

FOREWORD

This workshop manual has been prepared to provide information regarding repair procedures on Hino Trucks.

Applicable for J05D-TF engine

When making any repairs on your vehicle, be careful not to be injured through improper procedures.

As for maintenance items, refer to the Owner's Manual.

All information and specifications in this manual are based upon the latest product information available at the time of printing.

Hino Motors Sales U.S.A., Inc. reserves the right to make changes at any time without prior notice.

Hino Motors Sales U.S.A. , Inc.

CHAPTER REFERENCES REGARDING THIS WORKSHOP MANUAL

Use this chart to the appropriate chapter numbers for servicing your particular truck.

CHAPTER	MANUAL NO.	S5-UJ05E06A (U.S.A.), S5-CJ05E06A (CANADA)	
	MODEL	J05D-TF	
GENERAL INTRODUCTION		GN01-001	
ENGINE INTRODUCTION		EN01-001	
ENGINE MECHANICAL		EN02-001	
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COOLING SYSTEM		EN06-001	
FUEL SYSTEM		EN07-001	
TURBOCHARGER		EN08-001	
EMISSION CONTROL		EN10-001	
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TURBOCHARGER

FUEL INJECTION PUMP

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ALTERNATOR

STARTER

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**ENGINE PTO
(POWER TAKE-OFF)**

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GENERAL INTRODUCTION (ENGINE)

GENERAL PRECAUTIONS

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Some recommended and standard maintenance services for your engine are included in this section. When performing maintenance on your engine, be careful not to get injured by using improper work procedures. Improper or incomplete work can cause a malfunction of the engine, which may result in personal injury and/or property damage. If you have any questions about performing maintenance, please consult your Hino dealer.

WARNING

When working on your engine, observe the following general precautions to prevent death, personal injury and/or property damage, in addition to the particular **DANGERS, WARNINGS, CAUTIONS** and **NOTICE** in each chapter.

- Always wear safety glasses or goggles to protect your eyes.
- Remove rings, watches, ties, loose hanging jewelry and loose clothing before starting work on the vehicle.
- Bind long hair securely behind the head.
- When working on the vehicle, apply the parking brake firmly, place the gear shift lever in "Neutral" or "N" and block the wheels.
- Always stop the engine and turn off the starter switch, unless the operation requires the engine running. Removing the key from the switch is recommended.
- To avoid serious burns, keep yourself away from hot metal parts such as the engine, exhaust manifold, radiator, muffler, exhaust pipe and tail pipe.
- Do not smoke while working on the vehicle, since fuel and gas from battery are flammable.
- Take utmost care when working on the battery. It contains corrosive sulfuric acid.
- Large electric current flows through the battery cable and starter cable. Be careful not to cause a short, which can result in personal injury and/or property damage.
- Read carefully and observe the instructions placed on the jack before using it.
- Use safety stands to support the vehicle whenever you need to work under it. It is dangerous to work under a vehicle supported only by a jack.
- If it is necessary to run the engine after the hood is raised (tilted), make sure that the parking brake is firmly applied, the wheels are blocked, and the gear shift lever is positioned in "Neutral" before starting the engine.
- Run the engine only in a well-ventilated area to avoid inhaling of carbon monoxide.
- Keep yourself, your clothing and your tools away from moving parts such as the cooling fan and V-belt when the engine is running.
- Be careful not to damage lines and hoses by stepping or holding on them.
- Be careful not to leave any tool in the engine compartment. Tools may be hit by moving parts, which can cause personal injury.

DEFINITION OF SAFETY TERMS

 DANGER	Indicates an extremely hazardous situation if proper procedures are not followed and could result in death or serious injury.
 WARNING	Indicates a potential hazardous situation if proper procedures are not followed and could result in death or serious injury.
 CAUTION	Indicates a hazardous situation if proper procedures are not followed and could result in serious injury or damage to parts/equipment.
NOTICE	Indicates the need to follow proper procedures and to pay attention to precautions so that efficient service is provided.
HINT	Provides additional information to help you to perform the repair efficiently.

TOWING

- When being towed, always place the gear shift lever in "Neutral" and release the parking brake completely. In order to protect the bumper, fit a protection bar against the lower edge of the bumper and put a wood block under the frame near the No. 1 crossmember when attaching the towing chain. Never lift or tow the vehicle if the chain is in direct contact with the bumper.

1. Towing procedures

- (1) Make sure that the propeller shaft of the vehicle to be towed is removed. When the differential gear or rear axle shaft is defective, remove both right and left rear axle shafts, then cover the hub opening to prevent loss of axle lubricant and entry of dirt or foreign matter.
- (2) Use a heavy duty cable or rope when towing the vehicle. Fasten the cable securely to the towing hook on the frame. The hook should be used only if the towed vehicle is not loaded.
- (3) The angle of pulling direction of the cable fastened to the towing hook must not exceed 15° in horizontal and vertical directions from the straight ahead, level direction. Avoid using the hook in a way that subjects it to jerk, as in towing a vehicle trapped in a gutter.
- (4) Keep the gear shift lever in "Neutral".
- (5) Make sure that the starter switch is kept in the "ON" position.
- (6) Make sure that the engine of the towed vehicle is kept running. If the engine is off, no compressed air/ no vacuum will be available for the brake. This is dangerous, as the brake system does not function if the engine is not running. In addition, the power steering system will not function. The steering wheel, therefore, will become unusually hard to turn, making it impossible to control the vehicle.
- (7) Note that the engine brake and exhaust brake cannot be applied, if the propeller shaft is removed.
- (8) Make a slow start to minimize shock. Towing speed should be less than 30 km/h {18 mile/h}.

2. If the engine of the towed vehicle is defective, make sure that the vehicle is towed only by a tow truck designed for that purpose.

- (1) Front end towing (with front wheels raised off the ground)
When towing from the front end with the front wheels raised off the ground, remove the rear axle shafts to protect the transmission and differential gears from being damaged. The hub openings should be covered to prevent the loss of axle lubricant or the entry of dirt or foreign matter.
The above-mentioned precautions should be observed for vehicles equipped with either automatic or manual transmission, and for even short distance towing. After being towed, check and refill the rear axle housing with lubricant if necessary.
- (2) Rear end towing
When being towed with the rear wheels raised off the ground, fasten and secure the steering wheel in a straight ahead position.

CLEAN AIR ACT

1. Heavy-duty engine rebuilding practices.

§ 86.004-40

- The provisions of this section are applicable to heavy-duty engines subject to model year 2004 or later standards and are applicable to the process of engine rebuilding (or rebuilding a portion of an engine or engine system). The process of engine rebuilding generally includes disassembly, replacement of multiple parts due to wear, and reassembly, and also may include the removal of the engine from the vehicle and other acts associated with rebuilding an engine. Any deviation from the provisions contained in this section is a prohibited act under section 203(a) (3) of the Clean Air Act (42 U.S.C. 7522(a) (3)).
- (1) When rebuilding an engine, portions of an engine, or an engine system, there must be a reasonable technical basis for knowing that the resultant engine is equivalent, from an emissions standpoint, to a certified configuration (i.e., tolerances, calibrations, specifications) and the model year(s) of the resulting engine configuration must be identified. A reasonable basis would exist if:
 - a. Parts installed, whether the parts are new, used, or rebuilt, are such that a person familiar with the design and function of motor vehicle engines would reasonably believe that the parts perform the same function with respect to emissions control as the original parts; and
 - b. Any parameter adjustment or design element change is made only:
 - In accordance with the original engine manufacturer's instructions; or
 - Where data or other reasonable technical basis exists that such parameter adjustment or design element change, when performed on the engine or similar engines, is not expected to adversely affect in-use emissions.
 - (2) When an engine is being rebuilt and remains installed or is reinstalled in the same vehicle, it must be rebuilt to a configuration of the same or later model year as the original engine. When an engine is being replaced, the replacement engine must be an engine of (or rebuilt to) a configuration of the same or later model year as the original engine.
 - (3) At time of rebuild, emissions-related codes or signals from on-board monitoring systems may not be erased or reset without diagnosing and responding appropriately to the diagnostic codes, regardless of whether the systems are installed to satisfy requirements in § 86.004-25 or for other reasons and regardless of form or interface. Diagnostic systems must be free of all such codes when the rebuilt engine is returned to service. Such signals may not be rendered inoperative during the rebuilding process.
 - (4) When conducting a rebuild without removing the engine from the vehicle, or during the installation of a rebuilt engine, all critical emissions-related components listed in § 86.004-25(2) not otherwise addressed by paragraphs (1) through (3) of this section must be checked and cleaned, adjusted, repaired, or replaced as necessary, following manufacturer recommended practices.
 - (5) Records shall be kept by parties conducting activities included in paragraphs (1) through (4) of this section. The records shall include at minimum the mileage and/or hours at time of rebuild, a listing of work performed on the engine and emissions-related control components including a listing of parts and components used, engine parameter adjustments, emissions-related codes or signals responded to and reset, and work performed under paragraph (4) of this section.
 - a. Parties may keep records in whatever format or system they choose as long as the records are understandable to an EPA enforcement officer or can be otherwise provided to an EPA enforcement officer in an understandable format when requested.
 - b. Parties are not required to keep records of information that is not reasonably available through normal business practices including information on activities not conducted by themselves or information that they cannot reasonably access.
 - c. Parties may keep records of their rebuilding practices for an engine family rather than on each individual engine rebuilt in cases where those rebuild practices are followed routinely.
 - d. Records must be kept for a minimum of two years after the engine is rebuilt.

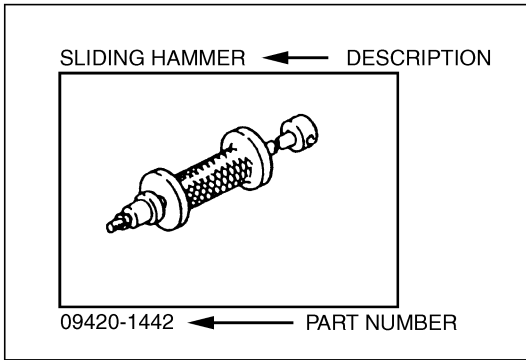
2. Maintenance instructions.

§ 86.007-38

- (1) For each new diesel-fueled engine subject to the standards prescribed in § 86.007-11, as applicable, the manufacturer shall furnish or cause to be furnished to the ultimate purchaser a statement that
“This engine must be operated only with ultra low-sulfur diesel fuel (meeting EPA specifications for highway diesel fuel, including a 15 ppm sulfur cap).”

HOW TO USE THIS WORKSHOP MANUAL

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This workshop manual is designed as a guide for servicing the vehicles. An INDEX is provided on the first page of each chapter.

TROUBLESHOOTING is dealt with in each chapter.

When beginning operations, refer to the TROUBLESHOOTING section for a guide to appropriate diagnoses.

SPECIAL TOOLS are dealt with in each chapter.

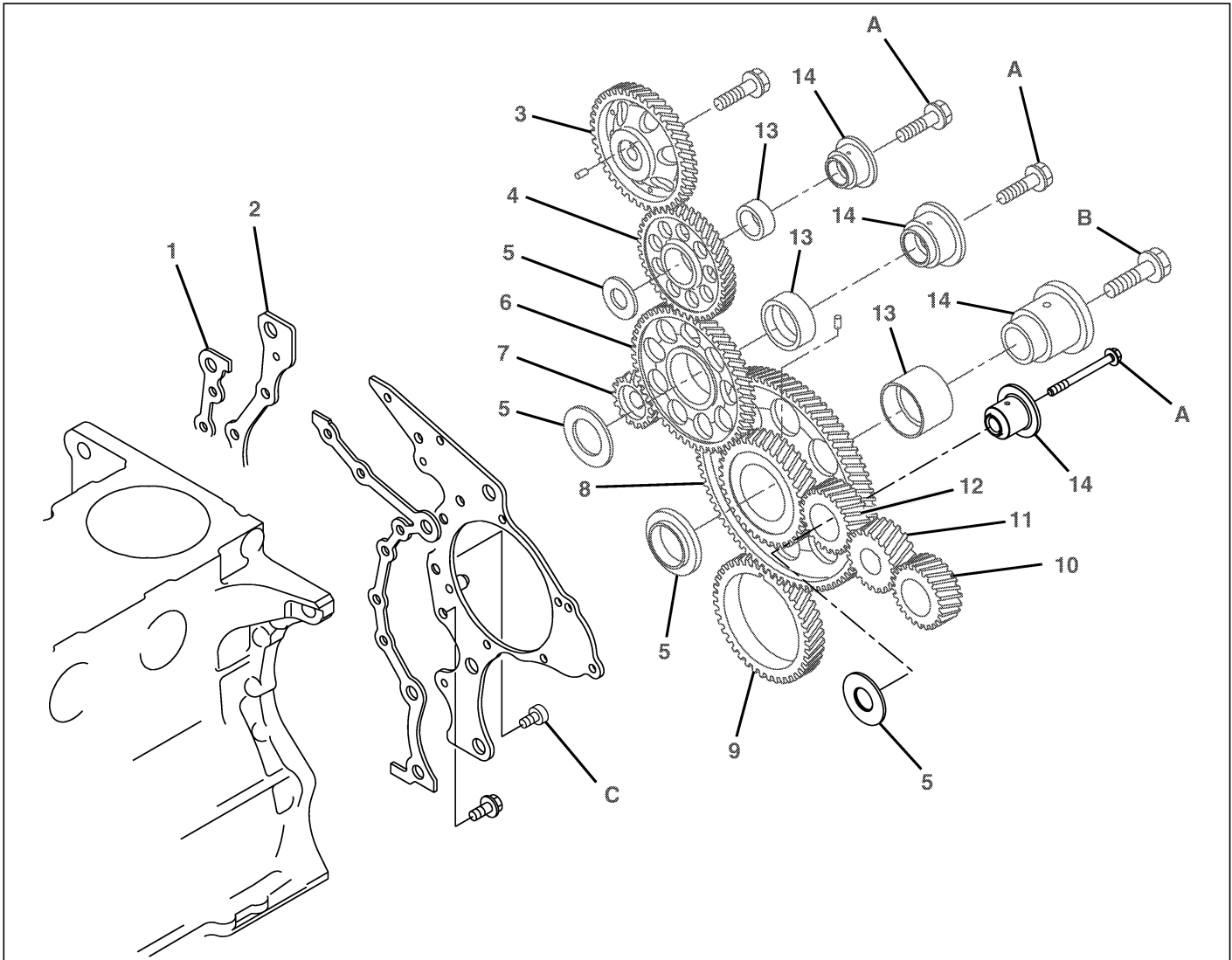
When ordering a special tool, confirm the part number with the applicable parts catalog.

- **REPAIR PROCEDURES**

Repair procedures when self-explanatory, such as simple installation and removal of parts, have been omitted. Illustrations, such as the one below, have been provided to make such simple procedures clear. Only essential procedures requiring specific directions have been dealt with explicitly.

TIMING GEAR AND CAMSHAFT

EXAMPLE:



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1	Gasket	8	Main idle gear
2	Rear end plate	9	Crankshaft gear
3	Camshaft gear	10	Power steering pump drive gear
4	Cam idle gear	11	Air compressor drive gear
5	Idle gear thrust plate	12	Air compressor idle gear
6	Sub-idle gear	13	Idle gear bushing
7	Oil pump gear	14	Idle gear shaft

Tightening torque**Unit: N·m {kgf·cm, lbf·ft}**

A	108 {1,100, 80}#	C	55 {560, 41} Application of lock sealant
B	172 {1,750, 127}#		

#=Apply oil to the threads and seat surfaces before tightening.

In some cases, illustrations may be of parts which differ in some nonessential way from the parts found on your particular vehicle. In such cases, the principle or procedure being illustrated applies regardless of such nonessential differences.

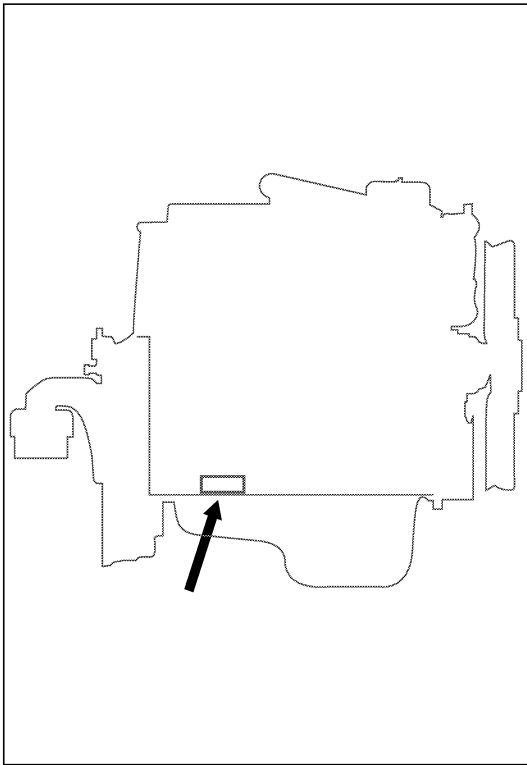
- DEFINITION OF TERMS**

This engine rotates counterclockwise viewed from the flywheel side.

IDENTIFICATION INFORMATION

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- **ENGINE SERIAL NUMBERS.**
Please quote these numbers when ordering spare parts or reporting technical matter to receive prompt service attention.
The engine serial number is engraved on the engine cylinder block.

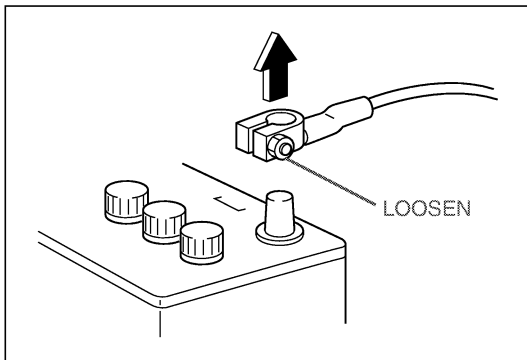


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PRECAUTIONS

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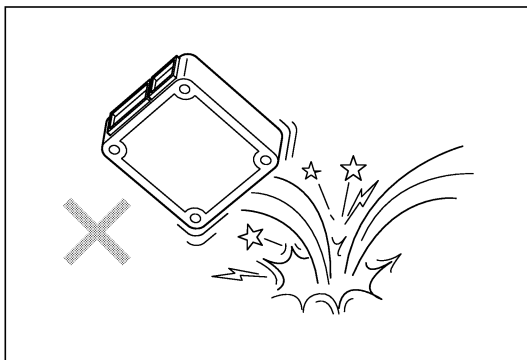
PRECAUTIONS FOR ELECTRICAL SYSTEM



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1. REMOVING THE BATTERY CABLE

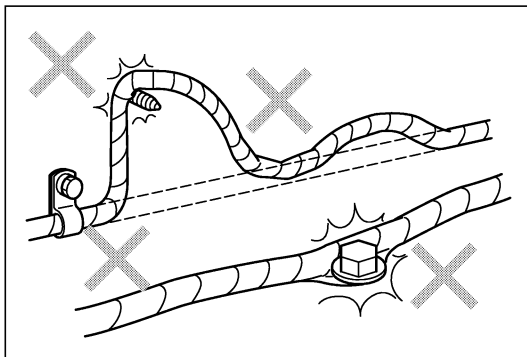
- (1) Before electrical system work, remove the cable from the minus terminal of the battery in order to avoid burning caused by short-circuiting.
- (2) To remove the battery cable, fully release the nut to avoid damage to the battery terminal. Never twist the terminal.



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2. HANDLING OF ELECTRONIC PARTS

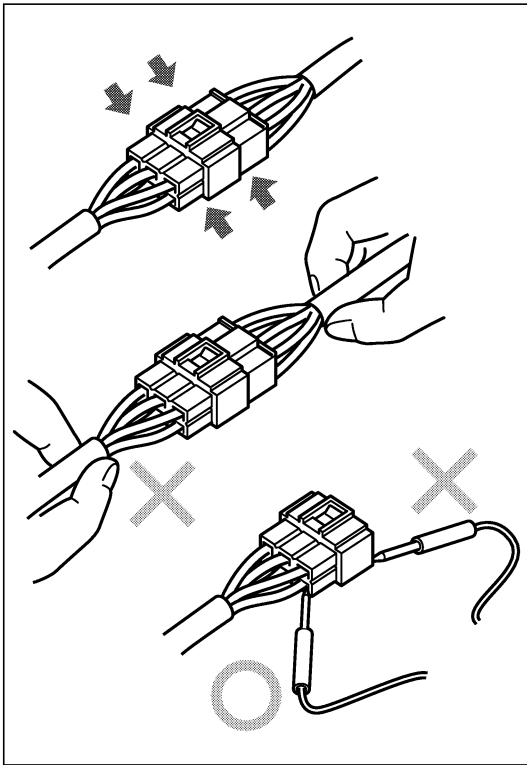
- (1) Never give an impact to electronic parts of a computer or relay.
- (2) Keep electronic parts away from high temperatures and humidity.
- (3) Never splash water onto electronic parts in washing the vehicle.



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3. HANDLING OF WIRE HARNESS

- (1) Perform marking on a clamp and a clip and secure then in original position so that the wire harness will not interfere with the end and acute angle section of the body and a bolt.
- (2) To attach a part, take care not to bite the wire harness.



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4. HANDLING OF CONNECTOR

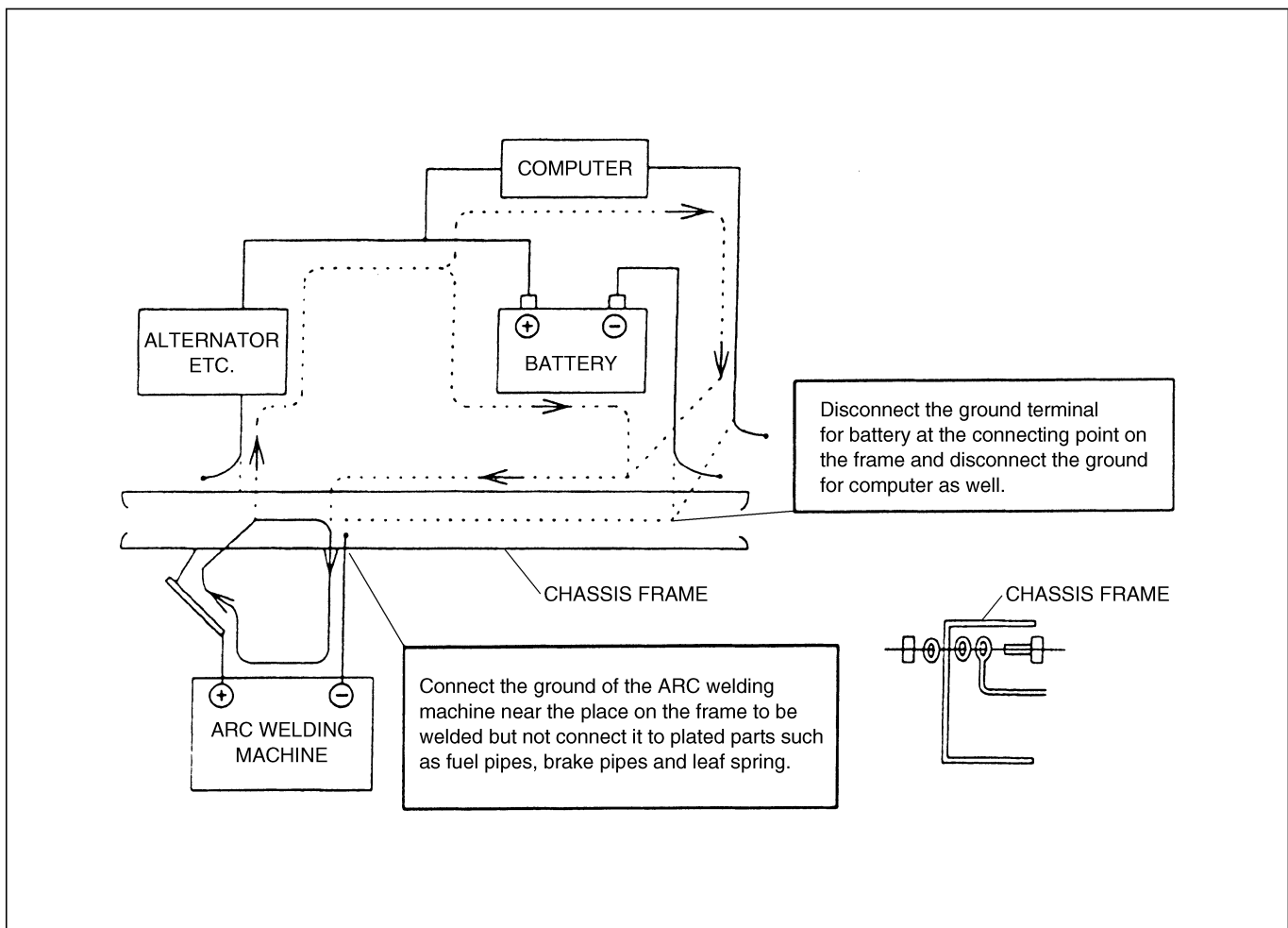
- (1) To remove a connector, hold the connector (indicated by an arrow in the figure) to pull it out. Never pull the harness.
- (2) To remove a connector with lock, release the lock then pull it out.
- (3) To connect a connector with lock, insert it until it clicks.
- (4) To insert a test lead into the connector, insert it from behind the connector.
- (5) In case it is difficult to insert a test lead from behind the connector, prepare a harness for inspection and perform inspection.

PRECAUTIONS FOR ELECTRIC WELDING

1. PRECAUTION FOR ELECTRIC WELDING

Electrical components such as the alternator and tachograph are directly connected to the battery and one end is earthed to the chassis frame. Under these conditions, welding current will flow back along the earth circuit if electric welding is carried out and damage may be caused to the alternator, tachograph, electrical components, etc. Consequently, the following precautions are always to be taken during welding.

- (1) Disconnect the earth terminal of the battery at the frame fitment and earth the welding equipment securely to the frame itself. (Do not fit the welding equipment earth to such things as the tire rims, brake pipes or fuel pipes and leaf spring, etc.)
 - a. Turn the starter switch off.
 - b. Disconnect the battery's negative terminal of the battery.
 - c. Earth welding equipment securely, near to the area to be welded.



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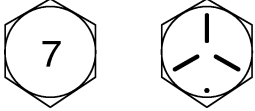

- (2) In order to prevent damage to ancillary equipment components from sparks during welding, take steps such as putting fire-resistant covers over things like the engine, meters, steering wheel, hoses, tubes, leaf spring and tires.

SPECIFIED TORQUE FOR STANDARD BOLTS AND NUTS

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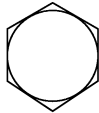
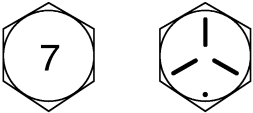

1. FLANGE BOLT

Unit: N·m {kgf·cm, lbf·ft}

Class	7T	9T
Representation		
Diameter x Pitch		
M8 x 1.25	28.5 {290, 21.0}	36 {370, 26.8}
M10 x 1.25	60 {610, 44.1}	74.5 {760, 55.0}
M10 x 1.5	55 {560, 40.5}	68.5 {700, 50.6}
M12 x 1.25	108 {1,100, 79.6}	136 {1,390, 100.5}
M12 x 1.75	97 {990, 71.6}	125 {1,280, 92.6}
M14 x 1.5	171.5 {1,750, 126.6}	216 {2,210, 159.8}
M14 x 2	154 {1,570, 113.6}	199 {2,030, 146.8}

2. BOLT WITH WASHER

Unit: N·m {kgf·cm, lbf·ft}

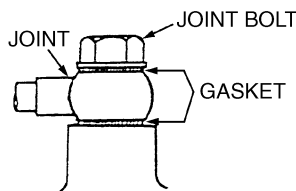
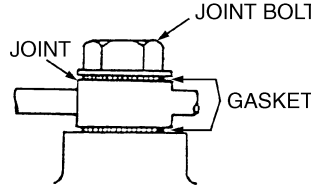
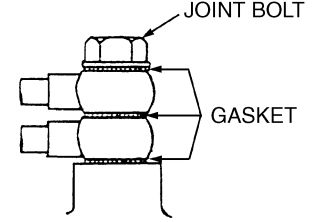
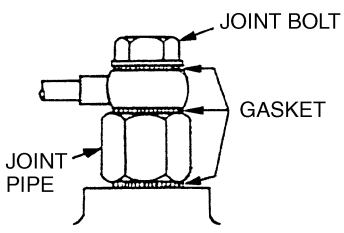
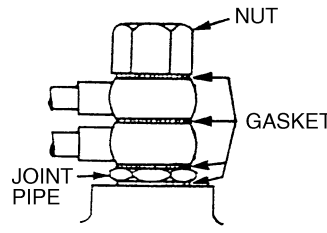
Class	4T	7T	9T
Representation			
Diameter x Pitch	No Mark		
M6 x 1	6 {60, 4.3}	10 {100, 7.2}	13 {130, 9.4}
M8 x 1.25	14 {140, 10.1}	25 {250, 18.1}	31 {320, 23.1}
M10 x 1.25	29 {300, 21.7}	51 {520, 37.6}	64 {650, 47.0}
M10 x 1.5	26 {270, 19.5}	47 {480, 34.7}	59 {600, 43.4}
M12 x 1.25	54 {550, 39.8}	93 {950, 68.7}	118 {1,200, 86.8}
M12 x 1.75	49 {500, 36.2}	83 {850, 61.5}	108 {1,100, 79.6}
M14 x 1.5	83 {850, 61.5}	147 {1,500, 108.5}	186 {1,900, 137.4}
M14 x 2	74 {750, 54.2}	132 {1,350, 97.6}	172 {1,750, 126.6}

DISMOUNTING AND MOUNTING

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PROCEDURE FOR INSTALLING JOINTS AND GAS-KETS OF ENGINE PIPING

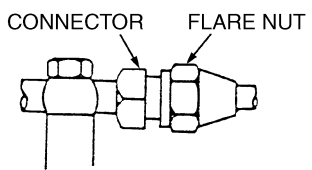
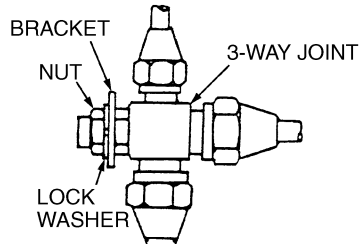
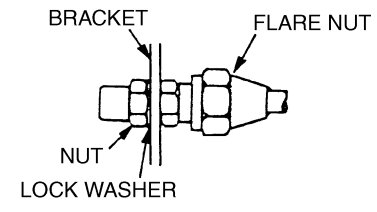
1. Gasket seal type (aluminum + rubber, asbestos or copper).

Location of gasket seal		
		
		

Tightening torque chart

Clamping screw size (Diameter) mm {in.}	Tightening torque N-m {kgf·cm, lbf·ft}
8 {0.315}	13 {130, 9}
10 {0.394}	20 {200, 14}
12 {0.472}	25 {250, 18}
14 {0.551}	25 {250, 18}
16 {0.630}	29 {300, 22}
18 {0.709}	39 {400, 29}
20 {0.787}	*39 {400, 29}
24 {0.945}	69 {700, 51}
28 {1.102}	127 {1,300, 94}

2. Metal seal type (Flare connector type).

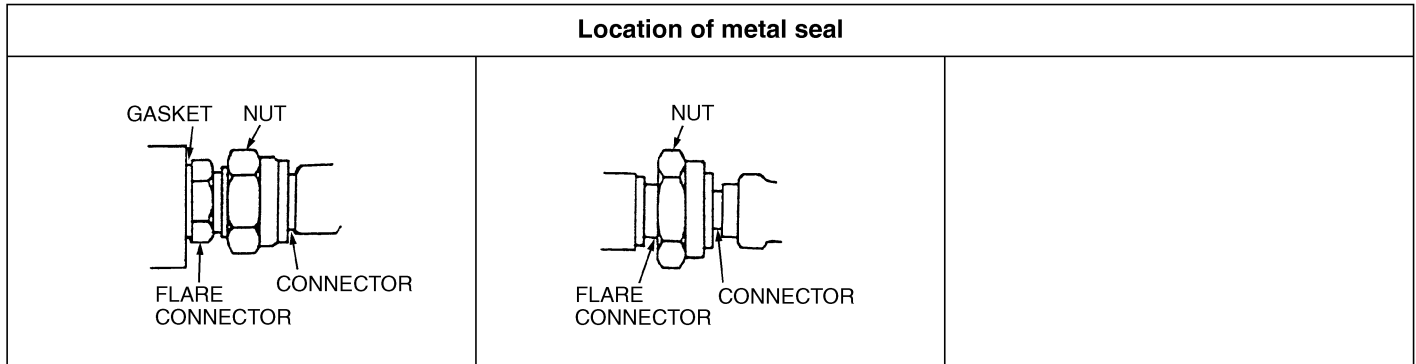
Location of metal seal		
		

Tightening torque chart

Clamping screw size (Diameter) mm {in.}	Tightening torque N·m {kgf·cm, lbf·ft}
12 {0.472}	20 {200, 14}
14 {0.551}	31 {320, 23}
16 {0.630}	39 {400, 29}
18 {0.709}	59 {600, 43}
20 {0.787}	64 {650, 47}

3. Metal seal type (Nipple connector type).

Location of metal seal



Tightening torque chart

Clamping screw size (Diameter) mm {in.}	Tightening torque N·m {kgf·cm, lbf·ft}
10 {0.394}	11 {110, 8}
24 {0.945}	20 {200, 14}

NOTICE

- Before installing the joints, ensure that there is no dirt or burrs adhering to the various seat faces (pipe joints, gasket, etc.)
- Because the pipes can move relatively freely during installation and the seat faces are liable to tilt, first temporarily tighten the pipes, then tighten them to the specified torque and ensure that there is no leakage from them.
- When tightening two pipes together, be very careful that they do not rotate together.
- After installing the pipes, apply the correct pressure to each pipe joint and ensure that there is no leakage.
- Ensure that the various tightening torques conform to the above table.

*If a soft washer #4840 FR-N (aluminum + rubber and carbon press fit part) is loosened or removed subsequent to being installed, be sure and replace it with a new one.

There is no need to replace it, however, for normal retightening.

SYMPTOM SIMULATION

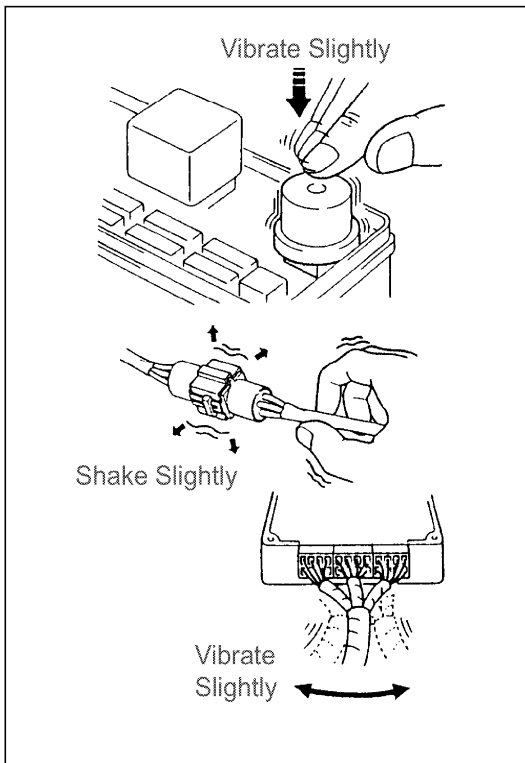
EN00Z01013200003

HINT

The most difficult case in troubleshooting is when no problem symptoms occur. In such a case, a thorough problem analysis must be carried out. A simulation of the same or similar conditions and environment in which the problem occurred in the customer's vehicle should be carried out. No matter how much skill or experience a technician has, troubleshooting without confirming the problem symptoms will lead to important repairs being overlooked and mistakes or delays.

For example:

With a problem that only occurs when the engine is cold or as a result of vibration caused by the road during driving, the problem can never be determined if the symptoms are being checked on a stationary vehicle or a vehicle with a warmed-up engine. Vibration, heat or water penetration (moisture) is difficult to reproduce. The symptom simulation tests below are effective substitutes for the conditions and can be applied on a stationary vehicle. Important points in the symptom simulation test: In the symptom simulation test, the problem symptoms as well as the problem area or parts must be confirmed. First, narrow down the possible problem circuits according to the symptoms. Then, connect the tester and carry out the symptom simulation test, judging whether the circuit being tested is defective or normal. Also, confirm the problem symptoms at the same time. Refer to the problem symptoms table for each system to narrow down the possible causes.



1. VIBRATION METHOD: When malfunction seems to occur as a result of vibration.

(1) PART AND SENSOR

Apply slight vibration with a finger to the part of the sensor suspected to be the cause of the problem, and check whether or not the malfunction occurs.

NOTICE

Applying strong vibration to relays may open relays

(2) CONNECTORS

Slightly shake the connector vertically and horizontally.

(3) WIRE HARNESS

Slightly shake the wire harness vertically and horizontally.

HINT

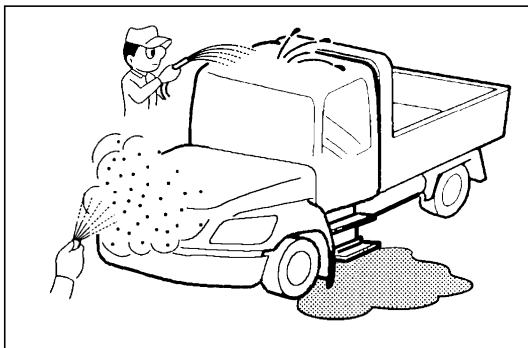
The connector joint and fulcrum of the vibration are the major areas that should be checked thoroughly.

2. HEAT METHOD: When a malfunction seems to occur when the area in question is heated.

(1) Heat the component that is the possible cause of the malfunction with a hair dryer or similar device. Check if the malfunction occurs.

NOTICE

- Do not heat to more than 60°C (140°F). Exceeding this temperature may damage components.
- Do not apply heat directly to the parts in the ECU.



SAPH00Z010100028

3. **WATER SPRINKLING METHOD:** When a malfunction seems to occur on a rainy day or in high-humidity.

- (1) Sprinkle water onto the vehicle and check if the malfunction occurs.

NOTICE

- Never sprinkle water directly into the engine compartment. Indirectly change the temperature and humidity by spraying water onto the front of the radiator.
- Never apply water directly onto the electronic components.

HINT

If the vehicle has or had a water leakage problem, the leakage may have damaged the ECU or connections. Look for evidence of corrosion or short circuits. Proceed with caution during water tests.

4. **HIGH ELECTRICAL LOAD METHOD:** When a malfunction seems to occur when electrical load is excessive.

- (1) Turn on the heater blower, headlight, rear window defogger and all other electrical loads. Check if the malfunction reoccurs.

ENGINE INTRODUCTION (J05D)

EN01-001

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ENGINE ASSEMBLY

DATA AND SPECIFICATIONS

EN0110301200001

Model		J05D-TF
Type		Diesel, 4 cycle, vertical, 4 cylinder, in-line overhead camshaft, water-cooled, direct injection
Aspiration		Turbocharged with intercooler
Bore and stroke		112x120 mm {4.41x4.72 in.}
Piston displacement		4.728 L {288.5 cu.in.}
Compression ratio		17.5: 1
Firing order		1-3-4-2 (The cylinder numbers are counted in order from the crankshaft pulley side)
Direction of rotation		Counterclockwise viewed from flywheel
Compression pressure		2.9-3.1 MPa {30-32 kgf/cm ² , 425-455 lbf/in. ² } at 150 r/min
Maximum revolution (at full load)		3,000 r/min
Idling revolution		750 r/min
Dry weight		Approximately 475 kg {1,047 lb}
Valve seat angle	Intake	30°
	Exhaust	45°
Valve face angle	Intake	30°
	Exhaust	45°
Valve timing (flywheel travel)	Intake opens	13° before top dead center
	Intake closes	21° after bottom dead center
	Exhaust opens	59° before bottom dead center
	Exhaust closes	13° after top dead center
Valve clearance (when cold)	Intake	0.30 mm {0.0118 in.}
	Exhaust	0.45 mm {0.0177 in.}
Engine oil pump	Type	Full forced pressure feed by gear pump
	Drive	By gear
Engine oil cooler		Multi-plate type, water cooled
Injector	Type	Multi-hole nozzle type
Coolant pump	Type	Forced circulation by volute pump
	Drive	By V-belt
Thermostat Type		Wax.type, bottom bypass system
Injection timing (flywheel travel)		0° before top dead center for No.1 cylinder of the compression stroke

TROUBLESHOOTING

EN0110301F300001

Engine overheating

Symptom	Possible cause	Remedy/Prevention
Engine overheating (Coolant)	Insufficient coolant	Add coolant
	Defective thermostat	Replace thermostat
	Overflow of coolant due to leakage of exhaust into cooling system	Repair
	Damaged rubber hose	Replace rubber hose
	Coolant leakage due to deteriorated rubber hose	Replace rubber hose
	Coolant leakage from coolant pump	Replace the coolant pump
	Coolant leakage from rubber hose connection	Retighten or replace clamp
	Coolant leakage from cylinder head gasket	Replace gasket
Engine overheating (Coolant pump)	Bearing seizure	Replace
	Damaged (corroded) vane	Replace vane
Engine overheating (Radiator)	Clogged with rust or scale	Clean radiator
	Clogged with iron oxide due to leakage of exhaust into cooling system	Clean coolant passage and correct exhaust leakage
	Coolant leakage	Repair or replace radiator
	Damaged cooling fan	Replace cooling fan
	Clogged radiator core due to mud or other debris	Clean radiator
	Defective radiator cap pressure valve	Replace radiator cap
Engine overheating (Abnormal combustion)	Poor fuel	Use good quality fuel
	Breakdown of injector	Replace the injector
Engine overheating (Other problems)	Defective or deteriorated engine oil	Change engine oil
	Unsatisfactory operation of oil pump	Replace or repair
	Insufficient oil	Add oil
	Brake drag	Repair or adjust
	Break water temperature sensor	Replace it
Engine overheating (Severe operating condition)	Lugging the engine	Operate engine properly

Excessive oil consumption

Symptom	Possible cause	Remedy/Prevention
Excessive oil consumption (Pistons, cylinder liners, and piston rings)	Wear of piston ring and cylinder liner	Replace piston rings and cylinder liner
	Worn, sticking or broken piston rings	Replace piston rings and cylinder liner
	Insufficient tension on piston rings	Replace piston rings and cylinder liner
	Unsatisfactory breaking in of piston rings	Replace piston rings and cylinder liner
	Unsuitable oil (viscosity too low)	Change oil as required and replace piston rings and cylinder liners
	Incorrectly fitted piston rings (upside down)	Replace piston rings
	Gaps of piston rings in cell with each other	Reassemble piston rings
Excessive oil consumption (Valve and valve guides)	Worn valve stem	Replace valve and valve guide
	Worn valve guide	Replace valve guide
	Incorrectly fitted valve stem seal	Replace the stem seal
	Excessive lubricant on rocker arm	Check clearance of rocker arm and shaft
Excessive oil consumption (Excess oil feed)	Defective oil level gauge	Replace oil level gauge
	Oil level too high	Drain excess oil
Excessive oil consumption (Oil leakage from miscellaneous parts)	Oil leakage from oil seal	Replace oil seal
	Cracks or blowhole in cylinder block	Replace cylinder block
	Oil leakage from connections of oil lines	Tighten connections of oil lines
	Oil leakage from oil cooler	Replace oil cooler
	Oil leakage from oil pan gasket	Replace oil pan gasket
	Oil leakage from O-ring	Replace O-ring
Excessive oil consumption (Other problems)	Overcooled engine (low temperature wear)	Warm up engine before moving vehicle. Check cooling system.

NOTICE

If oil consumption is excessive, the problems above will occur. Complaints from the customer are often related to such problems.

1. White smoke is emitted continuously when the engine is run at high speed.
2. White smoke is emitted only immediately after the engine speed is abruptly raised when idling.
3. The tail pipe is blackened with oil.
4. Oil leaks from the flanges of the exhaust manifold.
5. Lack of power.

Piston seizure

Symptom	Possible cause	Remedy/Prevention
Piston seizure (Pistons, cylinder liners and piston rings)	Incorrect clearance between piston and cylinder liner	Replace piston, piston rings and cylinder liner
	Unsatisfactory installation of piston pin	Replace piston, piston rings, cylinder liner and piston pin as required
	Broken piston ring	Replace piston, piston rings and cylinder liner
	Difference in expansion due to use of wrong piston	Replace piston, piston rings and cylinder liner
Piston seizure (Coolant)	Reduction in capacity of coolant pump (due to vane corrosion)	Replace the coolant pump
	Leakage of coolant	Repair
	Insufficient coolant	Add coolant
	Dirty coolant	Clean and replace coolant
	Defective radiator (coolant leakage, clogging)	Repair or replace the radiator
	Defective rubber hose (leakage)	Replace rubber hose
	Defective thermostat	Replace the thermostat
	Leakage of exhaust into cooling system	Repair
Piston seizure (Operation)	Abrupt stoppage of engine after running at high speed	Operate engine properly
	Hill climbing using unsuitable gear	Select suitable gear
Piston seizure (Oil)	Insufficient oil	Add oil
	Dirty oil	Change oil
	Poor quality oil	Replace with proper engine oil
	High oil temperature	Repair
	Low oil pressure	Repair
	Defective oil pump	Repair oil pump
	Reduced performance due to worn oil pump	Replace oil pump
Suction strainer sucking air	Add oil and/or repair strainer	
Piston seizure (Abnormal combustion)	Use of defective fuel	Change fuel
	Engine overheating	See Symptom: "Engine overheating"
	Breakdown of injector	Replace the injector

NOTICE

If piston seizure occurs, the problems above will occur. Complaints from the customer are often related to these problems.

1. White smoke is emitted.
2. Lack of power

Lack of power

Symptom	Possible cause	Remedy/Prevention
Lack of power (Supply pump)	Damaged suction control valve	Replace the supply pump
Lack of power (Intake)	Clogged air cleaner	Clean element or replace element
Lack of power (Overheating)		See Symptom: "Engine overheating"
Lack of power (Fuel and injector)	Air in fuel system	Repair and bleed air from fuel system
	Clogged fuel filter	Replace element
	Use of poor fuel	Use good quality fuel
	Breakdown of injector	Replace the injector
Lack of power (Pistons, cylinder liners and piston rings)	Seized or wear of piston	Replace the piston, piston rings and liner
	Worn or broken piston rings, piston and cylinder liner	Replace piston rings, piston and liner
Lack of power (Other problems)	Exhaust brake butterfly valve stuck in half-open position	Replace or repair exhaust brake
	Connecting rod bent	Replace or repair connecting rod
	Exhaust pipe or muffler crushed (increased back-pressure)	Replace exhaust pipe or muffler
	Breakage of turbine or blower	Replace turbocharger

Leakage of exhaust

Symptom	Possible cause	Remedy/Prevention
Leakage of exhaust (Head gasket)	Fatigued gasket (aging)	Replace gasket
	Damage	Replace gasket
	Improper installation	Replace gasket
Leakage of exhaust (Head bolts)	Loose bolts	Tighten bolts
	Elongated bolts	Replace bolts
	Improper tightening torque or tightening sequence	Tighten properly
Leakage of exhaust (Cylinder block)	Cracking	Replace cylinder block
	Surface distortion	Repair or replace
	Fretting of cylinder liner insertion portion (insufficient projection of cylinder liner)	Replace cylinder block
Leakage of exhaust (Cylinder head)	Cracking	Replace cylinder head
	Surface distortion	Repair or replace
Leakage of exhaust (Cylinder liners)	Cracking	Replace cylinder liner
	Corrosion	Replace cylinder liner
	Insufficient projection of cylinder liner	Replace cylinder liner

NOTICE

If leakage of the exhaust occurs, the problems above will occur. Complaints from the customer are often related to these problems.

1. Lack of power.
2. The engine overheats.
3. The coolant is discolored.

Difficulty starting engine

Symptom	Possible cause	Remedy/Prevention
Difficulty starting engine (Electrical system)	Discharged battery	Charge battery
	Defective wiring in starter circuit	Repair wiring of starter
	Loose or open-circuit battery cable	Tighten battery terminal connections or replace battery cable
	Broken glow plug	Replace
Difficulty starting engine (Supply pump)	Defective supply pump	Replace the supply pump
Difficulty starting engine (Air cleaner)	Clogged element	Replace the element
Difficulty starting engine (Fuel system)	No fuel in tank	Supply fuel
	Clogged fuel line	Clean fuel line
	Air sucked into fuel system through fuel line connections	Tighten fuel line connections
	Clogged fuel filter	Replace element
	Loose connection in high-pressure line	Tighten sleeve nut of high-pressure line
	Water in fuel	Drain and clean fuel system
Difficulty starting engine (Oil system)	Oil viscosity too high	Use proper viscosity oil, or install an oil immersion heater and warm up oil
Difficulty starting engine (Other problems)	Seized piston	Replace piston, piston rings, and liner
	Seized bearing	Replace bearing and/or crankshaft
	Reduced compression pressure	Overhaul engine
	Ring gear damaged or worn	Replace the ring gear and/or starter pinion
	Improperly adjusted or broken	Adjust

Rough idling

Symptom	Possible cause	Remedy/Prevention
Rough idling (Supply pump)	Damaged suction control valve	Replace the supply pump
Rough idling (Injector)	Breakdown of injector	Replace the injector
Rough idling (Engine proper)	Improper valve clearance	Adjust valve clearance
	Improper contact of valve seat	Replace or repair valve and valve seat
	Idling speed too low	Adjust idling speed
	Coolant temperature too low	Warm up engine
	Compression pressure of cylinders markedly different from one another	Overhaul engine
Rough idling (Other problems)	Clogged high pressure injection line	Replace line
	Leakage due to improper tightening of high pressure fuel line	Tighten sleeve nut
	Engine seizure	Replace pistons, piston rings and liners
	Incorrect valve timing	Replace camshaft

Diesel knock

Symptom	Possible cause	Remedy/Prevention
Diesel knock (Supply pump)	Damaged suction control valve	Replace the supply pump
Diesel knock (Injector)	Breakdown of injector	Replace the injector
Diesel knock (Fuel system)	Use of poor fuel	Use good quality fuel
Diesel knock (Other problems)	Excessively cooled or heated engine	Warm up or cool engine
	Insufficient air intake	Correct
	Insufficient compression pressure	Repair
	Compression pressure leaks at cylinder head gasket	Replace head gasket
	Improper valve clearance or valve sticking	Adjust or repair
	Tappet sticking	Replace tappet and camshaft

Unusual engine noise

Symptom	Possible cause	Remedy/Prevention
Unusual engine noise (Piston)	Wear of piston pin boss or piston pin	Replace piston and/or piston pin
	Seized, damaged, or worn piston pin bushing	Replace piston pin bushing.
	Worn pistons or cylinder liners	Replace piston or cylinder liner
	Damaged or seized piston	Replace piston and cylinder liner
	Foreign matter on top surface of the piston	Remove foreign matter and repair or replace piston, cylinder liner, and/or cylinder head
Unusual engine noise (Valve mechanism)	Incorrect valve clearance	Adjust valve clearance
	Valve cotter out of place	Replace valve cotter
	Seized valve stem	Replace valve and valve guide
	Broken valve	Replace valve
	Damaged rocker arm support	Replace rocker arm support
	Broken valve spring	Replace valve spring
Unusual engine noise (Bearings seizure)	Insufficient lubricating oil	Add oil
	Excessive or insufficient tightening of bearing housings	Retighten to specified torque
	Pits and scratches on bearing surface	Replace bearing and crankshaft
	Oil film formed on back of bearing	Replace bearing
	Improper installation of bearing	Replace bearing
	Reduction of spread dimension of bearing	Replace bearing
	Distorted bearing housing	Replace or correct bearing housing
	Excessive oil clearance	Replace bearing
Unusual engine noise (Various other parts)	Exhaust gas leakage from exhaust pipe joints	Retighten joints
	Loosen or missing intake manifold flange gasket	Retighten or replace
	Intake valve seating is not concentric	Replace or correct the valve and valve seat
	Intake gas leakage	Retighten

Symptom	Possible cause	Remedy/Prevention
Unusual engine noise (Other problems)	Loose cooling fan mounting bolts or fan pulley nut	Tighten the fan and crankshaft pulley
	Lack of lubricating oil (coolant pump, valves, etc.)	Lubricate
	Worn timing gear	Replace the timing gear
	Breakage of turbine or blower	Replace turbocharger

NOTICE

The items on this page concern unusual engine noise which is due to causes other than those given for diesel knock.

TROUBLESHOOTING (COMMON RAIL SYSTEM)

EN0110301F300002

Engine does not start

Symptom	Possible cause	Remedy/Prevention
Engine does not start (Fuel not reaching supply pump)	Fuel lines clogged or damaged	Clean or replace fuel lines
	Fuel filter clogged	Clean or replace the filter element
	Air in fuel caused by improper connections of fuel line between fuel tank and feed pump	Repair connections
	Filter incorporated in inlet side of feed pump clogged	Remove foreign material
	Breakdown feed pump	Replace the supply pump
Engine does not start (Fuel reaching supply pump)	Leakage due to improper tightening of high pressure fuel line	Tighten sleeve nut
	Breakdown ECU	Replace the ECU
Engine does not start (Injector faulty)	Injector broken	Replace the injector
Engine does not start (Electrical system)	Defective sensors or circuits	Refer to the chapter "FUEL CONTROL"
Engine starts and stops	Fuel lines clogged	Clean or replace fuel lines
	Air in fuel caused by damaged fuel lines or improper connection of fuel lines	Repair fuel lines or replace fuel lines and gaskets
Engine has low power (Injector faulty)	Injector broken	Replace the injector
Engine has low power (Electrical system)	Defective sensors or circuits	Refer to the chapter "FUEL CONTROL"

Excessive smoke (Black smoke)

Symptom	Possible cause	Remedy/Prevention
Excessive smoke (Black smoke)	Defective sensors or circuits	Refer to the chapter "FUEL CONTROL"
	Defective injector	Replace the injector
Excessive smoke (White smoke)	Water in fuel	Check and clean fuel lines
	Glow plug not operating	Check glow plug circuit

Low idle speed irregular

Symptom	Possible cause	Remedy/Prevention
Low idle speed irregular	Defective sensors or circuits	Refer to the chapter "FUEL CONTROL"
	Defective injector	Replace the injector

ENGINE TUNEUP

EN0110301H300001

VALVE CLEARANCE CHECKING AND ADJUSTING PROCEDURES

NOTICE

Valve clearance adjustment is performed only when the checking result is not within the specified value.

1. PREPARATION OF CHECKING AND ADJUSTMENT

- (1) Positioning the No.1 or No.4 piston at Top Dead Center of the compression stroke.
 - a. Turn the crankshaft counterclockwise (viewed from the flywheel side) to align mark "1/4" on the outer periphery of the flywheel with the pointer of the flywheel housing.

NOTICE

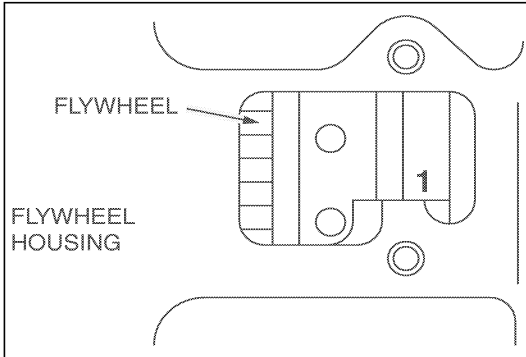
- Always turn the crankshaft counterclockwise (viewed from the flywheel side).
- In this position the No.1 or No.4 piston is at the Top Dead Center of the compression stroke.

- b. Turn the crankshaft clockwise in the engine direction and align the crankshaft pulley mark "1/4" to the retainer protrusion.

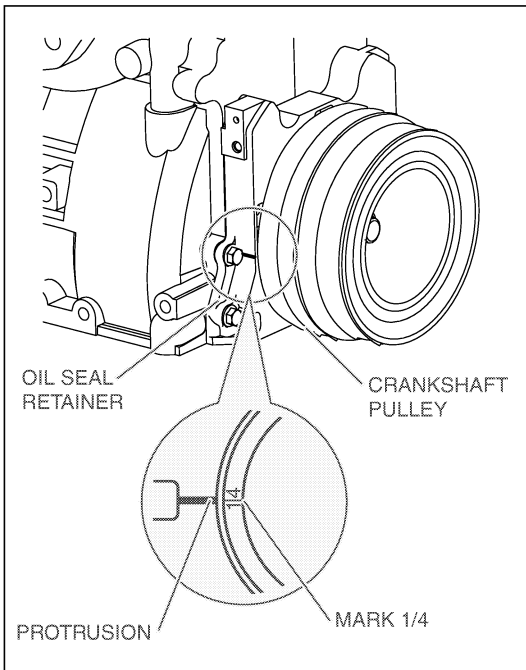
NOTICE

When matching the pulley mark "1/4" of the crankshaft pulley, attach the special tool to the 6 crankpulley tightening bolts. Then turn the torque wrench in a clockwise direction.

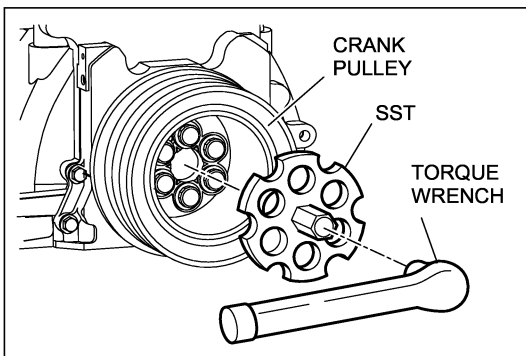
SST: Cranking Tool (S0940-91190)



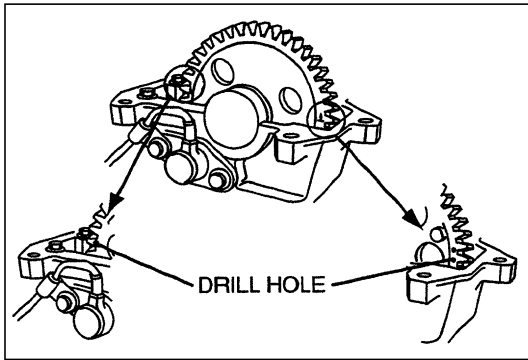
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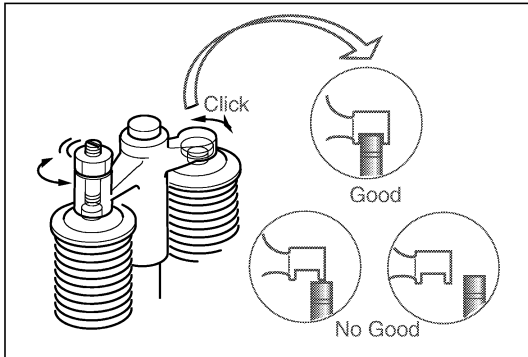


SAPH011030100004

- (2) Among three drill holes on the camshaft gear, when two drill holes are on horizontal position, and the rest of the drill hole is visible, the No.1 piston is at the Top Dead Center of the compression stroke.

NOTICE

If the rest of drill hole is invisible by camshaft housing, the No.6 piston is at the Top Dead Center of the compression stroke.



SAPH011030100005

- (3) Make sure that the valve stem is correctly inserted in the cross head.

NOTICE

Move the cross head with fingers right and left to confirm the valve stem is correctly inserted in the cross head by listening to the clicking sound.

- (4) Confirm that there are no foreign particles or dust between the cross head and the valve stem.

2. VALVE CLEARANCE CHECKING

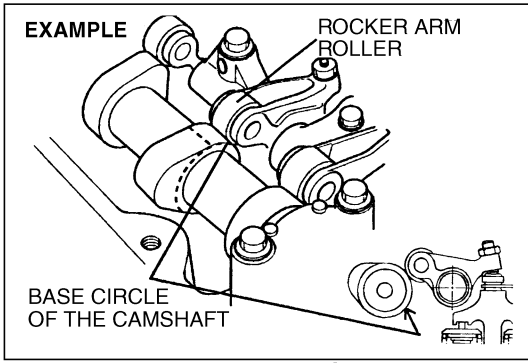
NOTICE

Before beginning the checking, you must perform "PREPARATION OF CHECKING AND ADJUSTMENT" described on page EN01-11.

- (1) You can understand which valve to adjust when No.1 or No.4 piston is at the Top Dead Center of the compression stroke by the following chart).

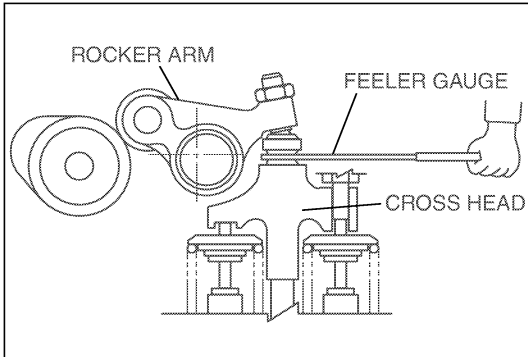
	Cylinder		1		2		3		4	
	Valve		IN	EX	IN	EX	IN	EX	IN	EX
With No.1 piston at T.D.C. on compression stroke	Camshaft gear condition		○	○	○			○		
With No.4 piston at T.D.C. on compression stroke						○	○		○	○

- #1= View from rear side of camshaft housing
- ○Mark: Possible to check valve clearance
- Firing order: 1-3-4-2
- T.D.C. : Top Dead Center



SAPH011030100008

- (2) Before checking the valve clearance, make sure that the roller is on the base circle of the camshaft.



SAPH011030100009

- (3) Insert a feeler gauge of the specified thickness as below between the rocker arm and the cross head to check the valve clearance.

VALVE CLEARANCE (when cold)

Intake valve	0.30 mm {0.0118 in.}
Exhaust valve	0.45 mm {0.0177 in.}

NOTICE

Valve clearance adjustment is performed only when the checking result is outside the specified value.

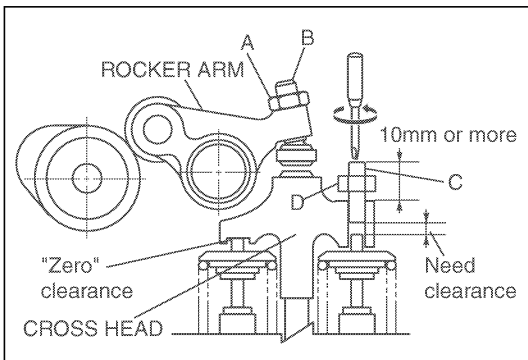
3. VALVE CLEARANCE ADJUSTMENT

NOTICE

Valve clearance adjustment is performed only when the checking result is outside the specified value.

NOTICE

- Before beginning the adjustment you must perform "PREPARATION OF CHECKING AND ADJUSTMENT" described on page EN01-11.
- As for the valve which can adjust the valve clearance refer to the chart on page EN01-12.
- Make sure that the cylinder head bolt, rocker arm support bolt, nozzle clamp bolt, and cam bearing cap bolt are tightened to the specified torque.

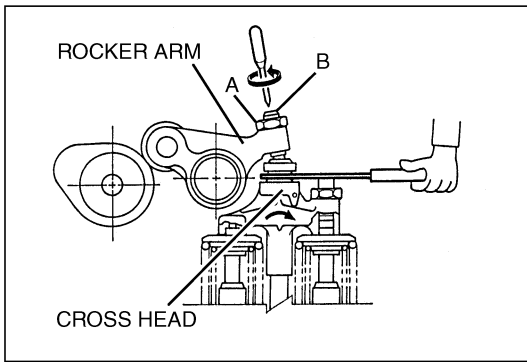


SAPH011030100010

- (1) Loosen the adjusting screw lock nut A, D of the rocker arm and cross head fully.
- (2) The cross head adjusting screw must protrude 10 mm {0.394 in.} or more from the cross head upper face.

NOTICE

Unless the adjusting screw is completely loose to the valve stem head, the following adjustments may be adversely affected.



SAPH011030100011

- (3) Insert a feeler gauge of the specified thickness shown below between the rocker arm and the cross head, and adjust the valve clearance with the adjust screw of the rocker arm.

VALVE CLEARANCE (when cold)

Intake valve	0.30 mm {0.0118 in.}
Exhaust valve	0.45 mm {0.0177 in.}

- (4) After completion of the adjustment, tighten the lock nut A securely with the specified tightening torque.

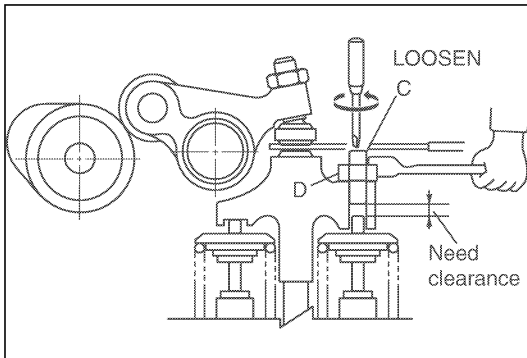
Tightening Torque:

25 N·m {250 kgf·cm, 18 lbf·ft}

- (5) The condition of inserted feeler gauge, loosen the adjusting screw of the cross head, make sure that the feeler gauge does not feel loose.

NOTICE

If the feeling of the feeler gauge becomes loose, repeat steps from (1).

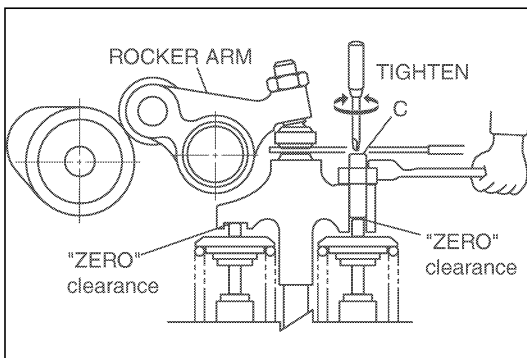


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- (6) Tighten the adjusting screw C of the cross head until the feeler gauge does not move.

NOTICE

In this situation, clearance between adjusting screw C and valve stem head is zero.

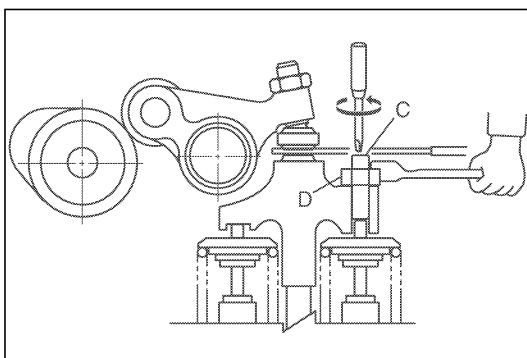


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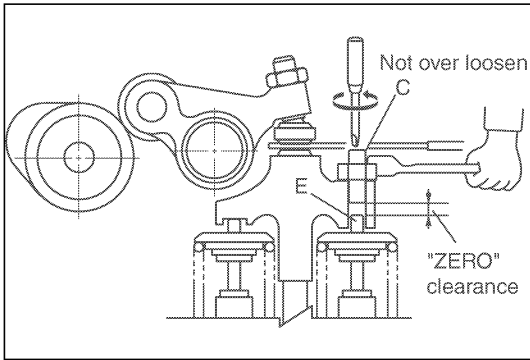
- (7) While loosening the adjusting screw C of the cross head gradually, adjust the valve clearance. Tighten the lock nut D of the cross head securely with the specified tightening torque when the feeler gauge feels correct.

Tightening Torque:

25 N·m {250 kgf·cm, 18 lbf·ft}



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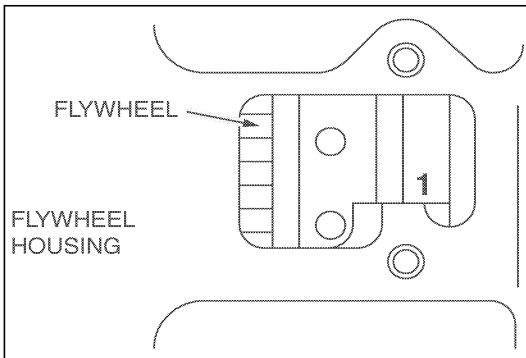


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NOTICE

- Do not over loosen the adjusting screw.
- Over loosening of the adjusting screw C will cause the same condition as in step (3) again. The feeler gauge may feel correct, but there may be excessive clearance between the adjusting screw C of the cross head and the valve stem head E. This does not allow for correct adjustment.

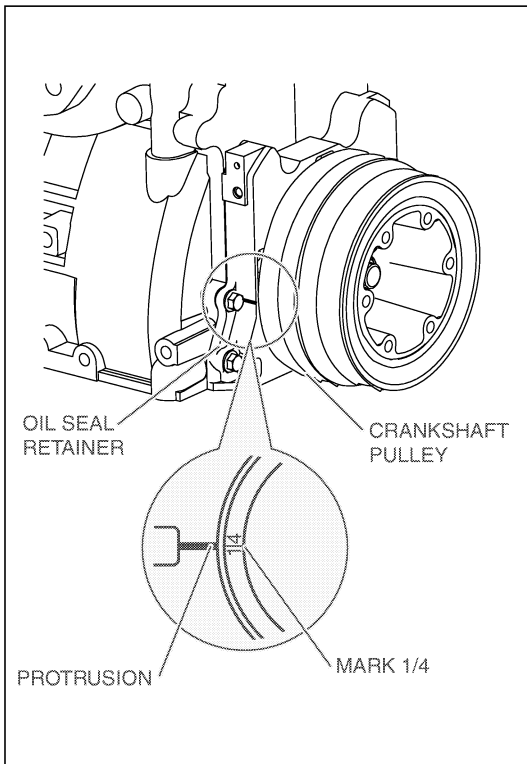
- (8) Position each piston at Top Dead Center of compression stroke by turning the crankshaft counterclockwise viewed from flywheel side. Then adjust the valve clearance for each cylinder in the firing order.



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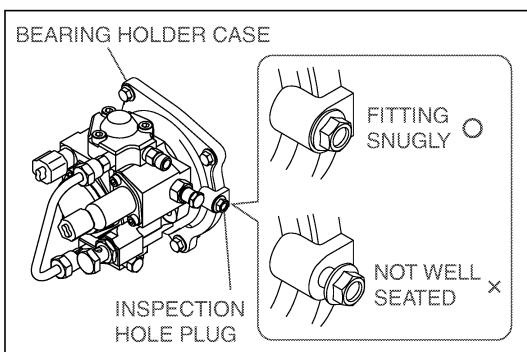
INJECTION TIMING INSPECTION PROCEDURES**1. INSPECT THE INJECTION TIMING.**

- (1) Turn the crankshaft counterclockwise, as viewed from the flywheel side, and then align the timing mark in the check window of the flywheel housing with a mark of "1/4". At this time, the No.1 cylinder or the No.4 cylinder is in the top dead center.



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- (2) Make sure that the timing mark "1/4" on the crankshaft pulley is aligned with the retainer mark protrusion.



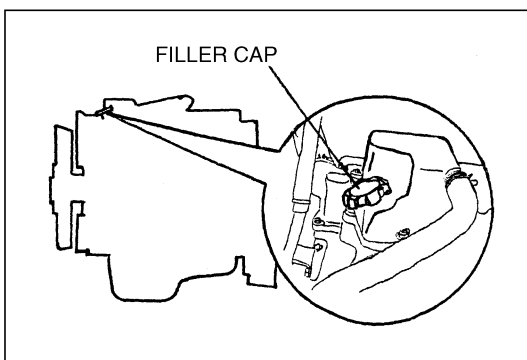
SAPH011030100017

- (3) Taking off the inspection hole plug, located at bearing holder case of supply pump and inserting the special tool therein, check that the seat face of tool is fitting snugly with the bearing holder.

SST: Guide pin (SZ105-08067)

NOTICE

When it is not well seated, it means it is contacting with other parts than the turning stopper hole of coupling flange. Therefore, don't insert in too much. In this case, the timing is not fit. So, perform again the setting for Top Dead Center of No.1 cylinder compression stroke in above (1).



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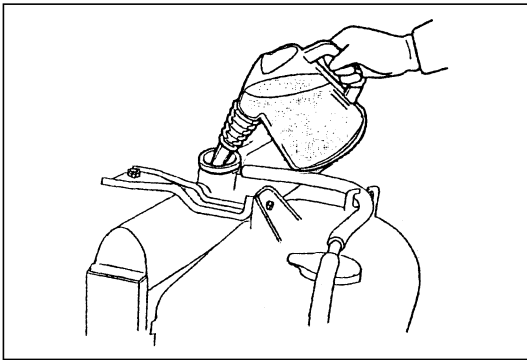
START THE ENGINE

⚠ WARNING

Do not leave tools on or around the engine. Contact of tools with moving parts may result in personal injury or damage to equipment.

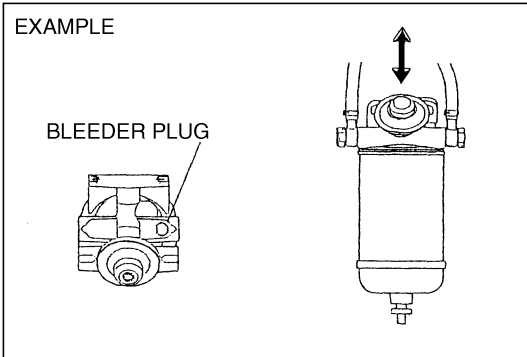
1. PREPARATION

- (1) Supply engine oil.



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(2) Supply cooling water and bleed air from it.



SAPH011030100020

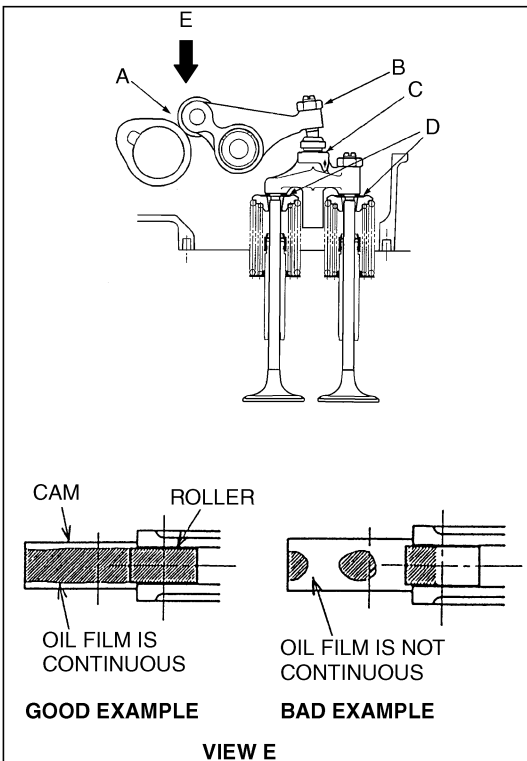
(3) Bleed air from the fuel system.

(4) Check connection to the alternator.

NOTICE

Starting the engine without wiring in place may burn out the alternator.

(5) Check the engine stopping performance.



SAPH011030100021

LUBRICATION

1. CHECK THE ROCKER ARM.

- (1) Remove the head cover.
- (2) Set the engine revolution to the specified idling revolution.
- (3) After the engine starts, check that oil is supplied to the following locations of all rocker arms within approximately 10 seconds.
 - a. Roller and cam face A
 - b. Cross head top C and spring upper seat top face D through adjusting screw B

NOTICE

If the supply of oil is delayed or not happening, hydraulic pressure may be low or the oil gallery may be clogged. Insufficient supply of oil may lead to seizure, abnormal wear or abnormal noise. Recheck the assembly.

SPECIAL TOOL

EN0110301K100001

Prior to starting an engine overhaul, it is necessary to have these special tools.

Illustration	Part number	Tool name	Remarks
	S0955-21110	COMPRESSION GAUGE ADAPTER (A)	For Overhaul criteria
	S0955-21030 S0955-21060	COMPRESSION GAUGE ADAPTER (B)	
	S0940-91190	CRANKING TOOL	
	SZ105-08067	GUIDE BOLT	

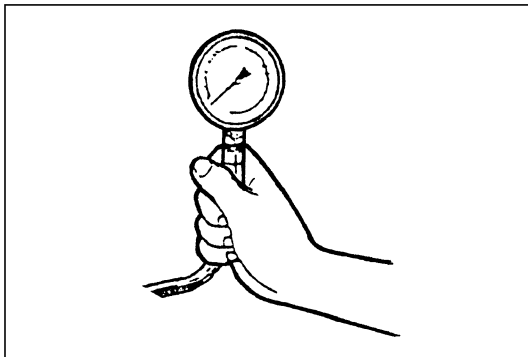
OVERHAUL CRITERIA

EN0110301H300002

FACTORS TO DETERMINE THE ENGINE OVERHAUL

1. LOW COMPRESSION PRESSURE

- (1) Before measurement
 - a. Charge the battery completely.
 - b. Set the valve clearance to the correct value.
 - c. Idle the engine (Coolant temperature at 80°C {176°F}).
 - d. Remove the air cleaner.
 - e. Remove all injector.
 - (2) Measurement
 - a. Insert the gauge adaptor into the nozzle holder hole.
- SST:**
Compression gauge adaptor (A) (S0955-21110)
Compression gauge adaptor (B) (S0955-21030)
Compression gauge adaptor (B) (S0955-21060)
- b. Run the engine with the starter and measure the compression pressure.



SAPH011030100026

Standard	Limit	Difference between each cylinder
2.9-3.1 MPa {30-32 kgf·cm ² , 425-455 lbf/in ² }	2.3 MPa {24 kgf·cm ² , 341 lbf/in ² }	0.3 MPa {3 kgf·cm ² , 43 lbf/in ² } or less
Engine revolution 150r/min		

NOTICE

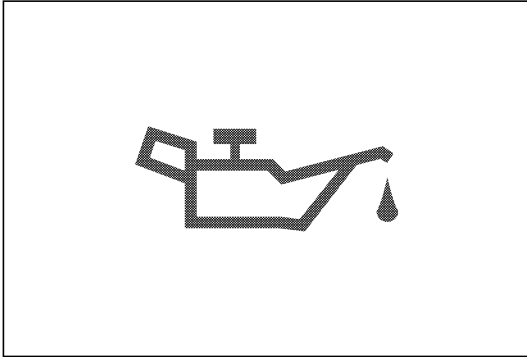
Do not operate the starter for more than 15 seconds.

- c. Measure the compression pressure of each cylinder.

NOTICE

Do not allow gas leakage from the seal face.

- (3) Reassemble the removed parts.



SAPH011030100027

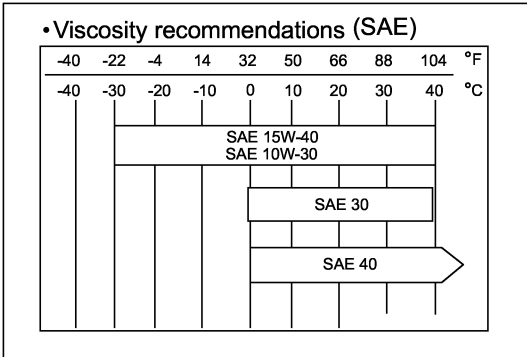
2. ENGINE OIL PRESSURE

- (1) Check the oil pressure warning lamp when the oil and coolant temperature is hot [about 80°C {176°F}].
 - a. If the warning lamp lightens, check the oil level.
 - b. Check oil deterioration.
If oil quality is poor, replace with a suitable grade oil.
 - c. Remove the oil pressure switch and install the oil pressure gauge.

- d. Measure the oil pressure at a coolant temperature of 80°C {176°F} or more.

Oil pressure

Standard	Limit
49-490 kPa {0.5-5.0 kg/cm², 7.11-71.10 lbf/in.²}	Less than 49kPa {0.5 kg/cm², 7.11 lbf/in.²}



SAPH011030100028

3. OTHER FACTORS

- (1) Increase of blow by gas
- (2) Defective engine start
- (3) Decrease of engine output
- (4) Increase of fuel consumption
- (5) Increase of engine noise
- (6) Increase of oil consumption

DISMOUNTING AND MOUNTING

EN0110301H100001

IMPORTANT POINT - DISMOUNTING

1. DISMOUNT THE ENGINE ASSEMBLY.

- (1) Park the vehicle on level ground and then block the wheels.
- (2) Tilt the hood.
- (3) Drain coolant from the radiator and cylinder block, and engine oil from the oil pan.

⚠ WARNING

To avoid the danger of burns, do not drain the coolant and engine oil while the engine and radiator are still hot.

- (4) Remove the splash board and fender.
- (5) Disconnect the power steering piping and hose.

NOTICE

Refer to CHAPTER POWER STEERING for details.

- (6) Disconnect the electric lines and parking brake cable.

NOTICE

- Disconnect the battery cable from the negative terminal (-) of the battery and disconnect the electric lines.
- Cover open ends of the pipes, hoses and pumps to prevent entry of dirt.

- (7) Disconnect the hoses (coolant, heater and air intake) and remove the radiator.

NOTICE

Do not damage the radiator.

- (8) Remove the air cleaner and bracket
- (9) Disconnect the air intake and exhaust lines.
- (10) Disconnect the propeller shaft.
- (11) Disconnect the transmission control and transmission with clutch housing from the flywheel housing.

NOTICE

Refer to **CHAPTER TRANSMISSION/TRANSFER CONTROL** and **CHAPTER TRANSMISSION MAIN UNIT** for details.

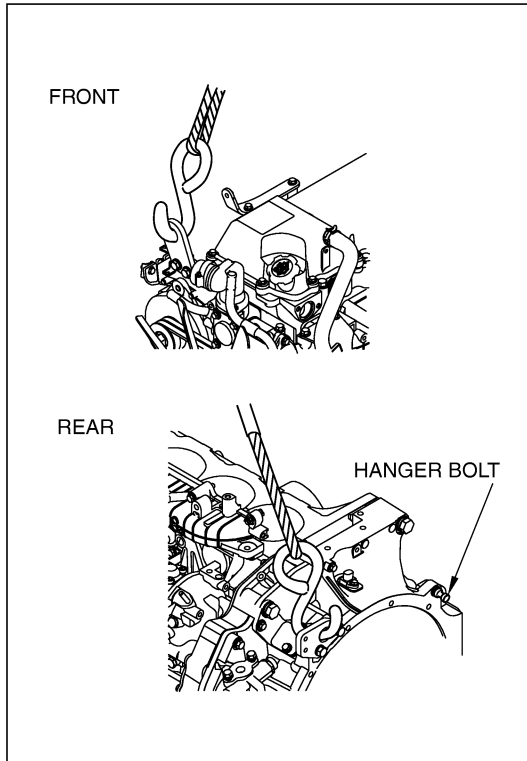
- (12) Connect a cable from an engine hanger to the hanger bracket (1 point) on the front of the engine, and to the hanger bracket (1 point) on the flywheel housing at the rear of the engine. Using a hoist, raise the hanger until there is a bit of slack in the cables.

Engine weight: **Refer to section DATA AND SPECIFICATIONS.**

- (13) Remove the engine mounting fitting nuts (front and rear, both sides).
- (14) Lift the engine hanger so that the cables are fully tightened, then, after checking that the cables are secure lift gently and remove the engine from the vehicle.

NOTICE

When the transmission is attached to the engine, attach the third cable to the hanger bolt.



SAPH011030100029

IMPORTANT POINTS - MOUNTING**1. MOUNT THE ENGINE ASSEMBLY.**

- (1) Mount the engine assembly in the reverse order of dismounting.

Tightening Torque:

(Engine mounting fitting nuts):

Front (chassis side): 86 N·m {880 kgf·cm, 64 lbf·ft}

Rear (engine side): 86 N·m {880 kgf·cm, 64 lbf·ft}

NOTICE

Check to see that there are no oil leaks, fuel leaks, coolant leaks, or air leaks.

LIQUID GASKET AND APPLICATION POINTS

EN0110301H200001

- Liquid gasket is used at the following positions for the J05D series engine.

Liquid gasket specification:

Three Bond S041321217: Black

Liquid gasket specification:

Three Bond 041321207A: Silver

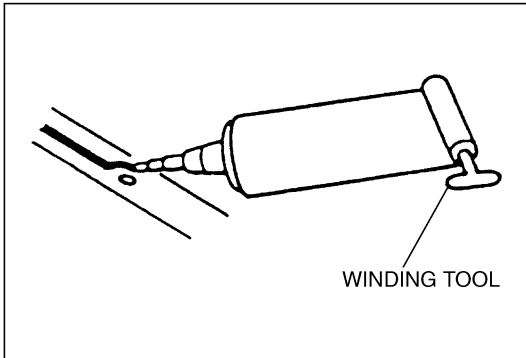
Liquid gasket specification:

Three Bond S041321211: White

1. LIQUID GASKET APPLICATION AND PART ASSEMBLY PROCEDURE.

- (1) Remove old liquid gasket from each part and matching parts and wipe off oil, moisture or dirt with a rag.
- (2) Overlap the liquid gasket at the start and end of application.
- (3) Be careful of misalignment when assembling parts with liquid gasket. If they are misaligned, reapply the liquid gasket.
- (4) Assemble parts within 20 minutes of application. If more than 20 minutes have passed, remove and reapply the liquid gasket.

- (5) Wait for at least 15 minutes or more after assembly of parts before starting the engine.



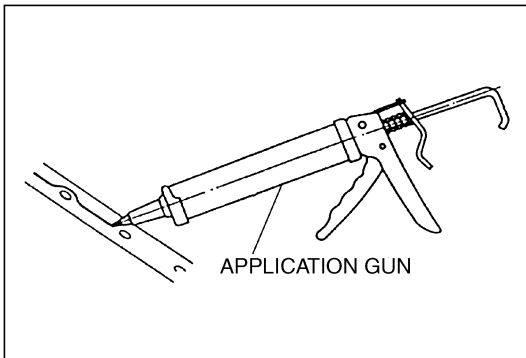
SAPH011030100030

2. REMOVE PARTS.

- (1) When removing parts, do not use a tool for removal at one location only. Use the tool at various locations such as a flange step or gap for removal. When removing the gasket, be careful that gasket residue does not enter the engine.

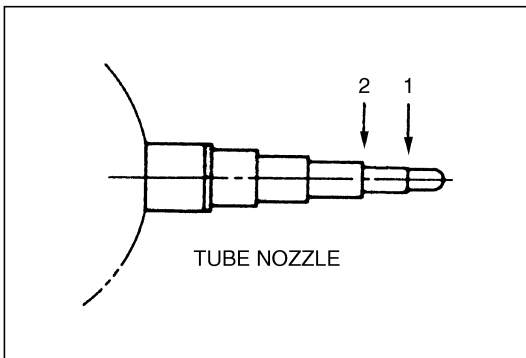
3. OTHERS.

- (1) For tube-type liquid gasket, use the winding tool that comes with the liquid gasket.



SAPH011030100031

- (2) For cartridge-type gasket, use an application gun.



SAPH011030100032

- (3) For tube-type liquid gasket, required width of application can be obtained by cutting the nozzle to suit.

**1: Approximately
2 mm wide when cut at the first step**

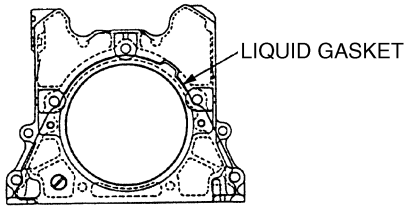
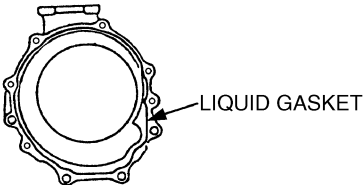
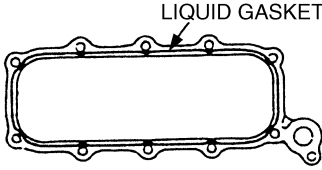
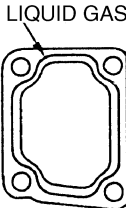
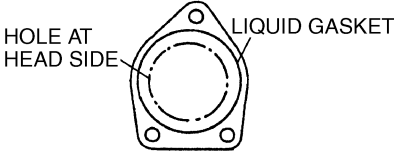
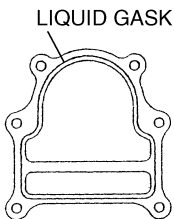
**2: Approximately
5 mm wide when cut at the second step**

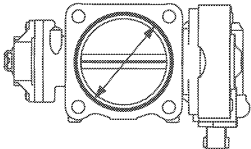
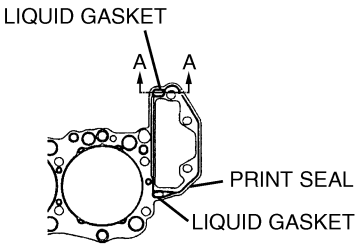
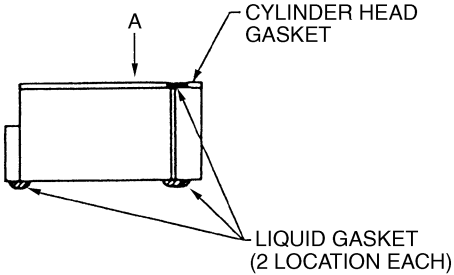
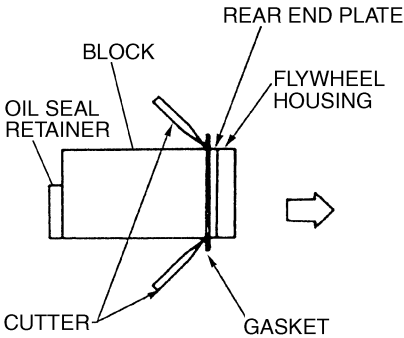
4. PARTS AND POSITIONS FOR LIQUID GASKET.

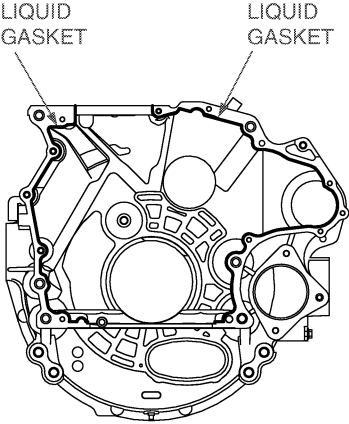
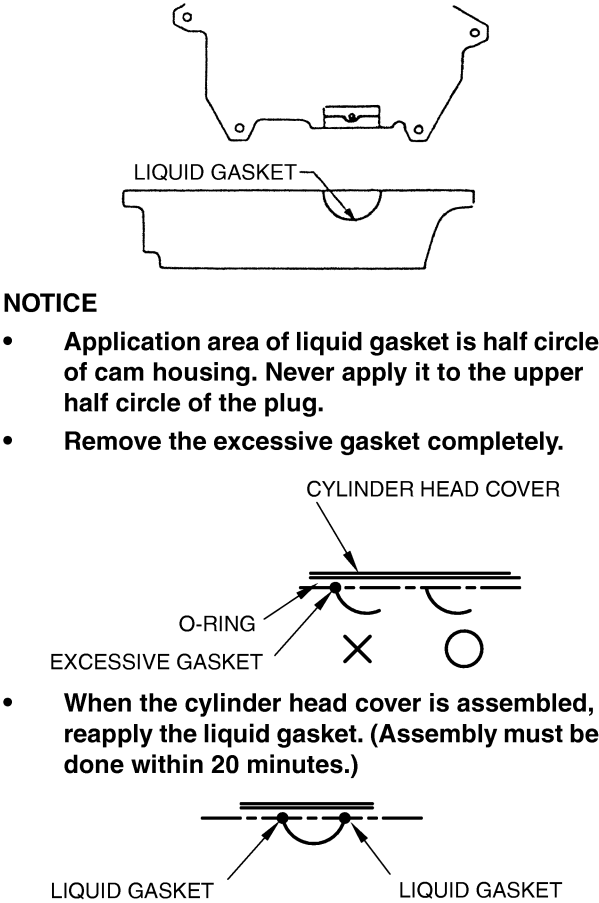
- (1) Apply liquid gasket to positions and types of gasket according to the table shown below.

Follow the application pattern at each position shown in the figures.

Unit: mm{in.}

No.	Part name	Application position and pattern	Application width	Gasket to be used	Remarks
1	Oil seal retainer	Matching flange face with the block  <p>LIQUID GASKET</p>	1.5-2.5 {0.0591-0.0984}	Black	
2	Coolant pump	Matching flange face with the block  <p>LIQUID GASKET</p>	1.5-2.5 {0.0591-0.0984}	Black	
3	Oil cooler	Matching flange face with the block  <p>LIQUID GASKET</p>	1.5-2.5 {0.0591-0.0984}	Silver	
4	Thermostat case	Matching flange face with the cylinder head  <p>LIQUID GASKET</p>	1.5-2.5 {0.0591-0.0984}	Silver	
5	Flange	Matching face with the rear edge  <p>HOLE AT HEAD SIDE</p> <p>LIQUID GASKET</p>	1.5-2.5 {0.0591-0.0984}	Silver	
6	Intake pipe	Matching flange face with the intake manifold  <p>LIQUID GASKET</p>	1.5-2.5 {0.0591-0.0984}	Black	

No.	Part name	Application position and pattern	Application width	Gasket to be used	Remarks
7	Intake pipe	<p>Matching flange face with the intake pipe</p> 	<p>1.5-2.5 {0.0591-0.0984}</p>	<p>Black</p>	
8	<p>Front and rear ends of upper/lower faces of block</p>	<p>Matching parts of block upper face rear end, gasket, rear end plate, flywheel housing, cylinder head gasket</p> <p>Matching parts of oil seal retainer and block lower face front end</p> <p>Matching parts of block lower front end, gasket, rear end plate and flywheel housing</p>    <p>NOTICE Cut the rear end plate gasket with a craft knife flush with the block upper face.</p>	<p>—</p> <p>1.5-2.5 {0.0591-0.0984}</p> <p>1.5-2.5 {0.0591-0.0984}</p>	<p>White</p> <p>Black</p> <p>Silver</p>	

No.	Part name	Application position and pattern	Application width	Gasket to be used	Remarks
9	Flywheel housing	<p>Matching face of rear end plate</p> 	1.5-2.5 {0.0591-0.0984}	Silver	
10	Cam housing	<ol style="list-style-type: none"> 1. Matching faces with cam housing and plug 2. Matching parts of cam housing, plug, cylinder head cover and gasket  <p>NOTICE</p> <ul style="list-style-type: none"> • Application area of liquid gasket is half circle of cam housing. Never apply it to the upper half circle of the plug. • Remove the excessive gasket completely. <p>When the cylinder head cover is assembled, reapply the liquid gasket. (Assembly must be done within 20 minutes.)</p>	1.5-2.5 {0.0591-0.0984}	Black	2 locations at front and rear ends

NOTICE

Figure on the right shows application "pattern" of the liquid gasket. Apply the liquid gasket to the center of seal flange inside whenever possible.



ENGINE MECHANICAL (J05D)

EN02-001

CYLINDER HEAD EN02-2

COMPONENT LOCATOR.....	EN02-2
SPECIAL TOOL	EN02-4
OVERHAUL	EN02-5
INSPECTION AND REPAIR	EN02-16

CRANKSHAFT FRONT END..... EN02-20

COMPONENT LOCATOR.....	EN02-20
SPECIAL TOOL	EN02-21
OVERHAUL	EN02-22

FLYWHEEL AND FLYWHEEL HOUSING**..... EN02-24**

COMPONENT LOCATOR.....	EN02-24
SPECIAL TOOL	EN02-25
OVERHAUL	EN02-25
INSPECTION AND REPAIR	EN02-30

TIMING GEAR..... EN02-31

COMPONENT LOCATOR.....	EN02-31
SPECIAL TOOL	EN02-32
OVERHAUL	EN02-32
INSPECTION AND REPAIR	EN02-35

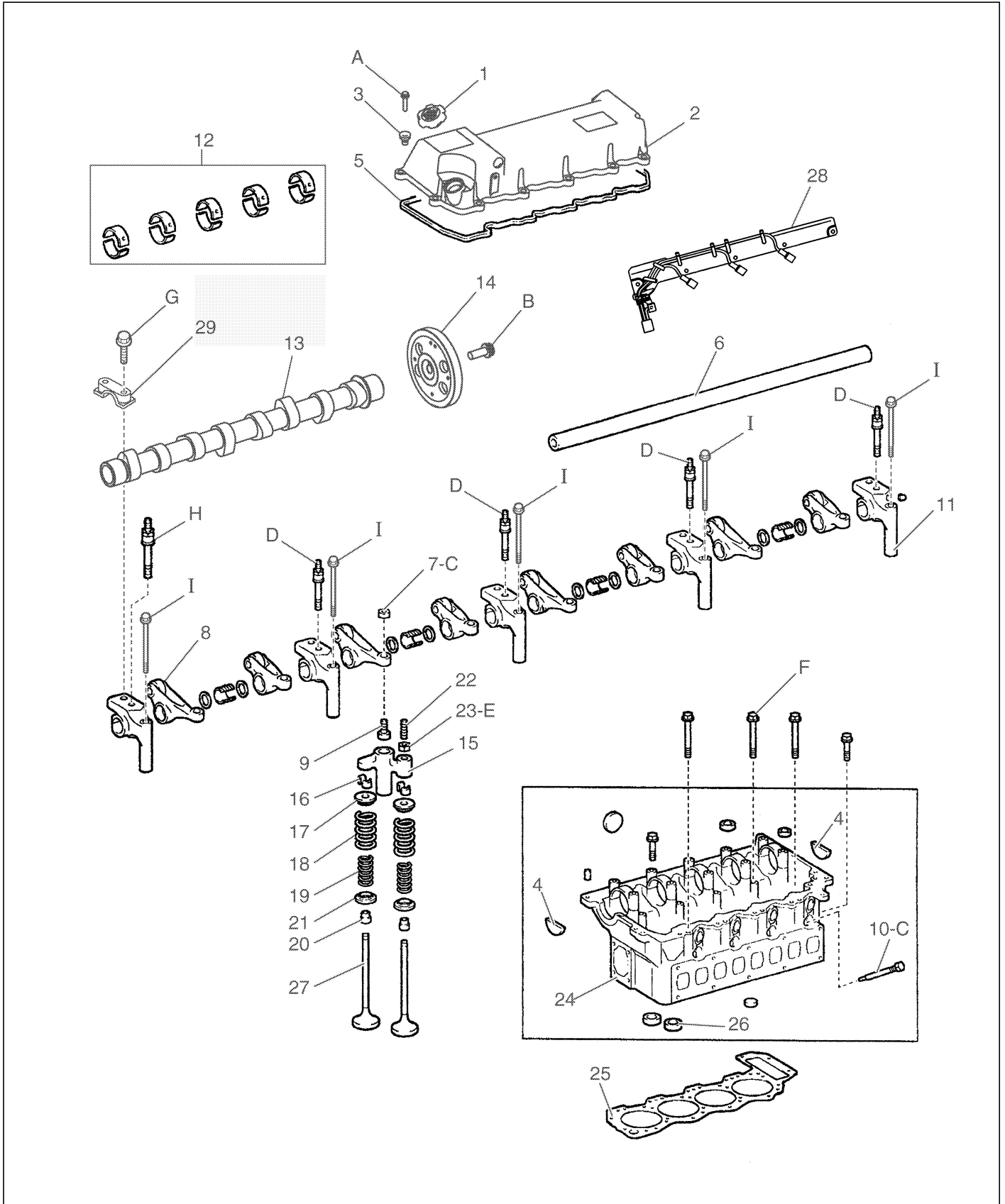
MAIN MOVING PARTS AND CYLINDER BLOCK**..... EN02-37**

COMPONENT LOCATOR.....	EN02-37
SPECIAL TOOL	EN02-39
OVERHAUL	EN02-41
INSPECTION AND REPAIR	EN02-53

CYLINDER HEAD

COMPONENT LOCATOR

EN0110302D100001





1	Oil filler cap	16	Valve spring retainer
2	Cylinder head cover	17	Valve spring seat upper
3	Silent block	18	Valve spring outer
4	Plug	19	Valve spring inner
5	Head cover gasket	20	Valve stem seal
6	Rocker arm shaft	21	Valve spring seat lower
7	Lock nut	22	Cross head adjusting screw
8	Rocker arm	23	Lock nut
9	Adjusting screw	24	Cylinder head
10	Heater plug	25	Cylinder head gasket
11	Rocker arm support	26	Valve seat
12	Camshaft bearing	27	Valve
13	Camshaft	28	Harness assy
14	Camshaft drive gear	29	Camshaft bearing cap
15	Cross head		

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A	28.5 {290, 21}	E	25 {250, 18}
B	59 {600, 43}+90°	F	59 {600, 44}+90°+90° or 135° or 180°
C	25 {250, 18}	H	55 {560, 41}

Unit: N·m {kgf·cm, lbf·ft}

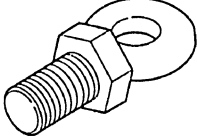
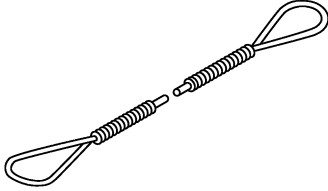
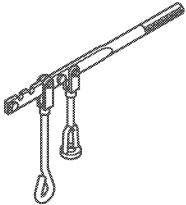
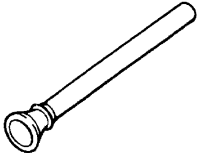
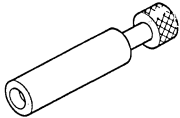
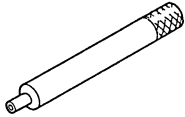


 7	 q	
* Up to Mar. 2007 production	* From Apr. 2007 production	
D	28.5 {290, 21}	36 {370, 27}
G	28.5 {290, 21}	36 {370, 27}
I	28.5 {290, 21}	36 {370, 27}

*D bolt 7T and 9T appearances are the same. Determine the tightening torque by referring to the production date on Engine information label on the cylinder head cover.

SPECIAL TOOL

EN0110302K100001

Prior to starting an engine overhaul, it is necessary to have these special tools.

Illustration	Part number	Tool name	Remarks
	S0943-31070	EYE BOLT	
	S0949-11010	WIRE	
	S0947-01170	VALVE SPRING PRESS	
	S0943-11020	VALVE LAPPING TOOL	
	S0947-22100	VALVE STEM SEAL PRESS	
	S0947-21210	BAR	For Nozzle sleeve
	SN441-00610	STEEL BALL	Used with S0947-21210
	S0947-11520	GUIDE	

OVERHAUL

EN0110302H200001

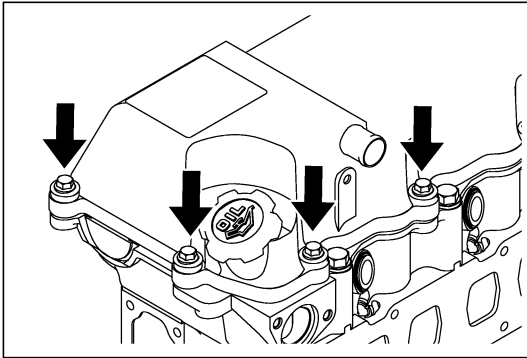
IMPORTANT POINTS DISASSEMBLY

1. DISASSEMBLE THE CYLINDER HEAD.

- (1) Remove the cylinder head cover.

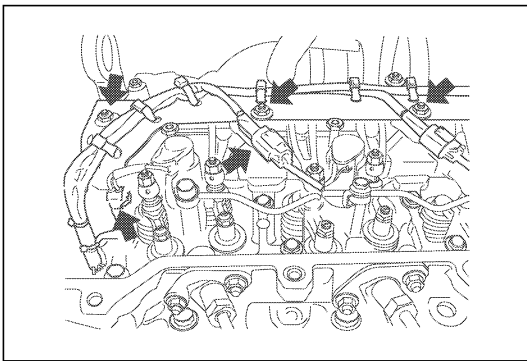
NOTICE

Clean all dust from around the cylinder head cover before removing it to prevent foreign particles from getting in.



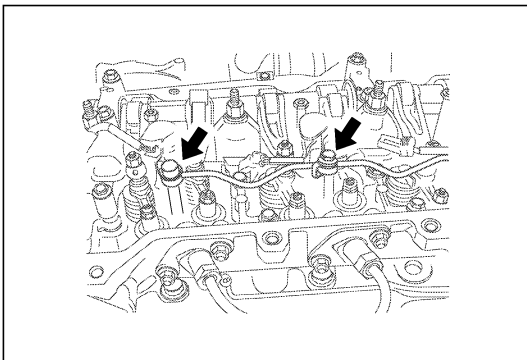
SAPH011030200012

- (2) Remove injector harness bracket
- Disconnect the injector connectors.
 - Remove the 5 nuts and injector harness bracket.



SAPH011030200013

- (3) Remove the leakage pipe.



SAPH011030200014

- (4) Clean parts around the injector and fuel system connections.

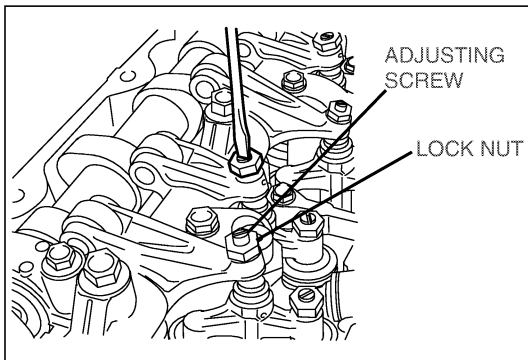
NOTICE

Entry of foreign particles into the combustion chamber may result in engine trouble.

- (5) Remove the injector assembly.

NOTICE

Refer to CHAPTER FUEL SYSTEM.



SAPH011030200015

- (6) Remove the rocker arm assembly.
- Loosen the lock nut at the end of the rocker arm and turn the adjusting screw counterclockwise completely.

NOTICE

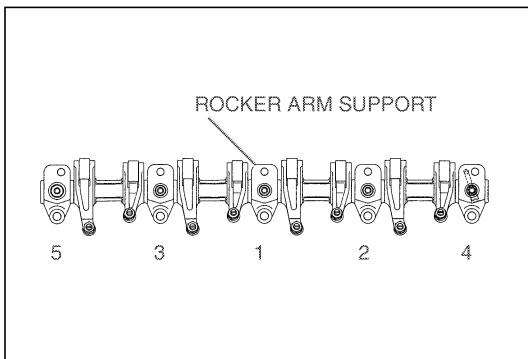
Not untightening the adjusting screw may result in a bent rocker shaft.

- Loosen the injector bolt.

- Loosen the rocker arm support bolt as shown in the figure.

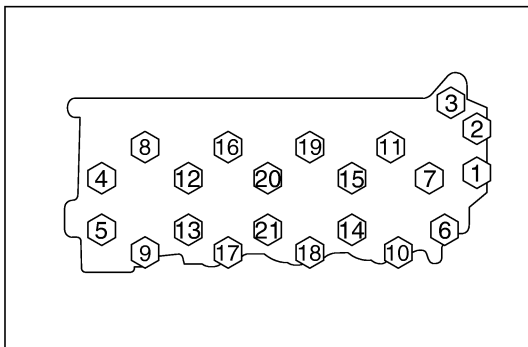
NOTICE

If the cross head is removed from the valve during disassembly of the rocker arm assembly, reassemble the cross head as it was.

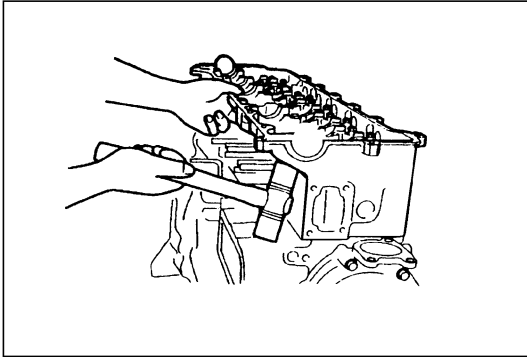


SAPH011030200016

- (7) Remove the cylinder head bolts.
- Gradually loosen bolts three times in the order shown in the figure.



SAPH011030200017



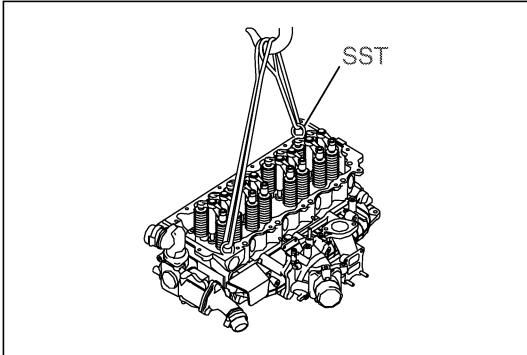
SAPH011030200018

- (8) Lift and remove the cylinder head from the cylinder block.
SST: Eye bolt (S0943-31070)

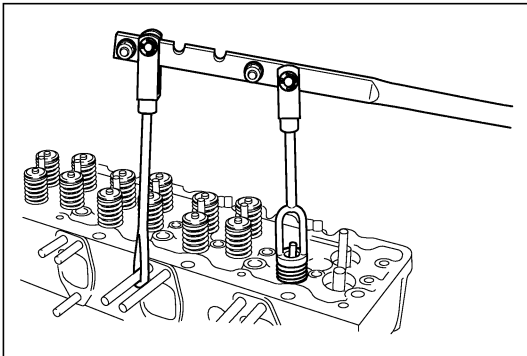
NOTICE

- Place a piece of wood between the cylinder head and table.
- When removing the cylinder head together with the injection nozzle, avoid contact between the injection nozzle and piece of wood.

Check that there is no oil, water or gas leakage in the cylinder head gasket if overheated or not.



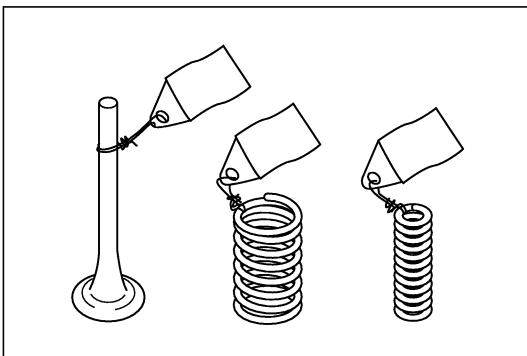
SAPH011030200019



SAPH011030200020

2. DISASSEMBLE THE VALVE SYSTEM.

- (1) Remove the valve spring retainer using the special tool.
SST: Valve spring press (S0947-01170)

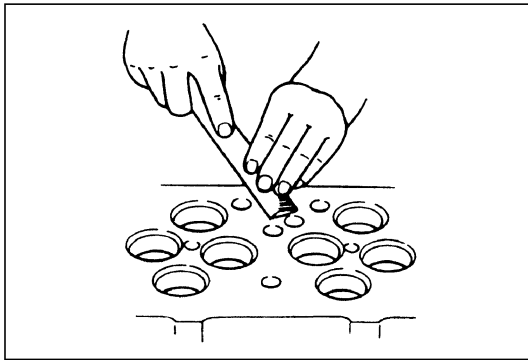


SAPH011030200021

- (2) Remove the intake and exhaust valve.

NOTICE

Attaching tags to the valves (giving corresponding cylinder Nos.) will eliminate time required for lapping the valve seats on reassembly.



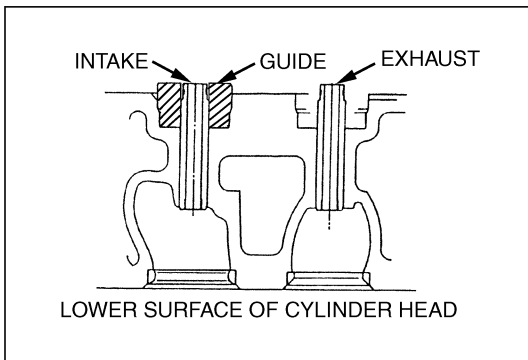
SAPH011030200022

3. CLEAN THE CYLINDER HEAD.

- (1) Clean the cylinder head and remove carbon deposits or foreign particles.

NOTICE

Be careful not to damage the cylinder head lower surface when removing carbon deposits or foreign particles.



SAPH011030200023

IMPORTANT POINTS-REPLACEMENT

1. REPLACE THE VALVE GUIDE.

- (1) Remove the valve stem seal.
- (2) For removal, strike the valve guide with a brass bar and hammer.

⚠ WARNING

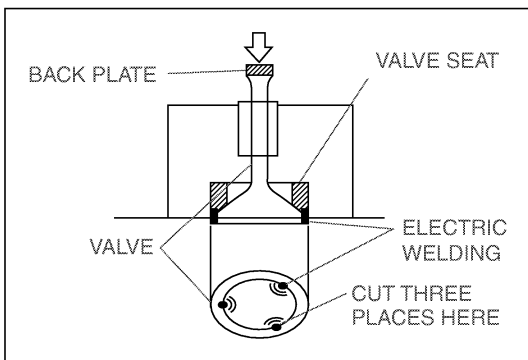
Be sure to wear protective goggles. Striking the valve guide when removing the valve guide may cause metal chips to fly up.

- (3) When installing a new valve guide, do not twist the end. Press fit the valve guide using the special tool.

SST: Guide (S0947-11520)

NOTICE

- Be careful not to damage the valve stem at the upper or lower end of the guide during press-fitting.
- Be sure to apply engine oil around the valve guide during press-fitting.



SAPH011030200024

2. REPLACE THE VALVE SEAT.

- (1) When replacing the valve seat, cut three places on the circumference of an unwanted valve and weld it to the valve seat.

NOTICE

To protect the lower surface of the cylinder head from welding spatter, be sure to apply grease before welding.

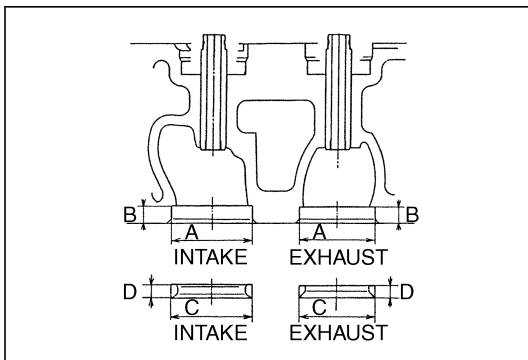
- (2) Place a (brass) back plate at the top of the valve system and strike it with a hammer to remove the valve seat.

⚠ WARNING

Be sure to wear protective goggles. Striking the valve seat for removal of valve seat may cause metal chips to fly up.

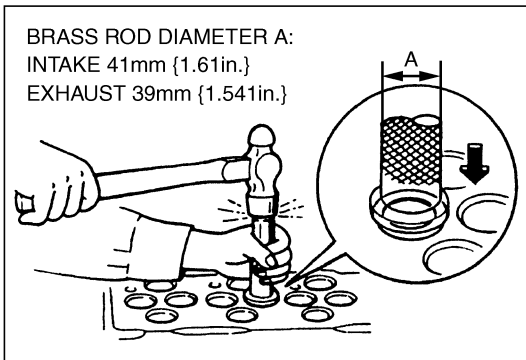
- (3) Machine the valve according to the valve seat dimensions.

Unit: mm {in.}



SAPH011030200025

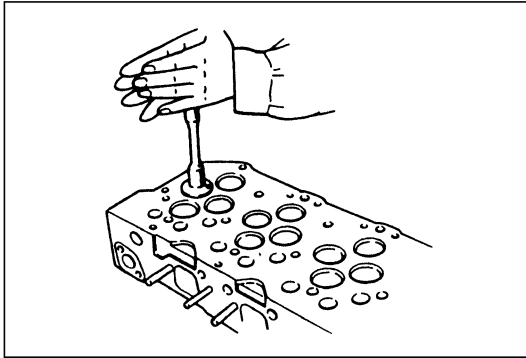
		Intake	Exhaust
Cylinder head side	A	41-41.016 {1.6142-1.6148}	39-39.016 {1.5355-1.5360}
	B	9.4-9.6 {0.3701-0.3779}	8.6-8.8 {0.3386-0.3464}
Valve seat side	C	41.085-41.1 {1.6176-1.6181}	39.12-39.135 {1.5402-1.5407}
	D	7-7.2 {0.2756-0.2834}	6-6.2 {0.2363-0.2440}



- (4) Heat the cylinder head to 80 - 100°C {176 - 212°F} in hot water. After cooling the valve seat, insert it into the cylinder head.

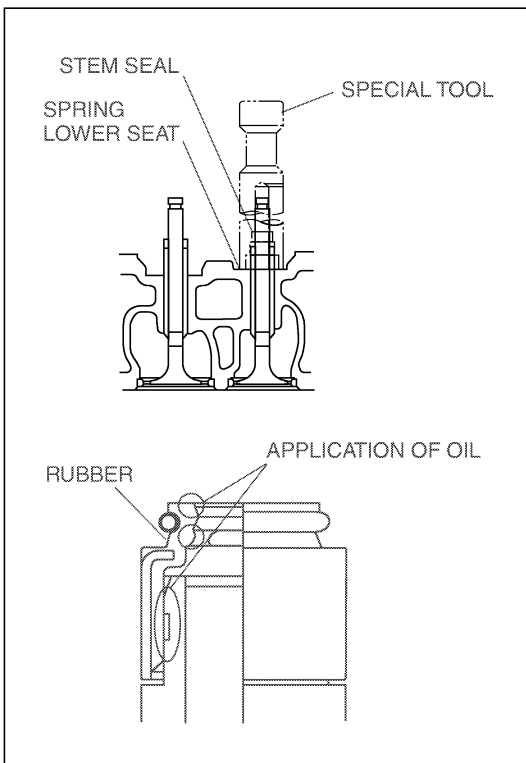
⚠ WARNING

Be sure to wear protective goggles. Punching the nozzle seat when installing nozzle seat may cause metal chips to fly up.



- (5) Apply a small amount of lapping compound to the contact surfaces of the valve and valve seat. Turn the valve using the special tool and tap it lightly to lap.

SST: Valve lapping tool (S0943-11020)



3. REPLACE THE VALVE STEM SEAL.

- (1) After removing the valve stem seal, assemble the spring lower seat and apply engine oil to the stem seal lip. Punch it into the valve guide using the special tool.

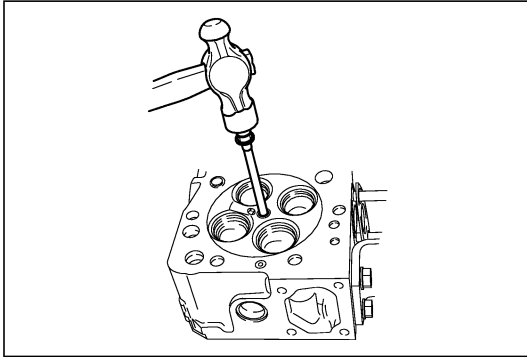
SST: Valve stem seal press (S0947-22100)

⚠ WARNING

Be sure to wear protective goggles. Striking the valve stem seal for installing of valve stem seal may cause metal chips to fly up.

NOTICE

After assembly of the stem seal, check for deformation or cracking of the rubber or incline.



SAPH011030200029

4. REPLACE THE NOZZLE SEAT.

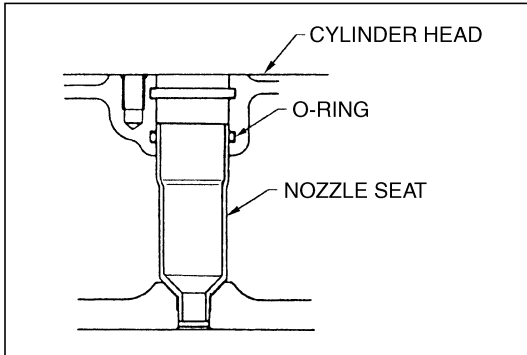
- (1) Tap the nozzle seat from the cylinder head lower surface. Then, screw in a suitable bolt and strike the bolt head with a hammer to remove the nozzle seat from the cylinder head.

⚠ WARNING

Be sure to wear protective goggles. Punching the nozzle seat when installing nozzle seat may cause metal chips to fly up.

NOTICE

After removing the nozzle seat, remove the rest of liquid gasket or the adhesion such as dust completely.

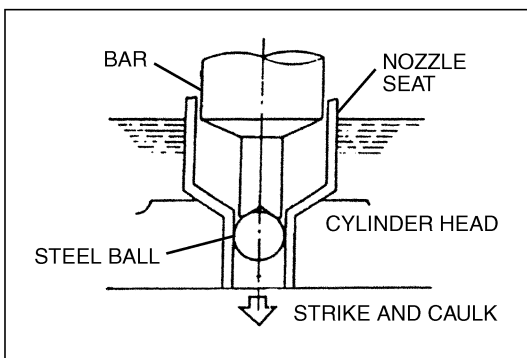


SAPH011030200030

- (2) After inserting the O-ring into the nozzle seat insertion hole of the cylinder head, apply liquid packing (Three Bond No. 1211 or equivalent) to the lower part of the new nozzle seat and assemble it onto the cylinder head.

NOTICE

Be sure to replace the O-ring with a new one. Reuse of the O-ring may cause water or gas leakage, resulting in overheating or cracking of the cylinder head.



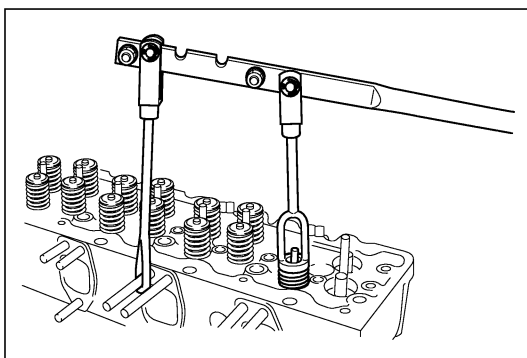
SAPH011030200031

- (3) Caulk the nozzle seat with the special tools.

SST:

Bar (S0947-21210)

Steel ball (SN441-00610)



SAPH011030200020

IMPORTANT POINTS - ASSEMBLY

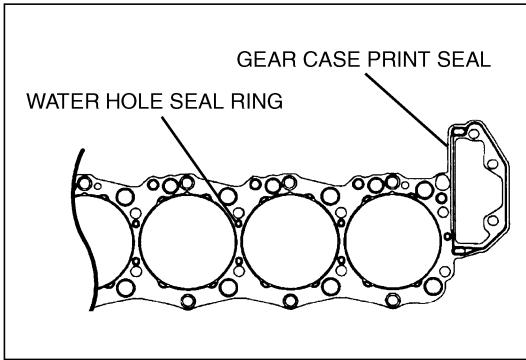
1. ASSEMBLE THE VALVE AND VALVE SPRING.

- (1) Install the valve spring retainer at the valve spring upper seat using the special tool.

SST: Valve spring press (S0947-01170)

NOTICE

- Be sure to apply engine oil to the contact surface of each part before assembly.
- Be sure to place each valve in its original position.
- When the valve spring is compressed, be careful of damage to the stem seal due to contact of the upper seat.
- Since this valve spring is evenly pitched, it can be installed either end up.



SAPH011030200032

2. INSTALL THE CYLINDER HEAD GASKET.

NOTICE

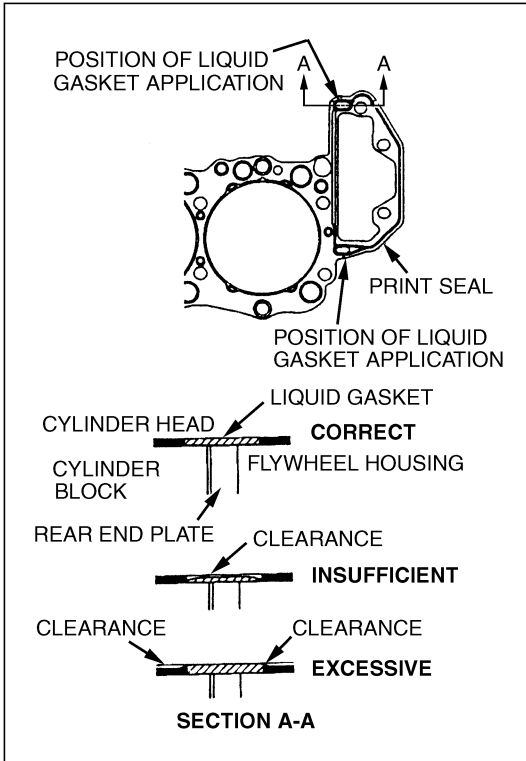
- When installing the cylinder head, install the new gasket after removing dirt, moisture and oil on the cylinder head and cylinder block surface.
- Never reuse the gasket as it may cause engine damage.
- The twelve water hole seal rings between the bores are easily damaged. Do not touch them with your hands or other objects. Make sure that the seal rings are not loose or damaged.
- Since silicon material is used for the gear case print seal, make sure that there is no peeling before assembly.

(1) Install the cylinder head gasket on the cylinder block and flywheel housing.

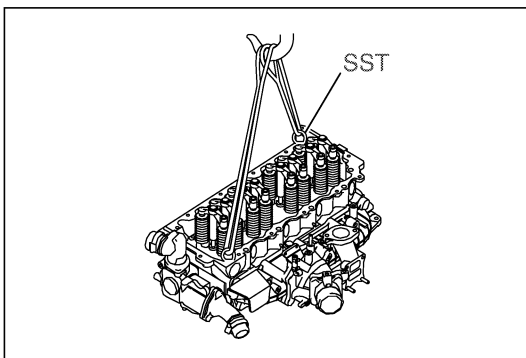
(2) Fill the hole at the back of the cylinder head gasket with liquid gasket.

NOTICE

Make sure that the liquid gasket surface is flush with the cylinder head gasket upper surface.



SAPH011030200033



SAPH011030200034

3. INSTALL THE CYLINDER HEAD.

(1) Using the special tool and hoist, install the cylinder head.

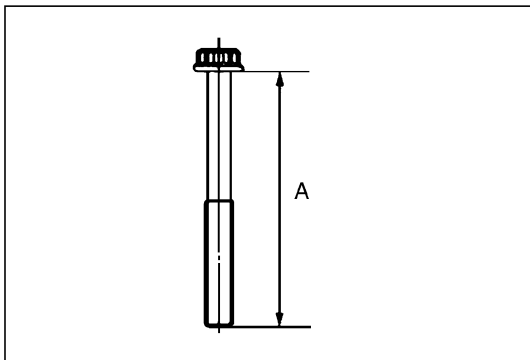
SST:

Eye bolt (S0943-31070)

Wire (S0949-11010)

NOTICE

When installing the cylinder head, pay attention to cam idle gear and sub idle gear engagement.



SAPH011030200035

4. INSTALL THE CYLINDER HEAD BOLT.

- (1) Preparation
 - a. Measure the length of the M12 head bolts, if the length is A or more, replace with new bolts

Bolt number	Limit A mm (in.)
5, 6, 7, 12, 13, 14, 15, 20, 21	126.5 {4.9803}
9, 10, 17, 18	156.5 {6.1614}
4, 8, 11, 16, 19	187.5 {7.3819}

- b. Make sure that no dirt or scratch is on the tightening surface of the cylinder head bolt.
- c. Apply clean engine oil to the bolt surface and bolt threads.

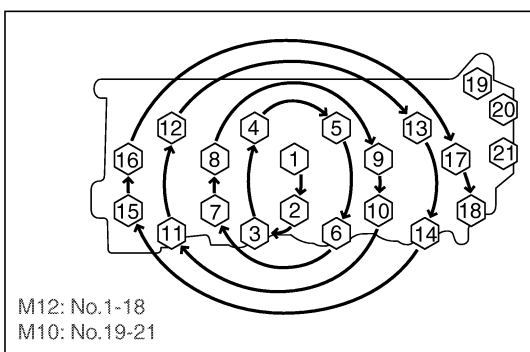
NOTICE

Since the cylinder head bolts are unique to this engine, do not substitute ordinary bolts.

- (2) Tighten the cylinder head bolt.

The total tightening torque and angles are shown in the table below. The tightening methods are shown in the steps below.

Head bolt number	Total tightening angle
1, 2, 7, 8, 9, 10, 15, 16, 17	59 N·m +90°+90°
4, 5, 12, 13	59 N·m +90°+135°
3, 6, 11, 14, 18	59 N·m +90°+180°
19, 20, 21	59 N·m



M12: No.1-18
M10: No.19-21

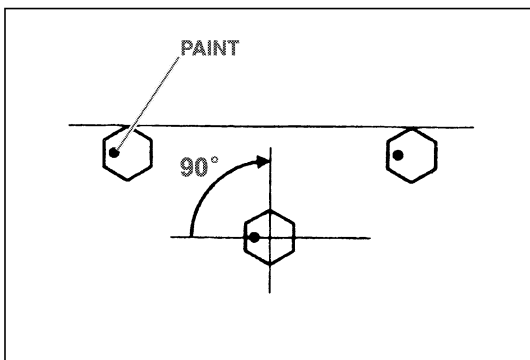
SAPH011030200036

- a. Tighten No.1-No.18 (M12) bolts in the order shown in the figure to the specified torque below.

Tightening Torque:

59 N·m {600 kgf·cm, 43 ft·lbf}

- b. After tightening bolt No. 18, check the torque again through all the bolts from No. 1 to No. 18.
- c. Mark the bolts with paint to indicate the same directions as shown in the figure.
- d. Turn No.1-No.18 bolts 90° (1/4 turn).
- e. Make sure that all paint marks face the same direction.



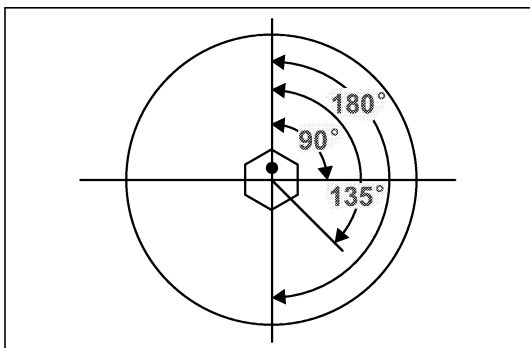
SAPH011030200037

- f. Tighten the head bolts again (M12 bolts only) in the same sequence and to their respective tightening angles

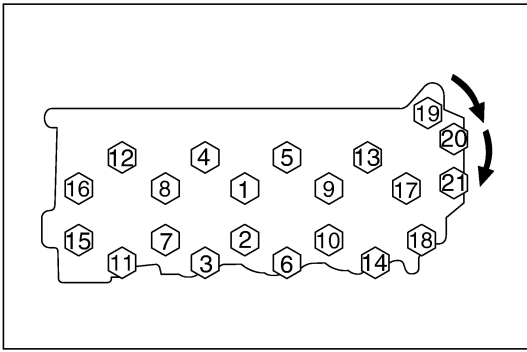
Head bolt number	Tightening angle
1, 2, 7, 8, 9, 10, 15, 16, 17	90°
4, 5, 12, 13	135°
3, 6, 11, 14, 18	180°

NOTICE

When adding torque, never untighten the nuts, even if they have been overtightened.



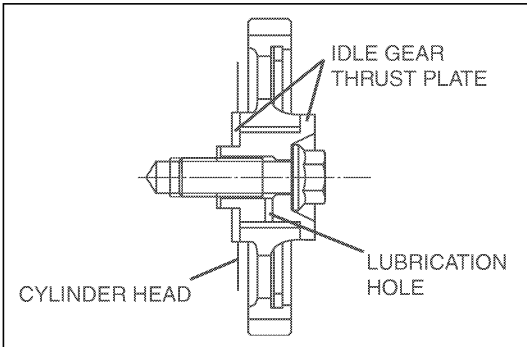
SAPH011030200038



SAPH011030200039

- g. Tighten No. 19 - No. 21 (M10 bolts) in the order shown in the figure to the specified torque below.

Tightening Torque:
59 N·m {600 kgf·cm, 43 lbf·ft}

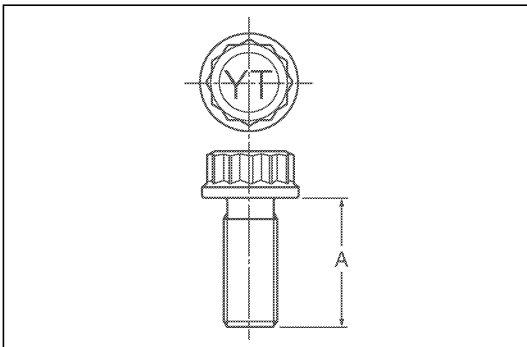


SAPH011030200040

5. INSTALL THE CAM IDLE GEAR.

NOTICE

- Install the cam idle gear shaft through the thrust plate as shown in the figure so that the lubrication hole is downward.
- Apply clean engine oil to the bolt seat and bolt threads.

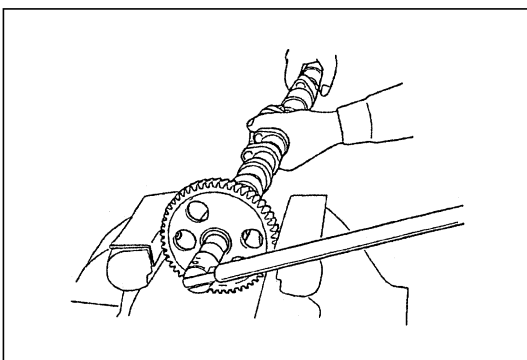


SAPH011030200041

6. ASSEMBLE THE CAMSHAFT GEAR.

- (1) Measure the length of the camshaft gear bolts, if the length is A or more, replace with new bolts.

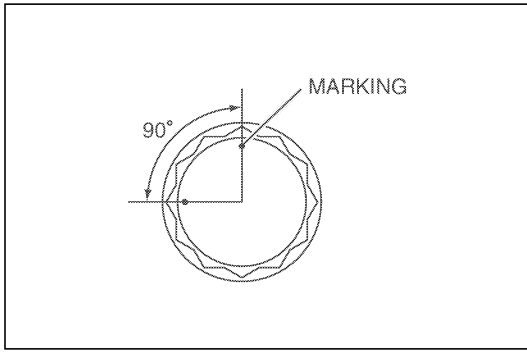
Dimension A	30.5 mm {1.2008 in.}
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SAPH011030200042

- (2) Make sure that there is neither damage to the camshaft gear or camshaft nor dirt on them.
- (3) Apply clean engine oil to the bolt surface and bolt threads and tighten them to the specified torque below.

Tightening Torque:
59 N·m {600 kgf·cm, 43 lbf·ft}

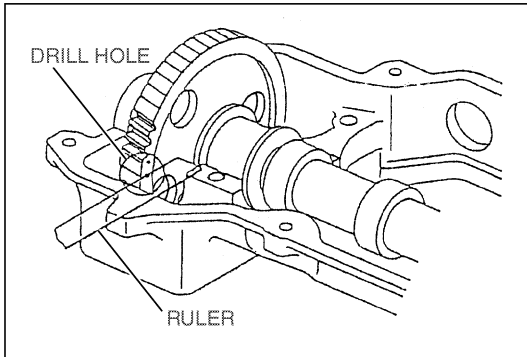


SAPH011030200043

- (4) Turn bolts an additional 90° (1/4 turn).

NOTICE

When adding torque, never untighten the bolt, even if it has been overtightened.



SAPH011030200044

7. INSTALL THE CAMSHAFT.

- (1) Align the mark on the flywheel with the flywheel housing pointer to set the No. 1 piston to top dead center of the compression stroke.

NOTICE

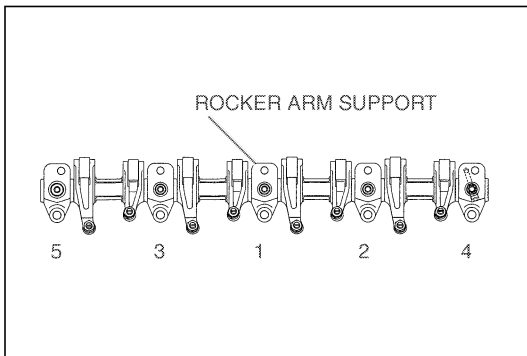
Engine adjustment - Refer to PREPARATION OF CHECKING AND ADJUSTMENT.

- (2) Install the camshaft into the cam housing.

NOTICE

Two drill holes on the camshaft gear should be located at left side and lower drill hole should match with the camshaft housing upper surface.

- (3) Install the camshaft bearing cap, and tighten the bolts.



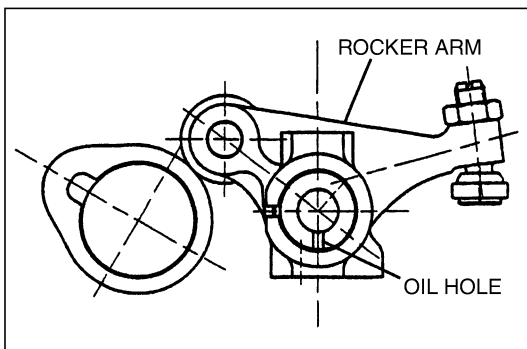
SAPH011030200046

8. INSTALL THE ROCKER ARM ASSEMBLY.

- (1) Make sure that the cross head is on each valve.

NOTICE

If the cross head is assembled whilst off the valve, the upper seat will be pressed, resulting in a loose valve.



SAPH011030200045

- (2) Make sure that the adjusting screw at the end of the rocker arm is completely screwed in.

NOTICE

Make sure the oil hole is placed below.

- (3) Tighten the rocker arm support bolt as shown in the figure to the specified torque.

Tightening Torque:

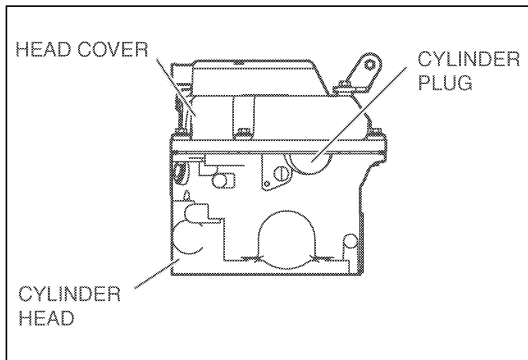
28.5 N·m {290 kgf·cm, 21 lbf·ft}

- (4) Tighten the nozzle clamp bolt to the specified torque.

Tightening Torque:

25 N·m {250 kgf·cm, 18 lbf·ft}

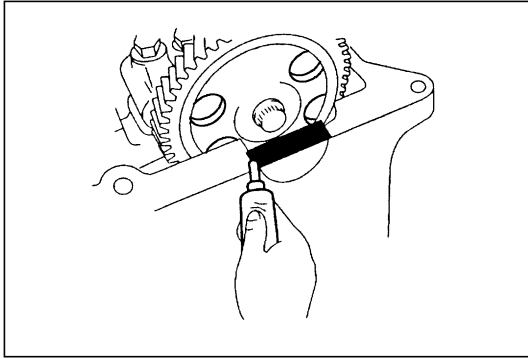
- (5) Make sure that the rocker arm moves smoothly.



SAPH011030200047

9. INSTALL CYLINDER HEAD COVER.

- (1) Install the cylinder plugs at the front and rear ends of the cam housing. Clean the cylinder plugs and the mounting surface of the cam housing.



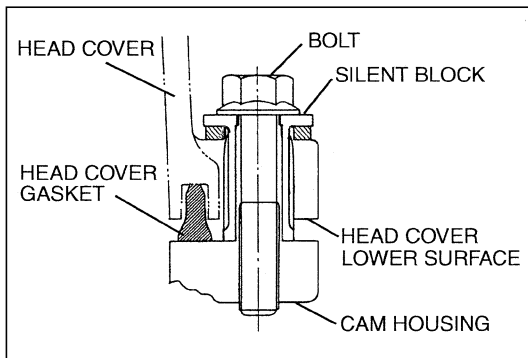
SAPH011030200048

- (2) Install the head cover gasket into the gasket groove at the head cover lower surface.

NOTICE

Make sure that there are no foreign particles (including liquid gasket), or oil on the gasket grooves of the head cover, gasket or cam housing upper surface nor damage to them.

- (3) Apply liquid gasket to plug corner at the front and rear half circles of the cam housing before installing the head cover.



SAPH011030200049

- (4) Insert the silent block from the head cover upper surface.
- (5) Tighten the bolt through the silent block to the specified torque below and fix the head cover on the cam housing.

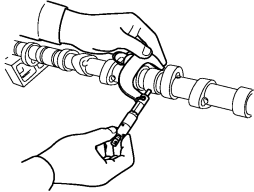
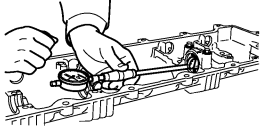
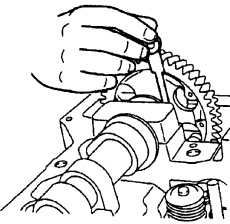
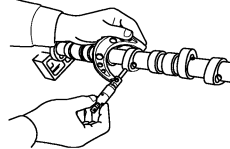
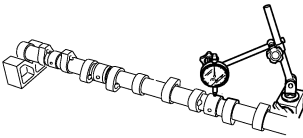
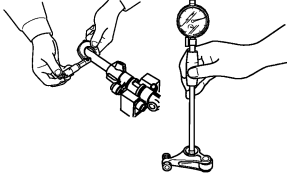
Tightening Torque:

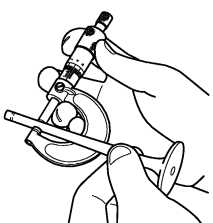

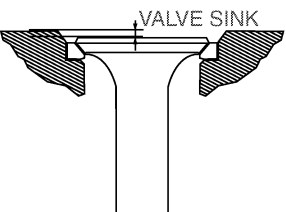
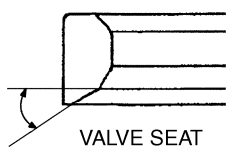
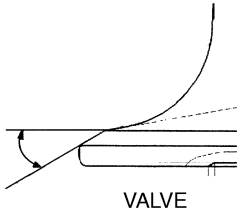
28.5 N·m {290 kgf·cm, 21 lbf·ft}

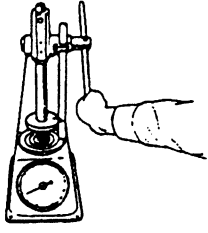
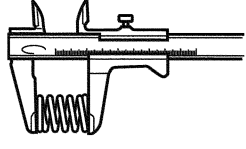
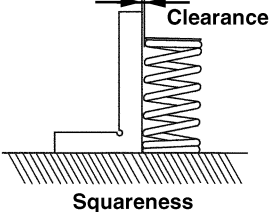
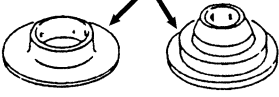
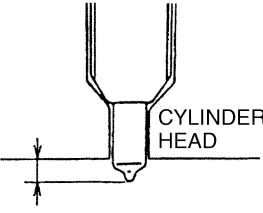
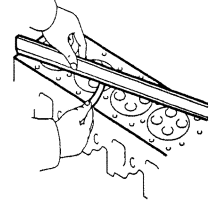
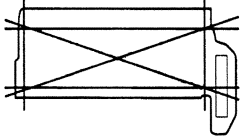
INSPECTION AND REPAIR

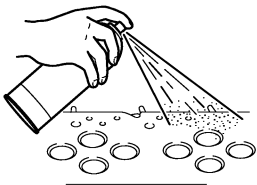
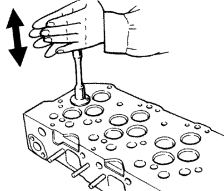
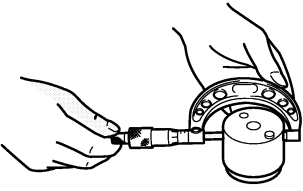
EN0110302H300001

Unit: mm {in.}

Inspection item		Standard	Limit	Remedy	Inspection procedure
Camshaft journal outside diameter		40 {1.5748}	39.85 {1.5689}	Replace camshaft.	Measure 
Camshaft bearing inside diameter		40 {1.5748}	40.15 {1.5807}	Replace cam bearing.	
Clearance between camshaft journal and camshaft bearing		0.020-0.063 {0.0008-0.0024}	—	Replace camshaft and/or cam bearing.	
Camshaft end play		0.110-0.296 {0.0043-0.0116}	—	Replace camshaft.	Measure 
Cam height	IN	50.046{1.9703}	49.966 {1.9612}	Replace camshaft.	Measure 
	EX	52.739{2.0763}	52.659 {2.0732}		
Camshaft deflection		0.04 {0.0016}	0.1 {0.0039}	Replace camshaft.	Measure 
Rocker arm bushing inside diameter		22.000-22.051 {0.8661-0.8681}	22.08 {0.8693}	Replace rocker arm.	Measure 
Rocker shaft outside diameter		21.959-21.980 {0.8645-0.8654}	21.92 {0.8630}	Replace rocker shaft.	
Clearance between rocker shaft and rocker arm bushing		0.020-0.092 {0.0007-0.0036}	0.16 {0.0063}	Replace rocker arm and/or rocker shaft.	

Inspection item		Standard	Limit	Remedy	Inspection procedure
Intake valve	Stem outside diameter	7 {0.2756}	6.92 {0.2724}	Replace the valve.	Measure 
	Guide inside diameter	7 {0.2756}	7.04 {0.2772}	Replace the valve guide.	
	Clearance	0.023-0.058 {0.0010-0.0022}	0.12 {0.0047}	Replace the valve and/or valve guide.	
Exhaust valve	Stem outside diameter	7 {0.2756}	6.85 {0.2697}	Replace the valve.	
	Guide inside diameter	7 {0.2756}	7.04 {0.2772}	Replace the valve guide.	
	Clearance	0.050-0.083 {0.0020-0.0033}	0.15 {0.0059}	Replace the valve and/or valve guide.	
Valve sink	IN	0.55-0.85 {0.0217-0.0334}	1.2 {0.0472}	Replace the valve and valve seat.	Measure 
	EX	1.15-1.45 {0.0453-0.0570}	1.8 {0.0708}	Replace the valve and valve seat.	
Valve seat angle	IN	30°	30°-30°35'	Resurface the valve and/or valve seat.	Measure 
	EX	45°	45°-45°30'		
Valve face angle	IN	30°	29°30'-30°		
	EX	45°	44°30'-45°		

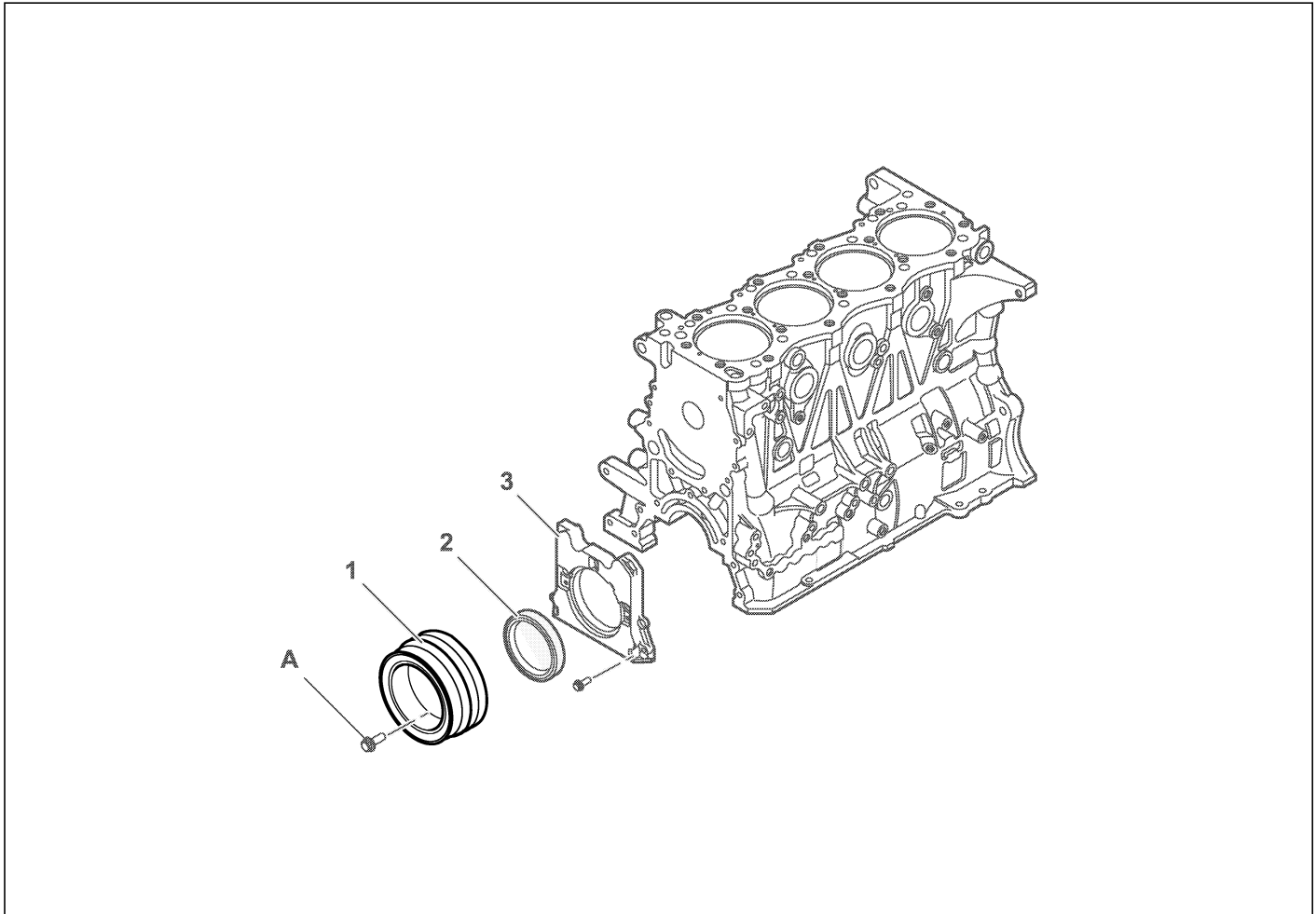
Inspection item		Standard	Limit	Remedy	Inspection procedure
Outer valve spring	Setting load	314 N {32.0 kgf, 70.5 lbf} at 46.8 {1.843}	291.8 N {29.8 kgf, 65.6 lbf}	Replace.	Measure  Setting load  Free length  Clearance Squareness
	Free length (reference value)	75.7 {2.980}	72.7 {2.862}	Replace.	
	Squareness	—	2.6 {0.1023} (2.0°)	Replace.	
Inner valve spring	Setting load	129 N {13.2 kgf, 29.1 lbf} at 44.8 {1.764}	119.5 N {12.2 kgf, 26.9 lbf}	Replace.	Visual check 
	Free length (reference value)	64.6 {2.543}	61.6 {2.425}	Replace.	
	Squareness	—	2.3 {0.0905} (2.0°)	Replace.	
Wear and damage of valve spring seat upper and lower		—	—	Replace.	
Nozzle protrusion		2.45-2.95 {0.0965-0.1162}	—	Replace nozzle seat.	Measure  CYLINDER HEAD
Cylinder head lower surface flatness	0.04 or less {0.0016 or less} for longitudinal direction	0.03 or less {0.0012 or less} for lateral direction	0.20 {0.0078}	Replace. NOTICE: Do not grind for repair.	Measure  

Inspection item	Standard	Limit	Remedy	Inspection procedure
Cracks or damage to cylinder head (Dye penetrant check)	—	—	Replace.	Visual check 
Contact of valve (Use of Red lead marking compound)	Entire periphery of valve head evenly in contact	—	Matches valve.	Visual check 
Cam idle gear shaft outside diameter	34 {1.3386}	33.8 {1.3307}	Replace.	Measure 
Cam idle gear shaft bushing inside diameter	34 {1.3386}	34.20 {1.3464}	Replace.	
Clearance between cam idle gear shaft and cam idle gear bushing	0.025-0.065 {0.0010-0.0026}	0.2 {0.0078}	Replace idle gear shaft and/or idle gear.	

CRANKSHAFT FRONT END

COMPONENT LOCATOR

EN0110302D100002



SAPH011030200065

1 Crankshaft pulley	3 Oil seal retainer
2 Crankshaft oil seal	

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

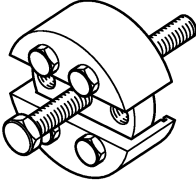
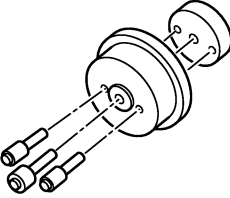
A 108 {1,100, 80}#	
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#=Apply oil to the threads and seat surfaces before tightening.

SPECIAL TOOL

EN0110302K100002

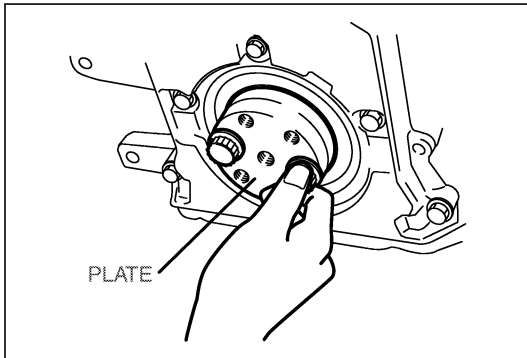
Prior to starting an engine overhaul, it is necessary to have these special tools.

Illustration	Part number	Tool name	Remarks
	S0942-01731	OIL SEAL PULLER	
	S0940-71030	OIL SEAL PRESS	

OVERHAUL

EN0110302H200002

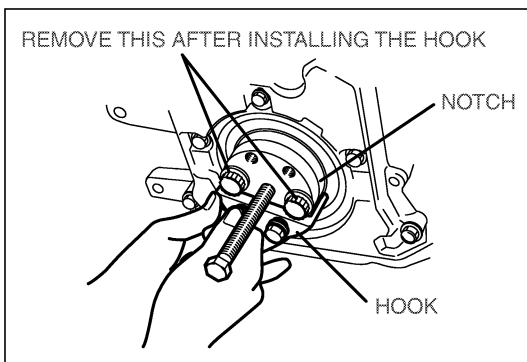
IMPORTANT POINTS - REPLACEMENT



SAPH011030200068

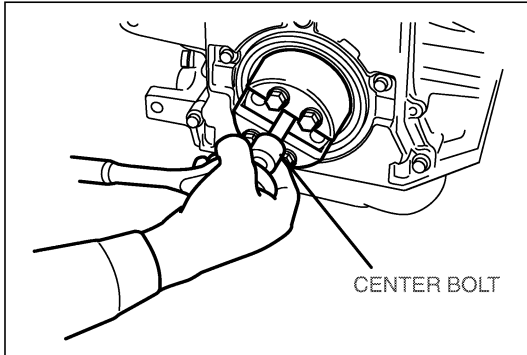
1. REMOVE THE CRANKSHAFT FRONT OIL SEAL. SST: Oil seal puller (S0942-01731)

- (1) Place the plate at the crankshaft end using the crankshaft pulley bolts.



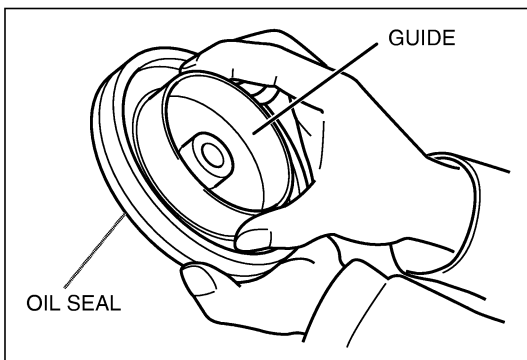
SAPH011030200069

- (2) Engage the hook with the oil seal notch and install the hook using the bolt supplied.
- (3) Remove the installed bolt in step (1).



SAPH011030200070

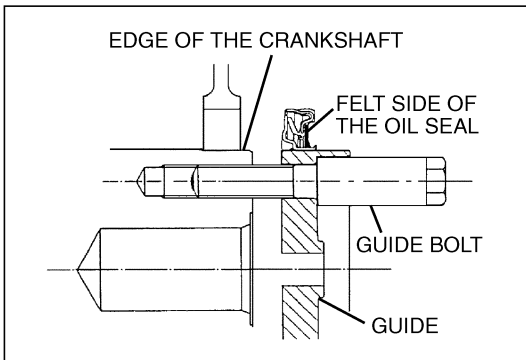
- (4) Install the center bolt and tighten it to remove the oil seal.



SAPH011030200071

2. INSTALL THE CRANKSHAFT FRONT OIL SEAL. SST: Oil seal press (S0940-71030)

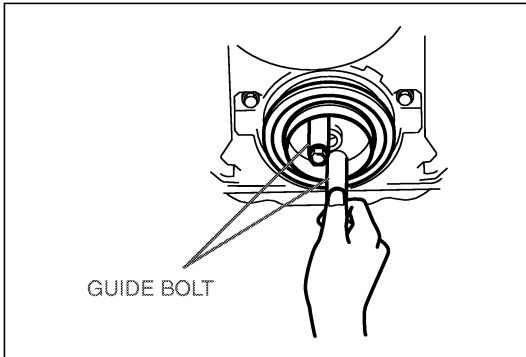
- (1) Clean the edges and surface of the crankshaft and the special tools.
- (2) Insert a new crankshaft oil seal into the guide of the oil seal press.



SAPH011030200072

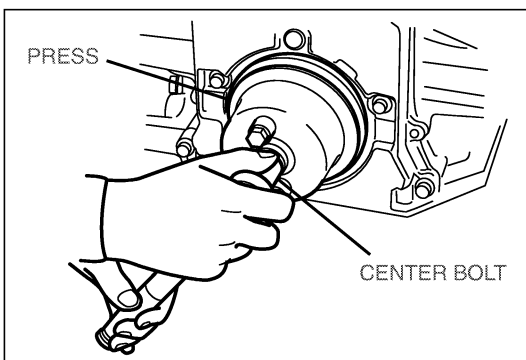
NOTICE

Pay attention to the orientation of the crankshaft oil seal (The felt side should face the outside of the cylinder block).



SAPH011030200073

- (3) Apply a little engine oil to the seal portion of the crankshaft oil seal.
- (4) Attach the oil seal press guide with the new crankshaft oil seal onto the crankshaft using the attached guide bolt.



SAPH011030200074

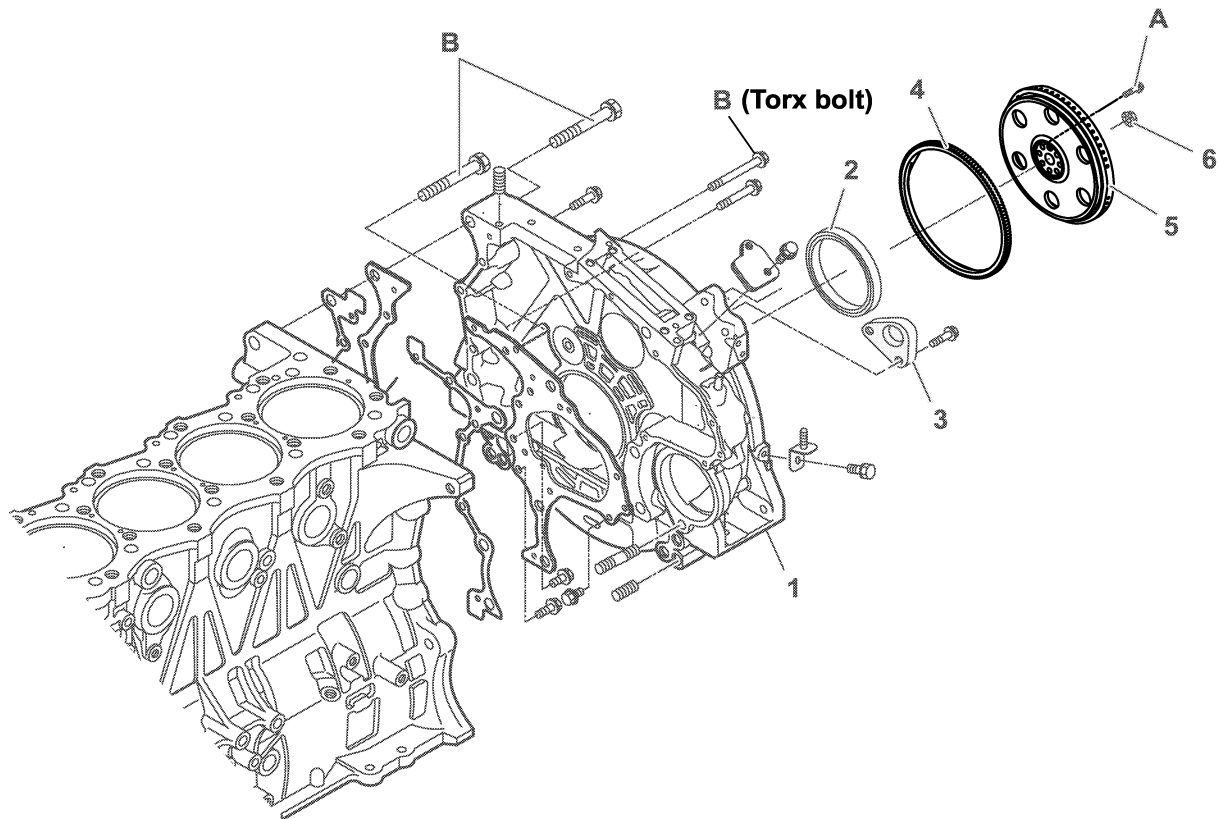
- (5) Insert the oil seal press by adjusting the oil seal press hole to the guide bolt.
- (6) Press the crankshaft oil seal inside by attaching the accompanying center bolt onto the oil seal press and tightening it until it stops.

FLYWHEEL AND FLYWHEEL HOUSING

COMPONENT LOCATOR

EN0110302D100003

EXAMPLE



SAPH011030200075

1	Flywheel housing	4	Ring gear
2	Crankshaft oil seal	5	Flywheel
3	Hanger bracket	6	Pilot bearing

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A	186 {1,900, 137}#○	B	M8: 28.5 {290, 21}
		B	M8 Torx bolt: 36 {367, 27}
		B	M10: 55 {560, 40.5}
		B	M16: 176.5 {1,800, 130}

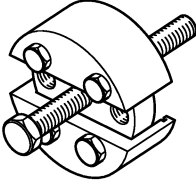
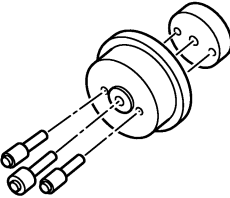
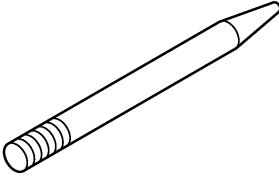
#=Apply oil to the threads and seat surface before tightening.

○=Tighten the bolt to the specified torque, then loosen it. Tighten to the specified torque again.

SPECIAL TOOL

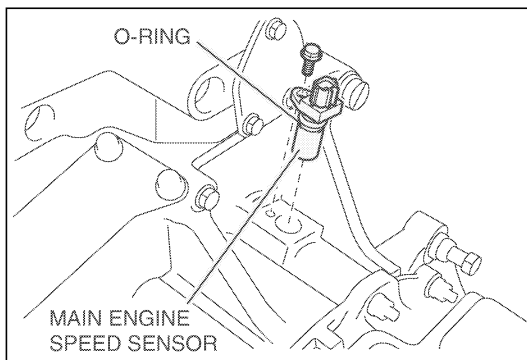
EN0110302K100003

Prior to starting an engine overhaul, it is necessary to have these special tools.

Illustration	Part number	Tool name	Remarks
	S0942-01742	REAR OIL SEAL PULLER	
	S0940-71040	OIL SEAL PRESS	
	S0948-11340	GUIDE BAR	

OVERHAUL

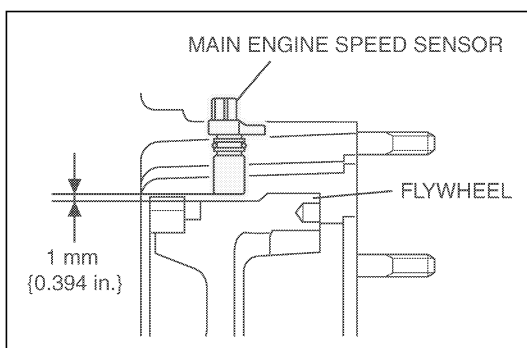
EN0110302H200003



SAPH011030200079

IMPORTANT POINT - DISMOUNTING

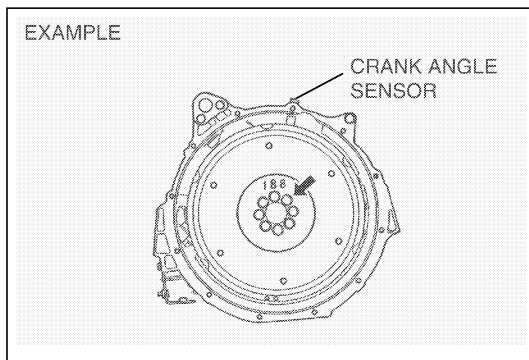
1. REMOVE THE FLYWHEEL.
 - (1) Remove the main engine speed sensor from the flywheel housing.



SAPH011030200080

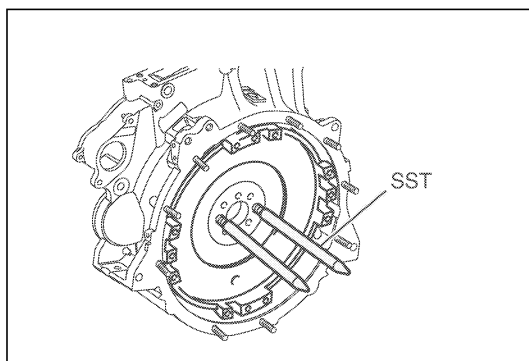
NOTICE

When dismantling and remounting the flywheel. Remove the main engine speed sensor. If not removed, it will result in damage of the sensor.



SAPH011030200081

- (2) Remove the 8 bolts of the flywheel assy.

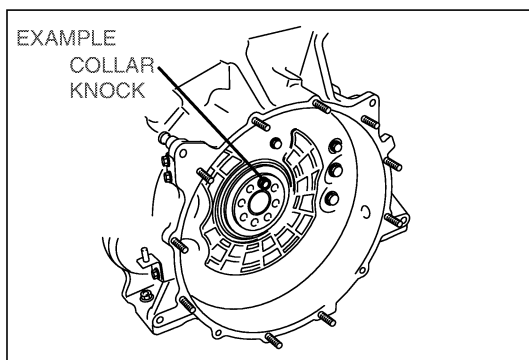


SAPH011030200082

- (3) Install the special tool, remove the flywheel.
SST: Guide bar (S0948-11340)

⚠ WARNING

The flywheel is heavy when removing, be careful not to drop it on your feet.



SAPH011030200083

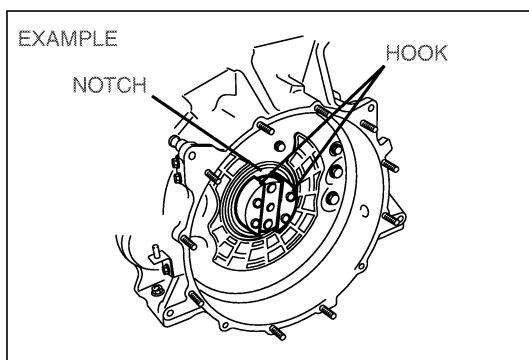
IMPORTANT POINTS - REPLACEMENT

1. REMOVE THE CRANKSHAFT REAR OIL SEAL.
SST: Oil seal puller (S0942-01742)

- (1) Place the plate at the crankshaft end using the flywheel bolts.

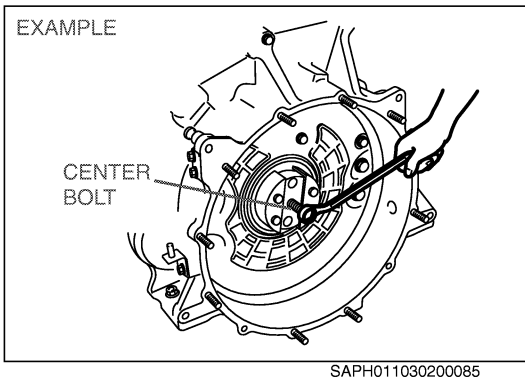
NOTICE

Match the plate hole to the crankshaft collar knock part.

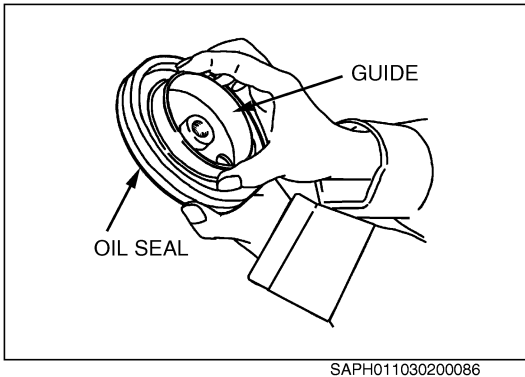


SAPH011030200084

- (2) Engage the hook with the oil seal notch and install the hook using the bolt supplied.
(3) Remove the installed flywheel bolts in step (1).



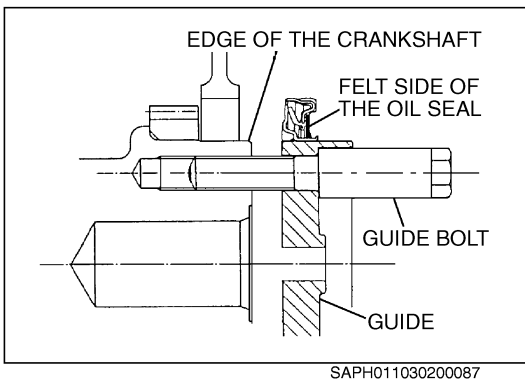
- (4) Install the center bolt and tighten it to remove the oil seal.



2. INSTALL THE CRANKSHAFT REAR OIL SEAL.

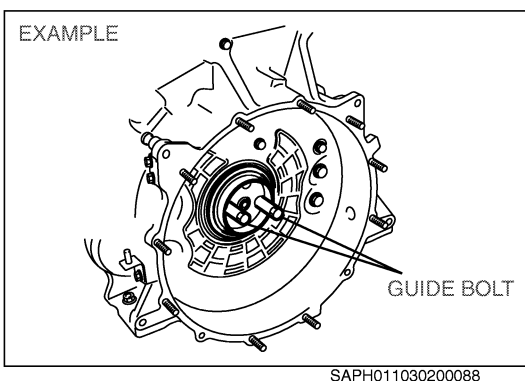
SST: Oil seal press (S0940-71040)

- (1) Clean the edges and surface of the crankshaft and the special tools.
- (2) Insert a new crankshaft oil seal into the guide of the oil seal press.

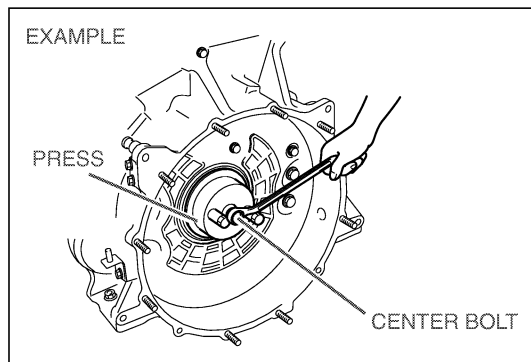


NOTICE

Pay attention to the orientation of the crankshaft oil seal (The felt side should face the outside of the cylinder block).

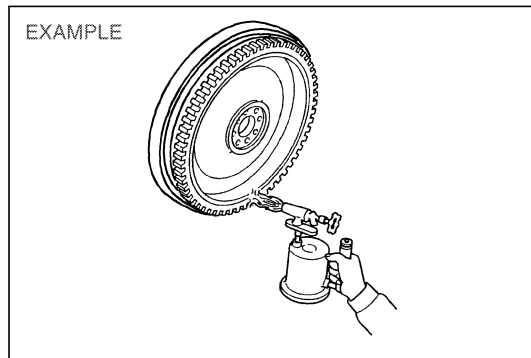


- (3) Apply a little engine oil to the seal portion of the crankshaft oil seal.
- (4) Attach the oil seal press guide with the new crankshaft oil seal onto the crankshaft using the attached guide bolt.



SAPH011030200089

- (5) Insert the oil seal press by adjusting the oil seal press hole to the guide bolt.
- (6) Press the crankshaft oil seal inside by attaching the accompanying center bolt onto the oil seal press and tightening it until it stops.



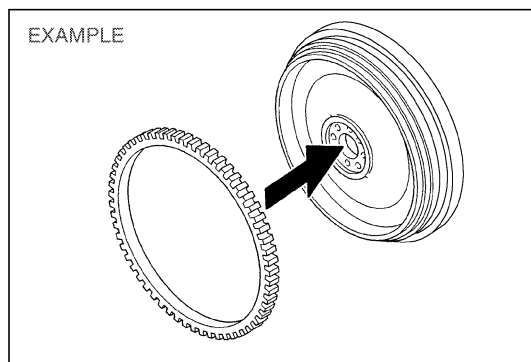
SAPH011030200090

3. REPLACE THE FLYWHEEL RING GEAR.

- (1) Heat the ring gear evenly to about 200°C {392°F} with a torch. Tap the ring gear periphery lightly using a cushion bar to remove the gear.

⚠ WARNING

Never touch the heated ring gear or flywheel with your bare hand. This can result in personal injury.

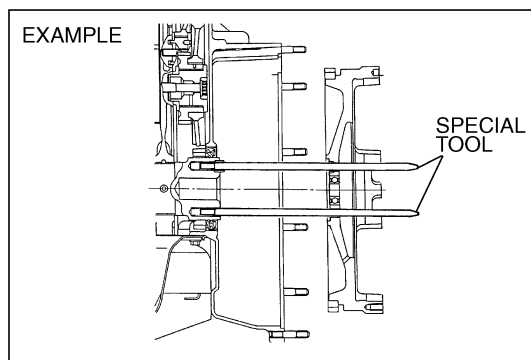


SAPH011030200091

- (2) Heat the ring gear evenly to about 200°C {392°F} with a torch. Insert the ring gear into the flywheel so that the chamfered side is upward.

⚠ CAUTION

Never touch the heated ring gear or flywheel with your bare hand. This can result in personal injury.



SAPH011030200092

IMPORTANT POINT - ASSEMBLY

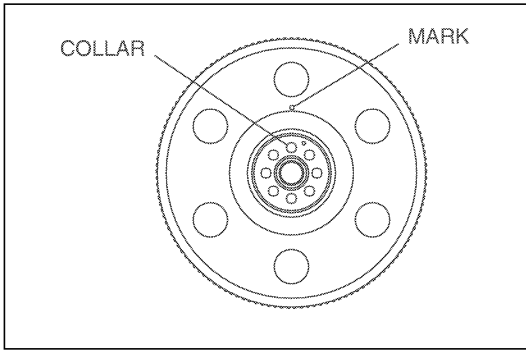
1. INSTALL THE FLYWHEEL.

- (1) Make sure that there are no burns or dirt on the contact surface or in the threaded holes of the crankshaft or flywheel. Install the special tool onto the crankshaft.

SST: Guide bar (S0948-11340)

NOTICE

Place one guide bar at the collar knock and another at the opposite side of the collar knock.



SAPH011030200093

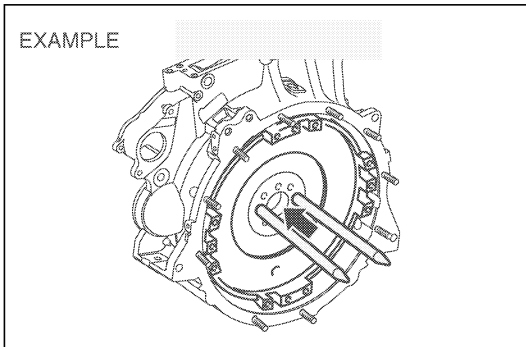
- (2) Insert the flywheel slowly until it contacts the collar knock to prevent impact on the guide bar. Adjust the position, then insert the flywheel completely.

⚠ WARNING

Be careful not to drop the flywheel on your foot when removing it, because it is very heavy.

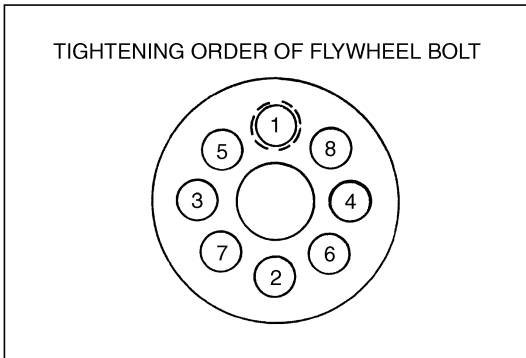
NOTICE

Align the "O" mark on the flywheel and crankshaft collar knock-pin.



SAPH011030200094

- (3) Apply clean engine oil to the threads of the flywheel bolt and the flywheel bolt seat. Be sure to tighten the flywheel bolts (6 pieces) with a low-torque impact wrench.
- (4) Pull out the guide bar and tighten the remaining two flywheel bolts provisionally as in step (3).



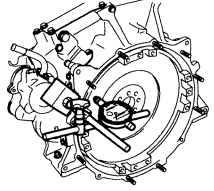
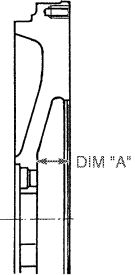
SAPH011030200095

- (5) Tighten the flywheel in the order shown in the figure to the specified torque below.
Tightening Torque:
186 N·m {1,900 kgf·cm, 137 lbf·ft}
- (6) Loosen all bolts and tighten them again to the specified torque.

INSPECTION AND REPAIR

EN0110302H300002

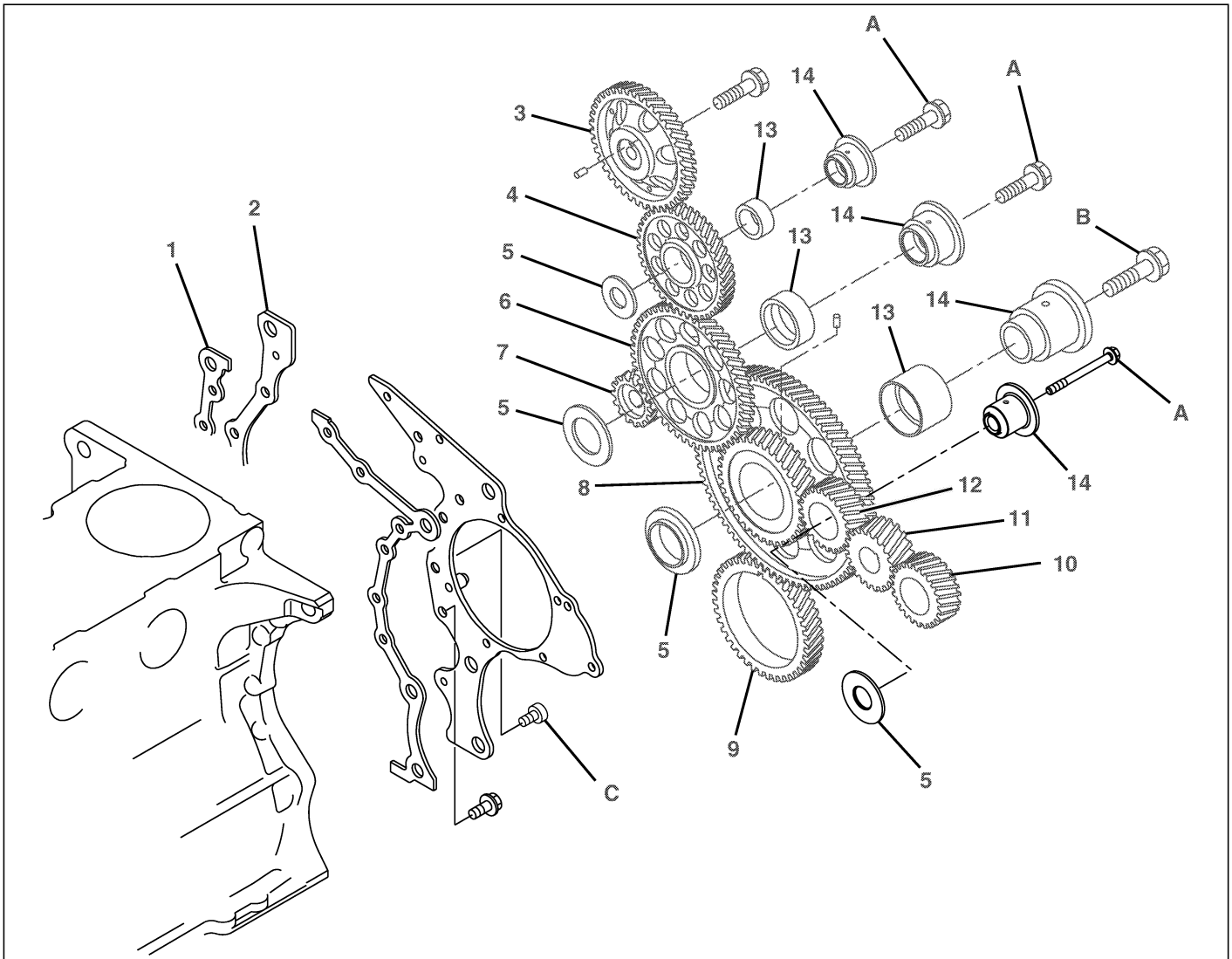
Unit: mm {in.}

Inspection item		Standard	Limit	Remedy	Inspection procedure
Flywheel surface deflection		—	0.15 {0.0059}	Repair.	Measure 
Flywheel thickness (Dimension A)	Manual T/M series (Diameter 390 mm {15 in.})	29 {1.142}	28 {1.102}	—	Measure 

TIMING GEAR

COMPONENT LOCATOR

EN0110302D100004



SAPH011030200098

1	Gasket	8	Main idle gear
2	Rear end plate	9	Crankshaft gear
3	Camshaft gear	10	Power steering pump drive gear
4	Cam idle gear	11	Air compressor drive gear
5	Idle gear thrust plate	12	Air compressor idle gear
6	Sub-idle gear	13	Idle gear bushing
7	Oil pump gear	14	Idle gear shaft

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

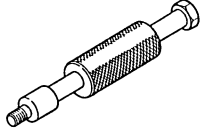
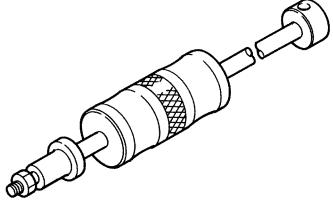
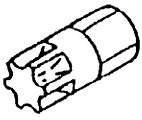
A	108 {1,100, 80}#	C	55 {560, 41} Application of lock sealant
B	172 {1,750, 127}#		

#=Apply oil to the threads and seat surfaces before tightening.

SPECIAL TOOL

EN0110302K100004

Prior to starting an engine overhaul, it is necessary to have these special tools.

Illustration	Part number	Tool name	Remarks
	S0942-01100	SLIDING HAMMER	For MAIN IDLE GEAR
	S0942-01442	SLIDING HAMMER	For SUB AND CAM IDLE GEAR
	S0941-11300	SOCKET WRENCH	For TORX BOLT

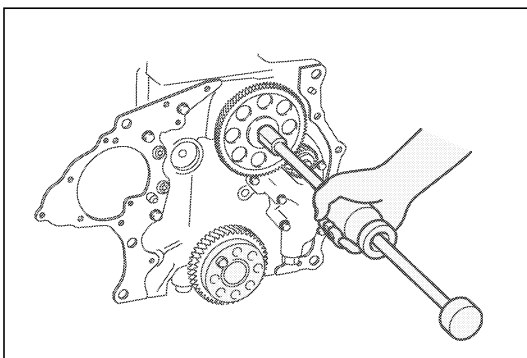
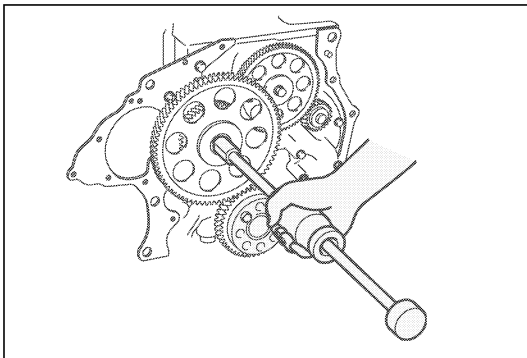
OVERHAUL

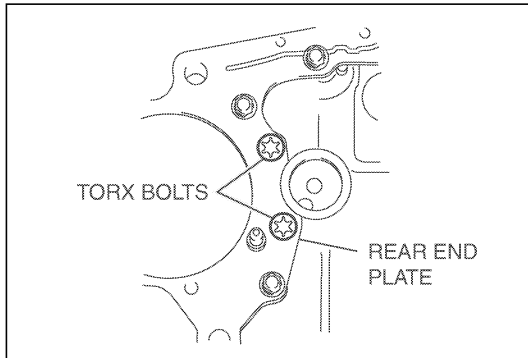
EN0110302H200004

IMPORTANT POINTS - DISASSEMBLY

1. REMOVE THE IDLE GEAR SHAFT.
 - (1) Remove the idle gear shaft using the special tool.

SST:
Sliding hammer (for main idle gear) (S0942-01100)
Sliding hammer (for sub and cam idle gear) (S0942-01442)





SAPH011030200104

IMPORTANT POINTS - ASSEMBLY

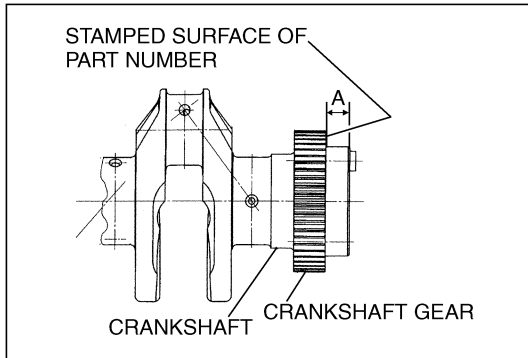
1. INSTALL THE REAR END PLATE.

- (1) Apply lock sealant (Nut Lock Super 5M or equivalent) to the threads of the torx bolts in the side of bearing holder case fitting (2 places) and tighten to the specified torque using the special tool.

SST: Socket wrench (S0941-11300)

Tightening Torque:

55 N·m {560 kgf·cm, 41 lbf·ft}



SAPH011030200105

2. INSTALL THE CRANKSHAFT GEAR.

- (1) Heat the crankshaft gear in oil heated to 100°C -150°C {212°F-302°F}.

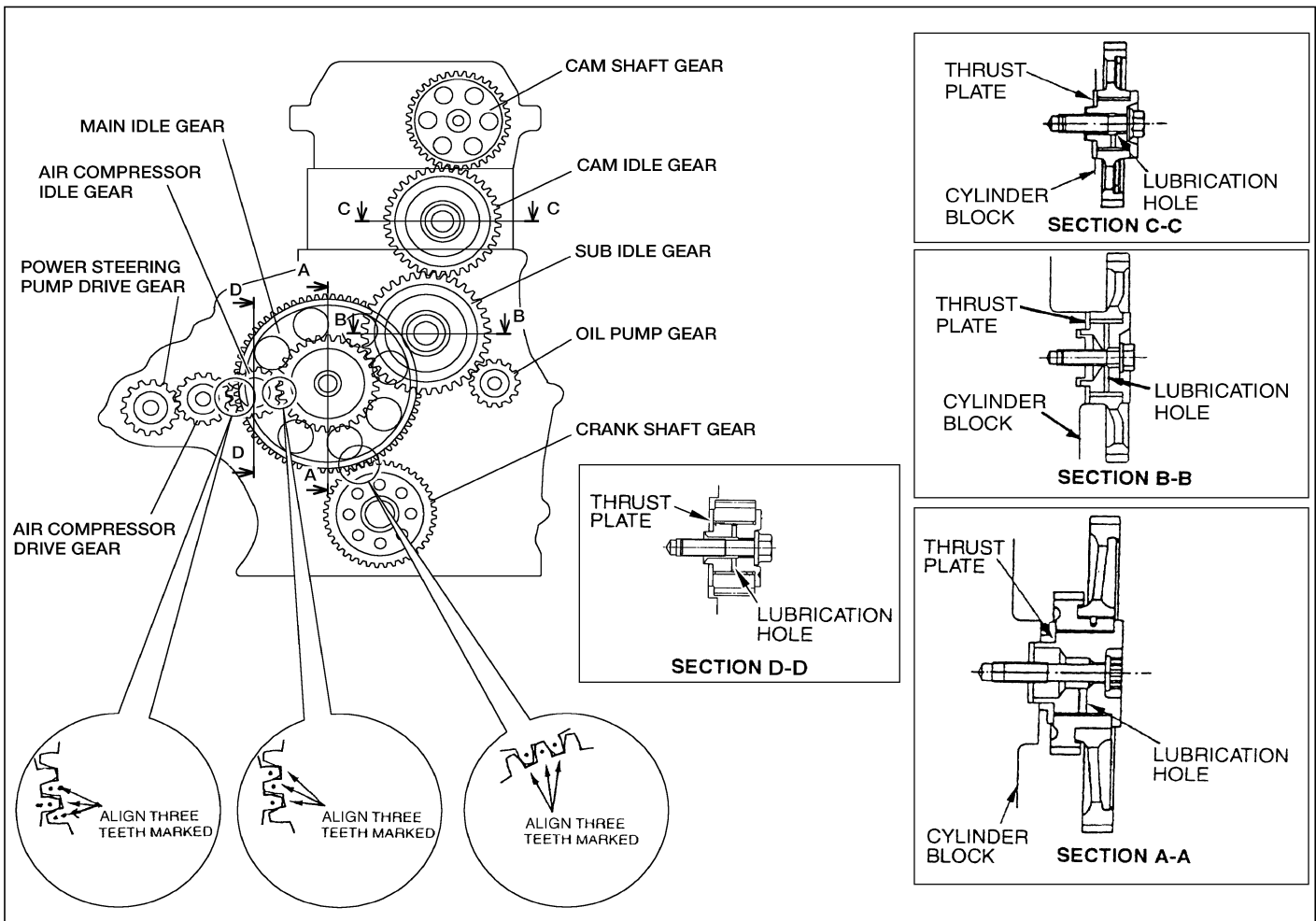
⚠ WARNING

Never touch the heated gear with your bare hand. This can result in personal injury.

- (2) Align the crankshaft gear groove with crankshaft pin.
- (3) Install the crankshaft gear onto the crankshaft as shown in the figure.

Dimension A: 22 mm {0.866 in.}

3. INSTALL THE IDLER GEAR SHAFT AND GEAR.



SAPH011030200106

NOTICE

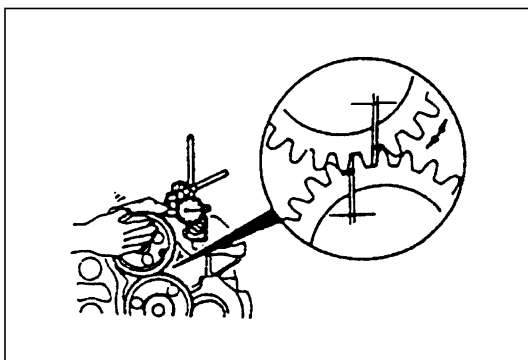
- Install each idle gear shaft through the thrust plate as shown in the figure so that the lubrication hole is downward.
- Adjust the timing of the main idle gear to align with the idle gear as shown in the figure.

4. MEASUREMENT OF GEAR BACKLASH.

- (1) Measure the backlash between the gears with a dial gauge. (Refer to the table of INSPECTION AND REPAIR)

NOTICE

After measurement of the backlash, apply engine oil to each gear surface.

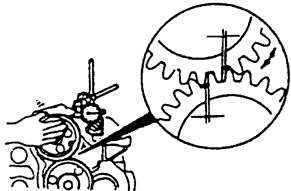


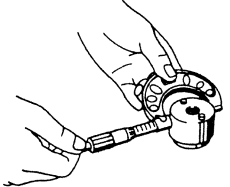
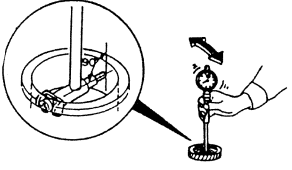
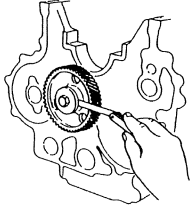
SAPH011030200107

INSPECTION AND REPAIR

EN0110302H300003

Unit: mm {in.}

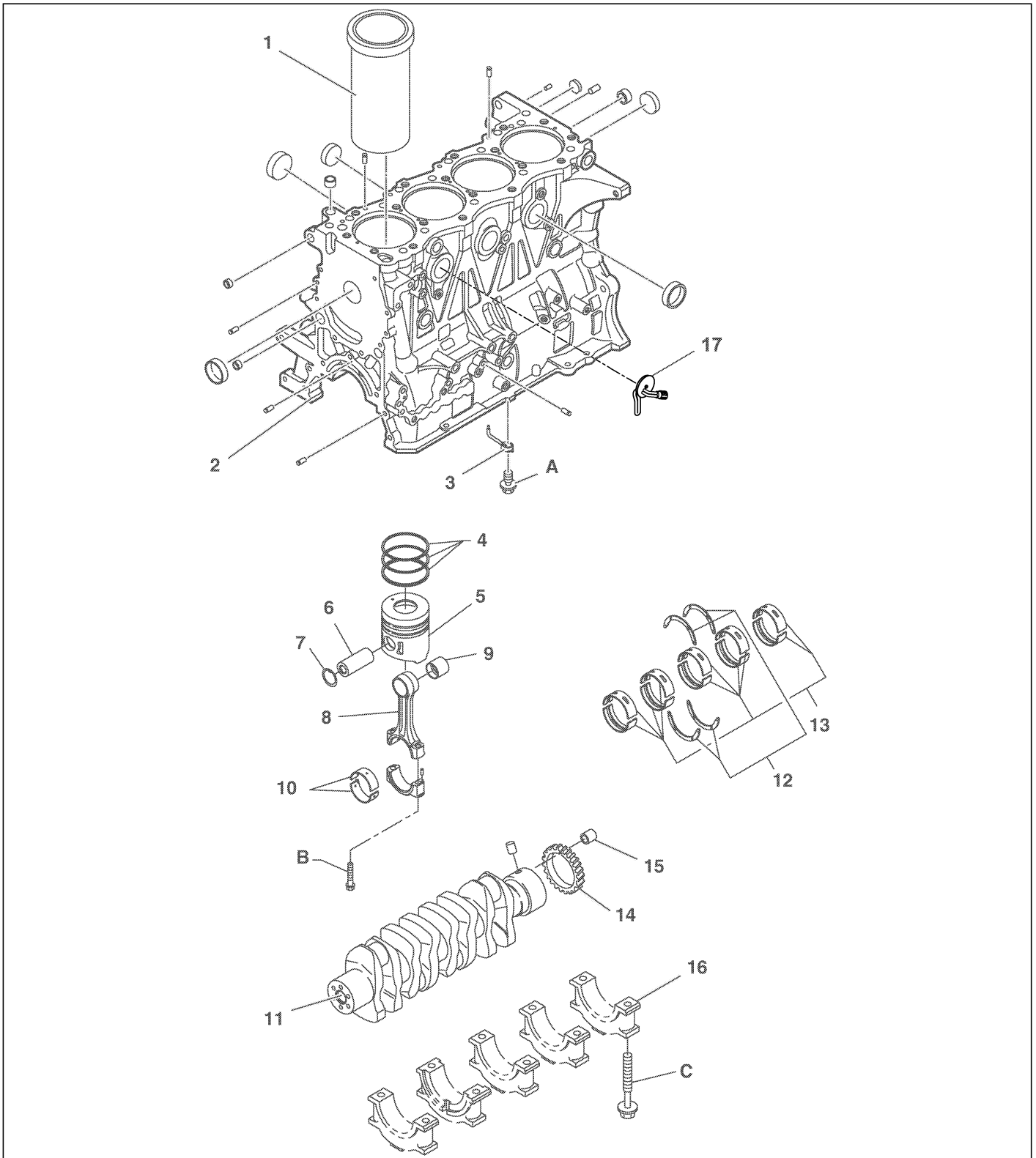
Inspection item		Standard	Limit	Remedy	Inspection procedure
Timing gear backlash	Crankshaft-Main idle	0.030-0.167 {0.0012-0.0065}	0.30 {0.0118}	Replace gear.	Measure 
	Main idle-Air compressor idle	0.032-0.096 {0.0013-0.0038}	0.10 {0.0039}		
	Air compressor idle-Air compressor	0.020-0.083 {0.0008-0.0033}	0.10 {0.0039}		
	Air compressor-Power steering pump	0.030-0.134 {0.0012-0.0052}	0.30 {0.0118}		
	Main idle-Sub idle	0.030-0.113 {0.0012-0.0044}	0.30 {0.0118}		
	Sub idle-Oil pump	0.030-0.131 {0.0012-0.0051}	0.30 {0.0118}		
	Sub idle-Cam idle	0.050-0.218 {0.0020-0.0085}	0.30 {0.0118}		
	Cam idle-Cam shaft	0.030-0.253 {0.0012-0.0099}	0.30 {0.0118}		

Inspection item		Standard	Limit	Remedy	Inspection procedure
Main idle shaft	Shaft outside diameter	57 {2.244}	—	—	Measure
	Bushing inside diameter	57 {2.244}	—	—	
	Clearance	0.030-0.090 {0.0012-0.0035}	0.20 {0.0079}	Replace bushing and/or shaft.	
	Gear width	44 {1.732}	—	—	
	Shaft length	44 {1.732}	—	—	
	End play	0.114-0.160 {0.0045-0.0062}	0.30 {0.0118}	Replace gear and/or shaft.	
Sub idle shaft	Shaft outside diameter	50 {1.969}	—	—	 Outside diameter
	Bushing inside diameter	50 {1.969}	—	—	
	Clearance	0.025-0.075 {0.0010-0.0029}	0.20 {0.0079}	Replace bushing and/or shaft.	
	Gear width	22 {0.866}	—	—	
	Shaft length	22 {0.866}	—	—	
	End play	0.040-0.120 {0.0016-0.0047}	0.30 {0.0118}	Replace gear and/or shaft.	
Cam idle shaft	Shaft outside diameter	34 {1.339}	—	—	 Inside diameter
	Bushing inside diameter	34 {1.339}	—	—	
	Clearance	0.025-0.075 {0.0010-0.0029}	0.20 {0.0079}	Replace bushing and/or shaft.	
	Gear width	22 {0.866}	—	—	
	Shaft length	22 {0.866}	—	—	
	End play	0.040-0.120 {0.0016-0.0047}	0.30 {0.0118}	Replace gear and/or thrust plate.	
Air compressor idle	Shaft outside diameter	34 {1.339}	—	—	 End play
	Bushing inside diameter	34 {1.339}	—	—	
	Clearance	0.025-0.057 {0.0010-0.0022}	0.10 {0.0039}	Replace bushing and/or shaft.	
	Gear width	28.5 {1.1220}	—	—	
	Shaft length	28.5 {1.1220}	—	—	
	End play	0.160-0.220 {0.0063-0.0086}	—	—	

MAIN MOVING PARTS AND CYLINDER BLOCK

COMPONENT LOCATOR

EN0110302D100005



SAPH011030200110

1	Cylinder liner	10	Connecting rod bearing
2	Cylinder block	11	Crankshaft
3	Piston cooling jet	12	Crankshaft thrust bearing
4	Piston ring	13	Crankshaft main bearing
5	Piston	14	Crankshaft gear
6	Piston pin	15	Collar knock
7	Retainer ring	16	Main bearing cap
8	Connecting rod	17	Block heater assy
9	Connecting rod bushing		

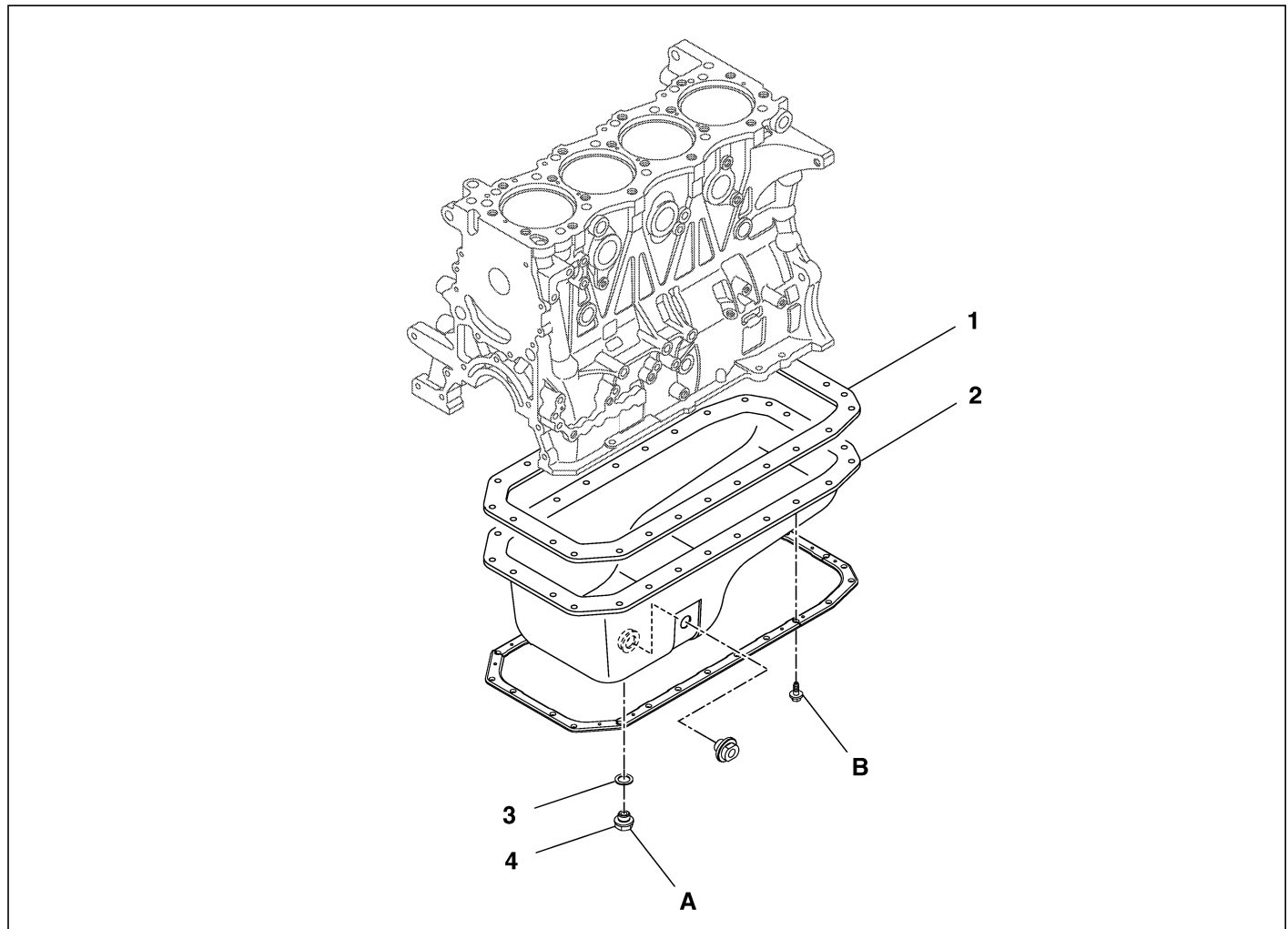
Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A	22 {220, 15.5}	C	69 {700, 50}+90°+45°#○
B	69 {700, 50}+90°+45°#		

#=Apply oil to the threads and seat surfaces before tightening.

○=Tighten the bolt to the specified torque, then loosen it. Tighten to the specified torque again.



SAPH011030200111

1	Gasket	3	Soft washer
2	Oil pan	4	Drain plug

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A	41 {420, 30}	B	30 {300, 21}
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SPECIAL TOOL

EN0110302K100005

Prior to starting an engine overhaul, it is necessary to have these special tools.

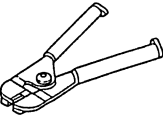
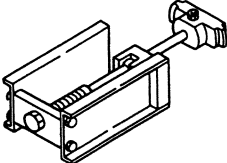
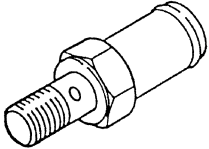

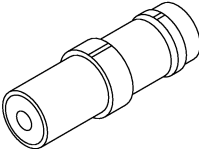
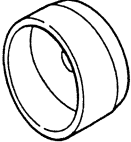
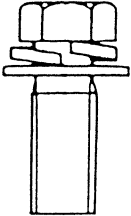
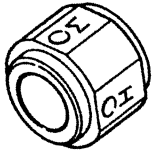
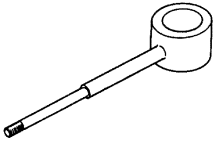
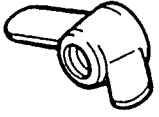
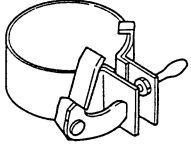
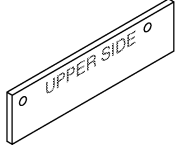
Illustration	Part number	Tool name	Remarks
	S0944-21011	PISTON RING EXPANDER	For Piston ring
	S0942-02100	PULLER	For Cylinder liner
	SZ910-24098	CONNECTOR BOLT	For Piston cooling jet
	S0947-11490	GUIDE	
	S0940-21540	SPINDLE	
	S0948-11540	GUIDE	
	SH691-20825	BOLT	

Illustration	Part number	Tool name	Remarks
	S0948-11130	GUIDE	For Connecting rod bushing
	S0940-21530	PRESS SUB-ASSEMBLY	
	SL271-01036	WING NUT	
	S0944-11370	PISTON RING HOLDER	
	09219-E4010	GAGE	For Cooling jet check

OVERHAUL

EN0110302H200005

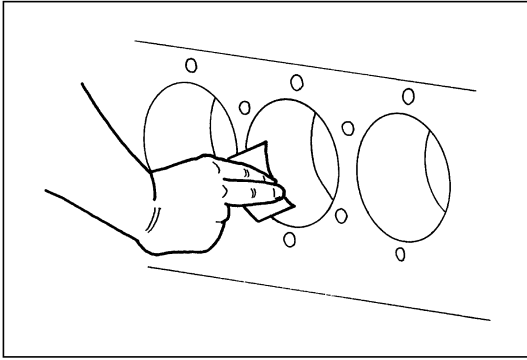
IMPORTANT POINTS - DISASSEMBLY

1. REMOVE THE PISTONS WITH CONNECTING RODS.

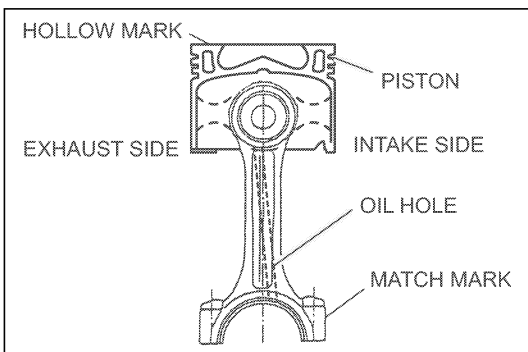
- (1) Remove the pistons and connecting rods from the cylinder block upper side.

NOTICE

- Remove carbon deposits from the end inside the cylinder liner with a scraper or emery paper (recommended: No. 150) in a circular direction.



SAPH011030200124



SAPH011030200125

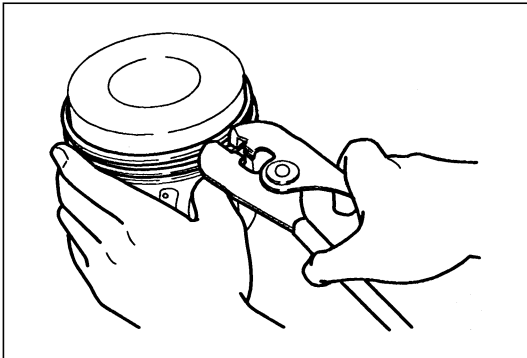
- Arrange the removed pistons and connecting rod caps in the order of cylinder Numbers. Be careful not to change the combination of the connecting rod and cap.

2. REMOVE THE PISTON RINGS.

- (1) Remove the piston ring using the special tool.
SST: Piston ring expander (S0944-21011)

NOTICE

- Handle the piston rings carefully because they are made of a special casting which is easily broken.
- Keep the piston rings for each cylinder separately.



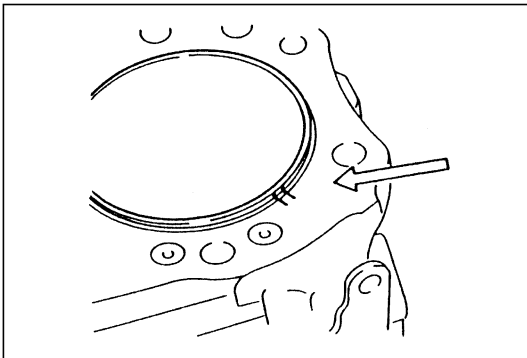
SAPH011030200126

3. REMOVE THE CYLINDER LINER.

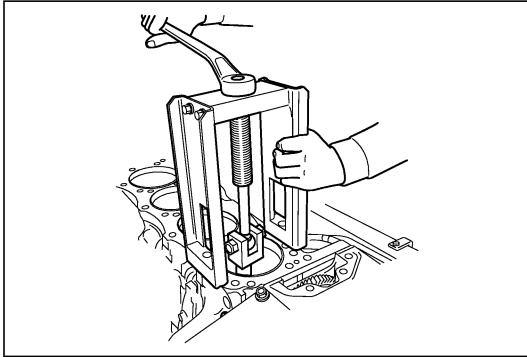
- (1) Before removing the cylinder liner, put alignment marks on the cylinder block and liner flange.

NOTICE

Do not make alignment marks with a punch.



SAPH011030200127

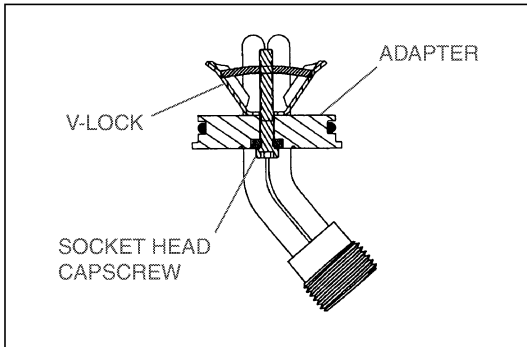


SAPH011030200128

- (2) Pull the cylinder liner from the cylinder block using the special tool.
SST: Puller (S0942-02100)

NOTICE

- Carefully set the special tool to prevent touching the piston cooling jet.
- After removing the cylinder liners, arrange them in sequence.



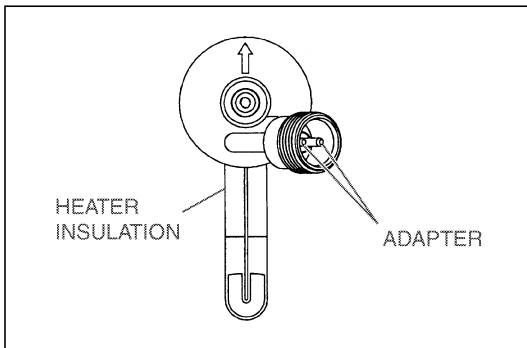
SAPH011030200129

4. REMOVE THE BLOCK HEATER

- (1) Remove the harness by loosening the cord nut.
- (2) Loosen the socket head cap screw.
- (3) Lever the heater out by using a bar.

NOTICE

- Do not damage the adapter installation hole, otherwise water will leak.
- Do not reuse the V-lock.



SAPH011030200130

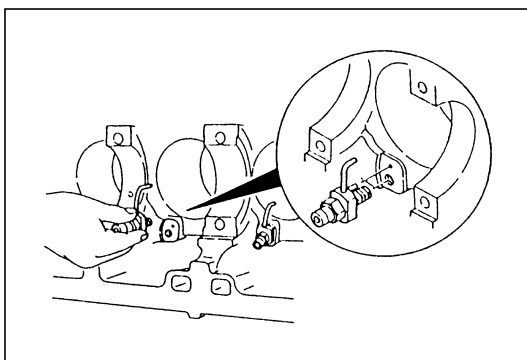
IMPORTANT POINTS - ON - VEHICLE INSPECTION**1. INSPECT THE BLOCK HEATER**

- (1) Measure the resistance between terminals.
 If not standard value, replace block heater assembly.

Standard	13.1—15.2Ω
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- (2) Measure the resistance of insulation between terminals and heater insulation. If not standard value, replace block heater assembly.

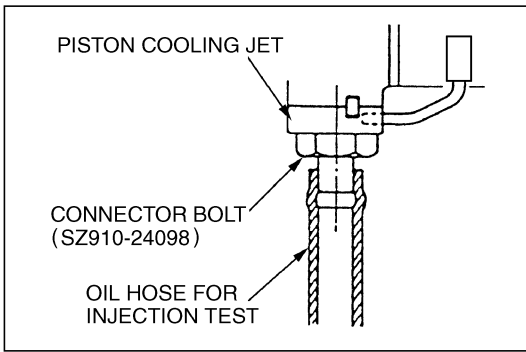
Standard	More than 5MΩ
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SAPH011030200131

IMPORTANT POINTS - ASSEMBLY**1. INSPECT AND ADJUST THE PISTON COOLING JET.**

- (1) Install the piston cooling jet on the cylinder block using the special tool.
SST: Connector bolt (SZ910-24098)

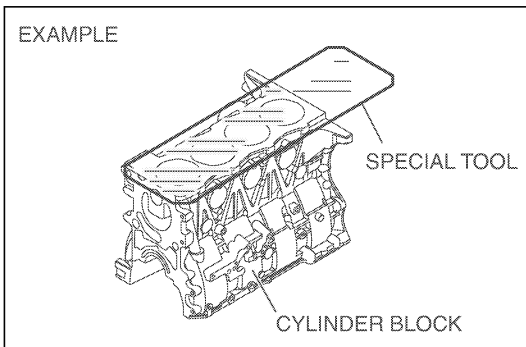


SAPH011030200132

- (2) For the jet test, connect the oil hose to the connector bolt from the cylinder block lower side.

