

• The ECM turns off the malfunction indicator light in case of favorable diagnosis operation.
• Clear the original DTC after performing continuously 40 times of transmission cycles favorably. Or clear DTC using Tech2 scanning tool.

Diagnostic aid

• If there may be a gap, see “Gap Conditions” in this section.

DTCP1120(trouble symptom code 1) (flash code 21)

Graphic reference: engine control illustration

Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Operating steps	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. Starting engine 4. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to the diagnostic aid procedure
3	1. Turn off the ignition switch 2. Disconnect the harness joint of the APP sensor. 3. The engine flames out. Turn on the ignition switch. 4. Use Tech2 scanning tool to monitor APP parameters. Are APP parameters less than rated value?	1%	Go to step 4	Go to step 5
4	1. Turn off the ignition switch 2. Connect the test lamp between the low voltage reference circuit of APP sensor wiring harness (Pin 1 of Connector B-80) and the battery voltage. 3. The engine flames out. Turn on the ignition switch. Is the test light turned on?	—	Go to step 11	Go to step 8

Step	Operating steps	Rated value	Yes	No
5	1. Turn off the ignition switch 2. Connect the diagnosis and maintenance monitor (DMM) between 5V reference circuit of APP sensor wiring harness (Pin 3 of Connector B-80) and the ground. 3. The engine flames out. Turn on the ignition switch. Is the diagnostic maintenance monitor voltage larger than the rated value?	4.7V	Go to step 6	Go to step 9
6	Is the diagnosis and maintenance monitor voltage less than the rated value in Step 5?	5.3V	Go to step 7	Go to step 10
7	**Key points:** If APP sensor signal circuit is short circuit to the voltage supply, the sensor may be damaged. 1. Check the signal circuit between ECM (Pin 38 of Connector E-234) and APP sensor (Pin 2 of Connector B-80) for the followings: • Shorting of battery or ignition switch • Short circuit to 5V reference circuit 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 15	Go to step 14
8	1. Check the low-voltage reference circuit between ECM (Pin 49 of Connector B-234) and APP sensor (Pin 1 of Connector B-80) for open circuit or high-resistance. 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 15	Go to step 12
9	1. Test the 5V reference circuit between the ECM (B-234 joint pin 57) and the APP sensor (B-80 joint pin 3). Do the following exist? • Grounded short circuit • LV reference circuit shorting 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 15	Go to step 14
10	1. Check 5V reference circuit between ECM (Pin 57 of Connector B-234) and APP sensor (Pin 3 of Connector B-80) for short circuit to the battery or the ignition switch. 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 15	Go to step 14

Step	Operating steps	Rated value	Yes	No
11	1. Turn off the ignition switch 2. Check whether the APP sensor harness joint (B-0 joint pin 1) has clearance and poor contact. 3. Repair the junction as necessary. Have the above cases been found and corrected?	—	Go to step 15	Go to step 13
12	1. Turn off the ignition switch 2. Disconnect the ECM harness joint. 3. Check APP sensor circuit at ECM wiring harness connector (Pin 49 of Connector B-234) for any gap and poor contact. 4. Repair the junction as necessary. Have the above cases been found and corrected?	—	Go to step 15	Go to step 14
13	Replace the APP sensor. See “APP Sensor Replacement” in this section. Has the replacement work been completed?	—	Go to step 15	—
14	**Key points:** ECM replacement must be programmed. Replace the ECM. Refer to the contents of “ECM replacement”. Has the replacement work been completed?	—	Go to step 15	—
15	1. Re-connect the previously disconnected harness joints. 2. Clear DTC using Tech2 scanning tool. 3. Turn off the ignition switch for 30s. 4. The engine flames out. Turn on the ignition switch. 5. Depress and release the accelerator pedal multiple times. 6. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to step 16
16	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P1120 (Trouble symptom code2) (flash code 21)

Circuit instructions

Install the Accelerator Pedal Position (APP) sensor onto the accelerator pedal bracket. The driver accelerates or decelerates via fuel injection; the ECM uses the APP sensor to decide the expected degree of acceleration nor deceleration. APP sensor includes the following circuits.

• 5V reference circuit
• LV reference circuit
• APP sensor signal circuit

The ECM provides 5V voltage to the APP sensor via the 5V reference circuit. The ECM also causes LV reference circuit grounding. The APP sensor provides a signal to the ECM via the APP sensor signal circuit, and the signal is related to the variation of the accelerator pedal angle position. The ECM monitors whether the voltage of the APP sensor signal exceeds the normal range of the APP sensor. The ECM will set the DTC in case of finding too low signal voltage of the air pressure sensor through detection.

DTC running conditions

• Ignition switch (ON).

Set DTC conditions.

• ECM detects that APP sensor signal voltage is below 0.3V and lasts for 0.5s.

Operation steps performed while setting DTC

• The ECM turns on the malfunction indicator light in case of diagnosis operation failure.
• ECM uses the 1400rpm engine for replacement.

Clear MIL/DTC conditions

• The ECM turns off the malfunction indicator light in case of favorable diagnosis operation.
• Clear the original DTC after performing continuously 40 times of transmission cycles favorably. Or clear DTC using Tech2 scanning tool.

Diagnostic aid

• If there may be a gap, see “Gap Conditions” in this section.

Test description

For the following numbers, please refer to step serial numbers in the diagnosis table.

4. If the signal circuit between ECM and APP sensor is normal, the sensor signal high voltage DTCP1120 (TSC 1) will be set.

DTCP1120(trouble symptom code 2) (flash code 21)

Graphic reference: engine control illustration

Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Operating steps	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. Starting engine 4. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to the diagnostic aid procedure
3	1. Turn off the ignition switch 2. Disconnect the harness joint of the APP sensor. 3. Connect the diagnosis and maintenance monitor between 5V reference circuit of APP sensor wiring harness (Pin 3 of Connector B-80) and the effective grounding line. 4. Shutdown the engine and turn on the ignition switch. Is the diagnostic maintenance monitor voltage larger than the rated value?	4.7V	Go to step 4	Go to step 5

Step	Operating steps	Rated value	Yes	No
4	1. Turn off the ignition switch 2. Use a 3A safety jumper to connect APP sensor connector between Pins 2 and 3 of Connector B-80. 3. The engine flames out. Turn on the ignition switch. Is DTCP1120 (TSC 1) set, instead of DTCP1120 (TSC 2)?	—	Go to step 7	Go to step 6
5	1. Test the 5V reference circuit between the ECM (B-234 joint pin 57) and the APP sensor (B-80 joint pin 3). Do the following exist? • Open circuit • Grounded short circuit • LV reference circuit shorting • High resistance 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 11	Go to step 8
6	1. Check the signal circuit between ECM (Pin 38 of Connector E-234) and APP sensor (Pin 2 of Connector B-80) for the followings: • Open circuit • Grounded short circuit • LV reference circuit shorting • High resistance 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 11	Go to step 8
7	1. Turn off the ignition switch 2. Check whether the APP sensor harness joint (B-0 joint pin 2) has clearance and poor contact. 3. Repair the junction as necessary. Have the above cases been found and corrected?	—	Go to step 11	Go to step 9
8	1. Turn off the ignition switch 2. Disconnect the ECM harness joint. 3. Check APP sensor circuit at ECM wiring harness connector (Pins 38 and 57 of Connector B-234) for any gap and poor contact. 4. Repair the junction as necessary. Have the above cases been found and corrected?	—	Go to step 11	Go to step 10

Step	Operating steps	Rated value	Yes	No
9	Replace the APP sensor. See “APP Sensor Replacement” in this section. Has the replacement work been completed?	—	Go to step 11	—
10	**Key points:** ECM replacement must be programmed. Replace the ECM. Refer to the contents of “ECM replacement”. Has the replacement work been completed?	—	Go to step 11	—
11	1. Re-connect the previously disconnected harness joints. 2. Clear DTC using Tech2 scanning tool. 3. Turn off the ignition switch for 30s. 4. The engine flames out. Turn on the ignition switch. 5. Depress and release the accelerator pedal multiple times. 6. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to step 12
12	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P1120 (Trouble symptom code7) (flash code 21)
Circuit instructions
Install the Accelerator Pedal Position (APP) sensor onto the accelerator pedal bracket. The driver accelerates or decelerates via fuel injection; the ECM uses the APP sensor to decide the expected degree of acceleration nor deceleration. APP sensor includes the following circuits.
• 5V reference circuit
• LV reference circuit
• APP sensor signal circuit
The ECM provides 5V reference voltage to the APP sensor via the 5V reference circuit. The ECM monitors the voltage on the 5V reference circuit. The ECM will set the DTC in case of finding that the 5V reference voltage of the APP sensor is too high.
DTC running conditions
• Ignition switch (ON).
Set DTC conditions.
ECM detects that APP sensor supply circuit voltage exceeds 5.2V and lasts for 0.5s.
Operation steps performed while setting DTC
• The ECM turns on the malfunction indicator light in case of diagnosis operation failure.
• ECM uses the 1400rpm engine for replacement.
Clear MIL/DTC conditions
• The ECM turns off the malfunction indicator light in case of favorable diagnosis operation.
• Clear the original DTC after performing continuously 40 times of transmission cycles favorably. Or clear DTC using Tech2 scanning tool.
Diagnostic aid
• If there may be a gap, see “Gap Conditions” in this section.
DTCP1120(trouble symptom code 7) (flash code 21)
Graphic reference: engine control illustration
Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Operating steps	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. Starting engine 4. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to the diagnostic aid procedure
3	1. Check 5V reference circuit between ECM (Pin 57 of Connector B-234) and APP sensor (Pin 3 of Connector B-80) for short circuit to the battery or the ignition switch. 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 5	Go to step 4
4	**Key points:** ECM replacement must be programmed. Replace the ECM. Refer to the contents of “ECM replacement”. Has the replacement work been completed?	—	Go to step 5	—

Step	Operating steps	Rated value	Yes	No
5	1. Re-connect the previously disconnected harness joints. 2. Clear DTC using Tech2 scanning tool. 3. Turn off the ignition switch for 30s. 4. The engine flames out. Turn on the ignition switch. 5. Depress and release the accelerator pedal multiple times. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to step 6
6	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P1120 (Trouble symptom code9) (flash code 21)

Circuit instructions

Install the Accelerator Pedal Position (APP) sensor onto the accelerator pedal bracket. The driver accelerates or decelerates via fuel injection; the ECM uses the APP sensor to decide the expected degree of acceleration nor deceleration. APP sensor includes the following circuits.

• 5V reference circuit
• LV reference circuit
• APP sensor signal circuit

The ECM provides 5V reference voltage to the APP sensor via the 5V reference circuit. The ECM monitors the voltage on the 5V reference circuit. The ECM will set the DTC in case of finding that the 5V reference voltage of the APP sensor is too high.

DTC running conditions

• Ignition switch (ON).

Set DTC conditions.

• ECM detects that APP sensor power line voltage is below 4.6V and lasts for 0.5s.

Operation steps performed while setting DTC

• The ECM turns on the malfunction indicator light in case of diagnosis operation failure.
• ECM uses the 1400rpm engine for replacement.

Clear MIL/DTC conditions

• The ECM turns off the malfunction indicator light in case of favorable diagnosis operation.
• Clear the original DTC after performing continuously 40 times of transmission cycles favorably. Or clear DTC using Tech2 scanning tool.

Diagnostic aid

• If there may be a gap, see “Gap Conditions” in this section.

Test description

For the following numbers, please refer to step serial numbers in the diagnosis table.

3. If 5V reference circuit between ECM and APP sensor is normal, the sensor signal low voltage DTCP1120 (TSC 2) will be set.

DTCP1120(trouble symptom code 9) (flash code 21)

Graphic reference: engine control illustration

Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Operating steps	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. Starting engine 4. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to the **diagnostic aid** Procedure
3	1. Turn off the ignition switch 2. Disconnect the harness joint of the APP sensor. 3. The engine flames out. Turn on the ignition switch. 4. Apply and release the accelerator pedal. 5. Monitor DTC information using Tech2 scanning tool. Is DTCP1110 (TSC 2) set, instead of DTCP1120? (TSC 9)?	—	Go to step 5	Go to step 4

Step	Operating steps	Rated value	Yes	No
4	1. Check 5V reference circuit between ECM (Pin 57 of Connector B-234) and APP sensor (Pin 3 of Connector B-80) for the followings: • Grounded short circuit • LV reference circuit shorting 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 7	Go to step 6
5	Replace the APP sensor. See “APP Sensor Replacement” in this section. Has the replacement work been completed?	—	Go to step 7	—
6	**Key points:** ECM replacement must be programmed. Replace the ECM. Refer to the contents of “ECM replacement”. Has the replacement work been completed?	—	Go to step 7	—
7	1. Re-connect the previously disconnected harness joints. 2. Clear DTC using Tech2 scanning tool. 3. Turn off the ignition switch for 30s. 4. The engine flames out. Turn on the ignition switch. 5. Depress and release the accelerator pedal multiple times. 6. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to step 8
8	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P1120 (Trouble symptom codeD) (flash code 21)

Circuit instructions

Install the Accelerator Pedal Position (APP) sensor onto the accelerator pedal bracket. The driver accelerates or decelerates via fuel injection; the ECM uses the APP sensor to decide the expected degree of acceleration nor deceleration. APP sensor includes the following circuits.

• 5V reference circuit
• LV reference circuit
• APP sensor signal circuit

The ECM provides 5V voltage to the APP sensor via the 5V reference circuit. The ECM also causes LV reference circuit grounding. The APP sensor provides a signal to the ECM via the APP sensor signal circuit, and the signal is related to the variation of the accelerator pedal angle position.

The brake pedal switch is installed on the brake pedal bracket. Brake pedal 1 switch is a normally open switch, and brake pedal 2 switch is a normally close switch. While depressing the brake pedal, the ECM will receive the signal from the brake pedal 1 switch , and turn on the stop light. Afterwards, the signal (low voltage) transmitted by the brake pedal switch 2 to the ECM is stopped.

When the brake pedal is applied, if ECM detects that APP sensor signal is interrupted, DTC will be set.

DTC running conditions

• Ignition switch (ON).
• The engine speed is over 1700rpm.
• Vehicle speed over 1. 5km/h (1MPH)

Set DTC conditions.

• ECM detects APP sensor angle is no change and greater than 18%, and apply the brake pedal and last for more than 2s.

Operation steps performed while setting DTC

• The ECM turns on the malfunction indicator light in case of diagnosis operation failure.
• ECM uses the 1400rpm engine for replacement.

Clear MIL/DTC conditions

• The ECM turns off the malfunction indicator light in case of favorable diagnosis operation.
• Clear the original DTC after performing continuously 40 times of transmission cycles favorably. Or clear DTC using Tech2 scanning tool.

Diagnostic aid

• If there may be a gap, see “Gap Conditions” in this section.
• If the brake pedal switch is not properly adjusted, DTC will be set.
• If APP sensor is not properly adjusted, DTC will be set.
• If the brake pedal is stuck or intermittently stuck, DTC will be set.

DTCP1120 (TSC D) (FC 21)

Graphic reference: engine control illustration

Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Operating steps	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. The engine flames out. Turn on the ignition switch. 4. Monitor DTC information using Tech2 scanning tool. Is DTCP0703 (TSC A or B) or P1120 (TSC 1, 7, 9 or E) set?	—	Perform applicable DTC.	Go to step 3
3	1. The engine flames out. Turn on the ignition switch. 2. Depress and then release the brake pedal while monitoring the parameter of the brake pedal 1 switch using Tech2 scanning tool. Are “Apply” and “Release” shown on Tech2 scanning tool respectively when the brake pedal is applied and released?	—	Go to step 9	Go to step 4

Step	Operating steps	Rated value	Yes	No
4	1. Check the brake pedal switch and ensure correct adjustment. When the brake pedal is released, the plunger should always be maintained inside, but should not obstruct the brake pedal return stroke. 2. Adjust the brake pedal switch as needed. Have the above cases been found and corrected?	—	Go to step 13	Go to step 5
5	1. Turn off the ignition switch 2. Disconnect the brake pedal switch wiring harness connector. 3. The engine flames out. Turn on the ignition switch. 4. Use a 3A safety jumper to temporarily bridge the clutch pedal 1 switch wiring harness connector between Pins 1 and 4 of Connector B-66 and use Tech2 scanning tool to monitor the clutch pedal 1 switch parameters. Are “Apply” and “Release” shown on Tech2 scanning tool respectively when the the circuit is jumpered and not jumpered?	—	Go to step 8	Go to step 6
6	1. Check the brake pedal 1 switch signal circuit between ECM (Pin 30 of Connector B-234) and the brake pedal 1 switch (Pin 4 of Connector B-66) for the followings: • Open circuit • Shorting of battery or ignition switch • High resistance 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 13	Go to step 7
7	1. Turn off the ignition switch 2. Disconnect the ECM harness joint. 3. Check the brake switch circuit at ECM wiring harness connector (Pin 30 of Connector B-234) for any gap and poor contact. 4. Repair the junction as necessary. Have the above cases been found and corrected?	—	Go to step 13	Go to step 12
8	Replace the brake pedal switch. See “Brake Switch Replacement” in this section. Has the replacement work been completed?	—	Go to step 13	—

Step	Operating steps	Rated value	Yes	No
9	1. The engine flames out. Turn on the ignition switch. 2. Monitor the parameter of the APP using Tech2 scanning tool while depressing and releasing the accelerator pedal repeatedly. Is APP parameter changed smoothly within the range of 0-100% when the accelerator pedal is applied and released?	—	Go to the diagnostic aid procedure	Go to step 10
10	1. Turn off the ignition switch 2. Check for the followings: • APP sensor is not properly adjusted. • The accelerator pedal is stuck when applying. 3. If necessary, repair or replace the accelerator pedal. Have the above cases been found and corrected?	—	Go to step 13	Go to step 11
11	Replace the APP sensor. See “APP Sensor Replacement” in this section. Has the replacement work been completed?	—	Go to step 13	—
12	**Key points:** Replace ECM with the programmed steps. Replace the ECM. Refer to the contents of “ECM replacement”. Has the replacement work been completed?	—	Go to step 13	—
13	1. Re-connect the previously disconnected harness joints. 2. Clear DTC using Tech2 scanning tool. 3. Turn off the ignition switch for 30s. 4. The engine flames out. Turn on the ignition switch. 5. Apply and release the accelerator pedal repeatedly and monitor APP parameters. 6. Depress and then release the brake pedal while monitoring the parameter of the brake pedal 1 switch using Tech2 scanning tool. Is APP parameter changed smoothly within the range of 0-100% when the accelerator pedal is applied and released? Are “Apply” and “Release” shown on Tech2 scanning tool respectively when the brake pedal is applied and released?	—	Go to step 14	Go to step 2
14	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P1120 (Trouble symptom codeE) (flash code 21)
Circuit instructions
Install the Accelerator Pedal Position (APP) sensor onto the accelerator pedal bracket. The driver accelerates or decelerates via fuel injection; the ECM uses the APP sensor to decide the expected degree of acceleration nor deceleration. APP sensor includes the following circuits.
• 5V reference circuit
• LV reference circuit
• APP sensor signal circuit
The ECM provides 5V voltage to the APP sensor via the 5V reference circuit. The ECM also causes LV reference circuit grounding. The APP sensor provides a signal to the ECM via the APP sensor signal circuit, and the signal is related to the variation of the accelerator pedal angle position.
The idling switch is also mounted on the accelerator pedal bracket and is a normally closed switch. When the accelerator pedal is released, the idling switch signal sent to ECM is low voltage.
If ECM detects that APP sensor signal is not related to the idling switch, DTC will be set.
DTC running conditions
Ignition switch (ON).
Set DTC conditions.
• ECM detects that APP sensor angle is greater than 18%, and then turn on the idling switch and last for more than 0.6s.
Operation steps performed while setting DTC
• The ECM turns on the malfunction indicator light in case of diagnosis operation failure.
• ECM uses the 1400rpm engine for replacement.
Clear MIL/DTC conditions
• The ECM turns off the malfunction indicator light in case of favorable diagnosis operation.
• Clear the original DTC after performing continuously 40 times of transmission cycles favorably. Or clear DTC using Tech2 scanning tool.
Diagnostic aid
• If there may be a gap, see “Gap Conditions” in this section.
DTCP1120 (Trouble symptom codeE) (flash code 21)
Graphic reference: engine control illustration
Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Operating steps	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. The engine flames out. Turn on the ignition switch. 2. Apply and release the accelerator pedal and use Tech2 scanning tool to monitor the idling switch parameters. Are “OFF” and “ON” shown on Tech2 scanning tool respectively when the accelerator pedal is applied and released?	—	Go to step 5	Go to step 3
3	1. Turn off the ignition switch 2. Disconnect the idling switch wiring harness connector. 3. The engine flames out. Turn on the ignition switch. 4. Use a 3A safety jumper to temporarily bridge the idling switch wiring harness connector between Pins 1 and 2 of Connector B-340 and use Tech2 scanning tool to monitor the idling switch parameters. Are “ON” and “OFF” shown on Tech2 scanning tool respectively when the circuit is jumpered and not jumpered?	—	Go to step 7	Go to step 4

Step	Operating steps	Rated value	Yes	No
4	1. Check that the switch signal circuit between ECM (Pin 69 of Connector B-234) and the idling switch (Pin 1 of Connector B-340) for short-circuit to the ground. 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 10	Go to step 9
5	1. The engine flames out. Turn on the ignition switch. 2. Monitor the parameter of the APP using Tech2 scanning tool while depressing and releasing the accelerator pedal repeatedly. Is APP parameter changed smoothly within the range of 0-100% when the accelerator pedal is applied and released?	—	Go to the diagnostic aid procedure	Go to step 6
6	1. Turn off the ignition switch 2. Disconnect the harness joint of the APP sensor. 3. Check APP sensor wiring harness connector (Pin 1 of Connector B-80) for any gap, poor contact, and corrosion. 4. Disconnect the ECM harness joint. 5. Check APP sensor circuit at ECM wiring harness connector (Pin 49 of Connector B-234) for any gap, poor contact, and corrosion. 6. Check APP sensor low voltage reference circuit for the high resistance. 7. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 10	Go to step 8
7	Replace the idling switch. See “Idling Switch Replacement” in this section. Has the replacement work been completed?	—	Go to step 10	—
8	Replace the APP sensor. See “APP Sensor Replacement” in this section. Has the replacement work been completed?	—	Go to step 10	—
9	**Key points:** ECM replacement must be programmed. Replace the ECM. Refer to the contents of “ECM replacement”. Has the replacement work been completed?	—	Go to step 10	—

Step	Operating steps	Rated value	Yes	No
10	1. Re-connect the previously disconnected harness joints. 2. Clear DTC using Tech2 scanning tool. 3. Turn off the ignition switch for 30s. 4. The engine flames out. Turn on the ignition switch. 5. Apply and release the accelerator pedal repeatedly and monitor the parameters of the idling switch and APP. Is APP parameter changed smoothly within the range of 0-100% when the accelerator pedal is applied and released? Are "ON" and "OFF" of the idling switch parameters shown on Tech2 scanning tool respectively when the accelerator pedal is applied and released?	—	Go to step 11	Go to step 2
11	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the "Diagnostic Trouble Code (DTC) Catalog".	System normal

P1173 (Trouble symptom code3) (flash code 22)
Circuit instructions
ECT sensor is mounted on the thermostat housing and it is a variable resistor. ECT sensor contains a signal circuit and a low-voltage reference circuit. ECT sensor can measure ECT. ECM provides a 5V voltage for ECT signal circuit and connects ECT low voltage reference circuit to the ground. The sensor resistance is high when ECT sensor temperature is low. ECT sensor resistance is reduced when ECT is increased. If the sensor resistance is bigger, ECM detects that the voltage on ECT signal circuit is higher. If the sensor resistance is smaller, ECM detects that the voltage on ECT signal circuit is lower. If ECM detects that ECT is too high, DTC will be set.
DTC running conditions
• Ignition switch (ON).
Set DTC conditions.
• ECM detects that ECT is too high and lasts for more than 30s.
DTCP1173 (TSC 3) (FC 22)
Operation steps performed while setting DTC
• ECM will not turn on MIL when the diagnosis operation fails.
Clear DTC conditions
• Clear the original DTC after performing continuously 40 times of transmission cycles favorably. Or clear DTC using Tech2 scanning tool.
Diagnostic aid
• If there may be a gap, see “Gap Conditions” in this section.
• After the engine is started, ECT should steadily rise to 80℃ ~ 85℃ (176℉ ~ 185℉), and then turn on and stabilize the thermostat.
• Test ECT sensors at different temperatures with “Temperature and Resistance Chart”, to assess the sensor error possibility. The sensor error may cause poor driving performance.
Caution:
• If the engine is overheated, DTC will be set (for example, the engine coolant level is too low); because DTC does not turn on any light, DTC will be cleared to ensure that there is no engine fault sign. The engine overheating may damage the parts in the engine.

Step	Operating steps	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. Start the engine till it is fully preheated. 4. Monitor the ECT parameter using Tech2 scanning tool. Is the ECT parameter more than the rated value?	100℃ (212℉)	Go to step 4	Go to step 3
3	Consult the driver whether the engine is overheated due to the low engine coolant level. If the engine is overheated, must check the engine; if necessary, repair it. Are the above steps completed?	—	Go to step 6	—
4	1. Test ECT sensor at different temperatures, to assess the sensor error possibility. 2. If necessary, replace ECT sensor. Have the above cases been found and corrected?	—	Go to step 6	Go to step 5

Step	Operating steps	Rated value	Yes	No
5	1. Check the engine cooling system for the following conditions. See “Test Engine Cooling System Diagnosis” section. • Engine coolant level • Engine coolant leakage • Cooling fan belt slipping • Cooling fan clutch operation • Thermostat operation • Cooling pump operation • Radiator blockage 2. If necessary, repair or replace it. Have the above cases been found and corrected?	—	Go to step 6	Go to the diagnostic aid procedure
6	1. Re-connect the previously disconnected harness joints. 2. Clear DTC using Tech2 scanning tool. 3. Turn off the ignition switch for 30s. 4. Start the engine till it is fully preheated. 5. Monitor the ECT parameter using Tech2 scanning tool. Is the ECT parameter more than the rated value?	100°C (212°F)	Go to step 4	Go to step 7
7	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P1173 (Trouble symptom code7 and A) (flash code 22)

Circuit instructions

The fuel temperature (FT) sensor is located inside the fuel injection pump controller (PCU) and used to measure the fuel temperature in the fuel injection pump. If PCU detects that the fuel temperature is too high or too low, DTC will be set.

DTC running conditions

• Ignition switch (ON).

Set DTC conditions.

• ECM detects that the fuel temperature is too high and lasts more than 30s. (Trouble symptom code7)

• ECM detects that the fuel temperature is too low and lasts more than 30s. (Trouble symptom code A)

DTCP1173 (TSC 7 and A) (FC 22)

Operation steps performed while setting DTC

• The ECM doesn't' turn on the malfunction indicator light in case of diagnosis operation failure.

• PCU limits the fuel injection. (TSC 7) DTC clearing conditions

• Clear the original DTC after performing continuously 40 times of transmission cycles favorably. Or clear DTC using Tech2 scanning tool.

Diagnostic aid

• If there may be a gap, see "Gap Conditions" in this section.

Caution:

• FT sensor is located inside PCU and is also a part of the injection pump assembly.