NOTICE

Use clean engine oil for jet flow.

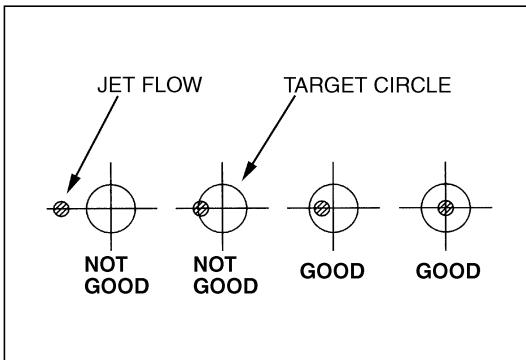


SAPH011030200133

- (3) Set the special tool on the cylinder block upper surface against the dowel pin.

SST: Gage (09219-E4010)

- (4) Test jet oil flow from the piston cooling jet nozzle at a hydraulic pressure of 245 kPa {2.5 kgf/cm², 35 lbf/in²}.



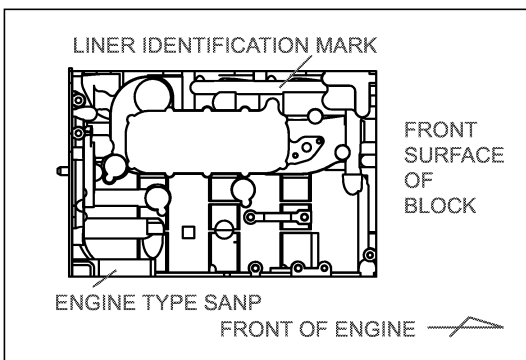
SAPH011030200134

- (5) If the center of the jet flow is within the two target circles (8 mm {0.3150 in} and 15 mm {0.5906 in} diameter: Blue), the test is acceptable.

⚠ WARNING

- **Engine oil is flammable.**
- **Never use an open flame or a naked bulb.**
- **Carry out the following inspection only in a well-ventilated area.**

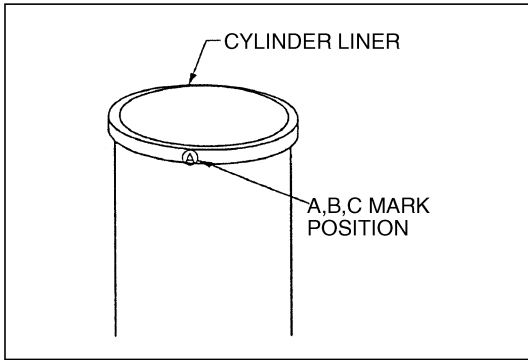
- (6) If the center of the jet flow is out of the two target circles, replace the jet.



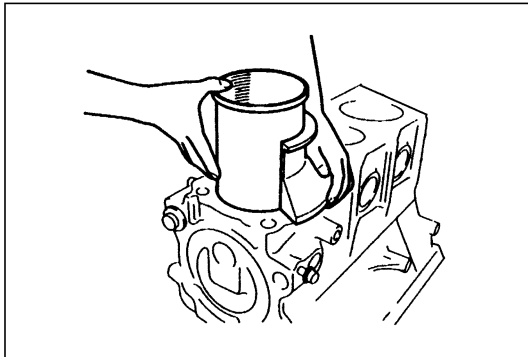
SAPH011030200135

2. INSTALL THE CYLINDER LINER.**NOTICE**

- **When assembling the cylinder liner with the cylinder block, clearance can be set to three levels.**
- **The upper surface and side surface of the cylinder block are stamped A, B or C depending on the inside diameter. Insert a matching cylinder liner having the same symbol.**



SAPH011030200136



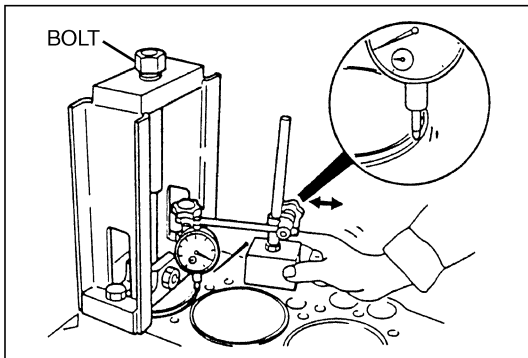
SAPH011030200137

- (1) Apply engine oil to the inner surface of the block bore and insert the cylinder liner using the special tool.

SST: Guide (S0947-11490)

NOTICE

Handle the cylinder liner carefully because it is thin.
(If it falls on the floor, it cannot be used.)



SAPH011030200138

3. **MEASURE THE PROTRUSION AT THE CYLINDER LINER FLANGE.**

SST: Puller (S0942-02100)

Tightening Torque:

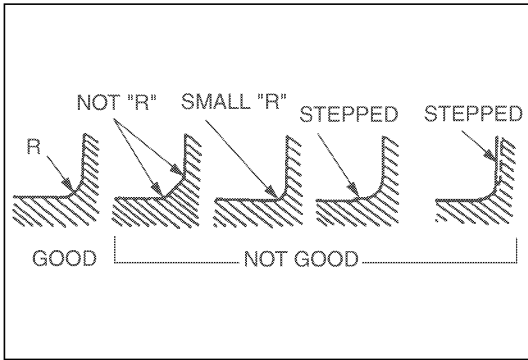
9.8 N·m {100 kgf·cm, 7 lbf·ft}

Standard	0.01-0.08 mm {0.0004-0.0031 in.}
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4. **MEASURE THE CRANKSHAFT.**

- (1) If necessary, grind the crankshaft and use an undersize bearing.

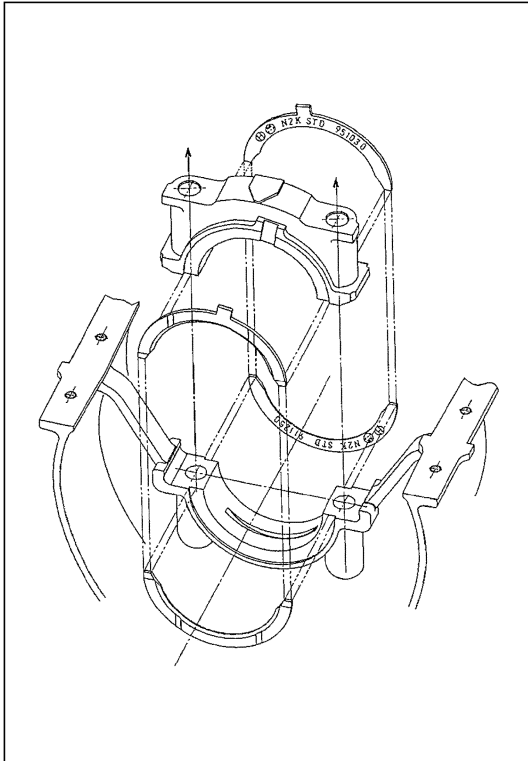
Bearing size	Outside diameter	
	Crank pin	Journal
Standard	64.94-64.96 mm {2.5567-2.5574 in.}	79.94-79.96 mm {3.1473-3.1480 in.}
0.25US	64.69-64.71 mm {2.5469-2.5476 in.}	79.69-79.71 mm {3.1375-3.1381 in.}
0.50US	64.44-64.46 mm {2.5371-2.5377 in.}	79.44-79.46 mm {3.1276-3.1283 in.}



SAPH011030200139

(2) Dimension of fillet "R"

Crank pin	2.5-3.0 mm {0.0985-0.1181 in.}
Journal	2.5-3.0 mm {0.0985-0.1181 in.}



SAPH011030200140

5. INSTALL THE CRANKSHAFT.

(1) Install the main bearing onto the bearing caps and the cylinder block.

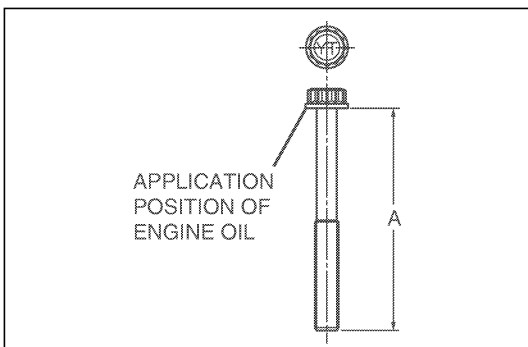
NOTICE

- **Install the bearing with the oil hole on the block side and the bearing without the oil hole on the cap side.**
- **Apply clean engine oil to inner surfaces of the bearings.**

(2) Install the thrust bearing with the groove side (front) toward the crank arm and with the part No. stamp (back) toward the main bearing cap or cylinder block.

HINT**Apply engine oil or grease to the back of the bearing to prevent loosening during installation.**

(3) Install the crankshaft onto the cylinder block.



SAPH011030200141

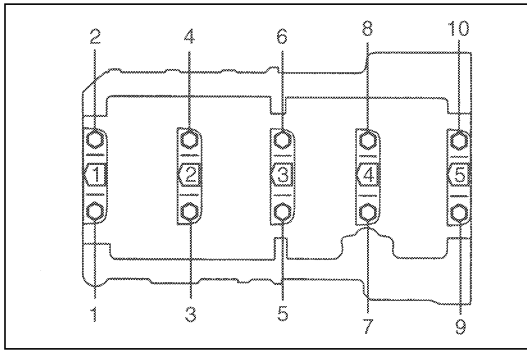
6. INSTALL THE MAIN BEARING CAP.

(1) Install the main bearing cap onto the cylinder block.

NOTICE**Check the number stamped on the cap.**

(2) Measure the length below the head of the bearing cap bolt and replace any bolts not meeting the limit with new ones.

Dimension A	108 mm {4.252 in.}
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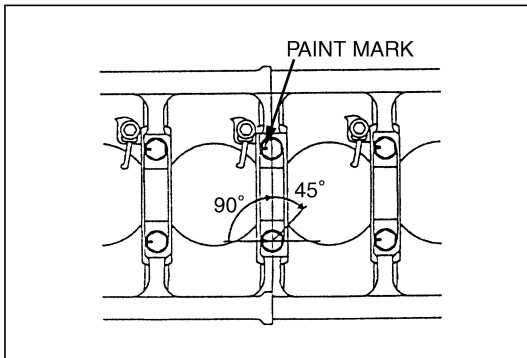


SAPH011030200142

- (3) Apply clean engine oil to the bolt seat and bolt threads.
- (4) Tighten the bolts in the order as shown in the figure to the specified torque.

Tightening Torque:
69 N·m {700 kgf·cm, 51 lbf·ft}

- (5) Loosen all bolts, tap the front and back ends of the crankshaft using a plastic hammer.
- (6) Tighten the bolts as in step (4).
- (7) Mark the bolt heads with paint.



SAPH011030200143

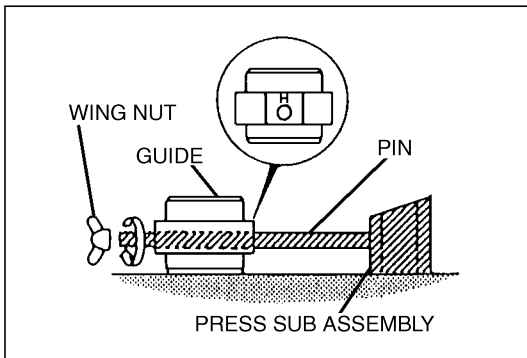
- (8) Tighten the bolts 90° (1/4 turn) in the same order as in step (4).
- (9) Retighten the bolts 45° (1/8 turn) as in step (8).

- (10) Make sure that all paint marks face the same direction.

NOTICE

When adding torque, never untighten the bolts, even if they have been overtightened.

- (11) After tightening, tap the front and back ends of the crankshaft using a plastic hammer to allow complete fit.



SAPH011030200144

7. REPLACE THE CONNECTING ROD BUSHING.

- (1) Prepare the special tools.
 - a. Assemble the guide and press sub-assembly inserting its pin into the guide then secure them with the wing nut.

SST:

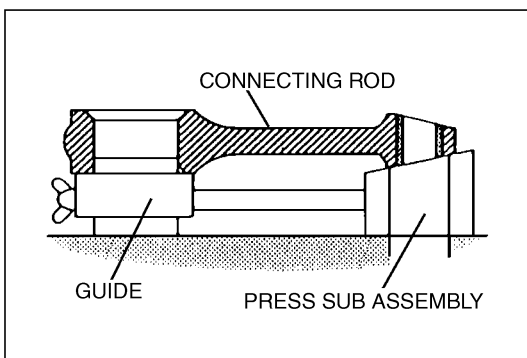
Guide (S0948-11130)

Press sub-assembly (S0940-21530)

Wing nut (SL271-01036)

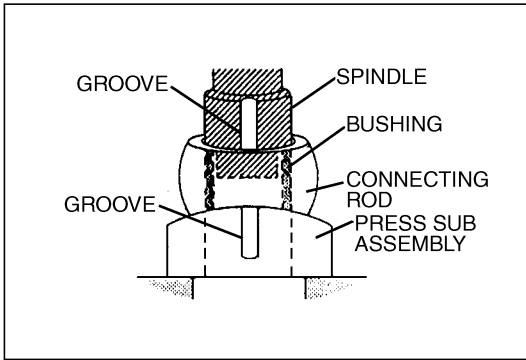
NOTICE

- Bring lever "H" punched on the guide above the pin.
- Making sure to align both supporting surfaces of the guide and press sub-assembly flush on a flat plane.



SAPH011030200145

- (2) Using a special tool, remove the connecting rod bushing.
 - a. Set the connecting rod assembled without connecting rod bearing on the guide and press sub-assembly.



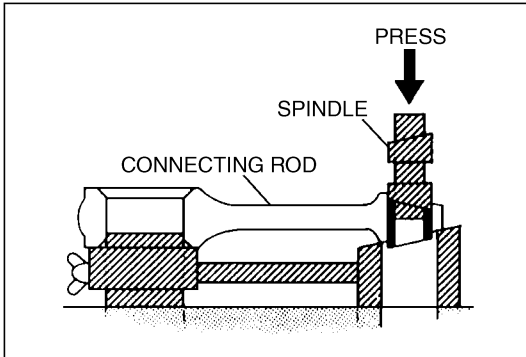
SAPH011030200146

b. Install the spindle into the bushing.

SST: Spindle (S0940-21540)

NOTICE

Align the groove of the spindle with the groove of the press sub assembly.

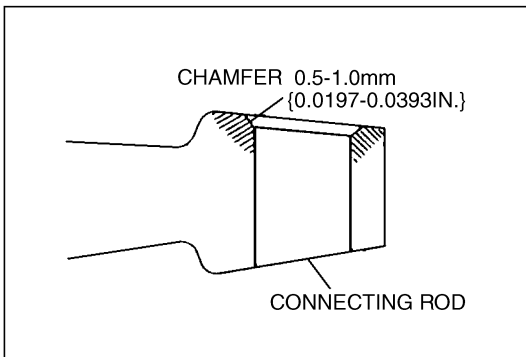


SAPH011030200147

c. Using a hydraulic press, remove the bushing.

NOTICE

Always operate the press slowly and smoothly.

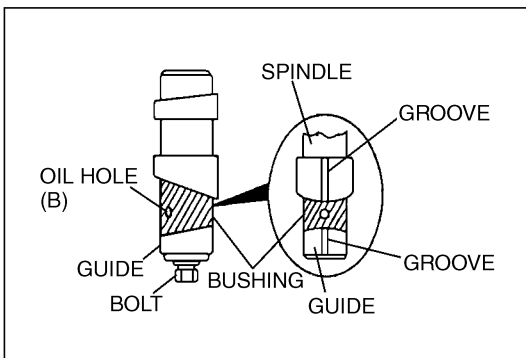


SAPH011030200148

(3) Chamfer one edge of the bushing hole at the small end of the connecting rod uniformly by 0.5-1.0 mm {0.0197-0.0393 in.}.

NOTICE

- **Irregular chamfering can cause out-of-roundness of the pressed bushing, which may result in jamming during insertion.**
- **Remove dust from the inner surface of the small-end hole.**



SAPH011030200149

(4) Mount the bushing on the spindle.

a. Set the bushing and guide on the spindle as shown in the figure, then secure them with the bolt.

SST:

Spindle (S0940-21540)

Guide (S0948-11540)

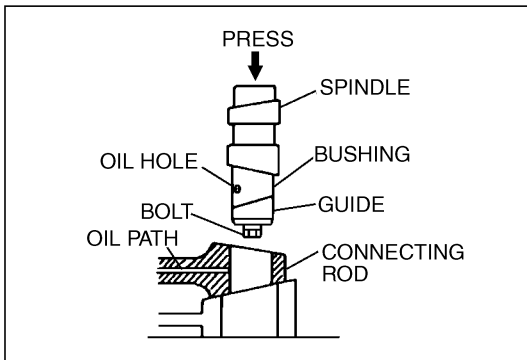
Bolt (SH691-20825)

Tightening Torque:

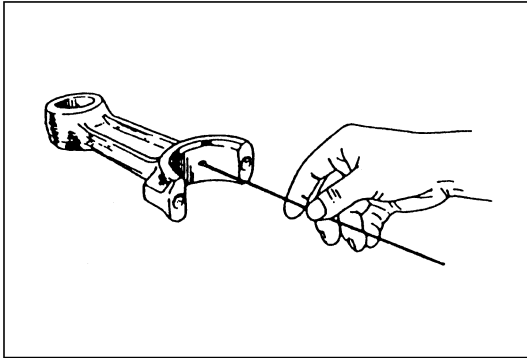
5.0-6.8 N·m {50-70 kgf·cm, 3.62-5.06 lbf·ft} (Bolt)

NOTICE

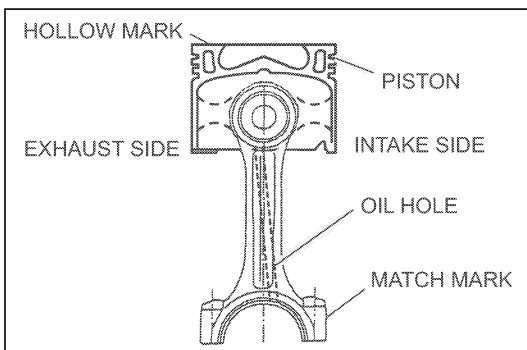
- **Align the groove of the spindle with the groove of the press sub assembly.**
- **Make sure that the contact surfaces of the bushing seats firmly against the contact surfaces of the spindle and guide.**



SAPH011030200150



SAPH011030200151



SAPH011030200125

- b. Apply the fresh engine oil around the bushing and guide.
- (5) Align the oil hole of the bushing with the oil hole of the connecting rod.

NOTICE

- **Put the connecting rod to the press sub assembly and the chamfer side of the small end to the bushing side.**
- **Apply the fresh engine oil to the bore of the connecting rod.**

- (6) Using a press, install the bushing in the connecting rod.

- (7) Inspect the bushing positioning after installation.

- a. Make sure that the oil hole of the bushing and the oil path of the connecting rod are suitably aligned allowing a 6 mm {0.2362 in.} diameter rod to penetrate.

NOTICE

Misalignment can lead to insufficient lubrication, which may result in seizure.

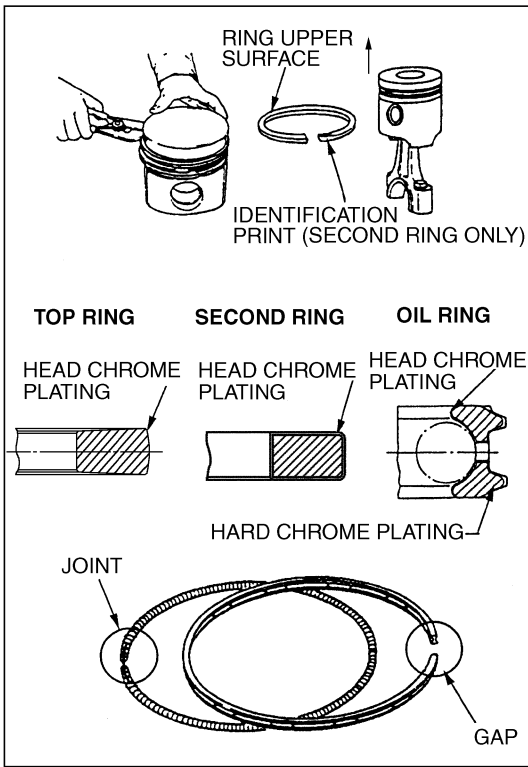
- b. Insert a new piston pin. When it is turned gently, make sure that there is no catch or rough movement.

8. ASSEMBLE THE PISTON AND CONNECTING ROD.

- (1) Heat the piston to 50°C {122°F}.
- (2) Assemble the piston hollow-mark to be opposite to the connecting rod match mark.

NOTICE

Replace the retainer ring with a new one.



9. ASSEMBLE THE PISTON RING.

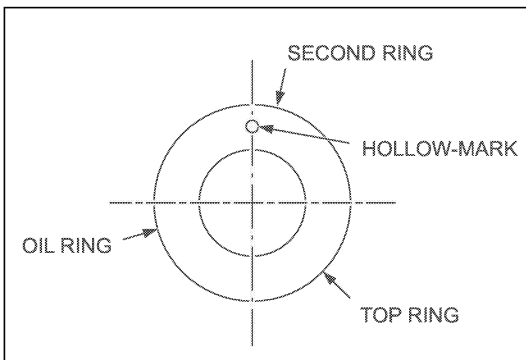
- (1) Install in the order of oil ring, second ring and top ring using the special tool.

SST: Piston ring expander (S0944-21011)

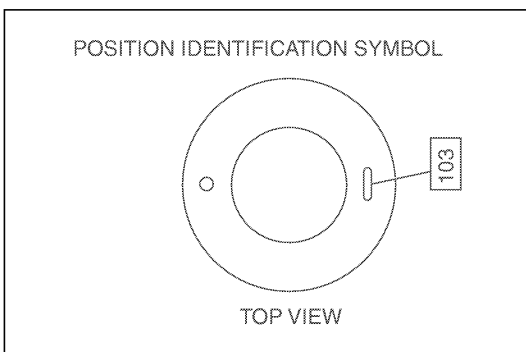
NOTICE

Install the second ring with the identification print on the piston ring facing towards the upper surface.

- (2) Connect the joint of the coil expander for the oil ring and install it inside the piston ring. Assemble the ring with the joint 180° opposite to the matching point.



- (3) Position the matching points of the piston ring at a even distance as shown in the figure.



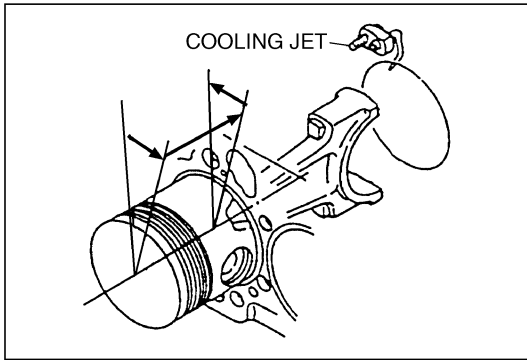
10. CHECK THE PISTON.

Before assembling the piston with the connecting rod, check whether the piston is specified for this engine.

NOTICE

Check using the engine compatible identification code on the top of the piston.

Engine compatible identification code: 103



SAPH011030200155

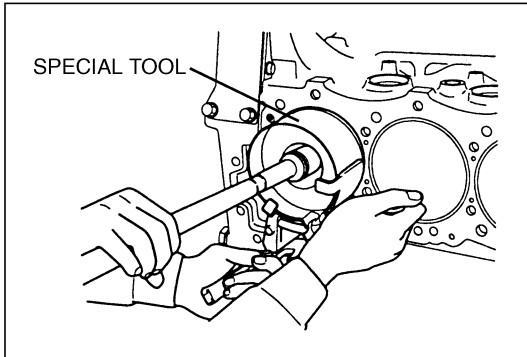
11. INSTALL THE PISTON.

- (1) Apply engine oil to the piston, cylinder liner and connecting rod bearing, then compress the piston ring using the special tool.

SST: Piston ring holder (S0944-11370)

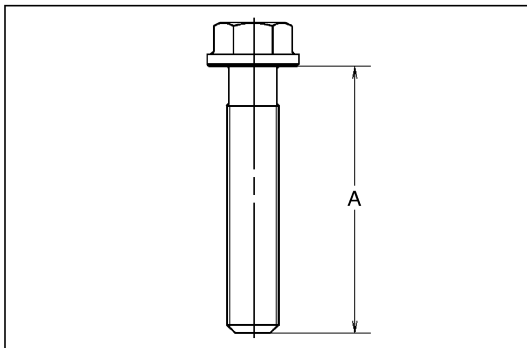
NOTICE

- When installing the piston, be careful that the cooling jet is not struck by the connecting rod.
- Make sure that the hollow-mark on the piston is at the exhaust side.



SAPH011030200156

- (2) Insert the piston into the cylinder liner.



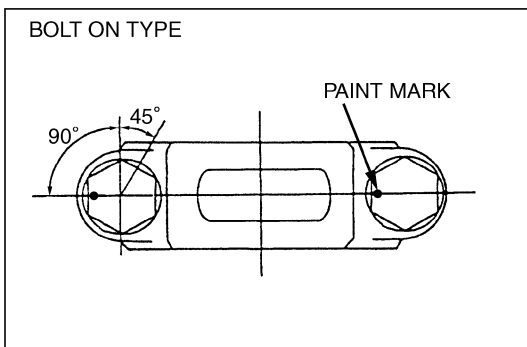
SAPH011030200157

12. TIGHTEN THE CONNECTING ROD BOLT.

- (1) Measure the length of the bolts, if the length is A or more, replace with new bolts.

Dimension A	68.0 mm {2.677 in.}
--------------------	----------------------------

- (2) Apply clean engine oil to the bolt thread and the bolt seat surface of the connecting rod cap.



SAPH011030200158

- (3) Tighten the connecting rod bolt to the specified torque.

Tightening Torque:

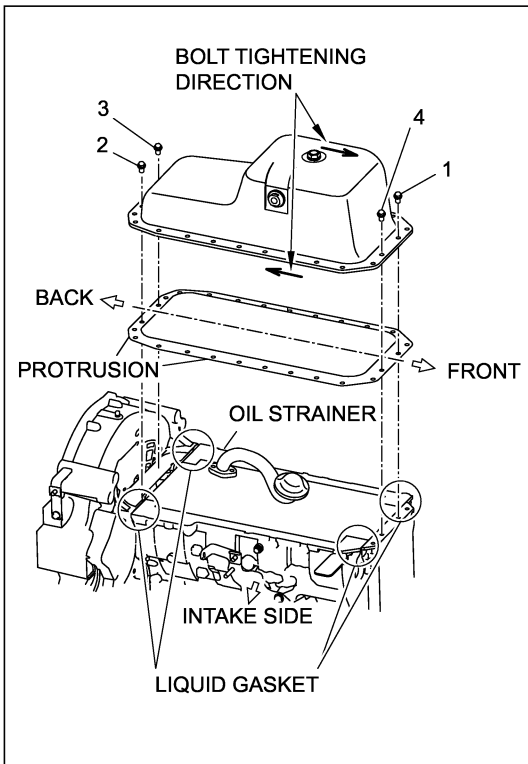
69 N·m {700 kgf·cm, 50 lbf·ft}

- (4) Mark the bolt heads in the same direction with paint.
- (5) Tighten the connecting rod bolt 90° (1/4 turn).
- (6) Tighten the connecting rod bolt 45° (1/8 turn).
- (7) Make sure that the paint marks face the same direction.

NOTICE

- When retightening the bolts, never adjust them by turning counterclockwise, even if they have been retightened more than the specified angle above.

If the angle of bolts is adjusted to the specified angle by turning counterclockwise, the axial force of the bolts might fall short and it is feared that this could reduce the engine reliability. Also there is a possibility that this could reduce the number of times a bolt can be reused.



SAPH011030200159

13. INSTALL THE OIL PAN.

- (1) Make sure that there is no deformation, impact marks or foreign particles on the cylinder block, oil pan or flange surface. Apply liquid gasket to the front and back ends of the cylinder block lower surface.

NOTICE

Refer to PARTS AND POSITIONS FOR LIQUID GASKET.

- (2) Install the gasket so that the protrusion is at the flywheel housing side and the intake side. (the print seal surface is at the cylinder block side)
- (3) Place a guide pin of 70 mm or more in the cylinder block and assemble the oil pan against the guide.
- (4) Tighten oil pan fitting bolts in the order 1 - 2 - 3 - 4 with an impact wrench.

Tightening Torque:

19.7-24.5 N·m {200-250 kgf·cm, 15-18 lbf·ft}

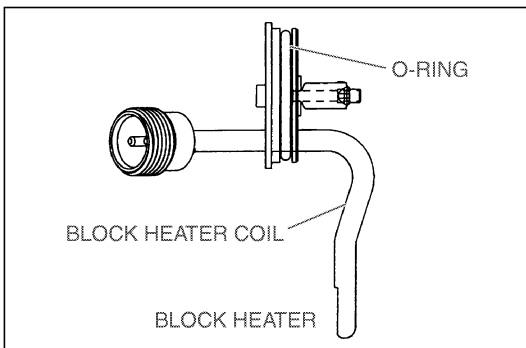
- (5) Finish tightening the bolts with a torque wrench to the specified torque. Tighten the bolts according to the arrow in the figure.

Tightening Torque:

30 N·m {300 kgf·cm, 22 lbf·ft}

NOTICE

Make sure that the washer is not on the flange.



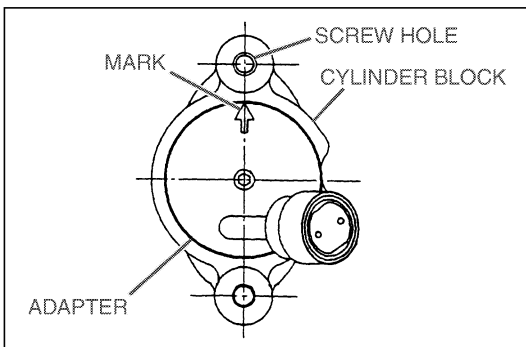
SAPH011030200160

14. INSTALL THE BLOCK HEATER

- (1) Apply silicone spray to O-ring. (LPS Laboratories: Parts No.01516 or equivalent.)

NOTICE

If O-ring is not applied, it could damage and allow water to leak.

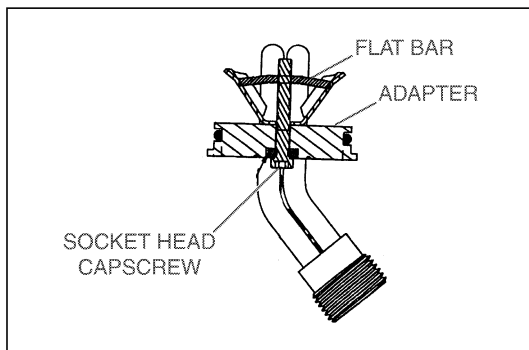


SAPH011030200161

- (2) When installing the block heater, match the arrow mark of a block heater to with upper part screw hole.

NOTICE

- **Do not damage the adapter installation hole, otherwise water will leak.**
- **If the marks don't match, the heater coil will touch the cylinder block.**



SAPH011030200162

- (3) Tighten the socket head capscrew.

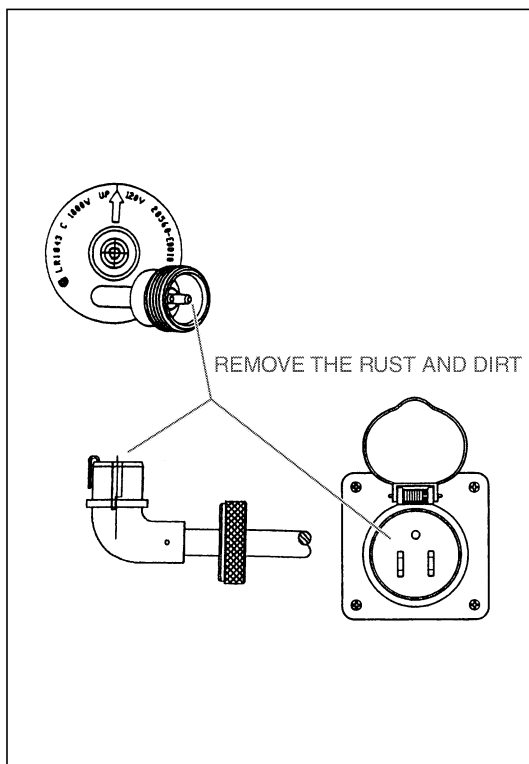
Tightening Torque:

2.3-3.3 N·m {23-33 kgf·cm, 1.7-2.3 lbf·ft}

NOTICE

Do not overtighten. If overtightened, the flat bar could come off the socket head capscrew and drop into the water jacket. This could cause the engine to over heat due to cooling system damage.

- (4) Install the harness by tightening the cord nut fully by hand only.



SAPH011030200163

- (5) Handling precaution

NOTICE

- Before using it, remove all the rust and dirt. Any rust and water attached to the terminal can trip the breaker.
- First, put the harness in the socket of the chassis side and turn on power (120 V)

CAUTION

Make sure to disconnect the power source plug outlet before starting the engine.

Starting the engine without disconnecting it can cause the breakdown of the block heater.

15. REFILL THE HINO LONG LIFE COOLANT

(1) Concentration of Hino long life coolant.

- The freezing point of the coolant varies with the concentration of anti-freeze. Select the appropriate concentration to protect against freezing according to the following table.

NOTICE

If water to coolant ratio is not mixed according to the following table the engine will overheat and block heater coil will melt.

LLC-Water Mixing Table											
	Freezing protection		Freezing temperature		LLC				Water		
	°F	°C	°F	°C		US Qt	Liter	%	%	US Qt	Liter
J05D engine	-27	-33	-36	-37.6	MT	10.6	10	50	50	10.6	10
					AT	10.3	9.75			10.3	9.75
*AT=Available with automatic transmission MT=Available with manual transmission											

NOTICE

Do not mix more than 60% or less than 50% LLC.

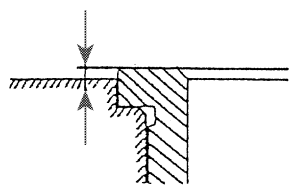
Concentrations more than 63% result in a loss of freezing protection.

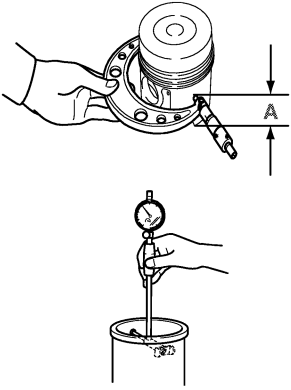
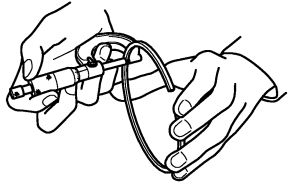
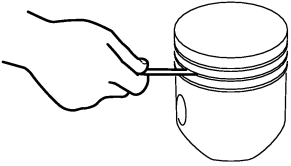
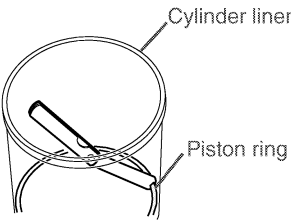
Concentrations below 50% result in a loss of corrosion protection.

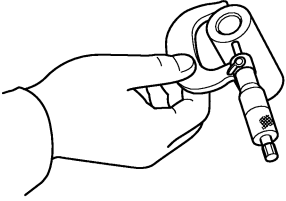
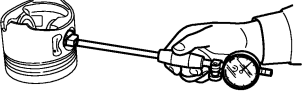
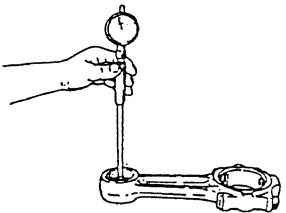
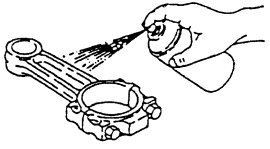
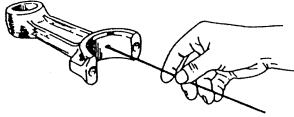
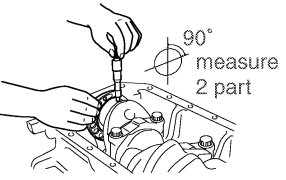
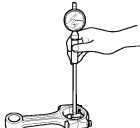
INSPECTION AND REPAIR

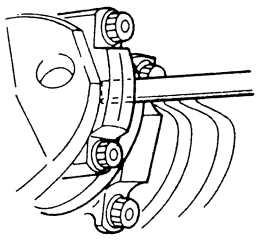
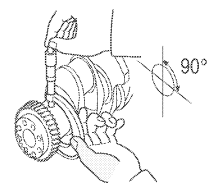
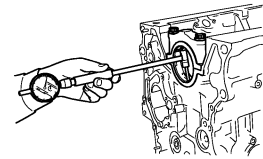
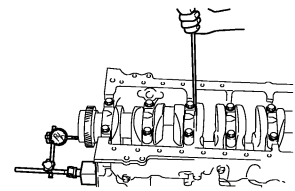
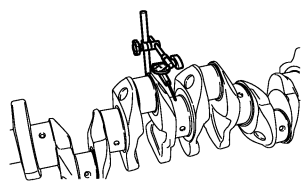
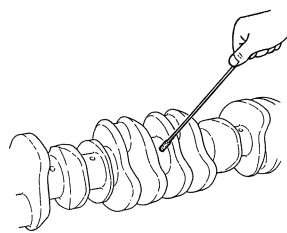
EN0110302H300004

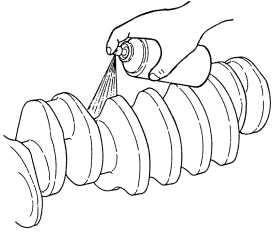
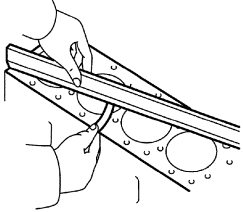
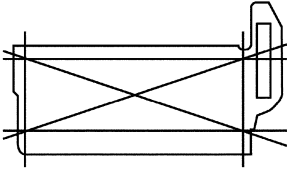
Unit: mm {in.}

Inspection item		Standard	Limit	Remedy	Inspection procedure
Cylinder block flange depth		8{0.3150}	—	—	Measure 
Cylinder liner thickness		8{0.3150}	—	—	
Cylinder liner protrusion		0.01-0.08 {0.0004-0.0031}	—	—	
Block inside diameter	A	117-117.008 {4.6063-4.6066}	—	—	Reference only
	B	117.008-117.014 {4.6067-4.6068}			
	C	117.014-117.022 {4.6069-4.6071}			
Liner outside diameter	A	116.982-116.990 {4.6056-4.6058}	—	—	Reference only
	B	116.990-116.996 {4.6059-4.6061}			
	C	116.996-117.004 {4.6062-4.6064}			

Inspection item		Standard	Limit	Remedy	Inspection procedure
Clearance between block and liner	A	0.010-0.026 {0.0004-0.0010}	—	—	Reference only
	B	0.012-0.024 {0.0005-0.0009}			
	C	0.010-0.026 {0.0004-0.0010}			
Piston outside diameter at A:17{0.6693}		111.927 - 111.943 {4.4066 - 4.4072}	—	Replace piston and/or liner.	
Liner inside diameter (Apply the value obtained at the most worn point to the cylinder liner inside diameter.)		112 {4.409}	112.15 {4.415}		
Clearance between piston and cylinder liner		0.057 - 0.073 {0.0022 - 0.0029}	—		
Piston ring width	Top	2.948 {0.1161}	Taper	Replace ring.	
	Second	1.970 - 1.990 {0.0776 - 0.0783}	1.9 {0.0748}		
	Oil	3.970 - 3.990 {0.1563 - 0.1570}	3.9 {0.1535}		
Piston groove width	Top	Taper	Taper	Replace piston.	
	Second	2.055 - 2.075 {0.0809 - 0.0817}	2.2 {0.0866}		
	Oil	4.015 - 4.035 {0.1581 - 0.1588}	4.1 {0.1614}		
Clearance between piston ring and piston ring groove	Top	—	—	—	—
	Second	0.065-0.105 {0.0026-0.0041}			
	Oil	0.025-0.065 {0.0010-0.0025}			
Gap between ends of piston ring	Top	0.30-0.40 {0.0119-0.0157}	1.5 {0.0591}	Replace piston ring.	
	Second	0.75-0.90 {0.0296-0.0354}	1.2 {0.0472}		
	Oil	0.15-0.30 {0.0059-0.0118}	1.2 {0.0472}		

Inspection item	Standard	Limit	Remedy	Inspection procedure
Piston pin outside diameter	37 {1.4567}	36.96 {1.4551}	Replace piston pin.	Measure 
Piston pin bore inside diameter	37 {1.4567}	37.05 {1.4586}	Replace piston.	
Clearance between piston pin and piston pin bore	-0.011-0.032 {-0.00043-0.00126}	0.05 {0.0020}	Replace piston and/or piston pin.	
Connecting rod bushing inside diameter	37 {1.4567}	37.1 {1.4606}	Replace connecting rod bushing.	Measure 
Clearance between piston pin and connecting rod bushing	0.015-0.036 {0.0006-0.0014}	0.08 {0.0031}	Replace piston pin and/or connecting rod bushing	—
Wear or damage of connecting rod *Dye penetrant check (Color check)	—	—	Replace.	Visual check 
Clogging of connecting rod oil hole	—	—	Replace.	Visual check 
Crank pin outside diameter	65 {2.559}	More than 0.2 {0.0079} (Repair)	Regrind under size.	Measure 
		64.3 {2.5314} (Service)	Replace crankshaft.	
Clearance between connecting rod bearing and crankpin	0.031-0.082 {0.0013-0.0032}	0.2 {0.0079}	Replace connecting rod bearing.	

Inspection item	Standard	Limit	Remedy	Inspection procedure
Connecting rod large end width	34 {1.339}	33.2 {1.3071}	Replace connecting rod.	Measure 
Crankpin width	34 {1.339}	34.8 {1.371}	Replace crankshaft.	
Connecting rod end play	0.20-0.52 {0.0079-0.0204}	1.0 {0.0394}	Replace connecting rod and/or crankshaft.	
Crank journal outside diameter	80 {3.150}	More than 0.2 {0.0079} (Repair)	Regrind under size.	Measure 
		79.3 {3.1220} (Service)	Replace crankshaft.	
Clearance between crank journal and main bearing	0.051-0.102 {0.0021-0.0040}	0.2 {0.0079}	Replace main bearing.	
Center journal width	36 {1.417}	37 {1.456}	Replace crankshaft.	Measure 
Thrust bearing thickness	2.5 {0.0984}	—	—	
Crankshaft end play	0.050-0.270 {0.0020-0.0106}	More than 0.5 {0.0197} (Repair)	Replace over size thrust bearing.	
		1.270 {0.0499} (Service)	Replace crankshaft.	
Crankshaft deflection	—	0.15 {0.0059}	Regrind under size.	Measure 
Clogging of crankshaft oil hole	—	—	Clean.	Visual check 

Inspection item	Standard	Limit	Remedy	Inspection procedure
Crack and wear of crankshaft *Dye penetrant check (Color check)	—	—	Replace.	Visual check 
Cylinder block upper surface flatness	Longitudinal direction: 0.06 {0.0024} Right angle direction: 0.03 {0.0012} or less	0.20 {0.0078}	Replace. NOTICE: Do not grind for repair.	Measure  

AIR INTAKE SYSTEM (J05D)

EN03-001

AIR INTAKE MANIFOLD AND PIPE EN03-2

COMPONENT LOCATOR..... EN03-2

DISMOUNTING AND MOUNTING EN03-3

AIR INTAKE EN03-4

COMPONENT LOCATOR..... EN03-4

AIR CLEANER EN03-5

DESCRIPTION EN03-5

OVERHAUL EN03-6

AIR HOSE EN03-7

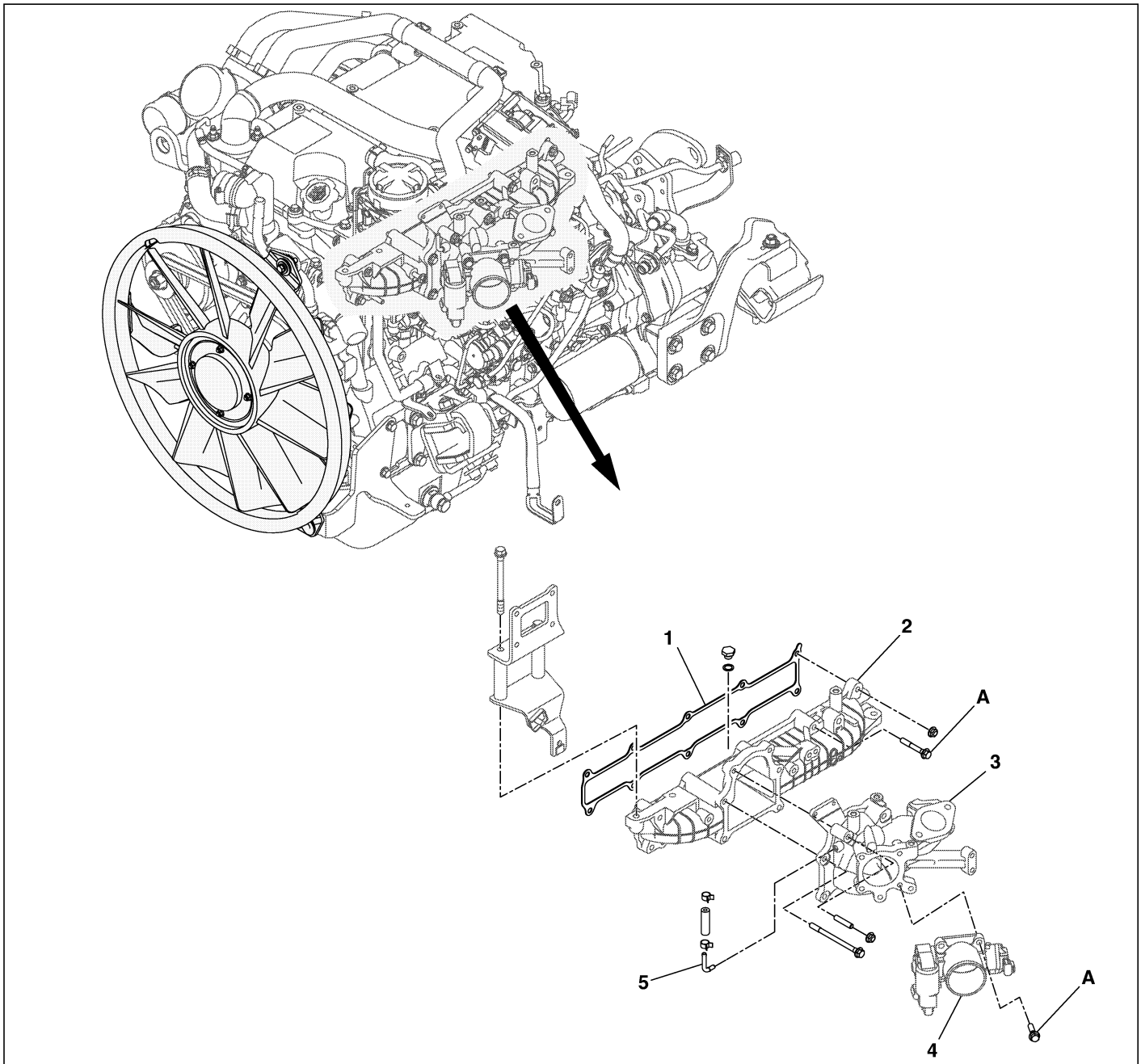
COMPONENT LOCATOR..... EN03-7

OVERHAUL EN03-8

AIR INTAKE MANIFOLD AND PIPE

COMPONENT LOCATOR

EN0110303D100001



SAPH011030300011

- 1 Intake manifold gasket
- 2 Intake manifold
- 3 Intake pipe

- 4 Diesel throttle valve
- 5 Boost compensator pipe

Tightening torque

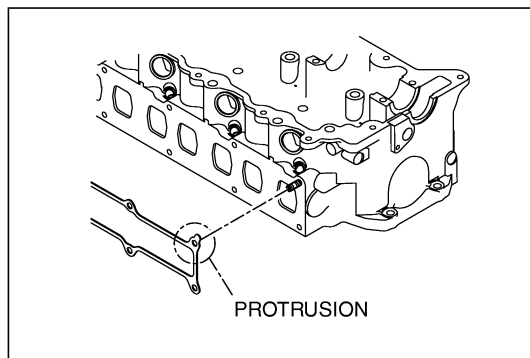
Unit: N·m {kgf·cm, lbf·ft}

A	28.5 {290, 21}
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DISMOUNTING AND MOUNTING

EN0110303H100001

IMPORTANT POINT - MOUNTING



SAPH011030300002

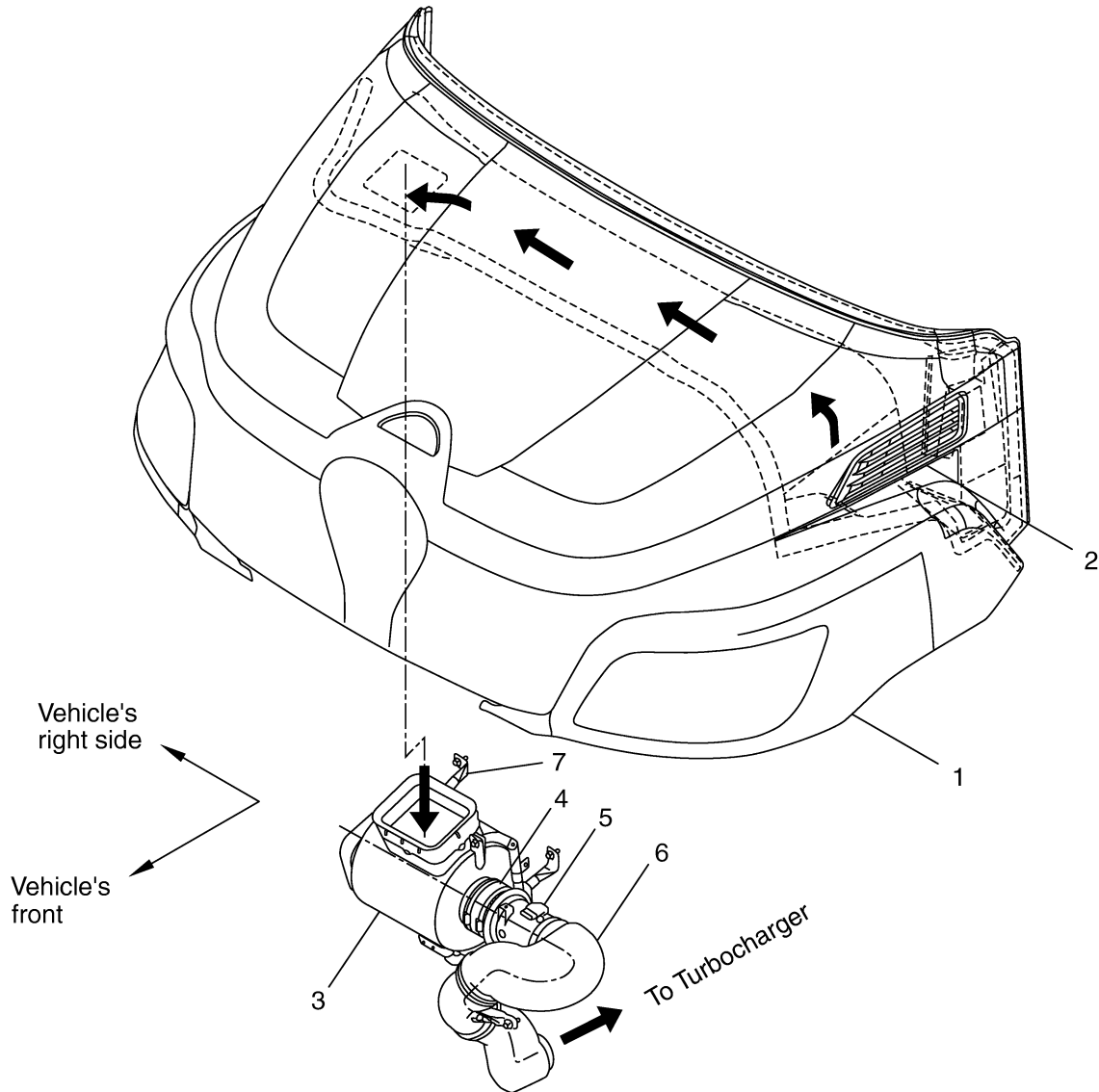
- 1. INSTALL THE INTAKE MANIFOLD GASKET.**
 - (1) Install the intake manifold gasket so that the protrusion is positioned at the stud bolt side of the cylinder head rear end.

AIR INTAKE

COMPONENT LOCATOR

EN0110303D100002

EXAMPLE



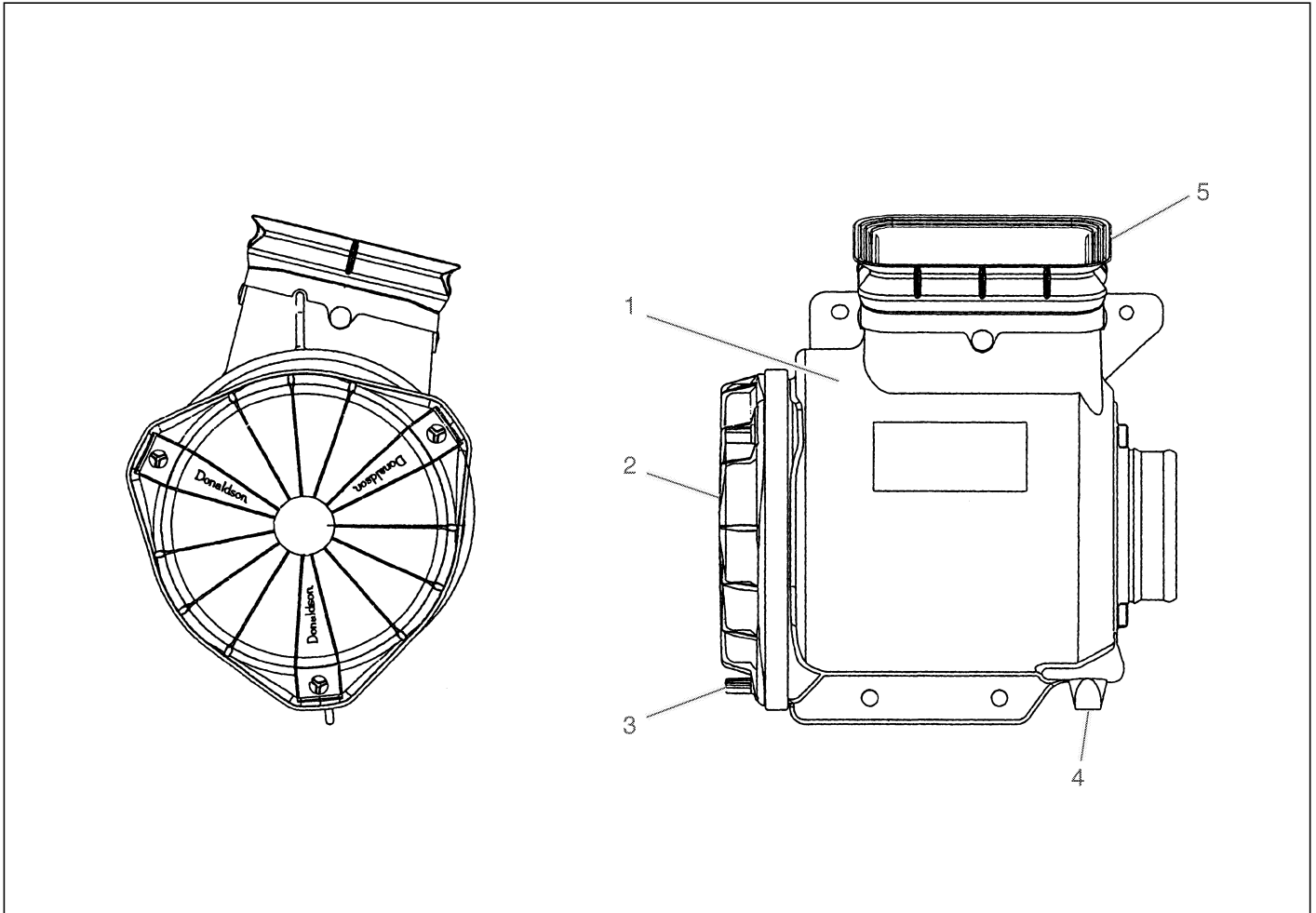
SAPH011030300003

1	Hood	5	Intake pipe
2	Air intake grille	6	Air hose
3	Air cleaner	7	Air cleaner bracket
4	Air hose		

AIR CLEANER

DESCRIPTION

EN0110303D10003



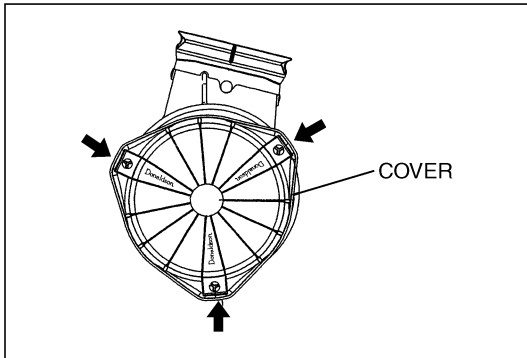
SAPH011030300004

1	Body assembly
2	Cover
3	Thumb screw

4	Unloader valve
5	Adapter

OVERHAUL

EN0110303H100002



SAPH011030300005

IMPORTANT POINTS - DISMOUNTING

1. REMOVE THE AIR CLEANER ELEMENT

- (1) Remove the thumb screw as shown in the figure and remove the cover.
- (2) Hold the outer projection end of the element and turn slightly, then detach the element.

⚠ CAUTION

- Never clean the element filter.
- When the element filter is subjected to blowing with compressed air, is washed, hit, or dropped, the filter function will be impaired and engine damage can be caused.

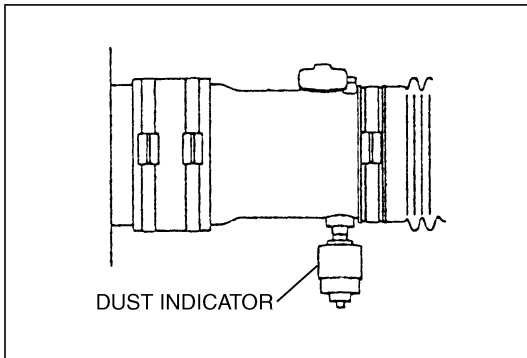
IMPORTANT POINTS - MOUNTING

1. INSTALL THE AIR CLEANER ELEMENT

- (1) Install in the reverse order of removing.

NOTICE

Ensure the cover over the thumb screw is properly affixed.

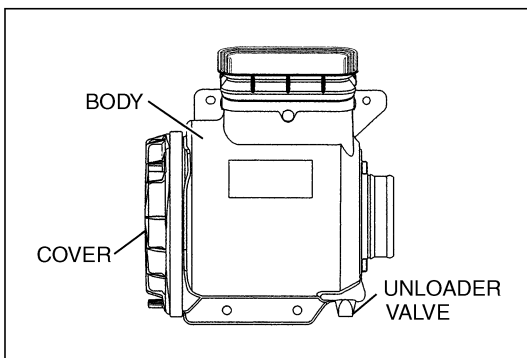


SAPH011030300006

IMPORTANT POINTS - INSPECTION

1. INSPECTING

- (1) If on inspection the dust indicator is red, replace it.



SAPH011030300007

- (2) If the cover, case or unloader valve is damaged, replace the part.
- (3) Check the element to see if it is flattened or deformed, or whether the filter paper of the element is torn.
- (4) Check to see if the sealing of the gasket is complete.

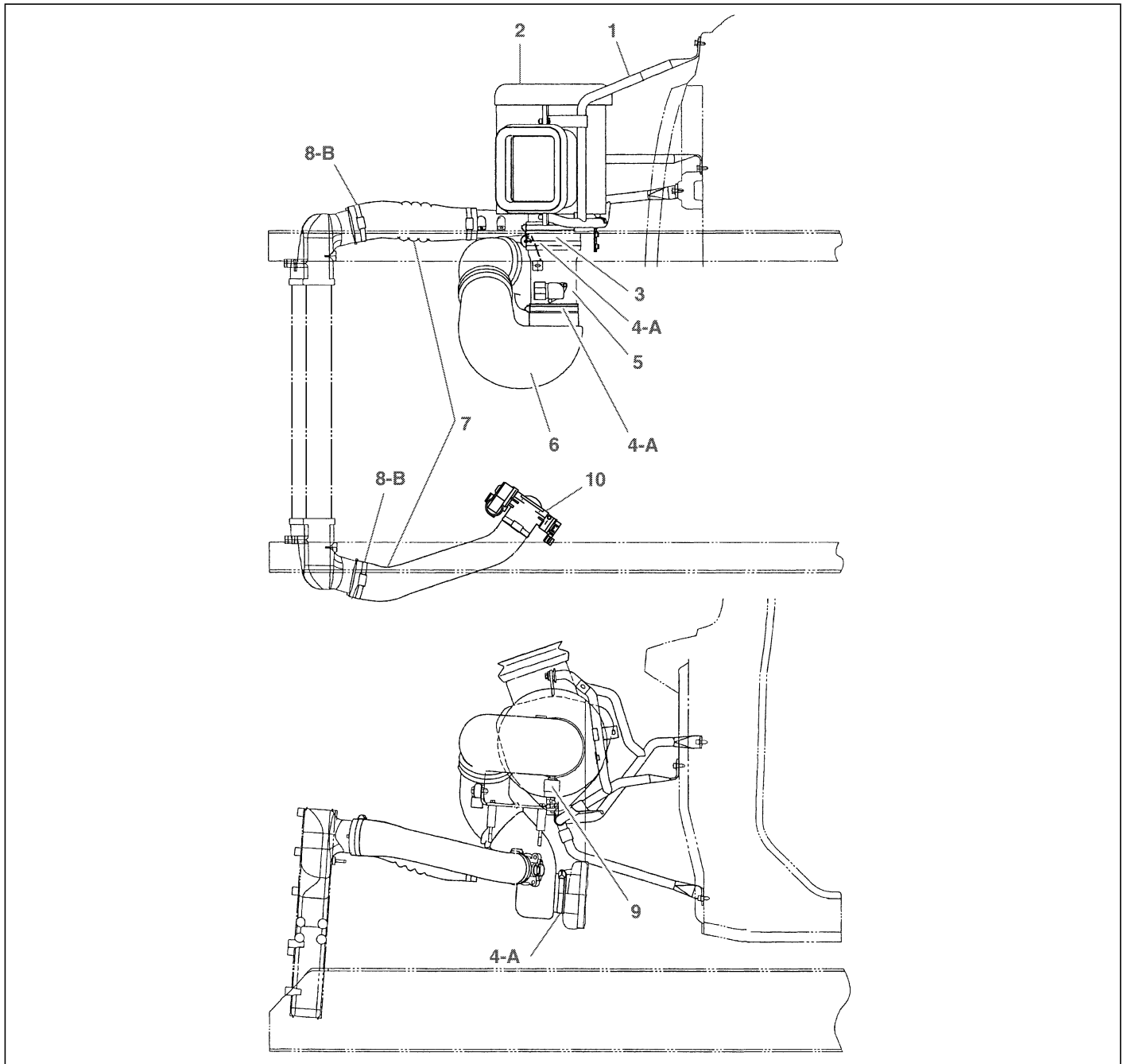
⚠ CAUTION

If an abnormality is found during the above inspection, replace the element with a new one. If dust is taken into the engine, the engine will wear and its performance will deteriorate.

AIR HOSE

COMPONENT LOCATOR

EN0110303D100004



SAPH011030300008

1	Air cleaner bracket	6	Air hose
2	Air cleaner	7	Air hose (intercooler)
3	Air hose	8	Clamp (B)
4	Clamp (A)	9	Dust indicator
5	Intake pipe	10	Diesel throttle valve

Tightening torque

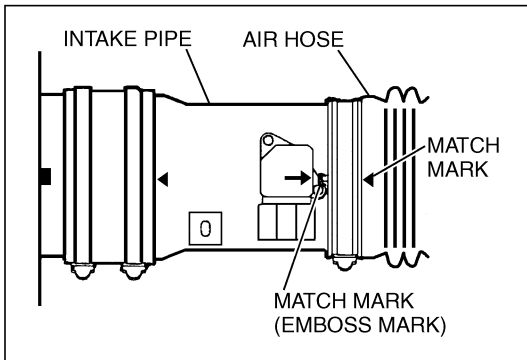
Unit: N·m {kgf·cm, lbf·ft}

A	4.5-5.5 {46-56, 3.326-4.049}	B	5.4-6.6 {55-67, 3.976-4.844}
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OVERHAUL

EN0110303H100003

IMPORTANT POINTS - MOUNTING



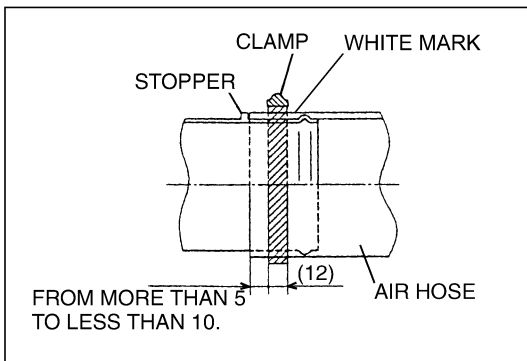
SAPH011030300009

1. INSTALL THE AIR HOSE

- (1) Location of the rotation direction of the intake pipe and the air hose should match emboss mark as shown in the figure.
- (2) Tighten the clamp.

Tightening Torque:

4.5-5.5 N·m {46-56 kgf·cm, 3.326-4.049 lbf·ft}



SAPH011030300010

2. INSTALL THE AIR HOSE (INTERCOOLER)

- (1) Install the air hose against the stopper as shown in the figure.
- (2) Match the white mark of the air hose and match mark (stopper) of the intercooler.
- (3) Tighten the clamp at the white paint portion as shown in the figure.

Tightening Torque:

5.4-6.6 N·m {55-67 kgf·cm, 3.976-4.844 lbf·ft}

EXHAUST SYSTEM (J05D)

EN04-001

EXHAUST MANIFOLD AND PIPE..... EN04-2

COMPONENT LOCATOR..... EN04-2
DISMOUNTING AND MOUNTING EN04-3

EXHAUST PIPE AND DPR-CLEANER..... EN04-4

DESCRIPTION EN04-4
COMPONENT LOCATOR..... EN04-5
OVERHAUL EN04-6

DPR(DIESEL PARTICULATE REDUCTION SYSTEM)..... EN04-9

SYSTEM CONFIGURATION EN04-9
STRUCTURE OF DPR-CLEANER EN04-10
DPR MAINTENANCE EN04-11
DPR INSPECTION EN04-11
INSPECTION PROCEDURE FOLLOWED WHEN "DPR MAINTENANCE" IS DISPLAYED ON THE INFORMATION DISPLAY EN04-12
INSPECTION BY WAY OF HINO-DX EN04-13
INSPECTION PROCEDURE FOLLOWED WHEN CHECK ENGINE LAMP ILLUMINATES (ABNORMAL) EN04-16
DETERMINATION BY WAY OF DPR STATE DETERMINATION MONITOR OF HINO-DX EN04-19
CHECKING THE DPR STATE EN04-19
REPLACEMENT OF DPR FILTER EN04-19
CLEANING OF DPR FILTER..... EN04-20

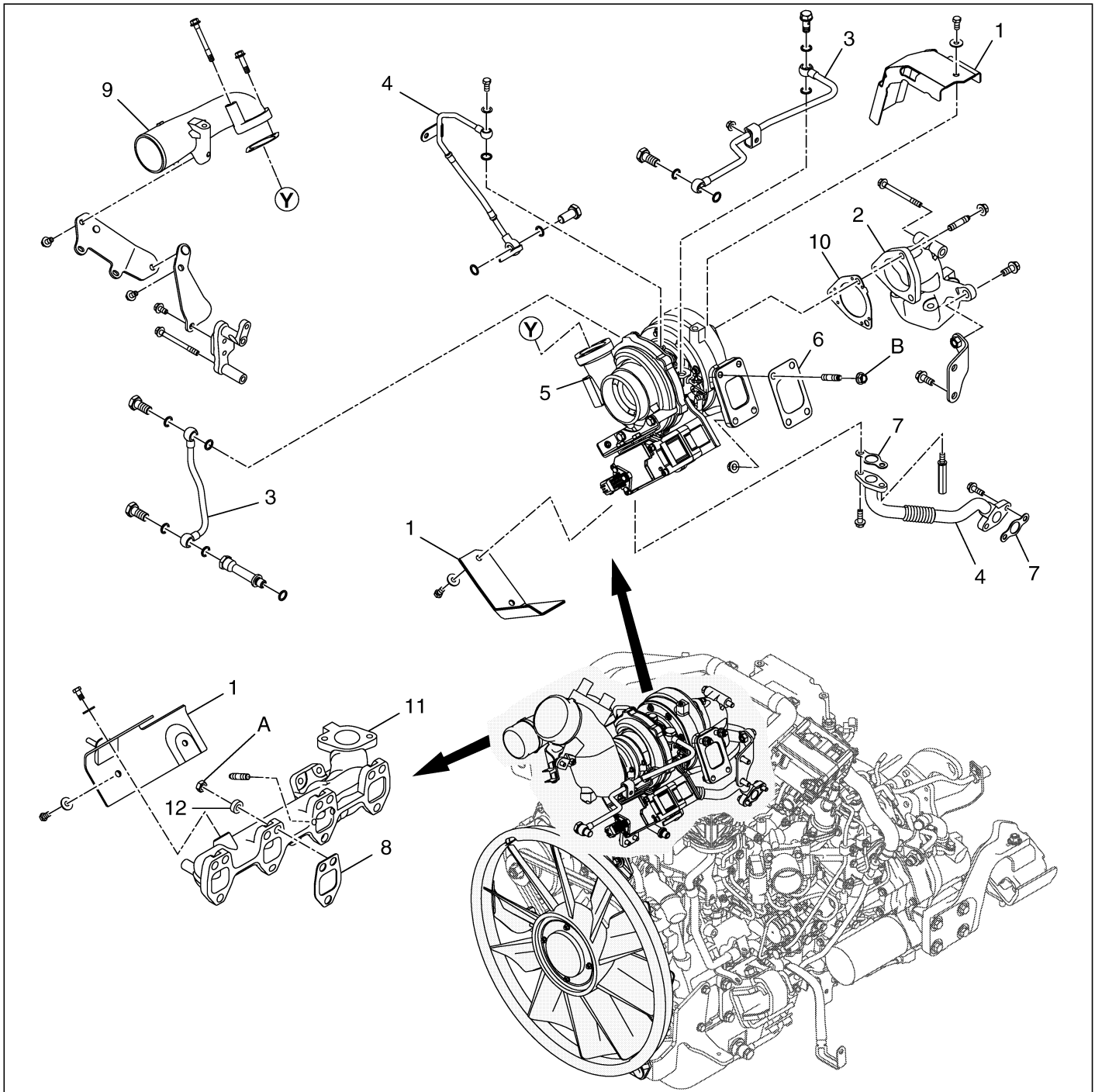
EXHAUST CONTROL VALVE..... EN04-21

SYSTEM CONFIGURATION EN04-21
PROCEDURE FOR CHECKING/ADJUSTING THE EXHAUST CONTROL VALVE OPENING EN04-22
DPR INSPECTION CHECK SHEET EN04-24

EXHAUST MANIFOLD AND PIPE

COMPONENT LOCATOR

EN0110304D100001



SAPH011030400001

1	Heat insulator	7	Gasket
2	Exhaust connector	8	Gasket
3	Coolant pipe	9	Intake pipe
4	Oil pipe	10	Gasket
5	Turbocharger	11	Exhaust manifold
6	Gasket	12	Spacer

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

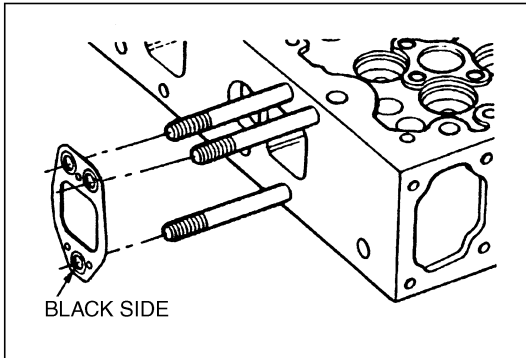
A 53 {540, 39}

B 56 {570, 41}

DISMOUNTING AND MOUNTING

EN0110304H100001

IMPORTANT POINT - MOUNTING



SAPH011030400002

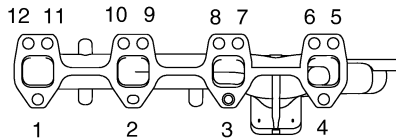
1. INSTALL THE EXHAUST MANIFOLD GASKET.

NOTICE

Since the exhaust manifold gasket must be installed in one way, install the gasket with the black side facing toward the exhaust manifold.

2. INSTALL THE EXHAUST MANIFOLD.

TIGHTENING ORDER NEW MANIFOLD



- (1) Install the exhaust manifold onto the cylinder head and tighten the mounting nut in the order shown in the figure to the specified torque.

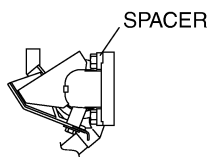
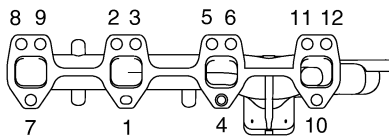
Tightening Torque:**53 N·m {540 kgf·cm, 39 lbf·ft}**

- (2) Retighten the same nuts according to the same procedure again.

NOTICE

Be sure to carry out the procedure.

TIGHTENING ORDER REUSED MANIFOLD

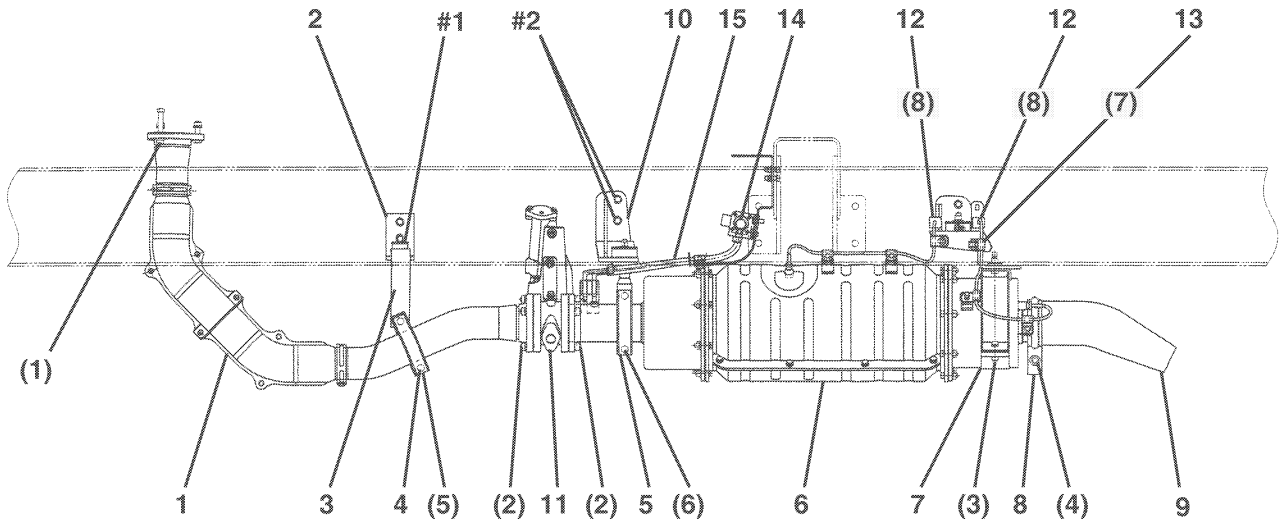


SAPH011030400003

EXHAUST PIPE AND DPR-CLEANER

DESCRIPTION

EN0110304H200001



HINT

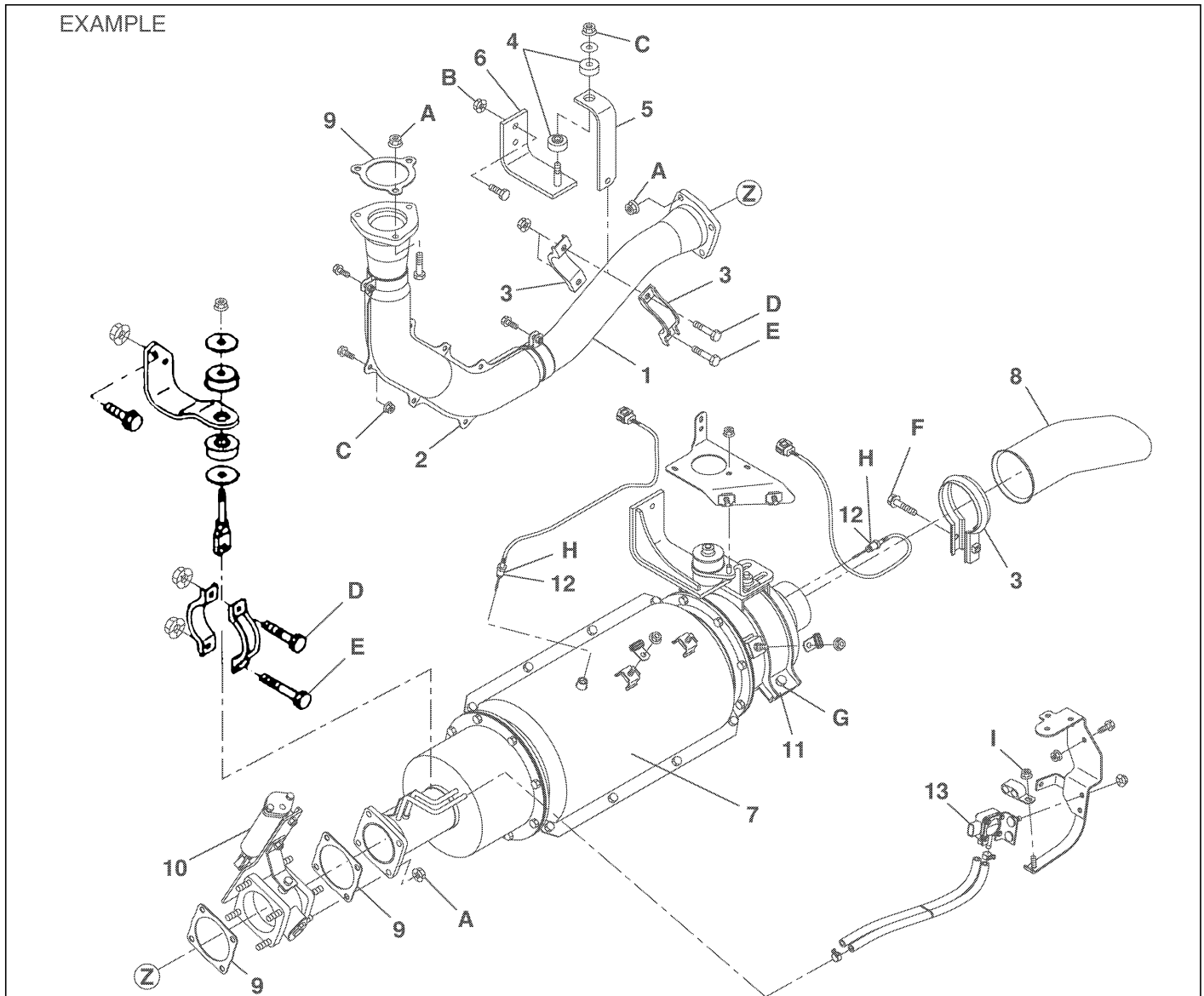
Numbers such as (1) and #1 in this figure correspond with ones in the section of "OVERHAUL".

SAPH011030400004

1	Exhaust pipe	9	Tail pipe
2	Exhaust pipe bracket	10	DPR-cleaner bracket
3	Exhaust pipe support	11	Exhaust control valve
4	Exhaust pipe clamp	12	Exhaust gas temperature sensor connector
5	DPR-cleaner clamp	13	Exhaust gas temperature sensor clip
6	DPR-cleaner	14	DPR-backpressure sensor
7	DPR-cleaner support	15	DPR-backpressure sensor hose
8	Tail pipe clamp		

COMPONENT LOCATOR

EN0110304D100002



SAPH011030400005

1	Exhaust pipe	8	Tail pipe
2	Insulator	9	Gasket#
3	Clamp	10	Exhaust control cylinder
4	Cushion	11	DPR-cleaner support clamp
5	Support	12	Exhaust gas temperature sensor
6	Bracket	13	DPR-backpressure sensor
7	DPR-cleaner		

#: This part cannot be reused.

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A	56 - 84 {572 - 857, 42 - 61}	F	27 - 33 {275 - 335, 20 - 24}
B	46 - 56 {470 - 570, 34 - 40}	G	34 - 44 {347 - 448, 25 - 32}
C	23.5 - 29.5 {240 - 300, 18 - 21}	H	25 - 35 {255 - 357, 19 - 26}
D	46 - 56 {470 - 570, 34 - 40}	I	20 - 24 {205 - 245, 15 - 17}
E	26.5 - 32.5 {270 - 330, 20 - 24}		

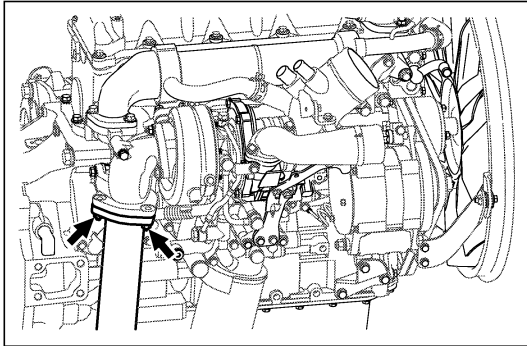
OVERHAUL

EN0110304H200002

IMPORTANT POINT - DISMOUNTING

⚠ WARNING

Do not touch the exhaust manifold when it could be hot. You can be severely burned.



SAPH011030400006

1. REMOVE THE EXHAUST PIPE FROM THE EXHAUST MANIFOLD.
2. REMOVE THE EXHAUST SYSTEM COMPONENTS.
 - (1) Referring to the section of "DESCRIPTION", remove the tightening sections (1)-(7) and (8) temperature sensor connector of the exhaust system components, then remove the exhaust pipe and DPR-cleaner.
 - (2) Disconnect the DPR-differential pressure hose.

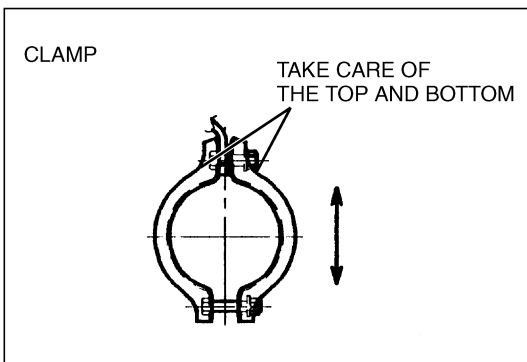
IMPORTANT POINT - MOUNTING

1. INSTALL THE EXHAUST SYSTEM COMPONENTS.

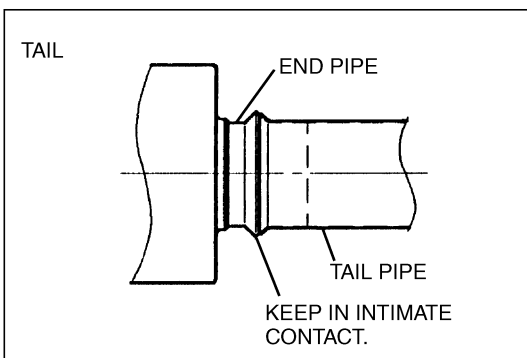
NOTICE

Install the exhaust pipe and DPR-cleaner while taking care of the following points.

- (1) Referring to the section of "DESCRIPTION", temporarily install all tightening sections (1)-(6) of the exhaust system components. If this attempt is unsuccessful, loosen #1 to #2 and make adjustment.
 - a. When installing the parts, check the top and bottom of the clamp.

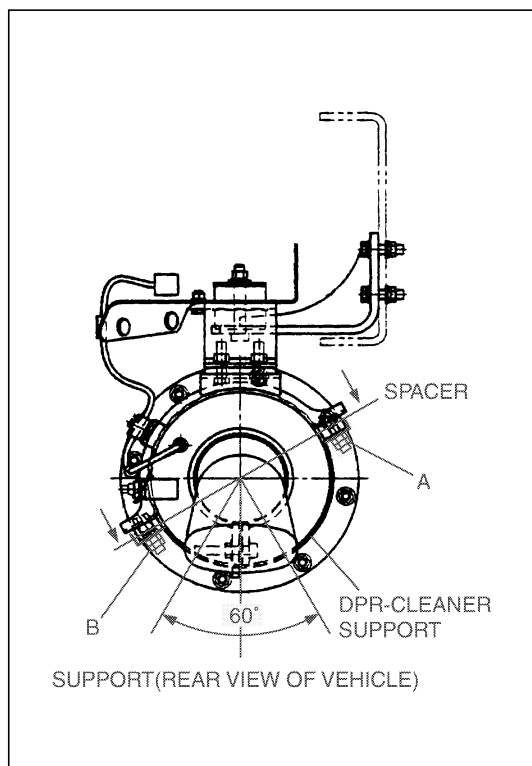


SAPH011030400007



SAPH011030400008

- b. When temporarily installing a tail pipe to the DPR-cleaner, keep the end pipe of the DPR-cleaner and tail pipe in intimate contact.



SAPH011030400009

- (2) Regularly tighten the exhaust system components in the order of "a" to "i".
- Regularly tighten the exhaust pipe into the exhaust pipe connector.

Tightening Torque:

56 - 84 N·m {572 - 857 kgf·cm, 42 - 61 lbf·ft}

NOTICE

- Replace the gasket with new one.
- The mounting portion of the exhaust manifold is subjected to heat and is likely to come loose, so special nuts are employed. Be sure to use the correct nuts.

- Regularly tighten the exhaust control valve into the DPR-cleaner.

Tightening Torque:

56 - 84 N·m {572 - 857 kgf·cm, 42 - 61 lbf·ft}

- Regularly tighten the exhaust control valve into the exhaust pipe.

Tightening Torque:

56 - 84 N·m {572 - 857 kgf·cm, 42 - 61 lbf·ft}

- Regularly tighten the DPR-cleaner support. In this practice, install a spacer to the vehicle exterior point A and perform final tightening in the bolt inserting direction shown by an arrow in the figure, then perform final tightening at the point B.

Tightening Torque:

34 - 44 N·m {350 - 450 kgf·cm, 25.1 - 32.5 lbf·ft} (DPR-cleaner support, points A and B in the figure)

- Regularly tighten the tail pipe clamp.

NOTICE

In this practice, check that the angle of the tail pipe clamp is within the range shown in the figure.

Tightening Torque:

27 - 33 N·m {275 - 335 kgf·cm, 20 - 24 lbf·ft}

- In case #1 in the section of "DESCRIPTION" is loosened, perform final tightening here.

Tightening Torque:

20 - 24 N·m {204 - 244 kgf·cm, 14.7 - 17.7 lbf·ft}

- Regularly tighten the exhaust pipe clamp. In this practice, first tighten the upper bolt of the clamp then tighten the lower bolt.

Tightening Torque:

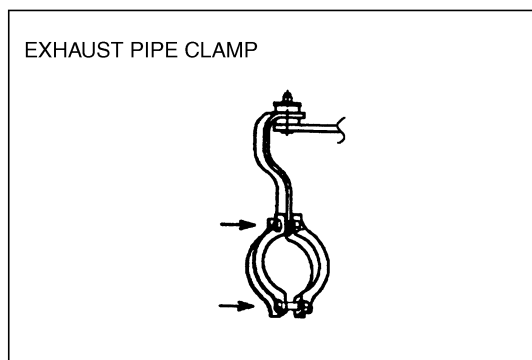
Clamp top: 46 - 56 N·m {470 - 570 kgf·cm, 33.9 - 41.3 lbf·ft}

Clamp bottom: 26.5 - 32.5 N·m {270 - 330 kgf·cm, 20 - 24 lbf·ft}

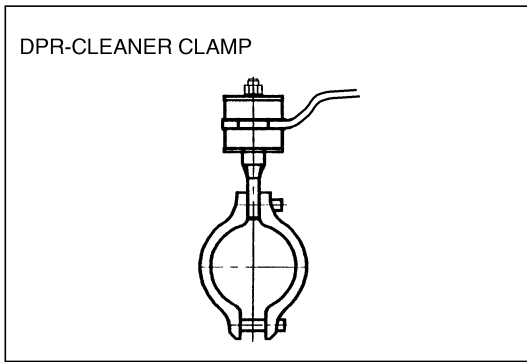
- In case #2 in the section of "DESCRIPTION" is loosened, perform final tightening here.

Tightening Torque:

46 - 56 N·m {470 - 570 kgf·cm, 33.9 - 41.3 lbf·ft}



SAPH011030400010



SAPH011030400011

- i. Regularly tighten the DPR-cleaner clamp. In this practice, first tighten the upper bolt of the clamp then tighten the lower bolt.

Tightening Torque:**Clamp top: 46 - 56 N·m {470 - 570 kgf·cm, 33.9 - 41.3 lbf·ft}****Clamp bottom: 26.5 - 32.5 N·m {270 - 330 kgf·cm, 20 - 24 lbf·ft}**

- j. Install the exhaust gas temperature sensor to the DPR-cleaner.

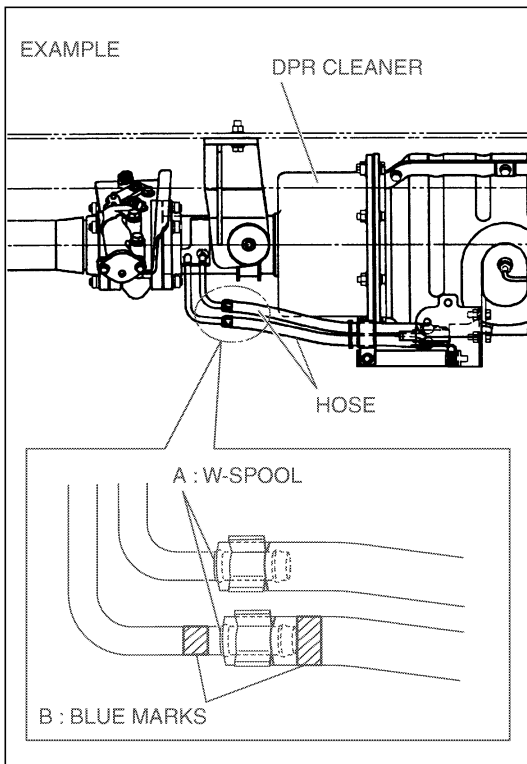
Tightening Torque:**25 - 35 N·m {255 - 357 kgf·cm, 19 - 26 lbf·ft}**

- k. Tighten the exhaust temperature sensor clip. In this practice, fit the white marking of the exhaust temperature sensor with the clip.

Tightening Torque:**20 - 24 N·m {204 - 244 kgf·cm, 14.7 - 17.7 lbf·ft}**

- l. Connect the exhaust temperature sensor connector to the chassis harness.

- (3) Connect the DPR-backpressure sensor hose to the DPR-cleaner as shown in the figure.



SAPH011030400012

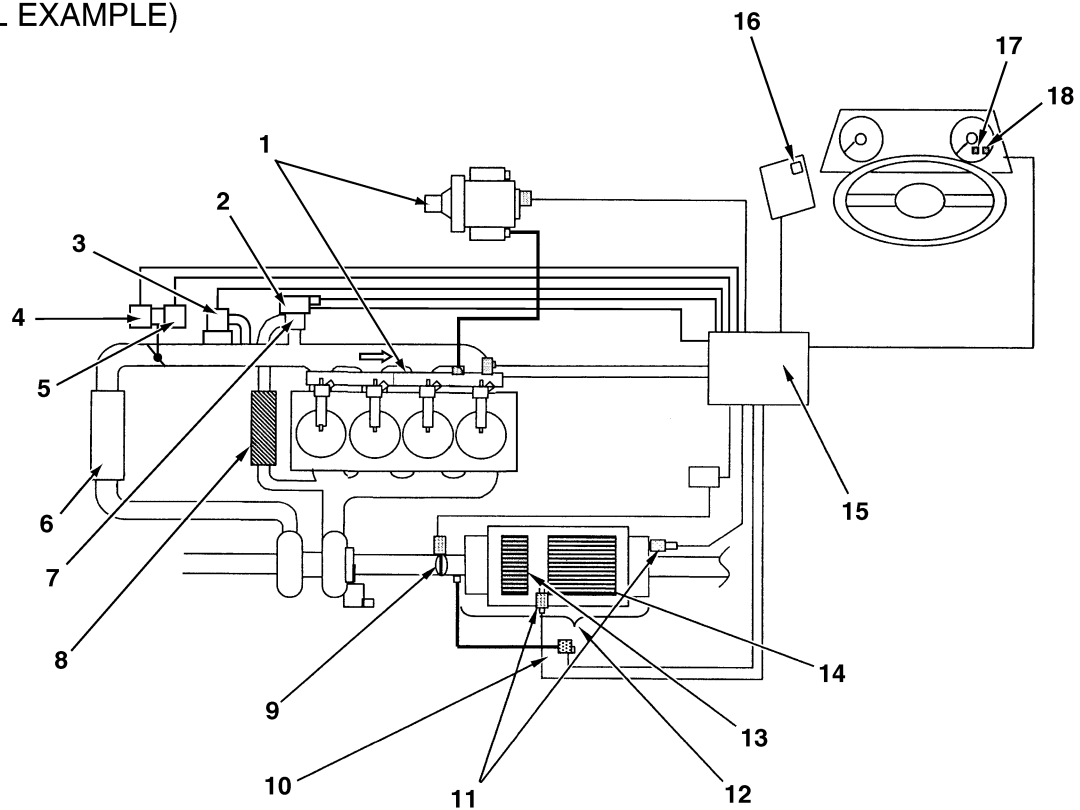
NOTICE**DPR doesn't operate correctly when DPR-backpressure sensor hose is inverted by mistake.****A: Insert the hoses securely until the hoses runs into the spool.****B: Match the blue marks.**

DPR(DIESEL PARTICULATE REDUCTION SYSTEM)

SYSTEM CONFIGURATION

EN0110304D100003

(TYPICAL EXAMPLE)

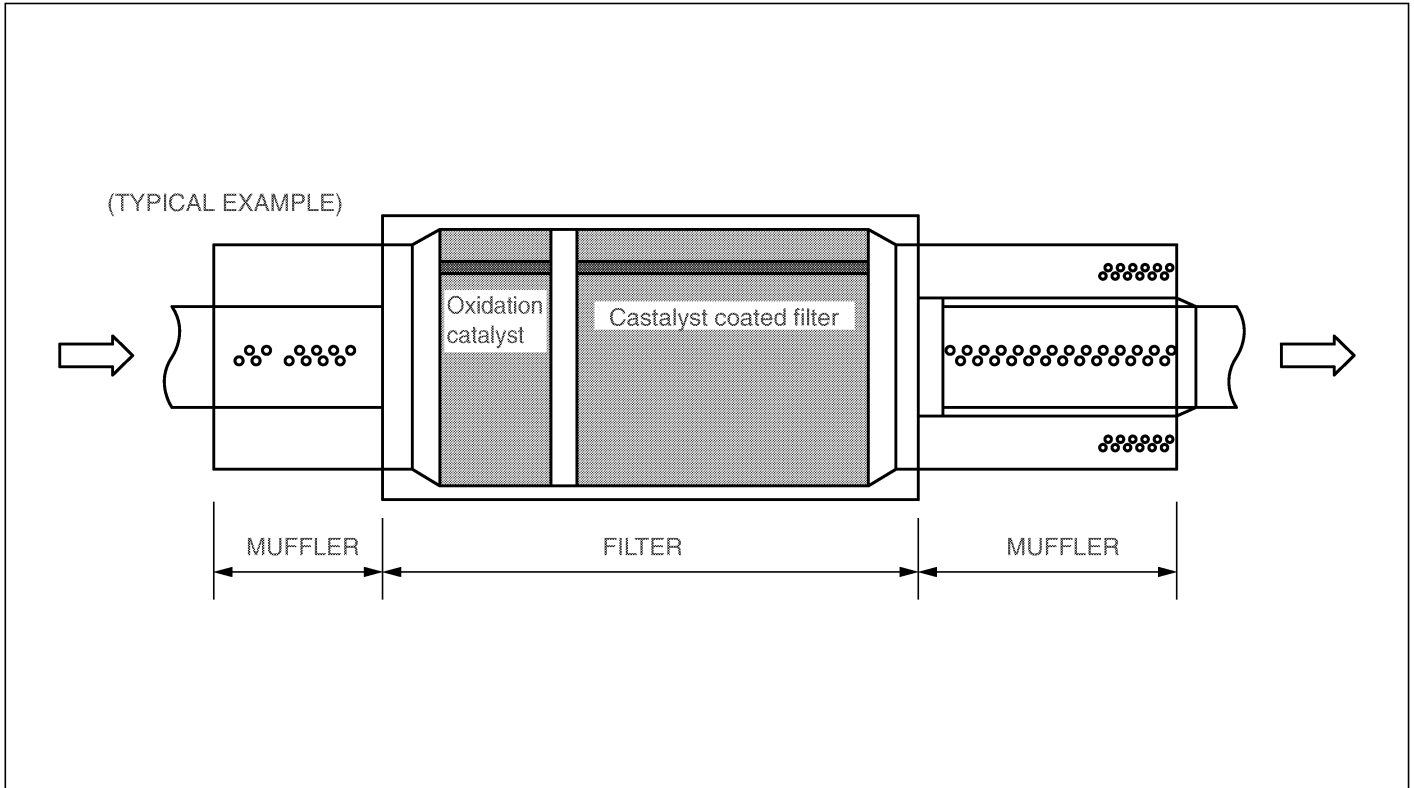


SAPH011030400013

1	Common rail fuel injection system	10	Backpressure sensor
2	EGR valve lift sensor	11	Exhaust temperature sensor
3	Intake air pressure sensor	12	DPR-cleaner
4	Diesel throttle valve	13	Oxidation catalyst
5	Diesel throttle valve aperture sensor	14	Catalyst coated filter
6	Intercooler	15	Engine ECU
7	EGR valve	16	DPR-cleaner switch
8	EGR cooler	17	DPR indicator lamp
9	Exhaust control valve	18	Check engine lamp

STRUCTURE OF DPR-CLEANER

EN0110304D100004



SAPH011030400014

DPR MAINTENANCE

EN0110304H200003

- DPR maintenance is performed every 200,000 miles (320,000 km).
- If "DPR maintenance" is displayed on the information display, DPR maintenance is required.

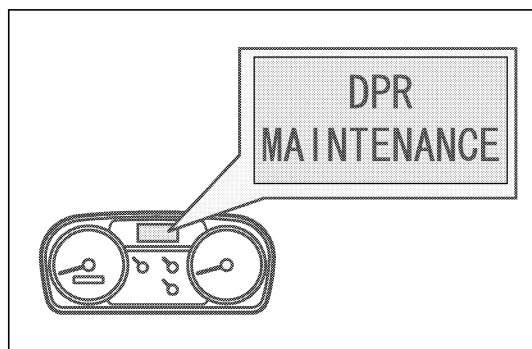
Check the DPR backpressure and determine whether maintenance is required.

If the DPR backpressure value is below the specified value, no maintenance is required.

If the DPR backpressure value exceeds the specified value, clean or replace the filter.

1. NOTIFICATION TO DRIVER

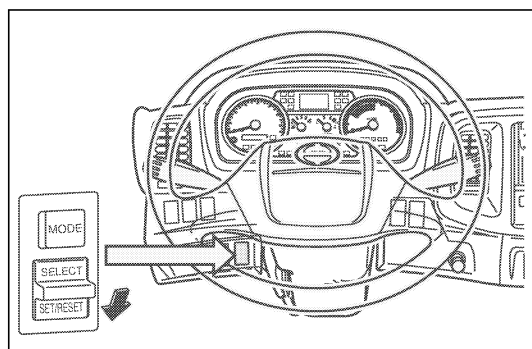
- (1) It informs with the indicator in the information display.
(Content of display "DPR Maintenance").



SAPH011030400015

2. INFORMATION DISPLAY

- (1) Typical interval of DPR maintenance is 200,000 mile.
- (2) Specific maintenance timing is guided by displaying instruction at instrument cluster.
- (3) The display will be cleared by pushing the information display control switch of the instrument cluster for about 20 seconds.



SAPH011030400016

DPR INSPECTION

EN0110304H200004

1. ROUTINE INSPECTION ITEMS

- (1) Check for an abnormal increase in the engine oil in the oil pan.

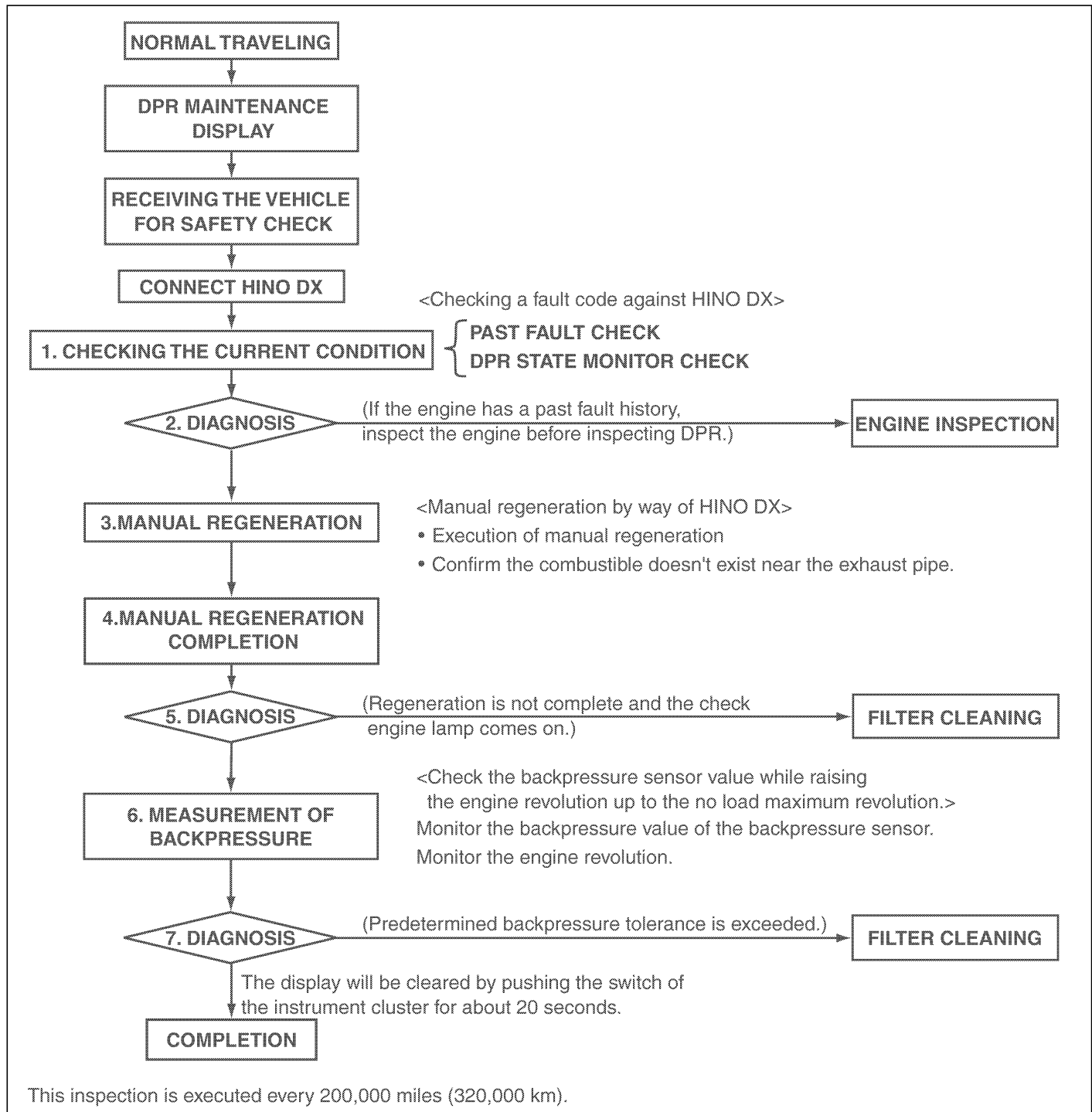
HINT

In case engine oil is abnormally increased, the injection system may be faulty or unburned fuel could have leaked into the oil pan from the gap between the piston ring and the cylinder liner.

- (2) Check the exhaust system tightening portions (exhaust pipe, main unit flange) for looseness or exhaust leakage.
- (3) Check external appearance of the harness of the exhaust temperature sensor for trouble (cracks in coating or missing clip).
- (4) Inspect the hose of the backpressure sensor and check the hose for deterioration or cracks. Replace a hose which has been used for three years or more with a new one.
- (5) Check for a blown indicator lamp or wire break in the DPR-cleaner switch and meter. (Stop the engine, turn ON the starter switch, and press the DPR-cleaner switch. If both the lamp in the switch and indicator lamp in the meter illuminate, the lamps are normal.)

INSPECTION PROCEDURE FOLLOWED WHEN "DPR MAINTENANCE" IS DISPLAYED ON THE INFORMATION DISPLAY

EN0110304H300001



SAPH011030400017

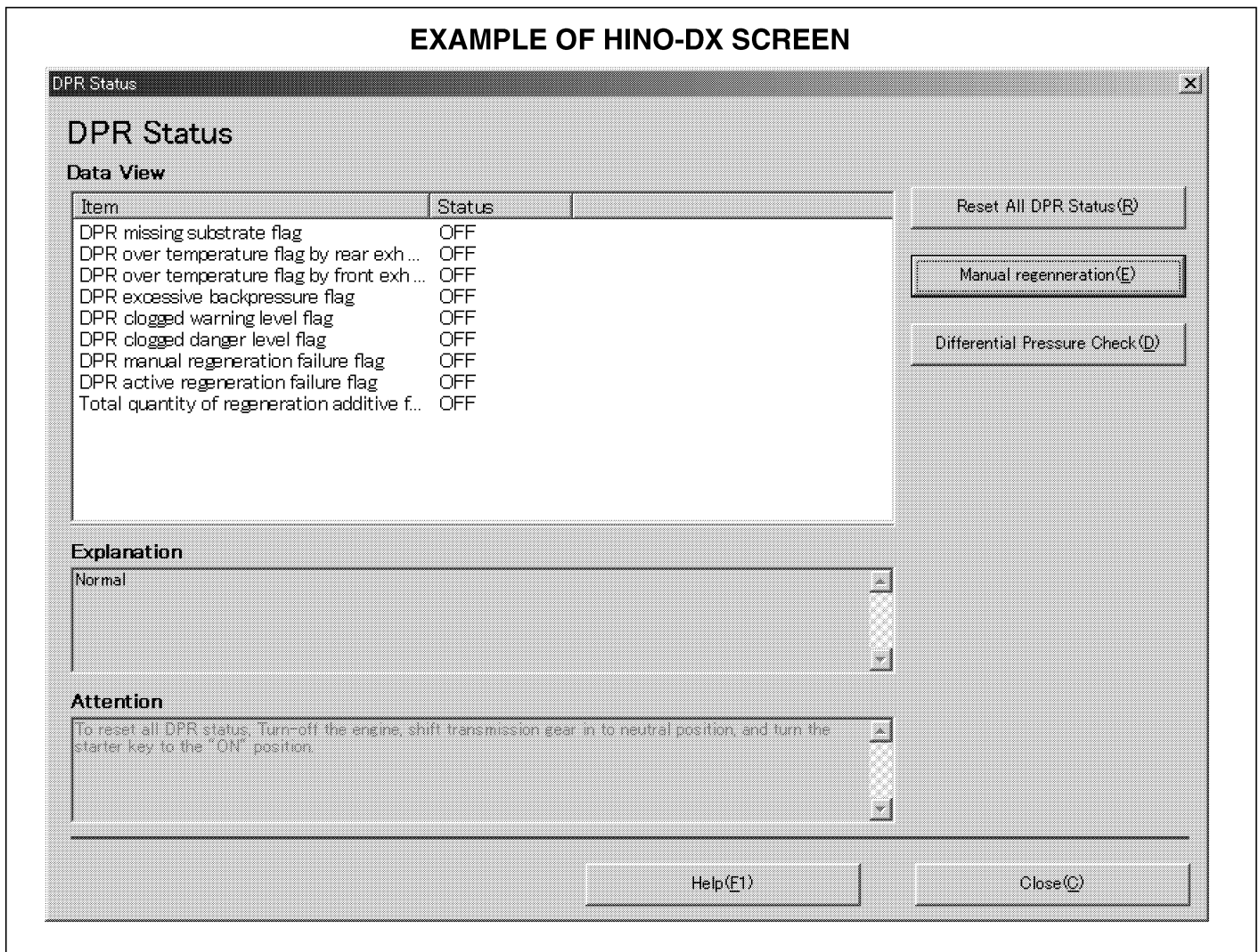
INSPECTION BY WAY OF HINO-DX

EN0110304H200005

1. DPR status check

- (1) Select the "DPR Reset confirmation" in the "Check function" menu of HINO-DX.
- (2) Confirm Data View of the "DPR Status " display (monitor), if the status for all the items are "OFF", DPR functions normally. Then "Manual regeneration" and "DPR backpressure check" can be done.
- (3) In case "ON" is displayed in Data View of the "DPR Status " display (monitor), check according to the procedure on page EN04-17, "DETERMINATION BY WAY OF DPR STATE DETERMINATION MONITOR OF HINO-DX".

EXAMPLE OF HINO-DX SCREEN



SAPH011030400018

2. Manual regeneration

(1) Manual regeneration is done by the "Manual regeneration" screen.

⚠ CAUTION

- **Confirm safety of the surrounding area, then press DPR regeneration switch inside the cabin to execute the regeneration.**
- **Confirm the PTO switch is OFF.**

(2) When the Catalyst Converter deterioration status is ON, wash or replace the filter.

When the status is OFF, DPR functions normally.

EXAMPLE OF HINO-DX SCREEN

Manual regeneration

Data View

Item	Status	Units
Engine speed	0	r/min
Manual regeneration status flag	OFF	
Exhaust Temperature (IN)	0	oC
Exhaust Temperature (OUT)	0	oC
Injection quantity	0.00	mm ³ /st
DPR Backpressure	16777211.0	KPa

Start(E)

1st: Click

Explanation

Confirm safety of the surrounding area, then press DPR regeneration switch inside the cabin to execute the regeneration process.

Attention

Park the vehicle in a secure position. Then idle the engine.

Help(E1) **Close(C)**

2nd: Push manual regeneration switch in cabin

3. DPR backpressure check

- (1) Check the DPR backpressure through the "DPR Status" display.
- (2) Confirm the exhaust gas temperature (in and out) is less than 200°C {392°F}.
- (3) Engine revolution will rise automatically, then record the indicated maximum DPR backpressure.
- (4) In case the central value of the recorded DPR backpressure value exceeds the specific value, clean or replace the filter. Then "Stop" the DPR backpressure check.

Specific value

Engine speed (no load maximum revolution)	Backpressure inspection standard value (kPa {kgf/cm ² , lbf/in. ² })
3,180 r/min.	16.0 {0.163, 2.32}

- (5) When the backpressure is unchanged check the following. If the following are normal, the backpressure sensor should be replaced.
 - a. Confirm backpressure hose for cracks or hole openings.
 - b. Confirm that the hose clamp is neither loose nor disconnected.
 - c. Confirm whether there is clogging in the backpressure pipe (DPR cleaner side).
Use compressed air from one end of the pipe to check for clogging. If the air passes to the other side easily, it is clear.

EXAMPLE OF HINO-DX SCREEN

DPR Backpressure Check

Data View

Item	Status	Units
Engine speed	0	r/min
DPR Backpressure Check	16777211.0	KPa

Start(E)

1st: Click

2nd: A central value is read

Explanation

This function will execute the DPR Backpressure Check. The engine revolution speed will rise to the non-loaded maximum speed once you click on "Start". Please confirm the safety of the surrounding area before engaging. Record the DPR Backpressure value after the Engine Revolution Speed and DPR Backpressure value are stabilized. Engine Revolution Speed will decrease and Backpressure Check will end by clicking on "STOP".

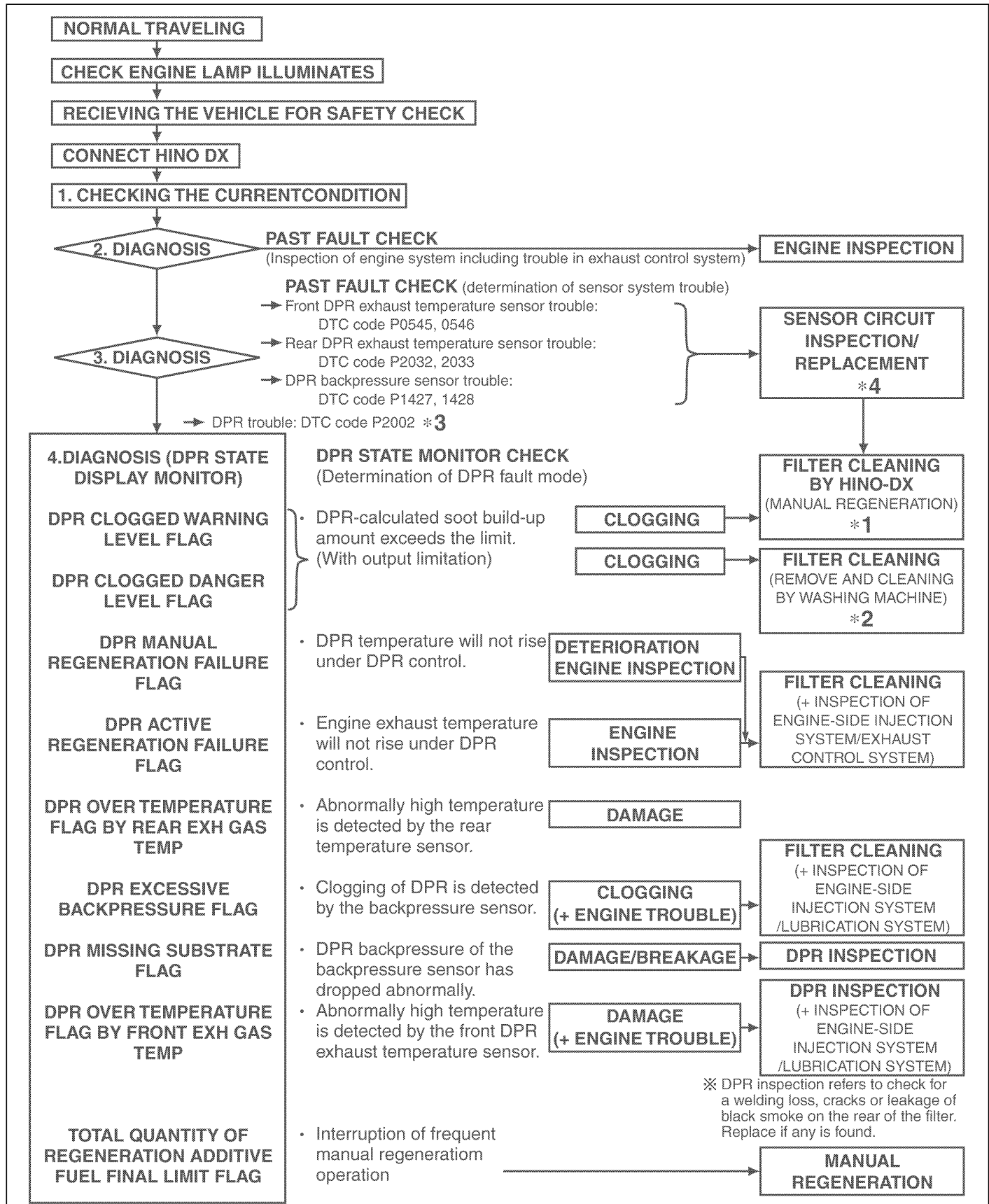
Attention

Park the vehicle in a safe location with the PTO disengaged, the transmission gear in a neutral position, and the engine in idle.

Help(F1) **Close(C)**

INSPECTION PROCEDURE FOLLOWED WHEN CHECK ENGINE LAMP ILLUMINATES (ABNORMAL)

EN0110304H300002



*1 Additional information for inspections with HINO-DX

Light cases of DPR clogging can be treated without removing the housing.

The procedure is shown below.

The "DPR STATUS" can be checked with the HINO-DX, and when only the "DPR clogged warning level flag" is "ON", regeneration processing can be performed with the DPR SW or the tool.

Confirmation method:

Use the HINO-DX, perform System Fix, then open screens in the order of Check function (E) → DPR Reset Confirmation (D) → DPR Status, and confirm that "status" is "ON" for the item "DPR clogged warning level flag" of the DPR Status. Only when this is "ON" can manual regeneration by pressing the DPR manual regeneration switch or manual regeneration by HINO-DX setting be performed.

1. Press the DPR Manual regeneration switch. When manual regeneration has started, wait until regeneration has been completed and confirm that the engine check lamp has gone out.
2. If the operation by means of the DPR SW is not accepted, connect the HINO-DX to the vehicle, record the "HINO-DX Report", erase the trouble code, and then perform manual regeneration according to the following procedure. When manual regeneration has started, wait until regeneration has been completed and confirm that the engine check lamp has gone out.

Confirmation method:

Use the HINO-DX, perform System Fix, and then continue in the order of Check Function (E) → DPR Reset Confirmation (D) → Manual regeneration (E).

Recording method for the "HINO-DX Report":

- a. Connect the HINO-DX to the vehicle and execute System Fix.
- b. Click the Equipment DTC button and then click Load (L).
- c. Click System Fix (W) after the DTC code has been put out.
- d. Enter Work memorandum (information), Customer Name, License Plate, and Mileage information at the pop-up screen.
- e. Click the OK button.
- f. Click the Close Work (C) button of the pull-down menu File (F) for Close Work.
- g. Click Past work information (O) of the File (F) pull-down menu.
- h. Select the files when System Fix was performed in items d and e from the pop-up screen and click the Print button.
- i. Click the Print button on the pop-up screen.
- j. When the HINO-DX Report image screen appears, click the Print button.
- k. Click the Printer Name pull-down button on the Print pop-up screen.
- l. Select Microsoft Office Document Image Writer from the Printer pull-down menu.
- m. Click the OK button.
- n. Save the data in any folder (example: Save to the desktop).
- o. When the folder is clicked, the contents of the HINO-DX Report can be confirmed and sent by e-mail or can be printed out.
3. After completion of manual regeneration by (1) or (2), keep the engine running and wait for the exhaust temperature (IN side) to drop. Confirm a drop to 200 degrees or lower and then inspect the exhaust gas backpressure according to the following procedure.

Confirmation method:

Execute in the order of DPR Reset Confirmation → Backpressure Check (D) → Start (E).

4. Confirm that the values of the exhaust gas backpressure are at or below the standard.

Standard:

Engine model	DPR Backpressure (Units: KPa)
J05D	16.0

5. When the confirmation result in (4) is at or below the standard, DPR manual regeneration and the confirmation work have been completed. Click "Stop" on the DPR Backpressure Check screen to end the work with the HINO-DX.
6. If the exhaust gas backpressure with the inspection in (5) exceeds the standard, repeat the steps (2), (3), (4), and (5).

7. If the exhaust gas backpressure with the work in (6) is within the standard, DPR manual regeneration and the confirmation work have been completed. Click "Stop" on the DPR Backpressure Check screen to end the work with the HINO-DX.
8. If the exhaust gas backpressure still exceeds the standard with the second manual regeneration, the DPR filter is defective and must be replaced.

***2 Additional information for filter cleaning with a washing machine**

Confirm the following for filter cleaning with a washing machine.

Use a washing machine from a manufacturer recommended by Hino Motors.

Perform cleaning with correct installation of the attachment for DPF filters made by Hino Motors.

In the following instances the filter cannot be cleaned. In these cases, the filter must be replaced.

1. Cleaning is not possible for filters where soot has escaped and the surroundings have turned black when the filter body is seen from the gas flow outlet side.
2. Cleaning is not possible when a large quantity of oil adheres to the filter body as seen from the gas flow inlet side.
3. Cleaning is not possible when the filter or the catalyst shows cracks or damage seen from any side.
When cleaning has been completed and the filter has been installed again, perform the following inspections.
4. Use the HINO-DX to perform DPR forced regeneration, then confirm normal completion.
5. In this condition, wait for the exhaust gas temperature to drop to 200°C or lower, perform the backpressure inspection, and confirm that the inspection value is at or below the standard.
6. If the backpressure value is high, the filter is defective and must be replaced.

***3 Check for sensor coupler disconnection even when P2002 is displayed.**

***4 Pay attention to the following when the temperature sensor is inspected because of P2002 or a temperature sensor DTC code.**

1. Replace if the tip is bent.
2. Do not bend the tip when it is normal.
3. When the sensor tip is bent, normal control may not be possible and this can lead to DPR trouble.
4. When disconnecting the sensor, remove the sensor body from the muffler after completely removing the harness fixing clips. If this is not done, the sensor tip could get damaged.

DETERMINATION BY WAY OF DPR STATE DETERMINATION MONITOR OF HINO-DX

EN0110304H200006

1. CHECK THAT THE CHECK ENGINE LAMP COMES ON.
2. CONNECT HINO-DX.
3. CHECK PAST FAULTS.
 - (1) Check past faults by way of HINO-DX. In case a general engine fault such as a trouble of an exhaust control system is displayed, inspect and repair the pertinent section.
 - (2) Inspect and repair general engine faults and check past faults again. In case a code indicating a sensor system trouble is displayed, inspect and replace the sensor circuit.

	DTC code
Front DPR exhaust temperature sensor trouble	P2080, P0545, P0546
Rear DPR exhaust temperature sensor trouble	P2084, P2032, P2033
DPR backpressure sensor trouble	P1426, P1427, P1428

- (3) Check past faults. In case DPR trouble (DTC code: P2002) is displayed, check the DPR state monitor.

CHECKING THE DPR STATE

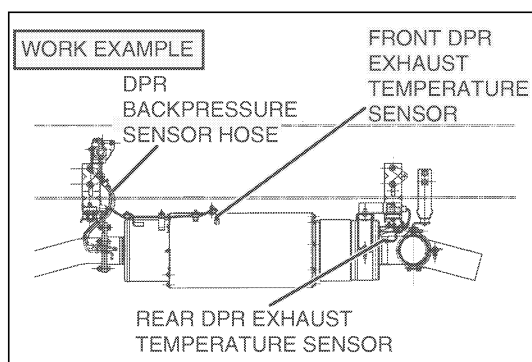
EN0110304H200007

1. CHECK THE DPR STATE MONITOR.
 - (1) Refer to "INSPECTION BY WAY OF HINO-DX" and check the DPR state monitor. Perform inspection as per the procedure under "INSPECTION BY WAY OF HINO-DX".

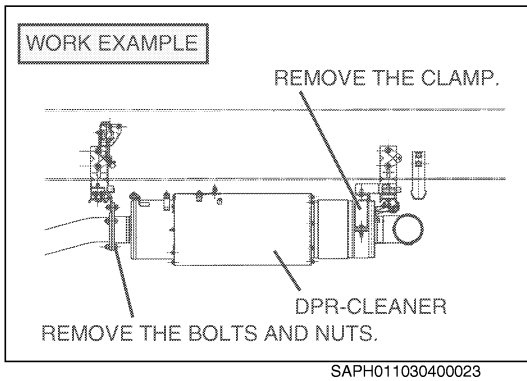
REPLACEMENT OF DPR FILTER

EN0110304H200008

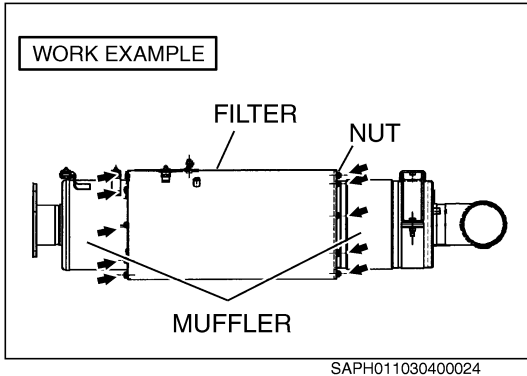
1. REMOVE THE DPR-CLEANER.
 - (1) Remove the connectors for the front and rear DPR exhaust temperature sensors and remove the hose of the DPR backpressure sensor.



SAPH011030400022



- (2) Use a jack to support the DPR-cleaner. Remove the bolts and nuts connecting the exhaust pipe and DPR-cleaner.
- (3) Remove the DPR-cleaner rear clamp and remove the DPR-cleaner.

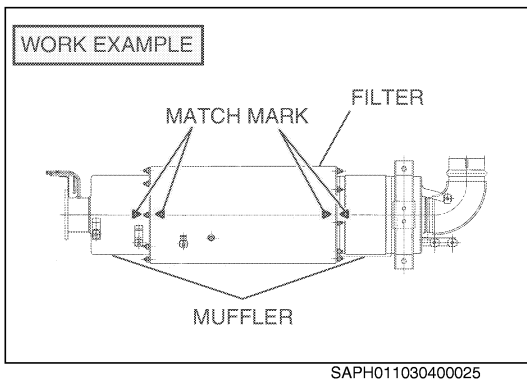


- (4) Remove the filter mounting nut and remove the front/rear muffler pipe.

NOTICE

The catalyst in the DPR-cleaner is made of ceramic; it could break if a strong impact is applied. Handle it with care.

- (5) When cleaning the filter, refer to "CLEANING OF DPR FILTER".



2. INSTALL THE DPR-CLEANER.

- (1) Align the front and rear muffler pipes then install into the filter.
- (2) After that, follow the reverse order of removing to install the DPR-cleaner.

HINT

Diagonally tighten the nuts.

Tightening Torque:

35±5 N·m {360±50 kgf·cm, 25.8±3.7 lbf·ft} (Filter mounting nut)

CLEANING OF DPR FILTER

EN0110304H200009

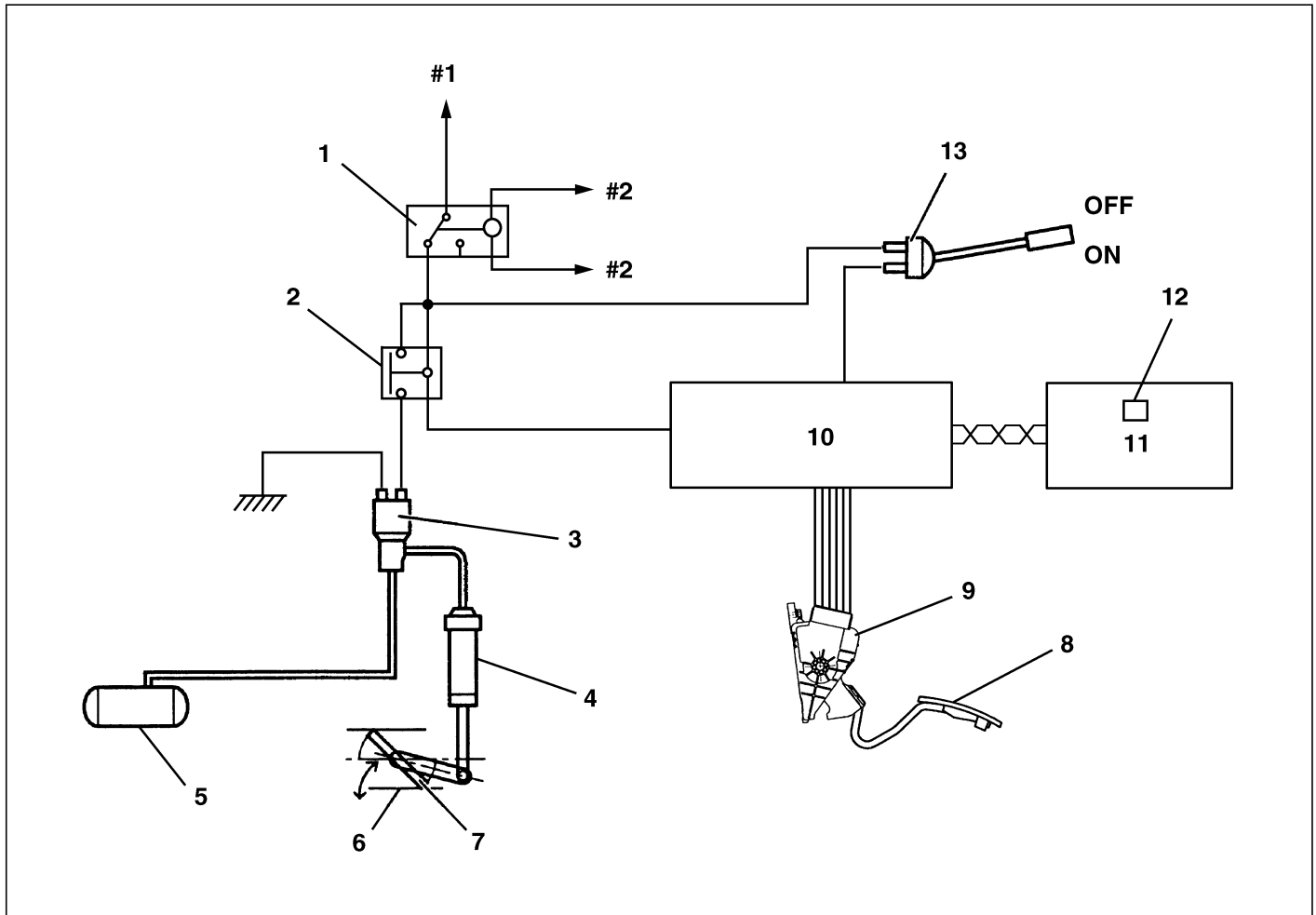
1. CLEANING METHOD

- (1) Use a dedicated cleaning machine to perform filter cleaning. Never clean the filter elsewhere. For the cleaning method, refer to the cleaning machine handling manual.

EXHAUST CONTROL VALVE

SYSTEM CONFIGURATION

EN0110304D100005



SAPH011030400026

1	ABS exhaust cut relay	9	Accelerator sensor
2	U2 exhaust relay	10	Engine ECU
3	Magnetic valve	11	Combination meter ECU
4	Exhaust control cylinder	12	Exhaust brake light
5	Air tank	13	Exhaust brake switch
6	Exhaust pipe	#1	To U2 actuator power relay
7	Butterfly valve	#2	To ABS ECU
8	Accelerator pedal		

PROCEDURE FOR CHECKING/ADJUSTING THE EXHAUST CONTROL VALVE OPENING

EN0110304H200010

1. Run the engine until it is completely warm.

- (1) Keep the engine running until the temperature gauge needle is in the normal temperature zone.
(The engine will warm up faster if the auxiliary brake switch is used. The warm-up operation is described below.)

2. Connect the HINO-DX.

- (1) Display the engine rpm (NE), fuel injection rate (QFIN), and temperature (THW) on the data display screen.

3. Set the exhaust control valve in warm-up state.

- (1) Set the transmission in neutral and securely engage the parking brake.
- (2) Turn off the air conditioner and headlights.
- (3) Make sure the air compressor has finished charging.
- (4) Turn off any other auxiliary equipment that may be in operation (refrigerator compressor, PTO drive, etc.).
- (5) Adjust the engine speed to the value of Adjustment Table.
- (6) Operate the exhaust control valve.
[Set the exhaust control valve in operation.]
- (7) Adjust the engine speed to the value of Adjustment Table by the idle set knob. Then record the fuel injection quantity (A).
- (8) Set the exhaust control valve to OFF and keep the state for 30 seconds. Then record the fuel injection quantity (B).
- (9) If difference of fuel injection quantity (A - B) is outside of the adjustable range, fuel injection quantity must be adjusted.

Adjustment Table

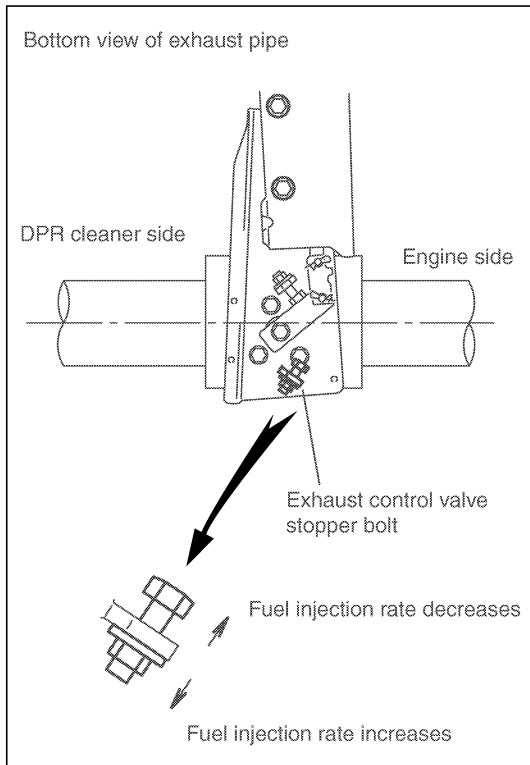
Engine speed (rpm)	980
Difference of adjustable range of fuel injection quantity (A — B) (q)	10 — 18
Adjustment target quantity	14

4. Adjust the exhaust control butterfly valve.

- (1) Make sure the engine is warm.
Check the HINO-DX temperature display and make sure the temperature is above 82°C {180°F}.
(Warm up the engine if the temperature is below 82°C {180°F}.)
- (2) Record the fuel injection rate (QFIN) on the HINO-DX.

NOTICE

- **At this time, be sure to use the switch on the steering column to turn the engine off. Do not use the clutch pedal or other part to turn it off.**
If the exhaust control valve does not go off when the engine has been turned off, idle mode will be engaged for a long time in idle mode, so QFIN will not be correctly measured. In this case, turn on the exhaust control valve again and warm it up.
- **Idle mode can be canceled if the ExH(in) temperature stays above 190°C {374°F} for 10 minutes.**



- (3) If the fuel injection rate is within the range shown in the adjustment table:
→ Adjustment is not required. Proceed to step 5 and check the manual forced-recovery function.
- (4) If the fuel injection rate is not within the range shown in the adjustment table:

NOTICE

- **Screwing in the stopper bolt will increase the fuel injection rate.**
- **Screwing out the stopper bolt will decrease the fuel injection rate.**

- (5) Once the stopper bolt adjustment has been completed, repeat this procedure starting at step 3, "Set the exhaust control valve in warm-up state." and confirm the engine rpm and fuel injection rate.

5. Check the manual regeneration function.

- (1) After the adjustment has been completed, check the manual regeneration function with the HINO-DX DPR check function.

NOTICE

- **The function is normal if recovery is completed within approximately 15 - 20 minutes.**

6. End of check and adjustment procedure

DPR INSPECTION CHECK SHEET

EN0110304D100006

HINT

After the inspection, enter check marks into the empty check boxes.

Step	1		2		3		4	
Inspection part	Fuel tank, Filter		Air intake system parts		Engine ECM		VNT turbocharger	
Inspection items	<input type="checkbox"/> Dirty or clogged fuel filter element <input type="checkbox"/> Entry of foreign matter or water into the fuel tank <input type="checkbox"/> Use of bad fuel		<input type="checkbox"/> Air filter element dirty, clogged, etc. <input type="checkbox"/> Damage to air cleaner body or air intake stack <input type="checkbox"/> Damaged or bent air hose <input type="checkbox"/> Damaged inter cooler body or hose		<input type="checkbox"/> Most recent program No.?		<input type="checkbox"/> Following characteristic at the time of inspection (Error within $\pm 5\%$)	
	OK	NG	OK	NG	OK	NG	OK	NG
Handling in case of "NG" judgment	<ul style="list-style-type: none"> • Element replacement • Fuel sampling → Investigation *Sampling from the fuel tank 		<ul style="list-style-type: none"> • Element replacement • Inspection of body and air intake stack • Replacement of inter-cooler body or hose 		<ul style="list-style-type: none"> • Updating to the most recent software version (**). 		<ul style="list-style-type: none"> • Replacement in case of bad following 	

(**) As long as the injection quantity is normal at the time of exhaust control valve is operating, there is no problem.

Injection quantity standard value table (value with all auxiliary equipment loads off)

Idling (normal)	Speed (rpm)	750
	Injection quantity (q)	8 - 17
Idling (at the time of adjustment)	Speed (rpm)	980
	Injection quantity (q)	B
Warming up with exhaust control valve	Speed (rpm)	980
	Injection quantity (q)	A
Suitable injection quantity (adjustment target value)	A - B	10 - 18
		(14)
At the time of manual regeneration (guide value)	Speed (rpm)	980
	Injection quantity (q)	25 - 35
Backpressure standard	Speed (rpm)	3,180
	Backpressure (kPa {kgf/cm ² , lbf/in. ² })	16.0 {0.163, 2.32}

5		6		7		8	
EGR valve		Supply pump, Injector		Fuel injection quantity		Manual regeneration	
<input type="checkbox"/> Following characteristic at the time of inspection (Error within $\pm 5\%$)		<input type="checkbox"/> Stability of the pump electrical current value *Standard = Refer to the supply pump inspection. <input type="checkbox"/> Injector correction value *Guide value = "Correction value for the correction injection quantity between cylinders" at the time of idle speed within $\pm 5 \text{ mm}^3/\text{st}$		<input type="checkbox"/> Injection quantity 1. At the time of idle 2. At the time of exhaust control valve is in operation <input type="checkbox"/> Exhaust control valve operation (No clinging or air leakage etc.?) *At the time of exhaust control valve opening adjustment, refer to the standard value table shown below left. *Confirm the injection quantity at the time of exhaust control valve is operating when the exhaust temperature has stabilized.		*To be performed with all auxiliary equipment load off. <input type="checkbox"/> Gas leakage at the time of regeneration <input type="checkbox"/> Discharge of white or black smoke at the time of regeneration <input type="checkbox"/> Exhaust gas temperature at the time of regeneration *Peak temperature : 500 °C or more (guide value) <input type="checkbox"/> Regeneration time *Guide value : Approximately 20 min	
OK	NG	OK	NG	OK	NG	OK	NG
<ul style="list-style-type: none"> Replacement in case of bad following 		<ul style="list-style-type: none"> Supply pump replacement when the inspection result is NG Injector replacement when the injector correction value is not within $\pm 5 \text{ mm}^3/\text{st}$ 		Repair or replacement the exhaust control valve in case of problems with exhaust control valve operation. (***)		White smoke means excessively closed exhaust control valve → Readjustment. Black smoke requires DPR filter confirmation. → Replace if the rear part is black. <ul style="list-style-type: none"> If the temperature rise is bad although injector, VNT, and EGR all are OK, inspect the temperature sensor and the front of the DPR. → Clean if the front is clogged. 	

(*) Caution items before inspection of the fuel injection quantity**

1. Connect the HINO-DX and perform warm-up until the engine temperature becomes 82°C or higher.
2. Set the gear to neutral and pull the parking brake lever sufficiently.
3. Switch off the air conditioner and the headlights.
4. Confirm that charging of the air compressor has been completed.
5. Switch off all other auxiliary equipment loads. (Refrigeration compressor, PTO, etc.)

LUBRICATING SYSTEM (J05D)

EN05-001

LUBRICATING SYSTEM EN05-2

DIAGRAM EN05-2

OIL PUMP AND OIL STRAINER EN05-4

COMPONENT LOCATOR..... EN05-4

OVERHAUL EN05-5

INSPECTION AND REPAIR EN05-6

OIL FILTER AND OIL COOLER EN05-7

COMPONENT LOCATOR..... EN05-7

SPECIAL TOOL EN05-8

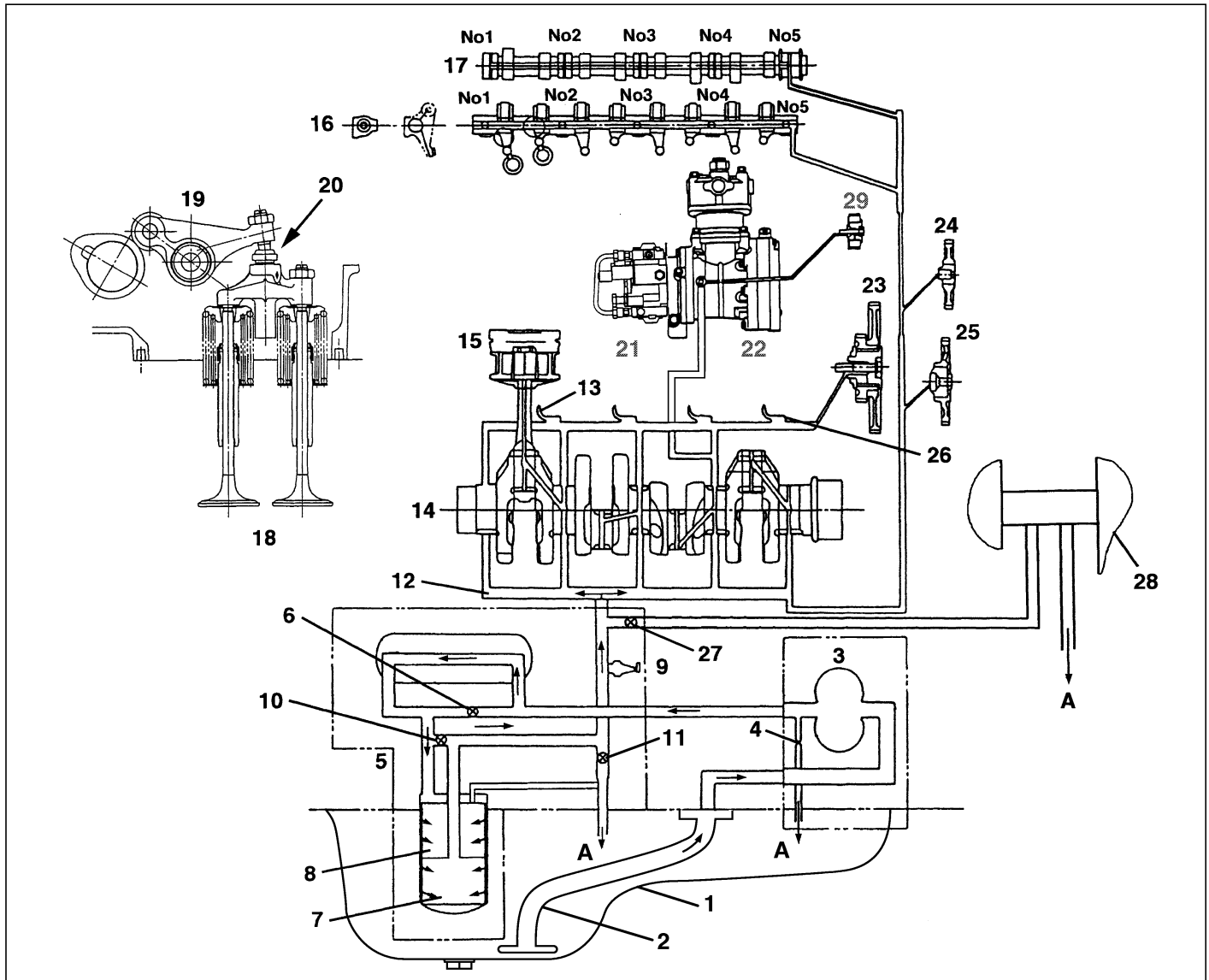
DISMOUNTING AND MOUNTING EN05-8

INSPECTION AND REPAIR EN05-9

LUBRICATING SYSTEM

DIAGRAM

EN0110305J100001



SAPH011030500015

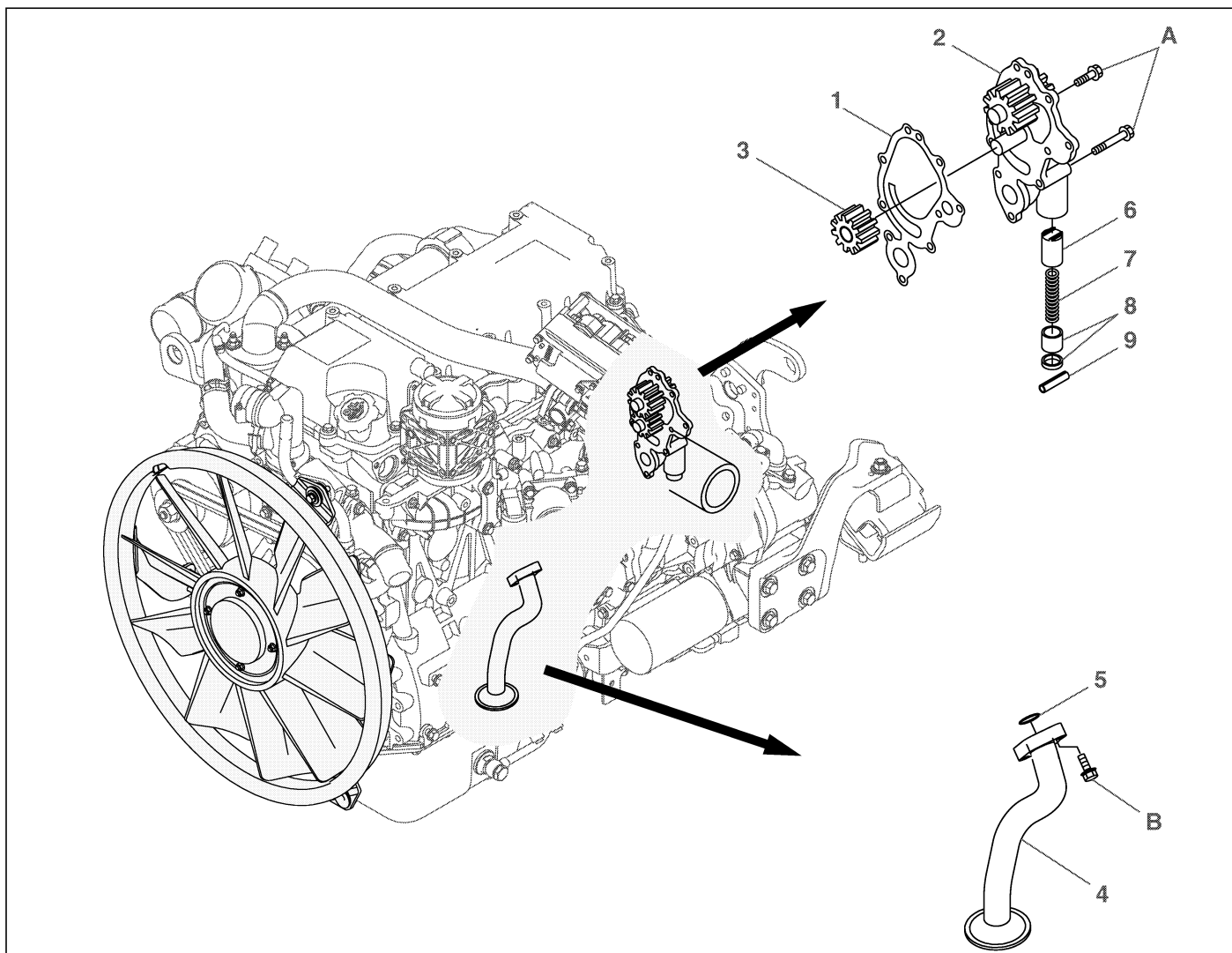
Unit: kPa {kgf/cm², lbf/in.²}

1	Oil pan	15	Piston
2	Oil strainer	16	Valve rocker shaft
3	Oil pump	17	Camshaft
4	Oil pump safety valve 1,648-1,746 {16.8-17.8, 239-253}	18	Valve
5	Oil cooler and oil filter	19	Rocker arm
6	Oil cooler safety valve 352-432 {3.6-4.4, 52-62}	20	Cross head
7	Oil filter (full flow)	21	Supply pump
8	Oil filter (by-pass)	22	Air compressor
9	Pressure switch	23	Main idle gear
10	Oil filter safety valve 176-216 {1.8-2.2, 26-31}	24	Cam idle gear
11	Regulator valve 490-570 {5.0-5.8, 72-82}	25	Sub idle gear
12	Main oil hole	26	Check valve 245 {2.5, 36}
13	Piston cooling jet	27	Check valve for turbocharger
14	Crankshaft	28	Turbocharger
		29	Idle gear
		A	To oil pan

OIL PUMP AND OIL STRAINER

COMPONENT LOCATOR

EN0110305D100001



SAPH011030500002

- | | |
|---|--------------|
| 1 | Gasket |
| 2 | Oil pump |
| 3 | Driven gear |
| 4 | Oil strainer |
| 5 | O-ring |

- | | |
|---|---------------|
| 6 | Safety valve |
| 7 | Relief spring |
| 8 | Spring seat |
| 9 | Cotter pin |

Tightening torque

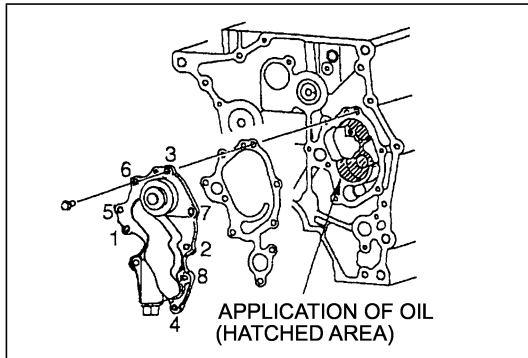
Unit: N·m {kgf·cm, lbf·ft}

A	28.5 {291, 21}
---	----------------

B	28.5 {291, 21}
---	----------------

OVERHAUL

EN0110305H200001



IMPORTANT POINTS - ASSEMBLY

1. INSTALLING THE OIL PUMP.

- (1) Apply oil to the pump case and bearings of the block (hatched area) before installing the oil pump.

NOTICE

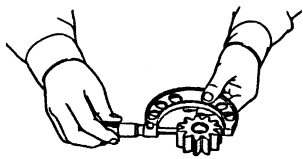
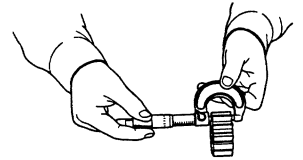
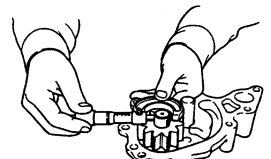
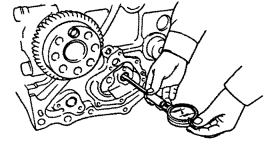
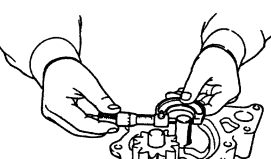
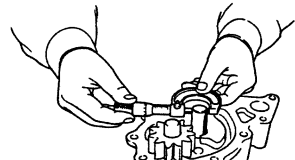
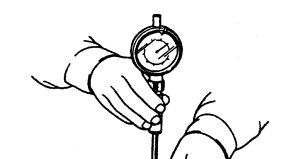
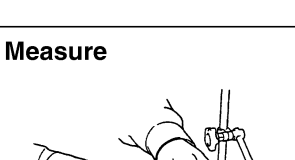
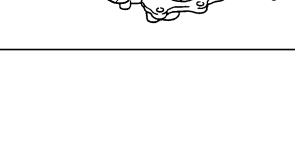
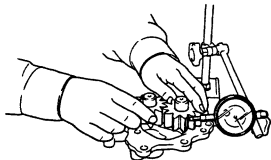
Not applying oil may cause oil suction failure at start-up, resulting in seizure and abnormality.

- (2) To prevent misalignment of the gasket, apply grease to the gasket matching face of the block. Then, place and fix the gasket.
- (3) Tighten the oil pump mounting bolts provisionally in the order as shown in the figure. Tighten them to the specified torque.

INSPECTION AND REPAIR

EN0110305H300001

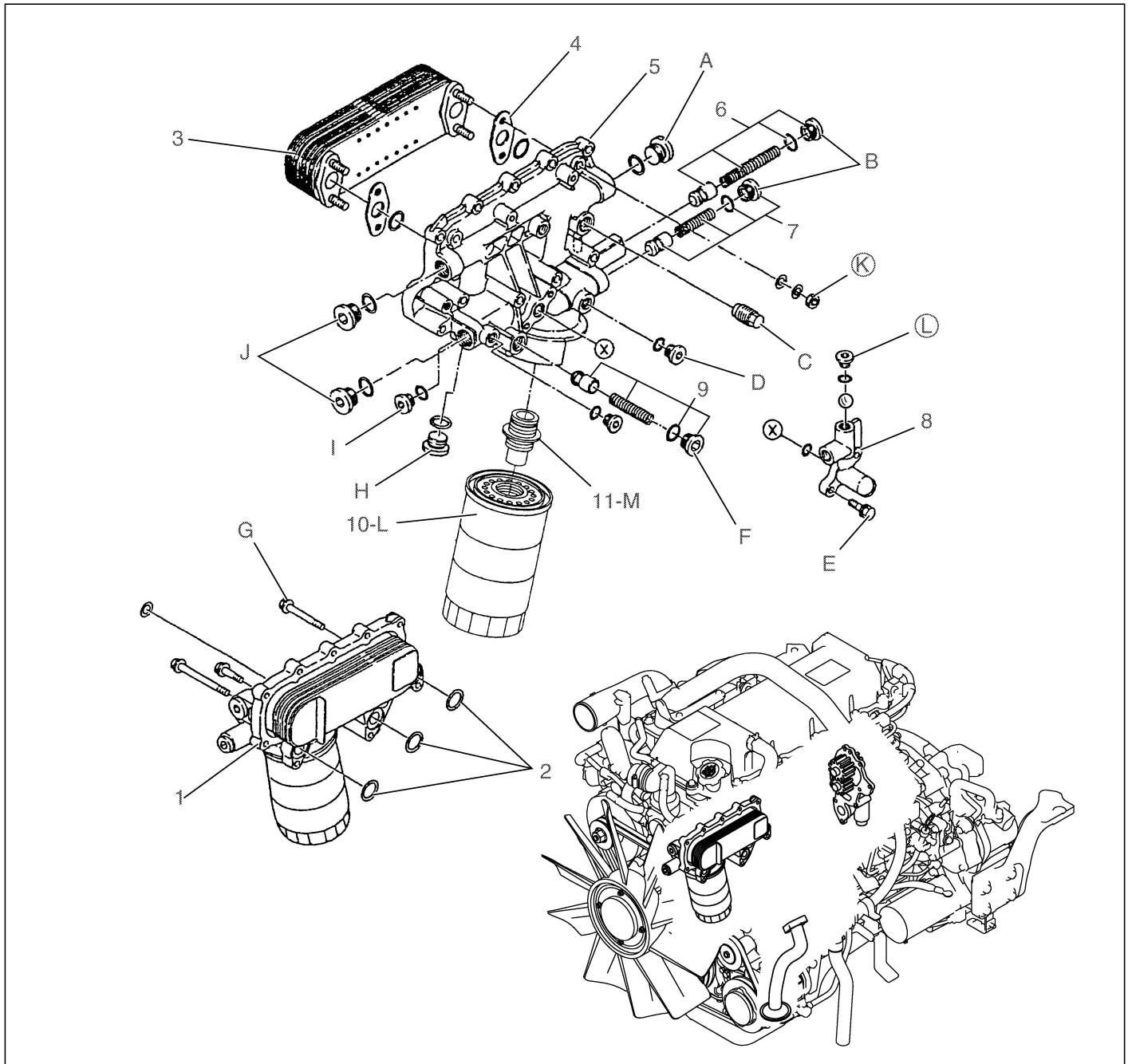
Unit: mm {in.}

Inspection item		Standard	Limit	Remedy	Inspection procedure
Gear outside diameter		54 {2.126}	—	—	Measure 
Block side pump body inside diameter		54 {2.126}	—	—	
Tip clearance		0.100-0.202 {0.004-0.0079}	0.30 {0.0118}	Replace gear or pump.	
Gear width		28.5 {1.122}	—	—	Measure 
Block side pump body inside depth		28.5 {1.122}	—	—	
End play		0.049-0.113 {0.0020-0.0044}	0.15 {0.0059}	Replace gear or pump.	
Drive gear	Shaft out-side diameter	18 {0.709}	—	—	Measure   
	Block side bushing inside diameter	18 {0.709}	—	—	
	Clearance	0.040-0.099 {0.0016-0.0038}	—	—	
Driven gear	Shaft out-side diameter	18 {0.709}	—	—	Measure    
	Block hole diameter	18 {0.709}	—	—	
	Clearance	0.030-0.075 {0.0012-0.0029}	—	—	
	Gear bushing inside diameter	18 {0.709}	—	—	
	Clearance	0.040-0.083 {0.0016-0.0032}	0.15 {0.0059}	Replace gear.	
Gear backlash		0.072-0.277 {0.0029-0.0109}	0.30 {0.0118}	Replace pump.	Measure 

OIL FILTER AND OIL COOLER

COMPONENT LOCATOR

EN0110305D100002



SAPH011030500009

- | | |
|---|---------------------------------|
| 1 | Oil cooler with filter assembly |
| 2 | O-ring |
| 3 | Oil cooler element |
| 4 | Gasket |
| 5 | Oil cooler case |
| 6 | Regulator valve |

- | | |
|----|-------------------------|
| 7 | Oil filter safety valve |
| 8 | Check valve |
| 9 | Oil cooler safety valve |
| 10 | Oil filter element |
| 11 | Insert |

Tightening torque

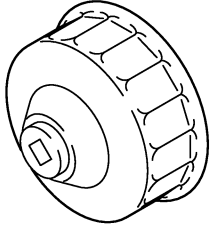
Unit: N·m {kgf·cm, lbf·ft}

A	29.4-39.2 {300-400, 22-28}	G	28.4 {290, 21}
B	24.5-34.3 {250-350, 19-25}	H	29.4-39.2 {300-400, 22-28}
C	39.2-49.0 {400-500, 29-36}	I	19.6-29.4 {200-300, 15-21}
D	19.6-29.4 {200-300, 15-21}	J	29.4-39.2 {300-400, 22-28}
E	14.7-19.7 {150-200, 11-14}	L	39.2-49.0 {400-500, 29-36}
F	24.5-34.3 {250-350, 19-25}	M	98.0-117.0 {1,000-1,190, 72-86}

SPECIAL TOOL

EN0110305K100001

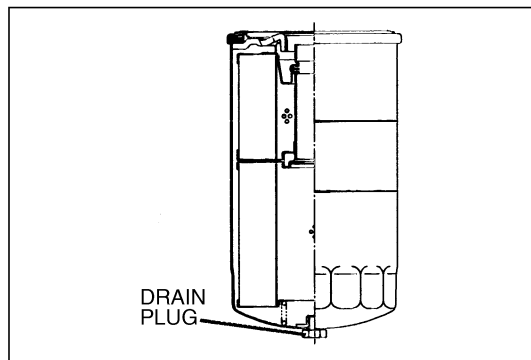
Prior to starting an engine overhaul, it is necessary to have this special tool.

Illustration	Part number	Tool name	Remarks
	S0950-31090	OIL FILTER WRENCH	

DISMOUNTING AND MOUNTING

EN0110305H200002

IMPORTANT POINTS - DISMOUNTING



SAPH011030500011

1. REMOVE THE OIL FILTER.

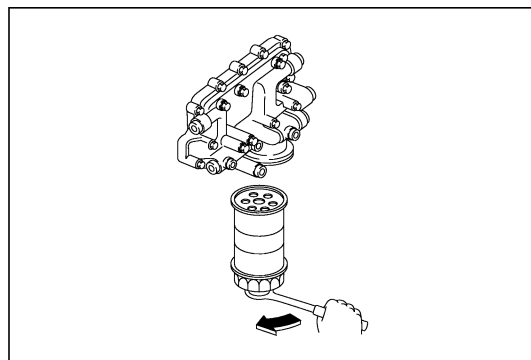
- (1) Remove the drain plug from bottom of the oil filter and drain the engine oil.

- (2) Using the special tool, remove the oil filter.

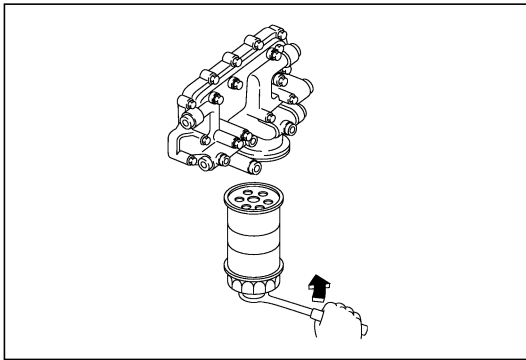
SST: Oil filter wrench (S0950-31090)

NOTICE

Make sure that O-rings are not on the oil cooler case side.



SAPH011030500012



SAPH011030500013

IMPORTANT POINT - MOUNTING

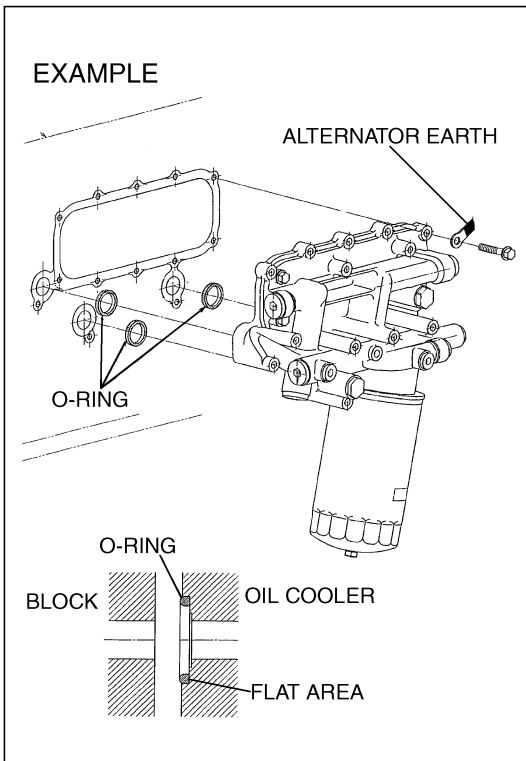
1. INSTALL THE OIL FILTER.

- (1) Remove the dust on installation surface of oil cooler case side.
- (2) Apply the engine oil to the O-ring on new oil filter.
- (3) Install the oil filter by turning it lightly to the right by hand until it comes in contact with the surface of the oil cooler. Then using the special tool, tighten the oil filter about 270°-360° (3/4-1 turn).

SST: Oil filter wrench (S0950-31090)

NOTICE

- Do not reuse the O-ring.
- Attention to damage of O-ring.



SAPH011030500014

2. INSTALL THE OIL COOLER AND OIL FILTER ASSEMBLY.

- (1) Insert the O-ring into the O-ring groove of the oil cooler.

NOTICE

Face the flat area of the O-ring toward the oil cooler for installation.

- (2) Apply liquid gasket to the oil cooler case and install it onto the cylinder block, then tighten the bolt to the specified torque.

Tightening Torque:

19.6 - 29.4 N·m {200 - 300 kgf·cm, 15 - 21 lbf·ft}

INSPECTION AND REPAIR

EN0110305H300002

Inspection item	Standard	Limit	Remedy	Inspection procedure
Oil cooler air leakage Air pressure: 588 kPa {6 kgf/cm ² , 85 lbf/in. ² }	0 mL	—	Replace, if necessary.	Visual check
Wear or damage to valve spring of oil cooler and oil filter	—	—	Replace, if necessary.	1. Damage to sliding face of valve 2. Valve movement (smoothness)

COOLING SYSTEM (J05D)

EN06-001

COOLING SYSTEM EN06-2

DIAGRAM EN06-2

COOLANT PUMP EN06-3

COMPONENT LOCATOR..... EN06-3

SPECIAL TOOL EN06-4

OVERHAUL EN06-5

INSPECTION AND REPAIR EN06-8

THERMOSTAT EN06-9

COMPONENT LOCATOR..... EN06-9

OVERHAUL EN06-10

RADIATOR AND INTERCOOLER EN06-12

COMPONENT LOCATOR..... EN06-12

OVERHAUL EN06-13

RADIATOR EN06-14

COMPONENT LOCATOR..... EN06-14

SPECIAL TOOL EN06-15

OVERHAUL EN06-16

INSPECTION AND REPAIR EN06-19

COOLING FAN EN06-20

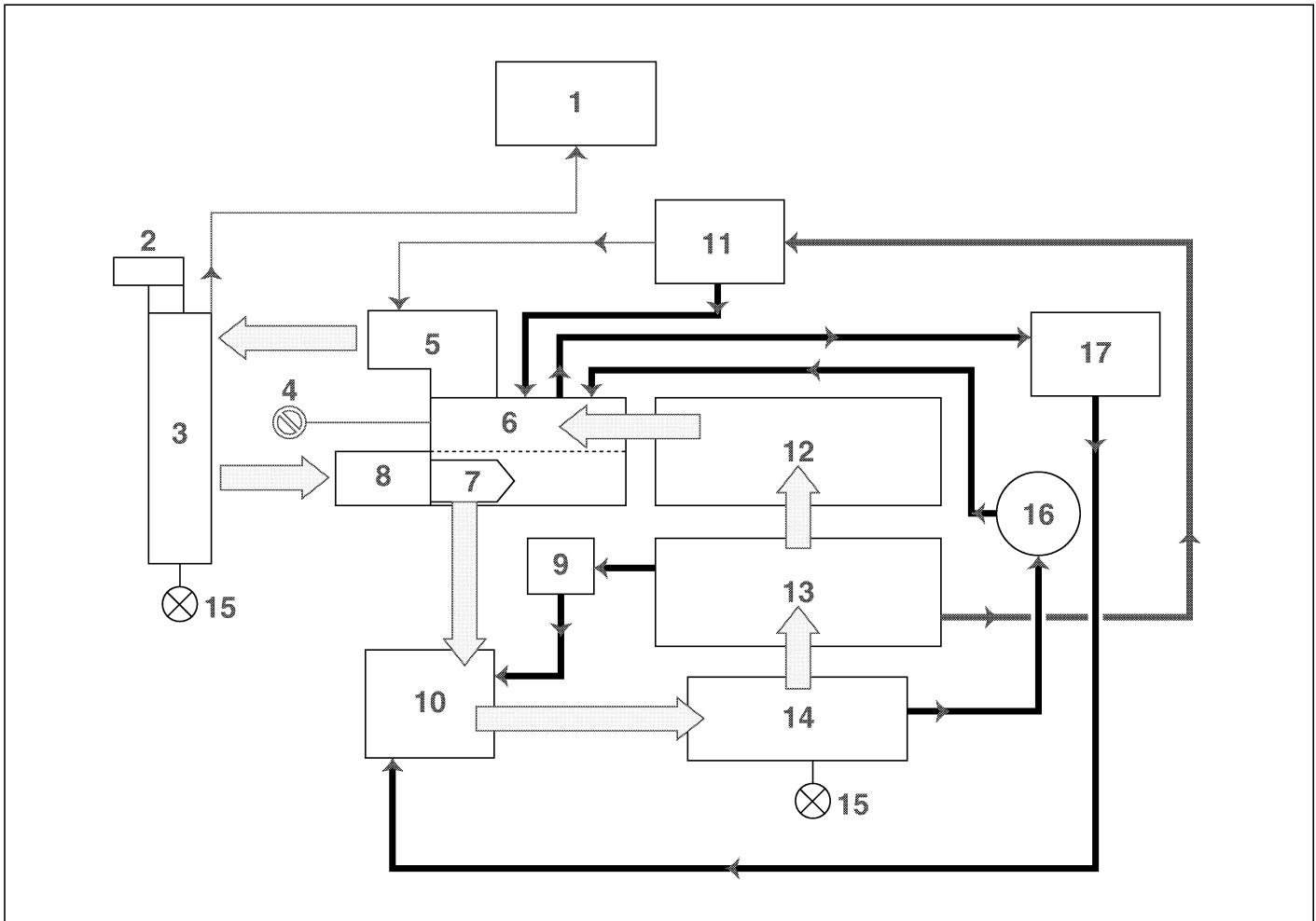
COMPONENT LOCATOR..... EN06-20

INSPECTION AND REPAIR EN06-21

COOLING SYSTEM

DIAGRAM

EN0110306J100001



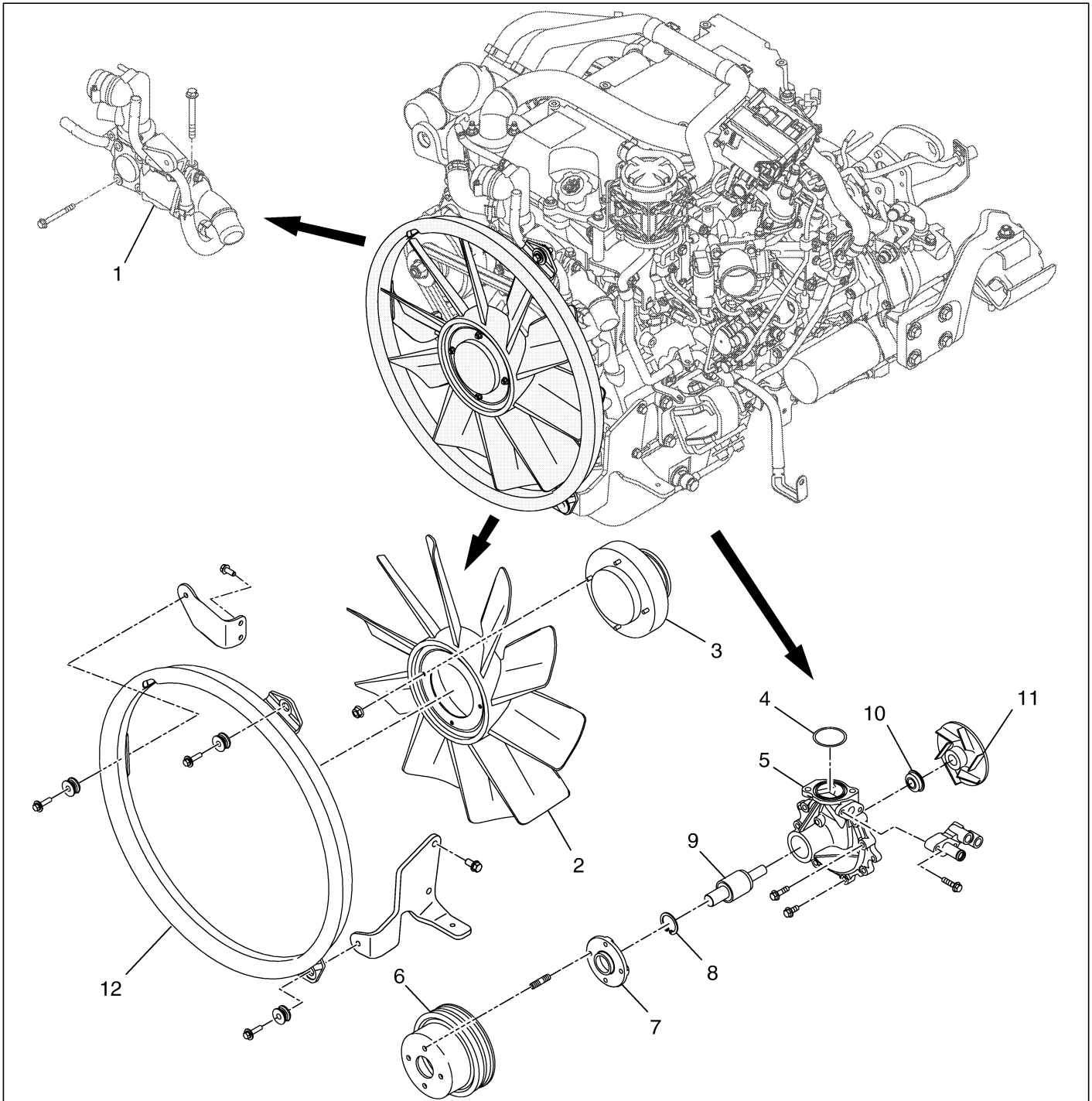
SAPH011030600001

1	Reservoir tank	10	Coolant pump
2	Radiator cap	11	EGR cooler
3	Radiator	12	Cylinder head
4	Coolant temperature gauge	13	Cylinder block
5	Thermostat case cover (Outlet)	14	Oil cooler
6	Thermostat case	15	Drain plug
7	Thermostat	16	Turbocharger
8	Thermostat case cover (Inlet)	17	Car heater
9	Air compressor		

COOLANT PUMP

COMPONENT LOCATOR

EN0110306D100001



SAPH011030600002

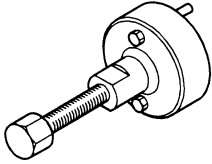
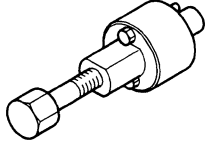
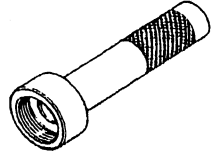
- | | |
|---|---------------------|
| 1 | Thermostat case |
| 2 | Cooling fan |
| 3 | Fan clutch |
| 4 | O-ring |
| 5 | Pump case |
| 6 | Coolant pump pulley |

- | | |
|----|---------------|
| 7 | Pulley center |
| 8 | Retainer ring |
| 9 | Coolant shaft |
| 10 | Coolant seal |
| 11 | Vane |
| 12 | Fan shroud |

SPECIAL TOOL

EN0110306K100001

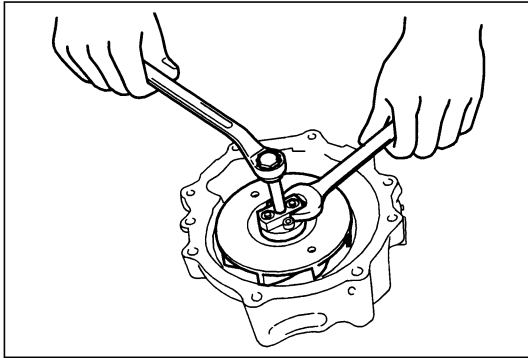
Prior to starting an engine overhaul, it is necessary to have these special tools.

Illustration	Part number	Tool name	Remarks
	S0942-01810	PULLER	For coolant pump pulley center
	S0942-01820	PULLER	For coolant pump vane
	S0948-22060	PRESS	For coolan pump seal

OVERHAUL

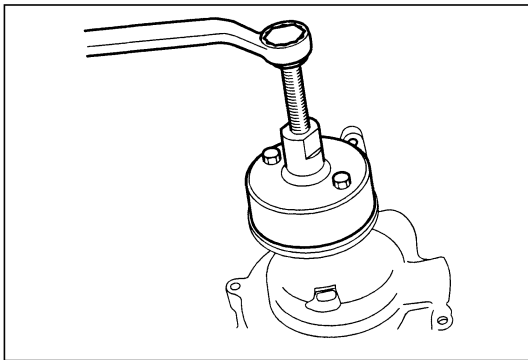
EN0110306H200001

IMPORTANT POINTS - DISASSEMBLY



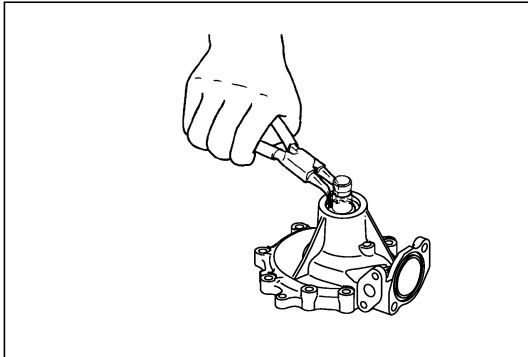
SAPH011030600006

1. **DISASSEMBLE THE COOLANT PUMP.**
 - (1) Remove the vane from the shaft using the special tool.
SST: Puller (S0942-01820)



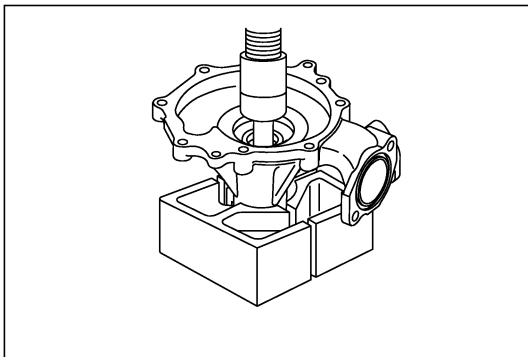
SAPH011030600007

- (2) Remove the pulley center from the shaft using the special tool.
SST: Puller (S0942-01810)



SAPH011030600008

- (3) Remove the retainer ring from the pump case using snap ring pliers.

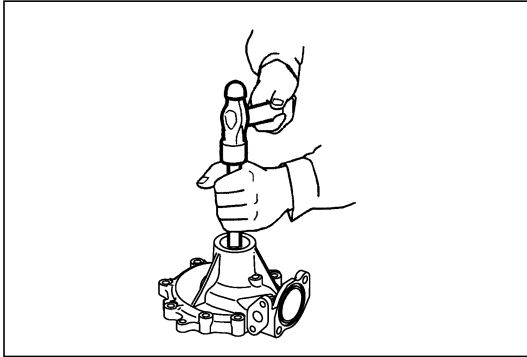


SAPH011030600009

- (4) Push the shaft from the vane side using a hydraulic press, and remove the coolant shaft from the pump case.

NOTICE

Before pressing, recheck that the retainer ring is removed completely.



SAPH011030600010

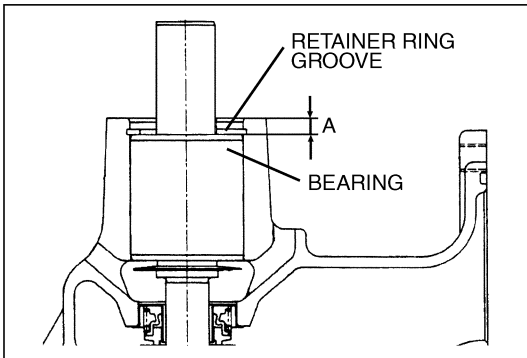
- (5) Remove the coolant seal from the pump case using a hammer and brass bar.

⚠ WARNING

Impact due to punching may cause metal chips to fly up. Be sure to wear protective goggles.

NOTICE

Replace the removed coolant seal with a new one. Never reuse it.



SAPH011030600011

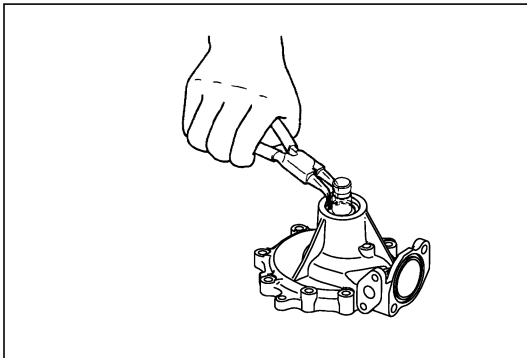
IMPORTANT POINTS - ASSEMBLY

1. ASSEMBLE THE COOLANT PUMP.

- (1) Install the coolant shaft onto the pump case using a hydraulic press.
Assembly standard (A): 4.9-5.1 mm {0.1930-0.2007 in}

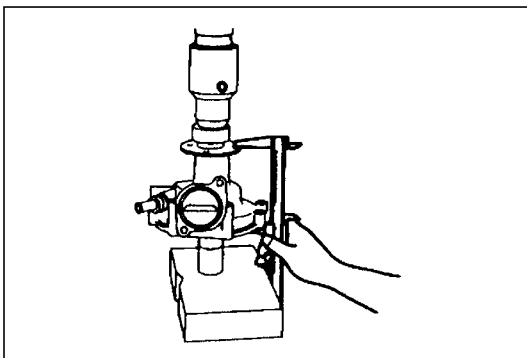
NOTICE

Press until the bearing upper end surface comes into contact with the retainer ring groove lower end surface.



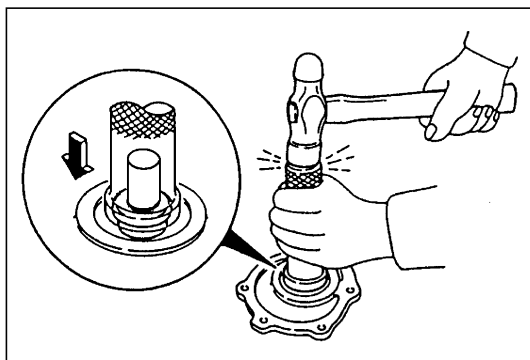
SAPH011030600012

- (2) Install the retainer ring onto the pump case using snap ring pliers.



SAPH011030600013

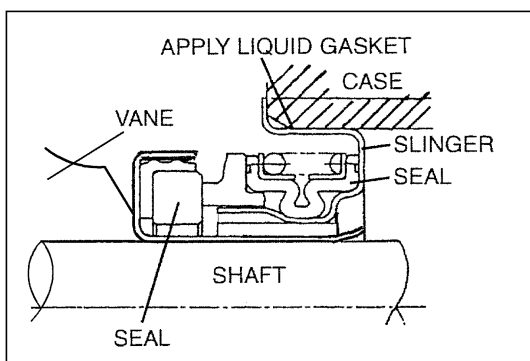
- (3) Install the pulley center onto the shaft using a hydraulic press.
Standard: 113.6 - 114.4 mm {4.472 - 4.504 in.} from the pulley center mounting surface to the pump case end surface



SAPH011030600014

- (4) Install the new coolant seal.
- Apply liquid gasket (Three Bond #1104 or equivalent) to the seal outer circumference and case bore.
 - Install the slinger and seal to the case using a press.

SST: Press (S0948-22060)

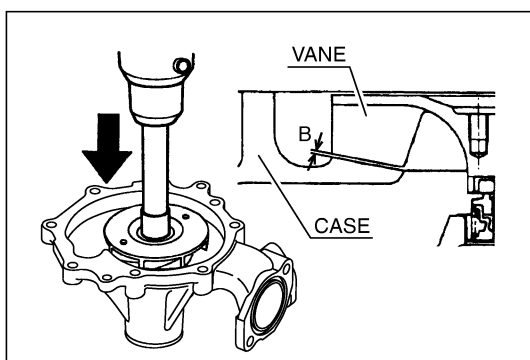


SAPH011030600015

- Install the seal to the vane.

NOTICE

Replace the coolant seal with new one.



SAPH011030600016

- (5) Install the vane onto the shaft using a hydraulic press.
Assembly standard (B): 0.7-1.3 mm {0.0276-0.0510 in}

NOTICE

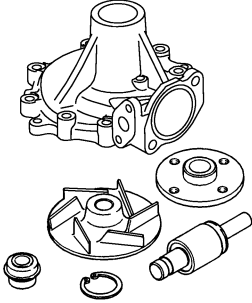
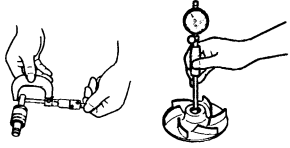
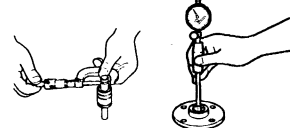
Press until the vane end face comes into contact with the shaft end surface.

- (6) After assembly, turn the shaft by hand and make sure that there is no noise, catching or rough movement in the shaft direction and that it rotates smoothly.

INSPECTION AND REPAIR

EN0110306H300001

Unit: mm {in.}

Inspection item	Standard	Limit	Remedy	Inspection procedure
Wear, damage and corrosion	—	—	Replace parts.	Visual check 
Tightness of shaft and vane	0.015-0.048 {0.0006-0.0018}	—	Replace shaft and/or vane.	Measure 
Tightness of shaft and pulley center	0.017-0.051 {0.0007-0.0020}	—	Replace shaft and/or pulley center.	Measure 

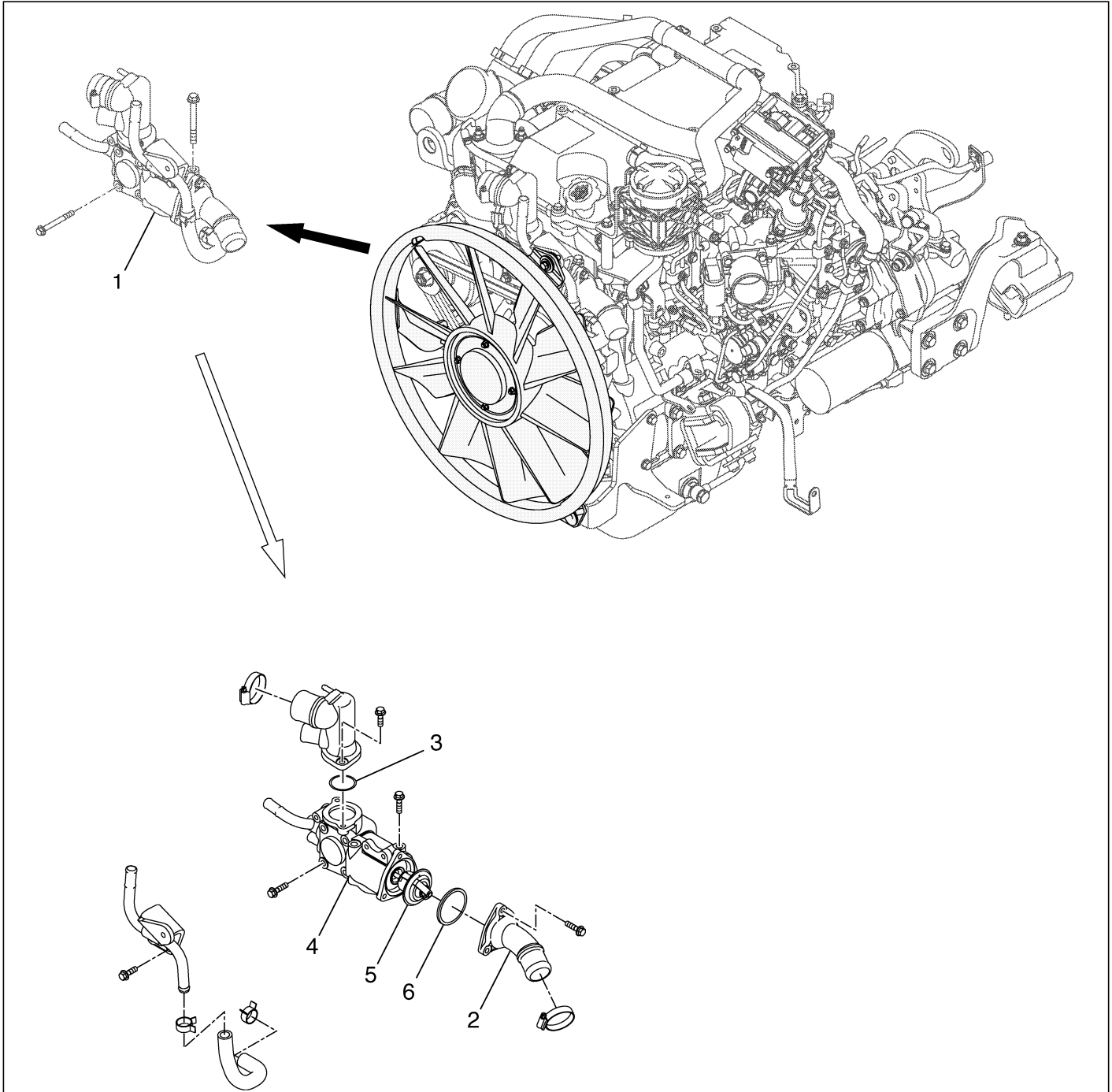
NOTICE

- Tightness= Outside diameter - Inside diameter
- Prevent reassembly more than three times even if it is within the standard value.

THERMOSTAT

COMPONENT LOCATOR

EN0110306D10002



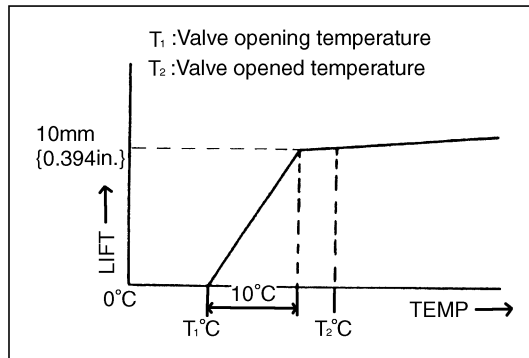
SAPH011030600020

- 1 Thermostat case assembly
- 2 Thermostat case cover
- 3 O-ring

- 4 Thermostat case
- 5 Thermostat
- 6 Gasket

OVERHAUL

EN0110306H200002



SAPH011030600021

IMPORTANT POINTS - INSPECTION AND REPAIR

1. INSPECT THE THERMOSTAT FUNCTION.

- (1) Place the thermostat in hot water and check the valve opening temperature and the valve lift.

Thermostat valve opening temperature:

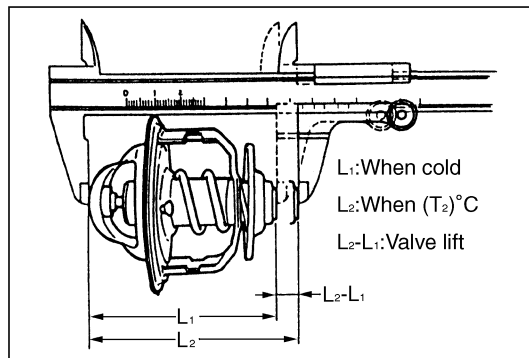
Thermostat valve opening temperature. (T_1)	Service standard
76.5°C {170°F}	74.5-78.5°C {166-173°F}

NOTICE

Check that the thermostat valve opening temperature (T_1) is engraved on the thermostat seat.

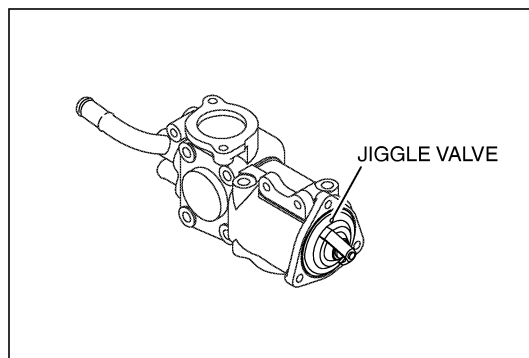
Thermostat valve lift:

Thermostat valve opening temp. (T_1)	Measuring temp. (T_2)	Valve lift (L_2-L_1)
76.5°C {170°F}	90°C {194°F}	10 mm {0.394 in.}



SAPH011030600022

- (2) Immerse the opened thermostat in water at normal temperature. If it completely closes within 5 minutes, it is satisfactory. If it remains slightly open, it is defective and must be replaced.



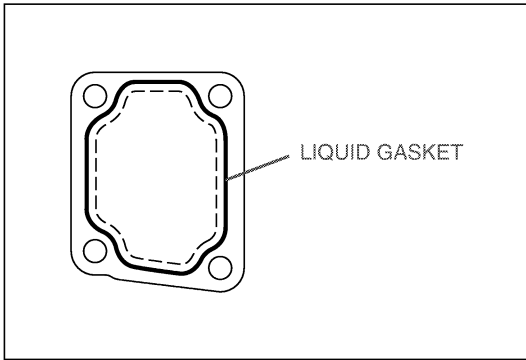
SAPH011030600023

IMPORTANT POINTS - ASSEMBLY

1. ASSEMBLE THE THERMOSTAT CASE.

NOTICE

- Remove water or dirt adhering to the thermostat case.
- Be sure to replace the gasket if it is corroded, damaged or flattened.
- Before installing the hose, apply liquid gasket to the hose installation part of the thermostat case cover.
- To prevent clogging of the radiator, do not use a large amount of liquid gasket.
- Be sure that the jiggle valve faces upward when installing it.

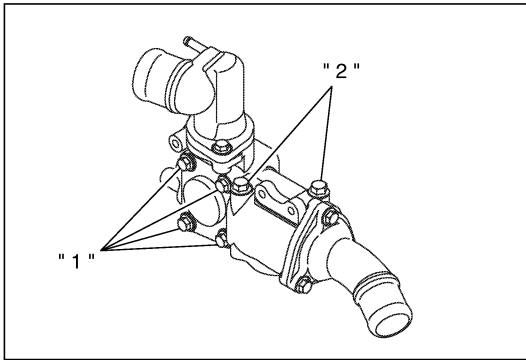


SAPH011030600024

IMPORTANT POINTS - MOUNTING

1. INSTALL THE THERMOSTAT CASE ASSEMBLY.

- (1) Apply liquid gasket to the thermostat case.
- (2) Install the o-ring into the groove of the coolant pump.



SAPH011030600025

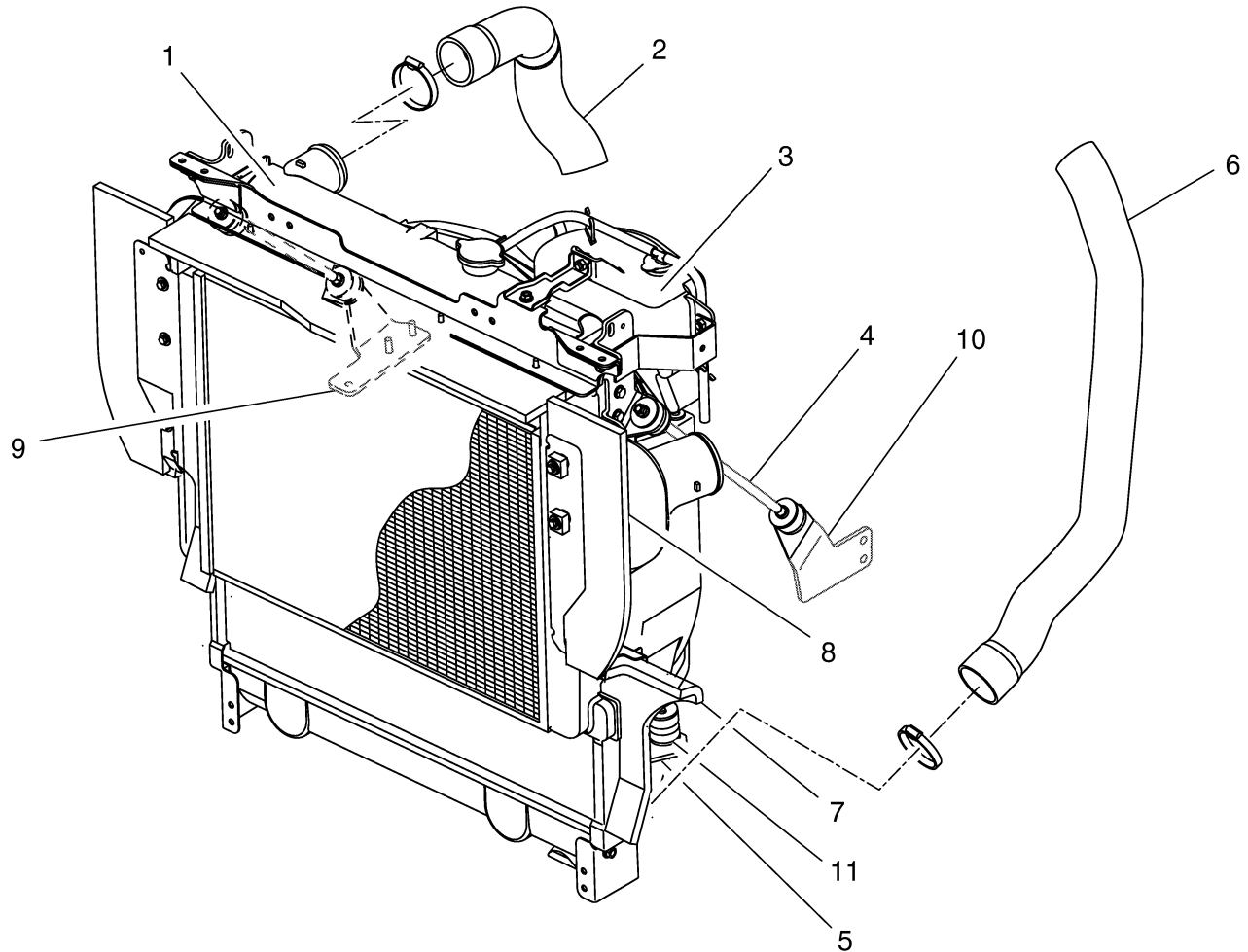
- (3) Temporarily tighten the bolts "1" and bolts "2" in that order, and securely contact the fitting surface.
- (4) Tighten the bolts in numeral order.

RADIATOR AND INTERCOOLER

COMPONENT LOCATOR

EN0110306D100003

EXAMPLE



SAPH011030600026

1	Radiator complete	7	Baffle plate assy
2	Inlet hose	8	Baffle plate assy
3	Reservoir tank	9	Bracket
4	Radiator stay assy	10	Bracket
5	Bracket	11	Cushion
6	Outlet hose		

OVERHAUL

EN0110306H200003

IMPORTANT POINTS - DISMOUNTING

1. DISMOUNT THE RADIATOR.

⚠ WARNING

Do not touch the exhaust manifold when it could be hot. You can be severely burned.

NOTICE

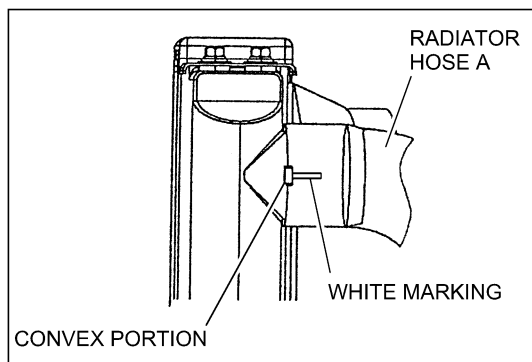
When dismantling and mounting the radiator, do not damage the radiator core.

IMPORTANT POINTS - MOUNTING

1. INSTALL THE RADIATOR HOSE A

NOTICE

- Install the radiator hose against the convex portion of the radiator.
- Match the white mark of the radiator hose and match mark (convex portion) of the radiator.

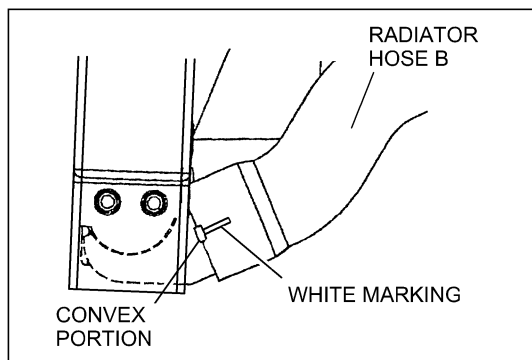


SAPH011030600027

2. INSTALL THE RADIATOR HOSE B

NOTICE

- Install the radiator hose against the convex portion of the radiator.
- Match the white mark of the radiator hose and match mark (convex portion) of the radiator.



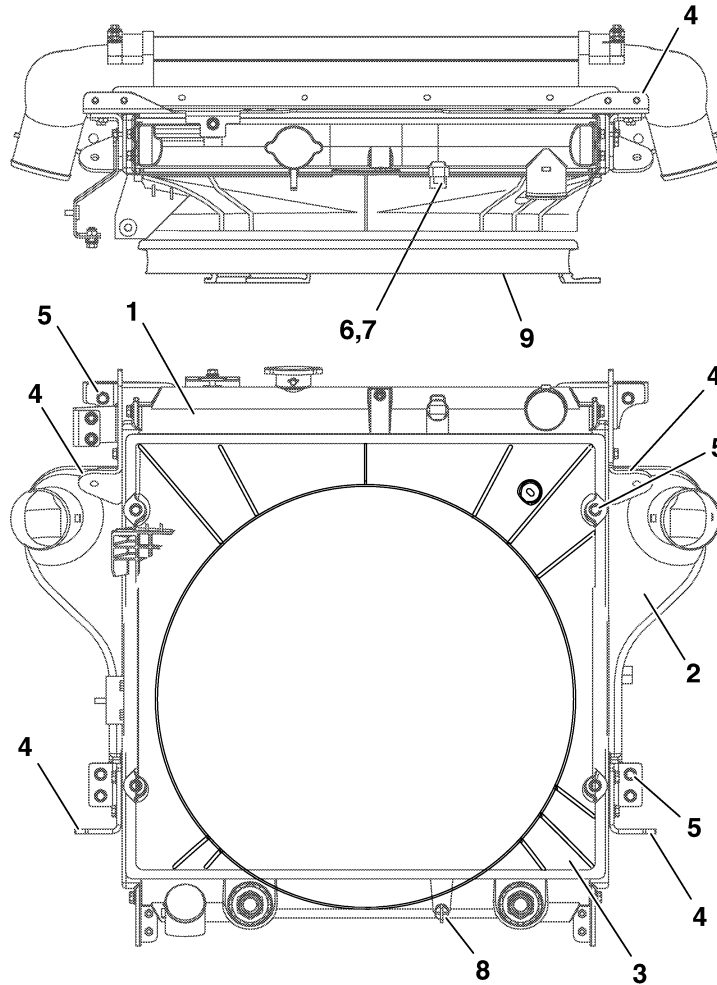
SAPH011030600028

RADIATOR

COMPONENT LOCATOR

EN0110306D100004

EXAMPLE



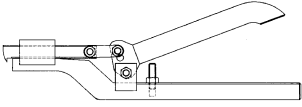
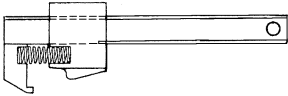
SAPH011030600049

1	Radiator Assy	6	Sensor
2	Intercooler Assy	7	Packing
3	Fan shroud	8	Drain plug
4	Bracket	9	Seal
5	Bolt		

SPECIAL TOOL

EN0110306K100002

Prior to starting an engine overhaul, it is necessary to have these special tools.

Illustration	Part number	Tool name	Remarks
 A technical drawing of a radiator tool with a long handle and a curved, pointed end. It has a small circular hole near the base of the handle.	S0976-01030	RADIATOR TOOL	TOOL FOR UNCAULKING
 A technical drawing of a radiator tool with a long handle and a rectangular head. The head has a textured, spring-like surface on one side and a circular hole on the other.	S0976-01040	RADIATOR TOOL	TOOL FOR CAULKING (USED WITH S0976-01030)

OVERHAUL

EN0110306H200004

IMPORTANT POINTS - DISMOUNTING

1. DISMOUNT THE RADIATOR.

⚠ WARNING

Do not drain the coolant while the engine and radiator are still hot to avoid burns and scalds.

NOTICE

When dismantling and mounting the radiator, do not damage the radiator core.

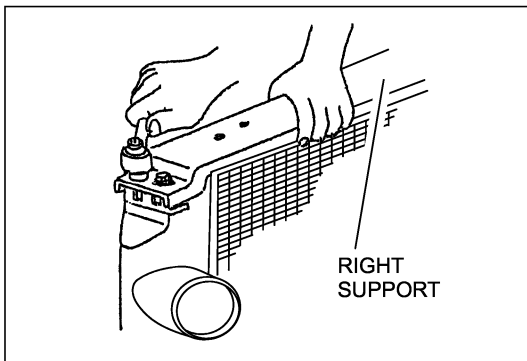
IMPORTANT POINTS - DISASSEMBLY

NOTICE

Recaulking should be limited to twice.

1. DISASSEMBLE THE UPPER TANK, LOWER TANK AND RADIATOR CORE.

- (1) Remove the left support and right support.



SAPH011030600032

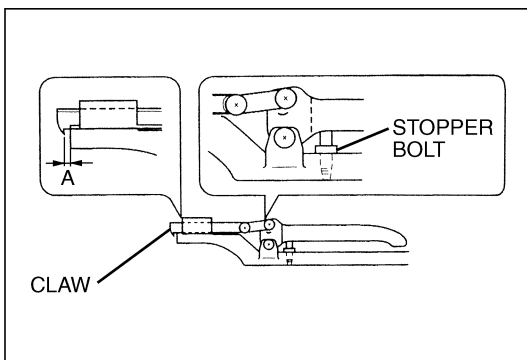
- (2) Grip the handle until it hits to the stopper bolt, then adjust the dimensions A with stopper bolt.

Dimension A: 0.2-0.3 mm {0.0079-0.0118 in.}

SST: Radiator (S0976-01030)

NOTICE

Be sure to adjust the dimension to prevent damage of the claw.

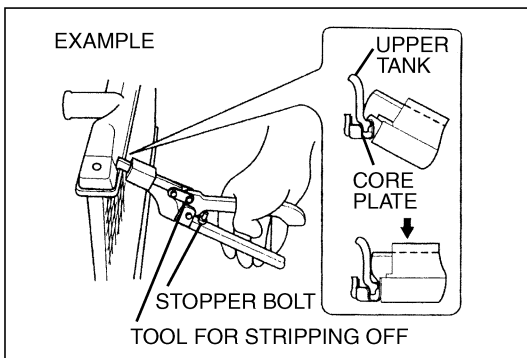


SAPH011030600033

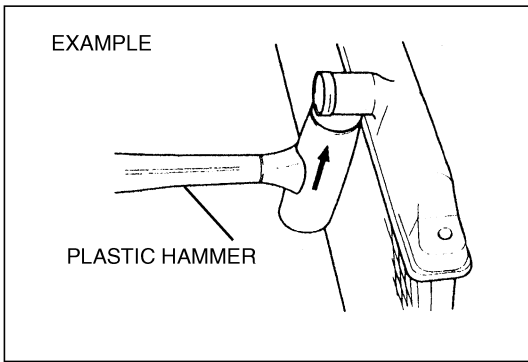
- (3) Using a special tool, lift the staked part.

NOTICE

Do not lift up tangs more than 90°.



SAPH011030600034

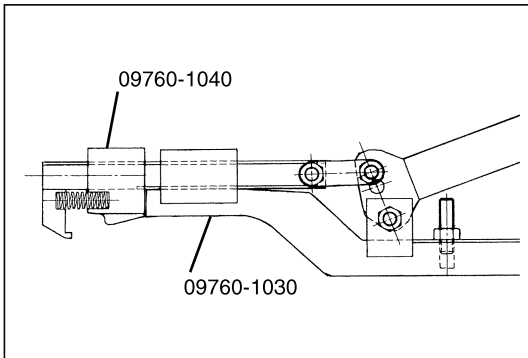


SAPH011030600035

- (4) Remove the upper tank and lower tank from the radiator core by tapping lightly with plastic hammer.

NOTICE

Do not remove the tank by forcing or prying.



SAPH011030600036

IMPORTANT POINTS - ASSEMBLY

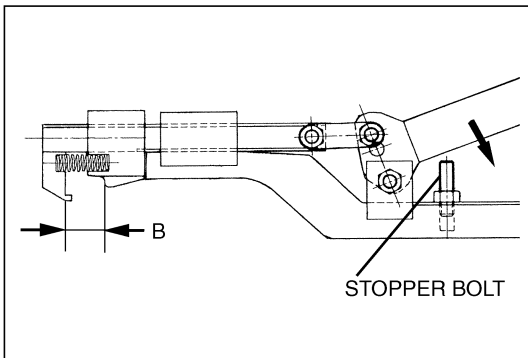
- 1. ASSEMBLE THE UPPER TANK, LOWER TANK AND RADIATOR CORE.**

- (1) Exchange the crow of the radiator tool (S0976-01030) for the radiator tool (S0976-01040) as shown in the figure.

SST:

Radiator tool (S0976-01030)

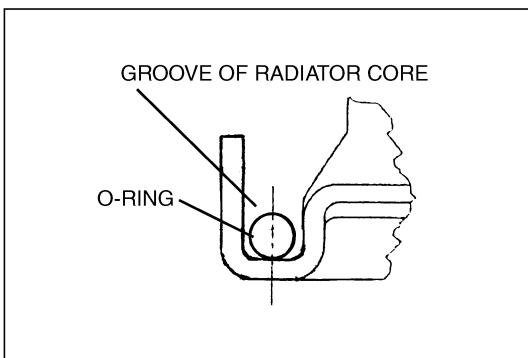
Radiator tool (S0976-01040)



SAPH011030600037

- (2) Grip the handle of the radiator tool until it hits the stopper bolt, then adjust the dimension B with stopper bolt.

Dimension B: 8.4 mm {0.3307 in.}



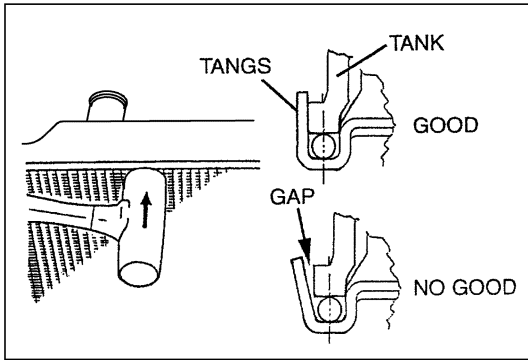
SAPH011030600038

- (3) Install the new O-ring into the groove of the radiator core (upper and lower) in such away that it will not be twisted.

NOTICE

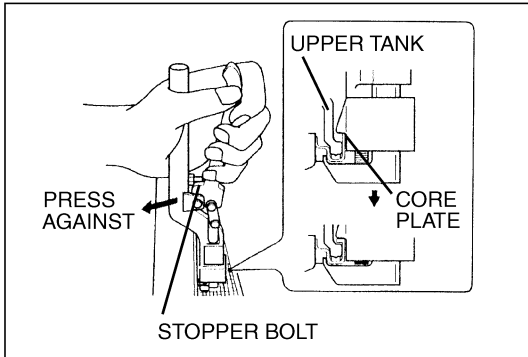
Be sure to clean the fitting portion before installing. When cleaning, lightly rub the inside portion of the groove with the emery paper.

- (4) Install the upper tank and lower tank into the groove of the radiator core.



SAPH011030600039

- (5) Tap the tangs to obtain a tight contact with the upper tank and lower tank.

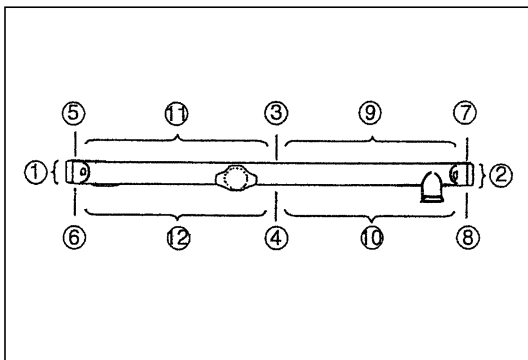


SAPH011030600040

- (6) Press the radiator tool (caulking tool) against the side portion. Temporarily caulk the tangs several times, then proceed to the final caulking by gripping the handle until it hits the stopper bolt.

NOTICE

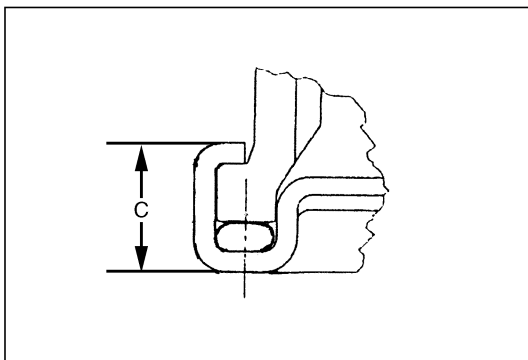
For the positions where the radiator tool is not usable, perform the caulking with pliers.



SAPH011030600041

NOTICE

Perform the caulking according to the sequence as shown in the figure.



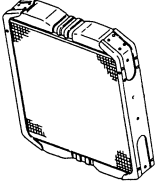
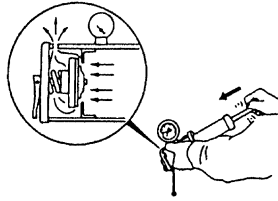
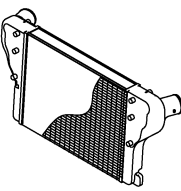
SAPH011030600042

- (7) Check the dimension C.
Assembly standard: 7.27-7.85 mm {0.2863-0.3090 in.}
 If the dimension is out of the standard value, adjust the stopper bolt of the handle once again and perform the caulking again.