Step	Operating steps	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. Starting engine 4. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to step 4
3	**Key points:** The fuel injection pump must run synchronously with the engine. Replace the fuel injection pump. See "Fuel Pump Replacement" in the engine mechanical section. (FT sensor is located inside PCU and is also a part of the injection pump assembly.) Has the replacement work been completed?	—	Go to step 4	—
4	1. Clear DTC using Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. Starting engine 4. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to step 5
5	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the "Diagnostic Trouble Code (DTC) Catalog".	System normal

P1335 (Trouble symptom codeA) (flash code 43)

Circuit instructions

The crankshaft position (CKP) sensor is located at the top of the flywheel housing. The flywheel circumference is equally divided by 4 lines with an equal distance of 90° between the lines. [CKP sensor is a magnetic coil sensor that generates AC signal voltage based on crankshaft speed. ECM can monitor the crankshaft position (CKP) sensor signal and the injection pump camshaft position (CMP) sensor signal to ensure the communication with each other. If PCU receives a wrong CKP sensor signal pulse, DTC will be set.

DTC running conditions

• The ignition switch is ON.

Set DTC conditions.

• PCU detects CKP sensor signal from ECM is wrong.

Operation steps performed while setting DTC

• The ECM turns on the malfunction indicator light in case of diagnosis operation failure.

• ECM limits fuel injection quantity.

Clear MIL/DTC conditions

• The ECM turns off the malfunction indicator light in case of favorable diagnosis operation.

• Clear the original DTC after performing continuously 40 times of transmission cycles favorably. Or clear DTC using Tech2 scanning tool.

Diagnostic aid

• If there may be a gap, see “Gap Conditions” in this section.

Caution:

• PCU is part of the fuel injection pump assy.

DTCP1335 (Trouble symptom codeA) (flash code 43)

Graphic reference: engine control illustration

Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Operating steps	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. Start the engine (Note: The engine is started with a slight delay). 4. Monitor DTC information using Tech2 scanning tool. Is DTCP0335 (TSC B or C) set?	—	Perform applicable DTC.	Go to step 3
3	1. Turn off the ignition switch 2. Disconnect the ECM B-233 harness joint. Connect B-234 wiring harness connector. 3. Connect the diagnosis and maintenance monitor between CKP sensor signal output circuit (Pin 91 of Connector B-233) and the effective grounding line. 4. The engine flames out. Turn on the ignition switch. Is the diagnostic maintenance monitor voltage larger than the rated value?	10V	Go to step 5	Go to step 4

Step	Operating steps	Rated value	Yes	No
4	1. Check CKP sensor signal output circuit between ECM (Pin 91 of Connector B-233) and the injection pump (Pin 8 of Connector E-110) for the followings: • Open circuit • Grounded short circuit • High resistance 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 10	Go to step 6
5	1. Check CKP sensor signal output circuit between ECM (Pin 91 of Connector B-233) and PCU (Pin 8 of Connector E-110) for short circuit to the battery or the ignition switch. **Caution:** In short circuit test, connect the test lamp between ECM wiring harness connector (Pin 91 of Connector B-233) and the effective grounding line. If the test lamp is turned on, it is short circuit to the battery or the ignition switch. 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 10	Go to step 7
6	1. Turn off the ignition switch 2. Disconnect the PCU harness joint. 3. Check CKP sensor signal circuit at PCU wiring harness connector (Pin 8 of Connector E-110) for any gap and poor contact. 4. Repair the junction as necessary. Have the above cases been found and corrected?	—	Go to step 10	Go to step 8
7	1. Turn off the ignition switch 2. Disconnect the ECM harness joint. 3. Check CKP sensor signal output circuit at ECM wiring harness connector (Pin 92 of Connector B-233) for any gap and poor contact. 4. Repair the junction as necessary. Have the above cases been found and corrected?	—	Go to step 10	Go to step 9
8	**Key points:** The fuel injection pump must run synchronously with the engine. Replace the fuel injection pump. See “Fuel Injection Pump Replacement” in the engine mechanical section. Has the replacement work been completed?	—	Go to step 10	—

Step	Operating steps	Rated value	Yes	No
9	**Key points:** ECM replacement must be programmed. Replace the ECM. Refer to the contents of "ECM replacement". Has the replacement work been completed?	—	Go to step 10	—
10	1. Re-connect the previously disconnected harness joints. 2. Clear DTC using Tech2 scanning tool. 3. Turn off the ignition switch for 30s. 4. Starting engine 5. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 2	Go to step 11
11	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the "Diagnostic Trouble Code (DTC) Catalog".	System normal

P1345 (Trouble symptom codeA) (flash code 41)
Circuit instructions
The ECM calculates the expected fuel injection quantity and time limit according to the data outputted by different sensors. The controller area network (CAN) communication bus transmits the anticipated data to the PCU. PCU also receives internal input signals: the CMP sensor is located in the fuel injection pump and decides the cam ring rotation angle and fuel injection pump speed. The fuel temperature sensor is inside the PCU. Compare the above rated value with the expected value from ECM and determine the injection timing piston position and the fuel injection amount with PCU. Activate the timing control valve and injection solenoid valve based on the control chart in PCU. PCU can also compare the engine speed from ECM and the fuel injection pump speed. If PCU receives a wrong injection pump CMP sensor signal, DTC will be set.
Set DTC conditions.
• PCU receives the wrong injection pump CMP sensor signal and lasts for 1s.
DTCP1345 (Trouble symptom codeA) (flash code 41)
Operation steps performed while setting DTC
• The ECM turns on the malfunction indicator light in case of diagnosis operation failure.
• ECM limits fuel injection quantity.
Clear MIL/DTC conditions
• The ECM turns off the malfunction indicator light in case of favorable diagnosis operation.
• Clear the original DTC after performing continuously 40 times of transmission cycles favorably. Or clear DTC using Tech2 scanning tool.
Diagnostic aid
• If there may be a gap, see “Gap Conditions” in this section.
Caution:
• The fuel injection pump CMP sensor is located inside the fuel injection pump assembly.
• PCU is part of the fuel injection pump assy.

Step	Operating steps	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. Starting engine 4. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to step 4
3	**Key points:** The fuel injection pump must run synchronously with the engine. Replace the fuel injection pump. See “Fuel Injection Pump Replacement” in the engine mechanical section. Has the replacement work been completed?	—	Go to step 4	—
4	1. Clear DTC using Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. Starting engine 4. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to step 5
5	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P1520 (Trouble symptom codeA) (flash code 47)
Circuit instructions
Install the neutral switch in the gear shift box of the transmission. In case of being at neutral position, the switch is turned off and signals will be signals will be transmitted to the ECM. If ECM detects that the neutral switch signal is no change within the predetermined ranges of engine speed and vehicle speed, DTC will be set.
DTC running conditions
• Ignition switch (ON).
• The engine speed is over 1500rpm.
• Vehicle speed over 64km/h (40MPH) .
• Release the clutch pedal.
Set DTC conditions.
• During 3 consecutive drive cycles, ECM detects that the neutral switch signal is always "ON" (neutral position).
Operation steps performed while setting DTC
• The ECM turns on the malfunction indicator light in case of diagnosis operation failure.
Clear MIL/DTC conditions
Key points:
• The following conditions must be reached during continuously 2 times of transmission cycles.(1st drive cycle: ignition switch "ON" > Engine operation > Vehicle operation > Ignition switch "OFF"; 10s).
The engine speed is over 1500rpm.
- The vehicle speed exceeds 64km/h (40MPH).
- Release the clutch pedal.
- Other gear positions.
• Clear the original DTC after performing the above procedure and then continuously 40 times of transmission cycles. Or clear DTC using Tech2 scanning tool.
Diagnostic aid
• If there may be a gap, see "Gap Conditions" in this section.
DTCP1520 (Trouble symptom codeA) (flash code 47)
Graphic reference: engine control illustration
Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Operating steps	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. The engine flames out. Turn on the ignition switch. 3. Shift to the neutral position or other positions, while monitoring the parameter of the neutral switch using Tech2 scanning tool. Are "ON" and "OFF" shown on Tech2 scanning tool respectively in neutral and other gear positions?	—	Go to the diagnostic aid procedure	Go to step 3
3	1. Turn off the ignition switch 2. Disconnect the neutral switch harness joint. 3. The engine flames out. Turn on the ignition switch. 4. Use Tech2 scanning tool to monitor the neutral switch parameters. Is "ON" shown on Tech2 scanning tool?	—	Go to step 4	Go to step 5
4	1. Check the neutral switch input signal circuit between ECM (Pin 87 of Connector B-233) and the clutch pedal switch (Pin 2 of Connector J-50) for short circuit to the battery or the ignition switch. 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 7	Go to step 6

Step	Operating steps	Rated value	Yes	No
5	Replace the neutral switch. See "Neutral Switch Replacement" in the transmission section. Has the replacement work been completed?	—	Go to step 7	—
6	**Key points:** ECM replacement must be programmed. Replace the ECM. Refer to the contents of "ECM replacement". Has the replacement work been completed? Re-connect the previously disconnected harness joints. Clear DTC using Tech2 scanning tool.	—	Go to step 7	—
7	**Key points:** Before clearing with Tech2 scanning tool and in 2 consecutive drive cycles, must fulfill the following conditions (1st drive cycle: ignition switch "ON" > Engine operation > Vehicle operation > Ignition switch "OFF"; 10s): • The engine speed is over 1500rpm. • Vehicle speed over 64km/h (40MPH) . • Release the clutch pedal. • Other gear positions 3. The engine flames out. Turn on the ignition switch. 4. Shift to the neutral position or other positions, while monitoring the parameter of the neutral switch using Tech2 scanning tool. Are "ON" and "OFF" shown on Tech2 scanning tool respectively in neutral and other gear positions?	—	Go to step 8	Go to step 3
8	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the "Diagnostic Trouble Code (DTC) Catalog".	System normal

P1520 (Trouble symptom codeB) (flash code 47)
Circuit instructions
Install the neutral switch in the gear shift box of the transmission. In case of being at neutral position, the switch is turned off and signals will be signals will be transmitted to the ECM. If ECM detects that the neutral switch signals from other gears are not changed within the predetermined range of engine speed and vehicle speed, DTC will be set for only manual transmission operation.
DTC running conditions
• Ignition switch (ON).
• The engine speed is over 665rpm.
• Vehicle speed less than 2km/h(3MPH).
• Press down the clutch pedal and then release it.
Set DTC conditions.
• During 3 consecutive drive cycles, ECM detects that the neutral switch signal is always "OFF" (other gear positions).
Operation steps performed while setting DTC
• ECM will turn on MIL when the diagnosis operation fails.
Clear MIL/DTC conditions
Key points:
• The following conditions must be reached during continuously 2 times of transmission cycles.(1st drive cycle: ignition switch "ON" > Engine operation > Vehicle operation > Ignition switch "OFF"; 10s)
— The engine speed is over 665rpm.
- The vehicle speed is less than 2km/h (3MPH).
- Apply and release the clutch pedal.
- Neutral position.
• Clear the original DTC after performing the above procedure and then continuously 40 times of transmission cycles. Or clear DTC using Tech2 scanning tool.
Diagnostic aid
• If there may be a gap, see "Gap Conditions" in this section.
DTCP1520 (Trouble symptom codeB) (flash code 47)
Graphic reference: engine control illustration
Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Operating steps	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. The engine flames out. Turn on the ignition switch. 3. Shift to the neutral position or other positions, while monitoring the parameter of the neutral switch using Tech2 scanning tool. Are "ON" and "OFF" shown on Tech2 scanning tool respectively in neutral and other gear positions?	—	Go to the diagnostic aid procedure	Go to step 3
3	1. Turn off the ignition switch. 2. Disconnect the neutral switch harness joint. 3. The engine flames out. Turn on the ignition switch. 4. Temporarily bridge the neutral switch wiring harness connector between Pins 1 and pin 2 of Connector J-50 and use Tech1 scanning tool to monitor the neutral switch parameters. Are "ON" and "OFF" shown on Tech2 scanning tool respectively when the circuit is jumpered and not jumpered?	—	Go to step 7	Go to step 4

Step	Operating steps	Rated value	Yes	No
4	1. Connect the test lamp between the ignition power supply circuit of the neutral switch wiring harness (Pin 1 of Connector J-50) and the effective grounding line. 2. The engine flames out. Turn on the ignition switch. Is the test light turned on?	—	Go to step 6	Go to step 5
5	Repair the open circuit or high resistance of the ignition power supply circuit between ECM main relay (Pin 14 of Connector X-14) and the neutral switch (Pin J-50 of Connector 1). Has the maintenance work been completed?	—	Go to step 11	—
6	1. Check the neutral switch signal circuit between ECM (Pin 87 of Connector B-233) and the neutral switch (Pin 2 of Connector J-50) for open circuit or high resistance. 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 11	Go to step 8
7	1. Turn off the ignition switch 2. Check the neutral switch wiring harness connector (Pins 1 and 2 of Connector J-50) for any gap and poor contact. 3. Repair the junction as necessary. Have the above cases been found and corrected?	—	Go to step 11	Go to step 9
8	1. Turn off the ignition switch 2. Disconnect the ECM harness joint. 3. Check the neutral switch circuit of ECM wiring harness connector (Pin 87 of Connector B-233) for any gap and poor contact. 4. Repair the junction as necessary. Have the above cases been found and corrected?	—	Go to step 11	Go to step 10
9	Replace the neutral switch. See “Neutral Switch Replacement” in the transmission section. Has the replacement work been completed?	—	Go to step 11	—
10	**Key points:** Replace ECM with the programmed steps. Replace the ECM. Refer to the contents of “ECM replacement”. Has the replacement work been completed?	—	Go to step 11	—

Step	Operating steps	Rated value	Yes	No
11	1. Re-connect the previously disconnected harness joints. 2. Clear DTC using Tech2 scanning tool. **Key points:** Before clearing with Tech2 scanning tool and in 2 consecutive drive conditions, must fulfill the following conditions (1st drive cycle: ignition switch "ON" > Engine operation > Vehicle operation > Ignition switch "OFF"; 10s): • The engine speed is over 665rpm. • Vehicle speed less than 2km/h(3MPH). • Press down the clutch pedal and then release it. • Neutral position 3. The engine flames out. Turn on the ignition switch. 4. Shift to the neutral position or other positions, while monitoring the parameter of the neutral switch using Tech2 scanning tool. Are "ON" and "OFF" shown on Tech2 scanning tool respectively in neutral and other gear positions?	—	Go to step 12	Go to step 3
12	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the "Diagnostic Trouble Code (DTC) Catalog".	System normal

P1576 (Trouble symptom code4) (flash code 71)
Circuit instructions
The ECM controls the exhaust brake. The brake excites the intake throttling solenoid valve and exhaust brake solenoid valve according to vehicle running situation. The ECM orders each solenoid valve to close all throttling valves as per vacuum pressure. The ECM will set the DTC in case of finding opening or grounded shorting of the control circuit of the intake throttling solenoid valve through detection.
DTC running conditions
• Ignition switch (ON).
Set DTC conditions.
• When the exhaust brake solenoid valve is closed with a command, ECM detects there is a low voltage current on the solenoid valve control circuit and lasts for more than 3s.
Operation steps performed while setting DTC
• The ECM turns on the malfunction indicator light in case of diagnosis operation failure.
Clear MIL/DTC conditions
• The ECM turns off the malfunction indicator light in case of favorable diagnosis operation.
• Clear the original DTC after performing continuously 40 times of transmission cycles favorably. Or clear DTC using Tech2 scanning tool.
Diagnostic aid
• If there may be a gap, see “Gap Conditions” in this section.
Test description
For the following numbers, please refer to step serial numbers in the diagnosis table.
5. If the solenoid valve control circuit between ECM and the exhaust brake solenoid valve is normal, the high pressure DTCP1576 (TSC 8) will be set.
DTCP1576(trouble symptom code 4) (flash code 71)
Graphic reference: engine control illustration
Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Operating steps	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. Starting engine 4. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to the diagnostic aid procedure
3	1. Turn off the ignition switch 2. Disconnect the exhaust air brake solenoid valve harness joint. 3. Connect the test lamp between the power supply circuit of the exhaust brake solenoid valve wiring harness (Pin 1 of Connector J-31) and the effective grounding line. 4. The engine flames out. Turn on the ignition switch. Is the test light turned on?	—	Go to step 4	Go to step 6
4	1. Turn off the ignition switch 2. Connect the test lamp between the control circuit of the exhaust brake solenoid valve wiring harness (Pin 2 of Connector J-31) and the battery voltage. 3. The engine flames out. Turn on the ignition switch. Is the test light turned on?	—	Go to step 8	Go to step 5

Step	Operating steps	Rated value	Yes	No
5	1. Use a 3A safety jumper to connect the exhaust brake solenoid valve wiring harness connector between Pins 1 and 2 of Connector J-31. 2. Raise the driving wheel or drive the vehicle. 3. Use Tech2 scanning tool to monitor the exhaust brake solenoid valve command parameters and operate the vehicle for the exhaust brake operation. Is DTCP1576 (TSC 6) set, instead of DTCP1576 (TSC 4) when the exhaust brake is applied?	—	Go to step 9	Go to step 7
6	Repair the open circuit or high resistance of the power supply circuit between ECM main relay (Pin 5 of Connector X-14) and the exhaust brake solenoid valve (Pin 1 of Connector J-31). Has the maintenance work been completed?	—	Go to step 13	—
7	1. Check the control circuit between ECM (Pin 40 of Connector B-234) and the exhaust brake solenoid valve (Pin 2 of Connector J-31) for open circuit or high resistance. 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 13	Go to step 10
8	1. Check the control circuit between ECM (Pin 40 of Connector B-234) and the exhaust brake solenoid valve (Pin 2 of Connector J-31) for short circuit to the ground. 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 13	Go to step 12
9	1. Turn off the ignition switch 2. Disconnect the exhaust air brake solenoid valve harness joint. 3. Check the exhaust brake solenoid valve wiring harness connector (Pins 1 and 2 of Connector J-31) for any gap and poor contact. 4. Repair the junction as necessary. Have the above cases been found and corrected?	—	Go to step 13	Go to step 11
10	1. Turn off the ignition switch 2. Disconnect the ECM harness joint. 3. Check the exhaust brake solenoid valve control circuit at ECM wiring harness connector (Pin 40 of Connector B-234) for any gap or poor contact. 4. Repair the junction as necessary. Have the above cases been found and corrected?	—	Go to step 13	Go to step 12

Step	Operating steps	Rated value	Yes	No
11	Replace the exhaust brake solenoid valve. See "Exhaust Brake Solenoid Valve Replacement" in this section. Has the replacement work been completed?	—	Go to step 13	—
12	**Key points:** ECM replacement must be programmed. Replace the ECM. Refer to the contents of "ECM replacement". Has the replacement work been completed?	—	Go to step 13	—
13	1. Re-connect the previously disconnected harness joints. 2. Clear DTC using Tech2 scanning tool. 3. Turn off the ignition switch for 30s. 4. Starting engine 5. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to step 14
14	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the "Diagnostic Trouble Code (DTC) Catalog".	System normal

P1576 (Trouble symptom code8) (flash code 71)
Circuit instructions
The ECM controls the exhaust brake. The brake excites the intake throttling solenoid valve and exhaust brake solenoid valve according to vehicle running situation. The ECM orders each solenoid valve to close all throttling valves as per vacuum pressure. If ECM detects that the exhaust brake solenoid valve control circuit is short circuit to the battery or the ignition switch, DTC will be set.
DTC running conditions
• Ignition switch (ON).
Set DTC conditions.
• When the exhaust brake solenoid is opened with a command, ECM detects that there is a high pressure on the solenoid valve control circuit and lasts for more than 3s.
Operation steps performed while setting DTC
• The ECM turns on the malfunction indicator light in case of diagnosis operation failure.
Clear MIL/DTC conditions
• The ECM turns off the malfunction indicator light in case of favorable diagnosis operation.
• Clear the original DTC after performing continuously 40 times of transmission cycles favorably. Or clear DTC using Tech2 scanning tool.
Diagnostic aid
• If there may be a gap, see “Gap Conditions” in this section.
Test description
For the following numbers, please refer to step serial numbers in the diagnosis table.
3. If the solenoid valve control circuit between ECM and the exhaust brake solenoid valve is normal, the low pressure DTCP1576 (TSC 4) will be set.
DTCP1576(trouble symptom code 8) (flash code 71)
Graphic reference: engine control illustration
Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Operating steps	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. Raise the driving wheel or drive the vehicle. 4. Monitor exhaust brake electromagnetic commands using Tech2 scanning tool while running the vehicle so as to carry out exhaust braking. DTC ignition failure during exhaust braking?	—	Go to step 3	Go to the diagnostic aid procedure
3	1. Turn off the ignition switch 2. Disconnect the exhaust air brake solenoid valve harness joint. 3. Starting engine 4. Monitor DTC information using Tech2 scanning tool. Is DTCP1576 (TSC 4) set, instead of DTCP1576 (TSC 8)?	—	Go to step 5	Go to step 4
4	1. Check the control circuit between ECM (Pin 40 of Connector B-234) and the exhaust brake solenoid valve (Pin 2 of Connector J-31) for short circuit to the battery or the ignition switch. 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 7	Go to step 6

Step	Operating steps	Rated value	Yes	No
5	Replace the exhaust brake solenoid valve. See “Exhaust Brake Solenoid Valve Replacement” in this section. Has the replacement work been completed?	—	Go to step 7	—
6	Replace the ECM. Refer to the contents of “ECM replacement”. Has the replacement work been completed?	—	Go to step 7	—
7	1. Re-connect the previously disconnected harness joints. 2. Clear DTC using Tech2 scanning tool. 3. Turn off the ignition switch for 30s. 4. Raise the driving wheel or drive the vehicle. 5. Monitor exhaust brake electromagnetic commands using Tech2 scanning tool while running the vehicle so as to carry out exhaust braking. DTC ignition failure during exhaust braking?	—	Go to step 3	Go to step 8
8	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P1605 (Trouble symptom code C, D, E) (flash code 55)

Circuit instructions

This diagnosis applies to the complete microprocessor in ECM. EEPROM can store ECM data and the communication data between ECM and other control modules. If ECM detects that there is a fault in ECM storage area, DTC will be set.

Set DTC conditions.

• ECM detects that the records and critical files in EEPROM are damaged (TSC).

• ECM detects that EEPROM data could not be read or recorded during initialization (TSC).

DTCP1605 (Trouble symptom codeC、D、 (flash code 55)

• ECM detects that the sum of EEPROM data is not match with the registered value during initialization.

Operation steps performed while setting DTC

• The ECM turns on the malfunction indicator light in case of diagnosis operation failure.

• ECM replaces the faulty EEPROM with the default EEPROM data (TSC D & E)

Clear MIL/DTC conditions

• The ECM turns off the malfunction indicator light in case of favorable diagnosis operation.

• Clear the original DTC after performing continuously 40 times of transmission cycles favorably. Or clear DTC using Tech2 scanning tool.

Step	Operating steps	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. The engine flames out. Turn on the ignition switch. 4. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to step 4
3	**Key points:** ECM replacement must be programmed. Replace the ECM. Refer to the contents of "ECM replacement". Has the replacement work been completed?	—	Go to step 4	—
4	1. Clear DTC using Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. The engine flames out. Turn on the ignition switch. 4. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to step 5
5	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the "Diagnostic Trouble Code (DTC) Catalog".	System normal

P1625 (Trouble symptom code A) (flash code 76)
Circuit instructions
ECM main relay will be energized when ECM receives "ON" signal of the ignition voltage switch The ECM main relay is powered off after the ignition is OFF for a certain period of time. If ECM detects that ECM main relay is closed before it receives the closing command, DTC will be set.
Set DTC conditions.
• ECM detects that ECM main relay is closed before it receives the closing command.
Operation steps performed while setting DTC
• The ECM doesn't' turn on the malfunction indicator light in case of diagnosis operation failure.
Clear DTC conditions
• Clear the original DTC after performing continuously 40 times of transmission cycles favorably. Or clear DTC using Tech2 scanning tool.
Diagnostic aid
• If there may be a gap, see "Gap Conditions" in this section.
• If ECM main relay fails, DTC will be set.
DTCP1625 (Trouble symptom code A) (flash code 76)
Graphic reference: engine control illustration
Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Operating steps	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. The engine flames out. Turn on the ignition switch. 4. Monitor DTC information using Tech2 scanning tool. 5. Turn off the ignition switch 6. The engine flames out. Turn on the ignition switch. DTC ignition failure?	—	Go to step 3	Go to the diagnostic aid procedure
3	1. Turn off the ignition switch 2. Disconnect the ECM main relay. 3. Check ECM main relay wiring harness connector (Pins 1, 2, 4 and 5 of Connector X-14) for any gap, poor contact and corrosion. 4. Disconnect the ECM harness joint. 5. Check ECM main relay control circuit and battery power supply circuit of ECM wiring harness connector (Pins 3 and 58 of Connector B-234) for any gap, poor contact, and corrosion. 6. Check each ECM main relay circuit for high resistance. 7. If necessary, repair the connectors or circuits. Have the above cases been found and corrected?	—	Go to step 5	Go to step 4
4	Replace the ECM main relay. Has the replacement work been completed?	—	Go to step 5	—

Step	Operating steps	Rated value	Yes	No
5	1. Re-connect the previously disconnected relays or joints. 2. Clear DTC using Tech2 scanning tool. 3. Turn off the ignition switch for 30s. 4. Starting engine 5. Monitor DTC information using Tech2 scanning tool. 6. Turn off the ignition switch 7. The engine flames out. Turn on the ignition switch. DTC ignition failure?	—	Go to step 3	Go to step 6
6	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P1625 (Trouble symptom codeB) (flash code 76)
Circuit instructions
ECM main relay will be energized when ECM receives “ON” signal of the ignition voltage switch. The ECM main relay is powered off after the ignition is OFF for a certain period of time. If ECM detects that ECM main relay is always “ON” when the ignition switch is turned off, DTC will be set.
DTC running conditions
• Ignition switch (ON). **Set DTC conditions.**
• ECM detects that ECM main relay is turned on and lasts for more than 2s.
Operation steps performed while setting DTC
• The ECM doesn’t’ turn on the malfunction indicator light in case of diagnosis operation failure.
Clear DTC conditions
• Clear the original DTC after performing continuously 40 times of transmission cycles favorably. Or clear DTC using Tech2 scanning tool.
Diagnostic aid
• If there may be a gap, see “Gap Conditions” in this section.
• In the event of ECM main relay fault or contact sticking, DTC can be set.
Test description
For the following numbers, please refer to step serial numbers in the diagnosis table.
2. When the ignition switch is turned off, if a DTC appears, Tech2 can communicate with ECM.
DTCP1625 (Trouble symptom codeB) (flash code 76)
Graphic reference: engine control illustration
Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Operating steps	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. Monitor DTC information using Tech2 scanning tool. Is the DTC at fault when the ignition switch is OFF?	—	Go to step 3	Go to the diagnostic aid procedure
3	1. Disconnect the ECM main relay. 2. Monitor DTC information using Tech2 scanning tool. Is the DTC at fault when the ignition switch is OFF?	—	Go to step 6	Go to step 4
4	1. Turn off the ignition switch 2. Disconnect the ECM main relay. 3. Connect the test lamp between the control circuit of ECM main relay wiring harness (Pin X-14 of Connector 4) and the battery voltage. 4. Keep the ignition switch OFF. Is the test light turned on?	—	Go to step 5	Go to step 7
5	1. Check the control circuit between ECM (Pin 58 of Connector B-234) and ECM main relay (Pin 4 of Connector X-14) for short-circuit to the ground. 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 9	Go to step 8

Step	Operating steps	Rated value	Yes	No
6	Repair the short circuit to the battery on the power supply circuit between ECM (Pin 3 of Connector B-234) and ECM main relay (Pin 5 of Connector X-14). Has the maintenance work been completed?	—	Go to step 9	—
7	Replace the ECM main relay. Has the replacement work been completed?	—	Go to step 9	—
8	**Key points:** ECM replacement must be programmed. Replace the ECM. Refer to the contents of "ECM replacement". Has the replacement work been completed?	—	Go to step 9	—
9	1. Reconnect the previously disconnected relay or wiring harness connector. 2. Clear DTC using Tech2 scanning tool. 3. Turn off the ignition switch for 30s. 4. Monitor DTC information using Tech2 scanning tool. Is the DTC at fault when the ignition switch is OFF?	—	Go to step 3	Go to step 10
10	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the "Diagnostic Trouble Code (DTC) Catalog".	System normal

P1630 (Trouble symptom codeA and B) (flash code 51)

Circuit instructions

The ECM calculates the expected fuel injection quantity and time limit according to the data outputted by different sensors. The controller area network (CAN) communication bus transmits the anticipated data to the PCU. PCU also receives internal input signals: the CMP sensor is located in the fuel injection pump and decides the cam ring rotation angle and fuel injection pump speed. The fuel temperature sensor is inside the PCU. The above rated value is compared with the expected rated value outputted by the ECM; then the PCU decides the position of the fuel injection timer piston and the fuel injection quantity; the timing control valve (TCV) and fuel injection solenoid valve are actuated according to the control diagram in the PCU.