INSPECTION AND REPAIR

EN0110306H300002

Unit:MPa{kgf/cm², lbf/in.²}

Inspection item		Standard	Limit	Remedy	Inspection procedure
Air leakage (When the air pressure of 100 {1,14} is applied.)		—	—	Replace radiator.	Visual check 
Clogging of the fins		—	—	Clean.	
Radiator cap valve opening pressure	Mark 0.5	40-58 {0.4-0.6, 5.7-8.5}	—	Replace.	Measure 
Intercooler					
<ul style="list-style-type: none"> Air leakage test (when the air pressure of 490 {5.0, 71} is applied.) Clogging of the fins 		0 mL	—	Replace the inter-cooler.	
		—	—		

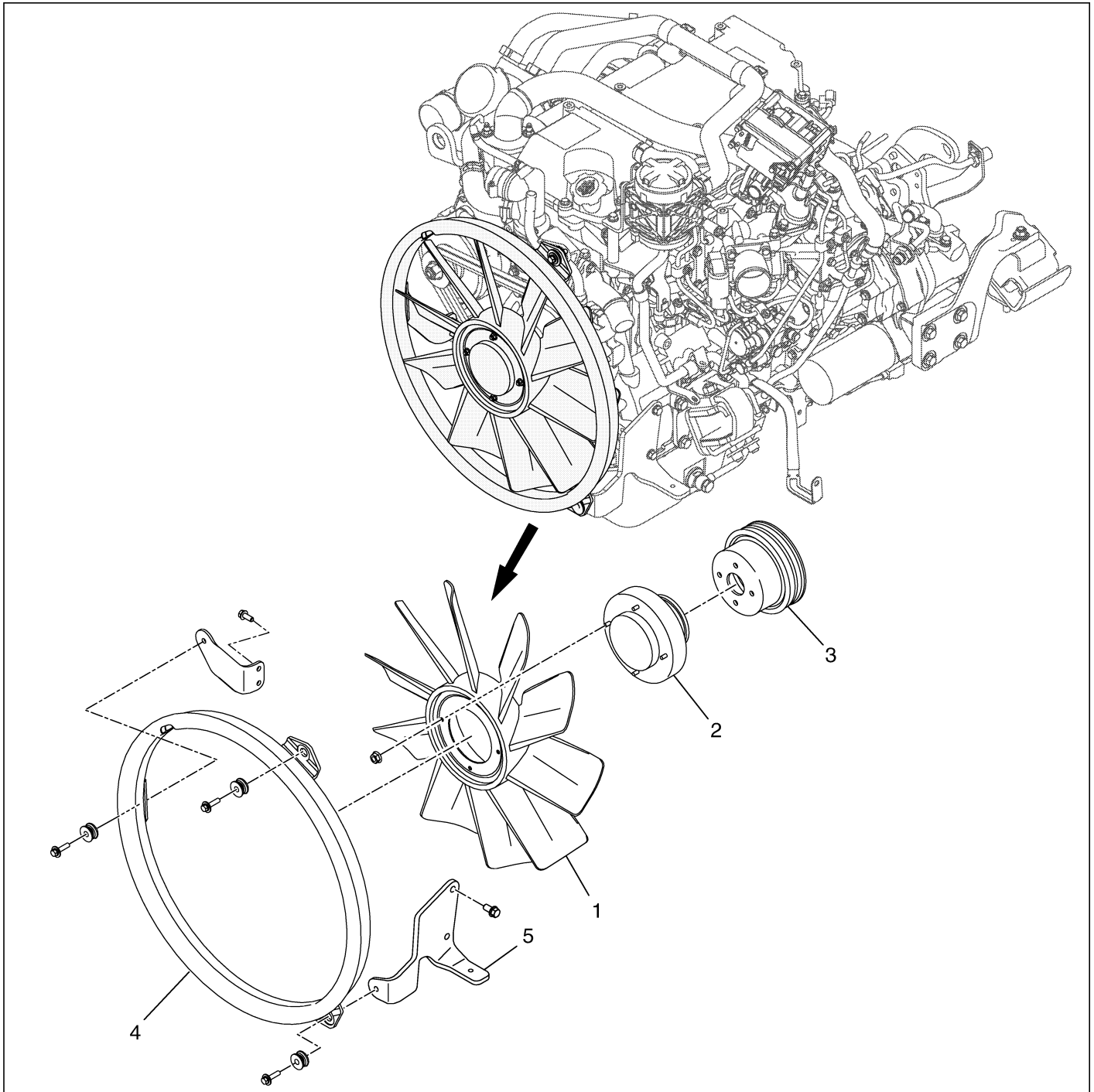
NOTICE

- The coolant filler cap valve opening pressure is indicated on the cap and it should be confirmed. If the cap pressure is incorrect, there is a risk of abnormally high pressure being generated in the cooling system, which may cause the hose to drop off or burst and may result in the damage of the engine.
- When carrying out high pressure washing to remove fin clogging, do not apply excessive pressure to the fins which may cause deformation and consequent performance deterioration.

COOLING FAN

COMPONENT LOCATOR

EN0110306D100005



SAPH011030600046

- 1 Cooling fan
- 2 Fan clutch
- 3 Fan pulley

- 4 Fan ring
- 5 Bracket

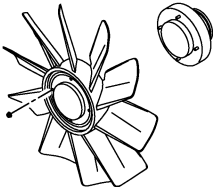
NOTICE

- **Shock to the fan clutch and fan.**
During maintenance and inspection, be careful not to drop or strike the fan clutch or fan itself. The resulting damage may lower the performance of the fan. Also, note that the fan is made of plastic and may become damaged or deformed if force is applied to it.
- **Replace the fan.**
Do not replace the fan unless it is faulty. When replacing the fan, replace with the same type. If the fan is replaced with one of a larger capacity because of overheating or, conversely is replaced with one of a smaller capacity due to overcooling, the performance may in fact be reduced and durability may be jeopardized.
- **Other items**
Check the bimetal to see if there is any mud or dust on it. If the bimetal is covered with mud or dust, the fan performance will be erratic, and may result in overheating or overcooling. In such case, carefully remove mud and dust adhering to the surface of the bimetal, using a wire brush, or the like.
Take particular care not to apply excessive force.
Do not paint the fan or fan clutch. Do not place any paint or other reagents which are likely to dissolve plastic in contact with the fan.

INSPECTION AND REPAIR

EN0110306H300003

Unit: mm {in.}

Inspection item	Standard	Limit	Remedy	Inspection procedure
Cooling fan and fan clutch deformation and damage	—	—	Replace if necessary.	Visual check 

FUEL SYSTEM (J05D)

EN07-001

FUEL SYSTEM.....EN07-2

DIAGRAM EN07-2

COMPONENT LOCATOR..... EN07-3

SUPPLY PUMPEN07-4

DESCRIPTION EN07-4

COMPONENT LOCATOR..... EN07-5

SPECIAL TOOL EN07-5

OVERHAUL EN07-6

COMMON RAIL.....EN07-11

DESCRIPTION EN07-11

OVERHAUL EN07-11

INJECTOR.....EN07-16

DESCRIPTION EN07-16

OVERHAUL EN07-17

FUEL FILTEREN07-21

DESCRIPTION EN07-21

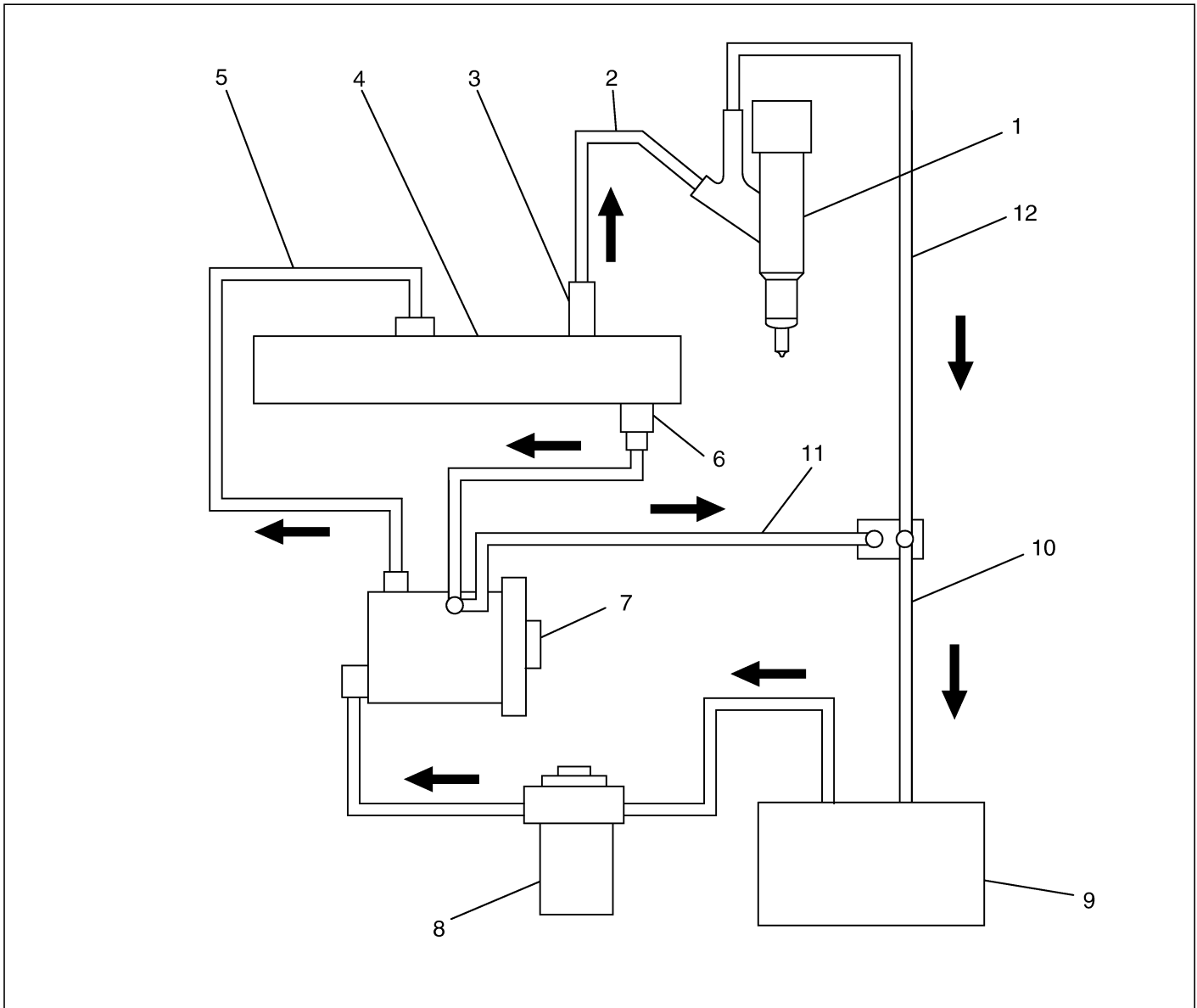
FUEL TANK.....EN07-22

COMPONENT LOCATOR..... EN07-22

FUEL SYSTEM

DIAGRAM

EN0110307J100001

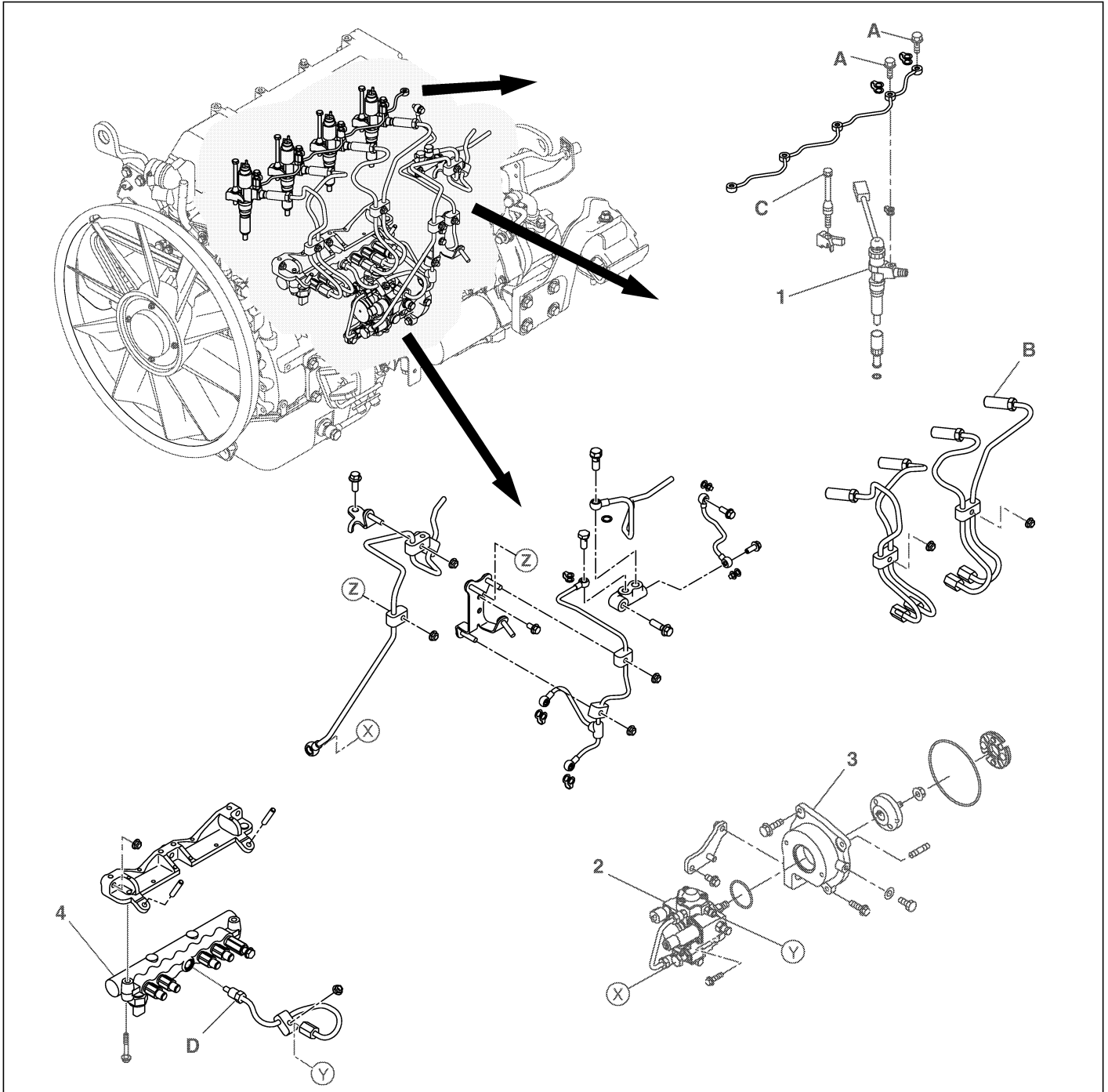


SAPH011030700001

1	Injector	7	Supply pump
2	Injection pipe	8	Fuel filter
3	Flow damper	9	Fuel tank
4	Common rail	10	Through feed pipe
5	Force feed pipe	11	Overflow pipe
6	Pressure limiter	12	Leakage pipe

COMPONENT LOCATOR

EN0110307C100001



SAPH011030700002

1	Injector	3	Bearing holder
2	Supply pump	4	Common rail

Tightening torque

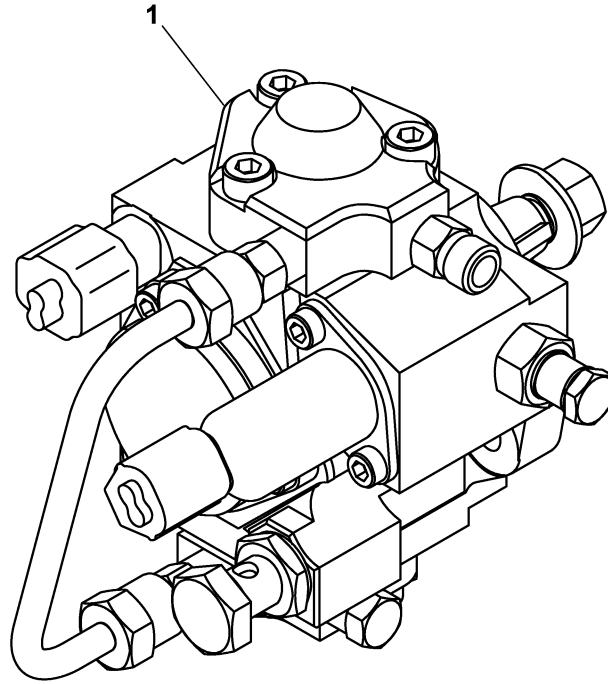
Unit: N·m {kgf·cm, lbf·ft}

A	12.7 {130, 9}	C	25 {250, 18}
B	39.2-49 {400-499, 29-36}	D	49-58.8 {500-599, 37-43}

SUPPLY PUMP

DESCRIPTION

EN0110307J100002

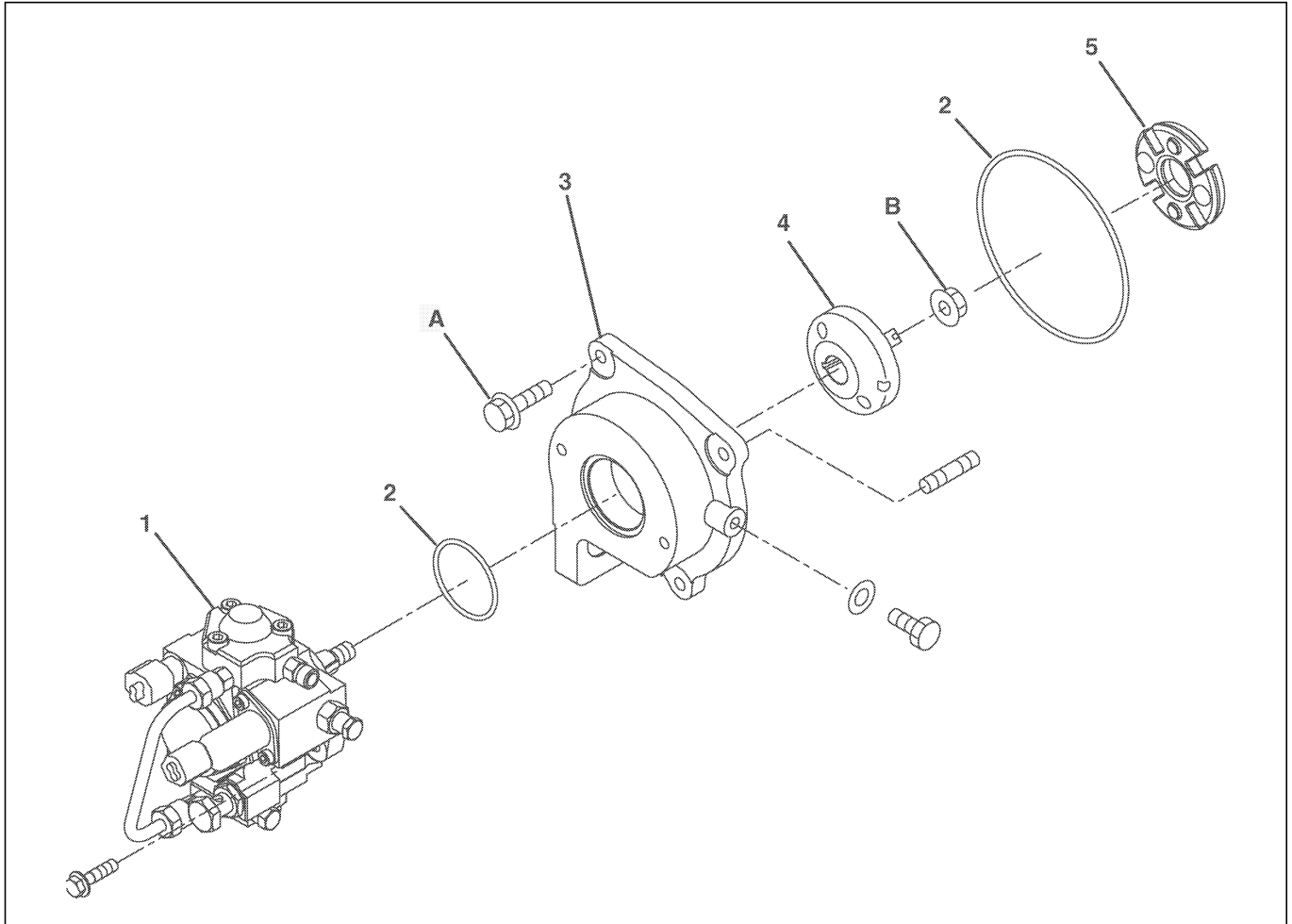


SAPH011030700003

1 Supply pump assembly	
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COMPONENT LOCATOR

EN0110307C100002



SAPH011030700004

1	Supply pump assembly	4	Coupling flange
2	O-ring	5	Coupling
3	Bearing holder case		

Tightening torque

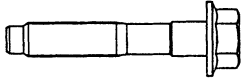
Unit: N·m {kgf·cm, lbf·ft}

A	28.5 {290, 21}	B	63.7 {650, 47}
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SPECIAL TOOL

EN0110307K100001

Prior to starting an engine overhaul, it is necessary to have these special tools.

Illustration	Part number	Tool name	Remarks
	SZ105-08067	GUIDE PIN	

OVERHAUL

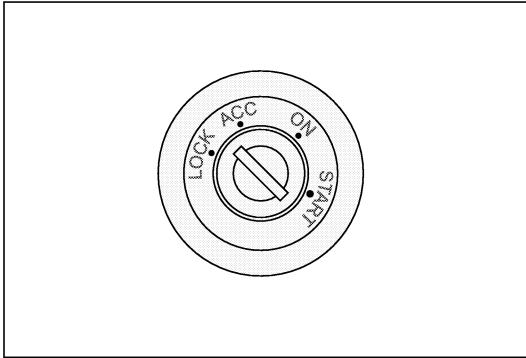
EN0110307H200001

IMPORTANT POINTS - DISMOUNTING

1. TURN THE STARTER SWITCH TO THE LOCK POSITION.

⚠ WARNING

Perform the following work after the engine cools off to avoid fire or burning. The fuel in the common rail could have a high temperature (approx. 100°C {212°F}) immediately after driving.



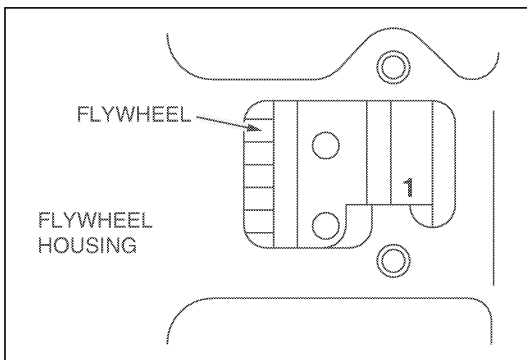
SAPH011030700006

2. POSITION THE No.1 CYLINDER TO THE TOP DEAD CENTER.

- (1) Turn the crankshaft counterclockwise (viewed from the flywheel side) to align mark "1" on the outer periphery of the flywheel with the pointer of the flywheel housing.

NOTICE

Always turn the crankshaft counterclockwise (viewed from the flywheel side).



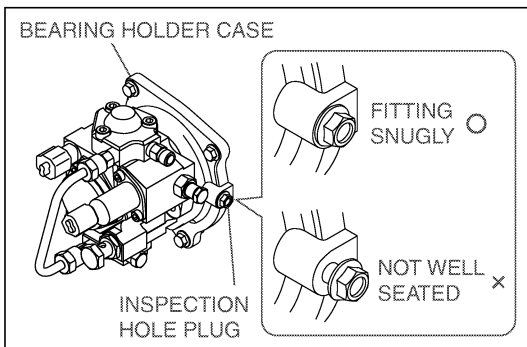
SAPH011030700007

- (2) Taking off the inspection hole plug, located at bearing holder case of supply pump and inserting the special tool therein, check that the seat face of tool is fitting snugly with the bearing holder.

SST: Guide pin (SZ105-08067)

NOTICE

When it is not well seated, it means it is contacting with other parts than the turning stopper hole of coupling flange. Therefore, don't insert in too much. In this case, the timing is not fit. So, perform again the setting for Top Dead Center of No.1 cylinder compression stroke in above (1).



SAPH011030700008

3. REMOVE THE FUEL SUPPLY PUMP.

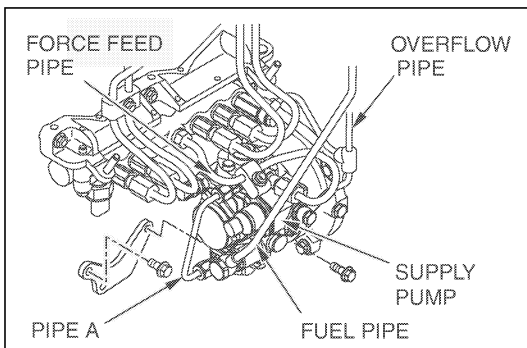
HINT

When the flow amount lacking, visit DENSO service center for the repair.

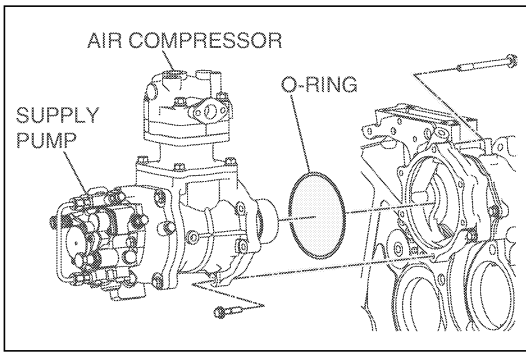
- (1) Disconnect the fuel lines, oil lines and harness connector.

NOTICE

Do not disconnect the pipe A shown in the figure.

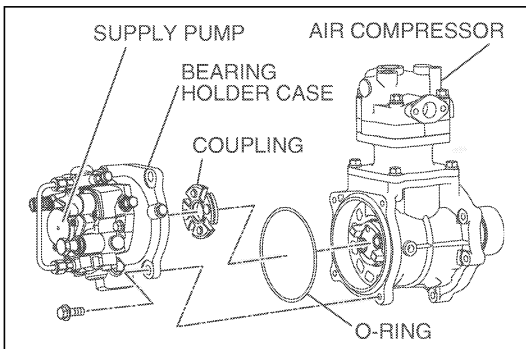


SAPH011030700009



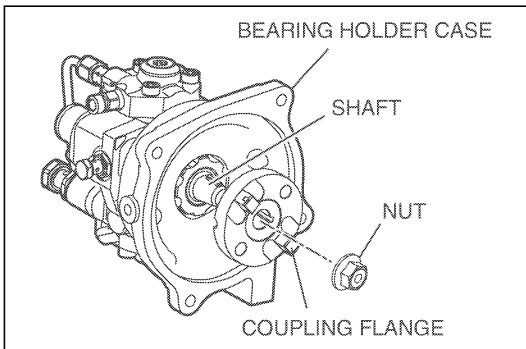
SAPH011030700010

- (2) Remove the six bolts for mounting the air compressor and dismounting the supply pump with the air compressor.



SAPH011030700011

- (3) Remove the bolts, and then the supply pump with the bearing holder case from the air compressor.



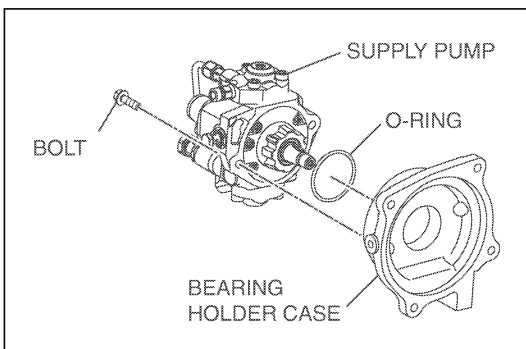
SAPH011030700012

- (4) Remove the nut, and then the coupling flange from the bearing holder case.

- (5) Remove the bolts, and then the bearing holder from the supply pump.

NOTICE

After dismounting the pump, cover the pump and high pressure pipe to prevent entry of dirt.

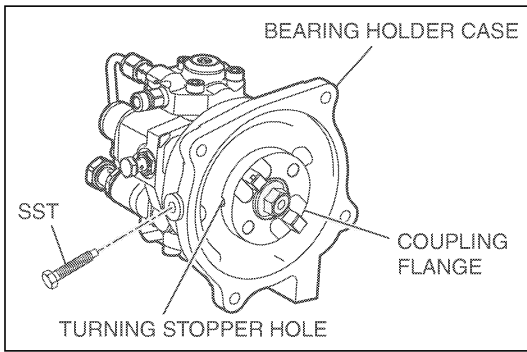


SAPH011030700013

IMPORTANT POINTS - MOUNTING

1. INSTALL THE FUEL SUPPLY PUMP.

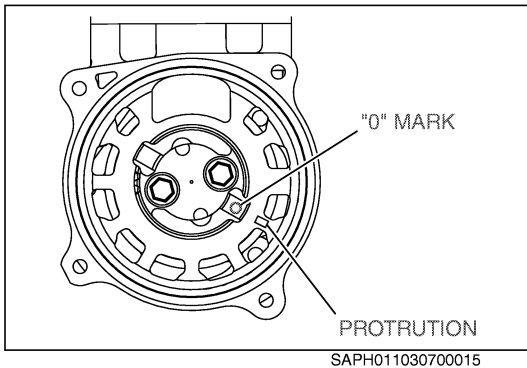
- (1) Install the O-ring to the supply pump.
- (2) Replace the O-ring with a new one and install the bearing holder to the supply pump.



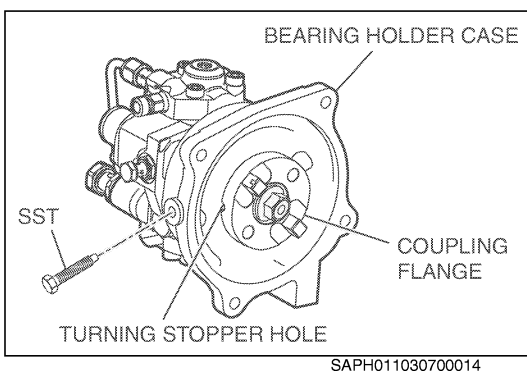
- (3) Install the coupling flange to the shaft.
- (4) Fixing the supply pump and performing the turning stop of Coupling flange with hand-vice or the like, tighten the nut in.

NOTICE

Don't use the special tool to stop the turning of Shaft.



- (5) Align the aligning mark "0" on the top of coupling flange with protrusion on the compressor housing.

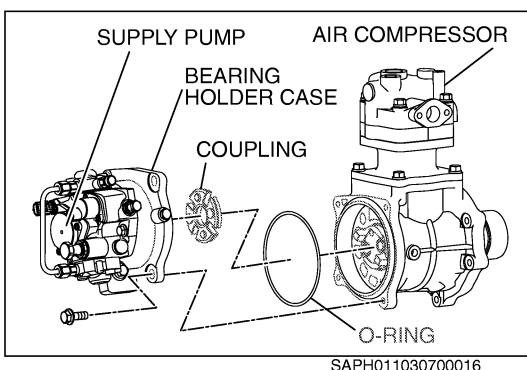


- (6) The special tool should be fit snugly with the turning stopper hole of Coupling flange through Bearing holder case.

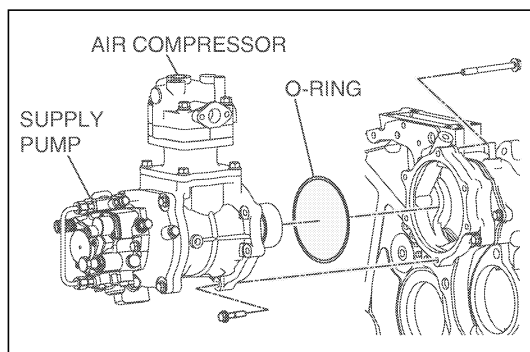
SST: Guide pin (S0904-81040)

NOTICE

- **Make sure not to insert the tool, fitting with other parts than the turning stopper hole of the Coupling and not to stop its inserting with use of other than the special tool.**
- **The specified tool is designed so that the tip of special tool might not touch deeply with its turning stopper hole (Clearance of the tip is 2 mm {0.079 in.}).**



- (7) Replace the O-ring with a new one and install it to the air compressor.
- (8) Install the supply pump to the air compressor.



SAPH011030700017

- (9) Replace the O-ring with a new one and install the air compressor with the supply pump to the flywheel housing.

NOTICE

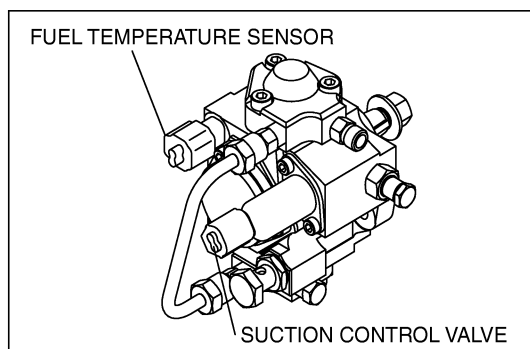
- Without moving the piston position fit to the top dead center of compression stroke in No. 1 cylinder, put the gears (timing gear side and air compressor one) in engagement.
- When cranking Engine, make sure to remove off the special tool.
- After completing the installation, make sure to remove the special tool and to install inspection window plug.

2. RESETTING FOR THE VALUES OF SUPPLY PUMP.

- (1) Reset the values memorized in Engine ECU by re-programing when replacing Supply pump.

NOTICE

Unless the same values are not reset, correct control of common rail will not be done, which will cause Engine stall or abnormality in high common rail pressure. Therefore, make sure to reset the same values when replacing Supply pump.



SAPH011030700018

IMPORTANT POINT - ONBOARD INSPECTION**1. INSPECT THE SUCTION CONTROL VALVE (SCV) AND FUEL TEMPERATURE SENSOR.**

- (1) Measure the resistance between terminals.
If not standard value, replace supply pump assembly.

Standard:

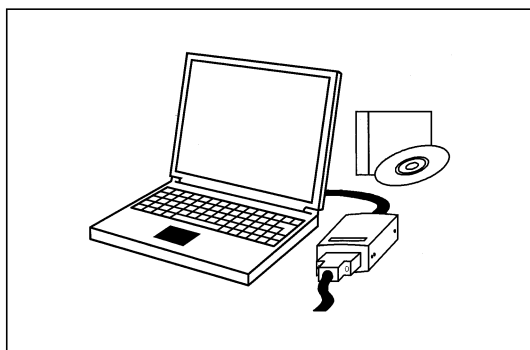
SCV	1.6 - 2.6 Ω at 20°C {68°F}
Fuel temperature sensor	2.45 kΩ at 20°C {68°F}
	1.15 kΩ at 40°C {104°F}
	584 Ω at 60°C {140°F}
	318 Ω at 80°C {176°F}

NOTICE

If SCV and fuel temperature sensor need replacements, they should be serviced by Denso service dealer.

2. RESET THE ECU DEFAULT VALUE.**NOTICE**

- It is necessary to reset the ECU default value using the diagnosis tool at the time of supply pump service replacement. In addition, the ECU has a function enabling it to learn the performance of the supply pump at the time of ECU service replacement, so ensure sufficient time (several minutes) is available.
- Diagnosis tool refer to chapter "FUEL CONTROL" on page DN02-18. ECU default value can be reset by "Supply pump specification learning" in the "Check function" menu.



SAPH011030700019

Supply pump specification learning

Supply pump specification learning

Data View

Item	Value	Unit
Engine coolant temperature	428497216	°C
Fuel temperature	428497216	°C
Flag of having learned specific value of t.	[Pre-Learning]	

Explanation

Warm up the engine till the coolant temperature is more than 80°C [180 °F] and the fuel temperature is more than 30°C [85 °F].

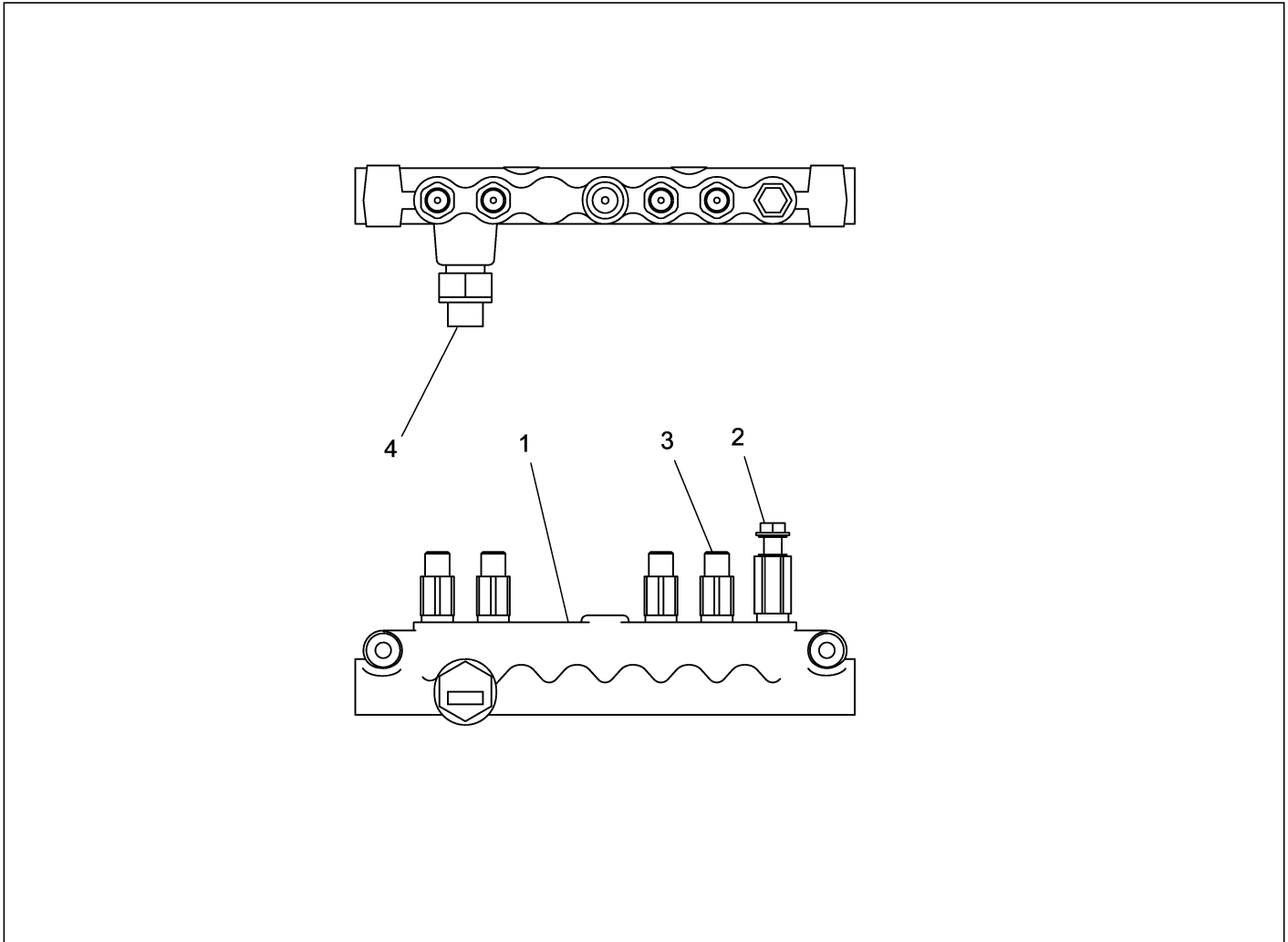
Confirm following diagnostic trouble code is not detected
 -P0191, P0192, P0193 (Sensor A/B pressure sensor malfunction)

SAPH011030700020

COMMON RAIL

DESCRIPTION

EN0110307J100003



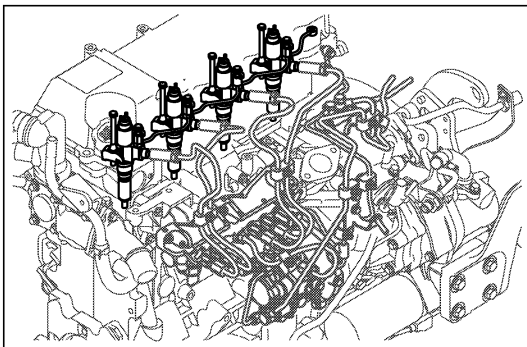
SAPH011030700021

1 Common rail
2 Pressure limiter

3 Flow damper
4 Pressure sensor

OVERHAUL

EN0110307H200002



SAPH011030700022

IMPORTANT POINTS - DISMOUNTING

1. CLEAN OFF SURROUNDING AREA OF THE NOZZLE AND THE FUEL LINE CONNECTORS.

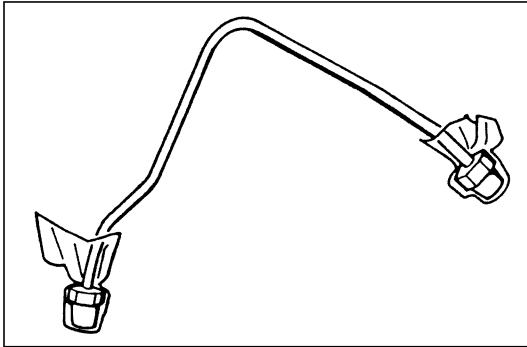
NOTICE

If foreign matter is allowed to enter the combustion chamber, engine trouble may result.

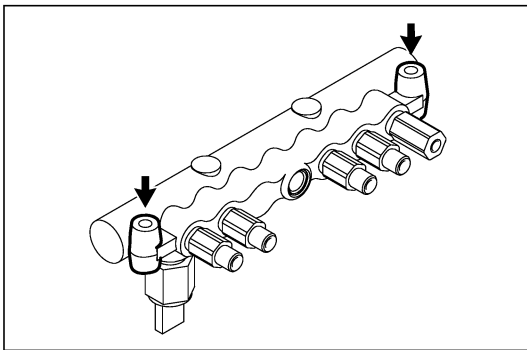
2. REMOVE THE FUEL INJECTION PIPE.
 - (1) Remove the return pipe.
 - (2) Loosen the injection pipe nut.
 - (3) Remove the force feed pipe.

NOTICE

Cover open ends of the pipes and fuel supply pump to prevent entry of dirt.



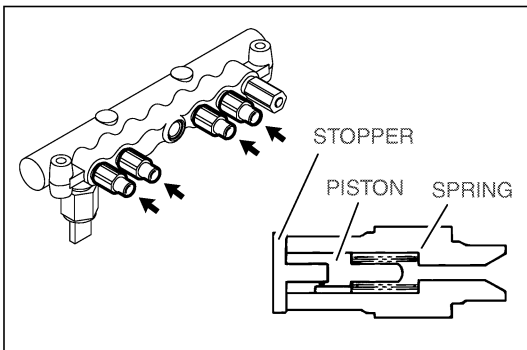
SAPH011030700023



SAPH011030700024

3. REMOVE THE COMMON RAIL

- (1) Disconnect the connectors.
- (2) Remove the 2 bolts and common rail.



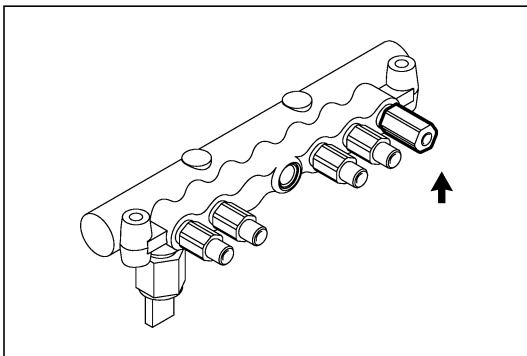
SAPH011030700025

IMPORTANT POINTS - DISASSEMBLY**1. REMOVE THE FLOW DAMPER**

- (1) Using a 19 mm {0.749 in} width across flats deep socket wrench, loosen the flow damper by turning in counter-clockwise direction.
- (2) Remove the flow damper assembly (spring, piston and stopper).

NOTICE

Be careful not drop parts into common rail.



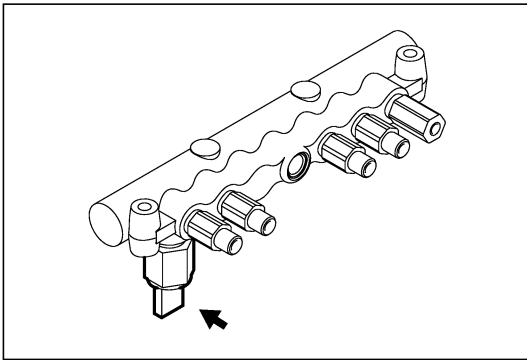
SAPH011030700026

2. REMOVE THE PRESSURE LIMITER.

- (1) Using a 19 mm {0.749 in} width across flats deep socket wrench, loosen the pressure limiter by turning in counter-clockwise direction.
- (2) Remove the pressure limiter.
- (3) Using tweezers, remove the gasket.

NOTICE

Be careful not to damage the seal surface.



SAPH011030700027

3. REMOVE THE COMMON-RAIL PRESSURE SENSOR.

- (1) Using a 30 mm {1.181 in} width across flats deep socket wrench, loosen the common-rail sensor by turning in counter-clockwise direction.
- (2) Remove the common-rail sensor.

NOTICE

Never reuse a used common-rail pressure sensor. Because if it is reused, its thread may break.

IMPORTANT POINT - ON - VEHICLE INSPECTION

1. INSPECT THE PRESSURE SENSOR.

- (1) If the diagnosis monitor lamp come on, and the following malfunction is displayed at the diagnosis system, replace the pressure sensor.
 - a. Harness disconnection or short-circuit in the pressure sensor circuit
 - b. Common rail pressure does not change at a certain time while the engine is running.
- (2) Measure the resistance between terminals. If not standard value, replace sensor.

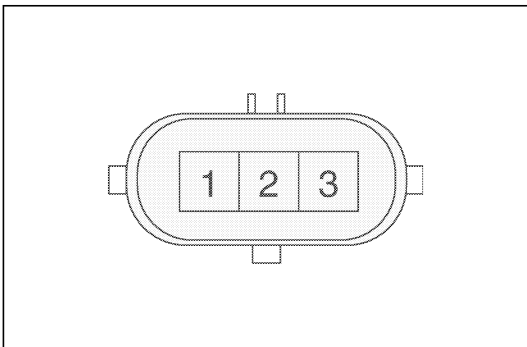
Standard: (Engine stop condition)

Terminal 2 and 3

6.5 - 18.5 k Ω

Terminal 1 and 2

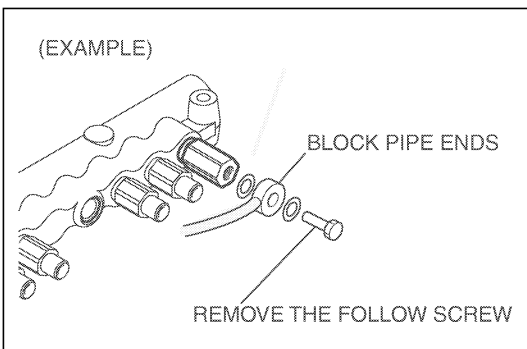
0.5 - 3.0 k Ω



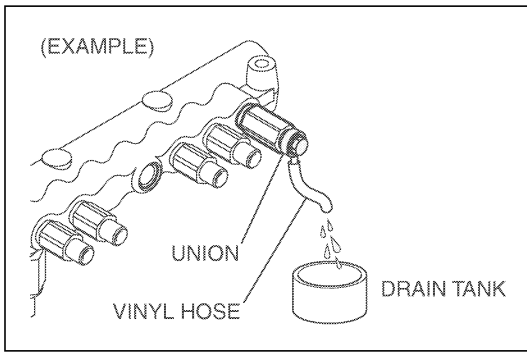
SAPH011030700028

2. INSPECT THE PRESSURE LIMITER.

- (1) Remove the follow screw from pressure limiter.
- (2) Block pipe ends to prevent fuel leak.



SAPH011030700029

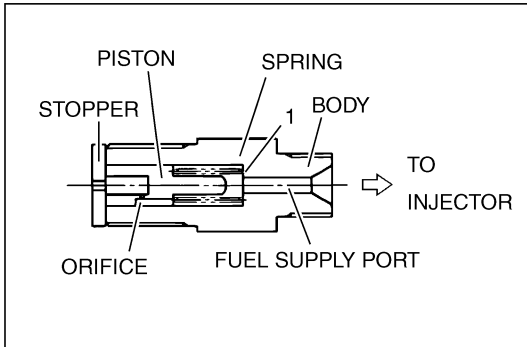


SAPH011030700030

- (3) Install the union to the pressure limiter.
- (4) Set a vinyl hose to the union and set a drain tank.
- (5) Start the engine. If the fuel flows continuously, replace the pressure limiter.

⚠ WARNING

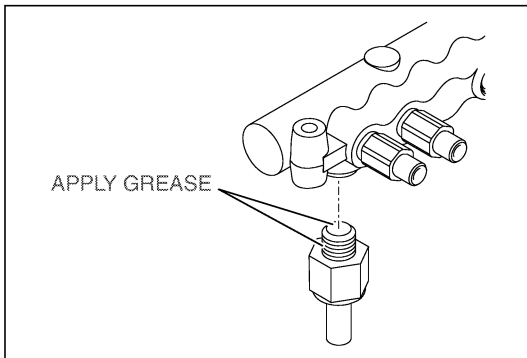
When the pressure limiter is working, fuel flows out at a high temperature and pressure. Serious injury like scalding could result from this hot fuel being blown out under pressure.



SAPH011030700031

3. INSPECT THE FLOW DAMPER.

- (1) Check that the piston is not sticking in the body. If the piston sticks, replace the flow damper.
- (2) Inspect the contact surface 1 between piston and fuel supply port. If there is wear and damage, replace the flow damper assembly.
- (3) Inspect clogging on the piston orifice. Clean or replace the flow damper assembly.



SAPH011030700032

IMPORTANT POINTS - ASSEMBLY

NOTICE

- Every part of the common rail should be washed clean carefully laying threaded side below.
- Be careful to prevent dust from entering inside.

1. INSTALL THE COMMON-RAIL PRESSURE SENSOR.

- (1) Install the new common-rail pressure sensor.

NOTICE

- Apply clean grease to the pressure sensor as shown in the figure.
- Be careful to prevent dust from entering inside.

- (2) Tighten the new pressure sensor.

Tightening Torque:

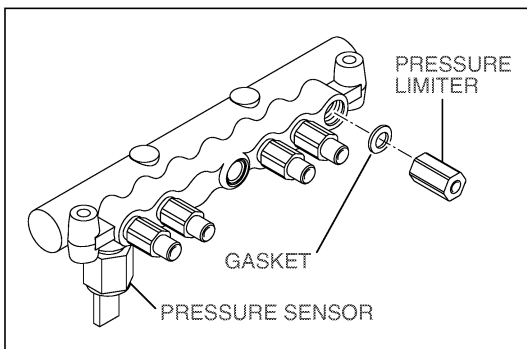
98 N·m {1,000 kgf·cm, 72 lbf·ft}

2. INSTALL THE PRESSURE LIMITER.

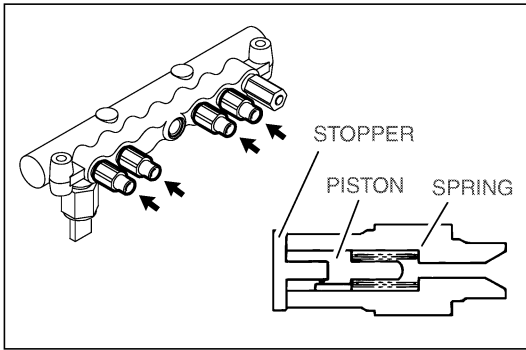
- (1) Install the pressure limiter with a new gasket.

Tightening Torque:

172 N·m {1,750 kgf·cm, 126 lbf·ft}



SAPH011030700033



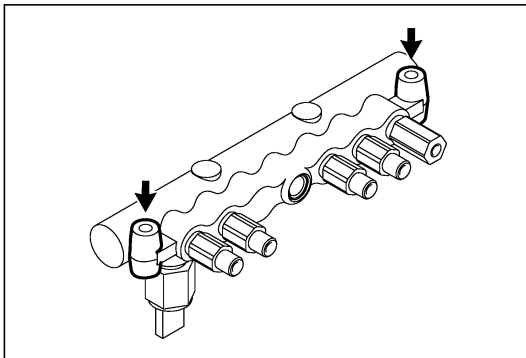
SAPH011030700034

3. INSTALL THE FLOW DAMPER.

- (1) Install the stopper.
- (2) Install the flow damper with the piston and spring.

Tightening Torque:

128 N·m {1,305 kgf·cm, 94 lbf·ft}



SAPH011030700035

IMPORTANT POINT - MOUNTING

1. INSTALL THE COMMON RAIL ASSY.

- (1) Install the common rail with 2 bolts.

Tightening Torque:

28.5 N·m {290 kgf·cm, 21 lbf·ft}

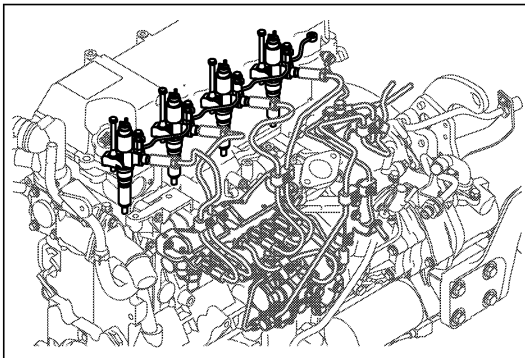
- (2) Connect the connector.

NOTICE

- Be careful to prevent dust from entering inside the common rail and parts when the mounting is performed. Dust and foreign matter must not adhere to the seats of the parts and common rail main unit.
 - After the operation is completed, wipe off the fuel which leaked and start the engine. Make sure that the fuel does not leak again.
- (3) Tighten the injector pipe nuts to the specified torque.

Tightening Torque:

44 N·m {450 kgf·cm, 32 lbf·ft}



SAPH011030700022

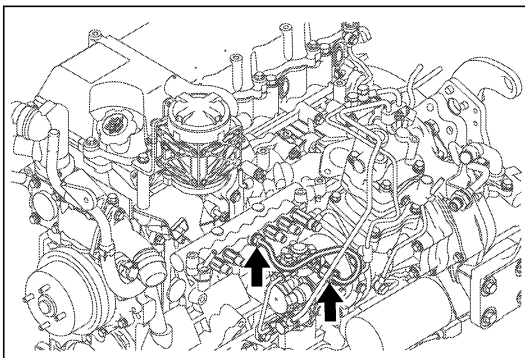
- (4) Tighten the force feed pipe nuts to the specified torque.

Tightening Torque:

44 N·m {450 kgf·cm, 32 lbf·ft}

NOTICE

- If the tightening torque of the nuts is less than the specified value, it may cause a fuel leak. If the tightening torque of the nuts is greater than the specified value it may have a negative influence on the engine function. As a result, always perform torque management.
- After mounting is completed, Fuel leak check using "check functions" menu of HINO DX.

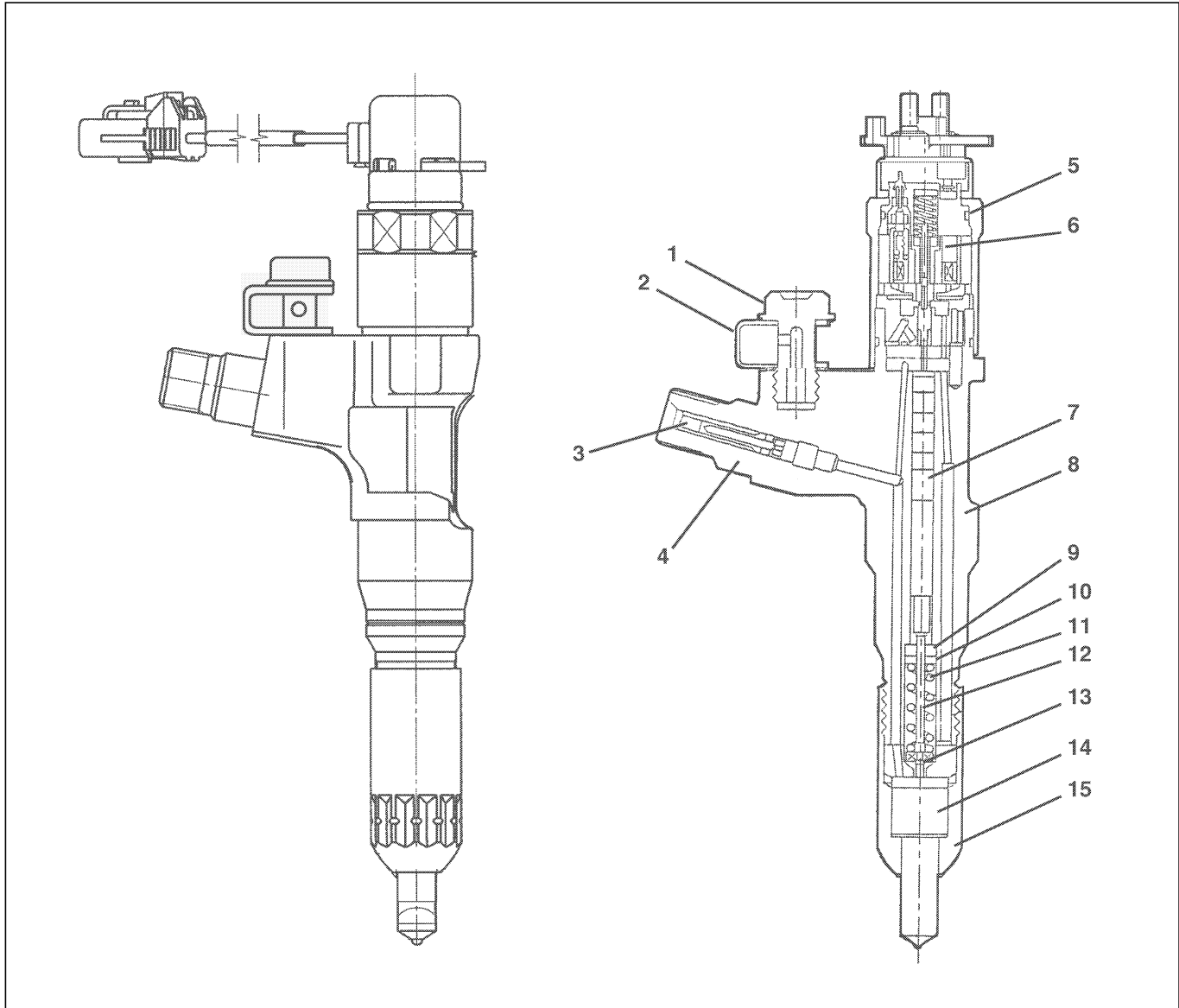


SAPH011030700036

INJECTOR

DESCRIPTION

EN0110307C100003



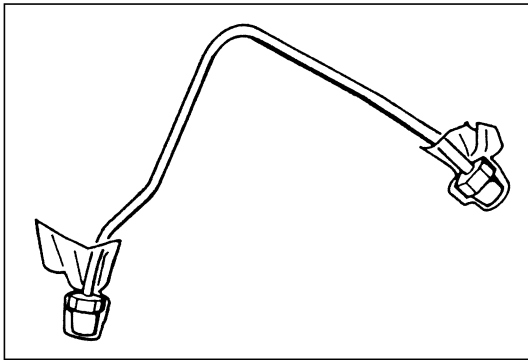
SAPH011030700037

- | | |
|---|---------------------|
| 1 | Return joint bolt |
| 2 | Gasket |
| 3 | Filter |
| 4 | Inlet connector |
| 5 | O-ring |
| 6 | Two way valve (TWV) |
| 7 | Piston |
| 8 | Lower body |

- | | |
|----|---------------|
| 9 | Guide bushing |
| 10 | Shim |
| 11 | Nozzle spring |
| 12 | Pressure pin |
| 13 | Tip seal |
| 14 | Nozzle |
| 15 | Retaining nut |

OVERHAUL

EN0110307H200003



SAPH011030700038

IMPORTANT POINTS - DISMOUNTING

1. **CLEAN OFF SURROUNDING AREA OF THE NOZZLE AND THE FUEL LINE CONNECTORS.**

NOTICE

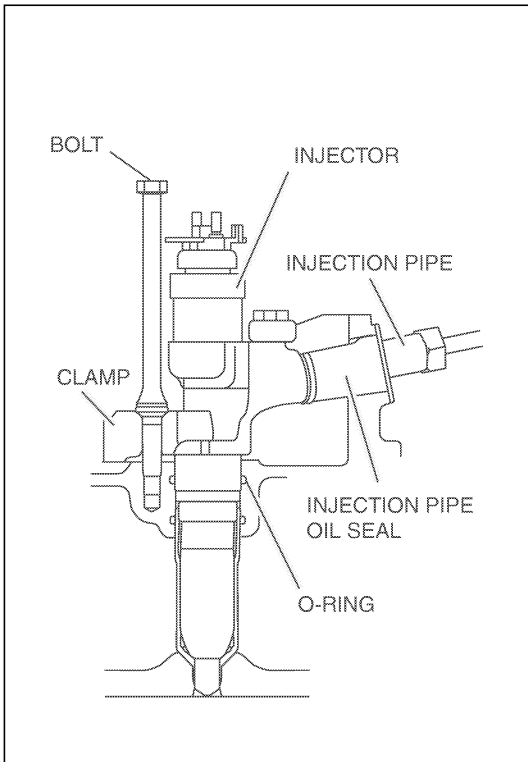
If foreign matter is allowed to enter the combustion chamber, engine trouble may result.

2. **REMOVE THE INJECTOR.**

- (1) Disconnect of the harness coupler.
- (2) Remove the leakage pipe.
- (3) Remove the injection pipe.
- (4) Remove the bolt of the injection pipe seal and pull it with the injection pipe from the camshaft housing.

NOTICE

Cover open ends of the pipes and fuel supply pump to prevent entry of dirt.



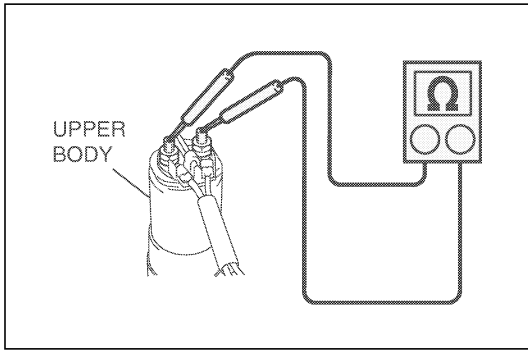
SAPH011030700039

3. **REMOVE THE INJECTOR ASSEMBLY.**

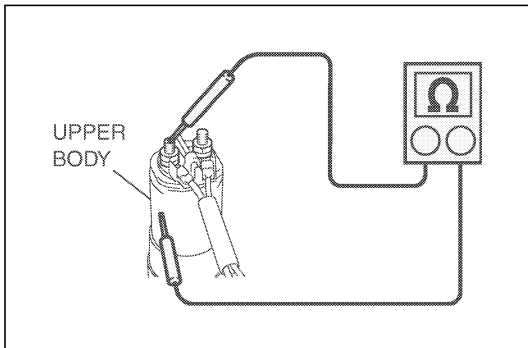
- (1) Remove the injector clamp bolt.
- (2) Pull out the injector assembly taking care not to contact other parts.
- (3) Remove the O-ring.

NOTICE

Replace the O-ring with a new one.



SAPH011030700040



SAPH011030700041

IMPORTANT POINT - ON-VEHICLE INSPECTION

1. INSPECT THE INJECTOR.

- (1) Measure the resistance between terminals.
If not standard value, replace injector assembly.

Standard:

0.35-0.55 Ω at 20°C {68°F}

- (2) Measure the resistance of insulation between terminals and upper body. If not standard value, replace injector assembly.

Standard:

More than 1000 M Ω

NOTICE

Other inspections and nozzle replacements should be done by Denso service dealer.

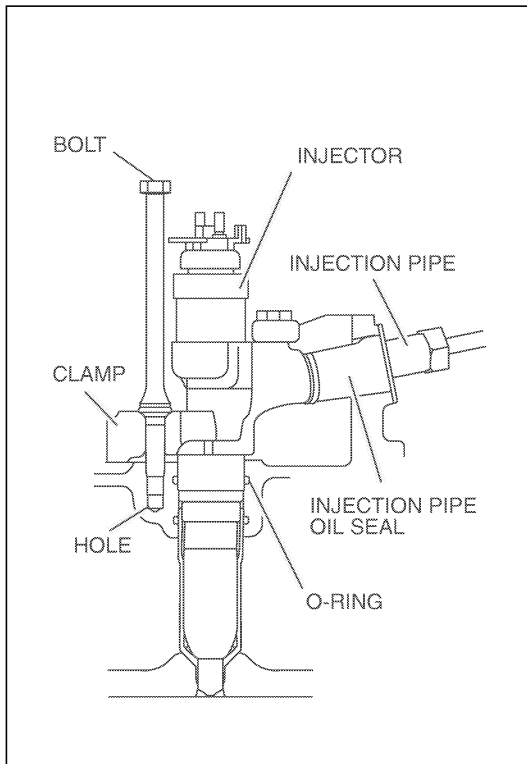
- (3) Inspect terminals.

Remove any sludge adhering to the terminals or area surrounding the terminals.

NOTICE

When removing sludge, do not use cleaning fluids.

Use dry cloth. (If cleaning fluids are used, there is a possibility that an electrical malfunction will occur.)



SAPH011030700042

IMPORTANT POINTS - MOUNTING

1. INSTALL THE INJECTOR ASSEMBLY.

- (1) Install a new O-ring into the groove of the cylinder head, and then insert the injector.

NOTICE

Apply engine oil to the O-ring, so that the O-ring will not be caught.

- (2) Install the injector clamp, and install the injector temporarily.

NOTICE

Do not fix the injector clamp before the injection pipe is temporarily installed.

- (3) Cover the injector with a new injection pipe oil seal, and then install the plate and nut.

NOTICE

Be careful not to apply excessive force to the injector when applying the injection pipe oil seal to it. If the injection pipe oil seal and injector are moved even slightly, it may cause oil leakage or faulty assembling of the injection pipe.

- (4) Assemble the injection pipe temporarily, and tighten the installation bolt of the injector clamp.

Tightening Torque:

25 N·m {250 kgf·cm, 18 lbf·ft}

NOTICE

Carefully using compressed air clean out any oil or debris from injector hold down mounting hole in cylinder head.

- (5) Tighten the nut of the injection pipe to the specified torque.

Tightening Torque:

44 N·m {450 kgf·cm, 32 lbf·ft}

- (6) Install the leakage pipe with the 4 new gasket and 4 joint bolts.

Tightening Torque:

12.7 N·m {130 kgf·cm, 9 lbf·ft}

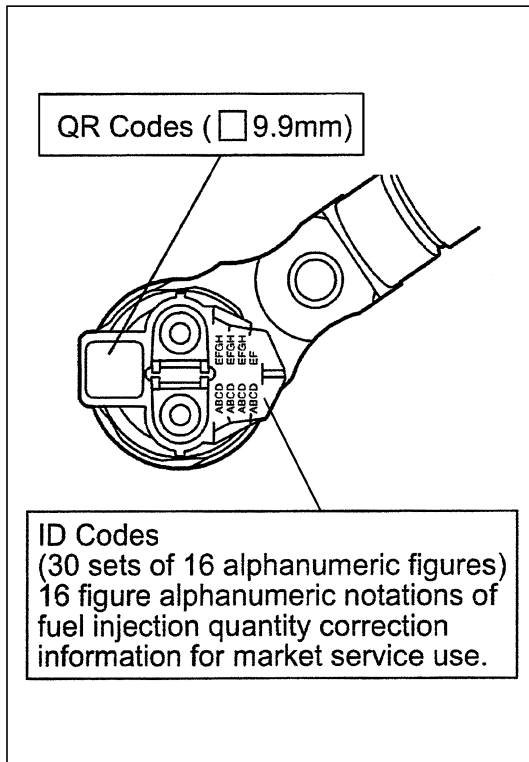
NOTICE

Avoid installation of wrong bolt at fuel return of injectors and fuel return of cylinder head. The bolt of cylinder head and injectors are different screw pitch each.

The bolt of fuel return of cylinder head: Flat head, 1.25 mm screw pitch

The bolt of fuel return of injectors: Concave head, 1 mm screw pitch

- (7) Connect the harness couplers.



SAPH011030700043

2. ENTER THE ID CODES IN THE ECU.

- (1) QR (Quick Response) codes displaying various injector characteristics and the ID codes showing these in numeric form (30 alphanumeric figures) are engraved on the injector head.

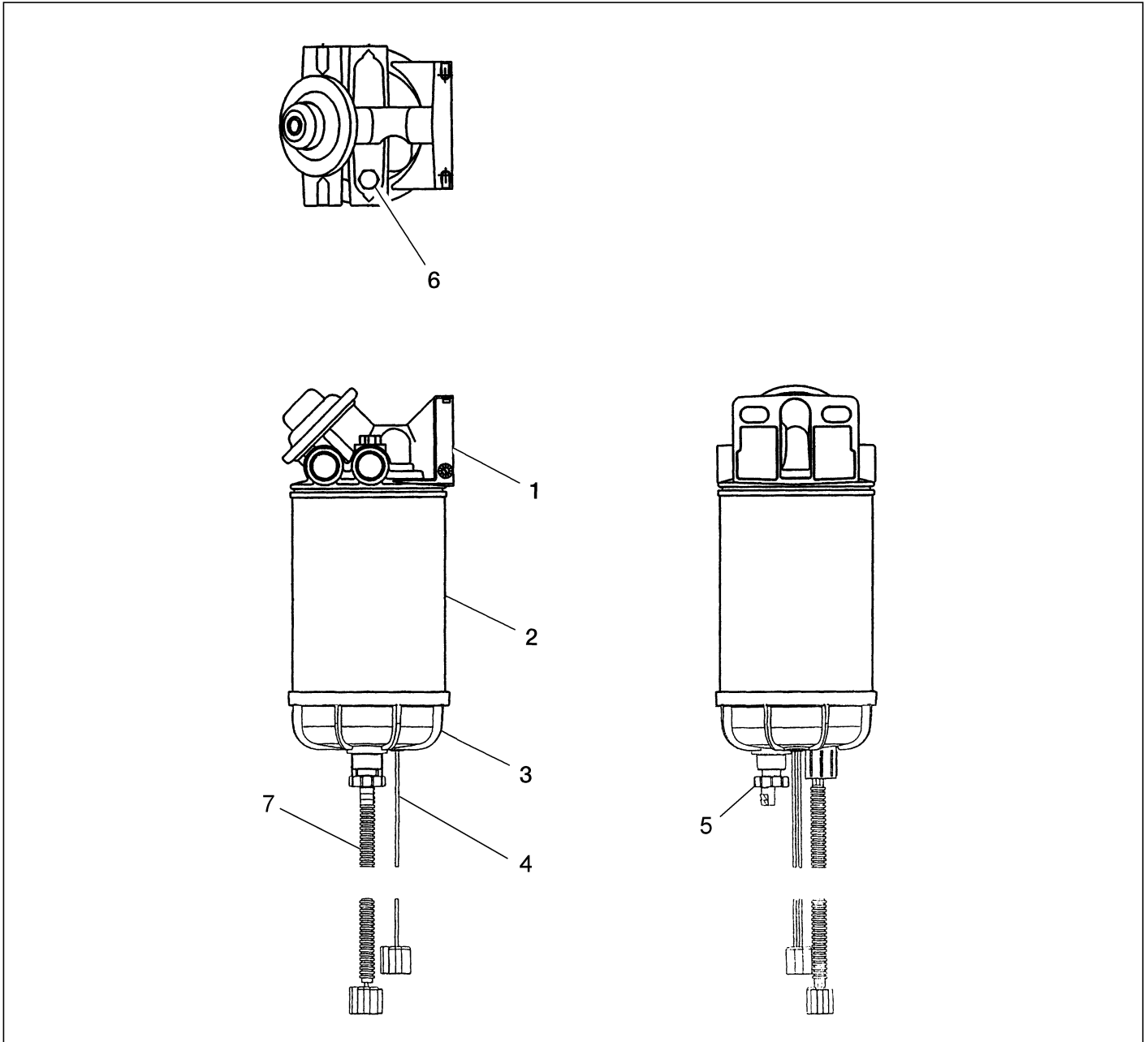
NOTICE

When replacing injectors with QR codes, or the engine ECU, it is necessary to record the ID codes (QR codes) in the ECU by using the Diagnostic tool. (If the ID codes of the installed injector are not registered correctly, engine failure such as rough idling and noise will result.)

FUEL FILTER

DESCRIPTION

EN0110307J100004



SAPH011030700044

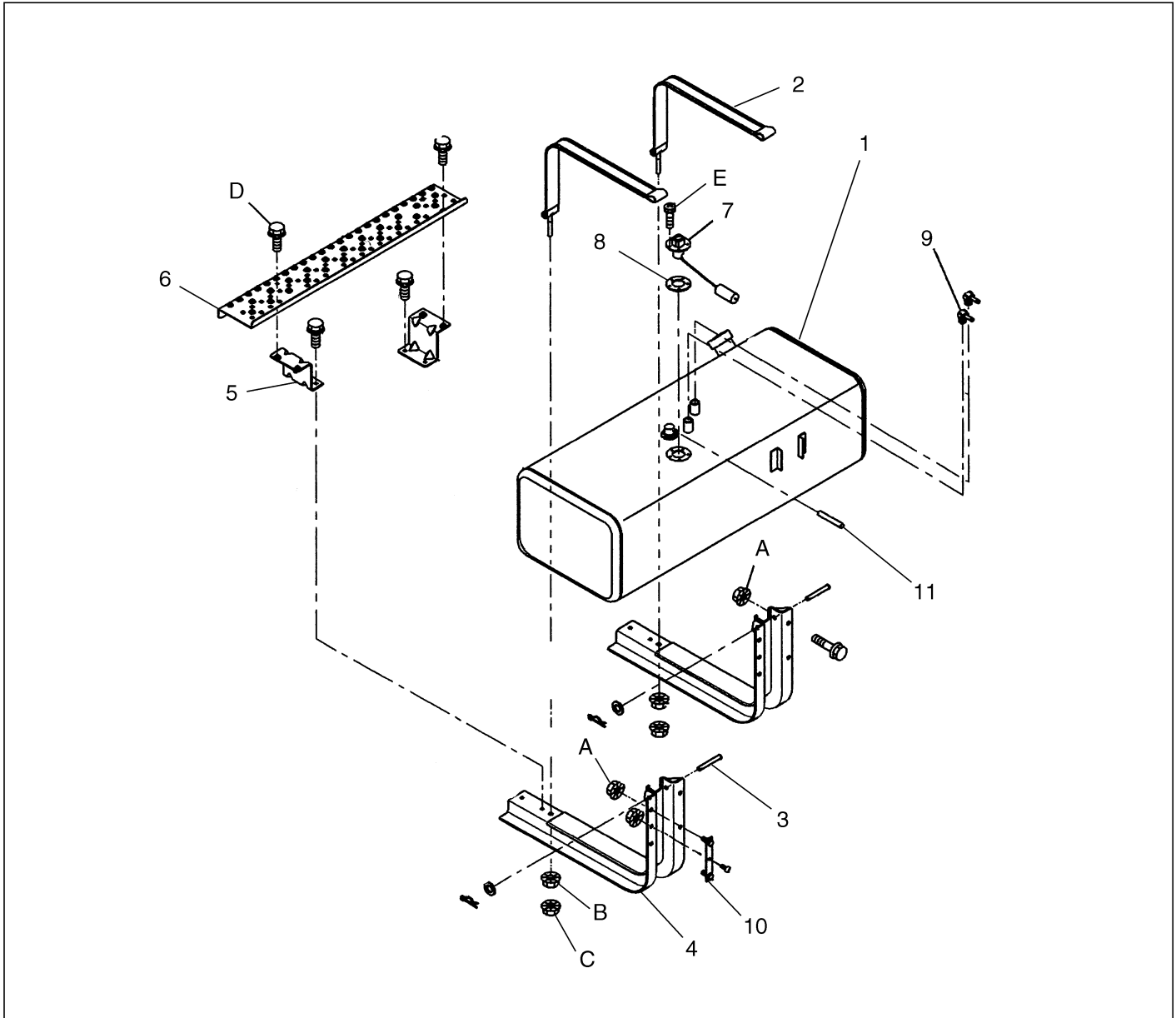
- 1 Hand priming pump head
- 2 Element
- 3 Bowl water drain
- 4 Heater (optional) harness

- 5 Drain valve
- 6 Vent plug
- 7 Water level sensor harness

FUEL TANK

COMPONENT LOCATOR

EN0110307J100005



SAPH011030700045

1	Fuel tank	7	Fuel sender
2	Fuel tank band	8	Gasket
3	Pin	9	Joint
4	Fuel tank support	10	Plate, fuel tank set
5	Step bracket	11	Hose
6	Step		

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A	73-109 {745-1112, 54 - 80}	D	34.5-51.5 {352-525, 25-38}
B	24.5-31.5 {250-320, 18 - 23}	E	0.5-0.7 {5-7, 0.369-0.506}
C	39.4-63 {402-643, 29-46}		

TURBOCHARGER (J05D)

EN08-001

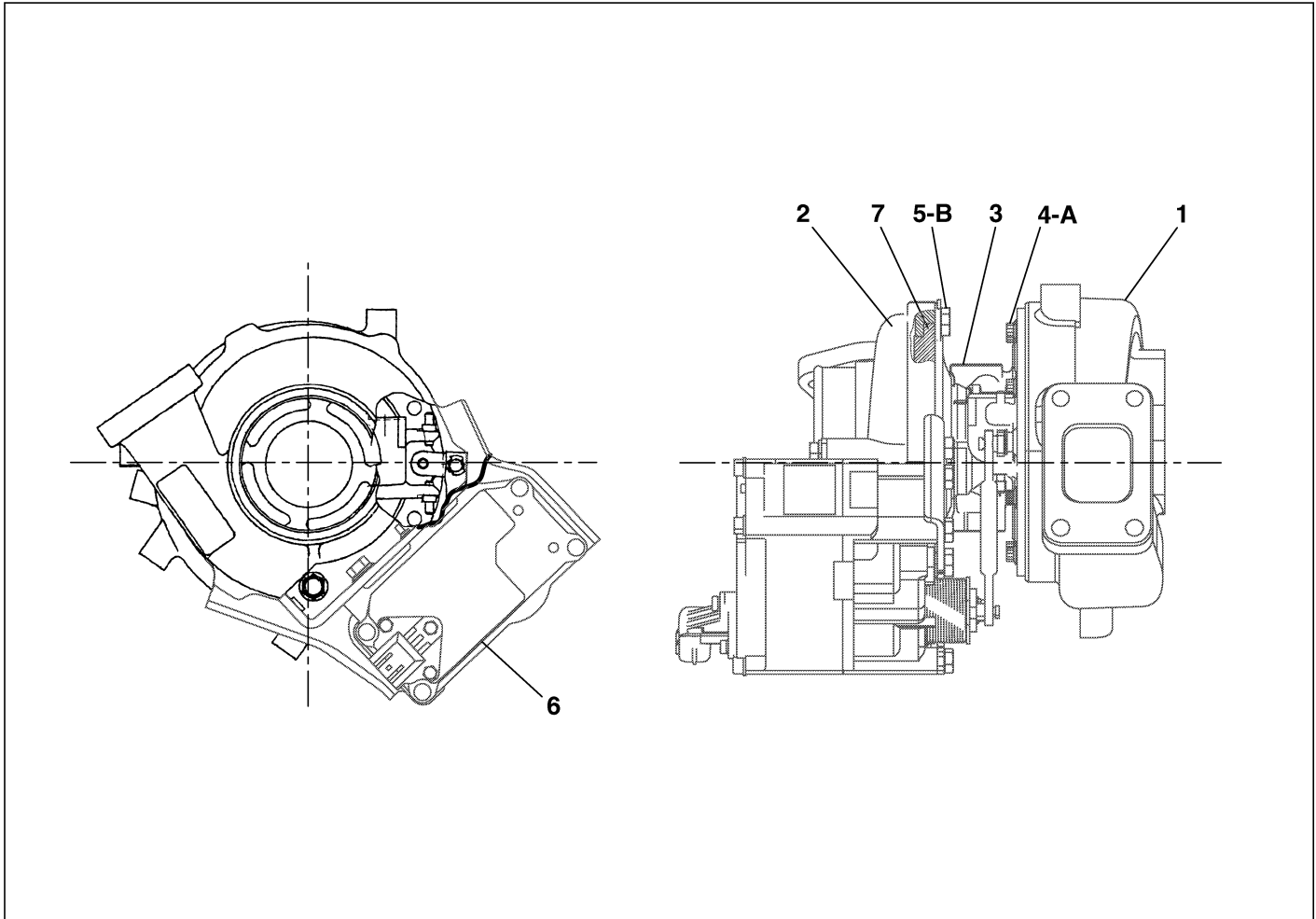
TURBOCHARGER	EN08-2
DESCRIPTION	EN08-2
TROUBLESHOOTING	EN08-3
SPECIAL TOOL	EN08-11
OVERHAUL CRITERIA.....	EN08-12



TURBOCHARGER

DESCRIPTION

EN0110308C100001



SAPH011030800001

1	Turbine housing	5	Bolt, compressor bolt
2	Compressor housing	6	Actuator assy
3	Center housing and rotating assy	7	O-ring
4	Belt, turbine		

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A	20.9-24.3 {213-248, 15.4-17.9}	B	10.8-14.2 {110-145, 7.9-10.4}
---	--------------------------------	---	-------------------------------

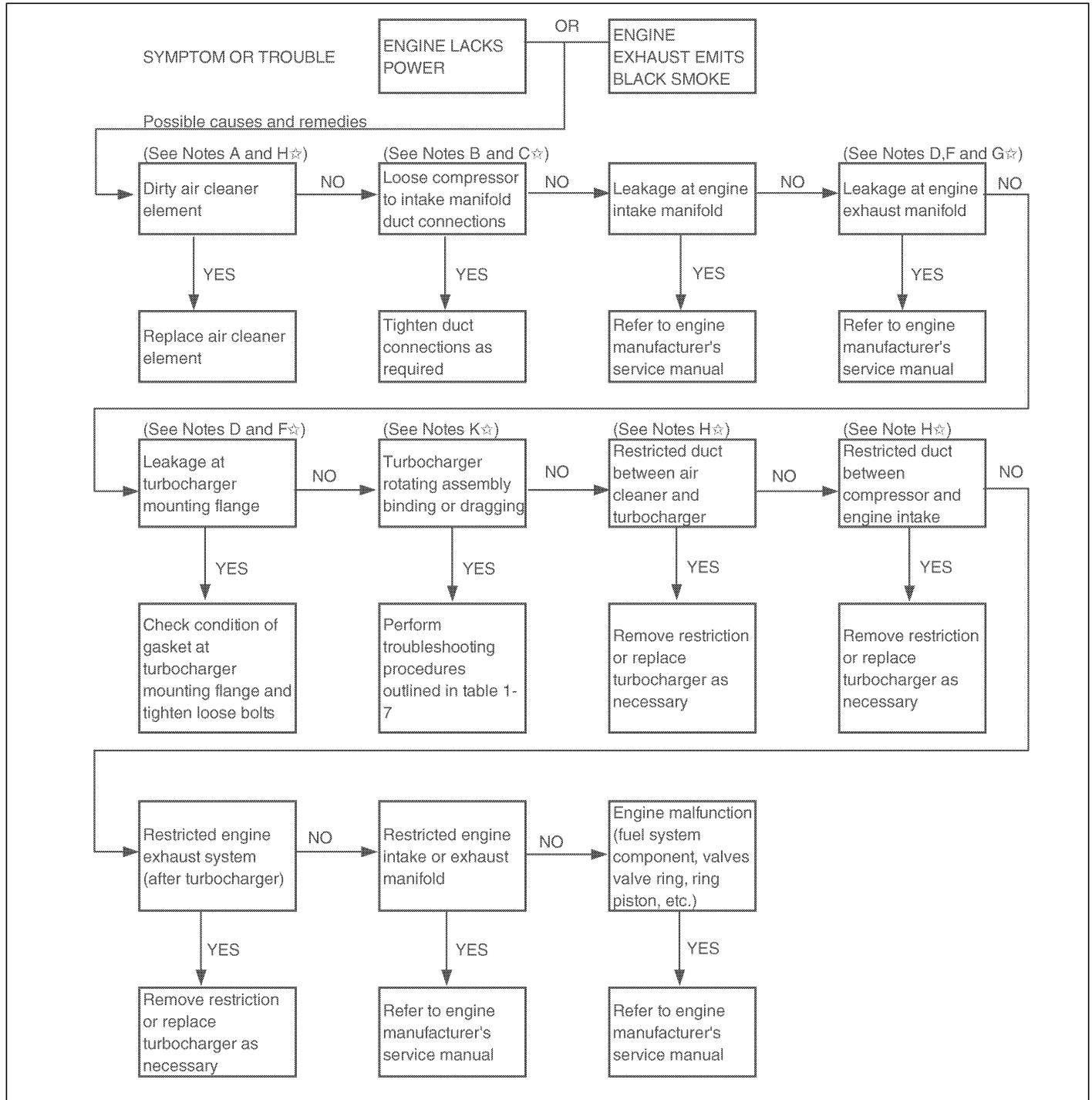
NOTICE

This turbocharger should not be disassembled unless by turbocharger manufacture. The turbocharger parts cannot be replaced.

TROUBLESHOOTING

EN0110308F300001

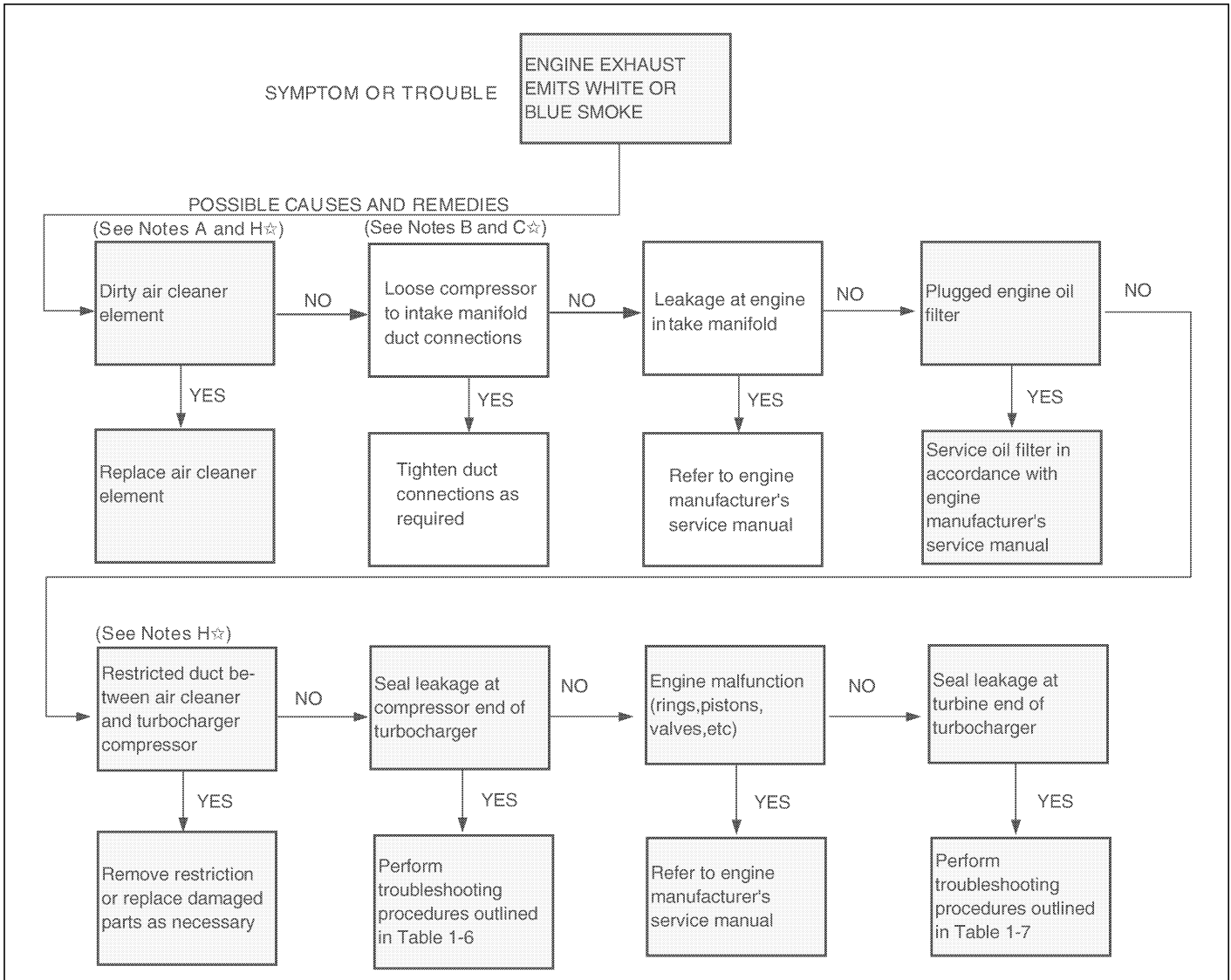
1. Table 1-1 Troubleshooting-Engine Exhaust Lacks Power or Engine Exhaust Emits Black Smoke



SAPH011030800002

☆ Shown on Table 1-9

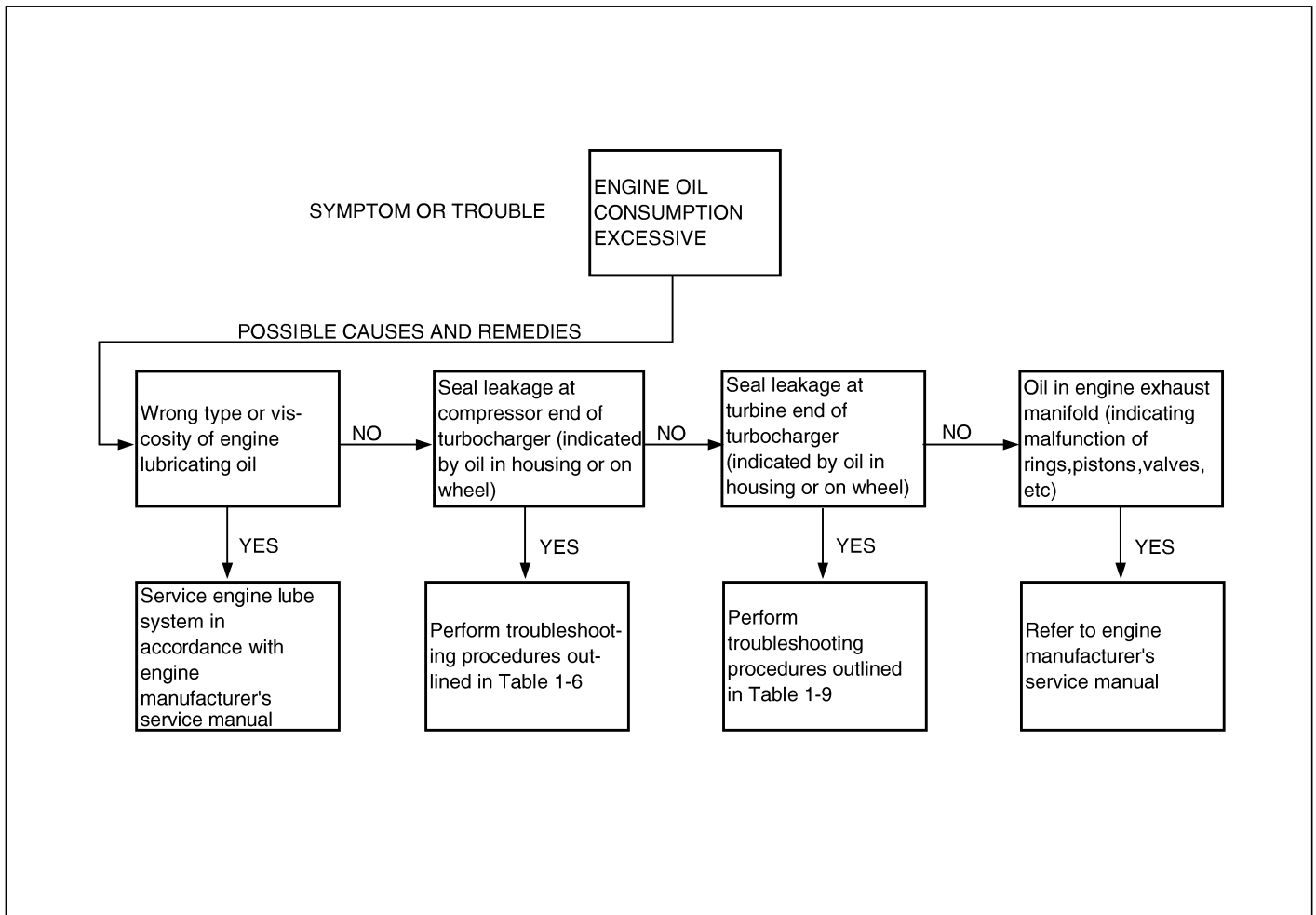
2. Table 1-2 Troubleshooting Engine Exhaust Emits WHITE or BLUE SMOKE



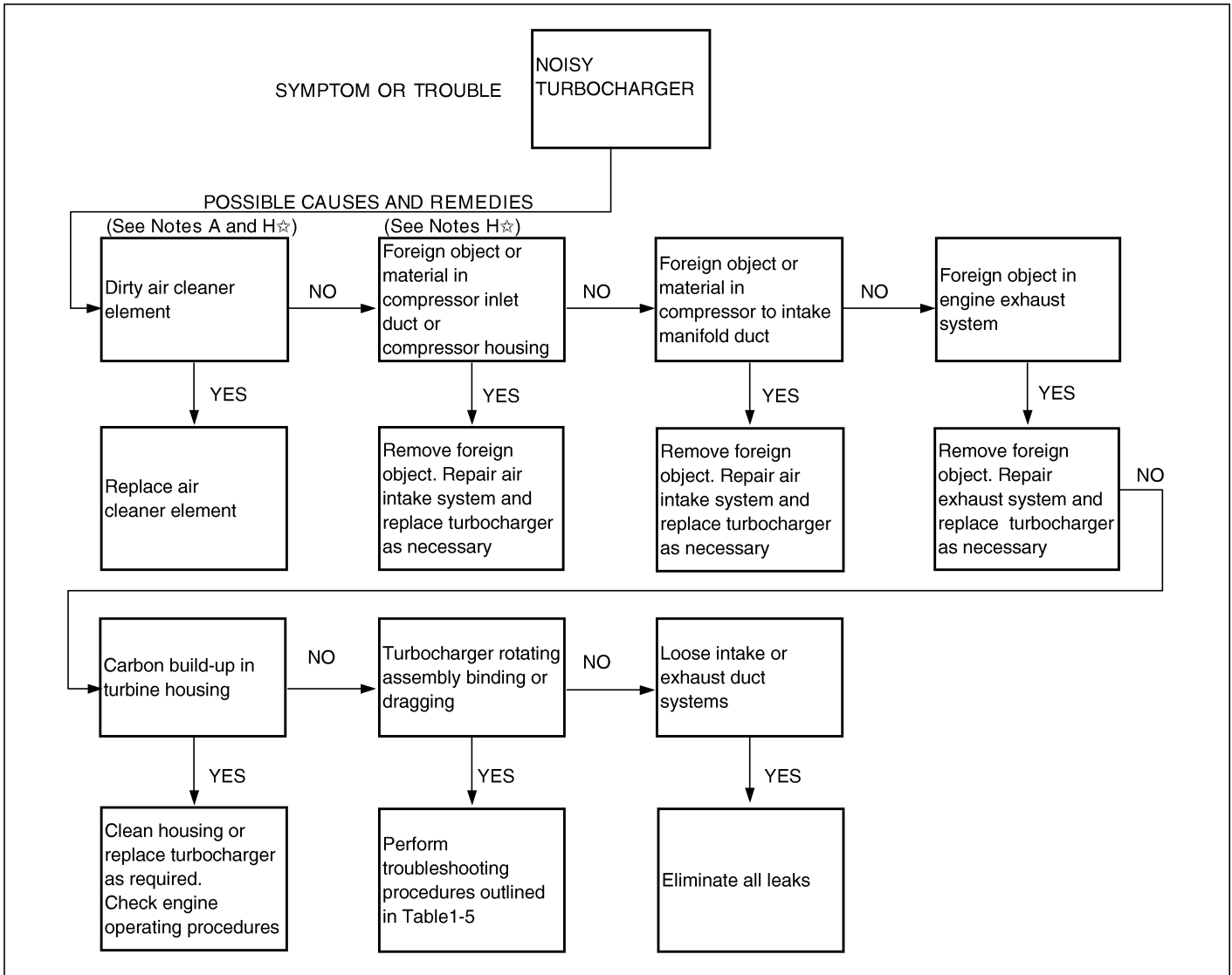
SAPH011030800003

☆ Shown on Table 1-9

3. Table 1-3 Troubleshooting Engine Oil Consumption Excessive



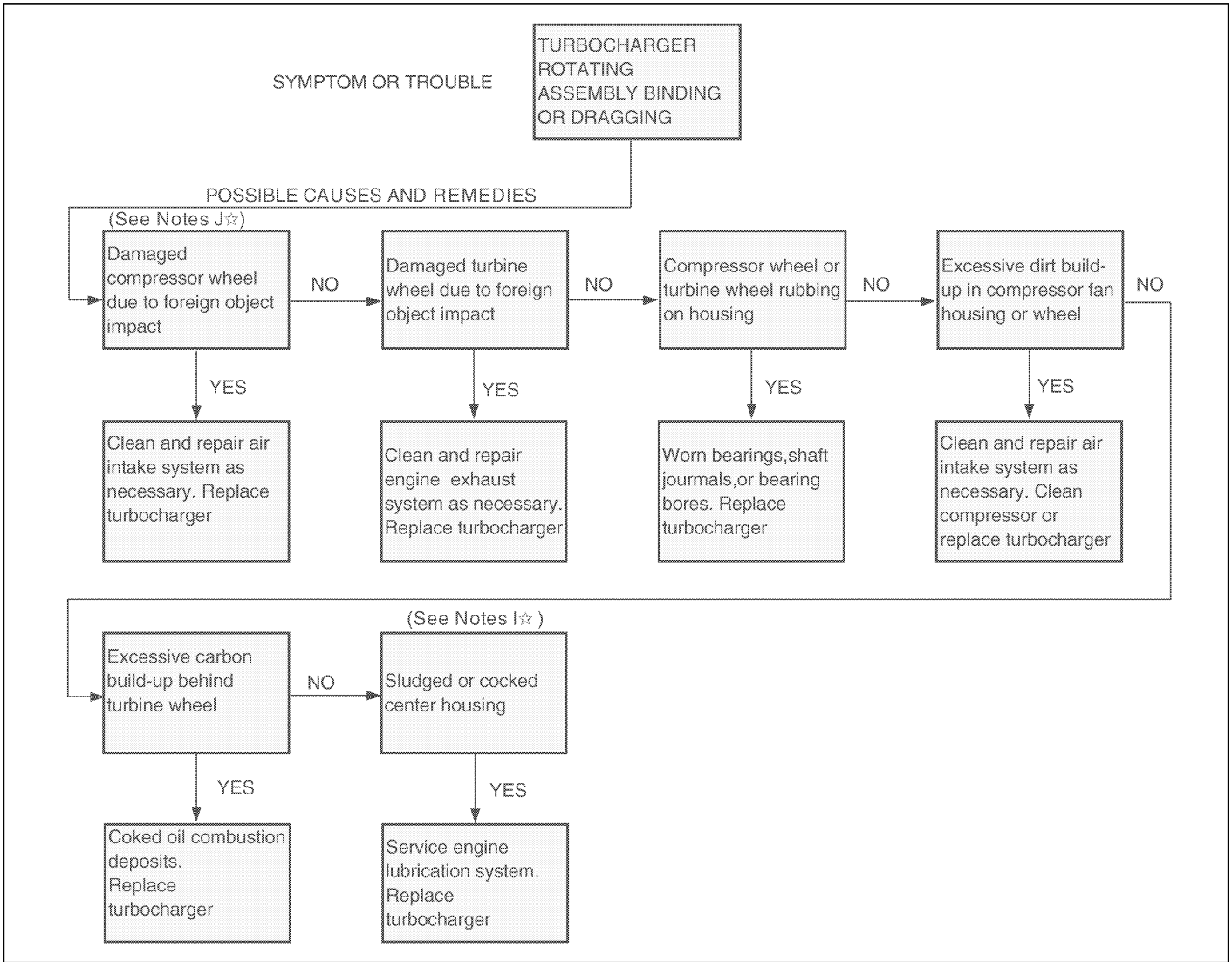
4. Table 1-4 Troubleshooting Noisy Turbocharger



SAPH011030800005

☆ Shown on Table 1-9

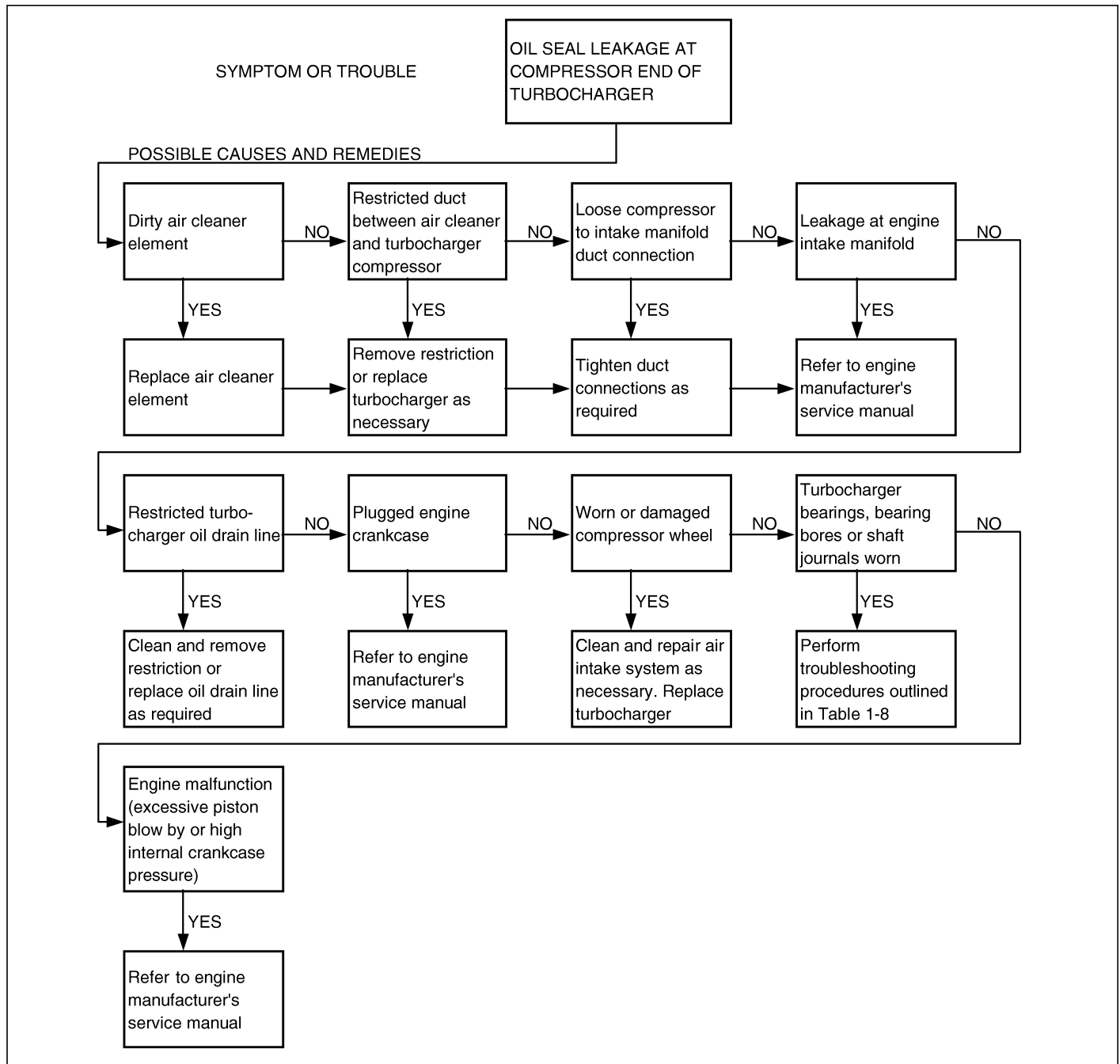
5. Table 1-5 Troubleshooting Turbocharger Rotating Assembly Binding or Dragging



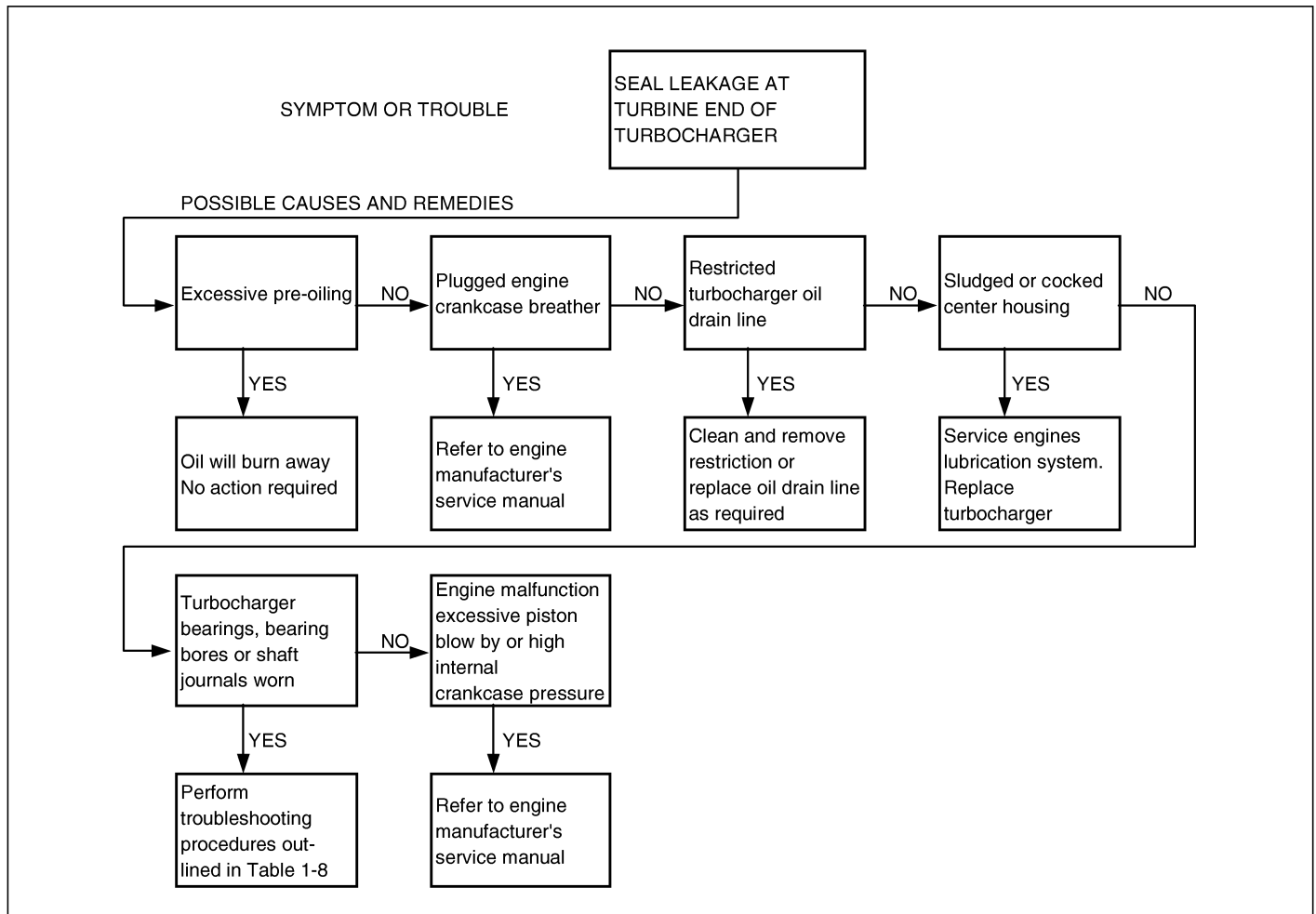
SAPH011030800006

☆ Shown on Table 1-9

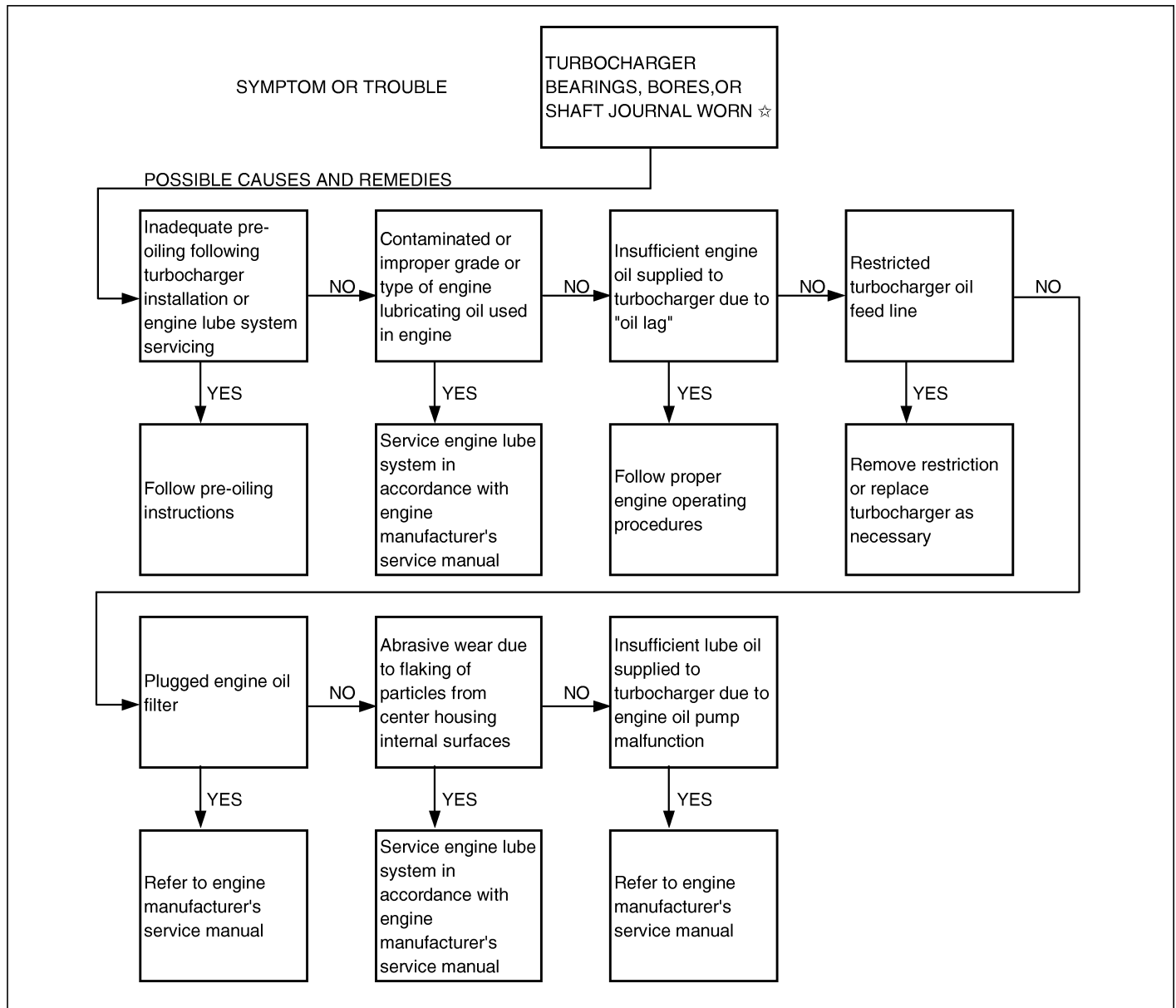
6. Table 1-6.Troubleshooting-Seal Leakage at Compressor End of Turbocharger



7. Table 1-7. Troubleshooting-Seal Leakage at Turbine End of Turbocharger



8. Table 1-8.Troubleshooting-Turbocharger Bearings,Bores,or Journals are Worn



SAPH011030800009

☆ Replace turbocharger ,then use this table to determine cause of failure.

9. Table 1-9. Troubleshooting Procedures Notes

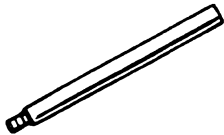
A	Refer to engine manufacturer's service manual for inspection requirements and replacement specifications.
B	With engine stopped, check duct clamping devices for tightness.
C	With engine running at idle speed, lightly spray duct connections with starting fluid. Leaks at connections will be indicated by an increase in engine speed due to the starting fluid being drawn into the compressor and pumped into the engine combustion chambers.
D	With engine running at idle speed, check duct connections for leaks by applying lightweight oil or liquid soap to areas of possible leakage and checking for bubbles. Exhaust gas leakage between the engine block and the turbocharger inlet will also create a noise level change.
E	With engine running at idle speed, check for unusual noise and vibration. If either condition is noted, shut down the engine immediately to protect the turbocharger and engine from further damage. With the engine stopped, check the turbocharger shaft wheel assembly for damage as outlined Note I, below.
F	With engine running, a change in the noise level to a higher pitch can indicate air leakage between the air cleaner and the engine or a gas leak between the engine block and the turbocharger inlet.
G	Exhaust gas leakage may be indicated by hat discoloration in the area of the leak.
H	With the engine running, noise level cycling from one level to another can indicate a plugged air cleaner, a restriction in the air-cleaner to compressor duct, or a heavy build-up of dirt in the compressor housing or on the compressor wheel.
I	Internal inspection of the center housing can be accomplished by removing the oil drain line and looking through the oil drain opening. When a slugged or cocked condition exists, a heavy sludge build-up will be seen on the shaft between the bearing journals and in the center housing from the oil drain opening back to the turbine end.
J	Thorough cleaning of the air intake system is essential following compressor wheel damage due to foreign object impact. In many cases, metal pieces from the wheel become imbedded in the air cleaner element. If the element is not changed, these metal pieces can be drawn into the replacement turbocharger and cause it to fail in the same manner as the original unit.
K	With the air inlet and exhaust gas ducting removed from the turbocharger, examine both the compressor and turbine wheels for blade damage. Examine the outer blade tip edges for evidence of rubbing on housing surfaces.

- Turn the rotating assembly by hand and feel for dragging or binding. Push the rotating assembly side-ways while rotating to feel for wheel rub. If there is any indication of rubbing, perform the bearing clearance inspection procedure. If the rotating assembly rotates freely and there is no evidence of binding or rubbing, it can be assumed that the turbocharger is serviceable.

SPECIAL TOOL

EN0110308K100001

Prior to starting a turbocharger overhaul, it is necessary to have this special tool.

Illustration	Part number	Tool name	Remarks
	S0944-41800	END PLAY GAUGE	For measuring the turbine shaft end play with a dial gauge.

OVERHAUL CRITERIA

EN0110308H300001

1. CONDITIONS WHICH DETERMINE WHEN A TURBOCHARGER OVERHAUL MAY BE NEEDED ON ENGINE TROUBLESHOOTING.

The most common symptoms of turbocharger failure are related to engine performance:

- Lack of power
- Excessive exhaust smoke
- Unusual noise
- Excessive oil or fuel consumption.

NOTICE

Any of these symptoms could be the result of an internal engine problem, and might not involve the turbocharger at all.

2. EXAMINE THE TURBOCHARGER EXTERIOR AND INSTALLATION.

⚠ WARNING

Do not work on the turbocharger while it could be still hot. This can result in personal injury.

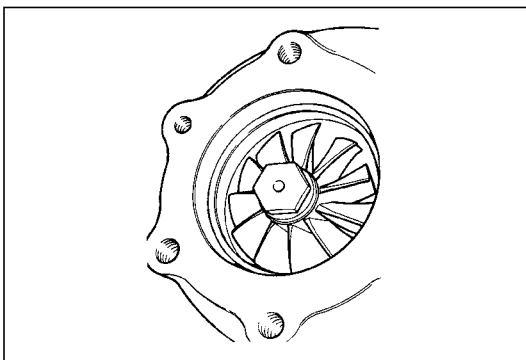
Visually check for:

- Missing or loose nuts and bolts.
- Loose or damaged intake and exhaust pipe.
- Damaged oil supply and drain lines.
- Cracked or deteriorating turbocharger housings.
- External oil or coolant leakage.

Correct any installation problems. If turbocharger parts are damaged, the unit should be overhauled after completion of the remainder of this troubleshooting procedure.

⚠ WARNING

Operation of the turbocharger without the intake pipe and air cleaner connected can result in personal injury and damage to equipment from foreign objects entering the turbocharger.



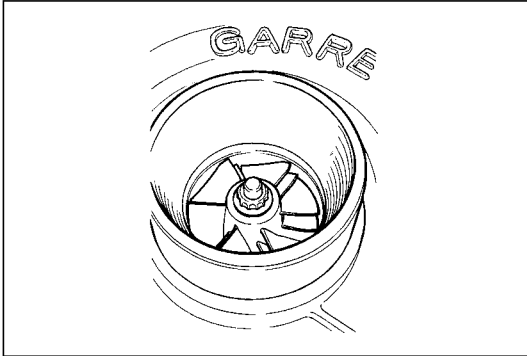
SAPH011030800011

3. INSPECTION TURBINE WHEEL AND HOUSING.

Remove the duct from the turbine outlet. Using a flash-light, check the turbine for wheel to housing rub, evidence of oil leakage or foreign object damage. Foreign object damage to the turbine is not usually visible through the turbine outlet unless the damage is severe.

- (1) Wheel to housing rub
 - a. If wheel rub is found, and the housing attaching hardware is secure, then the turbocharger is probably damaged internally and must be overhauled.
- (2) Oil leakage
 - a. If oil deposits are found, determine whether the oil has come from, the engine exhaust or from the turbocharger center housing.
 - b. If the oil has come from the engine, consult CHAPTER ENGINE MECHANICAL and correct the problem. If oil deposits on the wheel are heavy, the turbocharger should be disassembled, cleaned, and overhauled if necessary.

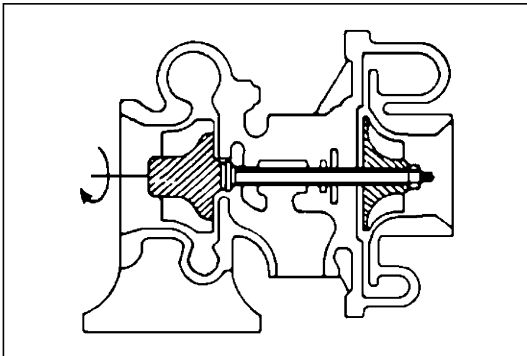
- (3) Foreign object damage
 - a. If foreign object damage to the turbine is visible, the turbocharger must be overhauled. Such damage destroys the wheel's balance and causes internal damage to the seal bores and journal bearings. Be sure to find the source of the foreign object. In many cases, the object has come out of the engine, and there may be engine damage as well.



SAPH011030800012

4. EXAMINE COMPRESSOR WHEEL AND HOUSING.

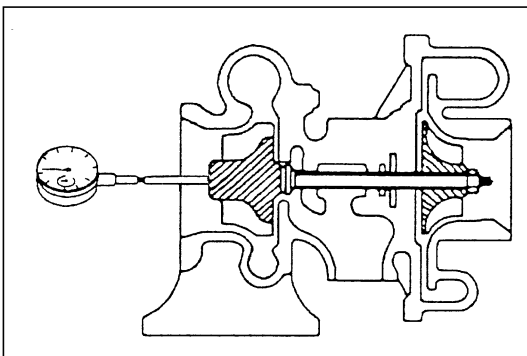
- Remove the duct from the compressor inlet. Using a flashlight, check the compressor for wheel to housing rub, evidence of oil leakage, or foreign object damage.
- (1) Wheel to housing rub
If wheel rub is found, and the housing attaching hardware is secure, then the turbocharger is probably damaged internally and must be overhauled.
 - (2) Oil leakage
Oil leakage into the compressor can be caused by:
 - a. Long periods of idling on a restricted oil drain line.
 - b. Oil leakage into the compressor can also be caused by a restricted air intake system.
 - c. Oil leakage into the compressor can be caused by frequent use of the engine as a brake. In this case, nothing is wrong with either the engine or the turbocharger, but frequent compressor wheel and housing clean-up is recommended.
 - (3) Foreign object damage
If the compressor wheel has been damaged by a foreign object, the turbocharger must be overhauled.



SAPH011030800013

5. CHECK ROTATING ASSEMBLY FOR NOISE OR EXCESSIVE PLAY.

- (1) If no damage is visible in the turbine and compressor areas, spin the rotating assembly by hand. It should spin freely with no drag or grinding noises.



SAPH011030800014

6. CHECK AXIAL BEARING CLEARANCES.

- (1) Check the turbine rotor (exhaust side) for axial play using the special tool and dial gauge.
SST: End play gauge (S0944-41800)

Service limit: 0.092 mm {0.0036 in.}
- (2) If the measurement is out of service limit, the turbocharger is worn or damaged internally and must be overhauled.

EMISSION CONTROL (J05D)

EN10-001

EGR VALVE AND EGR PIPE.....EN10-2

COMPONENT LOCATOR..... EN10-2

EGR VALVE.....EN10-3

DESCRIPTION EN10-3

DISMOUNTING AND MOUNTING EN10-4

CLOSED VENTILATOREN10-8

DESCRIPTION EN10-8

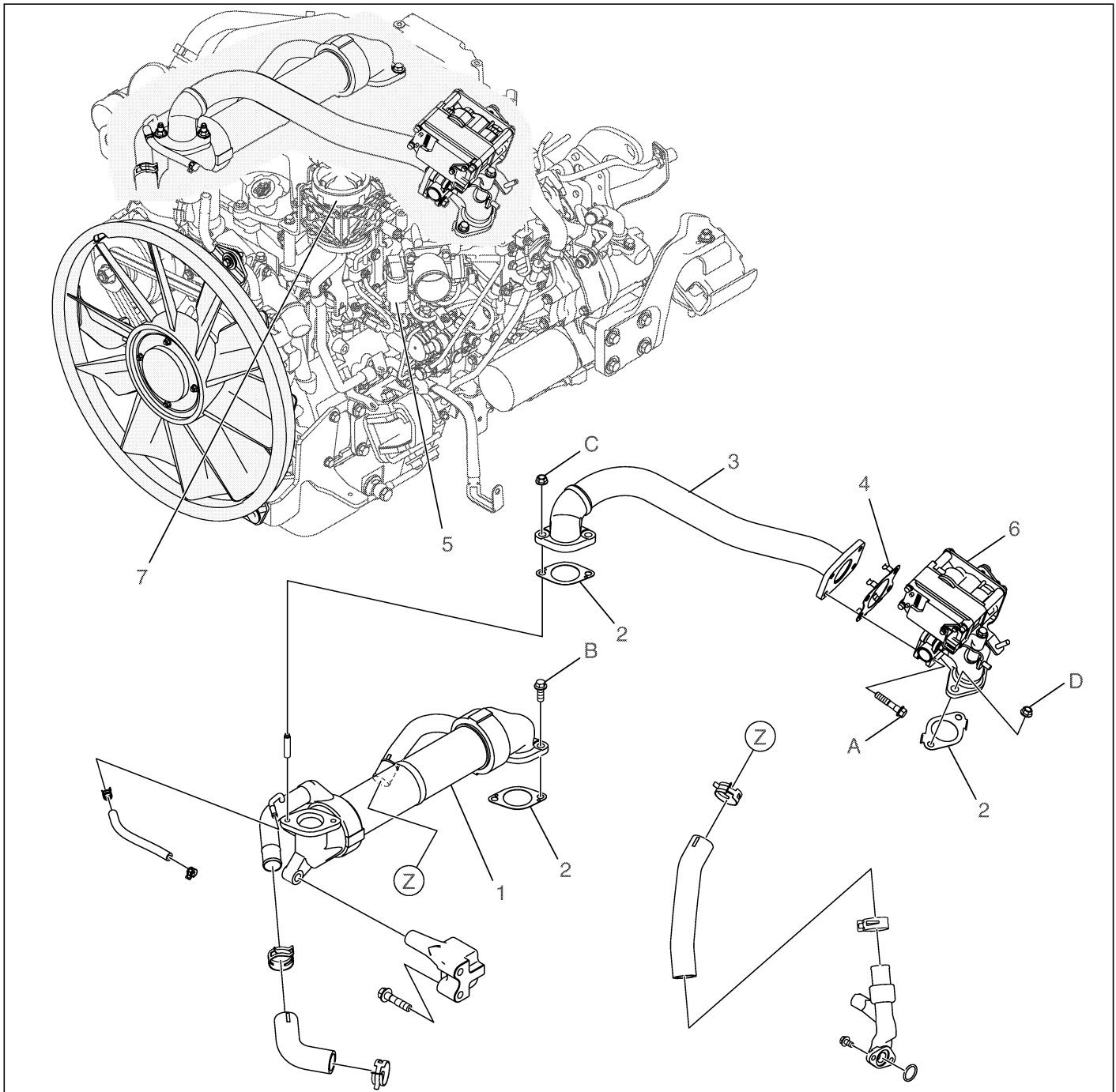
REPLACEMENT OF

CLOSED VENTILATOR EN10-8

EGR VALVE AND EGR PIPE

COMPONENT LOCATOR

EN0110310J100001



SAPH011031000001

- 1 EGR cooler sub assy
- 2 Gasket
- 3 EGR pipe assy
- 4 Gasket

- 5 Diesel throttle valve
- 6 EGR valve
- 7 Closed ventilator

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

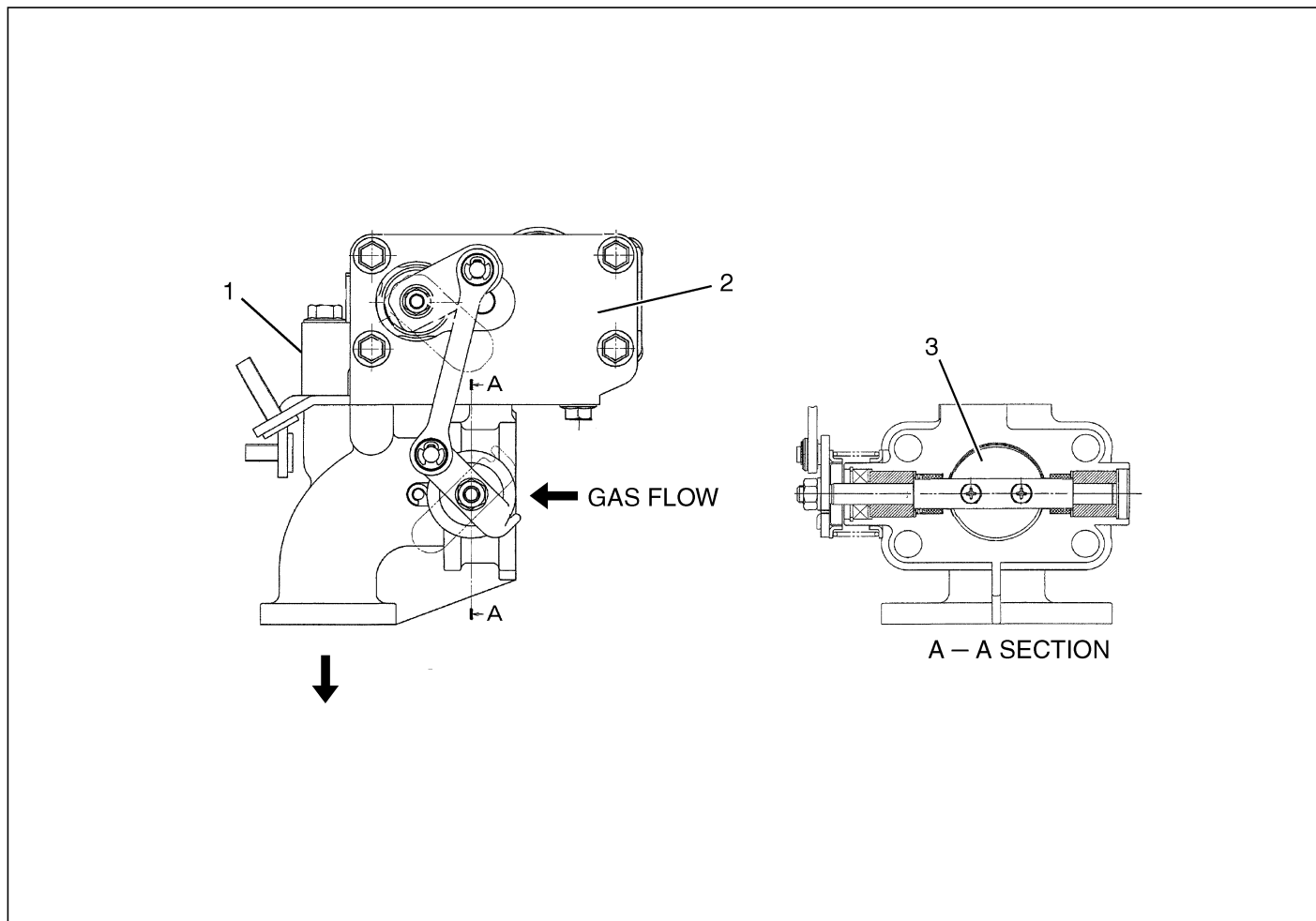
- A 55 {560, 40}
- B 55 {560, 40}

- C 55 {560, 40}
- D 55 {560, 40}

EGR VALVE

DESCRIPTION

EN0110310J100002



SAPH011031000002

1	EGR valve assy
2	DC Motor

3	Butterfly valve
---	-----------------

DISMOUNTING AND MOUNTING

EN0110310H200001

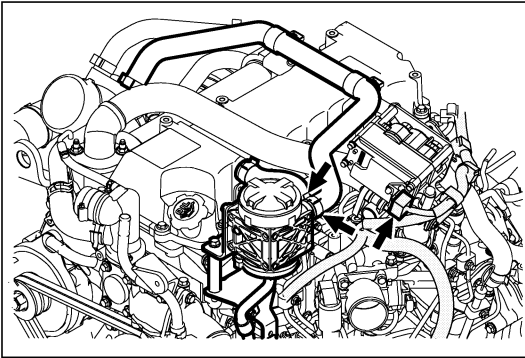
IMPORTANT POINTS - DISMOUNTING

1. REMOVE THE EGR VALVE.

⚠ CAUTION

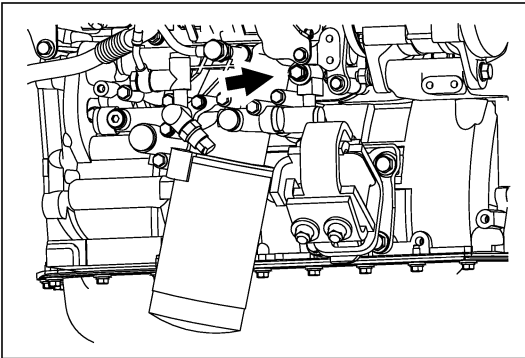
To prevent burns ensure the engine is cold before changing the valve.
(At least 30 minutes after switching off the engine)

- (1) Disconnect the harness coupler.
- (2) Remove the closed ventirator hose.



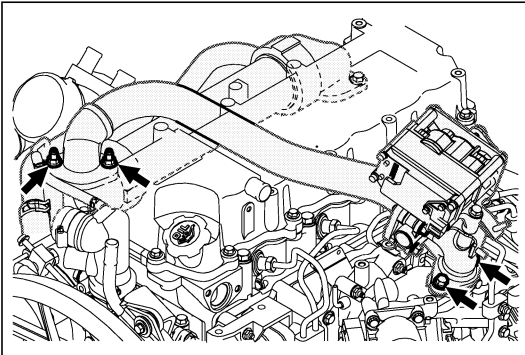
SAPH011031000003

- (3) Drain the coolant out of the drain plug of oil cooler situated on the right side of the engine.



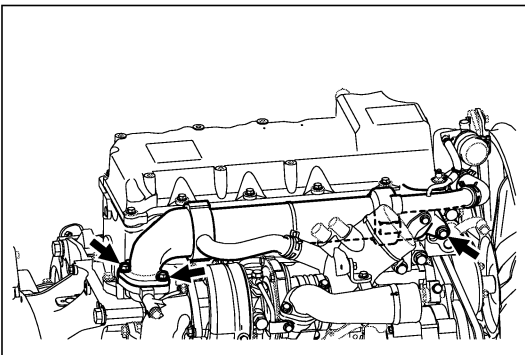
SAPH011031000004

- (4) Remove EGR pipe with EGR valve.
- (5) Remove the EGR cooler sub assembly.

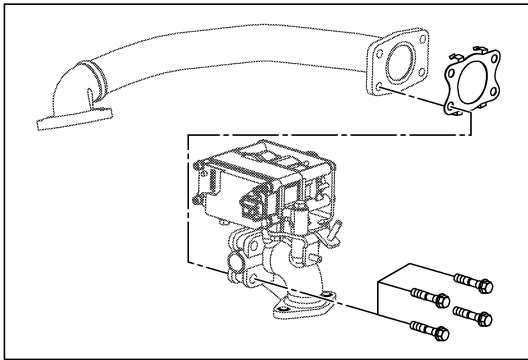


SAPH011031000005

- (6) Disconnect the water hose from EGR cooler sub assembly.



SAPH011031000006

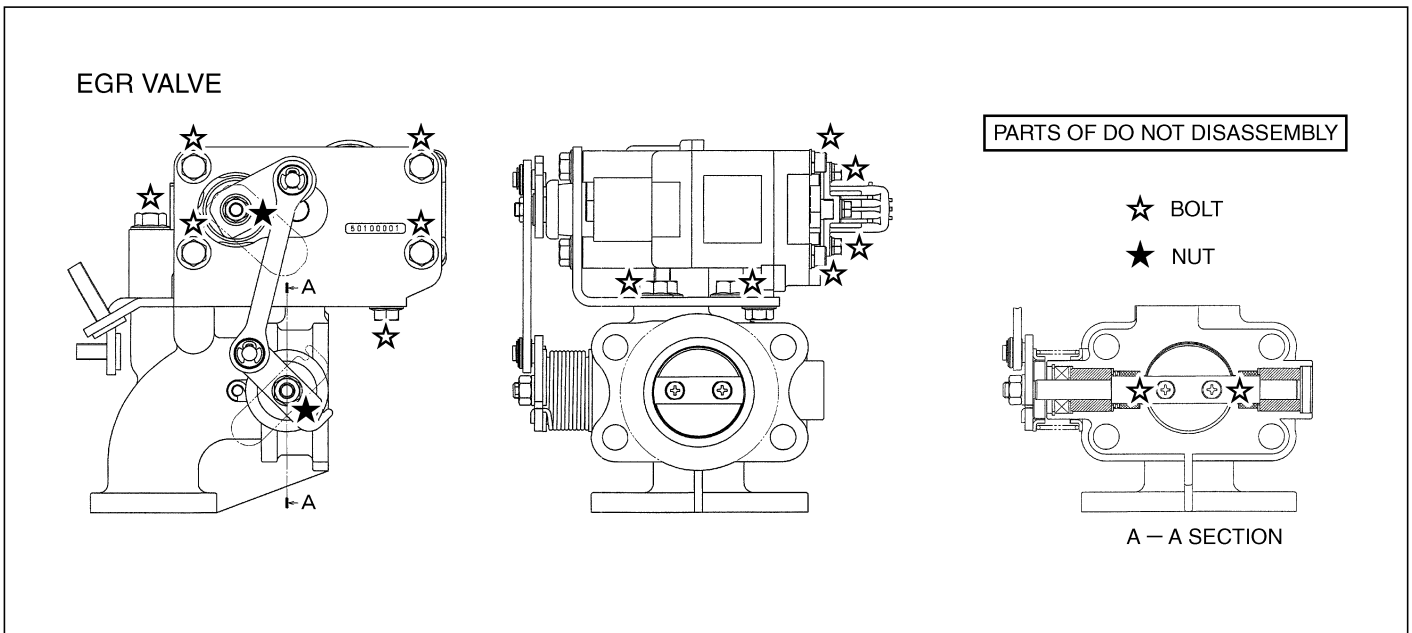


SAPH011031000007

- (7) Remove the EGR valve from the EGR pipe.

NOTICE

- If you have to place your feet on the engine while working on it, be careful not to fall off the engine or get your foot caught in the engine parts.
- Be careful not to step on the EGR valve when servicing the engine.
- Do not loosen or tighten the bolts and nuts securing the EGR valve components; otherwise, the valve will not perform properly. If you remove the nuts and bolts and dismantle a component, do not re-assemble it; instead, replace the valve with a new one.
- Be careful not to hit the EGR valve lever with a tool when you are removing or installing the valve.



SAPH011031000008

2. INSPECT THE EGR COOLER.

- (1) Visually inspect cracks or clogging in the main body gas passage and sub-coolant piping. In case a trouble is found, replace the EGR cooler with a new one.

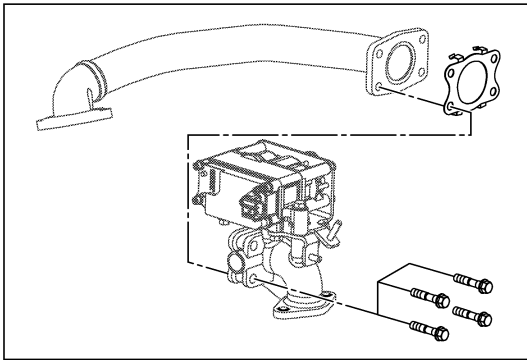
IMPORTANT POINTS - MOUNTING**1. INSTALL THE EGR VALVE**

- (1) Install the EGR valve to the EGR pipe.

Tightening Torque:
55 N·m {560 kgf·cm, 40 lbf·ft}

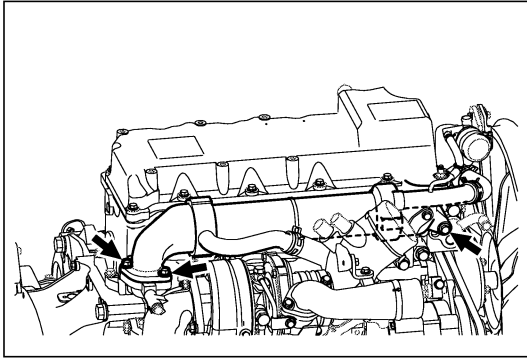
NOTICE

Use a new gasket.



SAPH011031000007

- (2) Connect the water hose to the EGR cooler sub assembly.



SAPH011031000006

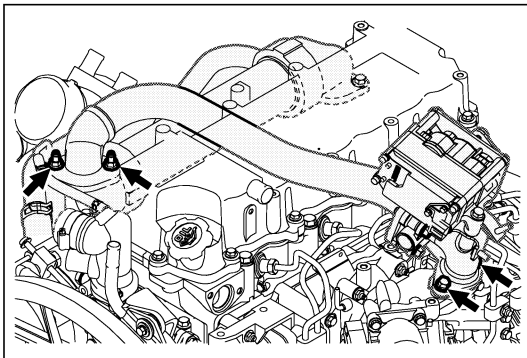
- (3) Install the EGR cooler sub assembly.

- (4) Install the EGR pipe with EGR valve.

Tightening Torque:
55 N·m {560 kgf·cm, 40 lbf·ft}

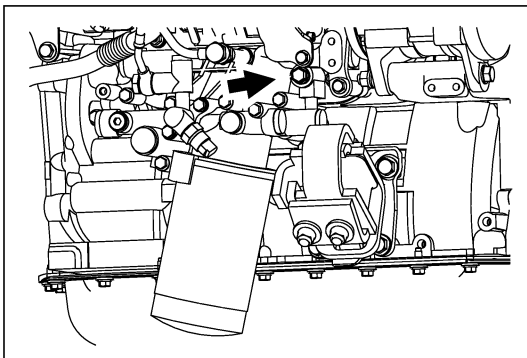
NOTICE

Fit the exhaust manifold gasket with the claw of the gasket facing down.

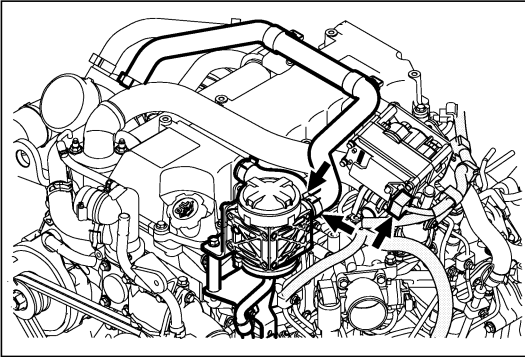


SAPH011031000005

- (5) Close the coolant plug of the oil cooler situated on the right side of the engine.



SAPH011031000004



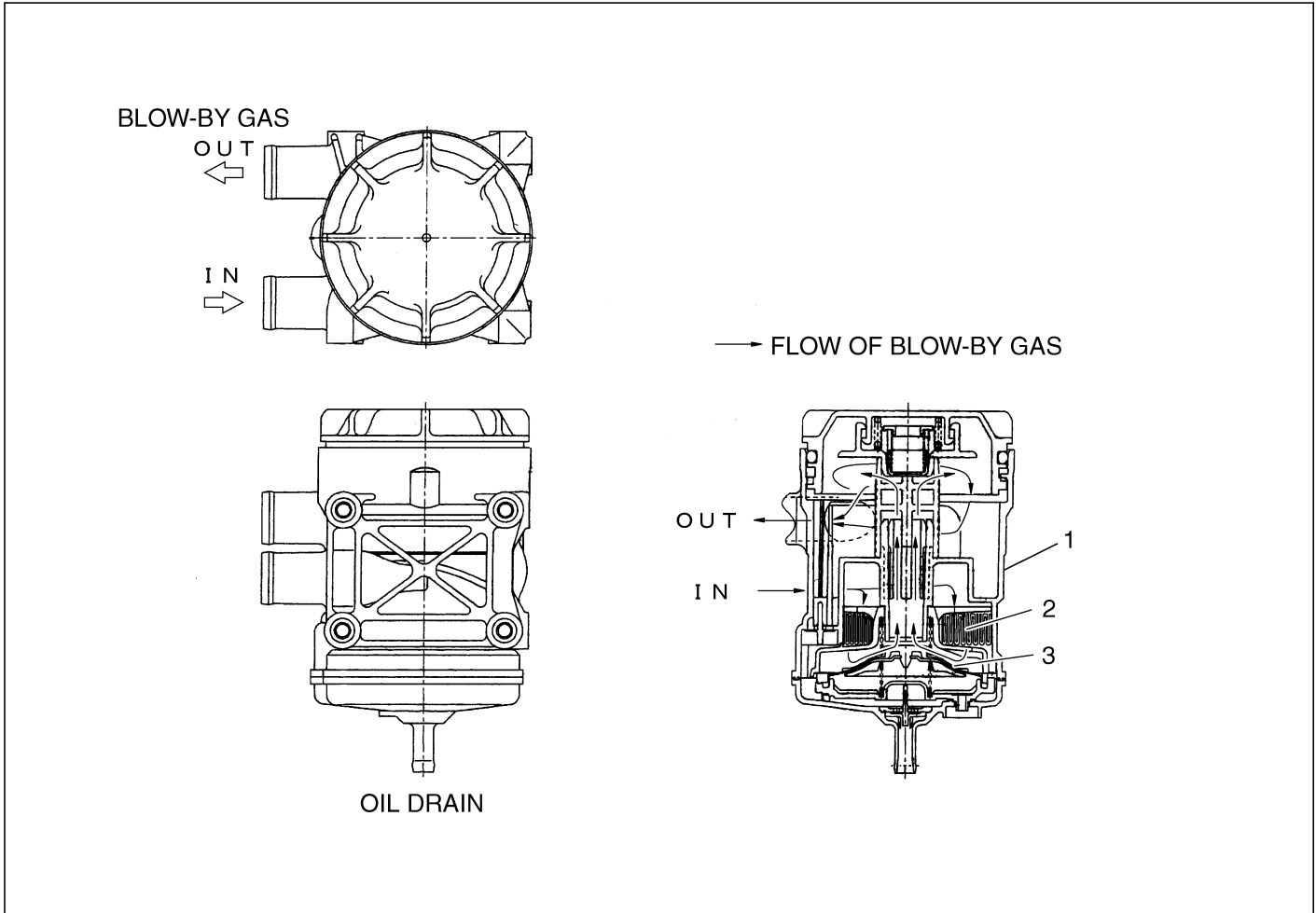
SAPH011031000009

- (6) Install the closed ventilator hose.
- (7) Connect the harness coupler.

CLOSED VENTILATOR

DESCRIPTION

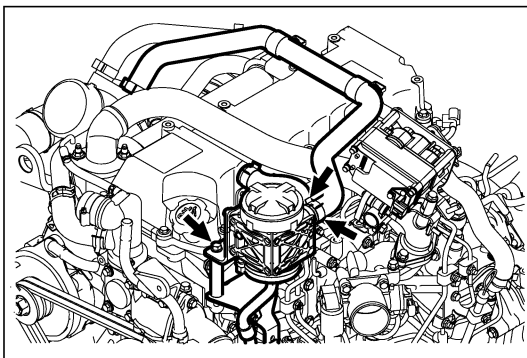
EN0110310C100001



SAPH011031000010

1 Body
2 Filter

3 PCV valve



SAPH011031000011

REPLACEMENT OF CLOSED VENTILATOR

EN0110310H200002

HINT

The closed ventilator is maintenance free.

1. REMOVE THE CLOSED VENTILATOR.
 - (1) Remove the hoses and then the closed ventilator.
2. INSTALL THE CLOSED VENTILATOR.
 - (1) Connect the hoses and install the closed ventilator.

ALTERNATOR (J05D: REMY 12V-100A)

EN11-001

ALTERNATOR.....EN11-2

DATA AND SPECIFICATIONS	EN11-2
TROUBLESHOOTING	EN11-2
COMPONENT LOCATOR.....	EN11-3
SPECIAL TOOL	EN11-6
OVERHAUL	EN11-7
INSPECTION AND REPAIR	EN11-19

ALTERNATOR

DATA AND SPECIFICATIONS

EN011031120001

Nominal voltage	12V
Nominal output	12V-100A
Max. output	105A at 13.5V, 5,000 r/min
Max. rotating	10,000 r/min
Rotating direction	Right (seen from pulley side)
Regulator	Mount-on

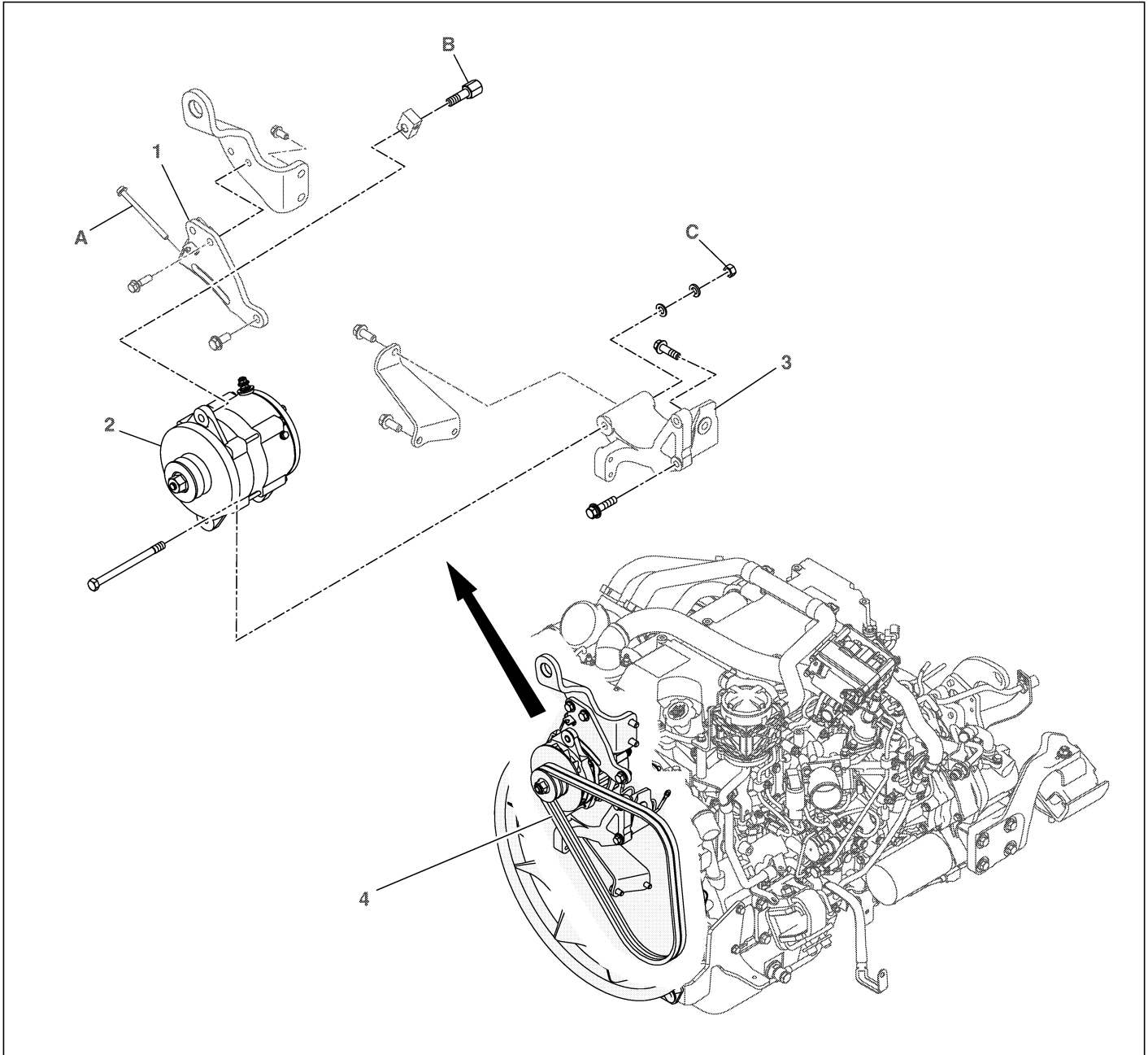
TROUBLESHOOTING

EN0110311F30001

Symptom	Possible cause	Remedy/Prevention
Charge warning lamp does not light with starter switch ON and engine off	Fuse blown	Determine cause and replace fuse
	Lamp burned out	Replace lamp
	Wiring connection loose	Tighten loose connections
	Charge lamp relay faulty	Check relay
	IC regulator faulty	Replace IC regulator
Charge warning lamp does not go out with engine running (Battery requires frequent recharging)	Drive belt loose or worn	Adjust or replace drive belt
	Battery cables loose, corroded or worn	Repair or replace cables
	Fuse blown	Determine cause and replace fuse
	Fusible link blown	Replace fusible link
	Charge lamp relay, IC regulator or alternator faulty	Check charging system
	Wiring faulty	Repair wiring

COMPONENT LOCATOR

EN0110311D100001



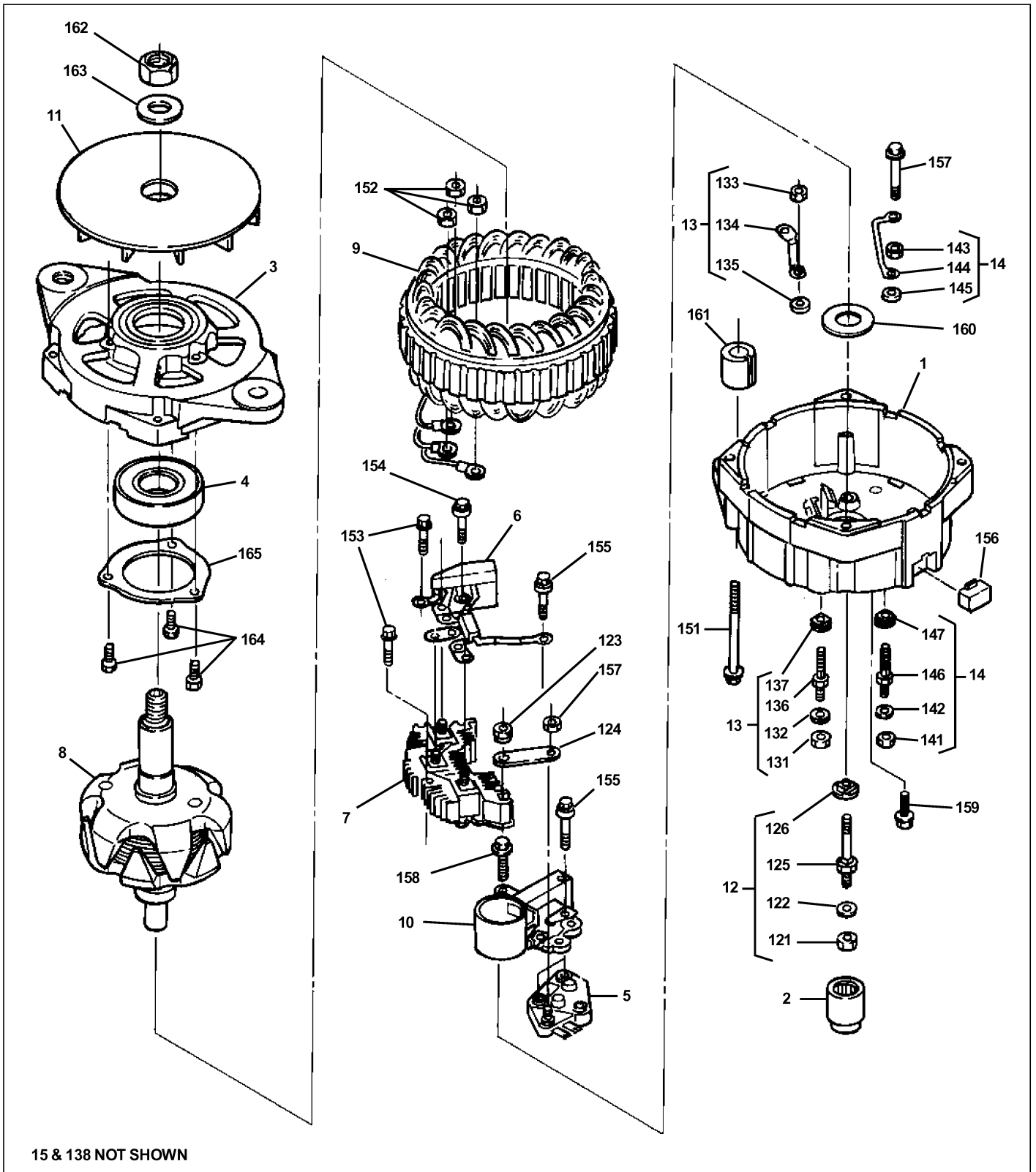
SAPH011031100001

1	Brace	3	Bracket
2	Alternator	4	V-belt

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A	25 {255, 19}	C	83 {850, 61}
B	81-95 {826-969, 60-70}		

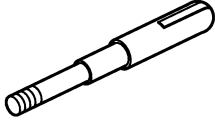


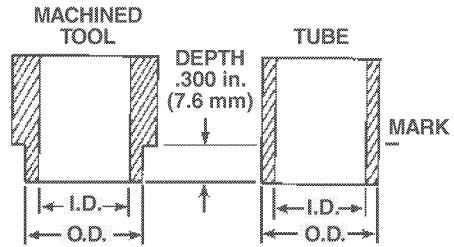
1 Slip Ring End Housing	138 Cap (Not Shown)
2 SRE Roller Bearing Assembly	14 Indicator Terminal Package
3 Drive End Housing	141 Hexagon Nut
4 DE Ball Bearing Assembly	142 Washer
5 Regulator	143 Nut Assembly
6 Auto Start and Trio Assembly	144 Connector
7 Rectifier Assembly	145 Washer
8 Rotor Assembly	146 Terminal Stud
9 Stator Assembly	147 Insulator
10 Brush Holder Assembly	15 Hardware Package (Not Shown)
11 Fan	151 Bolt, Thrn
12 Output Terminal Package	152 Nut, Reetifer Assembly
121 Nut	153 Screw and Washer Assembly
122 Washer	154 Screw, Insulated Rectifier
123 Nut	155 Screw, Insulated Regulator
124 Connector	156 Cover
125 Terminal Stud	157 Nut Assembly
126 Insulator	158 Screw and Washer Assembly
13 Relay Terminal Package	159 Screw Assembly
131 Hexagon Nut	160 Washer
132 Washer	161 Bushing
133 Nut Assembly	162 Hexagon Nut
134 Connector	163 Washer
135 Washer	164 Screw and Washer Assembly
136 Terminal Stud	165 Retainer Plate
137 Insulator	

SPECIAL TOOL

EN0110311K100001

Prior to starting an alternator overhaul, it is necessary to have this special tool.

Illustration	Part number	Tool name	Remarks
	S0944-41210	COMPRESSION GAUGE	

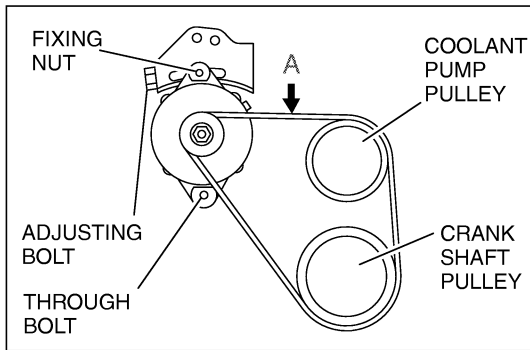


FOR PRESSING THE
SRE ROLLER BEARING

O.D. MAX 0.935 in. (25.5 mm)
I.D. MIN. 0.745 in. (19.0 mm)
DEPTH (MARK) 0.300 in. (7.6 mm)

OVERHAUL

EN0110311H200001



IMPORTANT POINTS - MOUNTING

1. ADJUST THE ALTERNATOR V-BELT DEFLECTION

- (1) Loosen the through bolt and the fixing nut.
- (2) Apply a load of about 98N {10 kgf} by pressing the measuring point A.
- (3) Turn the adjusting bolt, and adjust the deflection of the belt at measuring point A, so that it comes within the standard value.

SST: Compression gauge (S0944-41210)

Standard: 9-10.5 mm {0.354-0.413 in.}

NOTICE

- When installing a new V-belt, be sure to repeat the adjustment two or three times, after running the engine.
 - When adjusting the V-belt, do not apply the lever directly against the alternator.
- (4) After adjusting the deflection, tighten the through bolt and then securely tighten the fixing nut.
 - (5) Retighten the adjusting bolt.
 - (6) Connecting the harness.

2. INSTALL OR CONNECT

- (1) "I" and/or "R" terminal lead(s) (108 or 109), if used, to threaded terminal stud(s) (136 and/or 146), washer(s) and hexagon nut(s) (131 and/or 141).

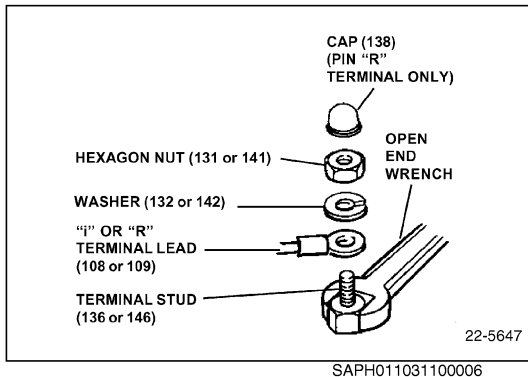
NOTICE

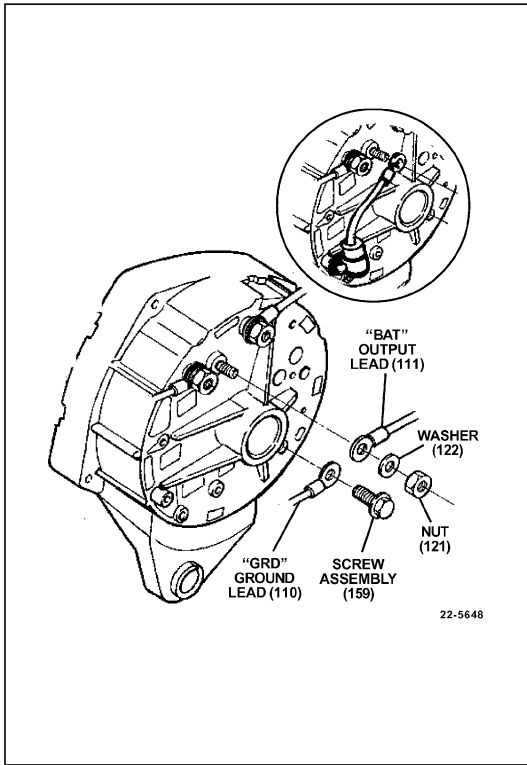
Use suitable open end wrench to hold nut portion of terminal stud(s) (125, 136 and/or 146).

Tightening Torque:

2.0 N·m {20 kgf·cm, 20 lbf·in}

- (2) Cap (138) to the "R" (or "Relay") pin terminal stud (146A) if necessary.





- (3) Ground lead (110) to "GRD" hole in SRE housing (1), with screw assembly (159).

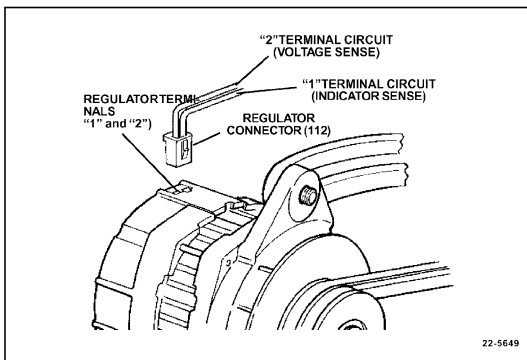
Tightening Torque:

6 N·m {61 kgf·cm, 55 lbf·in}

- (4) "BAT" output lead (111), washer (122) and nut (121) to "BAT" terminal stud (125).

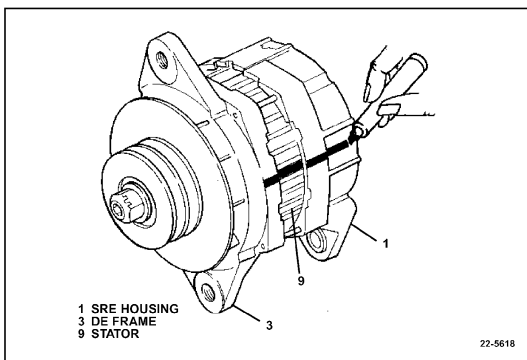
Tightening Torque:

11 N·m {112 kgf·cm, 100 lbf·in}



- (5) For 3-wire systems only, regulator connector (112) to regulator (5) terminals "1" and "2".

- (6) Negative cable at battery. Follow vehicle manufacturers instructions.



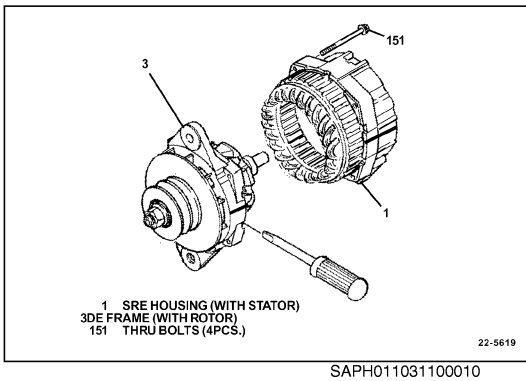
IMPORTANT POINTS - DISASSEMBLY

NOTICE

On some alternators on certain engine configurations, a 1.5 μ f capacitor has been installed to the output terminal and attached with a 3/8" long self tapping screw. Remove the screw and capacitor (DRA1985444) Before disassembly.

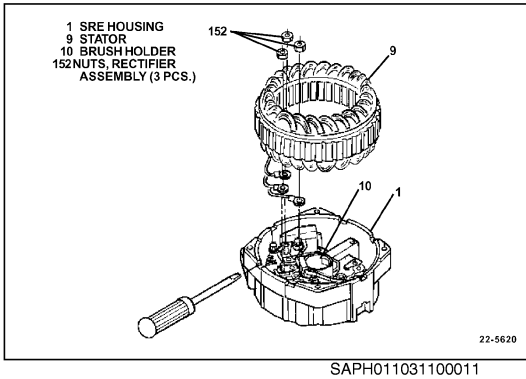
1. ALTERNATOR

- Place alignment mark across slip ring end (SRE) housing (1) and drive end (DE) frame (3) for reassembly after unit repair.
- Remove 4 thru bolts (151) from DE frame (3) and SRE housing (1).



- (3) Separate DE frame (3) (with rotor) from SRE housing (1) (with stator). If necessary, carefully pry DE frame from edge of stator with screwdriver. After separation, place tape over brush holder assembly (10) opening inside unit to prevent dirt from entering bearing during checks.

2. SRE HOUSING AND COMPONENTS.



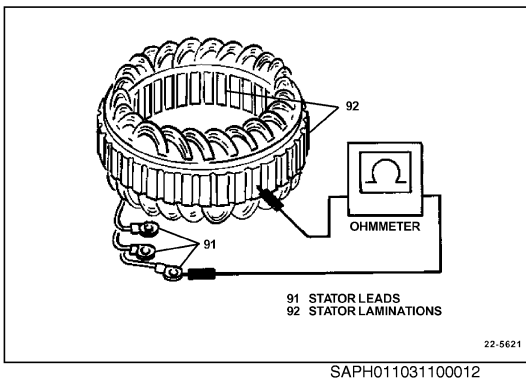
- (1) Inspect SRE housing (1) for loose connections or other obvious conditions. Correct as necessary. If none are found, proceed with SRE housing checks.

- (2) Remove 3 rectifier assembly nuts (152) to disconnect stator (9). Lift stator from SRE housing (1) assembly. If necessary, carefully pry stator away from SRE housing with screwdriver.

- (3) Inspect stator winding for a dark, burned appearance. View winding from inside of unit - black paint on outside of windings does not indicate burned windings. If all windings are uniform in color and varnish covering is not flaking off, proceed with electrical check. If some windings are dark and others are light, a shorted, open or grounded condition is indicated. Replace the stator.

NOTICE

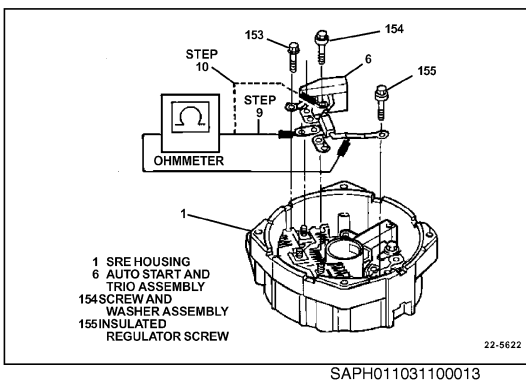
The stator should also be replaced if the windings are uniformly dark and burned, with the varnish coating flaking off to expose bare wires.



- (4) Perform electrical check on stator. Use ohmmeter or 110-volt test lamp. There should be no continuity between any of the stator leads (91) and the stator laminations (92).

If continuity is present, windings are grounded. Replace stator.

If there is no continuity, stator is probably good. However, there is no service electrical check for shorted or open delta stator windings. If all other electrical checks are normal and the alternator did not produce within 15 amps of the rated output, a shorted or open stator is indicated and the stator is to be replaced.



- (5) Remove one insulated regulator screw (155) one screw and washer assembly (153) and insulated rectifier screw (154), to disconnect auto start and trio assembly (6). Lift trio assembly from SRE housing (1) assembly.

NOTICE

Wherever "Ohmmeter" is specified for use when checking diodes, the "Diode Test Functions" setting should be used for "Digital Type" multimeters.

- (6) Use ohmmeter to check diode trio in assembly. Place negative ohmmeter lead on regulator strap and use positive ohmmeter lead to check for continuity to each of the three rectifier straps. All three readings should indicate continuity. Reverse the ohmmeter leads and perform checks again. Readings should all indicate open circuits.

If all readings are proper, diode trio is good.

If any reading is wrong, replace auto start and trio assembly (6).

- (7) Use ohmmeter to check auto start and trio assembly. Place negative lead of ohmmeter on regulator strap and positive lead to auto start and trio assembly B+ terminal.

The meter should indicate open circuit. Reverse the ohmmeter leads and the reading should indicate continuity.

If either reading is incorrect, replace the auto start and trio assembly (6).

If both readings are correct continue to Step (8).

- (8) Use ohmmeter to check rectifier assembly (7). Rectifier assembly may be checked in the SRE housing (1) without disassembly. Check 6 diodes as follows:

- a. Place negative ohmmeter lead on grounded heat sink (71). Touch positive ohmmeter lead firmly to metal diode clips (73) that surround each of the 3 threaded studs. All 3 readings should be the same, and indicate open circuits. Switch leads and repeat. All 3 new readings should indicate continuity.
- b. Repeat checks using (positive) insulated heat sink (72). With negative ohmmeter lead on insulated heat sink, all 3 readings should indicate continuity. Switch leads and repeat. All 3 new readings should indicate open circuits.

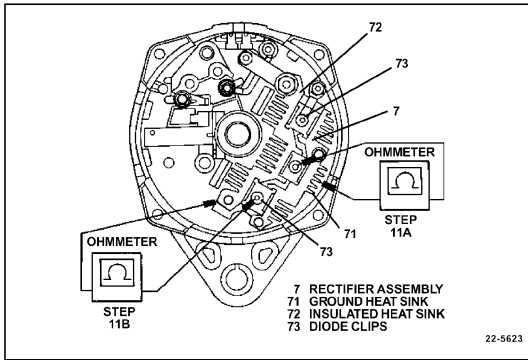
If all readings are correct, the rectifier assembly is good.

If any reading is wrong, an open or shorted diode is indicated and rectifier assembly (7) should be replaced. Remove nut (123), nut assembly (157) and connector (124) from terminal stud (125). Remove nut assembly (133), connector (134), washer (135) and screw and washer assembly (153). Lift rectifier assembly (7) from SRE housing (1).

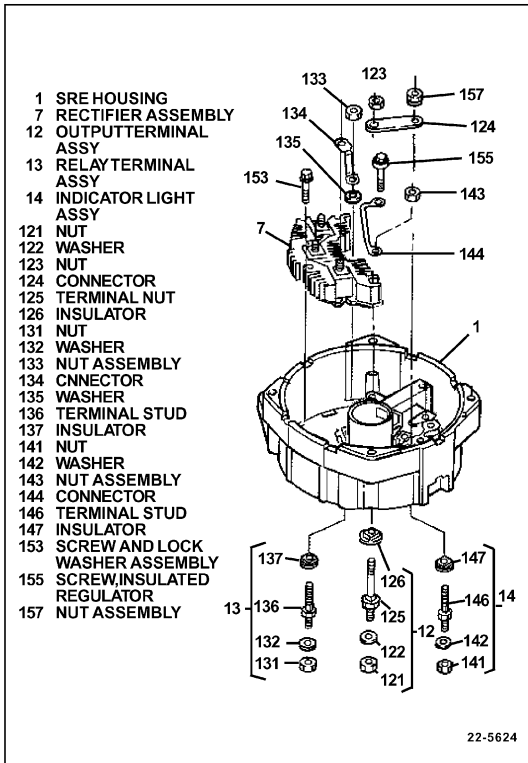
Remove nut assembly (143) and connector (144) as necessary for clearance.

NOTICE

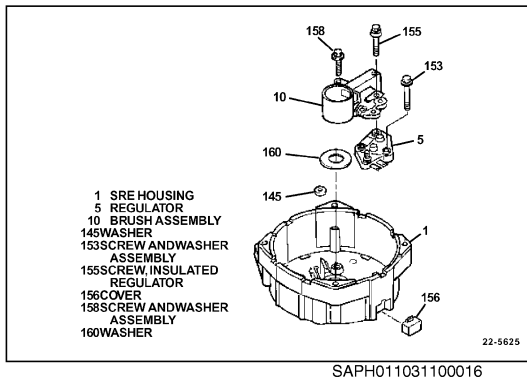
Hold brushes in retracted position and insert brush pin to keep brushes in retracted position.



SAPH011031100014



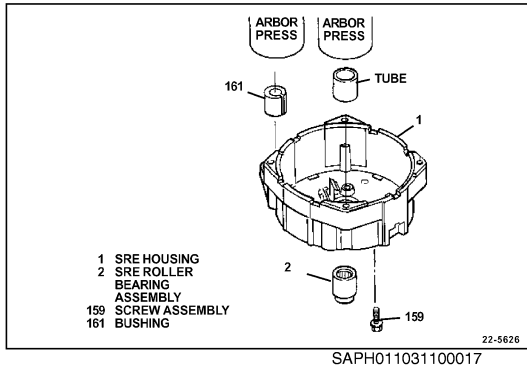
SAPH011031100015



- (9) Brush holder assembly (10) must be removed to service brushes or regulator (5). Remove cover (156) and insulated regulator screw (155). Remove screw and washer assembly (158). Lift brush holder assembly (10) from SRE housing. Remove washers (145 & 160) with care to prevent contamination of bearing grease.

Place tape over bearing to keep dirt out.

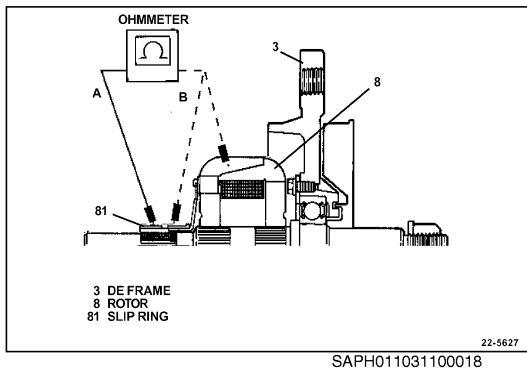
- (10) Inspect brushes and brush holder assembly for wear, cracks, broken leads or other damage. If damaged replace with a new brush holder assembly (10).



- (11) Remove remaining screw and washer assembly (153) attaching regulator (5). If previous checks lead to an instruction to replace the regulator, replace it. If it is not known whether regulator is good, use an approved tester for SI-type regulators. Always check field coil for shorts when replacing regulator.

- (12) Remove protective tape and check SRE roller bearing assembly (2) in SRE housing (1). Bearing is permanently lubricated; do not add grease. If bearing is dry or damaged, replace bearing. To remove bearing, use tube slightly smaller than opening in SRE housing (1) and press bearing through to inside of housing. If bearing is not replaced, put tape back over bearing.

Remove screw assembly (159) and press bushing (161) from SRE housing (1) if required.



3. DE FRAME AND COMPONENTS

- (1) Use ohmmeter to check rotor field resistance. Place ohmmeter leads on the two slip rings on the rotor shaft to make this check .

NOTICE

A 12V battery, voltmeter and ammeter may be used to check rotor current draw to specifications. Read the meters quickly. Core resistance will change as the core heats up from the current flow.

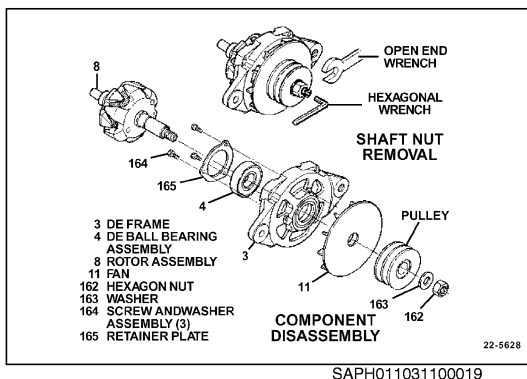
Refer to 22 SI Alternator Specifications at the end of this manual for proper value. Also use ohmmeter to check for a grounded field by touching one lead (A) to a slip ring (81) and one lead (B) to rotor frame (82) assembly. Reading should be infinite (open) to show that field is not grounded. If field resistance is outside specifications or if field is grounded, replace rotor assembly (8).

- (2) Hold DE frame (3) and spin rotor assembly (8) by hand to see that it spins freely in DE ball bearing assembly (4). Bearing is permanently lubricated; do not add grease. If movement is rough or wobbly, replace bearing.

- (3) Remove hexagon nut (162) by placing 5/16" hexagonal wrench in end of rotor assembly (8) shaft to hold while removing nut with open end wrench. Turn nut counterclockwise to remove. If hex wrench is not available, wrap rotor assembly in shop cloth and place in vise, tightening just enough to hold while removing hexagon nut.

- (4) Lift washer (163), pulley and fan (11) from rotor assembly shaft.

- (5) Remove rotor assembly (8) from DE frame (3) assembly ball bearing.



If rotor checked good electrically (step 16), inspect slip rings. If rough or out of round, turn in lathe, removing only enough material to make rings smooth and round. Maximum indicator reading for roundness is 0.025 mm (0.001"). Finish with 600 grain polishing cloth. Blow away

all copper dust. Clean shaft of any grease that may have accumulated copper dust.

- (6) Remove three screw and washer assemblies (164) and retainer plate (165) from DE frame (3).
- (7) Inspect DE ball bearing assembly (4). If bearing appears dry or if rotor assembly (8) did not turn smoothly when checked during DE frame disassembly, remove and replace bearing. Bearing is permanently lubricated. Do not attempt to add grease.

IMPORTANT POINTS - ASSEMBLY

1. DE FRAME AND COMPONENTS

- (1) Install or Connect
 - a. DE ball bearing assembly (4) and retainer plate (165) to DE frame (3) with three screw and washer assemblies (164).

Tightening Torque:

3.0 N·m {31 kgf·cm, 26 lbf·in}

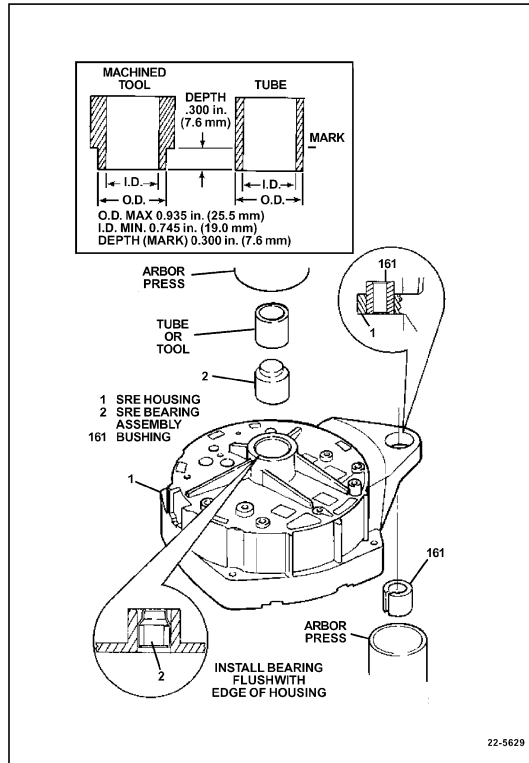
- b. Rotor assembly (8) into DE housing (3) assembly.
- c. Fan (11), pulley, washer (163), and hexagon nut (162) onto rotor assembly (8) shaft.

Tightening Torque:

100 N·m {1,020 kgf·cm, 75 lbf·ft}

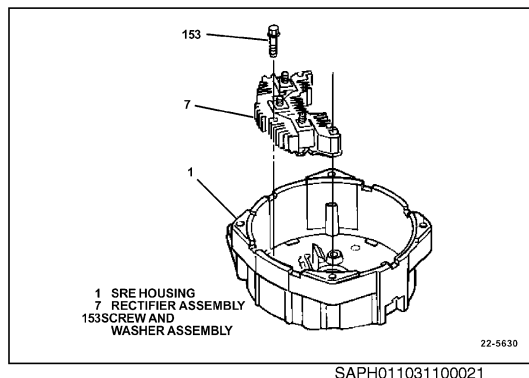
NOTICE

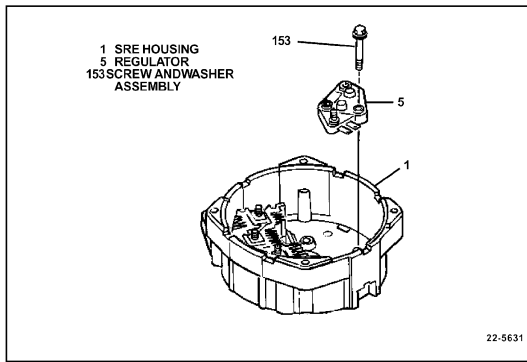
Hold shaft with 5/16" hexagonal wrench in socket end or wrap rotor assembly in shop cloth and tighten in vise just enough to hold while tightening hexagon nut.



2. SRE HOUSING AND COMPONENTS

- (1) Install or Connect
 - a. Lightly lubricate outside surface of bushing (161). Press bushing into hole in lug on SRE housing (1). Install bushing flush with inside of lug to allow maximum distance between two hinge lugs for mounting. Final position of hinge bushing will be adjusted during installation.
 - b. SRE roller bearing assembly (2) into SRE housing (1). Use suitable tube or tool to press SRE roller bearing in position, flush with outside lip of SRE housing. Cover opening in bearing with piece of tape to prevent dirt from entering during rest of procedure.
 - c. Rectifier assembly (7) to SRE housing (1) assembly. Install one screw and washer assembly (153) through rectifier assembly grounded heat sink into SRE housing. Finger tighten.





SAPH011031100022

(2) Inspect

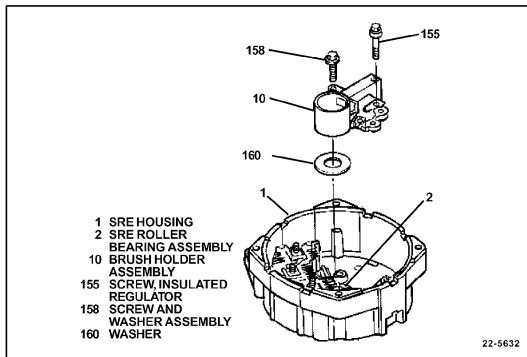
- a. Regulator mounting area in SRE housing (1) assembly for presence of grease or dirt. Good electrical contact is necessary in this area.

NOTICE

Do not immerse or wet regulator (5) with solvent. Internal damage to regulator could result.

(3) Clean

- a. Regulator mounting bosses in SRE housing (1) assembly, metal base plate and contact rings on regulator (5) by wiping with clean, dry cloth.



SAPH011031100023

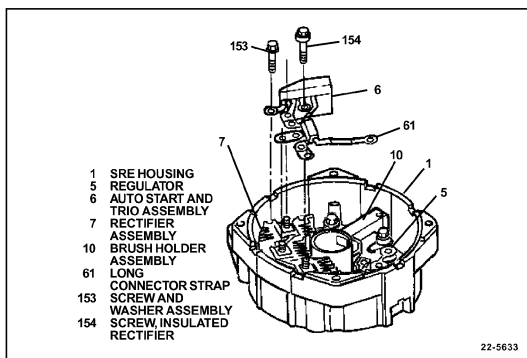
(4) Install or Connect

- a. Regulator (5) to SRE housing (1) assembly, with screw and washer assembly (153). Finger tighten.

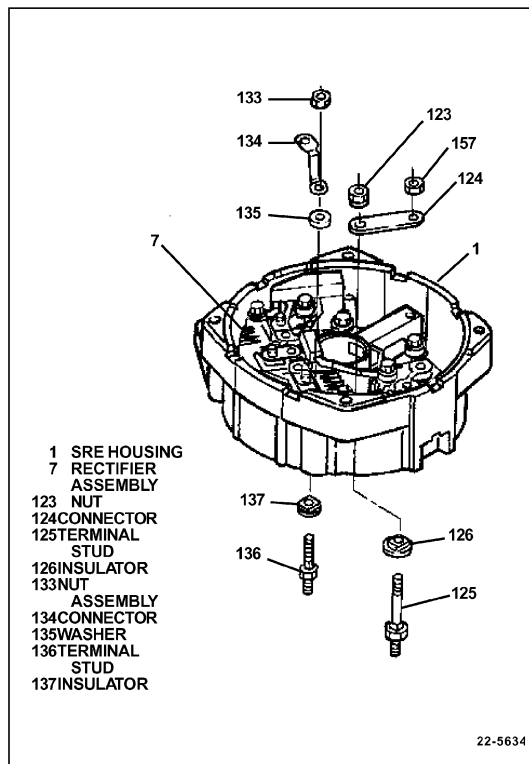
NOTICE

Remove the tape previously installed over the roller bearing assembly (2).

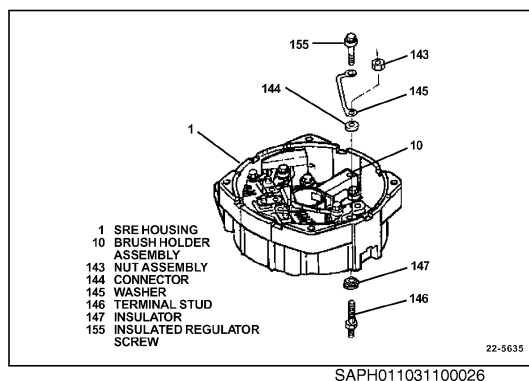
- b. Felt washer (160) so the hole is centered over the SRE roller bearing assembly (2).
- c. Brush holder assembly (10) with screw and washer assembly (158) and insulated regulator screw (155) nearest housing. Finger tighten.
- d. Tape over brush holder assembly (10) opening to protect bearing from dirt.
- e. Auto start and trio assembly (6) onto 3 threaded studs on rectifier assembly (7). Position auto start and trio assembly (6) with long connector strap (61) over closest mounting hole in brush holder (10) and regulator (5).
- f. Screw and washer assembly (153) and insulated rectifier screw (154) through auto start and trio assembly (6). Finger tighten.



SAPH011031100024



- g. Insulator (126) into "BAT" hole in SRE housing (1) assembly from the outside. Be sure square flange on insulator is seated in hole. Put terminal stud (125) through hole in insulator and add connector (124) and finger tighten nut (123) over exposed terminal stud (125) threads in rectifier assembly (7).
- h. Connector (124) exposed hole over threaded stud of regulator (5) and add nut (157). Finger tighten.
- i. Insulator (137) into "R" hole in SRE housing (1) from outside. Be sure square flange on insulator is seated in hole. Put terminal stud (136) through hole in insulator and add washer (135), connector (134) and finger tighten nut (133) over exposed terminal stud threads in rectifier assembly (7).



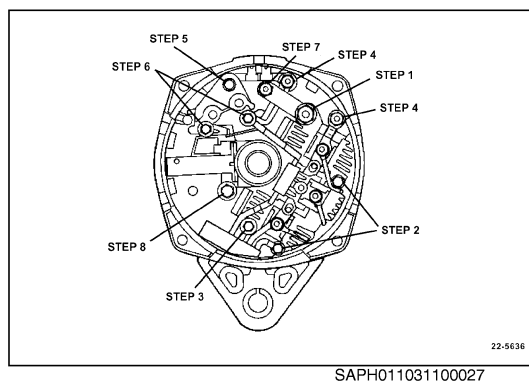
- j. Insulator (147) into "I" hole in SRE housing (1) assembly from the outside. Be sure square flange on insulator is seated in hole. Put terminal stud (146) through hole in insulator and add washer (145), connector (144) and finger tighten nut (143) over exposed terminal stud (146) threads inside SRE housing (1) assembly. Position other end of connector (144) over remaining mounting hole in brush holder assembly (10).
- k. Insulated regulator screw (155) through long connector strap (61) of auto start and trio assembly (6) and exposed hole of connector (144) into remaining mounting hole in brush holder assembly (10). Finger tighten.

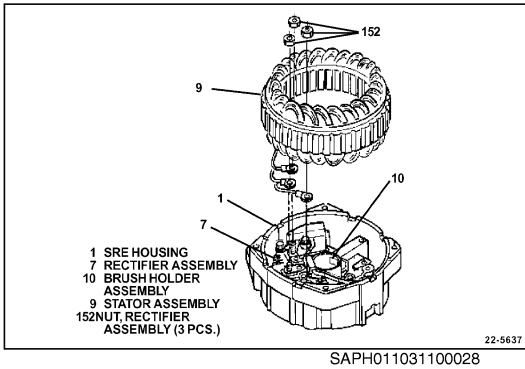
NOTICE

Secure SRE housing component fasteners in following order.

Tighting Torque

1	Nut (123) : 5.5 N·m {56 kgf·cm, 50 lbf·in}
2	Rectifier assembly (7) attaching screw and washer assembly (153) (2 places) : 3.0 N·m {31 kgf·cm, 25 lbf·in}
3	Insulated rectifier screw (154) : 2.5 N·m {25 kgf·cm, 22 lbf·in}
4	"R" and "I" terminal nut assemblies (133 & 143) : 2.5 N·m {25 kgf·cm, 22 lbf·in} It may be necessary to hold terminals on outside while tightening.
5	Screw and washer assembly (153) : 2.0 N·m {20 kgf·cm, 20 lbf·in} to ground the regulator (5).
6	Insulated regulator screws (155) (2 places) : 2.0 N·m {20 kgf·cm, 20 lbf·in}
7	Nut assembly (157) : 2.5 N·m {25 kgf·cm, 22 lbf·in}
8	Screw and washer assembly (158) : 2.0 N·m {20 kgf·cm, 20 lbf·in}





(5) Install or Connect

- Stator (9) to SRE housing (1) assembly, placing 3 phase leads over 3 threaded studs on rectifier assembly (7). Be sure stator is seated in register around edge of SRE housing.
- Rectifier assembly nuts (152) to 3 threaded studs on rectifier assembly (7).

Tightening Torque:
2.5 N·m {25 kgf·cm, 22 lbf·in}

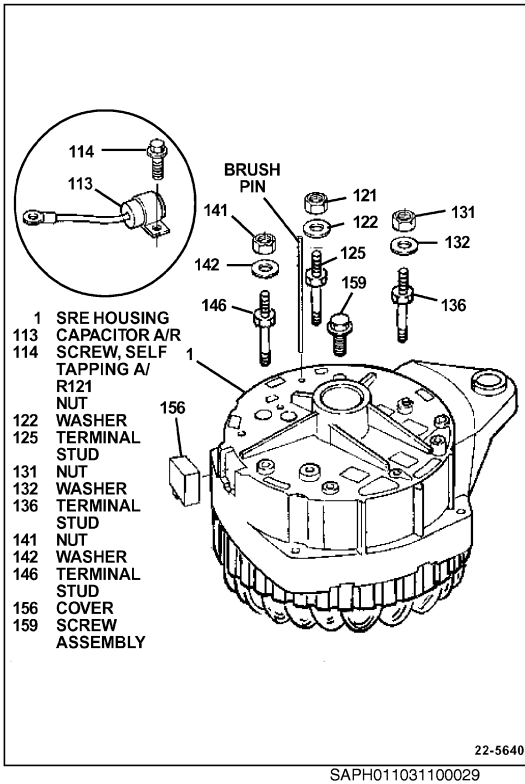
3. FINAL UNIT ASSEMBLY

(1) Clean

- Brushes in brush holder assembly (10) by removing tape and wiping brushes with clean soft cloth. Contact surfaces of brushes must be free of grease and other contaminants.

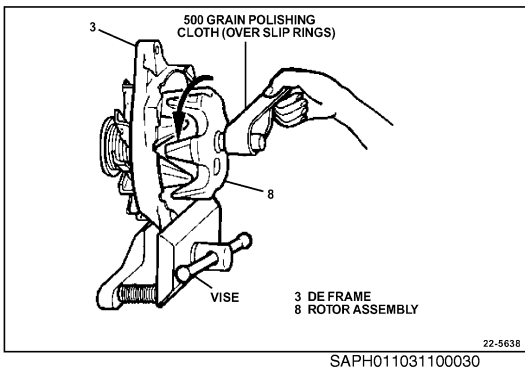
(2) Install or Connect

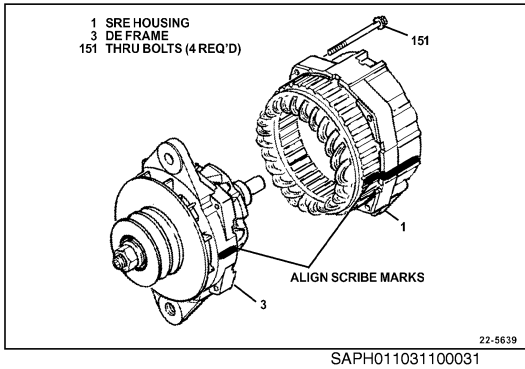
- Pin (or straightened paper clip) through SRE housing (1) assembly to hold brushes in retracted position.
- Cover (156) onto regulator terminals in hole "1" and "2". For one-wire systems only.
- Washer (122) and nut (121) onto "BAT" terminal stud (125). Finger tighten.
- Washer (132) and nut (131) onto "R" terminal stud (136). Finger tighten.
- Washer (142) and nut (141) to "I" terminal stud (146). Finger tighten.
- Screw assembly (159) into "GRD" hole in SRE housing. Finger tighten.
- As required, Capacitor (113) with self tapping screw (114) securely into hole in SRE housing (1).



(3) Clean

- Slip rings on rotor assembly (8) shaft (if not previously cleaned) by spinning rotor while holding 500 grain polishing cloth or 600 grit sandpaper around slip rings. Blow away all copper dust.
- Rotor assembly (8) shaft where it will slip into SRE housing (1) roller bearing assembly by wiping with soft cloth. Shaft must be free of dirt, copper dust and other foreign material.





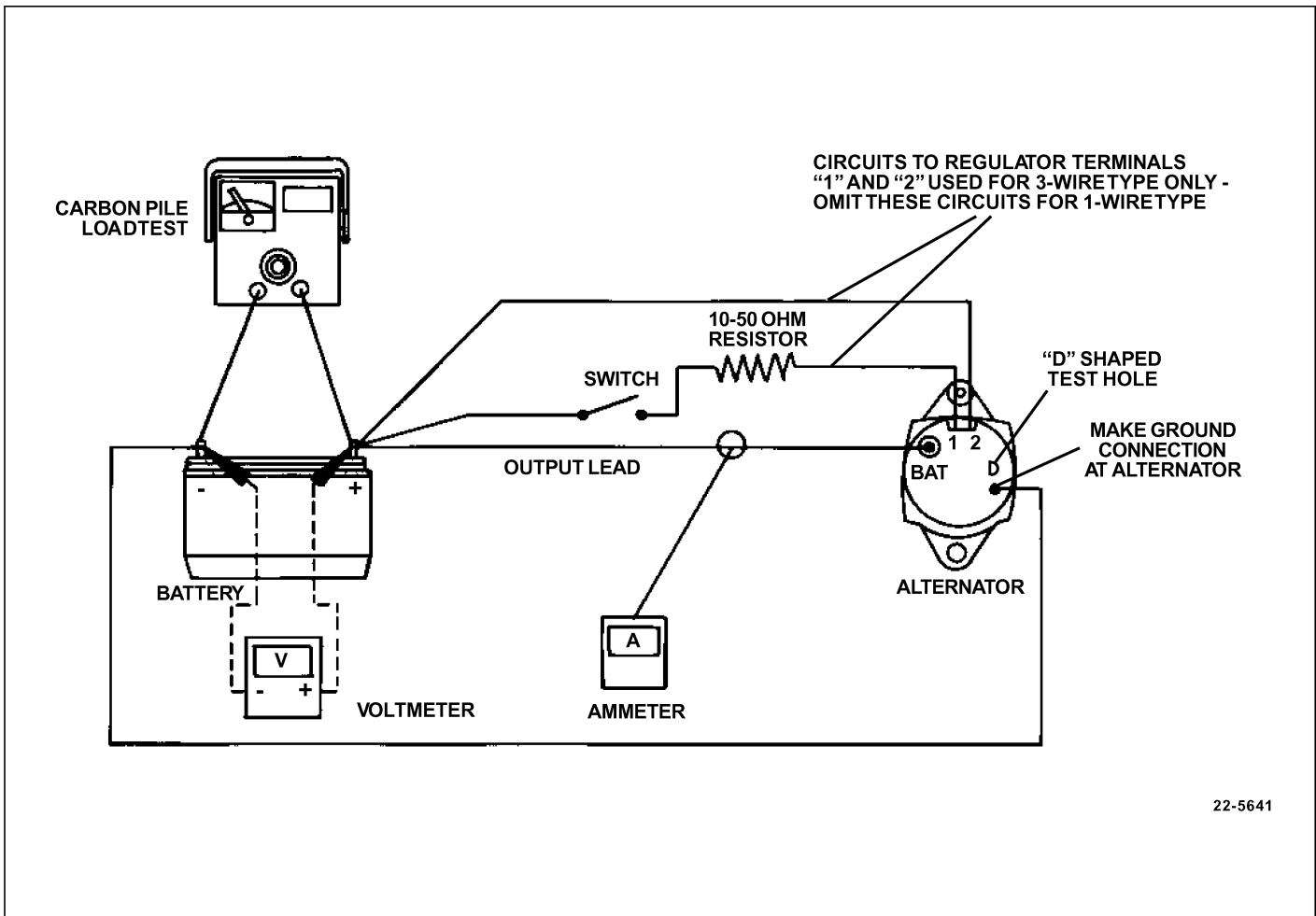
(4) Install or Connect

- a. DE frame (3) assembly to SRE housing (1) assembly, aligning marks made earlier on SRE housing and DE frame. If mark was lost due to part replacement, use mark on old part or match mounting lugs to application to determine proper frame orientation.
- b. Thru bolts (151) through 4 holes in SRE housing and DE frame. Finger tighten.

Tightening Torque:**11.0 N·m {112 kgf·cm, 100 lbf·in}**

(5) Remove or Disconnect

- a. Remove brush pin from SRE housing (1) assembly to release brushes onto slip rings inside unit.

IMPORTANT POINTS - INSPECTION**1. PERFORMANCE TEST**

22-5641

SAPH011031100032

TEST EQUIPMENT NEEDED:

- Alternator Test Stand (5000 rpm capability) (5HP min.)
- Battery or Battery Set (fully charged)
- Variable Carbon Pile Load Test
- Ammeter (current capability at least 15 amps higher than alternator rating)

- Voltmeter
- Ohmmeter

This bench test procedure is used to verify that the alternator is functioning properly prior to installation on the vehicle. The test checks the alternator output in the same manner as the Rated Output Check covered earlier in the "Troubleshooting" procedure. If bench test equipment is not available, install the alternator on the engine according to manufacturer's instructions and repeat the Rated Output Check to verify alternator operation. If bench test equipment is available, proceed as follows:

- (1) Mount alternator in suitable test stand, according to test stand manufacturer's instructions. Test stand must be capable of driving alternator at speeds up to 5000 rpm.

NOTICE

When a 12-volt carbon pile load test is used to diagnose a 24-volt system, attach load test only to 12-volt potential in battery set. Attaching a 12-volt load test to a 24-volt potential will damage the load test.

HINT

Battery or battery set must be fully charged for test results to be valid.

- (2) With carbon pile load turned off and with battery or battery set fully charged, make electrical connections as shown in Figure 35. Connect for one-wire or 3-wire type as applicable. Battery voltage and ground polarity must be same as system in which alternator is used. Check and record battery voltage before proceeding with test.
- (3) Turn on "1" terminal circuit switch (3-wire systems only). With carbon pile load "off" start test stand and slowly increase alternator speed to 5000 rpm. Observe voltmeter.

If voltage does not increase but remains at or below previous reading step (2), there is no alternator output. Skip to step (5).

If voltage increases above 15.5 volts on 12-volt system (or above 31 volts on 24-volt system), voltage is uncontrolled. Recheck alternator for proper assembly. Assure that test tab in "D" hole is not grounded. If alternator has been assembled properly, replace regulator as described under Unit Repair and test field coil for shorts or grounds.

If voltage is proper, proceed to next step.

- (4) With alternator running at about 5000 rpm, turn on carbon pile load and adjust to obtain maximum alternator output on ammeter.

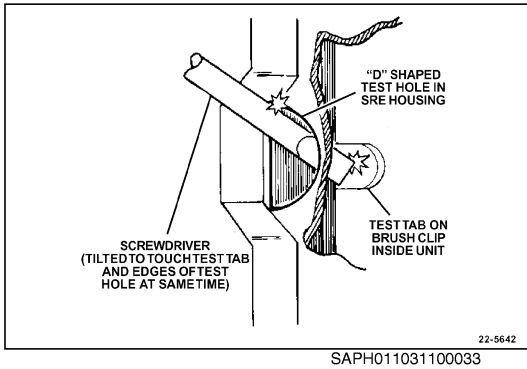
If ammeter reading is within 15 amps of cold output shown under "Alternator Specification", then alternator is good.

Turn off carbon pile and stop test stand.

If ammeter reading is more than 15 amps below the specification, alternator is not operating properly.

NOTICE

Do not insert screwdriver more than 3/4" into "D" shaped test hole during this step. The grounding tab on the brush holder assembly is reached at this distance. Inserting the screwdriver deeper may result in internal damage to the alternator.

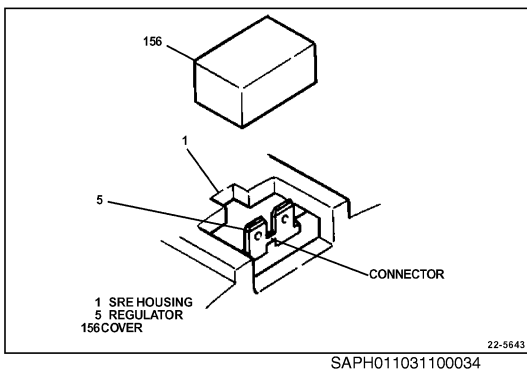


- (5) Test hole is provided in SRE housing to allow direct grounding of rotor field circuit. Grounding the brush tab inside this hole bypasses the regulator and turns the alternator on in "full field" mode. If the alternator output is proper with the brush tab grounded, the previous low output is due to conditions within the regulator. Because the voltage is not regulated and can exceed 16 volts in full field mode, the test hole should be used only for bench test procedures.

Insert screwdriver straight into test hole in SRE housing assembly to make contact with tab on brush clip. Tilt handle slightly to ground tab to housing at edge of test hole and hold. Again adjust carbon pile to obtain maximum output on ammeter without allowing voltage on voltmeter to rise above 15 volts on 12-volt system (30 volts on 24-volt system). Record reading then turn off carbon pile and stop test stand.

If there is still no output, check rotor and brushes for an open circuit. Be sure that brushes are assembled properly and in contact with the slip rings. Check internal electrical connections to be sure grounding and insulated mounting screws are installed in the proper locations.

For a one-wire system only, remove the cover (156) from the regulator terminal and verify that there is a connector between the terminals. If not, replace regulator.



If the output is now within 15 amps of the cold output in "22 SI Alternator Specifications", but was not when checked per step 4, check the regulator mounting to assure that grounding and insulated mounting screws are installed in the proper location. If assembly is proper, replace regulator.

If there is some alternator output, but it is still more than 15 amps below the cold output specification, check the rotor field, brushes, stator, diode trio, and rectifier bridge.

PRECAUTIONS

1. PRECAUTIONS DURING OPERATION

- Do not disconnect the battery while the alternator is rotating.
- Do not operate the alternator with the alternator's B terminal (output terminal) disconnected.
- Do not expose the alternator to water.

2. OTHER PRECAUTIONS

- Make sure to disconnect the battery terminal before inspecting the alternator.
- Do not interchange the polarity of the battery cables when replacing the battery.
- Make sure to disconnect the cables and charge the battery separately when using a quick charger.
- Never perform a megger tester on the alternator assembly.
- Make sure to disconnect the wiring to the alternator when performing a megger test on the vehicle's wiring.

INSPECTION AND REPAIR

EN0110311H300001

Rotor Field Coil Specifications at 80°F (27°C).

Alternator Model	Ohms	Amperes @ Volts	
12V/100A	1.6-1.9	6.4-7.5	12

For further information on rotations and exact specification number on these or other Delco Remy America Products Call: 1-800-DRA-0222

Cold current output at 80°F.

Alternator	Amperes @ 80°F	
Model	1600rpm	5000rpm
12V/100A	60	100

ALTERNATOR (J05D: 12V-105A)

EN11-002

ALTERNATOR.....EN11-2

DATA AND SPECIFICATIONS	EN11-2
TROUBLESHOOTING	EN11-2
COMPONENT LOCATOR.....	EN11-3
SPECIAL TOOL	EN11-5
OVERHAUL	EN11-6
INSPECTION AND REPAIR	EN11-17

ALTERNATOR

DATA AND SPECIFICATIONS

EN01Z0111I200001

Nominal voltage	12V
Nominal output	12V-105A
Max. output	105A at 13.5V, 5,000 r/min
Initial output starting speed	1,370 r/min at 13.5V
Max. rotating	10,000 r/min
Rotating direction	Right (seen from pulley side)
Regulator	Mount-on

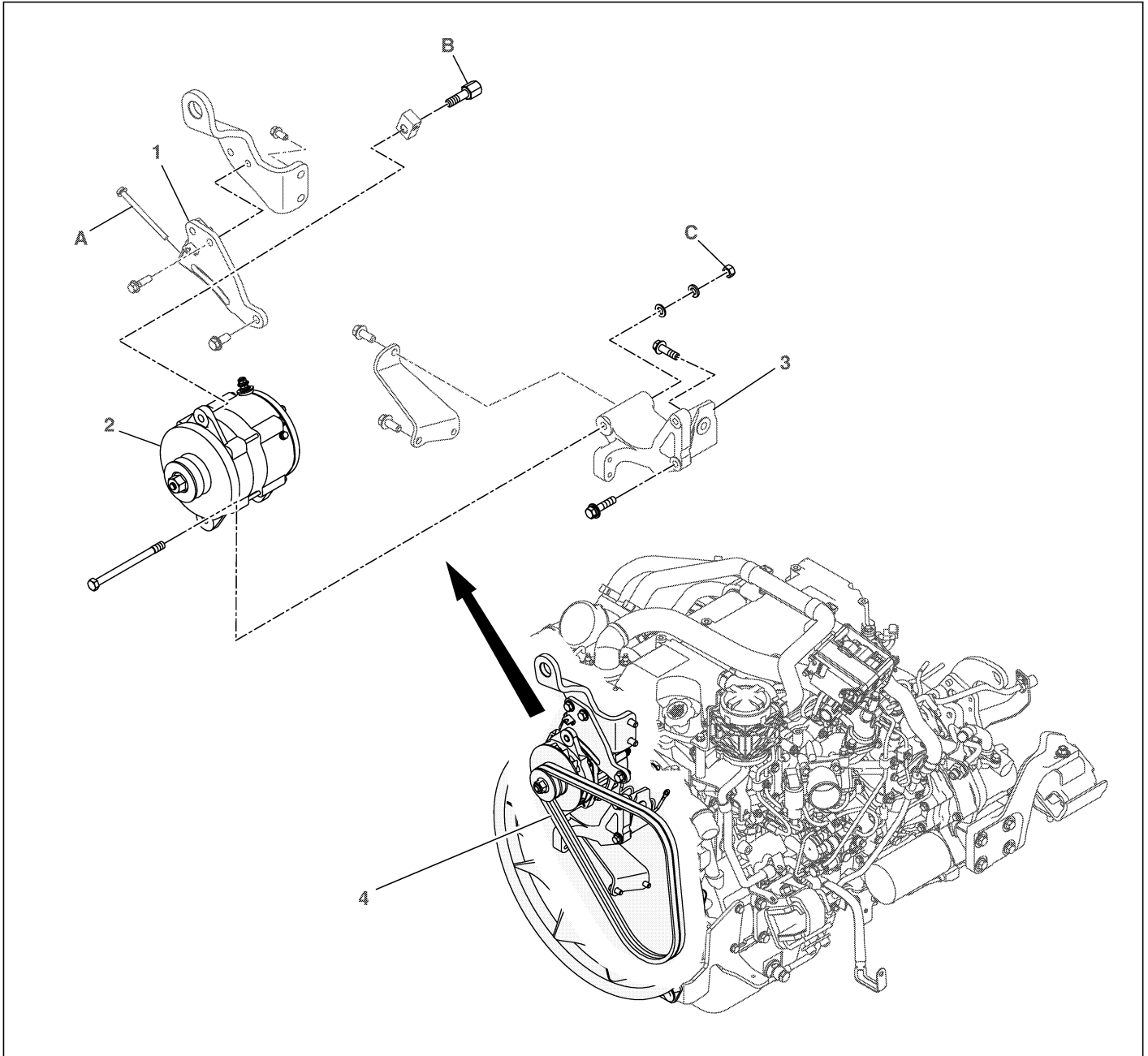
TROUBLESHOOTING

EN01Z0111F300001

Symptom	Possible cause	Remedy/Prevention
Charge warning lamp does not light with starter switch ON and engine off	Fuse blown	Determine cause and replace fuse
	Lamp burned out	Replace lamp
	Wiring connection loose	Tighten loose connections
	Charge lamp relay faulty	Check relay
	IC regulator faulty	Replace IC regulator
Charge warning lamp does not go out with engine running (Battery requires frequent recharging)	Drive belt loose or worn	Adjust or replace drive belt
	Battery cables loose, corroded or worn	Repair or replace cables
	Fuse blown	Determine cause and replace fuse
	Fusible link blown	Replace fusible link
	Charge lamp relay, IC regulator or alternator faulty	Check charging system
	Wiring faulty	Repair wiring

COMPONENT LOCATOR

EN01Z0111D100001



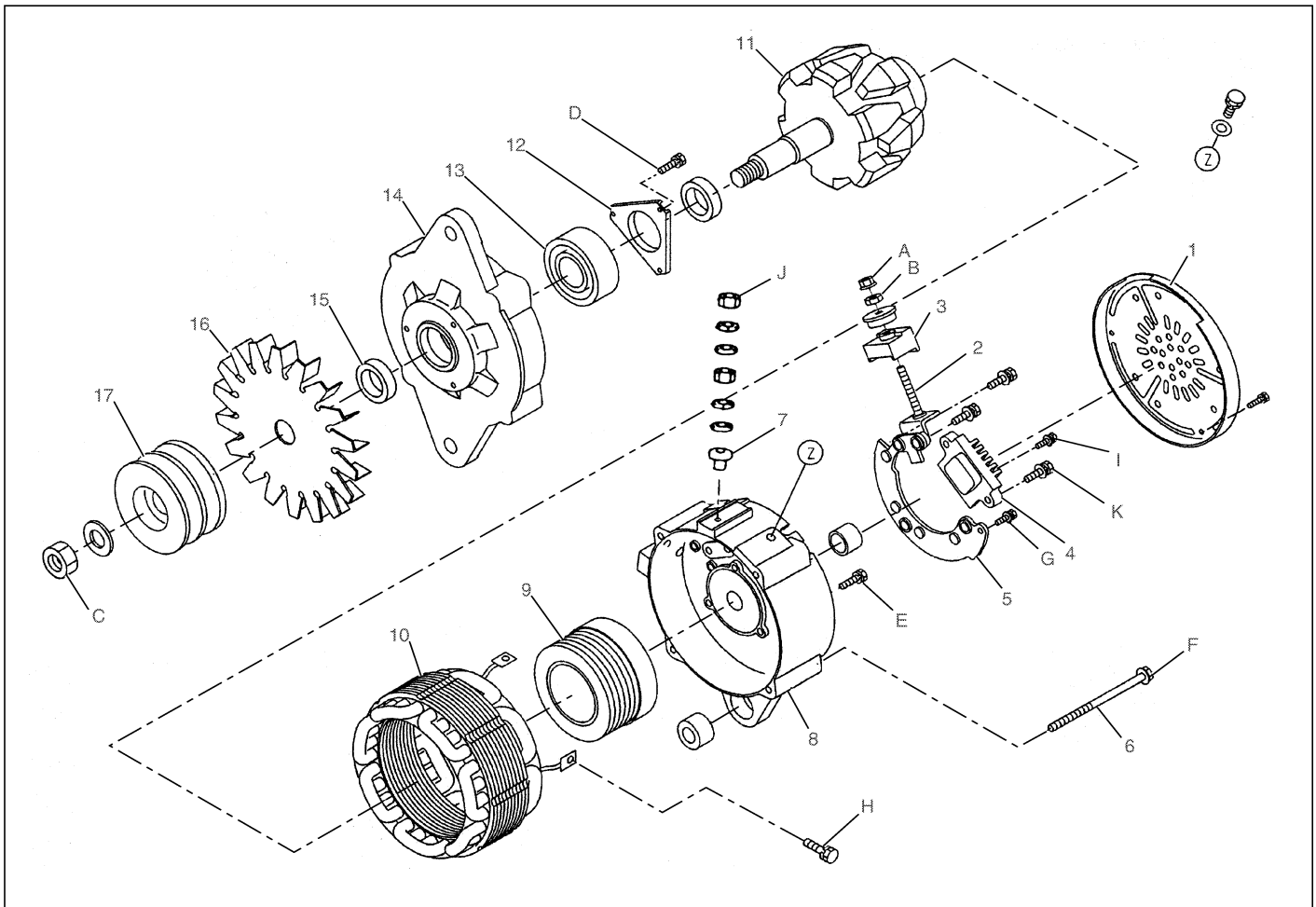
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1	Brace	3	Bracket
2	Alternator	4	V-belt

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A	25 {255, 19}	C	83 {850, 61}
B	81-95 {826-969, 60-70}		



SAPH01Z011100002

1	Cover	10	Stator
2	Terminal B sub assembly	11	Rotor
3	Insulator (inner)	12	Retainer plate
4	Rectifier (positive side)	13	Bearing
5	Rectifier (negative side)	14	Drive end frame
6	Through bolt	15	Collar
7	Insulator (outer)	16	Fan
8	Rear end frame	17	Pulley
9	Field coil		

Tightening torque

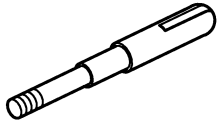
Unit: N·m {kgf·cm, lbf·ft}

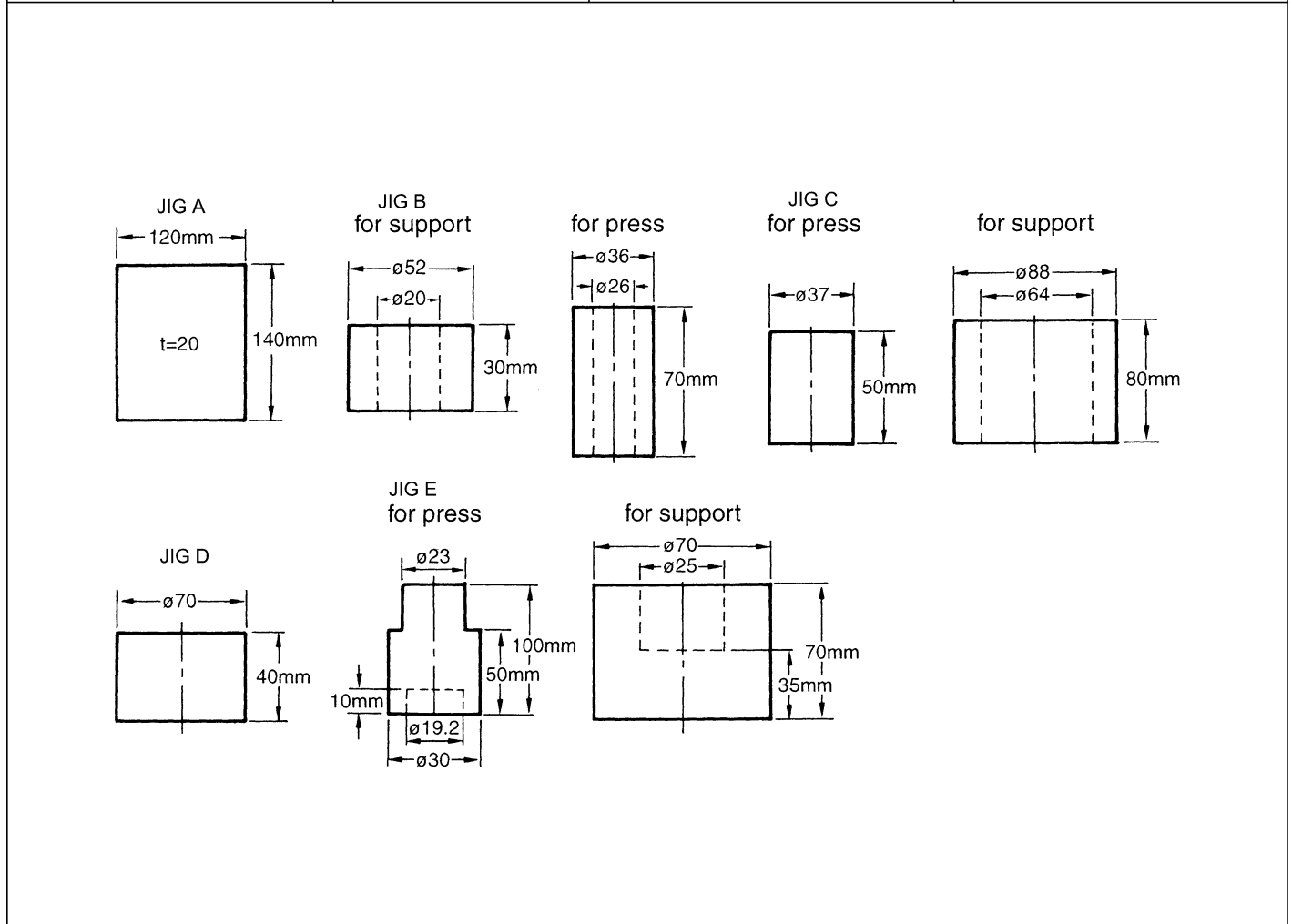
A	3.2-4.4 {33-45, 2.4-3.2}	G	3-5 {30-50, 2.1-3.6}
B	8-10 {80-110, 5.8-8.0}	H	1.9-2.5 {19-25, 1.4-1.8}
C	118-137 {1,200-1,400, 87-101}	I	1.6-2.0 {16-20, 1.2-1.4}
D	3-5 {30-50, 2.1-3.6}	J	1.6-2.0 {16-20, 1.2-1.4}
E	3-5 {30-50, 2.1-3.6}	K	3-5 {30-50, 2.1-3.6}
F	6.5-9.3 {66-95, 4.8-6.9}		

SPECIAL TOOL

EN01Z0111K100001

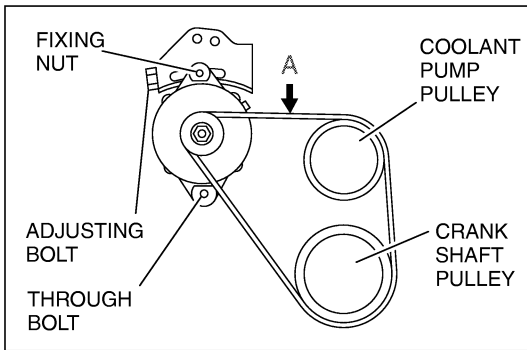
Prior to starting an alternator overhaul, it is necessary to have this special tool.

Illustration	Part number	Tool name	Remarks
	S0944-41210	COMPRESSION GAUGE	



OVERHAUL

EN01Z0111H200001



IMPORTANT POINTS - MOUNTING

1. ADJUST THE ALTERNATOR V-BELT DEFLECTION.

- (1) Loosen the through bolt and the fixing nut.
- (2) Apply a load of about 98N {10 kgf} by pressing the measuring point A.
- (3) Turn the adjusting bolt, and adjust the deflection of the belt at measuring point A, so that it comes within the standard value.

SST: Compression gauge (S0944-41210)

Standard: 9-10.5 mm {0.354-0.413 in.}

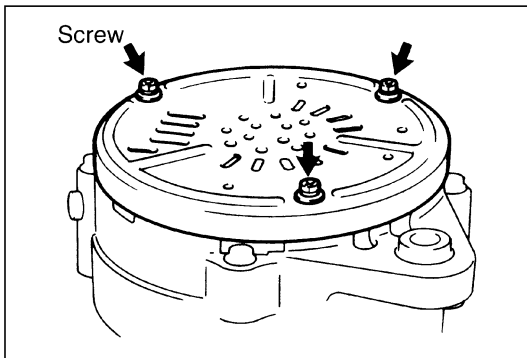
NOTICE

- When installing a new V-belt, be sure to repeat the adjustment two or three times, after running the engine.
 - When adjusting the V-belt, do not apply the lever directly against the alternator.
- (4) After adjusting the deflection, tighten the through bolt and then securely tighten the fixing nut.
 - (5) Retighten the adjusting bolt.
 - (6) Connecting the harness.

IMPORTANT POINTS - DISASSEMBLY

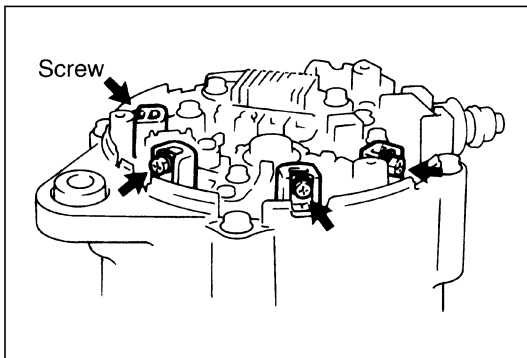
1. REMOVE THE REAR COVER.

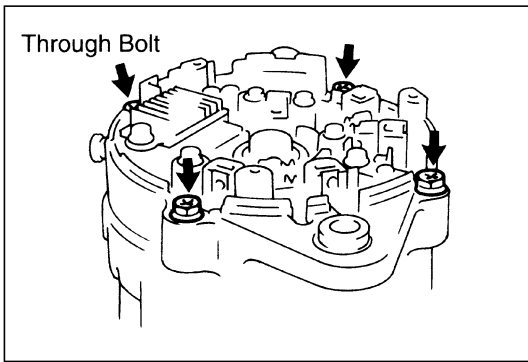
- (1) Remove 3 screws to remove the rear cover.



2. SEPARATE THE FRONT AND REAR PORTIONS.

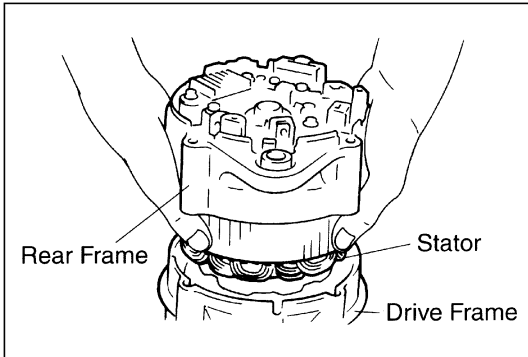
- (1) Remove 4 screws and separate the stator outlet terminal and the rectifier.





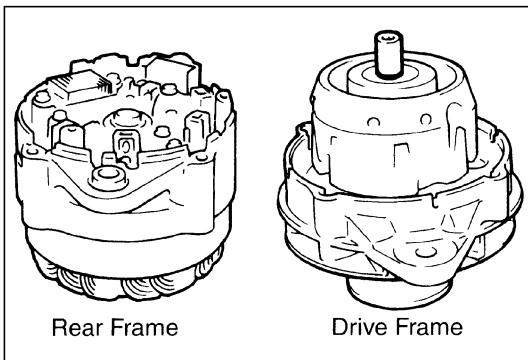
SAPH01Z011100008

- (2) Remove 4 through bolts.



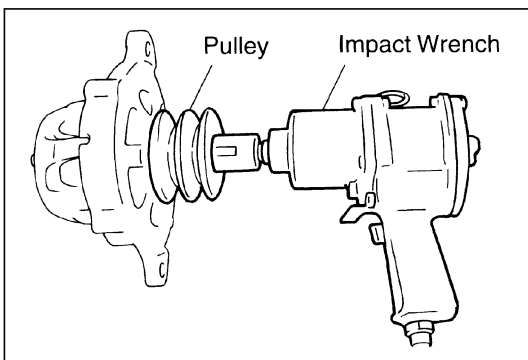
SAPH01Z011100009

- (3) While keeping the stator and the rear frame together, lift them away from the drive frame.



SAPH01Z011100010

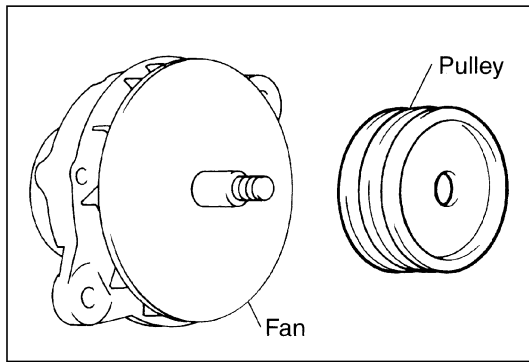
- (4) Drive and rear frames separated.



SAPH01Z011100011

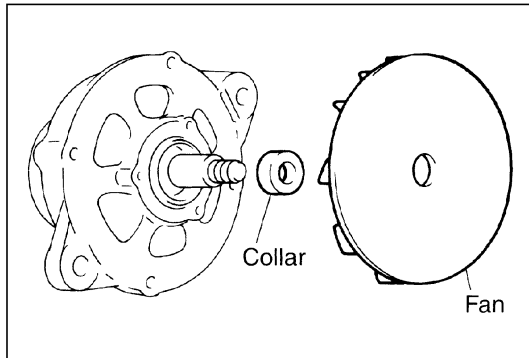
3. REMOVE THE PULLEY

- (1) Remove the pulley lock nut using an impact wrench.



SAPH01Z011100012

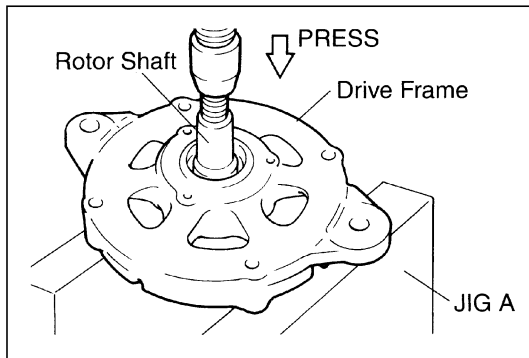
- (2) Remove the pulley from the shaft.



SAPH01Z011100013

4. REMOVE THE FAN.

5. REMOVE THE COLLAR.



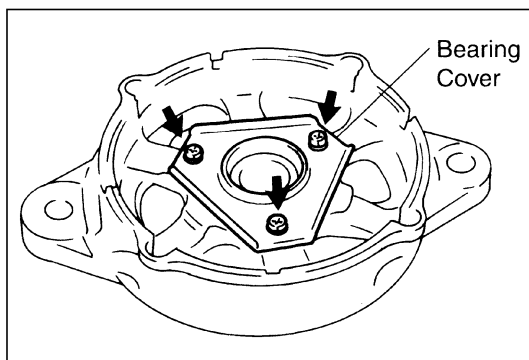
SAPH01Z011100014

6. REMOVE THE ROTOR.

- (1) Using the JIG A and press, remove the rotor from the drive frame.

NOTICE

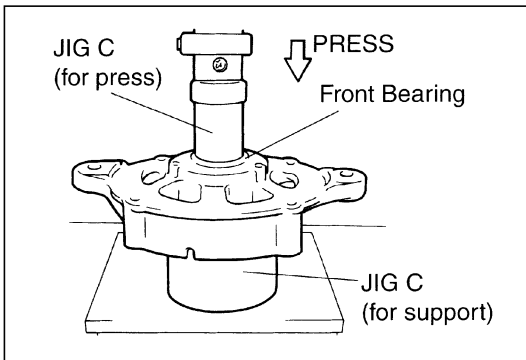
Do not drop the rotor.



SAPH01Z011100015

7. REMOVE THE FRONT BEARING.

- (1) Remove 3 screws to remove the bearing cover.

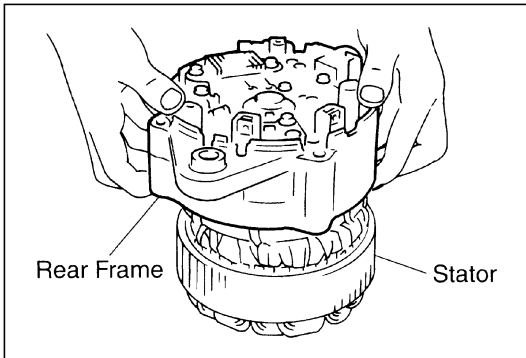


SAPH01Z011100016

- (2) Using the JIG C and press, remove the front bearing from the drive frame.

NOTICE

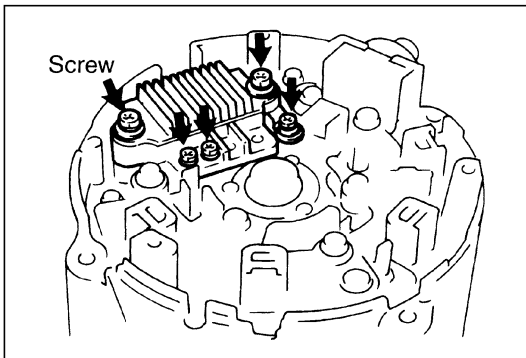
Do not drop the front bearing.



SAPH01Z011100017

8. SEPARATE THE REAR FRAME AND STATOR.

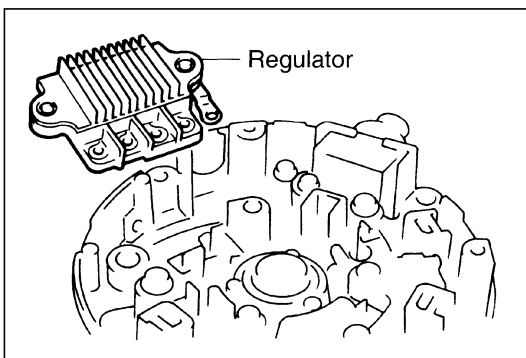
- (1) Pull out the rear frame to separate it from the stator.



SAPH01Z011100018

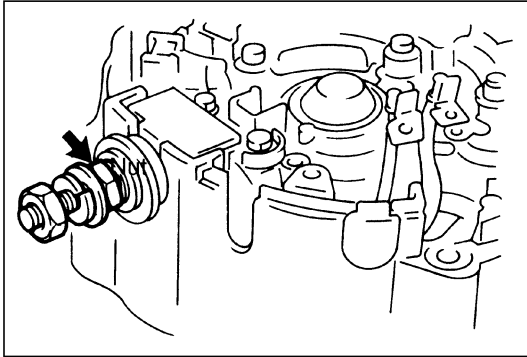
9. REMOVE THE REGULATOR.

- (1) Remove 3 screws to separate the rectifier, the exciting coil outlet terminal, and the regulator.
- (2) Remove 2 screws to remove the regulator.



SAPH01Z011100019

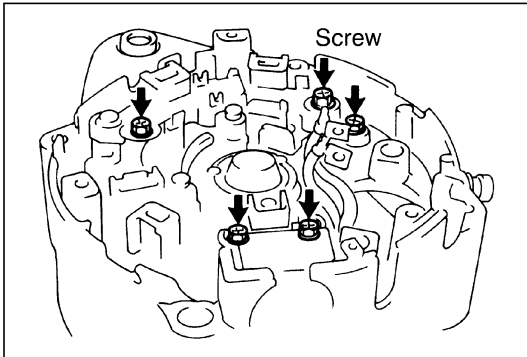
- (3) Regulator removed.



SAPH01Z011100020

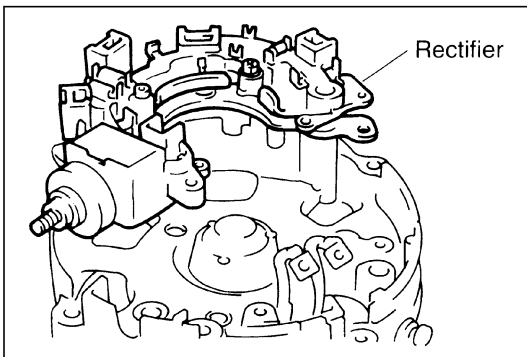
10. REMOVE THE RECTIFIER.

- (1) Loosen the B terminal nut.



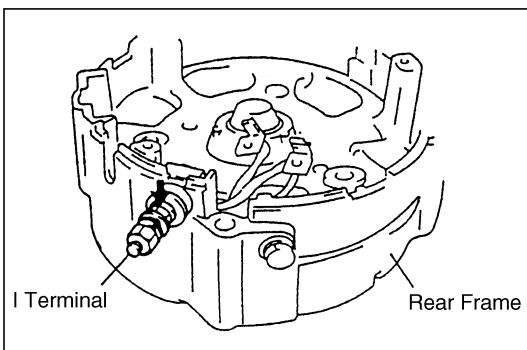
SAPH01Z011100021

- (2) Remove the screw from the rectifier's (-) terminal.
- (3) Remove 4 screws to remove the rectifier.



SAPH01Z011100022

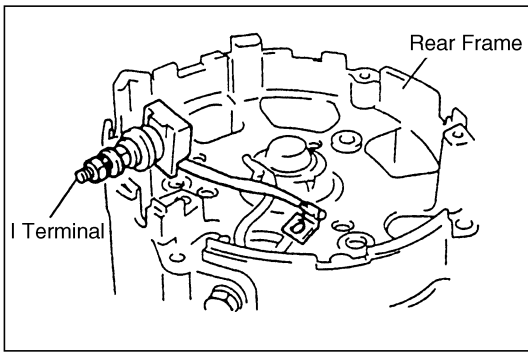
- (4) Rectifier removed.



SAPH01Z011100049

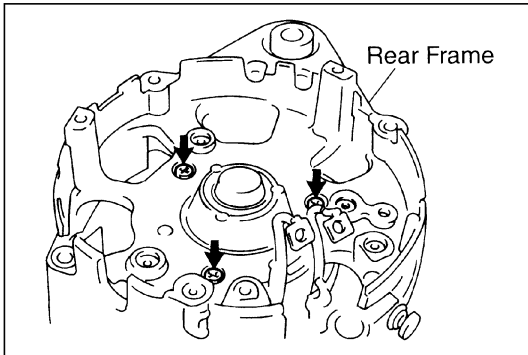
11. REMOVE THE I TERMINAL.

- (1) Loosen the I terminal nut to remove the I terminal.



SAPH01Z011100050

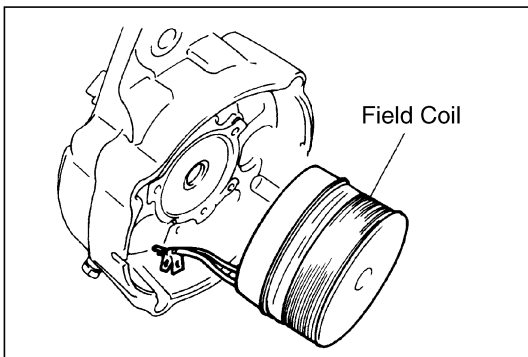
(2) I terminal removed.



SAPH01Z011100023

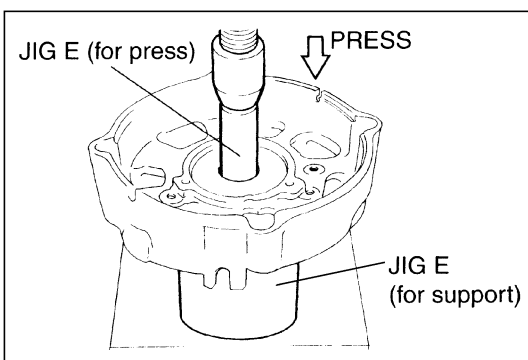
12. REMOVE THE FIELD COIL.

(1) Remove 3 screws to remove the field coil from the rear frame.



SAPH01Z011100024

(2) Field coil removed.

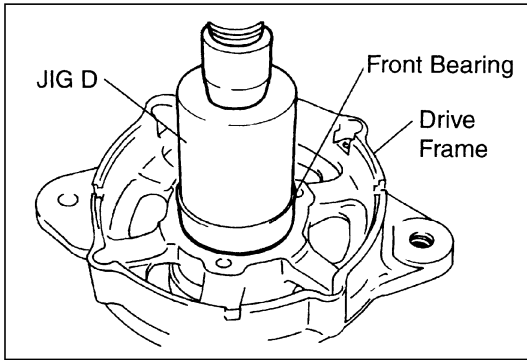


SAPH01Z011100025

13. REMOVE THE REAR BEARING.

(1) Using the JIG E and press, remove the rear bearing from the rear frame.

NOTICE**Do not reuse the rear bearing.**



SAPH01Z011100026

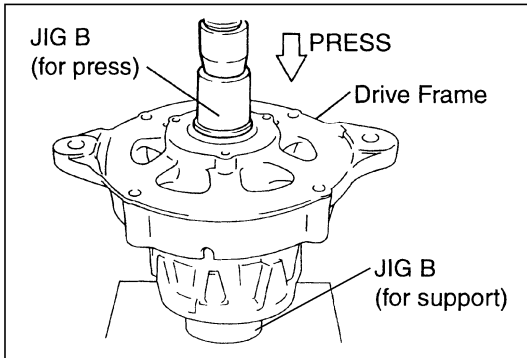
IMPORTANT POINTS - ASSEMBLY

1. INSTALL THE FRONT BEARING.

- (1) Using the JIG D and press, press the front bearing into the drive frame.
- (2) Using 3 screws, install the bearing cover.

Tightening Torque:

3-5 N·m {30-50 kgf·cm, 2.1-3.6 lbf·ft}



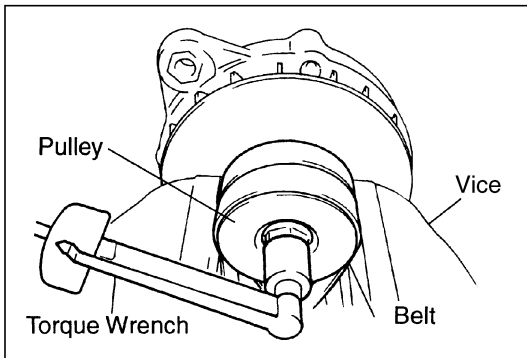
SAPH01Z011100027

2. INSTALL THE ROTOR.

- (1) Insert the collar to the rotor shaft.
- (2) Using the JIG B and press, press the rotor into the bearing in the drive frame.

NOTICE

- Press the rotor while making sure that the rotor's shaft is perpendicular to the bearing.
- During pressing, make sure not to damage the portion of the rotor that presses into the rear bearing.



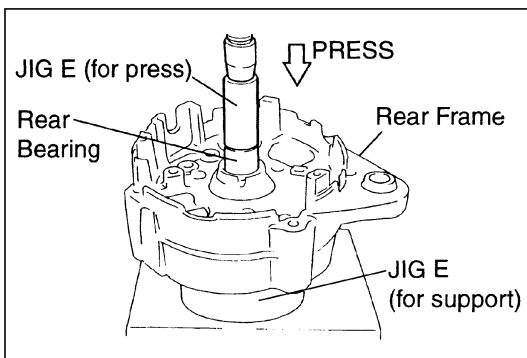
SAPH01Z011100028

3. TIGHTENING THE PULLEY.

- (1) Insert the collar and fan to the rotor shaft.
- (2) Secure the pulley with belt using a vice as shown in the figure, tighten the pulley lock nut with specified torque.

Tightening Torque:

118-137 N·m {1,200-1,400 kgf·cm, 87-101 lbf·ft}



SAPH01Z011100029

4. INSTALL THE REAR BEARING.

- (1) Using the JIG E and press, press a new rear bearing into the rear frame.

NOTICE

Once a bearing is removed, do not reuse it.

5. INSTALL THE FIELD COIL.

- (1) Using 3 screws, install the field coil on the rear frame.

Tightening Torque:

3-5 N·m {30-50 kgf·cm, 2.1-3.6 lbf·ft}

6. ASSEMBLING THE I TERMINAL

- (1) Install the I terminal on the rear frame and tighten the nut.

Tightening Torque:

1.6 - 2.0 N·m {16 - 20 kgf·cm, 1.2 - 1.4 lbf·ft}

7. ASSEMBLING THE RECTIFIER

- (1) Using 4 screws, install the rectifier.

Tightening Torque:

3-5 N·m {30-50 kgf·cm, 2.1-3.6 lbf·ft}

- (2) Using a screw, install the rectifier's (-) terminal.

Tightening Torque:

3-5 N·m {30-50 kgf·cm, 2.1-3.6 lbf·ft}

- (3) Tighten the B terminal nut.

Tightening Torque:

8-11 N·m {80-110 kgf·cm, 5.8-8.0 lbf·ft}

8. ASSEMBLING THE REGULATOR.

- (1) Using 2 screws, install the rectifier.

Tightening Torque:

3-5 N·m {30-50 kgf·cm, 2.1-3.6 lbf·ft}

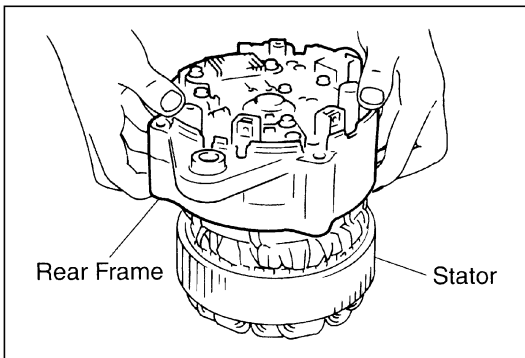
- (2) Using 3 screws, install the rectifier and the field coil outlet terminal to the regulator.

Tightening Torque:

1.6-2.0 N·m {16-20 kgf·cm, 1.2-1.4 lbf·ft}

9. INSTALL THE STATOR AND THE REAR FRAME.

- (1) Slowly insert the stator while maintaining it perpendicular to the rear frame.



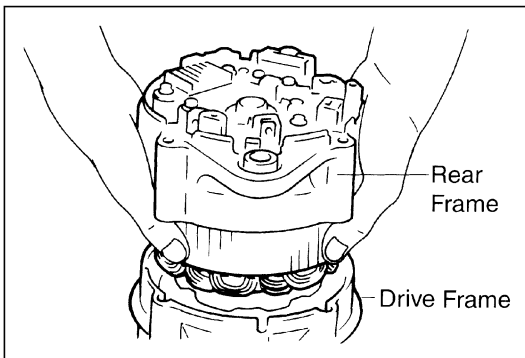
SAPH01Z011100030

10. ASSEMBLING THE DRIVE AND REAR FRAME.

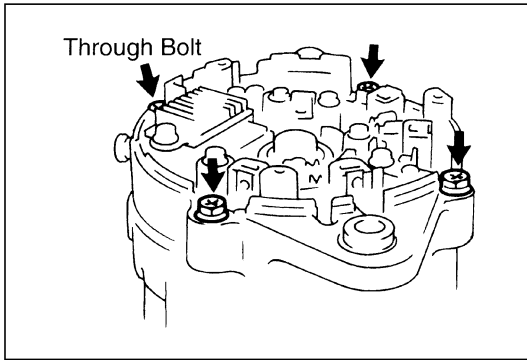
- (1) Apply a thin coat of NSK EA5 grease on the rear bearing portion of the rotor shaft.
- (2) Slowly insert the rear frame while maintaining it perpendicular to rotor shaft.

NOTICE

To prevent damage to the rear bearing, do not apply excessive force during the insertion.

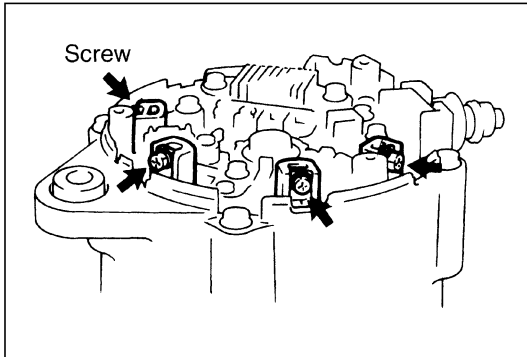


SAPH01Z011100031



SAPH01Z011100032

- (3) Install 4 through bolts.
Tightening Torque:
6.5-9.3 N·m {66-95 kgf·cm, 4.8-6.9 lbf·ft}



SAPH01Z011100033

- (4) Using 4 screws, install the stator outlet terminal to the rectifier.
Tightening Torque:
1.9-2.5 N·m {19-25 kgf·cm, 1.4-1.8 lbf·ft}
- (5) Using 3 screws, install the rear cover.

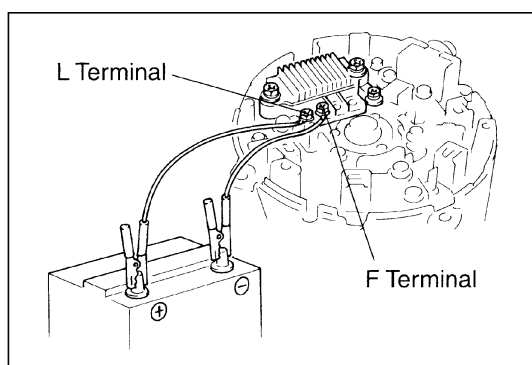
PERFORMANCE TEST

NOTICE

- Using a bench tester, perform a performance test according to the procedure described below.
- Note the battery polarity carefully so as not to make reverse connections.
If the connections are reversed, the rectifier will short the circuit and allow a large current to flow through and damage the diodes and I.C. regulator as well as burning the wiring harness.
- Take care not to make wrong connections of terminals.
- When charging the battery with a quick charge, disconnect the battery terminals.
- Do not perform tests with high voltage insulation resistance tester.
- In operation, never disconnect the battery.
- During this inspection, make sure to use a fully charged battery.

1. MAGNETIZING

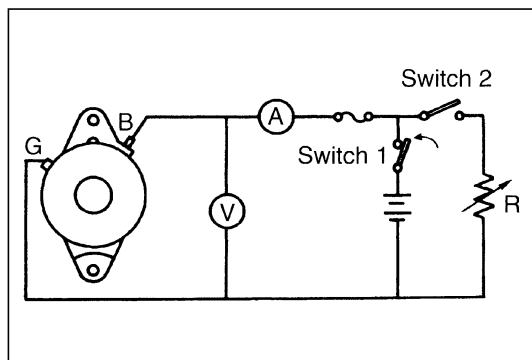
- (1) Apply a battery (12V) to the L terminal (positive) and F terminal (negative) of the regulator as shown in the figure.



SAPH01Z011100034

2. MEASURING THE SELF-EXCITED STARTING RPM.

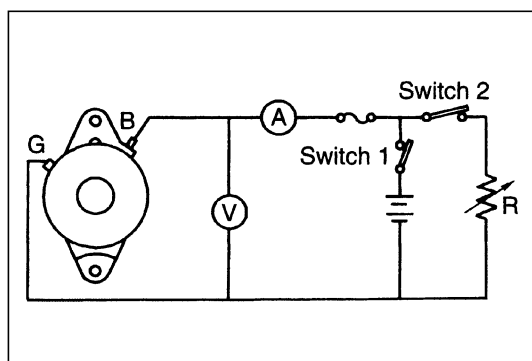
- (1) Turn Switch 1 ON.
- (2) Gradually increase the alternator rpm.
- (3) Measure the rpm (starting rpm) at which the charging current starts to flow. (it is normal if under 1,500 rpm)



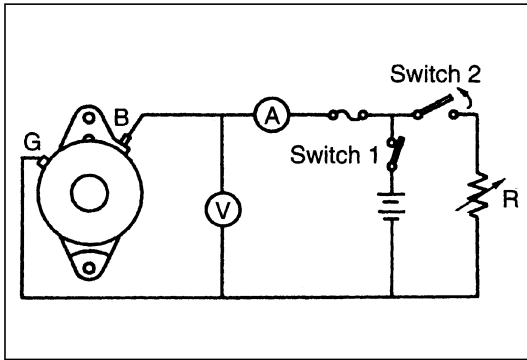
SAPH01Z011100035

3. MEASURING THE RATED OUTPUT

- (1) Turn Switch 1 and Switch 2 ON.
- (2) Maintain the alternator rpm at a constant 5,000 rpm.
- (3) While observing a voltmeter, regulate the load (variable resistance: R) so that a 12V system outputs 13.5V.
- (4) At this time, measure the output current (it is normal if more than the rated output current is obtained).



SAPH01Z011100036



SAPH01Z011100037

4. VERIFYING THE REGULATOR'S REGULATED VOLTAGE

- (1) In the state in which the rated output was measured, turn Switch 2 OFF.

NOTICE

At this time, reduce the current that flows to the load (variable resistance: R) to the minimum and turn Switch 2 OFF.

- (2) When the output current is less than 10A (the charging current to the battery is reduced), measure the voltage.

Standard: 14.0-14.4 V

PRECAUTIONS

1. PRECAUTIONS DURING OPERATION

- Do not disconnect the battery while the alternator is rotating.
- Do not operate the alternator with the alternator's B terminal (output terminal) disconnected.
- Do not expose the alternator to water.

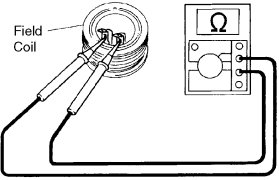
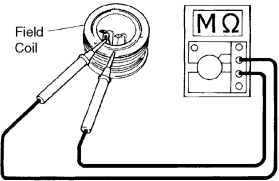
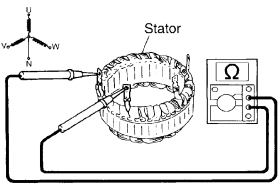
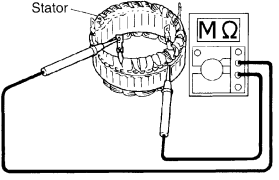
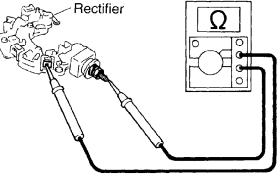
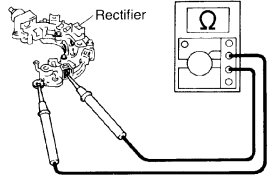
2. OTHER PRECAUTIONS

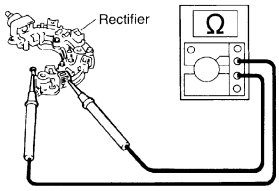
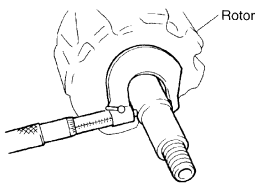
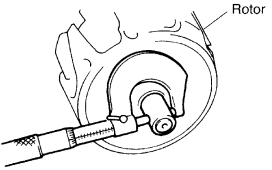
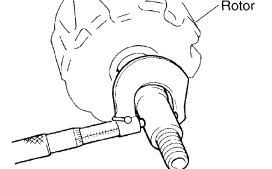
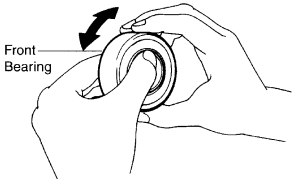
- Make sure to disconnect the battery terminal before inspecting the alternator.
- Do not interchange the polarity of the battery cables when replacing the battery.
- Make sure to disconnect the cables and charge the battery separately when using a quick charger.
- Never perform a megger tester on the alternator assembly.
- Make sure to disconnect the wiring to the alternator when performing a megger test on the vehicle's wiring.

INSPECTION AND REPAIR

EN01Z0111H300001

Unit: mm {in.}

Inspection item	Standard	Limit	Remedy	Inspection procedure
Resistance of field coil	2-3Ω	—	Replace.	<p>Measure</p> 
Insulation resistance of field coil	1MΩ min.	—	Replace.	<p>Measure</p> 
Resistance of stator coil	0.01-0.10Ω	—	Replace.	<p>Measure</p> 
Insulation resistance of stator	1MΩ min.	—	Replace.	<p>Measure</p> 
Resistance of rectifier (between B terminal and heat sink)	When polarity is changed, there is continuity in one direction but not in the opposite direction.	—	Replace.	<p>Measure</p> 
Resistance of rectifier (between (-) terminal and heat sink)	When polarity is changed, there is continuity in one direction but not in the opposite direction.	—	Replace.	<p>Measure</p> 

Inspection item	Standard	Limit	Remedy	Inspection procedure
Resistance of rectifier (between diode terminal and heat sink)	When polarity is changed, there is continuity in one direction but not in the opposite direction.	—	Replace.	Measure 
Rotor shaft outside diameter (front bearing portion)	25.00-25.01 {0.9843-0.9846}	24.99 {0.9839}	Replace.	Measure 
Rotor shaft outside diameter (rear bearing portion)	16.99-17.00 {0.6689-0.6693}	16.98 {0.6685}	Replace.	Measure 
Rotor shaft outside diameter (pulley portion)	22.189-22.202 {0.8739-0.8741}	22.18 {0.8732}	Replace.	Measure 
Bearing wear or damage	Rotates smoothly with no abnormal noise	—	Replace. Also, replace every 2 years.	Visual check 

STARTER (J05D)

EN12-001

STARTER	EN12-2
DATA AND SPECIFICATIONS	EN12-2
DESCRIPTION	EN12-3
TROUBLESHOOTING	EN12-4
COMPONENT LOCATOR.....	EN12-5
OVERHAUL	EN12-6
INSPECTION AND REPAIR	EN12-13



STARTER

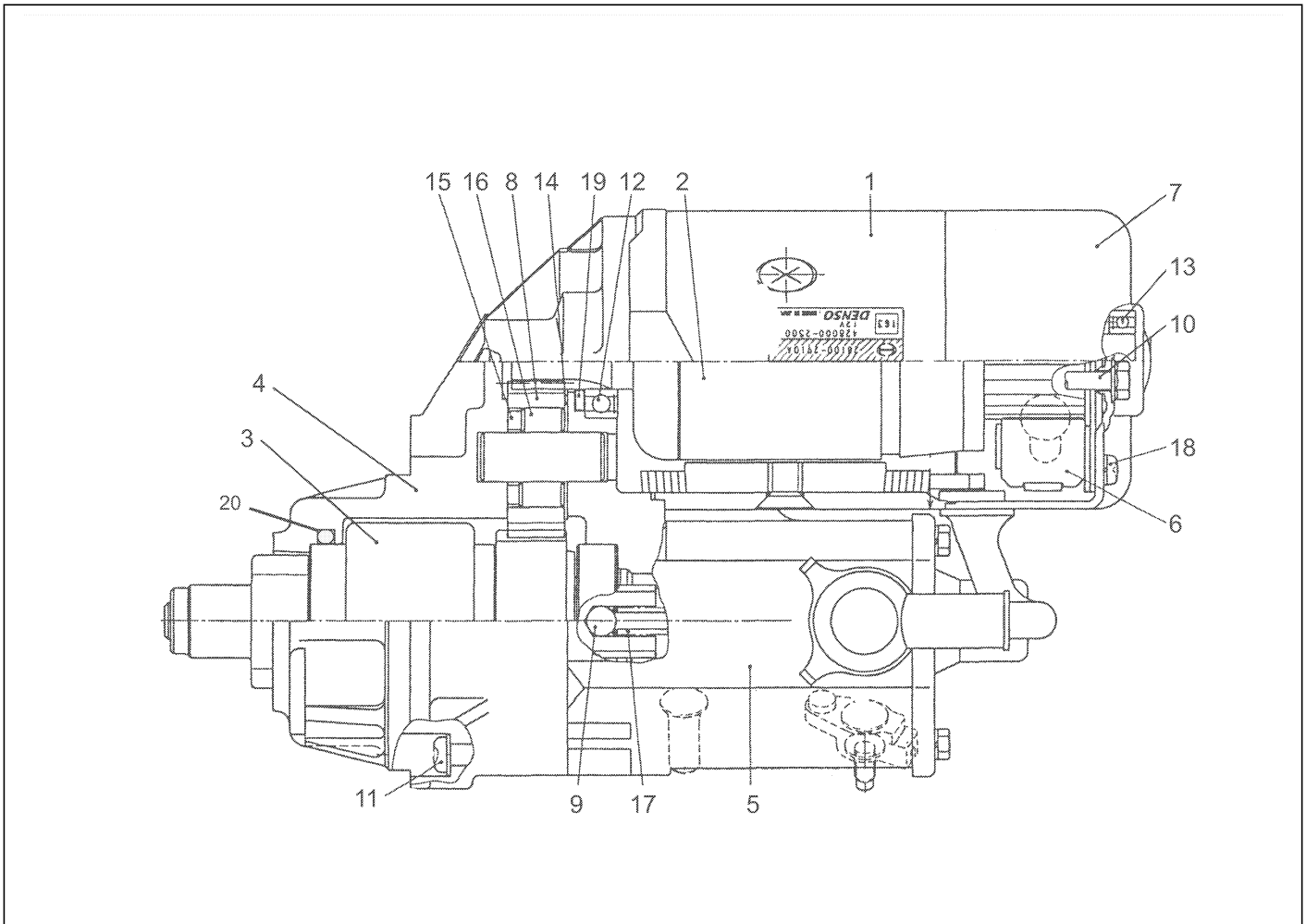
DATA AND SPECIFICATIONS

EN01103121200001

Type	Reduction gear type
Rated output	12 V, 2.5 kW
Number of teeth of pinion	11
Module	3
Rotating direction	Clockwise (Seen from pinion side)

DESCRIPTION

EN0110312C100001



SAPH011031200001

1	Yoke assy	11	Screw
2	Amature assy	12	Ball bearing
3	Clutch sub-assy	13	Ball bearing
4	Housing	14	Snap retainer
5	Magnetic switch assy	15	Retainer
6	Brush holder assy	16	Clutch roller
7	End frame	17	Coil spring
8	Pinion	18	Screw with washer
9	Steel ball	19	Felt washer
10	Through bolt	20	O-ring

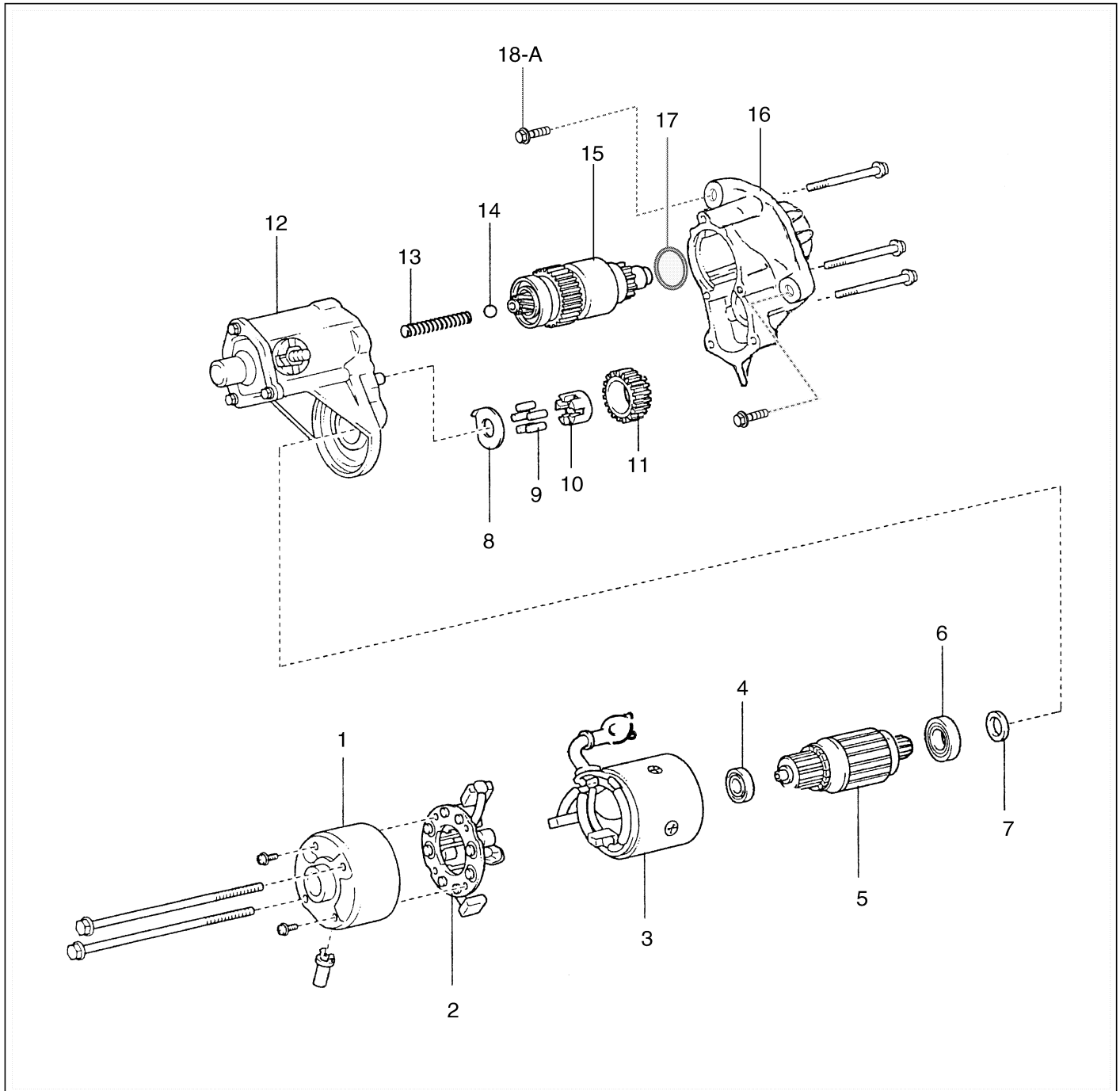
TROUBLESHOOTING

EN0110312F300001

Symptom	Possible cause	Remedy/Prevention
Engine does not crank, or cranks slowly. (Starter switch)	Poor contact	Clean or replace contacts.
Engine does not crank, or cranks slowly. (Battery)	Discharged battery	Charge.
	Short circuited between electrodes	Replace battery.
	Poor contact at battery terminal	Clean or retighten.
Engine does not crank, or cranks slowly. (Engine oil)	Improper viscosity oil	Change oil.
Engine does not crank, or cranks slowly. (Magnetic switch)	Poor contact caused by burnt contact plate	Clean or replace contact plate.
	Contact plate worn out	Repair.
	Holding coil disconnected (Overrunning clutch moves back and forth)	Replace field coil.
	Pull-in coil disconnected or short circuited	Replace.
Engine does not crank, or cranks slowly. (Starter relay)	Defective or poor contact	Repair or replace.
Engine does not crank, or cranks slowly. (Starter)	Brush worn out	Replace.
	Commutator burnt out	Correct on lathe.
	Commutator worn out	Correct by undercutting.
	Field winding shorted or grounded	Rewind or replace.
	Armature winding shorted or grounded	Replace armature.
	Insufficient brush spring tension	Replace brush spring.
	Poor contact between magnetic switch and field windings	Repair.
	Armature contact pole core because of worn bearing bushing or bent armature shaft	Replace bearing brush or armature.
	Overrunning clutch malfunction	Replace.
Engine does not crank while starter is running in good condition (Overrunning clutch)	Overrunning clutch malfunction	Replace.
	Pinion teeth worn out	Replace.
	Poor sliding of spline teeth	Remove foreign particles, dirt or replace.
Starter does not stop running. (Starter switch)	Contacts keep closing	Replace.
	Key switch sticks	Replace.
	Overrunning clutch sticks to armature	Repair or replace overrunning or armature.
Starter does not stop running. (Starter relay)	Contacts keep closing	Repair or replace.

COMPONENT LOCATOR

EN0110312D100001



SAPH011031200044

1	Starter end frame	10	Retainer
2	Brush holder assy	11	Idler gear
3	Yoke	12	Magnetic switch
4	Rear bearing	13	Return spring
5	Armature	14	Steel ball
6	Front bearing	15	Overrunning clutch
7	Washer	16	Starter housing
8	Washer	17	O-ring
9	Roller	18	Bolt

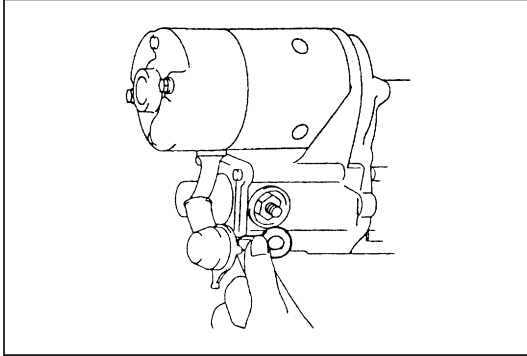
Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A 55 {560, 40}

OVERHAUL

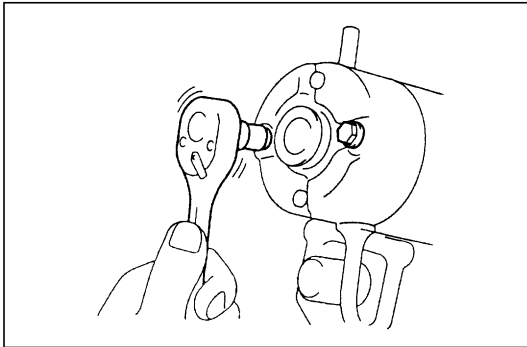
EN0110312H200001

IMPORTANT POINTS - DISASSEMBLY

SAPH011031200003

1. REMOVE STARTER YOKE ASSY.

- (1) Remove the nut, and disconnect the magnetic switch terminal.

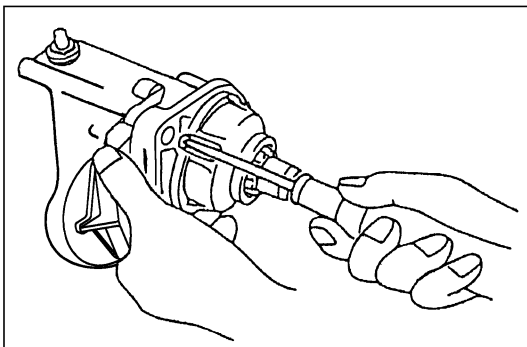


SAPH011031200004

- (2) Remove the 2 through bolts.

- (3) Pull out the starter yoke together with the armature.

- (4) Remove the felt seal and lock plate.

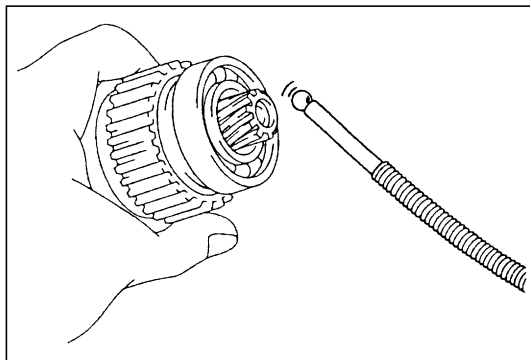


SAPH011031200005

2. REMOVAL STARTER CLUTCH SUB-ASSY

- (1) Remove the 3 screws.

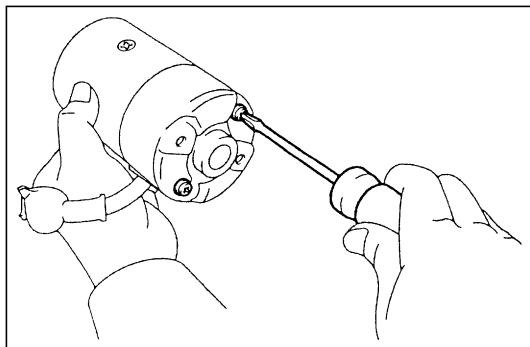
- (2) Remove the starter housing, clutch sub-assy, return spring, idle gear, bearing and plate washer from the magnetic switch.



SAPH011031200006

3. REMOVE STEEL BALL.

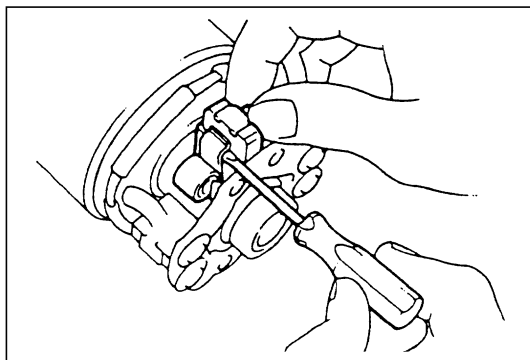
- (1) Using a magnetic finger, remove the steel ball from the clutch shaft hole.



SAPH011031200007

4. REMOVE STARTER BRUSH HOLDER ASSY

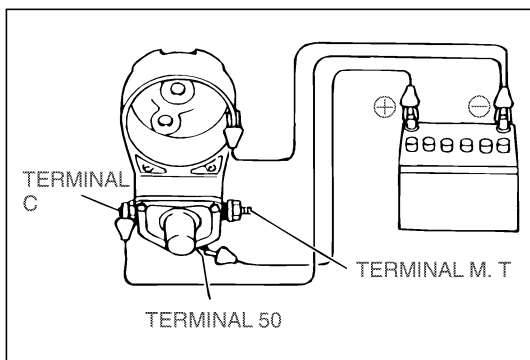
- (1) Remove the 2 screws and end cover from the starter yoke.



SAPH011031200008

- (2) Using a screwdriver, hold the spring back and disconnect the brushes from the brush holder
- (3) Disconnect the 4 brushes and remove the brush holder.
- (4) Unsolder the read wire from the brush holder.

5. REMOVE STARTER ARMATURE ASSY



SAPH011031200009

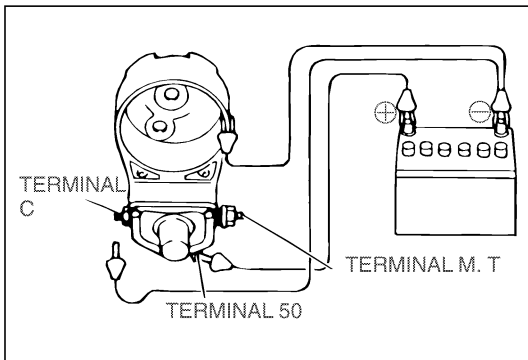
MAGNETIC SWITCH TEST

NOTICE

- The following tests should be performed without the armature assembly.
- Each test should be performed for a short time (3 to 5 sec.) to prevent the magnetic switch winding from burning.
- Each test should be performed with the specified voltage applied.

1. PULL-IN TEST

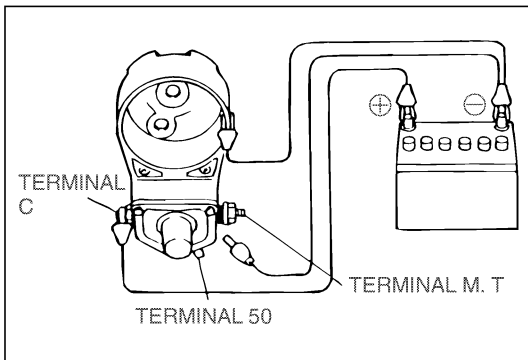
- (1) Connect the test leads as shown in the figure. When connecting terminal C and M. T are closed, the pinion should jump out.



SAPH011031200010

2. HOLD-IN TEST

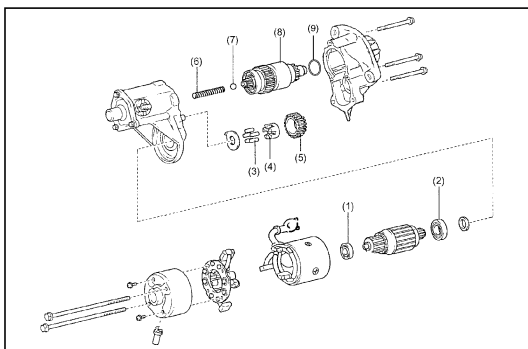
- (1) With the same condition as in the pull-in test, open the connecting terminal C.
The pinion should remain in the jumped out position.



SAPH011031200011

3. RETURN TEST

- (1) With the same condition as in the hold-in test, open the connecting terminal 50.
The pinion should return immediately.



SAPH011031200012

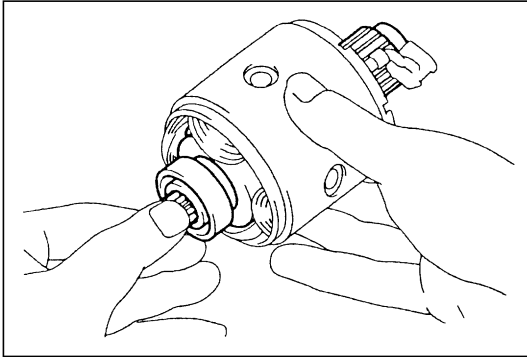
IMPORTANT POINTS - ASSEMBLY

NOTICE

Reverse the order of disassembly to reassemble the starter. However, attention should be paid to the following operations.

1. LUBRICATION

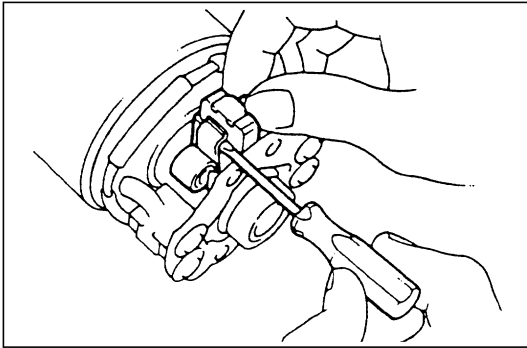
- (1) Before reassembling, apply the recommended grease to the following: [Apply Nippondenso No.50 grease or equivalent (Esso beacon 325)].
 1. Rear bearing
 2. Front bearing
 3. Roller
 4. Retainer
 5. Idle gear
 6. Return spring
 7. Steel ball
 8. Overrunning clutch
 9. O-ring



SAPH011031200013

2. INSTALL STARTER ARMATURE ASSY

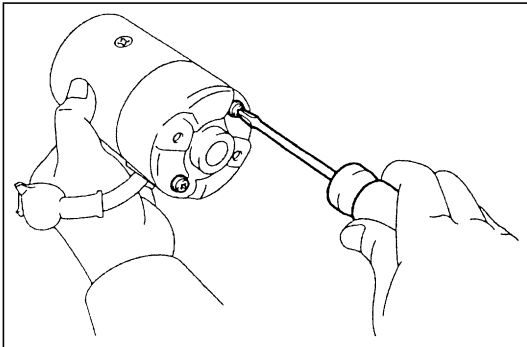
- (1) Apply grease to the armature bearings.
- (2) Install the armature to the starter yoke.



SAPH011031200014

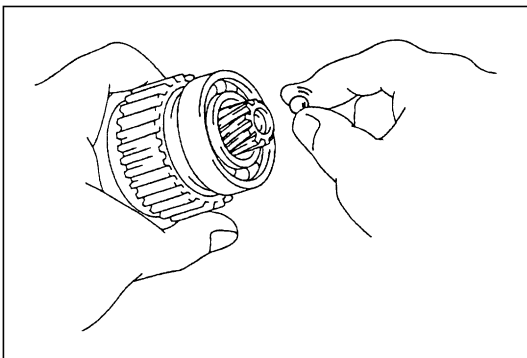
3. INSTALL STARTER BRUSH HOLDER ASSY

- (1) Place the brush holder in position on the armature.
- (2) Using a screwdriver, hold the brush spring back. Then, install the brush to the brush holder and install the 4 brushes.



SAPH011031200015

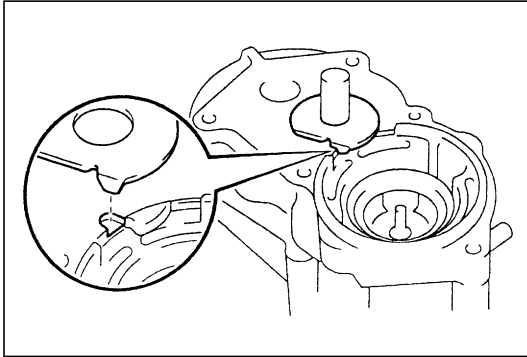
- (3) Install the end cover with the 2 screws.



SAPH011031200016

4. INSTALL STEEL BALL

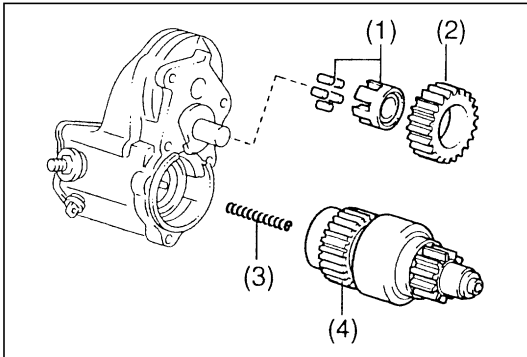
- (1) Apply grease to the steel ball.
- (2) Insert the steel ball into the clutch shaft hole.



SAPH011031200017

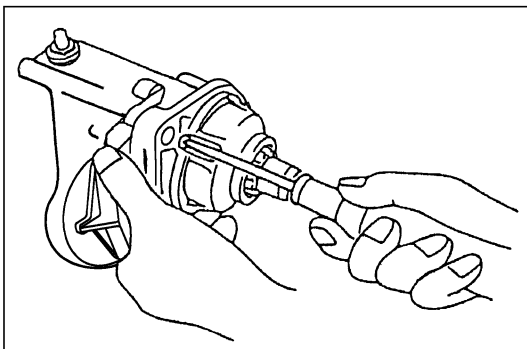
5. INSTALL STARTER CLUTCH SUB-ASSY

- (1) Place the plate washer in position on the magnetic switch assembly, as shown in the illustration.



SAPH011031200018

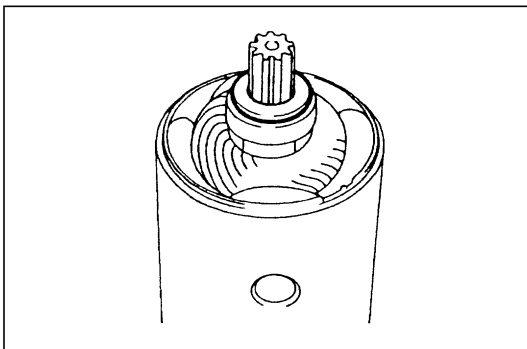
- (2) Place the bearing (1), idle gear (2), return spring (3) and clutch sub-assy (4) in position on the starter magnet switch.



SAPH011031200019

- (3) Install the o-ring to the starter housing.

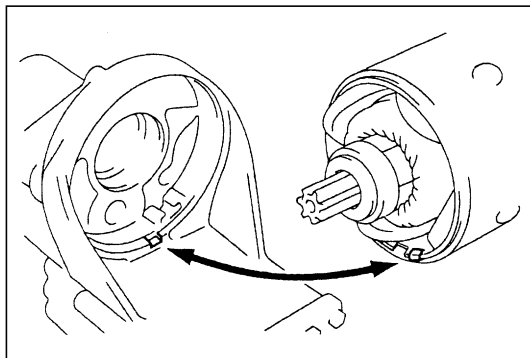
- (4) Assemble the starter housing and magnet switch with the 3 screws.



SAPH011031200020

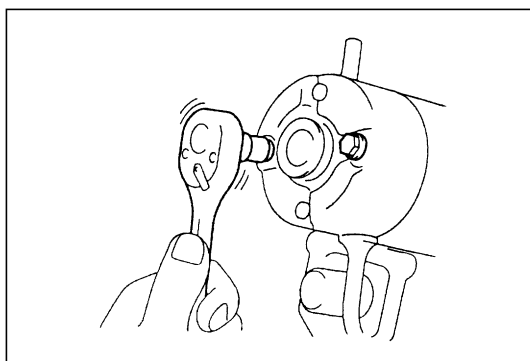
6. INSTALL STARTER YOKE ASSY

- (1) Place the felt seal on the armature shaft.



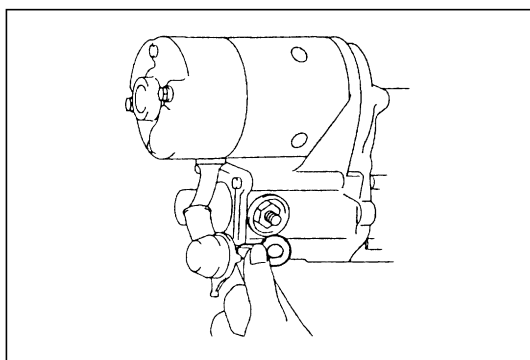
SAPH011031200021

- (2) Align the cutout of the magnet starter switch with the protrusion of the starter yoke.



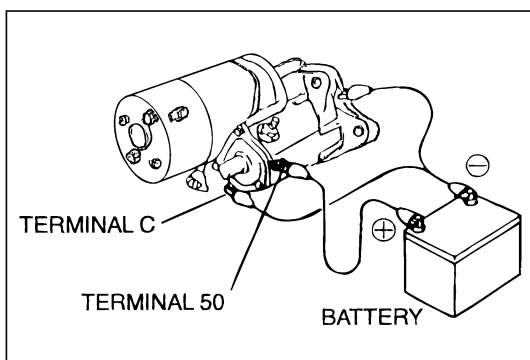
SAPH011031200022

- (3) Install the starter yoke and armature with the 2 through bolts.
Tightening Torque:
11-18 N·m {110-180 kgf·cm, 8.0-13 lbf·ft}



SAPH011031200023

- (4) Connect the lead wire to terminal C, and install the nut.
Tightening Torque:
18-25 N·m {180-250 kgf·cm, 13-18 lbf·ft}



SAPH011031200024

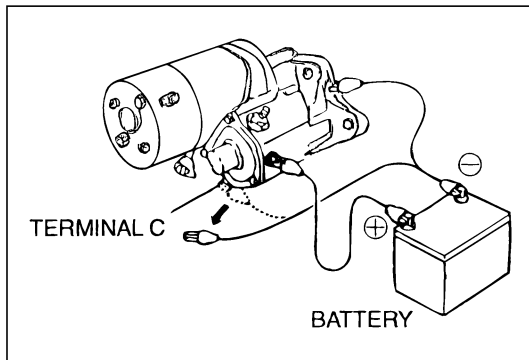
IMPORTANT POINTS - INSPECTION

NOTICE

These tests must be performed within 3 to 5 seconds to avoid burning out the coil.

1. PERFORM PULL-IN TEST.

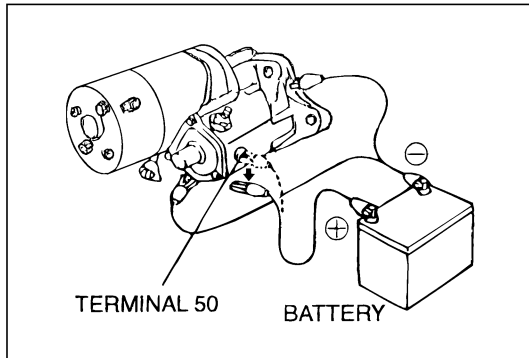
- (1) Disconnect the field coil lead wire from the terminal C.
- (2) Connect battery to the magnetic switch as shown.
- (3) Check that the pinion gear moves outward.
- (4) If the pinion gear does not move, replace the magnetic switch.



SAPH011031200025

2. PERFORMANCE HOLD-IN TEST.

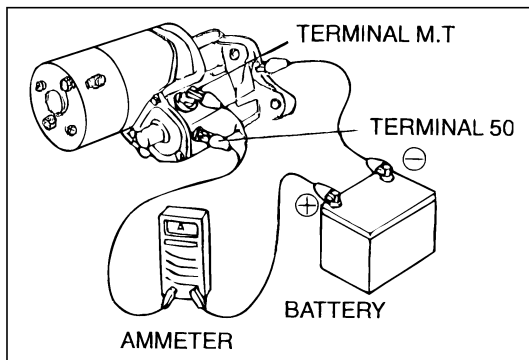
- (1) While connected as above with the pinion gear out, disconnect the negative (-) lead from terminal C.
- (2) Check that the pinion gear remains out.
- (3) If the pinion gear returns inward, replace the magnetic switch.



SAPH011031200026

3. INSPECTION PLUNGER RETURN. (Solenoid Coil Balance Check)

- (1) Disconnect the positive (+) lead from the terminal 50.
- (2) Check that the pinion gear returns inward.
- (3) If the pinion gear does not return, replace the magnetic switch.



SAPH011031200027

4. PERFORM NO-LOAD PERFORMANCE TEST.

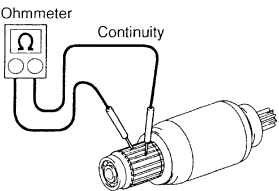
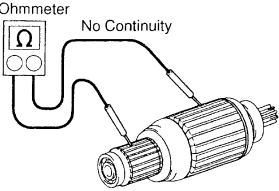
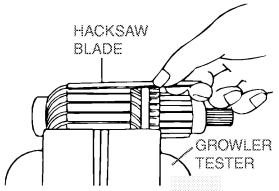
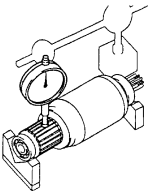
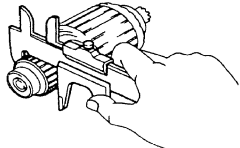
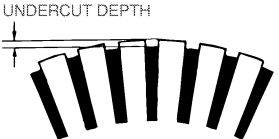
- (1) Connect battery and ammeter to the starter as shown.
- (2) Check that the starter rotates smoothly and steadily with the pinion gear moving out. Check the reading on the ammeter.

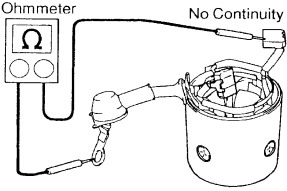
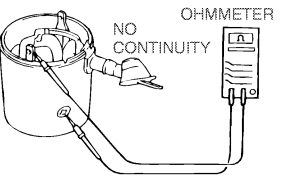
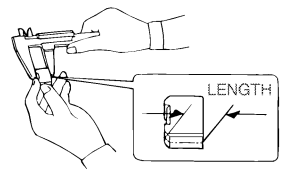
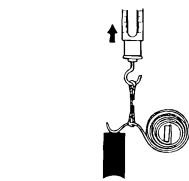
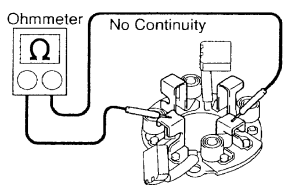

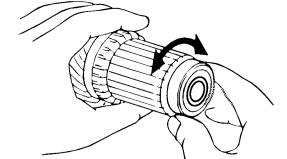
Standard amperage: 180 A or less/12 V

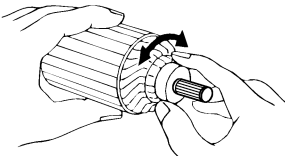
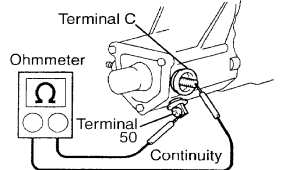
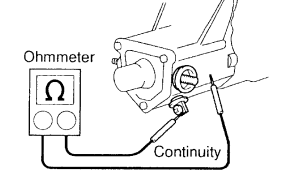
INSPECTION AND REPAIR

EN0110312H300001

Unit: mm {in.}

Inspection item	Standard	Limit	Remedy	Inspection procedure
Continuity between the segments of the commutator	Continuity	—	Replace.	<p>Measure</p> 
No continuity between the commutator and armature coil core.	No continuity	—	Replace.	<p>Measure</p> 
Armature short circuit test (Using a growler tester)	If the iron piece does not vibrate, the armature is good.	—	Replace.	<p>Measure</p> 
Measure the circle run-out	—	0.05 {0.0020}	Replace.	<p>Measure</p> 
Outside diameter of the commutator	36.0 {1.417}	35.0 {1.378}	Replace.	<p>Measure</p> 
Depth between the mica and the commutator (Under cut depth)	0.7-0.9 {0.028-0.035}	Less than 0.7 {0.028}	Replace or repair.	<p>Measure</p> 

Inspection item	Standard	Limit	Remedy	Inspection procedure
Continuity between the field coil end and the read wire.	Continuity	—	Replace.	<p>Measure</p> 
No continuity between the field coil end and yoke out side	No continuity	—	Replace.	<p>Measure</p> 
Brush length	20.0 {0.787}	13.0 {0.512}	Replace.	<p>Measure</p> 
Brush spring load	3,500-4,500 g {123.5-158.7 oz}	—	Replace.	<p>Measure</p> 
Insulation between the brush and brush holder	No continuity	—	Replace.	<p>Measure</p> 
Rotating of pinion	—	—	Replace.	<p>Visual check</p> 
Rotating of ball front bearing	—	Sticks or does not rotate	Replace.	<p>Visual check</p> 

Inspection item	Standard	Limit	Remedy	Inspection procedure
Rotating of ball rear bearing	—	Sticks or does not rotate	Replace.	Visual check 
Continuity between terminals 50 and C	Continuity	—	Replace.	Measure 
Continuity between terminal 50 and the switch body	Continuity	—	Replace.	Measure 

AIR COMPRESSOR (J05D)

EN13-001

AIR COMPRESSOR.....	EN13-2
DATA AND SPECIFICATIONS	EN13-2
DESCRIPTION	EN13-2
TROUBLESHOOTING	EN13-3
COMPONENT LOCATOR.....	EN13-4
SPECIAL TOOL	EN13-6
OVERHAUL	EN13-7
INSPECTION AND REPAIR	EN13-15

AIR COMPRESSOR

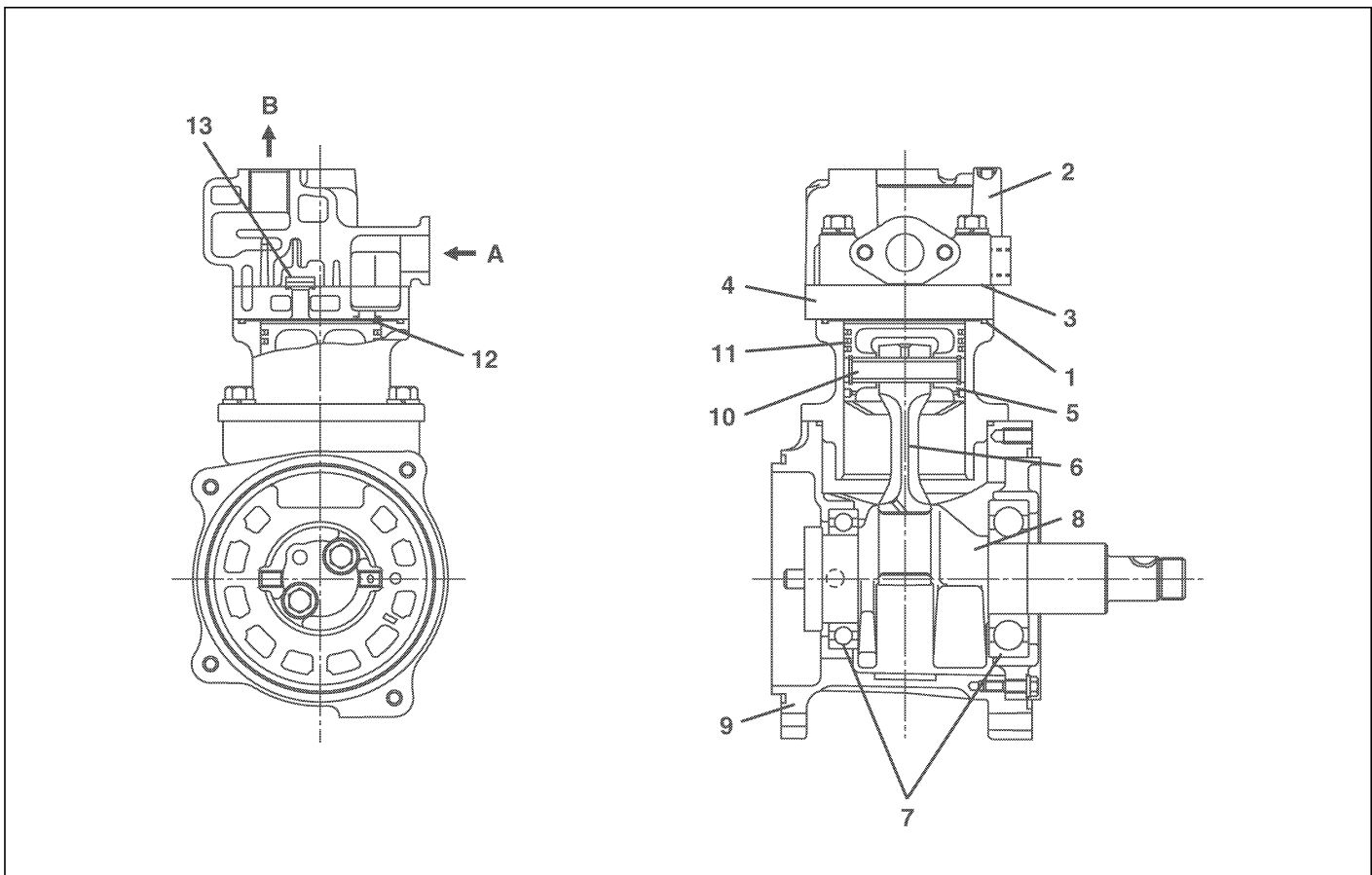
DATA AND SPECIFICATIONS

EN0110313I200001

Type	Reciprocating, single cylinder
Discharge amount	154cm ³ {9.4 cu.in.}
Bore x stroke	70 mm x 40 mm {2.76 in. x 1.57 in.}
Lubrication system	Forced feed lubrication
Cooling system	Forced water-circulated

DESCRIPTION

EN0110313C100001



SAPH011031300001

1	O-ring	9	Crankcase
2	Cylinder head assembly	10	Piston pin
3	Gasket	11	Piston ring
4	Valve seat	12	Suction valve
5	Piston	13	Delivery valve
6	Connecting rod	A	Suction
7	Bearing	B	Delivery
8	Crankshaft		

TROUBLESHOOTING

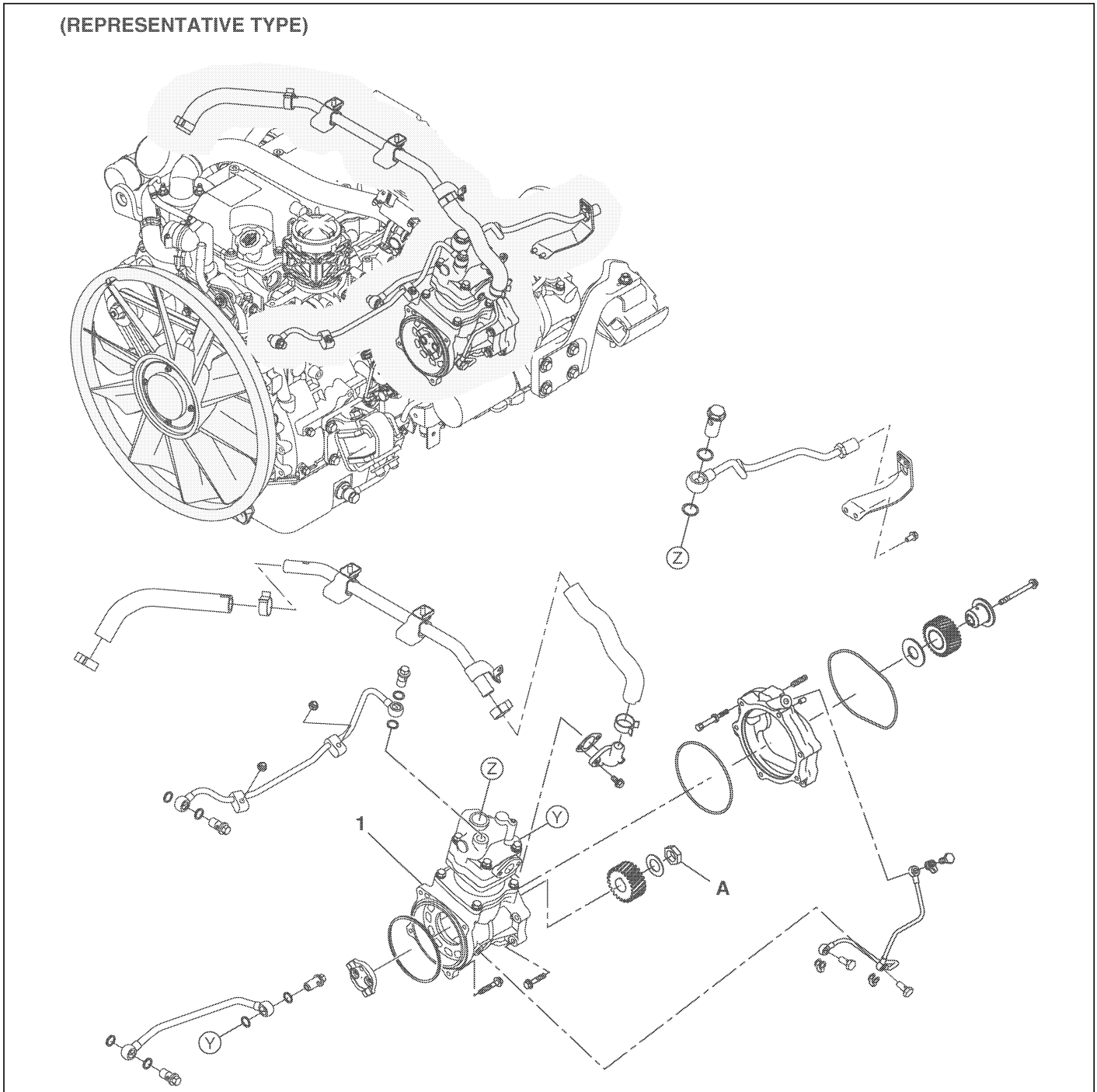
EN0110313F300001

Symptom	Possible cause	Remedy/Prevention
Charging efficiency dropped (Valve)	Abnormal wear, damage, or poor contact	Replace.
Charging efficiency dropped (Piston, Cylinder liner and piston rings)	Worn piston and cylinder liner	Replace.
	Seized piston	Replace (piston, piston rings and cylinder liner).
	Worn or broken piston ring	Replace.
Charging efficiency dropped (Air pipe and joints)	Leakage of high-pressure air	Replace or tighten pipe joint.
	Clogged air pipe	Replace.
Charging efficiency dropped (Air cleaner)	Clogged element	Clean or replace element.
Noisy operation (Piston)	Wear of piston pin boss or piston pin	Replace.
	Seized, damaged or worn connecting rod small end	Replace.
	Worn piston or cylinder liner	Replace.
	Damaged or seized piston	Replace.
	Foreign particles on the top surface of piston	Clean or replace.
Noisy operation (Bearing)	Damaged, or worn ball bearing and/or connecting rod bearing	Replace.
Excessive carbon or oil in the compressor cylinder head or discharge line (Piston ring)	Worn, sticking or broken piston rings	Replace piston rings and/or cylinder liner.
	Insufficient piston ring tension	Replace piston rings and/or cylinder liner.
	Malfunction of piston rings	Replace piston rings and/or cylinder liner.
Excessive carbon or oil in the compressor cylinder head or discharge line (Cylinder liner and piston rings)	Worn cylinder liner and piston rings	Replace.

COMPONENT LOCATOR

EN0110313D100001

(REPRESENTATIVE TYPE)



SAPH011031300002

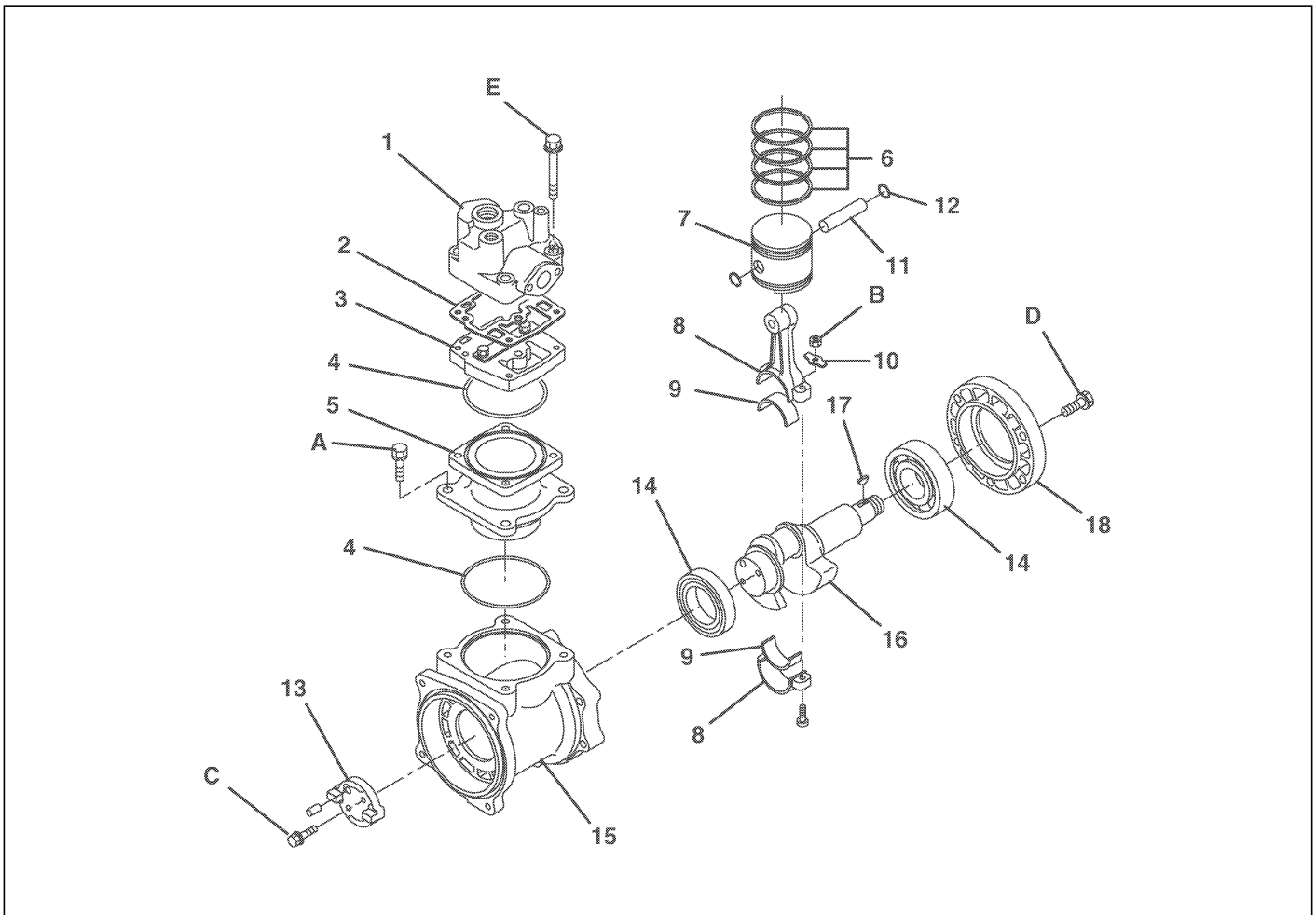
<p>1 Air compressor</p>	
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Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

<p>A 353 {3,600, 260} #</p>	
------------------------------------	--

#= Apply oil to the threads and seat surface before tightening.



SAPH011031300003

1	Cylinder head	10	Lock washer
2	Gasket	11	Piston pin
3	Valve seat	12	Retainer ring
4	O-ring	13	Coupling
5	Cylinder liner	14	Ball bearing
6	Piston ring	15	Cylinder block
7	Piston	16	Crankshaft
8	Connecting rod	17	Woodruff key
9	Connecting rod bearing	18	Bearing holder

Tightening torque

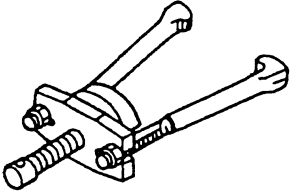
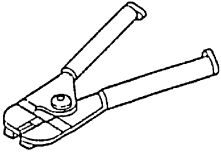
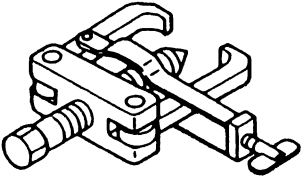
Unit: N·m {kgf·cm, lbf·ft}

A	25-30 {255-305, 19-22}	D	6-7.5 {61-76, 4.4-5.5}
B	23-26 {235-265, 17-19}	E	30-35 {306-356, 23-25}
C	30-36 {305-367, 22-26}		

SPECIAL TOOL

EN0110313K100001

Prior to starting an air compressor overhaul, it is necessary to have these special tools.

Illustration	Part number	Tool name	Remarks
	S0965-01310	PULLER ASSEMBLY	
	S0944-01060	PISTON RING EXPANDER	
	S0965-01101	BEARING PULLER	

OVERHAUL

EN0110313H200001

IMPORTANT POINTS - DISMOUNTING

1. REMOVE THE SUPPLY PUMP.

- (1) Refer to the chapter "FUEL SYSTEM".

2. REMOVE THE AIR COMPRESSOR.

- (1) Remove the six air compressor mounting bolts and remove the air compressor without applying excessive force.

NOTICE

Excessive force to the air compressor may damage the mounting spigot or may cause oil leakage due to flaking of liquid gasket between the flywheel housing and plate.

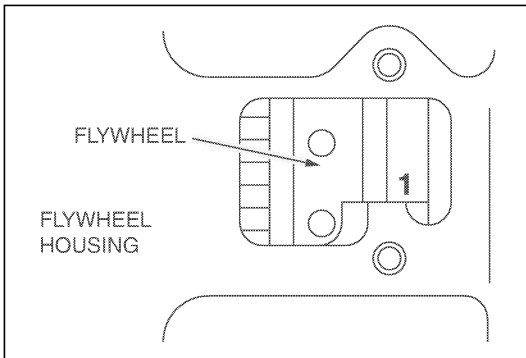
IMPORTANT POINTS - MOUNTING

1. INSTALLATION PROCEDURES

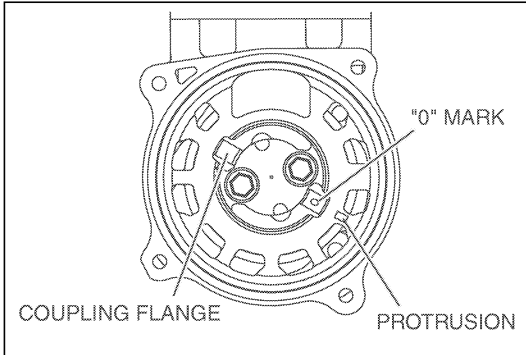
- (1) Fit the No.1 cylinder to the Top Dead Center.

NOTICE

Refer to the section "ENGINE TUNEUP" in the chapter "ENGINE INTRODUCTION (J05D)".



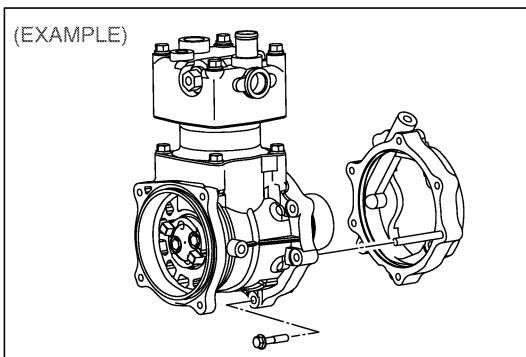
SAPH011031300007



SAPH011031300008

- (2) Align the aligning mark "O" on the top of coupling flange with protrusion on the compressor housing.

- (3) Insert the O-ring into the O-ring groove of the air compressor of bearing holder side.



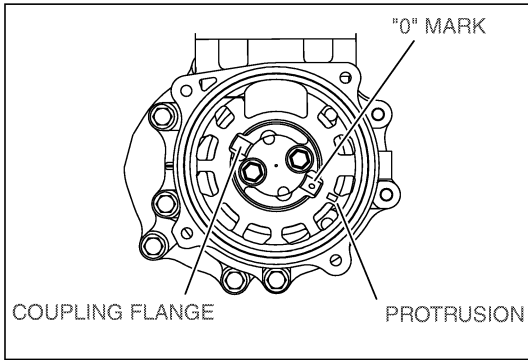
SAPH011031300009

- (4) Place a guide stud bolt (M8 x 1.25, length: 50 mm {1.968 in.} or more) in the flywheel housing as shown in the figure and insert the compressor onto the stud bolt.

- (5) Tighten the mounting bolts (other than the stud bolt) then remove the stud bolt. Insert a bolt in the place of the stud bolt.

Tightening Torque:

28.5 N·m {290 kgf·cm, 20 lbf·ft}



SAPH011031300010

- (6) Make sure that the aligning mark "0" on the top of the coupling flange is aligning with protrusion on the compressor housing.

2. INSTALL THE SUPPLY PUMP.

- (1) Refer to the chapter "FUEL SYSTEM".

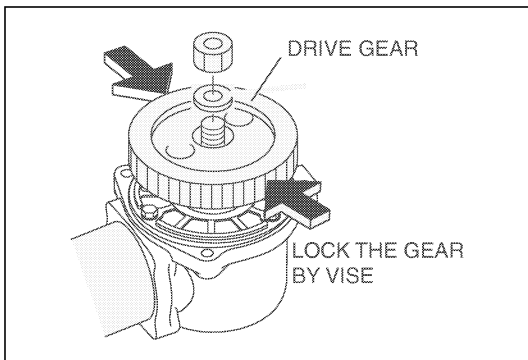
IMPORTANT POINTS - DISASSEMBLY

1. REMOVE THE DRIVE GEAR.

- (1) Remove the lock nut from the compressor drive gear.

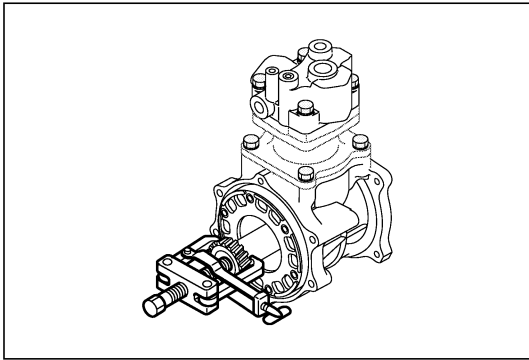
NOTICE

If the spread is insufficient, the drive gear will be damaged when loosening the nut.



SAPH011031300011

- (2) Pull the drive gear from the crankshaft, then remove the woodruff key.
SST: Bearing puller (S0965-01101)



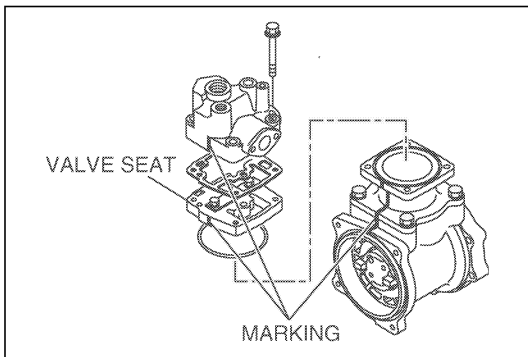
SAPH011031300012

2. REMOVE THE CYLINDER HEAD, GASKET, VALVE SEAT AND O-RING.

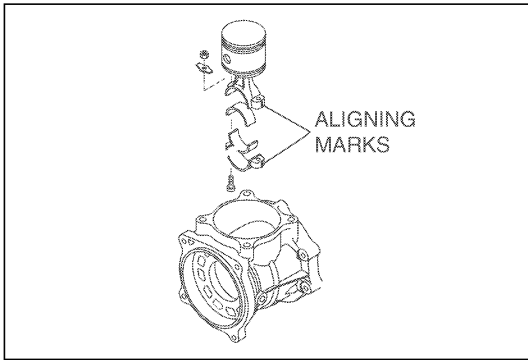
- (1) Remove the cylinder head, gasket, valve seat and o-ring.

NOTICE

- Put the marking through the cylinder head to the cylinder liner.
- Do not disassemble the valve seat.



SAPH011031300013



SAPH011031300014

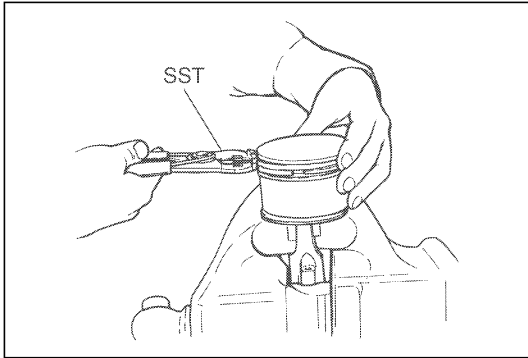
3. REMOVE THE CONNECTING ROD WITH THE PISTON.

- (1) Rotate the crankshaft to the top dead center position.
- (2) Spread the staking of the nut completely with a chisel, then loosen the nut.

NOTICE

Put the aligning marks to the connecting rod and the cap.

- (3) Remove the connecting rod with piston.



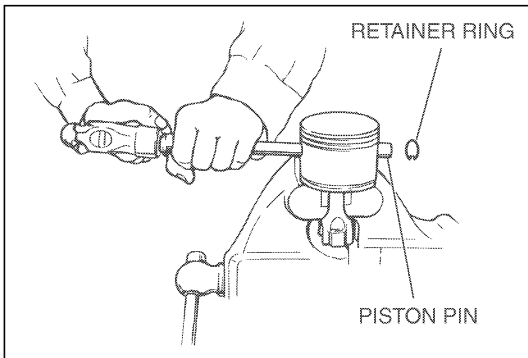
SAPH011031300015

4. REMOVE THE PISTON RINGS.

- (1) Remove the piston rings.
SST: Piston ring expander (S0944-01060)

NOTICE

- Handle the piston rings carefully because they are made of a special casting which is easily broken.
- When reusing the piston rings, first arrange them face up and in the correct installation sequence in order to prevent installing them incorrectly.



SAPH011031300016

5. REMOVE THE PISTON.

- (1) Remove the retainer rings installed on both ends of the piston, using retainer ring pliers.

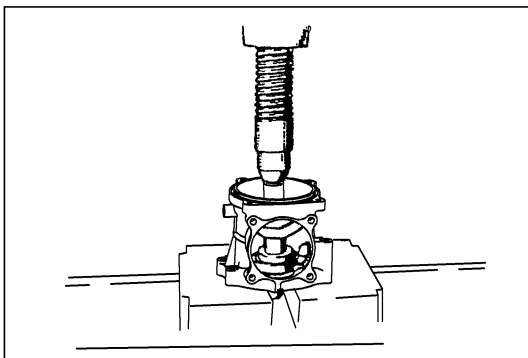
⚠ WARNING

Wear a pair of safety goggles, because the retainer rings may spring out the groove at the time of removal.

- (2) Strike out the piston pin.

NOTICE

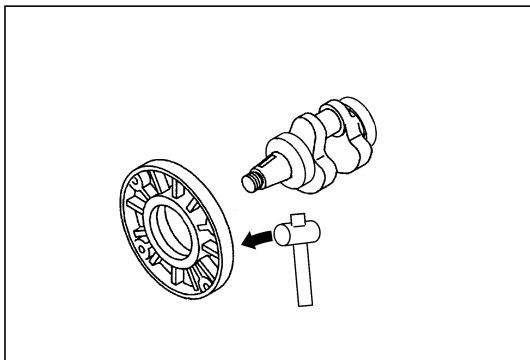
Warm up the piston first in hot water, 80-90°C {176-194°F}, for approximately 5 minutes before removing the piston pin.



SAPH011031300017

6. REMOVE THE CRANKSHAFT.

- (1) Remove the coupling.
- (2) Remove the bearing holder fitting bolts.
- (3) Using a press, remove the crankshaft with bearing holder.



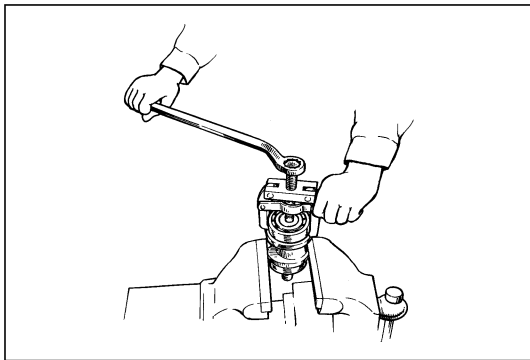
SAPH011031300018

7. REMOVE THE BEARING HOLDER.

- (1) Strike the circumference of the holder lightly with a plastic hammer or a mallet and remove the holder.

NOTICE

Be careful not to damage the bearing holder.



SAPH011031300019

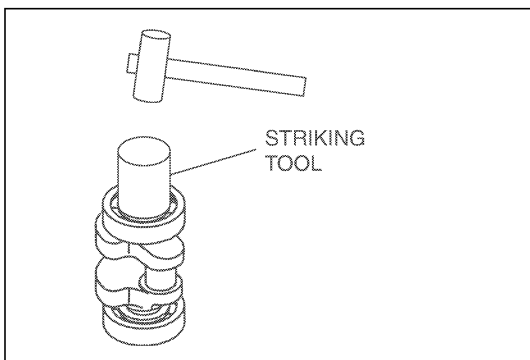
8. REMOVE THE BALL BEARING.

- (1) Using the special tool, remove the ball bearing from the end of the crankshaft.

SST:

Bearing puller (S0965-01101, for supply pump side)

Puller assembly (S0965-01310, for drive gear side)

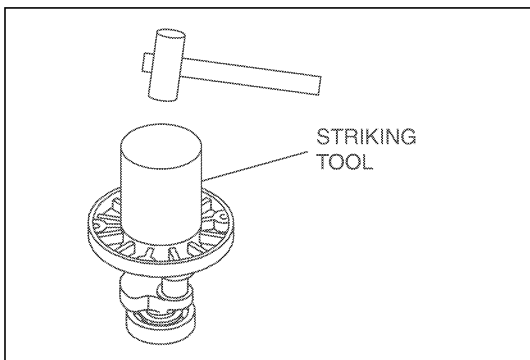


SAPH011031300020

IMPORTANT POINTS - ASSEMBLY

1. INSTALL THE BALL BEARING.

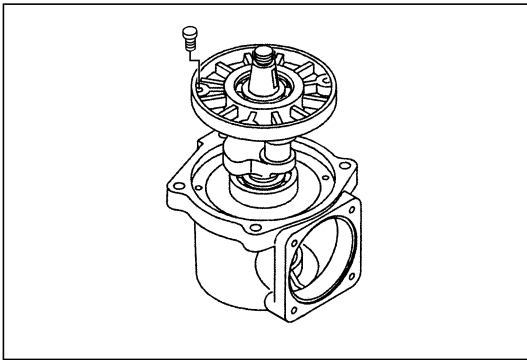
- (1) Install the ball bearing.



SAPH011031300021

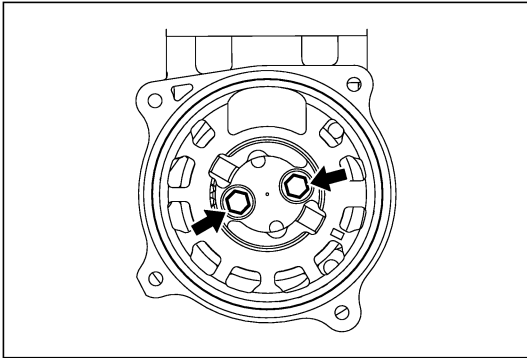
2. INSTALL THE CRANKSHAFT.

- (1) Using a copper hammer, install the crankshaft to the bearing holder.



SAPH011031300022

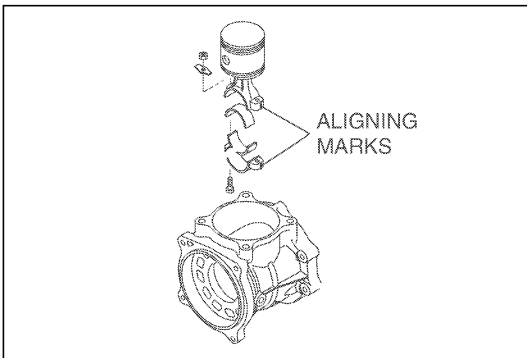
- (2) Install the crankshaft and bearing holder in the crankcase.
- (3) Tighten the bearing holder fitting bolt.



SAPH011031300023

3. INSTALL THE COUPLING.

- (1) Install the coupling.



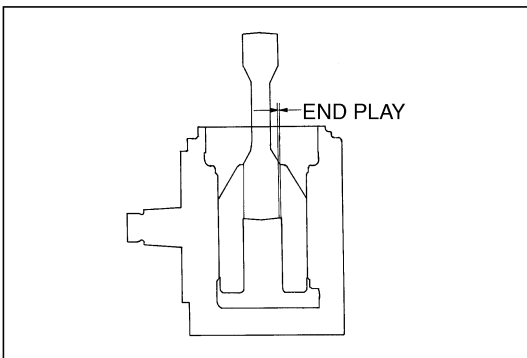
SAPH011031300024

4. INSTALL THE CONNECTING ROD AND MEASURE THE END PLAY.

NOTICE

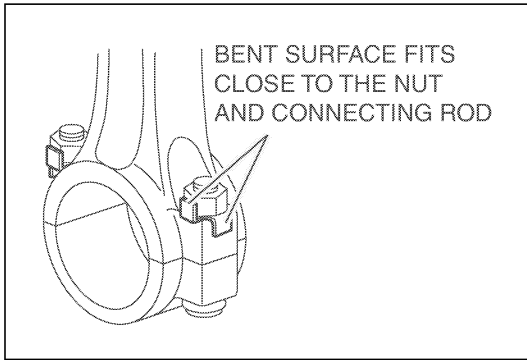
- Be sure to align the aligning mark.
- Apply engine oil to the bearing.

- (1) Apply engine oil to the thread before installing the connecting rod bolt.



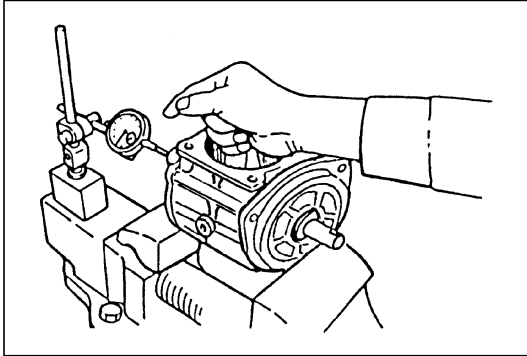
SAPH011031300025

- (2) Measure the connecting rod end play.
Assembly standard: 0.2-0.4 mm {0.008-0.015 in.}
Limit: 0.5 mm {0.02 in.}



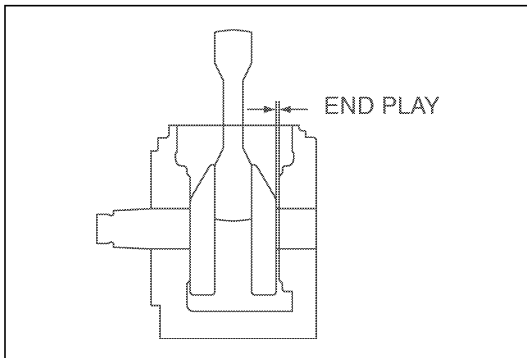
SAPH011031300026

- (3) Lock the nut with a lock washer.

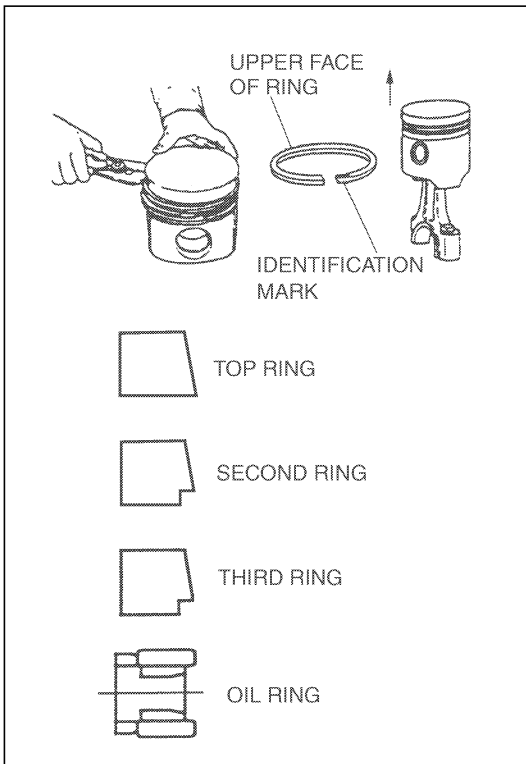


SAPH011031300027

5. **MEASURE THE END PLAY OF THE CRANKSHAFT.**
Assembly standard: 0-0.6 mm {0-0.023 in.}
Limit: 1.0 mm {0.039 in.}



SAPH011031300028



SAPH011031300029

6. ASSEMBLE THE PISTON.

NOTICE

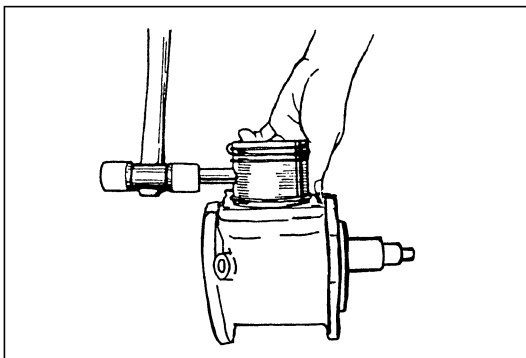
Assemble the various parts after applying engine oil to the sliding parts.

- (1) When installing the piston rings on the piston, ensure that the piston skirt is at the bottom, and use the special tool.

SST: Piston ring expander (S0944-01060)

NOTICE

Install the piston rings with the identification mark at the top of the ring facing up.



SAPH011031300030

7. ASSEMBLE THE PISTON AND CONNECTING ROD.

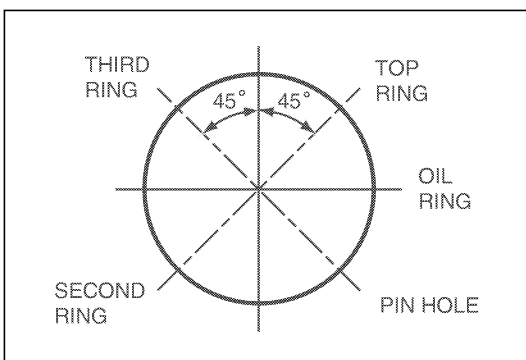
NOTICE

Warm up the piston first in hot water, to 80-90°C {176-194°F}, for approximately 5 minutes.

- (1) Install the retainer ring at one end of the piston holes.
- (2) Apply engine oil to the piston pin.
- (3) Fix the piston and connecting rod by inserting the pin.
- (4) Fit the new retainer ring at the other end.

⚠ WARNING

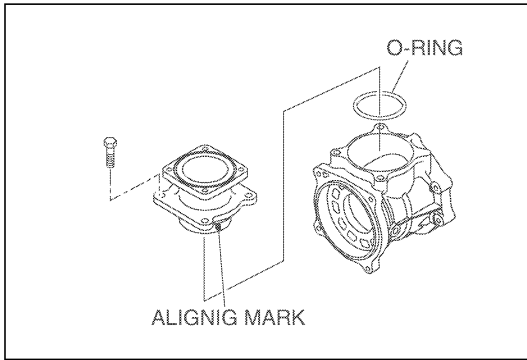
The retainer ring may spring out of the groove during assembly. Wear a pair of safety goggles during assembly.



SAPH011031300031

8. INSTALL THE CYLINDER LINER AND CYLINDER HEAD.

- (1) Rotate the crankshaft to the top dead center position.
- (2) Arrange the piston rings so that their gaps are equally spaced.

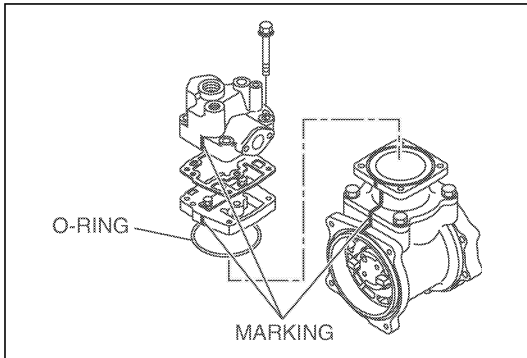


SAPH011031300032

(3) Install the cylinder liner.

NOTICE

- **Align the aligning marks.**
- **Do not twist the O-ring when installing.**

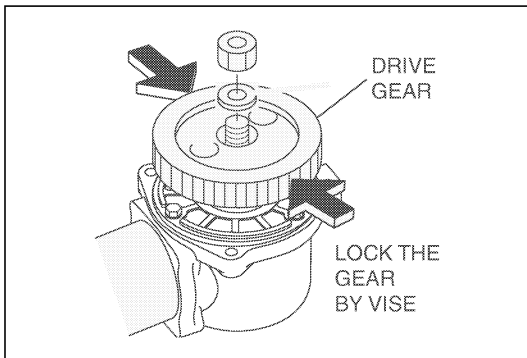


SAPH011031300033

(4) Install the cylinder head.

NOTICE

- **Align the aligning marks.**
- **Do not twist the O-ring when installing.**



SAPH011031300034

9. INSTALL THE DRIVE GEAR.

- (1) Install the key to the crankshaft.
- (2) Insert the drive gear.
- (3) Insert the collar and lock nut.

Tightening Torque:

353 N·m {3,600 kgf·cm, 260 lbf·ft}

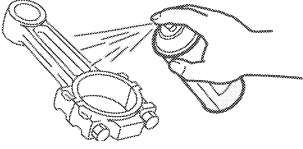
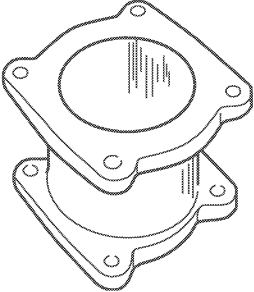
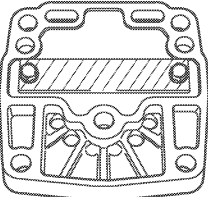
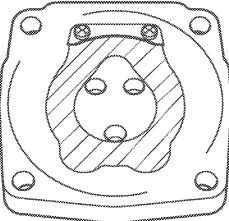
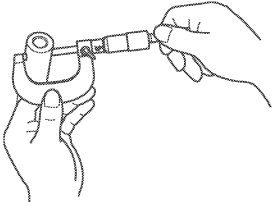
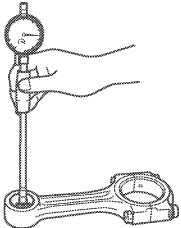
NOTICE

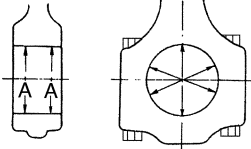
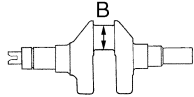
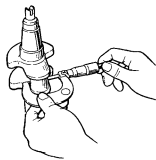
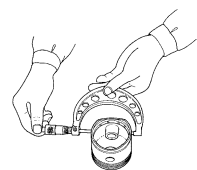
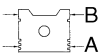
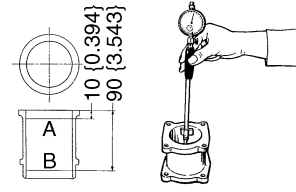
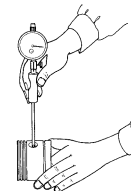
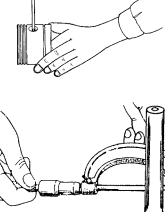
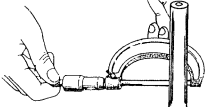
Apply oil to the threads and seat surface before tightening.

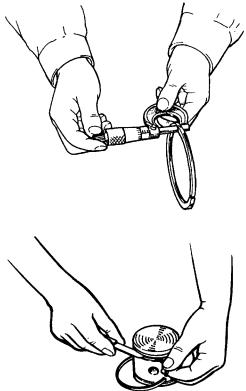

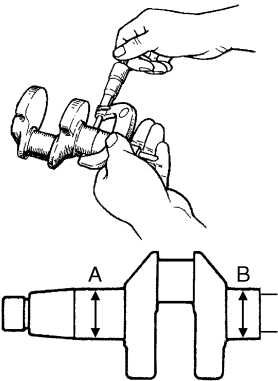
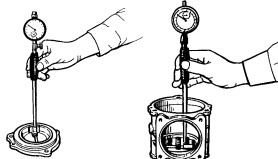

INSPECTION AND REPAIR

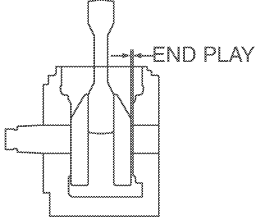
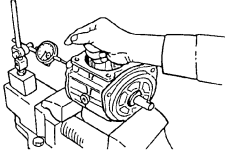
EN0110313H300001

Unit: mm {in.}

Inspection item	Standard	Limit	Remedy	Inspection procedure
Cracks or defects of the connecting rod	—	—	Replace.	Visual check 
Damage and scratches of the cylinder liner	—	—	Replace.	Visual check 
Worn or damaged delivery valve	—	—	Replace valve seat.	Visual check 
Worn or damaged suction valve	—	—	Replace valve seat.	Visual check 
Outside diameter of piston pin	14.0 {0.551}	—	Replace piston pin or connecting rod.	Measure  
Clearance between the piston pin and connecting rod	0.016-0.044 {0.0007-0.0017}	0.07 {0.0028}		

Inspection item	Standard	Limit	Remedy	Inspection procedure
Inside diameter of the connecting rod (with bearings): A #Tighten the bearing cap to the specified torque	34 {1.339}	—	Replace connecting rod bearing.	
Outside diameter of the crank pin: B	34 {1.339}	—		
Oil clearance between the connecting rod and the crank pin: C # Oil clearance C= A-B	0.017-0.083 {0.0007-0.0032}	0.1 {0.0039}		
Outside diameter of the piston (Measure at A and B)	70 {2.756}	—	Replace piston or cylinder liner.	Measure 
Inside diameter of the cylinder liner (Measure at A and B)	70 {2.756}	—		
Clearance between the piston and the cylinder liner	A: 0.18-0.245 {0.0071-0.0096}	0.285 {0.0112}		
Inside diameter of the piston pin hole: A	14.0 {0.551}	—	Replace piston or piston pin.	Measure 
Outer diameter of the piston pin: B	14.0 {0.551}	—		
Clearance between the piston pin hole and the piston pin: C # Clearance C= A-B	0-0.026 {0-0.0010}	0.08 {0.0031}		

Inspection item		Standard	Limit	Remedy	Inspection procedure
Clearance between the ring groove and the piston ring	Top, second ring	0.005-0.040 {0.0002-0.0016}	0.08 {0.0031}	Replace piston or piston ring.	<p>Measure</p> 
	Second, third ring	0.1-0.3 {0.0040-0.0118}	1.0 {0.0394}		
Piston ring gap: compression ring	Top ring	0.15-0.35 {0.0060-0.0137}	1.0 {0.0394}	Replace.	<p>Measure</p> 
	Second, third ring	0.1-0.3 {0.0040-0.0118}	1.0 {0.0394}		
Outside diameter of the crankshaft journal		A: 40.002-40.013 {1.5749-1.5753}	39.995 {1.575}	Replace.	<p>Measure</p> 
		B: 50.002-50.011 {1.9686-1.9689}	49.995 {1.968}		
Inside diameter of the bearing holder	Cylinder block	80 {3.1496}	80.04 {3.151}	Replace.	<p>Measure</p> 
	Bearing holder	90 {3.543}	90.04 {3.545}		
Worn or damaged bearing		—	—	Replace.	<p>Visual check</p> 

Inspection item	Standard	Limit	Remedy	Inspection procedure
Connecting rod end play	0.2-0.4 {0.0079-0.0157}	0.5 {0.0197}	Replace connecting rod or crankshaft.	<p>Measure</p> 
Crankshaft end play	0-0.6 {0-0.023}	1.0 {0.039}	Replace crank shaft bearing.	<p>Measure</p> 

ENGINE CONTROL (J05D)

EN16-001

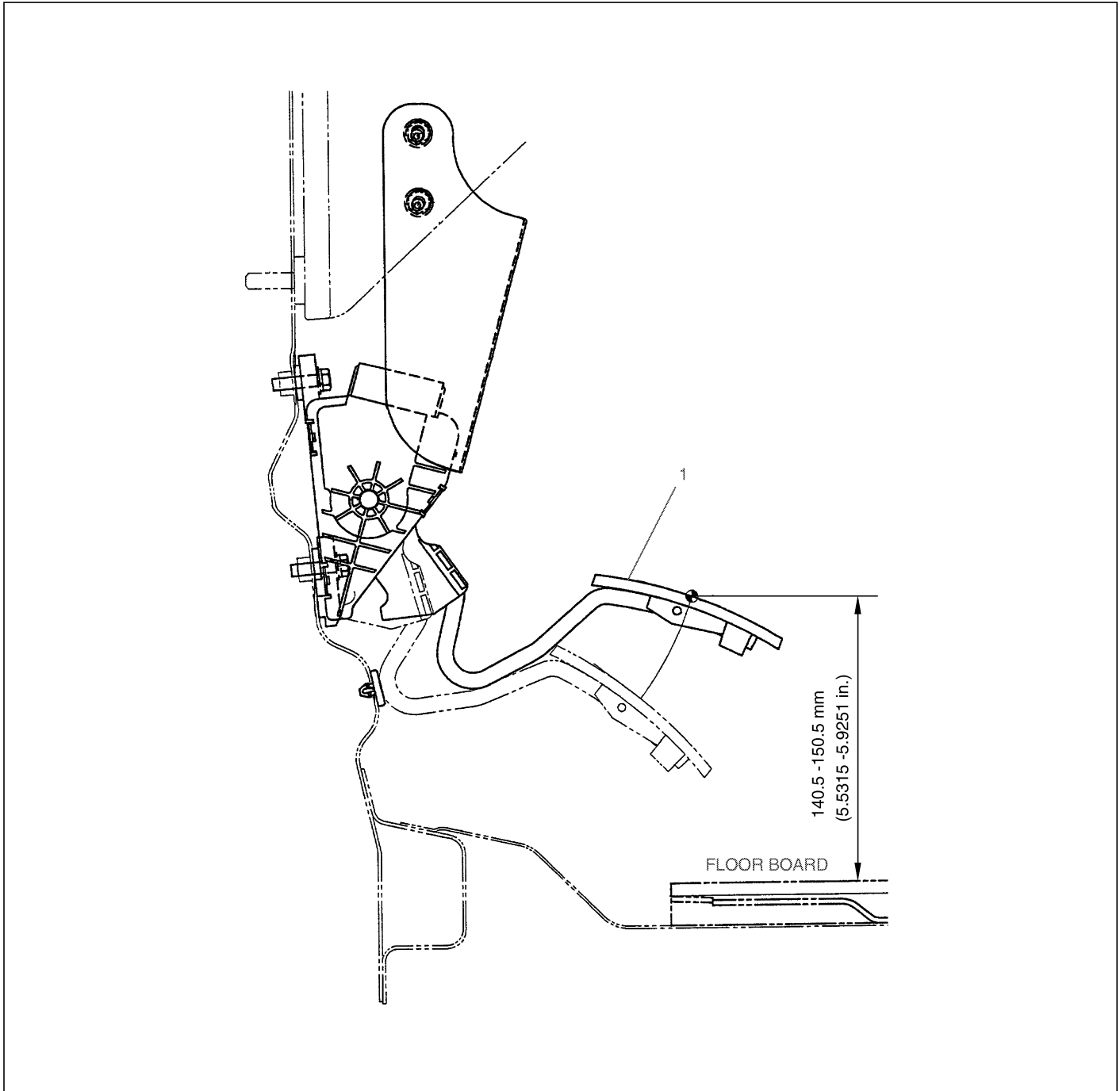
ACCELERATOR PEDAL.....EN16-2
DESCRIPTION EN16-2



ACCELERATOR PEDAL

DESCRIPTION

EN0110316C100001



SAPH011031600001

1 Accelerator pedal assy	
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FUEL CONTROL (J05D)

DN02-001

COMMON RAIL FUEL INJECTION SYSTEM

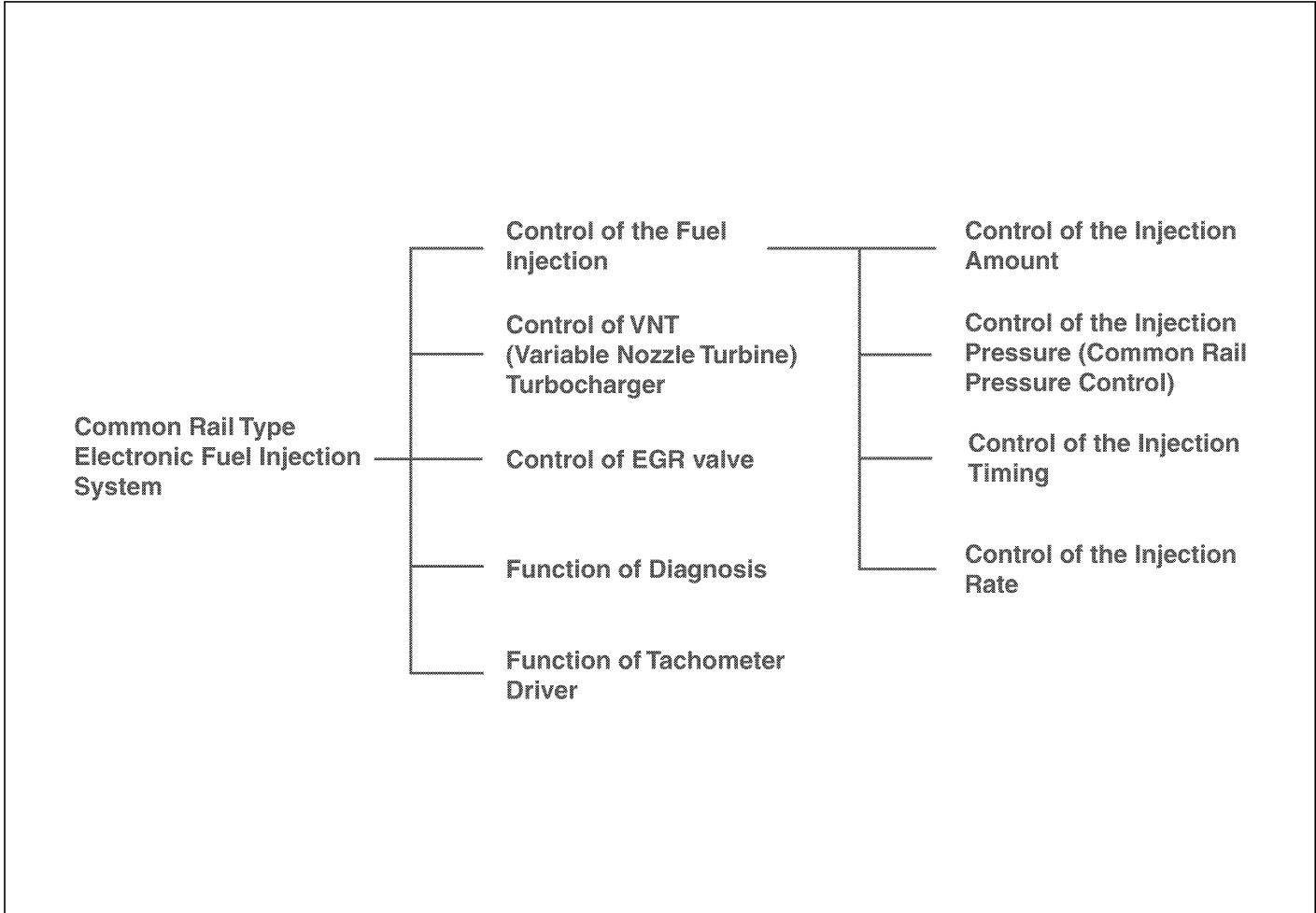
.....	DN02-2	AIR INTAKE PREHEATER RELAY	DN02-65
OVERVIEW	DN02-2	SUCTION CONTROL VALVE (SCV)	DN02-66
COMPONENT LOCATOR.....	DN02-3	EGR (CHECK BY HINO-DX).....	DN02-68
DIAGRAM	DN02-7	EGR ACTUATOR 1, 2.....	DN02-69
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DIAGNOSIS USING		TURBOCHARGER OVER BOOST	DN02-72
THE PC DIAGNOSIS TOOL	DN02-18	AIR FLOW SENSOR.....	DN02-73
INSPECTION OF AIR FLOW SENSOR		INTAKE AIR TEMPERATURE SENSOR	DN02-75
(CHECK/ADJUSTMENT OF AIR INTAKE		DPR (CHECK BY HINO-DX).....	DN02-76
VOLUME BY HINO-DX).....	DN02-27	DPR BACKPRESSURE SENSOR	
CHECK THE ECU POWER SUPPLY VOLTAGE		(CHECK BY HINO-DX).....	DN02-77
.....	DN02-28	DPR BACKPRESSURE SENSOR	DN02-78
CHECK THE GROUND	DN02-29	DPR EXHAUST GAS	
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ENGINE SPEED SUB SENSOR	DN02-32	DPR EXHAUST GAS	
ENGINE SPEED		TEMPERATURE SENSOR 1.....	DN02-81
MAIN AND SUB SENSOR.....	DN02-33	DPR EXHAUST GAS	
COOLANT TEMPERATURE SENSOR.....	DN02-34	TEMPERATURE SENSOR 2.....	DN02-82
FUEL TEMPERATURE SENSOR.....	DN02-35	DIESEL THROTTLE VALVE	DN02-83
STARTER SWITCH	DN02-36	DIESEL THROTTLE VALVE	
BOOST PRESSURE SENSOR	DN02-37	(CHECK BY HINO-DX).....	DN02-85
ACCELERATOR SENSOR 1	DN02-39	DIESEL THROTTLE VALVE	
ACCELERATOR SENSOR 2	DN02-41	OPENING SENSOR.....	DN02-86
ACCELERATOR SENSOR 1 & 2	DN02-43	EXHAUST BRAKE MAGNETIC VALVE.....	DN02-88
THROTTLE CONTROL.....	DN02-44	MAIN RELAY	DN02-89
VEHICLE SPEED SENSOR	DN02-46	BRAKE SWITCH	DN02-90
COMMON RAIL PRESSURE SENSOR	DN02-48	INJECTOR CORRECTION DATA	DN02-93
COMMON RAIL PRESSURE		CAN	
CONTROL SYSTEM.....	DN02-50	(CONTROLLER AREA NETWORK).....	DN02-94
COMMON RAIL PRESSURE AND		ENGINE OIL PRESSURE	DN02-95
SUPPLY PUMP	DN02-51	ACCELERATOR SENSOR	
COMMON RAIL PRESSURE		(FOR OPERATION OF P.T.O.).....	DN02-96
FIXED OUTPUT	DN02-52	CLUTCH SWITCH.....	DN02-99
CYLINDER CONTRIBUTION/BALANCE.....	DN02-53	ENGINE SPEED SUB SENSOR	
INJECTOR SOLENOID VALVE		(PULSE)	DN02-100
SYSTEM BREAKING	DN02-55	ENGINE SPEED MAIN SENSOR	
INJECTOR SOLENOID VALVE DRIVING		(PULSE)	DN02-102
SYSTEM +B SHORT- CIRCUIT	DN02-58	NEUTRAL SWITCH.....	DN02-104
INJECTOR SOLENOID VALVE DRIVING		SUPPLY PUMP	DN02-105
SYSTEM GND SHORT-CIRCUIT	DN02-60	WATER IN FUEL	DN02-106
ECU	DN02-62		
ENGINE OVERRUN	DN02-63		
ENGINE OVERHEAT	DN02-64		

COMMON RAIL FUEL INJECTION SYSTEM

OVERVIEW

EN1610302F200001

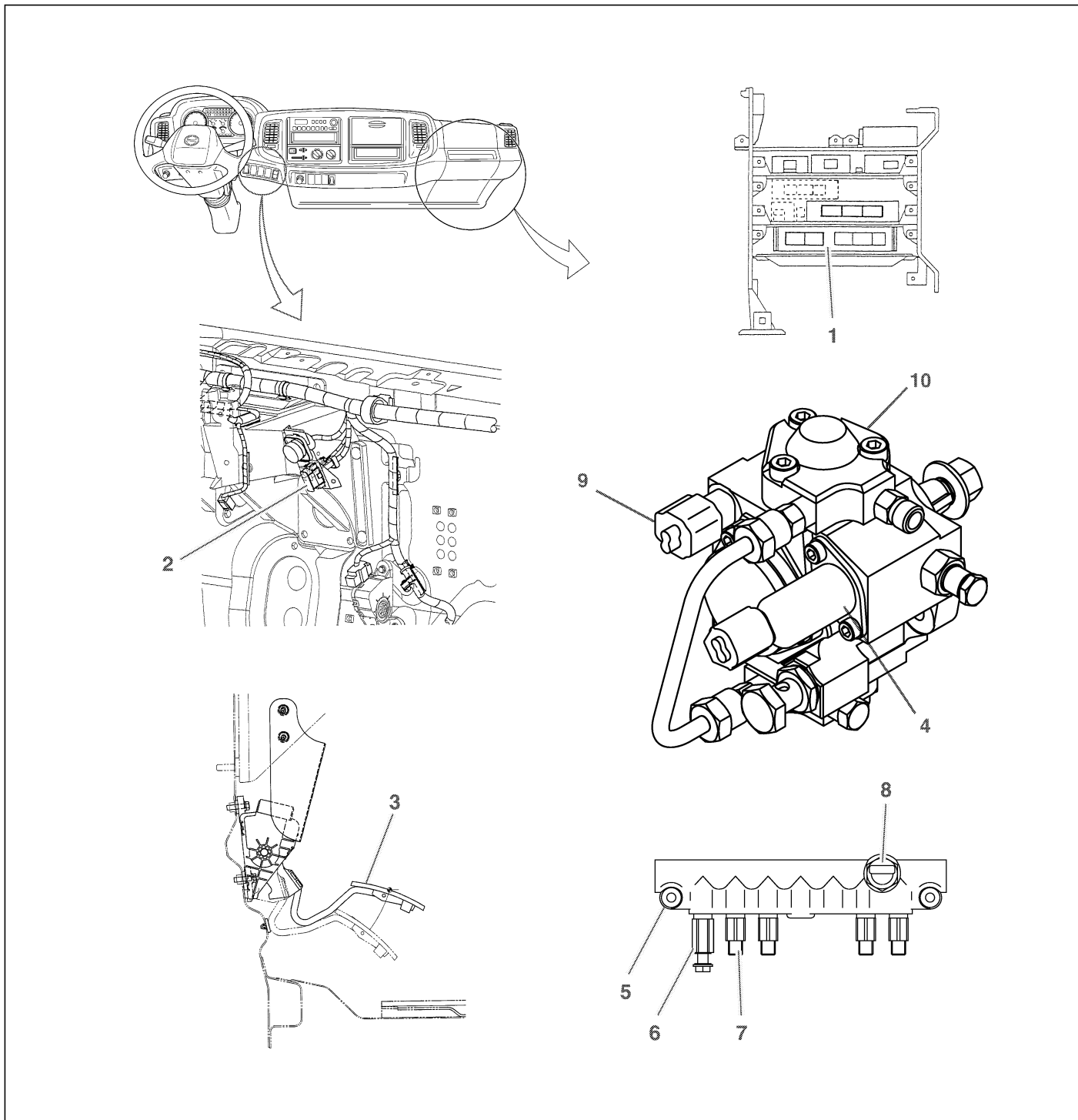
The Common Rail Fuel Injection System has a lot of control functions than the conventional injection pump system. These functions are controlled by the ECU (Electronic Control Unit).



SAPH161030200001

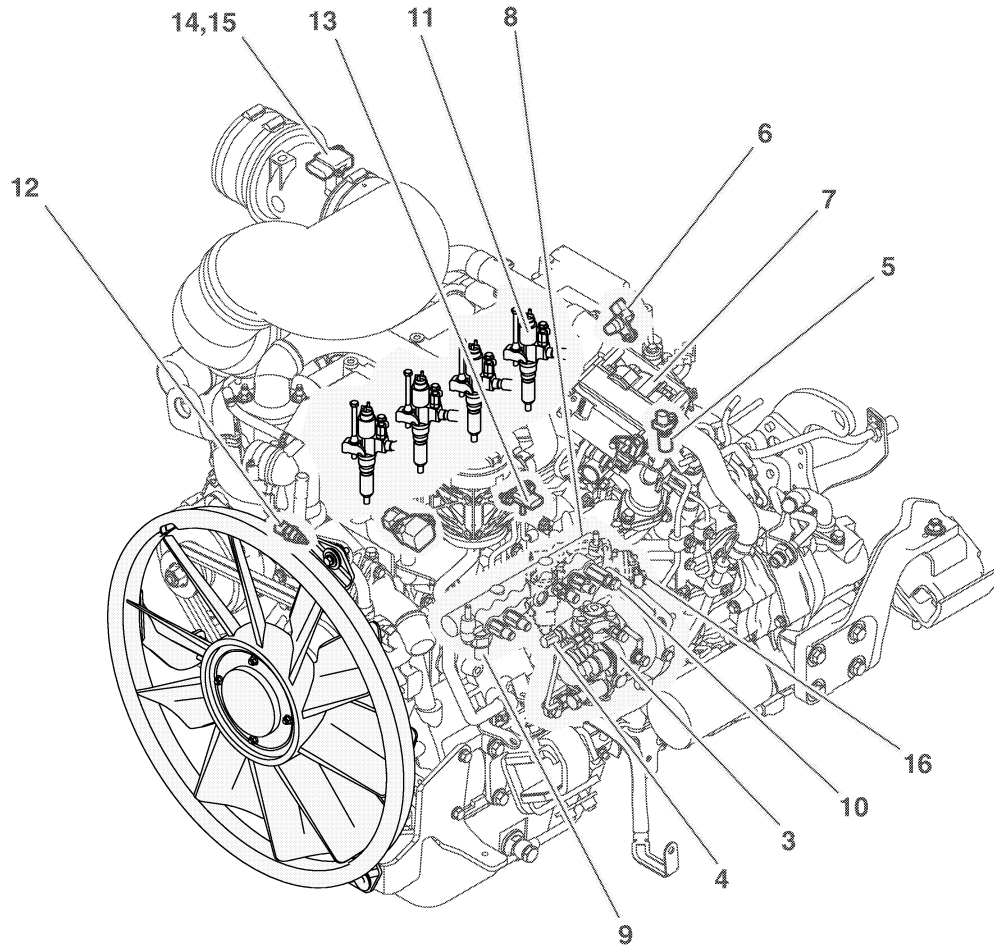
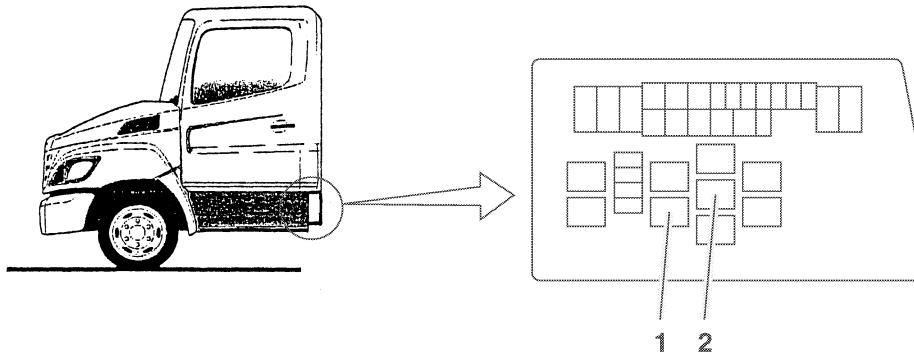
COMPONENT LOCATOR

EN1610302F200002



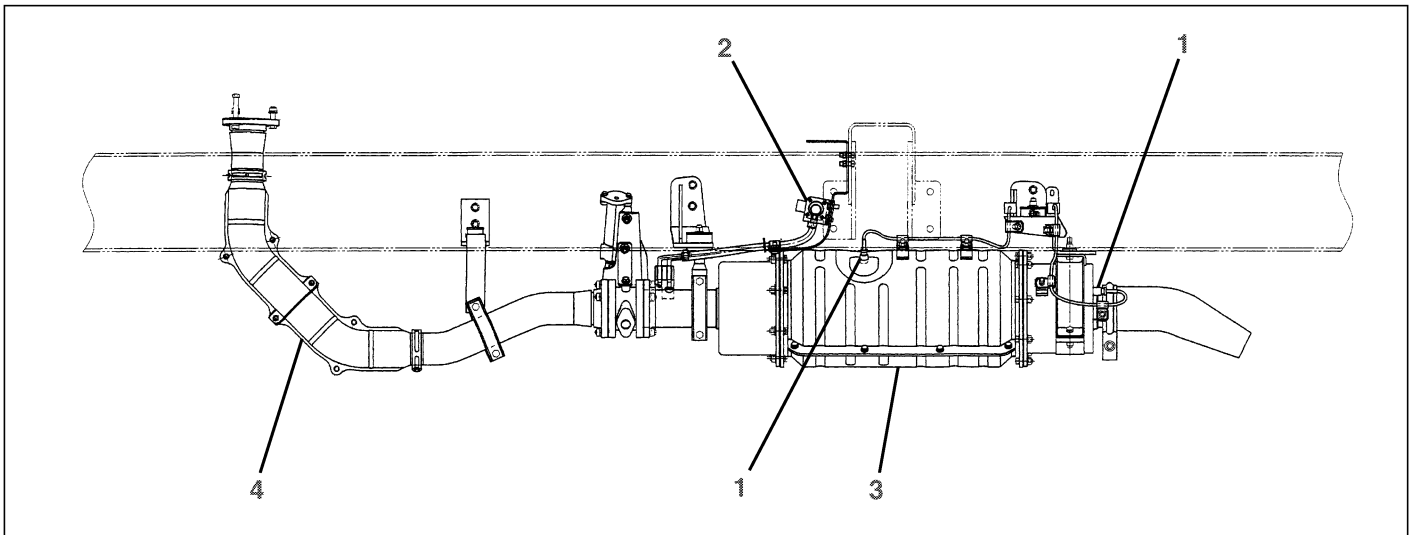
SAPH161030200002

1	Common rail fuel injection system ECU	6	Pressure limiter
2	Engine ECU diagnosis connector	7	Flow damper
3	Accelerator pedal (with sensor)	8	Pressure sensor
4	Suction control valve	9	Fuel temperature sensor
5	Common rail	10	Supply pump



SAPH16103020003

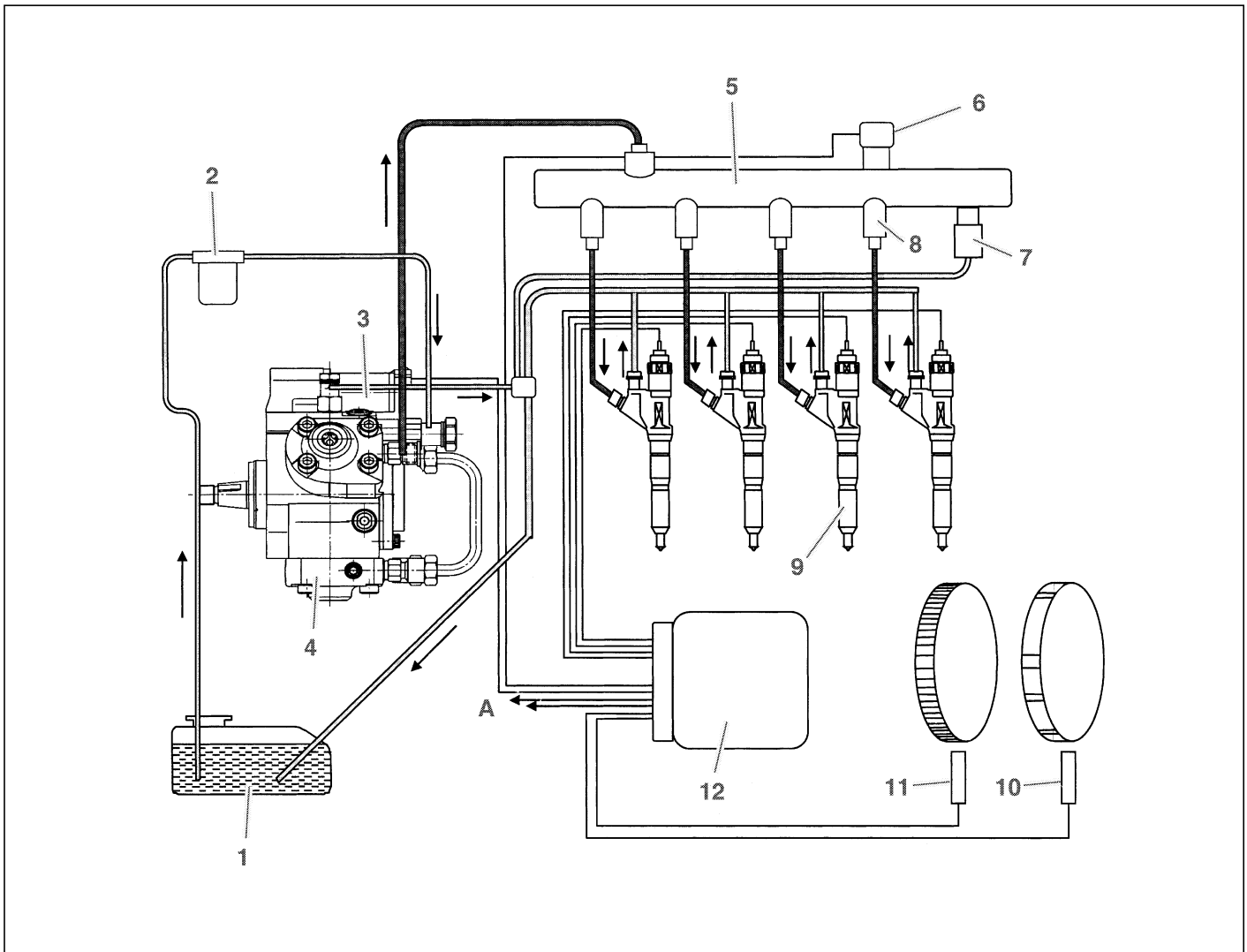
- | | | | |
|---|--------------------------|----|-------------------------------|
| 1 | ECU main relay | 9 | Common rail pressure sensor |
| 2 | Actuator relay | 10 | Common rail pressure limiter |
| 3 | Supply pump | 11 | Injector |
| 4 | Fuel temperature sensor | 12 | Coolant temperature sensor |
| 5 | Engine speed main sensor | 13 | Boost pressure sensor |
| 6 | Engine speed sub sensor | 14 | Air flow meter |
| 7 | EGR valve | 15 | Intake air temperature sensor |
| 8 | Common rail | 16 | Intake throttle valve |



SAPH161030200004

1 Exhaust gas temperature sensor
2 Backpressure sensor

3 DPR-cleaner
4 Exhaust pipe

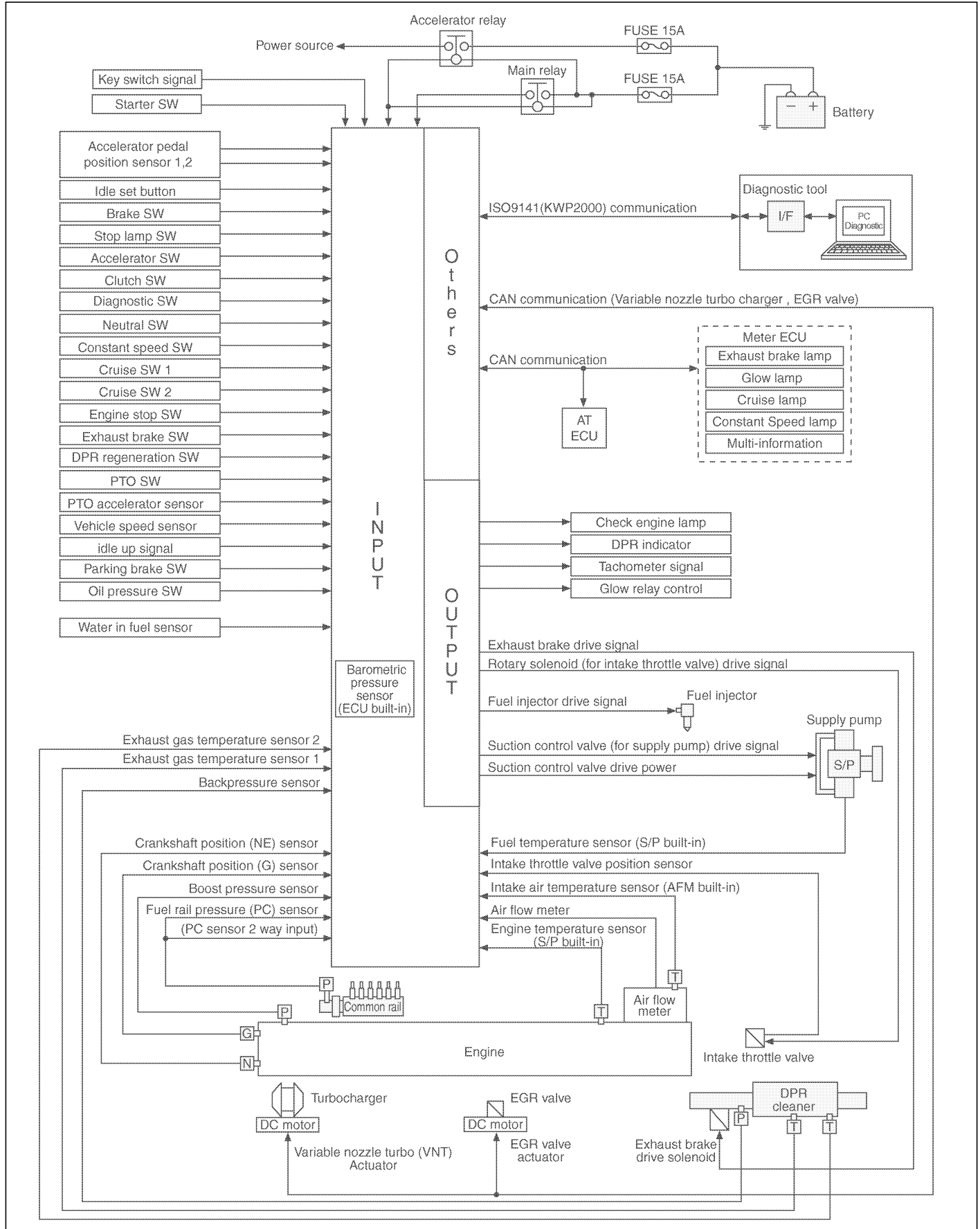


SAPH161030200005

1	Fuel tank	8	Flow damper
2	Fuel filter	9	Injector
3	Suction control valve	10	Engine speed sub sensor
4	Supply pump	11	Engine speed main sensor
5	Common rail	12	ECU
6	Pressure sensor	A	To sensors (Additional information)
7	Pressure limiter		

DIAGRAM

EN1610302F200003



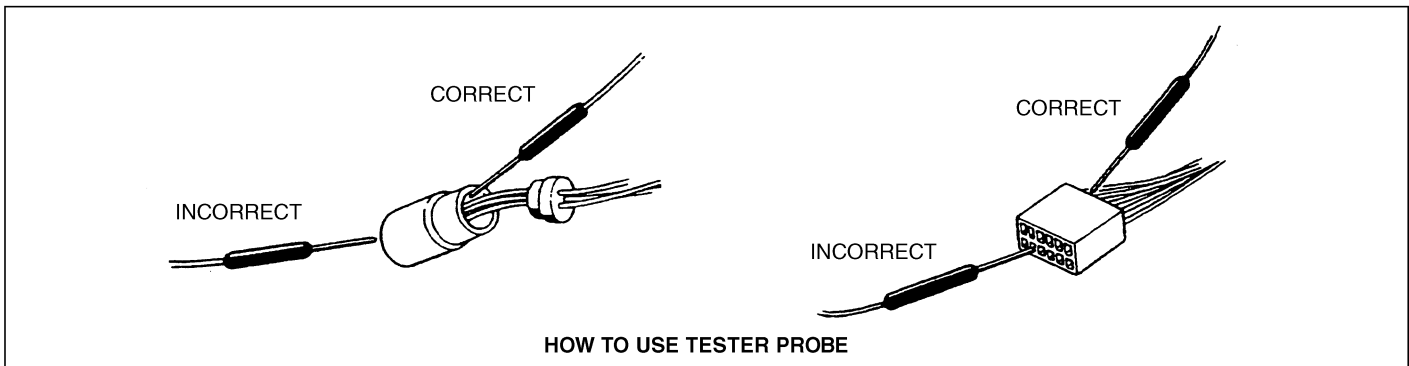
PRECAUTIONS

EN1610302F200004

WARNING

Approximately 110 V is generated for the injector drive actuation system. For this reason, electrical shock may result if the injector drive circuit is touched directly by hand. Turn the starter switch to the LOCK position if it is necessary to check or repair the computer, harnesses, or connectors.

1. **BE CAREFUL NOT TO LET DIRT OR DUST GET INSIDE THE ACTUATOR OR MAGNETIC VALVES.**
2. **HARNESS WIRE CONNECTOR.**
 - (1) Multi-contact connectors suitable for the small electrical signals of electronic circuitry are used for wiring connections to the sensors, actuator and control unit. Be very careful when handling them.
 - Before disconnecting any connectors, make sure that the starter switch is in the "LOCK" position.
 - When disconnecting connectors, try to pull them out in a straight line, disengaging the lock and holding onto the housing.
 - Do not try to disconnect connectors by gripping the wires or twisting them, as this could bend the contacts.
 - Do not disconnect connectors unnecessarily.
 - When using a circuit tester, apply the tester probe to the harness wire side only. Never stick the tester probe into the holes on the connector terminal side, as this could cause poor contacts when the connector is reconnected.



SAPH161030200007

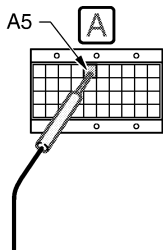
- Do not let water, oil or dust get on the connector when it is disconnected, as this could cause poor contacts when the connector is reconnected.
 - Do not open the control unit cover. It could malfunction if dust or water gets inside.
 - Take care to ensure that water, oil or dust do not get on or inside parts.
 - When connecting in connectors, push them in all the way and make sure that the lock engages.
3. **ERASING THE MALFUNCTION MEMORY STORED IN THE PAST, CHECK THE CURRENT MALFUNCTION BY PERFORMING A DIAGNOSIS OF THE PRESENT MALFUNCTION AGAIN.**

4. **AFTER COMPLETING THE MALFUNCTION ANALYSIS, ERASE THE MALFUNCTION MEMORY STORED IN THE PAST. OTHERWISE, THE MALFUNCTION LAMP IN THE DISPLAY WILL REMAIN LIT.**
5. **CONNECTOR DRAWING, ALL OF WHICH HAS A VIEW TO BE SEEN FROM THE CONNECTION SIDE, INSERT THE TESTING LEAD FROM THE BACKSIDE.**
6. **USING A CIRCUIT TESTER**
 - Use a circuit tester with an internal resistance of 100 kΩ or greater in the voltage measuring range.
7. **USING A SIGNAL CHECK HARNESS**
 - To prevent breakage of the ECU connector, connect the signal check harness and perform measuring by bringing the test lead into contact with the signal check harness side (contact box).

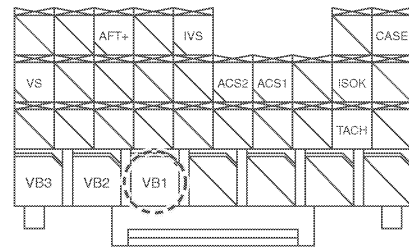
NOTICE

The terminal numbers in the text and in the illustrations correspond to the table on the next page (computer pin assignment) as shown below.

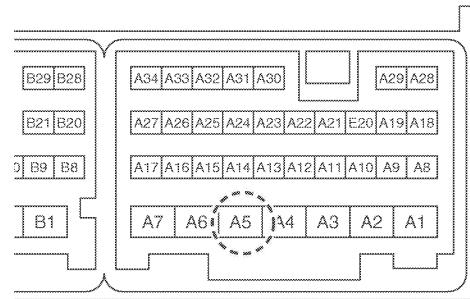
EXAMPLE:
 ECU: A5 TERMINAL ↔
 SIGNAL CHECK HARNESS
 CONTACT BOX:
 A5 TERMINAL



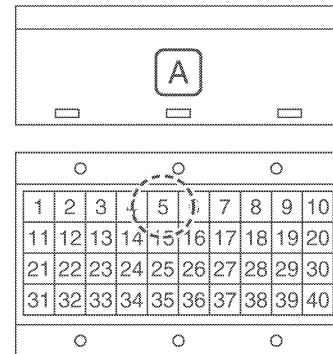
COMPUTER (ECU)
 TERMINAL SIGNAL

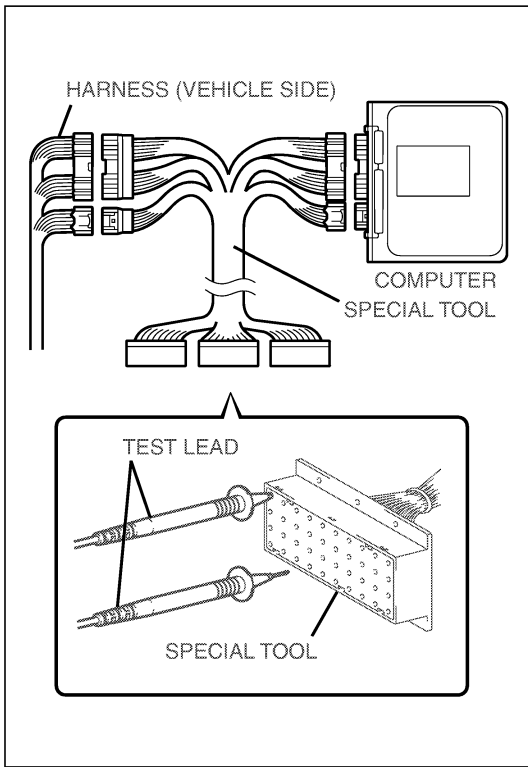


COMPUTER (ECU)
 TERMINAL No.



SIGNAL CHECK
 HARNESS
 (CONTACT BOX)



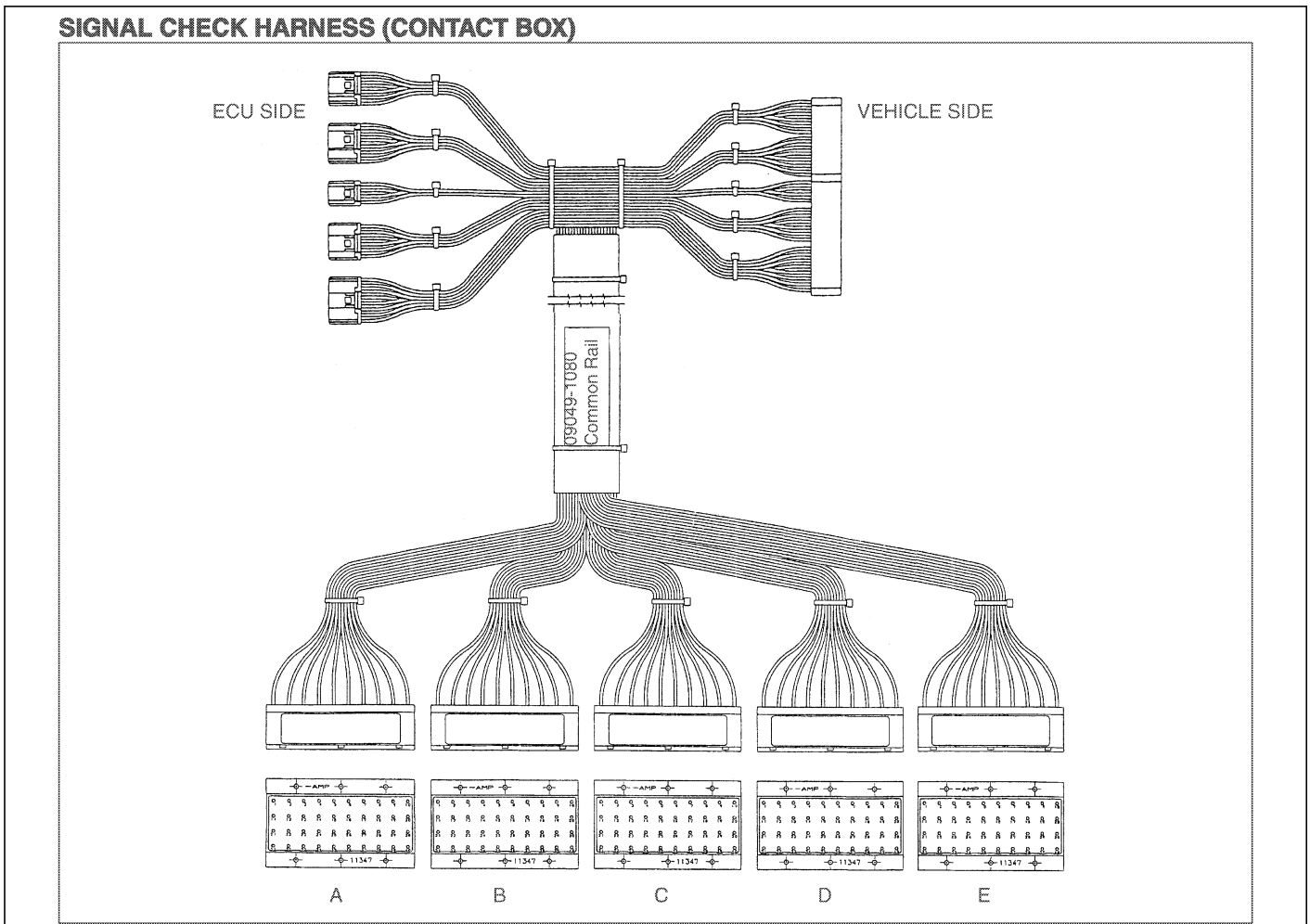


SAPH161030200009

8. CONNECT THE SIGNAL CHECK HARNESS.

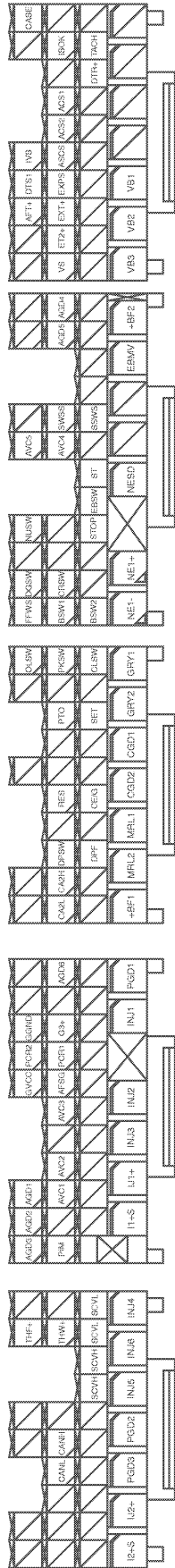
- (1) Disconnect the connectors from the ECU.
 - (2) Connect a signal check harness to the vehicle harness and the ECU.
- SST: Signal check harness (09049-1080)**

(3) COMPUTER (ECU) PIN ASSIGNMENT

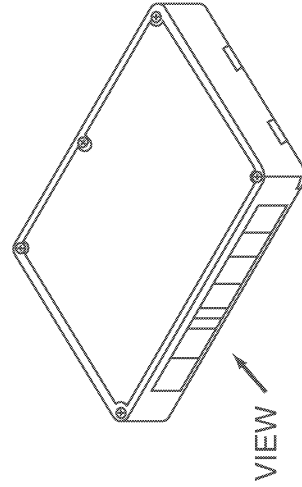
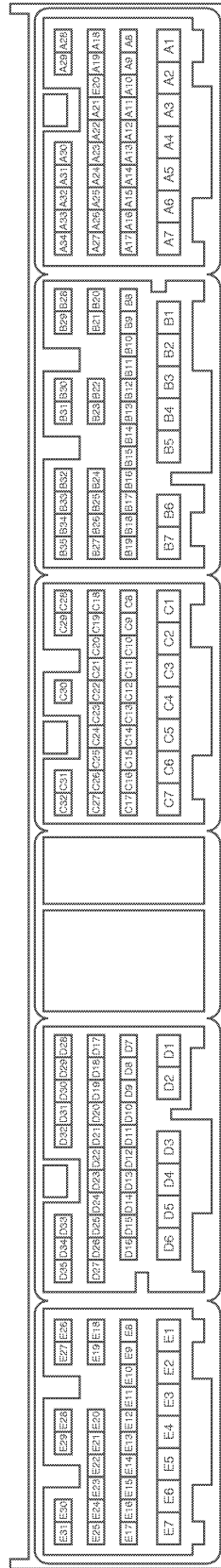


SAPH161030200010

COMPUTER (ECU) TERMINAL SIGNAL



COMPUTER (ECU) TERMINAL NO



9. RADIO INSTALLATION

- There is a danger that the control unit might malfunction if a high output radio transmitter (over 50 W) is installed in the vehicle.

10. USING A QUICK CHARGER

- Disconnect both battery terminals before using a quick charger.

11. AIR CONDITIONER INSTALLATION

- Be careful not to scratch or damage the engine, chassis or the harness inside the cab when installing an air conditioner. Also, make sure to reattach afterward any connectors that were disconnected during the installation process.

12. PERFORMING ELECTRIC WELDING

- Disconnect connector to the control unit before performing any electric welding.

13. OTHER

- Make sure to check the other connectors before connecting them in to prevent incorrect connections.
- Be careful not to allow the connectors to become soiled with dust, water, fuel or oil when performing inspections or removing and replacing parts.

COMPUTER (ECU) PIN CONNECTION

•The terminal number in the table below correspond with the contact box of signal check harness

No.	CONTACT BOX (A)		CONTACT BOX (B)	
	Signal	Connection destination	Signal	Connection destination
1			+BF2	Actuator power relay
2			EBMV	U2 exhaust brake relay
3				
4				
5	VB1	ECU main relay	NESD	Engine speed main sensor shield ground
6	VB2	ECU main relay	NE1+	Engine speed main sensor +
7	VB3	ECU main relay	NE1-	Engine speed main sensor -
8				
9	TACH	Tachometer		
10	DTR+	Diesel throttle valve		
11				
12			SSWS	Fuse U2 (M)
13				
14			ST	Starter relay
15			EBSW	Wiper and retarder switch
16			STOP	Engine stop switch
17				

COMPUTER (ECU) PIN CONNECTION				
•The terminal number in the table below correspond with the contact box of signal check harness				
No.	CONTACT BOX (A)		CONTACT BOX (B)	
	Signal	Connection destination	Signal	Connection destination
18				
19	ISOK	Diagnosis connector	BSW2	Brake switch
20			AGD4	Throttle control and accelerator sensor 1
21	ACS1	Accelerator sensor 1	AGD5	Accelerator sensor 2
22	ACS2	Accelerator sensor 2	SWSS	Fuse U2 (M)
23	ASCS	PTO accelerator sensor	AVC4	Throttle control and accelerator sensor 1
24	EXPS	Exhaust gas pressure sensor		
25	EXT+	Exhaust gas temperature sensor 1		
26	EX2+	Exhaust gas temperature sensor 2	CRSW	Cruise control main switch
27	VS	Vehicle speed pulse converter	BSW1	Stop and turn ECU
28	CASE	Cab ground		
29				
30	IVS	Throttle control signal		
31	DTS1	Diesel throttle valve sensor	AVC5	Accelerator sensor 2
32	AFT+	Air flow sensor	NUSW	Manual transmission: Neutral switch Automatic transmission A450: starter switch and A450 ECU
33				
34			DGSW	Diagnosis switch
35			FFWS	Fuel filter water level sensor
36				
37				
38				
39				
40				

COMPUTER (ECU) PIN CONNECTION

•The terminal number in the table below correspond with the contact box of signal check harness

No.	CONTACT BOX (C)		CONTACT BOX (D)	
	Signal	Connection destination	Signal	Connection destination
1	GRY1	Heater relay	PGD1	Cab ground
2	GRY2	Heater relay	INJ1	No.1 Fuel injector
3	CGD1	Cab ground	INJ4	No.4 Fuel injector
4	CGD2	Cab ground		
5	MRL1	ECU main relay	IJ1+	No.1,4 Fuel injector
6	MRL2	ECU main relay	I1+S	No.1,4 Fuel injector
7	+BF1	Actuator power relay		
8	CLSW	Clutch switch		
9				
10	SET	Cruise control set switch (Set)		
11				
12				
13	CE/G	Check engine warning light		
14				
15	DPR	DPR refresh switch		
16				
17			AGD6	Air flow sensor
18	PKSW	Cab ground		
19			G3+	Sub engine speed sensor
20	PTO	PTO signal	PCR1	Common rail pressure sensor
21			AFSG	Air flow sensor
22			AVC3	Diesel throttle valve sensor
23	RES	Cruise control set switch (Resume)		
24			AVC2	Common rail pressure sensor
25	DPSW	DPR refresh switch	AVC1	Boost sensor
26	CA2H	Diagnosis connector		
27	CA2L	Diagnosis connector	PIM	Boost sensor
28	OLSW	Engine oil pressure switch		
29				
30			GGND	Sub engine speed sensor
31			PCR2	Common rail pressure sensor
32			GVCC	Sub engine speed sensor

COMPUTER (ECU) PIN CONNECTION				
•The terminal number in the table below correspond with the contact box of signal check harness				
No.	CONTACT BOX (C)		CONTACT BOX (D)	
	Signal	Connection destination	Signal	Connection destination
33			AGD1	Boost sensor and common rail pressure sensor
34			AGD2	Coolant temperature sensor, fuel temperature sensor and air flow sensor
35			AGD3	Diesel throttle valve sensor
36				
37				
38				
39				
40				

COMPUTER (ECU) PIN CONNECTION		
• The terminal number in the table below correspond with the contact box of signal check harness		
No.	CONTACT BOX (E)	
	Signal	Connection destination
1	INJ3	No.3 Fuel injector
2	INJ2	No.2 Fuel injector
3		
4	PGD2	Cab ground
5	PGD3	Cab ground
6	IJ2+	No.2,3 Fuel injector
7	I2+S	No.2,3 Fuel injector
8	SCVL	Suction control valve
9	SCVL	Suction control valve
10	SCVH	Suction control valve
11	SCVH	Suction control valve
12	12	
13	13	
14	14	
15	15	
16	16	
17	17	
18	18	

COMPUTER (ECU) PIN CONNECTION		
<ul style="list-style-type: none"> The terminal number in the table below correspond with the contact box of signal check harness 		
No.	CONTACT BOX (E)	
	Signal	Connection destination
19	THW+	Coolant temperature sensor
20		
21	CANH	VNT control, EGR control
22	CANL	VNT control, EGR control
23		
24		
25		
26		
27	THF+	Fuel temperature sensor
28		
29		
30		
31		
32		
33		
34		
35		
36		
37		
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39		
40		

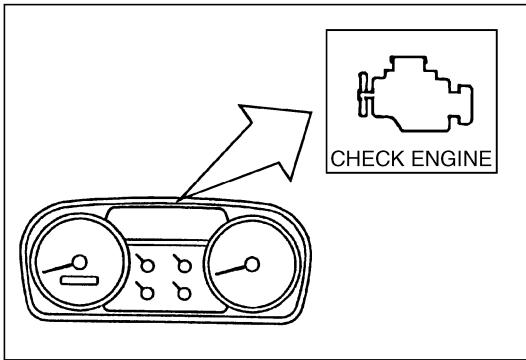
INSPECTION

EN1610302F200005

CHECK ENGINE LAMP STATUS

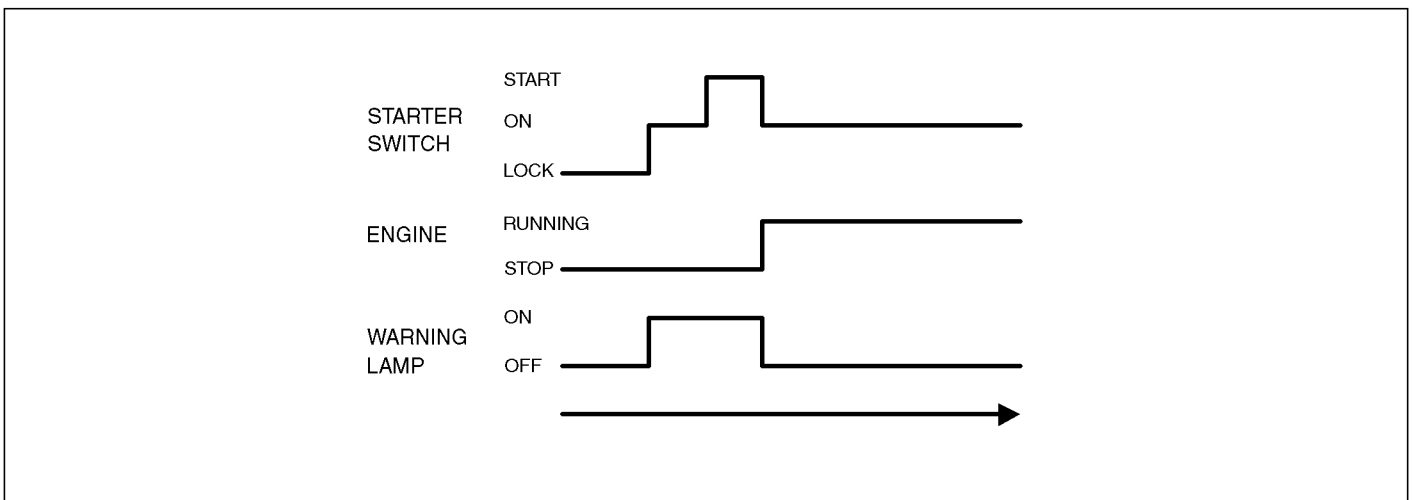
1. INSPECTION PROCEDURE

- (1) Turn the starter switch to the ON position (do not start the engine) and confirm that the Check Engine Lamp in the indicator area lights up.
- (2) Start the engine.
- (3) If the engine is normal, the Check Engine Lamp goes out.
- (4) If the Check Engine Lamp does not go out, the system is abnormal. Check the system according to diagnosis on the following page.



SAPH161030200012

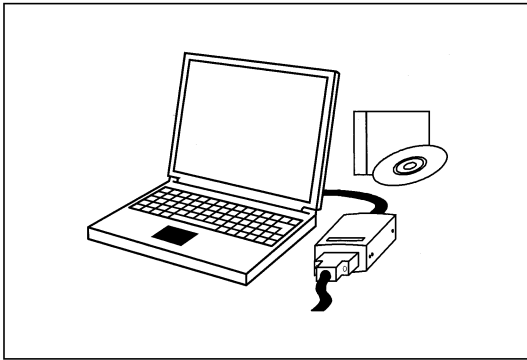
CHECK ENGINE LAMP ILLUMINATION PATTERN



SAPH161030200013

DIAGNOSIS USING THE PC DIAGNOSIS TOOL

EN1610302F200006



SAPH161030200014

1. DIAGNOSIS TOOL

- Trouble diagnosis can be performed using the PC diagnosis tool. By connection to the diagnosis connector, the trouble location is indicated.

SST:

Communication interface assembly (09993-E9070)

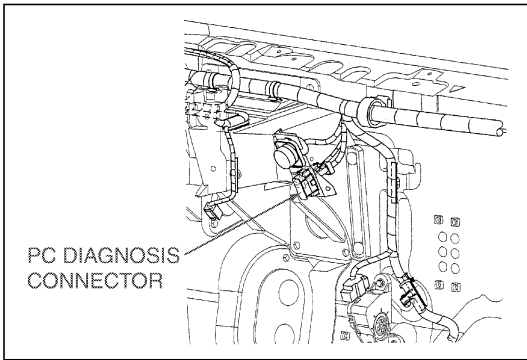
Cable communication (09042-1220)

Diagnosis software: HINO Diagnostic eXplorer (DX).

Reprogramming software: HINO Reprog Manager.

NOTICE

Only ECU reprogramming can be performed by authorized HINO dealer.



SAPH161030200015

2. CONNECT THE PC DIAGNOSIS TOOL

- (1) Turn the starter switch on the "LOCK" position.
- (2) Connect the PC DIAGNOSIS TOOL.

DIAGNOSTIC TROUBLE CODE (DTC) TABLE				
CHECK ENGINE WARNING LIGHT	DTC NO.	DIAGNOSIS ITEM	INSPECTION ITEM	REFER PAGE
Light	P0045	VNT turbocharger controller malfunction	<ul style="list-style-type: none"> • ECU (ECU connector) • Wire harness • Turbocharger 	DN02-71
Light	P0087	Lack of forced feed in supply pump	<ul style="list-style-type: none"> • Fuel leakage; by HINO-DX • Common rail pressure; by HINO-DX • Common rail pressure sensor • Wire harness 	DN02-51
Light	P0088	Excessive common rail pressure	<ul style="list-style-type: none"> • Fuel leakage; by HINO-DX • Common rail pressure; by HINO-DX • Common rail pressure sensor • ECU (ECU connector) • Wire harness 	DN02-50
Light	P0088	Excessive common rail pressure, supply pump excess forced feed	<ul style="list-style-type: none"> • Fuel leakage; by HINO-DX • Common rail pressure; by HINO-DX • Common rail pressure sensor 	DN02-51
Light	P0102	Air flow sensor circuit low input	<ul style="list-style-type: none"> • Air flow sensor • Wire harness • ECU (ECU connector) 	DN02-73
Light	P0103	Air flow sensor circuit high input	<ul style="list-style-type: none"> • Air flow sensor • Wire harness • ECU (ECU connector) 	DN02-73
Light	P0108	Boost pressure sensor circuit high input	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • Boost pressure sensor 	DN02-37
Light	P0112	Intake air temperature sensor circuit low input	<ul style="list-style-type: none"> • Wire harness • Intake air temperature sensor • ECU (ECU connector) 	DN02-75
Light	P0113	Intake air temperature sensor circuit high input	<ul style="list-style-type: none"> • Wire harness • Intake air temperature sensor • ECU (ECU connector) 	DN02-75
Light	P0117	Coolant temperature sensor circuit low input	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • Coolant temperature sensor 	DN02-34
Light	P0118	Coolant temperature sensor circuit high input	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • Coolant temperature sensor 	DN02-34

DIAGNOSTIC TROUBLE CODE (DTC) TABLE				
CHECK ENGINE WARNING LIGHT	DTC NO.	DIAGNOSIS ITEM	INSPECTION ITEM	REFER PAGE
Light	P0182	Fuel temperature sensor circuit low input	<ul style="list-style-type: none"> Wire harness ECU (ECU connector) Fuel temperature sensor 	DN02-35
Light	P0183	Fuel temperature sensor circuit high input	<ul style="list-style-type: none"> Wire harness ECU (ECU connector) Fuel temperature sensor 	DN02-35
Light	P0191	Common rail pressure sensor malfunction	<ul style="list-style-type: none"> Common rail pressure sensor Wire harness ECU (ECU connector) 	DN02-48, 52
Light	P0192	Common rail pressure sensor circuit low input	<ul style="list-style-type: none"> ECU (ECU connector) Wire harness Common rail pressure sensor 	DN02-48
Light	P0193	Common rail pressure sensor circuit high input	<ul style="list-style-type: none"> ECU (ECU connector) Wire harness Common rail pressure sensor 	DN02-48
Light	P0200	ECU charge circuit high input	<ul style="list-style-type: none"> ECU (ECU connector) 	DN02-62
Light	P0201	Injector circuit malfunction -cylinder 1	<ul style="list-style-type: none"> ECU (ECU connector) Wire harness Injector 	DN02-55
Light	P0202	Injector circuit malfunction -cylinder 2	<ul style="list-style-type: none"> ECU (ECU connector) Wire harness Injector 	DN02-55
Light	P0203	Injector circuit malfunction -cylinder 3	<ul style="list-style-type: none"> ECU (ECU connector) Wire harness Injector 	DN02-55
Light	P0204	Injector circuit malfunction -cylinder 4	<ul style="list-style-type: none"> ECU (ECU connector) Wire harness Injector 	DN02-55
Light	P0217	Engine overheat	<ul style="list-style-type: none"> ECU (ECU connector) Coolant temperature sensor Engine cooling system 	DN02-64
No light	P0219	Engine overrun	—	DN02-63
No light	P0234	Turbocharger over boost	<ul style="list-style-type: none"> ECU (ECU connector) Turbocharger system 	DN02-72
Light	P0237	Boost sensor circuit low input	<ul style="list-style-type: none"> Wire harness ECU (ECU connector) Boost pressure sensor 	DN02-37

DIAGNOSTIC TROUBLE CODE (DTC) TABLE				
CHECK ENGINE WARNING LIGHT	DTC NO.	DIAGNOSIS ITEM	INSPECTION ITEM	REFER PAGE
No light	P0263	Cylinder 1 contribution/balance fault	<ul style="list-style-type: none"> • Flow damper • Injector • Fuel filter • Injection pipe • ECU (ECU connector) 	DN02-53
No light	P0266	Cylinder 2 contribution/balance fault	<ul style="list-style-type: none"> • Flow damper • Injector • Fuel filter • Injection pipe • ECU (ECU connector) 	DN02-53
No light	P0269	Cylinder 3 contribution/balance fault	<ul style="list-style-type: none"> • Flow damper • Injector • Fuel filter • Injection pipe • ECU (ECU connector) 	DN02-53
No light	P0272	Cylinder 4 contribution/balance fault	<ul style="list-style-type: none"> • Flow damper • Injector • Fuel filter • Injection pipe • ECU (ECU connector) 	DN02-53
Light	P0335	Engine speed main sensor circuit malfunction	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • Engine speed main sensor 	DN02-30,33
Light	P0340	Engine speed sub sensor circuit malfunction	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • Engine speed sub sensor 	DN02-32,33
Light	P0122	Diesel throttle valve-opening sensor low input	<ul style="list-style-type: none"> • Diesel throttle valve-opening sensor • ECU (ECU connector) • Wire harness 	DN02-86
Light	P0123	Diesel throttle valve-opening sensor high input	<ul style="list-style-type: none"> • Diesel throttle valve-opening sensor • ECU (ECU connector) • Wire harness 	DN02-86
Light	P2101	Diesel throttle valve sticking	<ul style="list-style-type: none"> • Diesel throttle valve • ECU (ECU connector) 	DN02-85
Light	P0400	Abnormal flow amount of EGR	<ul style="list-style-type: none"> • EGR; by HINO-DX • EGR valve • Wire harness 	DN02-68

DIAGNOSTIC TROUBLE CODE (DTC) TABLE				
CHECK ENGINE WARNING LIGHT	DTC NO.	DIAGNOSIS ITEM	INSPECTION ITEM	REFER PAGE
Light	P0545	DPR exhaust gas temperature sensor 1 malfunction (Low input)	<ul style="list-style-type: none"> • DPR exhaust gas temperature sensor • ECU (ECU connector) • Wire harness 	DN02-81
Light	P0546	DPR exhaust gas temperature sensor 1 malfunction (High input)	<ul style="list-style-type: none"> • DPR exhaust gas temperature sensor • ECU (ECU connector) • Wire harness 	DN02-81
Light	P1426	Abnormality of backpressure sensor characteristic	<ul style="list-style-type: none"> • Backpressure sensor • Wire harness 	DN02-77
Light	P1427	DPR backpressure sensor malfunction (Low input)	<ul style="list-style-type: none"> • Backpressure sensor • ECU (ECU connector) • Wire harness 	DN02-78
Light	P1428	DPR backpressure sensor malfunction (High input)	<ul style="list-style-type: none"> • Backpressure sensor • ECU (ECU connector) • Wire harness 	DN02-78
Light	P1458	EGR actuator malfunction (Serious)	<ul style="list-style-type: none"> • EGR; by HINO-DX • EGR valve • Wire harness 	DN02-69
Light	P1459	EGR actuator malfunction (Slight)	<ul style="list-style-type: none"> • EGR; by HINO-DX • EGR valve • Wire harness 	DN02-69
No light	P1681	Exhaust brake magnetic valve malfunction (Open circuit, ground line short)	<ul style="list-style-type: none"> • Exhaust brake magnetic valve • ECU (ECU connector) • Wire harness 	DN02-88
No light	P1682	Exhaust brake magnetic valve malfunction (Power source line short)	<ul style="list-style-type: none"> • Exhaust brake magnetic valve • ECU (ECU connector) • Wire harness 	DN02-88
Light	P2002	DPR system malfunction	<ul style="list-style-type: none"> • DPR system; by HINO-DX • Exhaust brake 	DN02-76
Light	P2032	DPR exhaust gas temperature sensor 2 malfunction (Low input)	<ul style="list-style-type: none"> • Exhaust gas temperature sensor 2 • ECU (ECU connector) • Wire harness 	DN02-82
Light	P2033	DPR exhaust gas temperature sensor 2 malfunction (High input)	<ul style="list-style-type: none"> • Exhaust gas temperature sensor 2 • ECU (ECU connector) • Wire harness 	DN02-82
Light	P2080	Abnormality of exhaust gas temperature sensor 1 characteristic	<ul style="list-style-type: none"> • Exhaust gas temperature sensor 1 • Wire harness 	DN02-80

DIAGNOSTIC TROUBLE CODE (DTC) TABLE				
CHECK ENGINE WARNING LIGHT	DTC NO.	DIAGNOSIS ITEM	INSPECTION ITEM	REFER PAGE
Light	P2084	Abnormality of exhaust gas temperature sensor 2 characteristic	<ul style="list-style-type: none"> Exhaust gas temperature sensor 2 Wire harness 	DN02-80
Light	P2100	Diesel throttle valve malfunction (GND short)	<ul style="list-style-type: none"> Diesel throttle valve ECU (ECU connector) Wire harness 	DN02-83
No light	P2103	Diesel throttle valve malfunction (Open circuit or VB short)	<ul style="list-style-type: none"> Diesel throttle valve ECU (ECU connector) Wire harness 	DN02-83
No light	P0500	Vehicle speed sensor circuit low input	<ul style="list-style-type: none"> ECU (ECU connector) Wire harness Vehicle speed sensor 	DN02-46
No light	P0501	Vehicle speed sensor circuit high input	<ul style="list-style-type: none"> ECU (ECU connector) Wire harness Vehicle speed sensor Pulse converter 	DN02-46
No light	P0504	Brake switch malfunction	<ul style="list-style-type: none"> Brake switch Stop light switch Wire harness 	DN02-90
Light	P0524	Engine oil pressure low	<ul style="list-style-type: none"> Engine oil Wire harness Engine oil pressure switch ECU (ECU connector) 	DN02-95
No light	P0540	Preheat circuit malfunction	<ul style="list-style-type: none"> ECU (ECU connector) Heater relay Wire harness 	DN02-65
Light	P0605	Flash ROM error	<ul style="list-style-type: none"> ECU (ECU connector) 	DN02-62
Light	P0606	CPU malfunction (Hard detection)	<ul style="list-style-type: none"> ECU (ECU connector) 	DN02-62
Light	P0607	Monitoring IC malfunction in CPU	<ul style="list-style-type: none"> ECU (ECU connector) 	DN02-62
Light	P0611	ECU charge circuit malfunction	<ul style="list-style-type: none"> ECU (ECU connector) 	DN02-62
No light	P0617	Starter signal malfunction	<ul style="list-style-type: none"> Wire harness Starter signal ECU (ECU connector) 	DN02-36
Light	P0628	SCV malfunction	<ul style="list-style-type: none"> Supply pump Wire harness ECU (ECU connector) 	DN02-66
Light	P0629	SCV out put short to BATT	<ul style="list-style-type: none"> Supply pump Wire harness ECU (ECU connector) 	DN02-66

DIAGNOSTIC TROUBLE CODE (DTC) TABLE				
CHECK ENGINE WARNING LIGHT	DTC NO.	DIAGNOSIS ITEM	INSPECTION ITEM	REFER PAGE
Light	P0686	Main relay malfunction	<ul style="list-style-type: none"> • Main relay • Wire harness • ECU (ECU connector) 	DN02-89
No light	P1133	P.T.O. accelerator sensor circuit high input	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • Accelerator sensor 	DN02-96
No light	P1143	Throttle control malfunction	<ul style="list-style-type: none"> • ECU (ECU connector) • Wire harness • Throttle control 	DN02-44
Light	P1211	Injector common 1 short to GND	<ul style="list-style-type: none"> • Wire harness • Injector • ECU (ECU connector) 	DN02-60
Light	P1212	Injector common 1 short to BATT	<ul style="list-style-type: none"> • Wire harness • Injector • ECU (ECU connector) 	DN02-58
Light	P1214	Injector common 2 short to GND	<ul style="list-style-type: none"> • Wire harness • Injector • ECU (ECU connector) 	DN02-60
Light	P1215	Injector common 2 short to BATT	<ul style="list-style-type: none"> • Wire harness • Injector • ECU (ECU connector) 	DN02-58
Light	P1601	Injector correction data conformity error	<ul style="list-style-type: none"> • ECU (ECU connector) 	DN02-93
Light	P2120	Accelerator sensor 1 and 2 malfunction	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • Accelerator sensor 	DN02-39, 41, 43
Light	P2122	Accelerator sensor circuit 1 low voltage	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • Accelerator sensor 	DN02-39, 43
Light	P2123	Accelerator sensor circuit 1 high voltage	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • Accelerator sensor 	DN02-39, 43
Light	P2127	Accelerator sensor circuit 2 low voltage	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • Accelerator sensor 	DN02-41, 43
Light	P2128	Accelerator sensor circuit 2 high voltage	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • Accelerator sensor 	DN02-41, 43
Light	P2228	Atmospheric pressure sensor circuit low input	<ul style="list-style-type: none"> • ECU (ECU connector) 	DN02-62

DIAGNOSTIC TROUBLE CODE (DTC) TABLE				
CHECK ENGINE WARNING LIGHT	DTC NO.	DIAGNOSIS ITEM	INSPECTION ITEM	REFER PAGE
Light	P2229	Atmospheric pressure sensor circuit high input	<ul style="list-style-type: none"> • ECU (ECU connector) 	DN02-62
Light	U0073	CAN malfunction (Engine)	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • VNT turbocharger • EGR 	DN02-69, 71
No light	U0101	Communication error (Transmission)	<ul style="list-style-type: none"> • Wire harness • ATM ECU • ECU (ECU connector) 	DN02-94
Light	U1122	CAN communication malfunction (EGR)	<ul style="list-style-type: none"> • EGR; by HINO-DX • EGR valve • Wire harness 	DN02-69
Light	U1001	CAN communication malfunction (Vehicle)	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) 	DN02-94
Light	U0155	CAN communication malfunction (Meter)	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • Meter 	DN02-94
Light	U1123	CAN communication malfunction (VNT)	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • VNT turbocharger 	DN02-71
Light	P0704	Clutch switch malfunction	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • Clutch switch 	DN02-99
Light	P0341	Engine speed sub sensor pulse abnormal	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • Engine speed sub sensor 	DN02-100
Light	P0336	Engine speed main sensor pulse abnormal	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • Engine speed main sensor 	DN02-102
Light	P0850	Neutral switch malfunction	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • Neutral switch 	DN02-104
No light	P2635	Supply pump SCV sticking	<ul style="list-style-type: none"> • Supply pump: by HINO-DX • ECU (ECU connector) 	DN02-105
Light		Supply pump malfunction (Insufficient flow)		
Light		Supply pump abnormal high pressure record		
No light	P2269	Water in fuel condition	<ul style="list-style-type: none"> • Fuel filter • Wire harness • ECU (ECU connector) 	DN02-106

NOTICE

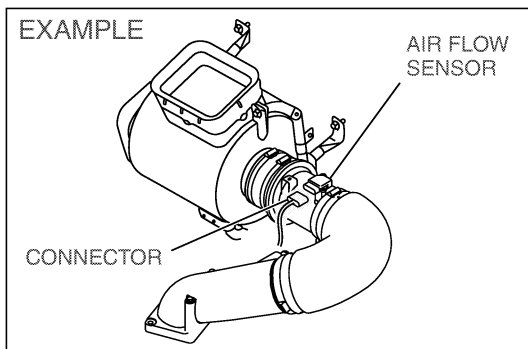
- It is necessary to reset the ECU default value using the diagnosis tool at the time of supply pump service replacement. In addition, the ECU has a function enabling it to learn the performance of the supply pump at the time of ECU service replacement, so ensure sufficient time (several minutes) is available.
- When an injector is newly installed in a vehicle, it is necessary to enter the ID codes in the engine ECU using the Diagnostic tool.

INSPECTION OF AIR FLOW SENSOR (CHECK/ADJUSTMENT OF AIR INTAKE VOLUME BY HINO-DX)

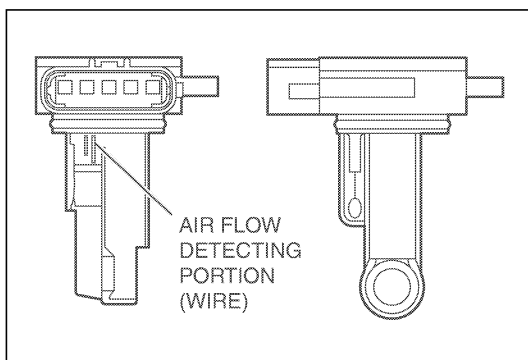
EN1610302F200007

1. INSPECTION OF AIR FLOW SENSOR.

- (1) Clean or replace it with a new air cleaner before checking under this method. Or, prepare a new air flow sensor, separate from the one installed on the vehicle.
- (2) Connect the PC DIAGNOSIS TOOL (HINO-DX).
- (3) Following the air intake volume measurement by HINO-DX, gauge air intake volume under NMR (No Load Maximum Revolution) with "Air flow sensor installed on the vehicle". ...**(A)**
- (4) Confirming a safety around the engine, entirely warmed up, stabilize the revolution by depressing the accelerator pedal from its idling condition (keep depressing the accelerator pedal).
Under the same condition, read out "Engine Revolution per min. (rpm)" and "Air intake volume (g/sec.)" from the PC screen.
- (5) After stopping engine and locking the starter key, remove air flow sensor unit from air cleaner case by removing off air flow sensor connector.
- (6) Make sure to fit the connector after installing "New air flow sensor" prepared.
- (7) Gauge air intake volume as the above (3) with "New air flow sensor". ...**(B)**
- (8) Judgement against deterioration of air flow sensor performance.
 - a. When checked air flow volume with "Air flow sensor installed on the vehicle", which is 10% lower than the one detected by a "New air flow sensor" (Refer to the calculation form listed below), a "New air flow sensor" should remain installed on the vehicle to complete this check due to the fact that the original one installed was deteriorated.
Calculation form: $\{(B)-(A)\} / (B) \times 100 > 10$
 - b. When the both air flow sensors identical flow volume, it means that "Air flow sensor installed on the vehicle" is functioning correctly. So, you can complete the check by swapping air flow sensor for its installation on the vehicle.



SAPH161030200016



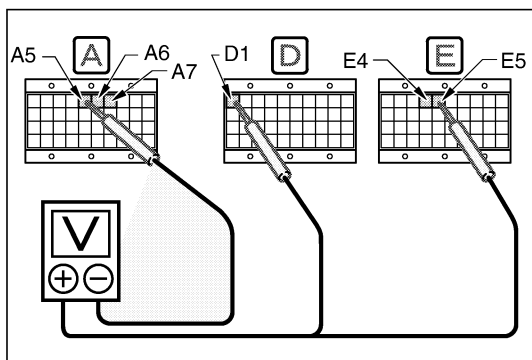
SAPH161030200017

NOTICE

- **Air flow detecting portion (Wire) is accurately machined, which is very fragile. Therefore, work carefully not to make direct touch by hand with the same detection portion.**
- **Don't put on excessive torque thereon when tightening bolt (M4) installing air flow sensor.**
Tightening Torque:
1.68 N·m {17 kgf·cm, 1.24 lbf·ft}
- **In case that the check result is not within specified area under this method, replace the air flow sensor with a new one.**

CHECK THE ECU POWER SUPPLY VOLTAGE

EN1610302F200008

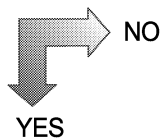


SAPH161030200018

1. CHECK THE VOLTAGE BETWEEN TERMINALS.

- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Set the starter switch to "ON".
- (3) Measure the voltage between VB1 (A5), VB2 (A6), VB3 (A7) and PGD1 (D1), PGD2 (E4), PGD3 (E5) terminals of ECU connector (vehicle harness side).

Standard: More than 10 V

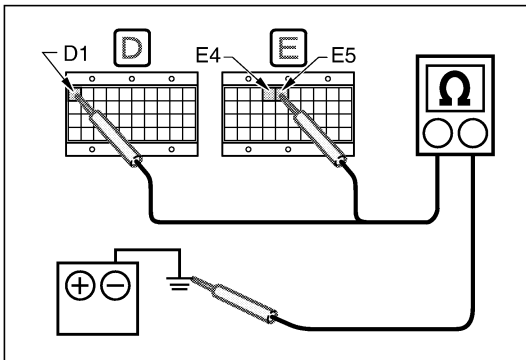


- 0 V: Fuse blows, harness malfunction, ground malfunction.
- Less than 10 V: Battery retrogradation, ground malfunction.

Normal

CHECK THE GROUND

EN1610302F200009

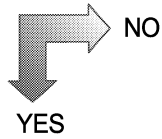


SAPH161030200019

1. CHECK THE RESISTANCE BETWEEN TERMINALS.

- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Disconnect the signal check harness connector on the ECU side.
- (3) Measure the resistance between PGD1 (D1), PGD2 (E4), PGD3 (E5) and battery (-) terminals.

Standard: Less than 1 Ω



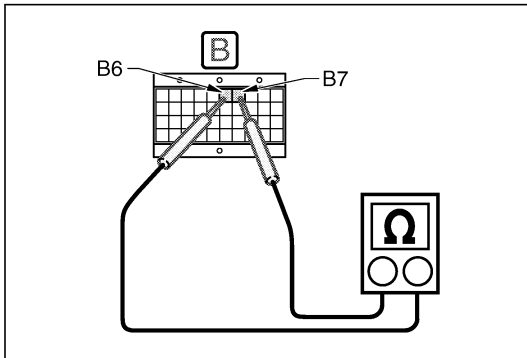
Ground harness disconnection, bad contact of terminal.

Normal

ENGINE SPEED MAIN SENSOR

EN1610302F200010

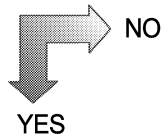
DTC	P0335	Engine speed main sensor circuit malfunction
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1. CHECK THE RESISTANCE BETWEEN TERMINALS.

- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Disconnect the signal check harness connector on the ECU side.
- (3) Measure the resistance between NE1+ (B6) and NE1- (B7) terminals of ECU connector (vehicle harness side).

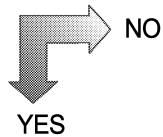
Standard: 108.5 — 142.5 Ω at 20°C {68°F}



Proceed to 3

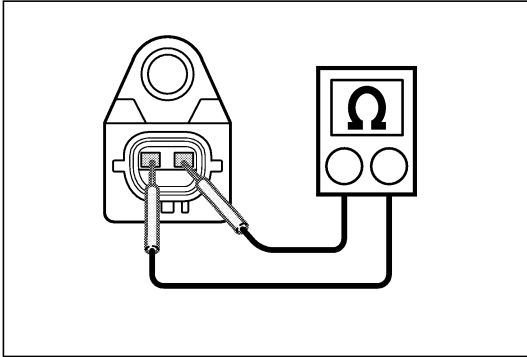
2. RECHECK THE DTC.

- (1) Connect the signal check harness connector on the ECU side.
- (2) Erase the DTC.
- (3) Check the DTC.



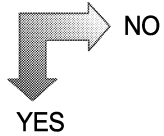
- Bad contact of ECU connectors
- Malfunction of ECU
- Malfunction of harness (Short circuit)

Normal



SAPH161030200021

- 3. CHECK THE ENGINE SPEED MAIN SENSOR.**
- (1) Disconnect the connectors of engine speed main sensor.
 - (2) Measure the resistance between terminals of engine speed main sensor.
- Standard: 108.5 — 142.5 Ω at 20°C {68°F}**



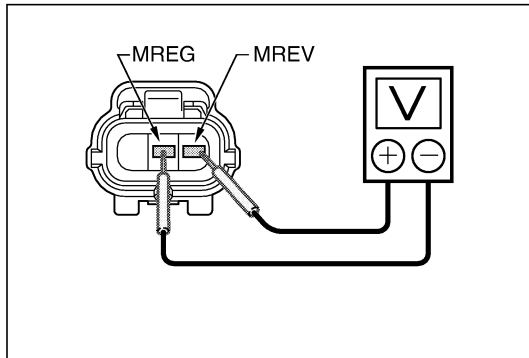
Malfunction of engine speed main sensor

- Harness disconnection
- Bad contact of connectors

ENGINE SPEED SUB SENSOR

EN1610302F200011

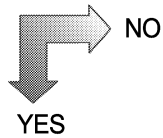
DTC	P0340	Engine speed sub sensor circuit malfunction
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1. CHECK THE VOLTAGE BETWEEN SENSOR TERMINALS.

- (1) Disconnect the connector of the engine speed sub sensor.
- (2) Set the starter to "ON" position.
- (3) Measure the voltage between MREG terminal and MREV terminal of engine speed sub sensor connector. (Vehicle harness side)

Standard: 4.5 — 5.5 V



NO

- Bad contact of ECU connectors
- Malfunction of ECU
- Malfunction of harness (Short circuit)

YES

Malfunction of engine speed sub sensor

ENGINE SPEED MAIN AND SUB SENSOR

EN1610302F200012

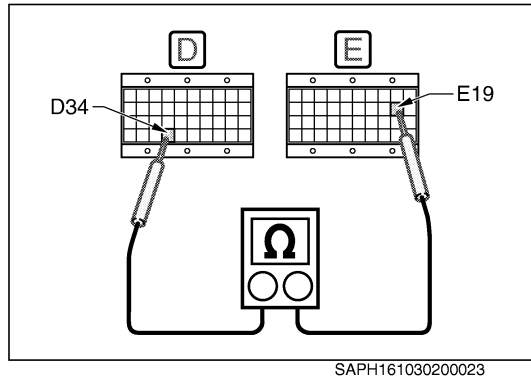
DTC	P0335	Engine speed main sensor circuit malfunction
DTC	P0340	Engine speed sub sensor circuit malfunction

- 1. MAKE SURE TO INSPECT IT IN ACCORDANCE WITH THE CONTENTS OF DTC P0335 AND P0340.**

COOLANT TEMPERATURE SENSOR

EN1610302F200013

DTC	P0117	Coolant temperature sensor circuit low input
DTC	P0118	Coolant temperature sensor circuit high input



1. CHECK THE RESISTANCE BETWEEN TERMINALS.

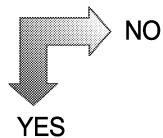
- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Disconnect the signal check harness connector on the ECU side.
- (3) Measure the resistance between THW+ (E19) and AGD2 (D34) terminals of ECU connector (vehicle harness side).

HINT

Measure the resistance under any of the following conditions.

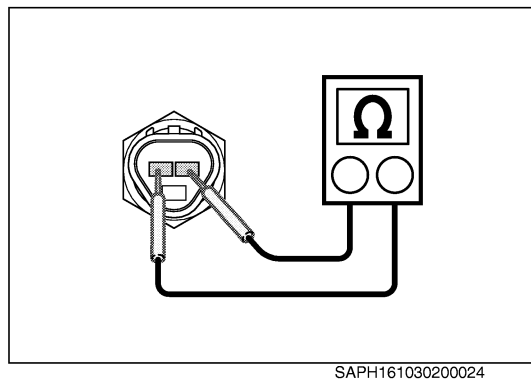
Standard:

- 2.45 k Ω at 20°C {68°F}
- 1.15 k Ω at 40°C {104°F}
- 584 Ω at 60°C {140°F}
- 318 Ω at 80°C {176°F}



Proceed to 2

- Malfunction of ECU
- Malfunction of ECU connectors
- Malfunction of harness (Short circuit)



2. CHECK THE COOLANT TEMPERATURE SENSOR.

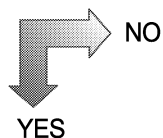
- (1) Disconnect the connector of coolant temperature sensor.
- (2) Measure the resistance of the coolant temperature sensor.

HINT

Measure the resistance under any of the following conditions.

Standard:

- 2.45 k Ω at 20°C {68°F}
- 1.15 k Ω at 40°C {104°F}
- 584 Ω at 60°C {140°F}
- 318 Ω at 80°C {176°F}



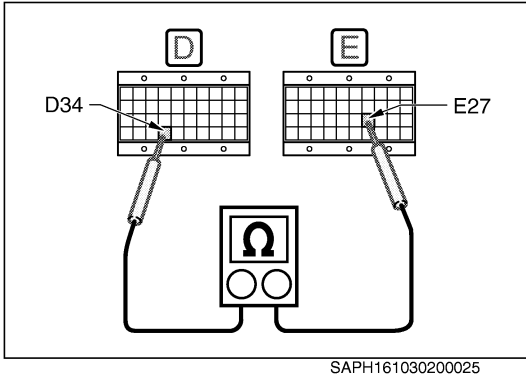
Malfunction of coolant temperature sensor

- Harness disconnection
- Malfunction of connectors
- Bad contact of connectors

FUEL TEMPERATURE SENSOR

EN1610302F200014

DTC	P0182	Fuel temperature sensor circuit low input
DTC	P0183	Fuel temperature sensor circuit high input



1. CHECK THE RESISTANCE BETWEEN TERMINALS.

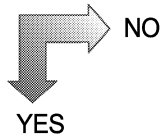
- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Disconnect the signal check harness connector on the ECU side.
- (3) Measure the resistance between THF+ (E27) and AGD2 (D34) terminals of ECU connector (vehicle harness side).

HINT

Measure the resistance under any of the following conditions.

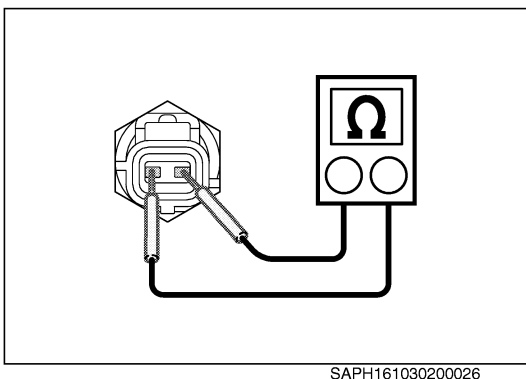
Standard:

- 2.45 kΩ at 20°C {68°F}
- 1.15 kΩ at 40°C {104°F}
- 584 Ω at 60°C {140°F}
- 318 Ω at 80°C {176°F}



Proceed to 2

- Malfunction of ECU
- Malfunction of ECU connectors
- Malfunction of harness (Short circuit)



2. CHECK THE FUEL TEMPERATURE SENSOR.

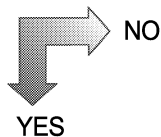
- (1) Disconnect the connector of fuel temperature sensor.
- (2) Measure the resistance of the fuel temperature sensor.

HINT

Measure the resistance under any of the following conditions.

Standard:

- 2.45 kΩ at 20°C {68°F}
- 1.15 kΩ at 40°C {104°F}
- 584 Ω at 60°C {140°F}
- 318 Ω at 80°C {176°F}



Malfunction of fuel temperature sensor

- Harness disconnection
- Malfunction of connectors
- Bad contact of connectors

STARTER SWITCH

EN1610302F200015

DTC	P0617	Starter signal malfunction
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1. CHECK THE VOLTAGE BETWEEN TERMINALS.

⚠ WARNING

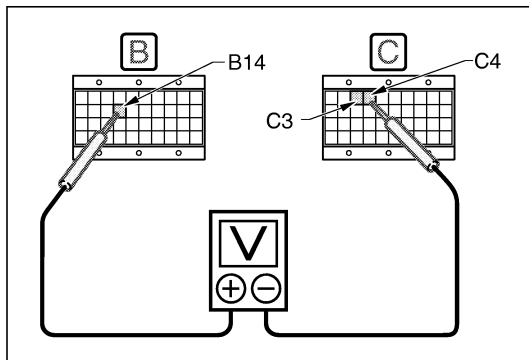
Make sure that transmission is in neutral position.

- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Disconnect the signal check harness connector on the ECU side.
- (3) Measure the voltage between ST (B14) and CGD (C3 and C4) terminals of ECU connectors (vehicle harness side).

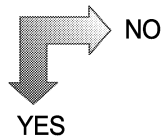
Standard:

Starter switch "LOCK": 0 V

Starter switch "START": 12 V



SAPH161030200027



NO

Malfunction of harness

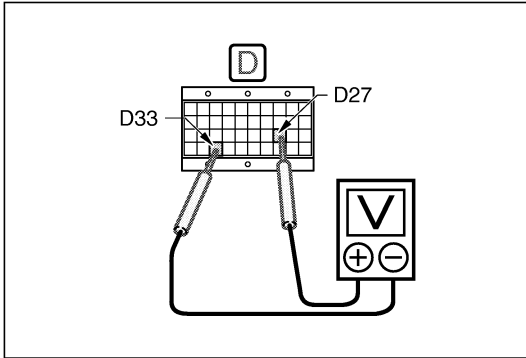
YES

- Malfunction of ECU
- Malfunction of ECU connectors
- Bad contact of ECU connectors

BOOST PRESSURE SENSOR

EN1610302F200016

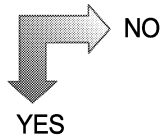
DTC	P0108	Boost pressure sensor circuit high input
DTC	P0237	Boost pressure sensor circuit low input



1. CHECK THE VOLTAGE BETWEEN TERMINALS.

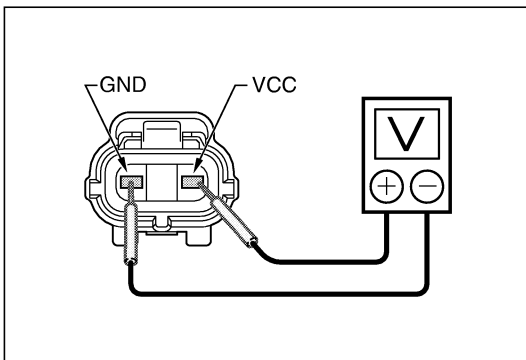
- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Set the starter switch to "ON" (ECU connectors remain connected and the engine is stopped).
- (3) Measure the voltage between PIM (D27) and AGD1 (D33) terminals of ECU connector (vehicle harness side).

Standard: 0.2 — 4.8 V



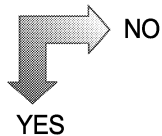
Proceed to (4)

- Malfunction of ECU
- Malfunction of ECU connectors
- Malfunction of harness

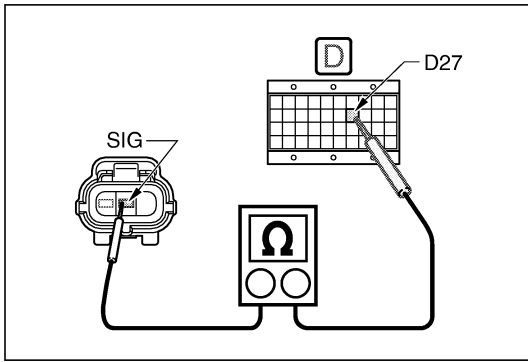


- (4) Set the starter switch to "LOCK" (ECU connectors remain connected).
- (5) Tilt the hood and disconnect the connector of boost pressure sensor.
- (6) Set the starter switch to "ON". (Engine is stopped.)
- (7) Measure the voltage between terminals of boost pressure sensor (vehicle harness side).

Standard: 4.5 — 5.5 V



Proceed to 2 - (3)

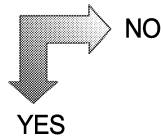


SAPH161030200030

2. CHECK THE RESISTANCE BETWEEN TERMINALS.

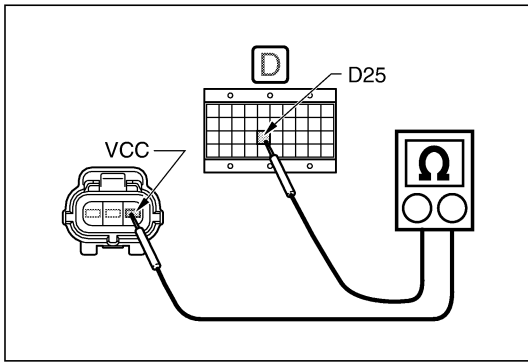
- (1) Set the starter switch to "LOCK" and disconnect the connectors of ECU.
- (2) Measure the resistance between the terminal PIM (D27) of the signal check harness and SIG terminal of boost pressure sensor connector (vehicle harness side).