The fuel injection solenoid valve is installed behind of the fuel injection pump and the fuel injection process is determined with the solenoid valve ON/OFF commands. When the engine shutoff (ESO) solenoid valve receives a closing command from PCU, the fuel injection solenoid valve will shut off the fuel supply. (The fuel injection solenoid valve and ESO solenoid valve are the same component.) When fuel supply is cut off, it is collectively referred to as ESO solenoid valve.) When the ignition switch is turned off or a command is received from the failsafe step, ESO solenoid valve will be closed with the command, to shutdown the engine operation. If ECM detects that there is a fuel injection solenoid valve control current fault, DTC will be set.

DTCP1630 (Trouble symptom codeA and B) (flash code 51)

Set DTC conditions.

• ECM detects that the fuel injection solenoid valve control current monitored with PCU is too high (TSC A).

• ECM detects that PCU continuously outputs the control current to the fuel injection solenoid valve (TSC B).

Operation steps performed while setting DTC

• The ECM turns on the malfunction indicator light in case of diagnosis operation failure.

• ECM limits fuel injection quantity. (Trouble symptom code A)

• ECM cuts off fuel injection. (Trouble symptom code B)

Clear MIL/DTC conditions

• The ECM turns off the malfunction indicator light in case of favorable diagnosis operation.

• Clear the original DTC after performing continuously 40 times of transmission cycles favorably. Or clear DTC using Tech2 scanning tool.

Diagnostic aid

• If there may be a gap, see “Gap Conditions” in this section.

Caution:

• The fuel injection solenoid valve is located inside the fuel injection pump assembly.

• PCU is part of the fuel injection pump assy.

Step	Operating steps	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. Starting engine 4. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to step 4
3	**Key points:** The fuel injection pump must run synchronously with the engine. Replace the fuel injection pump. See “Fuel Injection Pump Replacement” in the engine mechanical section. Has the replacement work been completed?	—	Go to step 4	—

Step	Operating steps	Rated value	Yes	No
4	1. Clear DTC using Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. Starting engine 4. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to step 5
5	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the "Diagnostic Trouble Code (DTC) Catalog".	System normal

P1650 (Trouble symptom codeA) (flash code 44)
Circuit instructions
The ECM calculates the expected fuel injection quantity and time limit according to the data outputted by different sensors.CAN bus is used to transmit the expected data to PCU and also receives the internal input signals of PCU: CMP sensor is located inside the fuel injection pump to determine the cam ring rotation angle and fuel injection pump speed. The fuel temperature sensor is inside the PCU. The above rated value is compared with the expected rated value outputted by the ECM; then the PCU decides the position of the fuel injection timer piston and the fuel injection quantity; the timing control valve (TCV) and fuel injection solenoid valve are actuated according to the control diagram in the PCU. The ECM monitors the CAN running state as per the constant information of PCU. If ECM detects that PCU receives a signal of CAN controller stop or the bus offline, DTC will be set.
Set DTC conditions.
• ECM detects that PCU received a signal of CAN controller stop or the bus offline.
Operation steps performed while setting DTC
• The ECM turns on the malfunction indicator light in case of diagnosis operation failure.
• ECM cuts off fuel injection. **Clear MIL/DTC conditions**
• The ECM turns off the malfunction indicator light in case of favorable diagnosis operation.
• Clear the original DTC after performing continuously 40 times of transmission cycles favorably. Or clear DTC using Tech2 scanning tool.
Diagnostic aid
• If there may be a gap, see “Gap Conditions” in this section.
DTCP1650 (Trouble symptom codeA) (flash code 44)
Graphic reference: engine control illustration
Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Operating steps	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. The engine flames out. Turn on the ignition switch. 4. Monitor DTC information using Tech2 scanning tool. Is DTCP1651 (TSC A or B) set?	—	Perform applicable DTC.	Go to step 3
3	Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 4	Go to the **diagnostic aid** Procedure
4	1. Turn off the ignition switch 2. Disconnect the PCU harness joint. 3. Use the diagnosis and maintenance monitor to connect CAN bus (Pins 1 and 2 of Connector E-110). 4. Measure the CAN wiring terminal resistance. Is the resistance within the rated value range?	110-130Ω	Go to step 5	Go to step 10
5	1. Connect the diagnosis and maintenance monitor between CAN low-voltage signal circuit (Pin 1 of Connector E-110) and the effective grounding line. 2. The engine flames out. Turn on the ignition switch. Is the diagnostic maintenance monitor voltage within the range of the rated value?	1.5-2.5V	Go to step 6	Go to step 11

Step	Operating steps	Rated value	Yes	No
6	1. Shutdown the engine and keep the ignition switch in "ON" position. 2. Connect the diagnosis and maintenance monitor between CAN high-voltage signal circuit (Pin 2 of Connector E-110) and the effective grounding line. Is the diagnostic maintenance monitor voltage within the range of the rated value?	3.0-4.0V	Go to step 7	Go to step 12
7	1. Turn off the ignition switch 2. Disconnect the PCU harness joint. 3. Disconnect the ECM B-233 harness joint. Connect ECM B-234 wiring harness connector. 4. Connect the diagnosis and maintenance monitor to CAN bus (Pins 99 and 100 of Connector B-233). 5. Measure the CAN wiring terminal resistance. Is the resistance within the rated value range?	110-130	Go to step 8	Go to step 14
8	1. Connect the diagnosis and maintenance monitor between CAN low voltage signal circuit of ECM wiring harness (Pin 1 of Connector E-110) and the effective grounding line. 2. The engine flames out. Turn on the ignition switch. Is the diagnostic maintenance monitor voltage within the range of the rated value?	1.5-2.5V	Go to step 9	Go to step 16
9	1. Shutdown the engine and keep the ignition switch in "ON" position. 2. Connect the diagnosis and maintenance monitor between CAN high-voltage signal circuit of ECM wiring harness (Pin 100 of Connector B-233) and the effective grounding line. Is the diagnostic maintenance monitor voltage within the range of the rated value?	3.0-4.0V	Go to step 13	Go to step 16
10	1. Check CAN low and high voltage circuits between ECM (Pins 99 and 100 of Connector B-233) and PCU (Pins 1 and 2 of Connector E-110) for the followings: • Open circuit • Mutual shorting • High resistance 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 18	Go to step 15
11	1. Check CAN low voltage circuit between ECM (Pin 99 of Connector E-233) and PCU (Pin 1 of Connector E-110) for the followings: • Grounded short circuit • Shorting of battery or ignition switch 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 18	Go to step 17

Step	Operating steps	Rated value	Yes	No
12	1. Check CAN low voltage circuit between ECM (Pin 100 of Connector B-233) and PCU (Pin 2 of Connector E-110) for the followings: • Grounded short circuit • Shorting of battery or ignition switch 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 18	Go to step 17
13	1. Re-connect the previously disconnected harness joints. 2. Clear DTC using Tech2 scanning tool. 3. Turn off the ignition switch for 30s. 4. The engine flames out. Turn on the ignition switch. 5. Monitor DTC information using Tech2 scanning tool. Is DTCP0251 (trouble symptom code E) set?	—	Go to step 16	Go to the diagnostic aid procedure
14	1. Turn off the ignition switch 2. Disconnect the PCU harness joint. 3. Check PCU wiring harness connector (Pins 1 and 2 of Connector E-110) for any gap and poor contact. 4. Repair the junction as necessary. Have the above cases been found and corrected?	—	Go to step 18	Go to step 16
15	1. Turn off the ignition switch 2. Disconnect the ECM harness joint. 3. Check CNN high-voltage circuit of ECM wiring harness connector (Pins 99 and 100 of Connector B-233) for any gap and poor contact. 4. Repair the junction as necessary. Have the above cases been found and corrected?	—	Go to step 18	Go to step 17
16	**Key points:** The fuel injection pump must run synchronously with the engine. Replace the fuel injection pump. See “Fuel Injection Pump Replacement” in the engine mechanical section. (PCU is a part of the fuel injection pump assembly). Has the replacement work been completed?	—	Go to step 18	—
17	**Key points:** ECM replacement must be programmed. Replace the ECM. Refer to the contents of “ECM replacement”. Has the replacement work been completed?	—	Go to step 18	—

Step	Operating steps	Rated value	Yes	No
18	1. Re-connect the previously disconnected harness joints. 2. Clear DTC using Tech2 scanning tool. 3. Starting engine 4. Monitor DTC information using Tech2 scanning tool. DTC ignition failure? Monitor DTC information using Tech2 scanning tool.	—	Go to step 2	Go to step 19
19	Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P1650 (Trouble symptom codeB) (flash code 44)
Circuit instructions
The ECM calculates the expected fuel injection quantity and time limit according to the data outputted by different sensors. The controller area network (CAN) communication bus transmits the anticipated data to the PCU. PCU also receives internal input signals: the CMP sensor is located in the fuel injection pump and decides the cam ring rotation angle and fuel injection pump speed. The fuel temperature sensor is inside the PCU. The above rated value is compared with the expected rated value outputted by the ECM; then the PCU decides the position of the fuel injection timer piston and the fuel injection quantity; the timing control valve (TCV) and fuel injection solenoid valve are actuated according to the control diagram in the PCU.
The ECM monitors the CAN running state as per the constant information of PCU. If ECM detects there is no response from the internal CAN controller, DTC will be set.

DTC P1650 (Trouble symptom codeB) (flash code 44)
Set DTC conditions.
• ECM detects there is no response from the internal CAN controller.
Operation steps performed while setting DTC
• The ECM turns on the malfunction indicator light in case of diagnosis operation failure.
• ECM cuts off fuel injection. **Clear MIL/DTC conditions**
• The ECM turns off the malfunction indicator light in case of favorable diagnosis operation.
• Clear the original DTC after performing continuously 40 times of transmission cycles favorably. Or clear DTC using Tech2 scanning tool.
Caution:
• CAN controller is inside of ECM.

Step	Operating steps	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. The engine flames out. Turn on the ignition switch. 4. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to step 4
3	**Key points:** ECM replacement must be programmed. Replace the ECM. Refer to the contents of "ECM replacement". Has the replacement work been completed?	—	Go to step 4	—
4	1. Clear DTC using Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. Starting engine 4. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to step 5
5	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the "Diagnostic Trouble Code (DTC) Catalog".	System normal

P1651 (Trouble symptom codeA and B) (flash code 45)

Circuit instructions

ECM can calculate the required fuel injection amount and timing with the data from each sensor. The required data can be transmitted to the PCU and PCU can also receive the signals from the following internal inputs via a CAN bus: The fuel injection pump camshaft position (CMP) sensor inside the fuel injection pump can determine the cam ring rotation angle and the injection pump speed. The fuel temperature (FT) sensor is located inside PCU. After these rated values are compared with the desired values from ECM, PCU will determine the fuel injection pump advancer piston position and the fuel injection mount and start the timing control valve (TCV) and the fuel injection solenoid valve based on PCU control chart.

ECM can monitor CAN operation by receiving continuous messages from PCU. If ECM can not receive the predicted PCU information, it will be set based on the lost communication signal types.

Set DTC conditions.

• ECM detects that PCU does not receive CAN messages from ECM. (TSC A)

• ECM does not receive CAN message from PCU. (TSC B)

Operation steps performed while setting DTC

• The ECM turns on the malfunction indicator light in case of diagnosis operation failure.

• ECM cuts off fuel injection. **Clear MIL/DTC conditions**

• The ECM turns off the malfunction indicator light in case of favorable diagnosis operation.

• Clear the original DTC after performing continuously 40 times of transmission cycles favorably. Or clear DTC using Tech2 scanning tool.

Diagnostic aid

• If clearance is suspected, please refer to the contents of “clearance conditions” in this chapter.

DTCP1651 (Trouble symptom codeA and B) (flash code 45)

Graphic reference: engine control illustration

Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Operating steps	Rated value	Yes	No
1	Is the diagnosis system check of engine control unit used?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. Turn off the ignition switch for 30s. 3. Starting engine 4. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to step 4
3	1. Turn off the ignition switch 2. Disconnect the fuel injection pump control module (PCU) connector. 3. Use the diagnosis and maintenance monitor to connect CAN wiring harness (Pins 1 and 2 of Connector E-110). 4. Measure the resistance between CAN terminals. Is the measured resistance within the rated value range?	110-130Ω	Go to step 4	Go to step 9
4	1. Connect the diagnosis and maintenance monitor between CAN low-voltage signal circuit (Pin 1 of Connector E-110) and the effective grounding line. 2. The engine flames out. Turn on the ignition switch. Is the diagnostic maintenance monitor voltage within the range of the rated value?	1.5-2.5V	Go to step 5	Go to step 10

Step	Operating steps	Rated value	Yes	No
5	1. The engine flames out. Keep the ignition switch ON. 2. Connect the diagnosis and maintenance monitor between CAN high-voltage signal circuit (Pin 2 of Connector E-110) and the effective grounding line. Is the diagnostic maintenance monitor voltage within the range of the rated value?	3.0-4.0V	Go to step 6	Go to step 11
6	1. Turn off the ignition switch 2. Reconnect PCU wiring harness connector. 3. Disconnect ECM B-233 wiring harness connector. Connect B-233 wiring harness connector. 4. Connect the diagnosis and maintenance monitor through CAN wiring harness (Pins 99 and 100 of Connector B-233). 5. Measure the resistance between CAN terminals. Is the measured resistance within the rated value range?	110-130Ω	Go to step 7	Go to step 13
7	1. Connect the diagnosis and maintenance monitor between CAN low-voltage signal circuit of ECM wiring harness (Pin 99 of Connector B-233) and the effective grounding line. 2. The engine flames out. Turn on the ignition switch. Is the diagnostic maintenance monitor voltage within the range of the rated value?	1.5-2.5V	Go to step 8	Go to step 15
8	1. The engine flames out. Keep the ignition switch ON. 2. Connect the diagnosis and maintenance monitor between CAN high-voltage signal circuit of ECM wiring harness (Pin 100 of Connector B-233) and the effective grounding line. Is the diagnostic maintenance monitor voltage within the range of the rated value?	3.0-4.0V	Go to step 12	Go to step 15
9	1. Check CAN high and low voltage circuits between ECM (Pins 99 and 100 of Connector B-233) and PCU (Pins 1 and 2 of Connector E-110) for the followings: • Open circuit • Mutual shorting • High resistance 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 17	Go to step 14
10	1. Test the CAN LV circuit between the ECM (B-233 joint pin 99) and PCU (E-110 joint pin 1); check for the following: • Grounded short circuit • Shorting of battery or ignition switch 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 17	Go to step 16

Step	Operating steps	Rated value	Yes	No
11	1. Test the CAN LV circuit between the ECM (B-233 joint pin 100) and PCU (E-110 joint pin 2); check for the following: • Grounded short circuit • Shorting of battery or ignition switch 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 17	Go to step 16
12	1. Re-connect the previously disconnected harness joints. 2. Clear DTC using Tech2 scanning tool. 3. Turn off the ignition switch for 30s. 4. The engine flames out. Turn on the ignition switch. 5. Monitor DTC information using Tech2 scanning tool. Is DTCP0251 (trouble symptom code E) set?	—	Go to step 15	Go to the diagnostic aid procedure
13	1. Turn off the ignition switch 2. Disconnect the PCU harness joint. 3. Check PCU wiring harness connector (Pins 1 and 2 of Connector E-110) for any gap and poor contact. 4. Repair the junction as necessary. Have the above cases been found and corrected?	—	Go to step 17	Go to step 15
14	1. Turn off the ignition switch 2. Disconnect the ECM harness joint. 3. Check CAN low or voltage circuits of ECM connector (Pins 99 and 100 of Connector B-233) for any gap and poor contact. 4. Repair the junction as necessary. Have the above cases been found and corrected?	—	Go to step 17	Go to step 16
15	**Key points:** The fuel injection pump must be timed on the engine. Replace the fuel injection pump. See “Fuel Injection Pump Replacement” in the engine mechanical section (PCU is a part of the fuel injection pump assembly). Has the replacement work been completed?	—	Go to step 17	—
16	**Key points:** ECM replacement must be programmed. Replace the ECM. Refer to the contents of “ECM "replacement.” Has the replacement work been completed?	—	Go to step 17	—

Step	Operating steps	Rated value	Yes	No
17	1. Re-connect the previously disconnected harness joints. 2. Clear DTC using Tech2 scanning tool. 3. Turn off the ignition switch for 30s. 4. Starting engine 5. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 3	Go to step 18
18	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the "Diagnostic Trouble Code (DTC) Catalog".	System normal

P1690 (Trouble symptom code4) (flash code 77)
Circuit instructions
The MIL is located on the dashboard (IPC). The MIL is powered by the battery voltage. The ECM will turn on the MIL via the MIL control circuit. The ECM turns off the MIL after a certain period of time; meanwhile, keep the ignition switch ON and engine flameout.MIL has the following functions:
• MIL can inform the driver of fault occurrence and the vehicle shall be repaired as soon as possible.
• The MIL will be turned on during bulb testing and system testing.
• If the ECM turns on the fault indictor light, DTC will be saved.
If ECM detects that there is open circuit or short circuit in MIL control circuit, DTC will be set.
DTC running conditions
• Ignition switch (ON).
Set DTC conditions.
• When MIL is turned off with a command, ECM detects that there is still a low voltage current on MIL control circuit and lasts for more than 3s.
Operation steps performed while setting DTC
• The ECM doesn't turn on the malfunction indicator light in case of diagnosis operation and failure.
Clear DTC conditions
• Clear the original DTC after performing continuously 40 times of transmission cycles favorably. Or clear DTC using Tech2 scanning tool.
Diagnostic aid
• If clearance is suspected, please refer to the contents of "clearance conditions" in this chapter.
DTCP1690(trouble symptom code 4) (flash code 77)
Graphic reference: engine control illustration
Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Operating steps	Rated value	Yes	No
1	Is the diagnosis system inspection of the engine control unit completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. The engine flames out. Turn on the ignition switch. 3. Conduct the malfunction indicator light (MIL) test using Tech2 scanning tool. 4. Turn on the MIL using Tech2 scanning tool. 5. Is MIL turned on when MIL is turned on with the command on Tech2 scanning tool?	—	Go to step 3	Go to step 4
3	Is MIL turned off when MIL is turned off with the command on Tech2 scanning tool?	—	Go to step 17	Go to step 10
4	1. Turn off the ignition switch 2. Check the instrument (10A) fuse (F-16) in the glove box fuse box. Is the instrument (10A) fuse (F-16) blown?	—	Go to step 5	Go to step 6
5	Replace the instrument (10A) fuse (F-16). If the fuse is still blown, must repair the instrument (10A) fuse (F-16) wiring harness or replace the instrument (10A) fuse (F-5) accessories. Has the maintenance work been completed?	—	Go to step 19	—

Step	Operating steps	Rated value	Yes	No
6	1. Turn off the ignition switch 2. Disconnect ECM connector. 3. The engine flames out. Turn on the ignition switch. 4. Connect a 3A safety jumper between MIL control circuit of ECM wiring harness connector (Pins 42 of Connector B-234) and the effective grounding line. Is MIL turned on?	—	Go to step 11	Go to step 7
7	1. Turn off the ignition switch 2. Remove the dashboard (IPC). 3. Remove MIL bulb from IPC (instrument cluster). Is MIL bulb blown?	—	Go to step 15	Go to step 8
8	1. Disconnect B-51 joint of IPC harness. 2. Connect the test lamp between MIL power supply circuit (Pin 8 of Connector B-51) and the effective grounding line. 3. The engine flames out. Turn on the ignition switch. Is the test light turned on?	—	Go to step 9	Go to step 12
9	1. Turn off the ignition switch 2. Reconnect ECM wiring harness connector. 3. Connect the test lamp between MIL power supply circuit and the control circuit (Pins 4 and 8 of Connector B-51). 4. The engine flames out. Turn on the ignition switch. 5. Use Tech2 scanning tool for MIL testing. 6. Turn on the MIL using Tech2 scanning tool. Is the test lamp turned on when it is turned on with the command on Tech2 scanning tool?	—	Go to step 14	Go to step 13
10	1. Check the control circuit between ECM (Pin 42 of Connector B-234) and IPC (Pin 4 of Connector B-51) for short circuit to the ground. 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 19	Go to step 18
11	1. Turn off the ignition switch 2. Disconnect the ECM harness joint. 3. Check MIL control circuit of ECM wiring harness connector (Pin 42 of Connector B-234) for any gap and poor contact. 4. Repair the junction as necessary. Have the above cases been found and corrected?	—	Go to step 19	Go to step 18

Step	Operating steps	Rated value	Yes	No
12	Repair the open circuit or high resistance on MIL power supply circuit between IPC (Pin 8 of Connector B-51) and the instrument (10A) fuse (F-16). Has the maintenance work been completed?	—	Go to step 19	—
13	Repair the open circuit or high resistance on MIL power supply circuit between ECM (Pin 42 of Connector B-234) and IPC (Pin 42 of Connector B-51). Has the maintenance work been completed?	—	Go to step 19	—
14	1. Turn off the ignition switch 2. Check MIL circuit at IPC connector (Pins 4 and 8 of Connector B-51) for any gap and poor contact. 3. Repair the junction as necessary. Have the above cases been found and corrected?	—	Go to step 19	Go to step 16
15	Replace MIL bulb. Has the replacement work been completed?	—	Go to step 19	—
16	Repair or replace the IPC (instrument cluster). Has the maintenance or replacement work been completed?	—	Go to step 19	—
17	1. Turn off the ignition switch for 30s. 2. Shutdown the engine, turn on the ignition switch and hold it for 10s. 3. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 18	Go to the diagnostic aid procedure
18	**Key points:** ECM replacement must be planned. Replace the ECM. See “ECM Replacement” in this section. Has the replacement work been completed?	—	Go to step 19	—
19	1. Re-connect the previously disconnected fuses or joints. 2. Clear DTC using Tech2 scanning tool. 3. Turn off the ignition switch for 30s. 4. Starting engine 5. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 2	Go to step 20
20	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the “Diagnostic Trouble Code (DTC) Catalog”.	System normal

P1690 (Trouble symptom code8) (flash code 77)
Circuit instructions
The MIL is located on the dashboard (IPC). The MIL is powered by the battery voltage. The ECM will turn on the MIL via the MIL control circuit. The ECM turns off the MIL after a certain period of time; meanwhile, keep the ignition switch ON and engine flameout.MIL has the following functions:
• MIL can inform the driver of fault occurrence and the vehicle shall be repaired as soon as possible.
• The MIL will be turned on during bulb testing and system testing.
• If the ECM turns on the fault indictor light, DTC will be saved.
If ECM detects that MIL control circuit is short circuit to the battery or the ignition switch, DTC will be set.
DTC running conditions
• Ignition switch (ON)
Set DTC conditions.
• When MIL is turned on with a command, ECM detects that there was still a high voltage current on MIL control circuit and lasts for more than 1s.
Operation steps performed while setting DTC
• The ECM doesn't turn on the malfunction indicator light in case of diagnosis operation and failure.
Clear DTC conditions
• Clear the original DTC after performing continuously 40 times of transmission cycles favorably. Or clear DTC using Tech2 scanning tool.
Diagnostic aid
• If clearance is suspected, please refer to the contents of "clearance conditions" in this chapter.
Test description
For the following numbers, please refer to step serial numbers in the diagnosis table.
3. If MIL control circuit between ECM and IPC is normal, the sensor signal low voltage DTCP1690 (TSC 4) will be set.
DTCP1690(trouble symptom code 8) (flash code 77)
Graphic reference: engine control illustration
Joint end face view reference: engine control joint end face view or engine control module joint end face view

Step	Operating steps	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 scanning tool. 2. The engine flames out. Turn on the ignition switch. 3. Conduct the malfunction indicator light (MIL) test using Tech2 scanning tool. 4. Turn on the MIL using Tech2 scanning tool. Is MIL turned on when it is turned with the command on Tech2 scanning tool?	—	Go to the diagnostic aid procedure	Go to step 3
3	1. Turn off the ignition switch 2. Remove the dashboard (IPC) to disconnect IPC wiring harness connector B-51. 3. Disconnect B-51 joint of IPC harness. 4. The engine flames out. Turn on the ignition switch. 5. Monitor DTC information using Tech2 scanning tool. Is DTCP1690 (TSC 4) set, instead of DTCP1690 (TSC 8)?	—	Go to step 5	Go to step 4

Step	Operating steps	Rated value	Yes	No
4	1. Check MIL control circuit between ECM (Pin 42 of Connector B-234) and IPC (Pin 4 of Connector B-51) for short circuit to the battery or the ignition switch. 2. Repair the circuit as necessary. Have the above cases been found and corrected?	—	Go to step 7	Go to step 6
5	Repair or replace the IPC (instrument cluster). Has the maintenance or replacement work been completed?	—	Go to step 7	—
6	**Key points:** ECM replacement must be planned. Replace the ECM. Refer to the contents of "ECM replacement". Has the replacement work been completed?	—	Go to step 7	—
7	1. Re-connect the previously disconnected harness joints. 2. Clear DTC using Tech2 scanning tool. 3. Turn off the ignition switch for 30s. 4. Starting engine 5. Monitor DTC information using Tech2 scanning tool. DTC ignition failure?	—	Go to step 2	Go to step 8
8	Monitor DTC information using Tech2 scanning tool. Is there any DTC which has not been diagnosed yet?	—	Refer to the "Diagnostic Trouble Code (DTC) Catalog".	System normal

Preheater control system check

Description

The preheater control system consists of an ECM (ECM), a preheater plug, and a preheater relay. The electric heating control system is operated at low ECT, to start easily the making the engine. When the engine is shutdown and the ignition switch is ON, ECM command that the preheater relay is ON and lasts for some time. When the engine is operated, in the post preheater stage, the preheater plug is maintained for a period of time.

Preheat control operation

• The preheater control system will be operated when ECT is below 30℃ (86℉).

• The preheater control system will be operated when ECT is below 30℃ (86℉).

Preheating control system check

Graphic reference: engine control illustration

Joint end face view reference: engine control joint end face view

Step	Measure	Rated value	Yes	No
1	Has the engine control diagnosis system testing been completed?	—	Go to step 2	Diagnosis system testing for engine control
2	1. Install Tech2 diagnosis tool. 2. Turn off the ignition switch and last for 30s. 3. Turn on the ignition switch and shut down the engine. 4. Use Tech2 diagnosis tool to monitor DTC information of the engine control system and check for following DTC settings: • P0115 (TC 1 & 2) •P0380 (Trouble Code 4&8) •P0381 (Trouble Code 4&8) Is one or more of the above DTCs set?	—	Perform applicable DTC.	Go to step 3
3	1. Turn off the ignition switch 2. Make sure that the switch-mode battery voltage supply terminal (J-122) is firmly connected to the metal busbars of all the preheater plugs. 3. Turn on the ignition switch and shut down the engine. 4. Connect the test lamp (preheater plug power terminal J-122) between the metal busbar and the effective grounding line. 5. Test the glow relay using Tech2 diagnosis apparatus. 6. Turn on the glow relay using Tech2 diagnosis apparatus while observing the test light. Is the test light on only when the Tech2 diagnosis apparatus orders it to be turned on?	—	Go to step 4	Go to step 5
4	1. Turn off the ignition switch 2. Remove the metal busbars from the preheater plug. 3. Measure the resistance of each preheater plug between each preheater plug terminal and the effective grounding line. Be sure to record all the measurements and make a quick measurement before the engine temperature changes. Is each resistance within the specified value?	1Ω	System normal	Go to step 15

Step	Measure	Rated value	Yes	No
5	1. Turn off the ignition switch 2. Replace the preheater relay with a starter relay or a effective relay. 3. Turn on the ignition switch and shut down the engine. 4. Connect a test lamp between the metal busbars (the preheater plug power connector J-122) and the effective grounding line. 5. Test the glow relay using Tech2 diagnosis apparatus. 6. Turn on the glow relay using Tech2 diagnosis apparatus while observing the test light. Is the test light on only when the Tech2 diagnosis apparatus orders it to be turned on?	—	Go to step 9	Go to step 6
6	Check the preheater (60A) slow-acting fuse (SBF-3) in the fuse & relay box. Is the preheater (60A) slow-acting fuse (SBF-3) opened?	—	Go to step 10	Go to step 7
7	1. Turn off the ignition switch 2. Remove the preheat relay from the fuse & relay box. 3. Connect a test lamp between the voltage supply circuit of the preheat relay terminal (Pin 3 of Connector X-20) and the effective grounding line. 4. Turn on the ignition switch and shut down the engine. Is the test lamp turned on?	—	Go to step 8	Go to step 11
8	1. Turn on the ignition switch and shut down the engine. 2. Connect a test lamp between the preheater plug power supply circuit (Pin 2 of Connector X-20) and the effective grounding line. Is the test lamp turned on?	—	Go to step 13	Go to step 12
9	1. Turn off the ignition switch 2. Check the preheater relay terminals (Pins 2 and 3 of Connector X-20) for disconnection or poor connection. 3. If necessary, repair the connector. Is the fault identified and repaired?	—	Go to step 16	Go to step 14
10	1. Replace the preheater (60A) slow-acting fuse (SBF-3). If the slow-acting fuse is still blown, repair the shorted ground circuit fed by the slow-acting fuse, or check the accessories for short circuit. 2. If necessary, replace the short circuit to the ground or replace the accessories. Have you completed maintenance?	—	Go to step 16	—

Step	Measure	Rated value	Yes	No
11	Repair the open circuit of the battery voltage supply circuit between the preheater (60A) slow-acting fuse (SBF-3) and the preheater relay (Pin 3 of Connector X-20). Have you completed maintenance?	—	Go to step 16	—
12	Repair the open circuit of the switching battery supply circuit between the preheater relay (Pin 2 of Connector X-20) and the preheater plug (Terminal J-122). Have you completed maintenance?	—	Go to step 16	—
13	**Caution:** If the battery voltage supply circuit is short circuit to the voltage source, the preheater plug may be blown. Repair the short circuit to the battery or the short circuit to the ignition voltage on the switching battery voltage supply circuit between the preheater relay (Pin 2 of Connector X-20) and the preheater plug (Terminal J-122). Have you completed maintenance?	—	Go to step 16	—
14	Replace the preheat relay. Have you completed replacement?	—	Go to step 16	—
15	Replace the appropriate preheater plug. Have you completed replacement?	—	Go to step 16	—
16	1. Reconnect the previously disconnected component, relay, fuse, or wiring harness connector. 2. Turn off the ignition switch and last for 30s. 3. Turn on the ignition switch and shut down the engine. 4. Connect a test lamp between the metal busbar (preheater plug power supply connector J-122) and the effective grounding line. 5. Test the glow relay using Tech2 diagnosis apparatus. 6. Turn on the glow relay using Tech2 diagnosis apparatus while observing the test light. Is the test light on only when the Tech2 diagnosis apparatus orders it to be turned on?	—	Go to step 4	Go to step 2

Trouble symptoms - Engine control components
Trouble symptoms — Engine control components
Important preliminary check before start
Perform the diagnosis system check of the engine controls before using TSC and confirm the followings:
• The ECM and MIL are operated normally.
• TDC is not stored or TDC is stored but MIL is not turned on.
• The diagnosis data on Tech2 is within normal operating range. See “Tech2 Diagnosis Data Sheet” in this section.
• Verify the customer fault and identify the correct fault symptom signs in the table of contents. Check the symptom items.
Visual and physical checks
Certain symptoms require careful visual and physical checks, which are very important. The visual and physical checks allow you to correct the faults without further checks and save valuable time. Please confirm the followings:
• ECM base is clean, secure and in the right position.
• The vacuum tube is no knots and is in the correct position. Thoroughly check it for any leakage or blockage.
• The mass air flow (MAF) sensor is installed correctly. The arrow on the plastic part of the sensor must point to the engine.
• The intake pipe is not detached or damaged.
• MAF sensor is no leakage and the sealing surface of the coupling or intake manifold is reliable.
• The engine wiring harness and terminals are correctly connected without pinching or cut-off.
Intermittent fault
Key points:
If there is an intermittent fault, check the electronic components for improper installation. Check the attached electronic devices, lights and on-board phones in after-sale maintenance. Verify that there is no after-sales service connection on the digital circuit marked with keyword 2000 or above. If the intermittent fault location is not identified, it may be caused by the phone communication signals.
Key points:
The fault may cause that MIL is turned on or not, or the DTC is stored or not.
Any wrong electronic connection or wiring harness may be the causes of most intermittent faults. For the following cases, must perform carefully visual and physical checks on the fault connector:
• The connector interface is not matched.
• The terminal is not fixed.
• The terminal is damaged or deformed.
Change or replace the connector terminals in the fault circuit to ensure the proper contact force. Remove the terminal from the connector to check the terminal wiring harness for poor contact.
Connect the multimeter to the fault circuit and carry out the road test for the vehicle. When there are abnormal readings in case of a fault, that the monitored circuit is faulty will be identified fully.
Use Tech2 diagnosis tool to detect the intermittent fault conditions. Tech2 diagnosis tool has the following useful features:
• In case of a fault, the snapshot function is activated to capture and store the engine parameters. Playback the stored information, to check the special operating conditions resulting in the fault.
• Use Plot Feature on Tech2 diagnosis tool to distinct the selected data parameters. Playback the stored information, to identify the intermittent fault. For more information, see Tech2 Diagnosis Tool Use Guidance.
Key points:
If there is an intermittent fault in the beginning, shutdown the engine and check DTC associated with the vehicle anti-theft system. Check the electronic options for improper installation, such as: lights, on-board phones, ECT.
Any of the following items may cause that MIL is turned on and off but DTC data is not stored:
• ECM base is loose and unclean. See Engine Controller Diagram.
• MIL circuit is intermittent short circuit to the ground.
• The electronic system interference is caused by fault relays, ECM-driven solenoid valves or switches. The electronic components can cause violent electronic shocks. This fault usually occurs when a faulty component is operated.
• The diode on the air conditioning compressor clutch is disconnected or any other diode is disconnected.
Key points:
The following TSCs contain several sets of possible causes for each symptom, and the order of these procedures is not important. If no fault is shown from the readings on Tech2 diagnosis tool, perform the procedures in logical order: to start from the easiest or most possible fault. See Engine Control Diagram to determine if a system or component is used on the vehicle.

Use the following list to diagnose the symptoms of a complaint fault:
• Intermittent conditions
• Start difficulties
• Not stable or abnormal idle speed and engine shutdown
• Cylinder shutdown or misfire
• Fuel blasting/intermittent combustion
• Lack of power, slow response or weakness
• Slow response, weak or intermittent power.
• Fuel blasting/combustion noise
• Poor fuel economy
• Excessive smoke (black smoke)
• Excessive smoke (white smoke)

Intermittent conditions

Check	Measure
Definition: The fault is not currently present but is shown in DTC history record. or The customer has a complaint, but if the fault can not be shown as a DTC, the symptom is not currently reproduced.	
Initial check	See Fault Symptoms - Engine Control Components Before Start
Wiring harness/connector	Many intermittent open circuits or short circuits are caused by the movement of the wiring harness/connectors due to vibrations, engine torque, bumps/uneven surfaces, and ECT. Perform the programs in the following list to detect this fault type:
	Move related connectors and wires and monitor the data on the corresponding Tech2 diagnosis tool. Move related connectors and wires, use Tech2 diagnosis tool to indicate that the component ON/OFF and observe the component operation. Move related connectors and wires and monitor the engine operation.
	If the moved wiring harness or connector affects the displayed data or the operation of the component/system or engine, check and repair the wiring harness/connector if necessary. See “Electrical Connections or Circuits”.
Electrical connections or circuits	Poor electrical connections, terminal stress, or wiring faults are the causes of most intermittent faults. Must perform the following checks:
	Check whether the connector interface is not matched or the terminal is incorrectly attached to the connector. Check the terminal for deformation or damage or poor stress. Check the terminals on the circuit for poor contact; for example, the terminal is curled on the insulation layer, which requires that the terminal is removed from the connector.
	Check whether there is corrosion/water entering. The penetration or damage of insulation layer may cause the moisture into the wire, resulting in conductor corrosion in the insulation layer, which is difficult to view from the outside. Check the swelling and hardening part in the fault circuit.
	Check the circuit in the insulation layer for disconnection. Check the wiring harness for pinching, cut-off or friction with each other. Make sure that the wiring harness is not touched with the radiator assembly.

Check	Measure
Control unit power and grounding components - Power and grounding line	Any poor power or grounding connection may cause various fault symptoms.
	Test all control module power circuits. There are multiple circuits to supply the power to the control module on many vehicles. Other components in the system may be equipped with a separate power circuits required for testing. Check the module/component connectors, the fuse connections, and all intermediate connections between the power supply and modules/components. The test lamps or DMMs can be used to indicate the voltage, but they can not be used to detect whether the circuit can carry enough current. Ensure that the circuit can have sufficient current to run components. Test all control module and system grounding circuits. There are multiple ground lines on the control module. Other components in the system may be equipped with separate ground lines required for testing. Check whether the grounding connections are clean and tightened. Test these component connection s and lap joints. Ensure that the circuit can have sufficient current to run components.

Check	Measure
Temperature sensing	Any interrupt fault may occur when the components/connections reach their normal operating temperature. This case only occurs when the components/connections are cooled or heated. If the intermittent fault is heat-related, check the data for the followings: - The ambient temperature is too high - The engine hood/engine is heated excessively - The circuit is heated excessively due to poor connection or high voltage load - The load exceeds the normal load, towing, ECT. If the intermittent fault is cool-related, check the data for the followings: - Under low or very low ambient temperature, the connections or components may be iced. Check them for water entering. - This case occurs only under the cold start conditions. - This case disappears when the vehicle is started. The information provided by the customer may help to determine whether the fault is related to the temperature.
EMI and electronic noise	Some electronic components/circuits are sensitive to EMI or other electronic noises. Check them for the followings: • Incorrect wiring harness is too close to high voltage/high current devices, such as fuel injection components, motor, generator, and ECT. These components may cause the electrical noise on the circuit and can interfere with normal circuit operation. • A faulty relay or EMI is caused by ECM-driven solenoid valve or switch. These cases may cause harsh electronic shocks and usually occurs in case the faulty component operation. • Improper installation of accessories provided by informal manufacturers or for aftermarket repairs, such as lights, two-way radio, amplifier, motor, remote starter, alarm system, cell phone and ECT. These accessories may cause emission-related faults during their use, but there may no error when they are not in use. • Check whether there is any disconnected diode when the air conditioning compressor clutch is closed. Some relays may include a clamp diode. • Check the generator for rectifier damage. This case may cause the air conditioning noise to enter the electronic system.
Incorrect ECM programming	• ECM programming is only appropriate in some cases: **Key points:** Do not reprogram the same software/verification file that has appeared in ECM. This is not a valid maintenance for any type of operational fault. - Install ECM from another vehicle. - Distribute the modified software/calibration file in this vehicle. • Verify whether ECM has the correct software/calibration file. If there is a wrong programming, reprogram ECM with the latest software/calibration file.

Check	Measure
Reproduced fault	• If none of the previous tests succeeds, must try to reproduce and/or capture the fault conditions. • The alternative method is to connect DMM into the fault circuit to drive the engine. If the fault occurs, the abnormal readings on DMM may help for fault identification.
Snapshot	Tech2 diagnosis tool can be installed to take snapshots of the available parameters for sequence data. The snapshot function can be used record the online data in a period of time. The recorded data can be re-analyzed. Tech2 diagnosis tool can also form the charts with the parameters one by one, or form an integrated chart for comparison. The snapshot function can be activated manually when a symptom is detected, or it can be activated earlier when DTC is set. Any abnormal value captured in the recorded data may point to a system or component, for further investigation. For more information on the snapshot function, see “Tech2 Diagnosis Tool User Guidance”.

Difficult starting

Check	Measure
Definition: The engine crankshaft is rotated but the engine can not be started in a long time. The engine is started eventually but it is shutdown immediately after start.	
Preliminary inspection	The diagnosis system check of engine control unit can ensures that the correct engine start-up procedure is used. Check the grounding line of ECM and the fuel injection control unit is clean, sturdy, and in correct position. Check for correct connection of harness connectors. Check the fuel type and quality. Check the data on Tech2 diagnosis tool. Check for ECM software updating for the maintenance manual.
Check the sensor.	Check the engine control sensor for the followings. See “Tech2 Diagnosis Tool Data Sheet” in this section.
	Use Tech2 diagnosis tool to compare ECT with intake temperature (IAT) and fuel temperature (FT) under cold engine conditions. If the temperature reading rating on the cold state engine is higher than 5°C(9°F), check for too high resistance of the low reading circuit and for deflection of the signal circuit sensor.
	Caution: The mass air flow (MAF) sensor is heated; then when the ignition switch is turned on, the IAT sensor may show the rated value higher than the normal IAT.FT sensor is within PCU and is a part of the fuel injection pump assembly.
	Check whether the crankshaft position (CKP) sensor is fastened and the flywheel circumference is damaged.

Check	Measure
Check fuel system	Check the fuel system for the followings. See “Fuel System” section. Check the fuel for water and other debris. Check for external fuel leakage or the fuel leakage into the engine oil. Check fuel lines between the fuel tank and fuel injection pump for tightness, check all fuel hoses for penetration, cracks and correct clamps. **Caution:** **The entire fuel system from the fuel tank to the fuel injection pump is in a compact vacuum when the engine is operated. Therefore, if these connections are not tightened, the air will enter the fuel system, especially at engine high speed and high load conditions, the air in the fuel system may cause the internal pressure fluctuation in the fuel injection pump.** Check the fuel system for air leakage. **Caution:** **If there is a lot of bubbles in the fuel, check that the fuel tubing connections between the fuel tank and the fuel injection pump for tightness and check all fuel hoses for penetration, cracks and correct clamps.** a. Remove the hose connected to the suction side of the fuel injection pump. b. Replace the hose with a clean one. **Caution:** **Hoses must be clean.** c. Connect a clean hose to the fuel injection pump. d. Allow the fuel to flow in the fuel system. e. Run the engine in idle state for more than 2min. f. Accelerate the engine from idle speed to full speed (accelerator pedal full-range) multiple times while observing the clean hose. Check the fuel tank outlet hose for jamming or kinking. Check the fuel tank for foreign objects; any foreign object inhaled and piled into the fuel tube may cause blockage. Suck out the fuel from the fuel tank at the fuel pipe (as close as possible to the fuel tank) led to the fuel accumulation pipeline so as to confirm that the fuel flowing out is clean fuel (using a handheld vacuum pump 5-8840-0279-0/J-23738-A with clean hoses or similar objects). This will ensure that air is not inhaled into the fuel tube due to its rupture. Check the fuel injection pump for operation. **Caution:** The fuel injection pump must be synchronized with the engine. Check for any blockage of the ring bolt or for falling of the filter screen. **Caution:** **If there is any form of blockage, check the fuel for contamination; for example, the fuel filter for after-sales repairs is used or the maintenance interval is prolonged. Check whether the fuel is waxed or frozen due to improper use of fuel types or water entering into the fuel system in the winter.** Check the fuel injection nozzle opening status and the operating pressure for normal operation. **Caution:** Only the first stage of operating pressure can be checked.

Check	Measure
Check the intake air system.	Check for existence of the following of the air intake system: Check whether the air filter and intake pipe are blocked, have holes or leak. Check whether the air inlet pipe of the turbocharger is blocked. Check whether the intake throttling hole is blocked or has sediments. Check whether the intake manifold is blocked or leaks.
Exhaust system check	Check the exhaust system for possible blockage. Refer to the exhaust system part. Check for blockage in the catalytic exhaust purifier or the exhaust pipe.
Mechanical check of engine	Check for existence of the following of the engine's mechanical part. See "Engine Mechanics" section.
	Check for poor compression of the cylinder. The normal compressing force shall be more than 2100kPa(309psi).Is there incorrect mechanical timing (timing gear)? Is there any incorrect valve clearance? Is the valve spring broken or unstable? Check for wear of the convex corner of the camshaft.
Electronic system inspection	Check for existence of the following of the engine's electronic system.See "Engine Electronics" section. Check for operation of the glow plug control (preheating) system. Check whether the start-up speed is too slow. Check whether the battery voltage is too low.

Instability, or abnormal idling, rotation stop

Check	Measure
Definition: It refers to unstable engine operation and even engine or vehicle vibration at idle speed. The engine rotation at idle speed may be changed. Any of the above conditions may be serious enough to cause the engine shutdown.	
Preliminary inspection	Diagnosis system check - Engine controls Dismantle the air filter and check for dirt. Or check whether the air duct is jammed or blocked. Change if necessary. Check whether the grounding line of ECM and the fuel injection pump control unit (PCU) is clean, tightened, and in the correct location. Check for correct connection of harness connectors. Check the fuel type and quality. Check the Tech2 tester data table in this part. Check for ECM software updating for the maintenance manual.

Check	Measure
sensor check	Check for existence of the following of the engine's control sensor. Refer to the contents of "Tech2 tester data table" in this part. Use the Tech2 diagnosis apparatus to compare the ECT, IAT and FT (fuel temperature) when the engine is in cold state. If the temperature reading rating on the cold state engine is higher than 5°C(9°F), check for too high resistance of the low reading circuit and for deflection of the signal circuit sensor. **Caution:** The mass air flow (MAF) sensor is heated, therefore, IAT sensor may show the rated value greater than the normal intake temperature when the ignition switch is turned on. The FT sensor is in the PCU, which is part of the fuel injection pump assy. Use the Tech2 diagnosis apparatus to compare the MAF sensor parameter with the standard MAF parameter. Start the engine and heat (the ECT shall reach at least 60°C[140°F]). The MAF sensor parameter must be in line with the standard MAF parameter and within the scope of ≤100g/stroke. Otherwise, check the intake system, EGR system components and MAF sensor for contamination, skewing or too slow operation. Check whether the crankshaft position (CKP) sensor is fastened and the flywheel circumference is damaged.

Check	Measure
Fuel system check	Check for existence of the following of the fuel system. See “Fuel System” section. • Check whether there are sewage impurities in fuel. • Check for external fuel leakage or for fuel leakage into engine oil. • Check whether the fuel pipeline between the fuel tank and the fuel injection pump is tightened; check for penetration and cracks of all fuel hoses and for correct use of clamps for fuel hoses. **Caution:** **The whole fuel system from fuel tank to fuel injection pump is in a small vacuum during engine running. Therefore, if these connections are not fastened, air will enter the fuel system. The air in the fuel system will result in fluctuation of internal pressure of the fuel injection pump especially when the engine has high speed and large load.** • Check whether there is air in the fuel system. **Caution:** **If there are lots of air bubbles in fuel, check whether the fuel system pipeline between the fuel tank and the fuel injection pump is tightened; in addition, check for penetration and cracks of all fuel hoses and for correct use of clamps for fuel hoses.** a. Dismantle the hose connected on the suction side of the fuel injection pump. b. Replace the hose with a clean one. **Caution:** **Hoses must be clean.** c. Connect the clean hose onto the fuel injection pump. d. Make fuel oil flow in the fuel system. e. Run the engine in idle state for more than 2min. f. Accelerate the engine from idle speed to full speed (accelerator pedal full-range) multiple times while observing the clean hose. • Check fuel tank outlet hose for jamming or kinking. • Check whether there are foreign matters in the fuel tank. Foreign matters may be sucked into the fuel pipeline and accumulate so as to result in blockage. Suck out the fuel from the fuel tank at the fuel pipe (as close as possible to the fuel tank) led to the fuel accumulation pipeline so as to confirm that the fuel flowing out is clean fuel (using a handheld vacuum pump 5-8840-0279-0/J-23738-A with clean hoses or similar objects). This will ensure that air will not be sucked into the fuel pipeline due to fuel accumulation pipe breakage. • Check for fuel injection pump operation. **Caution:** **The fuel injection pump must be synchronous with the engine.** • Check for any blockage of the ring bolt or for falling of the filter screen. **Caution:** **If there is any form of blockage, check the fuel for contamination; for example, the fuel filter for after-sales repairs is used or the maintenance interval is prolonged. Check whether the fuel is waxed or frozen due to improper use of fuel types or water entering into the fuel system in the winter.** • Check the fuel injection nozzle opening status and the operating pressure for normal operation. **Caution:** • Only check operating pressure on the first phase.

Check	Measure
Check the intake air system.	Check for existence of the following of the air intake system: Check whether the air filter and intake pipe are blocked, have holes or leak. Check whether the air inlet pipe of the turbocharger is blocked. Check whether the intake throttling hole is blocked or has sediments. Check whether the intake manifold is blocked or leaks. Check for blockage or damage of the MAF sensor.
Exhaust system check	Check the exhaust system for the followings. See “Exhaust System” section. Check for blockage in the catalytic exhaust purifier or the exhaust pipe.
Mechanical system check of engine	Check for existence of the following of the engine’s mechanical part. See “Engine Mechanics” section.
	Check for poor compression of the cylinder. The normal compressive force should be greater than 2100kPa (309psi). Check whether there is any incorrect mechanical timing. Is there any incorrect valve clearance? Is the valve spring broken or unstable? Check for wear of the convex corner of the camshaft. Whether any incorrect basic part is installed on the engine.
Extra inspection	Any EMI on the related circuit will result in an abnormal engine operation. The Tech2 diagnosis apparatus can detect EMI by monitoring the engine speed. If the speed increases sharply while the actual engine speed doesn’t change basically, this indicates the existence of EMI phenomenon. If the problem exists, check the wiring of high voltage components, e.g. the fuel injection solenoid valve line near the sensor. Check whether the engine suspension system is in poor conditions. Check whether the crankshaft pulley is in poor conditions. Check whether the generator & air conditioning compressor are in poor conditions. Check the output voltage of the generator. Repair if the voltage is lower than 9V or higher than 16V. Check EGR system for normal operation. Check for A/C running.

Shut down, flameout

Check	Measure
Definition: Constant engine vibration with the engine speed, generally referred to as engine load increase. In case of acceleration difficulties at idle speed, low speed or due to lack of fuel, there is a continuous sound during exhaust process, which may cause the engine cylinder operation stop.	
Preliminary inspection	Diagnosis system check - Engine controls Check for correct connection of harness connectors. Check whether the grounding line of ECM and the fuel injection control unit is clean, tightened and in the correct position. Check the Tech2 diagnosis apparatus data of this part. Check for ECM software updating for the maintenance manual.
sensor check	Check for existence of the following of the engine's control sensor. See "Tech2 Diagnosis Tool Data Sheet" in this section: Observe the accelerator pedal position using Tech2 diagnosis apparatus. As the accelerator pedal is operated, the APP indication angle parameter shall increase linearly from 0% to 100%. Check whether the crankshaft position (CKP) sensor is fastened and the flywheel circumference is damaged.

Check	Measure
Fuel system check	Check for existence of the following of the fuel system.See “Fuel System” section. • Check whether there are sewage impurities in fuel. • Check for external fuel leakage or for fuel leakage into engine oil. • Check whether the fuel pipeline between the fuel tank and the fuel injection pump is tightened; check for penetration and cracks of all fuel hoses and for correct use of clamps for fuel hoses. **Caution:** The whole fuel system from fuel tank to fuel injection pump is in a small vacuum during engine running. Therefore, if these connections are not fastened, air will enter the fuel system. The air in the fuel system will result in fluctuation of internal pressure of the fuel injection pump especially when the engine has high speed and large load. • Check whether there is the air in the fuel system. **Caution:** **If there is a lot of bubbles in the fuel, check that the fuel tubing connections between the fuel tank and the fuel injection pump for tightness and check all fuel hoses for penetration, cracks and correct clamps.** a. Dismantle the hose connected on the suction side of the fuel injection pump. b. Replace the hose with a clean one. **Caution:** **Hoses must be clean.** c. Connect a clean hose to the fuel injection pump. d. Make fuel oil flow in the fuel system. e. Run the engine in idle state for more than 2min. f. Accelerate the engine from idle speed to full speed (accelerator pedal full-range) multiple times while observing the clean hose. • Check the fuel tank outlet hose for jamming or kinking. • Check whether there are foreign matters in the fuel tank. Foreign matters may be sucked into the fuel pipeline and accumulate so as to result in blockage. Suck out the fuel from the fuel tank at the fuel pipe (as close as possible to the fuel tank) led to the fuel accumulation pipeline so as to confirm that the fuel flowing out is clean fuel (using a handheld vacuum pump 5-8840-0279-0/J-23738-A with clean hoses or similar objects). This will ensure that air will not be sucked into the fuel pipeline due to fuel accumulation pipe breakage. • Check for fuel injection pump operation. **Caution:** The fuel injection pump must be synchronized with the engine. • Check for any blockage of the ring bolt or for falling of the filter screen. **Caution:** **In case of finding any form of blockage, check whether there are some factors causing fuel pollution; e.g. the customer uses the fuel filter for after-sales maintenance or the maintenance time interval is increased. Check whether this is due to the use of incorrect fuel type in winter or water enters the fuel system so as to result in fuel waxing or icing.**

Check	Measure
Check the intake air system.	Check for existence of the following of the air intake system: Check whether the air filter and intake pipe are blocked, have holes or leak. Check whether the air inlet pipe of the turbocharger is blocked. Check whether the intake throttling hole is blocked or has sediments. Check whether the intake manifold is blocked or leaks. Check for blockage or damage of the MAF sensor.
Extra inspection	Check the output voltage of the generator. Repair if the voltage is lower than 9V or higher than 16V. Any EMI on the related circuit will cause abnormal engine operation. The Tech2 diagnosis apparatus can detect EMI by monitoring the engine speed. If the speed increases sharply while the actual engine speed doesn't change basically, this indicates the existence of EMI phenomenon. If the problem exists, check the wiring of high voltage components, e.g. the fuel injection solenoid valve line near the sensor.