Standard: Less than 2 Ω



NO
Malfunction of harness

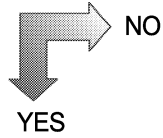
YES
Bad contact of harness connector



SAPH161030200031

- (3) Set the starter switch to "LOCK" and disconnect the connectors of ECU.
- (4) Measure the resistance between AVC1 (D25) terminals of ECU connector (vehicle harness side) and VCC terminal of boost pressure sensor (vehicle harness side).

Standard: Less than 2 Ω



NO
Malfunction of harness

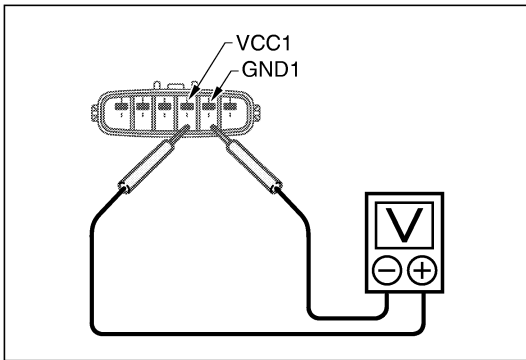
YES

- Malfunction of ECU
- Bad contact of harness connector
- Malfunction of boost pressure sensor

ACCELERATOR SENSOR 1

EN1610302F200017

DTC	P2120	Accelerator sensor 1 and 2 malfunction
DTC	P2122	Accelerator sensor circuit 1 low voltage
DTC	P2123	Accelerator sensor circuit 1 high voltage

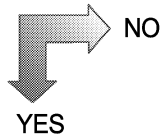


1. CHECK THE VOLTAGE BETWEEN TERMINALS.

- (1) Disconnect the connector of the accelerator sensor (ECU connectors remain connected).
- (2) Set the starter switch to "ON" (The engine is stopped).
- (3) Measure the voltage between VCC1 and GND1 terminals of accelerator sensor (vehicle harness side).

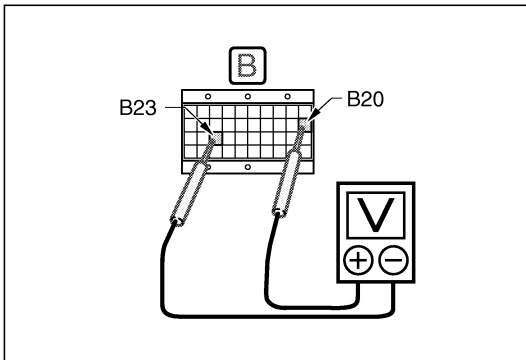
Standard: 4.5 — 5.5 V

(After measurement, turn the starter switch to "LOCK" position.)



Proceed to (4)

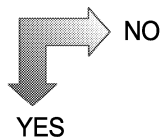
Proceed to (7)



- (4) ECU connectors remain connected and the connector of the accelerator sensor remain disconnected.
- (5) Set the starter switch to "ON" (The engine is stopped).
- (6) Measure the voltage between AVC4 (B23) and AGD4 (B20) terminals of ECU connector (vehicle harness side).

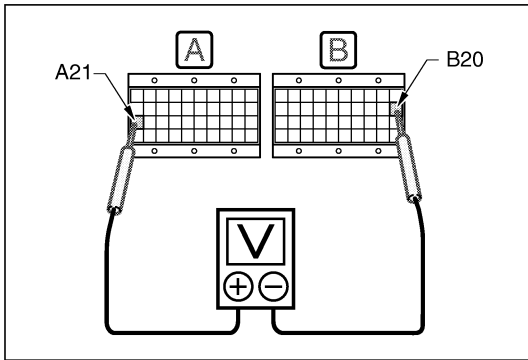
Standard: 4.5 — 5.5 V

(After measurement, turn the starter switch to "LOCK" position.)



- Malfunction of ECU
- Malfunction of ECU connectors

Malfunction of harness



SAPH161030200034

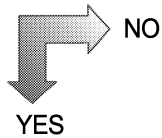
- (7) Connect the connector of the accelerator sensor.
- (8) Set the starter switch to "ON" (The engine is stopped).
- (9) Measure the voltage between ASC1 (A21) and AGD4 (B20) terminals of ECU connector (vehicle harness side).

Standard:

0.7 — 1.0 V: Release the accelerator pedal.

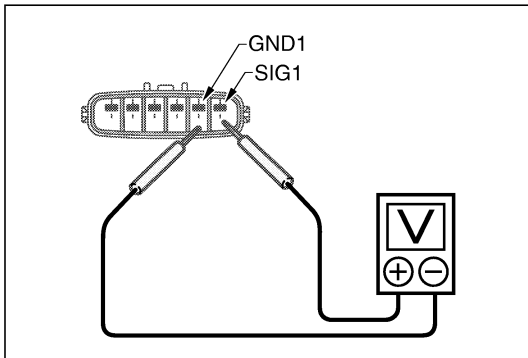
3.0 — 3.5 V: Depress the accelerator pedal fully.

(After measurement, turn the starter switch to "LOCK" position.)



Proceed to (10)

- Malfunction of ECU
- Malfunction of ECU connectors



SAPH161030200035

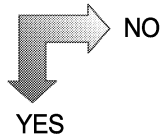
- (10) Connector of accelerator sensor remain connected.
- (11) Set the starter switch to "ON" (The engine is stopped).
- (12) Measure the voltage between SIG1 and GND1 terminals of accelerator sensor (vehicle harness side).

Standard:

0.7 — 1.0 V: Release the accelerator pedal.

3.0 — 3.5 V: Depress the accelerator pedal fully.

(After measurement, turn the starter switch to "LOCK" position.)



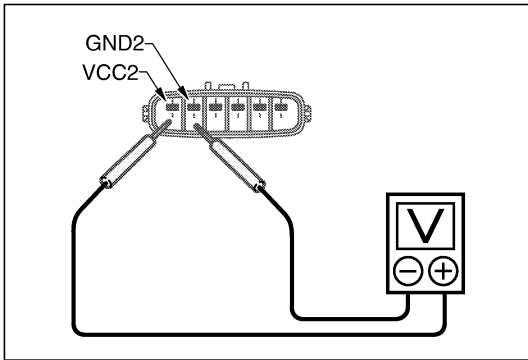
Malfunction of accelerator sensor

Harness disconnection or short circuit

ACCELERATOR SENSOR 2

EN1610302F200018

DTC	P2120	Accelerator sensor 1 and 2 malfunction
DTC	P2127	Accelerator sensor circuit 2 low voltage
DTC	P2128	Accelerator sensor circuit 2 high voltage

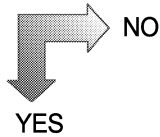


1. CHECK THE VOLTAGE BETWEEN TERMINALS.

- (1) Disconnect the connector of the accelerator sensor (ECU connectors remain connected).
- (2) Set the starter switch to "ON" (The engine is stopped).
- (3) Measure the voltage between the terminals VCC2 and GND2 terminals of accelerator sensor (vehicle harness side).

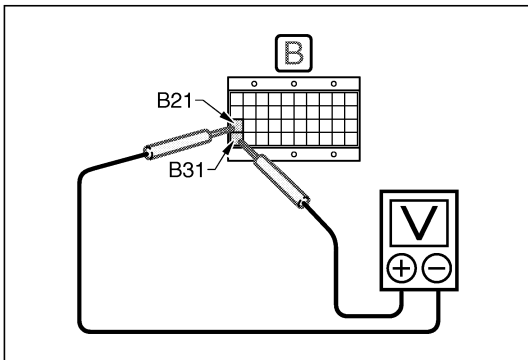
Standard: 4.5 — 5.5 V

(After measurement, turn the starter switch to "LOCK" position.)



Proceed to (4)

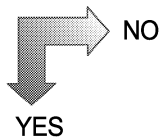
Proceed to (7)



- (4) ECU connectors remain connected and the connector of the accelerator sensor remain disconnected.
- (5) Set the starter switch to "ON" (The engine is stopped).
- (6) Measure the voltage between AVC5 (B31) and AGD5 (B21) terminals of ECU connector (vehicle harness side).

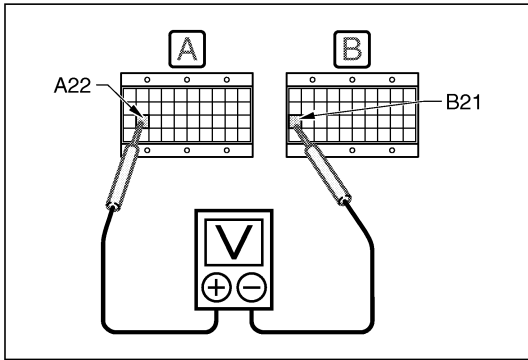
Standard: 4.5 — 5.5 V

(After measurement, turn the starter switch to "LOCK" position.)



- Malfunction of ECU
- Malfunction of ECU connectors

Malfunction of harness



SAPH161030200038

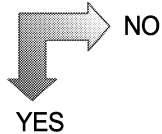
- (7) Connect the connector of the accelerator sensor.
- (8) Set the starter switch to "ON" (The engine is stopped).
- (9) Measure the voltage between ASC2 (A22) and AGD5 (B21) terminals of ECU connector (vehicle harness side).

Standard:

1.5 — 1.8 V: Release the accelerator pedal.

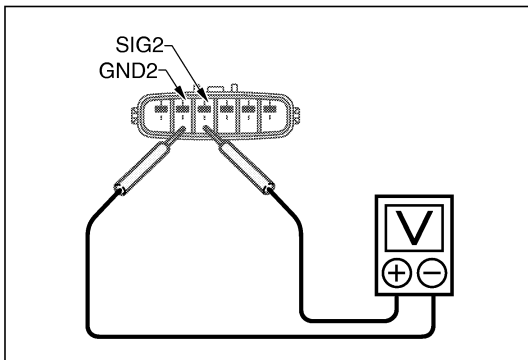
3.8 — 4.3 V: Depress the accelerator pedal fully.

(After measurement, turn the starter switch to "LOCK" position.)



NO
Proceed to (10)

- Malfunction of ECU
- Malfunction of ECU connectors



SAPH161030200039

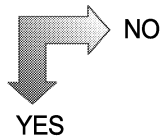
- (10) Connect the connector of the accelerator sensor.
- (11) Set the starter switch to "ON" (The engine is stopped).
- (12) Measure the voltage between SIG2 and GND2 terminals of accelerator sensor (vehicle harness side).

Standard:

1.5 — 1.8 V: Release the accelerator pedal.

3.8 — 4.3 V: Depress the accelerator pedal fully.

(After measurement, turn the starter switch to "LOCK" position.)



NO
Malfunction of accelerator sensor

Harness disconnection or short circuit

ACCELERATOR SENSOR 1 & 2

EN1610302F200019

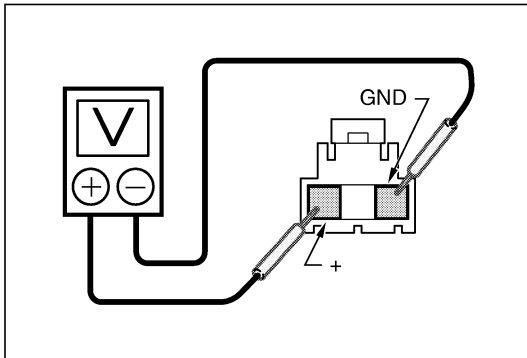
DTC	P2120	Accelerator sensor 1 and 2 malfunction
DTC	P2122	Accelerator sensor circuit 1 low voltage
DTC	P2123	Accelerator sensor circuit 1 high voltage
DTC	P2127	Accelerator sensor circuit 2 low voltage
DTC	P2128	Accelerator sensor circuit 2 high voltage

- 1. MAKE SURE TO INSPECT IT IN ACCORDANCE WITH THE CONTENTS OF DTC P2120, P2122, P2123, P2127 AND P2128.**

THROTTLE CONTROL

EN1610302F200020

DTC	P1143	Throttle control malfunction
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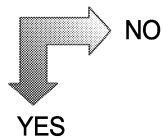
SAPH161030200040

1. CHECK THE VOLTAGE BETWEEN TERMINALS.

- (1) Disconnect the connector of throttle control (ECU connectors remain connected).
- (2) Set the starter switch to "ON" (The engine is stopped).
- (3) Measure the voltage between + and GND terminals of throttle control connectors (vehicle harness side).

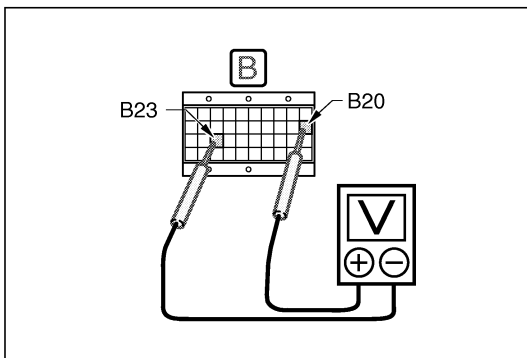
Standard: 4.5 — 5.5 V

(After measurement, turn the starter switch to "LOCK" position.)



Proceed to (4)

Proceed to (6)

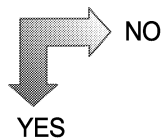


SAPH161030200041

- (4) Set the starter switch to "ON" (The engine is stopped).
- (5) Measure the voltage between AVC4 (B23) and AGD4 (B20) terminals of ECU connector (vehicle harness side).

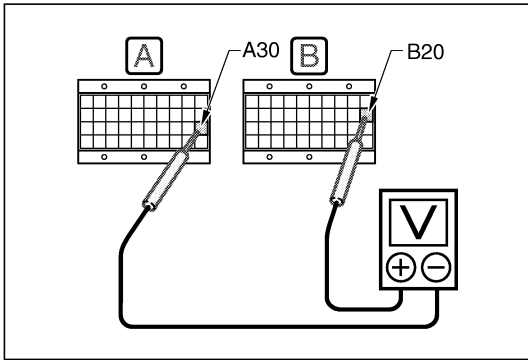
Standard: 4.5 — 5.5 V

(After measurement, turn the starter switch to "LOCK" position.)



- Malfunction of ECU
- Malfunction of ECU connectors

Harness disconnection



SAPH161030200042

- (6) Connect the connector of throttle control.
- (7) Set the starter switch to "ON" (The engine is stopped).
- (8) Measure the voltage between IVS (A30) and AGD4 (B20) terminals of ECU connector (vehicle harness side).

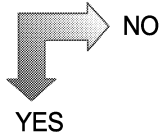
Standard:

APPROX. 0 V: Turn control knob to left fully

APPROX. 0.7 V: Turn control knob to left.

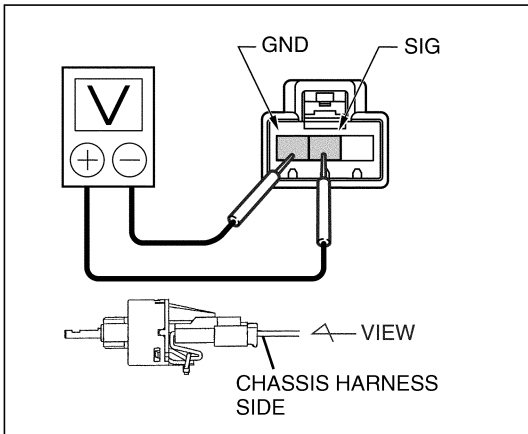
APPROX. 4.3 V: Turn control knob to right fully

(After measurement, turn the starter switch to "LOCK" position.)



NO
Proceed to (9)

- Malfunction of ECU
- Malfunction of ECU connectors



SAPH161030200043

- (9) Set the starter switch to "ON" (The engine is stopped).
- (10) Measure the voltage between SIG and GND terminals of throttle control connectors (chassis harness side).

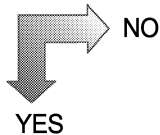
Standard:

APPROX. 0 V: Turn idle control knob to left fully

APPROX. 0.7 V: Turn idle control knob to left.

APPROX. 4.3 V: Turn idle control knob to right fully

(After measurement, turn the starter switch to "LOCK" position.)



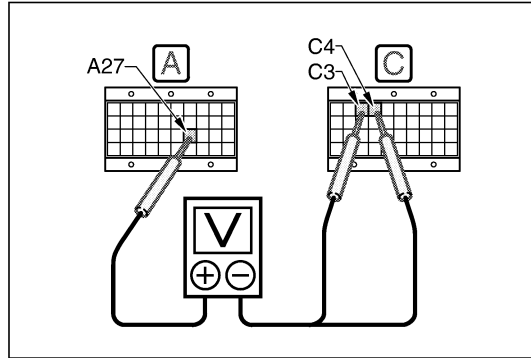
NO
Malfunction of throttle control

- Harness disconnection or short circuit

VEHICLE SPEED SENSOR

EN1610302F200021

DTC	P0500	Vehicle speed sensor circuit low input
DTC	P0501	Vehicle speed sensor circuit high input



1. CHECK THE VOLTAGE BETWEEN TERMINALS.

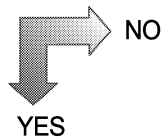
- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Start the engine.
- (3) Prepare the voltage measurement between VS (A27) and CGD (C3 and C4) terminals of ECU connector (vehicle harness side).
- (4) Measure the voltage while the vehicle starts to run at the speed of 10 km/h {6.2 miles/h}.

⚠ WARNING

Start the vehicle with caution to surroundings.

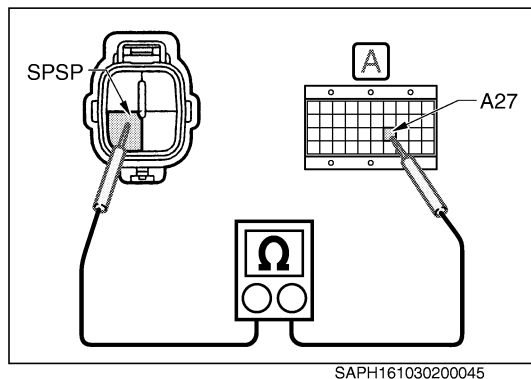
Standard: Pulse wave-shape by 12 V — 0 V

- (5) Stop the vehicle.



Proceed to 2

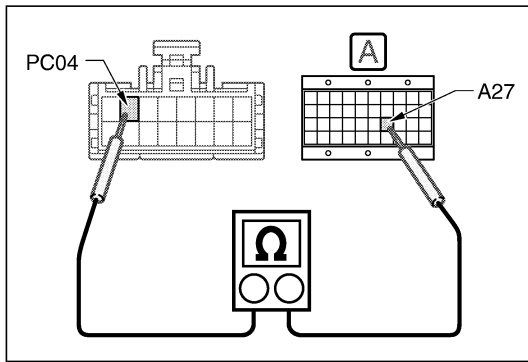
- Malfunction of ECU
- Bad contact of harness connector



2. CHECK THE CONTINUITY BETWEEN TERMINALS.

- (1) Set the starter switch to "LOCK" and disconnect the connectors of ECU.
- (2) For vehicle equipped with AISIN automatic transmission.
 - a. Disconnect the connectors of vehicle speed sensor.
 - b. Measure the resistance between VS (A27) terminal of ECU connector (vehicle harness side) and SPSP terminal of vehicle speed sensor connectors (vehicle harness side).

Standard: Less than 1 Ω

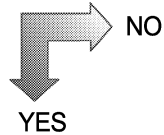


SAPH161030200046

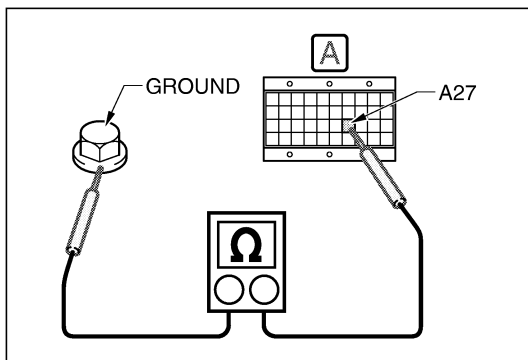
- (3) For vehicle equipped with EATON transmission and ALLISON automatic transmission.

- a. Disconnect the connectors of pulse converter.
- b. Measure the resistance between VS (A27) terminal of ECU connector (vehicle harness side) and PC04 terminal of connectors (vehicle harness side).

Standard: Less than 1 Ω



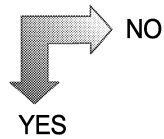
Harness disconnection of vehicle speed sensor circuit



SAPH161030200047

- (4) Set the starter switch to "LOCK".
- (5) ECU connectors remain connected.
- (6) Measure the resistance between VS (A27) terminal of ECU connector (vehicle harness side) and ground.

Standard: ∞ Ω



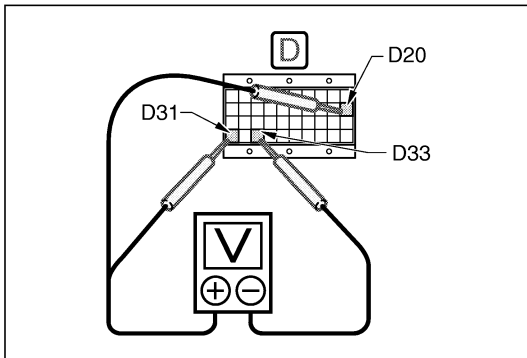
Short circuit due to vehicle speed sensor circuit connection to ground

Malfunction of vehicle speed sensor (The vehicle speed sensor should be solely checked. Erase the DTC and if displayed again the same code on the screen after testing, ECU should be replaced with a new one.)

COMMON RAIL PRESSURE SENSOR

EN1610302F200022

DTC	P0191	Common rail pressure sensor malfunction
DTC	P0192	Common rail pressure sensor circuit low input
DTC	P0193	Common rail pressure sensor circuit high input



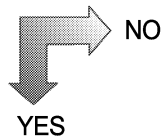
SAPH161030200048

1. CHECK THE VOLTAGE BETWEEN TERMINALS.

- (1) Set the starter switch to "ON" (ECU connectors remain connected and the engine is stopped).
- (2) Measure the voltage between PCR1 (D20), PCR2 (D31) and AGD 1 (D33) of ECU connector (ECU side).

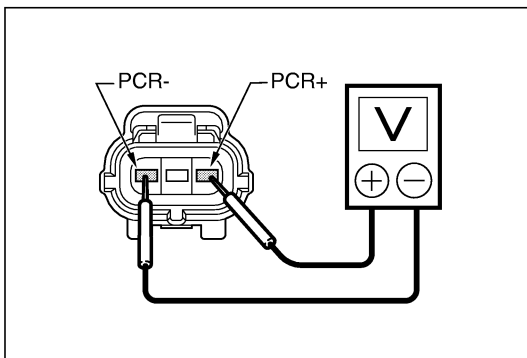
Standard: 0.7 — 4.7 V

(After measurement, turn the starter switch to "LOCK" position.)



Proceed to 2

- Malfunction of ECU
- Bad contact of harness connector

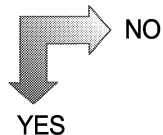


SAPH161030200049

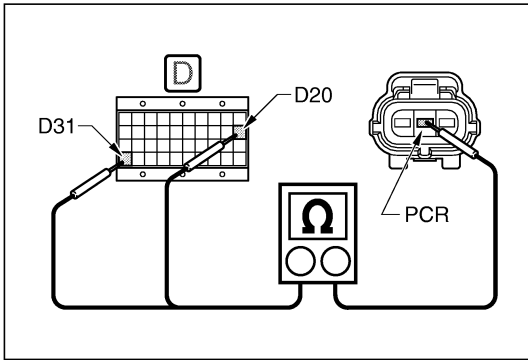
2. CHECK THE VOLTAGE BETWEEN TERMINALS.

- (1) Tilt the hood and disconnect the connector of common rail pressure sensor.
- (2) Measure the voltage between terminals of common rail pressure sensor (vehicle harness side).

Standard: 4.5 — 5.5V



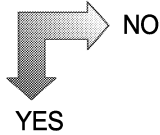
Proceed to (6)



SAPH161030200050

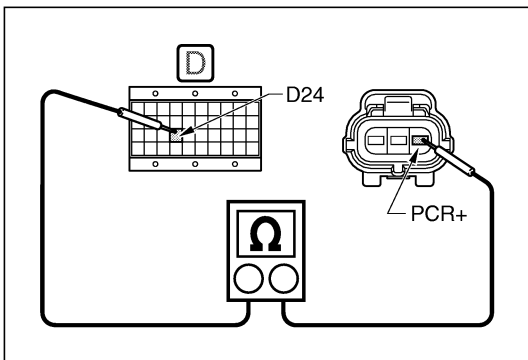
- (3) Turn the starter switch to "LOCK" position.
- (4) Disconnect the ECU connectors.
- (5) Measure the resistance between PCR (D20 and D31) terminals of ECU connector (vehicle harness side) and PCR terminal of common rail pressure sensor (vehicle harness side).

Standard: Less than 2 Ω



NO
Malfunction of harness

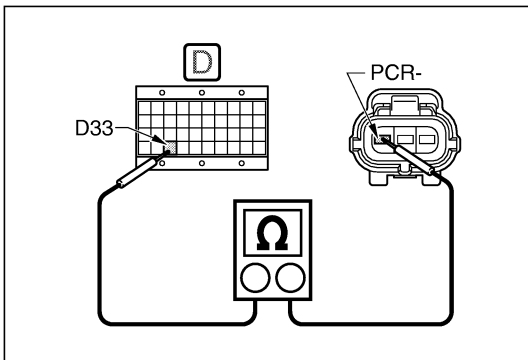
YES
Bad contact of harness connector



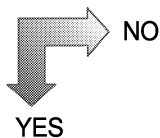
SAPH161030200051

- (6) Turn the starter switch to "LOCK" position.
- (7) Disconnect the ECU connectors.
- (8) Measure the resistance between AVC2 (D24) terminals and PCR+ terminal of common rail pressure sensor (Vehicle harness side), AGD1 (D33) terminal and PCR- terminal of common rail pressure sensor (Vehicle harness side).

Standard: Less than 2 Ω



SAPH161030200052



NO
Malfunction of harness

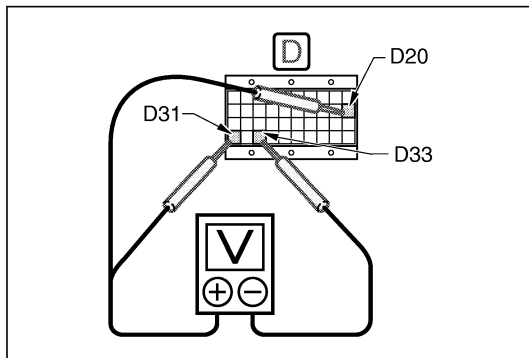
YES

- Malfunction of ECU
- Bad contact of harness connector

COMMON RAIL PRESSURE CONTROL SYSTEM

EN1610302F200023

DTC	P0088	Excessive common rail pressure
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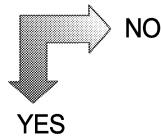
SAPH161030200053

1. CHECK THE VOLTAGE BETWEEN TERMINALS.

- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Set the starter switch to "ON" (ECU connectors remain connected).
- (3) Measure the voltage between PCR1 (D20), PCR2 (D31) and AGD1 (D33) terminals of ECU connector (vehicle harness side).

Standard: 3.6 — 4.7 V

(After measurement, turn the starter switch to "LOCK" position.)



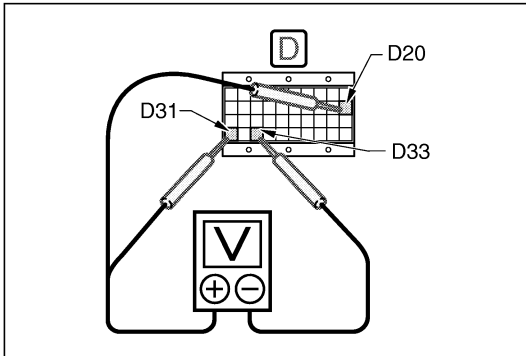
- Malfunction of ECU
 - Bad contact of harness connector
- (If the same code is again output after having erased the DTC memory, replace ECU. If there is no DTC, temporarily defective harness or connector would be possible. So, check the harness and connector.)

Malfunction of common rail pressure sensor

COMMON RAIL PRESSURE AND SUPPLY PUMP

EN1610302F200024

DTC No.	P0087	Lack of forced feed in supply pump
DTC No.	P0088	Excessive common rail pressure, supply pump excess forced feed

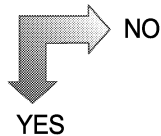


SAPH161030200054

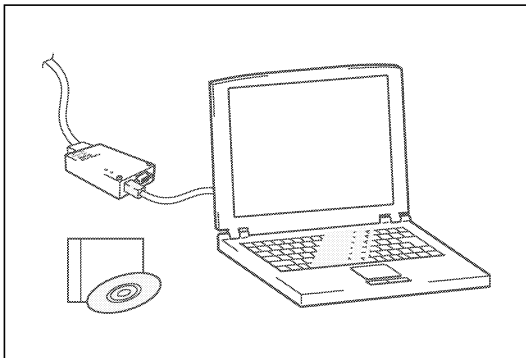
1. CHECK THE VOLTAGE BETWEEN TERMINALS.

- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Start the engine.
- (3) Perform warm-up until the coolant temperature gauge moves.
- (4) At engine speed idling. The target pressure (PFIN) = APPROX. 30 MPa {306 kgf/cm², 4,351 lbf/in.²} (APPROX. 1.5V)
- (5) Measure the voltage between PCR1 (D20), PCR2 (D31) and AGD1 (D33) terminals.

Standard: Less than 1.56V



Malfunction of common rail pressure sensor.



SAPH161030200055

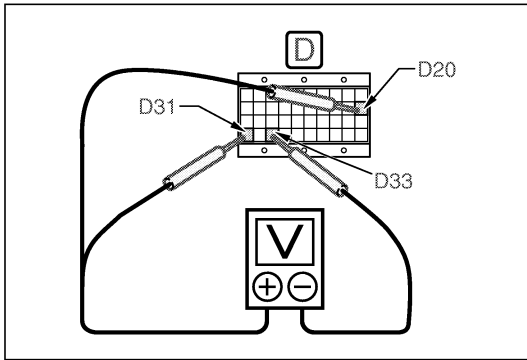
2. CHECK THE DTC.

- (1) Confirm that no other DTC is displayed. If another DTC is displayed repair that trouble and confirm that the DTC No. P0088, P0087 is displayed again. Especially in case of display DTC in regard to engine speed sensor (main and sub) system, perform repair so that these DTC are not displayed.
- (2) Confirm the injection timing of the supply pump. If installation has not been done at top dead center 0°, install correctly.
- (3) If the above check shows no abnormalities, erase the DTC and start the engine. If the same DTC is displayed again, malfunction of supply pump, malfunction of common rail pressure sensor system, and malfunction ECU can be assumed.

COMMON RAIL PRESSURE FIXED OUTPUT

EN1610302F200025

DTC	P0191	Common rail pressure sensor malfunction
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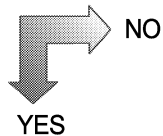
SAPH161030200056

1. CHECK THE VOLTAGE BETWEEN TERMINALS.

- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Set the starter switch to "ON" (ECU connectors remain connected).
- (3) Measure the voltage between PCR1 (D20), PCR2 (D31) and AGD1 (D33) terminals of ECU connector (ECU side).

Standard: 0.9 — 1.1 V

(After measurement, turn the starter switch to "LOCK" position.)



NO

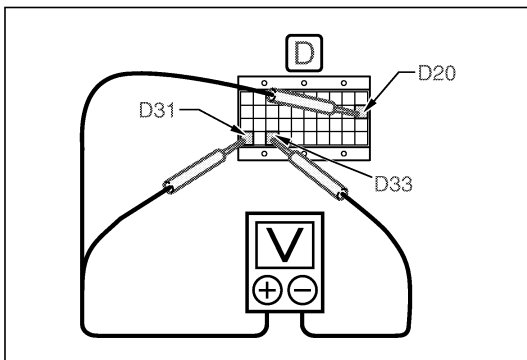
- Malfunction of ECU
- Bad contact of harness connector

- (4) Start the engine.
- (5) While measuring the voltage between PCR1 (D20), PCR2 (D31) and AGD1 (D33) terminals of ECU connector, repeat opening and closing full throttle.

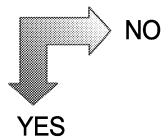
Standard: The voltage changes. (1.0 to 3.2 V)

NOTICE

As DTC P0191 is displayed only when DTC P0192, P0193 are not detected, P0191 may be displayed after you have fixed P0192, P0193 that were previously displayed.



SAPH161030200057



NO

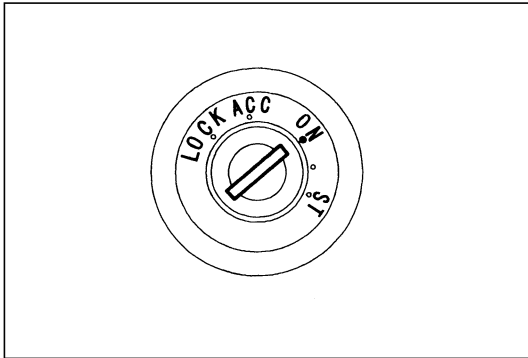
- Malfunction of common rail pressure sensor
- Bad contact of harness connector

- Malfunction of ECU
- Bad contact of harness connector

CYLINDER CONTRIBUTION/BALANCE

EN1610302F200026

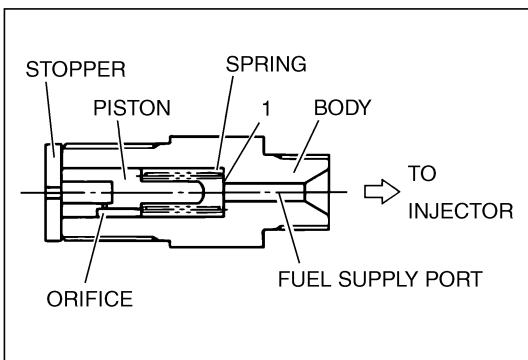
DTC	P0263	Cylinder 1 contribution/balance fault
DTC	P0266	Cylinder 2 contribution/balance fault
DTC	P0269	Cylinder 3 contribution/balance fault
DTC	P0272	Cylinder 4 contribution/balance fault



SAPH161030200058

1. CHECK THE FLOW DAMPER.

- (1) Turn the starter switch to "LOCK" position. Stop the engine.
- (2) Wait for about 30 seconds and then start the engine.
- (3) Perform warm-up until the coolant temperature becomes 60°C {140°F} or higher. And erase the DTC.

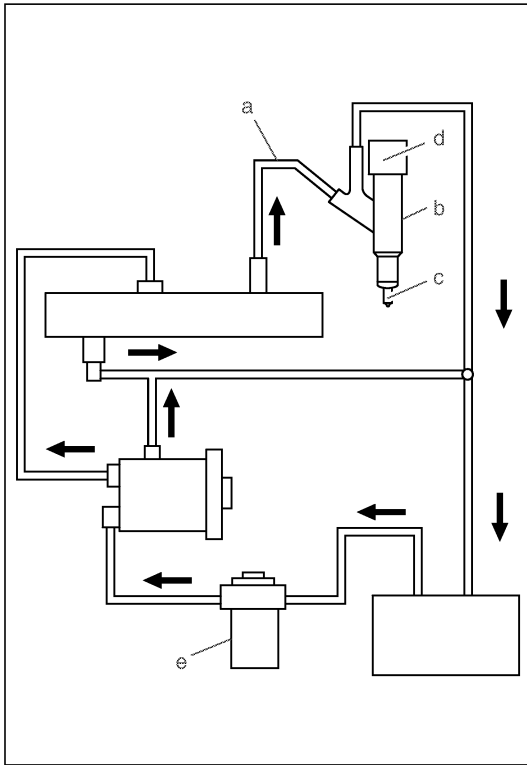


SAPH161030200059

- (4) If the same DTC is displayed again after erasing it, inspect the flow damper of displayed cylinder.

Inspection:

- a. When removing the flow damper from the common rail, check that the piston is not sticking in the body. If the piston sticks, replace the flow damper.
- b. Inspect the contact surface 1 between piston and fuel supply port. If there is wear and damage, replace the flow damper assembly.
- c. Inspect clogging on the piston orifice. Clean or replace the flow damper assembly.



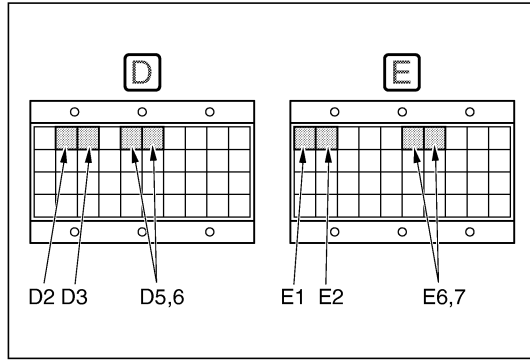
2. RECHECK THE DTC.

- (1) Check that the other DTC is not displayed.
 If the other DTC is displayed, repair the trouble.
 If the same DTC is displayed again, it is possibly from the following problems.
 - a. Excessive fuel flow will cause fuel leakage from injection pipe (between flow damper and injector) by bending, cracking and pipe connection looseness.
 → Check leakage.
 - b. Excessive or shortage fuel flow will cause an increase in the internal leakage of injector.
 → Check injector leakage using nozzle tester.
 - c. Excessive fuel flow will cause injector seat deflection.
 → Check injector nozzle seat using nozzle tester.
 - d. Excessive or shortage fuel flow will cause injector operation malfunction.
 → Check by replacing the injector.
 - e. Shortage fuel flow will cause clogging of the fuel supply system.
 → Check fuel filter.
- (2) The above problems can be diagnosed using the “Data Monitor” menu to determine the cylinder contribution quantity and “Activation Test” menu to stop the injector.

INJECTOR SOLENOID VALVE SYSTEM BREAKING

EN1610302F200027

DTC	P0201	Injector circuit malfunction -cylinder 1
DTC	P0202	Injector circuit malfunction -cylinder 2
DTC	P0203	Injector circuit malfunction -cylinder 3
DTC	P0204	Injector circuit malfunction -cylinder 4



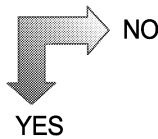
SAPH161030200061

1. CHECK THE RESISTANCE BETWEEN TERMINALS.

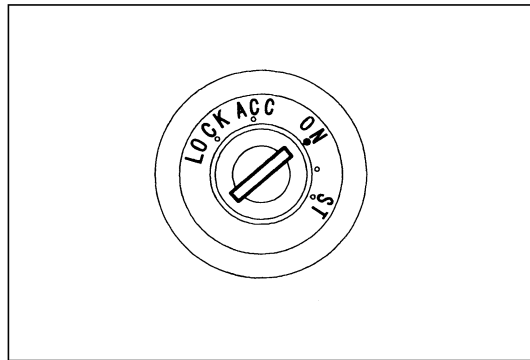
- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Disconnect the signal check harness connector on the ECU side.
- (3) Measure the resistance between the terminals of ECU connector (vehicle harness side).

DTC NO.	Failure position (Breaking position)	Terminals to measure the resistance
P0201	#1 Injector	INJ1 (D2) ↔ IJ1+ (D5) I1+S (D6)
P0202	#2 Injector	INJ2 (E2) ↔ IJ2+ (E6) I2+S (E7)
P0203	#3 Injector	INJ3 (E1) ↔ IJ2+ (E6) I2+S (E7)
P0204	#4 Injector	INJ4 (D3) ↔ IJ1+ (D5) I1+S (D6)

Standard: Less than 2 Ω

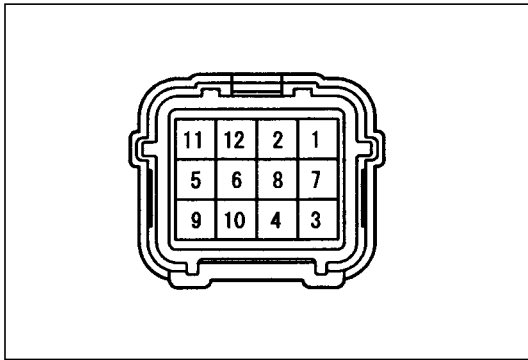


Proceed to (7)



SAPH161030200062

- (4) This is ECU failure or defective contact of the connector. Restore all connectors and start the engine.
- (5) Erase the DTC.
- (6) Check the current failure. If the same DTC is displayed, replace ECU. If there is no DTC, then the connector contact would have been defective. As long as no DTC is displayed, there is no problem.
- (7) Tilt the hood. Disconnect the injector connector that is located at the front side of the cam housing.

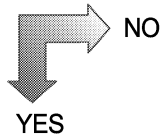


SAPH161030200063

(8) Measure the resistance between the pins of the injector connector (male) at the cam housing side.

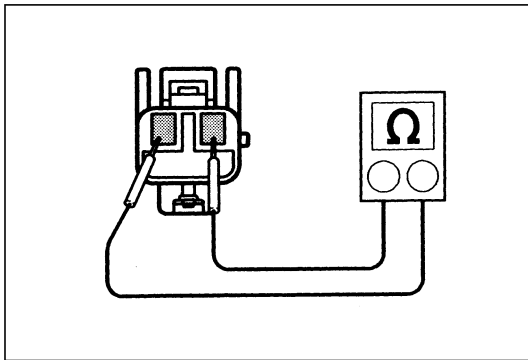
DTC NO.	Terminals to measure the resistance
P0201	2 ↔ 7
P0202	6 ↔ 12
P0203	5 ↔ 10
P0204	4 ↔ 8

Standard: Less than 2 Ω



Proceed to (9)

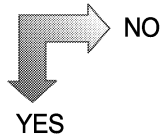
Harness disconnections (vehicle harness side)
(Check the harness between ECU and the injector connector.)



SAPH161030200064

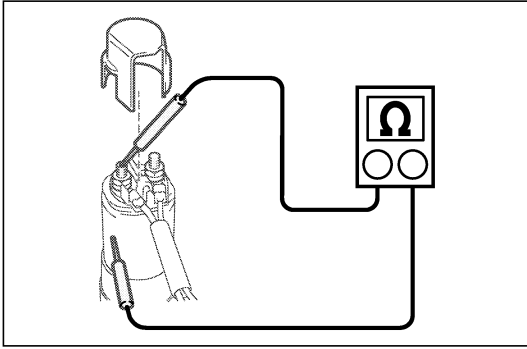
(9) Dismount the head cover.
(10) Disconnect the injector connector (injector side) of the cylinder displayed by DTC. Measure the resistance between the pins.

Standard: 0.35 — 0.55 Ω at 20°C {68°F}



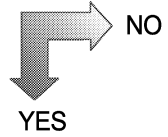
Proceed to (11)

Bad contact of the connector or the harness in the head cover
(Check the connector or the harness in the head cover.)



SAPH161030200065

- (11) Remove the injector terminal cap of the cylinder display by DTC.
Measure the insulation resistance between terminal and injector body.
Standard: More than 1000 M Ω



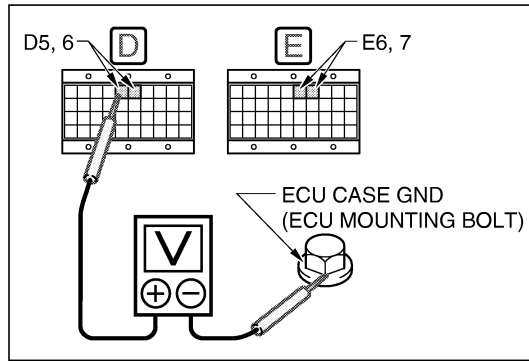
Injector coil disconnection (Replace the injector assembly.)

Injection harness disconnections (Replace the injector harness.)

INJECTOR SOLENOID VALVE DRIVING SYSTEM +B SHORT- CIRCUIT

EN1610302F200028

DTC	P1212	Injector common 1 short to BATT
DTC	P1215	Injector common 2 short to BATT



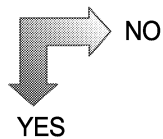
SAPH161030200066

1. CHECK THE VOLTAGE BETWEEN TERMINALS.

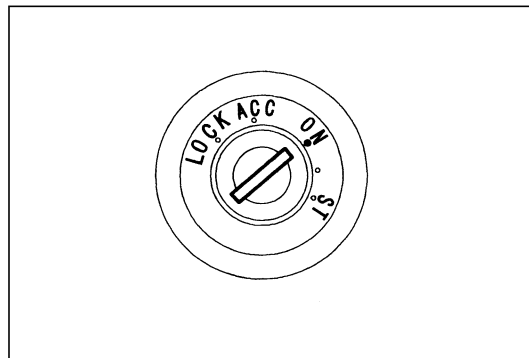
- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Turn "ON" the starter switch.
- (3) Measure the voltage between the terminals of ECU connector (vehicle harness side) and ECU case GND.

DTC NO.	Voltage measurement	
	+ side	- side
P1212	IJ1+ (D5) I1+S (D6)	ECU case GND
P1215	IJ2+ (E6) I2+S (E7)	ECU case GND

Standard: Less than 8 V

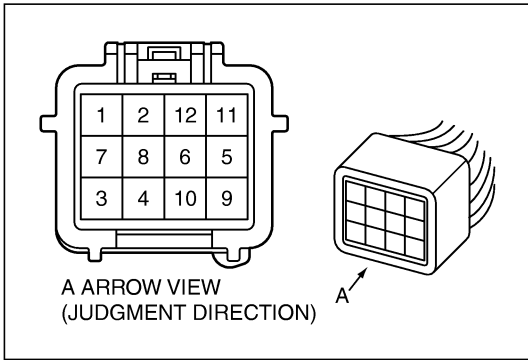


Proceed to (7)



SAPH161030200067

- (4) Turn the starter switch to "LOCK" position. Reconnect all the connectors.
- (5) Start the engine and erase the DTC.
- (6) If the same DTC is displayed, replace ECU. If no DTC is displayed, a temporary failure would have occurred.
- (7) Turn the starter switch to "LOCK" position.
- (8) Tilt the hood. Disconnect the injector connector that is located on the front side of the cam housing. Turn the starter switch to "ON" position.



SAPH161030200068

(9) Measure the voltage between the pins of injector connector (vehicle harness side) and ECU case GND.

NOTICE

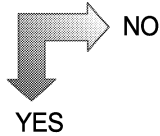
Measure the voltage of this connector from the connector terminals (female).

NOTICE

Do not damage the connector terminals.

DTC NO.	Failure position (breaking position)	Voltage measurement	
		+ side	- side
P1212	No.1 injector	7	ECU case GND
	No.4 injector	8	
P1215	No.2 injector	6	ECU case GND
	No.3 injector	5	

Standard: Less than 8 V



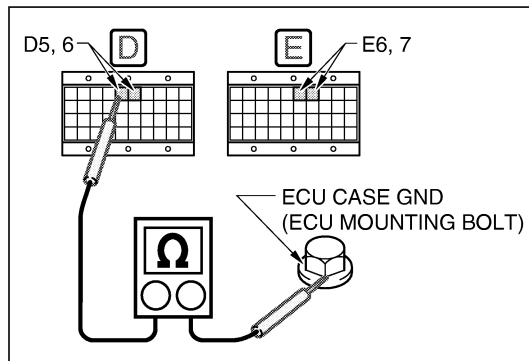
Malfunction of harness
(It is defective the harness which voltage value is out of the standard.)

Check the harness in the head cover.
(A short-circuit would occur between the harness in the head cover and the power source line.)

INJECTOR SOLENOID VALVE DRIVING SYSTEM GND SHORT-CIRCUIT

EN1610302F200029

DTC	P1211	Injector common 1 short to GND
DTC	P1214	Injector common 2 short to GND



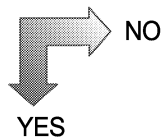
SAPH161030200069

1. CHECK THE RESISTANCE BETWEEN TERMINALS.

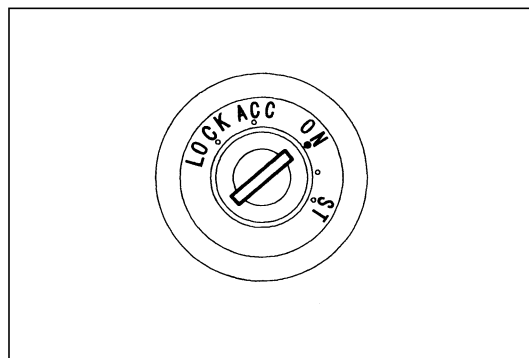
- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Disconnect the signal check harness connector on the ECU side.
- (3) Measure the resistance between the terminals of ECU connector (vehicle harness side).

DTC NO.	Resistance measurement	
	+ side	- side
P1211	IJ1+ (D5) I1+S (D6)	ECU case GND
P1214	IJ2+ (E6) I2+S (E7)	ECU case GND

Standard: $\infty \Omega$

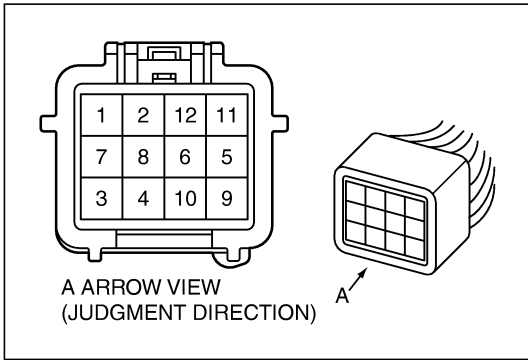


Proceed to (7)



SAPH161030200070

- (4) Turn the starter switch to "LOCK" position. Reconnect all the connectors.
- (5) Start the engine and erase the DTC.
- (6) If the same DTC is displayed, replace ECU. If no DTC is displayed, a temporary failure would have occurred.
- (7) Turn the starter switch to "LOCK" position (with all connectors of ECU disconnected).
- (8) Tilt the hood. Disconnect the injector connector that is located on the front side of the cam housing.



(9) Measure the resistance between the pins of injector connector (vehicle harness side) and ECU case GND.

NOTICE

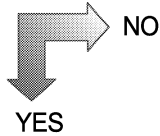
Measure the voltage of this connector from the connector terminals (female).

NOTICE

Do not damage the connector terminals.

DTC NO.	Failure position (breaking position)	Resistance measurement	
		+ side	- side
P1211	No.1 injector	2, 7	ECU case GND
	No.4 injector	4, 8	
P1214	No.2 injector	6, 12	ECU case GND
	No.3 injector	5, 10	

Standard: ∞ Ω



Malfunction of harness
(It is defective the harness which resistance value is out of the standard.)

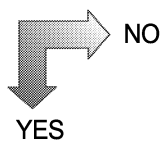
Check the harness in the head cover.
(A short-circuit would occur between the harness in the head cover and the GND line.)

ECU

EN1610302F200030

DTC	P0200	ECU charge circuit high input
DTC	P0605	Flash ROM error
DTC	P0606	CPU malfunction (Hard detection)
DTC	P0607	Monitoring IC malfunction in CPU
DTC	P0611	ECU charge circuit malfunction
DTC	P2228	Atmospheric pressure sensor circuit low input.
DTC	P2229	Atmospheric pressure sensor circuit high input.

1. After the starter switch is positioned on the "LOCK" once, it should be turned to "ON" position again.
2. After erasing the DTC, check that the same code is displayed again.



Malfunction of ECU.

Normal
(Temporary malfunction because of radio interference noise)

ENGINE OVERRUN

EN1610302F200031

DTC	P0219	Engine overrun
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1. The DTC will be displayed, once detected over 4,000 r/min. in the Engine revolution. Also, the fuel injection will be suspended during the DTC to be detected and the fuel injection will be resumed when Engine revolution goes down less than 3,800 r/min.

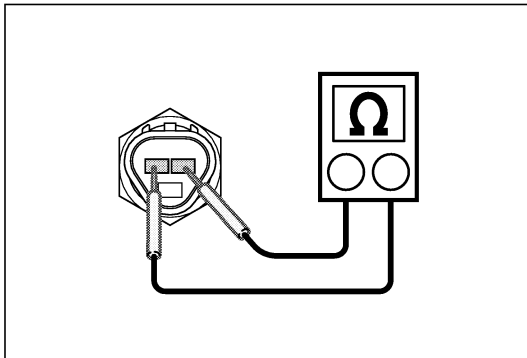
NOTICE

The DTC aim is not for detecting the Engine over-run under abnormal operation of the system, but for storing in memory the high revolution of the Engine. (For detection of wrong shifting, etc.) Also, there is a case in which "overrun" will be detected by misunderstanding the Engine revolution, with a noise to be generated by harness malfunction and its modification.

ENGINE OVERHEAT

EN1610302F200032

DTC	P0217	Engine overheat
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SAPH161030200024

1. CHECK THE COOLANT TEMPERATURE SENSOR.

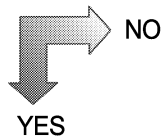
- (1) Set the starter switch to "LOCK".
- (2) Disconnect the connector of coolant temperature sensor.
- (3) Measure the resistance between terminals.

HINT

Measure the resistance under any of the following conditions.

Standard:

- 2.45 k Ω at 20°C {68°F}
- 1.15 k Ω at 40°C {104°F}
- 584 Ω at 60°C {140°F}
- 318 Ω at 80°C {176°F}



Malfunction of coolant temperature sensor

Malfunction of engine cooling system

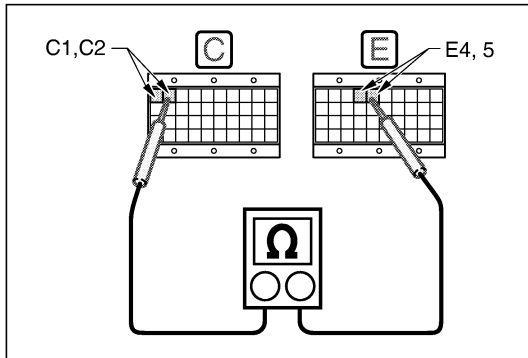
HINT

This code will be displayed when the coolant temperature sensor operates normally and coolant temperature ascends over 115°C {239°F}. Also, while the DTC is being detected, Max. volume of fuel injection will be limited and will return back to normal control volume when it descends less than 80°C {176°F}.

AIR INTAKE PREHEATER RELAY

EN1610302F200033

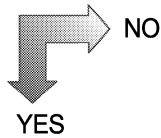
DTC	P0540	Preheat circuit malfunction
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1. CHECK THE RESISTANCE BETWEEN TERMINALS.

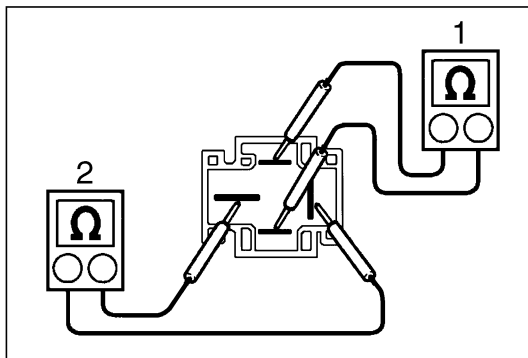
- (1) Set the starter switch to "LOCK" position and connect the signal check harness.
- (2) Disconnect the connector of the signal check harness (ECU side).
- (3) Measure the resistance between GRY (C1,C2) and PGD (E4, E5) terminals.

Standard: 64 — 96 Ω



Proceed to 2.

- Malfunction of ECU
- Malfunction of ECU connectors



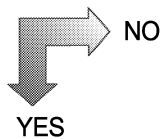
2. CHECK THE RESISTANCE OF PREHEATER RELAY.

- (1) Remove the preheater relay.
- (2) Measure the resistance between terminals of preheater relay.

Standard:

1. 64 — 96 Ω

2. $\infty \Omega$



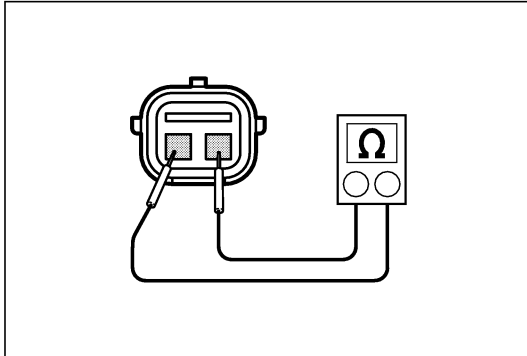
Malfunction of preheater relay

- Malfunction of harness
- Malfunction of connectors

SUCTION CONTROL VALVE (SCV)

EN1610302F200034

DTC	P0628	SCV malfunction
DTC	P0629	SCV out put short to BATT



SAPH161030200073

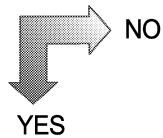
1. CHECK THE RESISTANCE OF SCV.

- (1) Set the starter switch to "LOCK" position.
- (2) Disconnect the harness of the SCV of the supply pump.
- (3) Measure the resistance between the terminals of SCV connector (SCV side).

Standard: 1.6–2.6 Ω at 20°C {68°F}

- (4) Measure the resistance of insulation between terminals and SCV body.

Standard: more than 100 M Ω at 20°C {68°F}



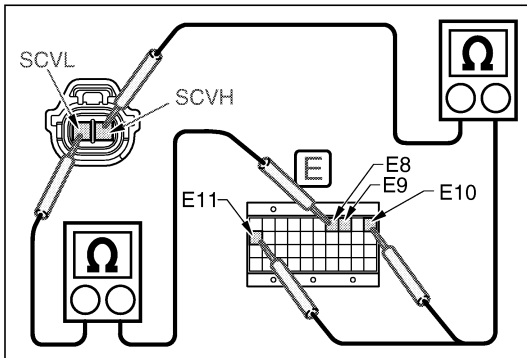
Malfunction of SCV (Replace the supply pump)

2. CHECK THE CONTINUITY BETWEEN TERMINALS.

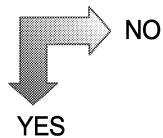
- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Disconnect the signal check harness connector on the ECU side.
- (3) Measure the resistance between SCVH (E10, E11) terminal of ECU connector (vehicle harness side) and SCVH terminal of SCV connectors (vehicle harness side).

In the same way, measure the resistance between SCVL (E8, E9) terminal of ECU connector and SCVL terminal of SCV connector.

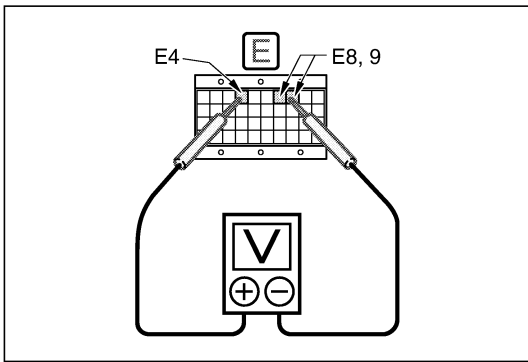
Standard: Less than 1 Ω



SAPH161030200074



- Harness disconnection
- Bad contact of harness connector



SAPH161030200075

3. CHECK THE VOLTAGE BETWEEN TERMINALS.

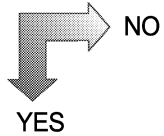
- (1) Connectors of signal check harness (ECU side).
- (2) Set the starter switch to "ON" (The engine is stopped).
- (3) Measure the voltage between PGD2 (E4) terminal and SCVL (E8, E9) terminals of ECU connectors (vehicle harness side)

Standard: Pulse wave-shape by 12 V — 0 V

(After measurement, turn the starter switch to "LOCK" position.)

NOTICE

Measure the voltage within 40 seconds after starter switch "ON".



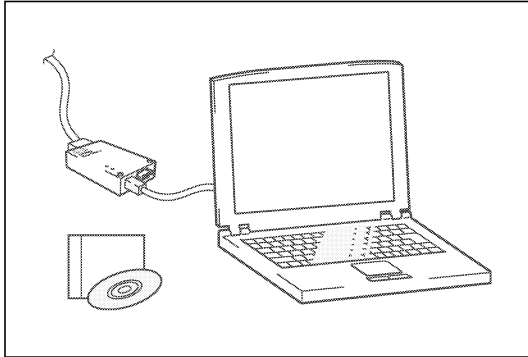
Malfunction of ECU connectors

Malfunction of ECU

EGR (CHECK BY HINO-DX)

EN1610302F200035

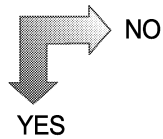
DTC No.	P0400	Abnormal flow amount of EGR
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SAPH161030200076

1. **CHECK THE EGR USING THE PC DIAGNOSIS TOOL (HINO-DX).**
 - (1) Confirm that no other DTC is displayed. If another DTC is displayed, repair that trouble and confirm that the DTC No. P0101 is displayed again. Especially in case of display DTC in regard to engine speed sensor (main and sub) system, perform repair so that these DTC are not displayed.
 - (2) Carry out "**INSPECTION OF AIR FLOW SENSOR (CHECK/ADJUSTMENT OF AIR INTAKE VOLUME BY HINO-DX)**", refer to **DN02-27**.
 - (3) Connect the PC DIAGNOSIS TOOL (HINO-DX).
 - (4) Set the starter switch to "ON".
 - (5) Confirm the EGR actuator malfunction (DTC No. P1458, P1459, U1122) is not displayed.
 - (6) Check the actual opening value is followed up by input value by activating the EGR valve.

Standard: Difference value is less than 5%



Malfunction of ECU.

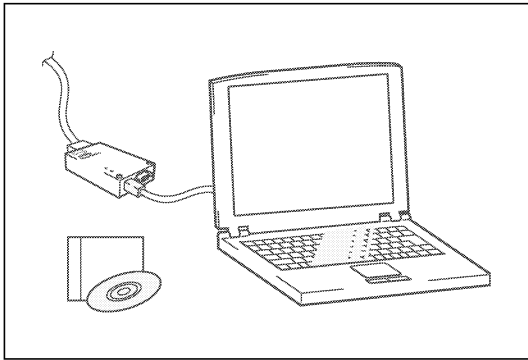
Normal.

- (7) If the above check shows no abnormalities, erase the DTC and start the engine. If the same DTC is displayed again, malfunction of air flow sensor can be assumed. Carry out the unit check of air flow sensor.

EGR ACTUATOR 1, 2

EN1610302F200036

DTC	P1458	EGR actuator malfunction
DTC	P1459	EGR actuator malfunction
DTC	U1122	CAN communication malfunction (EGR)
DTC	U0073	CAN malfunction

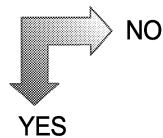


SAPH161030200077

1. CHECK THE EGR USING THE PC DIAGNOSIS TOOL (HINO-DX).

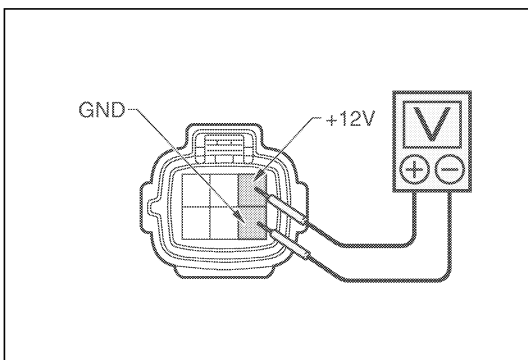
- (1) Connect the PC DIAGNOSIS TOOL (HINO-DX).
- (2) Set the starter switch to "ON".
- (3) Confirm the EGR actuator malfunction (DTC No. P1458, 1459) and CAN communication malfunction (EGR) (DTC No. U1122) is not displayed.
- (4) Check the actual opening value is followed up by input value by activating the EGR valve.

Standard: Difference value is less than 5%



Proceed to 2

Normal

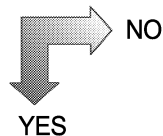


SAPH161030200078

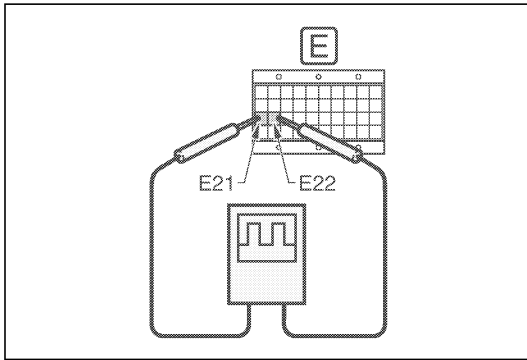
2. CHECK THE VOLTAGE BETWEEN TERMINALS

- (1) Set the starter switch to "LOCK" and disconnect the connector of EGR controller.
- (2) Set the starter switch to "ON".
- (3) Measure the voltage between EGRV (+12V) and EGRG (GND) terminals of EGR controller connector.

Standard: More than 10 V



Malfunction of harness

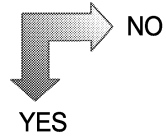


SAPH161030200079

3. CHECK THE VOLTAGE WAVE-SHAPE OF CAN COMMUNICATION TERMINALS.

- (1) Set the starter switch to "LOCK", connect the signal check harness and connector of EGR controller.
- (2) Set the starter switch to "ON".
- (3) Measure the voltage wave-shape between CANH (E21) and CANL (E22) terminals of the signal check harness.

Standard: 0 ↔ 5 V pulse wave



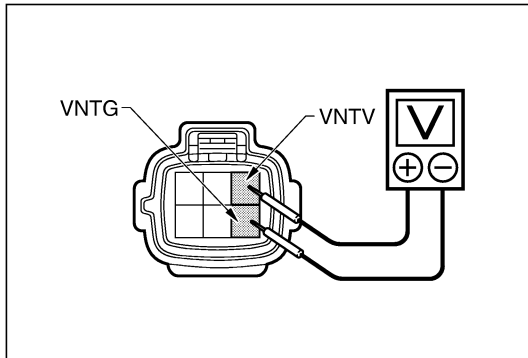
GDN or +12V short circuit

Malfunction of EGR controller

VNT (VARIABLE NOZZLE TURBINE) TURBOCHARGER CONTROLLER

EN1610302F200037

DTC	P0045	VNT turbocharger controller malfunction
DTC	U0073	CAN malfunction (Engine)
DTC	U1123	CAN communication malfunction (VNT)



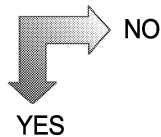
SAPH161030200080

1. CHECK THE VOLTAGE BETWEEN SENSOR TERMINALS.

- (1) Set the starter switch to "LOCK" position.
- (2) Disconnect the connectors of VNT controller.
- (3) Set the starter switch to "ON" position.
- (4) Measure the voltage between VNTV and VNTG terminals of VNTG connector (vehicle harness side).

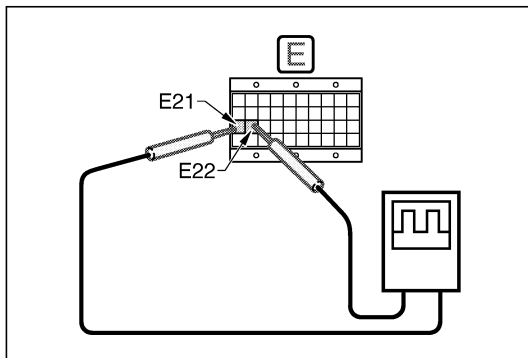
Standard: More than 10 V

(After measurement, turn the starter switch to "LOCK" position.)



NO
Malfunction of harness

YES
Proceed to 2

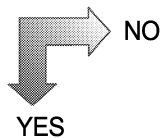


SAPH161030200081

2. CHECK THE VOLTAGE BETWEEN VNT ACTUATOR TERMINALS.

- (1) Set the starter switch to "LOCK" position.
- (2) Connect the connector of VNT controller.
- (3) Set the starter switch to "ON" position and measure the voltage between CANL (E22) and CANH (E21) terminals of signal check harness.

Standard: 0 ↔ 5 V pulse wave



NO
Malfunction of VNT turbocharger controller

- YES
- Malfunction of ECU
 - Malfunction of ECU connector

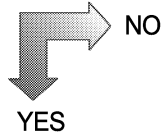
TURBOCHARGER OVER BOOST

EN1610302F200038

DTC	P0234	Turbocharger over boost
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1. CHECK THE VNT TURBOCHARGER CONTROLLER.

- (1) Set the starter switch to "ON" position.
- (2) Confirm the VNT turbocharger controller malfunction (DTC P0045, U0073, U1123) is not displayed.
- (3) Select the "VNT check" in the "Check function" menu.
- (4) Check the actual opening value is followed up by input value by activating the VNT turbocharger controller.

Standard: Difference value is less than 5%

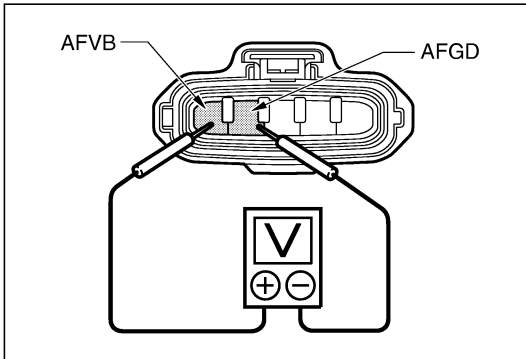
Malfunction of VNT turbocharger controller

Carry out diagnosis of the boost pressure sensor P0108 and P0237.

AIR FLOW SENSOR

EN1610302F200039

DTC	P0102	Air flow sensor circuit low input
DTC	P0103	Air flow sensor circuit high input

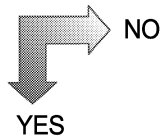


SAPH161030200082

1. CHECK THE VOLTAGE BETWEEN SENSOR TERMINALS.

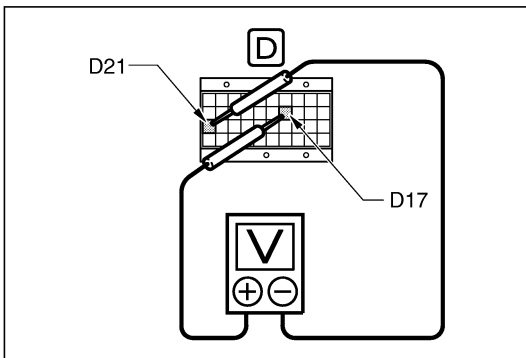
- (1) Disconnect the connector of the air flow sensor.
- (2) Set the starter to "ON" position.
- (3) Measure the voltage between AFVB and AFGD terminals of air flow sensor connector. (Vehicle harness side)

Standard: More than 10 V



Malfunction of harness

Proceed to 2

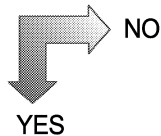


SAPH161030200083

2. CHECK THE VOLTAGE BETWEEN TERMINALS.

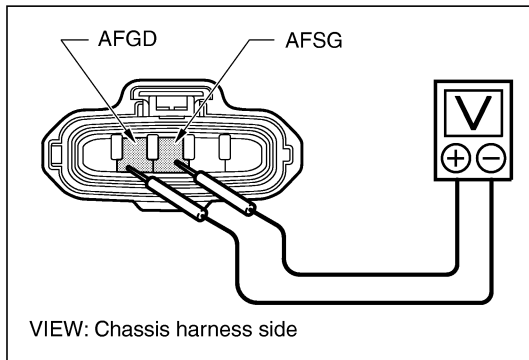
- (1) Set the starter switch "LOCK" position.
- (2) Connect the connector of air flow sensor.
- (3) Set the starter switch to "ON" position and measure the voltage between AFSG (D21) and AGD6 (D17) terminals of signal check harness.

Standard: 0.2 — 4.8 V



Proceed to 3

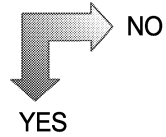
- Malfunction of ECU
- Malfunction of ECU connector



SAPH161030200084

3. CHECK THE VOLTAGE BETWEEN SENSOR TERMINALS

- (1) Air flow sensor connector remains connected.
- (2) Measure the voltage between AFGD and AFSG terminals of air flow sensor connector (vehicle harness side).

Standard: 0.2 — 4.8 V**(After measurement, turn the starter switch to "LOCK" position.)**

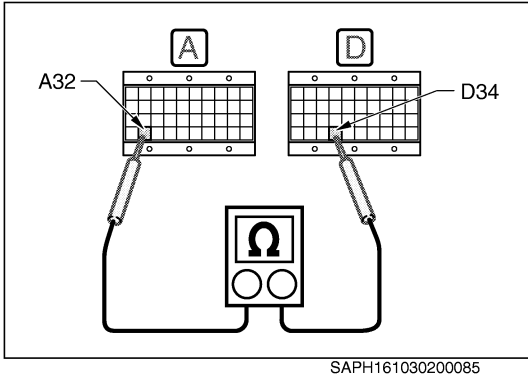
Malfunction of air flow sensor

Malfunction of harness

INTAKE AIR TEMPERATURE SENSOR

EN1610302F200040

DTC	P0112	Intake air temperature sensor circuit low input
DTC	P0113	Intake air temperature sensor circuit high input



1. CHECK THE RESISTANCE BETWEEN TERMINALS.

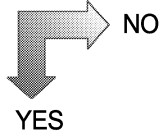
- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Disconnect the signal check harness connector on the ECU side.
- (3) Measure the resistance between AFT+ (A32) and AGD2 (D34) terminals of ECU connector (vehicle harness side).

HINT

Measure the resistance under any of the following conditions.

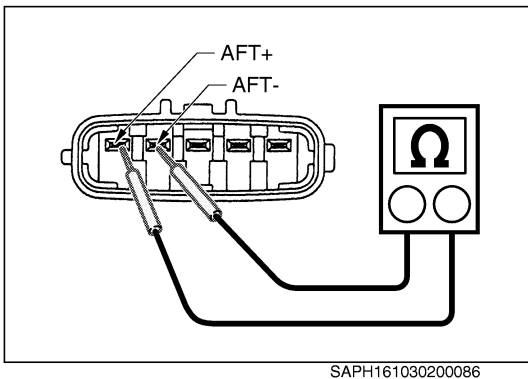
Standard:

- 13.6 — 18.4 kΩ at -20°C {-4°F}
- 2.21 — 2.69 kΩ at 20°C {68°F}
- 0.49 — 0.67 kΩ at 60°C {140°F}



Proceed to 2

- Malfunction of ECU
- Malfunction of ECU connectors
- Malfunction of harness (Short circuit)



2. CHECK THE INTAKE AIR TEMPERATURE SENSOR.

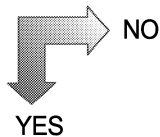
- (1) Disconnect the connector of intake air temperature (air flow) sensor.
- (2) Measure the resistance between AFT- and AFT+ terminals of the intake air temperature (air flow) sensor.

HINT

Measure the resistance under any of the following conditions.

Standard:

- 13.6 — 18.4 kΩ at -20°C {-4°F}
- 2.21 — 2.69 kΩ at 20°C {68°F}
- 0.49 — 0.67 kΩ at 60°C {140°F}



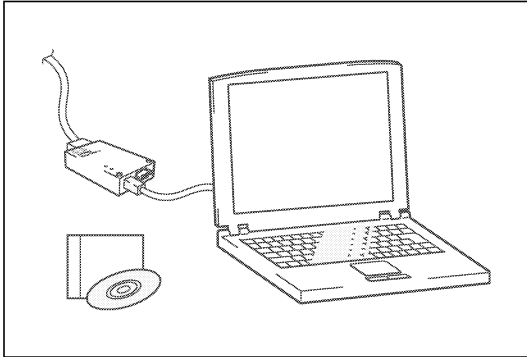
Malfunction of intake air temperature (air flow) sensor

- Harness disconnection
- Malfunction of connectors
- Bad contact of connectors

DPR (CHECK BY HINO-DX)

EN1610302F200041

DTC	P2002	DPR system malfunction
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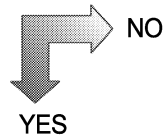


SAPH161030200087

1. CHECK THE DPR SYSTEM USING THE PC DIAGNOSIS TOOL (HINO-DX).

NOTICE

Refer to the item of "Exhaust brake" concerning the inspection method of DPR system.



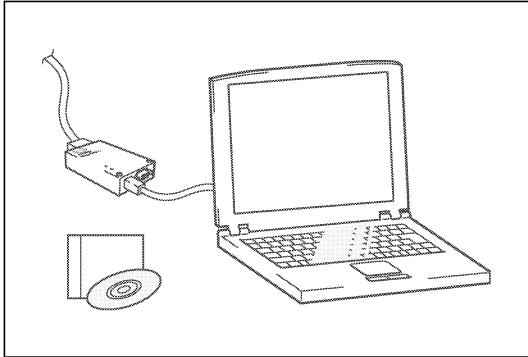
Check DPR

Malfunction of ECU

DPR BACKPRESSURE SENSOR (CHECK BY HINO-DX)

EN1610302F200042

DTC	P1426	DPR backpressure sensor characteristic abnormal
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SAPH161030200087

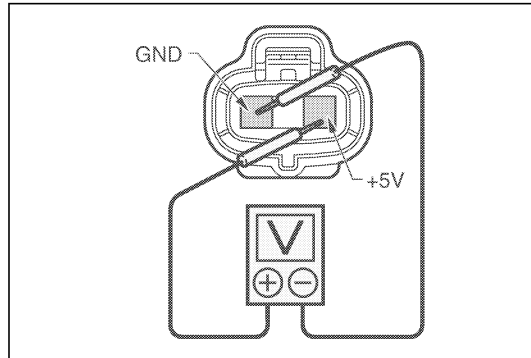
1. CHECK THE BACKPRESSURE USING THE PC DIAGNOSIS TOOL (HINO-DX).

- (1) Connect the PC DIAGNOSIS TOOL (HINO-DX).
- (2) Set the starter switch to "ON".
- (3) Confirm that no other DTC is displayed. If another DTC is displayed, repair that trouble and confirm that the DTC No. P1426 is displayed again.
- (4) Perform the backpressure check in DPR checking, and confirm the checking is complete normally.
- (5) If the above check shows no abnormalities, erase the DTC and start the engine. If the same DTC is displayed again, inspect the DPR.

DPR BACKPRESSURE SENSOR

EN1610302F200043

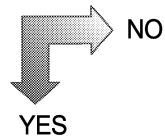
DTC	P1427	DPR backpressure sensor malfunction
DTC	P1428	DPR backpressure sensor malfunction



SAPH161030200088

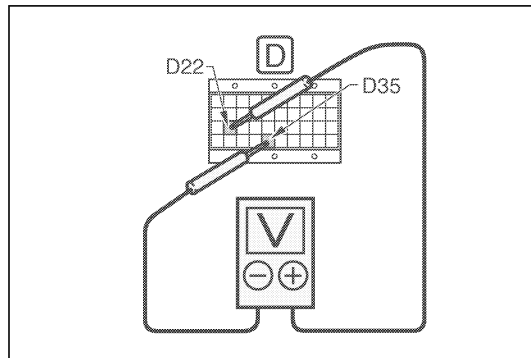
- 1. CHECK THE VOLTAGE BETWEEN TERMINALS OF SENSOR**
 - (1) Set the starter switch to "LOCK", connect the signal check harness.
 - (2) Disconnect the connector of DPR backpressure sensor.
 - (3) Set the starter switch to "ON".
 - (4) Measure the voltage between +5V and GND terminals of vehicle side connector of DPR backpressure sensor.

Standard: 5±0.5V



Proceed to 2

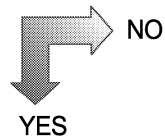
Proceed to 3



SAPH161030200089

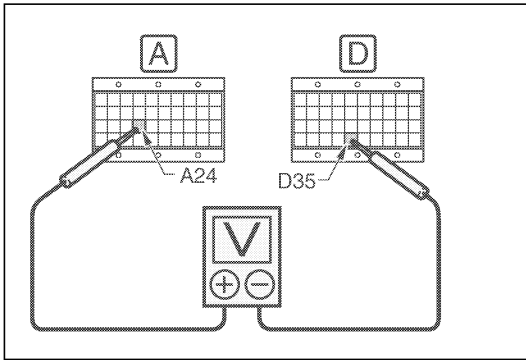
- 2. CHECK THE VOLTAGE BETWEEN TERMINALS**
 - (1) Measure the voltage between AGD3 (D35) and AVC3 (D22) terminals of signal check harness.

Standard: 5±0.5V



- Malfunction of ECU
- Malfunction of ECU connectors

Malfunction of harness

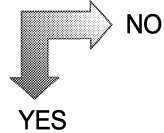


SAPH161030200090

3. CHECK THE VOLTAGE BETWEEN TERMINALS

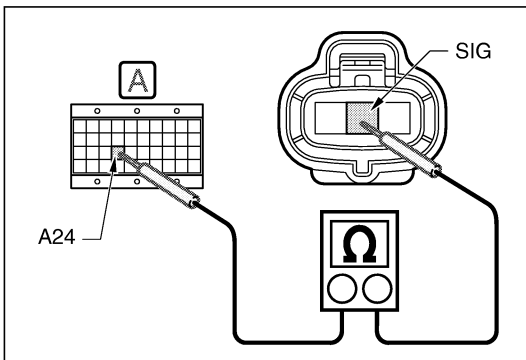
- (1) Set the starter switch to "LOCK", connect the connector of DPR backpressure sensor.
- (2) Set the starter switch to "ON".
- (3) Measure the voltage between EXPS (A24) and AGD3 (D35) terminals of signal check harness.

Standard: 0.2V — 4.8V



Proceed to 4

- Malfunction of ECU
- Malfunction of ECU connectors

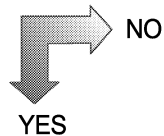


SAPH161030200091

4. CHECK THE CONTINUITY BETWEEN TERMINALS

- (1) Set the starter switch to "LOCK" and disconnect the connectors of ECU.
- (2) Disconnect the connectors of DPR backpressure sensor.
- (3) Measure the resistance between EXPS (A24) terminal of signal check harness and SIG terminal of DPR backpressure sensor connectors (vehicle harness side).

Standard: Less than 1 Ω



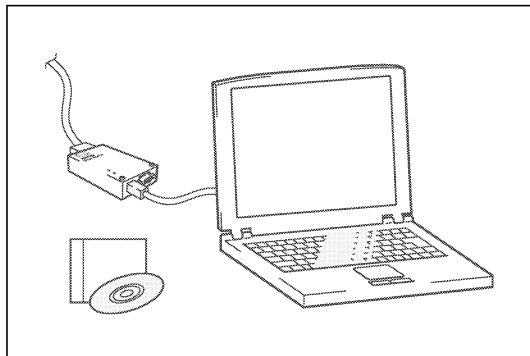
Malfunction of harness

Malfunction of DPR backpressure sensor

DPR EXHAUST GAS TEMPERATURE SENSOR 1, 2

EN1610302F200044

DTC	P2080	DPR exhaust gas temperature sensor 1 characteristic abnormal (Low input)
DTC	P2084	DPR exhaust gas temperature sensor 2 characteristic abnormal (High input)



SAPH161030200087

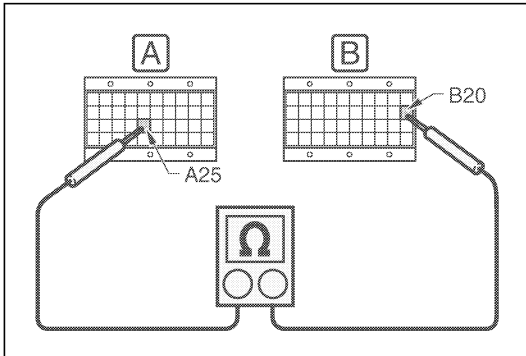
1. CHECK THE EXHAUST GAS TEMPERATURE SENSOR USING THE PC DIAGNOSIS TOOL (HINO-DX).

- (1) Connect the PC DIAGNOSIS TOOL (HINO-DX).
- (2) Set the starter switch to "ON".
- (3) Confirm that no other DTC is displayed. If another DTC is displayed, repair that trouble and confirm that the DTC No. P2080 or P2084 is displayed again.
- (4) Perform the manual forced reproduction in DPR checking, and confirm the checking is complete normally.
- (5) If the above check shows no abnormalities, erase the DTC and start the engine. If the same DTC is displayed again, inspect the DPR.

DPR EXHAUST GAS TEMPERATURE SENSOR 1

EN1610302F200045

DTC	P0545	DPR exhaust gas temperature sensor 1 malfunction (Low input)
DTC	P0546	DPR exhaust gas temperature sensor 1 malfunction (High input)



SAPH161030200092

1. CHECK THE RESISTANCE BETWEEN TERMINALS.

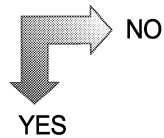
- (1) Set the starter switch to "LOCK", connect the signal check harness.
- (2) Disconnect the ECU side connector of signal check harness.
- (3) Measure the resistance between EXT+ (A25) and AGD4 (B20) terminals.

Standard: (Measure anyone point of below)

106 k Ω (at 50°C{122°F})

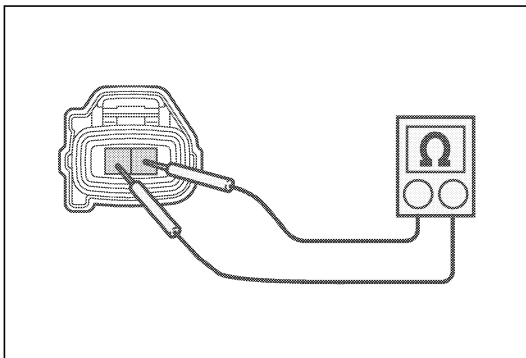
6.9 k Ω (at 200°C{392°F})

0.673 k Ω (at 500°C{932°F})



Proceed to 2

- Malfunction of ECU.
- Malfunction of harness connector.
- Short circuit of harness



SAPH161030200093

2. CHECK THE RESISTANCE BETWEEN SENSOR TERMINALS.

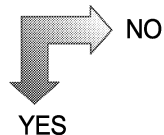
- (1) Disconnect the connector of exhaust gas temperature sensor 1.
- (2) Measure the resistance between a terminal and the other terminal of sensor side connector.

Standard: (Measure anyone point of below)

106 k Ω (at 50°C{122°F})

6.9 k Ω (at 200°C{392°F})

0.673 k Ω (at 500°C{932°F})



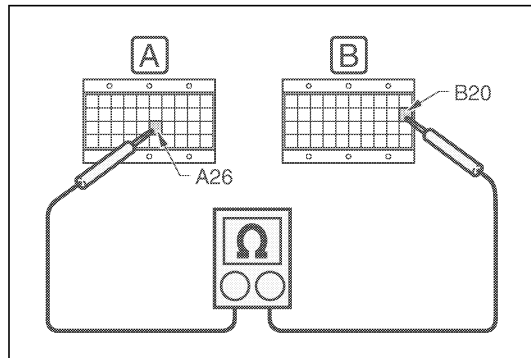
Malfunction of exhaust gas temperature sensor 1

- Open circuit of harness.
- Malfunction of harness connector.

DPR EXHAUST GAS TEMPERATURE SENSOR 2

EN1610302F200046

DTC	P2032	DPR exhaust gas temperature sensor 2 malfunction (Low input)
DTC	P2033	DPR exhaust gas temperature sensor 2 malfunction (High input)

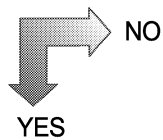


SAPH161030200094

1. CHECK THE RESISTANCE BETWEEN TERMINALS.

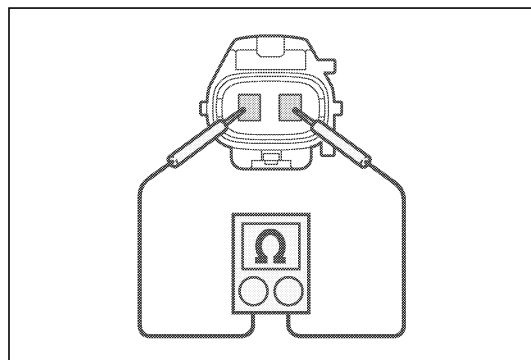
- (1) Set the starter switch to "LOCK", connect the signal check harness.
- (2) Disconnect the ECU side connector of signal check harness.
- (3) Measure the resistance between EXT+ (A26) and AGD4 (B20) terminals.

Standard: (Measure anyone point of below)
106 k Ω (at 50°C{122°F})
6.9 k Ω (at 200°C{392°F})



Proceed to 2

- Malfunction of ECU.
- Malfunction of harness connector.
- Short circuit of harness

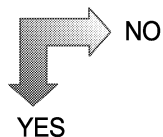


SAPH161030200095

2. CHECK THE RESISTANCE BETWEEN SENSOR TERMINALS.

- (1) Disconnect the connector of exhaust gas temperature sensor 2.
- (2) Measure the resistance between a terminal and the other terminal of sensor side connector.

Standard: (Measure anyone point of below)
106 k Ω (at 50°C{122°F})
6.9 k Ω (at 200°C{392°F})



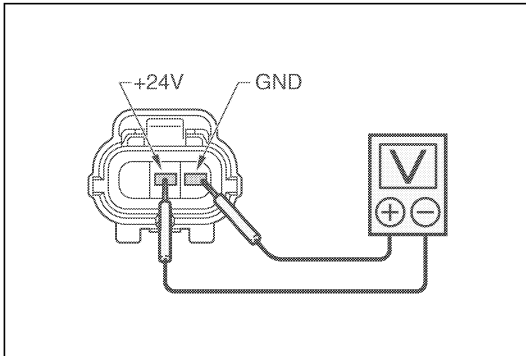
Malfunction of exhaust gas temperature sensor 2

- Open circuit of harness.
- Malfunction of harness connector.

DIESEL THROTTLE VALVE

EN1610302F200047

DTC	P2100	Diesel throttle valve malfunction (GND short)
DTC	P2103	Diesel throttle valve malfunction (Open circuit or VB short)

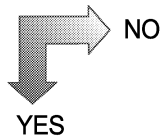


SAPH161030200096

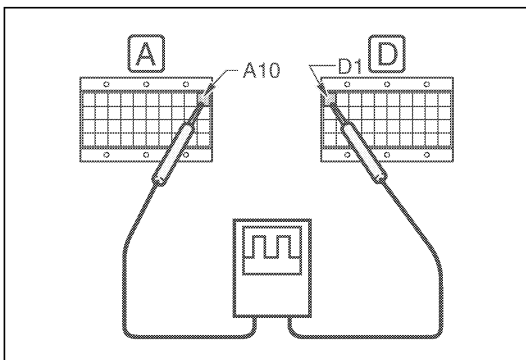
1. CHECK THE VOLTAGE BETWEEN TERMINALS

- (1) Set the starter switch to "LOCK", connect the signal check harness.
- (2) Set the starter switch to "ON".
- (3) Measure the voltage between +12V and GND terminals of vehicle side connector of diesel throttle valve.

Standard: More than 10 V



Malfunction of harness

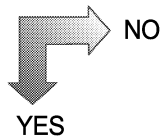


SAPH161030200097

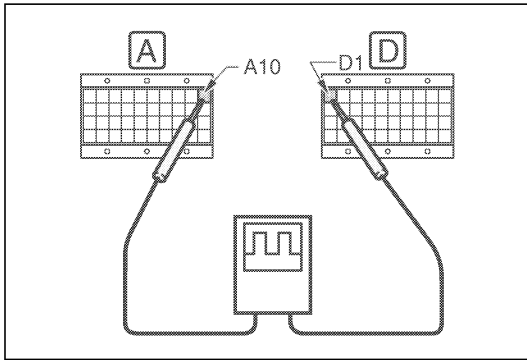
2. CHECK THE VOLTAGE WAVE-SHAPE BETWEEN TERMINALS

- (1) Leave the connector of diesel throttle valve connected.
- (2) Start the engine.
- (3) Measure the voltage between DTR+ (A10) and PGD1 (D1) terminals of signal check harness.
- (4) After checking, stop the engine.

Standard: Standard: 0 ↔ 5 V pulse wave



- Malfunction of ECU
- Malfunction of ECU connectors
- Malfunction of diesel throttle valve
- Malfunction of connector of diesel throttle valve

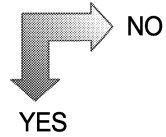


SAPH161030200097

3. CHECK THE VOLTAGE WAVE-SHAPE BETWEEN TERMINALS

- (1) Set the starter switch to "LOCK", disconnect the connector of diesel throttle valve.
- (2) Start the engine.
- (3) Measure the voltage wave-shape between (A10) and (D1) terminals of signal check harness.
- (4) After checking, stop the engine.

Standard: Standard: 0 ↔ 5 V pulse wave



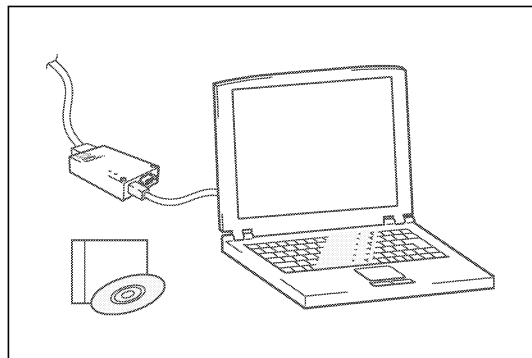
Connected malfunction of connector

Short circuit of harness

DIESEL THROTTLE VALVE (CHECK BY HINO-DX)

EN1610302F200048

DTC	P2101	Diesel throttle valve sticking
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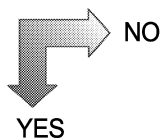


SAPH161030200087

1. CHECK THE DIESEL THROTTLE VALVE USING THE PC DIAGNOSIS TOOL (HINO-DX).

- (1) Connect the HINO-DX.
- (2) Set the starter switch to "ON"
- (3) Confirm DTC No. P2100, P2103 (Diesel throttle valve malfunction) and DTC No. P0122, P0123 (Diesel throttle valve opening sensor malfunction) are not displayed.
- (4) Confirm the actual opening value is followed up by input value by activating the diesel throttle valve.

Standard: Difference value is less than 5%



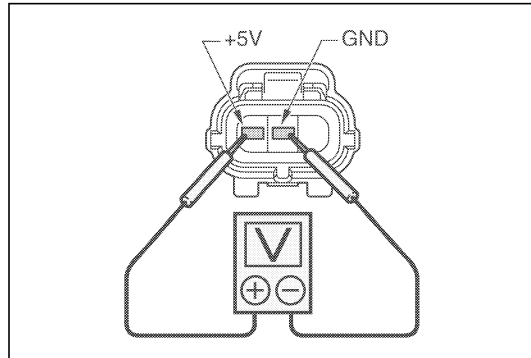
Malfunction of diesel throttle valve

Refer to "DIAGNOSIS USING THE PC DIAGNOSIS TOOL" DN02-18

DIESEL THROTTLE VALVE OPENING SENSOR

EN1610302F200049

DTC	P0122	Diesel throttle valve-opening sensor (Low input)
DTC	P0123	Diesel throttle valve-opening sensor (High input)

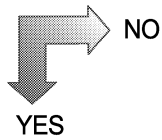


SAPH161030200098

1. CHECK THE VOLTAGE BETWEEN TERMINALS.

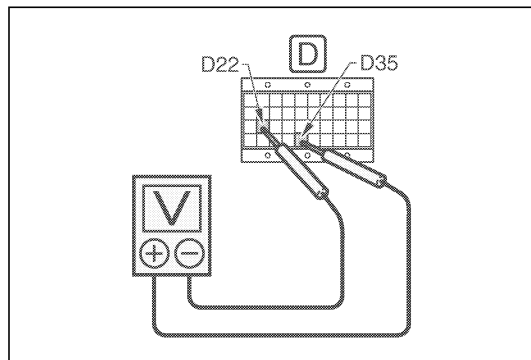
- (1) Set the starter switch to "LOCK", connect the signal check harness.
- (2) Disconnect the connector of diesel throttle valve opening sensor.
- (3) Set the starter switch to "ON".
- (4) Measure the voltage between +5V and GND terminals of vehicle side connector of diesel throttle valve-opening sensor.

Standard: 5±0.5 V



Proceed to 2

Proceed to 3

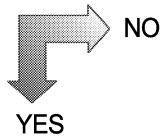


SAPH161030200099

2. CHECK THE VOLTAGE BETWEEN TERMINALS.

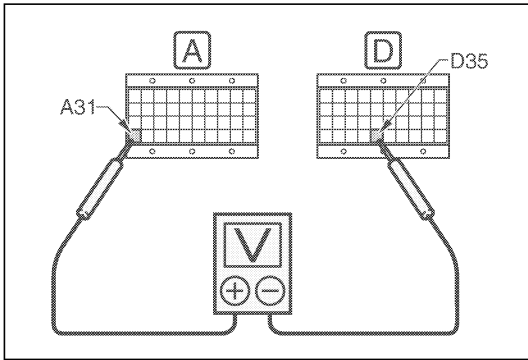
- (1) Measure the voltage between AVC3 (D22) and AGD3 (D35) terminals of signal check harness.

Standard: 5±0.5 V



- Malfunction of ECU
- Malfunction of ECU connectors

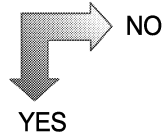
Malfunction of harness



SAPH161030200100

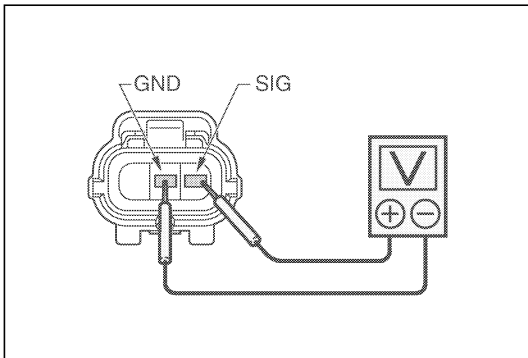
3. CHECK THE VOLTAGE BETWEEN TERMINALS.

- (1) Set the starter switch to "LOCK", connect the connector of diesel throttle valve-opening sensor.
- (2) Set the starter switch to "ON".
- (3) Measure the voltage between DTS1 (A31) and AGD3 (D35) terminals of signal check harness.

Standard: 0.5 — 4.5 V

Proceed to 4

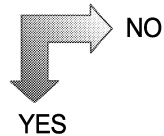
- Malfunction of ECU
- Malfunction of ECU connector



SAPH161030200101

4. CHECK THE VOLTAGE BETWEEN TERMINALS.

- (1) Leave the connector of diesel throttle valve-opening sensor connected.
- (2) Measure the voltage between SIG and GND terminals of vehicle side connector of diesel throttle valve-opening sensor.

Standard: 0.5 V — 4.5 V

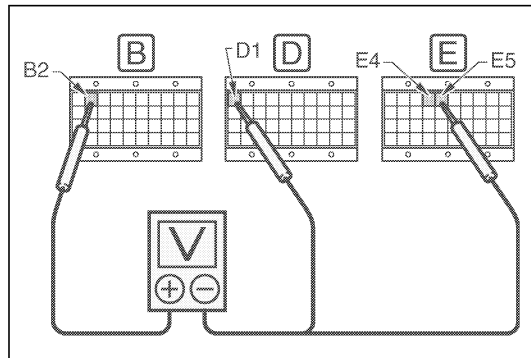
Malfunction of diesel throttle valve-opening sensor

Malfunction of harness

EXHAUST BRAKE MAGNETIC VALVE

EN1610302F200050

DTC No.	P1681	Exhaust brake magnetic valve malfunction (Open circuit, ground line short)
DTC No.	P1682	Exhaust brake magnetic valve malfunction (Power source line short)



SAPH161030200102

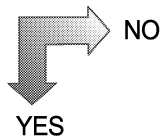
1. CHECK THE VOLTAGE BETWEEN TERMINALS.

- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Disconnect the signal check harness connector on the ECU side.
- (3) Set the starter switch to "ON" (The engine is stopped).
- (4) Measure the voltage between terminals.

+ side	- side
EBMV (B2)	PGD1 (D1), PGD2 (E4), PGD3 (E5)

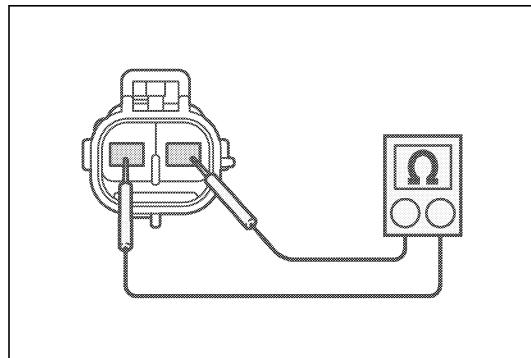
Standard: More than 19V

(After measurement, turn the starter switch to "LOCK" position.)



Proceed to 2.

- Malfunction of ECU.
- Malfunction of ECU connector.

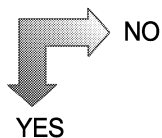


SAPH161030200103

2. CHECK THE EXHAUST BRAKE MAGNETIC VALVE.

- (1) Disconnect the connector of exhaust brake magnetic valve.
- (2) Measure the resistance between terminals (Exhaust brake magnetic valve side).

Standard: 35-45 Ω



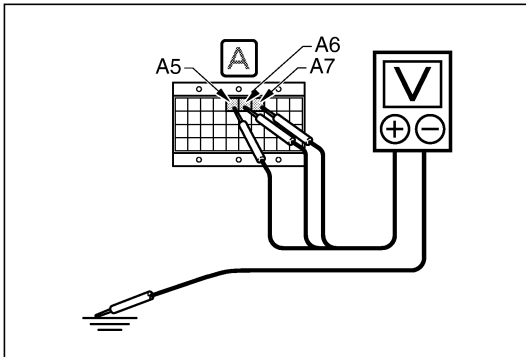
Malfunction of exhaust brake magnetic valve.

Malfunction of harness or connector.

MAIN RELAY

EN1610302F200051

DTC	P0686	Main relay malfunction
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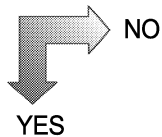


SAPH161030200104

1. CHECK THE VOLTAGE BETWEEN TERMINALS.

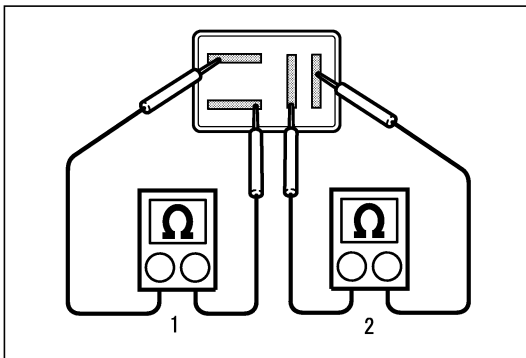
- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Set the starter to "ON" position.
- (3) Measure the voltage between VB1 (A5), VB2 (A6), VB3 (A7) terminal and Chassis GND.

Standard: More than 10 V



Proceed 2

- Malfunction of ECU
- Malfunction of ECU connectors



SAPH161030200105

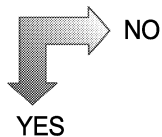
2. CHECK THE RESISTANCE BETWEEN RELAY TERMINALS.

- (1) Set the starter switch to "LOCK" and remove the main relay.
- (2) Measure the resistance between terminals.

Standard:

1. 111 Ω

2. $\infty \Omega$



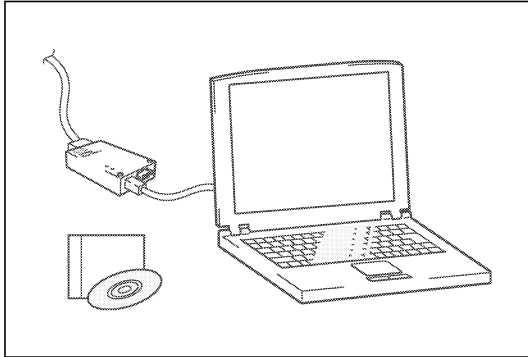
Malfunction of main relay

Malfunction of harness

BRAKE SWITCH

EN1610302F200052

DTC	P0504	Brake switch malfunction
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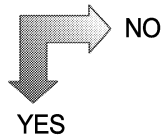
SAPH161030200087

1. CHECK THE BRAKE SWITCH USING THE PC DIAGNOSIS TOOL (HINO-DX).

- (1) Connect the PC DIAGNOSIS TOOL (HINO-DX).
- (2) Set the starter switch to "ON".
- (3) Confirm that no other DTC is displayed. If another DTC is displayed, repair that trouble and confirm that the DTC No. P0504 is displayed again.
- (4) Carry out diagnosis of brake switch and stop light switch.
- (5) Operate the brake pedal, and confirm the each signals are ON and OFF.

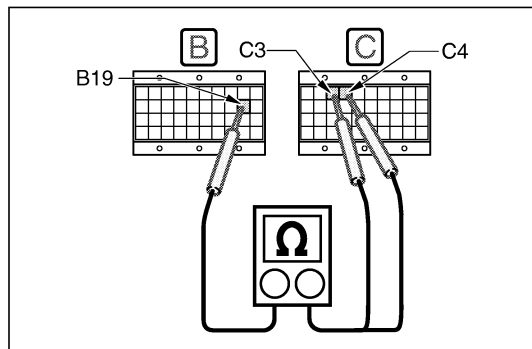
Depress the brake pedal: 1

Release the brake pedal: 0



Proceed to 2

Normal



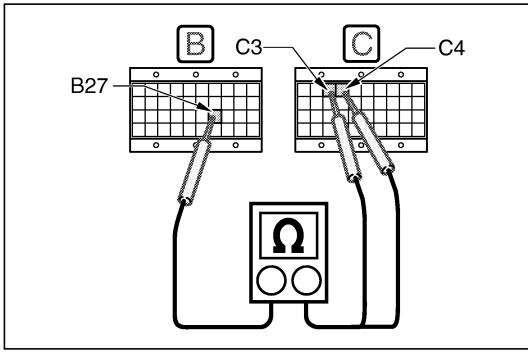
SAPH161030200106

2. CHECK THE VOLTAGE BETWEEN TERMINALS.

- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Set the starter switch to "ON".
- (3) Measure the voltage between terminals.

Brake switch: between BSW2 (B19) and CGD1 (C3), CGD2 (C4)

Stop light switch: between BSW1 (B27) and CGD1 (C3), CGD2 (C4)



SAPH161030200107

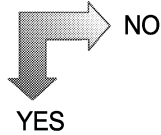
Standard:

Brake switch

More than 10 V: Relies the brake pedal
0 V: Depress the brake pedal

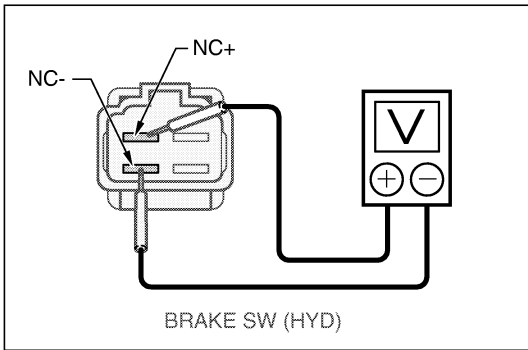
Stop light switch

More than 10 V: Depress the brake pedal
0 V: Relies the brake pedal



Proceed to 3

Malfunction of ECU



SAPH161030200108

3. CHECK THE RESISTANCE BETWEEN TERMINALS.

- (1) Set the starter switch to "LOCK".
- (2) Disconnect the connectors of brake switch and stop light switch.
- (3) Measure the resistance of terminals.

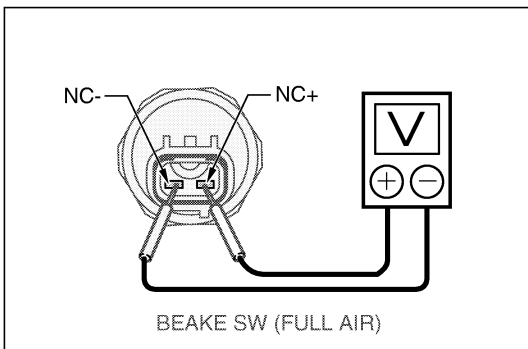
Standard:

Brake switch

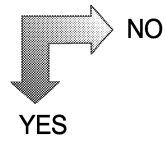
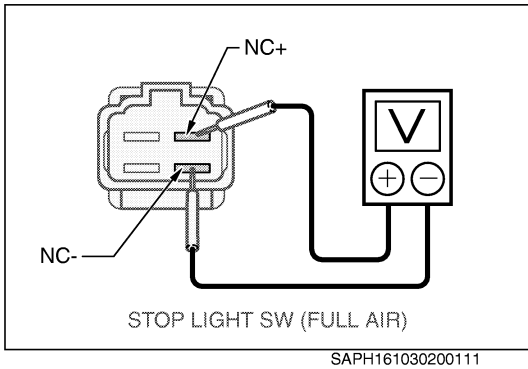
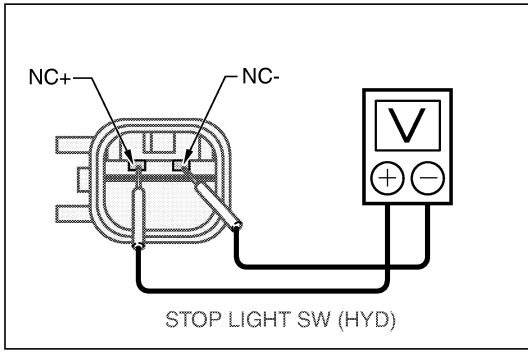
Less than 2 Ω: Relies the brake pedal
inf Ω: Depress the brake pedal

Stop light switch

Less than 2 Ω: Depress the brake pedal
inf Ω: Relies the brake pedal



SAPH161030200109



NO
Malfunction of brake switch or stop light switch

YES
Malfunction of harness

INJECTOR CORRECTION DATA

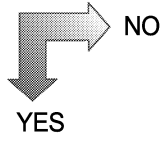
EN1610302F200053

DTC	P1601	Injector correction data conformity error
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1. CHECK THE QR CODE.

- (1) Read the QR codes using "Injector Calibration" menu.

Standard: Same as the installed injector or service record.



Re-input the QR codes

Replace the ECU

CAN (CONTROLLER AREA NETWORK)

EN1610302F200054

DTC	U0101	CAN communication error (Transmission)
DTC	U0155	CAN communication error (Meter)
DTC	U1001	CAN communication error (Vehicle)

1. CHECK THE COMMUNICATION LINE.

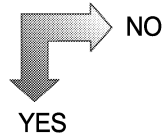
(Refer to workshop manual "Pub. No. S1-UNAE06A 2/2 or S1-CNAE06A 2/2" chapter "OTHERS DN06-001 (CAN COMMUNICATION)").

ENGINE OIL PRESSURE

EN1610302F200055

DTC	P0524	Engine oil pressure low
-----	-------	-------------------------

1. CHECK THE ENGINE OIL LEVEL.

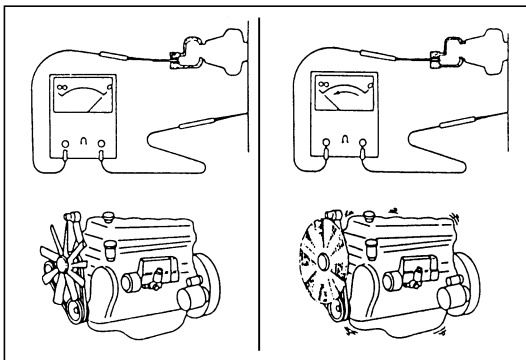


Check oil leakage and add oil

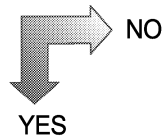
Proceed to 2

2. CHECK THE OPERATION OF THE OIL PRESSURE WARNING SWITCH.

- (1) Disconnect the connector.
- (2) Using an ohmmeter, check the continuity between the terminal and ground with the engine stopped (0Ω) and with the engine running ($\infty \Omega$).



SAPH161030200112



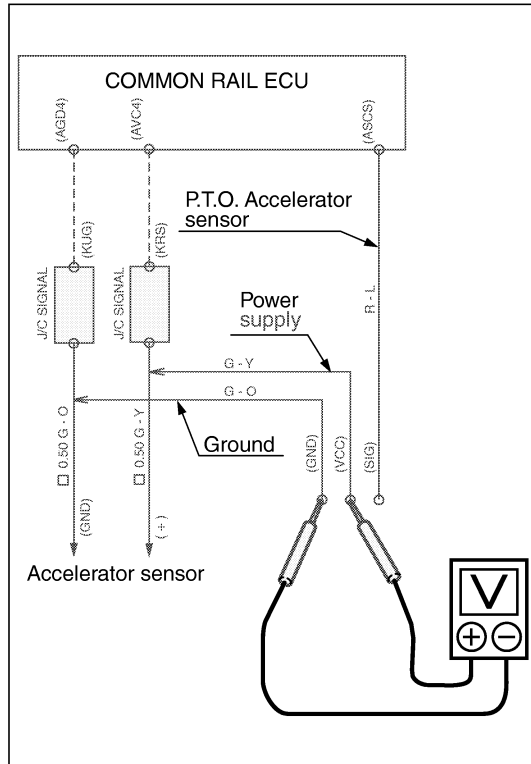
Malfunction of oil pressure switch

- Bad contact of ECU connectors
- Malfunction of ECU
- Malfunction of harness (Short circuit)

ACCELERATOR SENSOR (FOR OPERATION OF P.T.O.)

EN1610302F200056

DTC	P1133	P.T.O. accelerator sensor circuit high voltage
-----	-------	--



SAPH161030200113

1. CHECK THE VOLTAGE BETWEEN TERMINALS.

- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Disconnect the connector of the accelerator sensor.
- (3) Set the starter switch to "ON" (The engine is stopped).
- (4) Measure the voltage between VCC and GND terminals of accelerator sensor (Vehicle harness side).

Standard: 4.5 — 5.5V

HINT

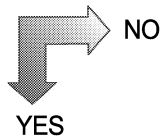
The P.T.O. accelerator sensor, harness and connector parts are used locally. And are installed by the body builder.

The measuring terminal is determined by the cab harness color.

R-L: Red with blue stripe color.

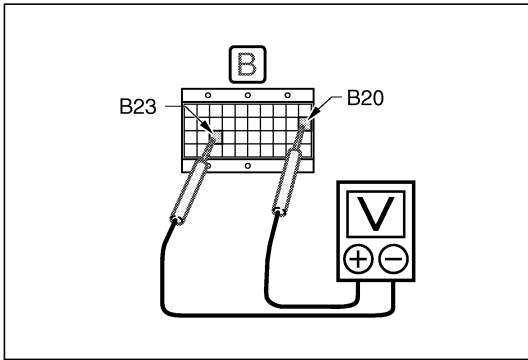
G-Y: Green with yellow stripe color.

G-O: Green with orange stripe color.



Proceed to (5)

Proceed to (6)

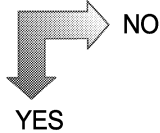


SAPH161030200114

(5) Measure the voltage between AVC4 (B23) and AGD4 (B20) terminals.

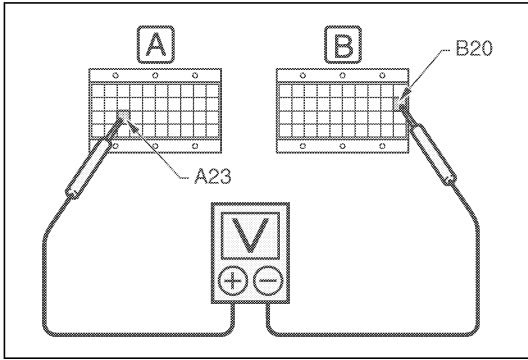
Standard: 4.5 — 5.5V

(After measurement, turn the starter switch to "LOCK" position.)



- Malfunction of ECU
- Malfunction of ECU connectors

Malfunction of harness



SAPH161030200115

(6) Connect the connector of the accelerator sensor.

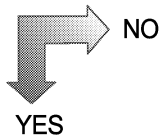
(7) Set the starter switch to "ON" (The engine is stopped).

(8) Measure the voltage between ASCS (A23) and AGD4 (B20) terminals.

Standard:

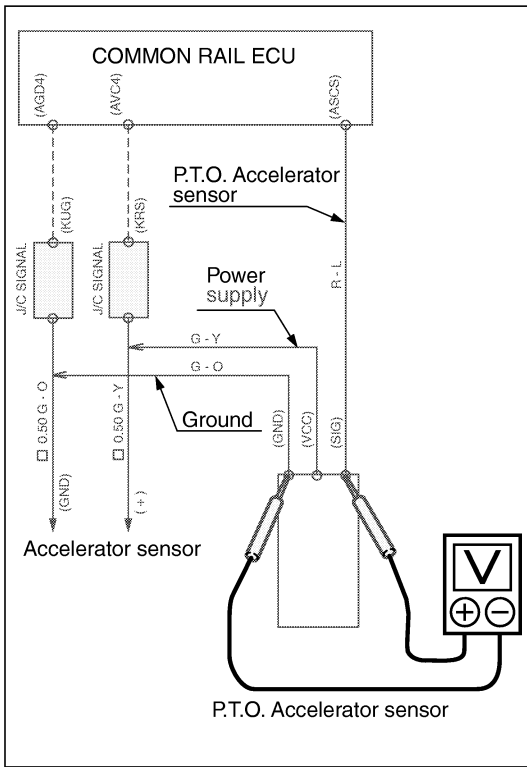
APPROX. 0.6 — 4.6V (Idle to full throttle)

(After measurement, turn the starter switch to "LOCK" position.)



Proceed to (9)

- Malfunction of ECU
- Malfunction of ECU connectors



- (9) Connect the connector of the accelerator sensor.
- (10) Set the starter switch to "ON" (The engine is stopped).
- (11) Measure the voltage between SIG and GND terminals of accelerator sensor (Vehicle harness side).

Standard:

APPROX. 0.6 — 4.6V (Idle to full throttle)

HINT

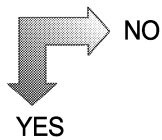
The P.T.O. accelerator sensor, harness and connector parts are used locally. And are installed by the body builder.

The measuring terminal is determined by the cab harness color.

R-L: Red with blue stripe color.

G-Y: Green with yellow stripe color.

G-O: Green with orange stripe color.



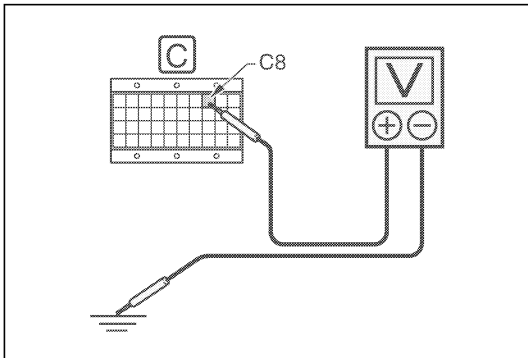
NO
Malfunction of accelerator sensor

YES
Harness disconnection or short circuit

CLUTCH SWITCH

EN1610302F200057

DTC	P0704	Clutch switch malfunction
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SAPH161030200117

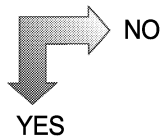
1. CHECK THE VOLTAGE BETWEEN TERMINAL AND GND.

- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Set the starter switch to "ON".
- (3) Measure the voltage between CLSW (C8) terminal and cab GND.

Standard:

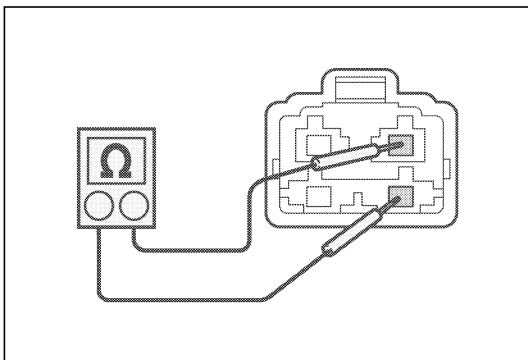
More than 10 V (Clutch pedal released)

0 V (Clutch pedal pressed)



Proceed to 2.

Malfunction of ECU.



SAPH161030200118

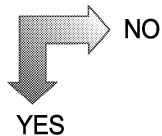
2. CHECK THE CLUTCH SWITCH.

- (1) Set the starter switch to "LOCK".
- (2) Disconnect the clutch switch connector.
- (3) Measure the resistance between clutch switch terminals.

Standard:

$\infty \Omega$ (Clutch switch not pressed)

Less than 1 Ω (Clutch switch pressed)



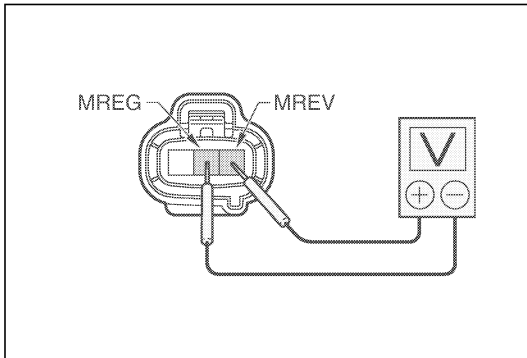
Malfunction of clutch switch.

Malfunction of harness.

ENGINE SPEED SUB SENSOR (PULSE)

EN1610302F200058

DTC	P0341	Engine speed sub sensor pulse abnormal
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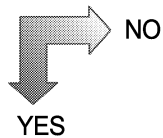


SAPH161030200119

1. CHECK THE VOLTAGE BETWEEN SENSOR TERMINALS.

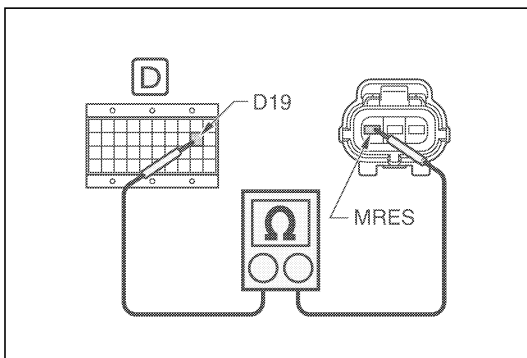
- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Disconnect the connector of the engine speed sub sensor.
- (3) Set the starter switch to "ON" (The engine is stopped)
- (4) Measure the voltage generation between MREG and MREV terminals of the engine speed sub sensor connector (Vehicle harness side).

Standard: 4.5-5.5V



Proceed to 2.

Proceed to 3.



SAPH161030200120

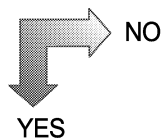
2. CHECK THE RESISTANCE BETWEEN RELAY TERMINALS.

- (1) Connector of engine sub sensor remain connected.
- (2) Measure the resistance between MRES terminal of the engine speed sub sensor connector (Vehicle harness side) and G3+ (D19) terminal.

Standard: Less than 2 Ω

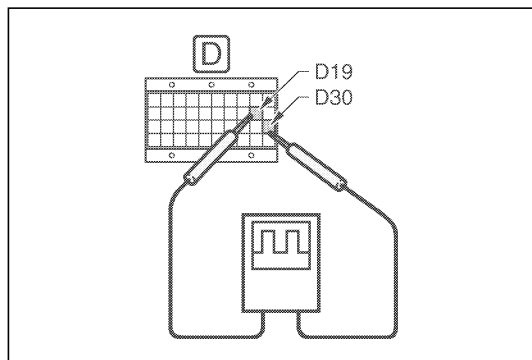
NOTICE

This figure is viewed from the coupling surface side.



Malfunction of harness.

Proceed to 3.



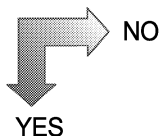
SAPH161030200121

3. CHECK THE INPUT PULSE GENERATION TO ENGINE ECU.

- (1) Connector of engine speed sub sensor remain connected.
- (2) Start the engine.
- (3) Measure the pulse generation between terminals G3+ (D19) and CGND (D30) terminals using an oscilloscope.

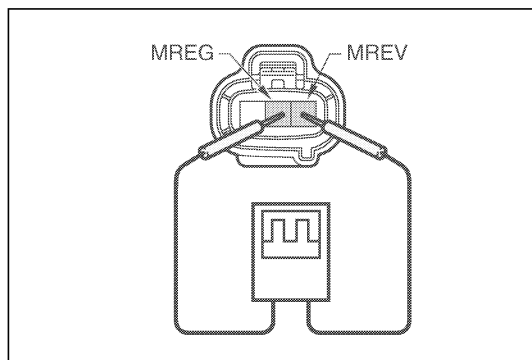
Standard: 7 pulse (Including extra signal pin)

- (4) After measurement, stop the engine.



Proceed to 4.

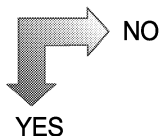
- Malfunction of ECU.
- Malfunction of ECU connectors.



SAPH161030200122

4. CHECK THE OUTPUT PULSE GENERATION FROM SENSOR.

- (1) Connector of engine speed main sensor remain connected.
- (2) Start the engine.
- (3) Measure the pulse generation between MREG and MREV terminals using an oscilloscope.

Standard: 7 pulse (Including extra signal pin)

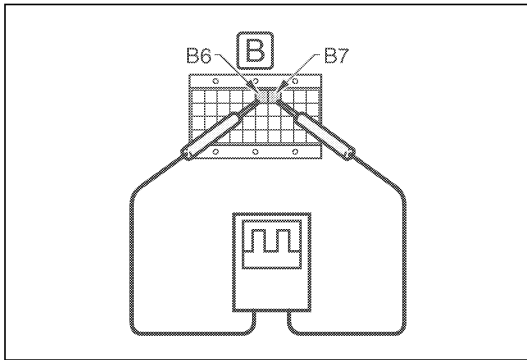
- Engine speed main sensor malfunction.
- Camshaft gear signal pin abnormal.

Bad contact of connector.

ENGINE SPEED MAIN SENSOR (PULSE)

EN1610302F200059

DTC	P0336	Engine speed main sensor pulse abnormal
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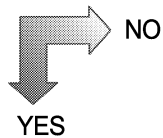
SAPH161030200123

1. CHECK THE INPUT PULSE GENERATION TO ENGINE ECU.

- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Start the engine.
- (3) Measure the pulse generation between NE1+ (B6) and NE1- (B7) terminals using an oscilloscope.

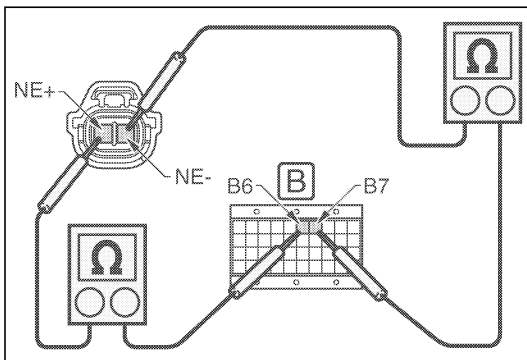
Standard: 56 pulse (Between non-signal holes)

- (4) After measurement, stop the engine.



Proceed to 2.

- Malfunction of ECU.
- Malfunction of ECU connectors.

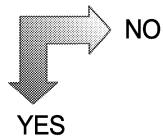


SAPH161030200124

2. CHECK THE RESISTANCE BETWEEN TERMINALS.

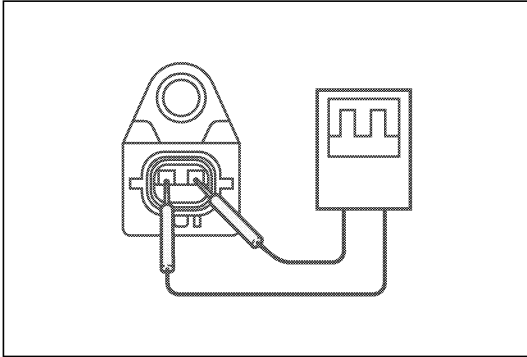
- (1) Connector of engine main sensor remains connected.
- (2) Measure the resistance between NE- main sensor connector (Vehicle harness side) and signal check harness NE1- (B7). In same way, measure the resistance between NE+ main sensor connector (Vehicle harness side) and signal check harness NE1+ (B6).

Standard: Less than 2 Ω



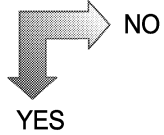
Malfunction of harness.

Proceed to 3.



SAPH161030200125

- 3. CHECK THE OUTPUT PULSE GENERATION FROM SENSOR.**
- (1) Connector of engine speed main sensor remains connected.
 - (2) Start the engine.
 - (3) Measure the pulse generation between terminals using an oscilloscope.
- Standard: 56 pulse (Between non-signal holes)**
- (4) After measurement, stop the engine.



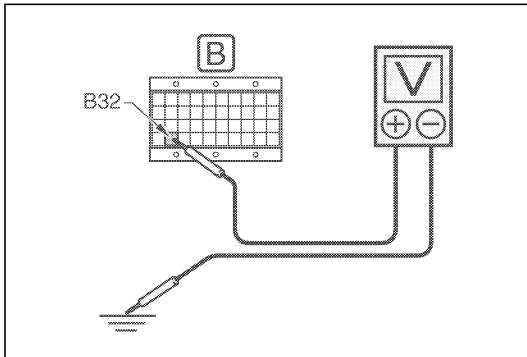
- Engine speed main sensor malfunction.
- Flywheel signal hole abnormal.

Bad contact of connector.

NEUTRAL SWITCH

EN1610302F200060

DTC	P0850	Neutral switch malfunction
-----	-------	----------------------------



SAPH161030200126

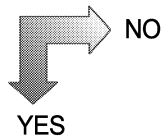
1. CHECK THE VOLTAGE BETWEEN TERMINAL AND GND.

- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Set the starter switch to "ON" (The engine is stopped).
- (3) Measure the voltage between NUSW terminal and chassis GND.

Standard:

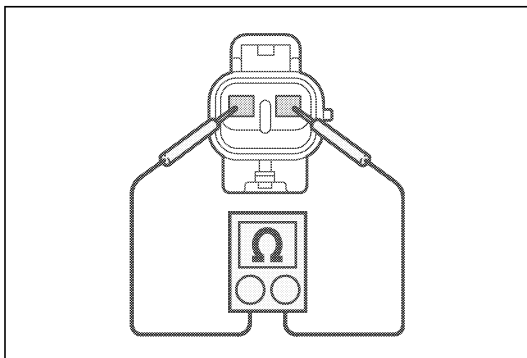
More than 10 V (Transmission: Neutral position)

0 V (Transmission: Not neutral position)



Proceed to 2.

Malfunction of ECU.



SAPH161030200127

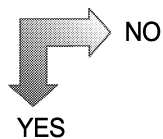
2. CHECK THE NEUTRAL SWITCH.

- (1) Set the starter switch to "LOCK".
- (2) Disconnect the connector of neutral switch.
- (3) Measure the resistance between terminals (Neutral switch side).

Standard:

$\infty \Omega$ (Neutral switch not pressed)

Less than 1 Ω (Neutral switch pressed)



Malfunction of neutral switch.

Malfunction of harness.

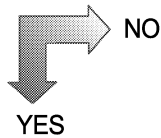
SUPPLY PUMP

EN1610302F200061

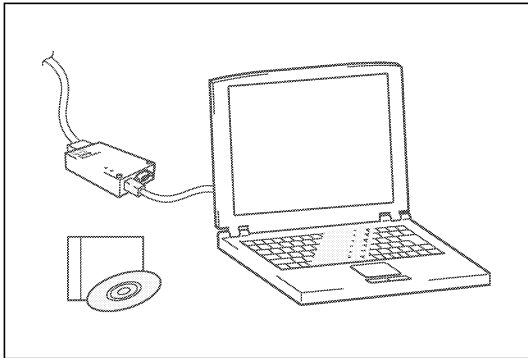
DTC	P2635	Supply pump SCV sticking
DTC	P2635	Supply pump malfunction
DTC	P2635	Supply pump abnormal high pressure record

1. CHECK THE SUPPLY PUMP.

- (1) Turn the starter switch to "LOCK" and stop the engine.
- (2) Wait for about 30 seconds and then start the engine.
- (3) Perform warm-up until the coolant temperature become 60°C {140°F} of higher. And erase the MC or DTC.
- (4) Confirm that the same MC or DTC is displayed again when raising engine revolution up to "No load max revolution" or racing engine.



Replace supply pump.



SAPH161030200128

2. CHECK THE MC OR DTC.

- (1) Confirm that no other MC or DTC is displayed. If another MC or DTC is displayed repair that trouble and confirm that the MC No. 75, 77, 79 or DTC No.P2635 is displayed again. Especially in case of display MC or DTC in regard to engine speed sensor (main and sub) system, perform repair so that these MC or DTC are not displayed.
- (2) If the above check shows no abnormalities, erase the MC or DTC and start the engine. If the same MC or DTC is displayed again, malfunction of supply pump and malfunction ECU can be assumed.

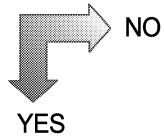
WATER IN FUEL

EN16Z0002F200001

DTC	P2269	Water in fuel condition
-----	-------	-------------------------

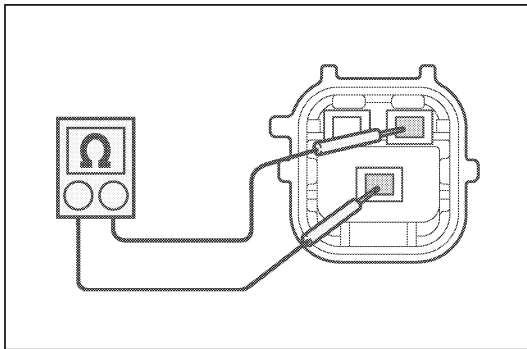
1. CHECK THE FUEL FILTER.

- (1) Confirm that the water is not accumulated in the fuel filter.



Drain the water.

Proceed to 2.



SAPH161030200129

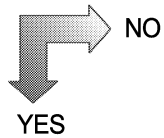
2. CHECK THE FUEL FILTER WATER LEVEL SENSOR.

- (1) Disconnect the connector of the fuel filter water level sensor.
 (2) Measure the resistance between terminals.

Standard:

$\infty \Omega$ (Without water in the fuel filter)

Less than 1Ω (Water accumulated in the fuel filter)



Malfunction of fuel filter water level sensor.

- Malfunction of ECU
- Malfunction of ECU connectors
- Malfunction of harness (Short)

Hino Motors Sales U.S.A., Inc.
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PRINTED IN JAPAN

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FOREWORD

This workshop manual has been prepared to provide information regarding repair procedures on Hino Trucks.

Applicable for J08E-TV, TW engine

When making any repairs on your vehicle, be careful not to be injured through improper procedures.

As for maintenance items, refer to the Owner's Manual.

All information and specifications in this manual are based upon the latest product information available at the time of printing.

Hino Motors Sales U.S.A., Inc. reserves the right to make changes at any time without prior notice.

Hino Motors Sales U.S.A. , Inc.

CHAPTER REFERENCES REGARDING THIS WORKSHOP MANUAL

Use this chart to the appropriate chapter numbers for servicing your particular truck.

CHAPTER	MANUAL NO.	S5-UJ08E06A (U.S.A.), S5-CJ08E06A (CANADA)	
	MODEL	J08E-TV, TW	
GENERAL INTRODUCTION		GN01-001	
ENGINE INTRODUCTION		EN01-001	
ENGINE MECHANICAL		EN02-001	
AIR INTAKE SYSTEM		EN03-001	
EXHAUST SYSTEM		EN04-001	
LUBRICATING SYSTEM		EN05-001	
COOLING SYSTEM		EN06-001	
FUEL SYSTEM		EN07-001	
TURBOCHARGER		EN08-001	
EMISSION CONTROL		EN10-001	
ALTERNATOR		EN11-001 (100A)	EN11-002 (105A)
STARTER		EN12-001	
AIR COMPRESSOR		EN13-001	EN13-002
ENGINE CONTROL		EN16-001	
FUEL CONTROL		DN02-001	



INDEX: ENGINE GROUP 1/2

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ENGINE INTRODUCTION

ENGINE MECHANICAL

AIR INTAKE SYSTEM

EXHAUST SYSTEM

LUBRICATING SYSTEM

COOLING SYSTEM

FUEL SYSTEM

TURBOCHARGER

FUEL INJECTION PUMP

EMISSION CONTROL

ALTERNATOR

STARTER

AIR COMPRESSOR

**ENGINE PTO
(POWER TAKE-OFF)**

ENGINE RETARDER

ENGINE CONTROL

INDEX: ENGINE GROUP 2/2

ENGINE CONTROL

FUEL CONTROL

BRAKE CONTROL

SUSPENSION CONTROL

CAB EQUIPMENT CONTROL

OTHERS

GENERAL INTRODUCTION (ENGINE)

GN01-001

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GENERAL INTRODUCTION (ENGINE)

GENERAL PRECAUTIONS

EN00Z01010100001




Some recommended and standard maintenance services for your engine are included in this section. When performing maintenance on your engine, be careful not to get injured by using improper work procedures. Improper or incomplete work can cause a malfunction of the engine, which may result in personal injury and/or property damage. If you have any questions about performing maintenance, please consult your Hino dealer.

WARNING

When working on your engine, observe the following general precautions to prevent death, personal injury and/or property damage, in addition to the particular **DANGERS, WARNINGS, CAUTIONS** and **NOTICE** in each chapter.

- Always wear safety glasses or goggles to protect your eyes.
- Remove rings, watches, ties, loose hanging jewelry and loose clothing before starting work on the vehicle.
- Bind long hair securely behind the head.
- When working on the vehicle, apply the parking brake firmly, place the gear shift lever in "Neutral" or "N" and block the wheels.
- Always stop the engine and turn off the starter switch, unless the operation requires the engine running. Removing the key from the switch is recommended.
- To avoid serious burns, keep yourself away from hot metal parts such as the engine, exhaust manifold, radiator, muffler, exhaust pipe and tail pipe.
- Do not smoke while working on the vehicle, since fuel and gas from battery are flammable.
- Take utmost care when working on the battery. It contains corrosive sulfuric acid.
- Large electric current flows through the battery cable and starter cable. Be careful not to cause a short, which can result in personal injury and/or property damage.
- Read carefully and observe the instructions placed on the jack before using it.
- Use safety stands to support the vehicle whenever you need to work under it. It is dangerous to work under a vehicle supported only by a jack.
- If it is necessary to run the engine after the hood is raised (tilted), make sure that the parking brake is firmly applied, the wheels are blocked, and the gear shift lever is positioned in "Neutral" before starting the engine.
- Run the engine only in a well-ventilated area to avoid inhaling of carbon monoxide.
- Keep yourself, your clothing and your tools away from moving parts such as the cooling fan and V-belt when the engine is running.
- Be careful not to damage lines and hoses by stepping or holding on them.
- Be careful not to leave any tool in the engine compartment. Tools may be hit by moving parts, which can cause personal injury.

DEFINITION OF SAFETY TERMS

 DANGER	Indicates an extremely hazardous situation if proper procedures are not followed and could result in death or serious injury.
 WARNING	Indicates a potential hazardous situation if proper procedures are not followed and could result in death or serious injury.
 CAUTION	Indicates a hazardous situation if proper procedures are not followed and could result in serious injury or damage to parts/equipment.
NOTICE	Indicates the need to follow proper procedures and to pay attention to precautions so that efficient service is provided.
HINT	Provides additional information to help you to perform the repair efficiently.

TOWING

- When being towed, always place the gear shift lever in "Neutral" and release the parking brake completely. In order to protect the bumper, fit a protection bar against the lower edge of the bumper and put a wood block under the frame near the No. 1 crossmember when attaching the towing chain. Never lift or tow the vehicle if the chain is in direct contact with the bumper.

1. Towing procedures

- (1) Make sure that the propeller shaft of the vehicle to be towed is removed. When the differential gear or rear axle shaft is defective, remove both right and left rear axle shafts, then cover the hub opening to prevent loss of axle lubricant and entry of dirt or foreign matter.
- (2) Use a heavy duty cable or rope when towing the vehicle. Fasten the cable securely to the towing hook on the frame. The hook should be used only if the towed vehicle is not loaded.
- (3) The angle of pulling direction of the cable fastened to the towing hook must not exceed 15° in horizontal and vertical directions from the straight ahead, level direction. Avoid using the hook in a way that subjects it to jerk, as in towing a vehicle trapped in a gutter.
- (4) Keep the gear shift lever in "Neutral".
- (5) Make sure that the starter switch is kept in the "ON" position.
- (6) Make sure that the engine of the towed vehicle is kept running. If the engine is off, no compressed air/ no vacuum will be available for the brake. This is dangerous, as the brake system does not function if the engine is not running. In addition, the power steering system will not function. The steering wheel, therefore, will become unusually hard to turn, making it impossible to control the vehicle.
- (7) Note that the engine brake and exhaust brake cannot be applied, if the propeller shaft is removed.
- (8) Make a slow start to minimize shock. Towing speed should be less than 30 km/h {18 mile/h}.

2. If the engine of the towed vehicle is defective, make sure that the vehicle is towed only by a tow truck designed for that purpose.

- (1) Front end towing (with front wheels raised off the ground)
When towing from the front end with the front wheels raised off the ground, remove the rear axle shafts to protect the transmission and differential gears from being damaged. The hub openings should be covered to prevent the loss of axle lubricant or the entry of dirt or foreign matter.
The above-mentioned precautions should be observed for vehicles equipped with either automatic or manual transmission, and for even short distance towing. After being towed, check and refill the rear axle housing with lubricant if necessary.
- (2) Rear end towing
When being towed with the rear wheels raised off the ground, fasten and secure the steering wheel in a straight ahead position.

CLEAN AIR ACT

1. Heavy-duty engine rebuilding practices.

§ 86.004-40

- The provisions of this section are applicable to heavy-duty engines subject to model year 2004 or later standards and are applicable to the process of engine rebuilding (or rebuilding a portion of an engine or engine system). The process of engine rebuilding generally includes disassembly, replacement of multiple parts due to wear, and reassembly, and also may include the removal of the engine from the vehicle and other acts associated with rebuilding an engine. Any deviation from the provisions contained in this section is a prohibited act under section 203(a) (3) of the Clean Air Act (42 U.S.C. 7522(a) (3)).
- (1) When rebuilding an engine, portions of an engine, or an engine system, there must be a reasonable technical basis for knowing that the resultant engine is equivalent, from an emissions standpoint, to a certified configuration (i.e., tolerances, calibrations, specifications) and the model year(s) of the resulting engine configuration must be identified. A reasonable basis would exist if:
 - a. Parts installed, whether the parts are new, used, or rebuilt, are such that a person familiar with the design and function of motor vehicle engines would reasonably believe that the parts perform the same function with respect to emissions control as the original parts; and
 - b. Any parameter adjustment or design element change is made only:
 - In accordance with the original engine manufacturer's instructions; or
 - Where data or other reasonable technical basis exists that such parameter adjustment or design element change, when performed on the engine or similar engines, is not expected to adversely affect in-use emissions.
 - (2) When an engine is being rebuilt and remains installed or is reinstalled in the same vehicle, it must be rebuilt to a configuration of the same or later model year as the original engine. When an engine is being replaced, the replacement engine must be an engine of (or rebuilt to) a configuration of the same or later model year as the original engine.
 - (3) At time of rebuild, emissions-related codes or signals from on-board monitoring systems may not be erased or reset without diagnosing and responding appropriately to the diagnostic codes, regardless of whether the systems are installed to satisfy requirements in § 86.004-25 or for other reasons and regardless of form or interface. Diagnostic systems must be free of all such codes when the rebuilt engine is returned to service. Such signals may not be rendered inoperative during the rebuilding process.
 - (4) When conducting a rebuild without removing the engine from the vehicle, or during the installation of a rebuilt engine, all critical emissions-related components listed in § 86.004-25(2) not otherwise addressed by paragraphs (1) through (3) of this section must be checked and cleaned, adjusted, repaired, or replaced as necessary, following manufacturer recommended practices.
 - (5) Records shall be kept by parties conducting activities included in paragraphs (1) through (4) of this section. The records shall include at minimum the mileage and/or hours at time of rebuild, a listing of work performed on the engine and emissions-related control components including a listing of parts and components used, engine parameter adjustments, emissions-related codes or signals responded to and reset, and work performed under paragraph (4) of this section.
 - a. Parties may keep records in whatever format or system they choose as long as the records are understandable to an EPA enforcement officer or can be otherwise provided to an EPA enforcement officer in an understandable format when requested.
 - b. Parties are not required to keep records of information that is not reasonably available through normal business practices including information on activities not conducted by themselves or information that they cannot reasonably access.
 - c. Parties may keep records of their rebuilding practices for an engine family rather than on each individual engine rebuilt in cases where those rebuild practices are followed routinely.
 - d. Records must be kept for a minimum of two years after the engine is rebuilt.

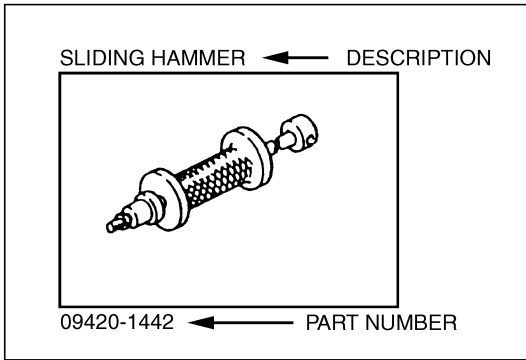
2. Maintenance instructions.

§ 86.007-38

- (1) For each new diesel-fueled engine subject to the standards prescribed in § 86.007-11, as applicable, the manufacturer shall furnish or cause to be furnished to the ultimate purchaser a statement that
“This engine must be operated only with ultra low-sulfur diesel fuel (meeting EPA specifications for highway diesel fuel, including a 15 ppm sulfur cap).”

HOW TO USE THIS WORKSHOP MANUAL

EN00Z01010200001



This workshop manual is designed as a guide for servicing the vehicles. An INDEX is provided on the first page of each chapter.

TROUBLESHOOTING is dealt with in each chapter.

When beginning operations, refer to the TROUBLESHOOTING section for a guide to appropriate diagnoses.

SPECIAL TOOLS are dealt with in each chapter.

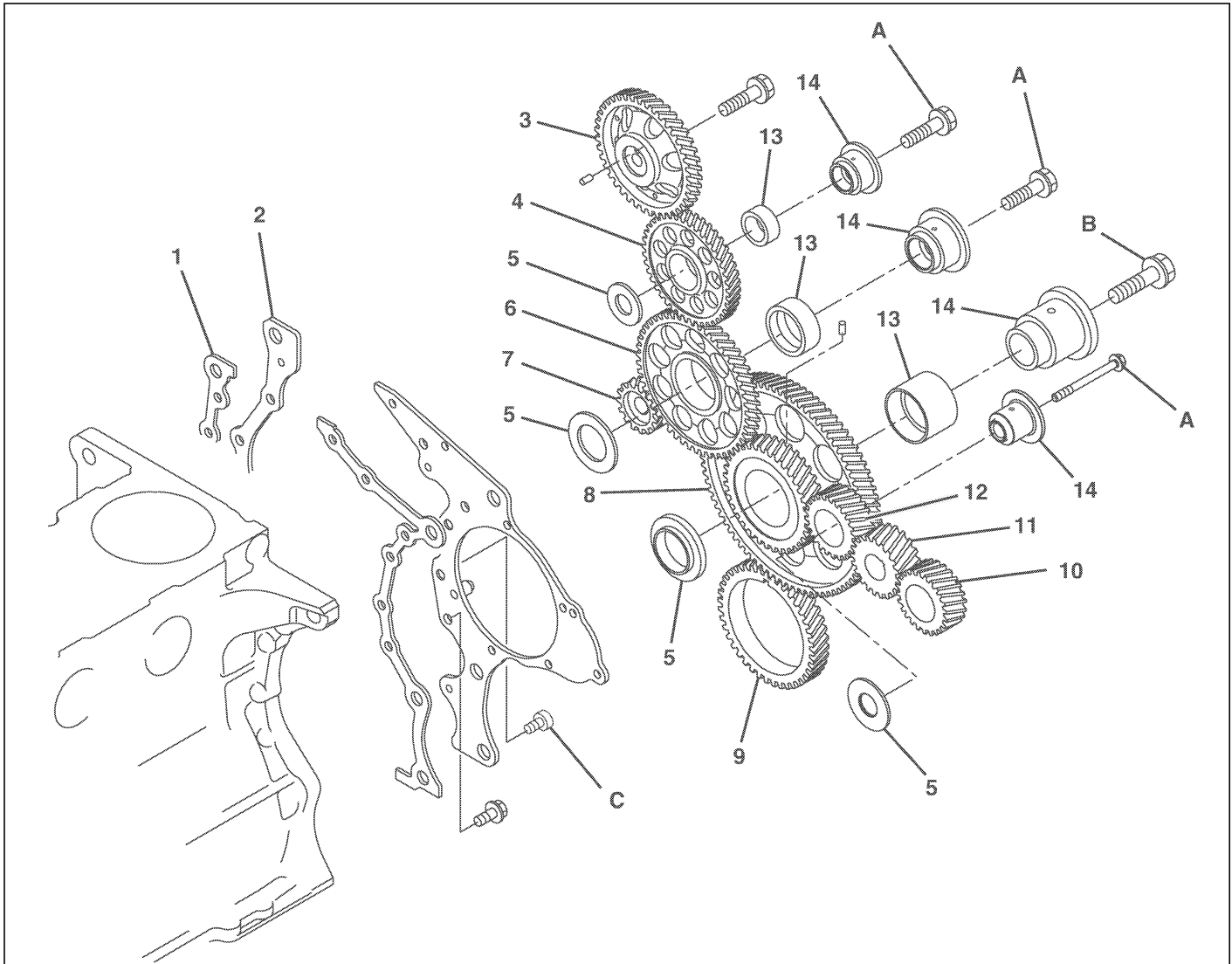
When ordering a special tool, confirm the part number with the applicable parts catalog.

- **REPAIR PROCEDURES**

Repair procedures when self-explanatory, such as simple installation and removal of parts, have been omitted. Illustrations, such as the one below, have been provided to make such simple procedures clear. Only essential procedures requiring specific directions have been dealt with explicitly.

TIMING GEAR AND CAMSHAFT

EXAMPLE:



SAPH00Z010100007

1	Gasket	8	Main idle gear
2	Rear end plate	9	Crankshaft gear
3	Camshaft gear	10	Power steering pump drive gear
4	Cam idle gear	11	Air compressor drive gear
5	Idle gear thrust plate	12	Air compressor idle gear
6	Sub-idle gear	13	Idle gear bushing
7	Oil pump gear	14	Idle gear shaft

Tightening torque**Unit: N·m {kgf·cm, lbf·ft}**

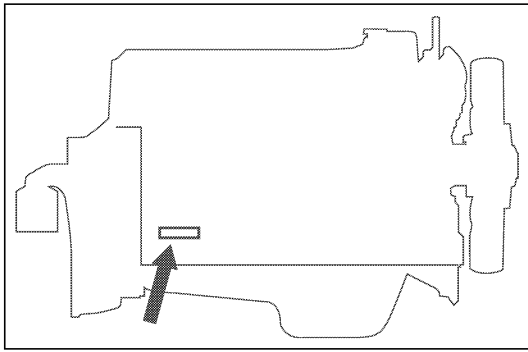
A	108 {1,100, 80}#	C	55 {560, 41} Application of lock sealant
B	172 {1,750, 127}#		

#=Apply oil to the threads and seat surfaces before tightening.

In some cases, illustrations may be of parts which differ in some nonessential way from the parts found on your particular vehicle. In such cases, the principle or procedure being illustrated applies regardless of such nonessential differences.

- DEFINITION OF TERMS**

This engine rotates counterclockwise viewed from the flywheel side.



SAPH00Z010100008

IDENTIFICATION INFORMATION

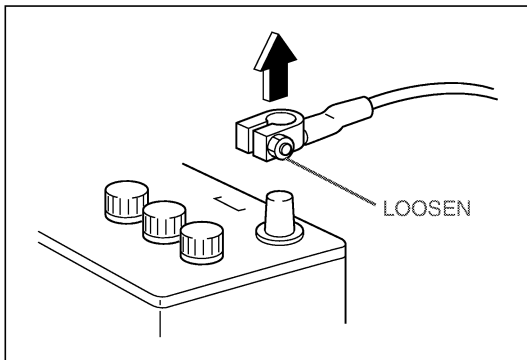
EN00Z01010200002

- **ENGINE SERIAL NUMBERS.**
Please quote these numbers when ordering spare parts or reporting technical matter to receive prompt service attention.
The engine serial number is engraved on the engine cylinder block.

PRECAUTIONS

EN00Z0101C100001

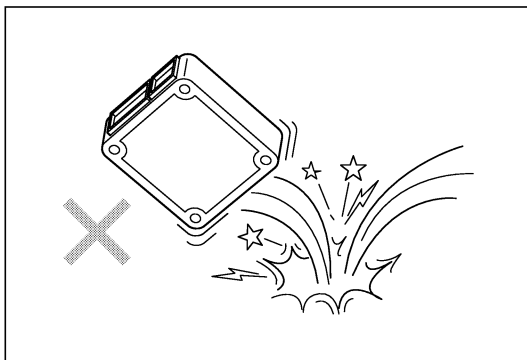
PRECAUTIONS FOR ELECTRICAL SYSTEM



SAPH00Z010100009

1. REMOVING THE BATTERY CABLE

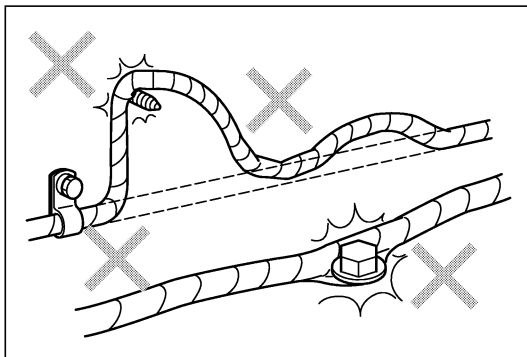
- (1) Before electrical system work, remove the cable from the minus terminal of the battery in order to avoid burning caused by short-circuiting.
- (2) To remove the battery cable, fully release the nut to avoid damage to the battery terminal. Never twist the terminal.



SAPH00Z010100010

2. HANDLING OF ELECTRONIC PARTS

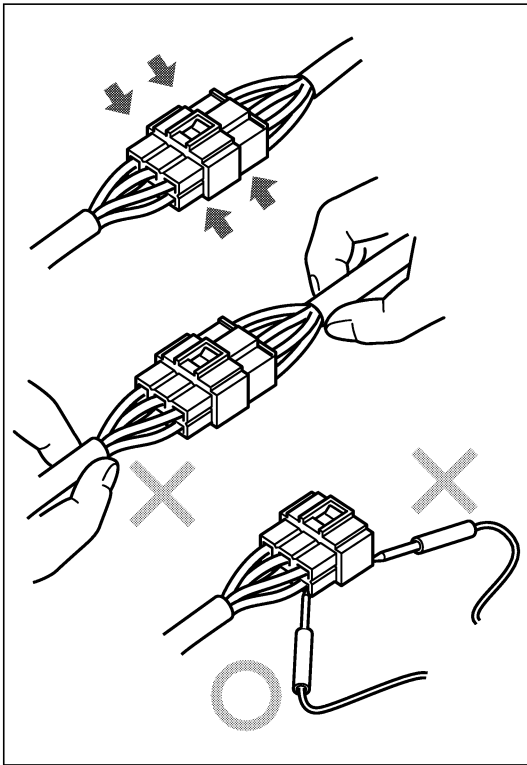
- (1) Never give an impact to electronic parts of a computer or relay.
- (2) Keep electronic parts away from high temperatures and humidity.
- (3) Never splash water onto electronic parts in washing the vehicle.



SAPH00Z010100011

3. HANDLING OF WIRE HARNESS

- (1) Perform marking on a clamp and a clip and secure then in original position so that the wire harness will not interfere with the end and acute angle section of the body and a bolt.
- (2) To attach a part, take care not to bite the wire harness.



SAPH00Z010100012

4. HANDLING OF CONNECTOR

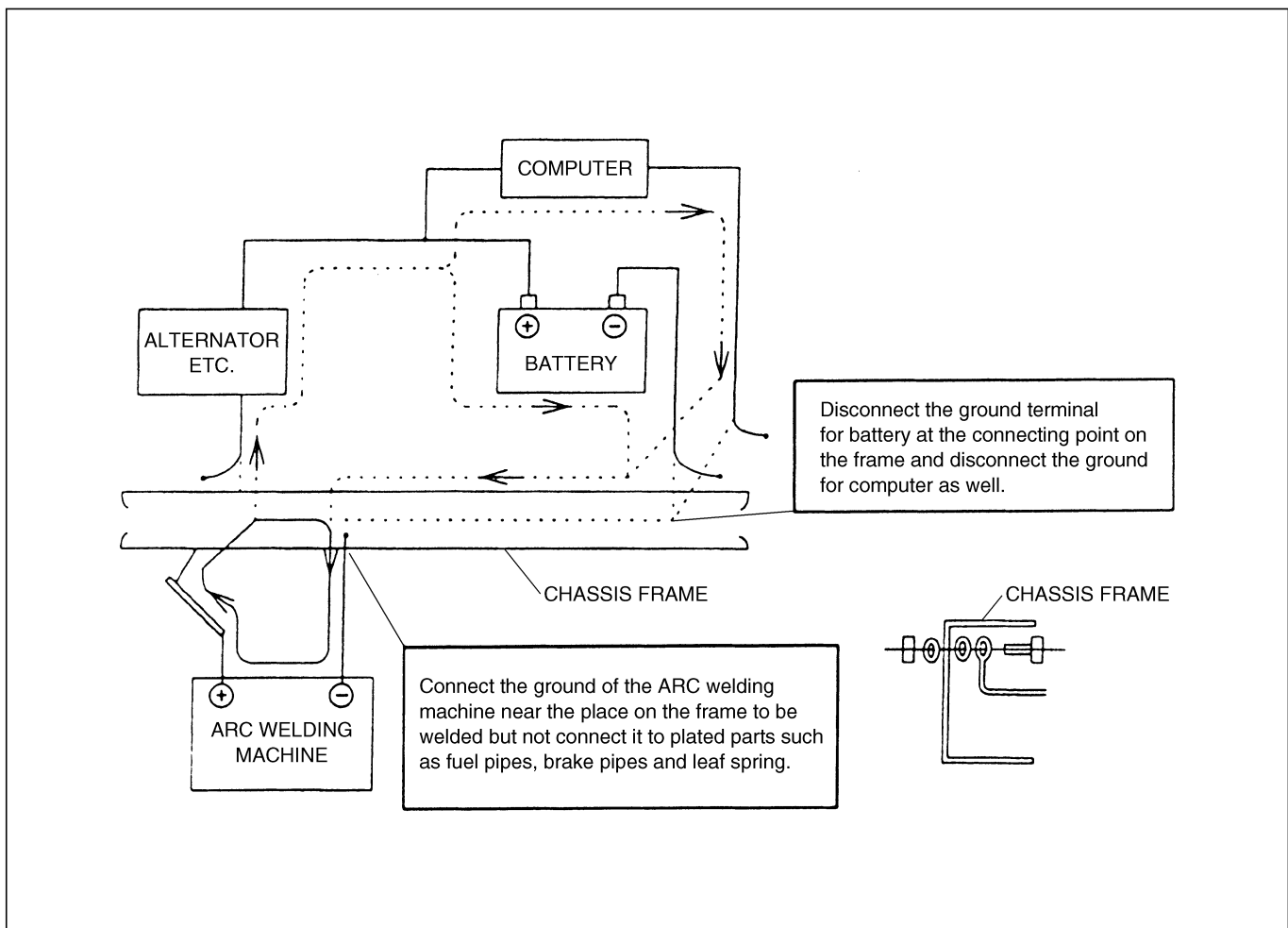
- (1) To remove a connector, hold the connector (indicated by an arrow in the figure) to pull it out. Never pull the harness.
- (2) To remove a connector with lock, release the lock then pull it out.
- (3) To connect a connector with lock, insert it until it clicks.
- (4) To insert a test lead into the connector, insert it from behind the connector.
- (5) In case it is difficult to insert a test lead from behind the connector, prepare a harness for inspection and perform inspection.

PRECAUTIONS FOR ELECTRIC WELDING

1. PRECAUTION FOR ELECTRIC WELDING

Electrical components such as the alternator and tachograph are directly connected to the battery and one end is earthed to the chassis frame. Under these conditions, welding current will flow back along the earth circuit if electric welding is carried out and damage may be caused to the alternator, tachograph, electrical components, etc. Consequently, the following precautions are always to be taken during welding.

- (1) Disconnect the earth terminal of the battery at the frame fitment and earth the welding equipment securely to the frame itself. (Do not fit the welding equipment earth to such things as the tire rims, brake pipes or fuel pipes and leaf spring, etc.)
 - a. Turn the starter switch off.
 - b. Disconnect the battery's negative terminal of the battery.
 - c. Earth welding equipment securely, near to the area to be welded.



SAPH00Z010100013

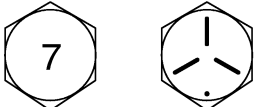
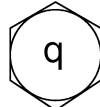
- (2) In order to prevent damage to ancillary equipment components from sparks during welding, take steps such as putting fire-resistant covers over things like the engine, meters, steering wheel, hoses, tubes, leaf spring and tires.

SPECIFIED TORQUE FOR STANDARD BOLTS AND NUTS

EN00Z01013200001

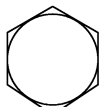
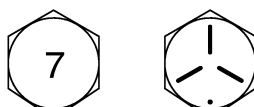
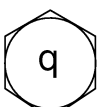
1. FLANGE BOLT

Unit: N·m {kgf·cm, lbf·ft}

Class	7T	9T
Representation		
Diameter x Pitch		
M8 x 1.25	28.5 {290, 21.0}	36 {370, 26.8}
M10 x 1.25	60 {610, 44.1}	74.5 {760, 55.0}
M10 x 1.5	55 {560, 40.5}	68.5 {700, 50.6}
M12 x 1.25	108 {1,100, 79.6}	136 {1,390, 100.5}
M12 x 1.75	97 {990, 71.6}	125 {1,280, 92.6}
M14 x 1.5	171.5 {1,750, 126.6}	216 {2,210, 159.8}
M14 x 2	154 {1,570, 113.6}	199 {2,030, 146.8}

2. BOLT WITH WASHER

Unit: N·m {kgf·cm, lbf·ft}

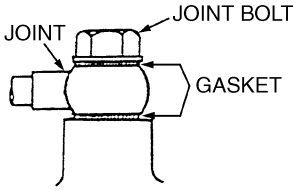
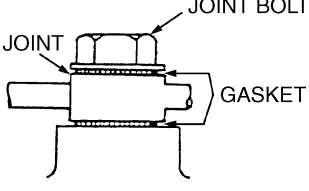
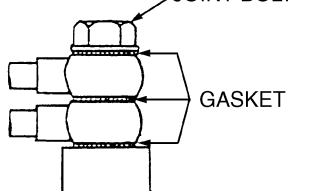
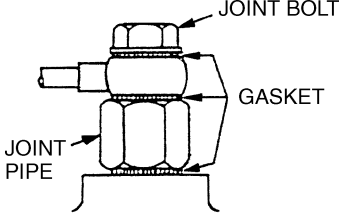
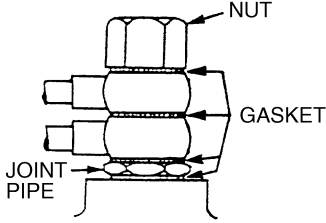
Class	4T	7T	9T
Representation			
Diameter x Pitch	No Mark		
M6 x 1	6 {60, 4.3}	10 {100, 7.2}	13 {130, 9.4}
M8 x 1.25	14 {140, 10.1}	25 {250, 18.1}	31 {320, 23.1}
M10 x 1.25	29 {300, 21.7}	51 {520, 37.6}	64 {650, 47.0}
M10 x 1.5	26 {270, 19.5}	47 {480, 34.7}	59 {600, 43.4}
M12 x 1.25	54 {550, 39.8}	93 {950, 68.7}	118 {1,200, 86.8}
M12 x 1.75	49 {500, 36.2}	83 {850, 61.5}	108 {1,100, 79.6}
M14 x 1.5	83 {850, 61.5}	147 {1,500, 108.5}	186 {1,900, 137.4}
M14 x 2	74 {750, 54.2}	132 {1,350, 97.6}	172 {1,750, 126.6}

DISMOUNTING AND MOUNTING

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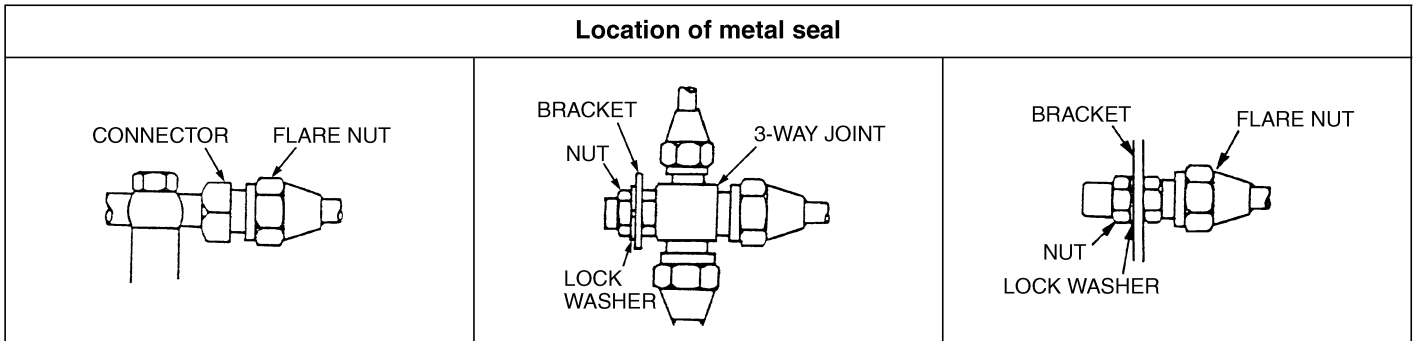
PROCEDURE FOR INSTALLING JOINTS AND GASKETS OF ENGINE PIPING

1. Gasket seal type (aluminum + rubber, asbestos or copper).

Location of gasket seal		
		
		

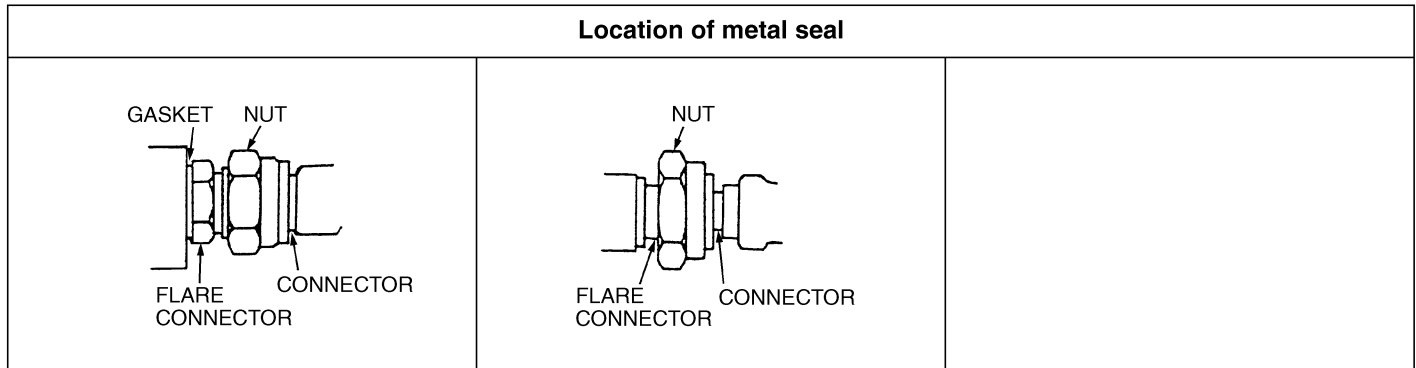
Tightening torque chart

Clamping screw size (Diameter) mm {in.}	Tightening torque N·m {kgf·cm, lbf·ft}
8 {0.315}	13 {130, 9}
10 {0.394}	20 {200, 14}
12 {0.472}	25 {250, 18}
14 {0.551}	25 {250, 18}
16 {0.630}	29 {300, 22}
18 {0.709}	39 {400, 29}
20 {0.787}	*39 {400, 29}
24 {0.945}	69 {700, 51}
28 {1.102}	127 {1,300, 94}

2. Metal seal type (Flare connector type).**Location of metal seal****Tightening torque chart**

Clamping screw size (Diameter) mm {in.}	Tightening torque N·m {kgf·cm, lbf·ft}
12 {0.472}	20 {200, 14}
14 {0.551}	31 {320, 23}
16 {0.630}	39 {400, 29}
18 {0.709}	59 {600, 43}
20 {0.787}	64 {650, 47}

3. Metal seal type (Nipple connector type).



Tightening torque chart

Clamping screw size (Diameter) mm {in.}	Tightening torque N·m {kgf·cm, lbf·ft}
10 {0.394}	11 {110, 8}
24 {0.945}	20 {200, 14}

NOTICE

- Before installing the joints, ensure that there is no dirt or burrs adhering to the various seat faces (pipe joints, gasket, etc.)
- Because the pipes can move relatively freely during installation and the seat faces are liable to tilt, first temporarily tighten the pipes, then tighten them to the specified torque and ensure that there is no leakage from them.
- When tightening two pipes together, be very careful that they do not rotate together.
- After installing the pipes, apply the correct pressure to each pipe joint and ensure that there is no leakage.
- Ensure that the various tightening torques conform to the above table.

*If a soft washer #4840 FR-N (aluminum + rubber and carbon press fit part) is loosened or removed subsequent to being installed, be sure and replace it with a new one.

There is no need to replace it, however, for normal retightening.

SYMPTOM SIMULATION

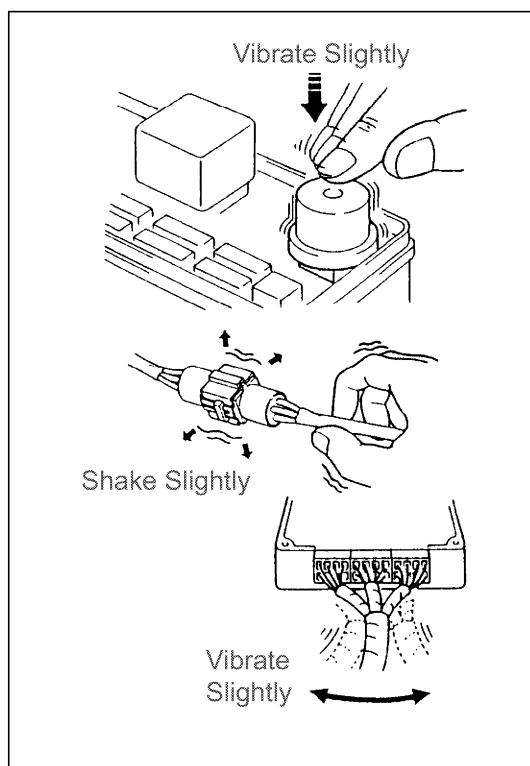
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HINT

The most difficult case in troubleshooting is when no problem symptoms occur. In such a case, a thorough problem analysis must be carried out. A simulation of the same or similar conditions and environment in which the problem occurred in the customer's vehicle should be carried out. No matter how much skill or experience a technician has, troubleshooting without confirming the problem symptoms will lead to important repairs being overlooked and mistakes or delays.

For example:

With a problem that only occurs when the engine is cold or as a result of vibration caused by the road during driving, the problem can never be determined if the symptoms are being checked on a stationary vehicle or a vehicle with a warmed-up engine. Vibration, heat or water penetration (moisture) is difficult to reproduce. The symptom simulation tests below are effective substitutes for the conditions and can be applied on a stationary vehicle. Important points in the symptom simulation test: In the symptom simulation test, the problem symptoms as well as the problem area or parts must be confirmed. First, narrow down the possible problem circuits according to the symptoms. Then, connect the tester and carry out the symptom simulation test, judging whether the circuit being tested is defective or normal. Also, confirm the problem symptoms at the same time. Refer to the problem symptoms table for each system to narrow down the possible causes.



1. **VIBRATION METHOD:** When malfunction seems to occur as a result of vibration.

(1) **PART AND SENSOR**

Apply slight vibration with a finger to the part of the sensor suspected to be the cause of the problem, and check whether or not the malfunction occurs.

NOTICE

Applying strong vibration to relays may open relays

(2) **CONNECTORS**

Slightly shake the connector vertically and horizontally.

(3) **WIRE HARNESS**

Slightly shake the wire harness vertically and horizontally.

HINT

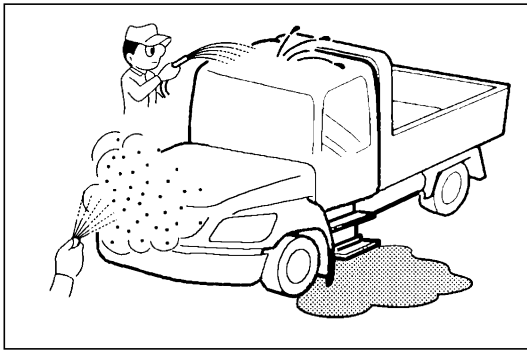
The connector joint and fulcrum of the vibration are the major areas that should be checked thoroughly.

2. **HEAT METHOD:** When a malfunction seems to occur when the area in question is heated.

(1) Heat the component that is the possible cause of the malfunction with a hair dryer or similar device. Check if the malfunction occurs.

NOTICE

- Do not heat to more than 60°C (140°F). Exceeding this temperature may damage components.
- Do not apply heat directly to the parts in the ECU.



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3. WATER SPRINKLING METHOD: When a malfunction seems to occur on a rainy day or in high-humidity.

- (1) Sprinkle water onto the vehicle and check if the malfunction occurs.

NOTICE

- Never sprinkle water directly into the engine compartment. Indirectly change the temperature and humidity by spraying water onto the front of the radiator.
- Never apply water directly onto the electronic components.

HINT

If the vehicle has or had a water leakage problem, the leakage may have damaged the ECU or connections. Look for evidence of corrosion or short circuits. Proceed with caution during water tests.

4. HIGH ELECTRICAL LOAD METHOD: When a malfunction seems to occur when electrical load is excessive.

- (1) Turn on the heater blower, headlight, rear window defogger and all other electrical loads. Check if the malfunction reoccurs.

ENGINE INTRODUCTION (J08E)

EN01-001

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ENGINE ASSEMBLY

DATA AND SPECIFICATIONS

EN0110601200001

Model		J08E-TV
Type		Diesel, 4 cycle, vertical, 6 cylinder, in-line overhead camshaft, water-cooled, direct injection
Aspiration		Turbocharged with intercooler
Bore and stroke		112x130 mm {4.41x5.11 in.}
Piston displacement		7.684 L {468.9 cu.in.}
Compression ratio		17.5: 1
Firing order		1-4-2-6-3-5 (The cylinder numbers are counted in order from the crankshaft pulley side)
Direction of rotation		Counterclockwise viewed from flywheel
Compression pressure		3.2-3.4 MPa {33-35 kgf/cm ² , 467-496 lbf/in. ² } at 150 r/min
Maximum revolution (at full load)		2,600 r/min
Idling revolution		750 r/min
Dry weight		Approximately 640 kg {1,411 lb}
Valve seat angle	Intake	30°
	Exhaust	45°
Valve face angle	Intake	30°
	Exhaust	45°
Valve timing (flywheel travel)	Intake opens	13° before top dead center
	Intake closes	21° after bottom dead center
	Exhaust opens	59° before bottom dead center
	Exhaust closes	13° after top dead center
Valve clearance (when cold)	Intake	0.30 mm {0.0118 in.}
	Exhaust	0.45 mm {0.0177 in.}
Engine oil pump	Type	Full forced pressure feed by gear pump
	Drive	By gear
Engine oil cooler		Multi-plate type, water cooled
Injector	Type	Multi-hole nozzle type
Coolant pump	Type	Forced circulation by volute pump
	Drive	By V-belt
Thermostat Type		Wax.type, bottom bypass system
Injection timing (flywheel travel)		0° before top dead center for No.1 cylinder of the compression stroke

Model		J08E-TW
Type		Diesel, 4 cycle, vertical, 6 cylinder, in-line overhead camshaft, water-cooled, direct injection
Aspiration		Turbocharged with intercooler
Bore and stroke		112x130 mm {4.41x5.11 in.}
Piston displacement		7.684 L {468.9 cu.in.}
Compression ratio		17.5: 1
Firing order		1-4-2-6-3-5 (The cylinder numbers are counted in order from the crankshaft pulley side)
Direction of rotation		Counterclockwise viewed from flywheel
Compression pressure		3.2-3.4 MPa {33-35 kgf/cm², 467-496 lbf/in.²} at 150 r/min
Maximum revolution (at full load)		2,600 r/min
Idling revolution		750 r/min
Dry weight		Approximately 645 kg {1,422 lb}
Valve seat angle	Intake	30°
	Exhaust	45°
Valve face angle	Intake	30°
	Exhaust	45°
Valve timing (flywheel travel)	Intake opens	13° before top dead center
	Intake closes	21° after bottom dead center
	Exhaust opens	59° before bottom dead center
	Exhaust closes	13° after top dead center
Valve clearance (when cold)	Intake	0.30 mm {0.0118 in.}
	Exhaust	0.45 mm {0.0177 in.}
Engine oil pump	Type	Full forced pressure feed by gear pump
	Drive	By gear
Engine oil cooler		Multi-plate type, water cooled
Injector	Type	Multi-hole nozzle type
Coolant pump	Type	Forced circulation by volute pump
	Drive	By V-belt
Thermostat Type		Wax.type, bottom bypass system
Injection timing (flywheel travel)		0° before top dead center for No.1 cylinder of the compression stroke

TROUBLESHOOTING

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Engine overheating

Symptom	Possible cause	Remedy/Prevention
Engine overheating (Coolant)	Insufficient coolant	Add coolant
	Defective thermostat	Replace thermostat
	Overflow of coolant due to leakage of exhaust into cooling system	Repair
	Damaged rubber hose	Replace rubber hose
	Coolant leakage due to deteriorated rubber hose	Replace rubber hose
	Coolant leakage from coolant pump	Replace the coolant pump
	Coolant leakage from rubber hose connection	Retighten or replace clamp
	Coolant leakage from cylinder head gasket	Replace gasket
Engine overheating (Coolant pump)	Bearing seizure	Replace
	Damaged (corroded) vane	Replace vane
Engine overheating (Radiator)	Clogged with rust or scale	Clean radiator
	Clogged with iron oxide due to leakage of exhaust into cooling system	Clean coolant passage and correct exhaust leakage
	Coolant leakage	Repair or replace radiator
	Damaged cooling fan	Replace cooling fan
	Clogged radiator core due to mud or other debris	Clean radiator
	Defective radiator cap pressure valve	Replace radiator cap
Engine overheating (Abnormal combustion)	Poor fuel	Use good quality fuel
	Breakdown of injector	Replace the injector
Engine overheating (Other problems)	Defective or deteriorated engine oil	Change engine oil
	Unsatisfactory operation of oil pump	Replace or repair
	Insufficient oil	Add oil
	Brake drag	Repair or adjust
	Break water temperature sensor	Replace it
Engine overheating (Severe operating condition)	Lugging the engine	Operate engine properly

Excessive oil consumption

Symptom	Possible cause	Remedy/Prevention
Excessive oil consumption (Pistons, cylinder liners, and piston rings)	Wear of piston ring and cylinder liner	Replace piston rings and cylinder liner
	Worn, sticking or broken piston rings	Replace piston rings and cylinder liner
	Insufficient tension on piston rings	Replace piston rings and cylinder liner
	Unsatisfactory breaking in of piston rings	Replace piston rings and cylinder liner
	Unsuitable oil (viscosity too low)	Change oil as required and replace piston rings and cylinder liners
	Incorrectly fitted piston rings (upside down)	Replace piston rings
	Gaps of piston rings in cell with each other	Reassemble piston rings
Excessive oil consumption (Valve and valve guides)	Worn valve stem	Replace valve and valve guide
	Worn valve guide	Replace valve guide
	Incorrectly fitted valve stem seal	Replace the stem seal
	Excessive lubricant on rocker arm	Check clearance of rocker arm and shaft
Excessive oil consumption (Excess oil feed)	Defective oil level gauge	Replace oil level gauge
	Oil level too high	Drain excess oil
Excessive oil consumption (Oil leakage from miscellaneous parts)	Oil leakage from oil seal	Replace oil seal
	Cracks or blowhole in cylinder block	Replace cylinder block
	Oil leakage from connections of oil lines	Tighten connections of oil lines
	Oil leakage from oil cooler	Replace oil cooler
	Oil leakage from oil pan gasket	Replace oil pan gasket
	Oil leakage from O-ring	Replace O-ring
Excessive oil consumption (Other problems)	Overcooled engine (low temperature wear)	Warm up engine before moving vehicle. Check cooling system.

NOTICE

If oil consumption is excessive, the problems above will occur. Complaints from the customer are often related to such problems.

1. White smoke is emitted continuously when the engine is run at high speed.
2. White smoke is emitted only immediately after the engine speed is abruptly raised when idling.
3. The tail pipe is blackened with oil.
4. Oil leaks from the flanges of the exhaust manifold.
5. Lack of power.

Piston seizure

Symptom	Possible cause	Remedy/Prevention
Piston seizure (Pistons, cylinder liners and piston rings)	Incorrect clearance between piston and cylinder liner	Replace piston, piston rings and cylinder liner
	Unsatisfactory installation of piston pin	Replace piston, piston rings, cylinder liner and piston pin as required
	Broken piston ring	Replace piston, piston rings and cylinder liner
	Difference in expansion due to use of wrong piston	Replace piston, piston rings and cylinder liner
Piston seizure (Coolant)	Reduction in capacity of coolant pump (due to vane corrosion)	Replace the coolant pump
	Leakage of coolant	Repair
	Insufficient coolant	Add coolant
	Dirty coolant	Clean and replace coolant
	Defective radiator (coolant leakage, clogging)	Repair or replace the radiator
	Defective rubber hose (leakage)	Replace rubber hose
	Defective thermostat	Replace the thermostat
	Leakage of exhaust into cooling system	Repair
Piston seizure (Operation)	Abrupt stoppage of engine after running at high speed	Operate engine properly
	Hill climbing using unsuitable gear	Select suitable gear
Piston seizure (Oil)	Insufficient oil	Add oil
	Dirty oil	Change oil
	Poor quality oil	Replace with proper engine oil
	High oil temperature	Repair
	Low oil pressure	Repair
	Defective oil pump	Repair oil pump
	Reduced performance due to worn oil pump	Replace oil pump
Suction strainer sucking air	Add oil and/or repair strainer	
Piston seizure (Abnormal combustion)	Use of defective fuel	Change fuel
	Engine overheating	See Symptom: "Engine overheating"
	Breakdown of injector	Replace the injector

NOTICE

If piston seizure occurs, the problems above will occur. Complaints from the customer are often related to these problems.

1. White smoke is emitted.
2. Lack of power

Lack of power

Symptom	Possible cause	Remedy/Prevention
Lack of power (Supply pump)	Damaged suction control valve	Replace the supply pump
Lack of power (Intake)	Clogged air cleaner	Clean element or replace element
Lack of power (Overheating)		See Symptom: "Engine overheating"
Lack of power (Fuel and injector)	Air in fuel system	Repair and bleed air from fuel system
	Clogged fuel filter	Replace element
	Use of poor fuel	Use good quality fuel
	Breakdown of injector	Replace the injector
Lack of power (Pistons, cylinder liners and piston rings)	Seized or wear of piston	Replace the piston, piston rings and liner
	Worn or broken piston rings, piston and cylinder liner	Replace piston rings, piston and liner
Lack of power (Other problems)	Exhaust brake butterfly valve stuck in half-open position	Replace or repair exhaust brake
	Connecting rod bent	Replace or repair connecting rod
	Exhaust pipe or muffler crushed (increased back-pressure)	Replace exhaust pipe or muffler
	Breakage of turbine or blower	Replace turbocharger

Leakage of exhaust

Symptom	Possible cause	Remedy/Prevention
Leakage of exhaust (Head gasket)	Fatigued gasket (aging)	Replace gasket
	Damage	Replace gasket
	Improper installation	Replace gasket
Leakage of exhaust (Head bolts)	Loose bolts	Tighten bolts
	Elongated bolts	Replace bolts
	Improper tightening torque or tightening sequence	Tighten properly
Leakage of exhaust (Cylinder block)	Cracking	Replace cylinder block
	Surface distortion	Repair or replace
	Fretting of cylinder liner insertion portion (insufficient projection of cylinder liner)	Replace cylinder block
Leakage of exhaust (Cylinder head)	Cracking	Replace cylinder head
	Surface distortion	Repair or replace
Leakage of exhaust (Cylinder liners)	Cracking	Replace cylinder liner
	Corrosion	Replace cylinder liner
	Insufficient projection of cylinder liner	Replace cylinder liner

NOTICE

If leakage of the exhaust occurs, the problems above will occur. Complaints from the customer are often related to these problems.

1. Lack of power.
2. The engine overheats.
3. The coolant is discolored.

Difficulty starting engine

Symptom	Possible cause	Remedy/Prevention
Difficulty starting engine (Electrical system)	Discharged battery	Charge battery
	Defective wiring in starter circuit	Repair wiring of starter
	Loose or open-circuit battery cable	Tighten battery terminal connections or replace battery cable
	Broken glow plug	Replace
Difficulty starting engine (Supply pump)	Defective supply pump	Replace the supply pump
Difficulty starting engine (Air cleaner)	Clogged element	Replace the element
Difficulty starting engine (Fuel system)	No fuel in tank	Supply fuel
	Clogged fuel line	Clean fuel line
	Air sucked into fuel system through fuel line connections	Tighten fuel line connections
	Clogged fuel filter	Replace element
	Loose connection in high-pressure line	Tighten sleeve nut of high-pressure line
	Water in fuel	Drain and clean fuel system
Difficulty starting engine (Oil system)	Oil viscosity too high	Use proper viscosity oil, or install an oil immersion heater and warm up oil
Difficulty starting engine (Other problems)	Seized piston	Replace piston, piston rings, and liner
	Seized bearing	Replace bearing and/or crankshaft
	Reduced compression pressure	Overhaul engine
	Ring gear damaged or worn	Replace the ring gear and/or starter pinion
	Improperly adjusted or broken	Adjust

Rough idling

Symptom	Possible cause	Remedy/Prevention
Rough idling (Supply pump)	Damaged suction control valve	Replace the supply pump
Rough idling (Injector)	Breakdown of injector	Replace the injector
Rough idling (Engine proper)	Improper valve clearance	Adjust valve clearance
	Improper contact of valve seat	Replace or repair valve and valve seat
	Idling speed too low	Adjust idling speed
	Coolant temperature too low	Warm up engine
	Compression pressure of cylinders markedly different from one another	Overhaul engine
Rough idling (Other problems)	Clogged high pressure injection line	Replace line
	Leakage due to improper tightening of high pressure fuel line	Tighten sleeve nut
	Engine seizure	Replace pistons, piston rings and liners
	Incorrect valve timing	Replace camshaft

Diesel knock

Symptom	Possible cause	Remedy/Prevention
Diesel knock (Supply pump)	Damaged suction control valve	Replace the supply pump
Diesel knock (Injector)	Breakdown of injector	Replace the injector
Diesel knock (Fuel system)	Use of poor fuel	Use good quality fuel
Diesel knock (Other problems)	Excessively cooled or heated engine	Warm up or cool engine
	Insufficient air intake	Correct
	Insufficient compression pressure	Repair
	Compression pressure leaks at cylinder head gasket	Replace head gasket
	Improper valve clearance or valve sticking	Adjust or repair
	Tappet sticking	Replace tappet and camshaft

Unusual engine noise

Symptom	Possible cause	Remedy/Prevention
Unusual engine noise (Piston)	Wear of piston pin boss or piston pin	Replace piston and/or piston pin
	Seized, damaged, or worn piston pin bushing	Replace piston pin bushing
	Worn pistons or cylinder liners	Replace piston or cylinder liner
	Damaged or seized piston	Replace piston and cylinder liner
	Foreign matter on top surface of the piston	Remove foreign matter and repair or replace piston, cylinder liner, and/or cylinder head
Unusual engine noise (Valve mechanism)	Incorrect valve clearance	Adjust valve clearance
	Valve cotter out of place	Replace valve cotter
	Seized valve stem	Replace valve and valve guide
	Broken valve	Replace valve
	Damaged rocker arm support	Replace rocker arm support
	Broken valve spring	Replace valve spring
Unusual engine noise (Bearings seizure)	Insufficient lubricating oil	Add oil
	Excessive or insufficient tightening of bearing housings	Retighten to specified torque
	Pits and scratches on bearing surface	Replace bearing and crankshaft
	Oil film formed on back of bearing	Replace bearing
	Improper installation of bearing	Replace bearing
	Reduction of spread dimension of bearing	Replace bearing
	Distorted bearing housing	Replace or correct bearing housing
	Excessive oil clearance	Replace bearing
Unusual engine noise (Various other parts)	Exhaust gas leakage from exhaust pipe joints	Retighten joints
	Loosen or missing intake manifold flange gasket	Retighten or replace
	Intake valve seating is not concentric	Replace or correct the valve and valve seat
	Intake gas leakage	Retighten

Symptom	Possible cause	Remedy/Prevention
Unusual engine noise (Other problems)	Loose cooling fan mounting bolts or fan pulley nut	Tighten the fan and crankshaft pulley
	Lack of lubricating oil (coolant pump, valves, etc.)	Lubricate
	Worn timing gear	Replace the timing gear
	Breakage of turbine or blower	Replace turbocharger

NOTICE

The items on this page concern unusual engine noise which is due to causes other than those given for diesel knock.

TROUBLESHOOTING (COMMON RAIL SYSTEM)

EN0110601F300002

Engine does not start

Symptom	Possible cause	Remedy/Prevention
Engine does not start (Fuel not reaching supply pump)	Fuel lines clogged or damaged	Clean or replace fuel lines
	Fuel filter clogged	Clean or replace the filter element
	Air in fuel caused by improper connections of fuel line between fuel tank and feed pump	Repair connections
	Filter incorporated in inlet side of feed pump clogged	Remove foreign material
	Breakdown feed pump	Replace the supply pump
Engine does not start (Fuel reaching supply pump)	Leakage due to improper tightening of high pressure fuel line	Tighten sleeve nut
	Breakdown ECU	Replace the ECU
Engine does not start (Injector faulty)	Injector broken	Replace the injector
Engine does not start (Electrical system)	Defective sensors or circuits	Refer to the chapter "FUEL CONTROL"
Engine starts and stops	Fuel lines clogged	Clean or replace fuel lines
	Air in fuel caused by damaged fuel lines or improper connection of fuel lines	Repair fuel lines or replace fuel lines and gaskets
Engine has low power (Injector faulty)	Injector broken	Replace the injector
Engine has low power (Electrical system)	Defective sensors or circuits	Refer to the chapter "FUEL CONTROL"

Excessive smoke (Black smoke)

Symptom	Possible cause	Remedy/Prevention
Excessive smoke (Black smoke)	Defective sensors or circuits	Refer to the chapter "FUEL CONTROL"
	Defective injector	Replace the injector
Excessive smoke (White smoke)	Water in fuel	Check and clean fuel lines
	Glow plug not operating	Check glow plug circuit

Low idle speed irregular

Symptom	Possible cause	Remedy/Prevention
Low idle speed irregular	Defective sensors or circuits	Refer to the chapter "FUEL CONTROL"
	Defective injector	Replace the injector

ENGINE TUNEUP

EN0110601H300001

VALVE CLEARANCE CHECKING AND ADJUSTING PROCEDURES

NOTICE

Valve clearance adjustment is performed only when the checking result is not within the specified value.

1. PREPARATION OF CHECKING AND ADJUSTMENT

- (1) Positioning the No.1 or No.6 piston at Top Dead Center of the compression stroke.
 - a. Turn the crankshaft counterclockwise (viewed from the flywheel side) to align mark "1/6" on the outer periphery of the flywheel with the pointer of the flywheel housing.

NOTICE

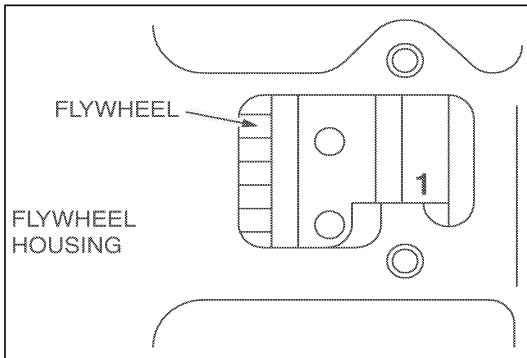
- Always turn the crankshaft counterclockwise (viewed from the flywheel side).
- In this position the No.1 or No.6 piston is at the Top Dead Center of the compression stroke.

- b. Turn the crankshaft clockwise in the engine direction and align the damper timing mark "1/6" to the pointer.

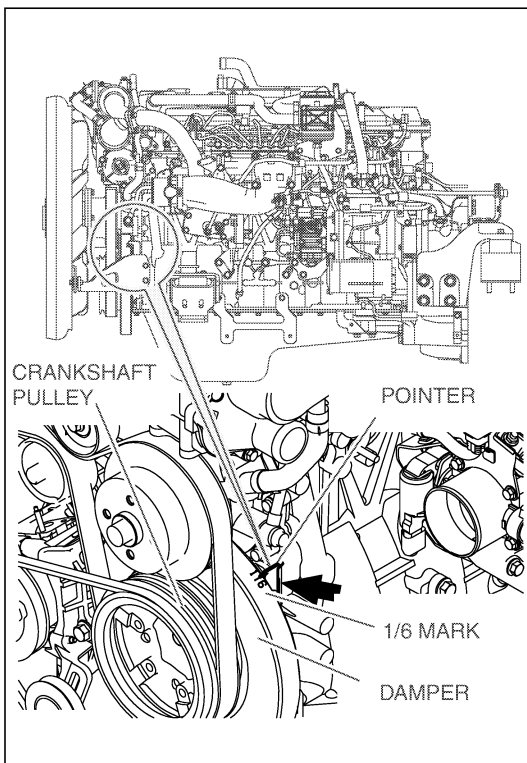
NOTICE

When matching the pulley mark "1/6" of the crankshaft pulley, attach the 3 pins on the special tool to any of the 6 corresponding holes on the crankpulley. Then turn the torque wrench in a clockwise direction.

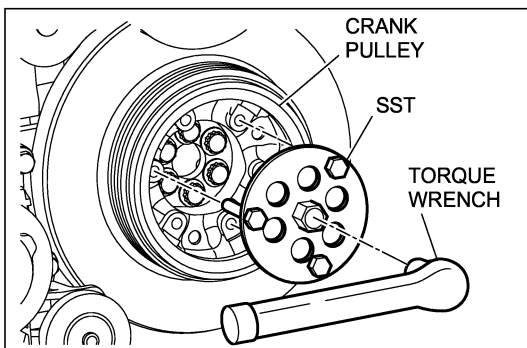
SST: Cranking Tool (S0940-91200)



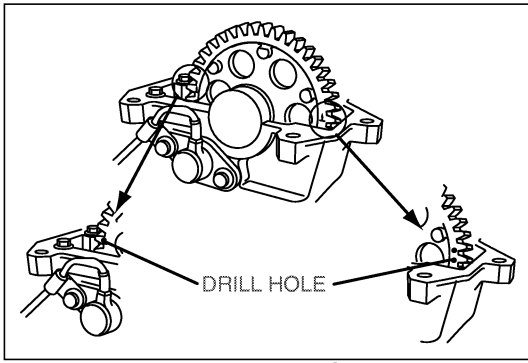
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SAPH011060100049



SAPH011060100003

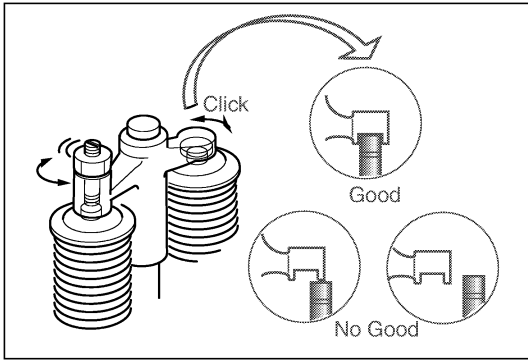


SAPH011060100004

- (2) Among three drill holes on the camshaft gear, when two drill holes are on horizontal position, and the rest of the drill hole is visible, the No.1 piston is at the Top Dead Center of the compression stroke .

NOTICE

If the rest of drill hole is invisible by camshaft housing, the No.6 piston is at the Top Dead Center of the compression stroke.



SAPH011060100005

- (3) Make sure that the valve stem is correctly inserted in the cross head.
NOTICE
Move the cross head with fingers right and left to confirm the valve stem is correctly inserted in the cross head by listening to the clicking sound.
- (4) Confirm that there are no foreign particles or dust between the cross head and the valve stem.

2. VALVE CLEARANCE CHECKING

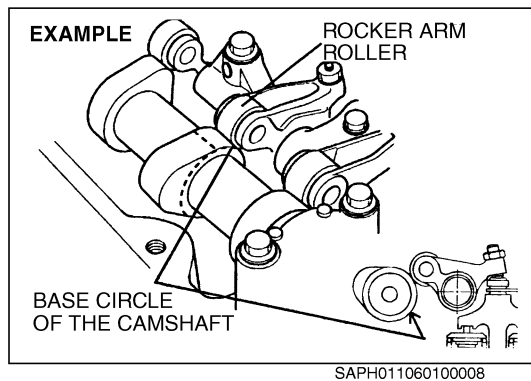
NOTICE

Before beginning the checking, you must perform "PREPARATION OF CHECKING AND ADJUSTMENT" described on page EN01-12.

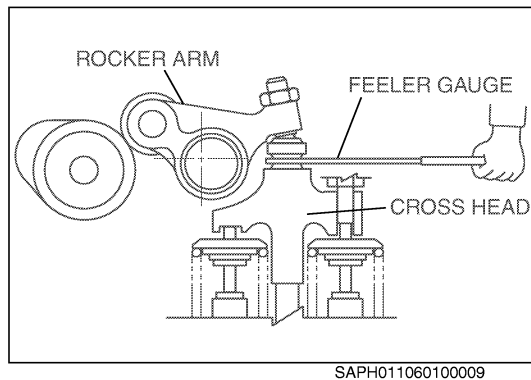
- (1) You can understand which valve to adjust when No.1 or No.6 piston is at the Top Dead Center of the compression stroke by the following chart).

	Cylinder			1		2		3		4		5		6	
	Valve			IN	EX	IN	EX	IN	EX	IN	EX	IN	EX	IN	EX
With No.1 piston at T.D.C. on compression stroke	Camshaft gear condition		Two drill holes and camshaft housing is horizontal. The rest of drill hole is visible. #1	○	○			○	○			○	○		
With No.6 piston at T.D.C. on compression stroke			Two drill holes and camshaft housing is horizontal. The rest of drill hole is invisible. #1				○			○	○			○	○

- #1= View from rear side of camshaft housing
- ○Mark: Possible to check valve clearance
- Firing order : 1-4-2-6-3-5
- T.D.C. : Top Dead Center



- (2) Before checking the valve clearance, make sure that the roller is on the base circle of the camshaft.



- (3) Insert a feeler gauge of the specified thickness as below between the rocker arm and the cross head to check the valve clearance.

VALVE CLEARANCE (when cold)

Intake valve	0.30 mm {0.0118 in.}
Exhaust valve	0.45 mm {0.0177 in.}

NOTICE

Valve clearance adjustment is performed only when the checking result is outside the specified value.

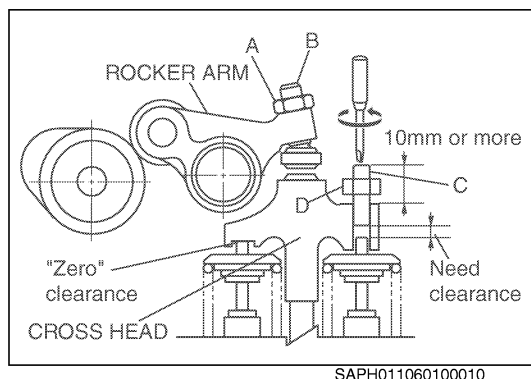
3. VALVE CLEARANCE ADJUSTMENT

NOTICE

Valve clearance adjustment is performed only when the checking result is outside the specified value.

NOTICE

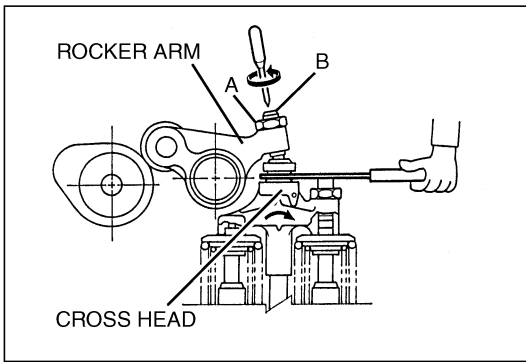
- Before beginning the adjustment you must perform "PREPARATION OF CHECKING AND ADJUSTMENT" described on page EN01-12.
- As for the valve which can adjust the valve clearance refer to the chart on page EN01-13.
- Make sure that the cylinder head bolt, rocker arm support bolt, nozzle clamp bolt, cam housing bolt and cam bearing cap bolt are tightened to the specified torque.



- (1) Loosen the adjusting screw lock nut A, D of the rocker arm and cross head fully.
- (2) The cross head adjusting screw must protrude 10 mm {0.394 in.} or more from the cross head upper face.

NOTICE

Unless the adjusting screw is completely loose to the valve stem head, the following adjustments may be adversely affected.



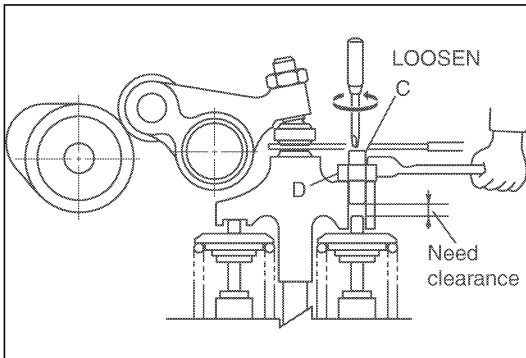
SAPH011060100011

- (3) Insert a feeler gauge of the specified thickness shown below between the rocker arm and the cross head, and adjust the valve clearance with the adjust screw of the rocker arm.

VALVE CLEARANCE (when cold)

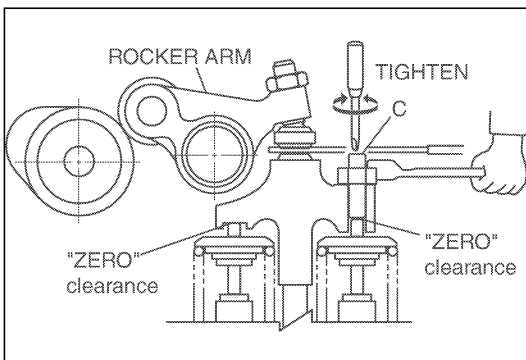
Intake valve	0.30 mm {0.0118 in.}
Exhaust valve	0.45 mm {0.0177 in.}

- (4) After completion of the adjustment, tighten the lock nut A securely with the specified tightening torque.

Tightening Torque:**25 N·m {250 kgf·cm, 18 lbf·ft}**

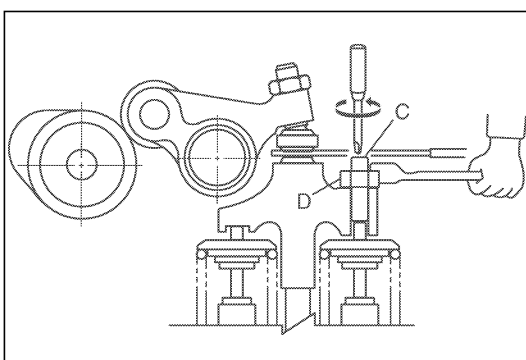
SAPH011060100012

- (5) The condition of inserted feeler gauge, loosen the adjusting screw of the cross head, make sure that the feeler gauge does not feel loose.

NOTICE**If the feeling of the feeler gauge becomes loose, repeat steps from (1).**

SAPH011060100013

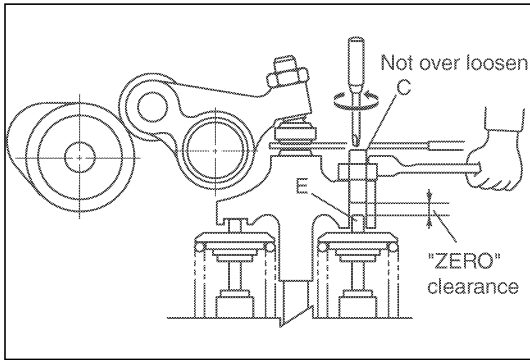
- (6) Tighten the adjusting screw C of the cross head until the feeler gauge does not move.

NOTICE**In this situation, clearance between adjusting screw C and valve stem head is zero.**

SAPH011060100014

- (7) While loosening the adjusting screw C of the cross head gradually, adjust the valve clearance. Tighten the lock nut D of the cross head securely with the specified tightening torque when the feeler gauge feels correct.

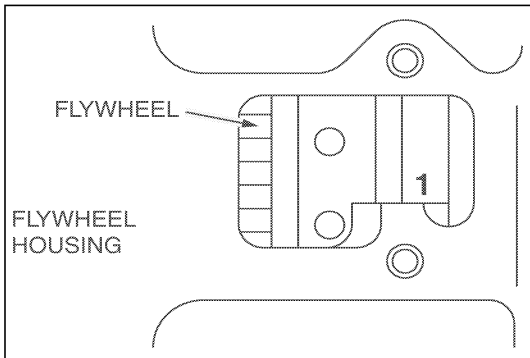
Tightening Torque:**25 N·m {250 kgf·cm, 18 lbf·ft}**



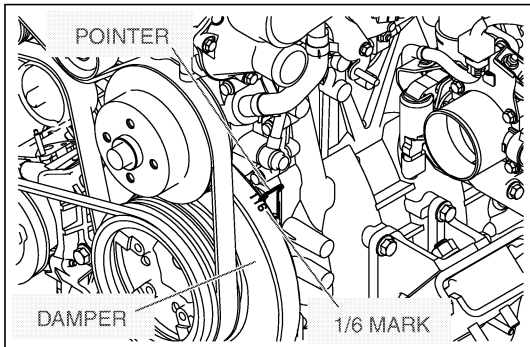
SAPH011060100015

NOTICE

- Do not over loosen the adjusting screw.
 - Over loosening of the adjusting screw C will cause the same condition as in step (3) again. The feeler gauge may feel correct, but there may be excessive clearance between the adjusting screw C of the cross head and the valve stem head E. This does not allow for correct adjustment.
- (8) Position each piston at Top Dead Center of compression stroke by turning the crankshaft counterclockwise viewed from flywheel side. Then adjust the valve clearance for each cylinder in the firing order.



SAPH011060100001



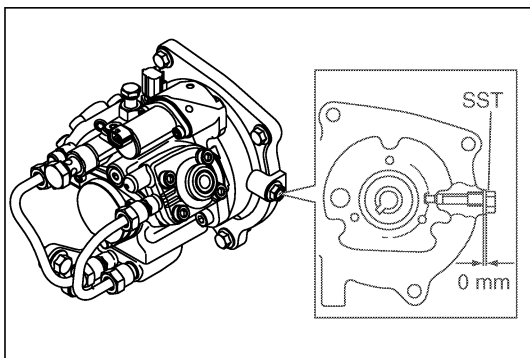
SAPH011060100050

INJECTION TIMING INSPECTION PROCEDURES**1. INSPECT THE INJECTION TIMING.**

- (1) Turn the crankshaft counterclockwise, as viewed from the flywheel side, and then align the timing mark in the check window of the flywheel housing with a mark of "1/6". At this time, the No.1 cylinder or the No.6 cylinder is in the top dead center.
- (2) Make sure that the timing mark "1/6" on the damper is aligned with the pointer.
- (3) At this time, insert a guide bolt (SST) through the plug hole in the side of the bearing holder case for installation of the supply pump.

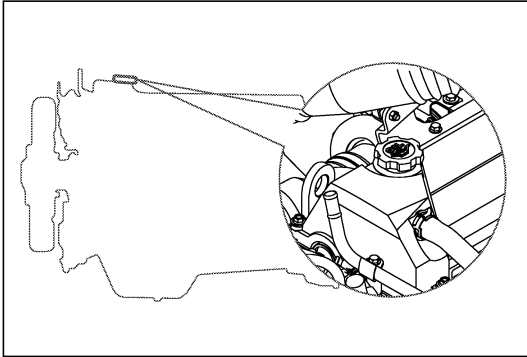
SST: Guide bolt (SZ105-08067)

- a. If the guide bolt is fully inserted, the No.1 cylinder is at Top Dead Center of compression stroke and the timing is correct.
- b. If the guide bolt cannot be fully inserted, turn the crankshaft 1 more turn to obtain the 1/6 mark.



SAPH011060100018

- (4) Insert the guide bolt again and confirm the correct timing.



SAPH011060100019

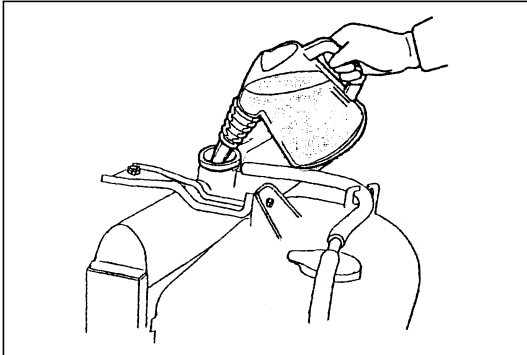
START THE ENGINE

⚠ WARNING

Do not leave tools on or around the engine. Contact of tools with moving parts may result in personal injury or damage to equipment.

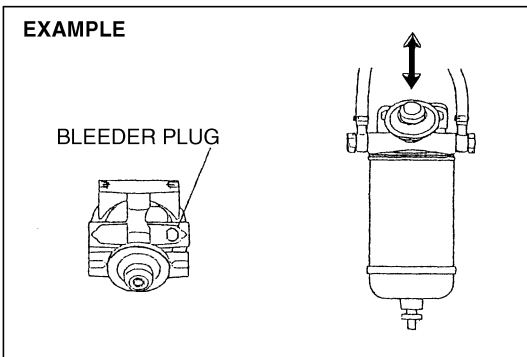
1. PREPARATION

(1) Supply engine oil.



SAPH011060100020

(2) Supply cooling water and bleed air from it.



SAPH011060100021

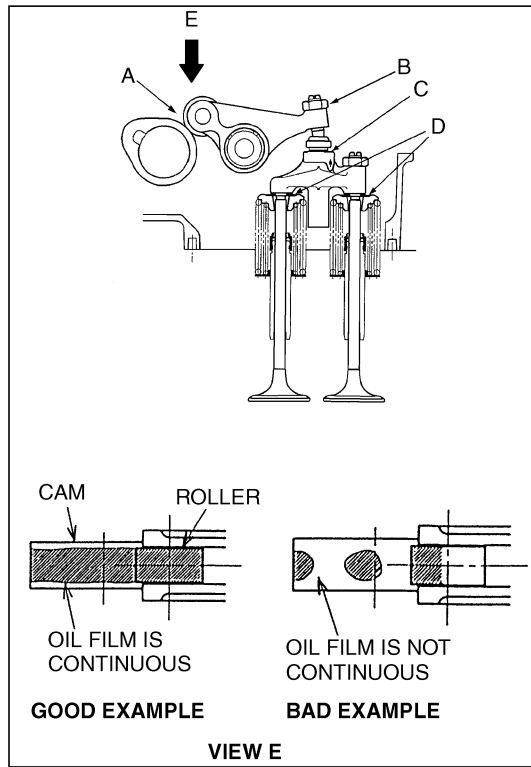
(3) Bleed air from the fuel system.

(4) Check connection to the alternator.

NOTICE

Starting the engine without wiring in place may burn out the alternator.

(5) Check the engine stopping performance.



LUBRICATION

1. CHECK THE ROCKER ARM.

- (1) Remove the head cover.
- (2) Set the engine revolution to the specified idling revolution.
- (3) After the engine starts, check that oil is supplied to the following locations of all rocker arms within approximately 10 seconds.
 - a. Roller and cam face A
 - b. Cross head top C and spring upper seat top face D through adjusting screw B

NOTICE

If the supply of oil is delayed or not happening, hydraulic pressure may be low or the oil gallery may be clogged. Insufficient supply of oil may lead to seizure, abnormal wear or abnormal noise. Recheck the assembly.

SPECIAL TOOL

EN0110601K100001

Prior to starting an engine overhaul, it is necessary to have these special tools.

Illustration	Part number	Tool name	Remarks
	S0955-21110	COMPRESSION GAUGE ADAPTER (A)	For Overhaul criteria
	S0955-21030 S0955-21060	COMPRESSION GAUGE ADAPTER (B)	
	S0940-91200	CRANKING TOOL	
	SZ105-08067	GUIDE BOLT	

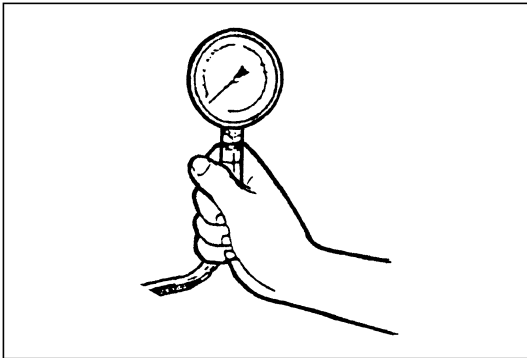
OVERHAUL CRITERIA

EN0110601H300002

FACTORS TO DETERMINE THE ENGINE OVERHAUL

1. LOW COMPRESSION PRESSURE.

- (1) Before measurement
 - a. Charge the battery completely.
 - b. Set the valve clearance to the correct value.
 - c. Idle the engine (Coolant temperature at 80°C {176°F}).
 - d. Remove the air cleaner.
 - e. Remove all injectors.