Surge/non-uniform combustion

Check	Measure
Definition: Engine power changes in case of stable throttle and cruise operation. The vehicle is accelerated or decelerated without any change in the accelerator pedal position.	
Preliminary inspection	Diagnosis system testing for engine control Make sure the driver understands the operation of the air conditioning compressor. Use Tech2 diagnosis apparatus to ensure that the vehicle speed parameter reading is in line with the odometer. Check whether the grounding line of ECM and the fuel injection control unit (PCU) is clean, tightened and in correct position. Check for correct connection of harness connectors. Check the fuel type and quality. Check the Tech2 diagnosis apparatus data of this part. Check for ECM software updating for the maintenance manual.
Sensor check	Check for existence of the following of the engine's control sensor. Refer to the contents of "Tech2 tester data table" in this part. Use the Tech2 diagnosis apparatus to compare the MAF sensor parameter with the standard MAF parameter. Start the engine and heat (the ECT shall reach at least 60°C[140°F]). The MAF sensor parameter must be in line with the standard MAF parameter and within the scope of ≤100g/stroke. Otherwise, check whether the intake air system, EGR system components and MAF sensor are polluted, tilted or too slow. Observe the accelerator pedal position using Tech2 diagnosis apparatus. As the accelerator pedal is operated, the APP indication angle parameter shall increase linearly from 0% to 100%.Check the position indication angle of the accelerator pedal under stable conditions. If the indication angle is changed, check the circuit for intermittent open circuit or high resistance, or check the sensor for skewing. Check whether the crankshaft position (CKP) sensor is fastened and the flywheel circumference is damaged.

Check	Measure
Check the fuel system	Check for existence of the following of the fuel system. Refer to the fuel system part. Check whether there are sewage impurities in fuel. Check for external fuel leakage or for fuel leakage into engine oil. Check whether the fuel pipeline between the fuel tank and the fuel injection pump is tightened; check for penetration and cracks of all fuel hoses and for correct use of clamps for fuel hoses. **Caution:** **The whole fuel system from fuel tank to fuel injection pump is in a small vacuum during engine running. Therefore, if these connections are not fastened, air will enter the fuel system. The air in the fuel system will result in fluctuation of internal pressure of the fuel injection pump especially when the engine has high speed and large load.** Check whether there is air in the fuel system. **Caution:** **If there are lots of air bubbles in fuel, check whether the fuel system pipeline between the fuel tank and the fuel injection pump is tightened; in addition, check for penetration and cracks of all fuel hoses and for correct use of clamps for fuel hoses.** **a. Dismantle the hose connected on the suction side of the fuel injection pump.** b. Replace the hose with a clean one. **Caution:** **Hoses must be clean.** c. Connect the clean hose onto the fuel injection pump. d. Make fuel oil flow in the fuel system. e. Run the engine in idle state for more than 2min. f. Accelerate the engine from idle speed to full speed (accelerator pedal full-range) multiple times while observing the clean hose. Check whether the fuel oil tank outlet hose is jammed or twisted. Check whether there are foreign matters in the fuel tank. Foreign matters may be sucked into the fuel pipeline and accumulate so as to result in blockage. Suck out the fuel from the fuel tank at the fuel pipe (as close as possible to the fuel tank) led to the fuel accumulation pipeline so as to confirm that the fuel flowing out is clean fuel (using a handheld vacuum pump 5-8840-0279-0/J-23738-A with clean hoses or similar objects). This will ensure that air will not be sucked into the fuel pipeline due to fuel accumulation pipe breakage. Check for fuel injection pump operation. **Caution:** **The fuel injection pump must be synchronous with the engine.** Check for any blockage of the ring bolt or for falling of the filter screen. **Caution:** **In case of finding any form of blockage, check whether there are some factors causing fuel pollution; e.g. the customer uses the fuel filter for after-sales maintenance or the maintenance time interval is increased. Check whether this is due to the use of incorrect fuel type in winter or water enters the fuel system so as to result in fuel waxing or icing.** Check whether the opening state of the fuel injection nozzle and the operating pressure are normal. **Caution:** **Only the first stage of operating pressure can be checked.** Check whether the timing device runs normally. Observe the actual fuel injection timing parameter using Tech2 diagnosis apparatus when the engine is running. The actual fuel injection timing parameter must be in line with the standard fuel injection timing parameter, and each engine speed shall be within the scope of ≤2°CA. engine idling >about 200rpm>about 3000rpm Otherwise, check for blockage of the fuel system, existence of air in fuel, or normal running of the fuel injection pump.

Check	Measure
Check the intake system	Check for existence of the following of the air intake system: Check whether the air filter and intake pipe are blocked, have holes or leak. Check whether the air inlet pipe of the turbocharger is blocked. Check whether the intake throttling hole is blocked or has sediments. Check whether the intake manifold is blocked or leaks. Check for blockage or damage of the MAF sensor.
Extra inspection	Check the output voltage of the generator. If the generator output voltage is lower than 9V or higher than 16V, must repair it. Check whether the EGR system works normally. Check for A/C running.

Insufficient power, slow reaction or soft pedal

Check	Measure
Definition: The engine output power can not reach the expected value. When the accelerator pedal is applied partly, there is a little or no acceleration.	
Preliminary inspection	Diagnosis system testing for engine control Compare the vehicle with similar units. Ensure that there is a problem with the vehicle indeed. Dismantle the air filter and check for dirt. Or check whether the air duct is jammed or blocked. Change if necessary. Is the tire size changed? Is a heavy load carried? Check for clutch slippage. Check the brake resistance. Check the fuel quality (Cetane index). Check the engine oil level and quality. Use Tech2 diagnosis apparatus to ensure that the vehicle speed parameter reading is in line with the odometer. Check whether the grounding line of ECM and the fuel injection control unit is clean, tightened and in the correct position. Check the Tech2 tester data table in this part. Check for ECM software updating for the maintenance manual.
Check the sensor.	Check for existence of the following of the engine's control sensor. Refer to the contents of "Tech2 tester data table" in this part.
	Use the Tech2 diagnosis apparatus to compare the ECT, IAT and FT (fuel temperature) when the engine is in cold state. If the temperature reading rating on the cold state engine is higher than 5°C(9°F), check for too high resistance of the low reading circuit and for deflection of the signal circuit sensor.
	Caution: **The mass air flow (MAF) sensor is heated; then when the ignition switch is turned on, the IAT sensor may show the rated value higher than the normal IAT. The FT sensor is in the PCU, which is part of the fuel injection pump assy.**
	Use Tech2 diagnosis tool to compare MAF sensor parameters with the standard MAF parameters. Start the engine and heat (the ECT shall reach at least 60°C[140°F]).The MAF sensor parameter must be in line with the standard MAF parameter and within the scope of ≤100g/stroke. Otherwise, check whether the intake air system, EGR system components and MAF sensor are polluted, tilted or too slow. Observe the accelerator pedal position using Tech2 diagnosis apparatus. As the accelerator pedal is operated, the APP indication angle parameter shall increase linearly from 0% to 100%.

Check	Measure
Fuel system check	Check for existence of the following of the fuel system. Refer to the fuel system part. Check whether there are sewage impurities in fuel. Check for external fuel leakage or for fuel leakage into engine oil. Check whether the fuel pipeline between the fuel tank and the fuel injection pump is tightened; check for penetration and cracks of all fuel hoses and for correct use of clamps for fuel hoses. The whole fuel system from fuel tank to fuel injection pump is in a small vacuum during engine running. Therefore, if these connections are not fastened, air will enter the fuel system. The air in the fuel system will result in fluctuation of internal pressure of the fuel injection pump especially when the engine has high speed and large load. • Check whether there is the air in the fuel system. **Caution:** **If there are lots of air bubbles in fuel, check whether the fuel system pipeline between the fuel tank and the fuel injection pump is tightened; in addition, check for penetration and cracks of all fuel hoses and for correct use of clamps for fuel hoses.** a. Dismantle the hose connected on the suction side of the fuel injection pump. b. Replace the hose with a clean one. **Caution:** **Hoses must be clean.** c. Connect a clean hose to the fuel injection pump. d. Make fuel oil flow in the fuel system. e. Run the engine in idle state for more than 2min. f. Accelerate the engine from idle speed to full speed (accelerator pedal full-range) multiple times while observing the clean hose. Check the fuel tank outlet hose for jamming or kinking. Check whether there are foreign matters in the fuel tank. Foreign matters may be sucked into the fuel pipeline and accumulate so as to result in blockage. Suck out the fuel from the fuel tank at the fuel pipe (as close as possible to the fuel tank) led to the fuel accumulation pipeline so as to confirm that the fuel flowing out is clean fuel (using a handheld vacuum pump 5-8840-0279-0/J-23738-A with clean hoses or similar objects). This will ensure that air will not be sucked into the fuel pipeline due to fuel accumulation pipe breakage. Check for fuel injection pump operation. **Caution:** **The fuel injection pump must be synchronous with the engine.** Check for any blockage of the ring bolt or for falling of the filter screen. **Caution:** **In case of finding any form of blockage, check whether there are some factors causing fuel pollution; e.g. the customer uses the fuel filter for after-sales maintenance or the maintenance time interval is increased. Check whether this is due to the use of incorrect fuel type in winter or water enters the fuel system so as to result in fuel waxing or icing.** Check whether the opening state of the fuel injection nozzle and the operating pressure are normal. **Caution:** Only the first stage of operating pressure can be checked. Check whether the timing device runs normally. Observe the actual fuel injection timing parameter using Tech2 diagnosis apparatus when the engine is running. The actual fuel injection timing parameter must be in line with the standard fuel injection timing parameter, and each engine speed shall be within the scope of ≤2°CA. engine idling >about 200rpm>about 3000rpm Otherwise, check for blockage of the fuel system, existence of air in fuel, or normal running of the fuel injection pump.

Check	Measure
Check the intake air system.	Check for existence of the following of the air intake system: Check whether the air filter and intake pipe are blocked, have holes or leak. Check whether the intercooler is blocked or leaks. Check whether the air inlet pipe of the turbocharger is blocked. Check whether the intake throttling hole is blocked or has sediments. Check whether the intake manifold is blocked or leaks. Check for blockage or damage of the MAF sensor. Check for wear or damage of the turbine wheel, connecting shaft or compressor impeller of the turbocharger. Refer to the contents of "turbocharger inspection" in the engine machinery part. Check for operation of the exhaust gas valve of the turbocharger. Refer to the contents of "waste gate inspection" in the engine machinery part.
Exhaust system check	Check for possible blockage of the exhaust system.. Refer to the exhaust system part. Check for blockage in the catalytic exhaust purifier or the exhaust pipe.
Mechanical check of engine	Check for existence of the following of the engine's machinery. See "Engine Mechanics" section.
	Check for poor compression of the cylinder. The normal compressing force shall be more than 2100kPa(309psi).Is there incorrect mechanical timing (timing gear)? Is there any incorrect valve clearance? Is the valve spring broken or unstable? Check for wear of the convex corner of the camshaft.
Extra inspection	Check the output voltage of the generator. Repair if the voltage is lower than 9V or higher than 16V. Check whether the EGR system works normally. Check the engine for overheating. See "Engine Cooling System" section. Check for A/C running.

Slow response, powerless, discontinuous

Check	Measure
Definition: When the accelerator pedal is applied, the vehicle does not respond instantly. This case may occur at any speed, especially when the vehicle is started; in serious case, it may cause the engine shutdown.	
Preliminary inspection	Diagnosis system testing for engine control Compare the vehicle with similar units. Ensure that there is a problem with the vehicle indeed. Dismantle the air filter and check for dirt. Or check whether the air duct is jammed or blocked. Change if necessary. Check for fuel quality (cetane index). Check the engine oil level and quality with “Tech2 Diagnosis Tool Data Sheet” in this section. Check whether the ECM and fuel injection control unit (PCU) ground wire are clear and firm and have correct position. Check for ECM software updating for the maintenance manual.
sensor check	Check for existence of the following of the engine’s control sensor. Refer to the contents of “Tech2 tester data table” in this part. Use the Tech2 diagnosis apparatus to compare the ECT, IAT and FT (fuel temperature) when the engine is in cold state. If the temperature reading rating on the cold state engine is higher than 5°C(9°F), check for too high resistance of the low reading circuit and for deflection of the signal circuit sensor. **Caution:** **The mass air flow (MAF) sensor is heated; then when the ignition switch is turned on, the IAT sensor may show the rated value higher than the normal IAT. The FT sensor is in the PCU, which is part of the fuel injection pump assy.**
	Use the Tech2 diagnosis apparatus to compare the MAF sensor parameter with the standard MAF parameter. Start the engine and heat (the ECT shall reach at least 60°C[140°F]). The MAF sensor parameter must be in line with the standard MAF parameter and within the scope of ≤100g/stroke. Otherwise, check whether the intake air system, EGR system components and MAF sensor are polluted, tilted or too slow. Observe the accelerator pedal position using Tech2 diagnosis apparatus. As the accelerator pedal is operated, the APP indication angle parameter shall increase linearly from 0% to 100%.

Check	Measure
Fuel system check	Check for existence of the following of the fuel system. See “Fuel System” section. Check whether there are sewage impurities in fuel. Check for external fuel leakage or for fuel leakage into engine oil. Check whether the fuel pipeline between the fuel tank and the fuel injection pump is tightened; check for penetration and cracks of all fuel hoses and for correct use of clamps for fuel hoses. **Caution:** **The entire fuel system from the fuel tank to the fuel injection pump is in a compact vacuum when the engine is operated. Therefore, if these connections are not fastened, air will enter the fuel system. The air in the fuel system will result in fluctuation of internal pressure of the fuel injection pump especially when the engine has high speed and large load.** Check whether there is air in the fuel system. **Caution:** **If there is a lot of bubbles in the fuel, check that the fuel tubing connections between the fuel tank and the fuel injection pump for tightness and check all fuel hoses for penetration, cracks and correct clamps.** a. Dismantle the hose connected on the suction side of the fuel injection pump. b. Replace the hose with a clean one. **Caution:** **Hoses must be clean.** c. Connect the clean hose onto the fuel injection pump. d. Make fuel oil flow in the fuel system. e. Run the engine in idle state for more than 2min. f. Accelerate the engine from idle speed to full speed (accelerator pedal full-range) multiple times while observing the clean hose. Check whether the fuel oil tank outlet hose is jammed or twisted. Check whether there are foreign matters in the fuel tank. Foreign matters may be sucked into the fuel pipeline and accumulate so as to result in blockage. Suck out the fuel from the fuel tank at the fuel pipe (as close as possible to the fuel tank) led to the fuel accumulation pipeline so as to confirm that the fuel flowing out is clean fuel (using a handheld vacuum pump 5-8840-0279-0/J-23738-A with clean hoses or similar objects). This will ensure that air will not be sucked into the fuel pipeline due to fuel accumulation pipe breakage. Check for fuel injection pump operation. **Caution:** **The fuel injection pump must be synchronous with the engine.** Check for any blockage of the ring bolt or for falling of the filter screen. **Caution:** **In case of finding any form of blockage, check whether there are some factors causing fuel pollution; e.g. the customer uses the fuel filter for after-sales maintenance or the maintenance time interval is increased. Check whether the fuel is waxed or frozen due to improper use of fuel types or water entering into the fuel system in the winter.** Check whether the opening state of the fuel injection nozzle and the operating pressure are normal. **Caution:** **Only the pressure in the first stage of operation can be checked.** Check whether the timing device runs normally. Observe the actual fuel injection timing parameter using Tech2 diagnosis apparatus when the engine is running. The actual fuel injection timing parameter must be in line with the standard fuel injection timing parameter, and each engine speed shall be within the scope of ≤2°CA. engine idling >about 200rpm>about 3000rpm Otherwise, check for blockage of the fuel system, existence of air in fuel, or normal running of the fuel injection pump.

Check	Measure
Check the intake air system.	Check for existence of the following of the air intake system: Check whether the air filter and intake pipe are blocked, have holes or leak. Check whether the intercooler is blocked or leaks. Check whether the air inlet pipe of the turbocharger is blocked. Check whether the intake throttling hole is blocked or has sediments. Check whether the intake manifold is blocked or leaks. Check for blockage or damage of the MAF sensor. Check for wear or damage of the turbine wheel, connecting shaft or compressor impeller of the turbocharger. Refer to the contents of "turbocharger inspection" in the engine machinery part. Check for operation of the exhaust gas valve of the turbocharger. Refer to the contents of "waste gate inspection" in the engine machinery part.
Exhaust system check	Check for possible blockage of the exhaust system..See "Exhaust System" section. Check for blockage in the catalytic exhaust purifier or the exhaust pipe.
Mechanical system check of engine	Check for existence of the following of the engine's machinery. See "Engine Mechanics" section.
	Check for poor compression of the cylinder. The normal compressing force shall be more than 2100kPa(309psi).Is there incorrect mechanical timing (timing gear)? Is there any incorrect valve clearance? Is the valve spring broken or unstable? Check for wear of the convex corner of the camshaft.
Extra inspection	Check the output voltage of the generator. Repair if the voltage is lower than 9V or higher than 16V. Check whether the EGR system works normally. Check for A/C running.

Fuel deflagration and combustion sound

Check	Measure
Definition: From moderate combustion to severe noise, this case is usually more serious when refueling. The engine sends a harsh metal crash sound with the throttle opening.	
Preliminary inspection	Diagnosis system testing for engine control Ensure that there is a problem with the vehicle indeed. Check whether there is smoke together with the combustion noise. Check for fuel quality (cetane index). Check the Tech2 tester data table in this part. Check for ECM software updating for the maintenance manual.
sensor check	Check for existence of the following of the engine's control sensor. See "Tech2 Diagnosis Tool Datasheet" in this section. Use Tech2 diagnosis tool to compare ECT, intake temperature (LAT) and fuel temperature (FT) under cold engine conditions. If the temperature reading rating on the cold state engine is higher than 5°C(9°F), check for too high resistance of the low reading circuit and for deflection of the signal circuit sensor.
	Caution: **The mass air flow (MAF) sensor is heated; then when the ignition switch is turned on, the IAT sensor may show the rated value higher than the normal IAT. The FT sensor is in the PCU, which is part of the fuel injection pump assy.**
	Use the Tech2 diagnosis apparatus to compare the MAF sensor parameter with the standard MAF parameter. Start the engine and heat (the ECT shall reach at least 60°C[140°F]). The MAF sensor parameter must be in line with the standard MAF parameter and within the scope of ≤100g/stroke. Otherwise, check whether the intake air system, EGR system components and MAF sensor are polluted, tilted or too slow.
	Check whether the crankshaft position (CKP) sensor is fastened and the flywheel circumference is damaged.
Fuel system check	In case of excessive smoke, check the fuel injector nozzle. Remove each preheater plug from the cylinder head and check whether the preheater plug tip is covered with fuel. Use the pressure gauge to check the cylinder pressure. The normal compressive force should be greater than 2100kPa (309psi). If there is a poor compression, check the engine mechanics. Check whether the opening state of the fuel injection nozzle and the operating pressure are normal. **Caution:** **Only the pressure in the first stage of operation can be checked.**
	Check whether the timing device runs normally. Observe the actual fuel injection timing parameter using Tech2 diagnosis apparatus when the engine is running. The actual fuel injection timing parameter must be in line with the standard fuel injection timing parameter, and each engine speed shall be within the scope of ≤2°CA. engine idling >about 200rpm>about 3000rpm Otherwise, check for blockage of the fuel system, existence of air in fuel, or normal running of the fuel injection pump.

Check	Measure
Mechanical system check of engine	Check for existence of the following of the engine's machinery. See "Engine Mechanics" section.
	Check for poor compression of the cylinder. The normal compressing force shall be more than 2100kPa(309psi) Check whether there is any incorrect basic part on the engine, such as camshaft, cylinder head, pistons, ECT.? Check whether excess engine oil enters the combustion chamber.
Extra inspection	Check EGR system for normal operation. Check other causes that may cause similar noise, such as loose components, brackets or suspension systems, and weak clutch springs.

Poor fuel economy

Check	Measure
Definition: From the actual road test and multiple tank measurements, the fuel economy is significantly lower than expected value; the fuel economy on the same vehicle is much lower than the rated value shown in previous road tests.	
Preliminary inspection	Dismantle the air filter and check for dirt. Or check whether the air duct is jammed or blocked. Change if necessary. Check the driver's driving habits. Check whether the air conditioning is fully opened or in defrosting mode. Check whether the tires are at normal pressure. Check whether the tire size is changed. Check whether any heavy load is carried. Check whether the acceleration is too frequent or too hard. Check for clutch slippage. Check the brake resistance. Check the deceleration belt tension. Check for fuel quality (cetane index). Check the engine oil level and quality It is recommended to re-check the fuel economy when the fuel tank is filled fully. It is recommended that the driver reads the main contents on fuel economy. Check the odometer for correct operation. Check for ECM software updating for the maintenance manual.

Check	Measure
sensor check	Check for existence of the following of the engine's control sensor. Refer to the contents of "Tech2 tester data table" in this part.
	Use the Tech2 diagnosis apparatus to compare the ECT, IAT and FT (fuel temperature) when the engine is in cold state. If the temperature reading rating on the cold state engine is higher than 5°C(9°F), check for too high resistance of the low reading circuit and for deflection of the signal circuit sensor..
	Caution: **The mass air flow (MAF) sensor is heated; then when the ignition switch is turned on, the IAT sensor may show the rated value higher than the normal IAT. The FT sensor is in the PCU, which is part of the fuel injection pump assy.**
Fuel system check	Check for existence of the following of the fuel system. See "Fuel System" section.
	Check the fuel type and quality. Check the fuel for leakage.
Cooling system check	Check the cooling system for the followings. See "Cooling System" section.
	Check the engine coolant level. Check whether the thermostat is always on or within the wrong thermal rated value. Check whether the engine cooling fan is always on.
Check the intake air system.	Check for existence of the following of the air intake system:
	Check whether the air filter and intake pipe are blocked, have holes or leak. Check whether the intercooler is blocked or leaks. Check whether the air inlet pipe of the turbocharger is blocked. Check whether the intake throttling hole is blocked or has sediments. Check whether the intake manifold is blocked or leaks. Check for blockage or damage of the MAF sensor.
Exhaust system check	Check for possible blockage of the exhaust system..See "Exhaust System" section.
	Check for blockage in the catalytic exhaust purifier or the exhaust pipe.
Mechanical check of engine	Check for existence of the following of the engine's machinery. See "Engine Mechanics" section.
	Check for poor compression of the cylinder. The normal compressing force shall be more than 2100kPa(309psi)

Excessive smoke (black smoke)

Check	Measure
Definition: There is black smoke from the engine under load, idling, hot or cold starting conditions.	
Preliminary inspection	Ensure that there is a problem with the vehicle indeed. Check whether the ECM and fuel injection control unit (PCU) ground wire are clear and firm and have correct position. Dismantle the air filter and check for dirt. Or check whether the air duct is jammed or blocked. Change if necessary. Check for fuel quality (cetane index). Check for ECM software updating for the maintenance manual.
sensor check	Check for existence of the following of the engine's control sensor. Refer to the contents of "Tech2 tester data table" in this part. Use the Tech2 diagnosis apparatus to compare the ECT, IAT and FT (fuel temperature) when the engine is in cold state. If the temperature reading rating on the cold state engine is higher than 5°C(9°F), check for too high resistance of the low reading circuit and for deflection of the signal circuit sensor. **Caution:** **The mass air flow (MAF) sensor is heated; then when the ignition switch is turned on, the IAT sensor may show the rated value higher than the normal IAT. The FT sensor is in the PCU, which is part of the fuel injection pump assy.** Use the Tech2 diagnosis apparatus to compare the MAF sensor parameter with the standard MAF parameter. Start the engine and heat (the ECT shall reach at least 60°C[140°F]). The MAF sensor parameter must be in line with the standard MAF parameter and within the scope of ≤100g/stroke. Otherwise, check whether the intake air system, EGR system components and MAF sensor are polluted, tilted or too slow. Observe the accelerator pedal position using Tech2 diagnosis apparatus. As the accelerator pedal is operated, the APP indication angle parameter shall increase linearly from 0% to 100%.
Fuel system check	Check for existence of the following of the fuel system. See "Fuel System" section. Check whether the opening state of the fuel injection nozzle and the operating pressure are normal. **Caution:** **Only the pressure in the first stage of operation can be checked.** Check whether the timing device runs normally. Observe the actual fuel injection timing parameter using Tech2 diagnosis apparatus when the engine is running. The actual fuel injection timing parameter must be in line with the standard fuel injection timing parameter, and each engine speed shall be within the scope of ≤2°CA. engine idling >about 200rpm>about 3000rpm Otherwise, check for blockage of the fuel system, existence of air in fuel, or normal running of the fuel injection pump.

Check	Measure
Check the intake air system.	Check for existence of the following of the air intake system: Check whether the air filter and intake pipe are blocked, have holes or leak. Check whether the intercooler is blocked or leaks. Check whether the air inlet pipe of the turbocharger is blocked. Check whether the intake throttling hole is blocked or has sediments. Check whether the intake manifold is blocked or leaks. Check for blockage or damage of the MAF sensor. Check for wear or damage of the turbine wheel, connecting shaft or compressor impeller of the turbocharger. Refer to the contents of “turbocharger inspection” in the engine machinery part.
Exhaust system check	Check for possible blockage of the exhaust system..See “Exhaust System” section. Check for blockage in the catalytic exhaust purifier or the exhaust pipe.
Mechanical check of engine	Check for existence of the following of the engine’s machinery. See “Engine Mechanics” section.
	Check for poor compression of the cylinder. The normal compressing force shall be more than 2100kPa(309psi).Does the engine use incorrect basic components, e.g. camshaft, cylinder head, piston, etc. Check whether excess engine oil enters the combustion chamber. Check whether there any incorrect mechanical timing. Is there any incorrect valve clearance? Is the valve spring broken or unstable? Check for wear of the convex corner of the camshaft.
Extra inspection	Check whether the EGR system works normally. Check for excessive air leakage. Check “Tech2 Diagnosis Tool Data Sheet” in this section.

Excessive smoke (white smoke)

Check	Measure
Definition: There is white smoke from the engine under load, idling, hot start or cold start conditions.	
Preliminary inspection	Ensure that there is a problem with the vehicle indeed. Check whether the ECM and fuel injection control unit (PCU) ground wire are clear and firm and have correct position. Check for fuel quality (cetane index). Check for ECM software updating for the maintenance manual.
sensor check	Check for existence of the following of the engine's control sensor. Refer to the contents of "Tech2 tester data table" in this part. Use the Tech2 diagnosis apparatus to compare the ECT, IAT and FT (fuel temperature) when the engine is in cold state. If the temperature reading rating on the cold state engine is higher than 5°C(9°F), check for too high resistance of the low reading circuit and for deflection of the signal circuit sensor.. **Caution:** The mass air flow (MAF) sensor is heated; then when the ignition switch is turned on, the IAT sensor may show the rated value higher than the normal IAT. The FT sensor is in the PCU, which is part of the fuel injection pump assy. Check whether the crankshaft position (CKP) sensor is fastened and the flywheel circumference is damaged.
Fuel system check	Check for existence of the following of the fuel system. See "Fuel System" section. Check whether the opening state of the fuel injection nozzle and the operating pressure are normal. **Caution:** Only check the pressure on the first phase of operation. Check whether the timing device runs normally. Observe the actual fuel injection timing parameter using Tech2 diagnosis apparatus when the engine is running. The actual fuel injection timing parameter must be in line with the standard fuel injection timing parameter, and each engine speed shall be within the scope of ≤2°CA. engine idling >about 200rpm>about 3000rpm Otherwise, check for blockage of the fuel system, existence of air in fuel, or normal running of the fuel injection pump.
Check the intake air system.	Check for existence of the following of the air intake system: Check whether the air filter and intake pipe are blocked, have holes or leak. Check whether the intercooler is blocked or leaks. Check whether the air inlet pipe of the turbocharger is blocked. Check whether the intake manifold is blocked or leaks. Check for blockage or damage of the MAF sensor. Check for wear or damage of the turbine wheel, connecting shaft or compressor impeller of the turbocharger. Refer to the contents of "turbocharger inspection" in the engine machinery part.

Check	Measure
Mechanical check of engine	Check for existence of the following of the engine's machinery. See "Engine Mechanics" section.
	Check for poor compression of the cylinder. The normal compressing force shall be more than 2100kPa(309psi).Does the engine use incorrect basic components, e.g. camshaft, cylinder head, piston, etc. Check whether there is any incorrect mechanical timing or incorrect valve opening. Is the valve spring broken or unstable? Check for wear of the convex corner of the camshaft. Check whether there is excessive fuel in the combustion chamber. Check whether there is coolant in the combustion chamber.
Electronic system inspection	Check for existence of the following of the engine's electronic system. See "Engine Electronics" section. Check for operation of the glow plug control (preheating) system.