SAPH011060100027

- (2) Measurement

- a. Insert the gauge adaptor into the nozzle s.

SST:

Compression gauge adaptor(A) (S0955-21110)

Compression gauge adaptor(B) (S0955-21030)

Compression gauge adaptor(B) (S0955-21060)

- b. Run the engine with the starter and measure the compression pressure.

Standard	Limit	Difference between each cylinder
3.2-3.4 MPa {33-35 kgf·cm ² , 467-496 lbf/in ² }	2.3 MPa {24 kgf·cm ² , 341 lbf/in ² }	0.3 MPa {3 kgf·cm ² , 43 lbf/in ² } or less
Engine revolution 150r/min		

NOTICE

Do not operate the starter for more than 15 seconds.

- c. Measure the compression pressure of each cylinder.

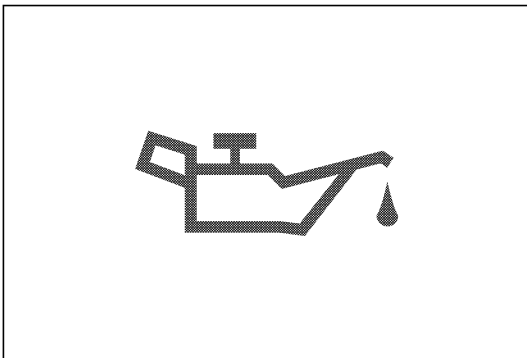
NOTICE

Do not allow gas leakage from the seal face.

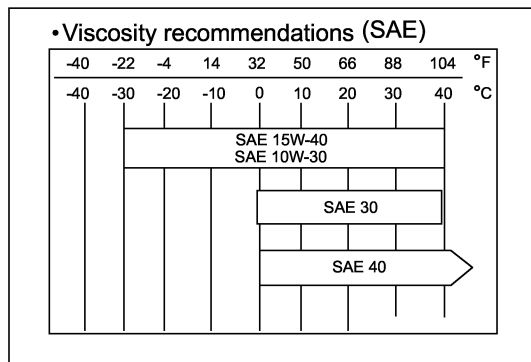
- (3) Reassemble the removed parts.

2. ENGINE OIL PRESSURE.

- (1) Check the oil pressure warning lamp when the oil and coolant temperature is hot [about 80°C {176°F}].
 - a. If the warning lamp lightens, check the oil level.
 - b. Check oil deterioration.
If oil quality is poor, replace with a suitable grade oil.
 - c. Remove the oil pressure switch and install the oil pressure gauge.



SAPH011060100028



- d. Measure the oil pressure at a coolant temperature of 80°C {176°F} or more.

Oil pressure

Standard	Limit
49-490 kPa {0.5-5.0 kg/cm ² , 7.11-71.10 lbf/in. ² }	Less than 49kPa {0.5 kg/cm ² , 7.11 lbf/in. ² }

3. OTHER FACTORS.

- (1) Increase of blowby gas
- (2) Defective engine start
- (3) Decrease of engine output
- (4) Increase of fuel consumption
- (5) Increase of engine noise
- (6) Increase of oil consumption

DISMOUNTING AND MOUNTING

EN0110601H100001

IMPORTANT POINT - DISMOUNTING

1. DISMOUNT THE ENGINE ASSEMBLY.

- (1) Park the vehicle on level ground and then block the wheels.
- (2) Tilt the hood.
- (3) Drain coolant from the radiator and cylinder block, and engine oil from the oil pan.

⚠ WARNING

To avoid the danger of burns, do not drain the coolant and engine oil while the engine and radiator are still hot.

- (4) Remove the splash board and fender.
- (5) Disconnect the power steering piping and hose.

NOTICE

Refer to CHAPTER POWER STEERING for details.

- (6) Disconnect the electric lines, fuel lines and air lines.

NOTICE

- Disconnect the battery cable from the negative terminal (-) of the battery and disconnect the electric lines.
- Cover open ends of the pipes, hoses and pumps to prevent entry of dirt.

- (7) Disconnect the hoses (coolant, heater and air intake) and remove the radiator with the intercooler.

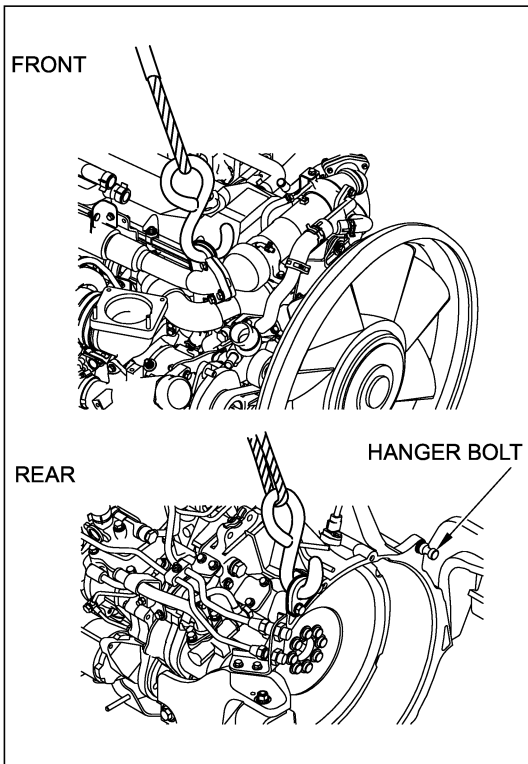
NOTICE

Do not damage the radiator.

- (8) Remove the air cleaner and bracket.
- (9) Disconnect the air intake and exhaust lines.
- (10) Disconnect the propeller shaft.
- (11) Disconnect the parking brake cable, transmission control lever and transmission with clutch housing from the flywheel housing.

NOTICE

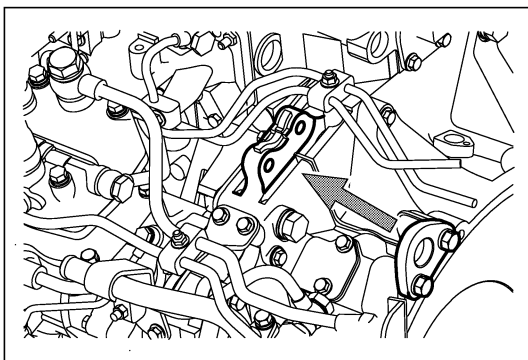
Refer to CHAPTER TRANSMISSION/TRANSFER CONTROL and CHAPTER TRANSMISSION MAIN UNIT for details.



SAPH011060100030

- (12) Connect a cable from an engine hanger to the hanger bracket (1 point) on the front of the engine, and to the hanger bracket (1 point) on the flywheel housing at the rear of the engine. Using a hoist, raise the hanger until there is a bit of slack in the cables.

Engine weight: **Refer to section DATA AND SPECIFICATIONS.**



SAPH011060100031

NOTICE

When the cable connection of the engine hanger to the hanger bracket causes infringement to the cab than follow procedure below.

1. Remove the fuel pipes (feed and return) to prevent damage.
2. Then remove the rear hanger bracket and install it on the front of the flywheel housing as shown in the figure.

- (13) Remove the engine mounting fitting nuts (front and rear, both sides).
 (14) Lift the engine hanger so that the cables are fully tightened, then, after checking that the cables are securely, lift gently and remove the engine from the vehicle.

NOTICE

When the transmission is attached to the engine, attach the third cable to the hanger bolt.

IMPORTANT POINTS - MOUNTING

1. MOUNT THE ENGINE ASSEMBLY.

- (1) Mount the engine assembly in the reverse order of dismounting.

Front side (chassis): 88 N·m {900 kgf·cm, 65 lbf·ft}

Front side (engine): 157 N·m {1600 kgf·cm, 115.6 lbf·ft}

Rear side (chassis): 88 N·m {900 kgf·cm, 65 lbf·ft}

Rear side (engine): 88 N·m {900 kgf·cm, 65 lbf·ft}

NOTICE

Check to see that there are no oil leaks, fuel leaks, coolant leaks, or air leaks.

LIQUID GASKET AND APPLICATION POINTS

EN0110601H200001

- Liquid gasket is used at the following positions for the J08E series engine.

Liquid gasket specification:

Three Bond S041321217: Black

Liquid gasket specification:

Three Bond 041321207A: Silver

Liquid gasket specification:

Three Bond S041321211: White

1. LIQUID GASKET APPLICATION AND PART ASSEMBLY PROCEDURE.

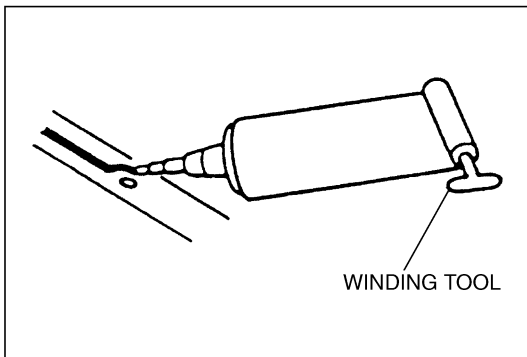
- (1) Remove old liquid gasket from each part and matching parts and wipe off oil, moisture or dirt with a rag.
- (2) Overlap the liquid gasket at the start and end of application.
- (3) Be careful of misalignment when assembling parts with liquid gasket. If they are misaligned, reapply the liquid gasket.
- (4) Assemble parts within 20 minutes of application. If more than 20 minutes have passed, remove and reapply the liquid gasket.
- (5) Wait for at least 15 minutes or more after assembly of parts before starting the engine.

2. REMOVE PARTS.

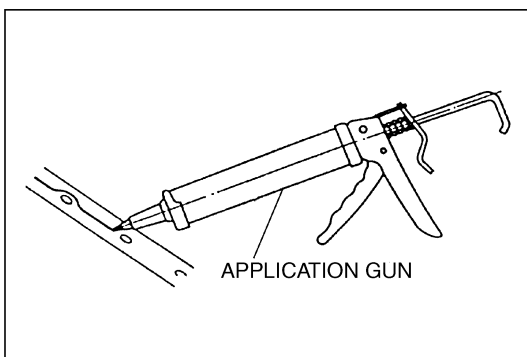
- (1) When removing parts, do not use a tool for removal at one location only. Use the tool at various locations such as a flange step or gap for removal. When removing the gasket, be careful that gasket residue does not enter the engine.

3. OTHERS.

- (1) For tube-type liquid gasket, use the winding tool that comes with the liquid gasket.

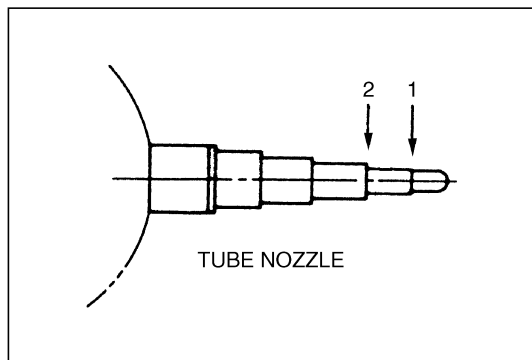


SAPH011060100032



SAPH011060100033

- (2) For cartridge-type gasket, use an application gun.



SAPH011060100034

(3) For tube-type liquid gasket, required width of application can be obtained by cutting the nozzle to suit.

- 1: Approximately 2 mm wide when cut at the first step
- 2: Approximately 5 mm wide when cut at the second step

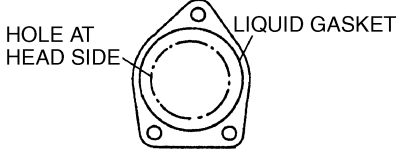
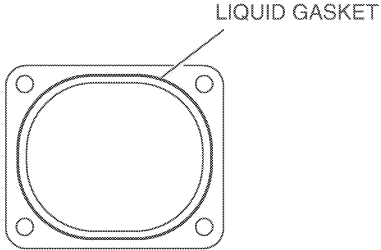
4. PARTS AND POSITIONS FOR LIQUID GASKET.

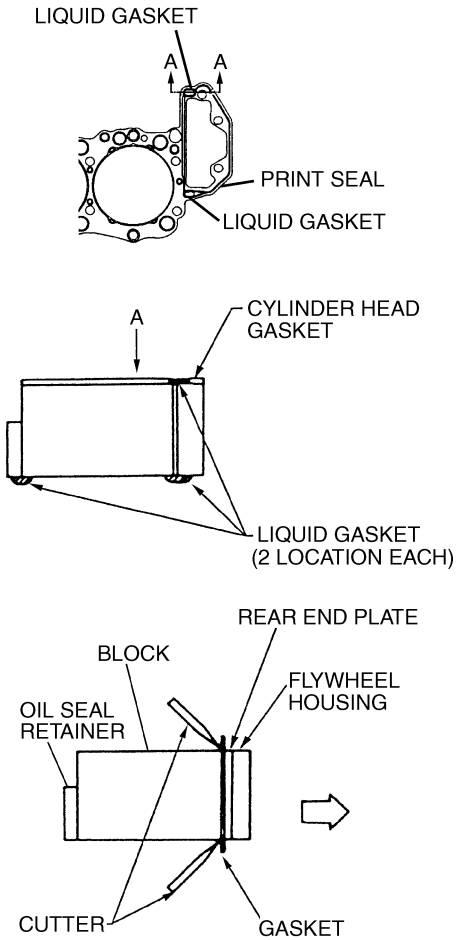
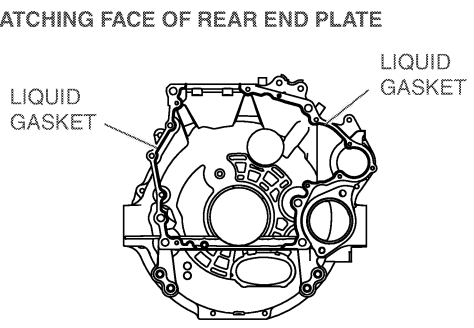
(1) Apply liquid gasket to positions and types of gasket according to the table shown below.

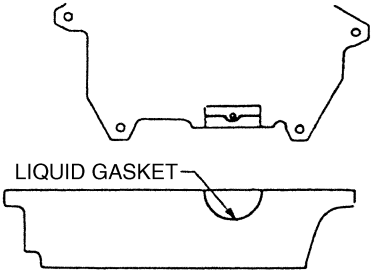
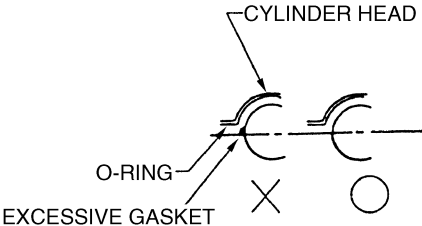
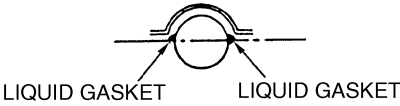

Follow the application pattern at each position shown in the figures.

Unit:mm{in.}

No.	Part name	Application position and pattern	Application width	Gasket to be used	Remarks
1	Oil seal retainer	<p>Matching flange face with the block</p>	1.5-2.5 {0.0591-0.0984}	Black	
2	Coolant pump	<p>Matching flange face with the block</p>	1.5-2.5 {0.0591-0.0984}	Black	
3	Oil cooler	<p>Matching flange face with the block</p>	1.5-2.5 {0.0591-0.0984}	Silver	
4	Thermostat case	<p>Matching flange face with the cylinder head</p>	1.5-2.5 {0.0591-0.0984}	Silver	

No.	Part name	Application position and pattern	Application width	Gasket to be used	Remarks
5	Flange	<p>Matching face with the rear edge</p>  <p>HOLE AT HEAD SIDE</p> <p>LIQUID GASKET</p>	1.5-2.5 {0.0591-0.0984}	Silver	
6	Intake pipe	<p>Matching face with the intake manifold</p> <p>MATCHING FACE WITH THE INTAKE MANIFOLD</p>  <p>LIQUID GASKET</p>	1.5-2.5 {0.0591-0.0984}	Black	
7	Front and rear ends of upper/lower faces of block	<p>Matching parts of block upper face rear end, gasket, rear end plate, flywheel housing, cylinder head gasket</p> <p>Matching parts of oil seal retainer and block lower face front end</p> <p>Matching parts of block lower front end, gasket, rear end plate and flywheel housing</p>	— 1.5-2.5 {0.0591-0.0984} 1.5-2.5 {0.0591-0.0984}	White Black Silver	

No.	Part name	Application position and pattern	Application width	Gasket to be used	Remarks
8	Front and rear ends of upper/lower faces of block	 <p>NOTICE Cut the rear end plate gasket with a craft knife flush with the block upper face.</p>			
9	Flywheel housing	<p>Matching face of rear end plate</p> 	1.5-2.5 {0.0591-0.0984}	Silver	

No.	Part name	Application position and pattern	Application width	Gasket to be used	Remarks
10	Cam housing	<p>1. Matching faces with cam housing and plug</p> <p>2. Matching parts of cam housing, plug, cylinder head cover and gasket</p>  <p>NOTICE</p> <ul style="list-style-type: none"> Application area of liquid gasket is half circle of cam housing. Never apply it to the upper half circle of the plug. Remove the excessive gasket completely.  <ul style="list-style-type: none"> When the cylinder head cover is assembled, reapply the liquid gasket. (Assembly must be done within 20 minutes.) 	1.5-2.5 {0.0591-0.0984}	Black	2 locations at front and rear ends
<p>NOTICE</p> <p>Figure on the right shows application "pattern" of the liquid gasket. Apply the liquid gasket to the center of seal flange inside whenever possible.</p>					

ENGINE MECHANICAL (J08E)

EN02-001

CYLINDER HEAD EN02-2

COMPONENT LOCATOR.....	EN02-2
SPECIAL TOOL	EN02-5
OVERHAUL	EN02-6
INSPECTION AND REPAIR	EN02-17

CRANKSHAFT FRONT END..... EN02-21

COMPONENT LOCATOR.....	EN02-21
SPECIAL TOOL	EN02-22
OVERHAUL	EN02-23

FLYWHEEL AND FLYWHEEL HOUSING**..... EN02-25**

COMPONENT LOCATOR.....	EN02-25
SPECIAL TOOL	EN02-26
OVERHAUL	EN02-26
INSPECTION AND REPAIR	EN02-31

TIMING GEAR..... EN02-32

COMPONENT LOCATOR.....	EN02-32
SPECIAL TOOL	EN02-33
OVERHAUL	EN02-34
INSPECTION AND REPAIR	EN02-36

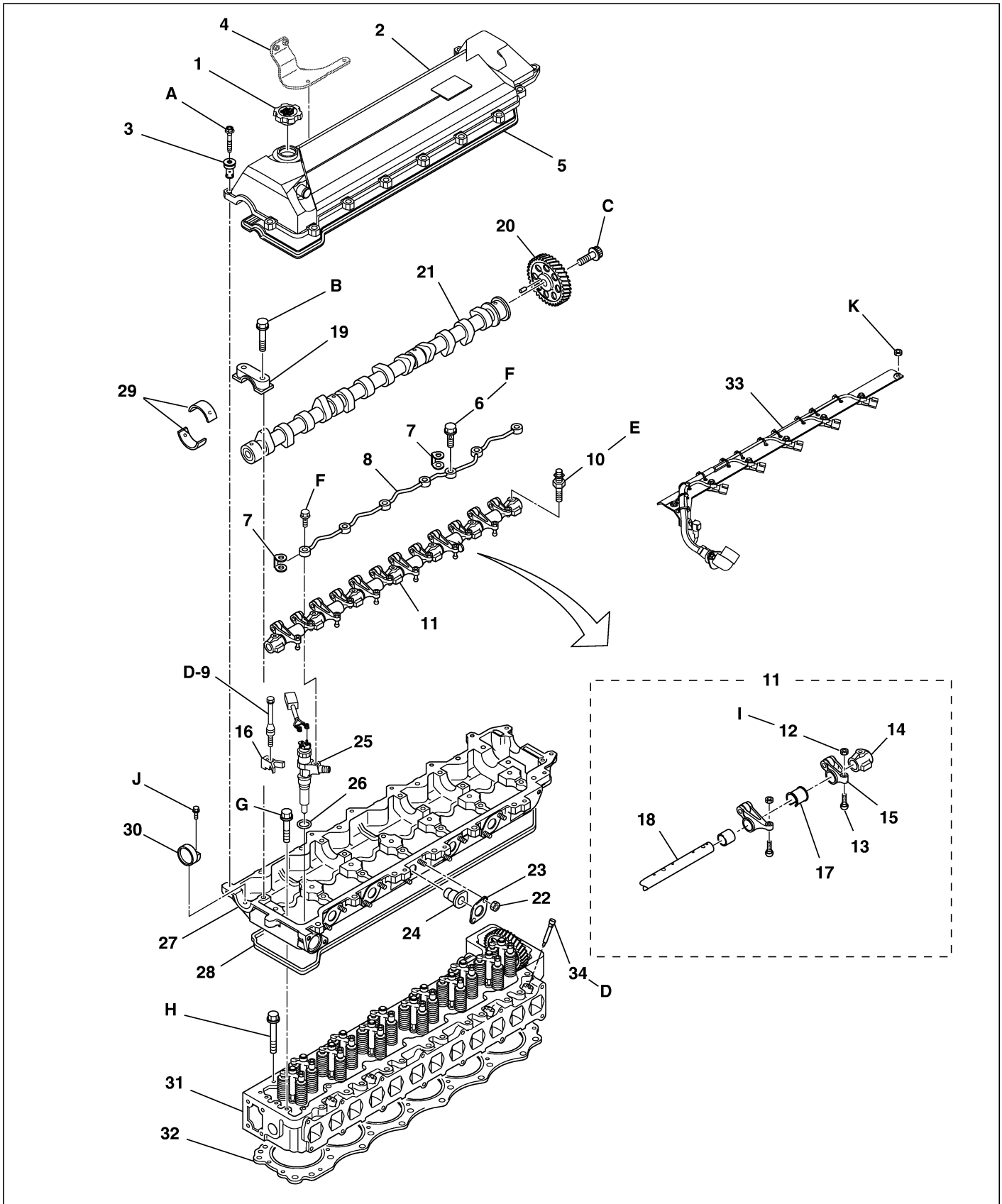
MAIN MOVING PARTS AND CYLINDER BLOCK**..... EN02-38**

COMPONENT LOCATOR.....	EN02-38
SPECIAL TOOL	EN02-41
OVERHAUL	EN02-43
INSPECTION AND REPAIR	EN02-56

CYLINDER HEAD

COMPONENT LOCATOR

EN0110602D100001



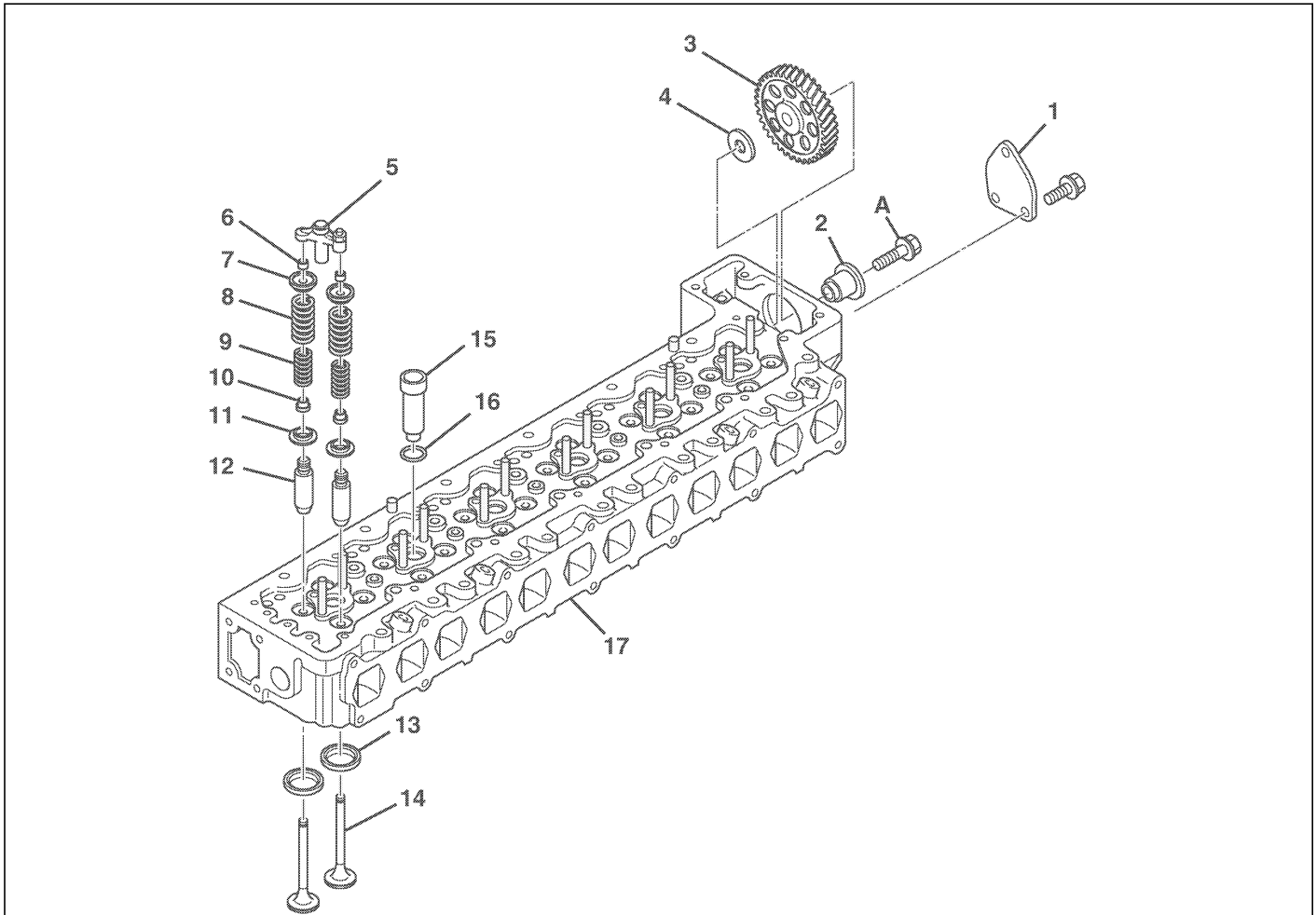
1	Oil filler cap	18	Valve rocker shaft
2	Cylinder head cover	19	Camshaft bearing cap
3	Silent block	20	Camshaft gear
4	Bracket (intake hose)	21	Camshaft
5	Head cover gasket	22	Nut
6	Union bolt	23	Plate
7	Gasket	24	Injection pipe oil seal
8	Leakage pipe	25	Injector
9	Injector clamp bolt	26	O-ring
10	Rocker arm support bolt	27	Camshaft housing
11	Rocker arm assembly	28	Camshaft housing gasket
12	Lock nut	29	Camshaft bearing
13	Adjust screw	30	Plug
14	Rocker arm support	31	Cylinder head assembly
15	Rocker arm	32	Cylinder head gasket
16	Injector clamp	33	Harness assy
17	Collar	34	Heater plug

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A	28.5 {290, 20}	G	23 {230, 16}
B	(Long bolt) 31 {320, 23} / (Short bolt) 23 {230, 16}	H	59 {600, 43}+90°+90°#
C	59 {600, 43}+90°#	I	25 {250, 18}
D	25 {250, 18}	J	6 {61, 4.4}
E	59 {600, 43}	K	28{286, 21}
F	12.7 {130, 9}		

#=Apply oil to the threads and seat surfaces before tightening.



SAPH011060200002

1 Flange	10 Valve stem seal
2 Idle gear shaft	11 Valve spring seat lower
3 Camshaft idle gear	12 Valve stem guide
4 Idle gear thrust plate	13 Valve seat
5 Cross head	14 Valve
6 Valve spring retainer	15 Nozzle seat
7 Valve spring seat upper	16 O-ring
8 Valve spring outer	17 Cylinder head block
9 Valve spring inner	

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

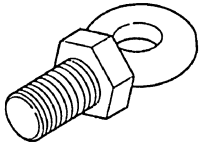
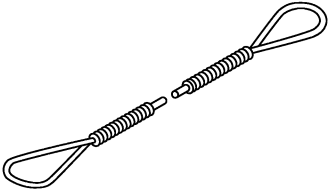
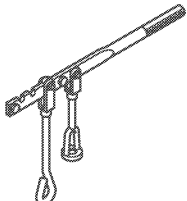
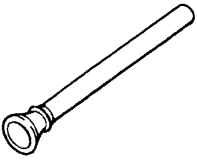
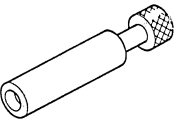
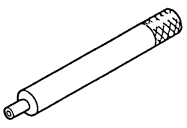

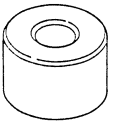
A 108 {1,100, 79}#	
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#=Apply oil to the threads and seat surfaces before tightening.

SPECIAL TOOL

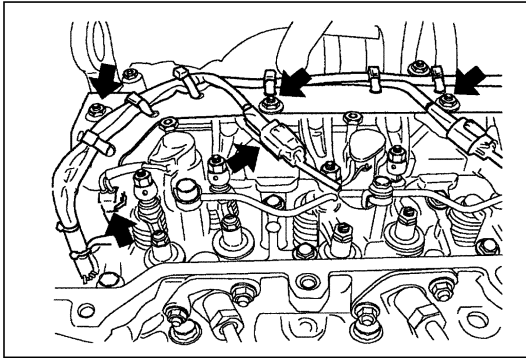
EN0110602K100001

Prior to starting an engine overhaul, it is necessary to have these special tools.

Illustration	Part number	Tool name	Remarks
	S0943-31070	EYE BOLT	
	S0949-11010	WIRE	
	S0947-01170	VALVE SPRING PRESS	
	S0943-11020	VALVE LAPPING TOOL	
	S0947-22100	VALVE STEM SEAL PRESS	
	S0947-21210	BAR	For Nozzle sleeve
	SN441-00160	STEEL BALL	Used with S0947-21210
	S0947-11520	GUIDE	

OVERHAUL

EN0110602H200001



SAPH011060200011

IMPORTANT POINTS DISASSEMBLY

1. DISASSEMBLE THE CYLINDER HEAD.

- (1) Clean parts around the injector and fuel system connections.

NOTICE

Entry of foreign particles into the combustion chamber may result in engine trouble.

- (2) Remove the injector harness assy.
 - a. Disconnect the connector of injector.
 - b. Remove the 7 nuts, disconnect the injector harness assy with plate.
- (3) Remove the injector assembly.

NOTICE

Refer to FUEL SYSTEM.

- (4) Remove the rocker arm assembly.
 - a. Loosen the lock nut at the end of the rocker arm and turn the adjusting screw counterclockwise completely.

NOTICE

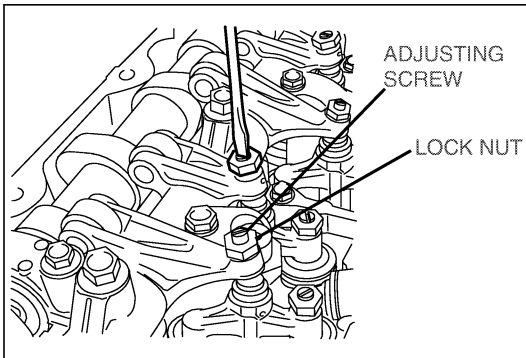
Not untightening the adjusting screw may result in a bent rocker shaft.

- b. Loosen the injector clamp bolt.

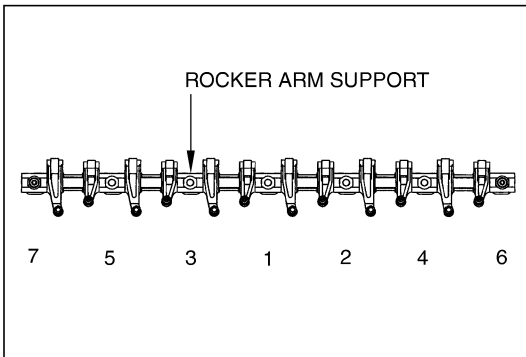
- c. Loosen the rocker arm support bolt as shown in the figure.

NOTICE

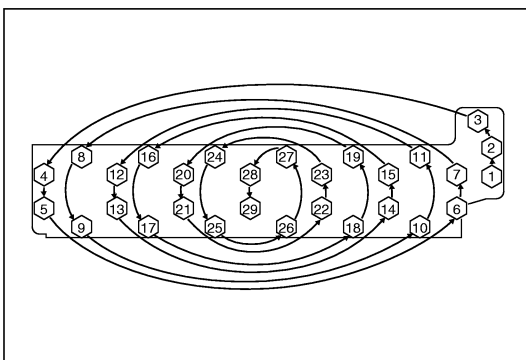
If the cross head is removed from the valve during disassembly of the rocker arm assembly, reassemble the cross head as it was.



SAPH011060200012

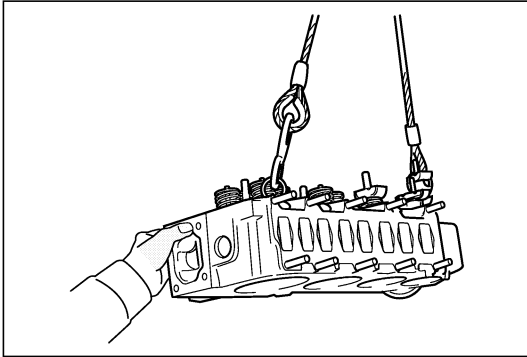


SAPH011060200013



SAPH011060200014

- (5) Remove the cylinder head bolts.
 - a. Gradually loosen bolts three times in the order shown in the figure.



SAPH011060200015

- (6) Lift and remove the cylinder head using the special tool and hoist.

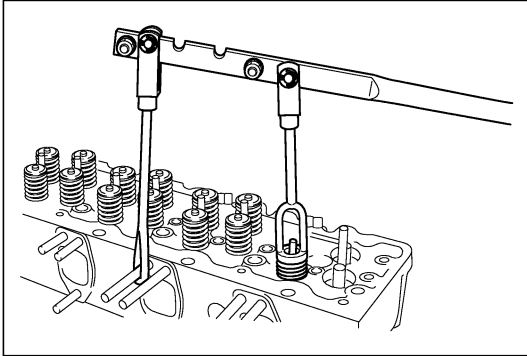
SST:

Eye bolt (S0943-31070)

Wire (S0949-11010)

NOTICE

- Do not damage the cylinder head lower surface or cylinder block upper surface during removal of the cylinder head.
- If it is difficult to lift off the cylinder head, pry with a chisel between the cylinder head and cylinder block.

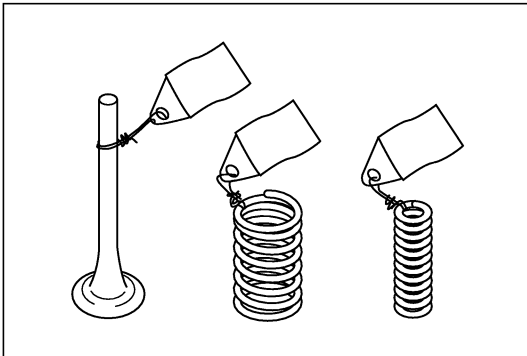


SAPH011060200016

2. DISASSEMBLE THE VALVE SYSTEM.

- (1) Remove the valve spring retainer using the special tool.

SST: Valve spring press (S0947-01170)

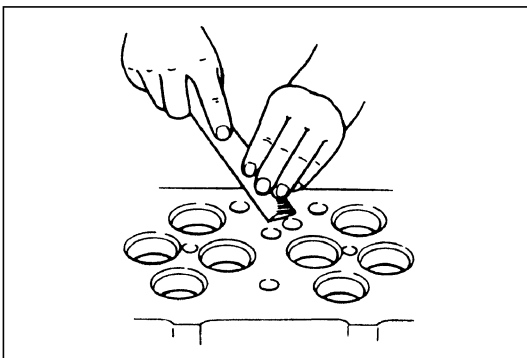


SAPH011060200017

- (2) Remove the intake and exhaust valve.

NOTICE

Attaching tags to the valves (giving corresponding cylinder Nos.) will eliminate time required for lapping the valve seats on reassembly.



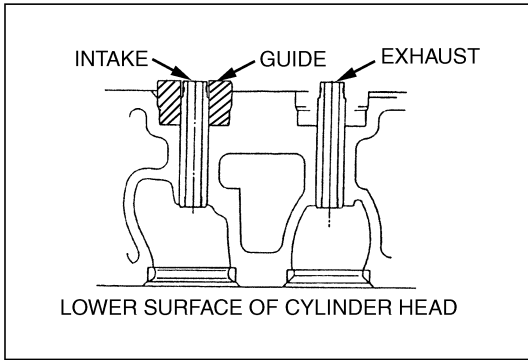
SAPH011060200018

3. CLEAN THE CYLINDER HEAD.

- (1) Clean the cylinder head and remove carbon deposits or foreign particles.

NOTICE

Be careful not to damage the cylinder head lower surface when removing carbon deposits or foreign particles.



SAPH011060200019

IMPORTANT POINTS-REPLACEMENT

1. REPLACE THE VALVE GUIDE.

- (1) Remove the valve stem seal.
- (2) For removal, strike the valve guide with a brass bar and hammer.

⚠ WARNING

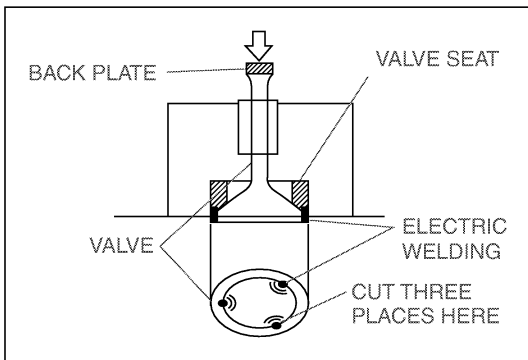
Be sure to wear protective goggles. Striking the valve guide when removing the valve guide may cause metal chips to fly up.

- (3) When installing a new valve guide, do not twist the end. Press fit the valve guide using the special tool.

SST: Guide (S0947-11520)

NOTICE

- Be careful not to damage the valve stem at the upper or lower end of the guide during press-fitting.
- Be sure to apply engine oil around the valve guide during press-fitting.



SAPH011060200020

2. REPLACE THE VALVE SEAT.

- (1) When replacing the valve seat, cut three places on the circumference of an unwanted valve and weld it to the valve seat.

NOTICE

To protect the lower surface of the cylinder head from welding spatter, be sure to apply grease before welding.

- (2) Place a (brass) back plate at the top of the valve system and strike it with a hammer to remove the valve seat.

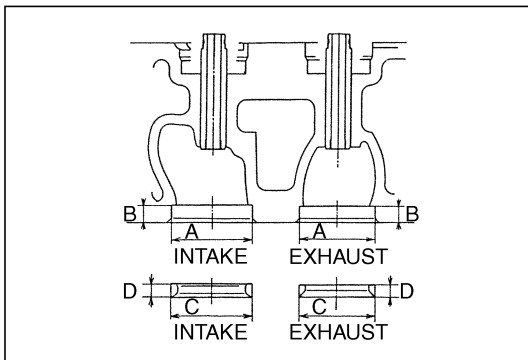
⚠ WARNING

Be sure to wear protective goggles. Striking the valve seat for removal of valve seat may cause metal chips to fly up.

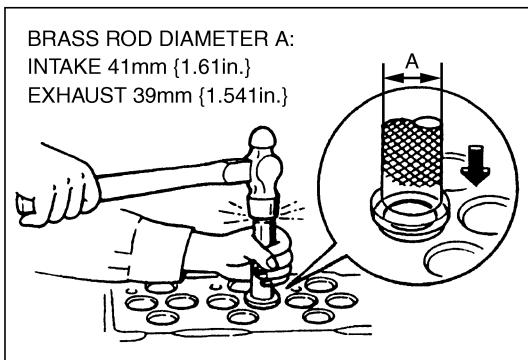
- (3) Machine the valve according to the valve seat dimensions.

Unit: mm {in.}

		Intake	Exhaust
Cylinder head side	A	41-41.016 {1.6142-1.6148}	39-39.016 {1.5355-1.5360}
	B	9.4-9.6 {0.3701-0.3779}	8.6-8.8 {0.3386-0.3464}
Valve seat side	C	41.085-41.1 {1.6176-1.6181}	39.12-39.135 {1.5402-1.5407}
	D	7-7.2 {0.2756-0.2834}	6-6.2 {0.2363-0.2440}



SAPH011060200021

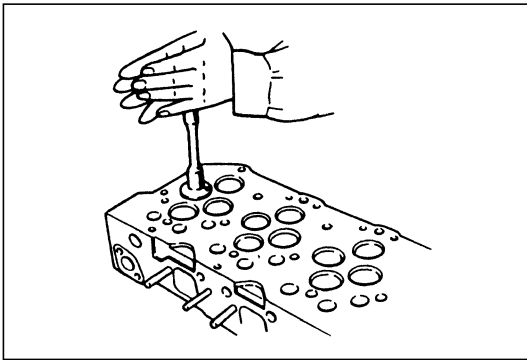


SAPH011060200022

- (4) Heat the cylinder head to 80 - 100°C {176 - 212°F} in hot water. After cooling the valve seat, insert it into the cylinder head.

⚠ WARNING

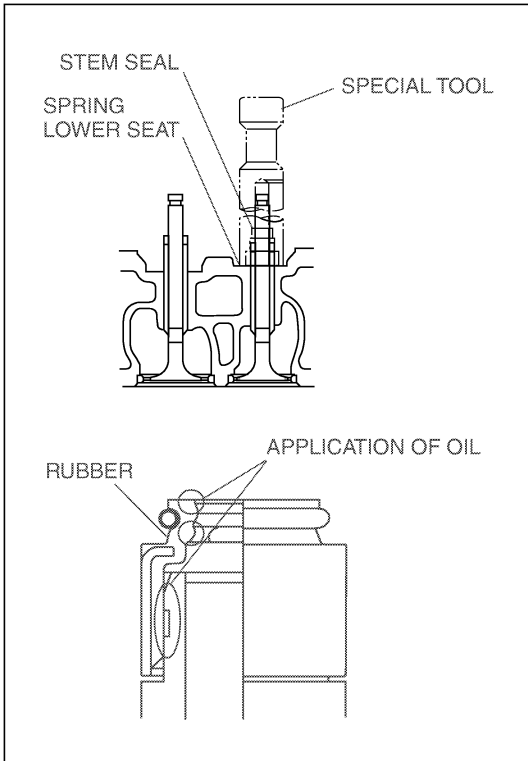
Be sure to wear protective goggles. Punching the nozzle seat when installing nozzle seat may cause metal chips to fly up.



SAPH011060200023

- (5) Apply a small amount of lapping compound to the contact surfaces of the valve and valve seat. Turn the valve using the special tool and tap it lightly to lap.

SST: Valve lapping tool (S0943-11020)



SAPH011060200024

3. REPLACE THE VALVE STEM SEAL.

- (1) After removing the valve stem seal, assemble the spring lower seat and apply engine oil to the stem seal lip. Punch it into the valve guide using the special tool.

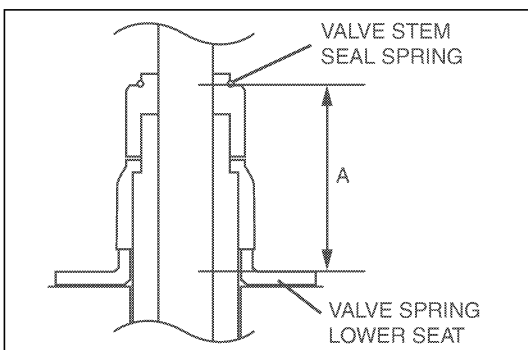
SST: Valve stem seal press (S0947-22100)

⚠ WARNING

Be sure to wear protective goggles. Striking the valve stem seal for installing of valve stem seal may cause metal chips to fly up.

NOTICE

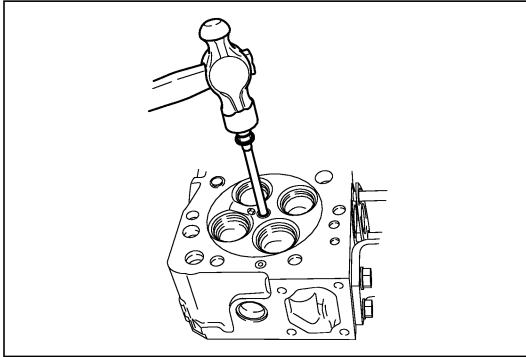
After assembly of the stem seal, check for deformation or cracking of the rubber or incline.



SAPH011060200025

- (2) After punching the valve stem seal, measure the height A.

Height A: 22.5-23.0 mm {0.886-0.906 in.}



SAPH011060200026

4. REPLACE THE NOZZLE SEAT.

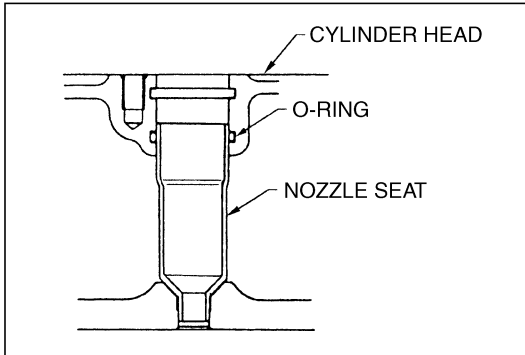
- (1) Tap the nozzle seat from the cylinder head lower surface. Then, screw in a suitable bolt and strike the bolt head with a hammer to remove the nozzle seat from the cylinder head.

⚠ WARNING

Be sure to wear protective goggles. Punching the nozzle seat when installing nozzle seat may cause metal chips to fly up.

NOTICE

After removing the nozzle seat, remove the rest of liquid gasket or the adhesion such as dust completely.

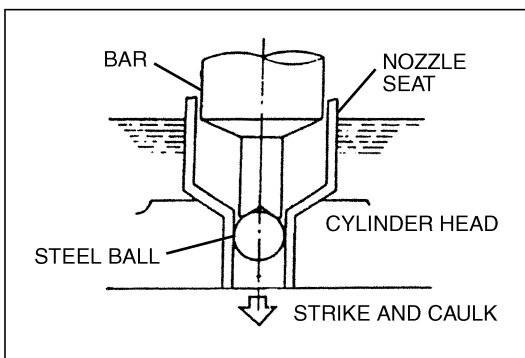


SAPH011060200027

- (2) After inserting the O-ring into the nozzle seat insertion hole of the cylinder head, apply liquid packing (Three Bond No. 1211 or equivalent) to the lower part of the new nozzle seat and assemble it onto the cylinder head.

NOTICE

Be sure to replace the O-ring with a new one. Reuse of the O-ring may cause water or gas leakage, resulting in overheating or cracking of the cylinder head.



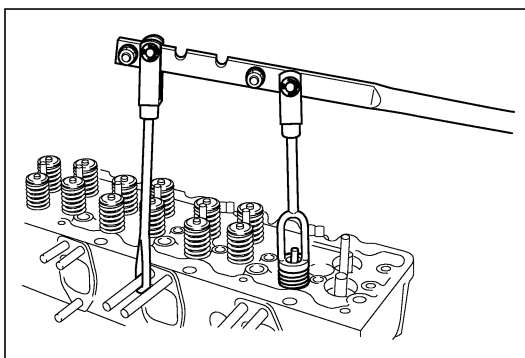
SAPH011060200028

- (3) Caulk the nozzle seat with the special tools.

SST:

Bar (S0947-21210)

Steel ball (SN441-00610)



SAPH011060200016

IMPORTANT POINTS - ASSEMBLY

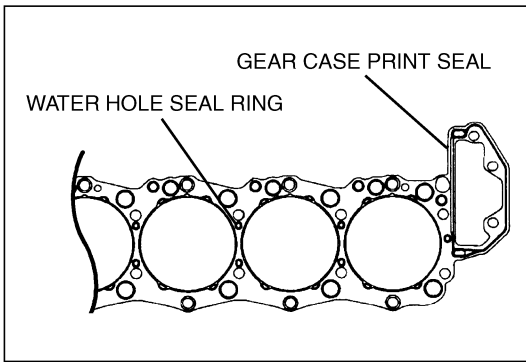
1. ASSEMBLE THE VALVE AND VALVE SPRING.

- (1) Install the valve spring retainer at the valve spring upper seat using the special tool.

SST: Valve spring press (S0947-01170)

NOTICE

- Be sure to apply engine oil to the contact surface of each part before assembly.
- Be sure to place each valve in its original position.
- When the valve spring is compressed, be careful of damage to the stem seal due to contact of the upper seat.
- Since this valve spring is evenly pitched, it can be installed either end up.



SAPH011060200029

2. INSTALL THE CYLINDER HEAD GASKET.

NOTICE

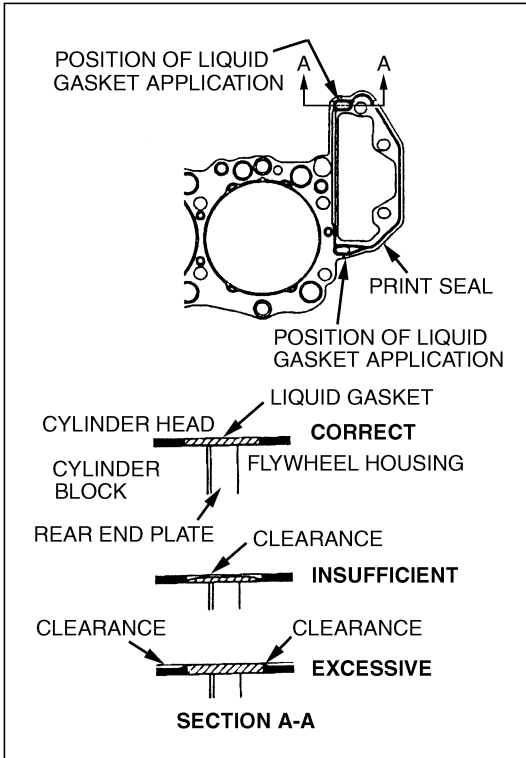
- When installing the cylinder head, install the new gasket after removing dirt, moisture and oil on the cylinder head and cylinder block surface.
- Never reuse the gasket as it may cause engine damage.
- The twelve water hole seal rings between the bores are easily damaged. Do not touch them with your hands or other objects. Make sure that the seal rings are not loose or damaged.
- Since silicon material is used for the gear case print seal, make sure that there is no peeling before assembly.

(1) Install the cylinder head gasket on the cylinder block and flywheel housing.

(2) Fill the hole at the back of the cylinder head gasket with liquid gasket.

NOTICE

Make sure that the liquid gasket surface is flush with the cylinder head gasket upper surface.



SAPH011060200030

3. INSTALL THE CYLINDER HEAD.

(1) Using the special tool and hoist, install the cylinder head.

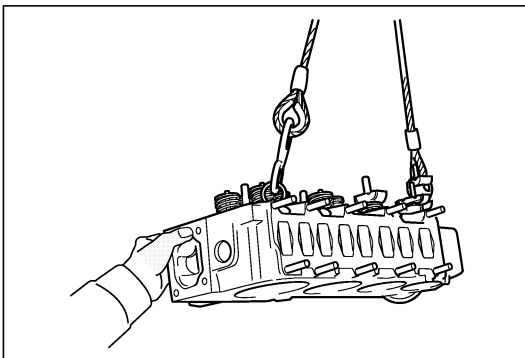
SST:

Eye bolt (S0943-31070)

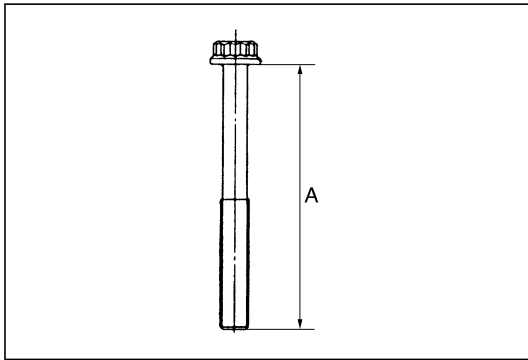
Wire (S0949-11010)

NOTICE

When installing the cylinder head, pay attention to cam idle gear and sub idle gear engagement.



SAPH011060200015

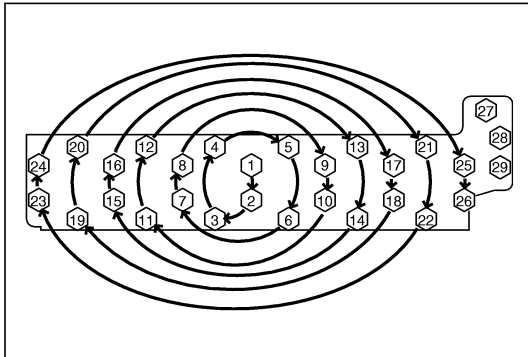


SAPH011060200031

4. MEASURE THE CYLINDER HEAD BOLT.

- (1) Measure the length of the M12 head bolts, if the length is A or more, replace with new bolts.

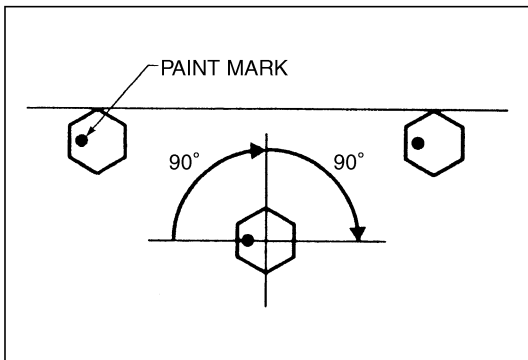
Dimension A	126.5 mm {4.980 in.}
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SAPH011060200032

- (2) Apply clean engine oil to the bolt surface and bolt threads of the M10 and M12 bolts.
- (3) Clean the bolt seats completely on the cylinder head upper surface.
- (4) Tighten No. 1 - No. 26 (M12 bolts) in the order shown in the figure to the specified torque.

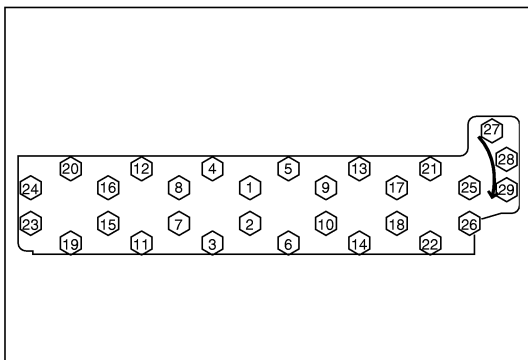
Tightening Torque:
59 N-m {600 kgf-cm, 43 lbf-ft}



SAPH011060200033

- (5) Mark the M12 bolts with paint to indicate the same directions as shown in the figure.
- (6) Turn No. 1 - No. 26 (M12 bolts) 90° (1/4 turn) in the same order as in (4).
- (7) Retighten them 90° (1/4 turn) as step (6).
- (8) Make sure that all paint marks face the same direction.

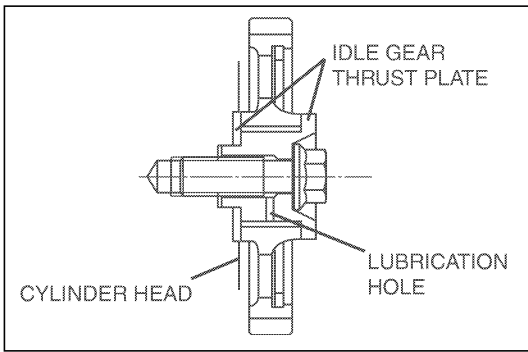
NOTICE
When adding torque, never untighten the bolts, even if they have been overtightened.



SAPH011060200034

- (9) Tighten No. 27 - No. 29 (M10 bolts) in the order shown in the figure to the specified torque below.

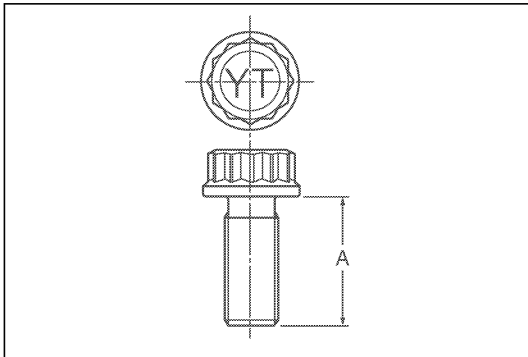
Tightening Torque:
59 N-m {600 kgf-cm, 43 lbf-ft}



SAPH011060200035

5. INSTALL THE CAM IDLE GEAR.**NOTICE**

- Install the cam idle gear shaft through the thrust plate as shown in the figure so that the lubrication hole is downward.
- Apply clean engine oil to the bolt seat and bolt threads.

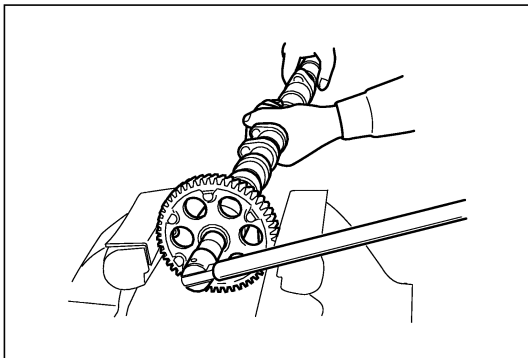


SAPH011060200036

6. ASSEMBLE THE CAMSHAFT GEAR.

- (1) Measure the length of the camshaft gear bolts, if the length is A or more, replace with new bolts.

Dimension A	30.5 mm {1.20 in.}
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SAPH011060200037

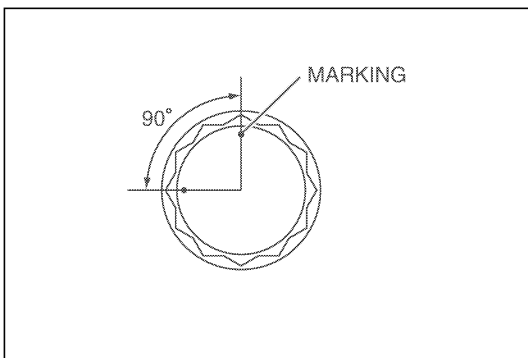
- (2) Make sure that there is neither damage to the camshaft gear or camshaft nor dirt on them.
- (3) Apply clean engine oil to the bolt surface and bolt threads and tighten them to the specified torque below.

Tightening Torque:**59 N·m {600 kgf·cm, 43 lbf·ft}**

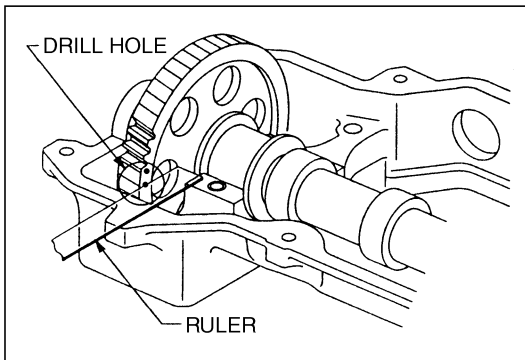
- (4) Turn bolts an additional 90° (1/4 turn).

NOTICE

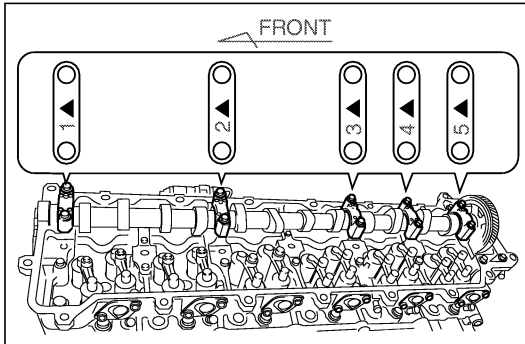
When adding torque, never untighten the bolt, even if it has been overtightened.



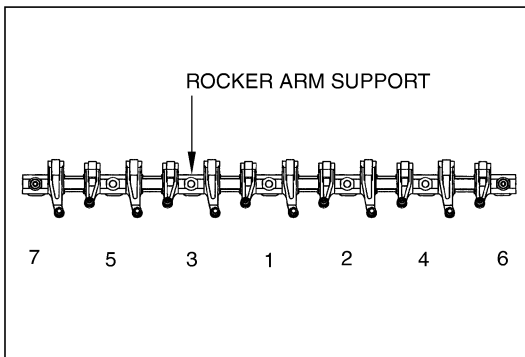
SAPH011060200038



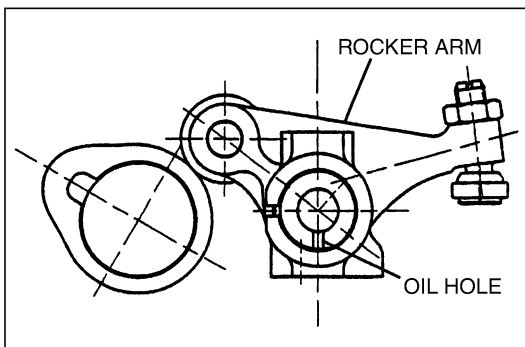
SAPH011060200039



SAPH011060200040



SAPH011060200041



SAPH011060200042

7. INSTALL THE CAMSHAFT.

- (1) Align the mark on the flywheel with the flywheel housing pointer to set the No. 1 piston to top dead center of the compression stroke.

NOTICE

Engine adjustment - Refer to PREPARATION OF CHECKING AND ADJUSTMENT.

- (2) Install the camshaft into the cam housing.

NOTICE

Two drill holes on the camshaft gear should be located at left side and lower drill hole should match with the camshaft housing upper surface.

- (3) Install Camshaft bearing caps by fitting the position, in the stamped order of 1, 2, 3, 4 and 5, with each engraved mark headed toward Engine front.

8. INSTALL THE ROCKER ARM ASSEMBLY.

- (1) Make sure that the cross head is on each valve.

NOTICE

If the cross head is assembled whilst off the valve, the upper seat will be pressed, resulting in a loose valve.

- (2) Make sure that the adjusting screw at the end of the rocker arm is completely screwed in.

NOTICE

Make sure the oil hole is placed below.

- (3) Tighten the rocker arm support bolt as shown in the figure to the specified torque.

Tightening Torque:

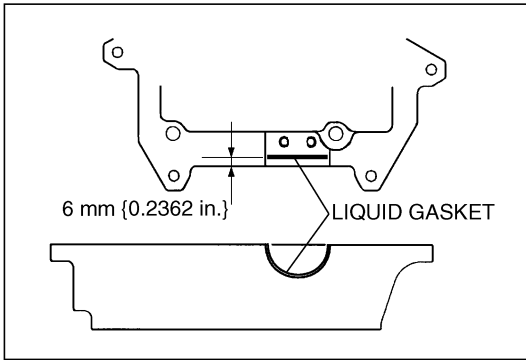
59 N·m {600 kgf·cm, 43 lbf·ft}

- (4) Tighten the injector clamp bolt to the specified torque.

Tightening Torque:

25 N·m {250 kgf·cm, 18 lbf·ft}

- (5) Make sure that the rocker arm moves smoothly.



SAPH011060200043

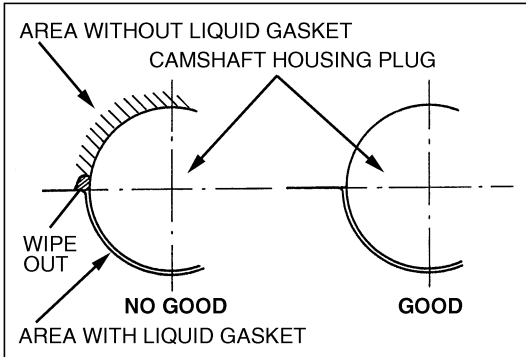
9. INSTALL THE HEAD COVER.

- (1) Remove the camshaft housing plugs at the front and rear ends of the camshaft housing.

NOTICE

Do not remove the plug except when there is oil leakage from plug.

- (2) Remove the liquid gasket from camshaft housing plugs and camshaft housing completely.

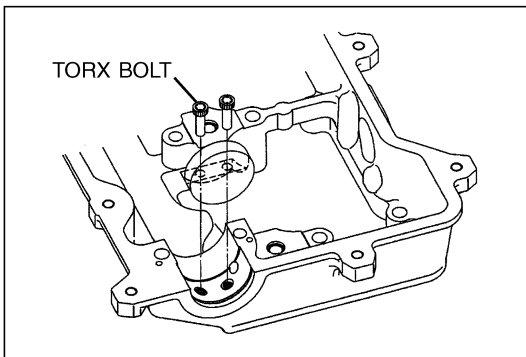


SAPH011060200044

- (3) Apply liquid gasket to the front and rear half circles of the camshaft housing.

NOTICE

Wipe out excess liquid gasket completely.



SAPH011060200045

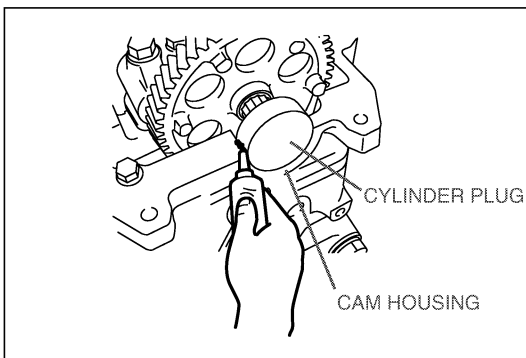
- (4) Install the camshaft housing plug to camshaft housing with torx bolt.

Tightening Torque:

6 N·m {60 kgf·cm, 4.4 lbf·ft}

NOTICE

Make sure that the camshaft housing plug is installed with no tilt.



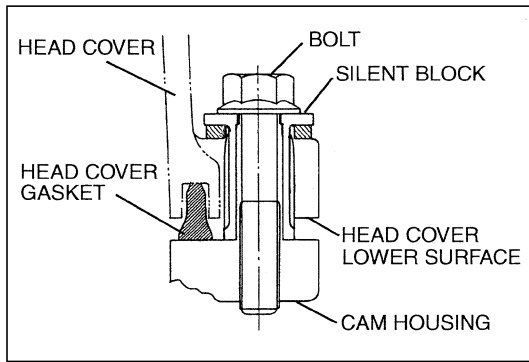
SAPH011060200046

- (5) Install the head cover gasket into the gasket groove at the head cover lower surface.

NOTICE

Make sure that there are no foreign particles (including liquid gasket), or oil on the gasket grooves of the head cover, gasket or cam housing upper surface nor damage to them.

- (6) Apply liquid gasket to plug corner at the front and rear ends of the cam housing before installing the head cover.



SAPH011060200047

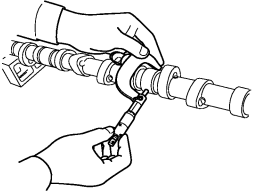
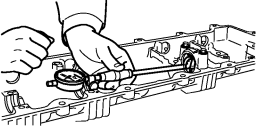
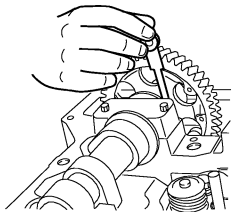
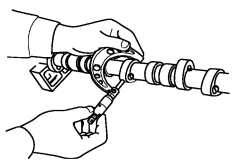
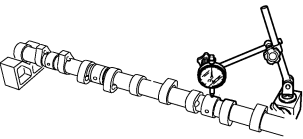
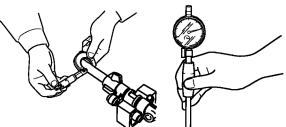
- (7) Insert the silent block from the head cover upper surface.
- (8) Tighten the bolt through the silent block to the specified torque below and fix the head cover on the cam housing.

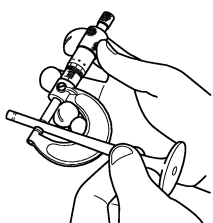

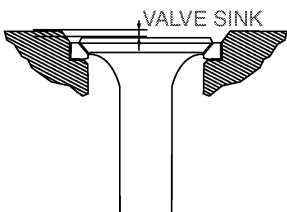
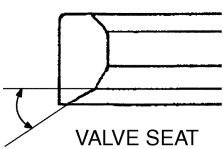
Tightening Torque:
25 N·m {250 kgf·cm, 18 lbf·ft}

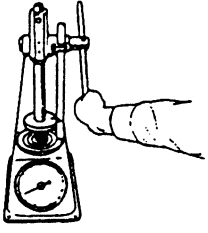
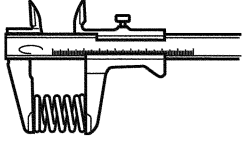
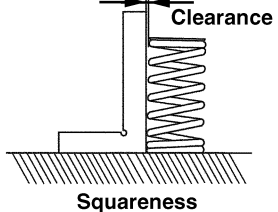
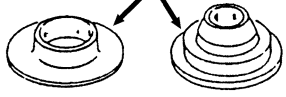
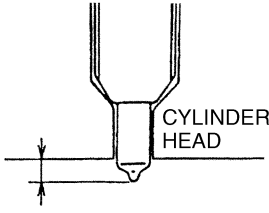
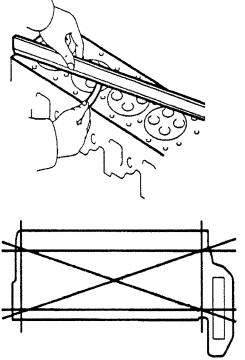
INSPECTION AND REPAIR

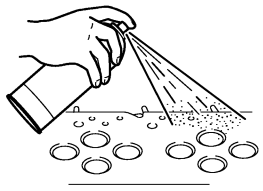
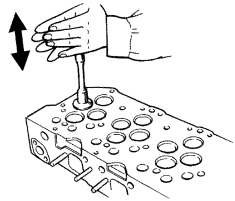
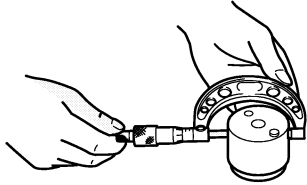
EN0110602H300001

Unit: mm {in.}

Inspection item		Standard	Limit	Remedy	Inspection procedure
Camshaft journal outside diameter		40 {1.5748}	39.85 {1.5689}	Replace camshaft.	Measure 
Camshaft bearing inside diameter		40 {1.5748}	40.15 {1.5807}	Replace cam bearing.	
Clearance between camshaft journal and camshaft bearing		0.020-0.063 (0.0008-0.0024)	—	Replace camshaft and/or cam bearing.	
Camshaft end play		0.100-0.178 (0.0040-0.0070)	—	Replace camshaft.	Measure 
Cam height	IN	50.046 {1.9703}	49.966 {1.9672}	Replace camshaft.	Measure 
	EX	52.739 {2.0763}	52.659 {2.0732}		
Camshaft deflection		0.04 {0.0016}	0.1 {0.0039}	Replace camshaft.	Measure 
Rocker arm bushing inside diameter		22 {0.866}	22.08 {0.8693}	Replace rocker arm.	Measure 
Rocker shaft outside diameter		22 {0.866}	21.92 {0.8630}	Replace rocker shaft.	
Clearance between rocker shaft and rocker arm bushing		0.030-0.101 {0.0012-0.0039}	0.15 {0.0059}	Replace rocker arm and/or rocker shaft.	

Inspection item		Standard	Limit	Remedy	Inspection procedure
Intake valve	Stem outside diameter	7 {0.2756}	6.92 {0.2724}	Replace the valve.	Measure 
	Guide inside diameter	7 {0.2756}	7.04 {0.2772}	Replace the valve guide.	
	Clearance	0.023-0.058 {0.0010-0.0022}	0.12 {0.0047}	Replace the valve and/or valve guide.	
Exhaust valve	Stem outside diameter	7 {0.2756}	6.85 {0.2697}	Replace the valve.	
	Guide inside diameter	7 {0.2756}	7.04 {0.2772}	Replace the valve guide.	
	Clearance	0.050-0.083 {0.0020-0.0032}	0.15 {0.0059}	Replace the valve and/or valve guide.	
Valve sink	IN	0.55-0.85 {0.0217-0.0334}	1.1 {0.0433}	Replace the valve and valve seat.	Measure 
	EX	1.15-1.45 {0.0453-0.0570}	1.7 {0.0669}	Replace the valve and valve seat.	
Valve seat angle	IN	30°	30°-30°35'	Resurface the valve and/or valve seat.	Measure 
	EX	45°	45°-45°30'		
Valve face angle	IN	30°	29°30'-30°		
	EX	45°	44°30'-45°		

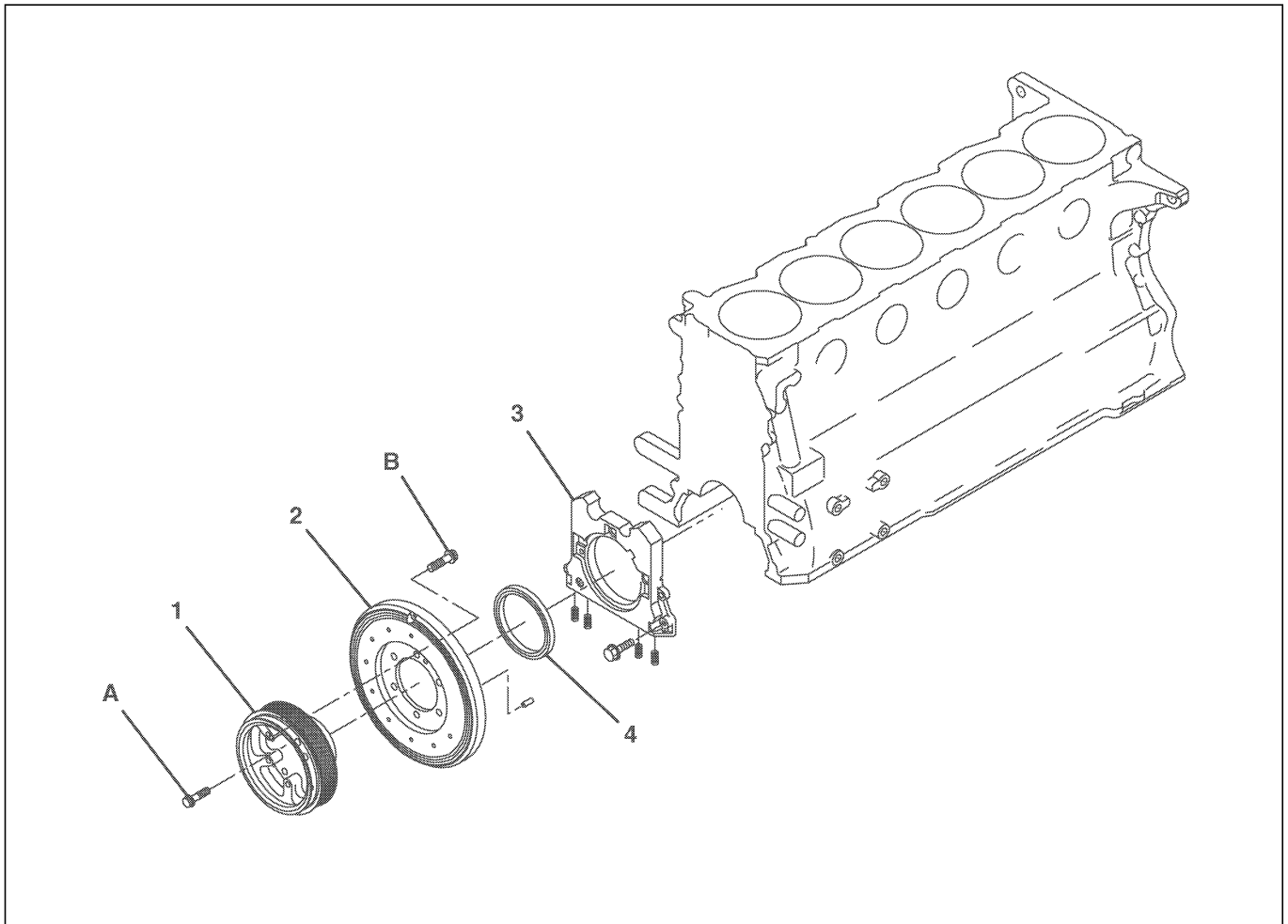
Inspection item		Standard	Limit	Remedy	Inspection procedure
Outer valve spring	Setting load	314 N {32.0 kgf, 70.5 lbf} at 46.8 {1.843}	291.8 N {29.8 kgf, 65.6 lbf}	Replace.	Measure  Setting load  Free length  Clearance Squareness
	Free length (reference value)	75.7 {2.980}	72.7 {2.862}	Replace.	
	Squareness	—	2.0 {0.0787}	Replace.	
Inner valve spring	Setting load	129 N {13.2 kgf, 29.1 lbf} at 44.8 {1.764}	119.5 N {12.2 kgf, 26.9 lbf}	Replace.	Visual check 
	Free length (reference value)	64.6 {2.543}	61.6 {2.425}	Replace.	
	Squareness	—	2.0 {0.0787}	Replace.	
Wear and damage of valve spring seat upper and lower		—	—	Replace.	Measure  CYLINDER HEAD
Nozzle protrusion		2.45-2.95 {0.0965-0.1161}	—	Replace nozzle seat.	Measure 
Cylinder head lower surface flatness		0.06 or less {0.0024 or less} for longitudinal direction	0.20 {0.0078}	Replace. NOTICE: Do not grind for repair.	
		0.03 or less {0.0012 or less} for lateral direction			

Inspection item	Standard	Limit	Remedy	Inspection procedure
Cracks or damage to cylinder head (Dye penetrant check)	—	—	Replace.	Visual check 
Contact of valve (Use of Red lead marking compound)	Entire periphery of valve head evenly in contact	—	Matches valve.	Visual check 
Cam idle gear shaft outside diameter	34 {1.3386}	—	—	Measure 
Cam idle gear shaft bushing inside diameter	34 {1.3386}	—	—	
Clearance between cam idle gear shaft and cam idle gear bushing	0.025-0.075 {0.0010-0.0029}	0.2 {0.0078}	Replace idle gear shaft and/or idle gear.	

CRANKSHAFT FRONT END

COMPONENT LOCATOR

EN0110602D10002



SAPH011060200063

1 Crankshaft pulley
2 Torsional damper

3 Oil seal retainer
4 Crankshaft oil seal

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A 118 {1,200, 86}#

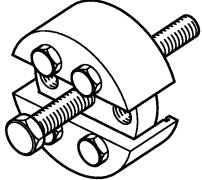
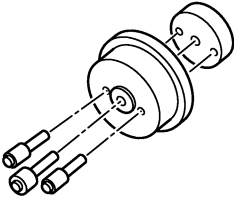
B 108 {1,100, 80}#

#=Apply oil to the threads and seat surfaces before tightening.

SPECIAL TOOL

EN0110602K100002

Prior to starting an engine overhaul, it is necessary to have these special tools.

Illustration	Part number	Tool name	Remarks
	S0942-01731	OIL SEAL PULLER	
	S0940-71030	OIL SEAL PRESS	

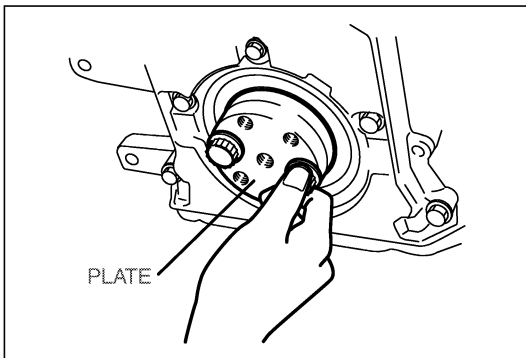
OVERHAUL

EN0110602H200002

IMPORTANT POINTS - REPLACEMENT

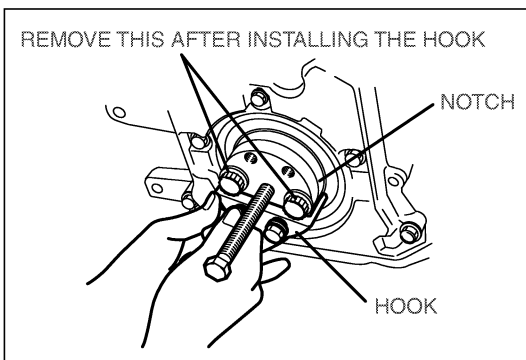
1. REMOVE THE CRANKSHAFT FRONT OIL SEAL. SST: Oil seal puller (S0942-01731)

- (1) Place the plate at the crankshaft end using the crankshaft pulley bolts.



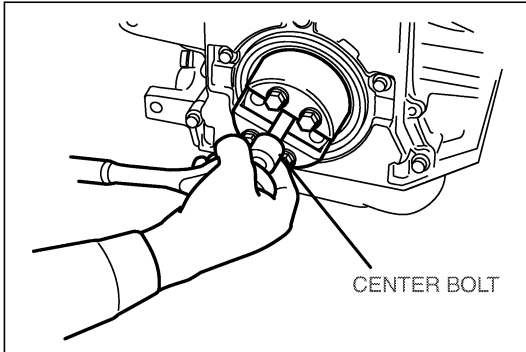
SAPH011060200066

- (2) Engage the hook with the oil seal notch and install the hook using the bolt supplied.
- (3) Remove the installed bolt in step (1).



SAPH011060200067

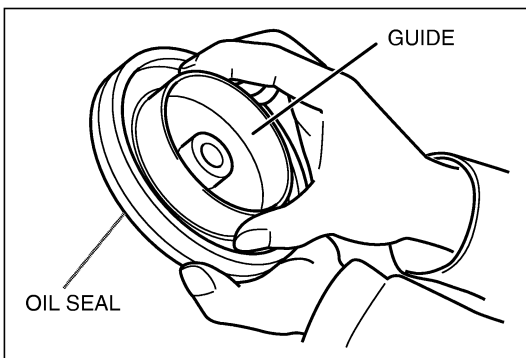
- (4) Install the center bolt and tighten it to remove the oil seal.



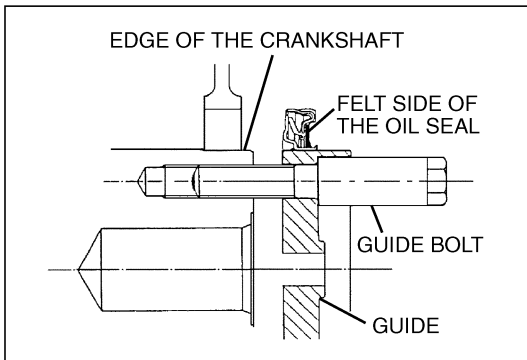
SAPH011060200068

2. INSTALL THE CRANKSHAFT FRONT OIL SEAL. SST: Oil seal press (S0940-71030)

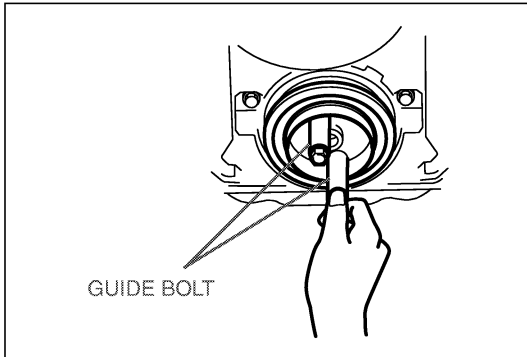
- (1) Clean the edges and surface of the crankshaft and the special tools.
- (2) Insert a new crankshaft oil seal into the guide of the oil seal press.



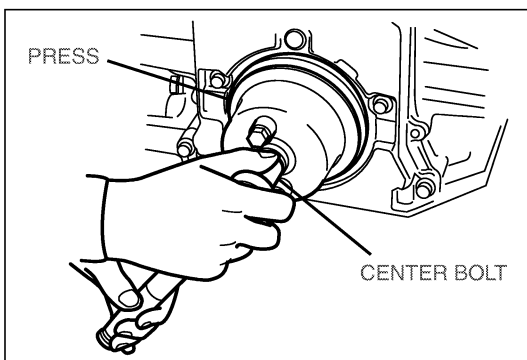
SAPH011060200069



SAPH011060200070



SAPH011060200071



SAPH011060200072

NOTICE

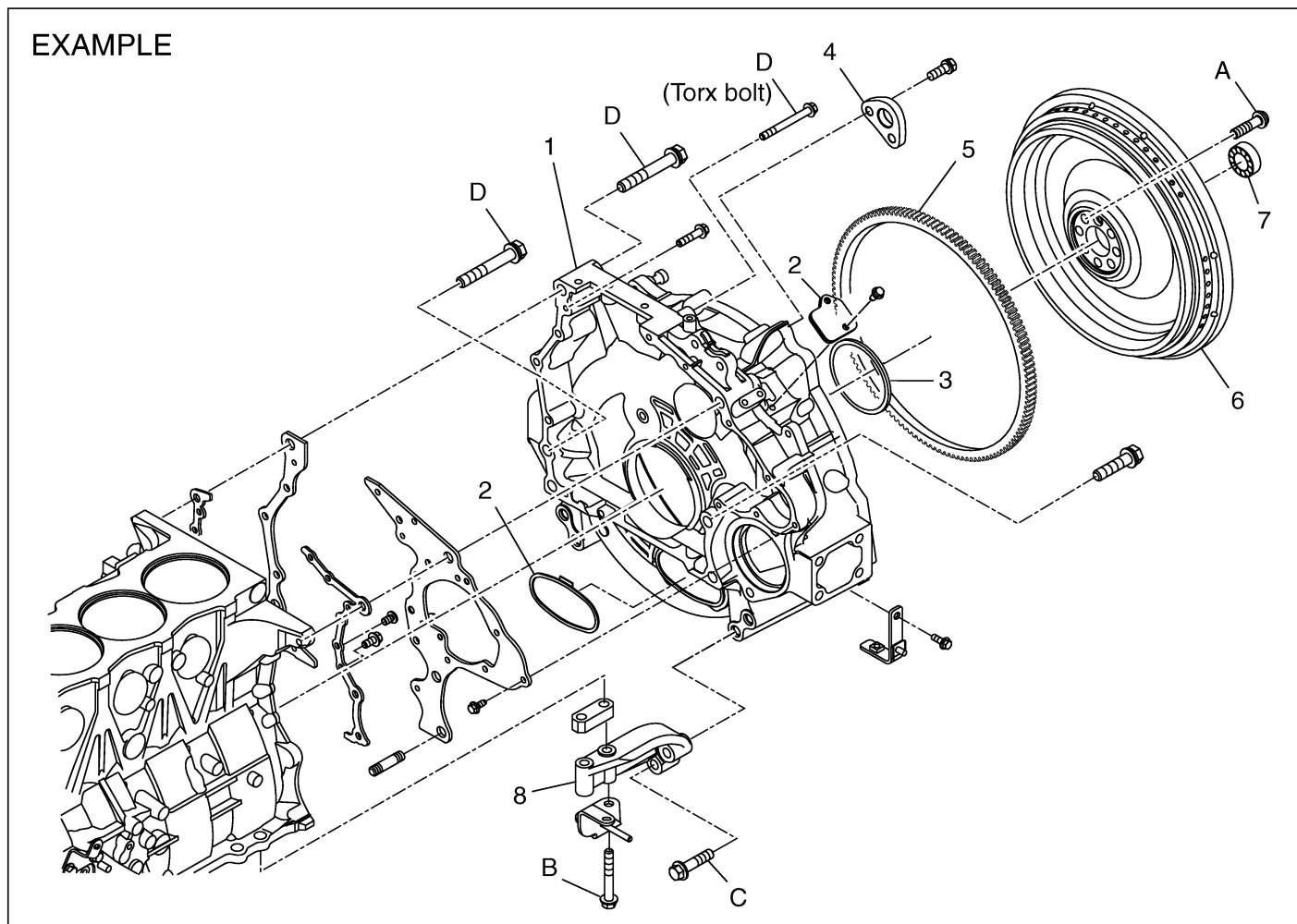
Pay attention to the orientation of the crankshaft oil seal (The felt side should face the outside of the cylinder block).

- (3) Apply a little engine oil to the seal portion of the crankshaft oil seal.
- (4) Attach the oil seal press guide with the new crankshaft oil seal onto the crankshaft using the attached guide bolt.
- (5) Insert the oil seal press by adjusting the oil seal press hole to the guide bolt.
- (6) Press the crankshaft oil seal inside by attaching the accompanying center bolt onto the oil seal press and tightening it until it stops.

FLYWHEEL AND FLYWHEEL HOUSING

COMPONENT LOCATOR

EN0110602D100003



SAPH011060200073

1	Flywheel housing	5	Ring gear
2	Dust cover	6	Flywheel
3	Crankshaft oil seal	7	Pilot bearing
4	Hanger bracket	8	Stay

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A	186 {1,900, 137}#○	D	M8: 28.5 {290, 21}
B	97 {990, 72}	D	M8 Torx bolt: 36 {367, 27}
C	171.5 {1,750, 127}	D	M10: 55 {560, 40.5}
		D	M16: 176.5 {1,800, 130}

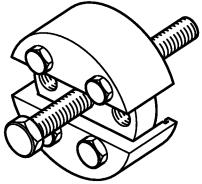
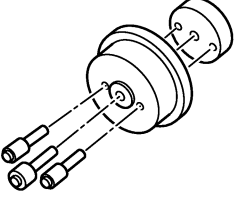
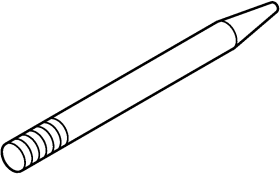
#=Apply oil to the threads and seat surface before tightening.

○=Tighten the bolt to the specified torque, then loosen it. Tighten to the specified torque again.

SPECIAL TOOL

EN0110602K100003

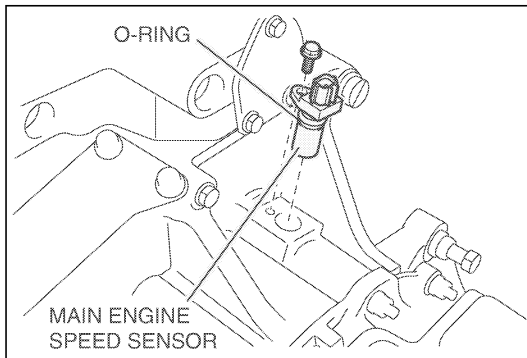
Prior to starting an engine overhaul, it is necessary to have these special tools.

Illustration	Part number	Tool name	Remarks
	S0942-01742	REAR OIL SEAL PULLER	
	S0940-71040	OIL SEAL PRESS	
	S0948-11340	GUIDE BAR	

OVERHAUL

EN0110602H200003

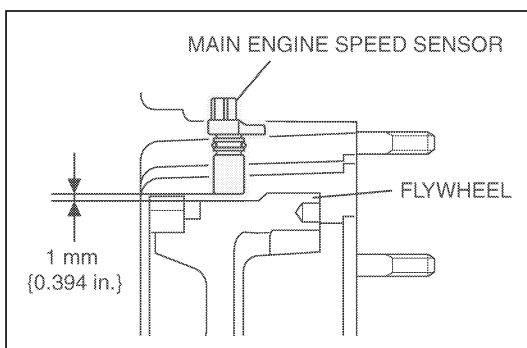
IMPORTANT POINTS - DISASSEMBLY



SAPH011060200077

1. REMOVE THE FLYWHEEL ASSY.

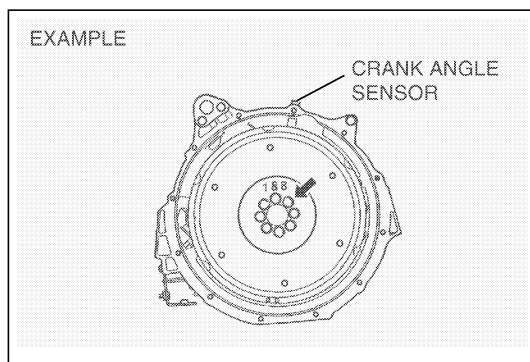
- (1) Remove the main engine speed sensor from the flywheel housing.



SAPH011060200078

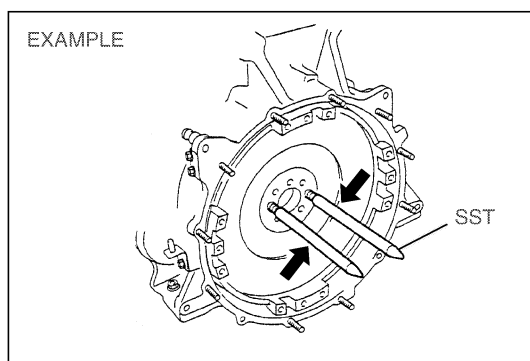
NOTICE

When dismantling and remounting the flywheel. Remove the main engine speed sensor. If not removed, it will result in damage of the sensor.



SAPH011060200079

- (2) Remove the 8 bolts of the flywheel assy.

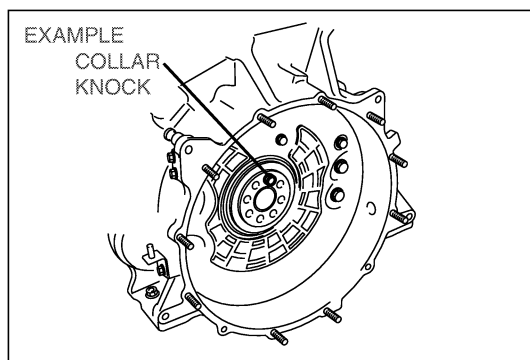


SAPH011060200080

- (3) Install the special tool, remove the flywheel assy.
SST: Guide bar (S0948-11340)

⚠ WARNING

Be careful not to drop the flywheel on your foot when removing it, because it is very heavy.



SAPH011060200081

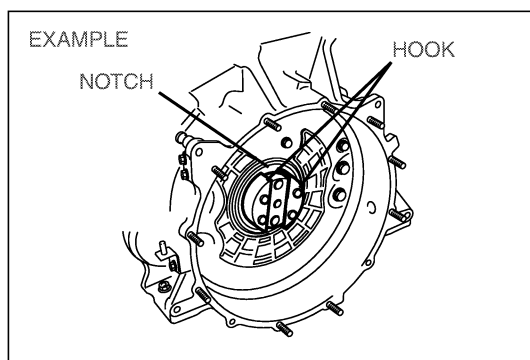
IMPORTANT POINTS - REPLACEMENT

1. REMOVE THE CRANKSHAFT REAR OIL SEAL.
SST: Oil seal puller (S0942-01742)

- (1) Place the plate at the crankshaft end using the flywheel bolts.

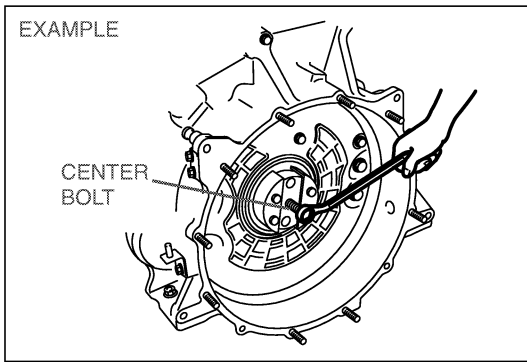
NOTICE

Match the plate hole to the crankshaft collar knock part.



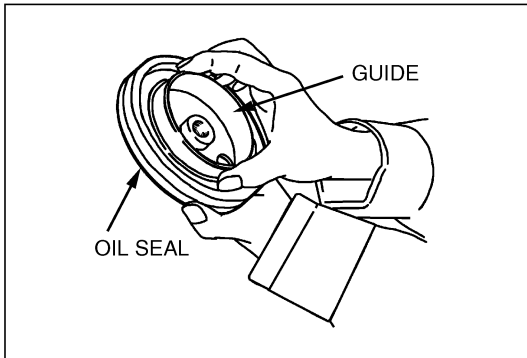
SAPH011060200082

- (2) Engage the hook with the oil seal notch and install the hook using the bolt supplied.
(3) Remove the installed flywheel bolts in step (1).



SAPH011060200083

- (4) Install the center bolt and tighten it to remove the oil seal.

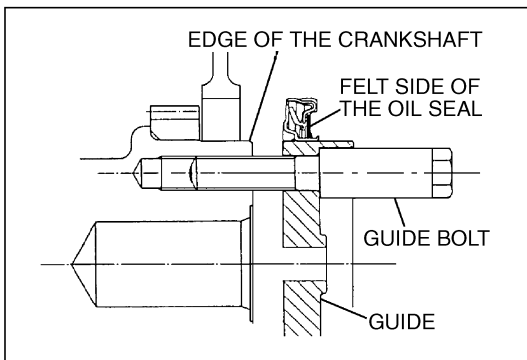


SAPH011060200084

2. INSTALL THE CRANKSHAFT REAR OIL SEAL.

SST: Oil seal press (S0940-71040)

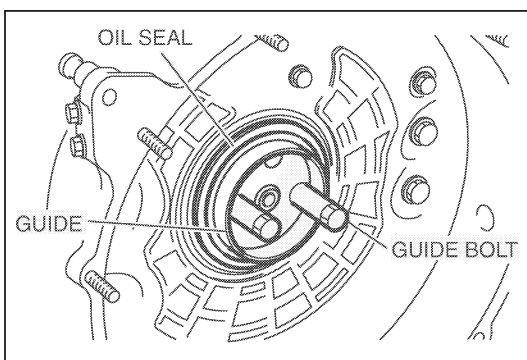
- (1) Clean the edges and surface of the crankshaft and the special tools.
- (2) Insert a new crankshaft oil seal into the guide of the oil seal press.



SAPH011060200085

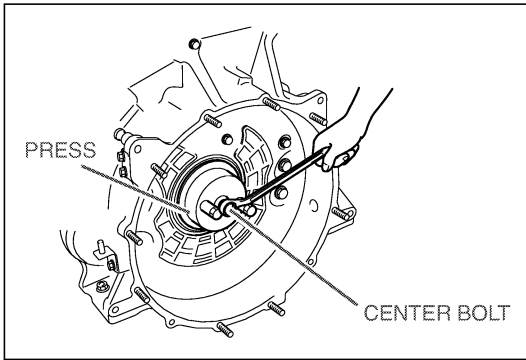
NOTICE

Pay attention to the orientation of the crankshaft oil seal (The felt side should face the outside of the cylinder block).



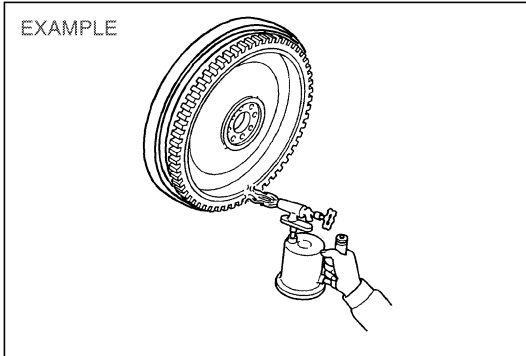
SAPH011060200086

- (3) Apply a little engine oil to the seal portion of the crankshaft oil seal.
- (4) Attach the oil seal press guide with the new crankshaft oil seal onto the crankshaft using the attached guide bolt.



SAPH011060200087

- (5) Insert the oil seal press by adjusting the oil seal press hole to the guide bolt.
- (6) Press the crankshaft oil seal inside by attaching the accompanying center bolt onto the oil seal press and tightening it until it stops.



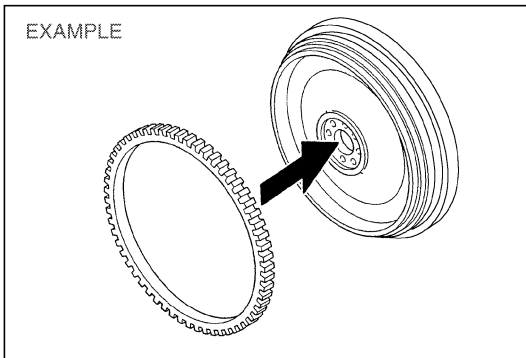
SAPH011060200088

3. REPLACE THE FLYWHEEL RING GEAR.

- (1) Heat the ring gear evenly to about 200°C {392°F} with a torch. Tap the ring gear periphery lightly using a cushion bar to remove the gear.

⚠ WARNING

Never touch the heated ring gear or flywheel with your bare hand. This can result in personal injury.

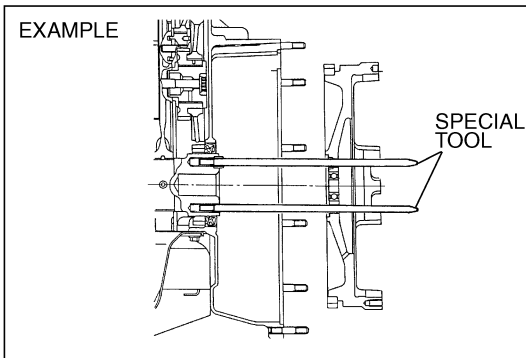


SAPH011060200089

- (2) Heat the ring gear evenly to about 200°C {392°F} with a torch. Insert the ring gear into the flywheel so that the chamfered side is upward.

⚠ WARNING

Never touch the heated ring gear or flywheel with your bare hand. This can result in personal injury.



SAPH011060200090

IMPORTANT POINT - ASSEMBLY

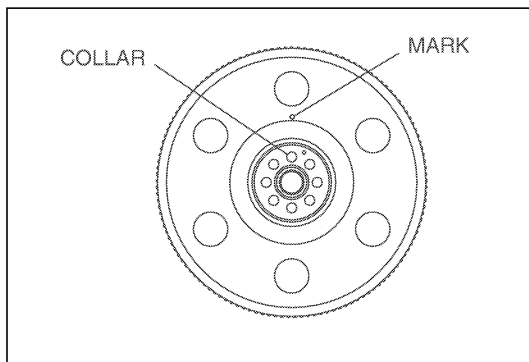
1. INSTALL THE FLYWHEEL.

- (1) Make sure that there are no burns or dirt on the contact surface or in the threaded holes of the crankshaft or flywheel. Install the special tool onto the crankshaft.

SST: Guide bar (S0948-11340)

NOTICE

Place one guide bar at the collar knock and another at the opposite side of the collar knock.



SAPH011060200091

- (2) Insert the flywheel slowly until it contacts the collar knock to prevent impact on the guide bar. Adjust the position, then insert the flywheel completely.

⚠ WARNING

Be careful not to drop the flywheel on your foot when removing it, because it is very heavy.

NOTICE

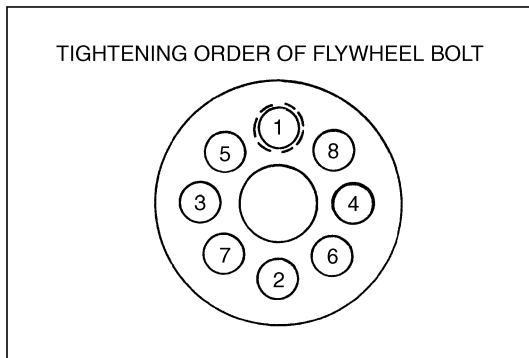
Align the "O" mark on the flywheel and crankshaft collar knock-pin.

- (3) Apply clean engine oil to the threads of the flywheel bolt and the flywheel bolt seat. Be sure to tighten the flywheel bolts (6 pieces) with a low-torque impact wrench.
- (4) Pull out the guide bar and tighten the remaining two flywheel bolts provisionally as in step (3).
- (5) Tighten the flywheel in the order shown in the figure to the specified torque below.

Tightening Torque:

186 N·m {1,900 kgf·cm, 137 lbf·ft}

- (6) Loosen all bolts and tighten them again to the specified torque.

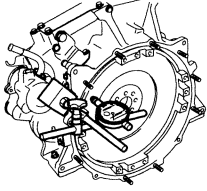
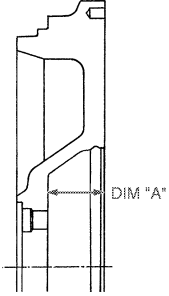


SAPH011060200092

INSPECTION AND REPAIR

EN0110602H300002

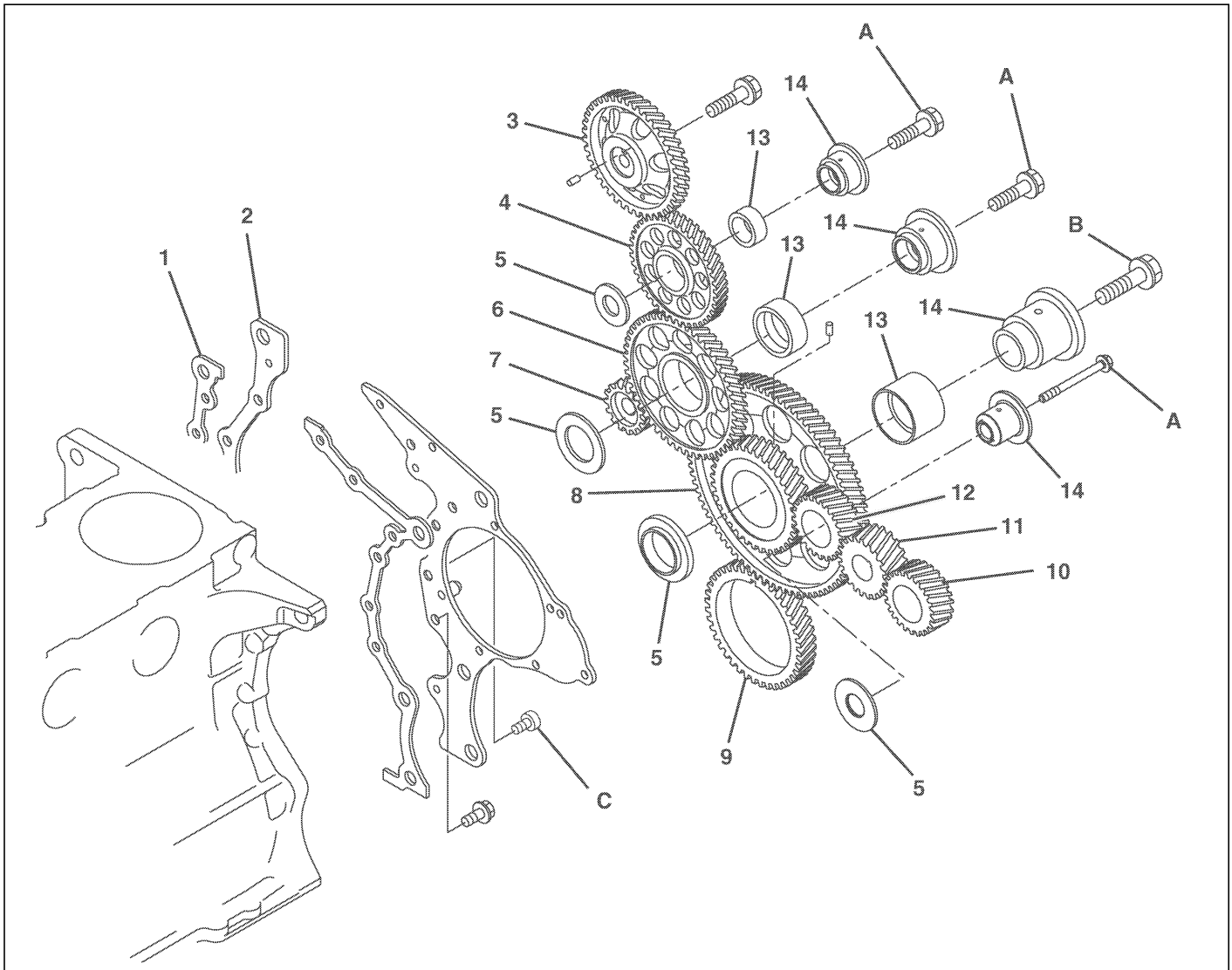
Unit: mm {in.}

Inspection item		Standard	Limit	Remedy	Inspection procedure
Flywheel surface deflection		—	0.15 {0.0059}	Repair.	Measure 
Flywheel thickness (Dimension A)	EATON SAS1401 SAS1402 series (Diameter 350 mm {14 in.})	43.5 {1.7126}	42.5 {1.6732}	Repair.	Measure 
Flywheel surface crank on heat spot		—	—	Repair.	Visual check

TIMING GEAR

COMPONENT LOCATOR

EN0110602D100004



SAPH011060200095

1	Gasket	8	Main idle gear
2	Rear end plate	9	Crankshaft gear
3	Camshaft gear	10	Power steering pump drive gear
4	Cam idle gear	11	Air compressor drive gear
5	Idle gear thrust plate	12	Air compressor idle gear
6	Sub-idle gear	13	Idle gear bushing
7	Oil pump gear	14	Idle gear shaft

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

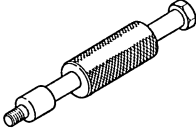
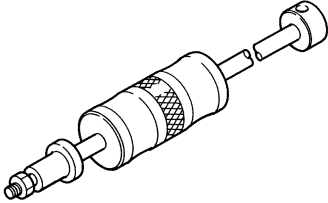

A	108 {1,100, 80}#	C	55 {560, 41} Application of lock sealant
B	172 {1,750, 127}#		

#=Apply oil to the threads and seat surfaces before tightening.

SPECIAL TOOL

EN0110602K100004

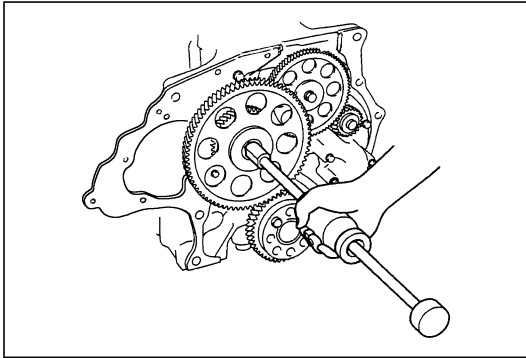
Prior to starting an engine overhaul, it is necessary to have these special tools.

Illustration	Part number	Tool name	Remarks
	S0942-01100	SLIDING HAMMER	For MAIN IDLE GEAR
	S0942-01442	SLIDING HAMMER	For SUB AND CAM IDLE GEAR
	S0941-11300	SOCKET WRENCH	For TORX BOLT

OVERHAUL

EN0110602H200004

IMPORTANT POINTS - DISASSEMBLY



SAPH011060200099

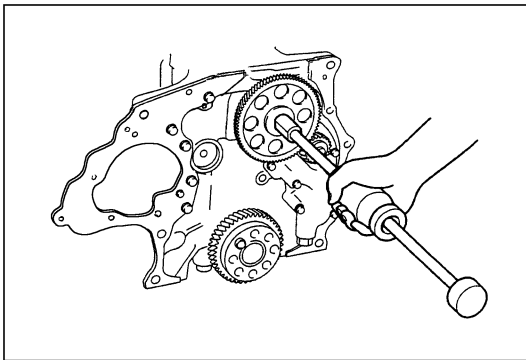
1. REMOVE THE IDLE GEAR SHAFT.

- (1) Remove the idle gear shaft using the special tool.

SST:

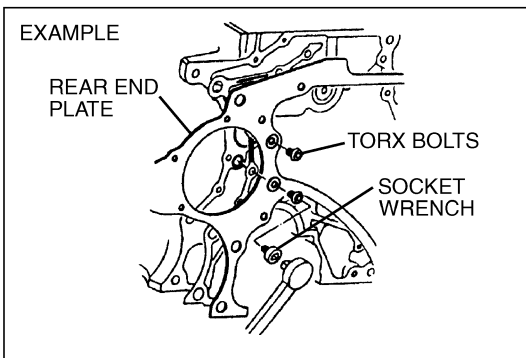
Sliding hammer (for main idle gear) (S0942-01100)

Sliding hammer (for sub and cam idle gear) (S0942-01442)



SAPH011060200100

IMPORTANT POINTS - ASSEMBLY



SAPH011060200101

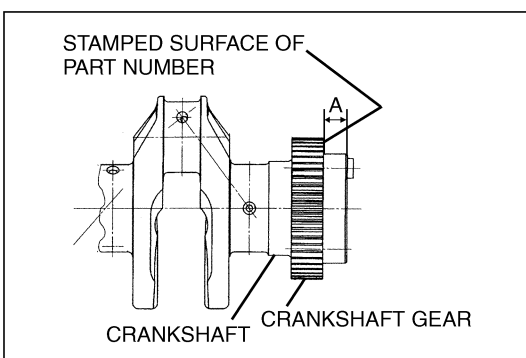
1. INSTALL THE REAR END PLATE.

- (1) Apply lock sealant (Nut Lock Super 5M or equivalent) to the threads of the torx bolts in the side of bearing holder case fitting (2 places) and tighten to the specified torque using the special tool.

SST: Socket wrench (S0941-11300)

Tightening Torque:

55 N·m {560 kgf·cm, 41 lbf·ft}



SAPH011060200102

2. INSTALL THE CRANKSHAFT GEAR.

- (1) Heat the crankshaft gear in oil heated to 100°C -150°C {212°F-302°F}.

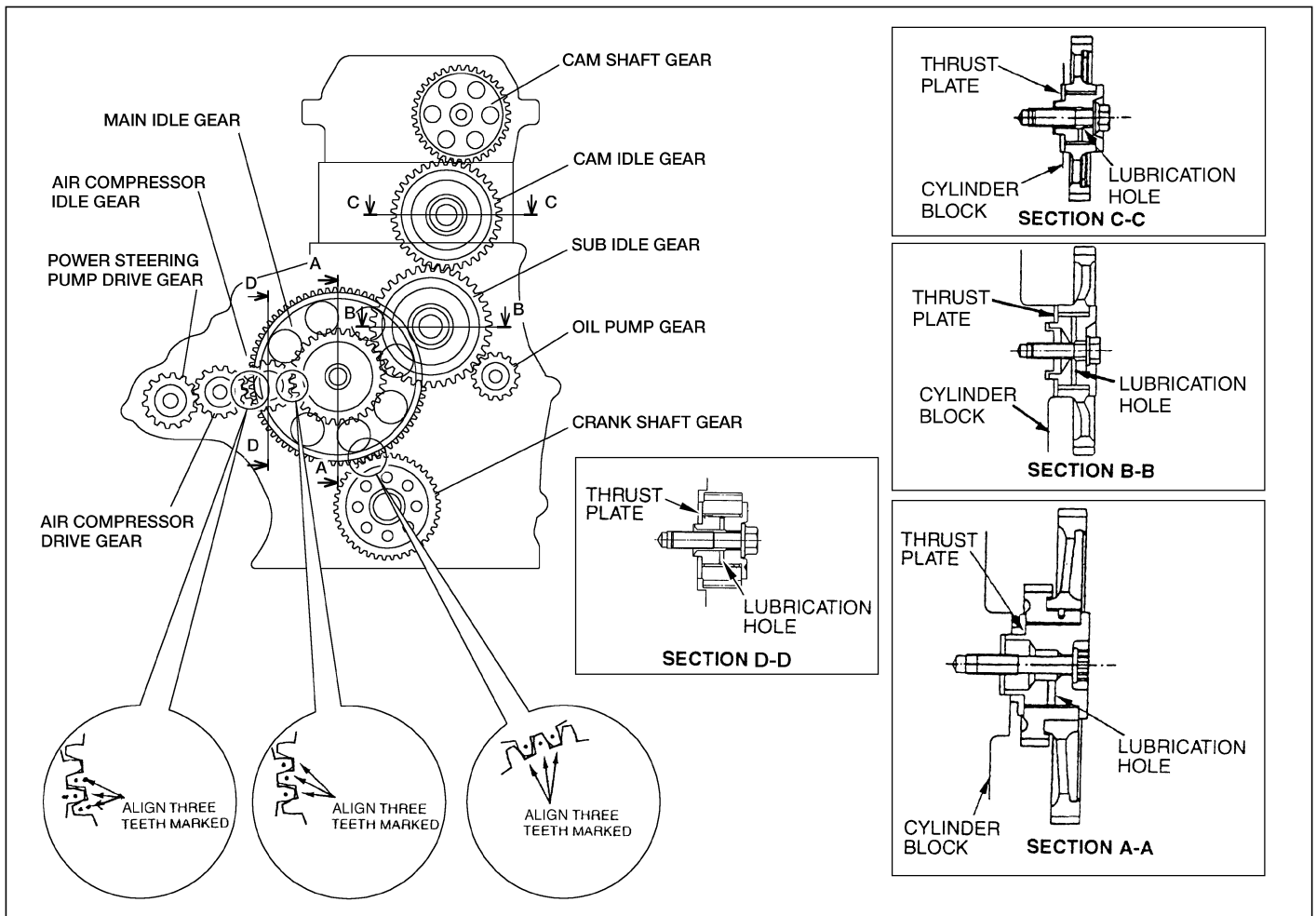
⚠ WARNING

Never touch the heated gear with your bare hand. This can result in personal injury.

- (2) Align the crankshaft gear groove with crankshaft pin.
- (3) Install the crankshaft gear onto the crankshaft as shown in the figure.

Dimension A: 22 mm {0.866 in.}

3. INSTALL THE IDLER GEAR SHAFT AND GEAR.



SAPH011060200103

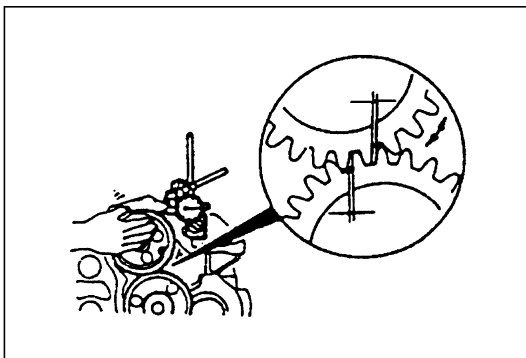
NOTICE

- Install each idle gear shaft through the thrust plate as shown in the figure so that the lubrication hole is downward.
- Adjust the timing of the main idle gear to align with the air compressor gear as shown in the figure.

4. MEASUREMENT OF GEAR BACKLASH.

- (1) Measure the backlash between the gears with a dial gauge. (Refer to the table of INSPECTION AND REPAIR)

After measurement of the backlash, apply engine oil to each gear surface.

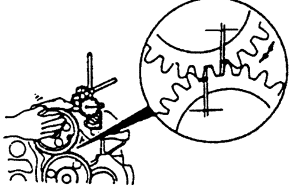


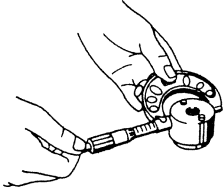
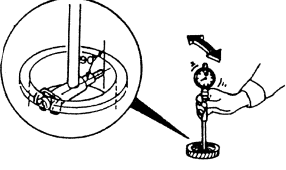
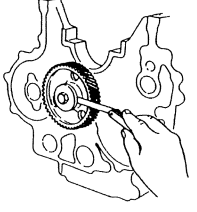
SAPH011060200104

INSPECTION AND REPAIR

EN0110602H300003

Unit: mm {in.}

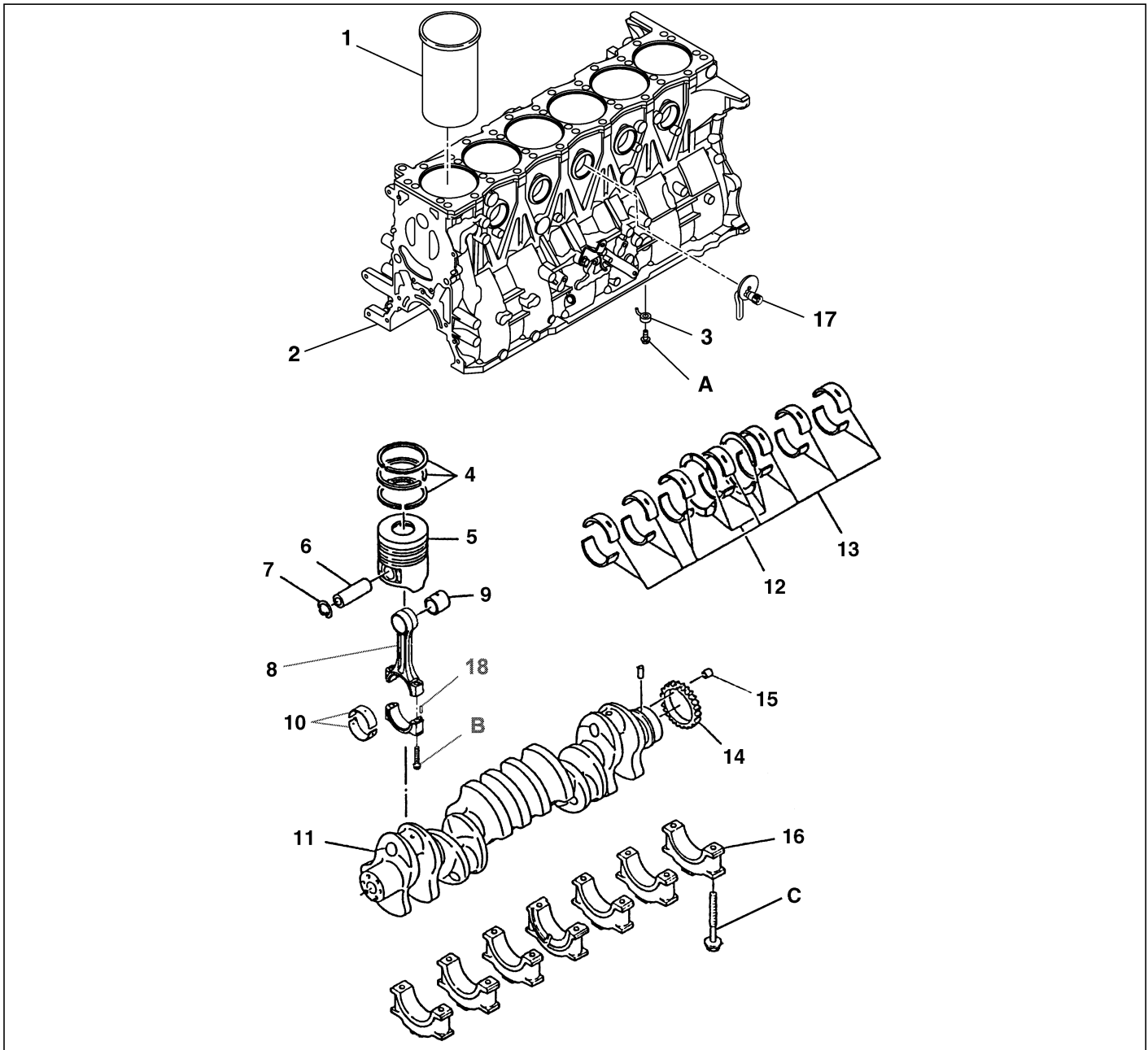
Inspection item		Standard	Limit	Remedy	Inspection procedure
Timing gear back- lash	Crankshaft- Main idle	0.030-0.167 {0.0012-0.0065}	0.30 {0.0118}	Replace gear.	Measure 
	Main idle-Air compressor idle	0.020-0.096 {0.0008-0.0038}	0.10 {0.0039}		
	Air compres- sor idle-Air compressor gear	0.020-0.083 {0.0008-0.0033}	0.10 {0.0039}		
	Air compres- sor-Power steering pump	0.030-0.134 {0.0012-0.0052}	0.30 {0.0118}		
	Main idle-Sub idle	0.030-0.113 {0.0012-0.0044}	0.30 {0.0118}		
	Sub idle-Oil pump	0.030-0.131 {0.0012-0.0051}	0.30 {0.0118}		
	Sub idle-Cam idle	0.050-0.218 {0.0020-0.0085}	0.30 {0.0118}		
	Cam idle- Camshaft	0.030-0.253 {0.0012-0.0099}	0.30 {0.0118}		

Inspection item		Standard	Limit	Remedy	Inspection procedure
Main idle shaft	Shaft outside diameter	57 {2.244}	—	—	Measure
	Bushing inside diameter	57 {2.244}	—	—	
	Clearance	0.030-0.090 {0.0012-0.0035}	0.20 {0.0079}	Replace gear and/or shaft.	
	Gear width	44 {1.732}	—	—	
	Shaft length	44 {1.732}	—	—	
	End play	0.114-0.160 {0.0045-0.0062}	0.30 {0.0118}	Replace gear and/or shaft.	
Sub idle shaft	Shaft outside diameter	50 {1.969}	—	—	 <p>Outside diameter</p>
	Bushing inside diameter	50 {1.969}	—	—	
	Clearance	0.025-0.075 {0.0010-0.0029}	0.20 {0.0079}	Replace gear and/or shaft.	
	Gear width	22 {0.866}	—	—	
	Shaft length	22 {0.866}	—	—	
	End play	0.040-0.120 {0.0016-0.0047}	0.30 {0.0118}	Replace gear and/or shaft.	
Cam idle shaft	Shaft outside diameter	34 {1.339}	—	—	 <p>Inside diameter</p>
	Bushing inside diameter	34 {1.339}	—	—	
	Clearance	0.025-0.075 {0.0010-0.0029}	0.20 {0.0079}	Replace gear and/or shaft.	
	Gear width	22 {0.866}	—	—	
	Shaft length	22 {0.866}	—	—	
	End play	0.040-0.120 {0.0016-0.0047}	0.30 {0.0118}	Replace gear and/or shaft.	
Air compressor idle	Shaft outside diameter	34 {1.339}	—	—	 <p>End play</p>
	Bushing inside diameter	34 {1.339}	—	—	
	Clearance	0.025-0.057 {0.0010-0.0022}	0.10 {0.0039}	Replace gear and/or shaft.	
	Gear width	28.5 {1.1220}	—	—	
	Shaft length	28.5 {1.1220}	—	—	
	End play	0.160-0.220 {0.0063-0.0086}	0.30 {0.0118}	Replace gear and/or shaft.	

MAIN MOVING PARTS AND CYLINDER BLOCK

COMPONENT LOCATOR

EN0110602D100005



SAPH011060200107

1	Cylinder liner	10	Connecting rod bearing
2	Cylinder block	11	Crankshaft
3	Piston cooling jet	12	Crankshaft thrust bearing
4	Piston ring	13	Crankshaft main bearing
5	Piston	14	Crankshaft gear
6	Piston pin	15	Collar knock
7	Retainer ring	16	Main bearing cap
8	Connecting rod	17	Block heater assy
9	Connecting rod bushing	18	Dowel pin

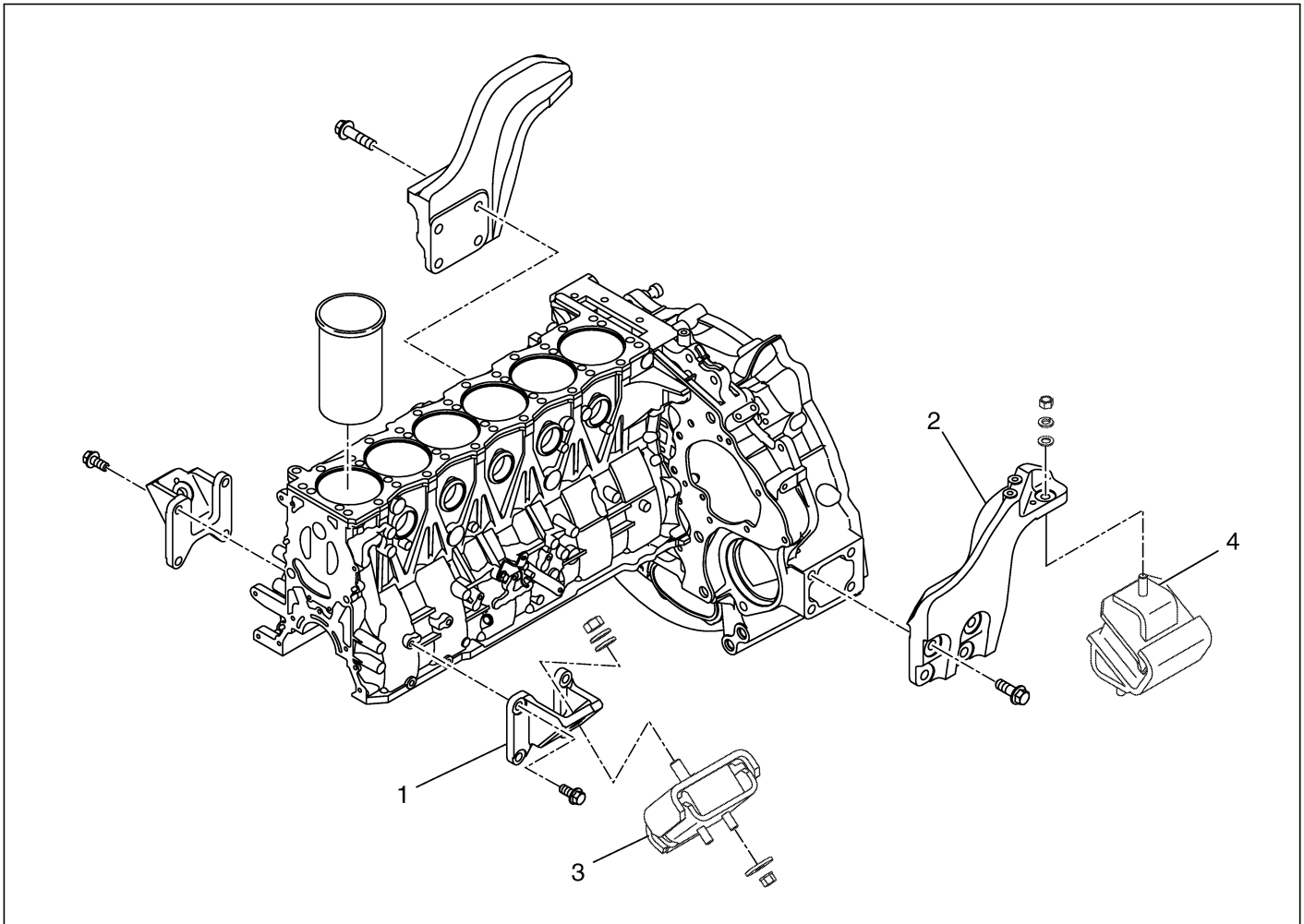
Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A	22 {220, 15.5}	C	69 {700, 50}+90°+45°#○
B	69 {700, 50}+90°+45°#		

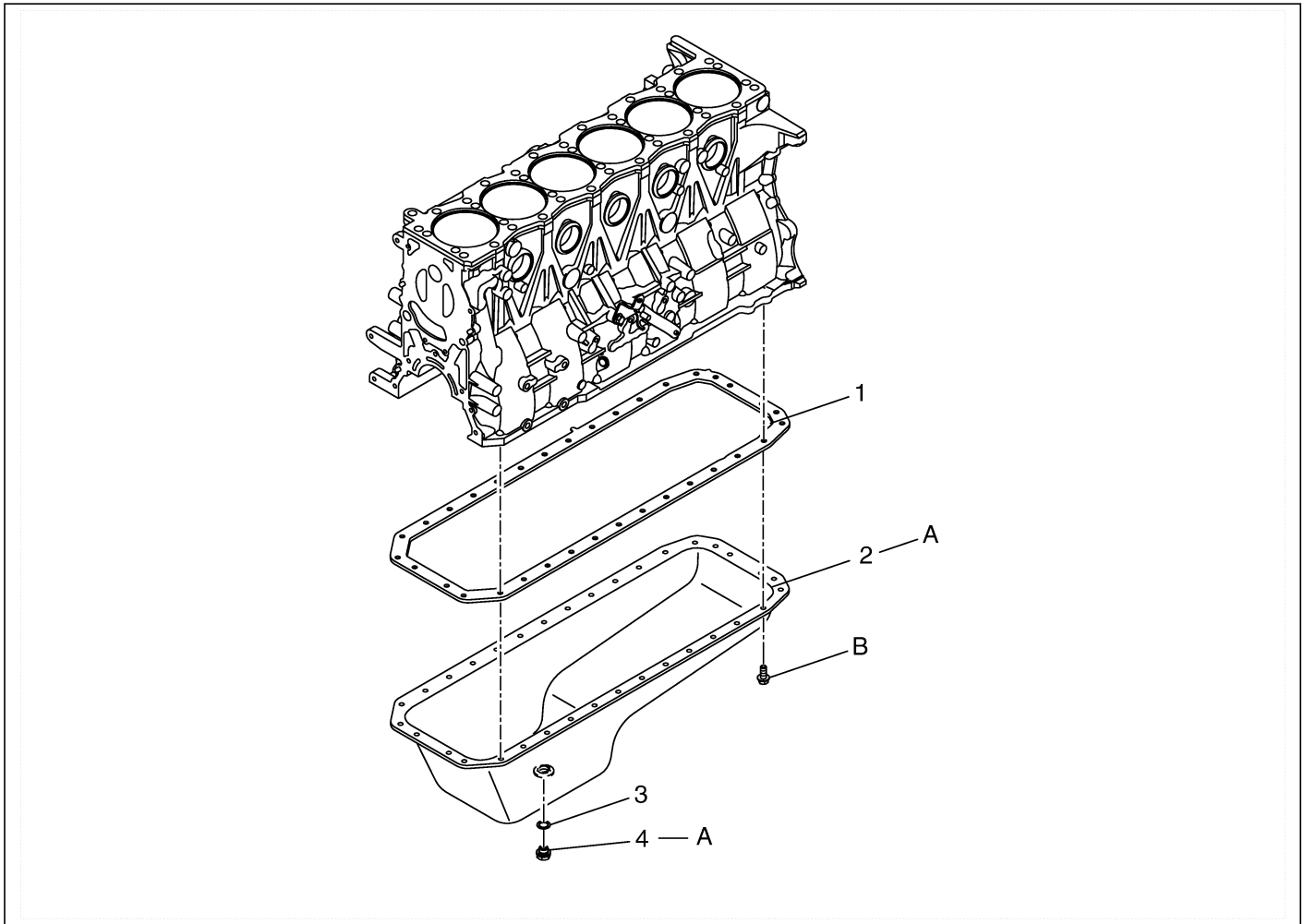
#=Apply oil to the threads and seat surfaces before tightening.

○=Tighten the bolt to the specified torque, then loosen it. Tighten to the specified torque again.



SAPH011060200108

1	Engine mounting bracket, front	3	Engine mounting, front
2	Engine mounting bracket, rear	4	Engine mounting, rear



SAPH011060200109

1 Gasket
2 Oil pan

3 Soft washer
4 Drain plug

Tightening torque**Unit: N·m {kgf·cm, lbf·ft}**

A 41 {420, 30}

B 30 {300, 21}

SPECIAL TOOL

EN0110602K100005

Prior to starting an engine overhaul, it is necessary to have these special tools.

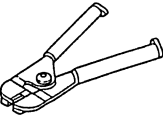
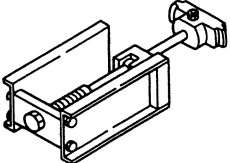
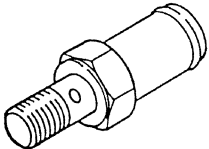

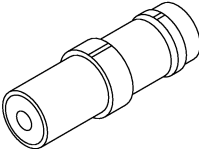
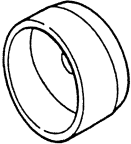
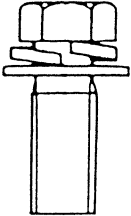
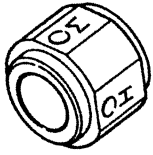
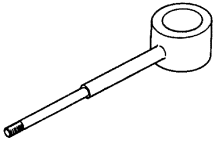
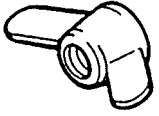
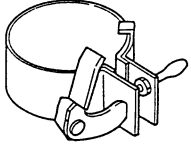
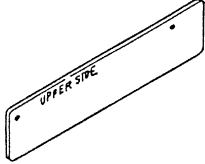
Illustration	Part number	Tool name	Remarks
	S0944-21011	PISTON RING EXPANDER	For Piston ring
	S0942-02100	PULLER	For Cylinder liner
	SZ910-24098	CONNECTOR BOLT	For Piston cooling jet
	S0947-11490	GUIDE	
	S0940-21540	SPINDLE	
	S0948-11540	GUIDE	
	SH691-20825	BOLT	

Illustration	Part number	Tool name	Remarks
	S0948-11130	GUIDE	For Connecting rod bushing
	S0940-21530	PRESS SUB-ASSEMBLY	
	SL271-01036	WING NUT	
	S0944-11370	PISTON RING HOLDER	
	09219-E4010	GAGE	

OVERHAUL

EN0110602H200005

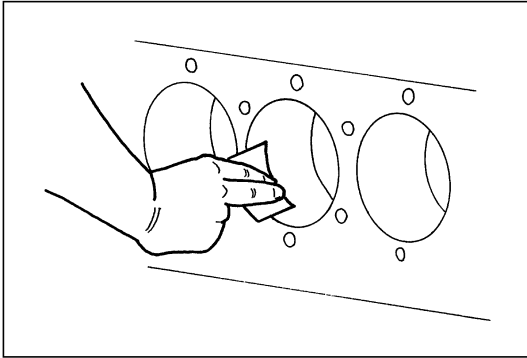
IMPORTANT POINTS - DISASSEMBLY

1. REMOVE THE PISTONS WITH CONNECTING RODS.

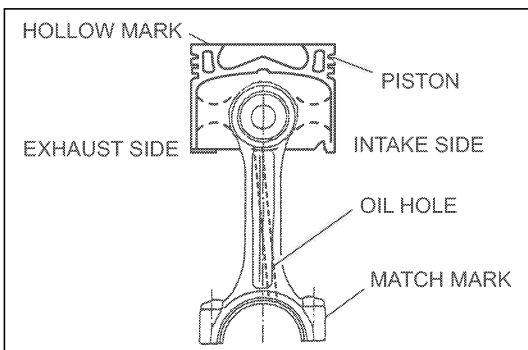
- (1) Remove the pistons and connecting rods from the cylinder block upper side.

NOTICE

- Remove carbon deposits from the end inside the cylinder liner with a scraper or emery paper (recommended: No. 150) in a circular direction.



SAPH011060200122



SAPH011060200123

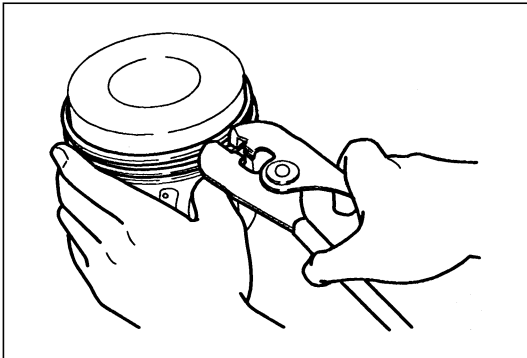
- Arrange the removed pistons and connecting rod caps in the order of cylinder Numbers. Be careful not to change the combination of the connecting rod and cap.

2. REMOVE THE PISTON RINGS.

- (1) Remove the piston ring using the special tool.
SST: Piston ring expander (S0944-21011)

NOTICE

- Handle the piston rings carefully because they are made of a special casting which is easily broken.
- Keep the piston rings for each cylinder separately.



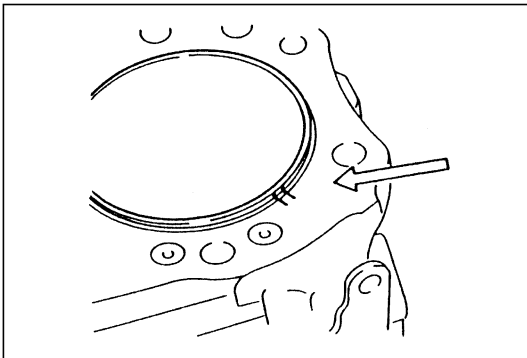
SAPH011060200124

3. REMOVE THE CYLINDER LINER.

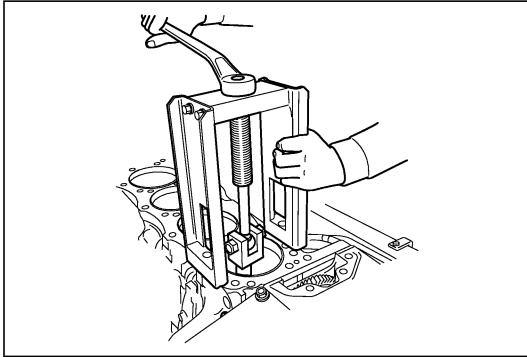
- (1) Before removing the cylinder liner, put alignment marks on the cylinder block and liner flange.

NOTICE

Do not make alignment marks with a punch.



SAPH011060200125

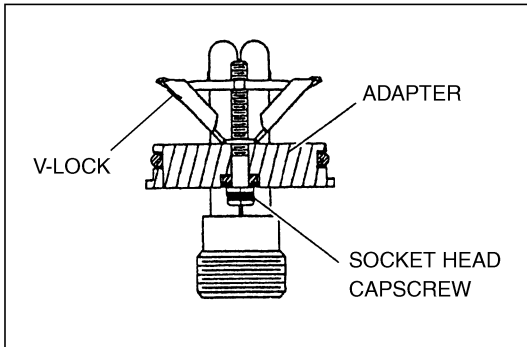


SAPH011060200126

- (2) Pull the cylinder liner from the cylinder block using the special tool.
SST: Puller (S0942-02100)

NOTICE

- Carefully set the special tool to prevent touching the piston cooling jet.
- After removing the cylinder liners, arrange them in sequence.



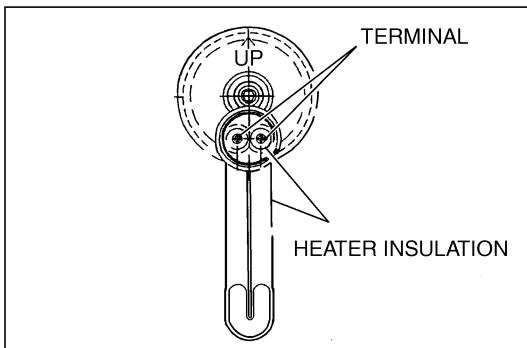
SAPH011060200127

4. REMOVE THE BLOCK HEATER.

- (1) Remove the harness by loosening the cord nut.
- (2) Loosen the socket head cap screw.
- (3) Lever the heater out by using a bar.

NOTICE

- Do not damage the adapter installation hole, otherwise water will leak.
- Do not reuse the V-lock.



SAPH011060200128

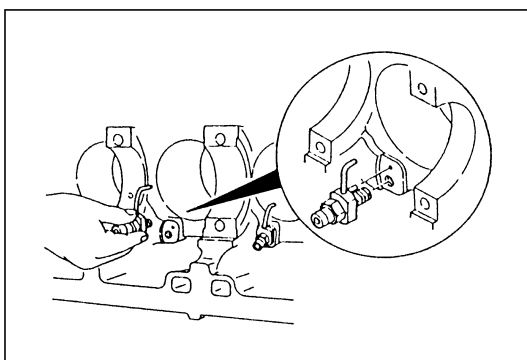
IMPORTANT POINTS - ON - VEHICLE INSPECTION**1. INSPECT THE BLOCK HEATER.**

- (1) Measure the resistance between terminals.
If not standard value, replace block heater assembly.

Standard	13.1—15.2Ω
-----------------	-------------------

- (2) Measure the resistance of insulation between terminals and heater insulation. If not standard value, replace block heater assembly.

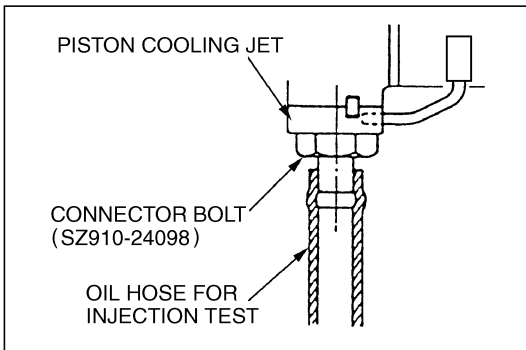
Standard	More than 5MΩ
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SAPH011060200129

IMPORTANT POINTS - ASSEMBLY**1. INSPECT AND ADJUST THE PISTON COOLING JET.**

- (1) Install the piston cooling jet on the cylinder block using the special tool.
SST: Connector bolt (SZ910-24098)

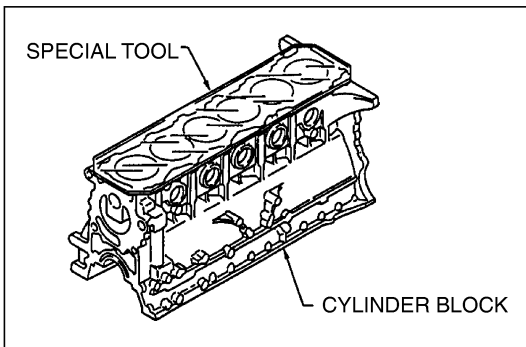


SAPH011060200130

- (2) For the jet test, connect the oil hose to the connector bolt from the cylinder block lower side.

NOTICE

Use clean engine oil for jet flow.

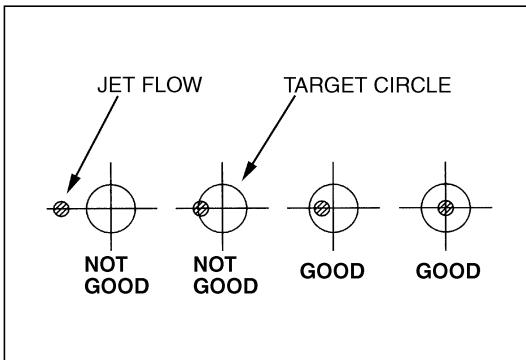


SAPH011060200131

- (3) Set the special tool on the cylinder block upper surface against the dowel pin.

SST: Gage (09219-E4010)

- (4) Test jet oil flow from the piston cooling jet nozzle at a hydraulic pressure of 245kPa {2.5 kgf/cm², 35lb/in²}.



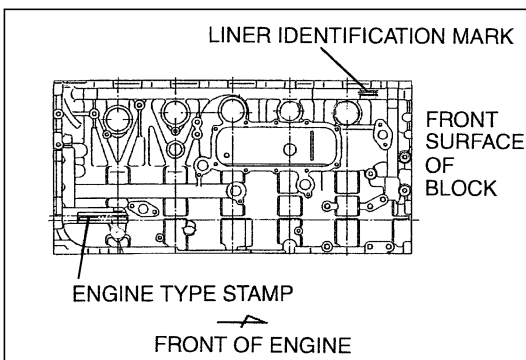
SAPH011060200132

- (5) If the center of the jet flow is within the two target circles (8 mm {0.3150 in} and 15 mm {0.5906 in} diameter: Red), the test is acceptable.

⚠ WARNING

- **Engine oil is flammable.**
- **Never use an open flame or a naked bulb.**
- **Carry out the following inspection only in a well-ventilated area.**

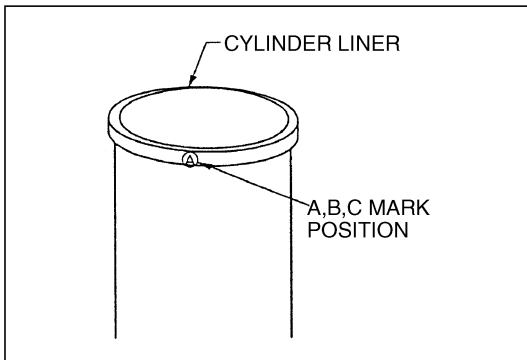
- (6) If the center of the jet flow is out of the two target circles, replace the jet.



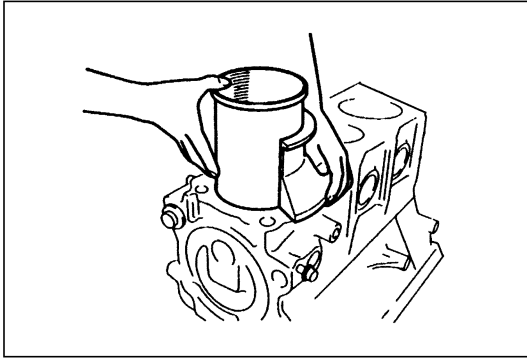
SAPH011060200133

2. INSTALL THE CYLINDER LINER.**NOTICE**

- **When assembling the cylinder liner with the cylinder block, clearance can be set to three levels.**
- **The upper surface and side surface of the cylinder block are stamped A, B or C depending on the inside diameter. Insert a matching cylinder liner having the same symbol.**



SAPH011060200134



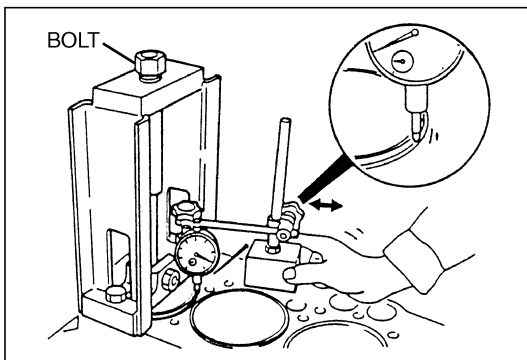
SAPH011060200135

- (1) Apply engine oil to the inner surface of the block bore and insert the cylinder liner using the special tool.

SST: Guide (S0947-11490)

NOTICE

Handle the cylinder liner carefully because it is thin.
(If it falls on the floor, it cannot be used.)



SAPH011060200136

- 3. MEASURE THE PROTRUSION AT THE CYLINDER LINER FLANGE.**

SST: Puller (S0942-02100)

Tightening Torque:

9.8 N·m {100 kgf·cm, 7 lbf·ft}

Standard	0.01-0.08 mm {0.0004-0.0031 in.}
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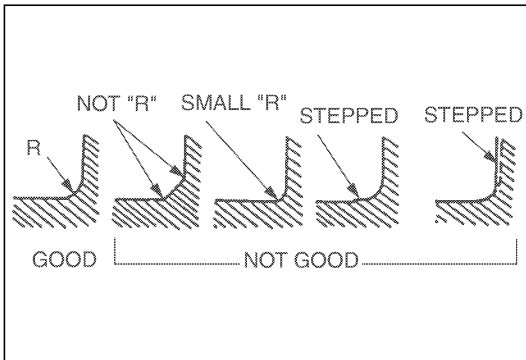
4. MEASURE THE CRANKSHAFT.

- (1) If necessary, grind the crankshaft and use an undersize bearing.

Bearing size	Outside diameter	
	Crank pin	Journal
Standard	64.94-64.96 mm {2.5567-2.5574 in.}	79.94-79.96 mm {3.1473-3.1480 in.}
0.25US	64.69-64.71 mm {2.5469-2.5476 in.}	79.69-79.71 mm {3.1375-3.1381 in.}
0.50US	64.44-64.46 mm {2.5371-2.5377 in.}	79.44-79.46 mm {3.1276-3.1283 in.}

- (2) Dimension of fillet "R".

Crank pin	2.5-3.0 mm {0.0985-0.1181 in.}
Journal	



SAPH011060200137

5. INSTALL THE CRANKSHAFT.

- (1) Install the main bearing onto the bearing caps and the cylinder block.

NOTICE

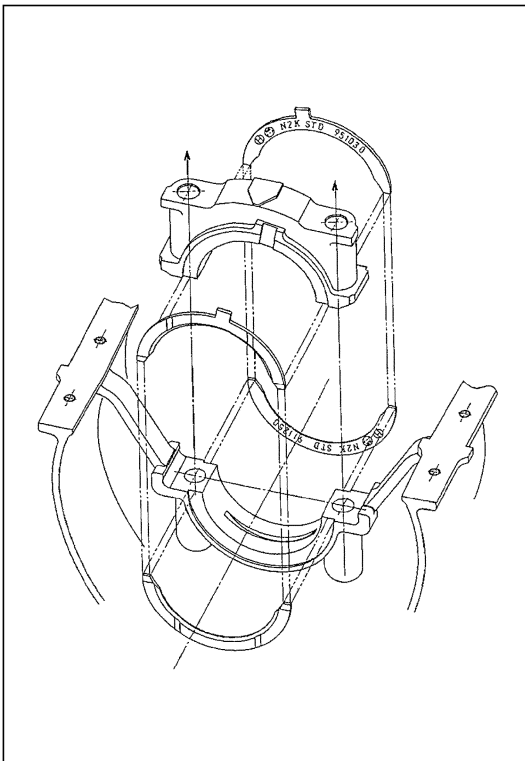
- Install the bearing with the oil hole on the block side and the bearing without the oil hole on the cap side.
- Apply clean engine oil to inner surfaces of the bearings.

- (2) Install the thrust bearing with the groove side (front) toward the crank arm and with the part No. stamp (back) toward the main bearing cap or cylinder block.

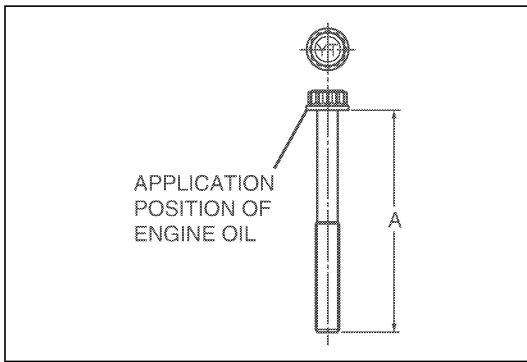
HINT

Apply engine oil or grease to the back of the bearing to prevent loosening during installation.

- (3) Install the crankshaft onto the cylinder block.



SAPH011060200138



SAPH011060200139

6. INSTALL THE MAIN BEARING CAP.

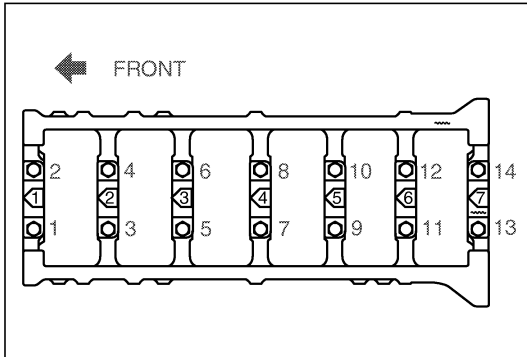
- (1) Install the main bearing cap onto the cylinder block.

NOTICE

Check the number stamped on the cap.

- (2) Measure the length below the head of the bearing cap bolt and replace any bolts not meeting the limit with new ones.

Dimension A	108 mm {4.252 in.}
--------------------	---------------------------



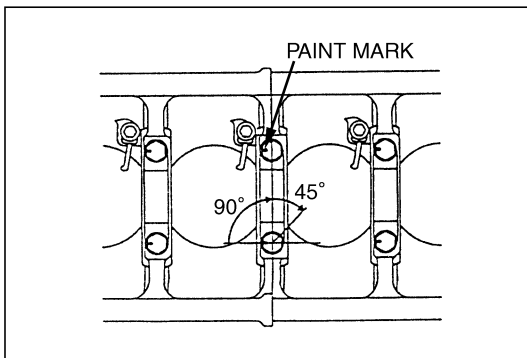
SAPH011060200140

- (3) Apply clean engine oil to the bolt seat and bolt threads.
- (4) Tighten the bolts in the order as shown in the figure to the specified torque.

Tightening Torque:

69 N·m {700 kgf·cm, 51 lbf·ft}

- (5) Loosen all bolts, tap the front and back ends of the crankshaft using a plastic hammer.
- (6) Tighten the bolts as in step (4).
- (7) Mark the bolt heads with paint.



SAPH011060200141

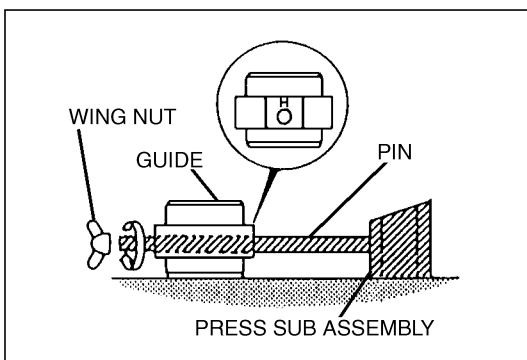
- (8) Tighten the bolts 90° (1/4 turn) in the same order as in step (4).
- (9) Retighten the bolts 45° (1/8 turn) as in step (8).

- (10) Make sure that all paint marks face the same direction.

NOTICE

When adding torque, never untighten the bolts, even if they have been overtightened.

- (11) After tightening, tap the front and back ends of the crankshaft using a plastic hammer to allow complete fit.



SAPH011060200142

7. REPLACE THE CONNECTING ROD BUSHING.

- (1) Prepare the special tools.
 - a. Assemble the guide and press sub-assembly inserting its pin into the guide then secure them with the wing nut.

SST:

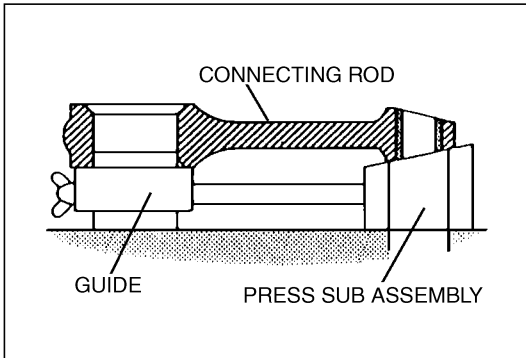
Guide (S0948-11130)

Press sub-assembly (S0940-21530)

Wing nut (SL271-01036)

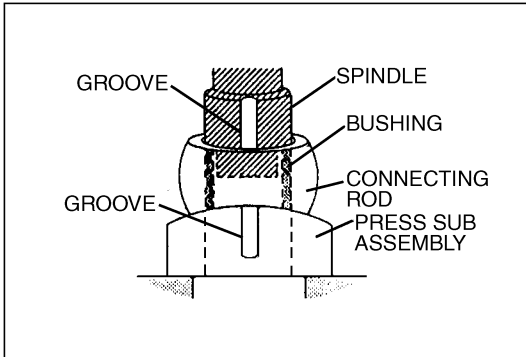
NOTICE

- Bring lever "H" punched on the guide above the pin.
- Making sure to align both supporting surfaces of the guide and press sub-assembly flush on a flat plane.



SAPH011060200143

- (2) Using a special tool, remove the connecting rod bushing.
- Set the connecting rod assembled without connecting rod bearing on the guide and press sub-assembly.

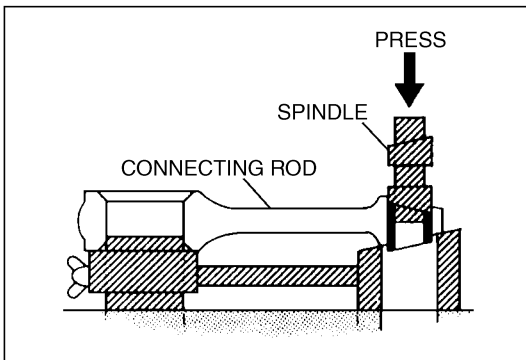


SAPH011060200144

- Install the spindle into the bushing.
SST: Spindle (S0940-21540)

NOTICE

Align the groove of the spindle with the groove of the press sub assembly.

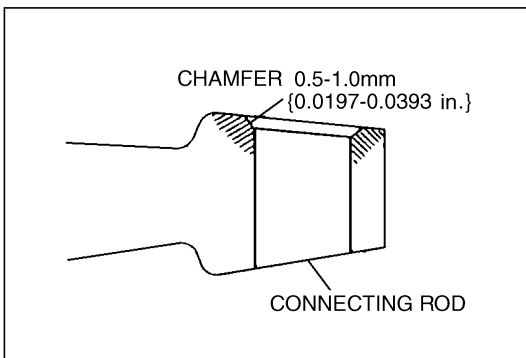


SAPH011060200145

- Using a hydraulic press, remove the bushing.

NOTICE

Always operate the press slowly and smoothly.

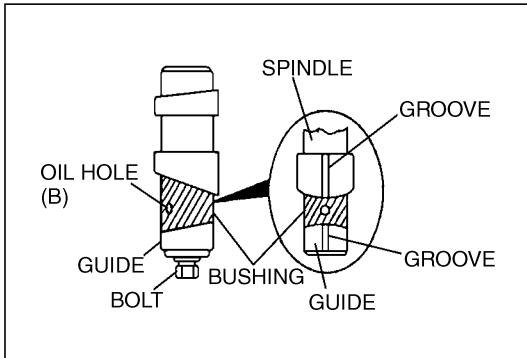


SAPH011060200146

- (3) Chamfer one edge of the bushing hole at the small end of the connecting rod uniformly by 0.5-1.0 mm {0.0197-0.0393 in.}.

NOTICE

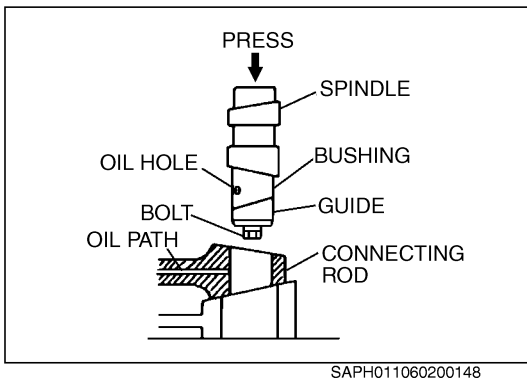
- Irregular chamfering can cause out-of-roundness of the pressed bushing, which may result in jamming during insertion.
- Remove dust from the inner surface of the small-end hole.



- (4) Mount the bushing on the spindle.
 - a. Set the bushing and guide on the spindle as shown in the figure, then secure them with the bolt.

SST:**Spindle (S0940-21540)****Guide (S0948-11540)****Bolt (SH691-20825)****Tightening Torque:****5.0-6.8 N·m {50-70 kgf·cm, 3.62-5.06 lbf·ft} (Bolt)****NOTICE**

- **Align the groove of the spindle with the groove of the press sub assembly.**
- **Make sure that the contact surfaces of the bushing seats firmly against the contact surfaces of the spindle and guide.**

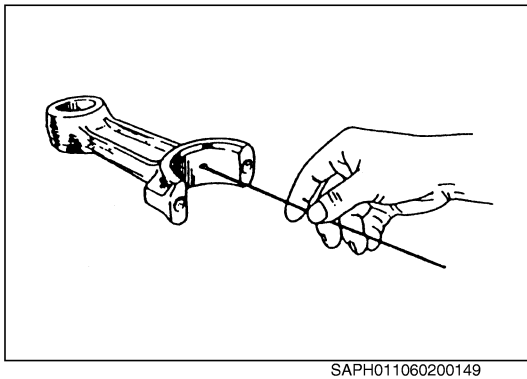


- b. Apply the fresh engine oil around the bushing and guide.
- (5) Align the oil hole of the bushing with the oil hole of the connecting rod.

NOTICE

- **Put the connecting rod to the press sub assembly and the chamfer side of the small end to the bushing side.**
- **Apply the fresh engine oil to the bore of the connecting rod.**

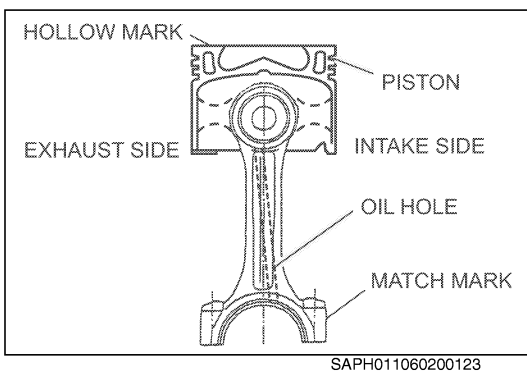
- (6) Using a press, install the bushing in the connecting rod.



- (7) Inspect the bushing positioning after installation.
 - a. Make sure that the oil hole of the bushing and the oil path of the connecting rod are suitably aligned allowing a 6 mm {0.2362 in.} diameter rod to penetrate.

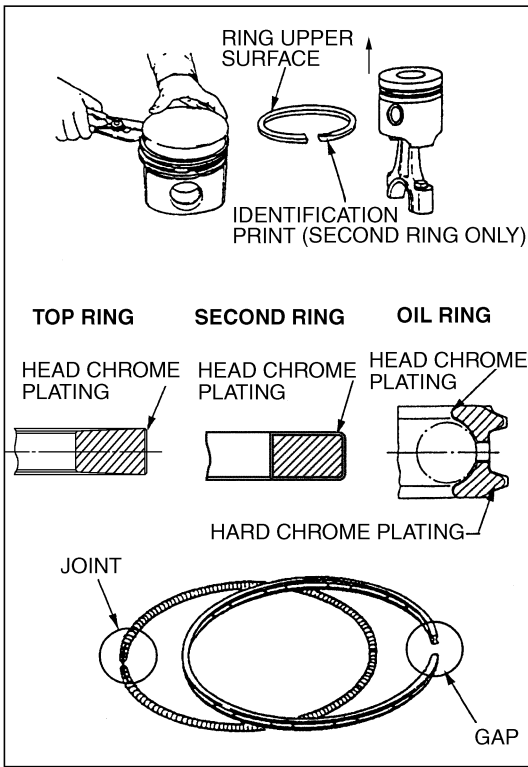
NOTICE**Misalignment can lead to insufficient lubrication, which may result in seizure.**

- b. Insert a new piston pin. When it is turned gently, make sure that there is no catch or rough movement.

**8. ASSEMBLE THE PISTON AND CONNECTING ROD.**

- (1) Heat the piston to 50°C {122°F}.
- (2) Assemble the piston O-mark to be opposite to the connecting rod match mark.

NOTICE**Replace the retainer ring with a new one.**



9. ASSEMBLE THE PISTON RING.

- (1) Install in the order of oil ring, second ring and top ring using the special tool.

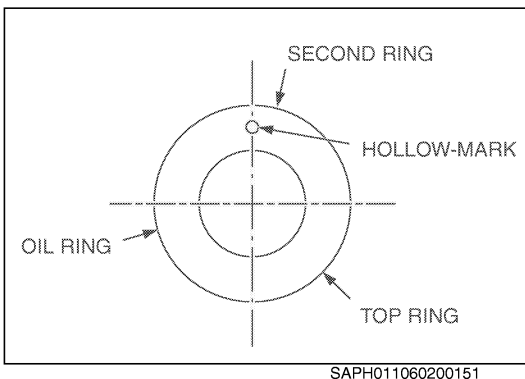
SST: Piston ring expander (S0944-21011)

NOTICE

Install the second ring with the identification print on the piston ring facing towards the upper surface.

- (2) Connect the joint of the coil expander for the oil ring and install it inside the piston ring. Assemble the ring with the joint 180° opposite to the matching point.

- (3) Position the matching points of the piston ring at an even distance as shown in the figure.



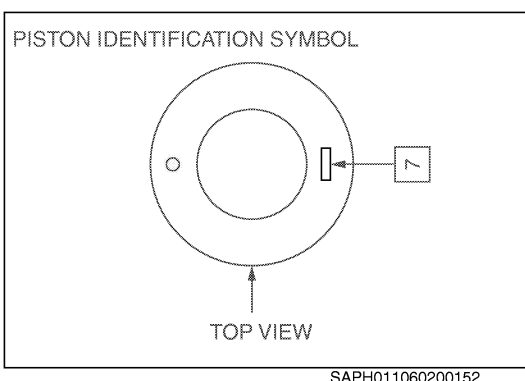
10. CHECK THE PISTON.

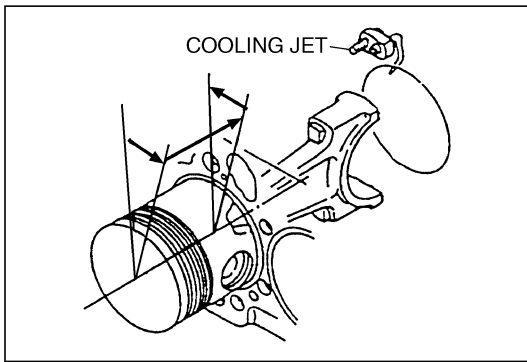
Before assembling the piston with the connecting rod, check whether the piston is specified for this engine.

NOTICE

Check using the engine compatible identification code on the top of the piston.

Engine compatible identification code.





SAPH011060200153

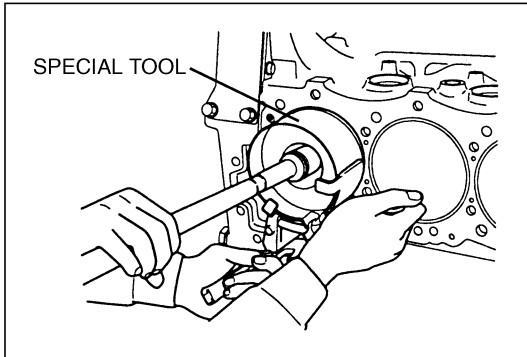
11. INSTALL THE PISTON.

- (1) Apply engine oil to the piston, cylinder liner and connecting rod bearing, then compress the piston ring using the special tool.

SST: Piston ring holder (S0944-11370)

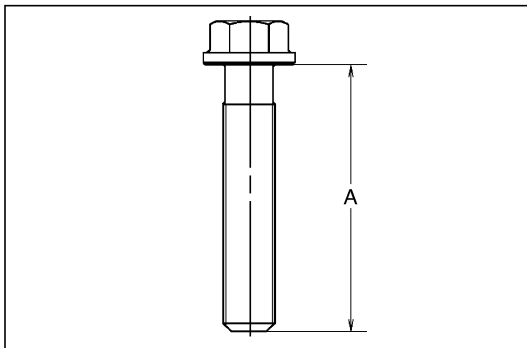
NOTICE

- When installing the piston, be careful that the cooling jet is not struck by the connecting rod.
- Make sure that the hollow-mark on the piston is at the exhaust side.



SAPH011060200154

- (2) Insert the piston into the cylinder liner.



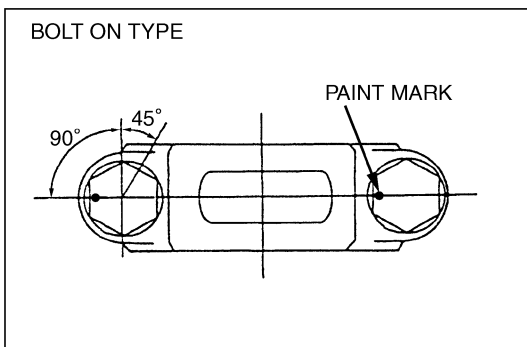
SAPH011060200155

12. TIGHTEN THE CONNECTING ROD BOLT.

- (1) Measure the length of the bolts, if the length is A or more, replace with new bolts.

Dimension A	68.0 mm {2.677 in.}
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- (2) Apply clean engine oil to the bolt thread and the bolt seat surface of the connecting rod cap.



SAPH011060200156

- (3) Tighten the connecting rod bolt to the specified torque.

Tightening Torque:

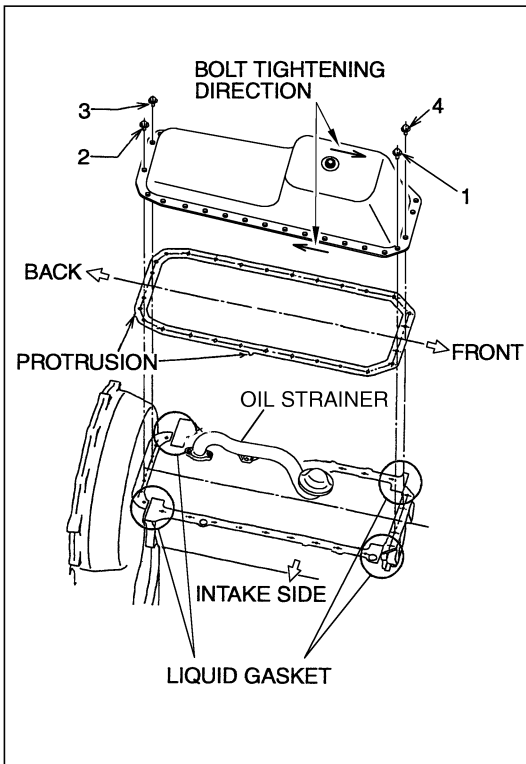
69 N·m {700 kgf·cm, 50 lbf·ft}

- (4) Mark the bolt heads in the same direction with paint.
- (5) Tighten the connecting rod bolt 90° (1/4 turn).
- (6) Tighten the connecting rod bolt 45° (1/8 turn).
- (7) Make sure that the paint marks face the same direction.

NOTICE

- When retightening the bolts, never adjust them by turning counterclockwise, even if they have been retightened more than the specified angle above.

If the angle of bolts is adjusted to the specified angle by turning counterclockwise, the axial force of the bolts might fall short and it is feared that this could reduce the engine reliability. Also there is a possibility that this could reduce the number of times a bolt can be reused.



SAPH011060200157

13. INSTALL THE OIL PAN.

- (1) Make sure that there is no deformation, impact marks or foreign particles on the cylinder block, oil pan or flange surface. Apply liquid gasket to the front and back ends of the cylinder block lower surface.

NOTICE

Refer to **PARTS AND POSITIONS FOR LIQUID GASKET.**

- (2) Install the gasket so that the protrusion is at the flywheel housing side and the intake side. (the print seal surface is at the cylinder block side)
- (3) Place a guide pin of 70 mm or more in the cylinder block and assemble the oil pan against the guide.
- (4) Tighten oil pan fitting bolts in the order 1 - 2 - 3 - 4 with an impact wrench.

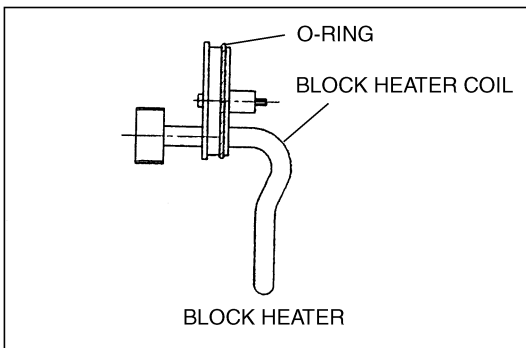
Tightening Torque:

19.7-24.5 N·m {200-250 kgf·cm, 15-18 lbf·ft}

- (5) Finish tightening the bolts with a torque wrench to the specified torque. Tighten the bolts according to the arrow in the figure.

NOTICE

Make sure that the washer is not on the flange.



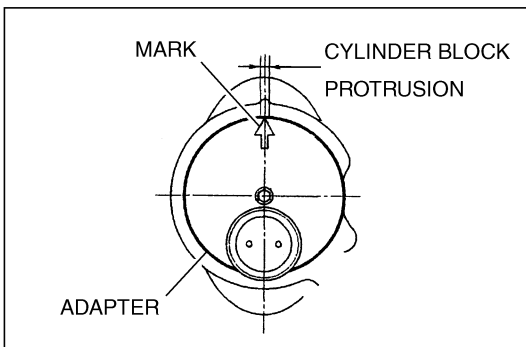
SAPH011060200158

14. INSTALL THE BLOCK HEATER.

- (1) Apply silicone spray to O-ring. (LPS Laboratories: Parts No.01516 or equivalent.)

NOTICE

If O-ring is not applied, it could damage and allow water to leak.

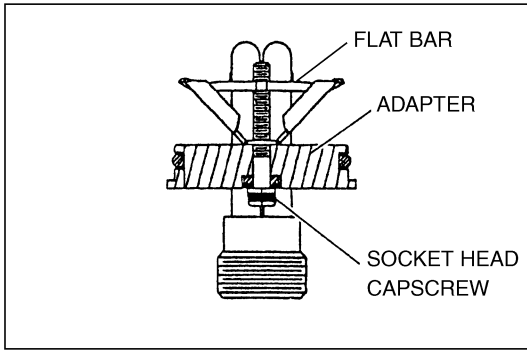


SAPH011060200159

- (2) When installing the block heater, match the arrow mark on the heater to the mark on the cylinder block protrusion.

NOTICE

- **Do not damage the adapter installation hole, otherwise water will leak.**
- **If the marks don't match, the heater coil will touch the cylinder block.**



SAPH011060200160

- (3) Tighten the socket head capscrew.

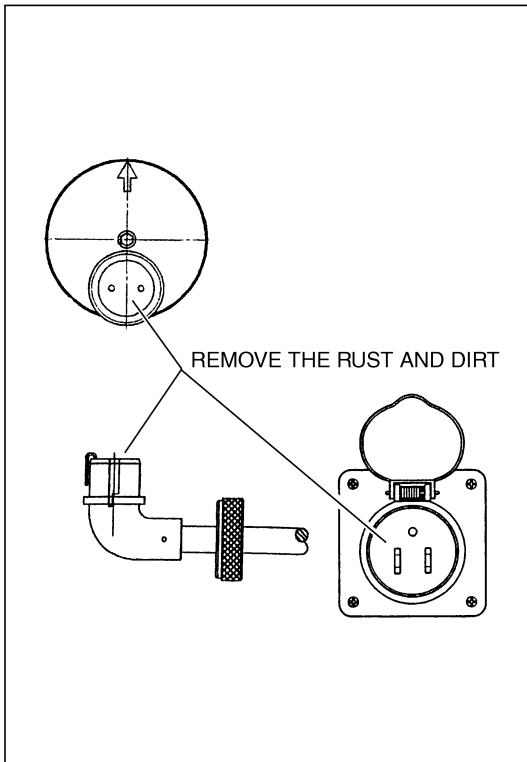
Tightening Torque:

2.3-3.3 N·m {23-33 kgf·cm, 1.7-2.3 lbf·ft}

NOTICE

Do not overtighten. If overtightened, the flat bar could come off the socket head capscrew and drop into the water jacket. This could cause the engine to over heat due to cooling system damage.

- (4) Install the harness by tightening the cord nut fully by hand only.



SAPH011060200161

- (5) Handling precaution

NOTICE

- Before using it, remove all the rust and dirt. Any rust and water attached to the terminal can trip the breaker.
- First, put the harness in the socket of the chassis side and turn on power (120 V).

⚠ CAUTION

Make sure to disconnect the power source plug outlet before starting the engine.

Starting the engine without disconnecting it can cause the breakdown of the block heater.

15. REFILL THE HINO LONG LIFE COOLANT.

(1) Concentration of Hino long life coolant.

- The freezing point of the coolant varies with the concentration of anti-freeze. Select the appropriate concentration to protect against freezing according to the following table.

NOTICE

If water to coolant ratio is not mixed according to the following table the engine will overheat and block heater coil will melt.

LLC-Water Mixing Table											
	Freezing protection		Freezing temperature		LLC				Water		
	°F	°C	°F	°C		US Qt	Liter	%	%	US Qt	Liter
J08E engine	-27	-33	-36	-37.6	MT	12.4	11.75	50	50	12.4	11.75
					AT	12.2	11.5			12.2	11.5
*AT=Available with automatic transmission MT=Available with manual transmission											

NOTICE

Do not mix more than 60% or less than 50% LLC.

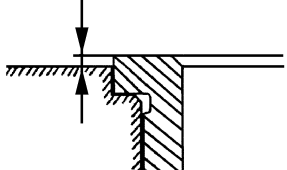
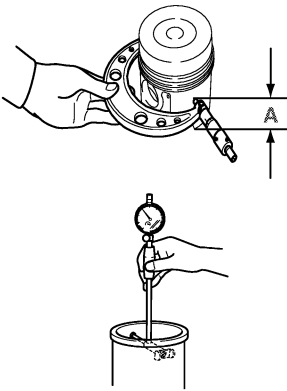
Concentrations more than 63% result in a loss of freezing protection.

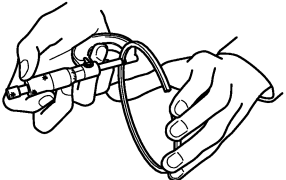
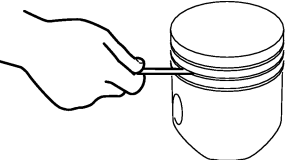
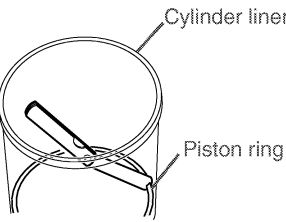
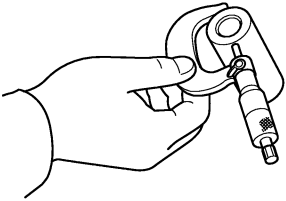
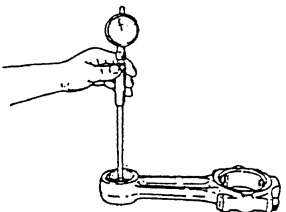
Concentrations below 50% result in a loss of corrosion protection.

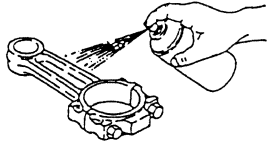
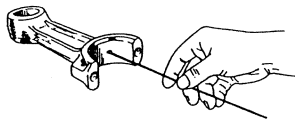
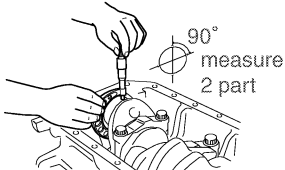
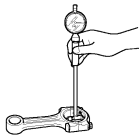
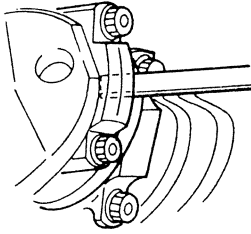
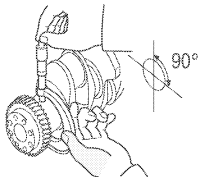
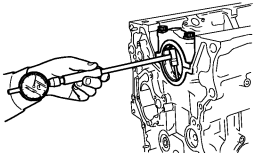
INSPECTION AND REPAIR

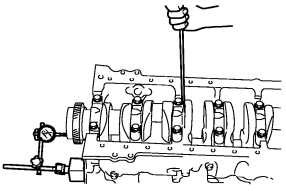
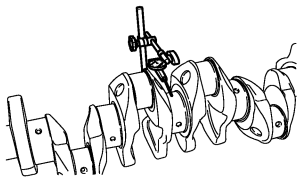
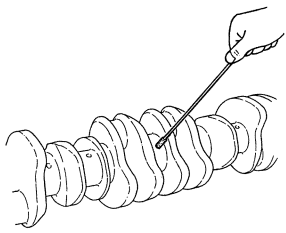
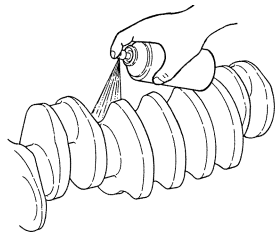
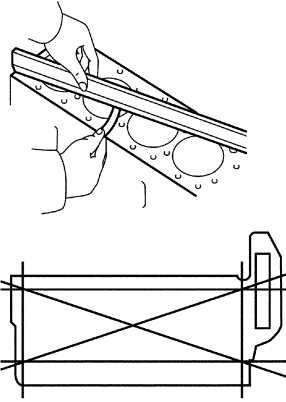
EN0110602H300004

Unit: mm {in.}

Inspection item		Standard	Limit	Remedy	Inspection procedure
Cylinder block flange depth		8{0.3150}	—	—	Measure 
Cylinder liner thickness		8{0.3150}	—	—	
Cylinder liner protrusion		0.01-0.08 {0.0004-0.0031}	—	—	
Block inside diameter	A	117-117.008 {4.6063-4.6066}	—	—	Reference only
	B	117.008-117.014 {4.6067-4.6068}			
	C	117.014-117.022 {4.6069-4.6071}			
Liner outside diameter	A	116.982-116.990 {4.6056-4.6058}	—	—	Reference only
	B	116.990-116.996 {4.6059-4.6061}			
	C	116.996-117.004 {4.6062-4.6064}			
Clearance between block and liner	A	0.010-0.026 {0.0004-0.0010}	—	—	Reference only
	B	0.012-0.024 {0.0005-0.0009}			
	C	0.010-0.026 {0.0004-0.0010}			
Piston outside diameter at A:17{0.6693}		111.927-111.943 {4.40657-4.40720}	—	Replace piston and/or liner.	Measure 
Liner inside diameter (Apply the value obtained at the most worn point to the cylinder liner inside diameter.)		112 {4.409}	112.15 {4.415}		
Clearance between piston and cylinder liner		0.057-0.073 {0.0023-0.0028}	—		

Inspection item		Standard	Limit	Remedy	Inspection procedure
Piston ring width	Top	2.948 {0.1161}	Taper	Replace ring.	Measure 
	Second	1.970-1.990 {0.0776-0.0783}	1.9 {0.0748}		
	Oil	3.970-3.990 {0.1563-0.1570}	3.9 {0.1535}		
Piston groove width	Top	Taper	Taper	Replace piston.	Measure 
	Second	2.055-2.075 {0.0809-0.0817}	2.2 {0.0866}		
	Oil	4.015-4.035 {0.1581-0.1588}	4.1 {0.1614}		
Clearance between piston ring and piston ring groove	Top	—	—	—	—
	Second	0.065-0.105 {0.0026-0.0041}			
	Oil	0.025-0.065 {0.0010-0.0025}			
Gap between ends of piston ring	Top	0.30-0.40 {0.0119-0.0157}	1.5 {0.0591}	Replace piston ring.	Measure 
	Second	0.75-0.90 {0.0296-0.0354}	1.2 {0.0472}		
	Oil	0.15-0.30 {0.0059-0.0118}	1.2 {0.0472}		
Piston pin outside diameter		37 {1.4567}	36.96 {1.4551}	Replace piston pin.	Measure 
Piston pin bore inside diameter		37 {1.4567}	37.05 {1.4586}	Replace piston.	
Clearance between piston pin and piston pin bore		0.011-0.032 {0.00043-0.00126}	0.05 {0.0020}	Replace piston and/or piston pin.	
Connecting rod bushing inside diameter		37 {1.4567}	37.1 {1.4606}	Replace connecting rod bushing.	Measure 

Inspection item	Standard	Limit	Remedy	Inspection procedure
Clearance between piston pin and connecting rod bushing	0.035-0.056 {0.0014-0.0022}	0.08 {0.0031}	Replace piston pin and/or connecting rod bushing.	—
Wear or damage of connecting rod *Dye penetrant check (Color check)	—	—	Replace.	Visual check 
Clogging of connecting rod oil hole	—	—	Replace.	Visual check 
Crank pin outside diameter	65 {2.559}	More than 0.2 {0.0079} (Repair)	Regrind under size.	Measure 
		64.3 {2.5314} (Service)	Replace crankshaft.	
Clearance between connecting rod bearing and crankpin	0.031-0.082 {0.0013-0.0032}	0.2 {0.0079}	Replace connecting rod bearing.	
Connecting rod large end width	34 {1.339}	33.2 {1.3071}	Replace connecting rod.	Measure 
Crankpin width	34 {1.339}	34.8 {1.371}	Replace crankshaft.	
Connecting rod end play	0.20-0.52 {0.0079-0.0204}	1.0 {0.0394}	Replace connecting rod and/or crankshaft.	
Crank journal outside diameter	80 {3.150}	More than 0.2 {0.0079} (Repair)	Regrind under size.	Measure 
		79.3 {3.1220} (Service)	Replace crankshaft.	
Clearance between crank journal and main bearing	0.051-0.102 {0.0021-0.0040}	0.2 {0.0079}	Replace main bearing.	

Inspection item	Standard	Limit	Remedy	Inspection procedure
Center journal width	36 {1.417}	37 {1.456}	Replace crankshaft.	Measure 
Thrust bearing thickness	2.5 {0.0984}	—	—	
Crankshaft end play	0.050-0.270 {0.0020-0.0106}	More than 0.5 {0.0197} (Repair)	Replace over size thrust bearing.	
		1.270 {0.0499} (Service)	Replace crankshaft.	
Crankshaft deflection	—	0.15 {0.0059}	Regrind under size.	Measure 
Clogging of crankshaft oil hole	—	—	Clean.	Visual check 
Crack and wear of crankshaft *Dye penetrant check (Color check)	—	—	Replace.	Visual check 
Cylinder block upper surface flatness	Longitudinal direction: 0.06 {0.0024} Right angle direction: 0.03 {0.0012} or less	0.20 {0.0078}	Replace. NOTICE: Do not grind for repair.	Measure 

AIR INTAKE SYSTEM (J08E)

EN03-001

AIR INTAKE MANIFOLD AND PIPE EN03-2

COMPONENT LOCATOR..... EN03-2

DISMOUNTING AND MOUNTING EN03-3

AIR INTAKE EN03-4

COMPONENT LOCATOR..... EN03-4

AIR CLEANER EN03-5

DESCRIPTION EN03-5

OVERHAUL EN03-6

AIR HOSE EN03-7

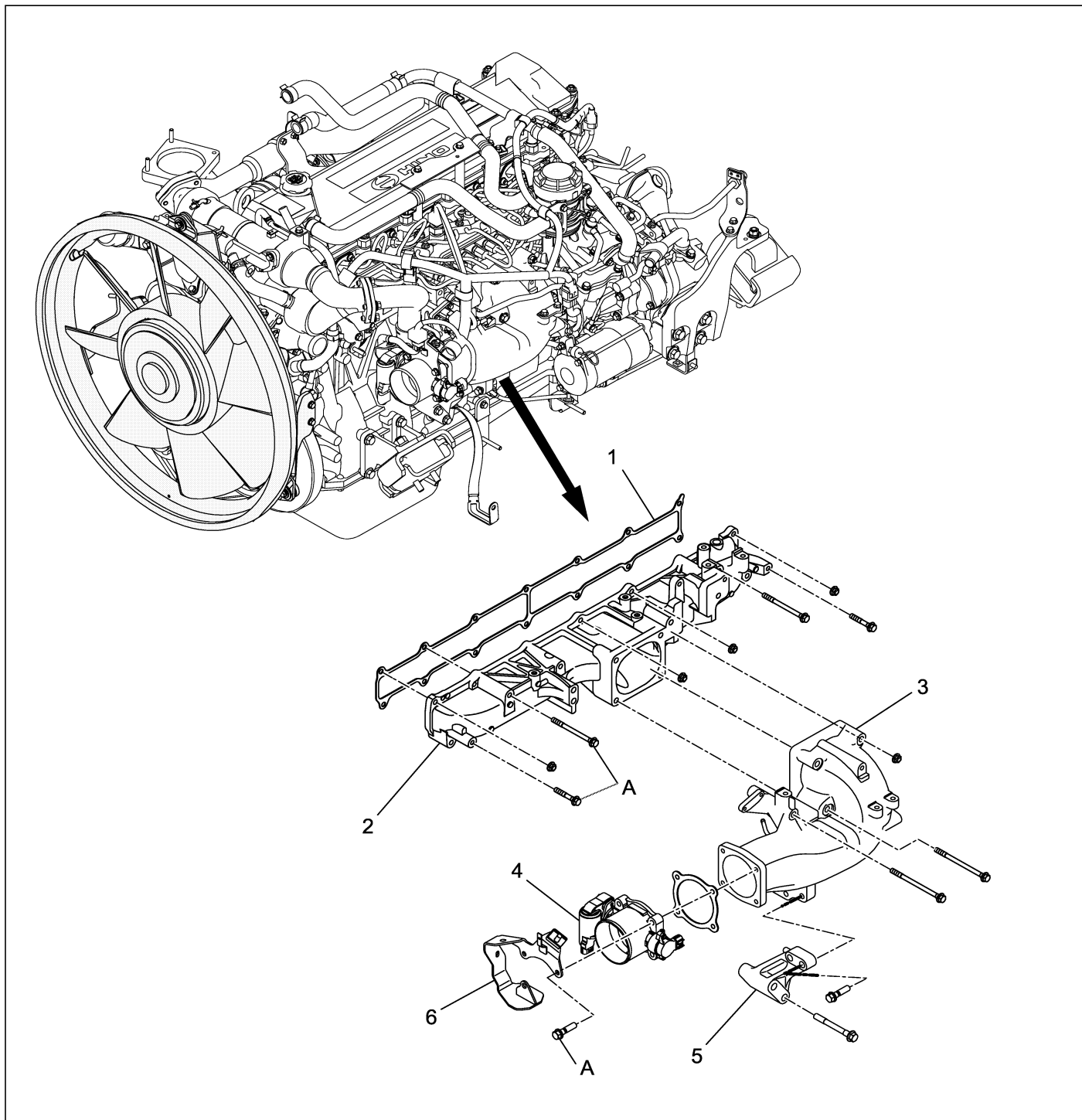
COMPONENT LOCATOR..... EN03-7

OVERHAUL EN03-8

AIR INTAKE MANIFOLD AND PIPE

COMPONENT LOCATOR

EN0110603D100001



SAPH011060300011

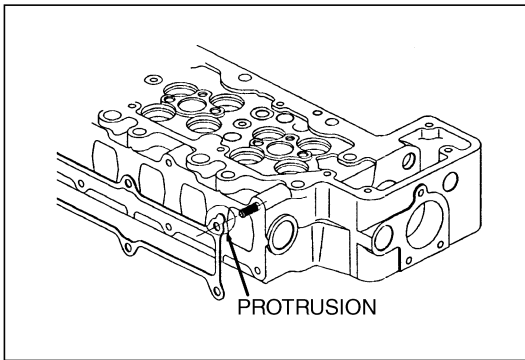
1 Intake manifold gasket
 2 Intake manifold
 3 Intake pipe

4 Diesel throttle valve
 5 Bracket
 6 Bracket

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A 28.5 {290, 21}



SAPH011060300002

DISMOUNTING AND MOUNTING

EN0110603H100001

IMPORTANT POINT - MOUNTING

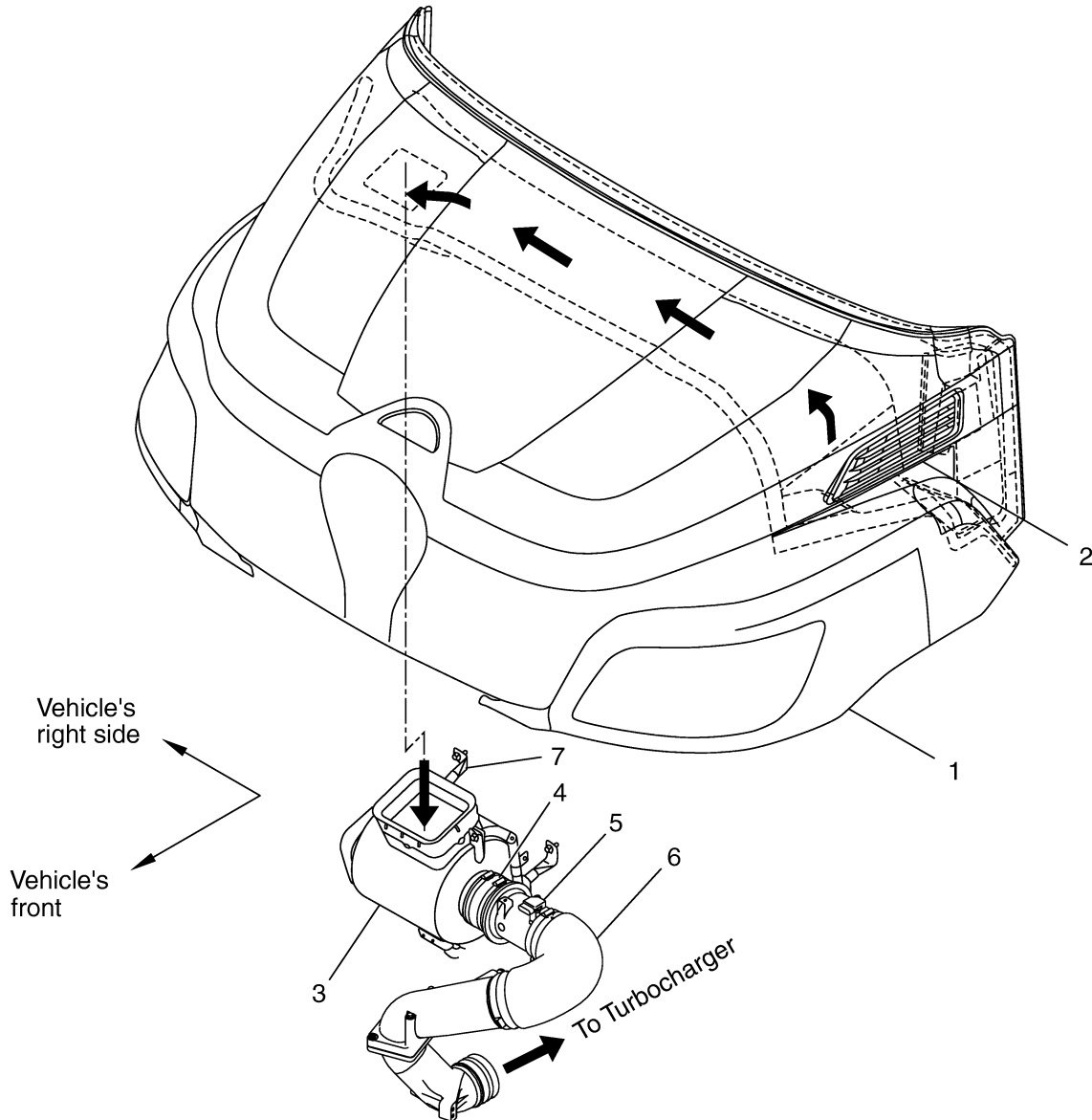
1. **INSTALL THE INTAKE MANIFOLD GASKET.**
 - (1) Install the intake manifold gasket so that the protrusion is positioned at the stud bolt side of the cylinder head rear end.

AIR INTAKE

COMPONENT LOCATOR

EN0110603D100002

EXAMPLE



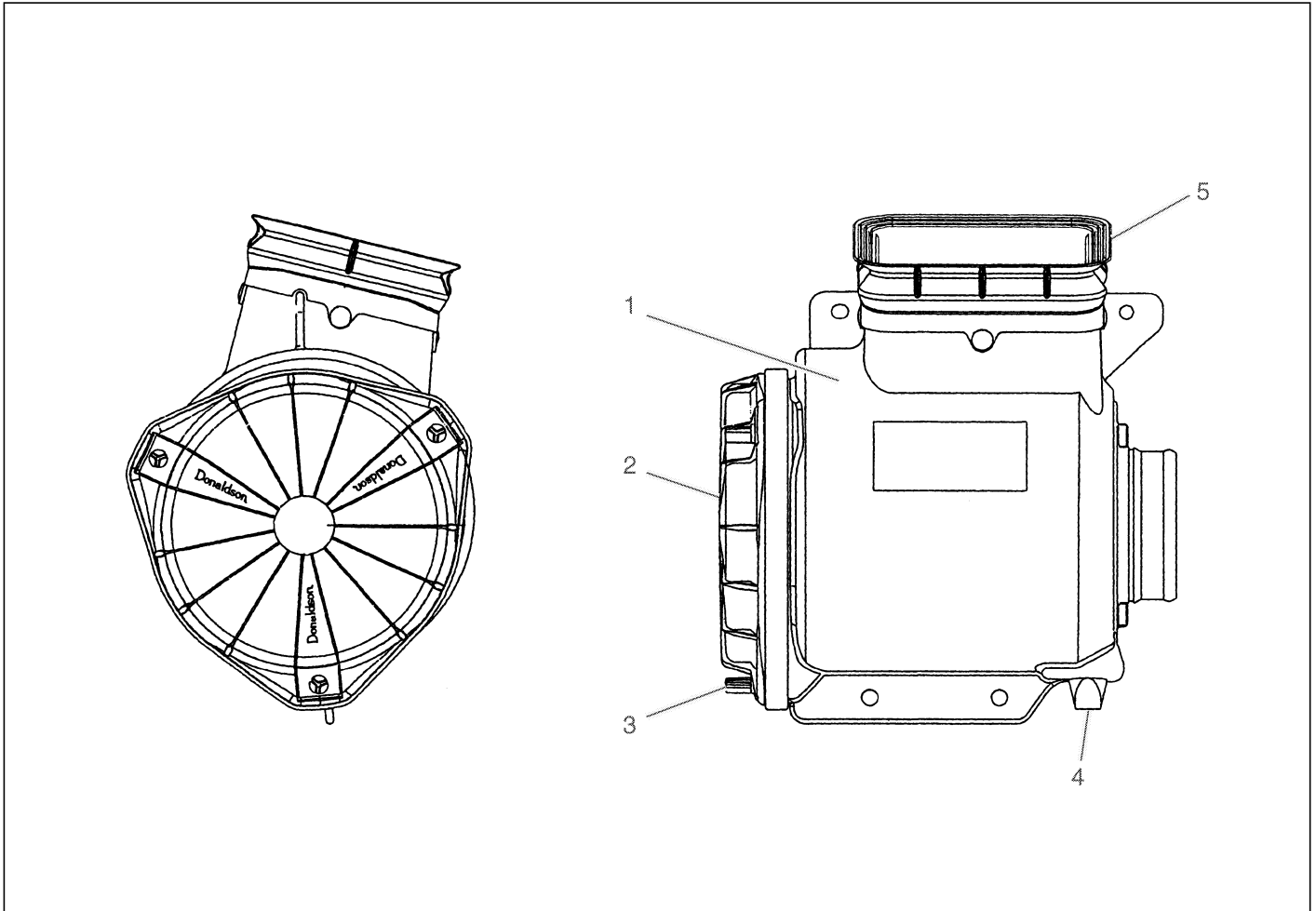
SAPH011060300003

1	Hood	5	Intake pipe
2	Air intake grille	6	Air hose
3	Air cleaner	7	Air cleaner bracket
4	Air hose		

AIR CLEANER

DESCRIPTION

EN0110603D10003



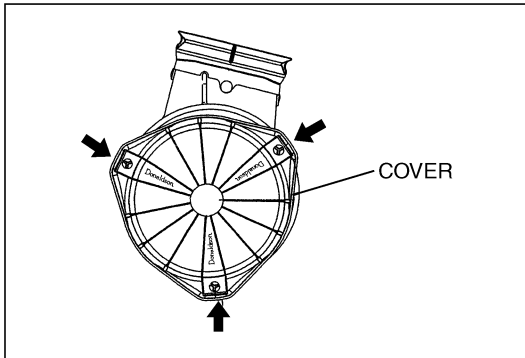
SAPH011060300004

1	Body assembly
2	Cover
3	Thumb screw

4	Unloader valve
5	Adapter

OVERHAUL

EN0110603H100002



SAPH011060300005

IMPORTANT POINTS - DISMOUNTING

1. REMOVE THE AIR CLEANER ELEMENT.

- (1) Remove the thumb screw as shown in the figure and remove the cover.
- (2) Hold the outer projection end of the element and turn slightly, then detach the element.

⚠ CAUTION

- Never clean the element filter.
- When the element filter is subjected to blowing with compressed air, is washed, hit, or dropped, the filter function will be impaired and engine damage can be caused.

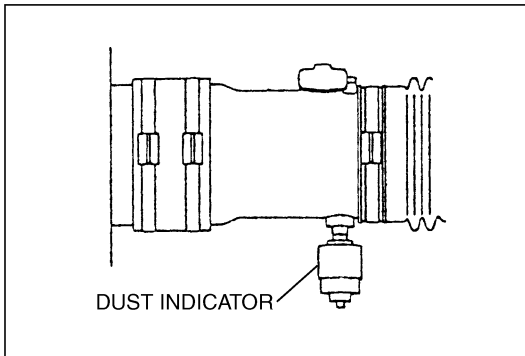
IMPORTANT POINTS - MOUNTING

1. INSTALL THE AIR CLEANER ELEMENT.

- (1) Install in the reverse order of removing.

NOTICE

Ensure the cover over the thumb screw is properly affixed.

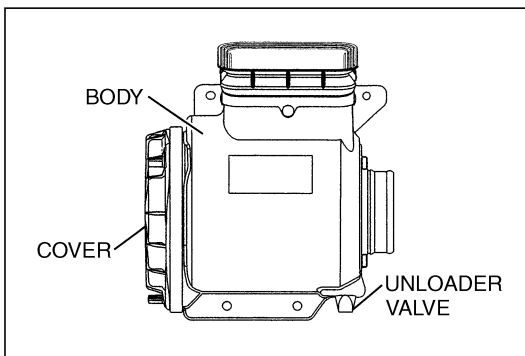


SAPH011060300006

IMPORTANT POINTS - INSPECTION

1. INSPECTING

- (1) If on inspection the dust indicator is red replace it.



SAPH011060300007

- (2) If the cover, case or unloader valve is damaged, replace the part.
- (3) Check the element to see if it is flattened or deformed, or whether the filter paper of the element is torn.
- (4) Check to see if the sealing of the gasket is complete.

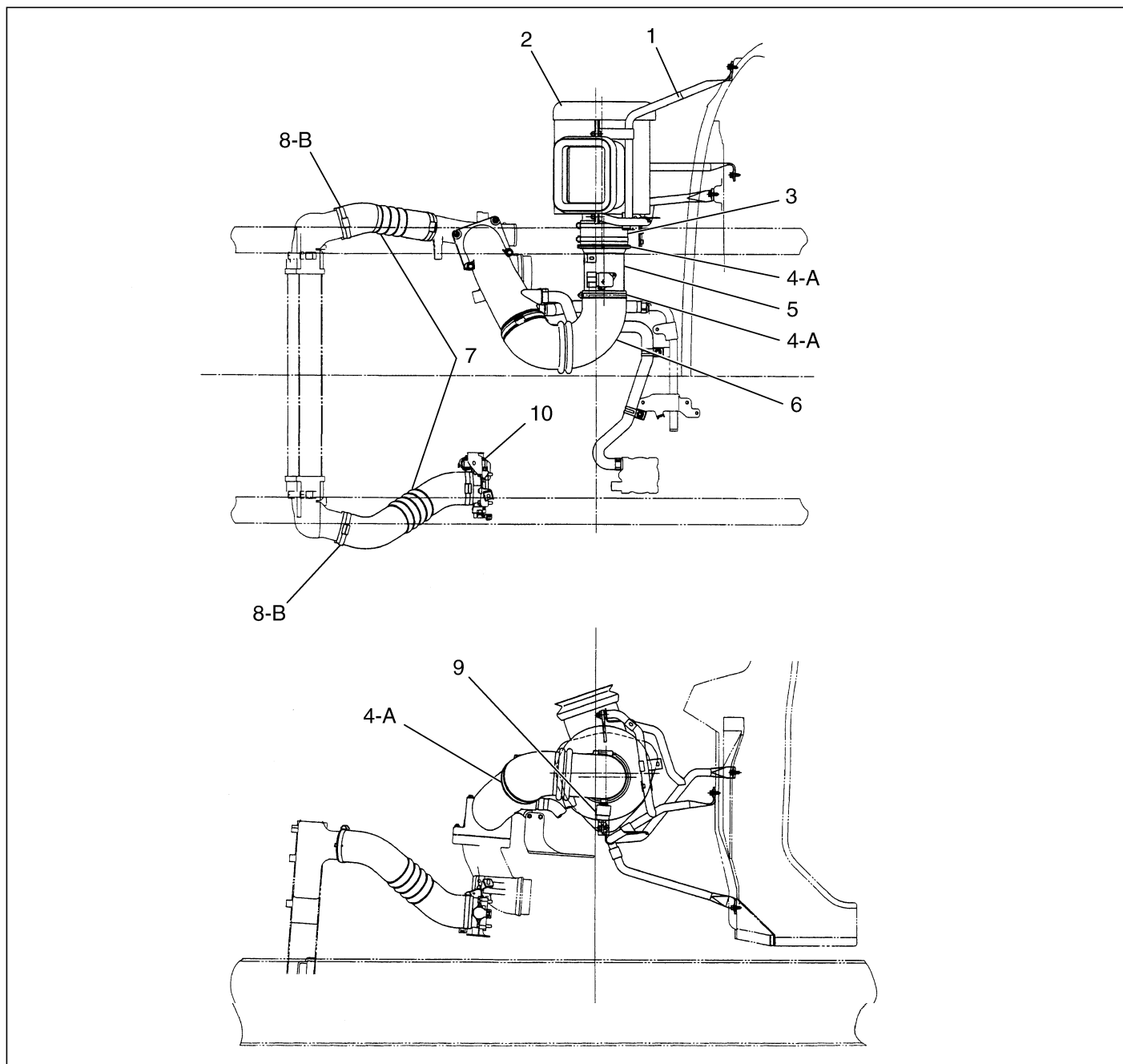
⚠ CAUTION

If an abnormality is found during the above inspection, replace the element with a new one. If dust is taken into the engine, the engine will wear and its performance will deteriorate.

AIR HOSE

COMPONENT LOCATOR

EN0110603D100004



SAPH011060300008

1	Air cleaner bracket	6	Air hose
2	Air cleaner	7	Air hose (Intercooler)
3	Air hose	8	Clamp (B)
4	Clamp (A)	9	Dust indicator
5	Intake pipe	10	Diesel throttle valve

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A	4.5-5.5 {46-56, 3,326-4,049}	B	5.4-6.6 {55-67, 3,976-4,844}
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OVERHAUL

EN0110603H100003

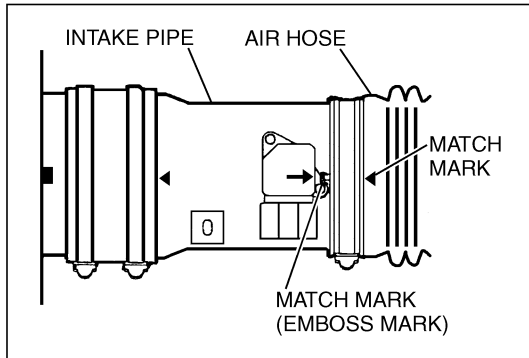
IMPORTANT POINTS - MOUNTING

1. INSTALL THE AIR HOSE.

- (1) Location of the rotation direction of the intake pipe and the air hose should match emboss mark as shown in the figure.
- (2) Tighten the clamp.

Tightening Torque:

4.5-5.5 N·m {46-56 kgf·cm, 3,326-4,049 lbf·ft}



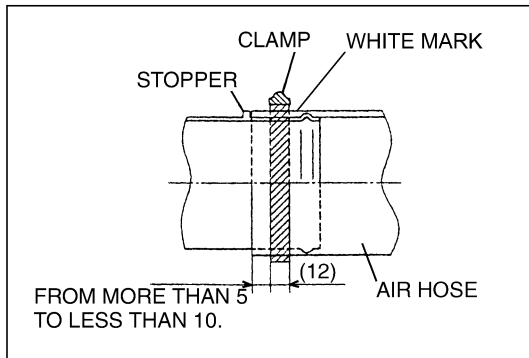
SAPH011060300009

2. INSTALL THE AIR HOSE (INTER COOLER).

- (1) Install the air hose against the stopper as shown in the figure.
- (2) Match the white mark of the air hose and match mark (stopper) of the intercooler.
- (3) Tighten the clamp at the white paint portion as shown in the figure.

Tightening Torque:

5.4-6.6 N·m {55-67 kgf·cm, 3,976-4,844 lbf·ft}



FROM MORE THAN 5
TO LESS THAN 10.