Maintenance instructions

ECM replacement

ECM replacement procedure

Key points:

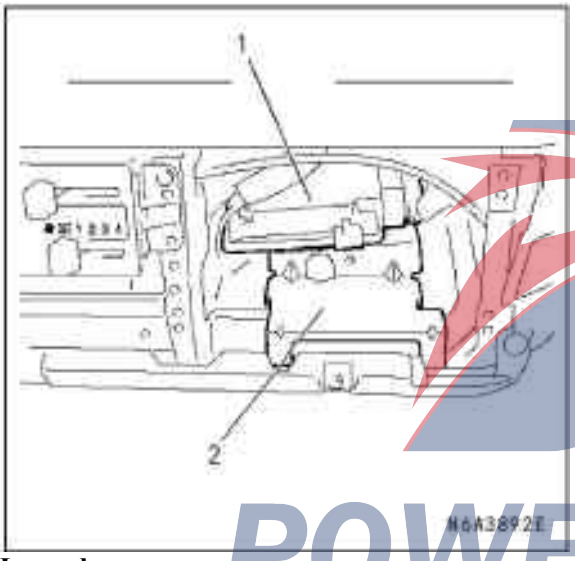
If an ECM is replaced, the following programming must be reprogrammed into the new ECM.

• VIN.

• The latest software/calibration program. See “Service Programming System (SPS)”, “Service Programming System (SPS)” (Remote Operating Procedures) or “Service Programming System (SPS) (Direct Operational Procedures)” in this section.

Dismantling procedure

1. Disconnect the negative battery cable.
2. Remove the cover from ECM unit.
3. Remove a screw from ECM bracket.
4. Disconnect 2 connectors from ECM.



Legend

1.ECM

2. Support

Installation steps

1. Connect 2 connectors to ECM.
2. Place ECM on the bracket and tighten the bolts.
3. Reinstall the cover on ECM unit with 4 screws.
4. Connect the negative battery cable.

VIN programming procedures

Key points:

If an ECM from another vehicle is installed, VIN can not be programmed with Tech2 diagnosis tool. Use SPS to change the initial VIN. See “Service Programming System (SPS)”, “Service Programming System (SPS)” (Remote Operating Procedures) or “Service Programming System (SPS) (Direct Operational Procedures)” in this section.

Key points:

If a newer software/calibration files is issued, do not reprogram VIN immediately. VIN programming is in the SPS procedures. See “Service Programming System (SPS)”, “Service Programming System (SPS)” (Remote Operating Procedures) or “Service Programming System (SPS) (Direct Operational Procedures)” in this section.

1. Connect Tech2 diagnosis tool to the vehicle DLC and turn off the engine and Tech2 diagnosis tool.
2. Turn on Tech2 diagnosis tool.
3. Select “Diagnosis” > “Appropriate Vehicle Logo” > “Powertrain” > 4KH-TC > “Programming” > “VIN Programming”.
4. Enter the correct VIN readings on the vehicle or the attached VIN plate.
5. Select “Lock ECU” and “Lock programmed VIN”.

Maintenance Programming System (SPS) description

SPS enables technicians to program the control unit through the data link connector (DLC). The serial data circuit used with Tech2 diagnosis tool is the same as the information transmission circuit used with DLC and is used to acquire the serial data circuit for diagnosing fault codes (DLC), data display and data clearing. In this step, the software/calibration files matched with the vehicle can be installed.

Most control modules have two types of memories. The software/calibration files are stored in the flash memories as follows:

• Electrically Erasable Programmable Read-Only Memory (EEPROM).

This type of memory allows the selected local memory to be programmed and the other parts to be unchanged.

Some of the known rated values are stored in EEPROM, such as:

- VIN
- Software/calibration file identification number
- Control module safety information

• Flash ROM - Flash memory can increase the storage capacity. During programming, all information in this memory will be erased and the new information will be entered.

Maintenance programming method

There are two ECM programming methods as follows:

• Remote programming

• Through-way programming

For information on above ECM programming methods, see “Service Programming System (SPS)”, “Service Programming System (SPS)” (Remote Operating Procedures) or “Service Programming System (SPS) (Direct Operational Procedures)” in this section.

Before ECM programming

Key points:

Do not program the current ECM with the same software/calibration file package. This step is not a shortcut to correct the operational issues and is an invalid repair. ECM can be programmed only under the followings:

• When a service procedure is required replace ECM. When ECM from another vehicle is installed and VIN must be changed. If necessary, change the vehicle information, such as: drive mode.

• Any updated software/calibration file is issued.

Before ECM programming, check the followings:

• Use the latest software to program PCMCIA card on Tech2 diagnosis tool.

• Install TIS2000 with the latest software.

• Insert the hardware key into the computer port.

• Vehicle system voltage:

- The charging system has no fault. All charging system faults are repaired before ECM programming.

- The battery voltage is higher than 12V and lower than 16V. The battery must be fully charged before ECM programming.

- The battery charger is not connected to the battery.

- Any wrong system voltage or battery charger voltage fluctuation may cause error programming or ECM damage.

- Shutdown or disable any system that may apply a load on the battery. Turn off or disable the following systems:

■ HVAC system.

■ Headlights

■ Interior lights

■ Accessories

• Place the ignition switch in the correct position. Tech2 diagnosis tool can prompt to turn on the ignition switch and maintain the engine off. Do not change the ignition switch position during programming unless otherwise specified.

• Connect correctly all tools:

- RS-232 cable

- DLC connection - Voltage output circuit

• Do not mess the tool wiring harness while programming. If there is an interruption during programming, there may be error programming or ECM damage.

• If a laptop without a power cord is used for direct programming, must make sure the computer internal power is fully charged.

SPS (Remote Operation Procedure)

SPS remote operation procedure has three steps as follows:

1. Connect Tech2 diagnosis tool to the vehicle, so as to get the information from ECM.
2. Connect Tech2 diagnosis tool to the terminal, so as to download the new calibration file from the terminal to Tech2 diagnosis tool memory.
3. Reconnect Tech2 diagnosis tool to the vehicle, so as to upload the new calibration file to ECM.

Execute the remote program

1. Connect Tech2 diagnosis tool to the vehicle, so as to obtain ECM information with following steps:

Key points:

Make sure that ECM is installed in the vehicle and the battery is fully charged before programming.

a. Connect Tech2 diagnosis tool to DLC and shutdown the engine and Tech2 diagnosis tool.

b. Turn on the Tech2 diagnosis apparatus.

c. Type “Enter” on the title screen

d. Turn on the ignition switch and shut down the engine.

e. Select “Maintenance Programming System” in the “Main Menu”

f. Select “Request Information”

g. If there is any data stored on Tech2 diagnosis tool, the current data will be shown on the screen. Tech2 diagnosis tool will allow the user to select “Save Data” for data storage, or select “Continue” to request ECM to provide new vehicle information. If there is no data in Tech2 diagnosis tool, it will immediately start the vehicle verification.

h. Follow the instructions on the screen to enter the vehicle description about the VIN on the nameplate or the attached VIN plate.

i. Tech2 diagnosis tool receives information from all modules at the same time during the information collection. However, only ECM information is shown on the screen.
j. Close all accessories and select “Continue”.
k. Verify that the correct VIN is entered in Tech2 diagnosis tool. If it is wrong, enter the correct VIN.
2. Turn off the Tech2 diagnosis apparatus..
3. Disconnect the Tech2 diagnosis apparatus from the vehicle.
4. Turn off the ignition switch
5. Transmit the data from the terminal to Tech2 diagnosis tool with following these steps:

Key points:

TIS uses only Tech2 diagnosis tool to support the maintenance programming.

a. Connect Tech2 diagnosis tool to the terminal.
b. Install TIS program into the terminal.
c. Select “Maintain Programming System” on the main screen,
d. Highlight the following message on “Select Diagnosis Tool and Programming Process” screen:
• Select “Diagnosis Tool” and “Tech2 Diagnosis Tool”.
• Select “Programming Process” – Identify that the current ECM is being programmed or is replaced with a new ECM.
• Select “ECU Location” - select “Vehicle”.
e. Select “Next”.
f. Confirm the connection on “Prepare Communication” screen and select “Next”.
g. Confirm VIN on “Confirm VIN” screen and select “Next”.

Key points:

If the ECM is replaced with a new one, VIN will not be shown. Input correct VIN reading according to the inscribed VIN or the VIN plate on the vehicle. If the installed ECM is the ECM of another vehicle, input the correct VIN using the same method:

h. If requested, highlight “Engine” on “System Type” screen and select “Next”:
i. Enter the following information based on the service ID plate on “Confirm Vehicle Data” screen until “Next” is highlighted:
• Model
• Vehicle model year
• Engine
• Transmission mode
• Target code
j. Select “Next”
k. Confirm the selection on “Overview” screen.

Key points:

If there is a maintenance guidance along with the calibration file, see the service guidance before performing maintenance programming.

Key points:

If a message that the selected calibration file is already the current calibration file in ECM and does not allow reprogramming with the same downloaded file is received, select “Cancel”.

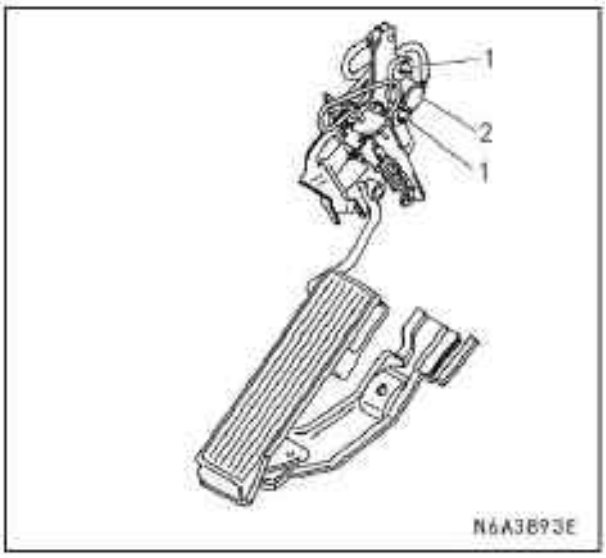
l. Select “Reprogramming”.
m. “Transmit Data” screen will appear until the progress bar is up to 100%.
6. Once it is downloaded, close the application software and return to “TIS Software Selection” screen.
7. Turn off Tech2 diagnosis tool.
8. Disconnect Tech2 diagnosis tool from the terminal.
9. Transmit the data from Tech2 diagnosis tool to ECM with the following steps:
a. Connect Tech2 diagnosis tool to the vehicle DLC when the engine and Tech2 diagnosis tool are disabled.
b. Turn on the Tech2 diagnosis apparatus.
c. Type “Enter” on the title screen.
d. Turn on the ignition switch and shut down the engine.
e. Select “Maintenance Programming System”.
f. Select “ECM Programming” on Tech2 diagnosis tool.
g. Follow the instructions on the screen to select “Continue”.
h. “Programming” message will appear until the programming progress bar is up to 100%.

Key points:

For the vehicle fitted with automatic transmission, the Check Trans may flash during ECM programming due to interruption of the communication between ECM and TCM. Clear DTC in all modules after programming.

i. Select “Continue” and exit the program when “Programming Success” is shown on Tech2 diagnosis tool.
10. Turn off the ignition switch
11. Turn off the Tech2 diagnosis apparatus.
12. Disconnect the Tech2 diagnosis apparatus from the vehicle.

SPS (Direct Operational Procedures)
The direct programming allows Tech2 diagnosis tool to connect to the terminal and the vehicle during the programming process. When the direct programming is used, the vehicle must be very close to the terminal.
Key points:
TIS only uses Tech2 diagnosis tool to support the maintenance programming.
1. Install TIS software onto the terminal.
2. Select "Maintain Programming System" on the main screen.
3. Highlight the following message on "Select Diagnosis Tool and Programming Process" screen:
• Select "Diagnosis Tool" – "Direct"
• Select "Programming Process" – verify that the current ECM is being programmed or is replaced with a new ECM.
• Select "ECU Position" and select "Engine".
4. Select "Next"
5. Enter all the vehicle data on "Prepare Communication/Verify Vehicle" screen until "Next" is highlighted.
6. Select "Next".
7. Follow the instructions on "Prepare Communication" screen.
Key points:
To reduce the potential signal loss, RS-232 cable length should not exceed 25 ft.
8. Select "Next".
9. Confirm VIN on "VIN" screen and select "Next".
Key points:
If the ECM is replaced with a new one, VIN will not be shown. Input correct VIN reading according to the inscribed VIN or the VIN plate on the vehicle. If the installed ECM is the ECM of another vehicle, input the correct VIN using the same method:
10. If requested, highlight "Engine" on "System Type" screen and select "Next":
11. Follow Maintenance ID card on "Confirm Vehicle Data" screen to fill in the following information until "Next" is highlighted:
• Model
• Vehicle model year
• Engine
• Transmission mode
• Target code
12. Select "Next".
13. Confirm the selection on "Overview" screen.
Key points:
If there is a maintenance guidance along with the calibration procedure, see the service guidance before performing maintenance programming.
Key points:
If a message that the selected calibration file is already the current calibration file in ECM and does not allow reprogramming with the same downloaded file is received, select "Cancel".
14. Select "Reprogramming".
15. "Transmit Data" screen will appear until the progress bar is up to 100%.
Key points:
For the vehicle fitted with automatic transmission, the Check Trans may flash during ECM programming due to interruption of the communication between ECM and TCM. Clear DTC in all modules after programming. Select "End" on "Programming End" screen.
16. Turn off Tech2 diagnosis tool.
17. Disconnect the Tech2 diagnosis apparatus from the vehicle.
Accelerator pedal position (APP) sensor replacement
Dismantling steps
1. Disconnect the battery negative cable.
2. Disconnect APP and the idle connector.
3. Remove the accelerator pedal assembly from the bracket.
4. Loosen 2 nuts and remove APP from the accelerator pedal bracket.

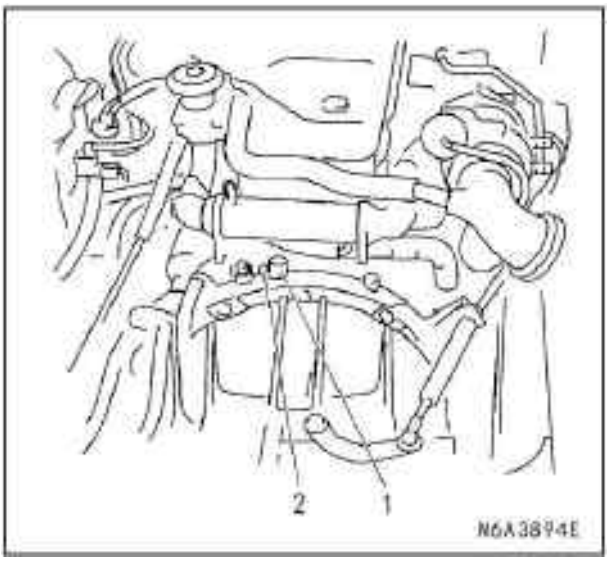


Legend
1. Accelerator Pedal Position (APP) sensor
2. Nut

Installation steps
1. Temporarily tighten APP with two nuts.
2. Re-install the accelerator pedal bracket on the accelerator pedal body.
3. Connect the idling switch and APP connector.
4. Connect Tech2 diagnosis tool to the vehicle.
5. Connect the battery negative cable.
6. Select “Data Display” on Tech2 diagnosis tool.
7. Check the accelerator pedal position data and adjust APP position.
8. Tighten 2 nuts.

Crankshaft position (CKP) sensor replacement

Dismantling steps
1. Disconnect the battery negative cable.
2. Disconnect the connector from CKP sensor.
3. Loosen 1 bolt and remove CKP sensor from the clutch housing.



Legend
1. Crankshaft position (CKP) sensor
2. Bolt

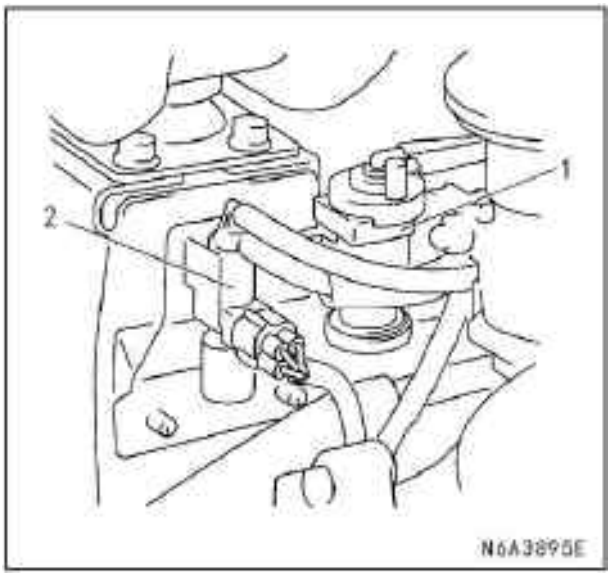
Installation steps
1. Install CKP sensor on the clutch housing.
2. Tighten CKP sensor to the specified torque with the specified tool.

Tightening torque:
Bolt **tightening torque:** 8.0-12.0N.m (0.8-1.2kg_m/5.9-8.9lb.ft)

3. Connect CKP sensor connector to CKP sensor.
4. Connect the battery negative cable.

EGR solenoid valve replacement

Dismantling steps
1. Disconnect the battery negative cable.
2. Disconnect EGR solenoid valve connector from EGR solenoid valve.
3. Disconnect 2 hoses from EGR solenoid valve.
4. Loosen 2 nuts and remove ERG solenoid valve from the bracket.



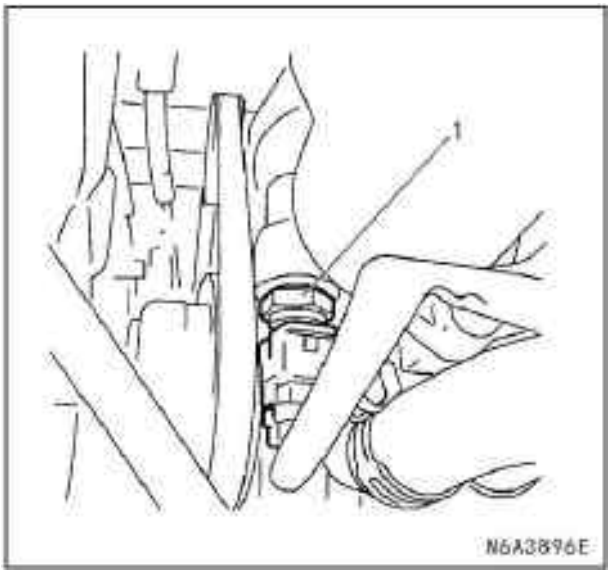
Legend
1. ECT sensor
2. Intake throttle solenoid valve

Installation steps
1. Fasten the solenoid valve with 2 screws.
2. Connect EGR solenoid valve connector.
3. Connect 2 hoses to EGR solenoid valve.
4. Connect the battery negative cable.

ECT sensor replacement

Dismantling steps
1. Remove the negative battery cable.
2. Drain the engine coolant completely so that the coolant level is below ECT sensor.
3. Disconnect the connector from ECT sensor.
4. Loosen and remove ECT sensor from the thermostat housing.

Caution:
Cool the engine before performing the above steps.



Legend
1. Engine coolant temperature (ECT) sensor

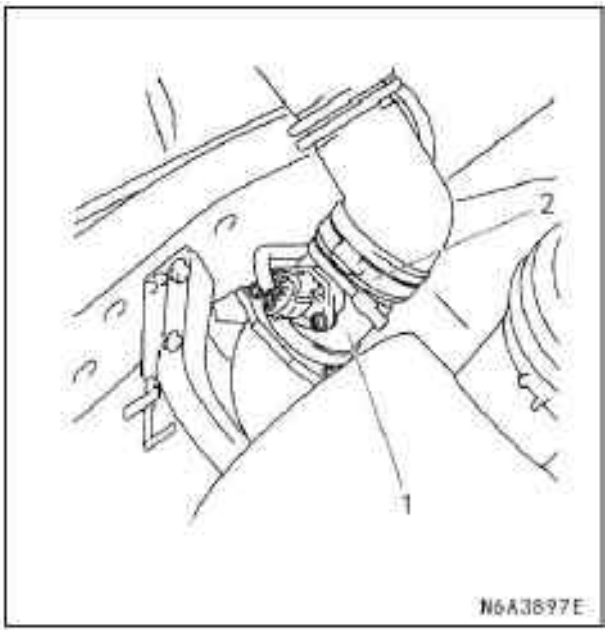
Installation steps
1. Seal the thread on ECT sensor screws.
2. Fasten ECT sensor to the specified tightening torque.

Tightening torque:
Bolt **tightening torque:** 13N.m (1.3kg.m/9.6lb.ft)
3. Connect ECT sensor connector to the sensor.
4. Fill fully the engine coolant.
5. Connect the battery negative cable.

Caution:
Confirm that there is no DTC after replacement. Verify that there is no engine coolant leakage at the sensor thread after the replacement.

MAF & IAT sensor replacement

Dismantling steps
4. Disconnect the battery negative cable.
5. Disconnect MAF & IAT sensor connector from MAF & IAT sensor assembly.
6. Loosen the clip and remove MAF & IAT sensor assembly from the intake manifold housing.

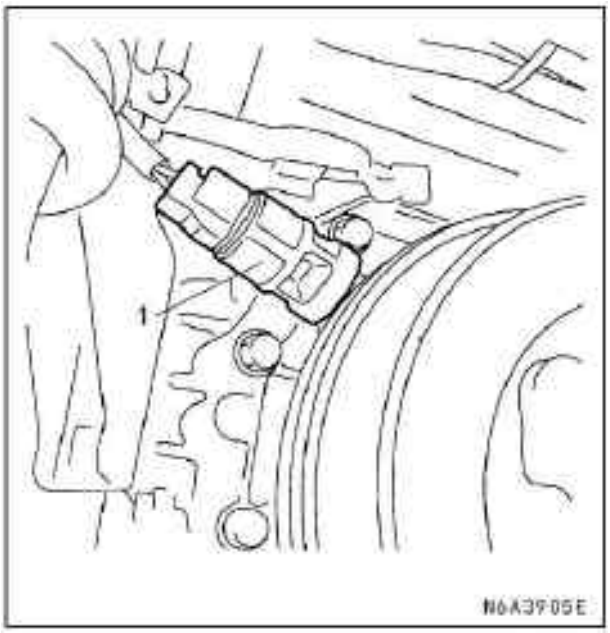


Legend
1. MAF & IAT sensor
2. Hoop

Installation procedures
1. Install MAF & IAT sensor assembly onto intake manifold.
2. Tighten the hoop.
3. Connect MAF & IAT sensor connector to MAF & IAT sensor assembly.
4. Connect the battery negative cable.

Vehicle speed sensor (VSS) replacement

Dismantling procedure
1. Disconnect the battery negative cable.
2. Disconnect the vehicle speed sensor connector.
3. Loosen and remove the vehicle speed sensor.



Legend
1. Vehicle speed sensor (VSS)

Installation procedures
1. Tighten the vehicle speed sensor to the specified tightening torque.

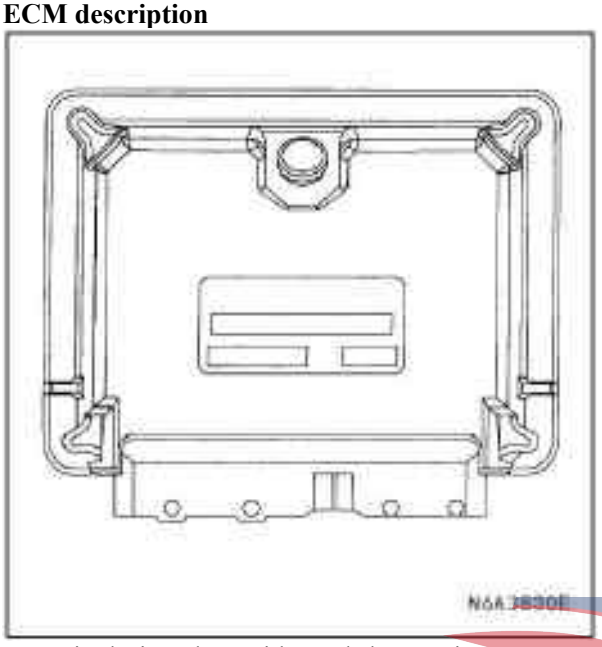
Tightening torque:
Sensor hex part **tightening torque:** 25N.m (2.5kg.m/18psi)

Warning:
Must tighten the sensor at the hex part; if the sensor is tightened at the body, it may be damaged.

2. Connect the vehicle speed sensor connector to the vehicle speed sensor.
3. Connect the battery negative cable.

Description and operation

ECM description



ECM is designed to withstand the maximum normal current under the vehicle operation. Must avoid any circuit overloading. When any open circuit or short circuit is tested, do not apply the power supply voltage to any ECM circuit unless otherwise specified. At some times, these circuits can only be tested with a digital multimeter. ECM Must be connected with its wiring harness.

ECM is behind the dashboard radio and has the mainly controls as follows:

• Fuel system control
• EGR system control
• Preheater system control
• Air conditioning compressor control
• Exhaust brake valve control
• On-board diagnosis of engine control

ECM can continually observe the information from different sensors, control the systems that affect the vehicle performance, perform the system diagnosis, identify the operating faults, warn the driver with a MIL and store DTC to identify the system fault, to provide the helps for technician's services.

ECM voltage description

ECM can provide a variety of switches and sensors with the buffer voltage, because its rated resistance is so high that the test lamp may not be turned on when it is connected to the circuit. The voltage meter bought from the common shop may not provide accurate readings, because its output resistance is too small. A DMM with 10ohm output resistance can ensure accurate voltage readings. The output and/or output devices in ECM include an analog-to-digital converter, a signal buffer, a counter, and a dedicated drive. ECM uses the electronic switches to control most of the components. A complete grounding circuit can be formed when these electronic switches are turned on.

Electronic and vacuum equipment for after-sales services

The electronic and vacuum equipment for after-sales services or additional addition mean all the equipment attached to the electronics or vacuum systems after the vehicles are shipped from the factory. Such equipment are not allowed in the original design of the vehicles. The vehicle should not be equipped with additional vacuum equipments, and the additional electronic equipment must only be connected with the electronic systems at the power supply and the grounding line. Even if any additional electronic equipment is installed in accordance with this principle, it still may cause the power system fault. It may also include electronic systems that are not connected to the vehicle, such as on-board telephone and radio. Therefore, the first step in powertrain fault diagnosis is to remove all electronic systems from the vehicle; after that, if there is still a fault, it should be diagnosed under normal status.

Electrostatic discharge damage

The electronic components used in ECM are usually designed to carry a very low voltage. The electronic components are easily affected by damage caused by electrostatic discharge. By comparison, the shock of an electrostatic discharge under almost 4,000V can be felt. There are many ways of electrostatic discharge and the most common ways include friction and sensing.

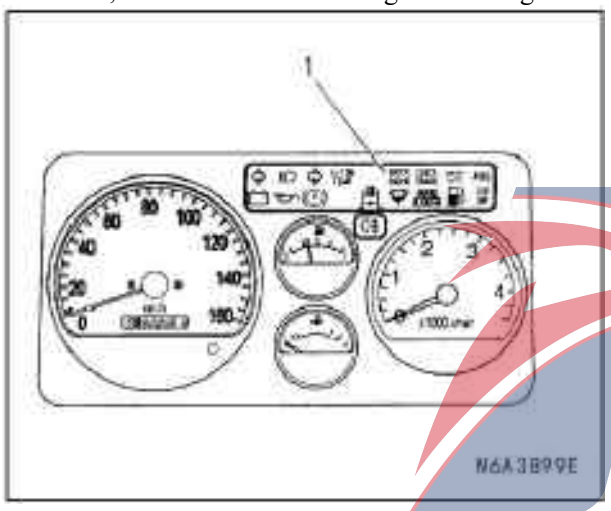
• An example of the friction discharge is that a person slides across a seat.

Key points:

Please follow the instructions below to prevent any potential electrostatic discharge damage:

• Do not touch ECM connector pin or a separate component on ECM wiring board.
• Do not open the package of the replacement part before the part is installed.

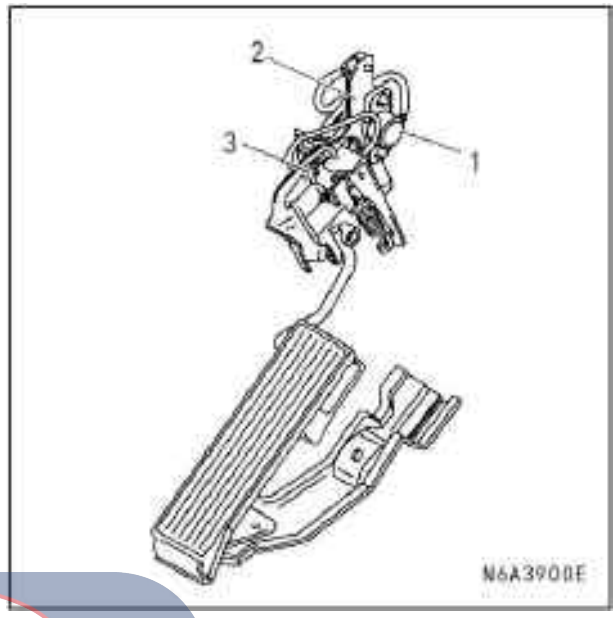
• Before a part is removed from its package, connect the part package to the effective grounding line in the vehicle.
• When a person slides over a seat and a person sits down from a standing position or walks for a distance, if the part has been handled, it should be touch the effective grounding line before installation.
• The inductive discharge occurs when a person wearing insulated shoes stands next to am object with high discharge and momentarily touches the ground. The same electrode discharge is slowly weakened, which makes the person carrying a high opposite voltage.MIL operation
MIL is located on the dashboard (IPC). When MIL is turned on, it will show “Check Engine” message.



Legend
1. MIL

MIL indicates a discharge or performance fault and is required for repair. The following is a list of MIL operation modes:
• MIL will be turned on and last for about 2s when the ignition switch is turned on when the engine is shutdown. It is the lamp test to ensure that MIL can be turned on.
• If a fault is detected with ECM module, MIL can still be turned on after the engine is started. Once ECM turns on MIL due to emission or performance fault, a DTC will be stored.

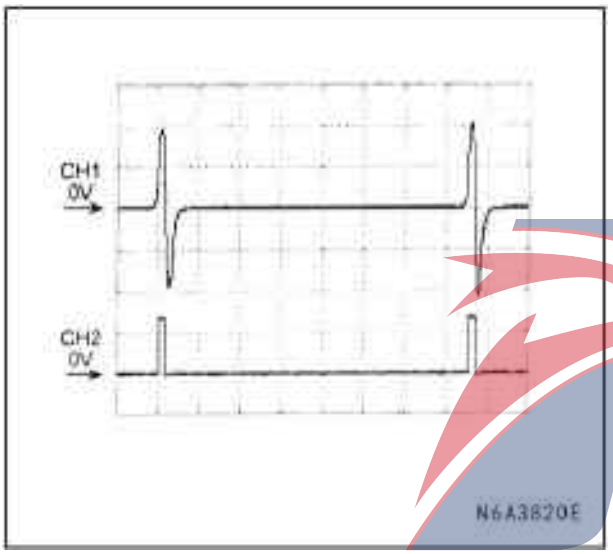
Description of the engine control module (ECM)
Accelerator pedal position sensor (APP) & idling switch



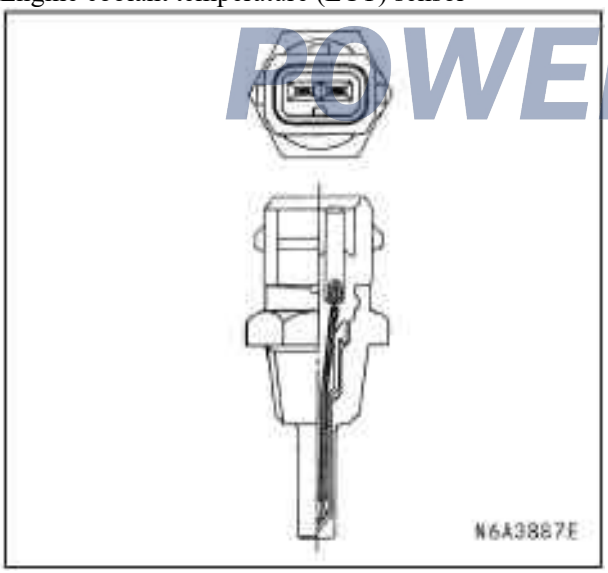
Legend
1. Accelerator pedal position (APP) sensor
2. Accelerator pedal bracket
3. Idling switch

The accelerator pedal position sensor is installed on the accelerator pedal bracket. ECM uses APP sensor to determine the driver’s acceleration or deceleration control with the fuel injection.
The idling switch is also mounted on the accelerator pedal bracket. The idling switch is normally closed. When the accelerator pedal is released, the idling switch signal delivered to ECM is at a low voltage.
Crankshaft position (CKP) sensor

The crankshaft position (CKP) sensor is located at the top of the flywheel. There are 4 90° slits around the flywheel. CKP sensor is a magnetic coil sensor that generates an AC signal voltage based on the crankshaft speed. ECM can monitor the signals from CKP sensor and the injection pump crankshaft position (CMP) sensor to ensure their correlation.
The following waveform can help the diagnosis on oscilloscopes or the likes.
• When the engine is accelerated, the amplitude of CKP sensor signal (CH1) will be increased.
• When the engine is accelerated, the length of each waveform will be shortened.



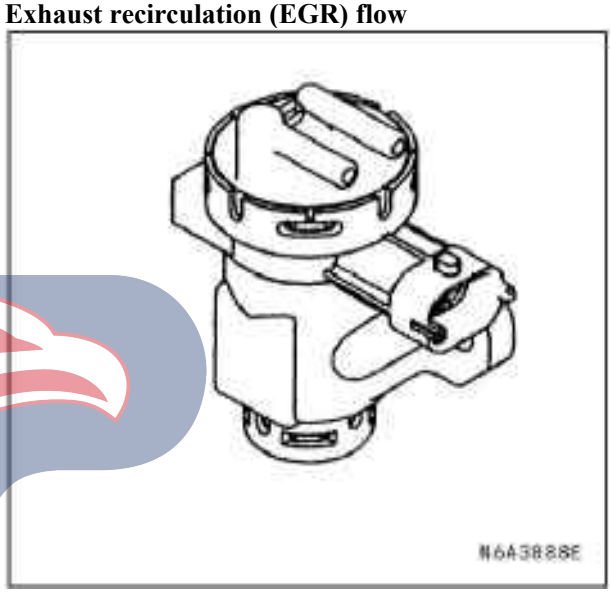
Engine coolant temperature (ECT) sensor



Legend
1. Engine coolant (ECT) sensor

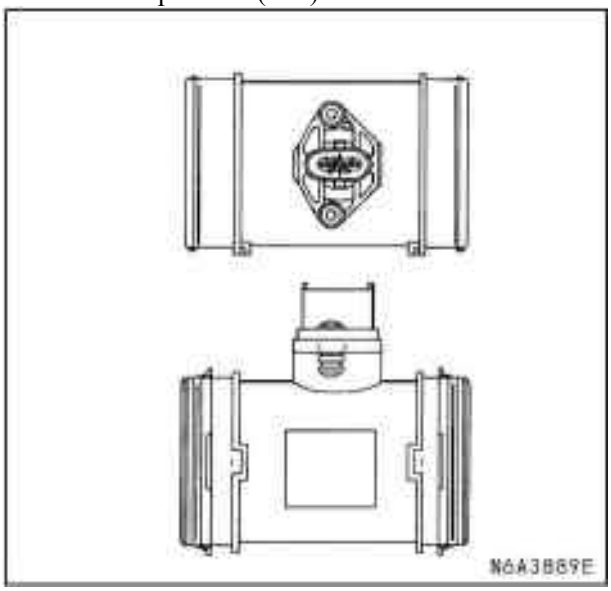
ECT sensor is mounted on the thermostat housing. ECT sensor is a variable resistor that measures the engine coolant temperature. ECM supplies a 5V voltage to ECT signal circuit and provides the power cord to ECT low interference circuit. The sensor resistance is high when ECT sensor is cold. As ECT increase, the sensor resistance will be decreased. If the sensor resistance is high, ECM detects that there is a high voltage on ECT signal circuit; if the sensor resistance is low, ECM detects there is a low voltage on ECT signal circuit.

Exhaust recirculation (EGR) flow



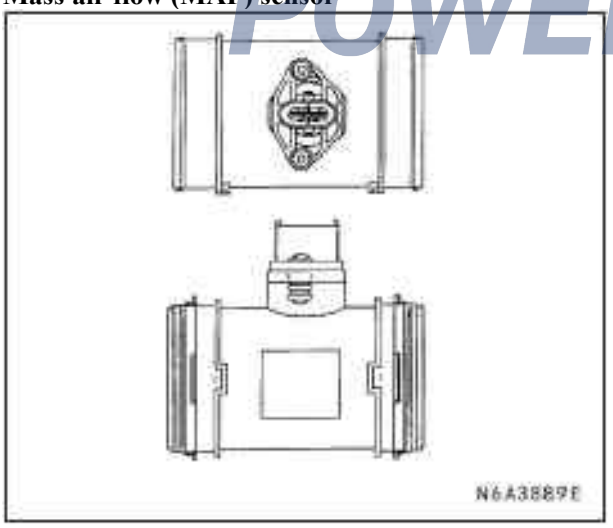
ECM can control the exhaust recirculation (EGR) flow based on engine speed, ECT, intake temperature, barometric pressure, and fuel injection. ECM can control EGR air flow monitored with MAF sensor by controlling EGR solenoid valve. When the engine is operated, it can detect a certain amount of MAF.

Intake air temperature (IAT) sensor



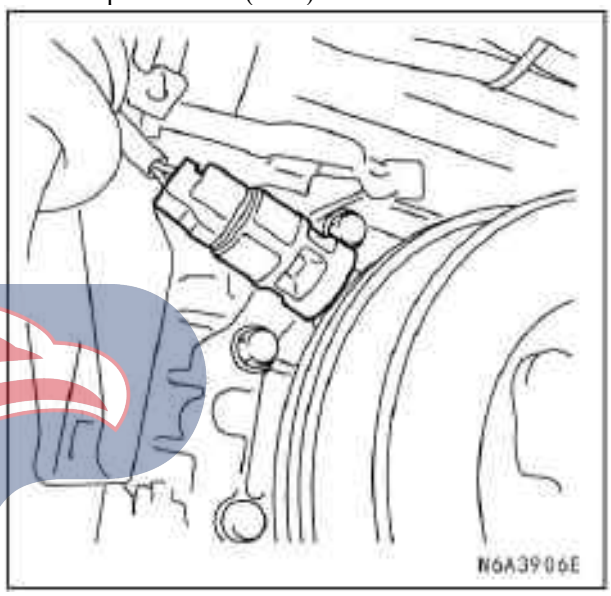
IAT sensor is installed in the intake duct between the air filter and the turbocharger, together with the mass air flow (MAF) sensor. IAT sensor is a variable resistor. The IAT sensor can measure the engine intake temperature. ECM can provide a 5V voltage to IAT information circuit and provide the power cord to IAT low interference circuit. When IAT sensor is cold, the sensor resistance is high. As the air temperature increase, the sensor resistance will be decreased. If the sensor resistance is high, ECM detects that there is a high voltage on IAT signal circuit; if the sensor resistance is low, ECM detects that there is a low voltage on IAT signal circuit.

Mass air flow (MAF) sensor

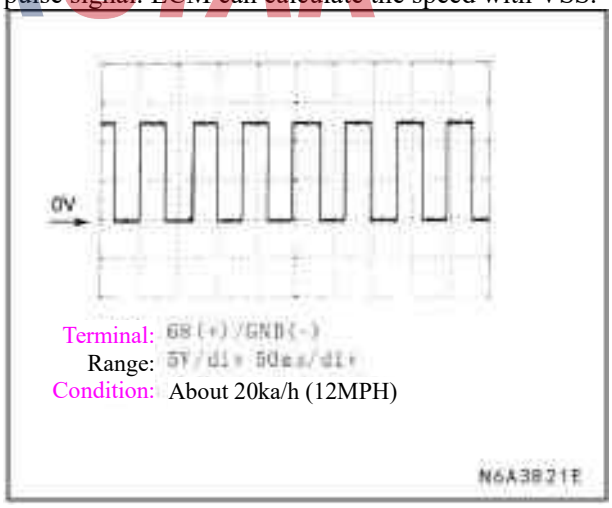


MAF sensor is an air flow meter that measures the engine intake amount. It is installed between the air filter and the turbocharger. A small amount of intake into the engine indicates the deceleration or idling. A lot of intake into the engine indicates the acceleration or high load. MAF sensor assembly consists of a MAF sensor assembly and an intake temperature sensor, all of which are exposed to the air to be measured. MAF sensor assembly can measure a part of the mass air with the measuring tube on the sensor housing.

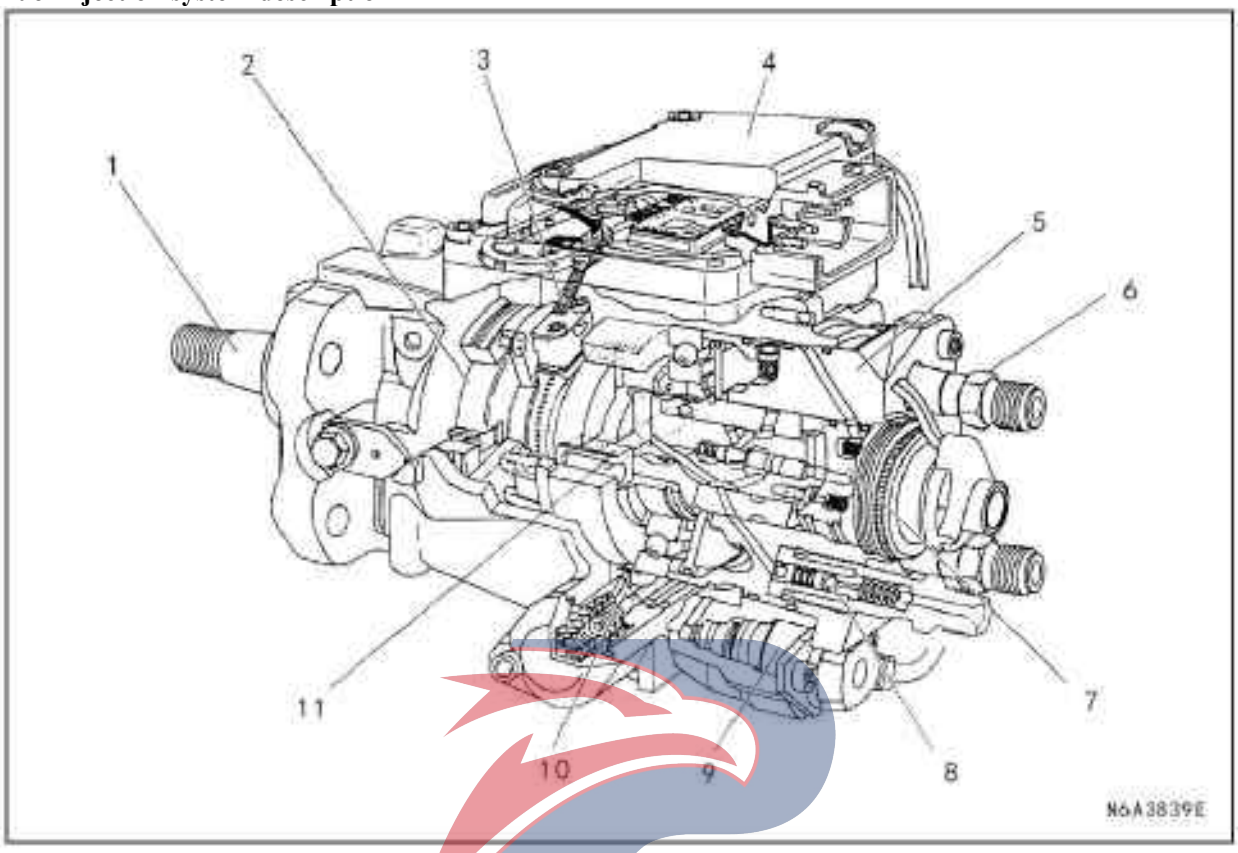
Vehicle speed sensor (VSS)



VSS is used on ECM and the odometer, which can generate a speed signal from the drive output shaft. VSS uses a Hall effect element that can interact with a rotating magnetic field and output a square wave pulse signal. ECM can calculate the speed with VSS.



Fuel injection system description



Legend

1. Driving shaft
2. Feed pump
3. Pump camshaft position (CMP) sensor
4. Fuel injection pump control unit (PCU)
5. dispensing pump head
6. Constant pressure valve (CPV) pedestal
7. Fuel injection solenoid valve
8. Constant pressure valve (CPV)
9. Timing control valve (TCV)
10. Timing device
11. Radial plunger pump

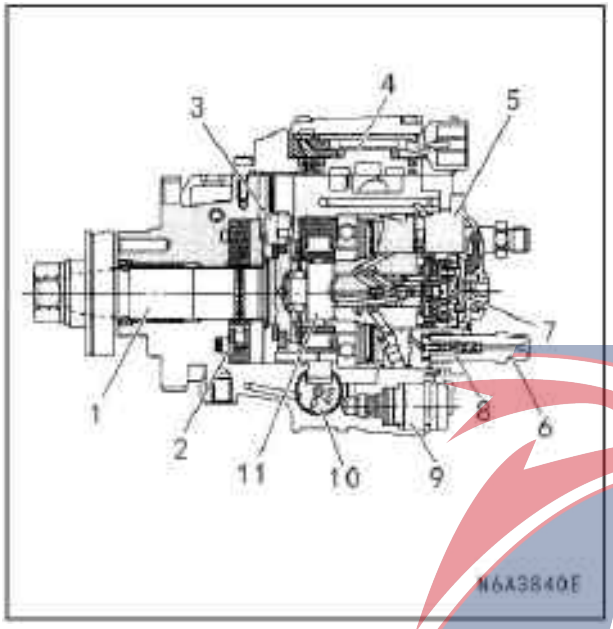
Bosch VP44 fuel injection pump

The radial plunger dispensing fuel injection pump uses the cam ring instead of the previous planar cam for fuel injection at high pressure and is suitable for small, high-speed and direct-injection diesel engines. The injection pump is developed to provide a more suitable fuel injection and injection timing to meet the requirements for engine reliability, operability, low smoke, low noise, high output and low emissions.

ECM uses the data from various sensors to calculate the expected fuel injection and injection timing. These expected data are sent to the fuel injection pump control unit (PCU) via CAN bus.

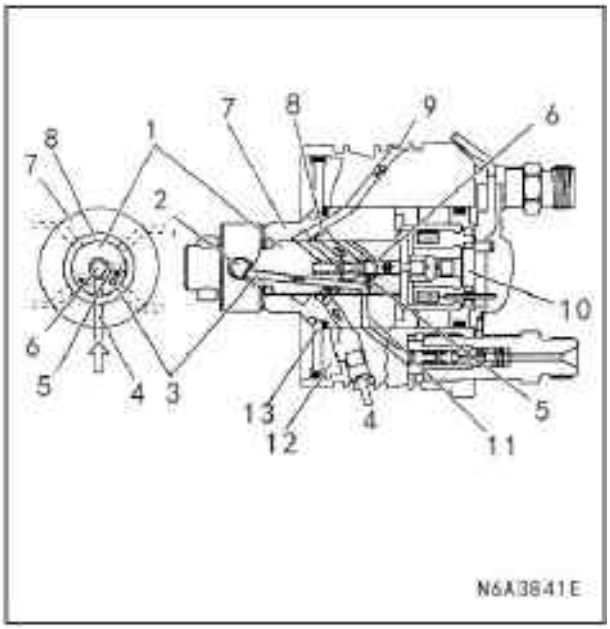
PCU also receives the various signals from the internal inputs: the fuel injection camshaft position (CMP) sensor mounted inside the fuel injection pump is used to determine the cam ring rotation angle and fuel injection pump speed. The fuel temperature (FT) sensor is mounted in PCU. These rated values are used for comparison with the desired ratings from ECM, to allow PCU to determine the injection timing piston position and injection amount and start the timing control valve (TCV) and fuel injection solenoid valve based on the control chart in PCU.

The timing device can change the best injection time based on different engine status, to adjust the fuel pressure supplied with the fuel injection pump and apply TCV-controlled fuel pressure on the timing piston (TCV is mounted behind of the fuel injection pump and is controlled with the duty ratio of PCU). The timing plunger is connected to the cam ring via a ball pin. The axial movement of the timing plunger is transmitted to the cam ring to converse into a rotational movement.



Legend

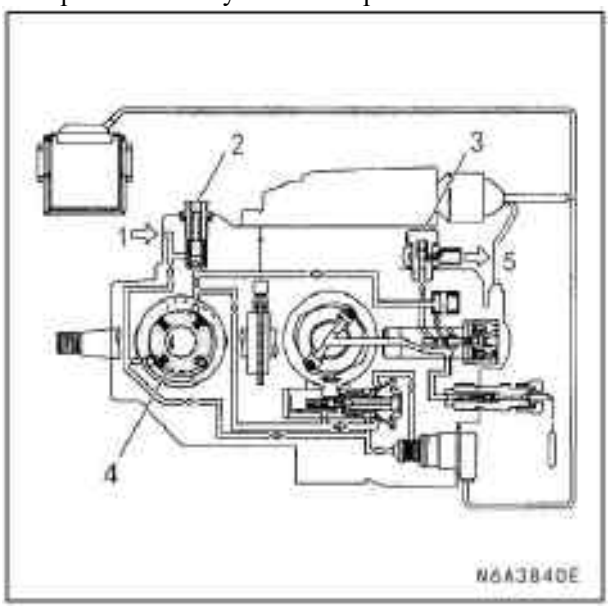
1. Driving shaft
2. Feed pump
3. Pump camshaft position (CMP) sensor
4. Fuel injection pump control unit (PCU)
5. dispensing pump head
6. Constant pressure valve (CPV) pedestal
7. Fuel injection solenoid valve
8. Constant pressure valve (CPV)
9. Timing control valve (TCV)
10. Timing device
11. Radial plunger pump



Legend

1. rotor shaft
2. Radial plunger
3 High-pressure channel
4. Low-pressure inlet
5. Distribution slot
6. Valve needle
7. Barrel pipe
8. Ring channel
9. Fuel return
10. Fuel injection solenoid valve
11. High pressure outlet
12. Diaphragm compartment
13. Capacity accumulation diaphragm

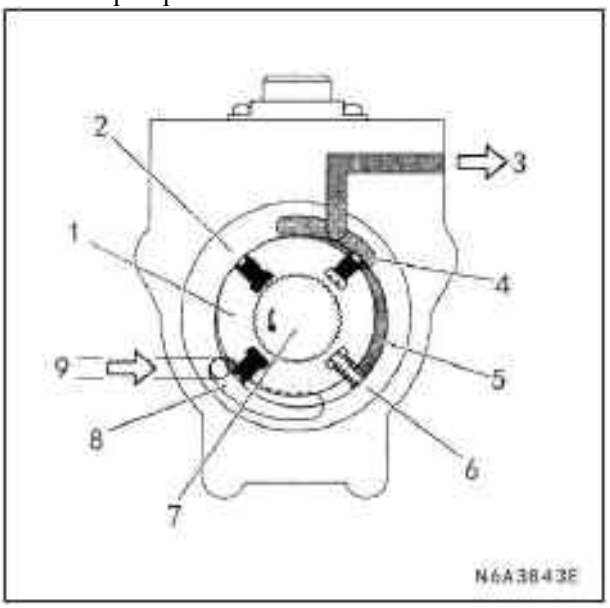
Low pressure fuel system description



Legend
1. Fuel suction
2. Control valve
3. Relief valve
4. Feed pump
5. To the fuel tank

Low pressure fuel circuits must provide a sufficient fuel to the high pressure fuel circuits; its main components include fuel feed pump, the control valve and the relief valve.

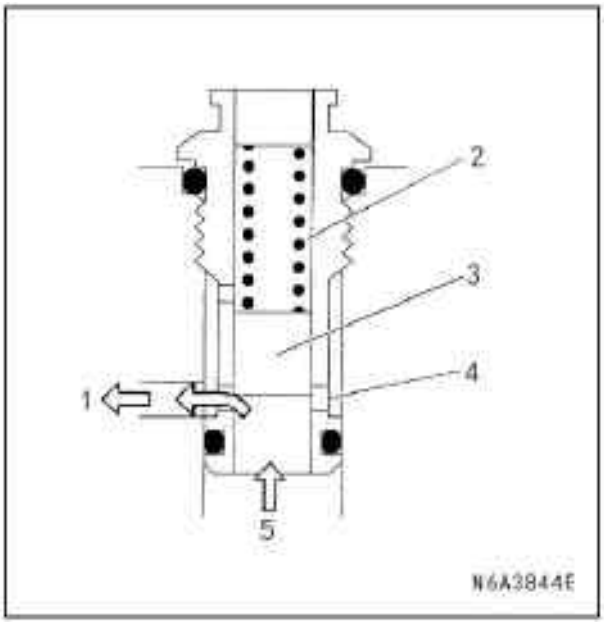
Fuel feed pump



Legend
1. rotor
2. Collar
3. Fuel supply
4. Outlet
5. Cabin
6. Fin
7. Driving shaft
8. Inlet
9. Fuel suction

The fuel feed pump is driven with the drive shaft, for fuel suction and supply. During rotation, the fins mounted on the rotor are pressed onto the inside of the collar with the spring force and the centrifugal gravitational pressure, forming a cabin. As the fins are rotated, these cabins are rotated and connected to the collar hatch at the inlet cabin; with increase of the number of cabins, the pressure will be decreased and the fuel is sucked. When the cabins are rotated to the inlet and hatch, its number will be decreased and the fuel will be compressed. The fuel pressure will be increased until the fuel is fed into the high-pressure fuel circuit through the control valve at the outlet.

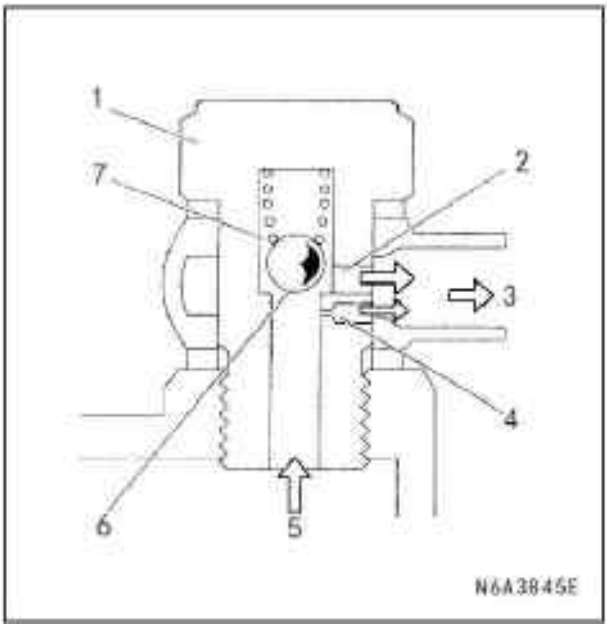
Control valve



Legend
1. To the inlet
2. spring
3. Piston valve
4. Hatch opening
5. From the outlet

The plunger will be pushed up when the feed pump speed is increased so that the discharge pressure delivered from the outlet exceeds the control valve spring force. The excess fuel will be returned to the inlet through the hatch, while the feed pressure will be maintained within specified range. When the feed pump speed is reduced to reduce the discharge pressure, the plunger spring will be pushed down to close the hatch.