SAPH011060300010

EXHAUST SYSTEM (J08E)

EN04-001

EXHAUST MANIFOLD AND PIPE..... EN04-2

- COMPONENT LOCATOR..... EN04-2
- DISMOUNTING AND MOUNTING EN04-3

EXHAUST PIPE AND DPR-CLEANER..... EN04-4

- DESCRIPTION EN04-4
- COMPONENT LOCATOR..... EN04-5
- OVERHAUL EN04-7

DPR(DIESEL PARTICULATE REDUCTION SYSTEM)..... EN04-11

- SYSTEM CONFIGURATION EN04-11
- STRUCTURE OF DPR-CLEANER EN04-12
- DPR MAINTENANCE EN04-13
- DPR INSPECTION EN04-13
- INSPECTION PROCEDURE FOLLOWED WHEN "DPR MAINTENANCE" IS DISPLAYED ON THE INFORMATION DISPLAY EN04-14
- INSPECTION BY WAY OF HINO-DX EN04-15
- INSPECTION PROCEDURE FOLLOWED WHEN CHECK ENGINE LAMP ILLUMINATES (ABNORMAL) EN04-18
- DETERMINATION BY WAY OF DPR STATE DETERMINATION MONITOR OF HINO-DX EN04-21
- CHECKING THE DPR STATE EN04-21
- REPLACEMENT OF DPR FILTER EN04-21
- CLEANING OF DPR FILTER..... EN04-22

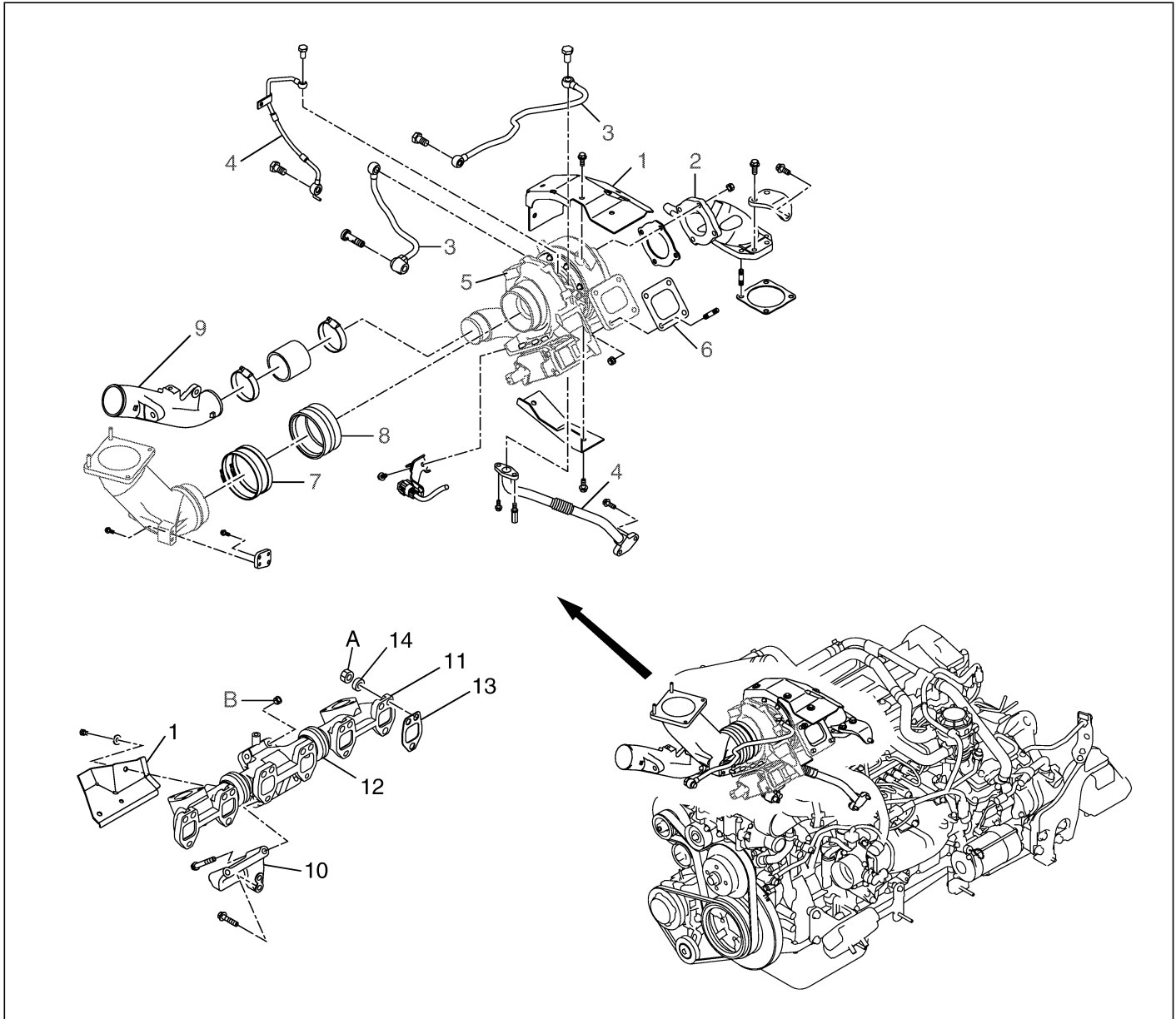
EXHAUST CONTROL VALVE..... EN04-23

- SYSTEM CONFIGURATION EN04-23
- PROCEDURE FOR CHECKING/ADJUSTING THE EXHAUST CONTROL VALVE OPENING EN04-24
- DPR INSPECTION CHECK SHEET EN04-26

EXHAUST MANIFOLD AND PIPE

COMPONENT LOCATOR

EN0110604D100001



SAPH011060400001

1	Heat insulator	8	Hose
2	Exhaust connector	9	Intake pipe
3	Coolant pipe	10	Bracket
4	Oil pipe	11	Exhaust manifold
5	Turbocharger	12	Seal ring
6	Gasket	13	Exhaust manifold gasket
7	Clamp	14	Spacer

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A 53 {540, 39}

B 56 {570, 41}

DISMOUNTING AND MOUNTING

EN0110604H100001

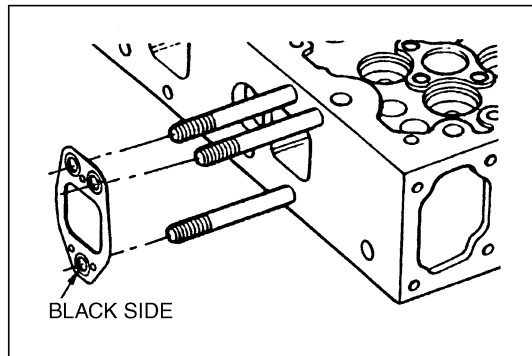
IMPORTANT POINT - MOUNTING

1. INSTALL THE EXHAUST MANIFOLD GASKET.

NOTICE

Since the exhaust manifold gasket must be installed in one way, install the gasket with the black side facing toward the exhaust manifold.

2. INSTALL THE EXHAUST MANIFOLD.



SAPH011060400002

- (1) Install the exhaust manifold onto the cylinder head and tighten the mounting nut in the order shown in the figure to the specified torque.

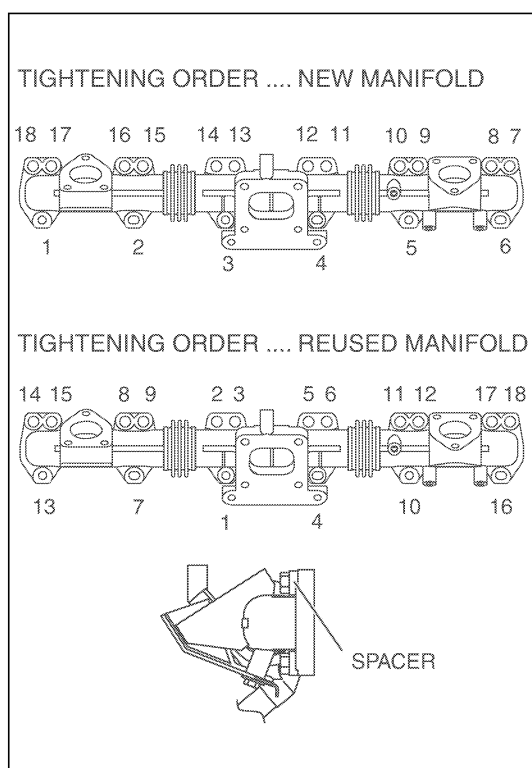
Tightening Torque:

53 N·m {540 kgf·cm, 39 lbf·ft}

- (2) Retighten the same nuts according to the same procedure again.

NOTICE

Be sure to carry out the procedure.

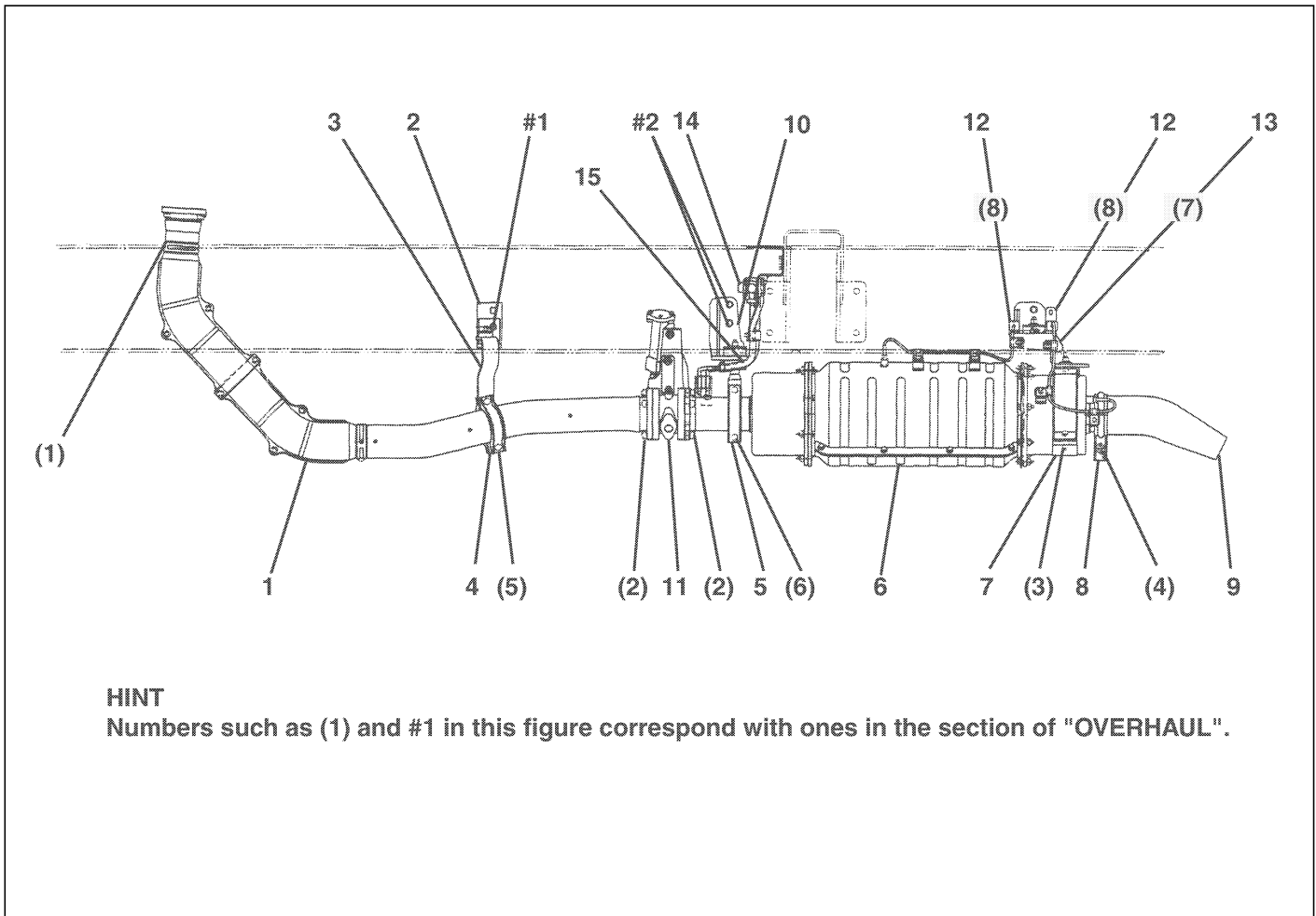


SAPH011060400003

EXHAUST PIPE AND DPR-CLEANER

DESCRIPTION

EN0110604H200001



HINT

Numbers such as (1) and #1 in this figure correspond with ones in the section of "OVERHAUL".

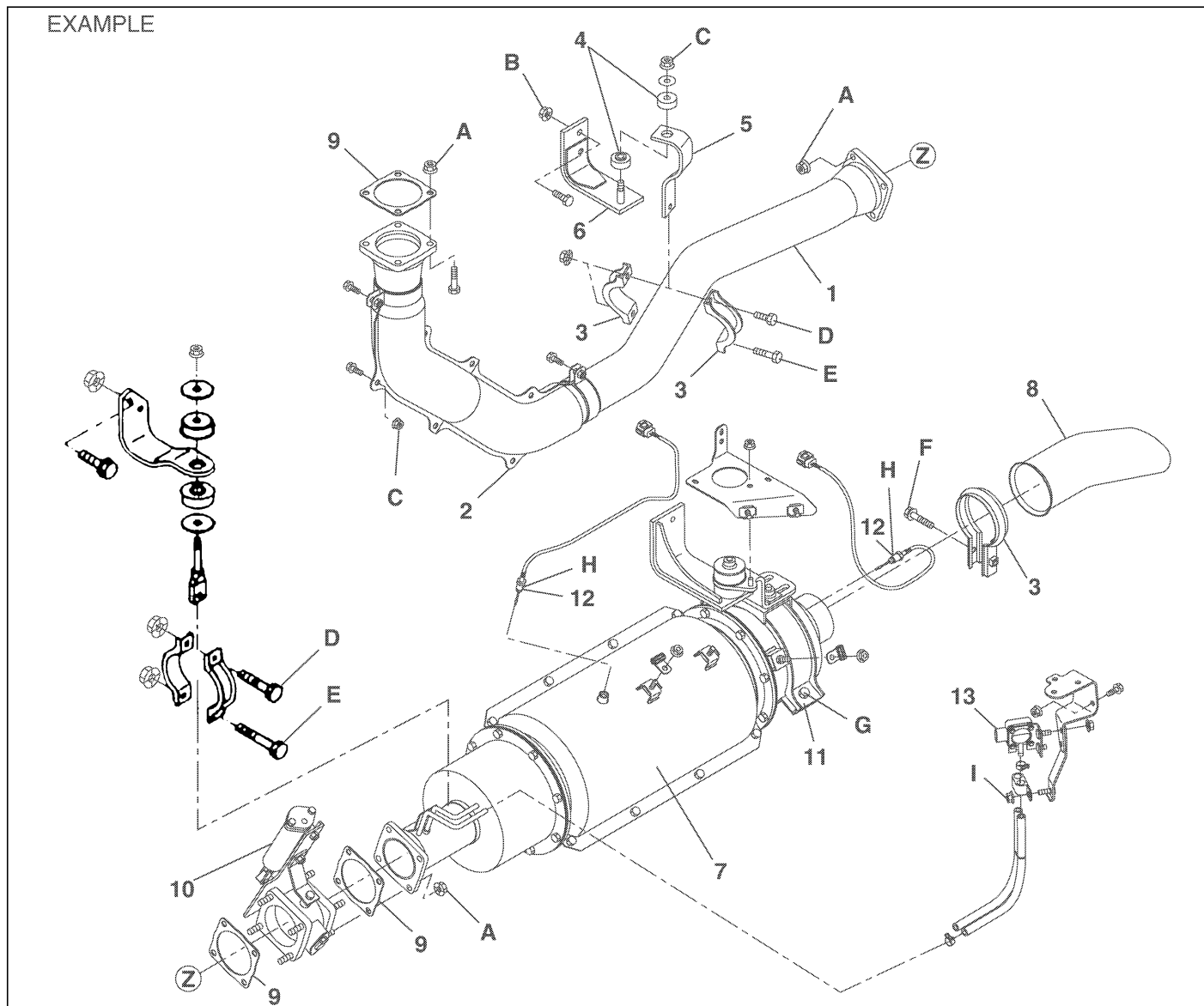
SAPH011060400004

1	Exhaust pipe	9	Tail pipe
2	Exhaust pipe bracket	10	DPR-cleaner bracket
3	Exhaust pipe support	11	Exhaust control valve
4	Exhaust pipe clamp	12	Exhaust gas temperature sensor connector
5	DPR-cleaner clamp	13	Exhaust gas temperature sensor clip
6	DPR-cleaner	14	DPR-backpressure sensor
7	DPR-cleaner support	15	DPR-backpressure sensor hose
8	Tail pipe clamp		

COMPONENT LOCATOR

EN0110604D100002

EXAMPLE



SAPH011060400005

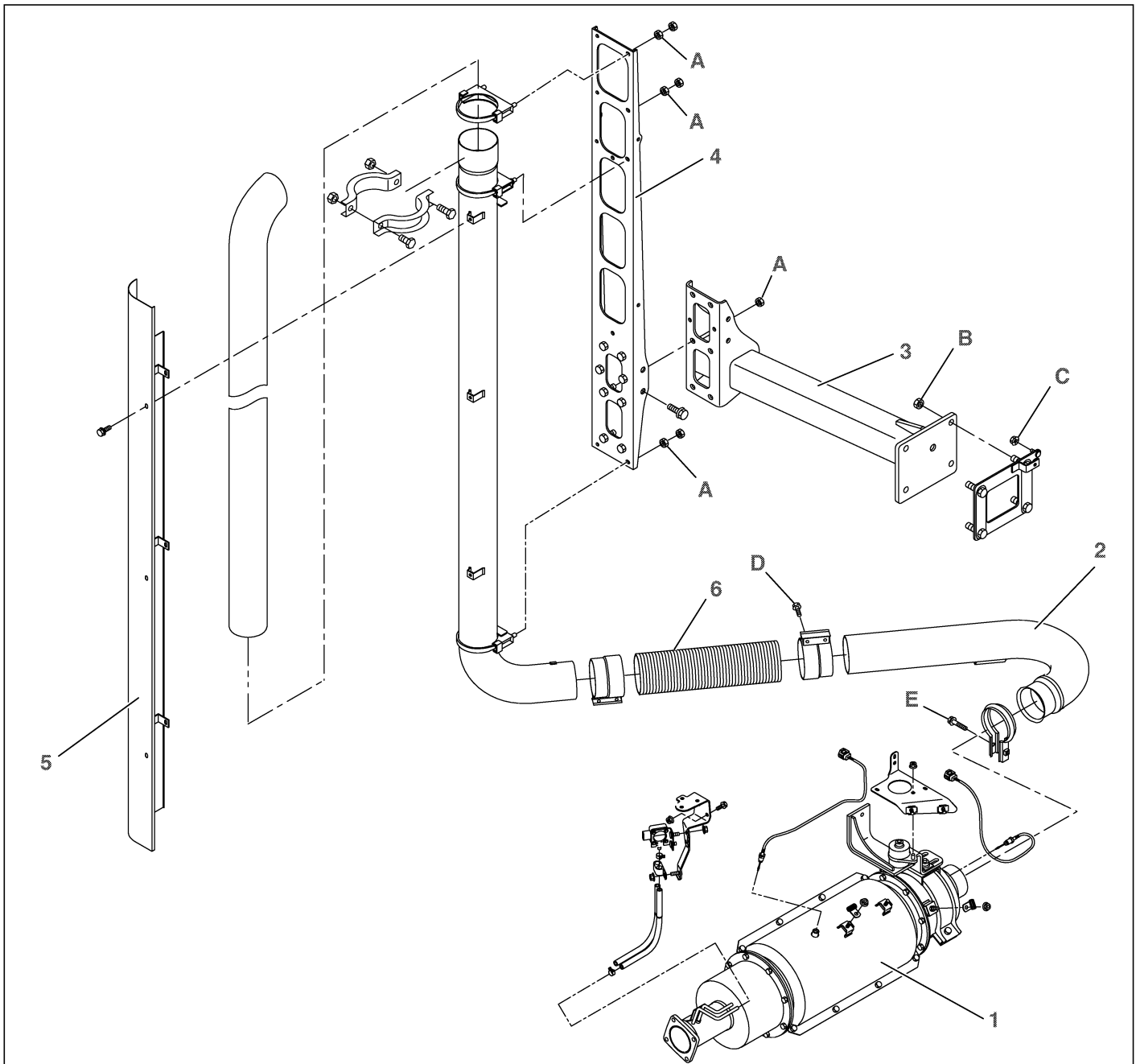
1 Exhaust pipe	8 Tail pipe
2 Insulator	9 Gasket#
3 Clamp	10 Exhaust control cylinder
4 Cushion	11 DPR-cleaner support clamp
5 Support	12 Exhaust gas temperature sensor
6 Bracket	13 DPR-backpressure sensor
7 DPR-cleaner	

#: This part cannot be reused.

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A 56 - 84 {572 - 857, 42 - 61}	F 27 - 33 {275 - 335, 20 - 24}
B 46 - 56 {470 - 570, 34 - 40}	G 34 - 44 {347 - 448, 25 - 32}
C 23.5 - 29.5 {240 - 300, 18 - 21}	H 25 - 35 {255 - 357, 19 - 26}
D 46 - 56 {470 - 570, 34 - 40}	I 20 - 24 {205 - 245, 15 - 17}
E 26.5 - 32.5 {270 - 330, 20 - 24}	



SAPH011060400006

1 DPR-cleaner	4 Bracket
2 Tail pipe	5 Insulator
3 Bracket	6 Flex pipe

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A 36 - 44 {368 - 448, 27 - 32}	D 60 - 80 {613 - 816, 44 - 59}
B 104 - 126 {1062 - 1285, 77 - 92}	E 27 - 33 {275 - 336, 15 - 24}
C 20 - 24 {204 - 245, 15 - 18}	

OVERHAUL

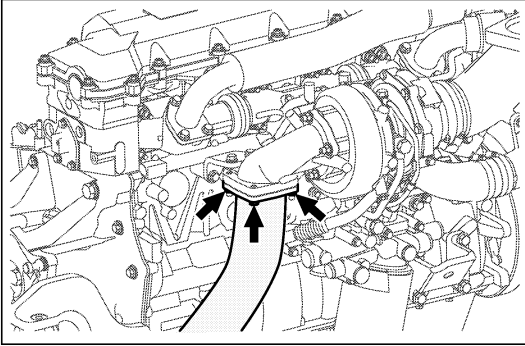
EN0110604H200002

IMPORTANT POINT - DISMOUNTING

⚠ WARNING

Do not touch the exhaust manifold when it could be hot. You can be severely burned.

1. REMOVE THE EXHAUST PIPE FROM THE EXHAUST MANIFOLD.
2. REMOVE THE EXHAUST SYSTEM COMPONENTS.
 - (1) Referring to the section of "DESCRIPTION", remove the tightening sections (1)-(7) and (8) temperature sensor connector of the exhaust system components, then remove the exhaust pipe and DPR-cleaner.
 - (2) Disconnect the DPR-backpressure hose.



SAPH011060400007

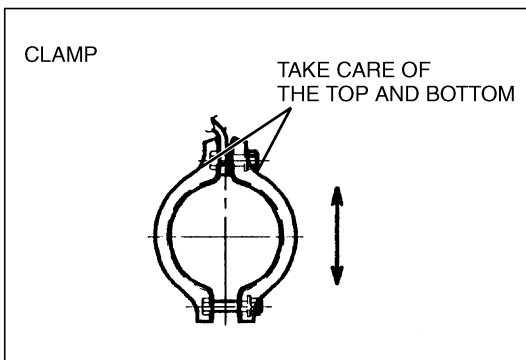
IMPORTANT POINT -MOUNTING

1. INSTALL THE EXHAUST SYSTEM COMPONENTS.

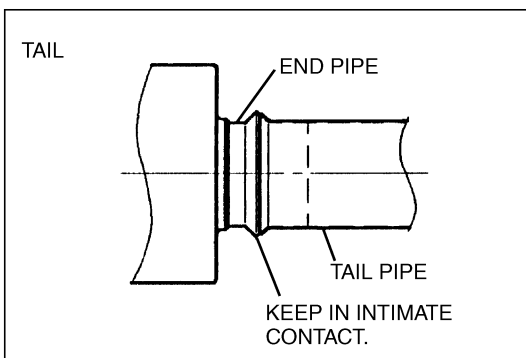
NOTICE

Install the exhaust pipe and DPR-cleaner while taking care of the following points.

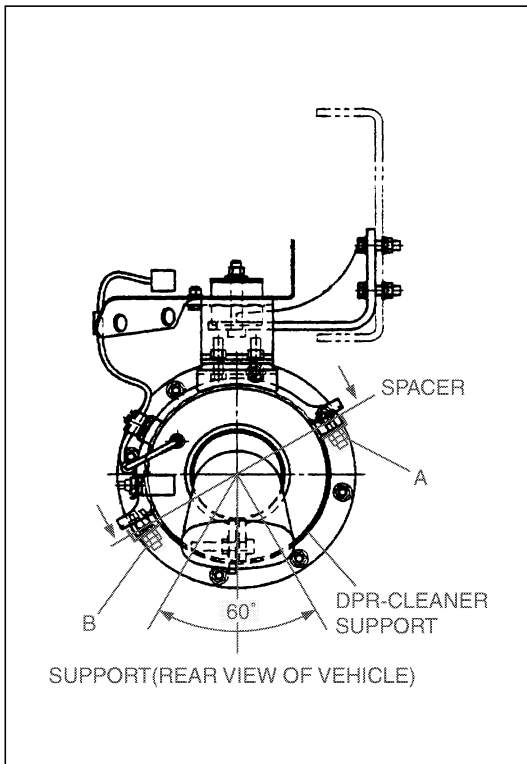
- (1) Referring to the section of "DESCRIPTION", temporarily install all tightening sections (1)-(6) of the exhaust system components. If this attempt is unsuccessful, loosen #1 to #2 and make adjustment.
 - a. When installing the parts, check the top and bottom of the clamp.
 - b. When temporarily installing a tail pipe to the DPR-cleaner, keep the end pipe of the DPR-cleaner and tail pipe in intimate contact.



SAPH011060400008



SAPH011060400009



SAPH011060400010

- (2) Regularly tighten the exhaust system components in the order of "a" to "i".
- Regularly tighten the exhaust pipe into the exhaust pipe connector.

Tightening Torque:

56 - 84 N·m {572 - 857 kgf·cm, 42 - 61 lbf·ft}

NOTICE

- Replace the gasket with new one.
- The mounting portion of the exhaust manifold is subjected to heat and is likely to come loose, so special nuts are employed. Be sure to use the correct nuts.

- Regularly tighten the exhaust control valve into the DPR-cleaner.

Tightening Torque:

56 - 84 N·m {572 - 857 kgf·cm, 42 - 61 lbf·ft}

- Regularly tighten the exhaust control valve into the exhaust pipe.

Tightening Torque:

56 - 84 N·m {572 - 857 kgf·cm, 42 - 61 lbf·ft}

- Regularly tighten the DPR-cleaner support. In this practice, install a spacer to the vehicle exterior point A and perform final tightening in the bolt inserting direction shown by an arrow in the figure, then perform final tightening at the point B.

Tightening Torque:

34 - 44 N·m {350 - 450 kgf·cm, 25.1 - 32.5 lbf·ft} (DPR-cleaner support, points A and B in the figure)

- Regularly tighten the tail pipe clamp.

NOTICE

In this practice, check that the angle of the tail pipe clamp is within the range shown in the figure.

Tightening Torque:

27 - 33 N·m {275 - 335 kgf·cm, 20 - 24 lbf·ft}

- In case #1 in the section of "DESCRIPTION" is loosened, perform final tightening here.

Tightening Torque:

20 - 24 N·m {204 - 244 kgf·cm, 14.7 - 17.7 lbf·ft}

- Regularly tighten the exhaust pipe clamp. In this practice, first tighten the upper bolt of the clamp then tighten the lower bolt.

Tightening Torque:

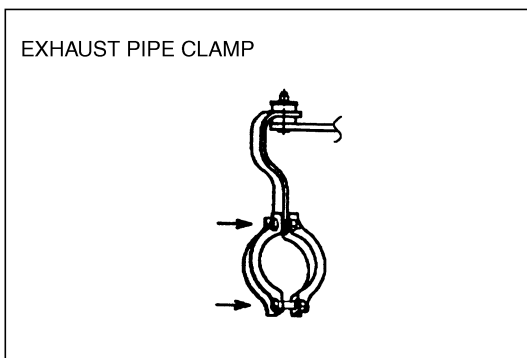
Clamp top: 46 - 56 N·m {470 - 570 kgf·cm, 33.9 - 41.3 lbf·ft}

Clamp bottom: 26.5 - 32.5 N·m {270 - 330 kgf·cm, 20 - 24 lbf·ft}

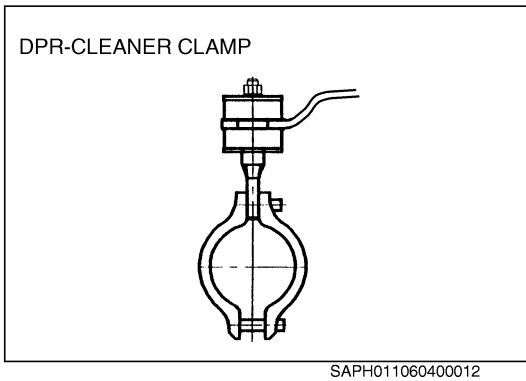
- In case #2 in the section of "DESCRIPTION" is loosened, perform final tightening here.

Tightening Torque:

46 - 56 N·m {470 - 570 kgf·cm, 33.9 - 41.3 lbf·ft}



SAPH011060400011



- i. Regularly tighten the DPR-cleaner clamp. In this practice, first tighten the upper bolt of the clamp then tighten the lower bolt.

Tightening Torque:

Clamp top: 46 - 56 N·m {470 - 570 kgf·cm, 33.9 - 41.3 lbf·ft}

Clamp bottom: 26.5 - 32.5 N·m {270 - 330 kgf·cm, 20 - 24 lbf·ft}

- j. Install the exhaust gas temperature sensor to the DPR-cleaner.

Tightening Torque:

25 - 35 N·m {255 - 357 kgf·cm, 19 - 26 lbf·ft}

- k. Tighten the exhaust temperature sensor clip. In this practice, fit the white marking of the exhaust temperature sensor with the clip.

Tightening Torque:

20 - 24 N·m {204 - 244 kgf·cm, 14.7 - 17.7 lbf·ft}

- l. Connect the exhaust temperature sensor connector to the chassis harness.

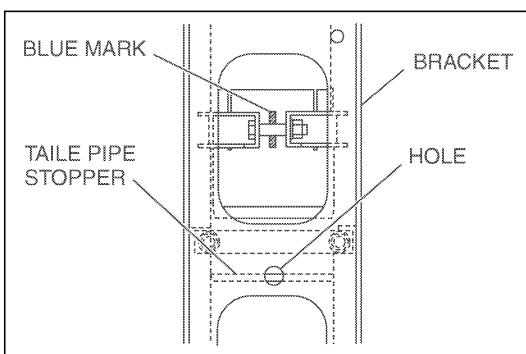
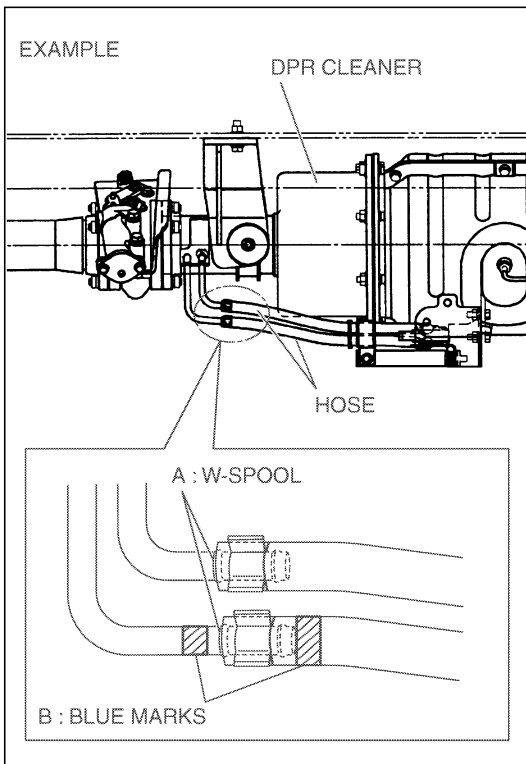
- (3) Connect the DPR-backpressure sensor hose to the DPR-cleaner as shown in the figure.

NOTICE

DPR doesn't operate correctly when DPR-backpressure sensor hose is invented by mistake.

A: Insert the hoses securely until the hoses runs into the spool.

B: Match the blue marks.



- (4) Install the exhaust tail pipe to the bracket as shown in the figure.

NOTICE

- **Locating stopper of tail pipe match the locating hole of tail pipe bracket.**
- **Match the blue mark.**

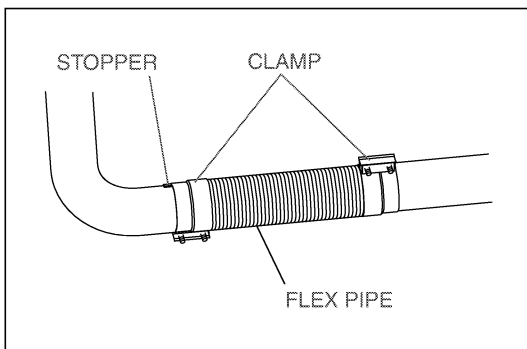
- (5) Flex pipe installation
- a. Place clamp over flex pipe.
Fully insert the flex pipe into the major diameter of the clamp until the flex pipe reaches the step in the clamp.
 - b. Insert rigid pipe into flex pipe
Insert the clamp up to the stopper of tail pipe.
 - c. Snug minor diameter of clamp on rigid pipe
Tighten the bolt on smaller diameter of the clamp until the clamp band begins to pull into the aluminium reaction block.
Assembly tool speed not to exceed 400 rpm.
 - d. Tighten major diameter of the clamp over flex pipe to the specified torque.
Typical torque recommendation is 60-80 Nm (45-60 ft-lbs.) static torque.
Static (Audit) torque is measured immediately following run-down by rotating the fastener a minimum amount in the tightening direction.
Dynamic torque (measured during run-down) specifications can be developed to generate the desired static torque.
 - e. Tighten minor diameter of Clamp over rigid pipe to the specified torque.
Repeat step 4 for the minor diameter of the clamp.
This step may reduce the audit torque of the fastener on the major diameter of the clamp.

NOTICE

- **There should be a slight gap between clamp band curls.**
- **Clamp may be loosened, repositioned and tightened again by the assembly plant before final inspection.**
- **Secondary installations outside of the plant environments not recommended.**

NOTICE

- **Insert the clamp up to the stopper of tail pipe.**
- **Fully insert the flex pipe until it reaches the step in the clamp.**
- **Before installation, confirm the flex pipe length (15 in). If incorrect, adjust.**



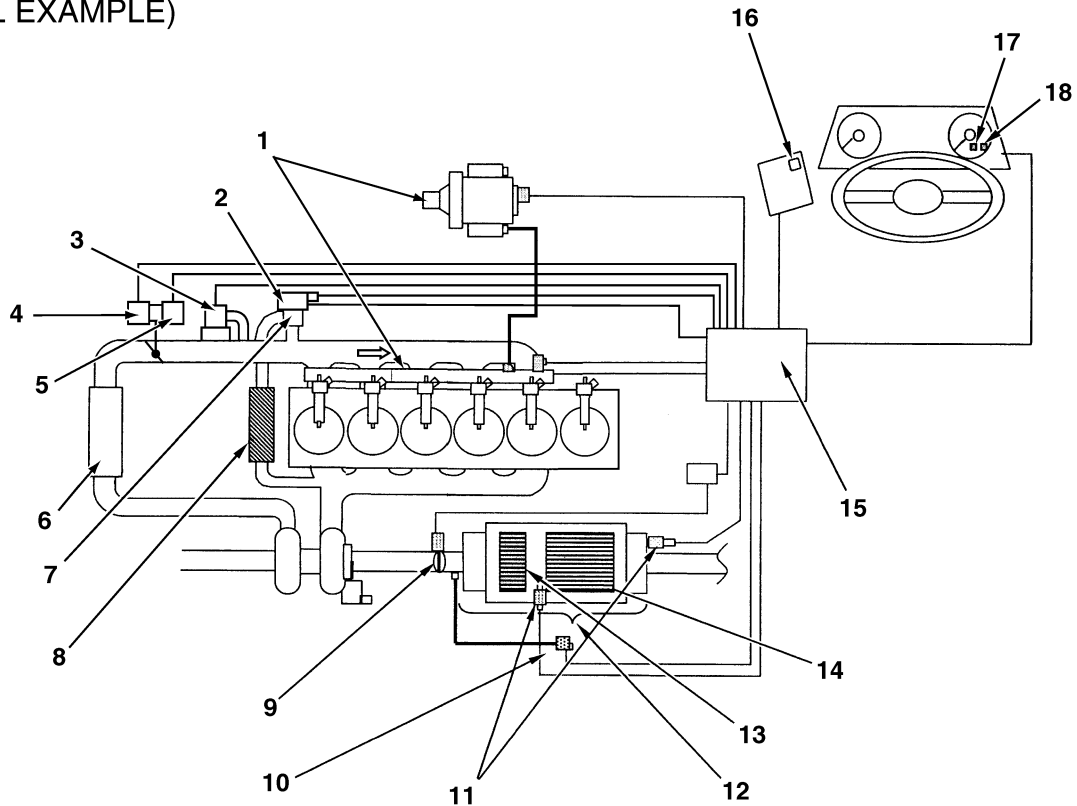
SAPH011060400015

DPR(DIESEL PARTICULATE REDUCTION SYSTEM)

SYSTEM CONFIGURATION

EN0110604D100003

(TYPICAL EXAMPLE)

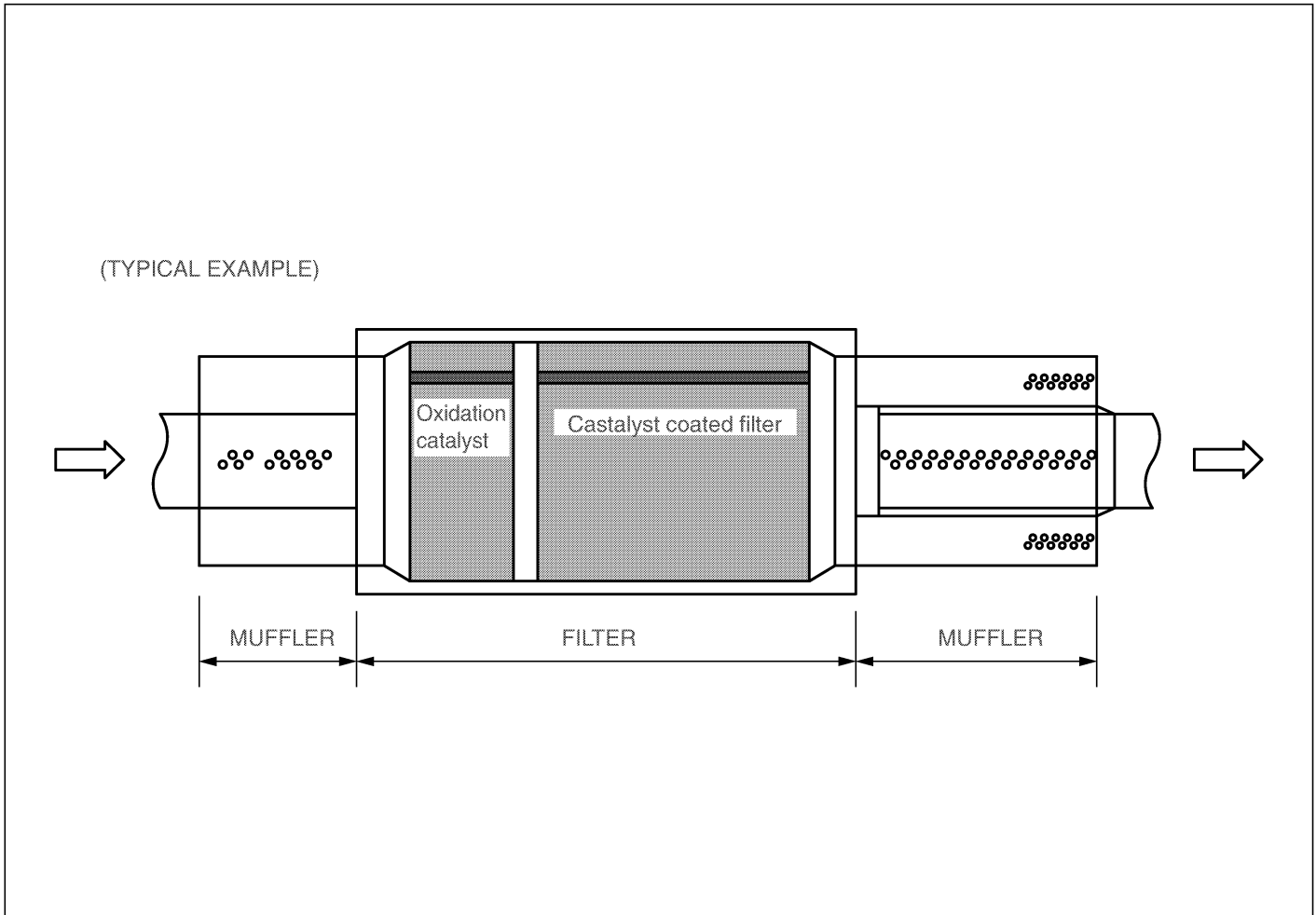


SAPH011060400016

1	Common rail fuel injection system	10	Backpressure sensor
2	EGR valve lift sensor	11	Exhaust temperature sensor
3	Intake air pressure sensor	12	DPR-cleaner
4	Diesel throttle valve	13	Oxidation catalyst
5	Diesel throttle valve aperture sensor	14	Catalyst coated filter
6	Intercooler	15	Engine ECU
7	EGR valve	16	DPR-cleaner switch
8	EGR cooler	17	DPR indicator lamp
9	Exhaust control valve	18	Check engine lamp

STRUCTURE OF DPR-CLEANER

EN0110604D100004



SAPH011060400017

DPR MAINTENANCE

EN0110604H200003

- DPR maintenance is performed every 200,000 miles (320,000 km).
- If "DPR maintenance" is displayed on the information display, DPR maintenance is required.

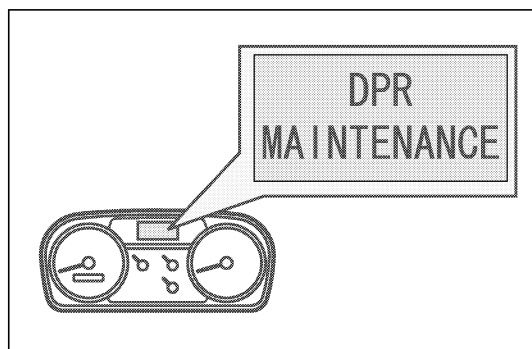
Check the DPR backpressure and determine whether maintenance is required.

If the DPR backpressure value is below the specified value, no maintenance is required.

If the DPR backpressure value exceeds the specified value, clean or replace the filter.

1. NOTIFICATION TO DRIVER

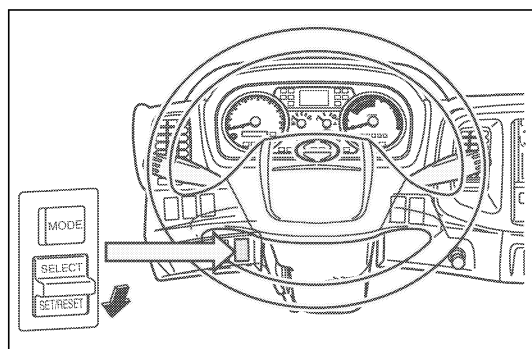
- (1) It informs with the indicator in the information display. (Content of display "DPR Maintenance").



SAPH011060400018

2. INFORMATION DISPLAY

- (1) Typical interval of DPR maintenance is 200,000 mile.
- (2) Specific maintenance timing is guided by displaying instruction at instrument cluster.
- (3) The display will be cleared by pushing the information display control switch of the instrument cluster for about 20 seconds.



SAPH011060400019

DPR INSPECTION

EN0110604H200004

1. ROUTINE INSPECTION ITEMS

- (1) Check for an abnormal increase in the engine oil in the oil pan.

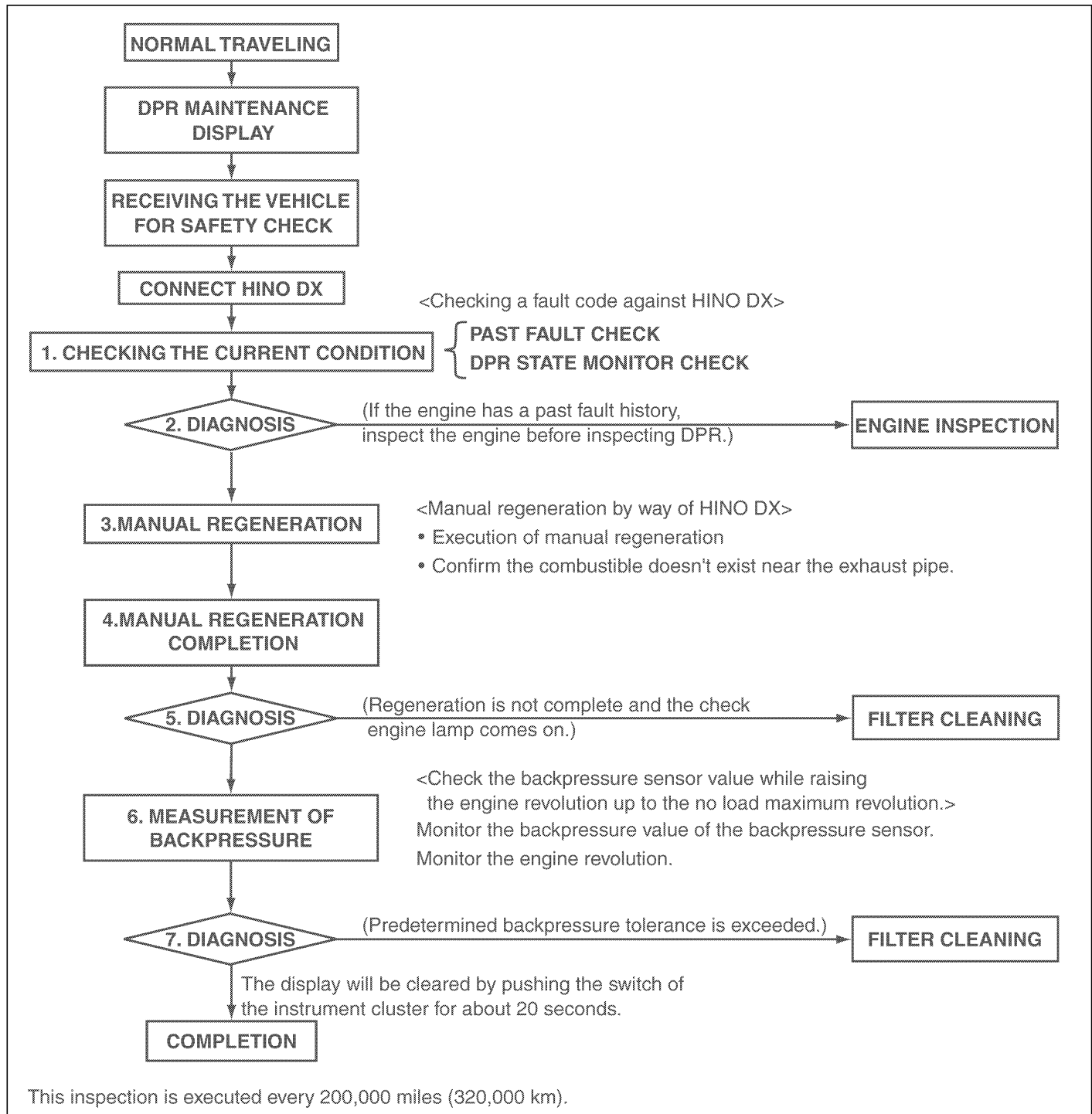
HINT

In case engine oil is abnormally increased, the injection system may be faulty or unburned fuel could have leaked into the oil pan from the gap between the piston ring and the cylinder liner.

- (2) Check the exhaust system tightening portions (exhaust pipe, main unit flange) for looseness or exhaust leakage.
- (3) Check external appearance of the harness of the exhaust temperature sensor for trouble (cracks in coating or missing clip).
- (4) Inspect the hose of the backpressure sensor and check the hose for deterioration or cracks. Replace a hose which has been used for three years or more with a new one.
- (5) Check for a blown indicator lamp or wire break in the DPR-cleaner switch and meter. (Stop the engine, turn ON the starter switch, and press the DPR-cleaner switch. If both the lamp in the switch and indicator lamp in the meter illuminate, the lamps are normal.)

INSPECTION PROCEDURE FOLLOWED WHEN "DPR MAINTENANCE" IS DISPLAYED ON THE INFORMATION DISPLAY

EN0110604H300001



SAPH011060400020

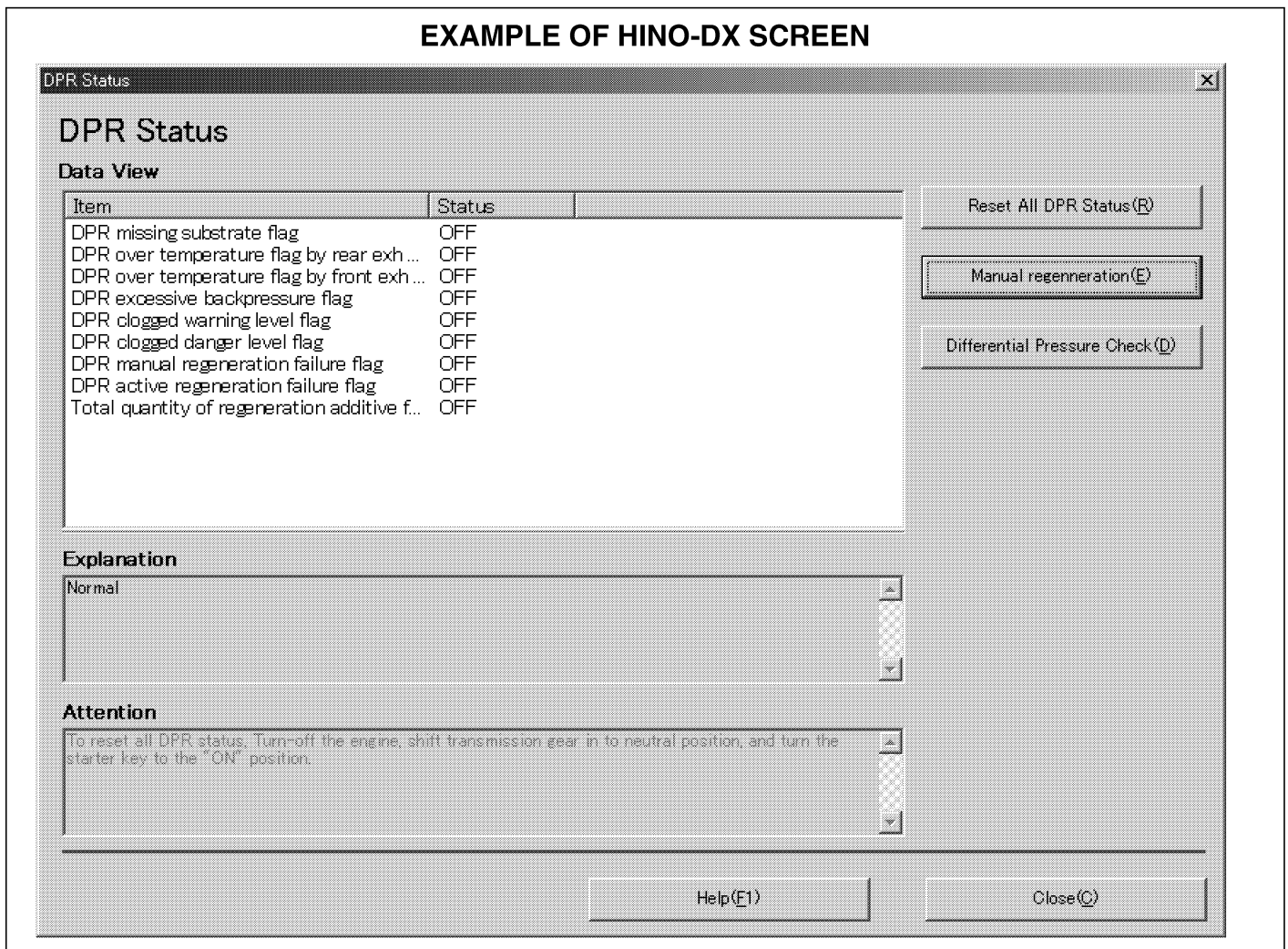
INSPECTION BY WAY OF HINO-DX

EN0110604H200005

1. DPR status check

- (1) Select the "DPR Reset confirmation" in the "Check function" menu of HINO-DX.
- (2) Confirm Data View of the "DPR Status " display (monitor), if the status for all the items are "OFF", DPR functions normally. Then "Manual Incineration" and "DPR backpressure check" can be done.
- (3) In case "ON" is displayed in Data View of the "DPR Status " display (monitor), check according to the procedure on page EN04-19, "DETERMINATION BY WAY OF DPR STATE DETERMINATION MONITOR OF HINO-DX".

EXAMPLE OF HINO-DX SCREEN



SAPH011060400021

2. Manual regeneration

(1) Manual regeneration is done by the "Manual regeneration" screen.

⚠ CAUTION

- **Confirm safety of the surrounding area, then press DPR regeneration switch inside the cabin to execute the regeneration.**
- **Confirm the PTO switch is OFF.**

(2) When the Catalyst Converter deterioration status is ON, wash or replace the filter.

When the status is OFF, DPR functions normally.

EXAMPLE OF HINO-DX SCREEN

Manual regeneration

Data View

Item	Status	Units
Engine speed	0	r/min
Manual regeneration status flag	OFF	
Exhaust Temperature (IN)	0	°C
Exhaust Temperature (OUT)	0	°C
Injection quantity	0.00	mm ³ /st
DPR Backpressure	16777211.0	KPa

Start

1st: Click

Explanation

Confirm safety of the surrounding area, then press DPR regeneration switch inside the cabin to execute the regeneration process.

Attention

Park the vehicle in a secure position. Then idle the engine.

Help **Close**

2nd: Push manual regeneration switch in cabin

3. DPR backpressure check

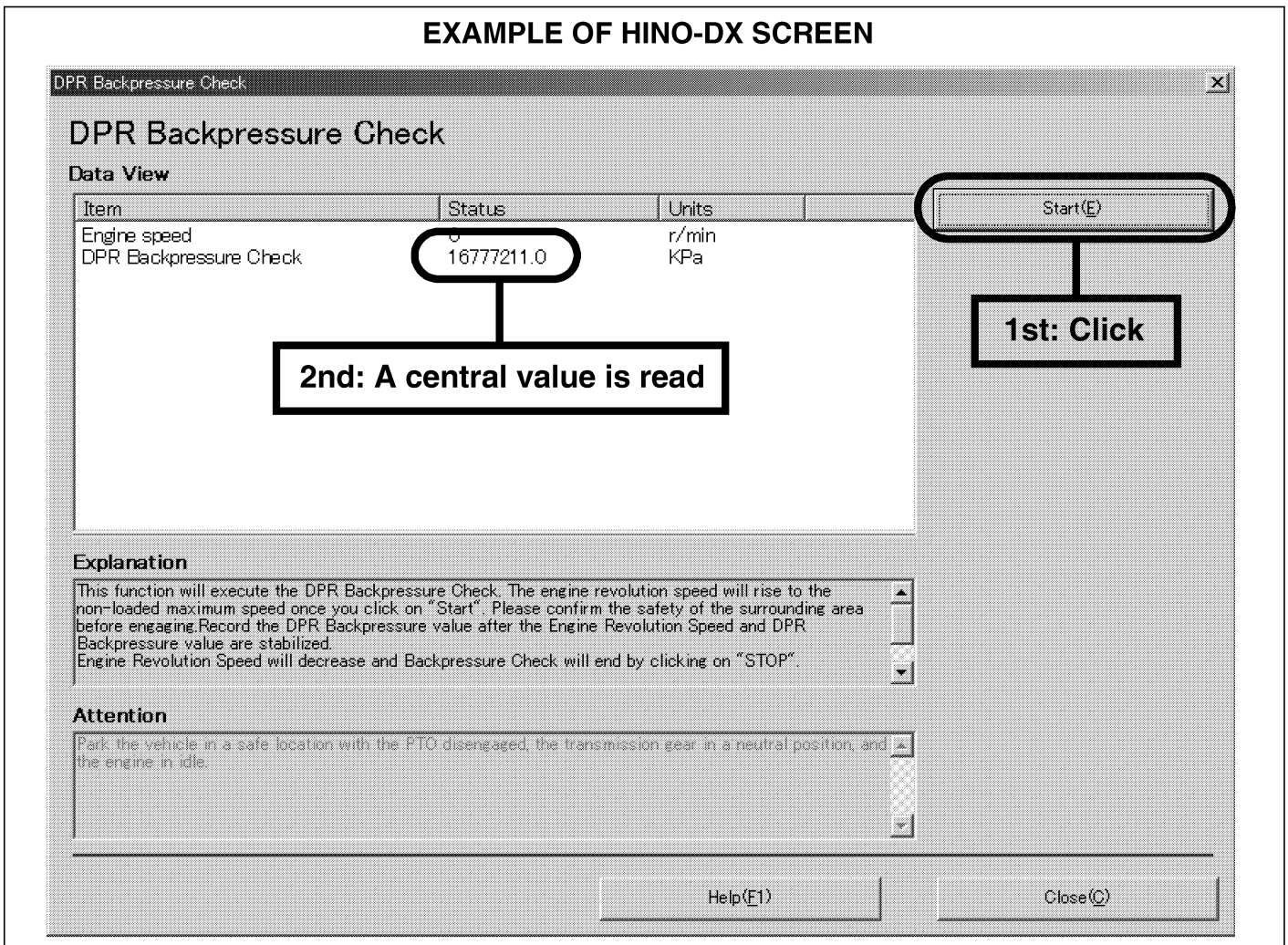
- (1) Check the DPR backpressure through the "DPR Status" display.
- (2) Confirm the exhaust gas temperature (in and out) is less than 200°C {392°F}.
- (3) Engine revolution will rise automatically, then record the indicated maximum DPR backpressure.
- (4) In case the central value of the recorded DPR backpressure value exceeds the specific value, clean or replace the filter. Then "Stop" the DPR backpressure check.

Specific value

Engine speed (no load maximum revolution)	Backpressure inspection standard value (kPa {kgf/cm ² , lbf/in. ² })
2,800 r/min.	23.0 {25.2, 3.3}

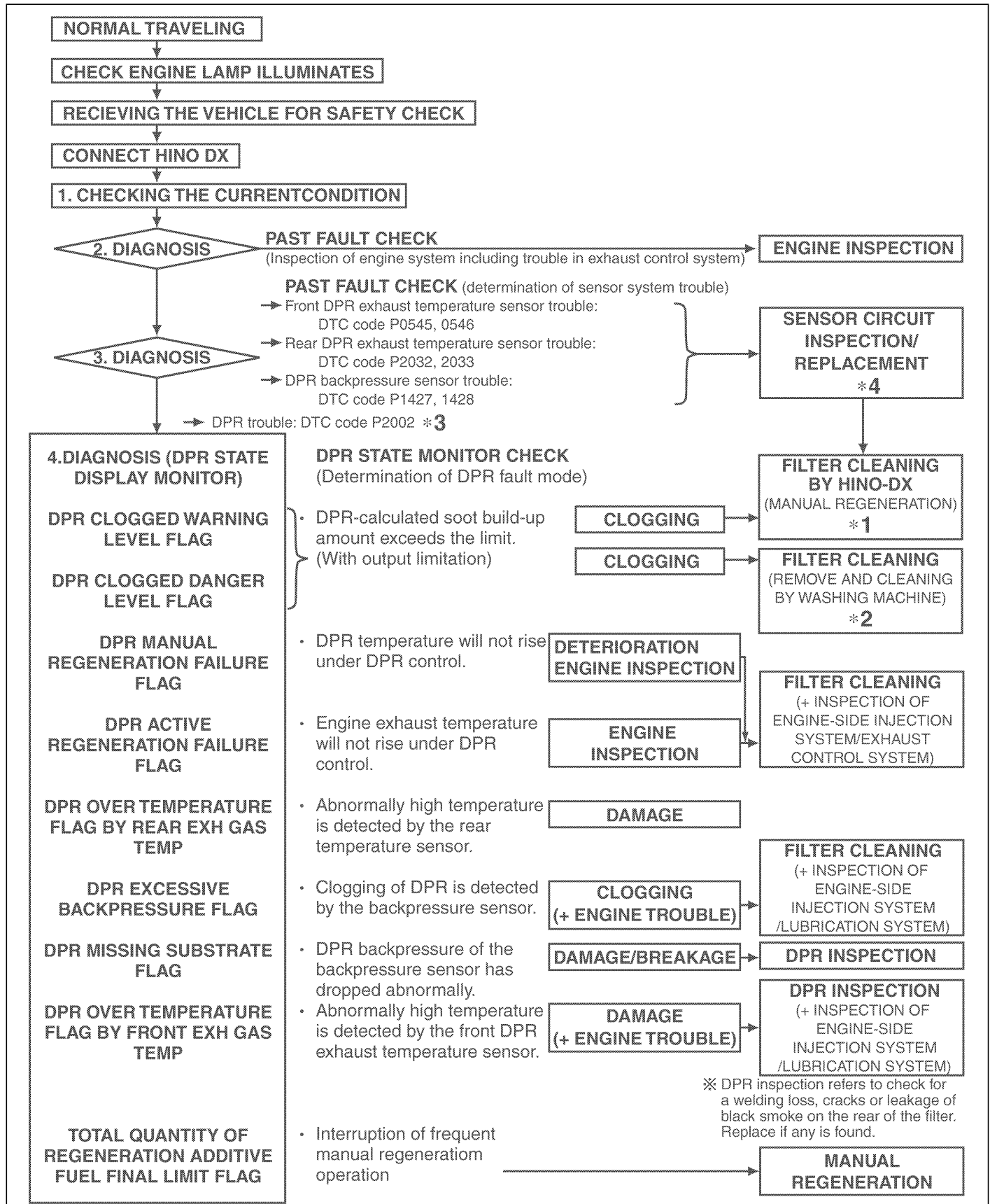
- (5) When the backpressure is unchanged check the following. If the following are normal, the backpressure sensor should be replaced.
 - a. Confirm backpressure hose for cracks or hole openings.
 - b. Confirm that the hose clamp is neither loose nor disconnected.
 - c. Confirm whether there is clogging in the backpressure pipe (DPR cleaner side).
Use compressed air from one end of the pipe to check for clog-
ging. If the air passes to the other side easily, it is clear.

EXAMPLE OF HINO-DX SCREEN



INSPECTION PROCEDURE FOLLOWED WHEN CHECK ENGINE LAMP ILLUMINATES (ABNORMAL)

EN0110604H300002



*1 Additional information for inspections with HINO-DX

Light cases of DPR clogging can be treated without removing the housing.

The procedure is shown below.

The "DPR STATUS" can be checked with the HINO-DX, and when only the "DPR clogged warning level flag" is "ON", regeneration processing can be performed with the DPR SW or the tool.

Confirmation method:

Use the HINO-DX, perform System Fix, then open screens in the order of Check function (E) → DPR Reset Confirmation (D) → DPR Status, and confirm that "status" is "ON" for the item "DPR clogged warning level flag" of the DPR Status. Only when this is "ON" can manual regeneration by pressing the DPR manual regeneration switch or manual regeneration by HINO-DX setting be performed.

1. Press the DPR Manual regeneration switch. When manual regeneration has started, wait until regeneration has been completed and confirm that the engine check lamp has gone out.
2. If the operation by means of the DPR SW is not accepted, connect the HINO-DX to the vehicle, record the "HINO-DX Report", erase the trouble code, and then perform manual regeneration according to the following procedure. When manual regeneration has started, wait until regeneration has been completed and confirm that the engine check lamp has gone out.

Confirmation method:

Use the HINO-DX, perform System Fix, and then continue in the order of Check Function (E) → DPR Reset Confirmation (D) → Manual regeneration (E).

Recording method for the "HINO-DX Report":

- a. Connect the HINO-DX to the vehicle and execute System Fix.
- b. Click the Equipment DTC button and then click Load (L).
- c. Click System Fix (W) after the DTC code has been put out.
- d. Enter Work memorandum (information), Customer Name, License Plate, and Mileage information at the pop-up screen.
- e. Click the OK button.
- f. Click the Close Work (C) button of the pull-down menu File (F) for Close Work.
- g. Click Past work information (O) of the File (F) pull-down menu.
- h. Select the files when System Fix was performed in items d and e from the pop-up screen and click the Print button.
- i. Click the Print button on the pop-up screen.
- j. When the HINO-DX Report image screen appears, click the Print button.
- k. Click the Printer Name pull-down button on the Print pop-up screen.
- l. Select Microsoft Office Document Image Writer from the Printer pull-down menu.
- m. Click the OK button.
- n. Save the data in any folder (example: Save to the desktop).
- o. When the folder is clicked, the contents of the HINO-DX Report can be confirmed and sent by e-mail or can be printed out.
3. After completion of manual regeneration by (1) or (2), keep the engine running and wait for the exhaust temperature (IN side) to drop. Confirm a drop to 200 degrees or lower and then inspect the exhaust gas backpressure according to the following procedure.

Confirmation method:

Execute in the order of DPR Reset Confirmation → Backpressure Check (D) → Start (E).

4. Confirm that the values of the exhaust gas backpressure are at or below the standard.

Standard:

Engine model	DPR Backpressure (Units: KPa)
J08E	23.0

5. When the confirmation result in (4) is at or below the standard, DPR manual regeneration and the confirmation work have been completed. Click "Stop" on the DPR Backpressure Check screen to end the work with the HINO-DX.
6. If the exhaust gas backpressure with the inspection in (5) exceeds the standard, repeat the steps (2), (3), (4), and (5).

7. If the exhaust gas backpressure with the work in (6) is within the standard, DPR manual regeneration and the confirmation work have been completed. Click "Stop" on the DPR Backpressure Check screen to end the work with the HINO-DX.
8. If the exhaust gas backpressure still exceeds the standard with the second manual regeneration, the DPR filter is defective and must be replaced.

***2 Additional information for filter cleaning with a washing machine**

Confirm the following for filter cleaning with a washing machine.

Use a washing machine from a manufacturer recommended by Hino Motors.

Perform cleaning with correct installation of the attachment for DPF filters made by Hino Motors.

In the following instances the filter cannot be cleaned. In these cases, the filter must be replaced.

1. Cleaning is not possible for filters where soot has escaped and the surroundings have turned black when the filter body is seen from the gas flow outlet side.
2. Cleaning is not possible when a large quantity of oil adheres to the filter body as seen from the gas flow inlet side.
3. Cleaning is not possible when the filter or the catalyst shows cracks or damage seen from any side.
When cleaning has been completed and the filter has been installed again, perform the following inspections.
4. Use the HINO-DX to perform DPR forced regeneration, then confirm normal completion.
5. In this condition, wait for the exhaust gas temperature to drop to 200°C or lower, perform the backpressure inspection, and confirm that the inspection value is at or below the standard.
6. If the backpressure value is high, the filter is defective and must be replaced.

***3 Check for sensor coupler disconnection even when P2002 is displayed.**

***4 Pay attention to the following when the temperature sensor is inspected because of P2002 or a temperature sensor DTC code.**

1. Replace if the tip is bent.
2. Do not bend the tip when it is normal.
3. When the sensor tip is bent, normal control may not be possible and this can lead to DPR trouble.
4. When disconnecting the sensor, remove the sensor body from the muffler after completely removing the harness fixing clips. If this is not done, the sensor tip could get damaged.

DETERMINATION BY WAY OF DPR STATE DETERMINATION MONITOR OF HINO-DX

EN0110604H200006

1. CHECK THAT THE CHECK ENGINE LAMP COMES ON.
2. CONNECT HINO-DX.
3. CHECK PAST FAULTS.
 - (1) Check past faults by way of HINO-DX. In case a general engine fault such as a trouble of an exhaust control system is displayed, inspect and repair the pertinent section.
 - (2) Inspect and repair general engine faults and check past faults again. In case a code indicating a sensor system trouble is displayed, inspect and replace the sensor circuit.

	DTC code
Front DPR exhaust temperature sensor trouble	P2080, P0545, P0546
Rear DPR exhaust temperature sensor trouble	P2084, P2032, P2033
DPR backpressure sensor trouble	P1426, P1427, P1428

- (3) Check past faults. In case DPR trouble (DTC code: P2002) is displayed, check the DPR state monitor.

CHECKING THE DPR STATE

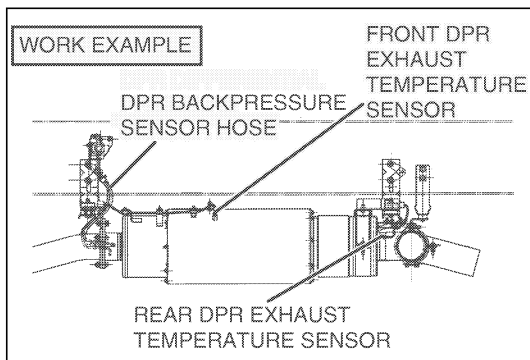
EN0110604H200007

1. CHECK THE DPR STATE MONITOR.
 - (1) Refer to "INSPECTION BY WAY OF HINO-DX" and check the DPR state monitor. Perform inspection as per the procedure under "INSPECTION BY WAY OF HINO-DX".

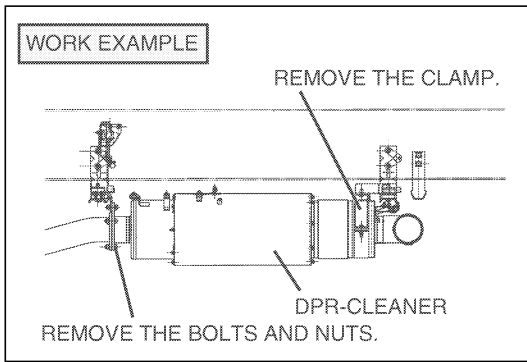
REPLACEMENT OF DPR FILTER

EN0110604H200008

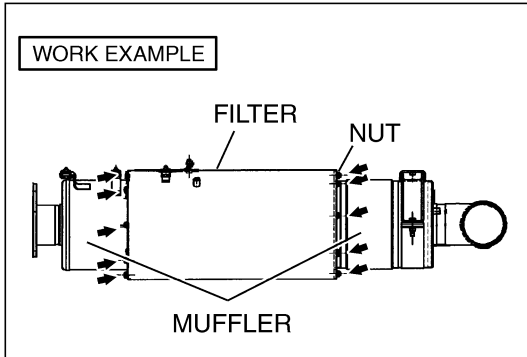
1. REMOVE THE DPR-CLEANER.
 - (1) Remove the connectors for the front and rear DPR exhaust temperature sensors and remove the hose of the DPR backpressure sensor.



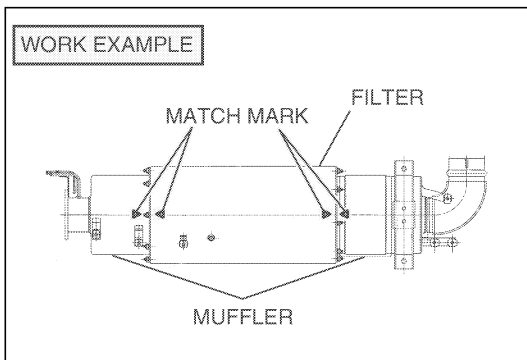
SAPH011060400025



SAPH011060400026



SAPH011060400027



SAPH011060400028

- (2) Use a jack to support the DPR-cleaner. Remove the bolts and nuts connecting the exhaust pipe and DPR-cleaner.
- (3) Remove the DPR-cleaner rear clamp and remove the DPR-cleaner.

- (4) Remove the filter mounting nut and remove the front/rear muffler pipe.

NOTICE

The catalyst in the DPR-cleaner is made of ceramic; it could break if a strong impact is applied. Handle it with care.

- (5) When cleaning the filter, refer to "CLEANING OF DPR FILTER".

2. INSTALL THE DPR-CLEANER.

- (1) Align the front and rear muffler pipes then install into the filter.
- (2) After that, follow the reverse order of removing to install the DPR-cleaner.

HINT

Diagonally tighten the nuts.

Tightening Torque:

35±5 N·m {360±50 kgf·cm, 25.8±3.7 lbf·ft} (Filter mounting nut)

CLEANING OF DPR FILTER

EN0110604H200009

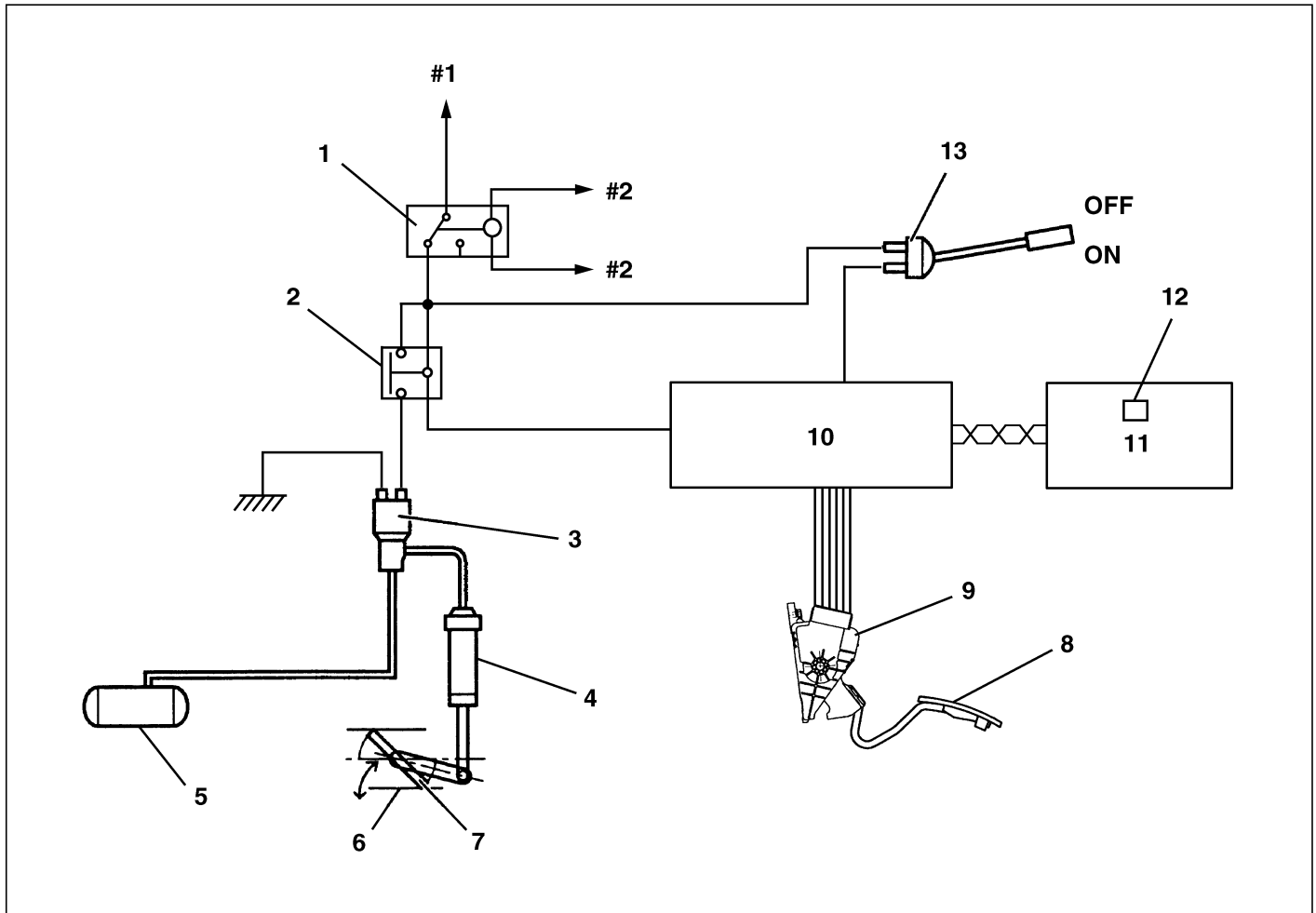
1. CLEANING METHOD

- (1) Use a dedicated cleaning machine to perform filter cleaning. Never clean the filter elsewhere. For the cleaning method, refer to the cleaning machine handling manual.

EXHAUST CONTROL VALVE

SYSTEM CONFIGURATION

EN0110604D100005



SAPH011060400029

1	ABS exhaust cut relay	9	Accelerator sensor
2	U2 exhaust relay	10	Engine ECU
3	Magnetic valve	11	Combination meter ECU
4	Exhaust control cylinder	12	Exhaust brake light
5	Air tank	13	Exhaust brake switch
6	Exhaust pipe	#1	To U2 actuator power relay
7	Butterfly valve	#2	To ABS ECU
8	Accelerator pedal		

PROCEDURE FOR CHECKING/ADJUSTING THE EXHAUST CONTROL VALVE OPENING

EN0110604H200010

- 1. Run the engine until it is completely warm.**
 - (1) Keep the engine running until the temperature gauge needle is in the normal temperature zone.
(The engine will warm up faster if the auxiliary brake switch is used. The warm-up operation is described below.)
- 2. Connect the HINO-DX.**
 - (1) Display the engine rpm (NE), fuel injection rate (QFIN), and temperature (THW) on the data display screen.
- 3. Set the exhaust control valve in warm-up state.**
 - (1) Set the transmission in neutral and securely engage the parking brake.
 - (2) Turn off the air conditioner and headlights.
 - (3) Make sure the air compressor has finished charging.
 - (4) Turn off any other auxiliary equipment that may be in operation (refrigerator compressor, PTO drive, etc.).
 - (5) Adjust the engine speed to the value of Adjustment Table.
 - (6) Operate the exhaust control valve.
[Set the exhaust control valve in operation.]
 - (7) Adjust the engine speed to the value of Adjustment Table by the idle set knob. Then record the fuel injection quantity (A).
 - (8) Set the exhaust control valve to OFF and keep the state for 30 seconds. Then record the fuel injection quantity (B).
 - (9) If difference of fuel injection quantity (A - B) is outside of the adjustable range, fuel injection quantity must be adjusted.

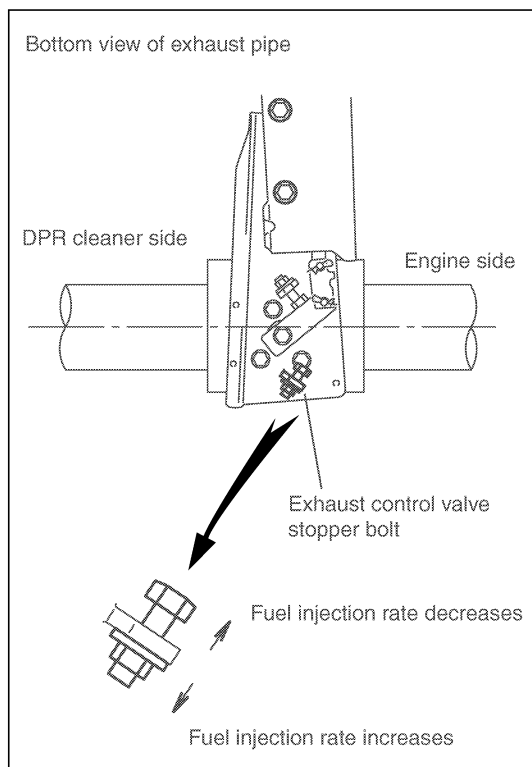
Adjustment Table

Engine speed (rpm)	980
Difference of adjustable range of fuel injection quantity (A — B) (q)	10 — 18
Adjustment target quantity	14

- 4. Adjust the exhaust control butterfly valve.**
 - (1) Make sure the engine is warm.
Check the HINO-DX temperature display and make sure the temperature is above 82°C {180°F}.
(Warm up the engine if the temperature is below 82°C {180°F}.)
 - (2) Record the fuel injection rate (QFIN) on the HINO-DX.

NOTICE

- **At this time, be sure to use the switch on the steering column to turn the engine off. Do not use the clutch pedal or other part to turn it off.**
If the exhaust control valve does not go off when the engine has been turned off, idle mode will be engaged for a long time in idle mode, so QFIN will not be correctly measured. In this case, turn on the exhaust control valve again and warm it up.
- **Idle mode can be canceled if the ExH(in) temperature stays above 190°C {374°F} for 10 minutes.**



- (3) If the fuel injection rate is within the range shown in the adjustment table:
→ Adjustment is not required. Proceed to step 5 and check the manual forced-recovery function.
- (4) If the fuel injection rate is not within the range shown in the adjustment table:

NOTICE

- **Screwing in the stopper bolt will increase the fuel injection rate.**
- **Screwing out the stopper bolt will decrease the fuel injection rate.**

- (5) Once the stopper bolt adjustment has been completed, repeat this procedure starting at step 3, "Set the exhaust control valve in warm-up state." and confirm the engine rpm and fuel injection rate.

5. Check the manual regeneration function.

- (1) After the adjustment has been completed, check the manual regeneration function with the HINO-DX DPR check function.

NOTICE

- **The function is normal if recovery is completed within approximately 15 - 20 minutes.**

6. End of check and adjustment procedure

DPR INSPECTION CHECK SHEET

EN0110604D100006

HINT

After the inspection, enter check marks into the empty check boxes.

Step	1		2		3		4	
Inspection part	Fuel tank, Filter		Air intake system parts		Engine ECM		VNT turbocharger	
Inspection items	<input type="checkbox"/> Dirty or clogged fuel filter element <input type="checkbox"/> Entry of foreign matter or water into the fuel tank <input type="checkbox"/> Use of bad fuel		<input type="checkbox"/> Air filter element dirty, clogged, etc. <input type="checkbox"/> Damage to air cleaner body or air intake stack <input type="checkbox"/> Damaged or bent air hose <input type="checkbox"/> Damaged inter cooler body or hose		<input type="checkbox"/> Most recent program No.?		<input type="checkbox"/> Following characteristic at the time of inspection (Error within $\pm 5\%$)	
	OK	NG	OK	NG	OK	NG	OK	NG
Handling in case of "NG" judgment	<ul style="list-style-type: none"> • Element replacement • Fuel sampling → Investigation *Sampling from the fuel tank 		<ul style="list-style-type: none"> • Element replacement • Inspection of body and air intake stack • Replacement of inter-cooler body or hose 		<ul style="list-style-type: none"> • Updating to the most recent software version (**). 		<ul style="list-style-type: none"> • Replacement in case of bad following 	

(**) As long as the injection quantity is normal at the time of exhaust control valve is operating, there is no problem.

Injection quantity standard value table (value with all auxiliary equipment loads off)

Idling (normal)	Speed (rpm)	750
	Injection quantity (q)	7 - 16
Idling (at the time of adjustment)	Speed (rpm)	980
	Injection quantity (q)	B
Warming up with exhaust control valve	Speed (rpm)	980
	Injection quantity (q)	A
Suitable injection quantity (adjustment target value)	A - B	10 - 18
		(14)
At the time of manual regeneration (guide value)	Speed (rpm)	980
	Injection quantity (q)	25 - 35
Backpressure standard	Speed (rpm)	2,800
	Backpressure (kPa {kgf/cm ² , lbf/in. ² })	23.0 {25.2, 3.3}

EN0110604D100007

5		6		7		8	
EGR valve		Supply pump, Injector		Fuel injection quantity		Manual regeneration	
<input type="checkbox"/> Following characteristic at the time of inspection (Error within $\pm 5\%$)		<input type="checkbox"/> Stability of the pump electrical current value *Standard = Refer to the supply pump inspection. <input type="checkbox"/> Injector correction value *Guide value = "Correction value for the correction injection quantity between cylinders" at the time of idle speed within $\pm 5 \text{ mm}^3/\text{st}$		<input type="checkbox"/> Injection quantity 1. At the time of idle 2. At the time of exhaust control valve is in operation <input type="checkbox"/> Exhaust control valve operation (No clinging or air leakage etc.?) *At the time of exhaust control valve opening adjustment, refer to the standard value table shown blow left. *Confirm the injection quantity at the time of exhaust control valve is operating when the exhaust temperature has stabilized.		*To be performed with all auxiliary equipment load off. <input type="checkbox"/> Gas leakage at the time of regeneration <input type="checkbox"/> Discharge of white or black smoke at the time of regeneration <input type="checkbox"/> Exhaust gas temperature at the time of regeneration *Peak temperature: 500 °C or more (guide value) <input type="checkbox"/> Regeneration time *Guide value: Approximately 20 min	
OK	NG	OK	NG	OK	NG	OK	NG
<ul style="list-style-type: none"> Replacement in case of bad following 		<ul style="list-style-type: none"> Supply pump replacement when the inspection result is NG Injector replacement when the injector correction value is not within $\pm 5 \text{ mm}^3/\text{st}$ 		Repair or replacement the exhaust control valve in case of problems with exhaust control valve operation. (***)		White smoke means excessively closed exhaust control valve → Readjustment. Black smoke requires DPR filter confirmation. → Replace if the rear part is black. <ul style="list-style-type: none"> If the temperature rise is bad although injector, VNT, and EGR all are OK, inspect the temperature sensor and the front of the DPR. → Clean if the front is clogged. 	

(*) Caution items before inspection of the fuel injection quantity**

1. Connect the HINO-DX and perform warm-up until the engine temperature becomes 82°C or higher.
2. Set the gear to neutral and pull the parking brake lever sufficiently.
3. Switch off the air conditioner and the headlights.
4. Confirm that charging of the air compressor has been completed.
5. Switch off all other auxiliary equipment loads. (Refrigeration compressor, PTO, etc.)

LUBRICATING SYSTEM (J08E)

EN05-001

LUBRICATING SYSTEM EN05-2

DIAGRAM EN05-2

OIL PUMP AND OIL STRAINER EN05-4

COMPONENT LOCATOR..... EN05-4

OVERHAUL EN05-5

INSPECTION AND REPAIR EN05-6

OIL FILTER AND OIL COOLER EN05-7

COMPONENT LOCATOR..... EN05-7

SPECIAL TOOL EN05-8

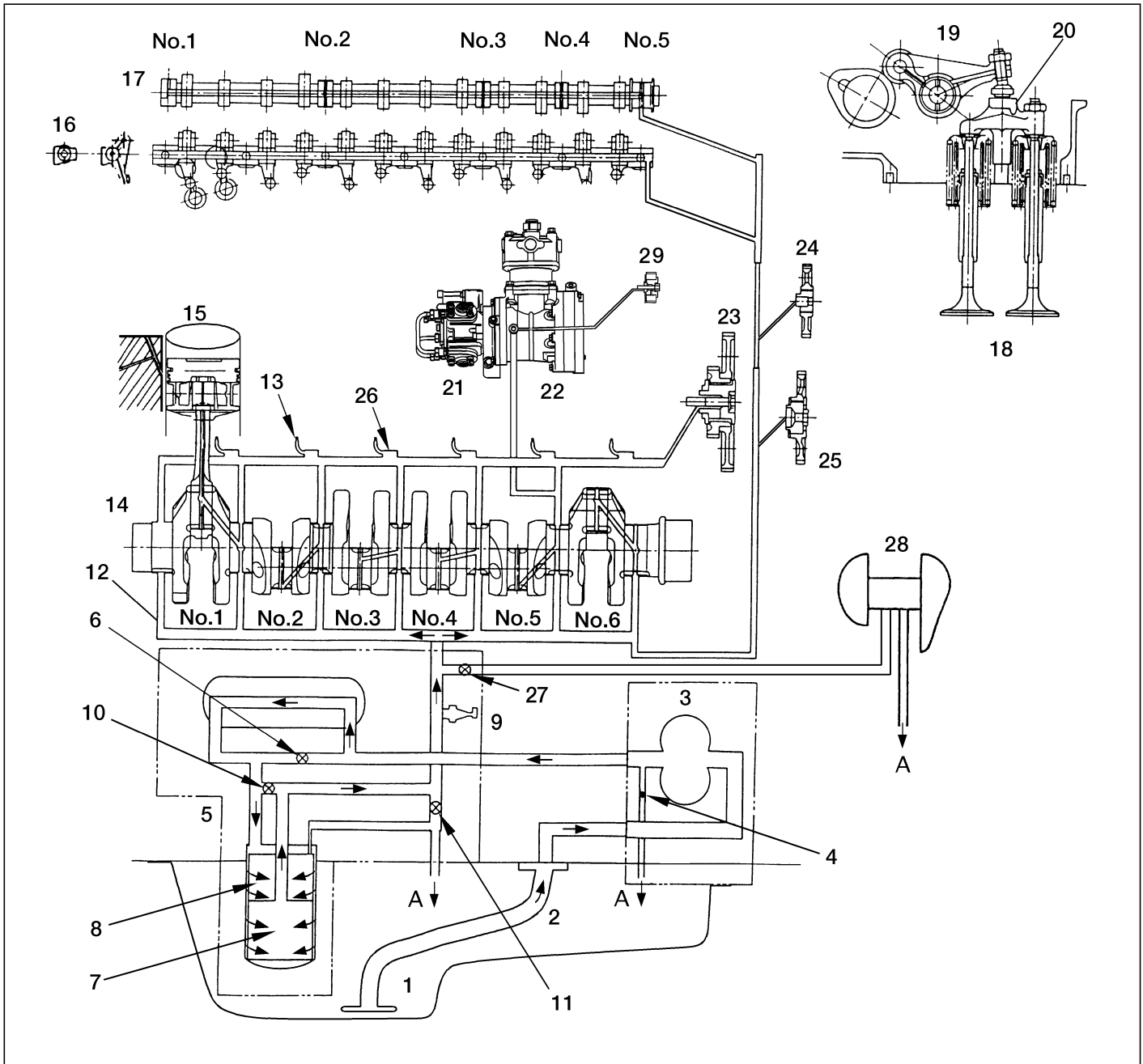
DISMOUNTING AND MOUNTING EN05-8

INSPECTION AND REPAIR EN05-10

LUBRICATING SYSTEM

DIAGRAM

EN0110605J100001



SAPH011060500001

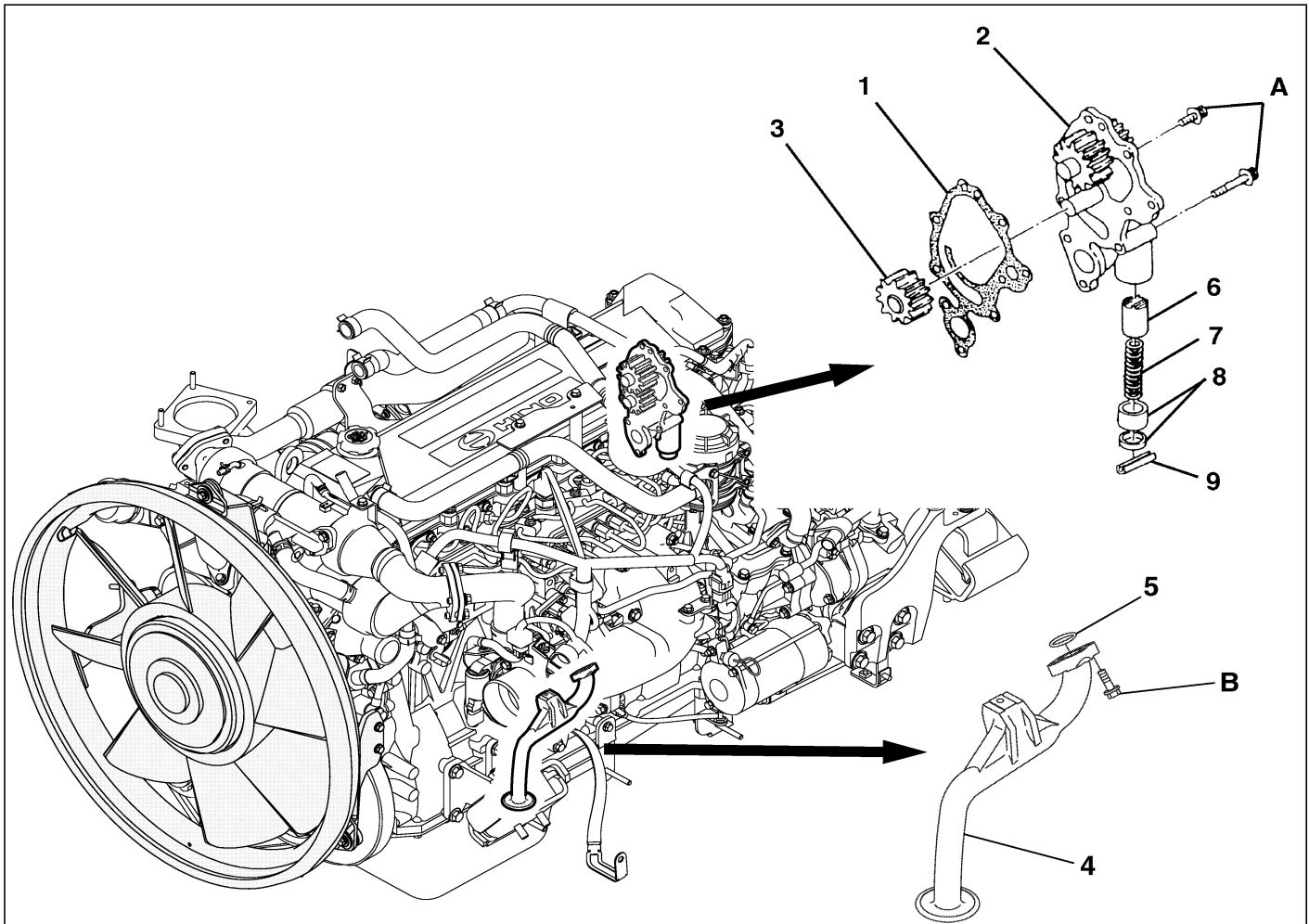
Unit: kPa {kgf/cm², lbf/in.²}.

1	Oil pan	15	Piston
2	Oil strainer	16	Valve rocker shaft
3	Oil pump	17	Camshaft
4	Oil pump safety valve 1,648-1,746 {16.8-17.8, 239-253}	18	Valve
5	Oil cooler and oil filter	19	Rocker arm
6	Oil cooler safety valve 352-432 {3.6-4.4, 52-62}	20	Cross head
7	Oil filter (full flow)	21	Supply pump
8	Oil filter (by-pass)	22	Air compressor
9	Pressure switch	23	Main idle gear
10	Oil filter safety valve 176-216 {1.8-2.2, 26-31}	24	Cam idle gear
11	Regulator valve 490-570 {5.0-5.8, 72-82}	25	Sub idle gear
12	Main oil hole	26	Check valve 245 {2.5, 36}
13	Piston cooling jet	27	Check valve for turbocharger
14	Crankshaft	28	Turbocharger
		29	Idle gear
		A	To oil pan

OIL PUMP AND OIL STRAINER

COMPONENT LOCATOR

EN0110605D100001



SAPH011060500015

1	Gasket	6	Safety valve
2	Oil pump	7	Relief spring
3	Driven gear	8	Spring seat
4	Oil strainer	9	Cotter pin
5	O-ring		

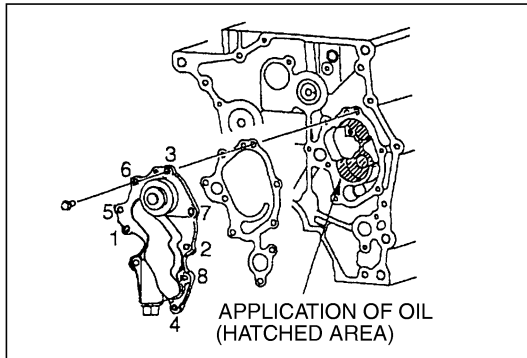
Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A	28.5 {291, 21}	B	28.5 {291, 21}
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OVERHAUL

EN0110605H200001



IMPORTANT POINTS - ASSEMBLY

1. INSTALLING THE OIL PUMP.

- (1) Apply oil to the pump case and bearings of the block (hatched area) before installing the oil pump.

NOTICE

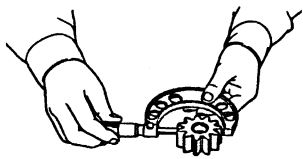
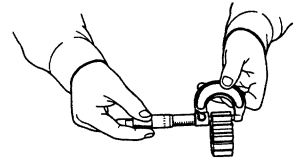
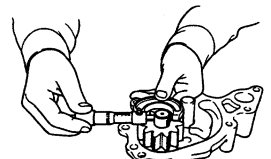
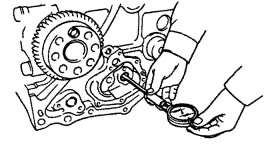
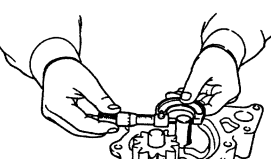
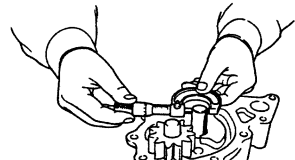
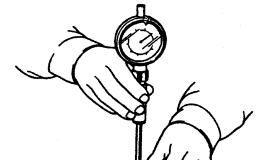
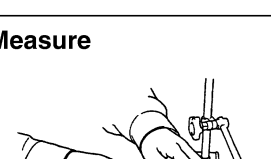
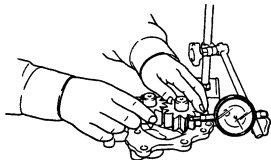
Not applying oil may cause oil suction failure at start-up, resulting in seizure and abnormality.

- (2) To prevent misalignment of the gasket, apply grease to the gasket matching face of the block. Then, place and fix the gasket.
- (3) Tighten the oil pump mounting bolts provisionally in the order as shown in the figure. Tighten them to the specified torque.

INSPECTION AND REPAIR

EN0110605H300001

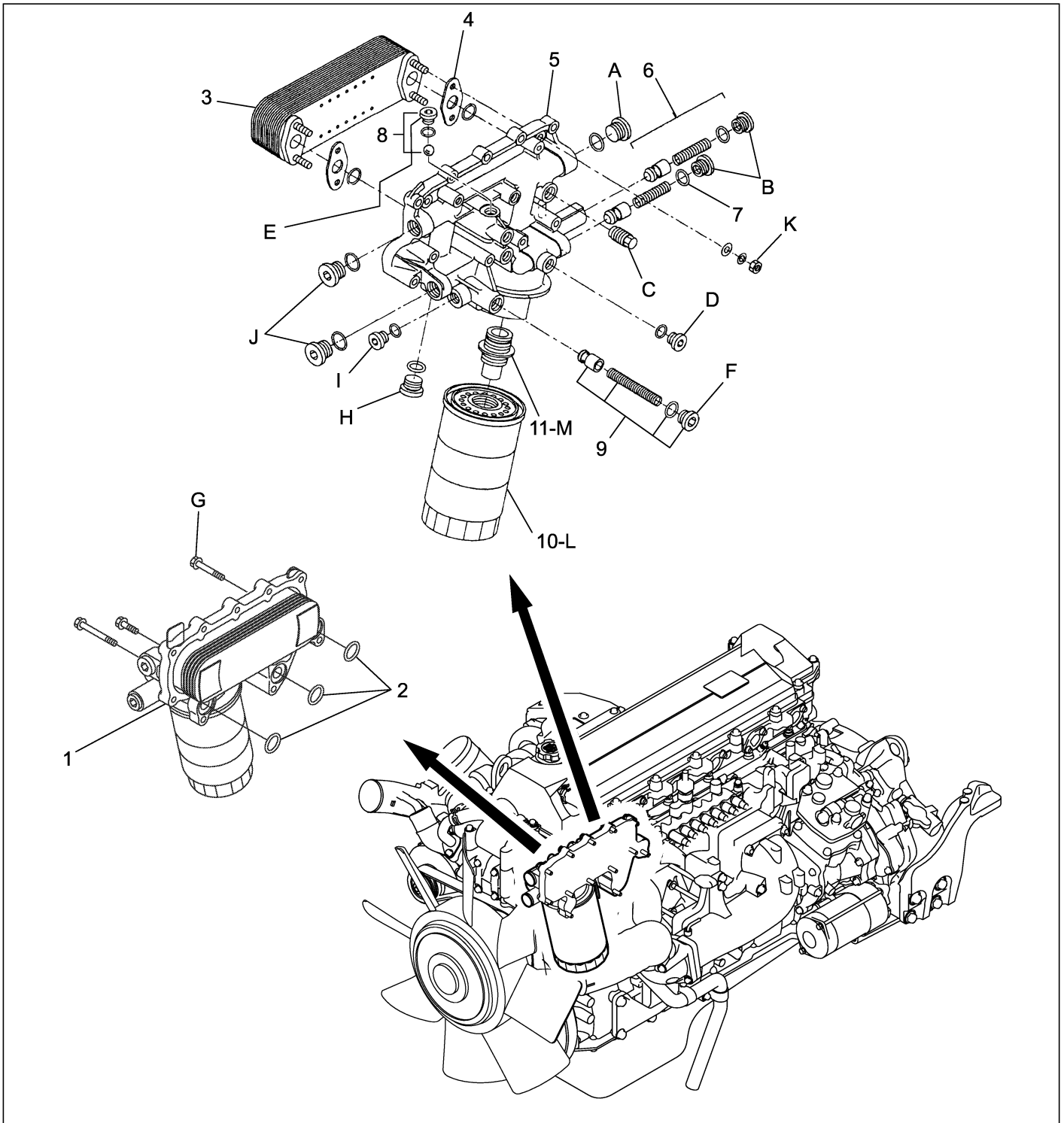
Unit: mm {in.}

Inspection item		Standard	Limit	Remedy	Inspection procedure
Gear outside diameter		54 {2.126}	—	—	Measure 
Block side pump body inside diameter		54 {2.126}	—	—	
Tip clearance		0.100-0.202 {0.004-0.0079}	0.30 {0.0118}	Replace gear or pump.	
Gear width		37.5 {1.476}	—	—	Measure 
Block side pump body inside depth		37.5 {1.476}	—	—	
End play		0.049-0.113 {0.0020-0.0044}	0.15 {0.0059}	Replace gear or pump.	
Drive gear	Shaft outside diameter	18 {0.709}	—	—	Measure   
	Block side bushing inside diameter	18 {0.709}	—	—	
	Clearance	0.040-0.099 {0.0016-0.0038}	—	—	
Driven gear	Shaft outside diameter	18 {0.709}	—	—	Measure   
	Block hole diameter	18 {0.709}	—	—	
	Clearance	0.030-0.075 {0.0012-0.0029}	—	—	
	Gear bushing inside diameter	18 {0.709}	—	—	
	Clearance	0.040-0.083 {0.0016-0.0032}	0.15 {0.0059}	Replace gear.	
Gear backlash		0.073-0.207 {0.0029-0.0081}	0.30 {0.0118}	Replace pump.	Measure 

OIL FILTER AND OIL COOLER

COMPONENT LOCATOR

EN0110605D100002



SAPH011060500009

1	Oil cooler with filter assembly	7	Oil filter safety valve
2	O-ring	8	Check valve
3	Oil cooler element	9	Oil cooler safety valve
4	Gasket	10	Oil filter element
5	Oil cooler case	11	Insert
6	Regulator valve		

Tightening torque

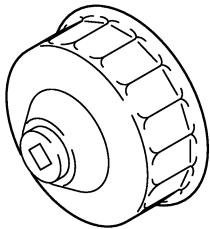
Unit: N·m {kgf·cm, lbf·ft}

A	29.4-39.2 {300-400, 22-28}	H	29.4-39.2 {300-400, 22-28}
B	24.5-34.3 {250-350, 19-25}	I	19.6-29.4 {200-300, 15-21}
C	39.2-49 {400-500, 29-36}	J	29.4-39.2 {300-400, 22-28}
D	19.6-29.4 {200-300, 15-21}	K	19.6-29.4 {200-300, 15-21}
E	19.6-29.4 {200-300, 15-21}	L	39.2-49 {400-500, 29-36}
F	24.5-34.3 {250-350, 19-25}	M	98-117 {1,000-1,190, 72-86}
G	28.4 {290, 21}		

SPECIAL TOOL

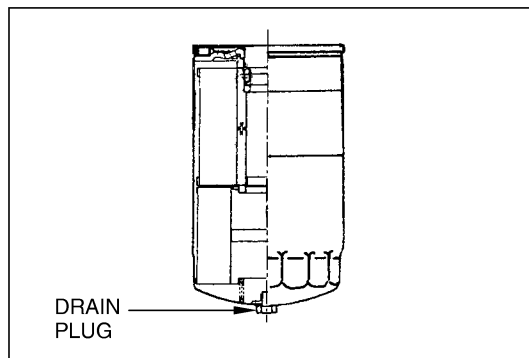
EN0110605K100001

Prior to starting an engine overhaul, it is necessary to have this special tool.

Illustration	Part number	Tool name	Remarks
	S0950-31110	OIL FILTER WRENCH	

DISMOUNTING AND MOUNTING

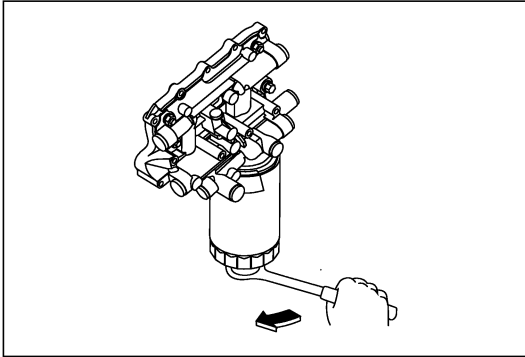
EN0110605H200002

IMPORTANT POINTS - DISMOUNTING

SAPH011060500011

1. REMOVE THE OIL FILTER.

- (1) Remove the drain plug from bottom of the oil filter and drain the engine oil.

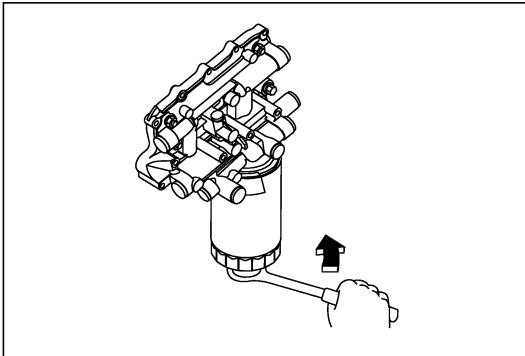


SAPH011060500012

- (2) Using the special tool, remove the oil filter.
SST: Oil filter wrench (S0950-31110)

NOTICE

Make sure that O-rings are not on the oil cooler case side.



SAPH011060500013

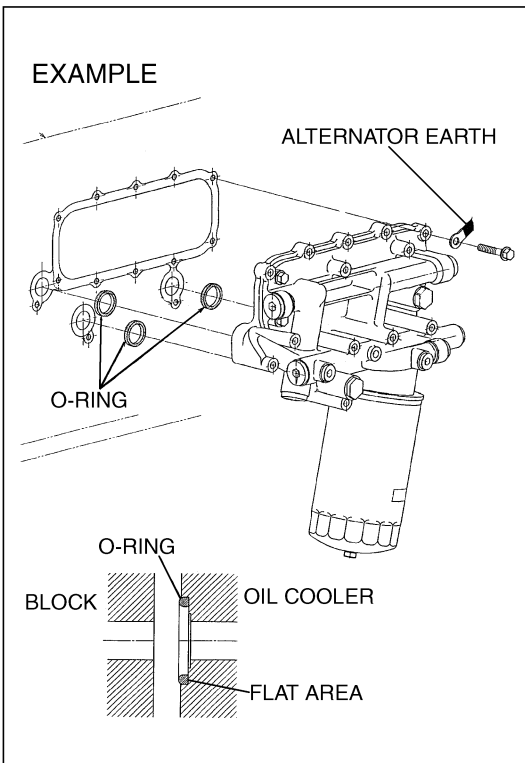
IMPORTANT POINT - MOUNTING**1. INSTALL THE OIL FILTER.**

- (1) Remove the dust on installation surface of oil cooler case side.
- (2) Apply the engine oil to the O-ring on new oil filter.
- (3) Install the oil filter by turning it lightly to the right by hand until it comes in contact with the surface of the oil cooler. Then using the special tool, tighten the oil filter about 270°-360° (3/4-1 turn).

SST: Oil filter wrench (S0950-31110)

NOTICE

- **Do not reuse the O-ring.**
- **Attention to damage of O-ring to damage.**



SAPH011060500014

2. INSTALL THE OIL COOLER AND OIL FILTER ASSEMBLY.

- (1) Insert the O-ring into the O-ring groove of the oil cooler.

NOTICE

Face the flat area of the O-ring toward the oil cooler for installation.

- (2) Apply liquid gasket to the oil cooler case and install it onto the cylinder block, then tighten the bolt to the specified torque.

Tightening Torque:

28.4 N·m {290 kgf·cm, 21 lbf·ft}

INSPECTION AND REPAIR

EN0110605H300002

Inspection item	Standard	Limit	Remedy	Inspection procedure
Oil cooler air leakage Air pressure: 588 kPa {6 kgf/cm ² , 85 lbf/in. ² }	0 mL	—	Replace, if necessary.	Visual check
Wear or damage to valve spring of oil cooler and oil filter	—	—	Replace, if necessary.	<ol style="list-style-type: none"> 1. Damage to sliding face of valve 2. Valve movement (smoothness)

COOLING SYSTEM (J08E)

EN06-001

COOLING SYSTEM EN06-2

DIAGRAM EN06-2

COOLANT PUMP EN06-3

COMPONENT LOCATOR..... EN06-3

SPECIAL TOOL EN06-4

OVERHAUL EN06-4

INSPECTION AND REPAIR EN06-7

THERMOSTAT EN06-8

COMPONENT LOCATOR..... EN06-8

OVERHAUL EN06-9

RADIATOR AND INTERCOOLER EN06-11

COMPONENT LOCATOR..... EN06-11

OVERHAUL EN06-12

RADIATOR EN06-13

COMPONENT LOCATOR..... EN06-13

SPECIAL TOOL EN06-14

OVERHAUL EN06-14

INSPECTION AND REPAIR EN06-18

COOLING FAN EN06-19

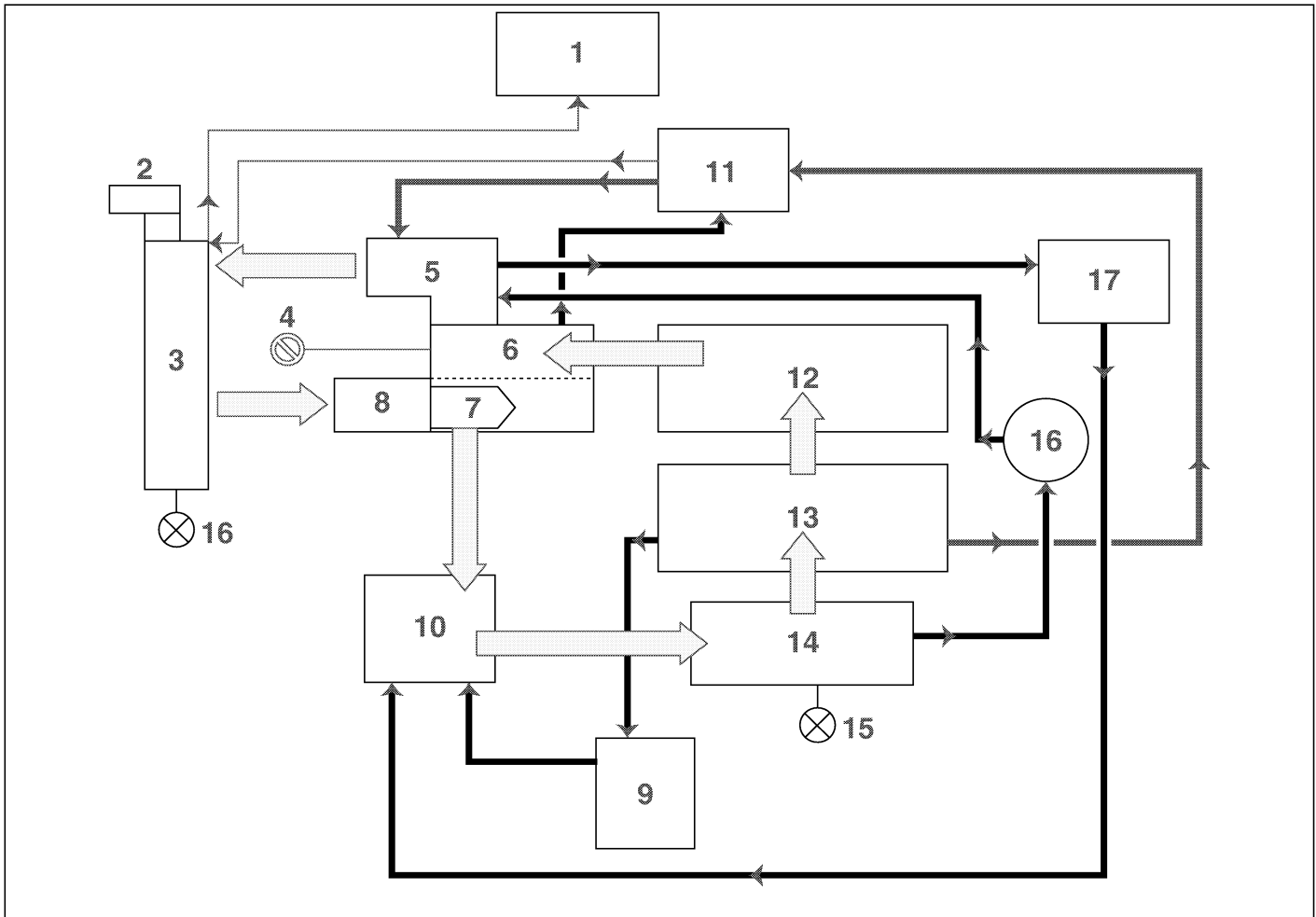
COMPONENT LOCATOR..... EN06-19

INSPECTION AND REPAIR EN06-20

COOLING SYSTEM

DIAGRAM

EN0110606J100001



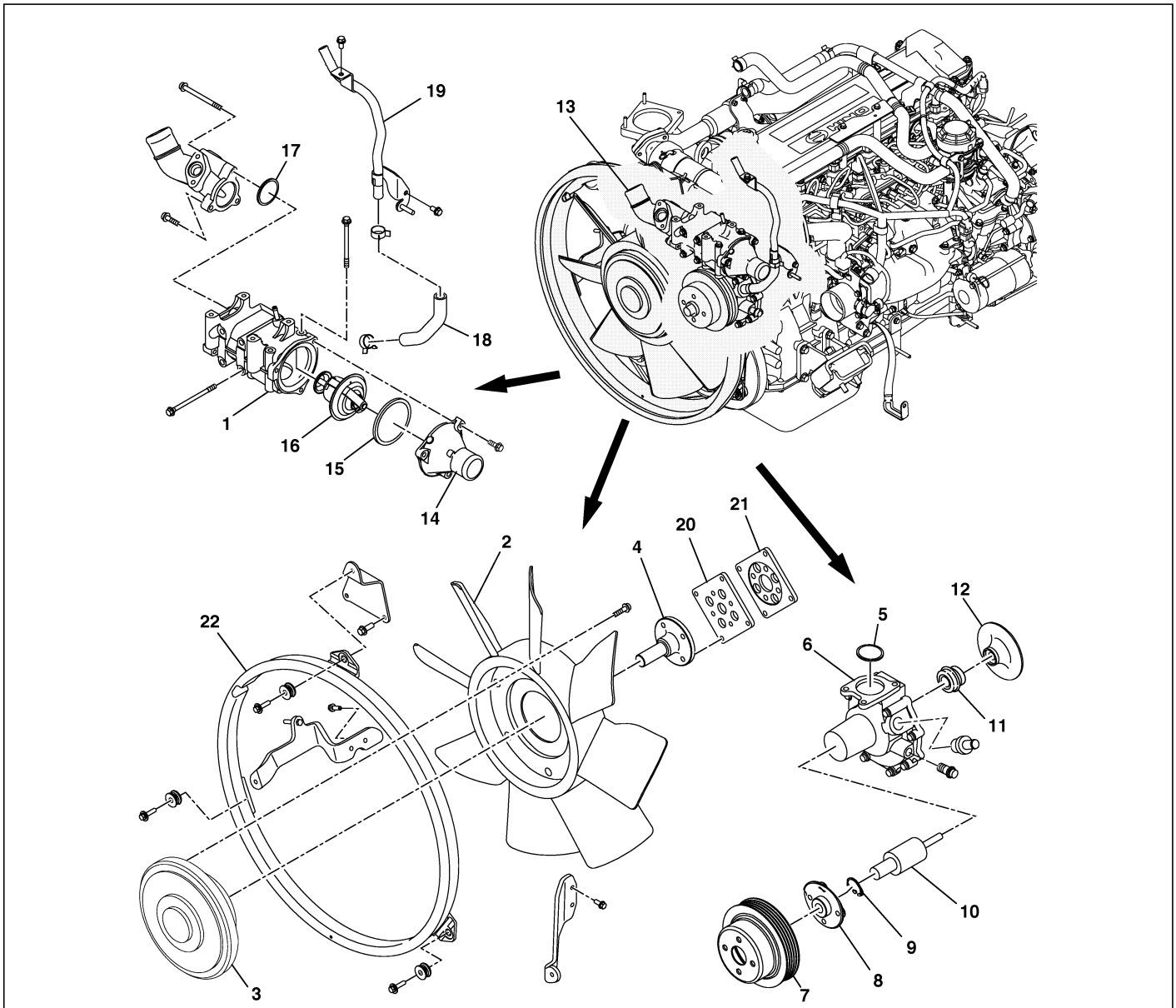
SAPH011060600001

1	Reservoir tank	10	Coolant pump
2	Radiator cap	11	EGR cooler
3	Radiator	12	Cylinder head
4	Coolant temperature gauge	13	Cylinder block
5	Thermostat case cover (Outlet)	14	Oil cooler
6	Thermostat case	15	Drain plug
7	Thermostat	16	Turbocharger
8	Thermostat case cover (Inlet)	17	Car heater
9	Air compressor		

COOLANT PUMP

COMPONENT LOCATOR

EN0110606D100001



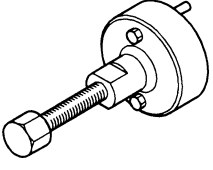
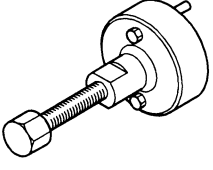
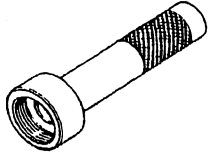
SAPH011060600002

1	Thermostat case	12	Vane
2	Cooling fan	13	Thermostat case assy
3	Fan clutch	14	Thermostat case cover
4	Fan pulley shaft	15	Gasket
5	O-ring	16	Thermostat
6	Pump case	17	O-ring
7	Pulley	18	Heater hose
8	Pulley center	19	Heater pipe
9	Retainer ring	20	Spacer
10	Coolant shaft	21	Spacer
11	Coolant seal	22	Fan shroud

SPECIAL TOOL

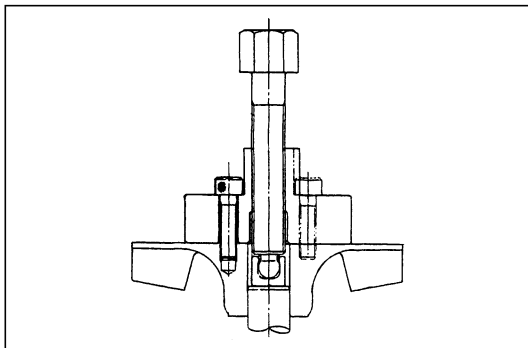
EN0110606K100001

Prior to starting an engine overhaul, it is necessary to have these special tools.

Illustration	Part number	Tool name	Remarks
	S0942-01810	PULLER	For coolant pump pulley center
	S0942-01620	PULLER	For coolant pump vane
	S0948-22060	PRESS	For coolant pump seal

OVERHAUL

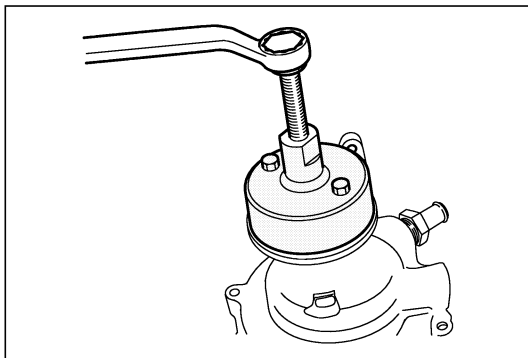
EN0110606H200001



SAPH011060600005

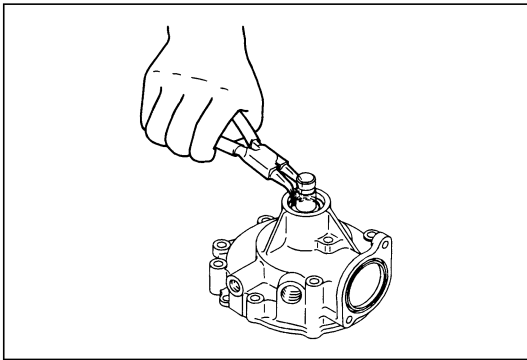
IMPORTANT POINTS - DISASSEMBLY

1. **DISASSEMBLE THE COOLANT PUMP.**
 - (1) Remove the vane from the shaft using the special tool.
SST: Puller (S0942 - 01620)



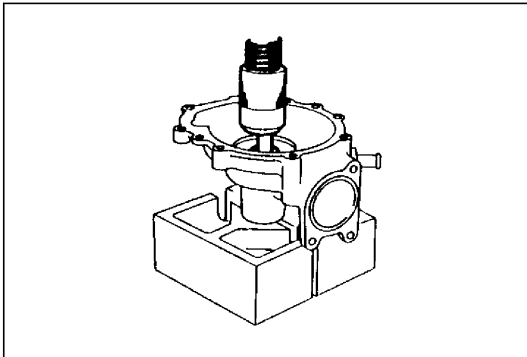
SAPH011060600006

- (2) Remove the pulley center from the shaft using the special tool.
SST: Puller (S0942 - 01810)



SAPH011060600007

- (3) Remove the retainer ring from the pump case using snap ring pliers.



SAPH011060600008

- (4) Push the shaft from the vane side using a hydraulic press, and remove the coolant shaft from the pump case.

NOTICE

Before pressing, recheck that the retainer ring is removed completely.



SAPH011060600009

- (5) Remove the coolant seal from the pump case using a hammer and brass bar.

⚠ WARNING

Impact due to punching may cause metal chips to fly up. Be sure to wear protective goggles.

NOTICE

Replace the removed coolant seal with a new one. Never reuse it.

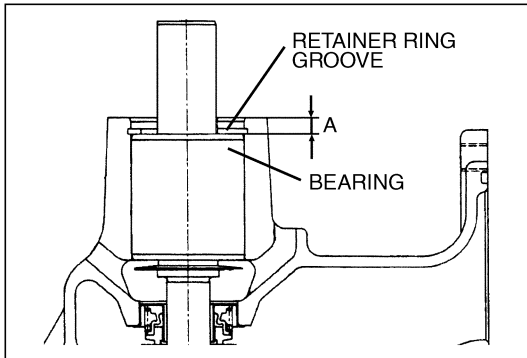
IMPORTANT POINTS - ASSEMBLY

1. ASSEMBLE THE COOLANT PUMP.

- (1) Install the coolant shaft onto the pump case using a hydraulic press.
Assembly standard (A): 4.9-5.1 mm {0.1930-0.2007 in.}

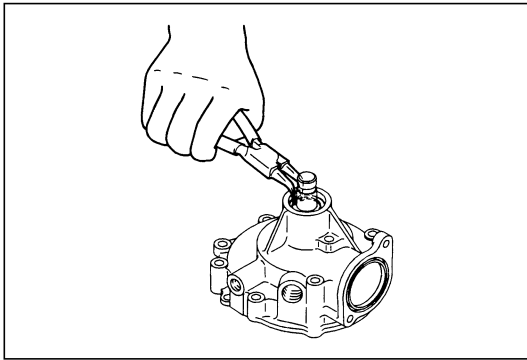
NOTICE

Press until the bearing upper end surface comes into contact with the retainer ring groove lower end surface.



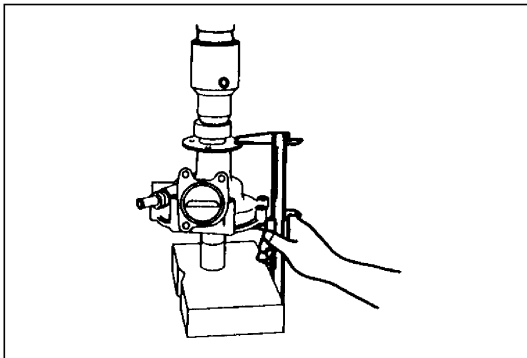
SAPH011060600010

- (2) Install the retainer ring onto the pump case using snap ring pliers.



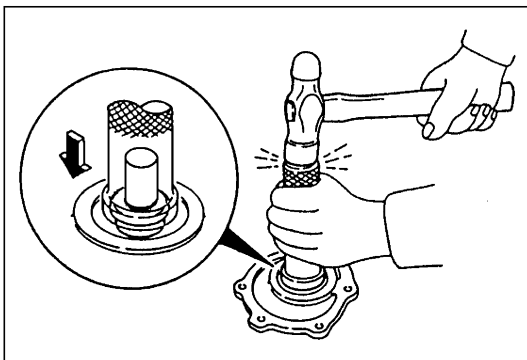
SAPH011060600011

- (3) Install the pulley center onto the shaft using a hydraulic press.
Standard: 149.7 - 150.5 mm {5.894 - 5.925 in.} from the pulley center mounting surface to the pump case end surface

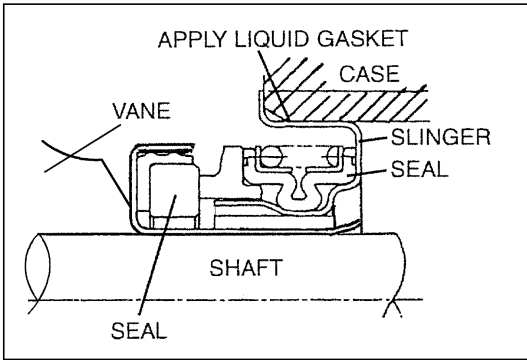


SAPH011060600012

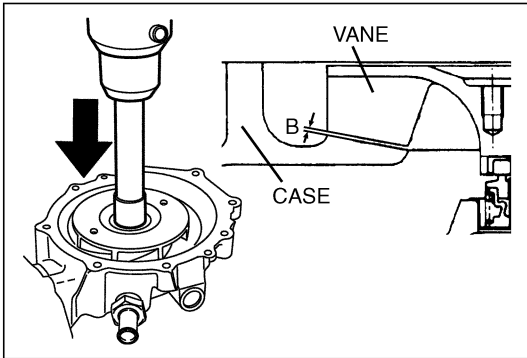
- (4) Install the new coolant seal.
 a. Apply liquid gasket (Three Bond #1104 or equivalent) to the seal outer circumference and case bore.
 b. Install the slinger and seal to the case using a press.
SST: Press (S0948-22060)



SAPH011060600013



SAPH011060600014



SAPH011060600015

c. Install the seal to the vane.

NOTICE

Replace the coolant seal with new one.

(5) Install the vane onto the shaft using a hydraulic press.

Assembly standard (B): 0.6-1.2 mm {0.0237-0.0472 in.}

NOTICE

Press until the vane end face comes into contact with the shaft end surface.

(6) After assembly, turn the shaft by hand and make sure that there is no noise, catching or rough movement in the shaft direction and that it rotates smoothly.

INSPECTION AND REPAIR

EN0110606H300001

Unit: mm {in.}

Inspection item	Standard	Limit	Remedy	Inspection procedure
Wear, damage and corrosion	—	—	Replace parts.	Visual check
Tightness of shaft and vane	0.015-0.048 {0.0006-0.0018}	—	Replace shaft and/or vane.	Measure
Tightness of shaft and pulley center	0.017-0.051 {0.0007-0.0020}	—	Replace shaft and/or pulley center.	Measure

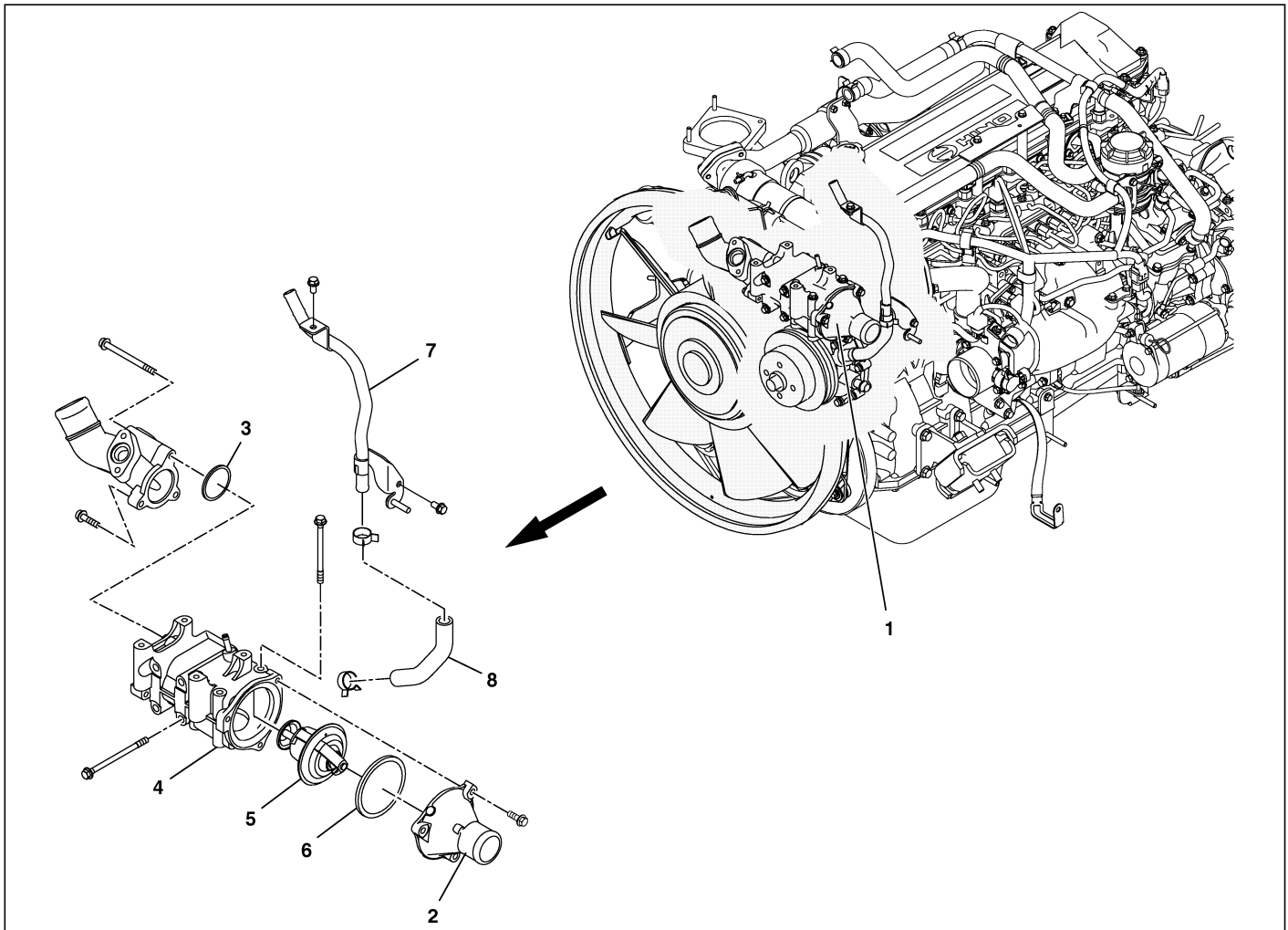
NOTICE

- Tightness= Outside diameter - Inside diameter
- Prevent reassembly more than three times even if it is within the standard value.

THERMOSTAT

COMPONENT LOCATOR

EN0110606D10002



SAPH011060600019

1	Thermostat case assembly	5	Thermostat
2	Thermostat case cover	6	Gasket
3	O-ring	7	Heater pipe
4	Thermostat case	8	Heater hose

OVERHAUL

EN0110606H200002

IMPORTANT POINTS - INSPECTION AND REPAIR

1. INSPECT THE THERMOSTAT FUNCTION.

- (1) Place the thermostat in hot water and check the valve opening temperature and the valve lift.

Thermostat valve opening temperature:

Thermostat valve opening temperature. (T_1)	Service standard
82°C {180°F}	80-84°C {176-183°F}

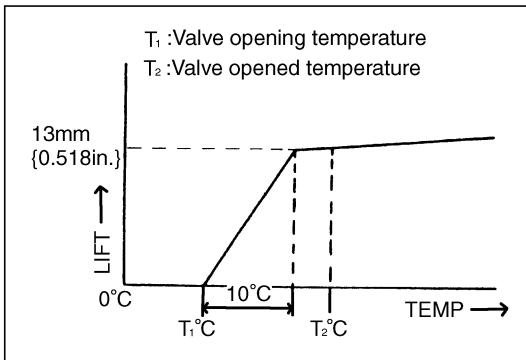
NOTICE

Check that the thermostat valve opening temperature (T_1) is engraved on the thermostat seat.

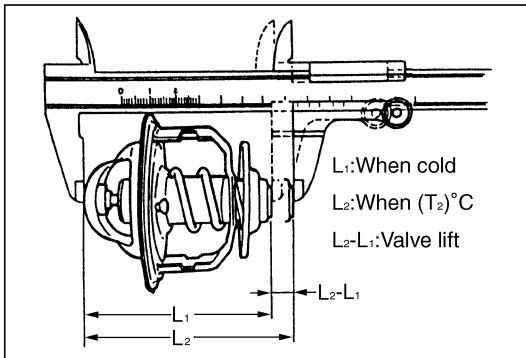
Thermostat valve lift:

Thermostat valve opening temp. (T_1)	Measuring temp. (T_2)	Valve lift (L_2-L_1)
82°C {180°F}	95°C {203°F}	13 mm {0.512 in.} or more

- (2) Immerse the opened thermostat in water at normal temperature. If it completely closes within 5 minutes, it is satisfactory. If it remains slightly open, it is defective and must be replaced.



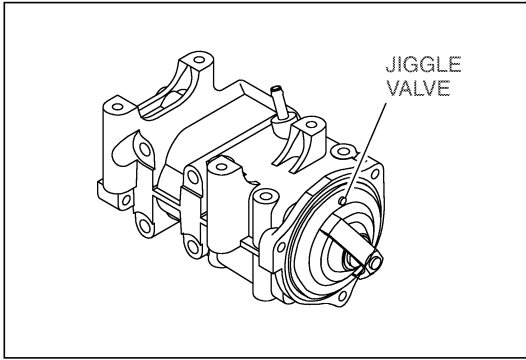
SAPH011060600020



SAPH011060600021

IMPORTANT POINTS - ASSEMBLY**1. ASSEMBLE THE THERMOSTAT CASE.****NOTICE**

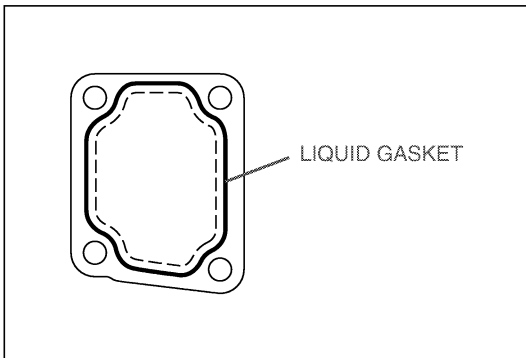
- Remove water or dirt adhering to the thermostat case.
- Be sure to replace the gasket if it is corroded, damaged or flattened.
- Before installing the hose, apply liquid gasket to the hose installation part of the thermostat case cover.
- To prevent clogging of the radiator, do not use a large amount of liquid gasket.
- Be sure that the jiggle valve faces upward when installing it.



SAPH011060600022

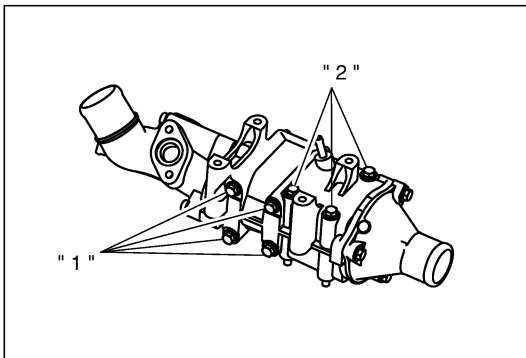
IMPORTANT POINTS - MOUNTING**1. INSTALL THE THERMOSTAT CASE ASSEMBLY.**

- (1) Apply liquid gasket to the thermostat case.
- (2) Install the o-ring into the groove of the coolant pump.



SAPH011060600023

- (3) Temporarily tighten the bolts "1" and bolts "2" in that order, and securely contact the fitting surface.
- (4) Tighten the bolts in numeral order.



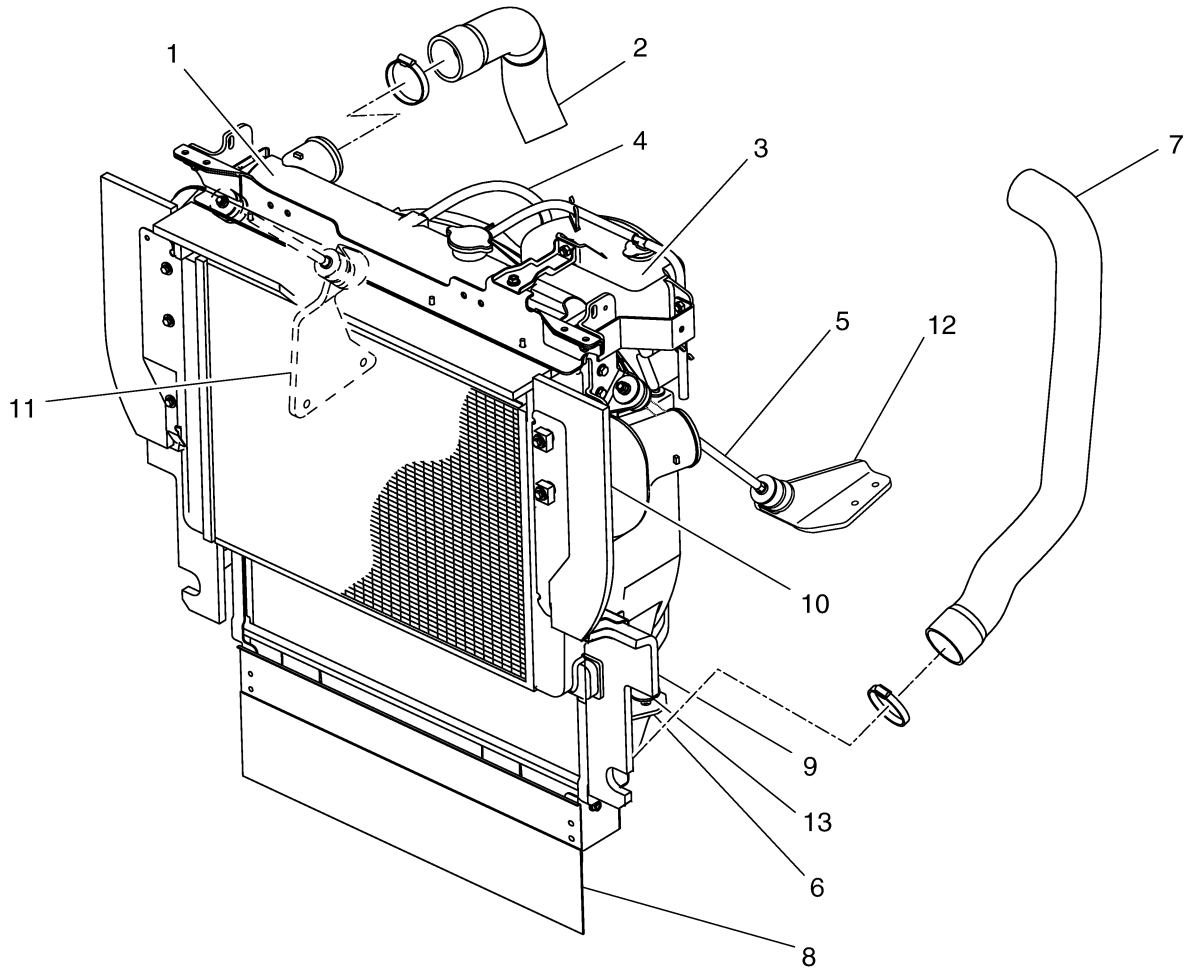
SAPH011060600024

RADIATOR AND INTERCOOLER

COMPONENT LOCATOR

EN0110606D10003

EXAMPLE



SAPH011060600025

1	Radiator complete	8	Baffle plate assy
2	Inlet hose	9	Baffle plate assy
3	Reservoir tank	10	Baffle plate assy
4	Hose	11	Bracket
5	Radiator stay assy	12	Bracket
6	Bracket	13	Cushion
7	Outlet hose		

OVERHAUL

EN0110606H200003

IMPORTANT POINTS - DISMOUNTING

1. DISMOUNT THE RADIATOR.

⚠ WARNING

Do not drain the coolant while the engine and radiator are still hot to avoid burns and scalds.

NOTICE

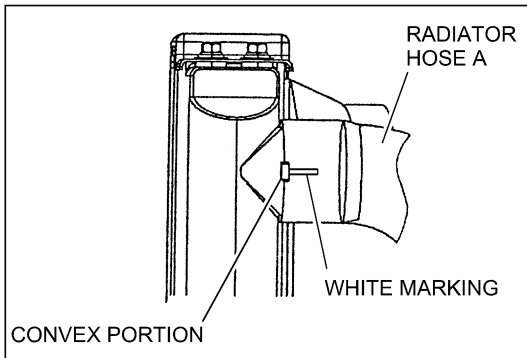
When dismantling and mounting the radiator, do not damage the radiator core.

IMPORTANT POINTS - MOUNTING

1. INSTALL THE RADIATOR HOSE A.

NOTICE

- Install the radiator hose against the convex portion of the radiator.
- Match the white mark of the radiator hose and match mark (convex portion) of the radiator.

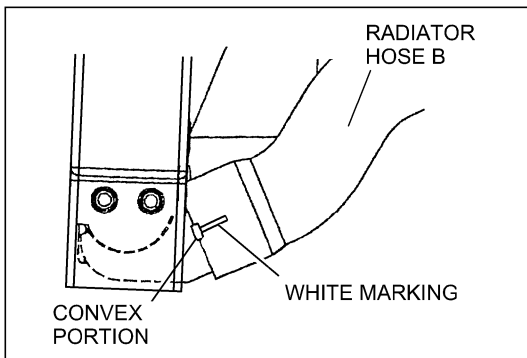


SAPH011060600026

2. INSTALL THE RADIATOR HOSE B.

NOTICE

- Install the radiator hose against the convex portion of the radiator.
- Match the white mark of the radiator hose and match mark (convex portion) of the radiator.



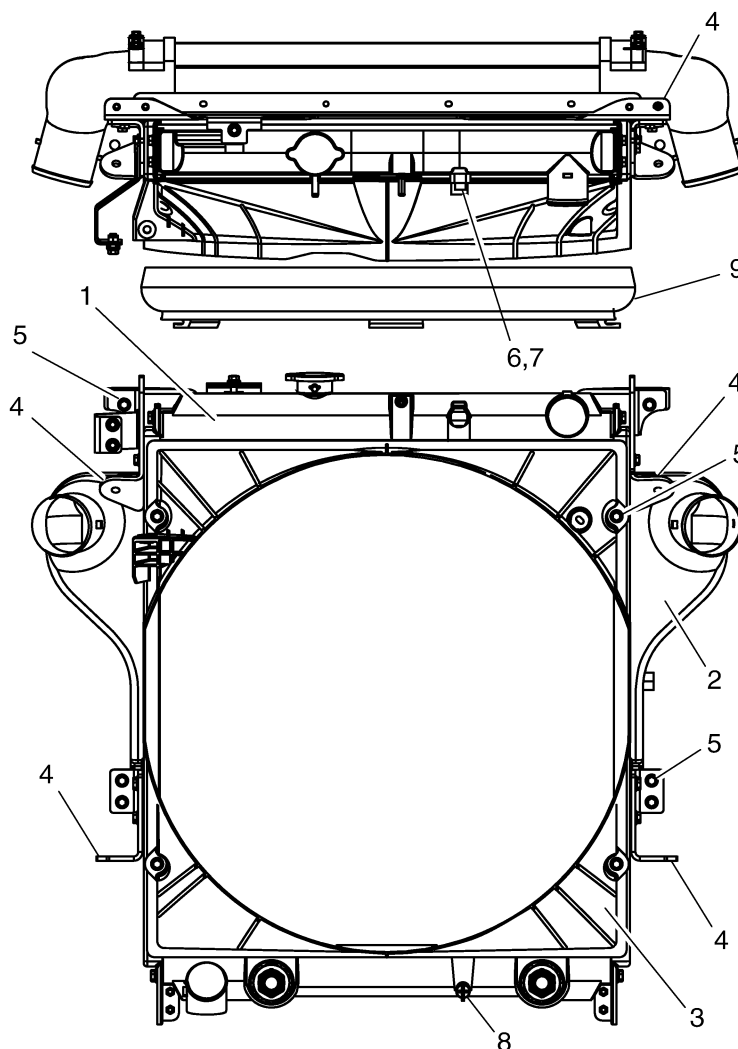
SAPH011060600027

RADIATOR

COMPONENT LOCATOR

EN0110606D100004

EXAMPLE



SAPH011060600028

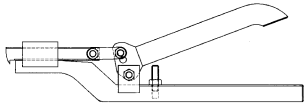
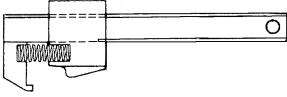
- 1 Radiator assy
- 2 Intercooler assy
- 3 Fan shroud
- 4 Bracket
- 5 Bolt

- 6 Sensor
- 7 Packing
- 8 Drain plug
- 9 Seal

SPECIAL TOOL

EN0110606K100002

Prior to starting an engine overhaul, it is necessary to have these special tools.

Illustration	Part number	Tool name	Remarks
	S0976-01030	RADIATOR TOOL	TOOL FOR UNCAULKING
	S0976-01040	RADIATOR TOOL	TOOL FOR CAULKING (USED WITH S0976-01030)

OVERHAUL

EN0110606H200004

IMPORTANT POINTS - DISMOUNTING

1. DISMOUNT THE RADIATOR.

⚠ WARNING

Do not drain the coolant while the engine and radiator are still hot to avoid burns and scalds.

NOTICE

When dismantling and mounting the radiator, do not damage the radiator core.

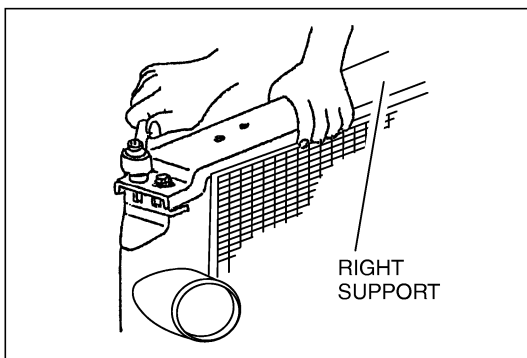
IMPORTANT POINTS - DISASSEMBLY

NOTICE

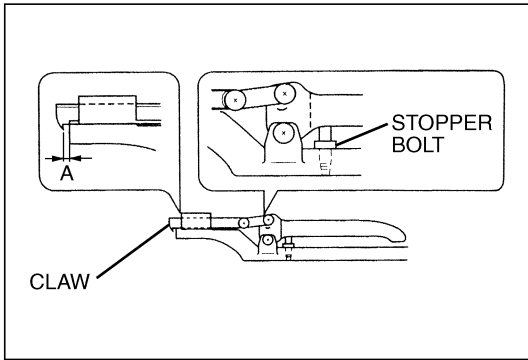
Recaulking should be limited to twice.

1. DISASSEMBLE THE UPPER TANK, LOWER TANK AND RADIATOR CORE.

- (1) Remove the left support and right support.



SAPH011060600031



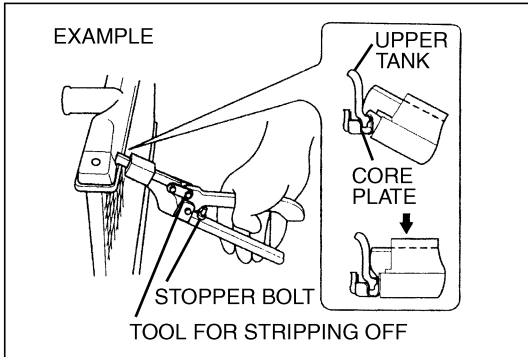
SAPH011060600032

- (2) Grip the handle until it hits to the stopper bolt, then adjust the dimensions A with stopper bolt.

Dimension A: 0.2-0.3 mm {0.0079-0.0118 in.}
SST: Radiator (S0976-01030)

NOTICE

Be sure to adjust the dimension to prevent damage of the claw.

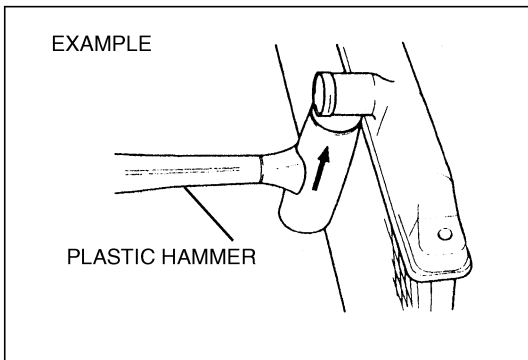


SAPH011060600033

- (3) Using a special tool, lift the staked part.

NOTICE

Do not lift up tangs more than 90°.

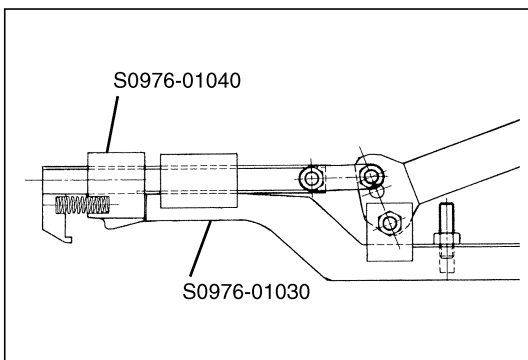


SAPH011060600034

- (4) Remove the upper tank and lower tank from the radiator core by tapping lightly with plastic hammer.

NOTICE

Do not remove the tank by forcing or prying.



SAPH011060600035

IMPORTANT POINTS - ASSEMBLY

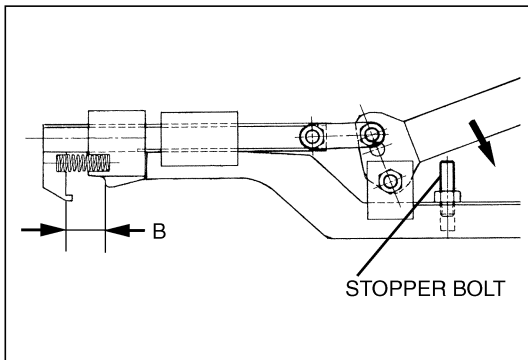
- 1. ASSEMBLE THE UPPER TANK, LOWER TANK AND RADIATOR CORE.**

- (1) Exchange the crow of the radiator tool (S0976-01030) for the radiator tool (S0976-01040) as shown in the figure.

SST:

Radiator tool (S0976-01030)

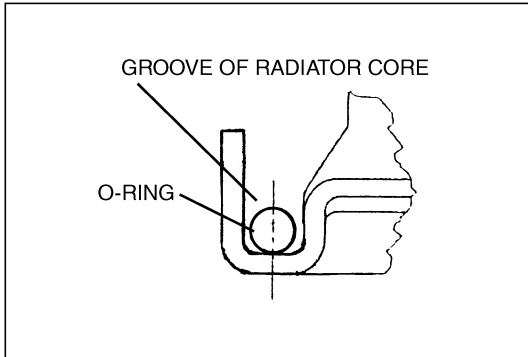
Radiator tool (S0976-01040)



SAPH011060600036

- (2) Grip the handle of the radiator tool until it hits the stopper bolt, then adjust the dimension B with stopper bolt.

Dimension B: 8.4 mm {0.3307 in.}



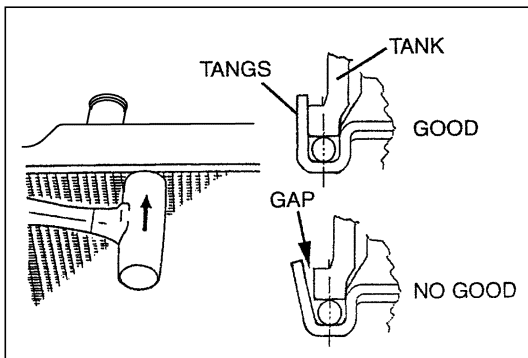
SAPH011060600037

- (3) Install the new O-ring into the groove of the radiator core (upper and lower) in such a way that it will not be twisted.

NOTICE

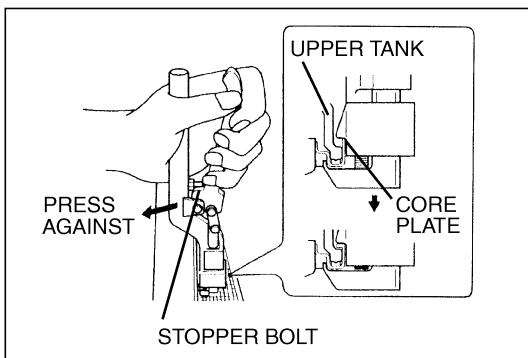
Be sure to clean the fitting portion before installing. When cleaning, lightly rub the inside portion of the groove with the emery paper.

- (4) Install the upper tank and lower tank into the groove of the radiator core.



SAPH011060600038

- (5) Tap the tangs to obtain a tight contact with the upper tank and lower tank.

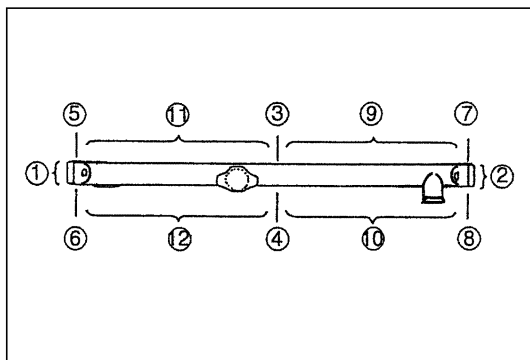


SAPH011060600039

- (6) Press the radiator tool (caulking tool) against the side portion. Temporarily caulk the tangs several times, then proceed to the final caulking by gripping the handle until it hits the stopper bolt.

NOTICE

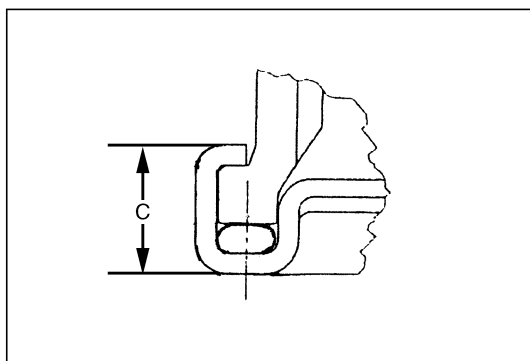
For the positions where the radiator tool is not usable, perform the caulking with pliers.



SAPH011060600040

NOTICE

Perform the caulking according to the sequence as shown in the figure.



SAPH011060600041

- (7) Check the dimension C.

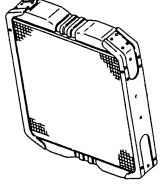
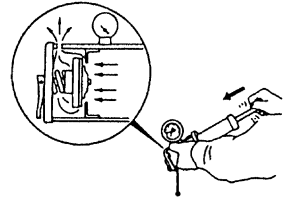
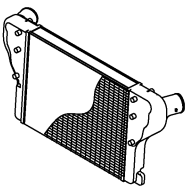
Assembly standard: 7.27-7.85 mm {0.2863-0.3090 in.}

If the dimension is out of the standard value, adjust the stopper bolt of the handle once again and perform the caulking again.

INSPECTION AND REPAIR

EN0110606H300002

Unit: MPa{kgf/cm², lbf/in.²}

Inspection item		Standard	Limit	Remedy	Inspection procedure
Air leakage (When the air pressure of 100 {1,14} is applied.)		—	—	Replace radiator.	Visual check 
Clogging of the fins		—	—	Clean.	
Radiator cap valve opening pressure	Mark 0.5	40-58 {0.4-0.6, 5.7-8.5}	—	Replace.	Measure 
Intercooler <ul style="list-style-type: none"> Air leakage test (when the air pressure of 490 {5.0, 71} is applied.) Clogging of the fins 		0 mL	—	Replace the inter-cooler.	
		—	—		

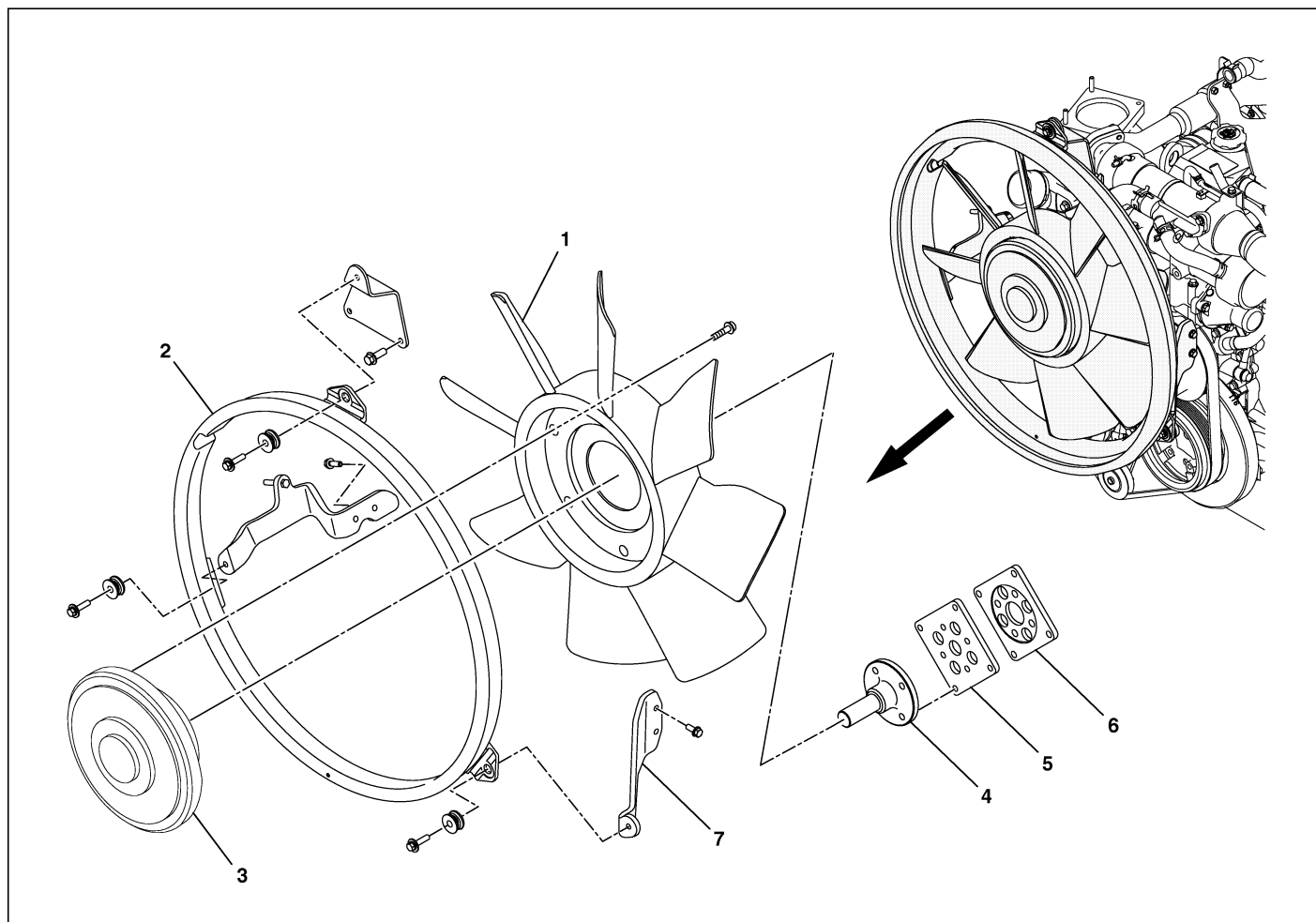
NOTICE

- The coolant filler cap valve opening pressure is indicated on the cap and it should be confirmed. If the cap pressure is incorrect, there is a risk of abnormally high pressure being generated in the cooling system, which may cause the hose to drop off or burst and may result in the damage of the engine.
- When carrying out high pressure washing to remove fin clogging, do not apply excessive pressure to the fins which may cause deformation and consequent performance deterioration.

COOLING FAN

COMPONENT LOCATOR

EN0110606D10005



SAPH011060600045

1	Cooling fan	5	Spacer
2	Fan ring	6	Spacer
3	Fan clutch	7	Bracket
4	Fan pulley shaft		

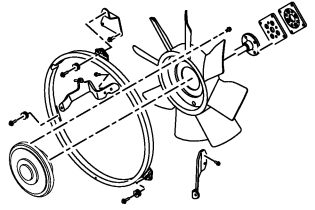
NOTICE

- **Shock to the fan clutch and fan.**
During maintenance and inspection, be careful not to drop or strike the fan clutch or fan itself. The resulting damage may lower the performance of the fan. Also, note that the fan is made of plastic and may become damaged or deformed if force is applied to it.
- **Replace the fan.**
Do not replace the fan unless it is faulty. When replacing the fan, replace with the same type. If the fan is replaced with one of a larger capacity because of overheating or, conversely is replaced with one of a smaller capacity due to overcooling, the performance may in fact be reduced and durability may be jeopardized.
- **Other items**
Check the bimetal to see if there is any mud or dust on it. If the bimetal is covered with mud or dust, the fan performance will be erratic, and may result in overheating or overcooling. In such case, carefully remove mud and dust adhering to the surface of the bimetal, using a wire brush, or the like.
Take particular care not to apply excessive force.
Do not paint the fan or fan clutch. Do not place any paint or other reagents which are likely to dissolve plastic in contact with the fan.

INSPECTION AND REPAIR

EN0110606H300003

Unit: mm {in.}

Inspection item	Standard	Limit	Remedy	Inspection procedure
Cooling fan and fan clutch deformation and damage	—	—	Replace if necessary.	Visual check 

FUEL SYSTEM (J08E)

EN07-001

FUEL SYSTEM.....EN07-2

DIAGRAM EN07-2

COMPONENT LOCATOR..... EN07-3

SUPPLY PUMPEN07-4

DESCRIPTION EN07-4

COMPONENT LOCATOR..... EN07-5

SPECIAL TOOL EN07-5

OVERHAUL EN07-6

COMMON RAIL.....EN07-9

DESCRIPTION EN07-9

OVERHAUL EN07-10

INJECTOR.....EN07-15

DESCRIPTION EN07-15

OVERHAUL EN07-16

FUEL FILTEREN07-20

DESCRIPTION EN07-20

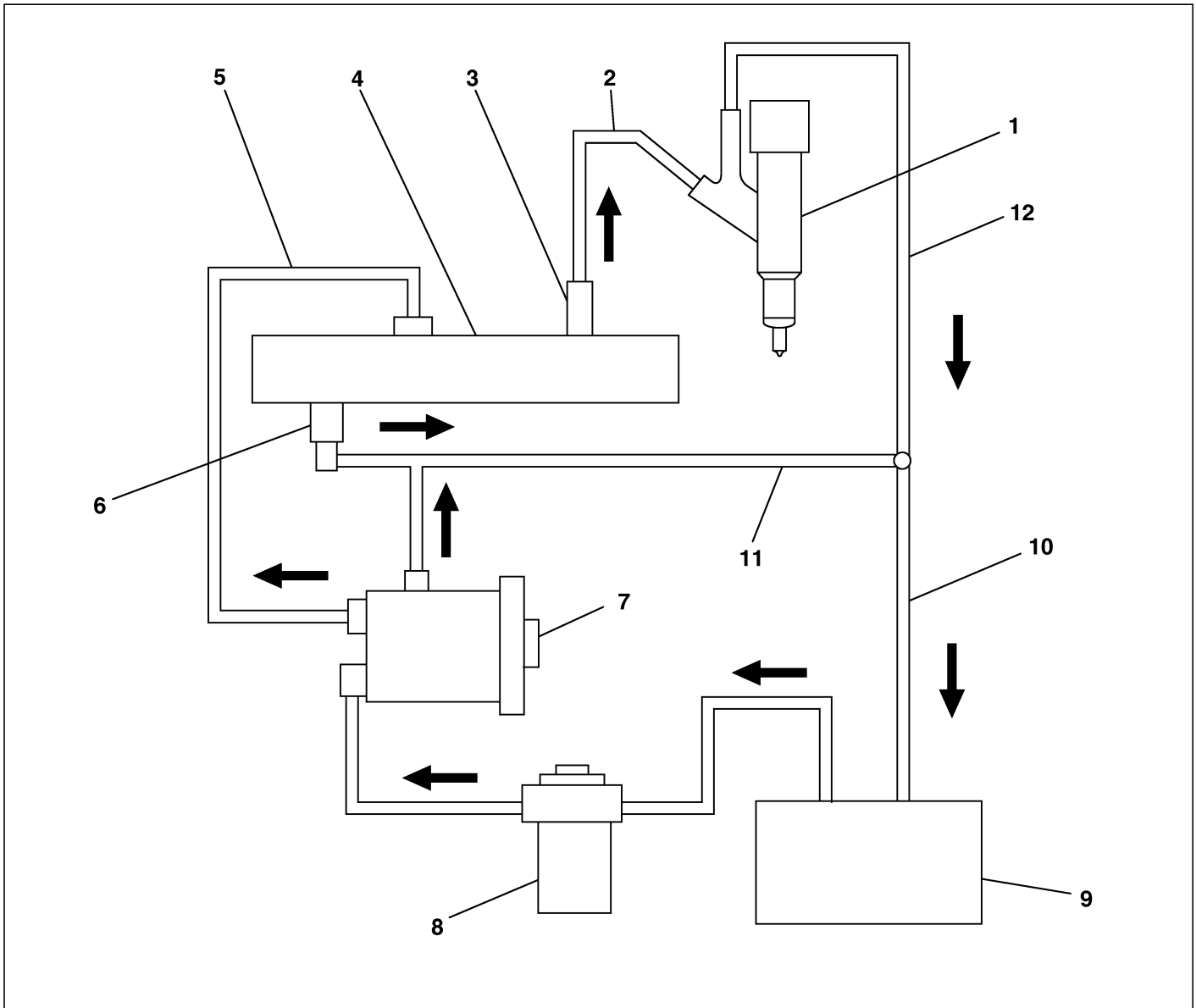
FUEL TANK.....EN07-22

COMPONENT LOCATOR..... EN07-22

FUEL SYSTEM

DIAGRAM

EN0110607J100001

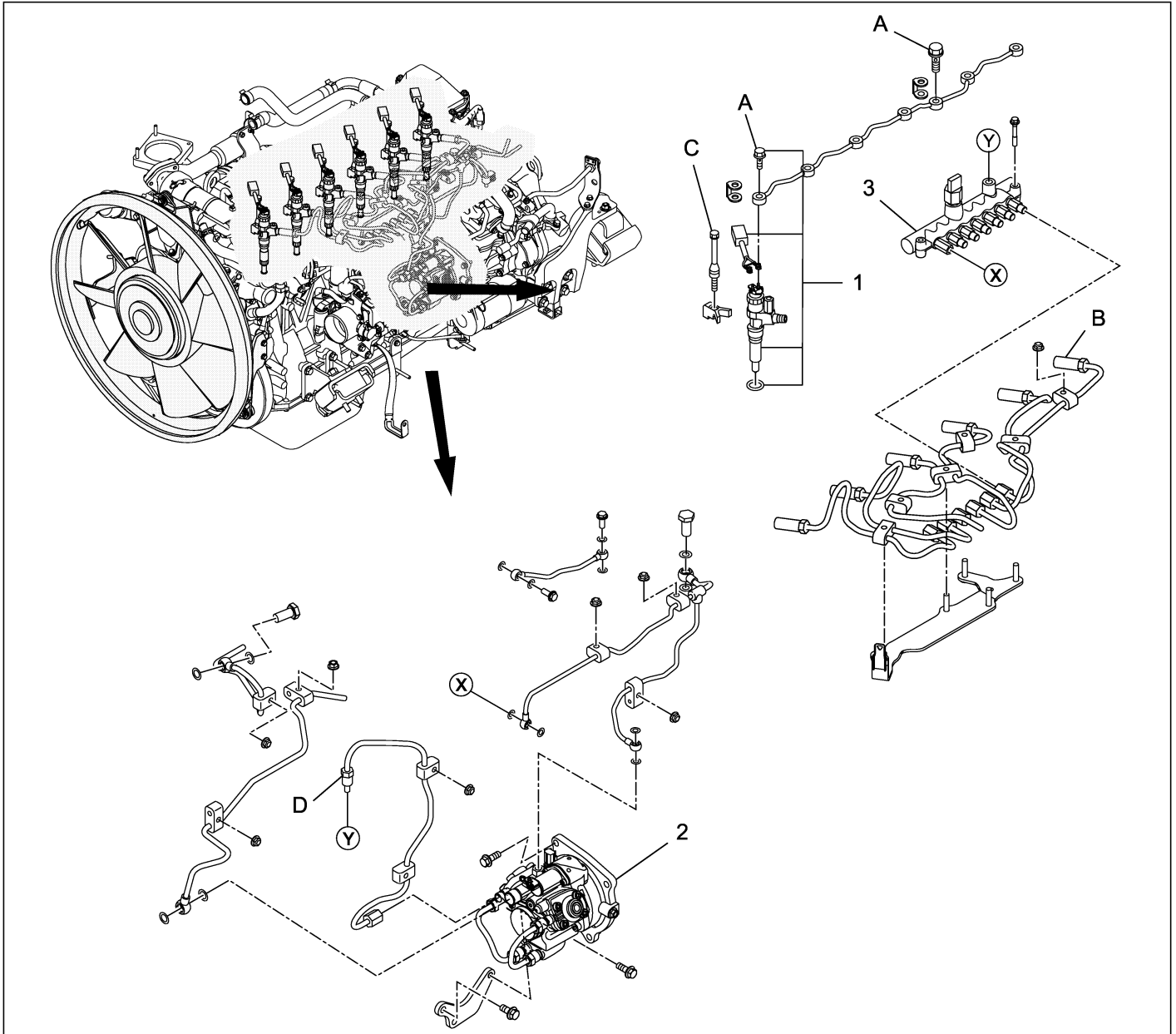


SAPH011060700001

1	Injector	7	Supply pump
2	Injection pipe	8	Fuel filter
3	Flow damper	9	Fuel tank
4	Common rail	10	Through feed pipe
5	Force feed pipe	11	Overflow pipe
6	Pressure limiter	12	Leakage pipe

COMPONENT LOCATOR

EN0110607C100001



SAPH011060700002

1	Injector	3	Common rail
2	Supply pump		

Tightening torque

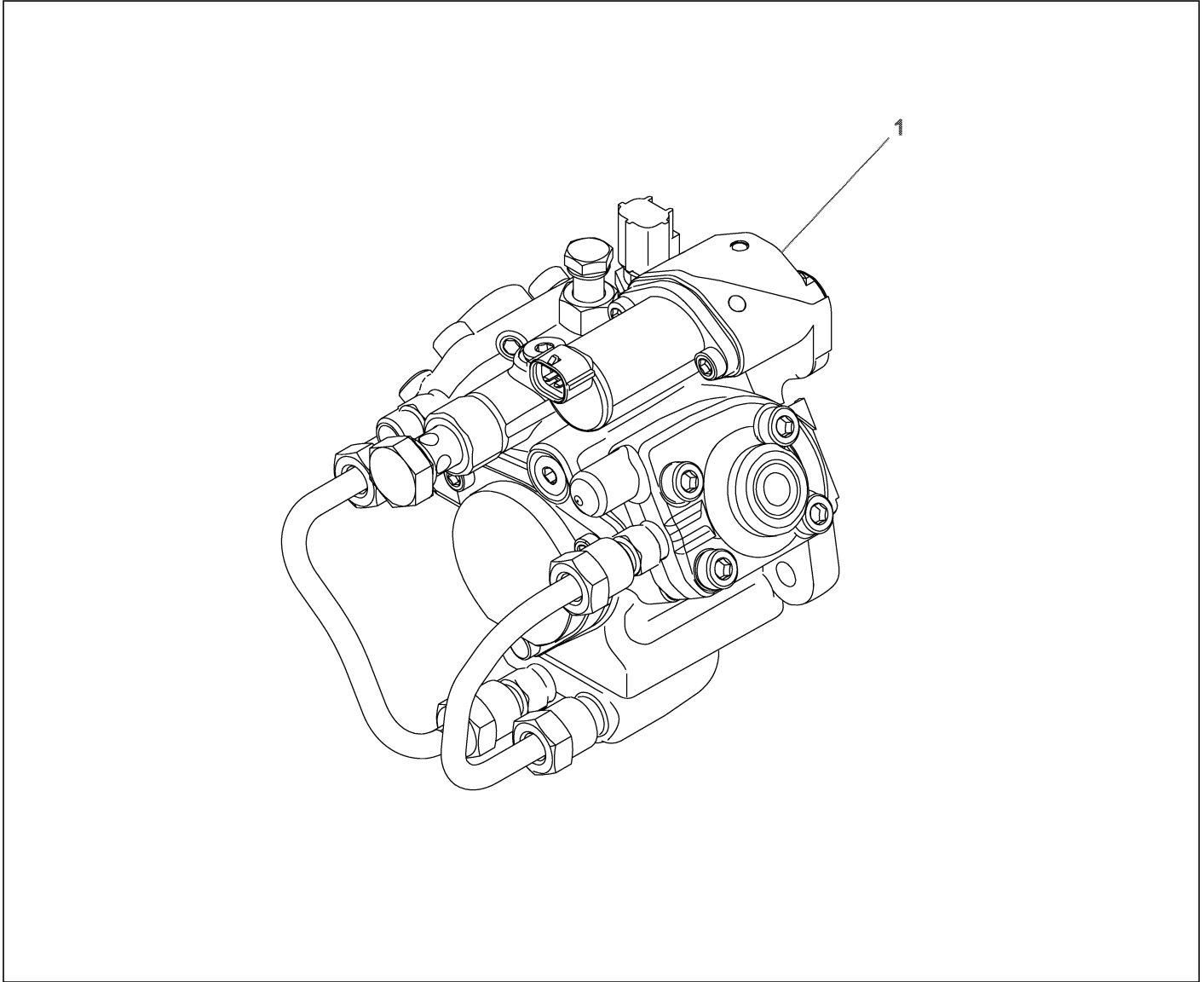
Unit: N·m {kgf·cm, lbf·ft}

A	12.7 {130, 9}	C	25 {250, 18}
B	39.2-49 {400-499, 29-36}	D	49-58.8 {500-599, 37-43}

SUPPLY PUMP

DESCRIPTION

EN0110607J100002

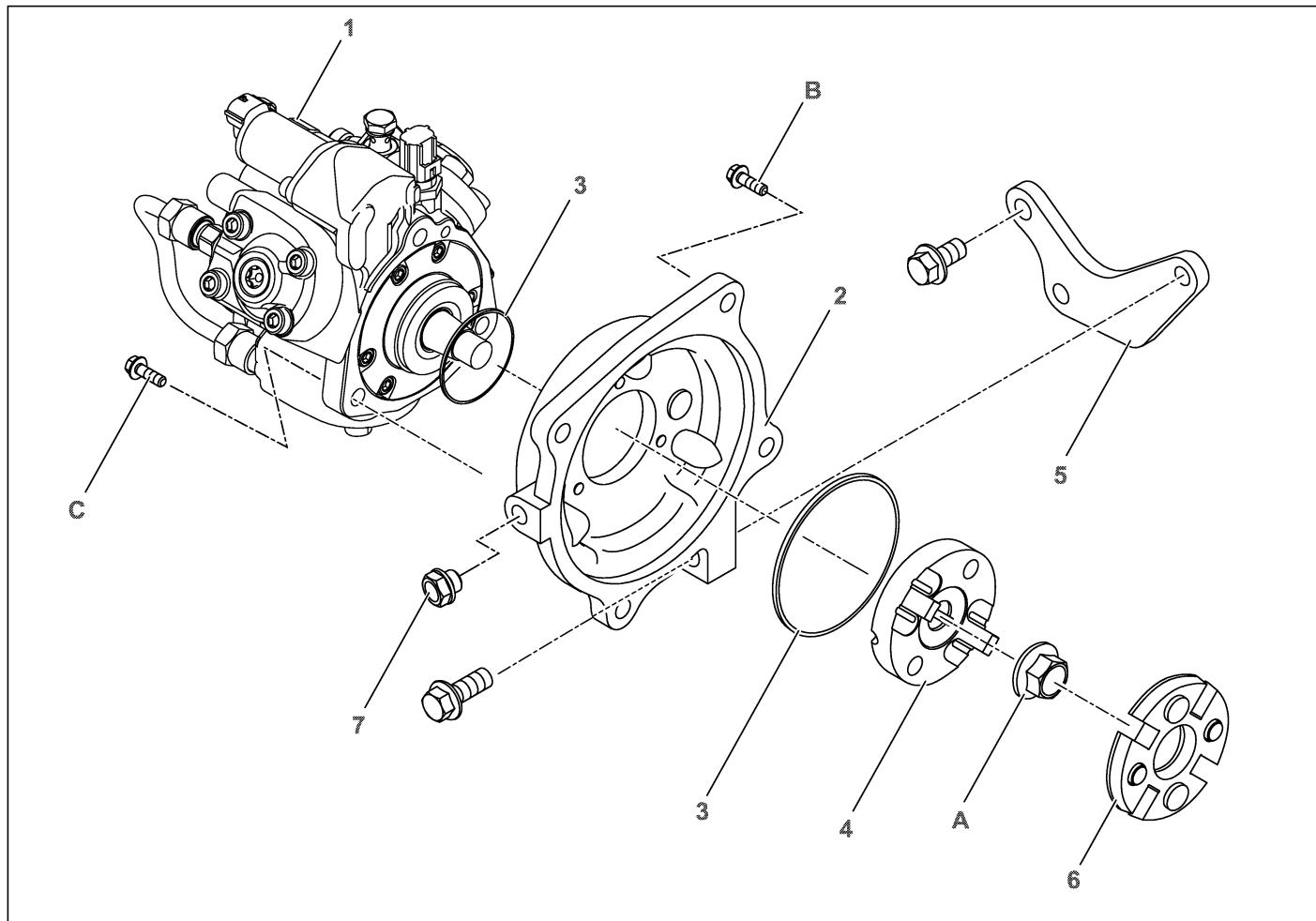


SAPH011060700003

1 Supply pump assembly	
-------------------------------	--

COMPONENT LOCATOR

EN0110607C100002



SAPH011060700004

1	Supply pump assy	5	Bracket
2	Bearing holder case	6	Coupling assy
3	O-ring	7	Plug
4	Coupling flange		

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A	64.3 {656, 47}	C	28 {290, 21}
B	28.5 {290, 21}		

SPECIAL TOOL

EN0110607K100001

Prior to starting an engine overhaul, it is necessary to have this special tool.

Illustration	Part number	Tool name	Remarks
	SZ105-08067	GUIDE BOLT	

OVERHAUL

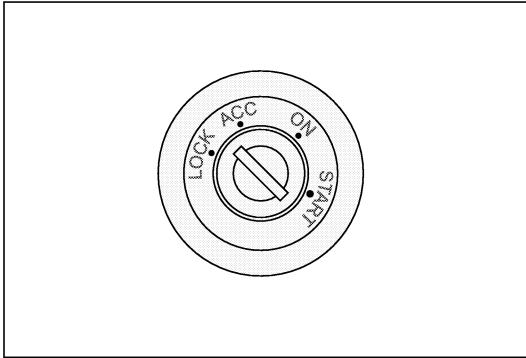
EN0110607H200001

IMPORTANT POINTS - DISMOUNTING

1. TURN THE STARTER SWITCH TO THE LOCK POSITION.

⚠ WARNING

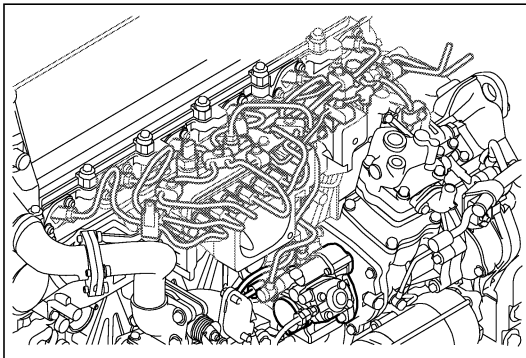
Perform the following work after the engine cools off to avoid fire or burning. The fuel in the common rail could have a high temperature (approx. 100°C {212°F}) immediately after driving.



SAPH011060700006

2. REMOVE THE FUEL SUPPLY PUMP.

- (1) Disconnect the fuel lines, oil lines and harness coupler.

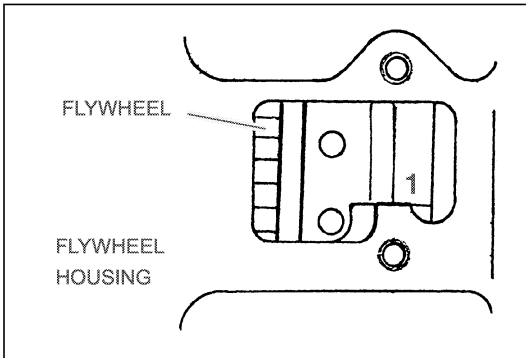


SAPH011060700007

- (2) Turn the flywheel clockwise in the engine direction and align the No.1 cylinder mark to the pointer in the flywheel housing inspection opening.

NOTICE

Refer to **ENGINE TUNEUP** of **CHAPTER ENGINE INTRODUCTION**.

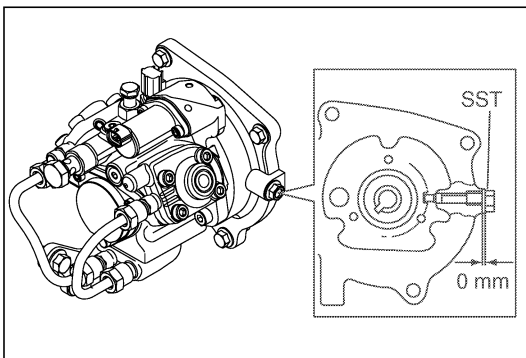


SAPH011060700008

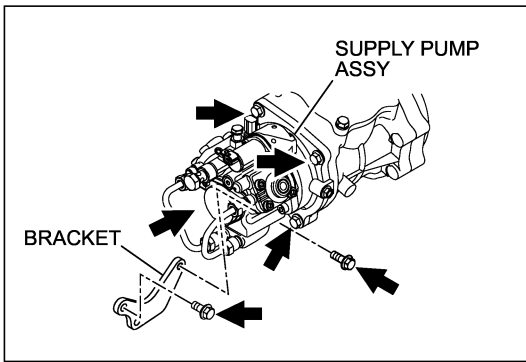
- (3) When the No.1 cylinder is at Top Dead Center of the compression stroke, the supply pump coupling SST can be fully inserted in to the bearing holder case plug opening.

Once certain that the SST can be inserted to the required 0 mm, proceed to the removal of the supply pump assy.

SST: Guide bolt (SZ105-08067)



SAPH011060700009

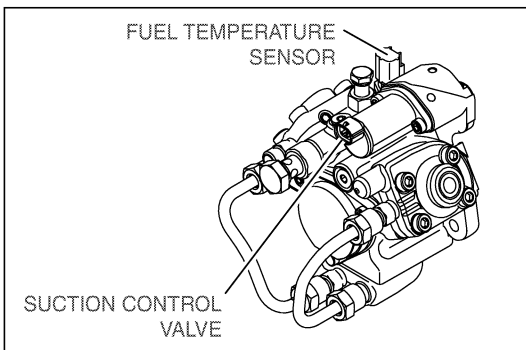


SAPH011060700010

- (4) Remove the two bolts on the front bracket of the supply pump.
- (5) Remove the four bolts on the front and the single bolt on the side of the supply pump.
- (6) Remove the supply pump with the bearing holder case from the air compressor or pump drive shaft.
- (7) Remove the flange coupling
- (8) Remove the 3 bolts
- (9) Remove the supply pump from the bearing holder case.

NOTICE

After dismantling the pump, cover the pump and high pressure pipe to prevent entry of dirt.



SAPH011060700011

IMPORTANT POINTS - ON - VEHICLE INSPECTION**1. INSPECT THE SUCTION CONTROL VALVE (SCV) AND FUEL TEMPERATURE SENSOR.**

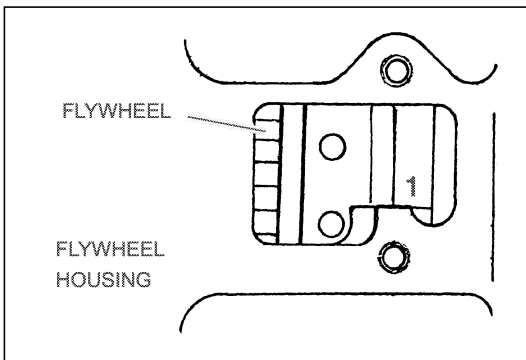
- (1) Measure the resistance between terminals.
If not standard value, replace supply pump assembly.

Standard:

SCV	1.6 - 2.6 Ω at 20°C {68°F}
Fuel temperature sensor	2.45 kΩ at 20°C {68°F}
	1.15 kΩ at 40°C {104°F}
	584 Ω at 60°C {140°F}
	318 Ω at 80°C {176°F}

NOTICE

If SCV and fuel temperature sensor need replacements, they should be serviced by Denso service dealer.



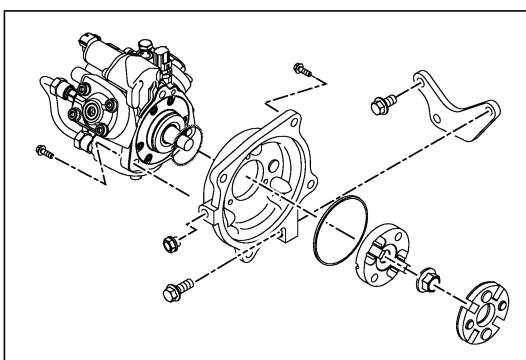
SAPH011060700012

IMPORTANT POINTS - MOUNTING**1. INSTALL THE FUEL SUPPLY PUMP.**

- (1) Turn the flywheel clockwise in the engine direction so the engraving of the cylinder is aligned with the pointer in the flywheel housing inspection opening.

NOTICE

- Refer to **ENGINE TUNEUP** of **CHAPTER ENGINE INTRODUCTION**.
- Make sure that the **No.1** cylinder is positioned at the top dead center point of the compression stroke.



SAPH011060700013

- (2) Install the O-ring to the supply pump.
- (3) Install the supply pump with 3 bolts to the bearing holder case.

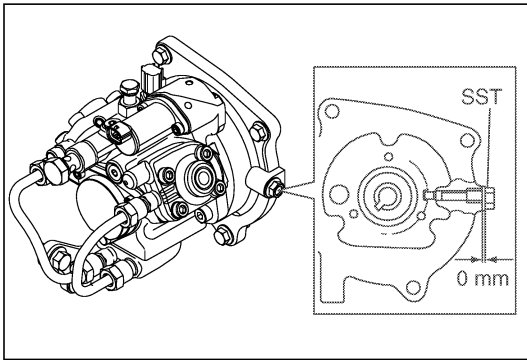
Tightening Torque:

28.5 N·m {290 kgf·cm, 21 lbf·ft}

- (4) Install the coupling flange to the supply pump.

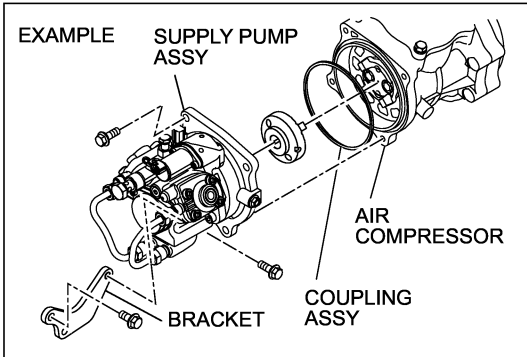
Tightening Torque:

64.3 N·m {656 kgf·cm, 47 lbf·ft}



SAPH011060700014

- (5) Insert the SST (guide bolt) through the plug hole of the bearing holder case as shown in the figure and fix the direction of the coupling flange by matching the SST with the groove of the coupling flange.
SST: Guide bolt (SZ105-08067)



SAPH011060700015

- (6) Install the O-ring, coupling assy and the supply pump.

NOTICE
Refer to **CHAPTER AIR COMPRESSOR**.

- a. Tighten the four bolts on the front and the single bolt on the side of the bearing holder case.

Tightening Torque:
28.5 N·m {290 kgf·cm, 21 lbf·ft}

- b. Tighten the two bolts on the bracket.

NOTICE

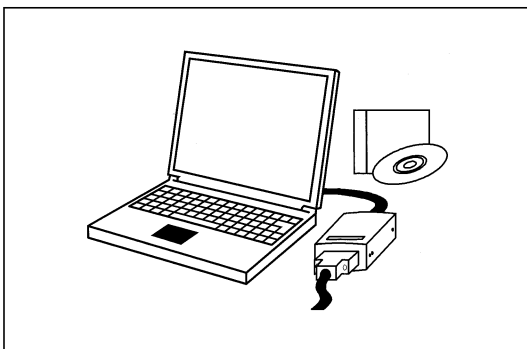
Once the bolts have been tightened to a point where the bracket is in contact with both the surface of the cylinder block and the surface of the bearing holder case, tighten fully by alternating between the bolts on either surface.

- (7) Remove the SST and install the plug.
(8) Connect the fuel lines, air lines and harness connectors.

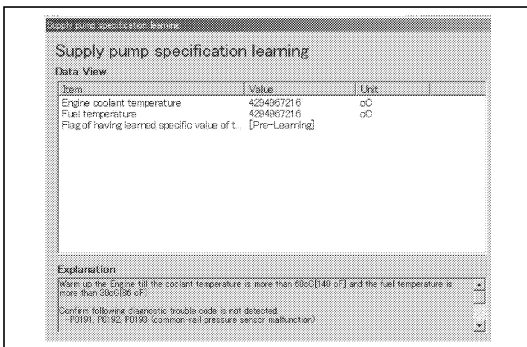
2. RESET THE ECU DEFAULT VALUE.

NOTICE

- It is necessary to reset the ECU default value using the diagnosis tool at the time of supply pump service replacement. In addition, the ECU has a function enabling it to learn the performance of the supply pump at the time of ECU service replacement, so ensure sufficient time (several minutes) is available.
- Diagnosis tool refer to chapter "FUEL CONTROL" on page DN02-18. ECU default value can be reset by "Supply pump specification learning" in the "Check function" menu.



SAPH011060700016

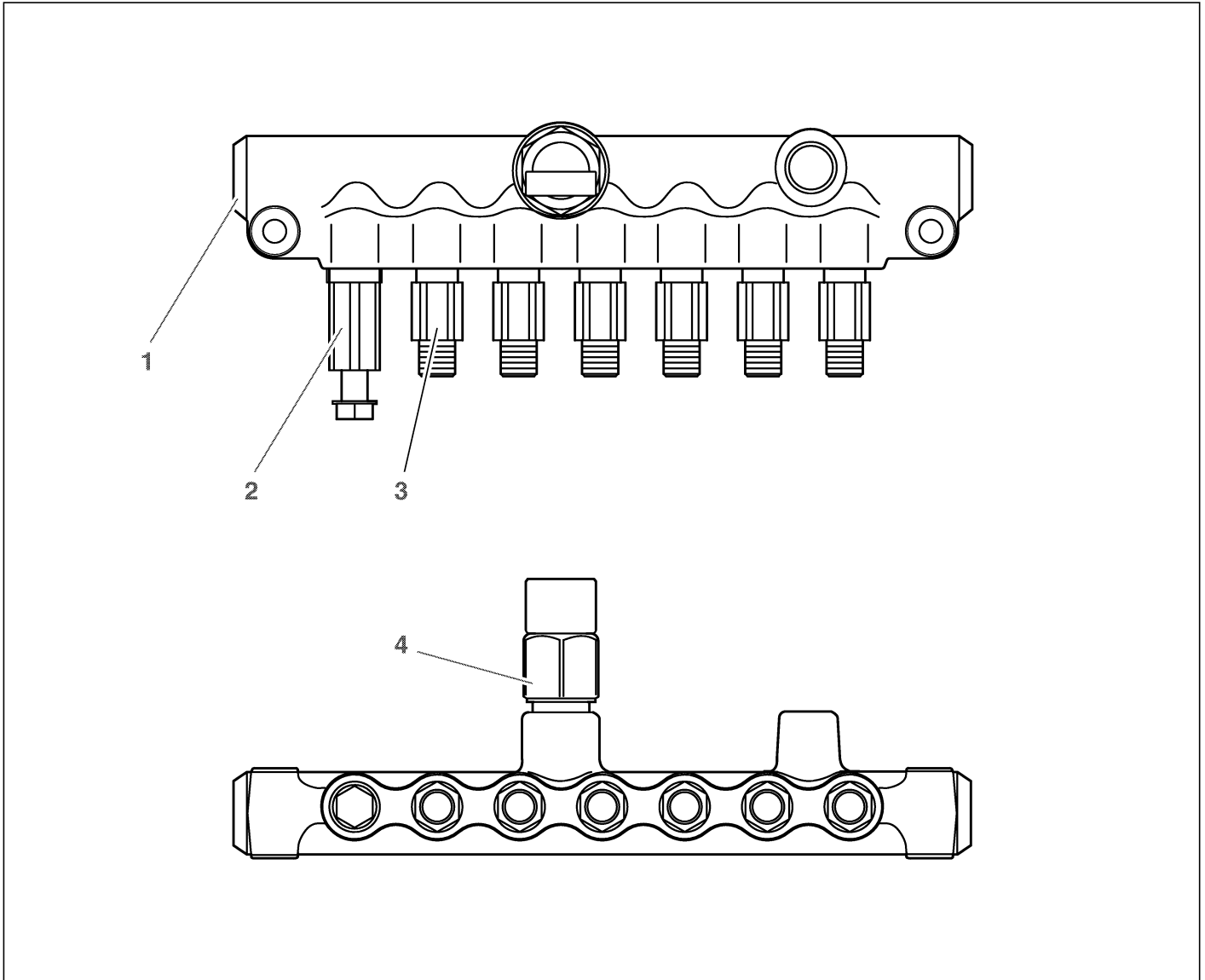


SAPH011060700017

COMMON RAIL

DESCRIPTION

EN0110607J100003



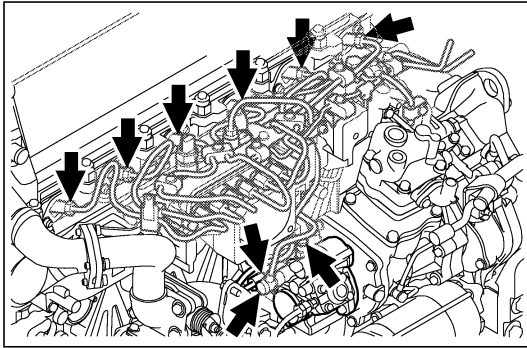
SAPH011060700018

1 Common rail
2 Pressure limiter

3 Flow damper
4 Pressure sensor

OVERHAUL

EN0110607H200002



SAPH011060700045

IMPORTANT POINTS - DISMOUNTING

1. CLEAN OFF SURROUNDING AREA OF THE NOZZLE AND THE FUEL LINE CONNECTORS.

NOTICE

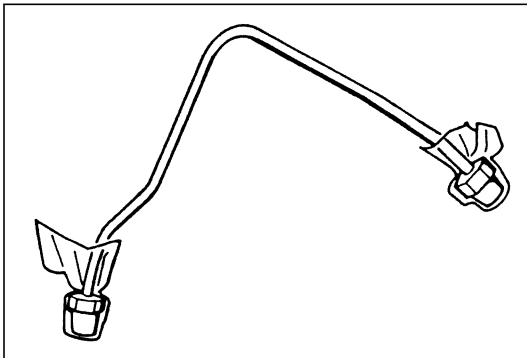
If foreign matter is allowed to enter the combustion chamber, engine trouble may result.

2. REMOVE THE FUEL INJECTION PIPE.

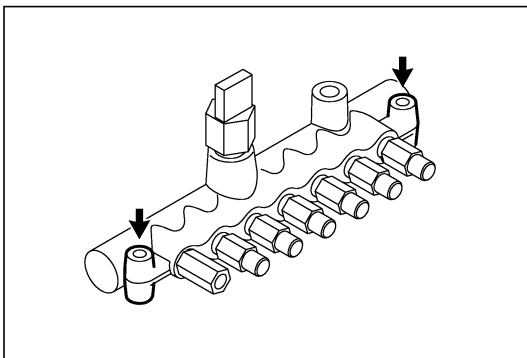
- (1) Remove the return pipe.
- (2) Loosen the injection pipe nut.
- (3) Remove the force feed pipe.

NOTICE

Cover open ends of the pipes and fuel supply pump to prevent entry of dirt.



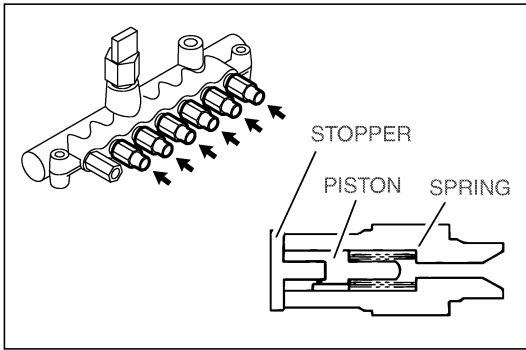
SAPH011060700020



SAPH011060700021

3. REMOVE THE COMMON RAIL.

- (1) Disconnect the connectors.
- (2) Remove the 2 bolts and common rail.



SAPH011060700022

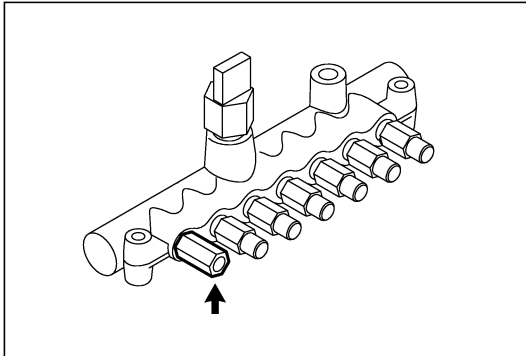
IMPORTANT POINTS - DISASSEMBLY

1. REMOVE THE FLOW DAMPER.

- (1) Using a 19 mm {0.749 in.} width across flats deep socket wrench, loosen the flow damper by turning in counter-clockwise direction.
- (2) Remove the flow damper assembly (spring, piston and stopper).

NOTICE

Be careful not to drop parts into common rail.



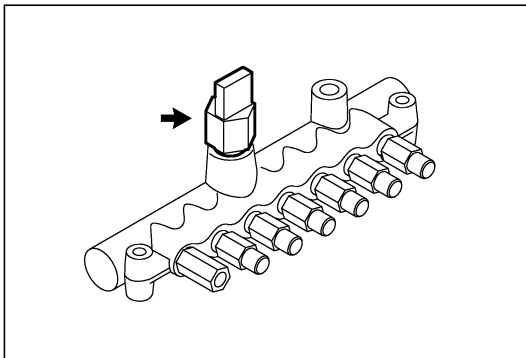
SAPH011060700023

2. REMOVE THE PRESSURE LIMITER.

- (1) Using a 19 mm {0.749 in.} width across flats deep socket wrench, loosen the pressure limiter by turning in counter-clockwise direction.
- (2) Remove the pressure limiter.
- (3) Using tweezers, remove the gasket.

NOTICE

Be careful not to damage the seal surface.



SAPH011060700024

3. REMOVE THE COMMON-RAIL PRESSURE SENSOR.

- (1) Using a 30 mm {1.181 in.} width across flats deep socket wrench, loosen the common-rail sensor by turning in counter-clockwise direction.
- (2) Remove the common-rail sensor.

NOTICE

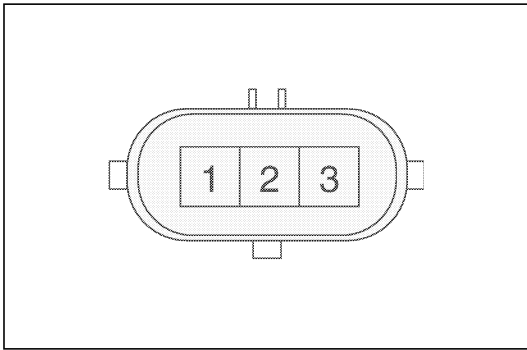
Never reuse a used common-rail pressure sensor.

Because if it is reused, its thread may break.

IMPORTANT POINT - ON - VEHICLE INSPECTION

1. INSPECT THE PRESSURE SENSOR.

- (1) If the diagnosis monitor lamp come on, and the following malfunction is displayed at the diagnosis system, replace the pressure sensor.
 - a. Harness disconnection or short-circuit in the pressure sensor circuit
 - b. Common rail pressure does not change at a certain time while the engine is running.

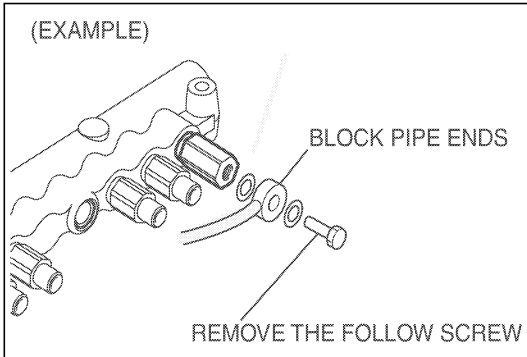


SAPH011060700025

- (2) Measure the resistance between terminals.
If not standard value, replace sensor.
Standard: (Engine stop condition)

Terminal 2 and 3
6.5 - 18.5 kΩ

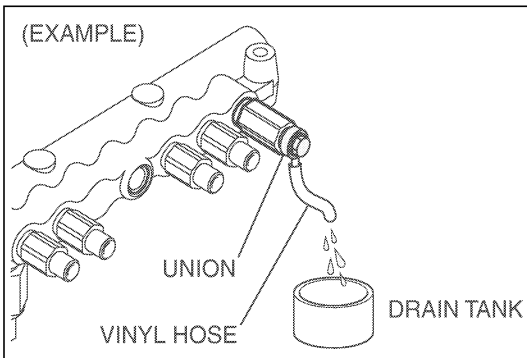
Terminal 1 and 2
0.5 - 3.0 kΩ



SAPH011060700026

2. INSPECT THE PRESSURE LIMITER.

- (1) Remove the follow screw from pressure limiter.
(2) Block pipe ends to prevent fuel leak.

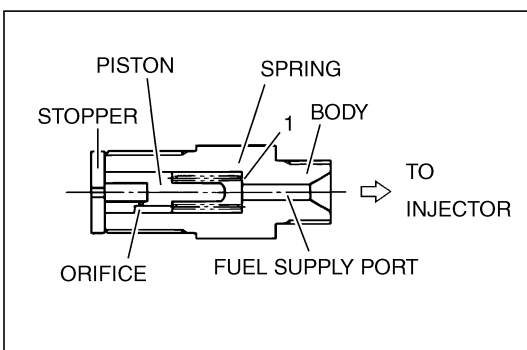


SAPH011060700027

- (3) Install the union to the pressure limiter.
(4) Set a vinyl hose to the union and set a drain tank.
(5) Start the engine. If the fuel flows continuously, replace the pressure limiter.

⚠ WARNING

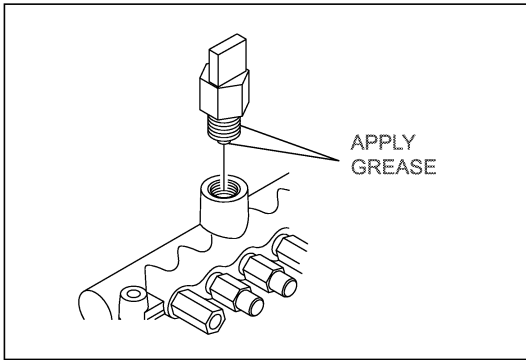
When the pressure limiter is working, fuel flows out at a high temperature and pressure. Serious injury like scalding could result from this hot fuel being blown out under pressure.



SAPH011060700028

3. INSPECT THE FLOW DAMPER.

- (1) Check that the piston is not sticking in the body. If the piston sticks, replace the flow damper.
(2) Inspect the contact surface 1 between piston and fuel supply port. If there is wear and damage, replace the flow damper assembly.
(3) Inspect clogging on the piston orifice. Clean or replace the flow damper assembly.



SAPH011060700029

IMPORTANT POINTS - ASSEMBLY

NOTICE

- Every part of the common rail should be washed clean carefully laying threaded side below.
- Be careful to prevent dust from entering inside.

1. INSTALL THE COMMON-RAIL PRESSURE SENSOR.

- (1) Install the new common-rail pressure sensor.

NOTICE

- Apply clean grease to the pressure sensor as shown in the figure.
- Be careful to prevent dust from entering inside.

- (2) Tighten the new pressure sensor.

Tightening Torque:

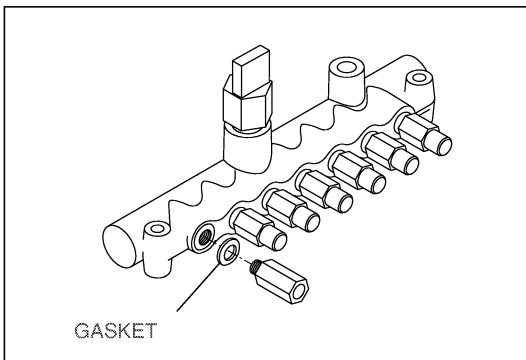
98 N·m {1,000 kgf·cm, 72 lbf·ft}

2. INSTALL THE PRESSURE LIMITER.

- (1) Install the pressure limiter with a new gasket.

Tightening Torque:

172 N·m {1,750 kgf·cm, 126 lbf·ft}



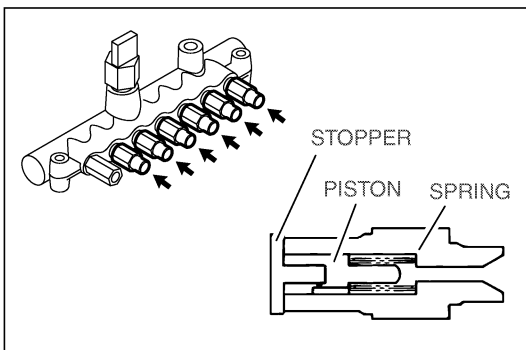
SAPH011060700030

3. INSTALL THE FLOW DAMPER.

- (1) Install the stopper.
- (2) Install the flow damper with the piston and spring.

Tightening Torque:

128 N·m {1,305 kgf·cm, 94 lbf·ft}



SAPH011060700031

IMPORTANT POINT - MOUNTING

1. INSTALL THE COMMON RAIL ASSY.

- (1) Install the common rail with 2 bolts.

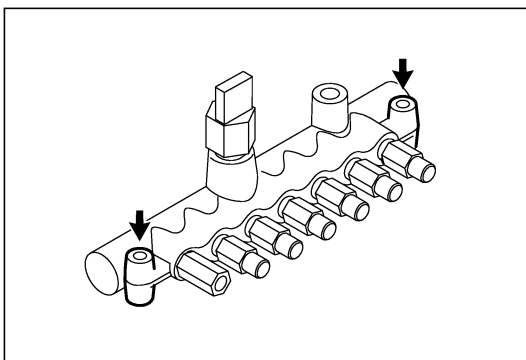
Tightening Torque:

28.5 N·m {290 kgf·cm, 21 lbf·ft}

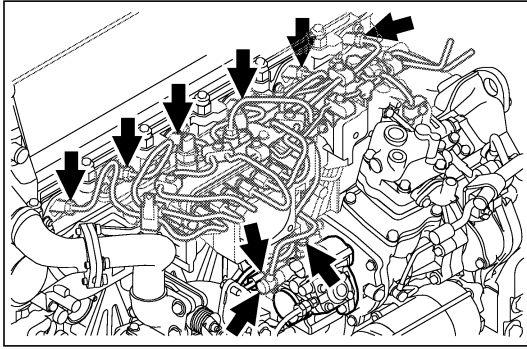
- (2) Connect the connector.

NOTICE

- Be careful to prevent dust from entering inside the common rail and parts when the mounting is performed. Dust and foreign matter must not adhere to the seats of the parts and common rail main unit.
- After mounting is completed, check fuel leak using "Activation Test" menu of HINO DX.



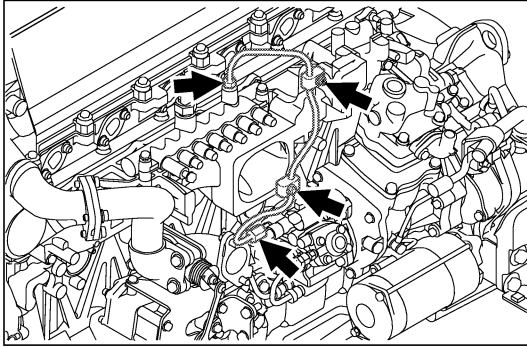
SAPH011060700032



SAPH011060700046

- (3) Tighten the injector pipe nuts to the specified torque.

Tightening Torque:
44 N·m {450 kgf·cm, 32 lbf·ft}



SAPH011060700047

- (4) Tighten the force feed pipe nuts to the specified torque.

Tightening Torque:
44 N·m {450 kgf·cm, 32 lbf·ft}

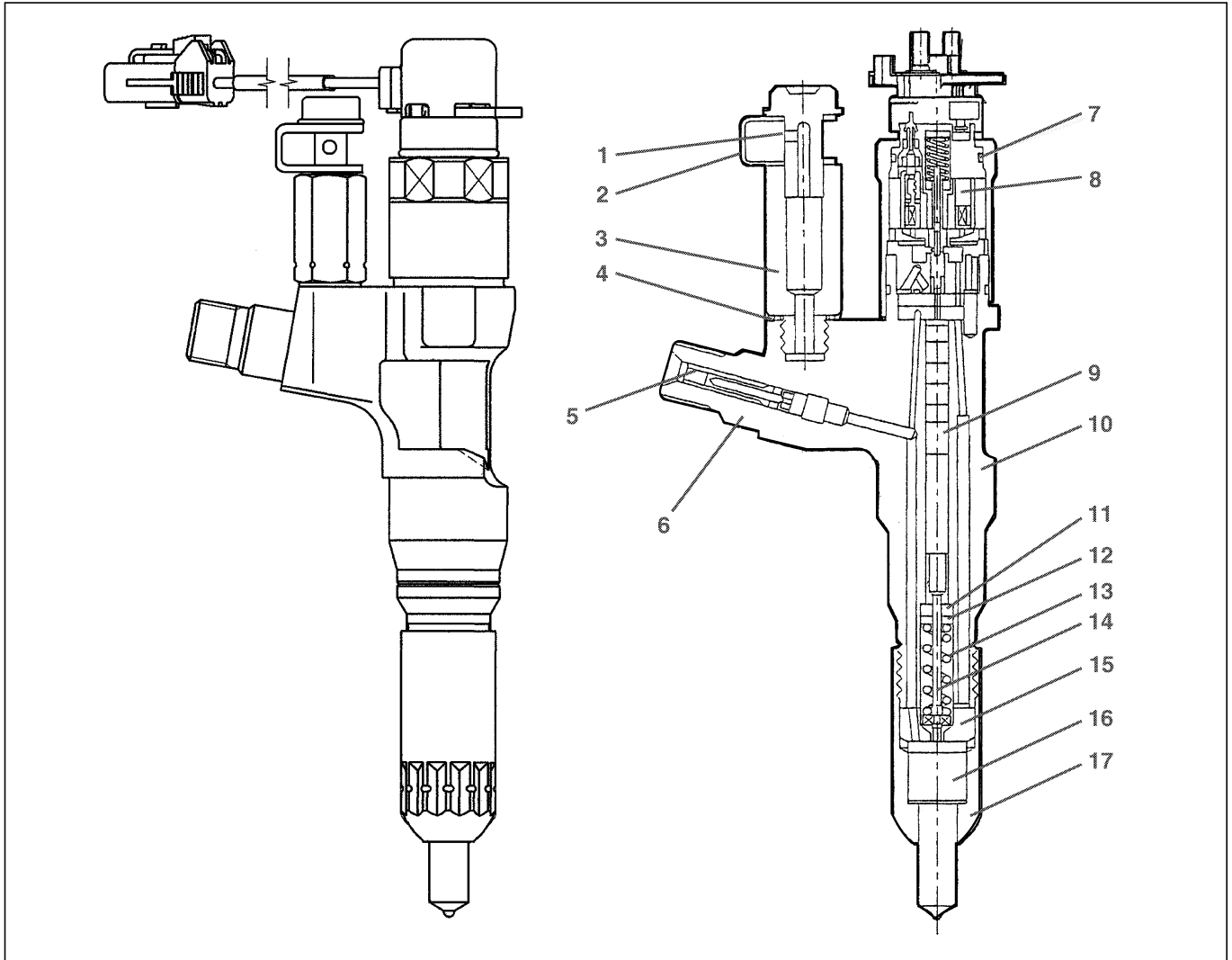
NOTICE

- If the tightening torque of the nuts is less than the specified value, it may cause a fuel leak. If the tightening torque of the nuts is greater than the specified value it may have a negative influence on the engine function. As a result, always perform torque management.
- After mounting is completed, Fuel leak check using "check functions" menu of HINO DX.