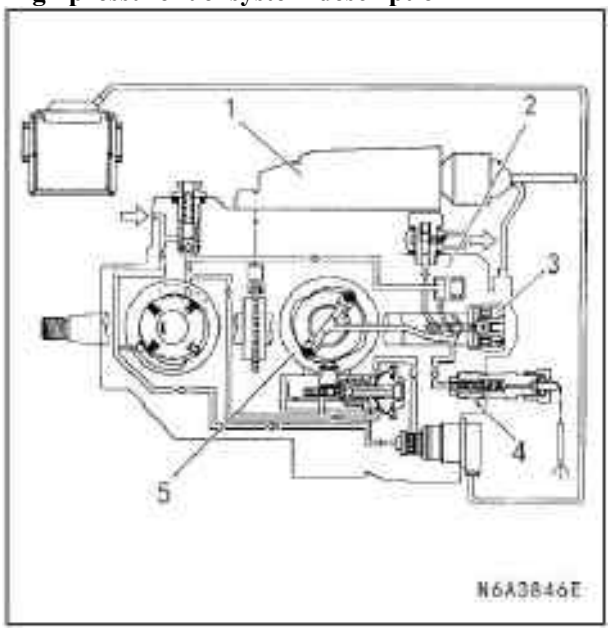
Relief valve



Legend
1. Valve seat
2. Hatch opening
3. To the fuel tank
4. Hole cabin
5. From the fuel tank
6. Ball valve
7. Spring

When the fuel pressure returned from the distribution pump head exceeds the spring force, the ball valve of the relief valve will be pushed up. The excess fuel will overflow from the hatch and be returned into the fuel tank, while the fuel pressure in the fuel injection pump does not exceed the specified value. During this process, the excess fuel flow will play the cooling function and automatically drain from the fuel injection pump. Also, the hole cabin installed can help the automatic air flow.

High pressure fuel system description

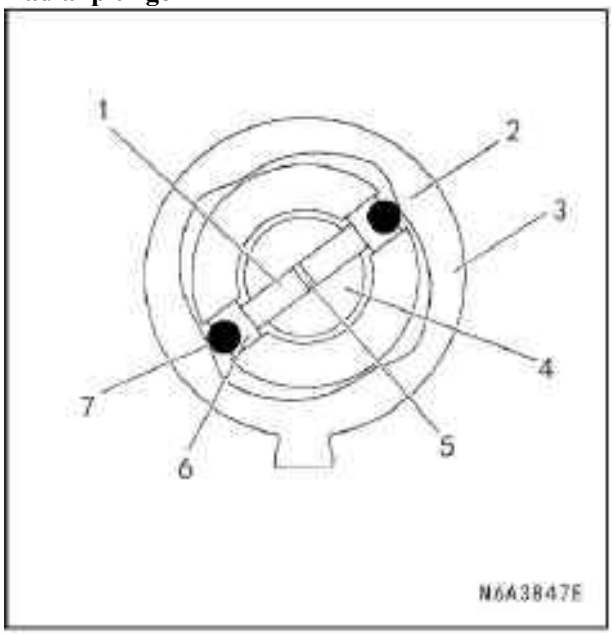


Coil
1. Fuel injection pump control unit (PCU)
2. dispensing pump head
3. Fuel injection solenoid valve
4. Constant pressure valve (CPV)
5. Radial plunger

In addition to the high-pressure generating device, the high-pressure circuit includes a fuel pipe, an injection start timing setting device, and a fuel injection amount setting device, with the main components as follows:

• Generate the high pressure: Radial plunger
• Fuel distribution: Distribution pump head
• Injection timing start: Timing device
• Secondary fuel injection prevention: Constant pressure valve (CPV)

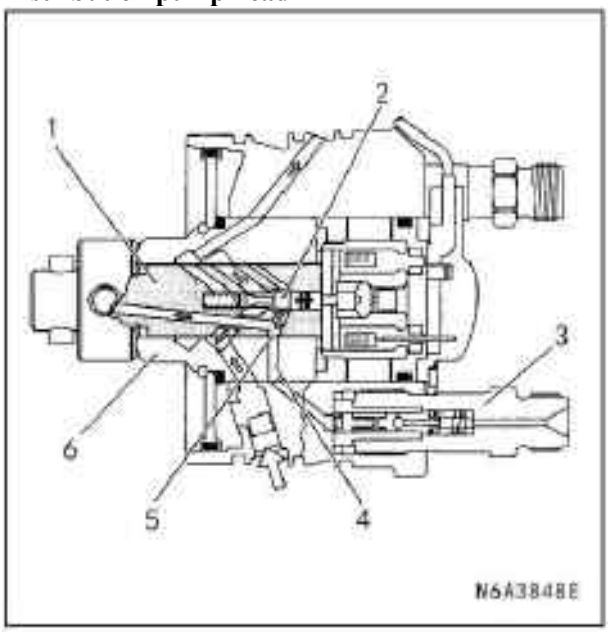
Radial plunger



Coil
1. Radial plunger
2. Inner cam
3. Cam ring
4. rotor shaft
6 Rotor guide shoe
7. Roller

When the radial plungers are mounted onto the central shaft of the rotor shaft, they are attached inside of the cam ring (via the rollers and the rotor shoes) with the fuel pressure and the gravitational force from the feed pump. When the radial plungers are rotated, they can drive the inner cam for reciprocal movement, to suck the fuel into the plunger cabin for compression.

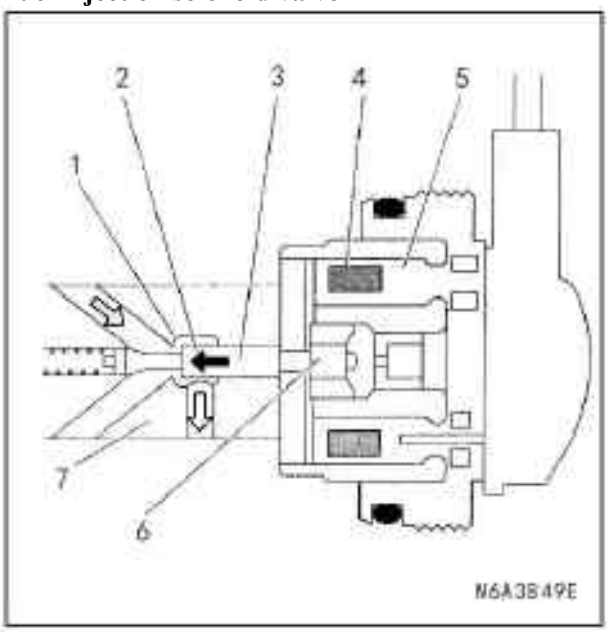
Distribution pump head



Coil
1. rotor shaft
2. Valve needle
3. Constant pressure valve (CPV) bracket
4. High pressure outlet
5. Distribution pump shaft
6. Barrel pipe

The distribution pump head can distribute the high pressure fuel flowing through the rotating rotor shaft distribution pump slots and the high pressure outlet (4 cylinders) of the tubes to the engine cylinders via a constant pressure valve (CPV) and nozzle mount assembly. The fuel injection solenoid valve needle can change the channel of the radial plunger high pressure pump between fuel suction and fuel compression.

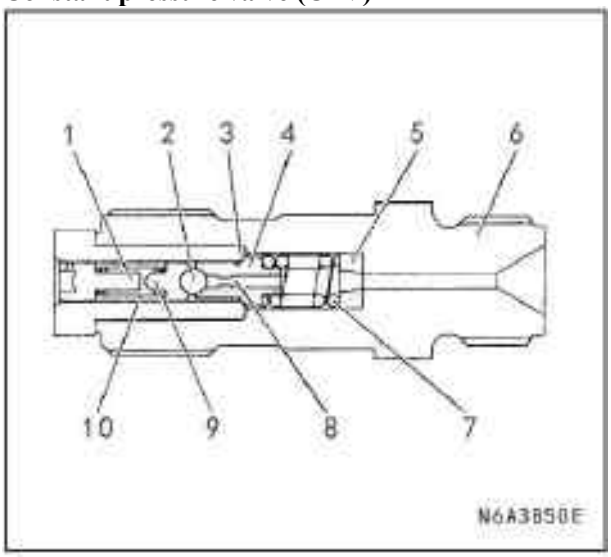
Fuel injection solenoid valve



Coil
1. Valve seat
2. Valve closed direction
3. Valve needle
4. Coil
5. Magnet
6. Magnetic anchor
7. Rotor shaft

The fuel injection solenoid valve consists of a valve seat, a valve needle, a magnetic anchor (ie, a movable magnetic core), a coil, and a magnet. The valve needle is rotated with the rotor shaft. When the current controlled by the fuel injection pump control unit (PCU) flows into the coil, the magnetic anchor and the valve needle will be pushed toward the valve seat. When the valve seat is completely closed with the valve needle, the fuel in the high-pressure channel is separated from the low-pressure channel and compressed with the radial plunger high-pressure pump and injected into the engine cylinders through the nozzle bracket. When the required amount of fuel injection is reached, the current into the coil will be cut off, the valve seat should be opened, and the fuel injection will be completed.

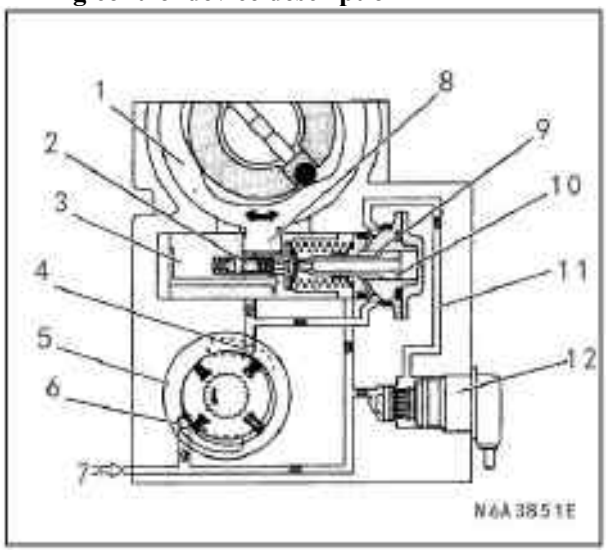
Constant pressure valve (CPV)



Legend
1. Plug
2. Ball
3. Seat
4. Valve
5. Gasket
6. Support
7. Valve spring
8. Hole
9. Ball seat
10. spring

The constant pressure valve (CPV) consists of bearing, gasket, valve spring, valve, seat, ball, ball seat, spring and plug. The valve hole can withstand the rebound pressure wave caused by closing the nozzles at the end of fuel injection (the rebound pressure wave will cause the secondary fuel injection) and maintain a fixed pressure (residual pressure) in the fuel injection tube, to ensure the stability of the next fuel injection time. When the valve is opened with the compressed fuel, the fuel will be sent into the nozzle holder assembly.

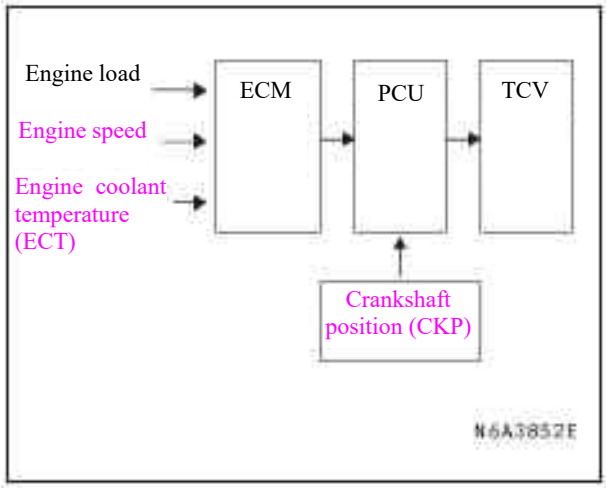
Timing control device description



Legend
1. Cam ring
2. Servo valve
3. Timing plug
4. Outlet
5. Feed pump
6. Inlet
7. Fuel inlet
8. Ball pin
9. Annular cabin
10. Hydraulic stopper
11. Return channel
12. Time control valve (TCV)

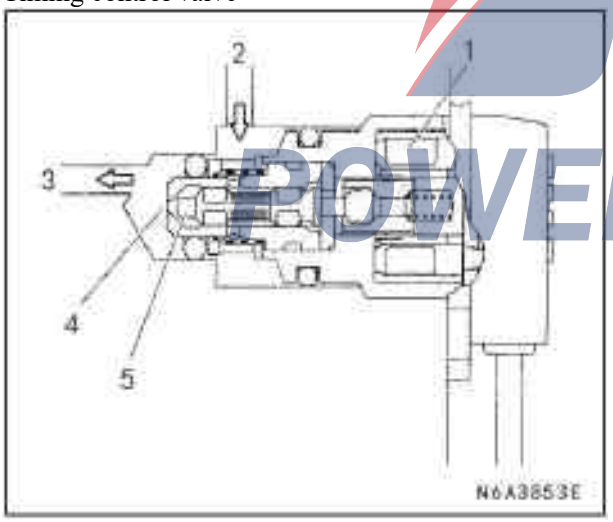
The timing device can determine the best fuel injection time in the engine speed changes. Adjust the fuel pressure from the feed pump to match the fuel feed speed with the adjusting valve. This feed pressure forms a control pressure applied on the annular cabin of the hydraulic stopper. The pressure in the annular cabin is controlled with the timing control valve (TCV). The timing plug is connected to the cam ring via a ball pin. The axial movement of the timing plug is converted into rotational movement and transferred to the cam ring. When it is moved to the right of the timing plug (to the spring side), it is the advance fuel injection time. The main components include the plug, TCV and camshaft position (CMP) sensor.

Fuel injection start monitor



ECM contains the fuel injection start feature map in accordance with the engine operating conditions (engine load, speed and coolant temperature). The fuel injection pump control unit (PCU) can continuously compare the start time of the fuel injection with the actual start of the fuel injection. If there is a difference between them, the timing control valve (TCV) is controlled with the duty ratio. (The actual injection start time is determined with the camshaft position (CMP) sensor)

Timing control valve



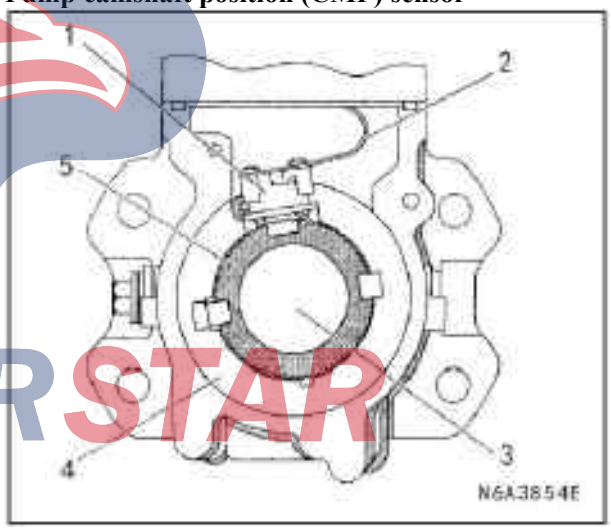
Legend
1. Coil
2 From the annular cabin
3. To the fuel feed pump
4. Hole
5. Needle valve

The timing control valve (TCV) acts as a variable valve that utilizes the rapid opening and closing (cycling) functions of the needle valve in TCV. In normal operation, TCV can control the pressure on the annular cabin, so that the hydraulic stopper cam can be moved from any position from the delay position to the advance position. The duty cycle at this time is set with the fuel injection pump control unit (PCU).

When the control current flows into TCV coil, the needle valve will be opened and the fuel will flow the hole through the annular cabin into the feed pump inlet. Therefore, the pressure in the annular cabin is then reduced and the hydraulic stopper is moved to the delay position.

When the control current into TCV coil is cut off, the needle valve will be closed and the return channel will also be closed. Therefore, the pressure in the annular cabin is increased and the hydraulic stopper is moved to the advance position.

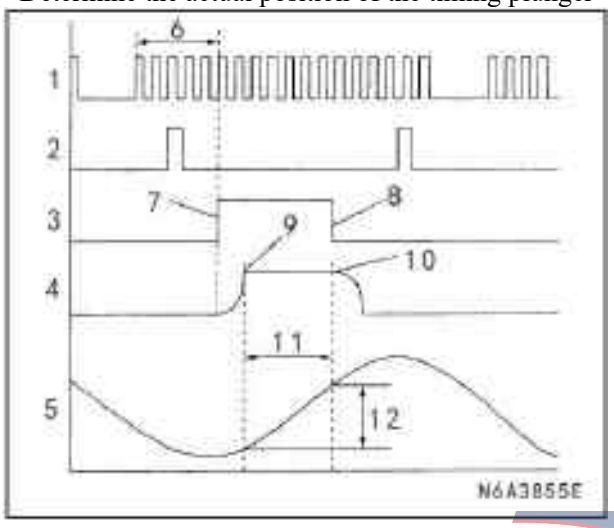
Pump camshaft position (CMP) sensor



Legend
1. Pump camshaft position (CMP) sensor
2. Flexible wiring harness
3. Driving shaft
4. Pump camshaft position (CMP) sensor positioning ring
5. Sensor wheel

When the drive shaft is rotated, the pump camshaft position (CMP) sensor can receive the signal from the sensor impeller, so that an electrical pulse is sent to the fuel injection pump control unit via the flexible wiring harness, to determine the average pump speed and instantaneous pump speed. The fuel injection pump CMP sensor is mounted on the cam ring, so that the cam ring is continuously related to the fuel injection pump CMP sensor signals. The fuel injection pump CMP sensor signals are used for the following purposes:

• Determine the instantaneous angle position of the cam ring
• Calculate the actual speed of the fuel injection pump.
• Determine the actual position of the timing plunger



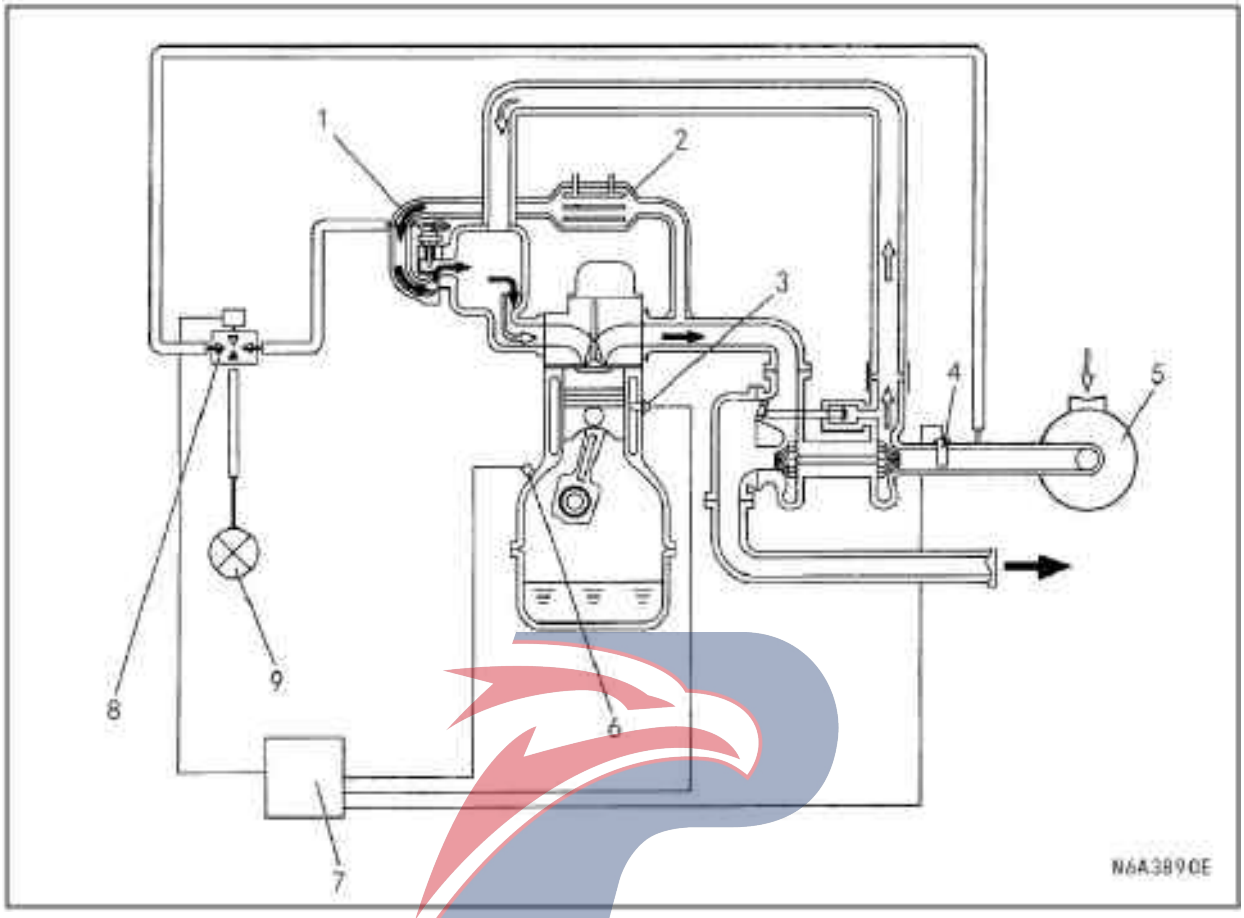
Legend
1. Pump camshaft position (CMP) sensor signal
2. Crankshaft position (CKP) sensor signal
3. Fuel injection solenoid valve control pulse
4. Fuel injection solenoid valve needle lifting stroke
5. Cam lifting stroke (cam profile)
6. Number of pulses
7. Fuel injection solenoid valve closed
8. Fuel injection solenoid valve opened
9. Pressure transmission start
10. Pressure transmission end
11. Pressure transmission angle
12. Effective stroke

■ Instantaneous angle position of cam ring
The instantaneous angular position of cam ring is entered into the fuel injection PCU as a fuel injection solenoid control signals. Depending on the instantaneous inputs of the angle positions during fluctuations under operating conditions, the fuel injection solenoid valve can precisely determine the opening and closing gap based on the lifting stroke of the cam ring.

■ Actual speed of fuel injection pump
When the crankshaft speed (CKP) sensor fails, the engine control module (ECM) will treat the injection pump CMP signal as a change signal.

■ Actual position of timing plunger
By comparing CKP sensor signal to the fuel injection pump CMP sensor angle, the actual position of the timing plunger can be determined, for timing control.

Exhaust recirculation (EGR) system description

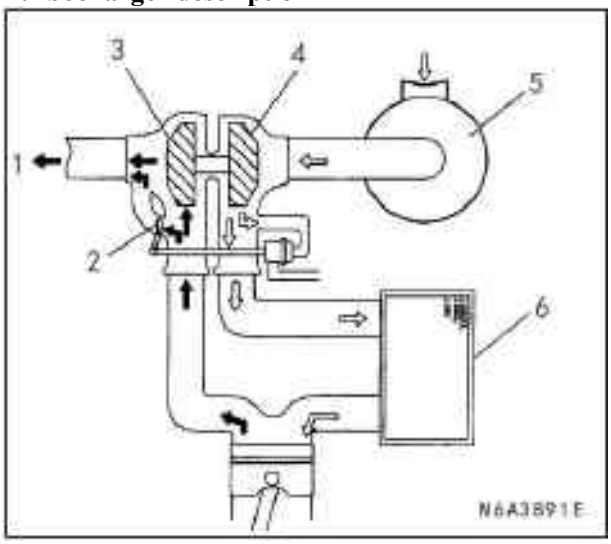


Legend
1. EGR valve
2. EGR cooler
3. ECT sensor
4. MAF & IAT sensor
5. Air filter
6. CKP sensor
7.ECM
8. EEG solenoid valve
9. Vacuum pump

EGR system can recirculate a portion of the exhaust back into the intake manifold, to reduce nitrogen oxide emissions. EGR control system uses the electronically controlled solenoid valve and the vacuum-controlled EGR valve to ensure both maneuverability and low emissions. ECM can control EGR flow based on engine speed, ECT, intake temperature, barometric pressure, and fuel injection. ECM controls the opening of EGR valve by controlling the load driven by EGR solenoid valve. MAF sensor can monitor EGR flow.

A certain MAF flow can be detected during engine operation.

Turbocharger description



Legend
1. Exhaust
2. Exhaust valve
3. Turbine impeller
4. Compression impeller
5. Air filter
6. Turbocharged air cooler (intercooler)

The turbocharger is used to increase the air amount entered into the engine cylinders, which allows a corresponding increase in the amount of fuel injected into the cylinders, so as to deliver more power, complete fuel combustion, and increased cooling of the cylinder head, pistons, valves and exhaust. This cooling effect can extend the service life of the engine.
The heat and pressure of the engine exhaust are used to drive the turbine. The exhaust is introduced into the turbine chamber on the exhaust side as a nozzle, to drive the shaft assembly. Since the compression impeller is directly connected with the shaft, the compression impeller and the turbine impeller are rotated at the same speed. The clean air is drawn into the turbine chamber and impeller on the intake side via the air filter. The air is compressed and fed into the engine intake manifold via a transverse tube and then fed into the cylinders. The increased amount of air and the amount of air delivered to the engine via the compression outlet are controlled with the exhaust valve in the turbine chamber on the exhaust side. The position of the exhaust valve is controlled with the pressure accumulated in the turbocharger on the intake side. The diaphragm in the exhaust valve can sense the pressure and thus control the position of the exhaust valve in the turbocharger. The position of the valve will be increased or decreased to provide the push force to the turbocharger.

The intercooler can also improve the diesel engine performances. The intake is drawn into the turbine chamber on the turbocharger intake side via the air filter. The compressed air in the turbocharger can continuously flow forward via the intercooler in front of the radiator.
The air can flow back into the intake manifold via the intercooler.
The intercooler is a heat exchanger that uses the air flow to cool the intake. The temperature will be increased when the air is turbocharged, to compress more air molecules into one space, so as to reduce the intake temperature and improve the engine efficiency and power.

Special tools and equipment

Special tools and equipment

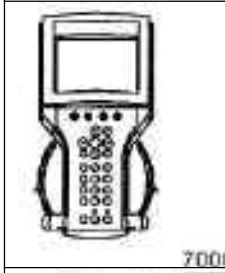
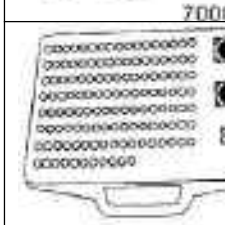
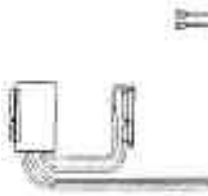
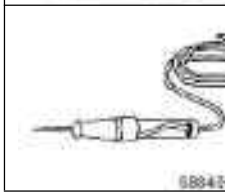
Figure	Tool No./description
	5-8840-2835-0 (J-35616-A) Connector test adapter kit with test lamp
	5-8840-0285-0 (J-39200) High resistance multimeter
	Tech2
	Power distribution box
	Adapter wiring harness
	5-8840-0607-0 (J-34142-B) Test lamp

Figure	Tool No./description
	5-8840-0279-0 (J-23738-A) Vacuum pump with meter