INJECTOR

DESCRIPTION

EN0110607C100003

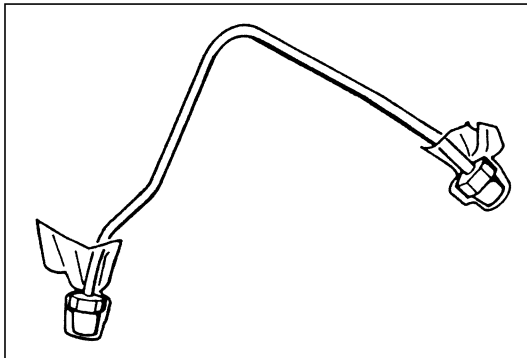


SAPH011060700034

1	Return joint bolt	10	Lower body
2	Gasket	11	Guide bushing
3	Outlet connector	12	Shim
4	Steel washer	13	Nozzle spring
5	Filter	14	Pressure pin
6	Inlet connector	15	Tip seal
7	O-ring	16	Nozzle
8	Two-way valve (TWV)	17	Retaining nut
9	Piston		

OVERHAUL

EN0110607H200003



SAPH011060700035

IMPORTANT POINTS - DISMOUNTING

1. **CLEAN OFF SURROUNDING AREA OF THE NOZZLE AND THE FUEL LINE CONNECTORS.**

NOTICE

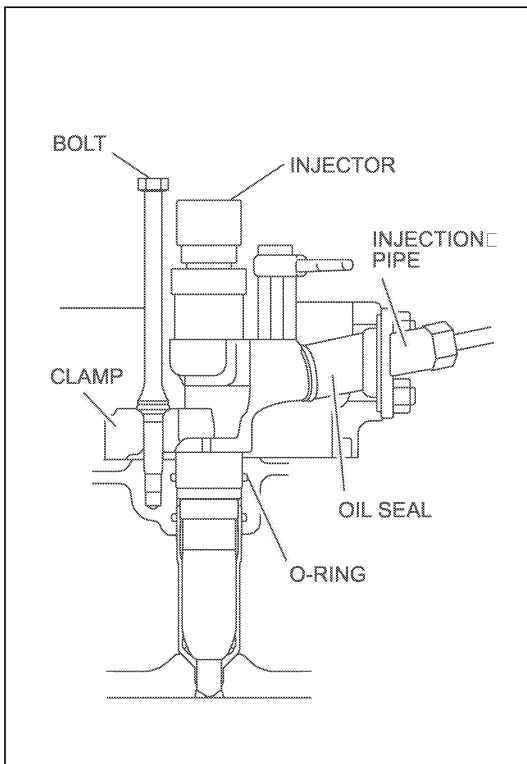
If foreign matter is allowed to enter the combustion chamber, engine trouble may result.

2. **REMOVE THE INJECTOR.**

- (1) Disconnect of the harness coupler.
- (2) Remove the leakage pipe.
- (3) Remove the injection pipe.
- (4) Remove the bolt of the injection pipe seal and pull it with the injection pipe from the camshaft housing.

NOTICE

Cover open ends of the pipes and fuel supply pump to prevent entry of dirt.



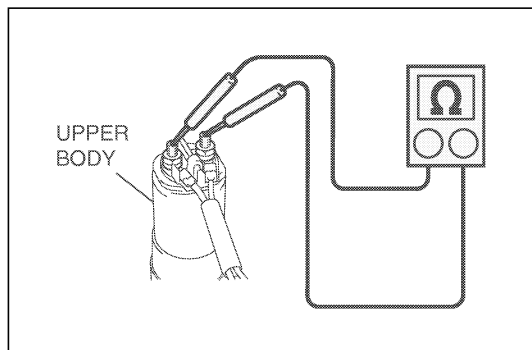
SAPH011060700036

3. **REMOVE THE INJECTOR ASSEMBLY.**

- (1) Remove the injector clamp bolt.
- (2) Pull out the injector assembly taking care not to contact other parts.
- (3) Remove the O-ring.

NOTICE

Replace the O-ring with a new one.



SAPH011060700037

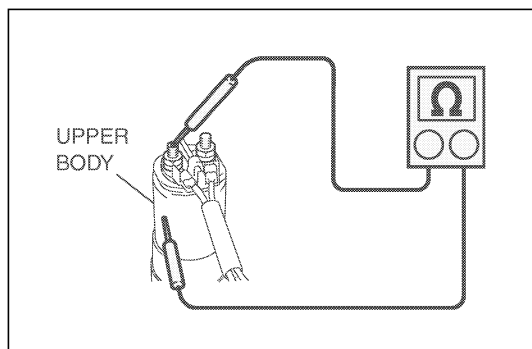
IMPORTANT POINT - ON-VEHICLE INSPECTION

1. INSPECT THE INJECTOR.

- (1) Measure the resistance between terminals.
If not standard value, replace injector assembly.

Standard:

0.35-0.55 Ω at 20°C {68°F}



SAPH011060700038

- (2) Measure the resistance of insulation between terminals and upper body. If not standard value, replace injector assembly.

Standard:

More than 1000 MΩ

NOTICE

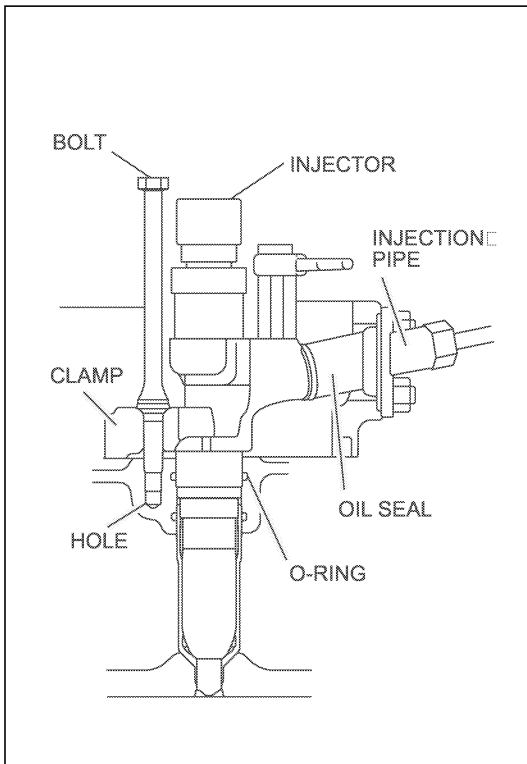
Other inspections and nozzle replacements should be done by Denso service dealer.

- (3) Inspect terminals.
Remove any sludge adhering to the terminals or area surrounding the terminals.

NOTICE

When removing sludge, do not use cleaning fluids.

Use dry cloth. (If cleaning fluids are used, there is a possibility that an electrical malfunction will occur.)



SAPH011060700039

IMPORTANT POINTS - MOUNTING

1. INSTALL THE INJECTOR ASSEMBLY.

- (1) Install a new O-ring into the groove of the cylinder head, and then insert the injector.

NOTICE

Apply engine oil to the O-ring, so that the O-ring will not be caught.

- (2) Install the injector clamp, and install the injector temporarily.

NOTICE

Do not fix the injector clamp before the injection pipe is temporarily installed.

- (3) Cover the injector with a new injection pipe oil seal, and then install the plate and nut.

NOTICE

Be careful not to apply excessive force to the injector when applying the injection pipe oil seal to it. If the injection pipe oil seal and injector are moved even slightly, it may cause oil leakage or faulty assembling of the injection pipe.

- (4) Assemble the injection pipe temporarily, and tighten the installation bolt of the injector clamp.

Tightening Torque:

25 N·m {250 kgf·cm, 18 lbf·ft}

NOTICE

Carefully using compressed air clean out any oil or debris from injector hold down mounting hole in cylinder head.

- (5) Tighten the nut of the injection pipe to the specified torque.

Tightening Torque:

44 N·m {450 kgf·cm, 32 lbf·ft}

- (6) Install the leakage pipe with the 6 new gasket and 6 joint bolts.

Tightening Torque:

12.7 N·m {130 kgf·cm, 9 lbf·ft}

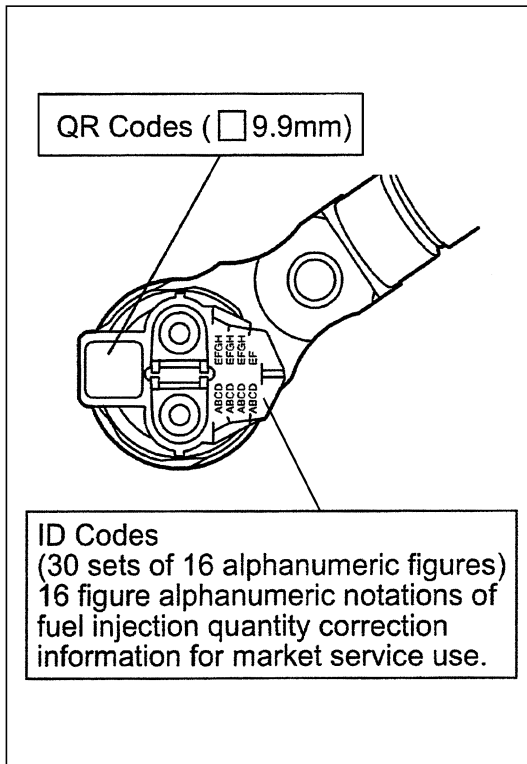
NOTICE

Avoid installation of wrong bolt at fuel return of injectors and fuel return of cylinder head. The bolt of cylinder head and injectors are different screw pitch each.

The bolt of fuel return of cylinder head: Flat head, 1.25 mm screw pitch

The bolt of fuel return of injectors: Concave head, 1 mm screw pitch

- (7) Connect the harness couplers.



SAPH011060700040

2. ENTER THE ID CODES IN THE ECU.

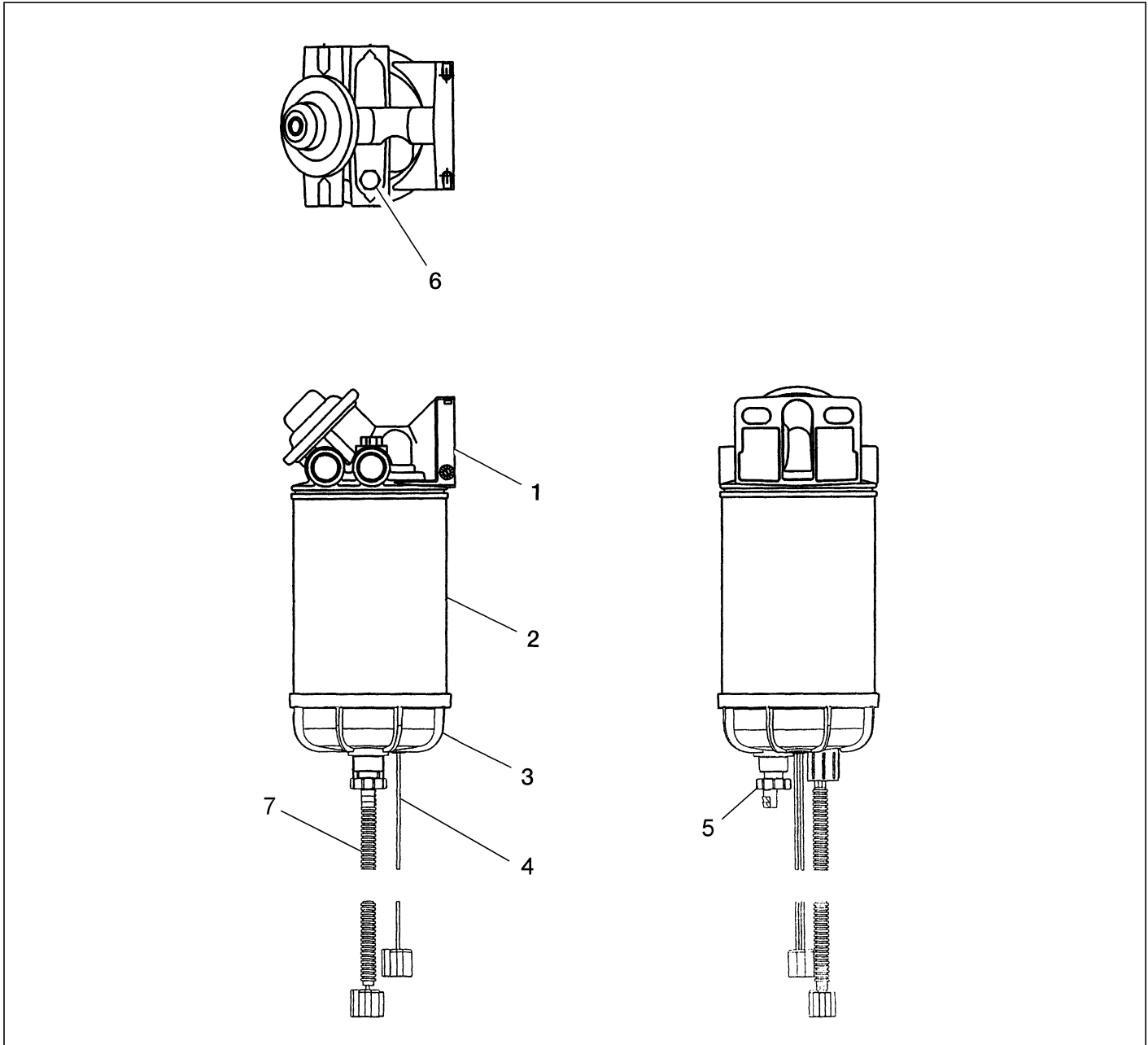
- (1) QR (Quick Response) codes displaying various injector characteristics and the ID codes showing these in numeric form (30 alphanumeric figures) are engraved on the injector head.

NOTICE

When replacing injectors with QR codes, or the engine ECU, it is necessary to record the ID codes (QR codes) in the ECU by using the Diagnostic tool. (If the ID codes of the installed injector are not registered correctly, engine failure such as rough idling and noise will result.)

FUEL FILTER**DESCRIPTION**

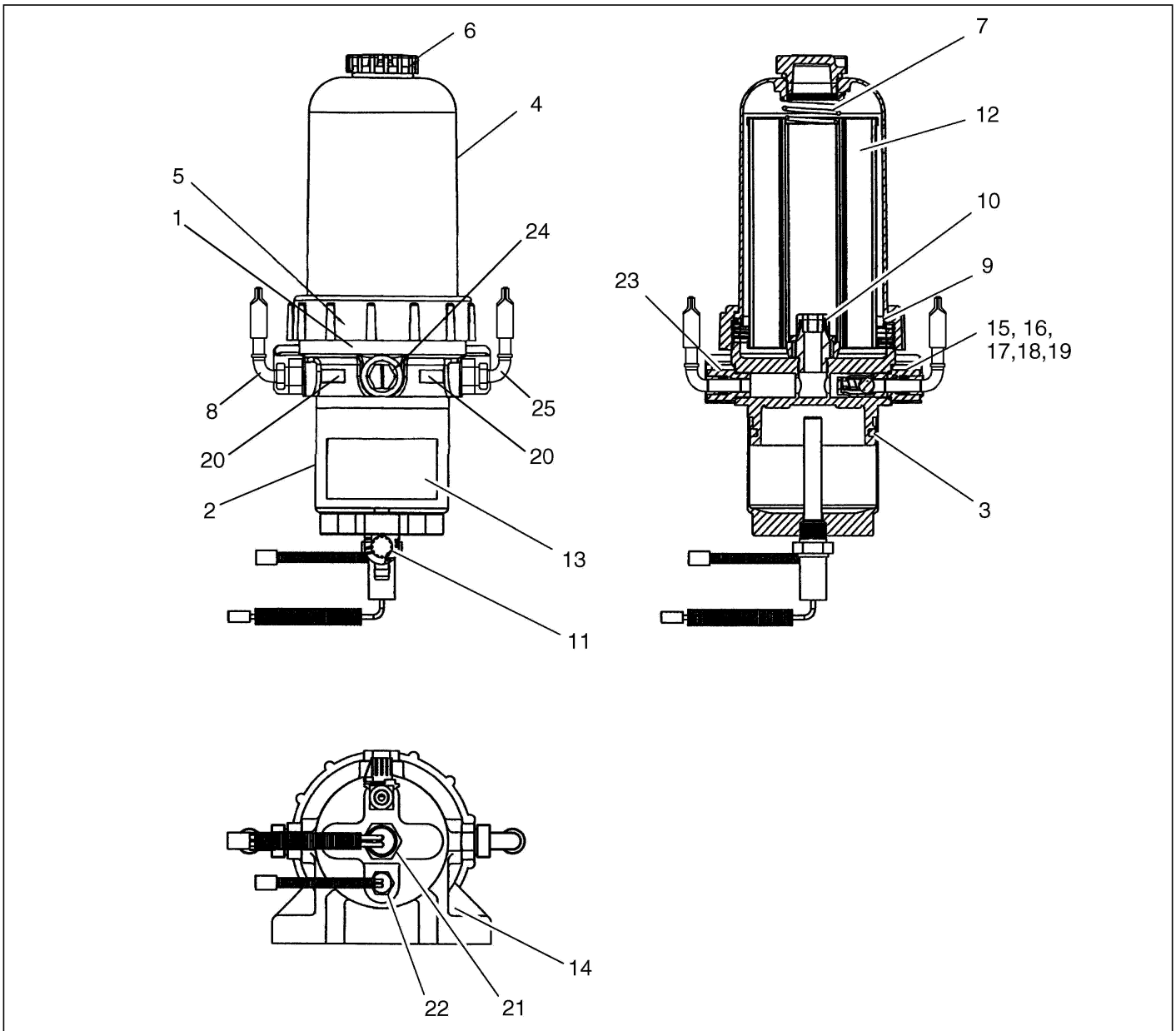
EN0110607J100004



SAPH011060700041

- | | |
|---|---------------------------|
| 1 | Hand priming pump head |
| 2 | Element |
| 3 | Bowl water drain |
| 4 | Heater (optional) harness |

- | | |
|---|----------------------------|
| 5 | Drain valve |
| 6 | Vent plug |
| 7 | Water level sensor harness |



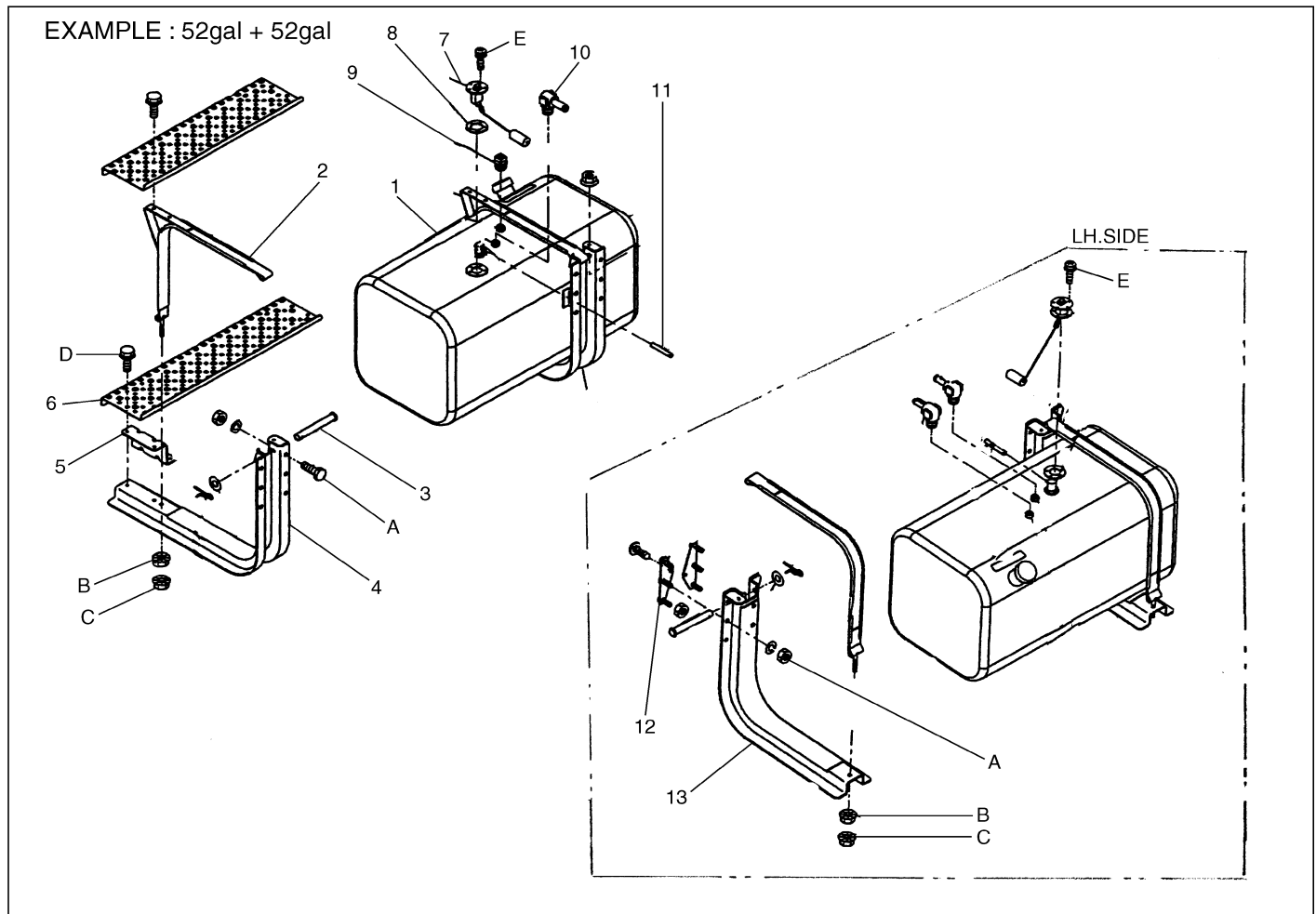
SAPH011060700042

1	Head	14	Label
2	Body	15	Fitting, check valve body
3	Seal	16	Retainer, check valve
4	Cover	17	Seal
5	Collar	18	Ball, check valve
6	Cap, vent	19	Spring, check valve
7	Spring	20	Label
8	Pipe, fuel out	21	Heater (optional)
9	Seal	22	Water level sensor
10	Stud	23	Fitting, adapter
11	Valve, drain	24	Plug
12	Filter	25	Pipe, fuel in
13	Label		

FUEL TANK

COMPONENT LOCATOR

EN0110607J100005



SAPH011060700043

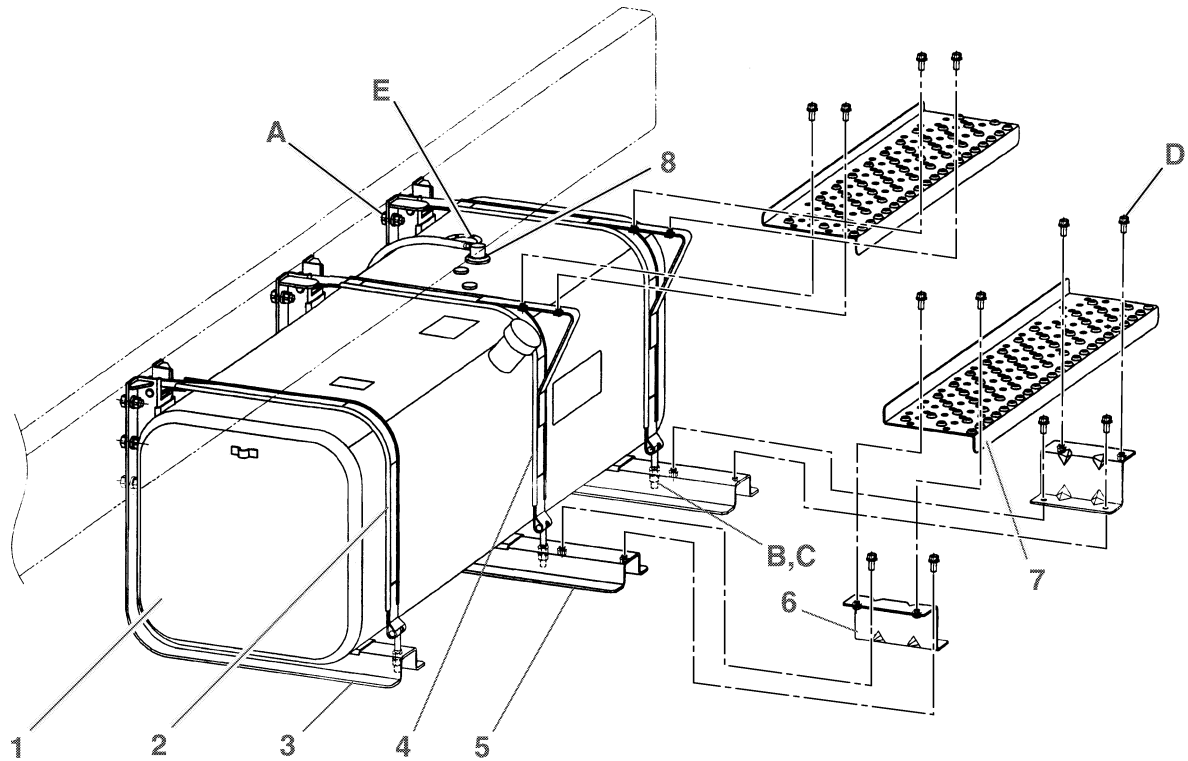
1 Fuel tank	8 Gasket
2 Fuel tank band	9 Plug
3 Pin	10 Joint
4 Fuel tank support	11 Hose
5 Step bracket	12 Plate, fuel tank set
6 Step	13 Fuel tank support
7 Fuel sender	

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A 91.2 - 136.8 {930 - 1,396, 67 - 100}	D 34.5 - 51.5 {352 - 525, 25 - 38}
B 24.5 - 31.5 {250 - 320, 18 - 23}	E 0.5 - 0.7 {5 - 7, 0.362 - 0.506}
C 39.4 - 63 {402 - 643, 29 - 46}	

EXAMPLE : 90 gal (Option)



SAPH011060700044

1	Fuel tank	5	Fuel tank support
2	Fuel tank band	6	Step bracket
3	Fuel tank support	7	Step
4	Fuel tank band	8	Fuel sender

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A	91.2-136.8 {930 - 1,396, 67-100}	D	34.5 - 51.5 {352 - 525, 25 - 38}
B	24.5 - 31.5 {250 - 320, 18 - 23}	E	0.5-0.7 {5-7, 0.362-0.506}
C	39.4 - 63 {402 - 643, 29 - 46}		

TURBOCHARGER (J08E)

EN08-001

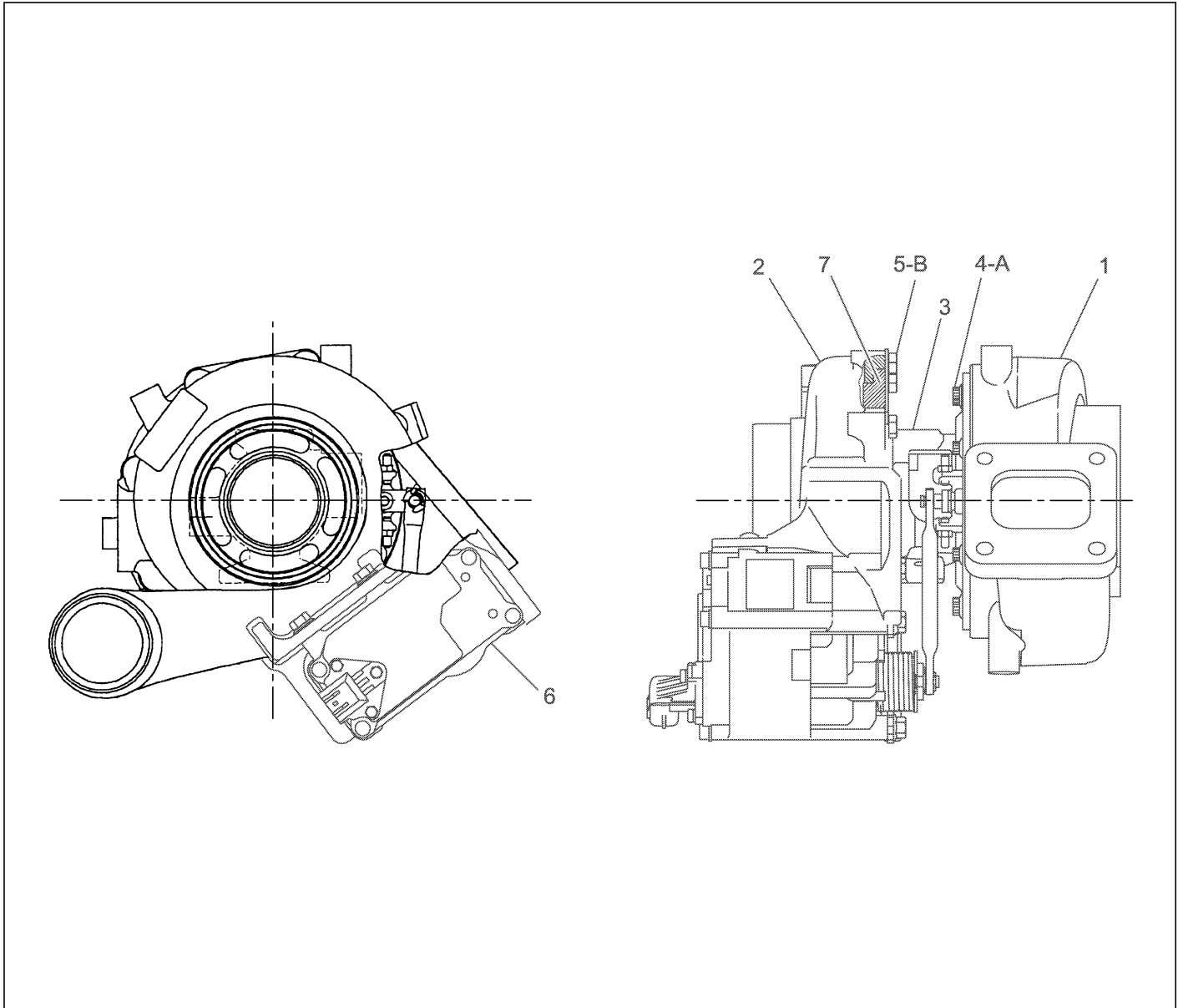
TURBOCHARGER	EN08-2
DESCRIPTION	EN08-2
TROUBLESHOOTING	EN08-3
SPECIAL TOOL	EN08-11
OVERHAUL CRITERIA.....	EN08-12



TURBOCHARGER

DESCRIPTION

EN0110608C100001



SAPH011060800001

1	Turbine housing	5	Compressor bolt
2	Compressor housing	6	Actuator assembly
3	Center housing and rotating assy	7	O-ring
4	Turbine bolt		

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A	20.9-24.3 {213-248, 15.4-17.9}	B	10.8-14.2 {110-145, 7.9-10.4}
---	--------------------------------	---	-------------------------------

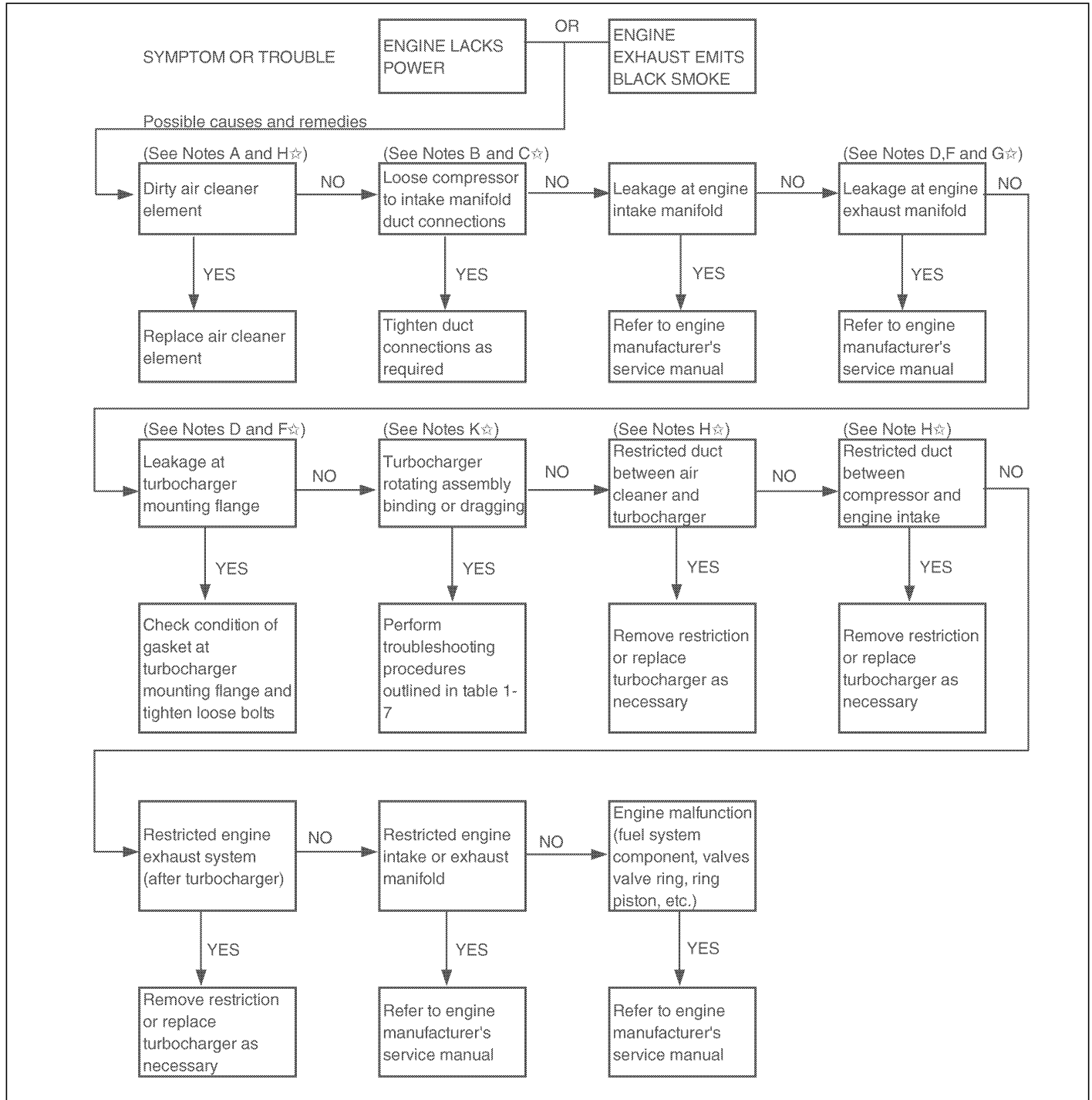
NOTICE

This turbocharger should not be disassembled unless by turbocharger manufacture. The turbocharger parts cannot be replaced.

TROUBLESHOOTING

EN0110608F300001

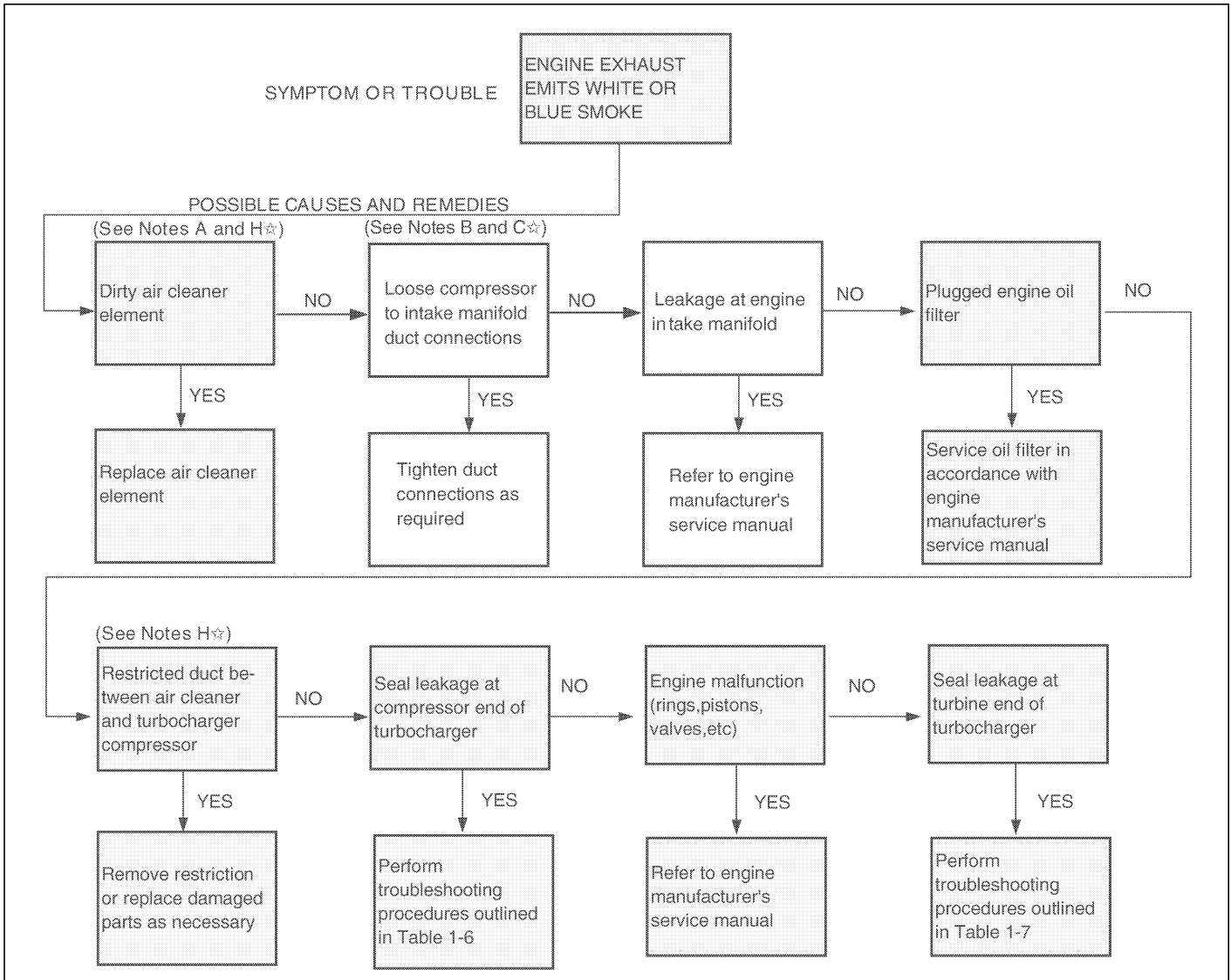
1. Table 1-1 Troubleshooting-Engine Exhaust Lacks Power or Engine Exhaust Emits Black Smoke



SAPH011030800002

☆ Shown on Table 1-9

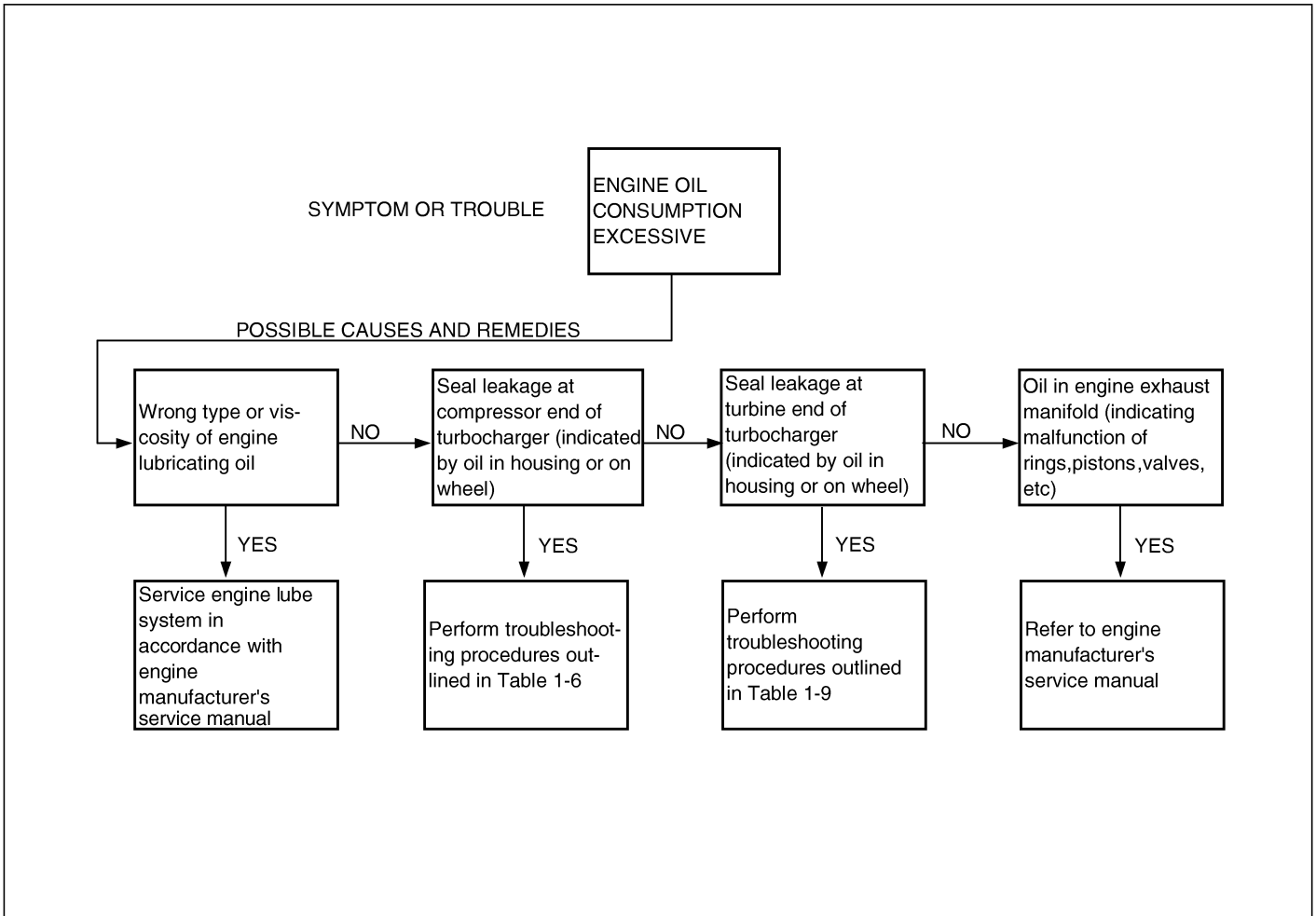
2. Table 1-2 Troubleshooting Engine Exhaust Emits WHITE or BLUE SMOKE



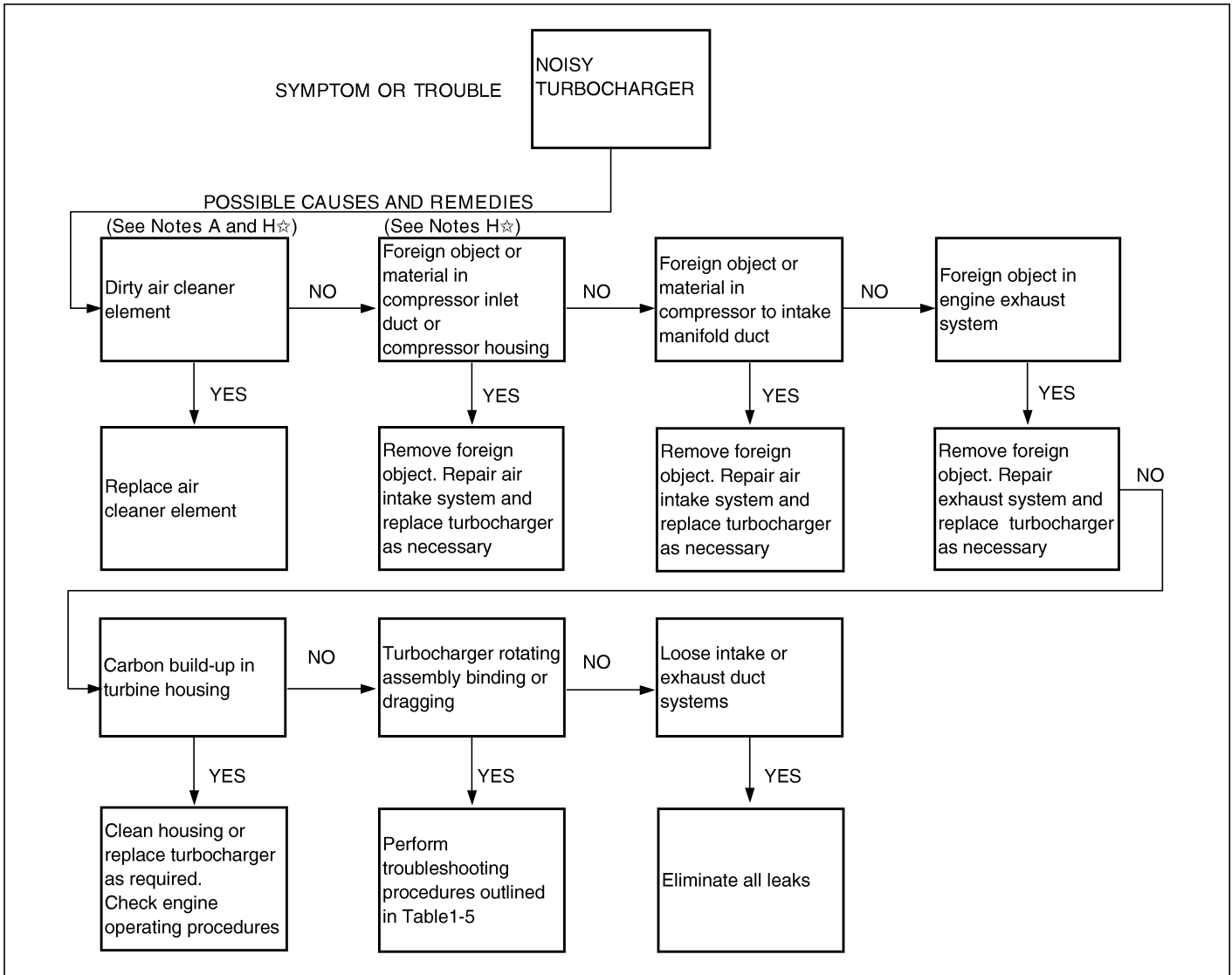
SAPH011030800003

☆ Shown on Table 1-9

3. Table 1-3 Troubleshooting Engine Oil Consumption Excessive



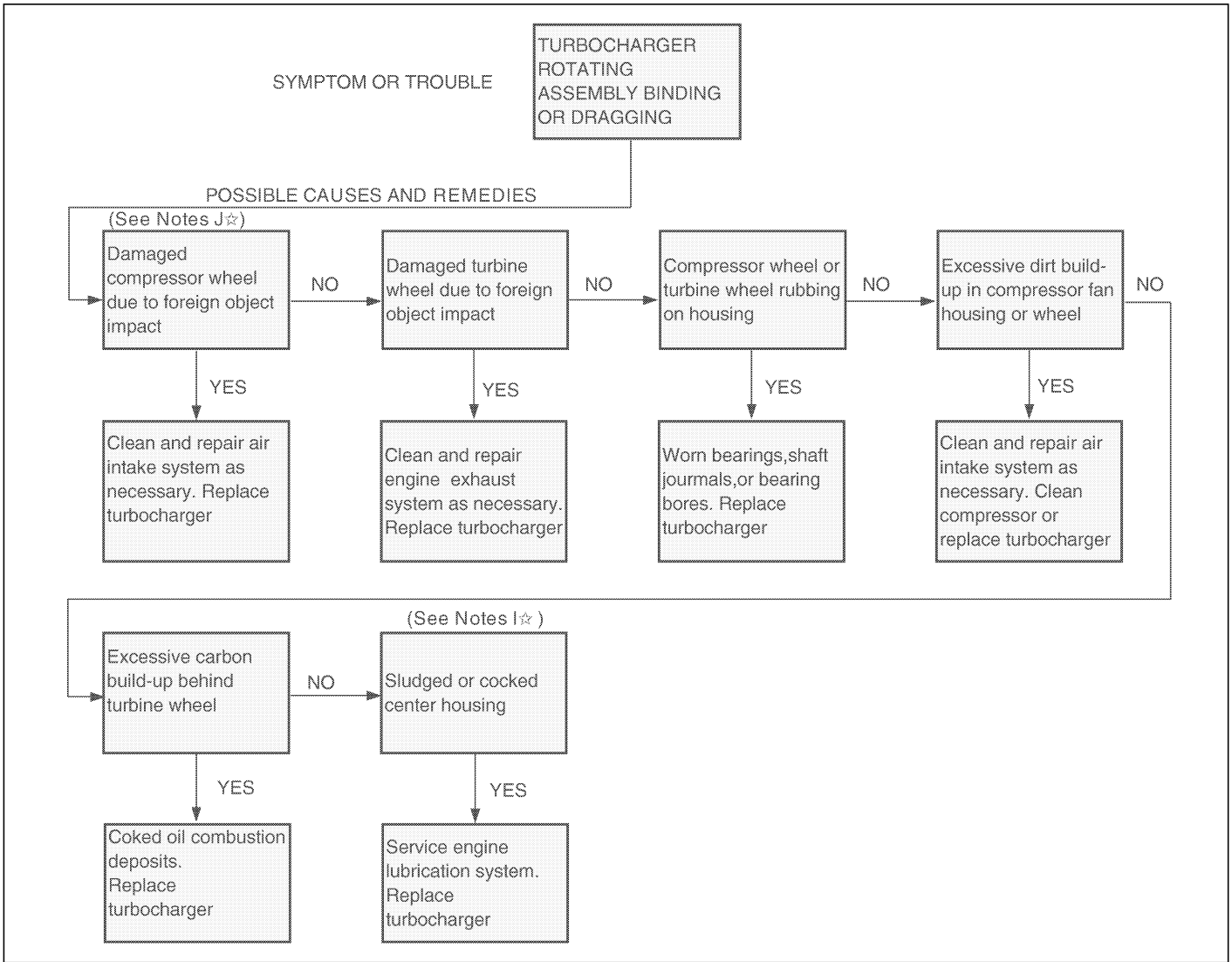
4. Table 1-4 Troubleshooting Noisy Turbocharger



SAPH011030800005

☆ Shown on Table 1-9

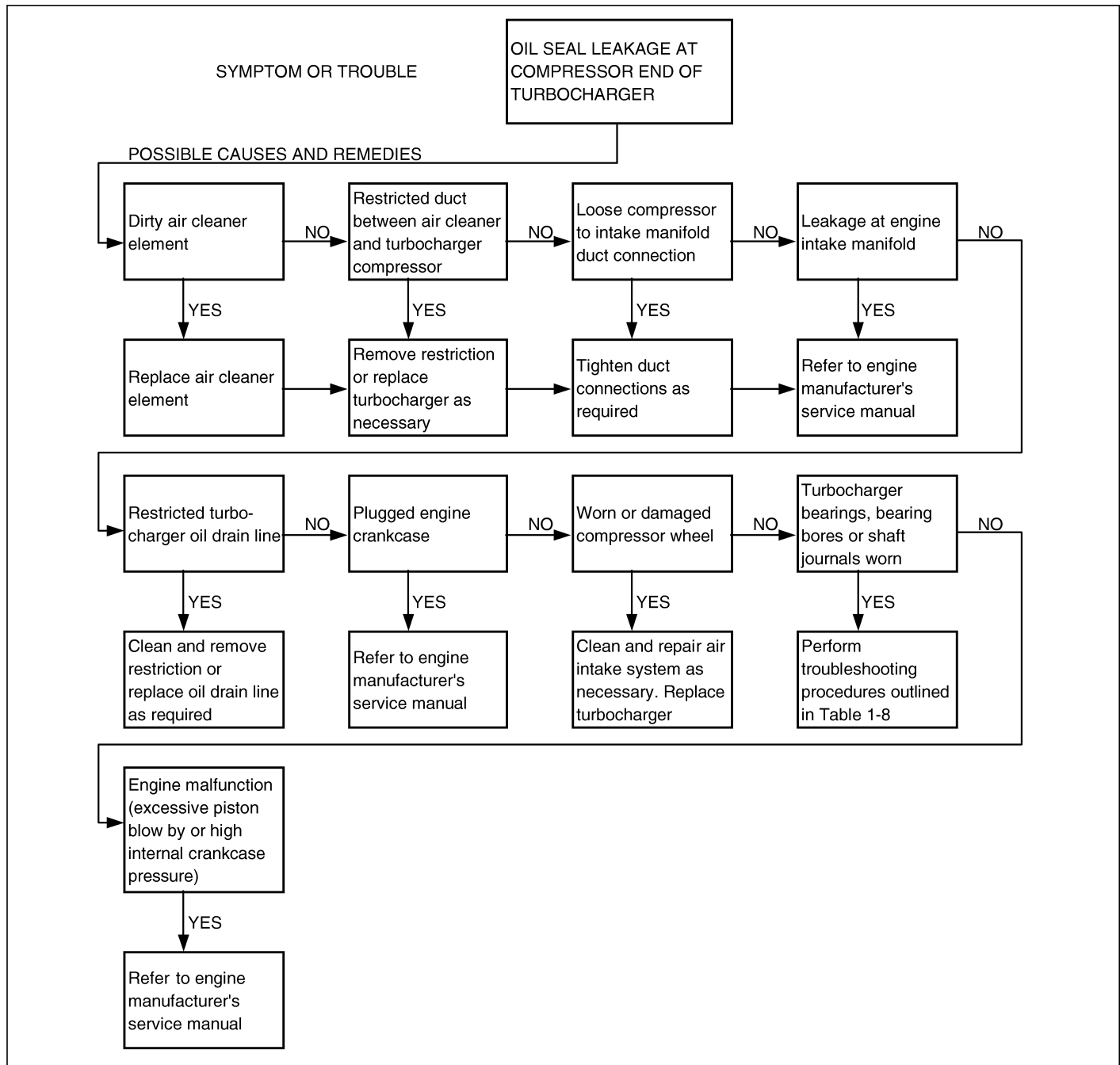
5. Table 1-5 Troubleshooting Turbocharger Rotating Assembly Binding or Dragging



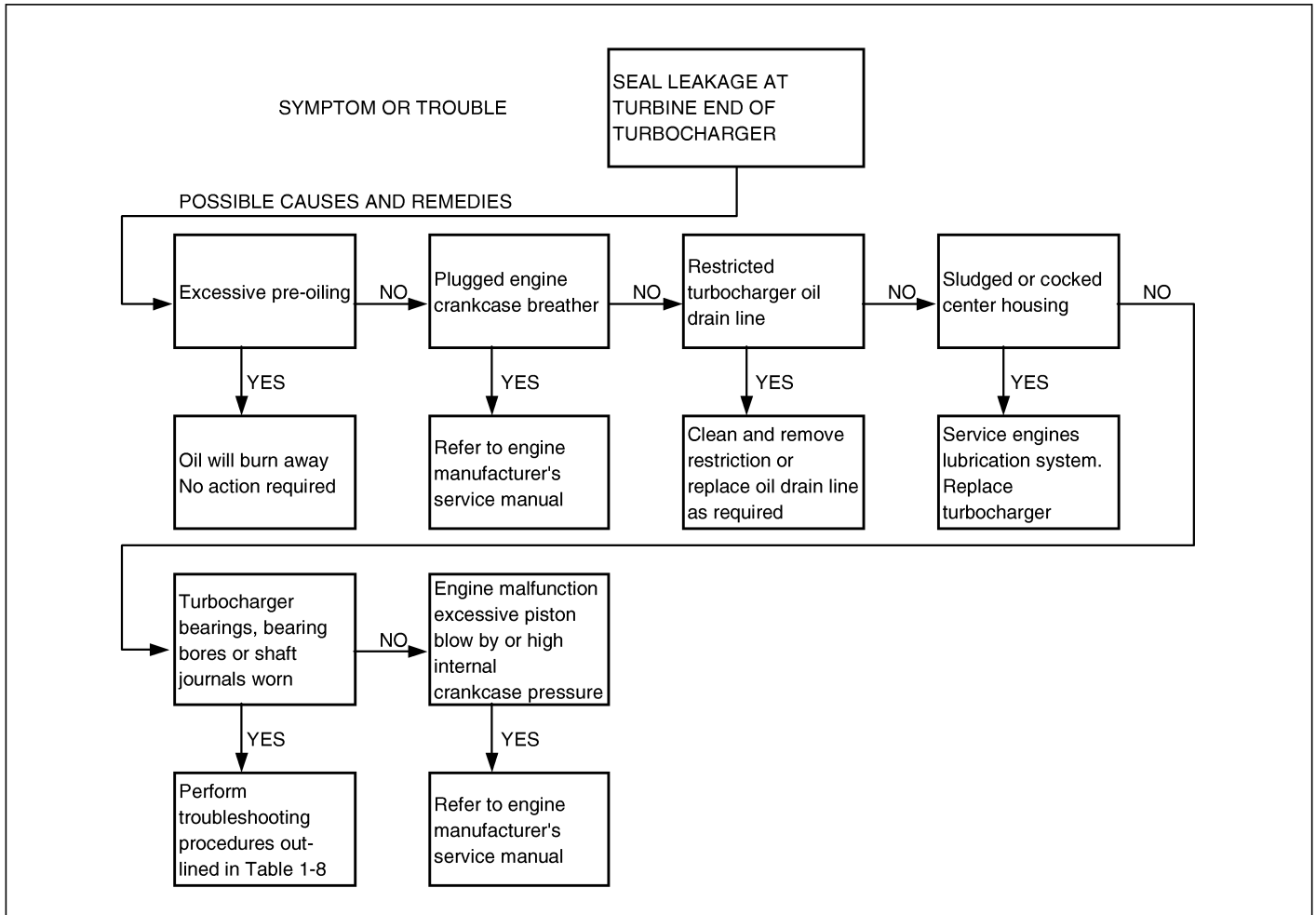
SAPH011030800006

☆ Shown on Table 1-9

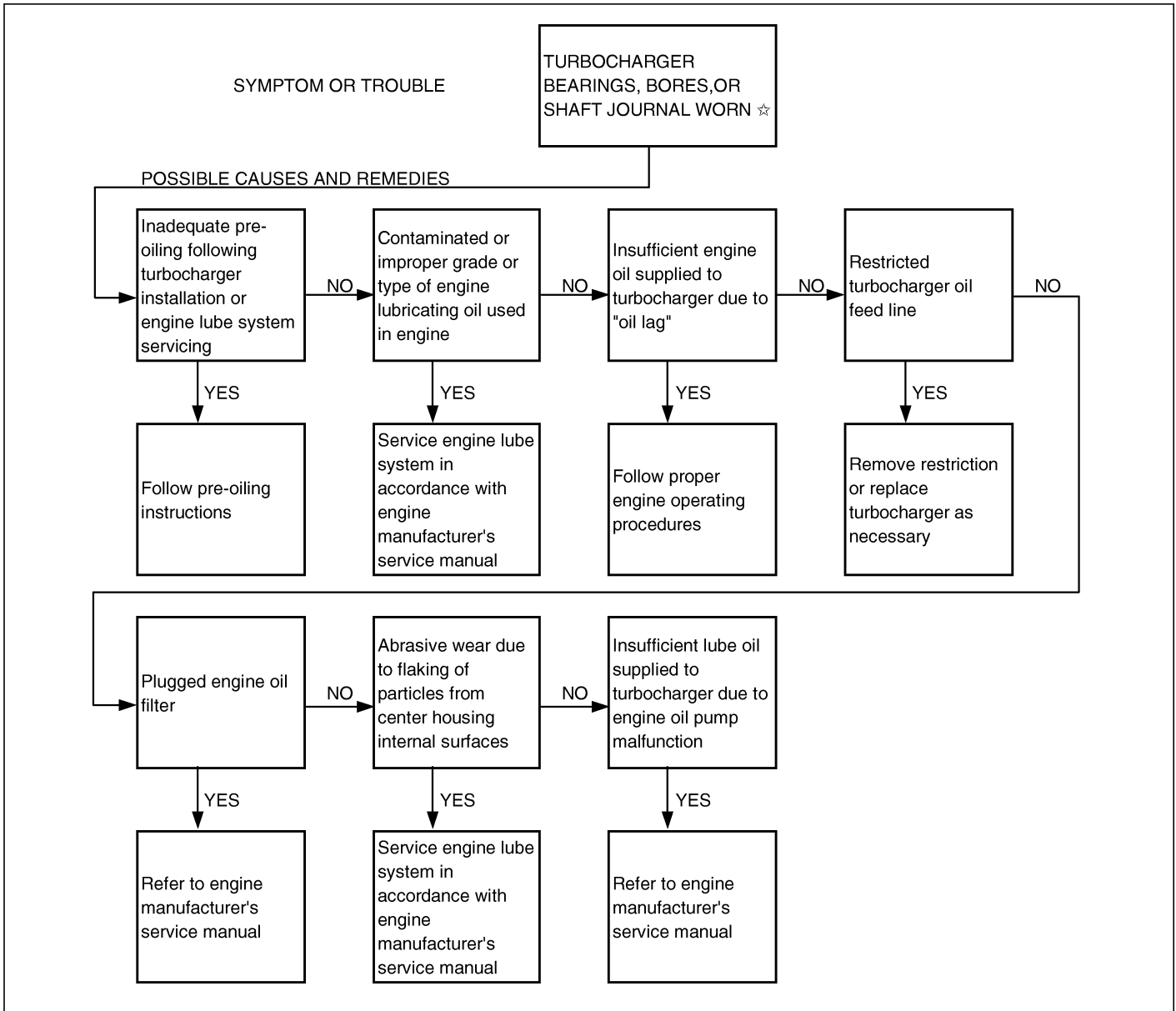
6. Table 1-6.Troubleshooting-Seal Leakage at Compressor End of Turbocharger



7. Table 1-7.Troubleshooting-Seaal Leakage at Turbine End of Turbocharger



8. Table 1-8.Troubleshooting-Turbocharger Bearings, Bores, or Journals are Worn



SAPH011030800009

☆ Replace turbocharger, then use this table to determine cause of failure.

9. Table 1-9. Troubleshooting Procedures Notes

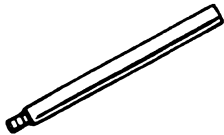
A	Refer to engine manufacturer's service manual for inspection requirements and replacement specifications.
B	With engine stopped, check duct clamping devices for tightness.
C	With engine running at idle speed, lightly spray duct connections with starting fluid. Leaks at connections will be indicated by an increase in engine speed due to the starting fluid being drawn into the compressor and pumped into the engine combustion chambers.
D	With engine running at idle speed, check duct connections for leaks by applying lightweight oil or liquid soap to areas of possible leakage and checking for bubbles. Exhaust gas leakage between the engine block and the turbocharger inlet will also create a noise level change.
E	With engine running at idle speed, check for unusual noise and vibration. If either condition is noted, shut down the engine immediately to protect the turbocharger and engine from further damage. With the engine stopped, check the turbocharger shaft wheel assembly for damage as outlined Note I, below.
F	With engine running, a change in the noise level to a higher pitch can indicate air leakage between the air cleaner and the engine or a gas leak between the engine block and the turbocharger inlet.
G	Exhaust gas leakage may be indicated by hat discoloration in the area of the leak.
H	With the engine running, noise level cycling from one level to another can indicate a plugged air cleaner, a restriction in the air-cleaner to compressor duct, or a heavy build-up of dirt in the compressor housing or on the compressor wheel.
I	Internal inspection of the center housing can be accomplished by removing the oil drain line and looking through the oil drain opening. When a slugged or cocked condition exists, a heavy sludge build-up will be seen on the shaft between the bearing journals and in the center housing from the oil drain opening back to the turbine end.
J	Thorough cleaning of the air intake system is essential following compressor wheel damage due to foreign object impact. In many cases, metal pieces from the wheel become imbedded in the air cleaner element. If the element is not changed, these metal pieces can be drawn into the replacement turbocharger and cause it to fail in the same manner as the original unit.
K	With the air inlet and exhaust gas ducting removed from the turbocharger, examine both the compressor and turbine wheels for blade damage. Examine the outer blade tip edges for evidence of rubbing on housing surfaces.

- Turn the rotating assembly by hand and feel for dragging or binding. Push the rotating assembly side-ways while rotating to feel for wheel rub. If there is any indication of rubbing, perform the bearing clearance inspection procedure. If the rotating assembly rotates freely and there is no evidence of binding or rubbing, it can be assumed that the turbocharger is serviceable.

SPECIAL TOOL

EN0110608K10001

Prior to starting a turbocharger overhaul, it is necessary to have this special tool.

Illustration	Part number	Tool name	Remarks
	S0944-41800	END PLAY GAUGE	For measuring the turbine shaft end play with a dial gauge.

OVERHAUL CRITERIA

EN0110608H300001

1. CONDITIONS WHICH DETERMINE WHEN A TURBOCHARGER OVERHAUL MAY BE NEEDED ON ENGINE TROUBLESHOOTING.

The most common symptoms of turbocharger failure are related to engine performance:

- Lack of power
- Excessive exhaust smoke
- Unusual noise
- Excessive oil or fuel consumption.

NOTICE

Any of these symptoms could be the result of an internal engine problem, and might not involve the turbocharger at all.

2. EXAMINE THE TURBOCHARGER EXTERIOR AND INSTALLATION.

⚠ WARNING

Do not work on the turbocharger while it could be still hot. This can result in personal injury.

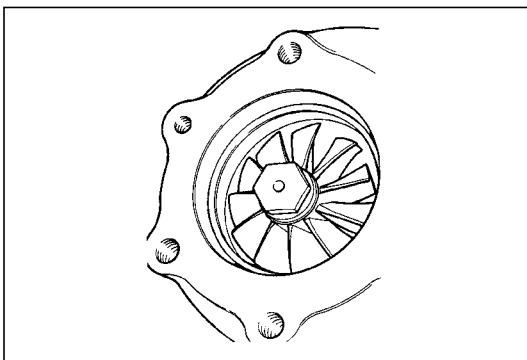
Visually check for:

- Missing or loose nuts and bolts.
- Loose or damaged intake and exhaust pipe.
- Damaged oil supply and drain lines.
- Cracked or deteriorating turbocharger housings.
- External oil or coolant leakage.

Correct any installation problems. If turbocharger parts are damaged, the unit should be overhauled after completion of the remainder of this troubleshooting procedure.

⚠ WARNING

Operation of the turbocharger without the intake pipe and air cleaner connected can result in personal injury and damage to equipment from foreign objects entering the turbocharger.



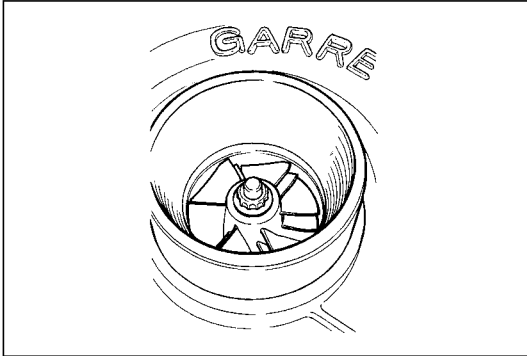
SAPH011060800011

3. INSPECTION TURBINE WHEEL AND HOUSING.

Remove the duct from the turbine outlet. Using a flash-light, check the turbine for wheel to housing rub, evidence of oil leakage or foreign object damage. Foreign object damage to the turbine is not usually visible through the turbine outlet unless the damage is severe.

- (1) Wheel to housing rub
 - a. If wheel rub is found, and the housing attaching hardware is secure, then the turbocharger is probably damaged internally and must be overhauled.
- (2) Oil leakage
 - a. If oil deposits are found, determine whether the oil has come from, the engine exhaust or from the turbocharger center housing.
 - b. If the oil has come from the engine, consult CHAPTER ENGINE MECHANICAL and correct the problem. If oil deposits on the wheel are heavy, the turbocharger should be disassembled, cleaned, and overhauled if necessary.

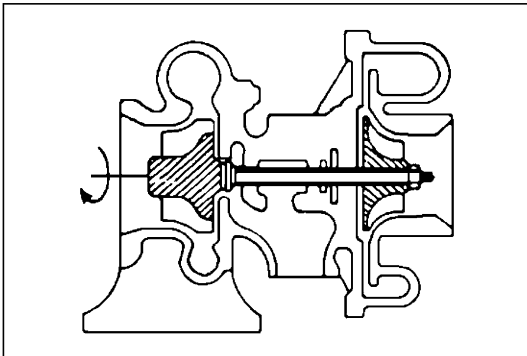
- (3) Foreign object damage
 - a. If foreign object damage to the turbine is visible, the turbocharger must be overhauled. Such damage destroys the wheel's balance and causes internal damage to the seal bores and journal bearings. Be sure to find the source of the foreign object. In many cases, the object has come out of the engine, and there may be engine damage as well.



SAPH011060800012

4. EXAMINE COMPRESSOR WHEEL AND HOUSING.

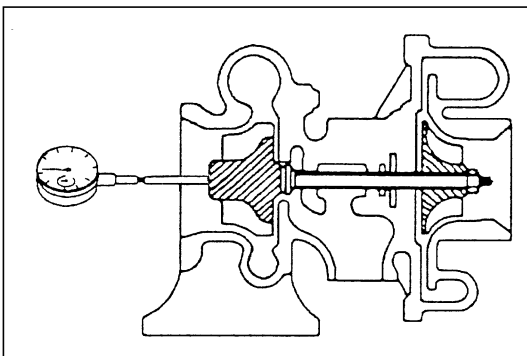
- Remove the duct from the compressor inlet. Using a flashlight, check the compressor for wheel to housing rub, evidence of oil leakage, or foreign object damage.
- (1) Wheel to housing rub
If wheel rub is found, and the housing attaching hardware is secure, then the turbocharger is probably damaged internally and must be overhauled.
 - (2) Oil leakage
Oil leakage into the compressor can be caused by:
 - a. Long periods of idling on a restricted oil drain line.
 - b. Oil leakage into the compressor can also be caused by a restricted air intake system.
 - c. Oil leakage into the compressor can be caused by frequent use of the engine as a brake. In this case, nothing is wrong with either the engine or the turbocharger, but frequent compressor wheel and housing clean-up is recommended.
 - (3) Foreign object damage
If the compressor wheel has been damaged by a foreign object, the turbocharger must be overhauled.



SAPH011060800013

5. CHECK ROTATING ASSEMBLY FOR NOISE OR EXCESSIVE PLAY.

- (1) If no damage is visible in the turbine and compressor areas, spin the rotating assembly by hand. It should spin freely with no drag or grinding noises.



SAPH011060800014

6. CHECK AXIAL BEARING CLEARANCES.

- (1) Check the turbine rotor (exhaust side) for axial play using the special tool and dial gauge.
SST: End play gauge (S0944-41800)

Service limit: 0.092 mm {0.0036 in.}
- (2) If the measurement is out of service limit, the turbocharger is worn or damaged internally and must be overhauled.

EMISSION CONTROL (J08E)

EN10-001

EGR VALVE AND EGR PIPE.....EN10-2

COMPONENT LOCATOR..... EN10-2

EGR VALVE.....EN10-3

DESCRIPTION EN10-3

DISMOUNTING AND MOUNTING EN10-4

CLOSED VENTILATOREN10-9

DESCRIPTION EN10-9

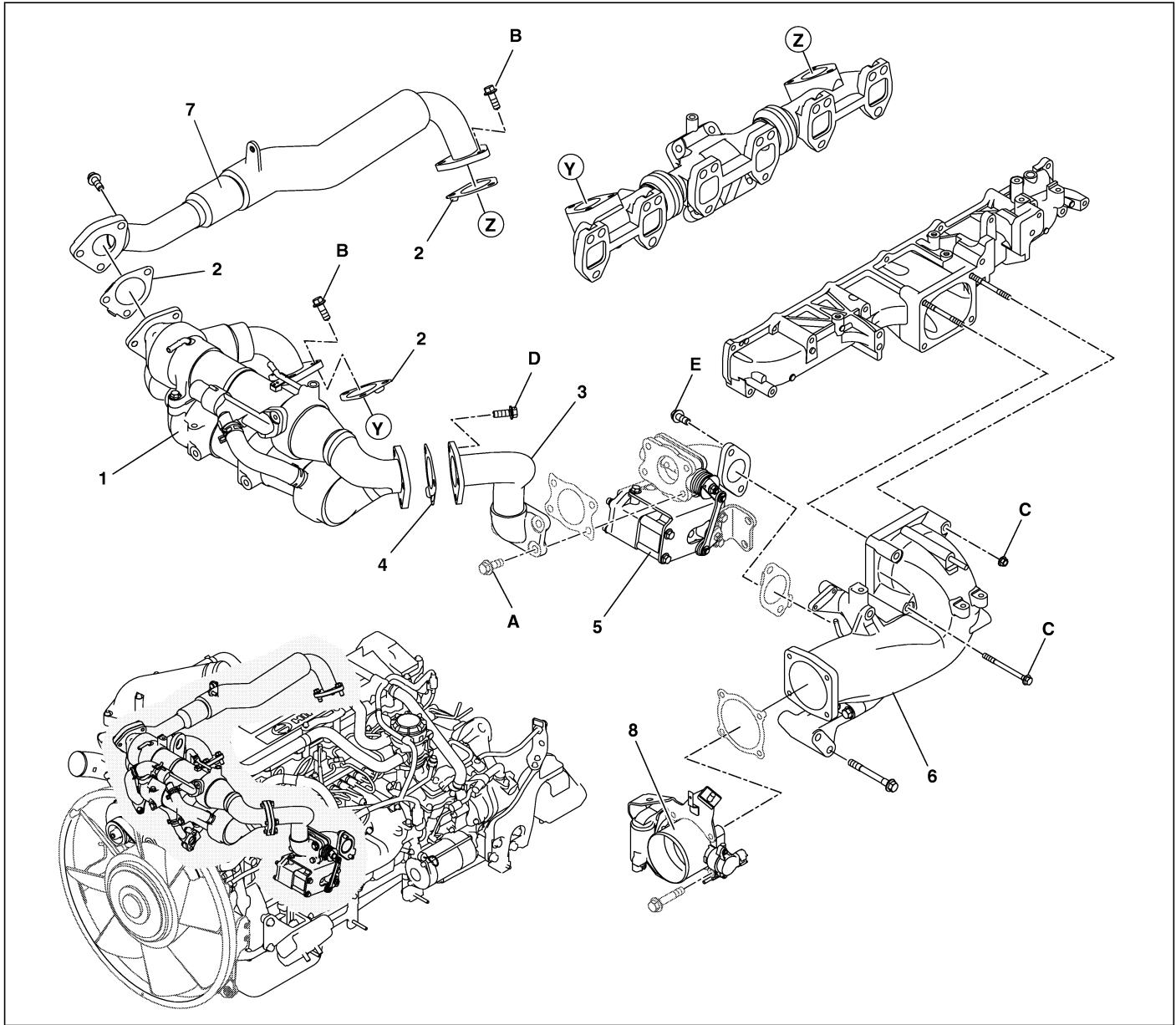
REPLACEMENT OF

CLOSED VENTILATOR EN10-9

EGR VALVE AND EGR PIPE

COMPONENT LOCATOR

EN0110610J100001



SAPH011061000001

1	EGR cooler sub assy	5	EGR valve
2	Gasket	6	Intake pipe
3	EGR pipe assy	7	EGR pipe
4	Gasket	8	Diesel throttle valve

Tightening torque

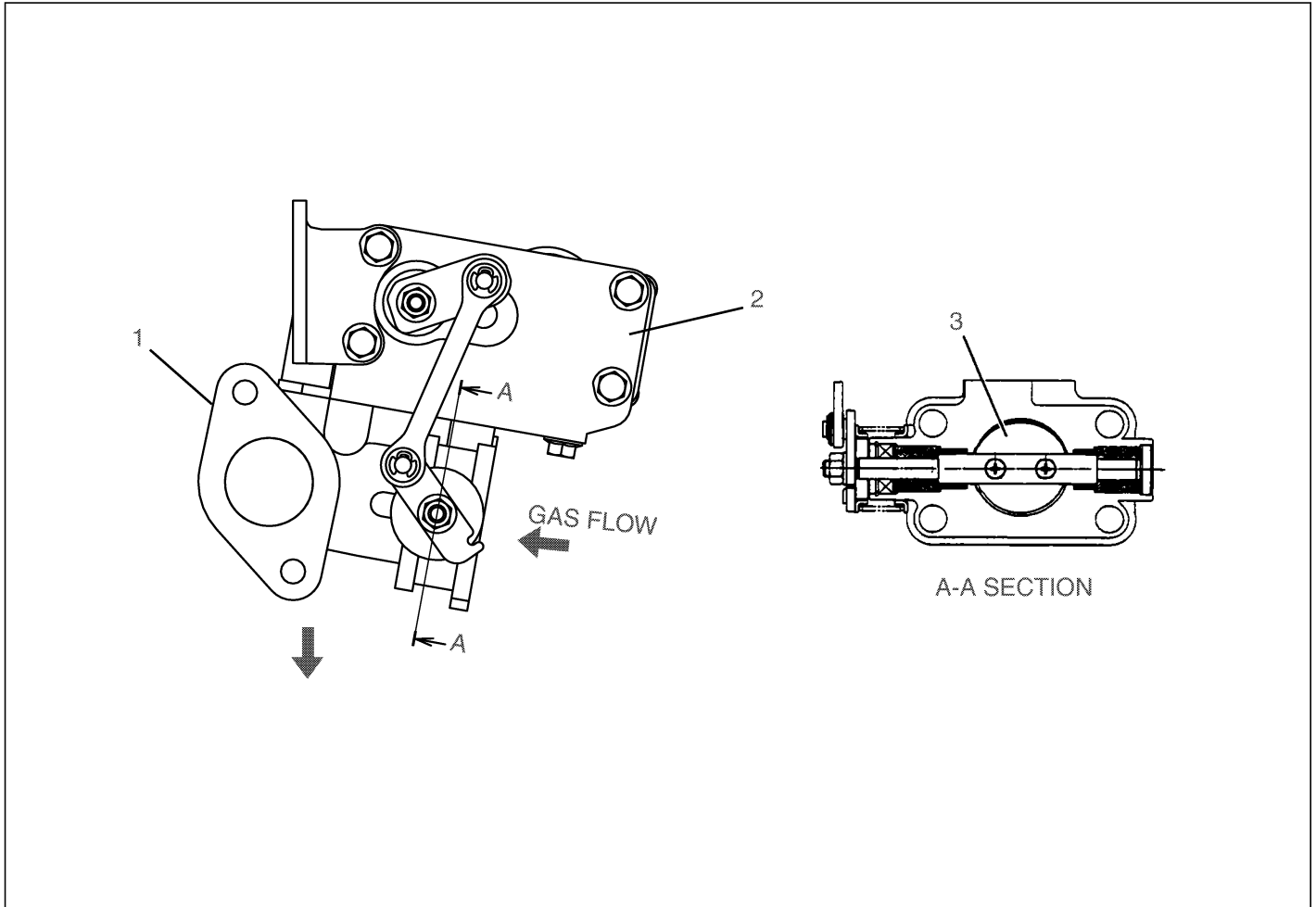
Unit: N·m {kgf·cm, lbf·ft}

A	55 {560, 40}	D	55 {560, 40}
B	55 {560, 40}	E	55 {560, 40}
C	28.5 {290, 21}		

EGR VALVE

DESCRIPTION

EN0110610J100002



SAPH011061000011

1 EGR valve assy
2 DC Motor

3 Butterfly valve

DISMOUNTING AND MOUNTING

EN0110610H200001

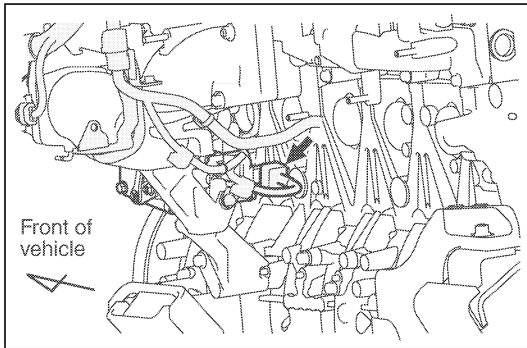
IMPORTANT POINTS - DISMOUNTING

1. REMOVE THE EGR VALVE AND EGR COOLER.

NOTICE

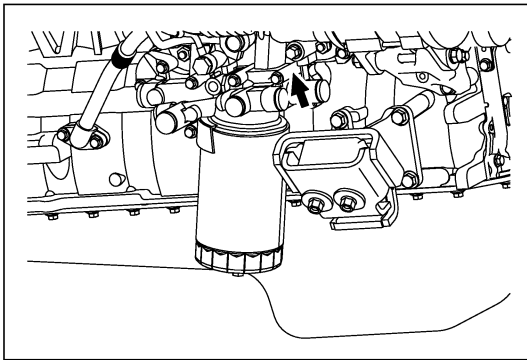
To prevent burns ensure the engine is cold before changing the valve.
(At least 30 minutes after switching off the engine)

- (1) Disconnect the harness coupler.



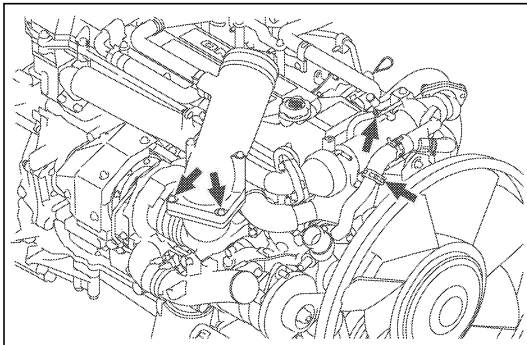
SAPH018041000015

- (2) Drain the coolant out of the drain plug of oil cooler situated on the right side of the engine.



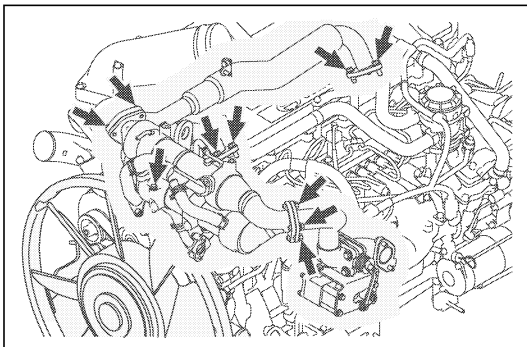
SAPH011061000004

- (3) Disconnect and remove all pipes connected to the EGR pipe as well as coolant hose and related parts.

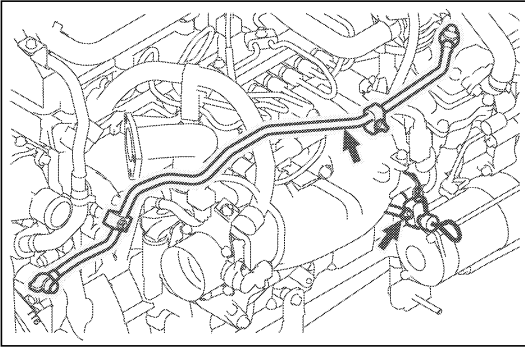


SAPH018041000025

- (4) Remove EGR pipe.
- (5) Remove EGR Cooler sub assy.

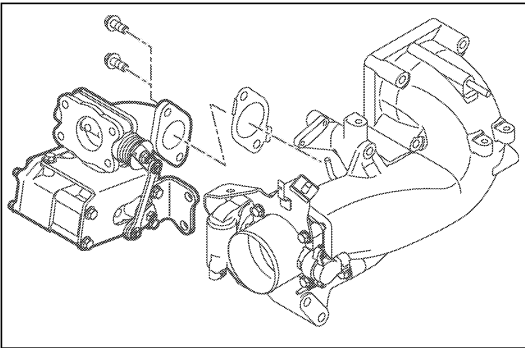


SAPH018041000017



SAPH018041000026

- (6) Remove the oil level gauge clamp, water pipe and inter cooler hose from the intake pipe.
- (7) Remove the intake pipe (with EGR valve) from the intake manifold.

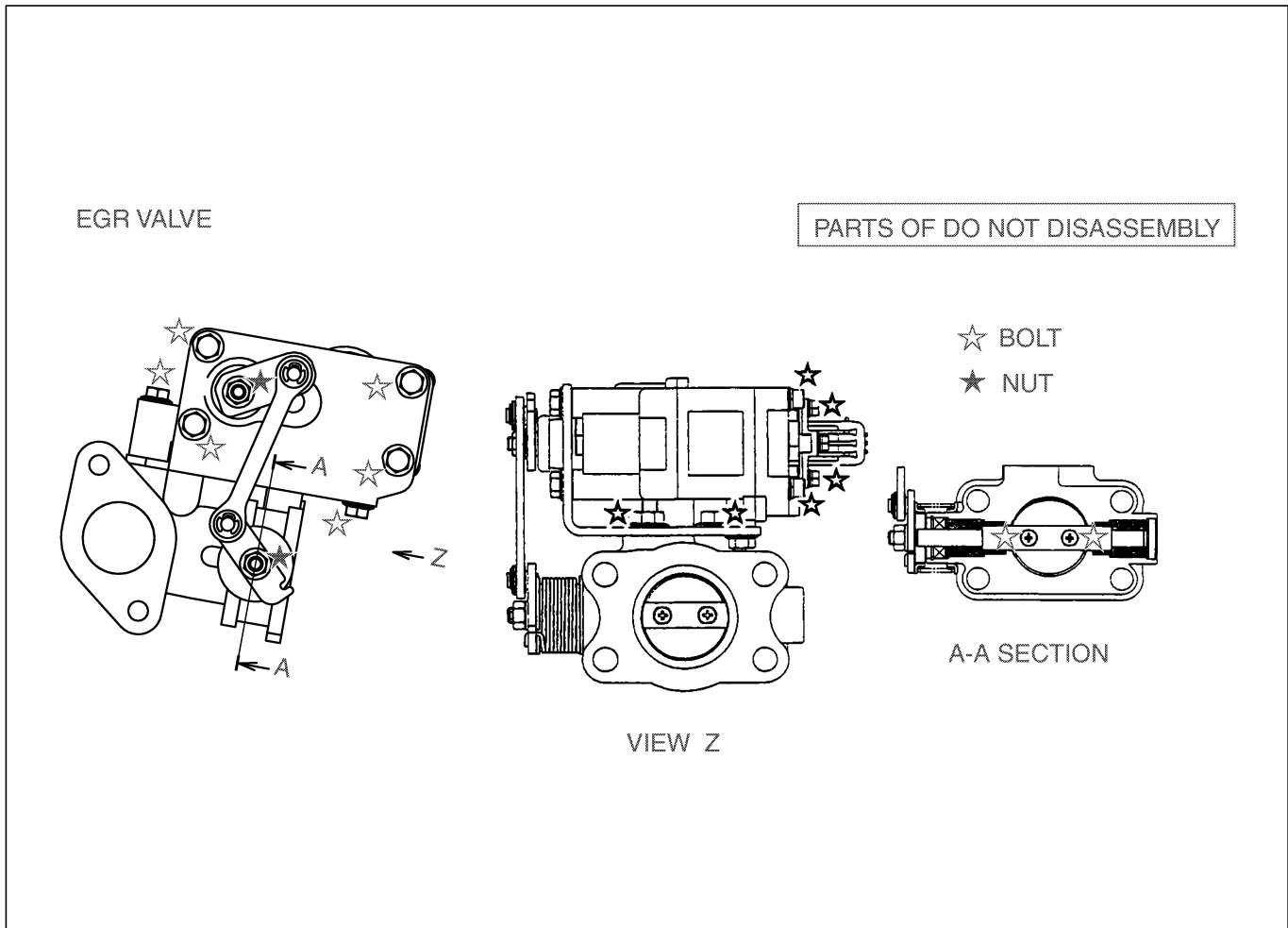


SAPH018041000018

- (8) Remove the EGR valve from the intake pipe.

NOTICE

- If you have to place your feet on the engine while working on it, be careful not to fall off the engine or get your foot caught in the engine parts.
- Be careful not to step on the EGR valve when servicing the engine.
- Do not loosen or tighten the bolts and nuts securing the EGR valve components; otherwise, the valve will not perform properly. If you remove the nuts and bolts and dismantle a component, do not re-assemble it; instead, replace the valve with a new one.
- Be careful not to hit the EGR valve lever with a tool when you are removing or installing the valve.



SAPH011061000008

2. INSPECT THE EGR COOLER.

- (1) Visually inspect cracks or clogging in the main body gas passage and sub-coolant piping. In case a trouble is found, replace the EGR cooler with a new one.

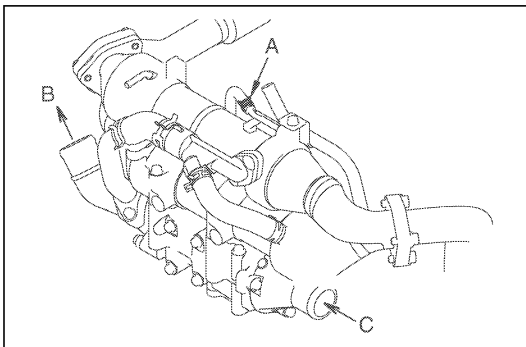
AIR BLEEDING FROM EGR COOLER

1. BLEED AIR FROM THE EGR COOLER

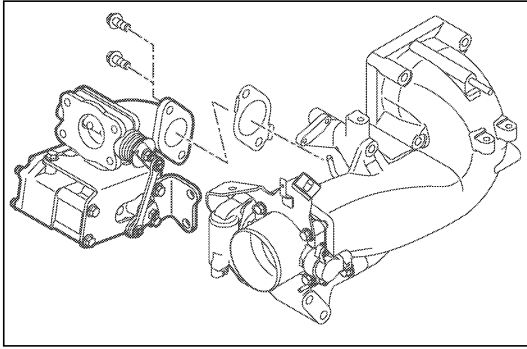
- (1) The hose connection parts are (A), (B), and (C), and the others are to be plugged or to be made closed circuits.
- (2) Supply water from (B). ((C) is closed during cooling by the thermostat.)
- (3) Air venting (judgment of water filling) is completed when cooling water reaches the hose connected to (A), and cooling water remains in the hose even when the water supply is stopped.

NOTICE

- This work is the procedure for air venting for the engine by itself.
- Air remaining in the hose of part (A) after completion of water supply is eliminated by operating the engine.
- Visual confirmation of the water flow must be possible at the hose connected to part (A). Also, the hose should not sag.



SAPH018041000019

IMPORTANT POINTS - MOUNTING

SAPH01106100008

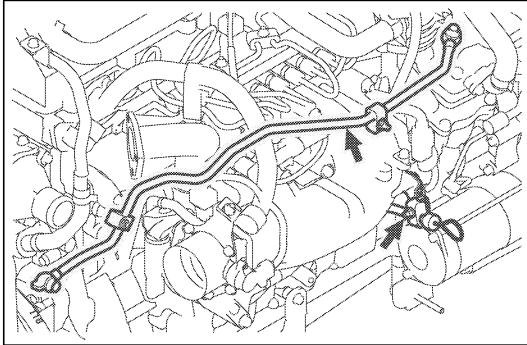
1. INSTALL THE EGR VALVE

- (1) Install the EGR valve to the intake pipe.
Tightening Torque:
55 N·m {560 kgf·cm, 40 lbf·ft}

NOTICE

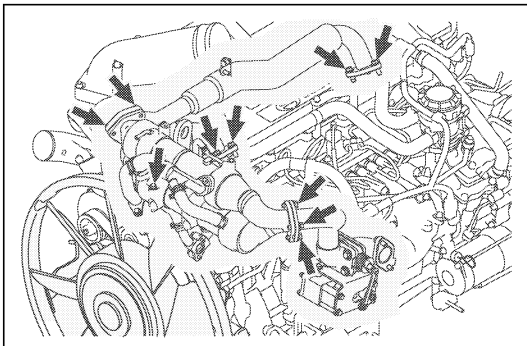
Use a new gasket.

- (2) Install the intake pipe (with EGR valve) to the intake manifold.
Tightening Torque:
28.5 N·m {290 kgf·cm, 21 lbf·ft}



SAPH011061000011

- (3) Install the oil level gauge clamp, water pipe (for air compressor) and intercooler hose to the intake pipe.
 (4) Install the EGR cooler sub Assy.

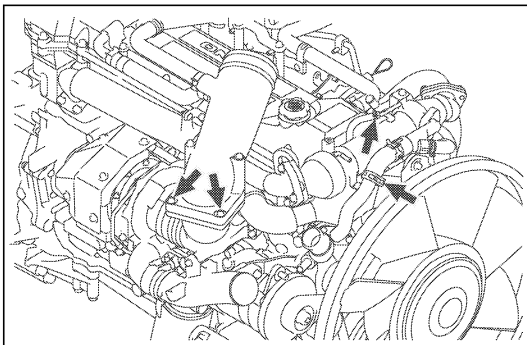


SAPH011061000012

- (5) Install the EGR pipe.
Tightening Torque:
55 N·m {560 kgf·cm, 40 lbf·ft}

NOTICE

Fit the exhaust manifold gasket with the claw of the gasket facing down.

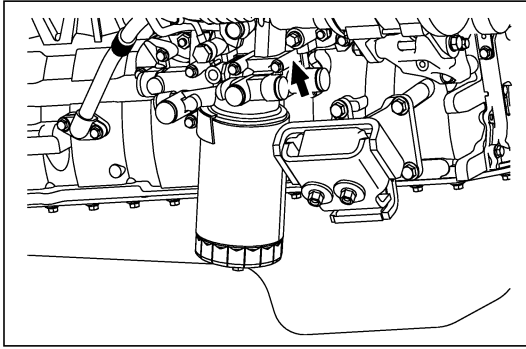


SAPH011061000013

- (6) Connect and install all pipes connected to the EGR pipe as well as coolant hose and related parts.

NOTICE

Install all pipes with new gasket.

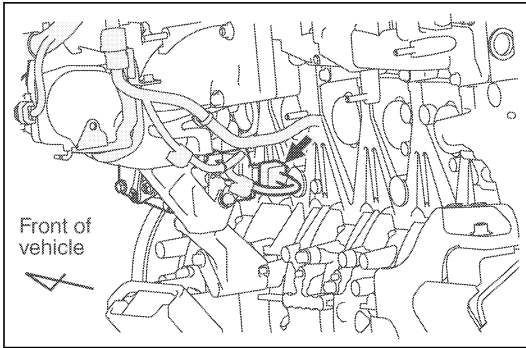


SAPH018041000022

- (7) Close the coolant plug of the oil cooler situated on the right side of the engine.

NOTICE

Fit the exhaust manifold gasket with the claw of the gasket facing down.



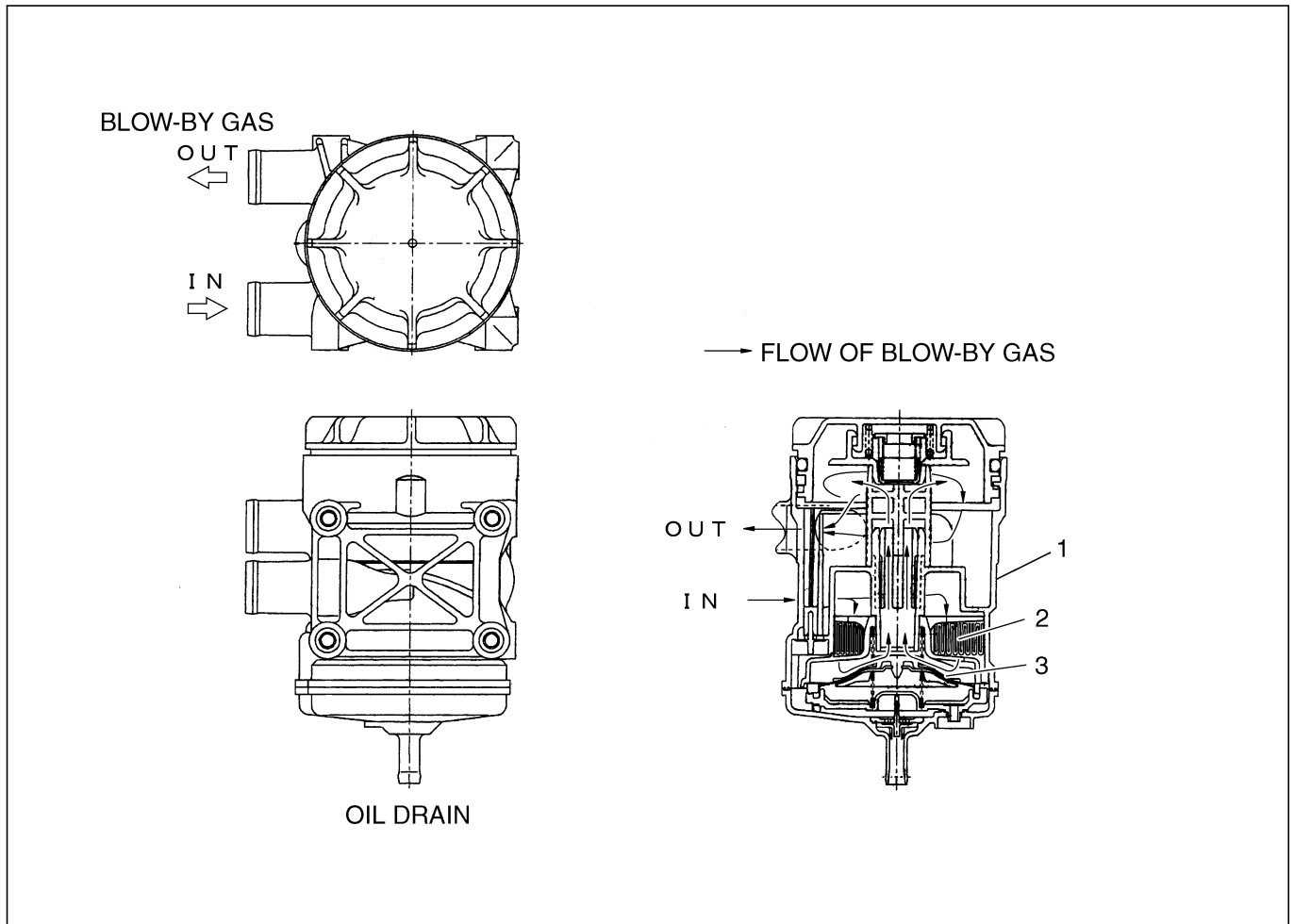
SAPH018041000023

- (8) Connect the harness coupler.

CLOSED VENTILATOR

DESCRIPTION

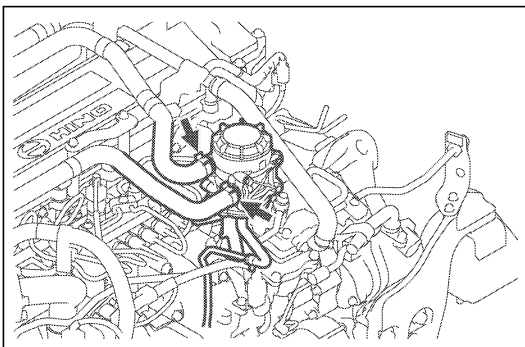
EN0110610C100001



SAPH011061000010

1 Body
2 Filter

3 PCV valve



SAPH018041000024

REPLACEMENT OF CLOSED VENTILATOR

EN0110610H200002

HINT

The closed ventilator is maintenance free.

1. REMOVE THE CLOSED VENTILATOR.
 - (1) Remove the hoses and then the closed ventilator.
2. INSTALL THE CLOSED VENTILATOR.
 - (1) Connect the hoses and install the closed ventilator.

ALTERNATOR (J08E: REMY 12V-100A)

EN11-001

ALTERNATOR.....EN11-2

DATA AND SPECIFICATIONS	EN11-2
TROUBLESHOOTING	EN11-2
COMPONENT LOCATOR.....	EN11-3
SPECIAL TOOL	EN11-6
OVERHAUL	EN11-7
INSPECTION AND REPAIR	EN11-21

ALTERNATOR

DATA AND SPECIFICATIONS

EN011061120001

Nominal voltage	12V
Nominal output	12V-100A
Max. output	105A at 13.5V, 5,000 r/min
Max. rotating	10,000 r/min
Rotating direction	Right (seen from pulley side)
Regulator	Mount-on

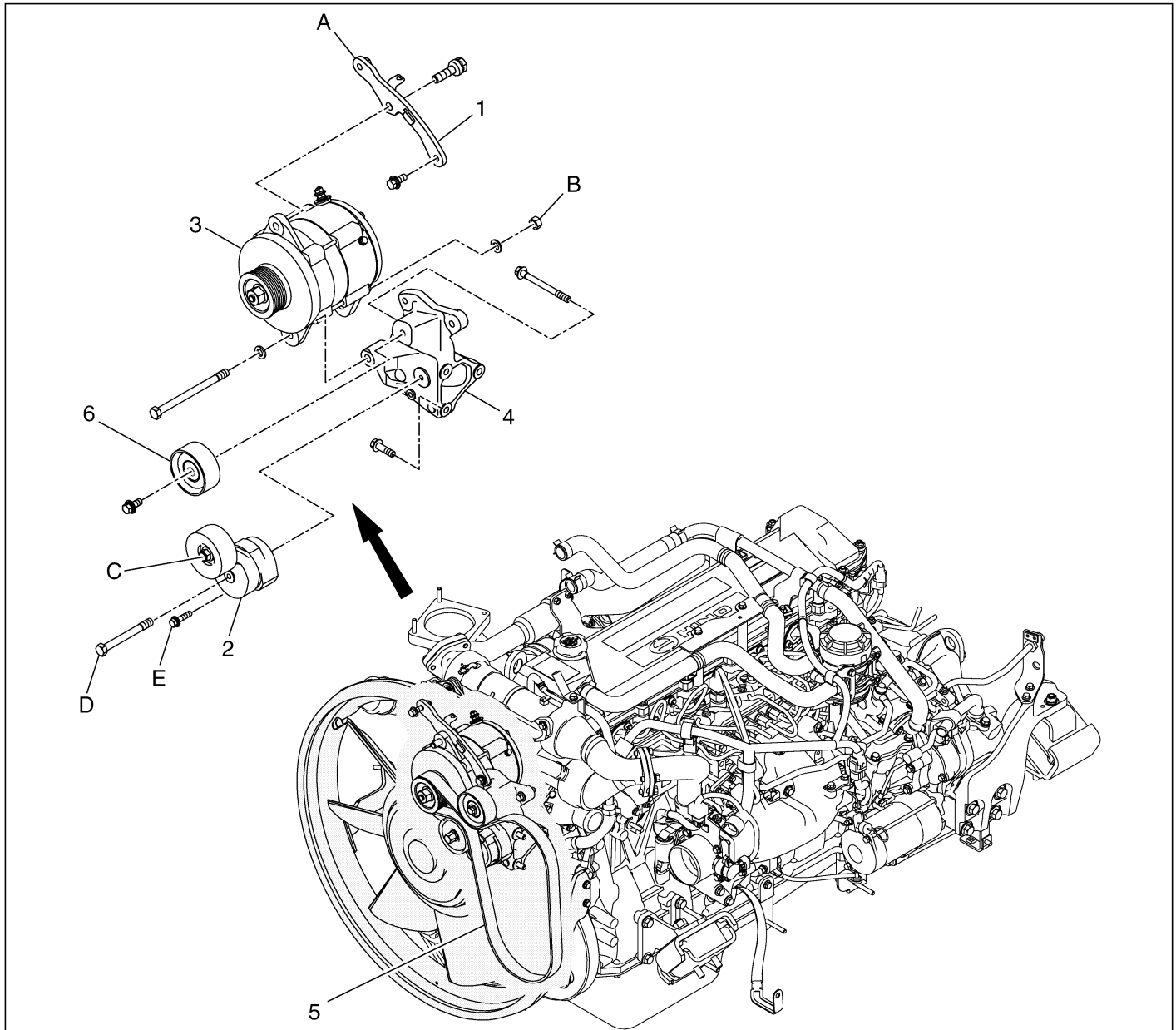
TROUBLESHOOTING

EN0110611F30001

Symptom	Possible cause	Remedy/Prevention
Charge warning lamp does not light with starter switch ON and engine off	Fuse blown	Determine cause and replace fuse
	Lamp burned out	Replace lamp
	Wiring connection loose	Tighten loose connections
	Charge lamp relay faulty	Check relay
	IC regulator faulty	Replace IC regulator
Charge warning lamp does not go out with engine running (Battery requires frequent recharging)	Drive belt loose or worn	Adjust or replace drive belt
	Battery cables loose, corroded or worn	Repair or replace cables
	Fuse blown	Determine cause and replace fuse
	Fusible link blown	Replace fusible link
	Charge lamp relay, IC regulator or alternator faulty	Check charging system
	Wiring faulty	Repair wiring

COMPONENT LOCATOR

EN0110611D100001



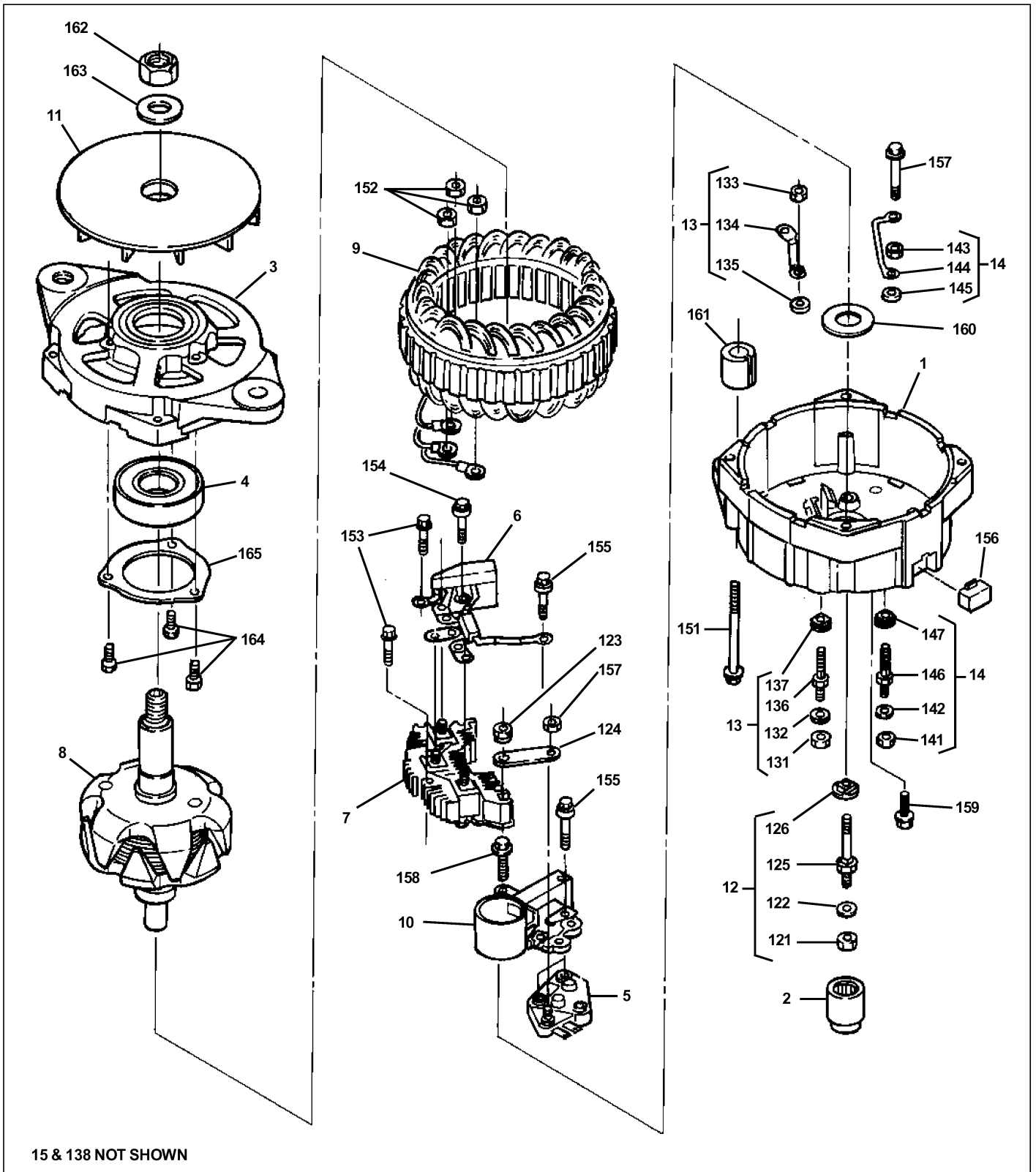
SAPH011061100040

1	Brace	4	Bracket
2	Tensioner pulley	5	V-belt
3	Alternator	6	Tension pully

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A	88 {897, 65}	D	36 {367, 27}
B	93 {948, 69}	E	36 {367, 27}
C	55-70 {561-713, 41-51}		

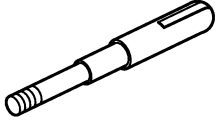


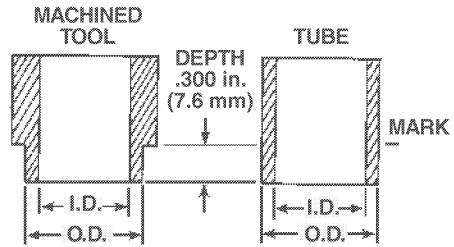
1 Slip Ring End Housing	138 Cap (Not Shown)
2 SRE Roller Bearing Assembly	14 Indicator Terminal Package
3 Drive End Housing	141 Hexagon Nut
4 DE Ball Bearing Assembly	142 Washer
5 Regulator	143 Nut Assembly
6 Auto Start and Trio Assembly	144 Connector
7 Rectifier Assembly	145 Washer
8 Rotor Assembly	146 Terminal Stud
9 Stator Assembly	147 Insulator
10 Brush Holder Assembly	15 Hardware Package (Not Shown)
11 Fan	151 Bolt, Thrn
12 Output Terminal Package	152 Nut, Reetifer Assembly
121 Nut	153 Screw and Washer Assembly
122 Washer	154 Screw, Insulated Rectifier
123 Nut	155 Screw, Insulated Regulator
124 Connector	156 Cover
125 Terminal Stud	157 Nut Assembly
126 Insulator	158 Screw and Washer Assembly
13 Relay Terminal Package	159 Screw Assembly
131 Hexagon Nut	160 Washer
132 Washer	161 Bushing
133 Nut Assembly	162 Hexagon Nut
134 Connector	163 Washer
135 Washer	164 Screw and Washer Assembly
136 Terminal Stud	165 Retainer Plate
137 Insulator	

SPECIAL TOOL

EN0110611K100001

Prior to starting an alternator overhaul, it is necessary to have this special tool.

Illustration	Part number	Tool name	Remarks
	S0944-41210	COMPRESSION GAUGE	

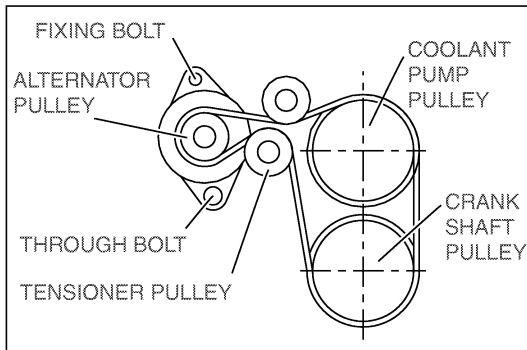


FOR PRESSING THE
SRE ROLLER BEARING

O.D. MAX 0.935 in. (25.5 mm)
I.D. MIN. 0.745 in. (19.0 mm)
DEPTH (MARK) 0.300 in. (7.6 mm)

OVERHAUL

EN0110611H200001



IMPORTANT POINTS - DISMOUNTING

1. REMOVE THE ALTERNATOR.

- (1) Remove the drive belt.
- (2) Remove the through bolt and the fixing belt.

NOTICE

To remove the belt, turn the nut of the tension pulley with a wrench in counterclockwise direction to turn the tension pulley in arrow direction. Then the belt becomes loose and can be removed.

⚠ CAUTION

As the belt is under tension, take care not to get your hand caught at the time of removal.

Failure to disconnect negative battery cable at battery before removing or attaching alternator "BAT" terminal lead may result in an injury. If a tool is shorted at alternator "BAT" terminal, the tool can quickly heat enough to cause a skin burn.

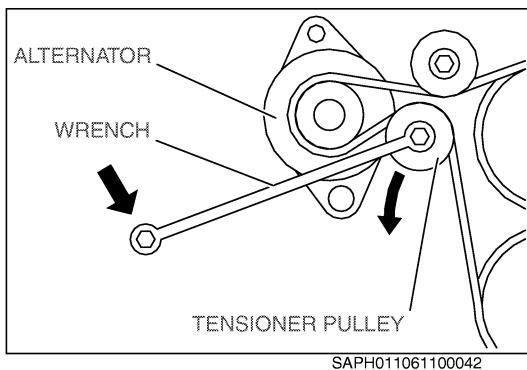
NOTICE

Always reinstall fasteners at original location. If necessary to replace fasteners, use only correct part number or equivalent.

- If correct part number is not available, use only equal size and strength. For alternator internal fasteners, refer to Delco Remy America Standard Hardware Fasteners section in Service Parts Catalog.
- Fasteners that are NOT to be reused will be noted in procedure.
- Fasteners requiring thread locking compound will be noted in procedure.
- Use specified torque values when shown.

Using or replacing fasteners in any other manner could result in part or system damage.

If diagnosis determines that alternator repair is needed, remove alternator from engine according to manufacturer's instructions.



IMPORTANT POINTS - MOUNTING

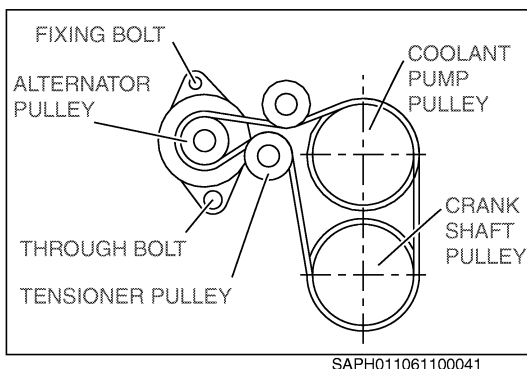
1. INSTALL THE ALTERNATOR.

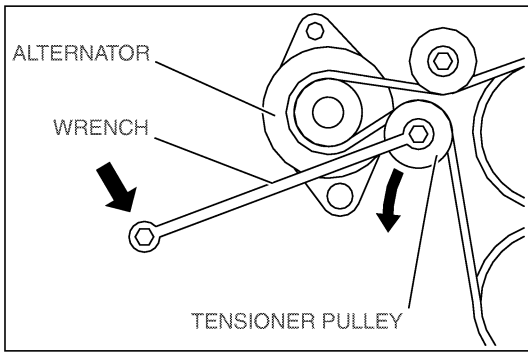
- (1) Install the alternator with through bolt and fixing bolt.

Tightening Torque:

Through bolt: 93 N·m {948 kgf·cm, 69 lbf·ft}

Fixing bolt: 88 N·m {897 kgf·cm, 65 lbf·ft}



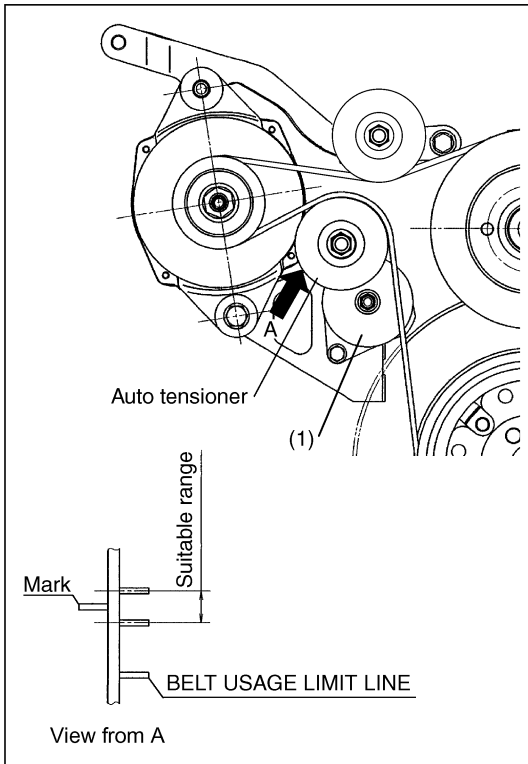


SAPH011061100042

(2) Install the drive belt.

NOTICE

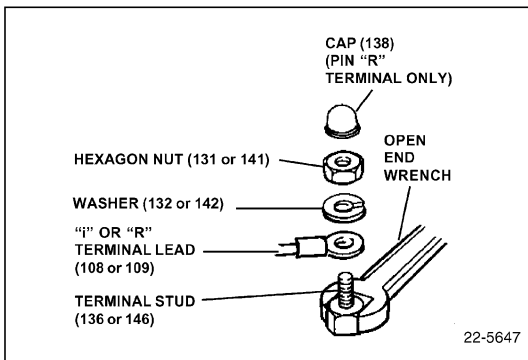
- Turn the tension pulley in the same way as for the belt removal and install the belt.



SAPH011061100043

NOTICE

- When installing the drive belt, use the gauge on the belt tensioner (1) to confirm that the tensioner arm is correctly positioned. (View from A.)



SAPH011061100010

2. INSTALL OR CONNECT

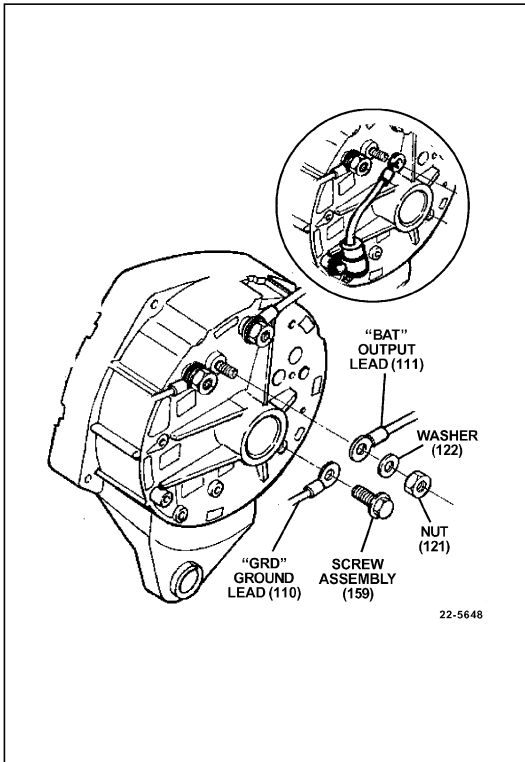
- (1) "I" and/or "R" terminal lead(s) (108 or 109), if used, to threaded terminal stud(s) (136 and/or 146), washer(s) and hexagon nut(s) (131 and/or 141).

NOTICE

Use suitable open end wrench to hold nut portion of terminal stud(s) (125, 136 and/or 146).

Tightening Torque:
 2.0 N·m {20 kgf·cm, 20 lbf·in}

- (2) Cap (138) to the "R" (or "Relay") pin terminal stud (146A) if necessary.

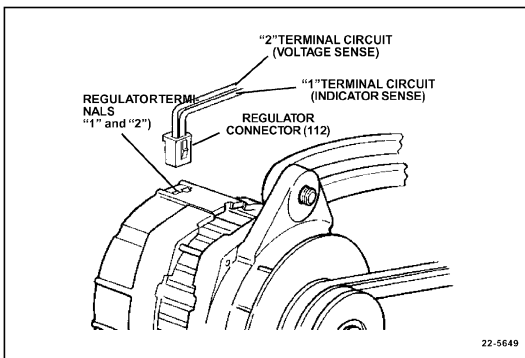


SAPH011061100011

- (3) Ground lead (110) to "GRD" hole in SRE housing (1), with screw assembly (159).

Tightening Torque:**6 N·m {61 kgf·cm, 55 lbf·in}**

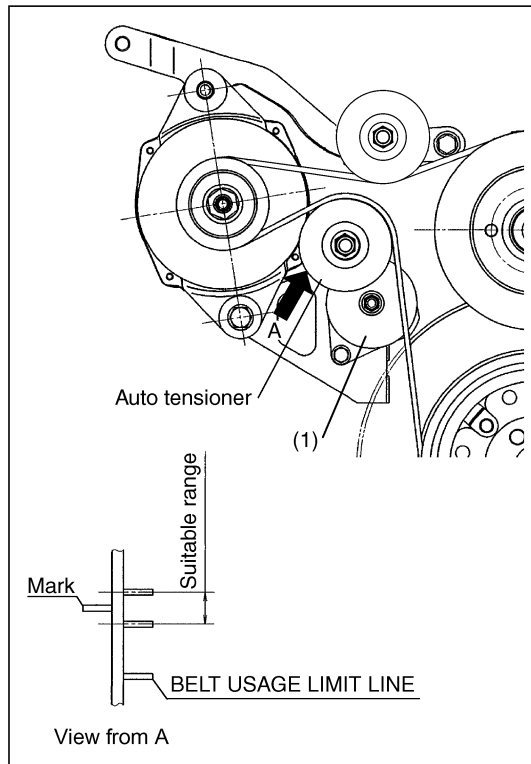
- (4) "BAT" output lead (111), washer (122) and nut (121) to "BAT" terminal stud (125).

Tightening Torque:**11 N·m {112 kgf·cm, 100 lbf·in}**

SAPH011061100012

- (5) For 3-wire systems only, regulator connector (112) to regulator (5) terminals "1" and "2".

- (6) Negative cable at battery. Follow vehicle manufacturers instructions.

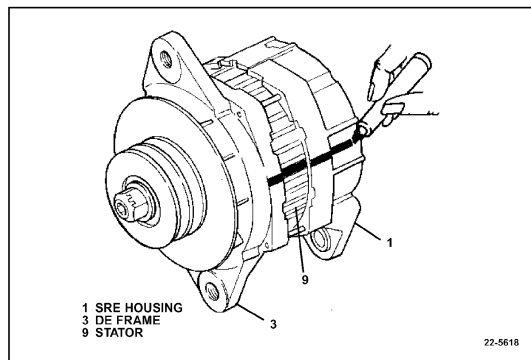


SAPH011061100043

IMPORTANT POINTS - ON - VEHICLE INSPECTION

1. INSPECT THE DRIVE BELT

If the indicator (engraved line) is out of the belt usage limit line, or if the belt is damaged, replace the belt.



22-5618

SAPH011061100014

IMPORTANT POINTS - DISASSEMBLY

NOTICE

On some alternators on certain engine configurations, a 1.5 μ f capacitor has been installed to the output terminal and attached with a 3/8" long self tapping screw. Remove the screw and capacitor (DRA1985444) Before disassembly.

1. ALTERNATOR

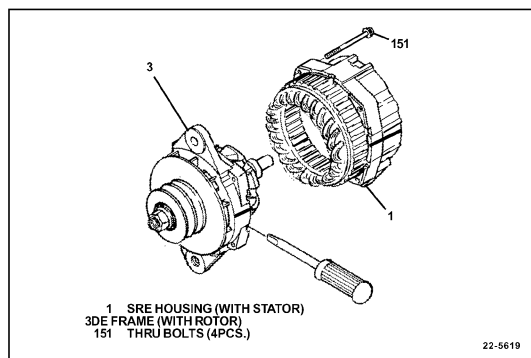
(1) Place alignment mark across slip ring end (SRE) housing (1) and drive end (DE) frame (3) for reassembly after unit repair.

(2) Remove 4 thru bolts (151) from DE frame (3) and SRE housing (1).

(3) Separate DE frame (3) (with rotor) from SRE housing (1) (with stator). If necessary, carefully pry DE frame from edge of stator with screwdriver. After separation, place tape over brush holder assembly (10) opening inside unit to prevent dirt from entering bearing during checks.

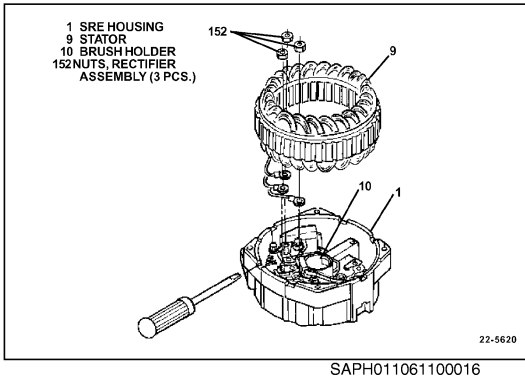
2. SRE HOUSING AND COMPONENTS.

(1) Inspect SRE housing (1) for loose connections or other obvious conditions. Correct as necessary. If none are found, proceed with SRE housing checks.



22-5619

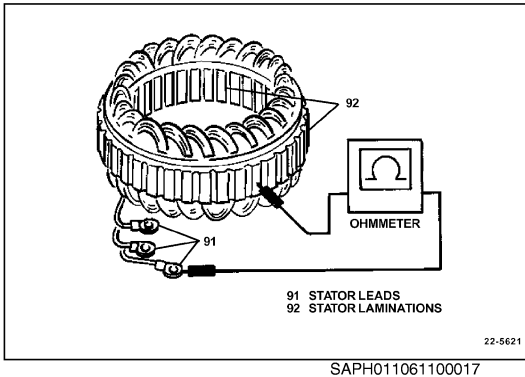
SAPH011061100015



- (2) Remove 3 rectifier assembly nuts (152) to disconnect stator (9). Lift stator from SRE housing (1) assembly. If necessary, carefully pry stator away from SRE housing with screwdriver.
- (3) Inspect stator winding for a dark, burned appearance. View winding from inside of unit - black paint on outside of windings does not indicate burned windings. If all windings are uniform in color and varnish covering is not flaking off, proceed with electrical check. If some windings are dark and others are light, a shorted, open or grounded condition is indicated. Replace the stator.

NOTICE

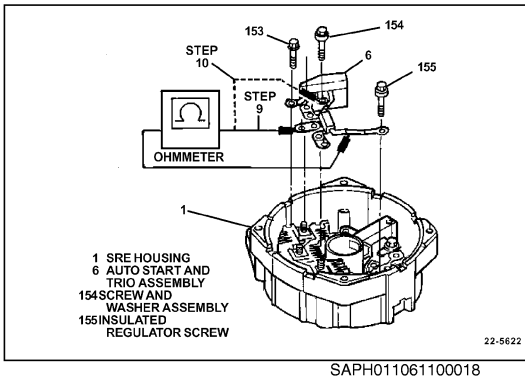
The stator should also be replaced if the windings are uniformly dark and burned, with the varnish coating flaking off to expose bare wires.



- (4) Perform electrical check on stator. Use ohmmeter or 110-volt test lamp. There should be no continuity between any of the stator leads (91) and the stator laminations (92).

If continuity is present, windings are grounded. Replace stator.

If there is no continuity, stator is probably good. However, there is no service electrical check for shorted or open delta stator windings. If all other electrical checks are normal and the alternator did not produce within 15 amps of the rated output, a shorted or open stator is indicated and the stator is to be replaced.



- (5) Remove one insulated regulator screw (155) one screw and washer assembly (154) and insulated rectifier screw (154), to disconnect auto start and trio assembly (6). Lift trio assembly from SRE housing (1) assembly.

NOTICE

Wherever "Ohmmeter" is specified for use when checking diodes, the "Diode Test Functions" setting should be used for "Digital Type" multimeters.

- (6) Use ohmmeter to check diode trio in assembly. Place negative ohmmeter lead on regulator strap and use positive ohmmeter lead to check for continuity to each of the three rectifier straps. All three readings should indicate continuity. Reverse the ohmmeter leads and perform checks again. Readings should all indicate open circuits.

If all readings are proper, diode trio is good.

If any reading is wrong, replace auto start and trio assembly (6).

- (7) Use ohmmeter to check auto start and trio assembly. Place negative lead of ohmmeter on regulator strap and positive lead to auto start and trio assembly B+ terminal.

The meter should indicate open circuit. Reverse the ohmmeter leads and the reading should indicate continuity.

If either reading is incorrect, replace the auto start and trio assembly (6).

If both readings are correct continue to Step (8).

- (8) Use ohmmeter to check rectifier assembly (7). Rectifier assembly may be checked in the SRE housing (1) without disassembly. Check 6 diodes as follows:

- a. Place negative ohmmeter lead on grounded heat sink (71). Touch positive ohmmeter lead firmly to metal diode clips (73) that surround each of the 3 threaded studs. All 3 readings should be the same, and indicate open circuits. Switch leads and repeat. All 3 new readings should indicate continuity.
- b. Repeat checks using (positive) insulated heat sink (72). With negative ohmmeter lead on insulated heat sink, all 3 readings should indicate continuity. Switch leads and repeat. All 3 new readings should indicate open circuits.

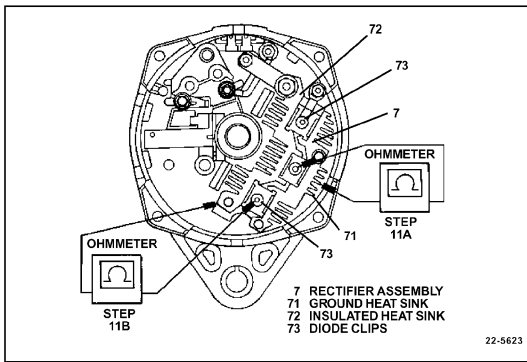
If all readings are correct, the rectifier assembly is good.

If any reading is wrong, an open or shorted diode is indicated and rectifier assembly (7) should be replaced. Remove nut (123), nut assembly (157) and connector (124) from terminal stud (125). Remove nut assembly (133), connector (134), washer (135) and screw and washer assembly (153). Lift rectifier assembly (7) from SRE housing (1).

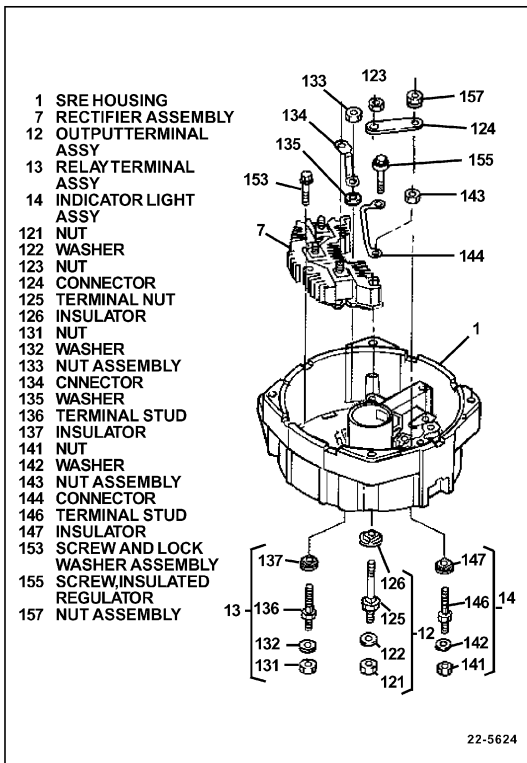
Remove nut assembly (143) and connector (144) as necessary for clearance.

NOTICE

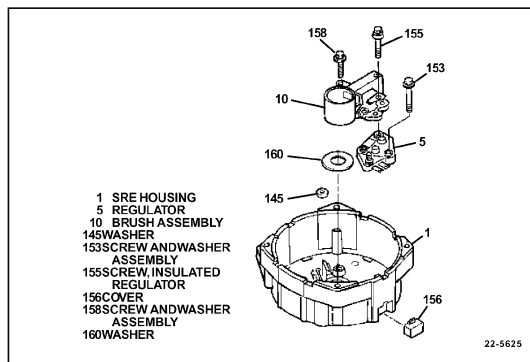
Hold brushes in retracted position and insert brush pin to keep brushes in retracted position.



SAPH011061100019



SAPH011061100020

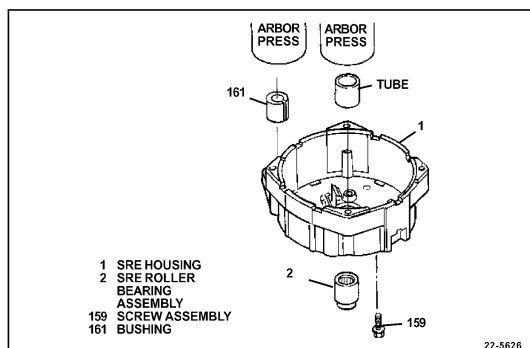


SAPH011061100021

- (9) Brush holder assembly (10) must be removed to service brushes or regulator (5). Remove cover (156) and insulated regulator screw (155). Remove screw and washer assembly (153). Lift brush holder assembly (10) from SRE housing. Remove washers (145 & 160) with care to prevent contamination of bearing grease.

Place tape over bearing to keep dirt out.

- (10) Inspect brushes and brush holder assembly for wear, cracks, broken leads or other damage. If damaged replace with a new brush holder assembly (10).

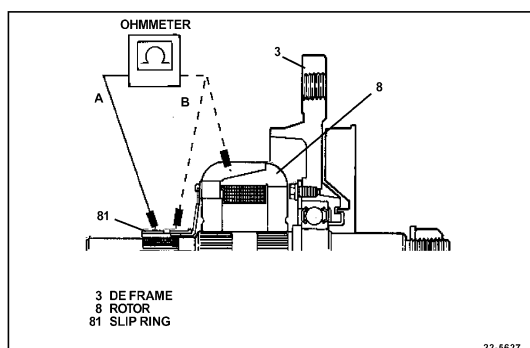


SAPH011061100022

- (11) Remove remaining screw and washer assembly (153) attaching regulator (5). If previous checks lead to an instruction to replace the regulator, replace it. If it is not known whether regulator is good, use an approved tester for SI-type regulators. Always check field coil for shorts when replacing regulator.

- (12) Remove protective tape and check SRE roller bearing assembly (2) in SRE housing (1). Bearing is permanently lubricated; do not add grease. If bearing is dry or damaged, replace bearing. To remove bearing, use tube slightly smaller than opening in SRE housing (1) and press bearing through to inside of housing. If bearing is not replaced, put tape back over bearing.

Remove screw assembly (159) and press bushing (161) from SRE housing (1) if required.



SAPH011061100039

3. DE FRAME AND COMPONENTS

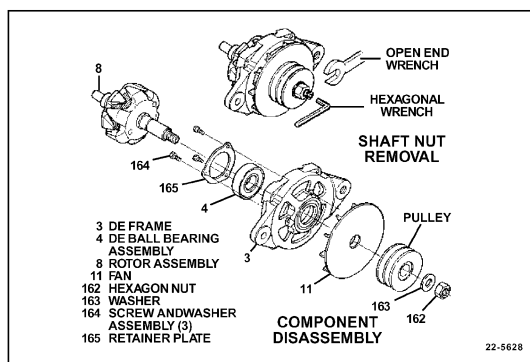
- (1) Use ohmmeter to check rotor field resistance. Place ohmmeter leads on the two slip rings on the rotor shaft to make this check .

NOTICE

A 12V battery, voltmeter and ammeter may be used to check rotor current draw to specifications. Read the meters quickly. Core resistance will change as the core heats up from the current flow.

Refer to 22 SI Alternator Specifications at the end of this manual for proper value. Also use ohmmeter to check for a grounded field by touching one lead (A) to a slip ring (81) and one lead (B) to rotor frame (82) assembly. Reading should be infinite (open) to show that field is not grounded. If field resistance is outside specifications or if field is grounded, replace rotor assembly (8).

- (2) Hold DE frame (3) and spin rotor assembly (8) by hand to see that it spins freely in DE ball bearing assembly (4). Bearing is permanently lubricated; do not add grease. If movement is rough or wobbly, replace bearing.
- (3) Remove hexagon nut (162) by placing 5/16" hexagonal wrench in end of rotor assembly (8) shaft to hold while removing nut with open end wrench. Turn nut counterclockwise to remove. If hex wrench is not available, wrap rotor assembly in shop cloth and place in vise, tightening just enough to hold while removing hexagon nut.
- (4) Lift washer (163), pulley and fan (11) from rotor assembly shaft.
- (5) Remove rotor assembly (8) from DE frame (3) assembly ball bearing.



SAPH011061100023

If rotor checked good electrically (step 16), inspect slip rings. If rough or out of round, turn in lathe, removing only enough material to make rings smooth and round. Maximum indicator reading for roundness is 0.025 mm (0.001"). Finish with 600 grain polishing cloth. Blow away

all copper dust. Clean shaft of any grease that may have accumulated copper dust.

- (6) Remove three screw and washer assemblies (164) and retainer plate (165) from DE frame (3).
- (7) Inspect DE ball bearing assembly (4). If bearing appears dry or if rotor assembly (8) did not turn smoothly when checked during DE frame disassembly, remove and replace bearing. Bearing is permanently lubricated. Do not attempt to add grease.

IMPORTANT POINTS - ASSEMBLY

1. DE FRAME AND COMPONENTS

- (1) Install or Connect
 - a. DE ball bearing assembly (4) and retainer plate (165) to DE frame (3) with three screw and washer assemblies (164).

Tightening Torque:

3.0 N·m {31 kgf·cm, 26 lbf·in}

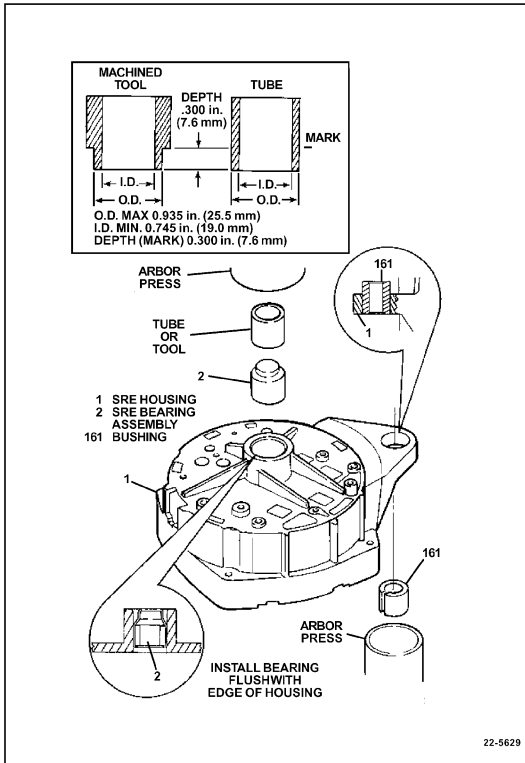
- b. Rotor assembly (8) into DE housing (3) assembly.
- c. Fan (11), pulley, washer (163), and hexagon nut (162) onto rotor assembly (8) shaft.

Tightening Torque:

100 N·m {1,020 kgf·cm, 75 lbf·ft}

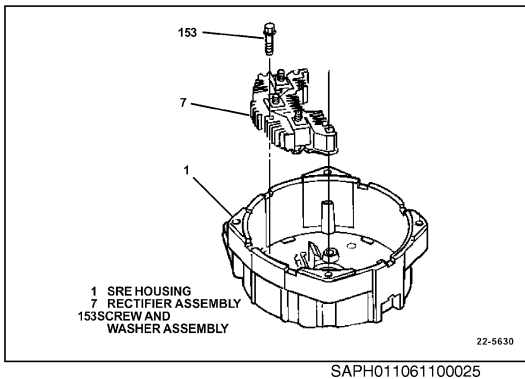
NOTICE

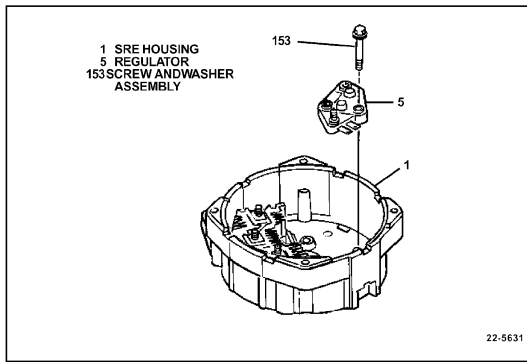
Hold shaft with 5/16" hexagonal wrench in socket end or wrap rotor assembly in shop cloth and tighten in vise just enough to hold while tightening hexagon nut.



2. SRE HOUSING AND COMPONENTS

- (1) Install or Connect
 - a. Lightly lubricate outside surface of bushing (161). Press bushing into hole in lug on SRE housing (1). Install bushing flush with inside of lug to allow maximum distance between two hinge lugs for mounting. Final position of hinge bushing will be adjusted during installation.
 - b. SRE roller bearing assembly (2) into SRE housing (1). Use suitable tube or tool to press SRE roller bearing in position, flush with outside lip of SRE housing. Cover opening in bearing with piece of tape to prevent dirt from entering during rest of procedure.
 - c. Rectifier assembly (7) to SRE housing (1) assembly. Install one screw and washer assembly (153) through rectifier assembly grounded heat sink into SRE housing. Finger tighten.





SAPH011061100026

(2) Inspect

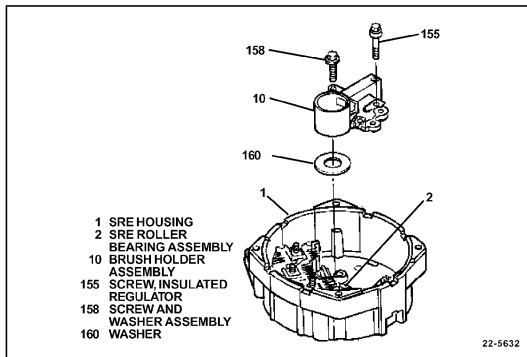
- a. Regulator mounting area in SRE housing (1) assembly for presence of grease or dirt. Good electrical contact is necessary in this area.

NOTICE

Do not immerse or wet regulator (5) with solvent. Internal damage to regulator could result.

(3) Clean

- a. Regulator mounting bosses in SRE housing (1) assembly, metal base plate and contact rings on regulator (5) by wiping with clean, dry cloth.



SAPH011061100027

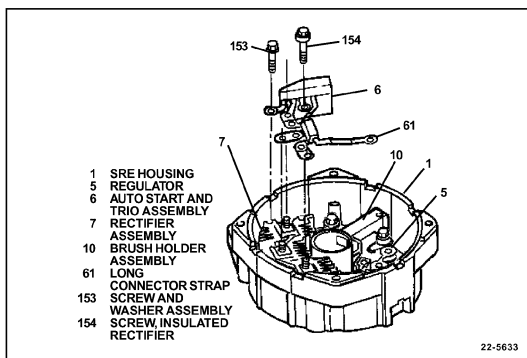
(4) Install or Connect

- a. Regulator (5) to SRE housing (1) assembly, with screw and washer assembly (153). Finger tighten.

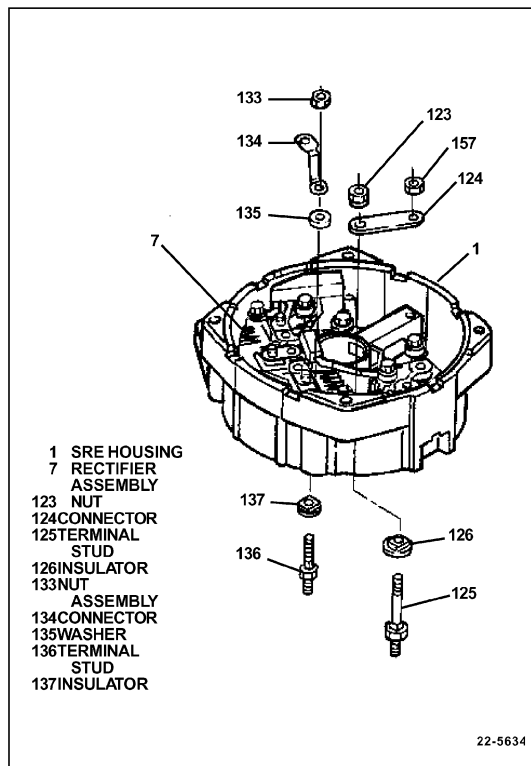
NOTICE

Remove the tape previously installed over the roller bearing assembly (2).

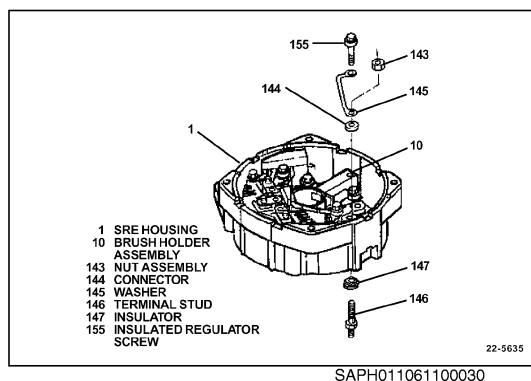
- b. Felt washer (160) so the hole is centered over the SRE roller bearing assembly (2).
- c. Brush holder assembly (10) with screw and washer assembly (158) and insulated regulator screw (155) nearest housing. Finger tighten.
- d. Tape over brush holder assembly (10) opening to protect bearing from dirt.
- e. Auto start and trio assembly (6) onto 3 threaded studs on rectifier assembly (7). Position auto start and trio assembly (6) with long connector strap (61) over closest mounting hole in brush holder (10) and regulator (5).
- f. Screw and washer assembly (153) and insulated rectifier screw (154) through auto start and trio assembly (6). Finger tighten.



SAPH011061100028



- g. Insulator (126) into "BAT" hole in SRE housing (1) assembly from the outside. Be sure square flange on insulator is seated in hole. Put terminal stud (125) through hole in insulator and add connector (124) and finger tighten nut (123) over exposed terminal stud (125) threads in rectifier assembly (7).
- h. Connector (124) exposed hole over threaded stud of regulator (5) and add nut (157). Finger tighten.
- i. Insulator (137) into "R" hole in SRE housing (1) from outside. Be sure square flange on insulator is seated in hole. Put terminal stud (136) through hole in insulator and add washer (135), connector (134) and finger tighten nut (133) over exposed terminal stud threads in rectifier assembly (7).



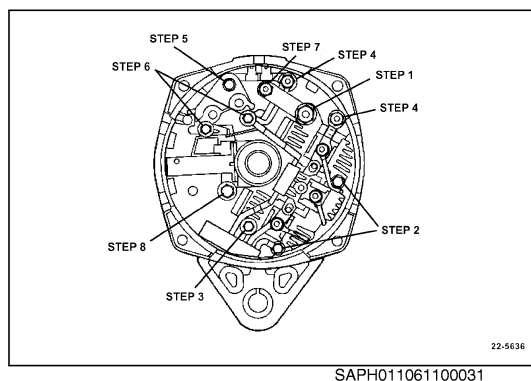
- j. Insulator (147) into "I" hole in SRE housing (1) assembly from the outside. Be sure square flange on insulator is seated in hole. Put terminal stud (146) through hole in insulator and add washer (145), connector (144) and finger tighten nut (143) over exposed terminal stud (146) threads inside SRE housing (1) assembly. Position other end of connector (144) over remaining mounting hole in brush holder assembly (10).
- k. Insulated regulator screw (155) through long connector strap (61) of auto start and trio assembly (6) and exposed hole of connector (144) into remaining mounting hole in brush holder assembly (10). Finger tighten.

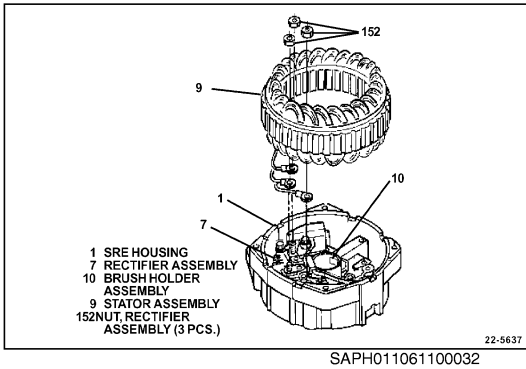
NOTICE

Secure SRE housing component fasteners in following order.

Tighting Torque

1	Nut (123) : 5.5 N·m {56 kgf·cm, 50 lbf·in}
2	Rectifier assembly (7) attaching screw and washer assembly (153) (2 places) : 3.0 N·m {31 kgf·cm, 25 lbf·in}
3	Insulated rectifier screw (154) : 2.5 N·m {25 kgf·cm, 22 lbf·in}
4	"R" and "I" terminal nut assemblies (133 & 143) : 2.5 N·m {25 kgf·cm, 22 lbf·in} It may be necessary to hold terminals on outside while tightening.
5	Screw and washer assembly (153) : 2.0 N·m {20 kgf·cm, 20 lbf·in} to ground the regulator (5).
6	Insulated regulator screws (155) (2 places) : 2.0 N·m {20 kgf·cm, 20 lbf·in}
7	Nut assembly (157) : 2.5 N·m {25 kgf·cm, 22 lbf·in}
8	Screw and washer assembly (158) : 2.0 N·m {20 kgf·cm, 20 lbf·in}





(5) Install or Connect

- Stator (9) to SRE housing (1) assembly, placing 3 phase leads over 3 threaded studs on rectifier assembly (7). Be sure stator is seated in register around edge of SRE housing.
- Rectifier assembly nuts (152) to 3 threaded studs on rectifier assembly (7).

Tightening Torque:
2.5 N·m {25 kgf·cm, 22 lbf·in}

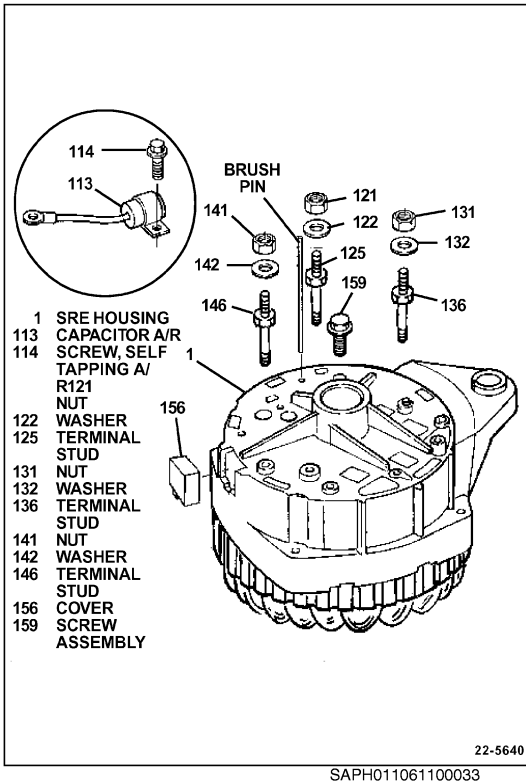
3. FINAL UNIT ASSEMBLY

(1) Clean

- Brushes in brush holder assembly (10) by removing tape and wiping brushes with clean soft cloth. Contact surfaces of brushes must be free of grease and other contaminants.

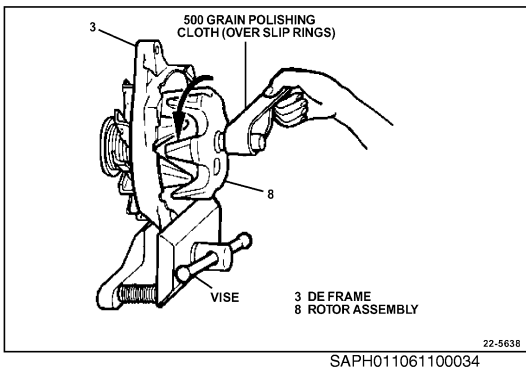
(2) Install or Connect

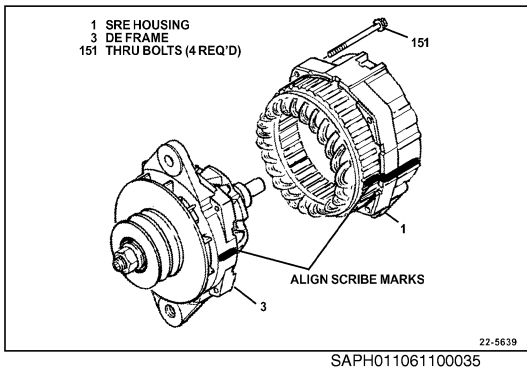
- Pin (or straightened paper clip) through SRE housing (1) assembly to hold brushes in retracted position.
- Cover (156) onto regulator terminals in hole "1" and "2". For one-wire systems only.
- Washer (122) and nut (121) onto "BAT" terminal stud (125). Finger tighten.
- Washer (132) and nut (131) onto "R" terminal stud (136). Finger tighten.
- Washer (142) and nut (141) to "I" terminal stud (146). Finger tighten.
- Screw assembly (159) into "GRD" hole in SRE housing. Finger tighten.
- As required, Capacitor (113) with self tapping screw (114) securely into hole in SRE housing (1).



(3) Clean

- Slip rings on rotor assembly (8) shaft (if not previously cleaned) by spinning rotor while holding 500 grain polishing cloth or 600 grit sandpaper around slip rings. Blow away all copper dust.
- Rotor assembly (8) shaft where it will slip into SRE housing (1) roller bearing assembly by wiping with soft cloth. Shaft must be free of dirt, copper dust and other foreign material.





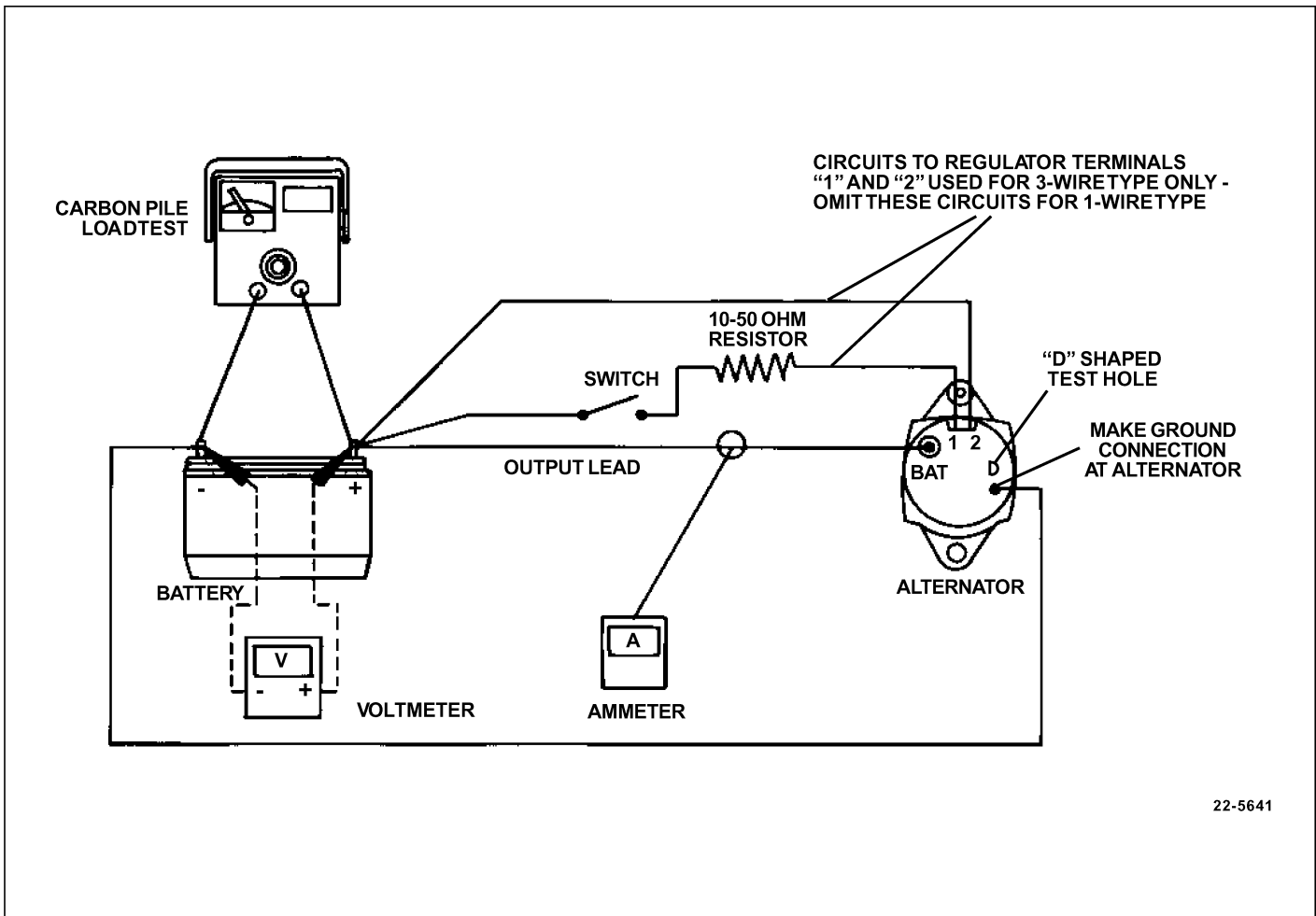
(4) Install or Connect

- a. DE frame (3) assembly to SRE housing (1) assembly, aligning marks made earlier on SRE housing and DE frame. If mark was lost due to part replacement, use mark on old part or match mounting lugs to application to determine proper frame orientation.
- b. Thru bolts (151) through 4 holes in SRE housing and DE frame. Finger tighten.

Tightening Torque:**11.0 N·m {112 kgf·cm, 100 lbf·in}**

(5) Remove or Disconnect

- a. Remove brush pin from SRE housing (1) assembly to release brushes onto slip rings inside unit.

IMPORTANT POINTS - INSPECTION**1. PERFORMANCE TEST****TEST EQUIPMENT NEEDED:**

- Alternator Test Stand (5000 rpm capability) (5HP min.)
- Battery or Battery Set (fully charged)
- Variable Carbon Pile Load Test
- Ammeter (current capability at least 15 amps higher than alternator rating)

- Voltmeter
- Ohmmeter

This bench test procedure is used to verify that the alternator is functioning properly prior to installation on the vehicle. The test checks the alternator output in the same manner as the Rated Output Check covered earlier in the "Troubleshooting" procedure. If bench test equipment is not available, install the alternator on the engine according to manufacturer's instructions and repeat the Rated Output Check to verify alternator operation. If bench test equipment is available, proceed as follows:

- (1) Mount alternator in suitable test stand, according to test stand manufacturer's instructions. Test stand must be capable of driving alternator at speeds up to 5000 rpm.

NOTICE

When a 12-volt carbon pile load test is used to diagnose a 24-volt system, attach load test only to 12-volt potential in battery set. Attaching a 12-volt load test to a 24-volt potential will damage the load test.

HINT

Battery or battery set must be fully charged for test results to be valid.

- (2) With carbon pile load turned off and with battery or battery set fully charged, make electrical connections as shown in Figure 35. Connect for one-wire or 3-wire type as applicable. Battery voltage and ground polarity must be same as system in which alternator is used. Check and record battery voltage before proceeding with test.
- (3) Turn on "1" terminal circuit switch (3-wire systems only). With carbon pile load "off" start test stand and slowly increase alternator speed to 5000 rpm. Observe voltmeter.

If voltage does not increase but remains at or below previous reading step (2), there is no alternator output. Skip to step (5).

If voltage increases above 15.5 volts on 12-volt system (or above 31 volts on 24-volt system), voltage is uncontrolled. Recheck alternator for proper assembly. Assure that test tab in "D" hole is not grounded. If alternator has been assembled properly, replace regulator as described under Unit Repair and test field coil for shorts or grounds.

If voltage is proper, proceed to next step.

- (4) With alternator running at about 5000 rpm, turn on carbon pile load and adjust to obtain maximum alternator output on ammeter.

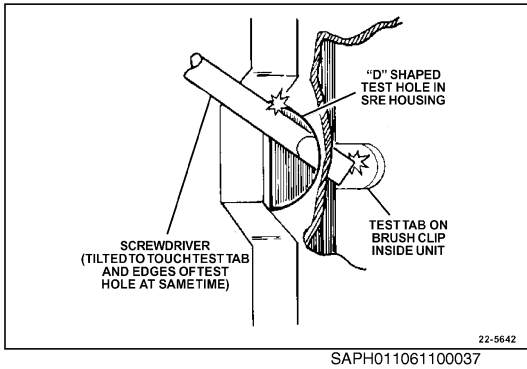
If ammeter reading is within 15 amps of cold output shown under "Alternator Specification", then alternator is good.

Turn off carbon pile and stop test stand.

If ammeter reading is more than 15 amps below the specification, alternator is not operating properly.

NOTICE

Do not insert screwdriver more than 3/4" into "D" shaped test hole during this step. The grounding tab on the brush holder assembly is reached at this distance. Inserting the screwdriver deeper may result in internal damage to the alternator.

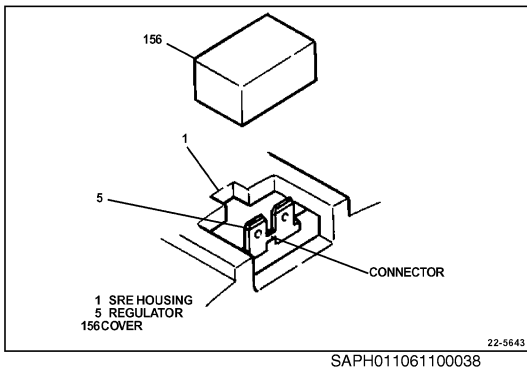


- (5) Test hole is provided in SRE housing to allow direct grounding of rotor field circuit. Grounding the brush tab inside this hole bypasses the regulator and turns the alternator on in "full field" mode. If the alternator output is proper with the brush tab grounded, the previous low output is due to conditions within the regulator. Because the voltage is not regulated and can exceed 16 volts in full field mode, the test hole should be used only for bench test procedures.

Insert screwdriver straight into test hole in SRE housing assembly to make contact with tab on brush clip. Tilt handle slightly to ground tab to housing at edge of test hole and hold. Again adjust carbon pile to obtain maximum output on ammeter without allowing voltage on voltmeter to rise above 15 volts on 12-volt system (30 volts on 24-volt system). Record reading then turn off carbon pile and stop test stand.

If there is still no output, check rotor and brushes for an open circuit. Be sure that brushes are assembled properly and in contact with the slip rings. Check internal electrical connections to be sure grounding and insulated mounting screws are installed in the proper locations.

For a one-wire system only, remove the cover (156) from the regulator terminal and verify that there is a connector between the terminals. If not, replace regulator.



If the output is now within 15 amps of the cold output in "22 SI Alternator Specifications", but was not when checked per step 4, check the regulator mounting to assure that grounding and insulated mounting screws are installed in the proper location. If assembly is proper, replace regulator.

If there is some alternator output, but it is still more than 15 amps below the cold output specification, check the rotor field, brushes, stator, diode trio, and rectifier bridge.

PRECAUTIONS

1. PRECAUTIONS DURING OPERATION

- Do not disconnect the battery while the alternator is rotating.
- Do not operate the alternator with the alternator's B terminal (output terminal) disconnected.
- Do not expose the alternator to water.

2. OTHER PRECAUTIONS

- Make sure to disconnect the battery terminal before inspecting the alternator.
- Do not interchange the polarity of the battery cables when replacing the battery.
- Make sure to disconnect the cables and charge the battery separately when using a quick charger.
- Never perform a megger tester on the alternator assembly.
- Make sure to disconnect the wiring to the alternator when performing a megger test on the vehicle's wiring.

INSPECTION AND REPAIR

EN0110611H300001

Rotor Field Coil Specifications at 80°F (27°C).

Alternator Model	Ohms	Amps @ Volts	
12V/100A	1.6-1.9	6.4-7.5	12

For further information on rotations and exact specification number on these or other Delco Remy America Products Call: 1-800-DRA-0222

Cold current output at 80°F.

Alternator	Amperes @ 80°F	
Model	1600rpm	5000rpm
12V/100A	60	100

ALTERNATOR (J08E: 12V-105A)

EN11-002

ALTERNATOR.....EN11-2

DATA AND SPECIFICATIONS	EN11-2
TROUBLESHOOTING	EN11-2
COMPONENT LOCATOR.....	EN11-3
SPECIAL TOOL	EN11-5
OVERHAUL	EN11-6
INSPECTION AND REPAIR	EN11-17

ALTERNATOR

DATA AND SPECIFICATIONS

EN01Z0111I200001

Nominal voltage	12V
Nominal output	12V-105A
Max. output	105A at 13.5V, 5,000 r/min
Initial output starting speed	1,370 r/min at 13.5V
Max. rotating	10,000 r/min
Rotating direction	Right (seen from pulley side)
Regulator	Mount-on

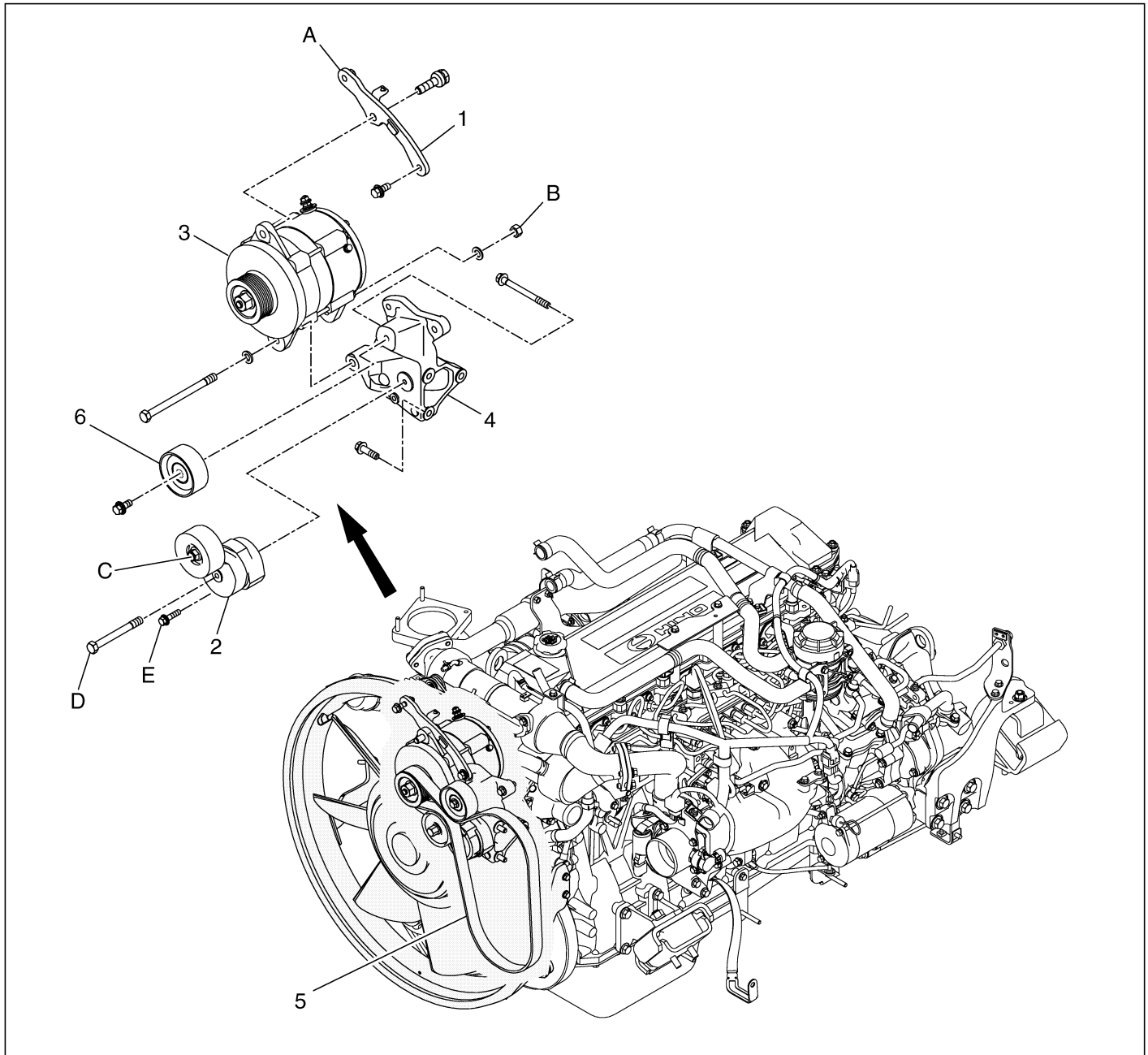
TROUBLESHOOTING

EN01Z0111F300001

Symptom	Possible cause	Remedy/Prevention
Charge warning lamp does not light with starter switch ON and engine off	Fuse blown	Determine cause and replace fuse
	Lamp burned out	Replace lamp
	Wiring connection loose	Tighten loose connections
	Charge lamp relay faulty	Check relay
	IC regulator faulty	Replace IC regulator
Charge warning lamp does not go out with engine running (Battery requires frequent recharging)	Drive belt loose or worn	Adjust or replace drive belt
	Battery cables loose, corroded or worn	Repair or replace cables
	Fuse blown	Determine cause and replace fuse
	Fusible link blown	Replace fusible link
	Charge lamp relay, IC regulator or alternator faulty	Check charging system
	Wiring faulty	Repair wiring

COMPONENT LOCATOR

EN01Z0111D100001



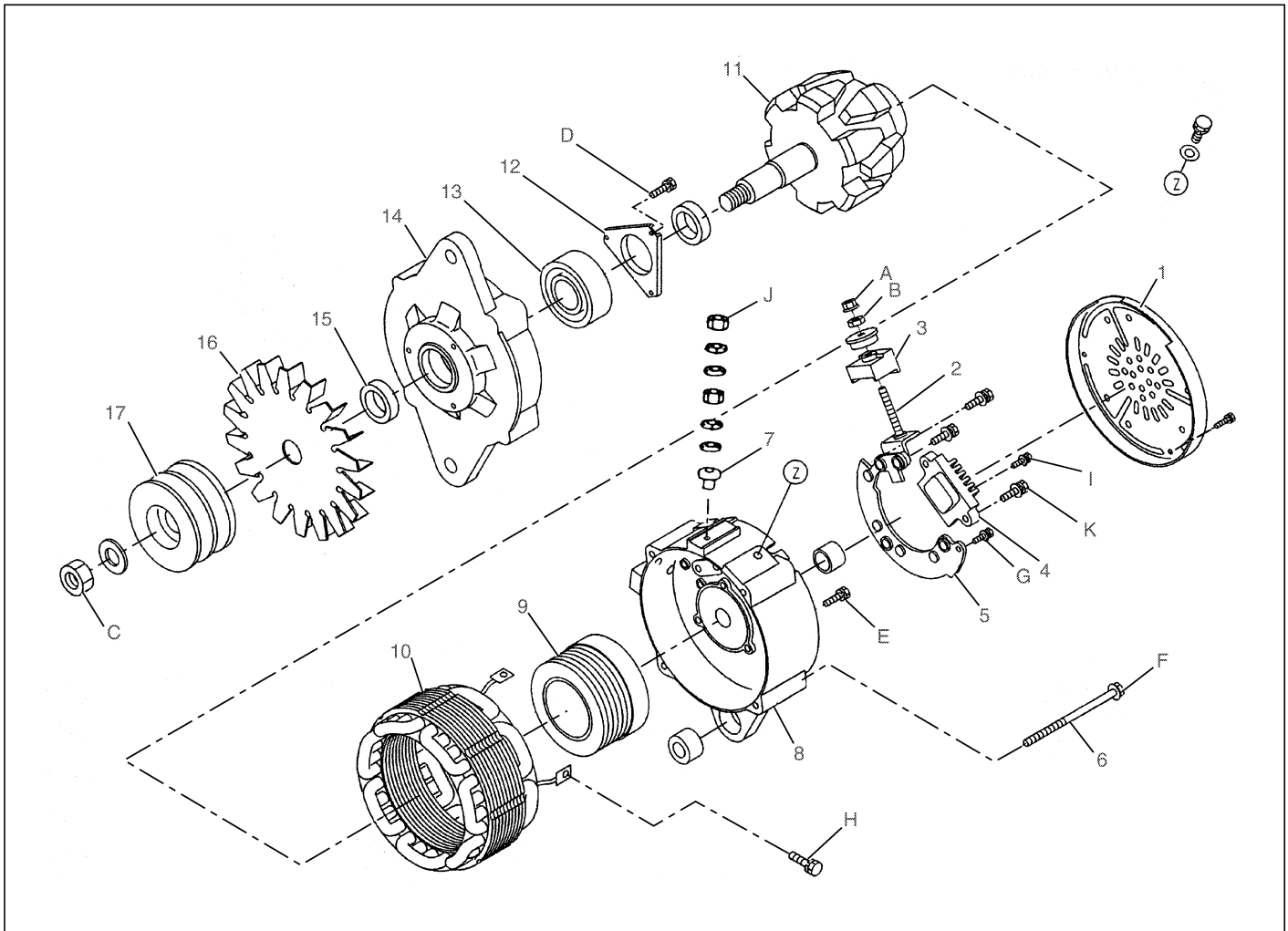
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1	Brace	4	Bracket
2	Tensioner pulley	5	V-belt
3	Alternator	6	Tension pulley

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A	88 {897, 65}	D	36 {367, 27}
B	93 {948, 69}	E	36 {367, 27}
C	55-70 {561-713, 41-51}		



SAPH01Z011100002

1	Cover	10	Stator
2	Terminal B sub assembly	11	Rotor
3	Insulator (inner)	12	Retainer plate
4	Rectifier (positive side)	13	Bearing
5	Rectifier (negative side)	14	Drive end frame
6	Through bolt	15	Collar
7	Holder	16	Fan
8	Rear end frame	17	Pulley
9	Field coil		

Tightening torque

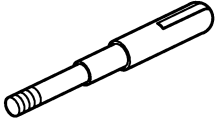
Unit: N·m {kgf·cm, lbf·ft}

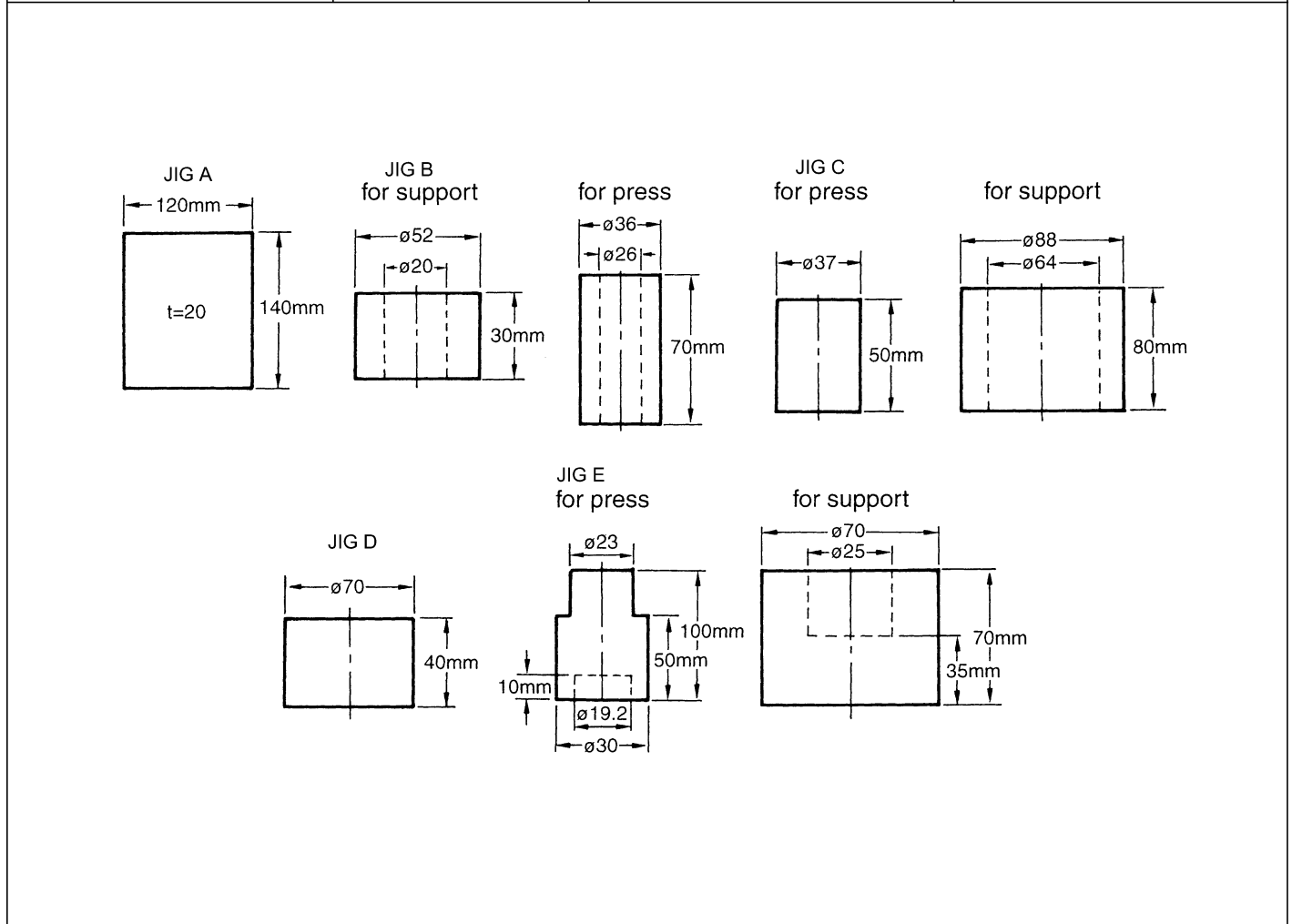
A	3.2-4.4 {33-45, 2.4-3.2}	G	3-5 {30-50, 2.1-3.6}
B	8-10 {80-110, 5.8-8.0}	H	1.9-2.5 {19-25, 1.4-1.8}
C	118-137 {1,200-1,400, 87-101}	I	1.6-2.0 {16-20, 1.2-1.4}
D	3-5 {30-50, 2.1-3.6}	J	3-5 {30-50, 2.1-3.6}
E	3-5 {30-50, 2.1-3.6}	K	3-5 {30-50, 2.1-3.6}
F	6.5-9.3 {66-95, 4.8-6.9}		

SPECIAL TOOL

EN01Z0111K100001

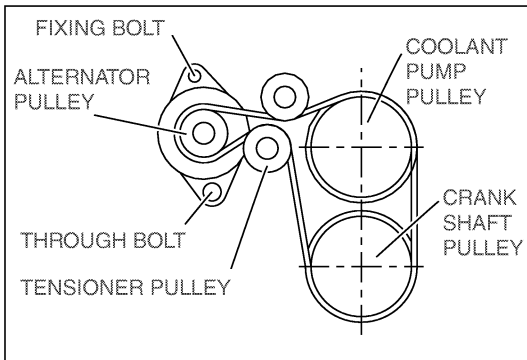
Prior to starting an alternator overhaul, it is necessary to have this special tool.

Illustration	Part number	Tool name	Remarks
	S0944-41210	COMPRESSION GAUGE	



OVERHAUL

EN01Z0111H200001



SAPH01Z011100005

IMPORTANT POINTS - DISMOUNTING

1. REMOVE THE ALTERNATOR.

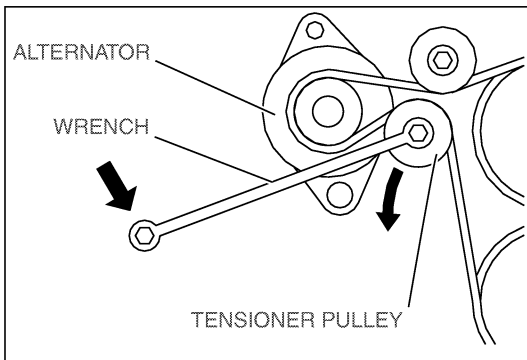
- (1) Remove the V-belt.
- (2) Remove the through bolt and the fixing belt.

NOTICE

To remove the belt, turn the nut of the tension pulley with a wrench in counterclockwise direction to turn the tension pulley in arrow direction. Then the belt becomes loose and can be removed.

⚠ CAUTION

As the belt is under tension, take care not to get your hand caught at the time of removal.



SAPH01Z011100006

IMPORTANT POINTS - MOUNTING

1. INSTALL THE ALTERNATOR.

- (1) Install the alternator with through bolt and fixing bolt.

Tightening Torque:

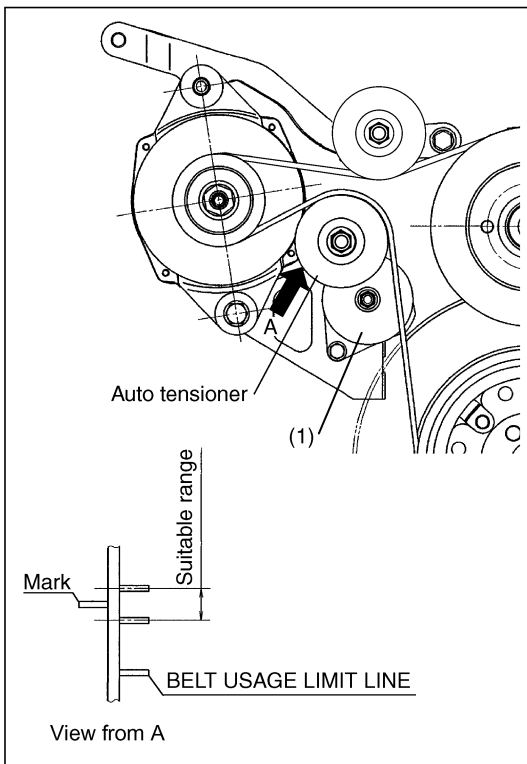
Through bolt: 93 N·m {948 kgf·cm, 69 lbf·ft}

Fixing bolt: 88 N·m {897 kgf·cm, 65 lbf·ft}

- (2) Install the V-belt.

NOTICE

- Turn the tension pulley in the same way as for the belt removal and install the belt.
- When installing the drive belt, use the gauge on the belt tensioner (1) to confirm that the tensioner arm is correctly positioned. (Refer to diagram showing view from A.)



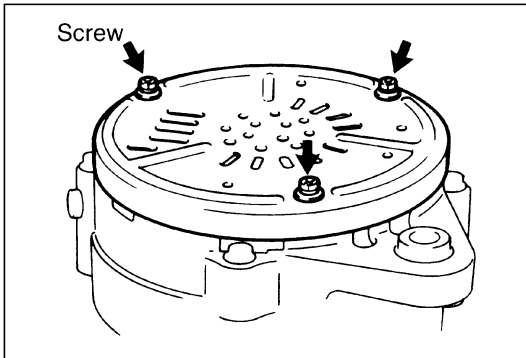
SAPH01Z011100007

IMPORTANT POINTS - ON - VEHICLE INSPECTION**1. INSPECT THE DRIVE BELT**

If the indicator (engraved line) is out of the belt usage limit line, or if the belt is damaged, replace the belt.

IMPORTANT POINTS - DISASSEMBLY**1. REMOVE THE REAR COVER.**

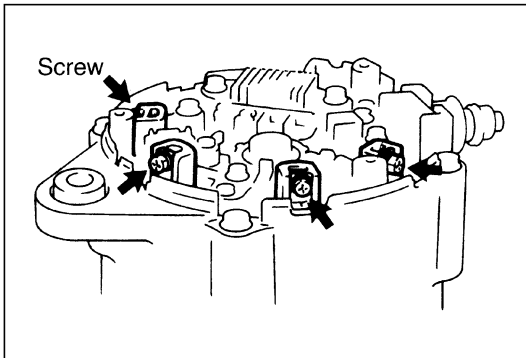
- (1) Remove 3 screws to remove the rear cover.



SAPH01Z011100008

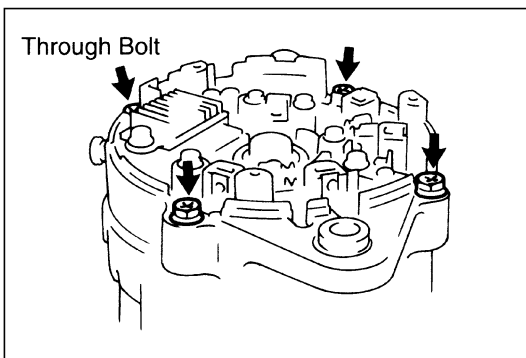
2. SEPARATE THE FRONT AND REAR PORTIONS.

- (1) Remove 4 screws and separate the stator outlet terminal and the rectifier.



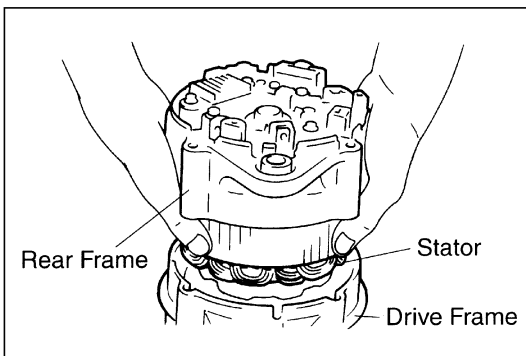
SAPH01Z011100009

- (2) Remove 4 through bolts.



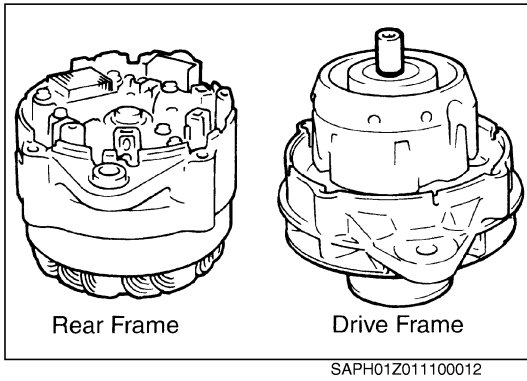
SAPH01Z011100010

- (3) While keeping the stator and the rear frame together, lift them away from the drive frame.



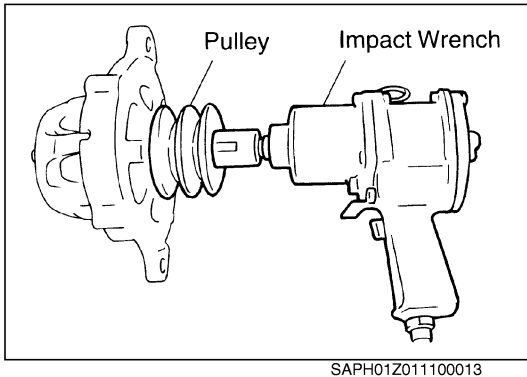
SAPH01Z011100011

- (4) Drive and rear frames separated.

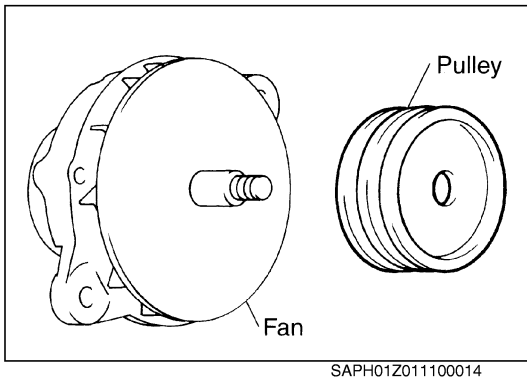


3. REMOVE THE PULLEY

- (1) Remove the pulley lock nut using an impact wrench.

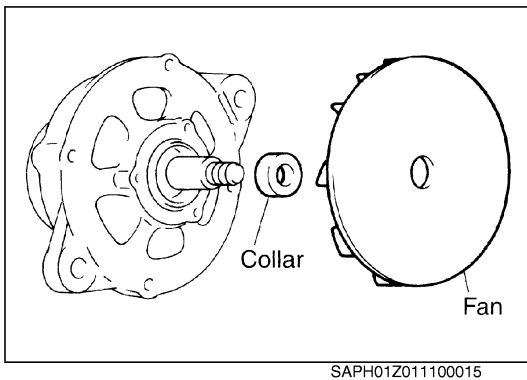


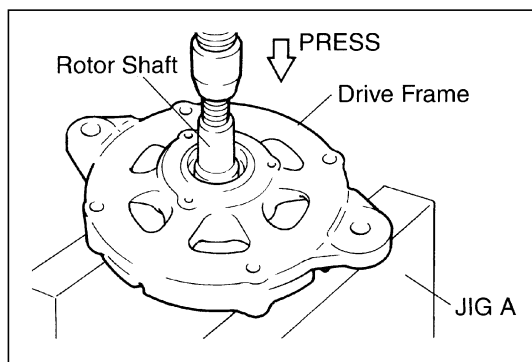
- (2) Remove the pulley from the shaft.



4. REMOVE THE FAN.

5. REMOVE THE COLLAR.





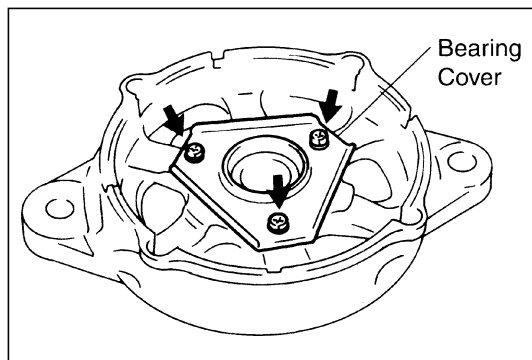
SAPH01Z011100016

6. REMOVE THE ROTOR.

- (1) Using the JIG A and press, remove the rotor from the drive frame.

NOTICE

Do not drop the rotor.



SAPH01Z011100017

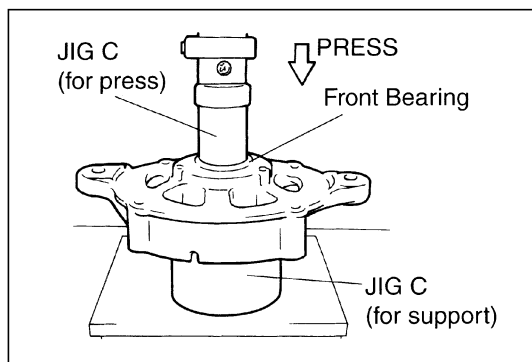
7. REMOVE THE FRONT BEARING.

- (1) Remove 3 screws to remove the bearing cover.

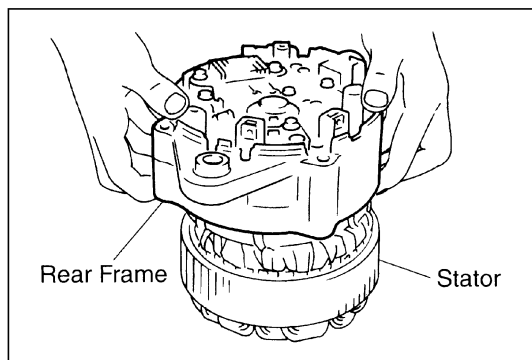
- (2) Using the JIG C and press, remove the front bearing from the drive frame.

NOTICE

Do not drop the front bearing.



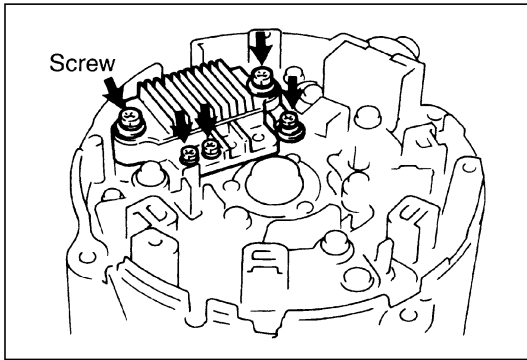
SAPH01Z011100018



SAPH01Z011100019

8. SEPARATE THE REAR FRAME AND STATOR.

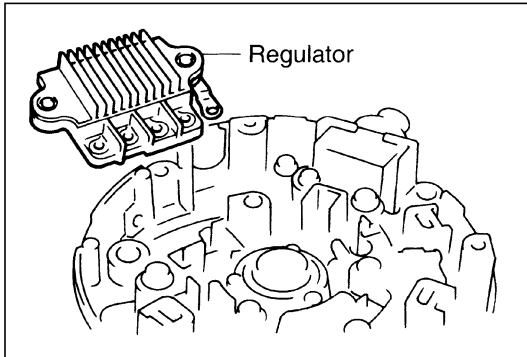
- (1) Pull out the rear frame to separate it from the stator.



SAPH01Z011100020

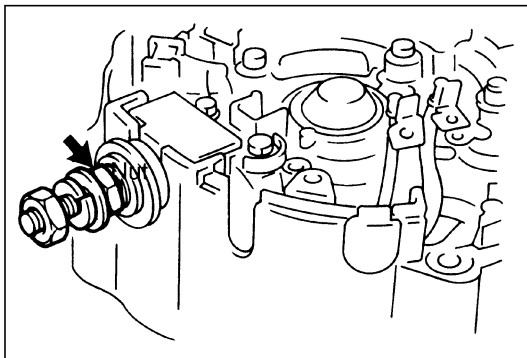
9. REMOVE THE REGULATOR.

- (1) Remove 3 screws to separate the rectifier, the exciting coil outlet terminal, and the regulator.
- (2) Remove 2 screws to remove the regulator.



SAPH01Z011100021

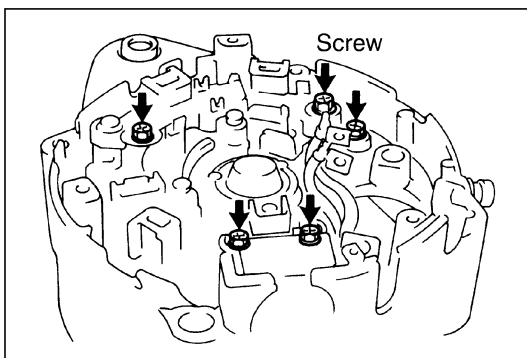
- (3) Regulator removed.



SAPH01Z011100022

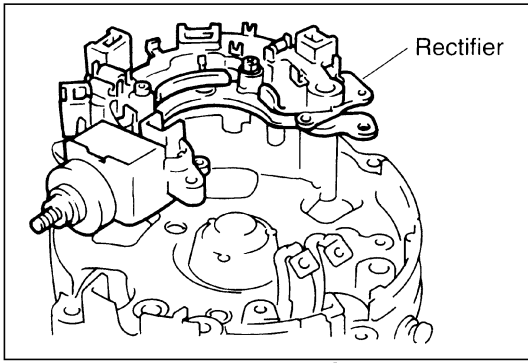
10. REMOVE THE RECTIFIER.

- (1) Loosen the B terminal nut.



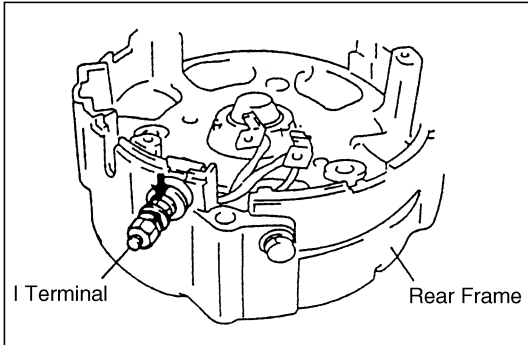
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- (2) Remove the screw from the rectifier's (-) terminal.
- (3) Remove 4 screws to remove the rectifier.



SAPH01Z011100024

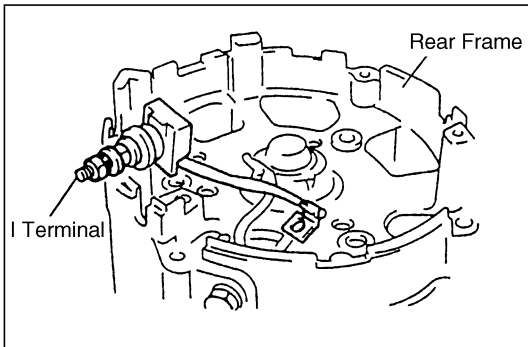
(4) Rectifier removed.



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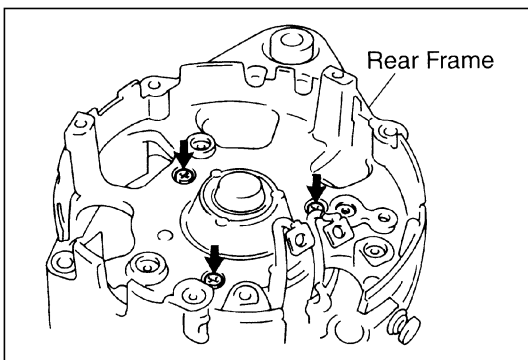
11. REMOVE THE I TERMINAL.

(1) Loosen the 1 terminal nut to remove the I terminal.



SAPH011061100002

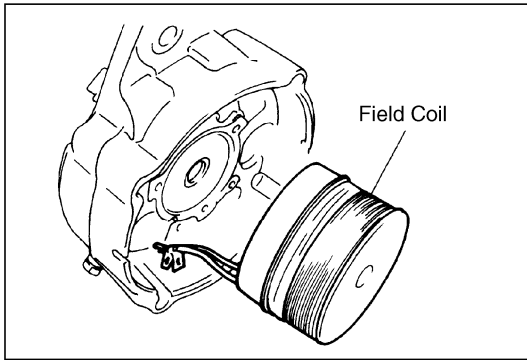
(2) I terminal removed.



SAPH01Z011100025

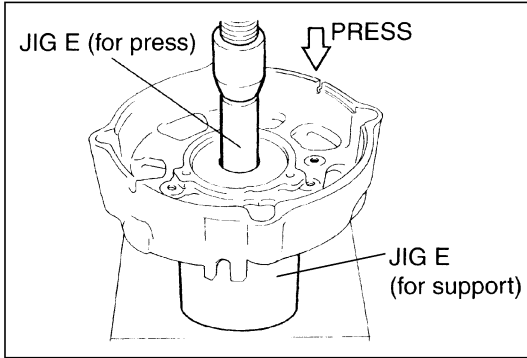
12. REMOVE THE FIELD COIL.

(1) Remove 3 screws to remove the field coil from the rear frame.



SAPH01Z011100026

(2) Field coil removed.



SAPH01Z011100027

13. REMOVE THE REAR BEARING.

(1) Using the JIG E and press, remove the rear bearing from the rear frame.

NOTICE

Do not reuse the rear bearing.

IMPORTANT POINTS - ASSEMBLY

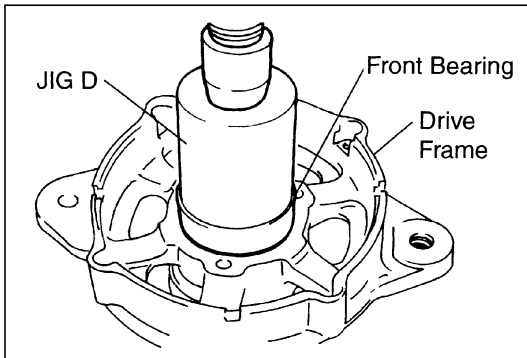
1. INSTALL THE FRONT BEARING.

(1) Using the JIG D and press, press the front bearing into the drive frame.

(2) Using 3 screws, install the bearing cover.

Tightening Torque:

3-5 N·m {30-50 kgf·cm, 2.1-3.6 lbf·ft}



SAPH01Z011100028

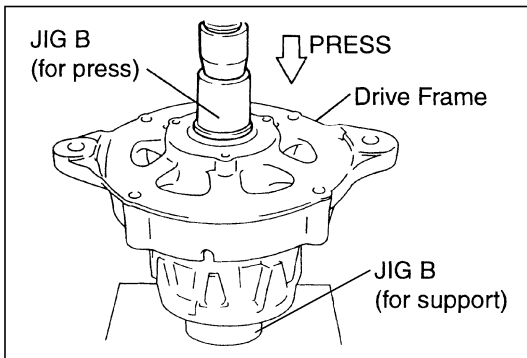
2. INSTALL THE ROTOR.

(1) Insert the collar to the rotor shaft.

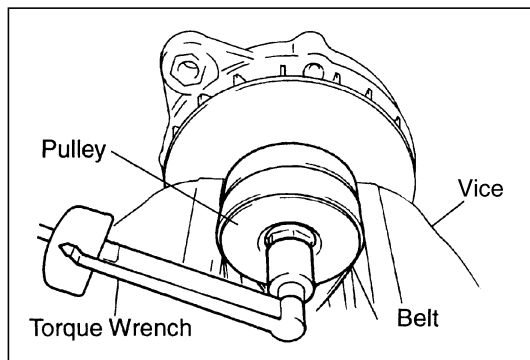
(2) Using the JIG B and press, press the rotor into the bearing in the drive frame.

NOTICE

- Press the rotor while making sure that the rotor's shaft is perpendicular to the bearing.
- During pressing, make sure not to damage the portion of the rotor that presses into the rear bearing.



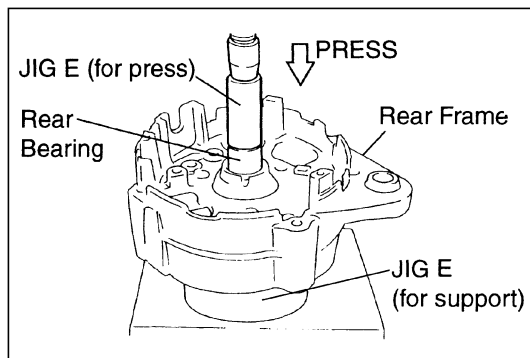
SAPH01Z011100029



SAPH01Z011100030

3. TIGHTENING THE PULLEY.

- (1) Insert the collar and fan to the rotor shaft.
- (2) Secure the pulley with belt using a vice as shown in the figure, tighten the pulley lock nut with specified torque.

Tightening Torque:**118-137 N·m {1,200-1,400 kgf·cm, 87-101 lbf·ft}**

SAPH01Z011100031

4. INSTALL THE REAR BEARING.

- (1) Using the JIG E and press, press a new rear bearing into the rear frame.

NOTICE**Once a bearing is removed, do not reuse it.****5. INSTALL THE FIELD COIL.**

- (1) Using 3 screws, install the field coil on the rear frame.

Tightening Torque:**3-5 N·m {30-50 kgf·cm, 2.1-3.6 lbf·ft}****6. ASSEMBLING THE I TERMINAL**

- (1) Install the I terminal on the rear frame and tighten the nut.

Tightening Torque:**1.6 - 2.0 N·m {16 - 20 kgf·cm, 1.2 - 1.4 lbf·ft}****7. ASSEMBLING THE RECTIFIER**

- (1) Using 4 screws, install the rectifier.

Tightening Torque:**3-5 N·m {30-50 kgf·cm, 2.1-3.6 lbf·ft}**

- (2) Using a screw, install the rectifier's (-) terminal.

Tightening Torque:**3-5 N·m {30-50 kgf·cm, 2.1-3.6 lbf·ft}**

- (3) Tighten the B terminal nut.

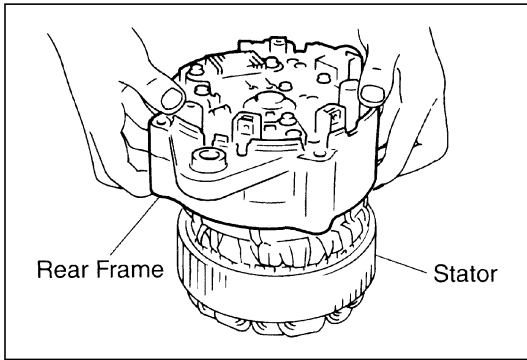
Tightening Torque:**8-11 N·m {80-110 kgf·cm, 5.8-8.0 lbf·ft}****8. ASSEMBLING THE REGULATOR.**

- (1) Using 2 screws, install the rectifier.

Tightening Torque:**3-5 N·m {30-50 kgf·cm, 2.1-3.6 lbf·ft}**

- (2) Using 3 screws, install the rectifier and the field coil outlet terminal to the regulator.

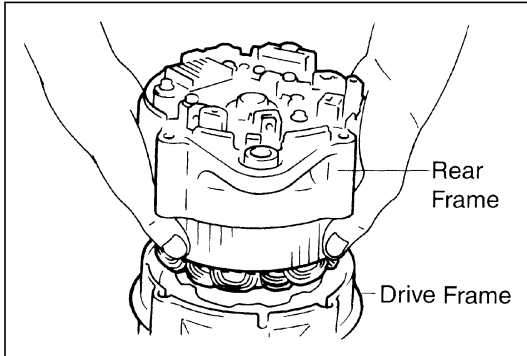
Tightening Torque:**1.6-2.0 N·m {16-20 kgf·cm, 1.2-1.4 lbf·ft}**



SAPH01Z011100032

9. INSTALL THE STATOR AND THE REAR FRAME.

- (1) Slowly insert the stator while maintaining it perpendicular to the rear frame.



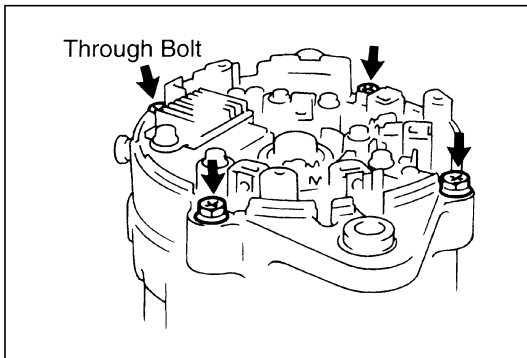
SAPH01Z011100033

10. ASSEMBLING THE DRIVE AND REAR FRAME.

- (1) Apply a thin coat of NSK EA5 grease on the rear bearing portion of the rotor shaft.
- (2) Slowly insert the rear frame while maintaining it perpendicular to rotor shaft.

NOTICE

To prevent damage to the rear bearing, do not apply excessive force during the insertion.

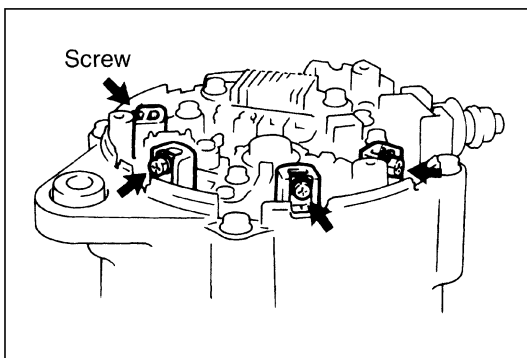


SAPH01Z011100034

- (3) Install 4 through bolts.

Tightening Torque:

6.5-9.3 N·m {66-95 kgf·cm, 4.8-6.9 lbf·ft}



SAPH01Z011100035

- (4) Using 4 screws, install the stator outlet terminal to the rectifier.

Tightening Torque:

1.9-2.5 N·m {19-25 kgf·cm, 1.4-1.8 lbf·ft}

- (5) Using 3 screws, install the rear cover.

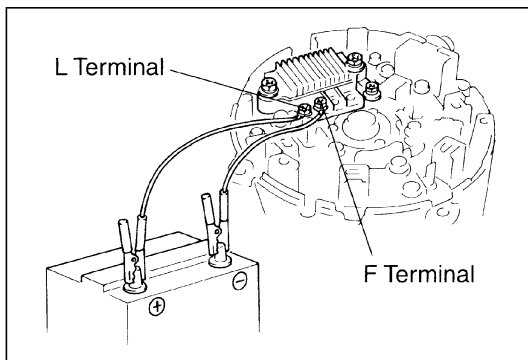
PERFORMANCE TEST

NOTICE

- Using a bench tester, perform a performance test according to the procedure described below.
- Note the battery polarity carefully so as not to make reverse connections.
If the connections are reversed, the rectifier will short the circuit and allow a large current to flow through and damage the diodes and I.C. regulator as well as burning the wiring harness.
- Take care not to make wrong connections of terminals.
- When charging the battery with a quick charge, disconnect the battery terminals.
- Do not perform tests with high voltage insulation resistance tester.
- In operation, never disconnect the battery.
- During this inspection, make sure to use a fully charged battery.

1. MAGNETIZING

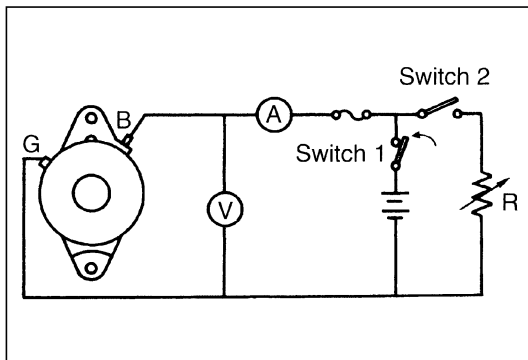
- (1) Apply a battery (12V) to the L terminal (positive) and F terminal (negative) of the regulator as shown in the figure.



SAPH01Z011100036

2. MEASURING THE SELF-EXCITED STARTING RPM.

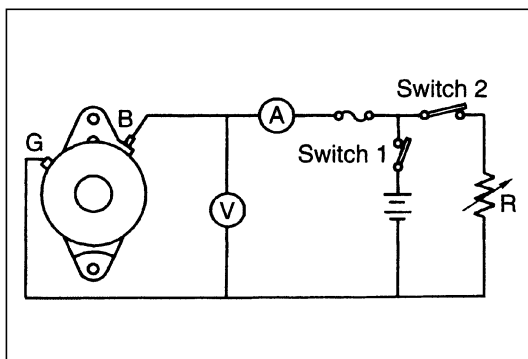
- (1) Turn Switch 1 ON.
- (2) Gradually increase the alternator rpm.
- (3) Measure the rpm (starting rpm) at which the charging current starts to flow. (it is normal if under 1,500 rpm)



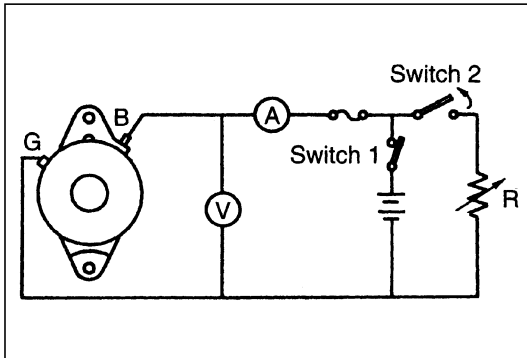
SAPH01Z011100037

3. MEASURING THE RATED OUTPUT

- (1) Turn Switch 1 and Switch 2 ON.
- (2) Maintain the alternator rpm at a constant 5,000 rpm.
- (3) While observing a voltmeter, regulate the load (variable resistance: R) so that a 12V system outputs 13.5V.
- (4) At this time, measure the output current (it is normal if more than the rated output current is obtained).



SAPH01Z011100038



SAPH01Z011100039

4. VERIFYING THE REGULATOR'S REGULATED VOLTAGE

- (1) In the state in which the rated output was measured, turn Switch 2 OFF.

NOTICE

At this time, reduce the current that flows to the load (variable resistance: R) to the minimum and turn Switch 2 OFF.

- (2) When the output current is less than 10A (the charging current to the battery is reduced), measure the voltage.

Standard: 14.0-14.4 V

PRECAUTIONS

1. PRECAUTIONS DURING OPERATION

- Do not disconnect the battery while the alternator is rotating.
- Do not operate the alternator with the alternator's B terminal (output terminal) disconnected.
- Do not expose the alternator to water.

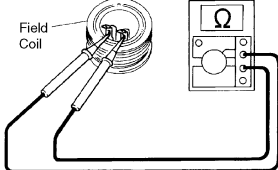
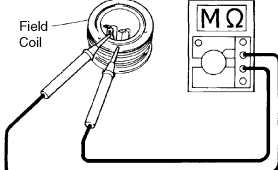
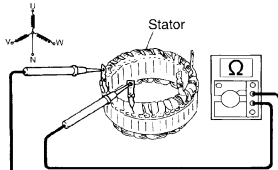
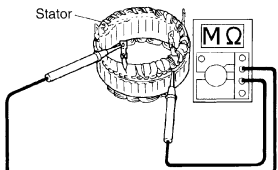
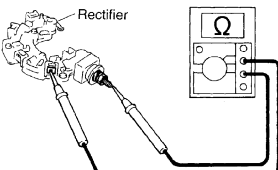
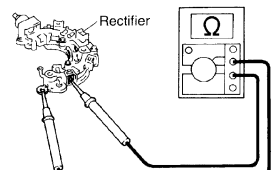
2. OTHER PRECAUTIONS

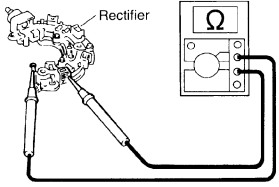
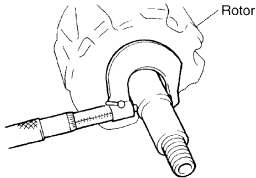
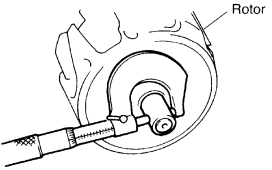
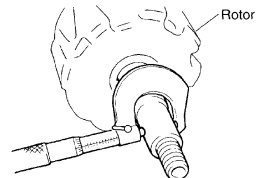
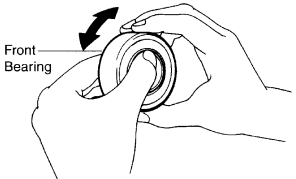
- Make sure to disconnect the battery terminal before inspecting the alternator.
- Do not interchange the polarity of the battery cables when replacing the battery.
- Make sure to disconnect the cables and charge the battery separately when using a quick charger.
- Never perform a megger tester on the alternator assembly.
- Make sure to disconnect the wiring to the alternator when performing a megger test on the vehicle's wiring.

INSPECTION AND REPAIR

EN01Z0111H300001

Unit: mm {in.}

Inspection item	Standard	Limit	Remedy	Inspection procedure
Resistance of field coil	2-3Ω	—	Replace.	<p>Measure</p> 
Insulation resistance of field coil	1MΩ min.	—	Replace.	<p>Measure</p> 
Resistance of stator coil	0.01-0.10Ω	—	Replace.	<p>Measure</p> 
Insulation resistance of stator	1MΩ min.	—	Replace.	<p>Measure</p> 
Resistance of rectifier (between B terminal and heat sink)	When polarity is changed, there is continuity in one direction but not in the opposite direction.	—	Replace.	<p>Measure</p> 
Resistance of rectifier (between (-) terminal and heat sink)	When polarity is changed, there is continuity in one direction but not in the opposite direction.	—	Replace.	<p>Measure</p> 

Inspection item	Standard	Limit	Remedy	Inspection procedure
Resistance of rectifier (between diode terminal and heat sink)	When polarity is changed, there is continuity in one direction but not in the opposite direction.	—	Replace.	Measure 
Rotor shaft outside diameter (front bearing portion)	25.00-25.01 {0.9843-0.9846}	24.99 {0.9839}	Replace.	Measure 
Rotor shaft outside diameter (rear bearing portion)	16.99-17.00 {0.6689-0.6693}	16.98 {0.6685}	Replace.	Measure 
Rotor shaft outside diameter (pulley portion)	22.189-22.202 {0.8739-0.8741}	22.18 {0.8732}	Replace.	Measure 
Bearing wear or damage	Rotates smoothly with no abnormal noise	—	Replace. Also, replace every 2 years.	Visual check 

STARTER (J08E)

EN12-001

STARTER	EN12-2
DATA AND SPECIFICATIONS	EN12-2
DESCRIPTION	EN12-3
TROUBLESHOOTING	EN12-4
COMPONENT LOCATOR.....	EN12-5
OVERHAUL	EN12-6
INSPECTION AND REPAIR	EN12-14

STARTER

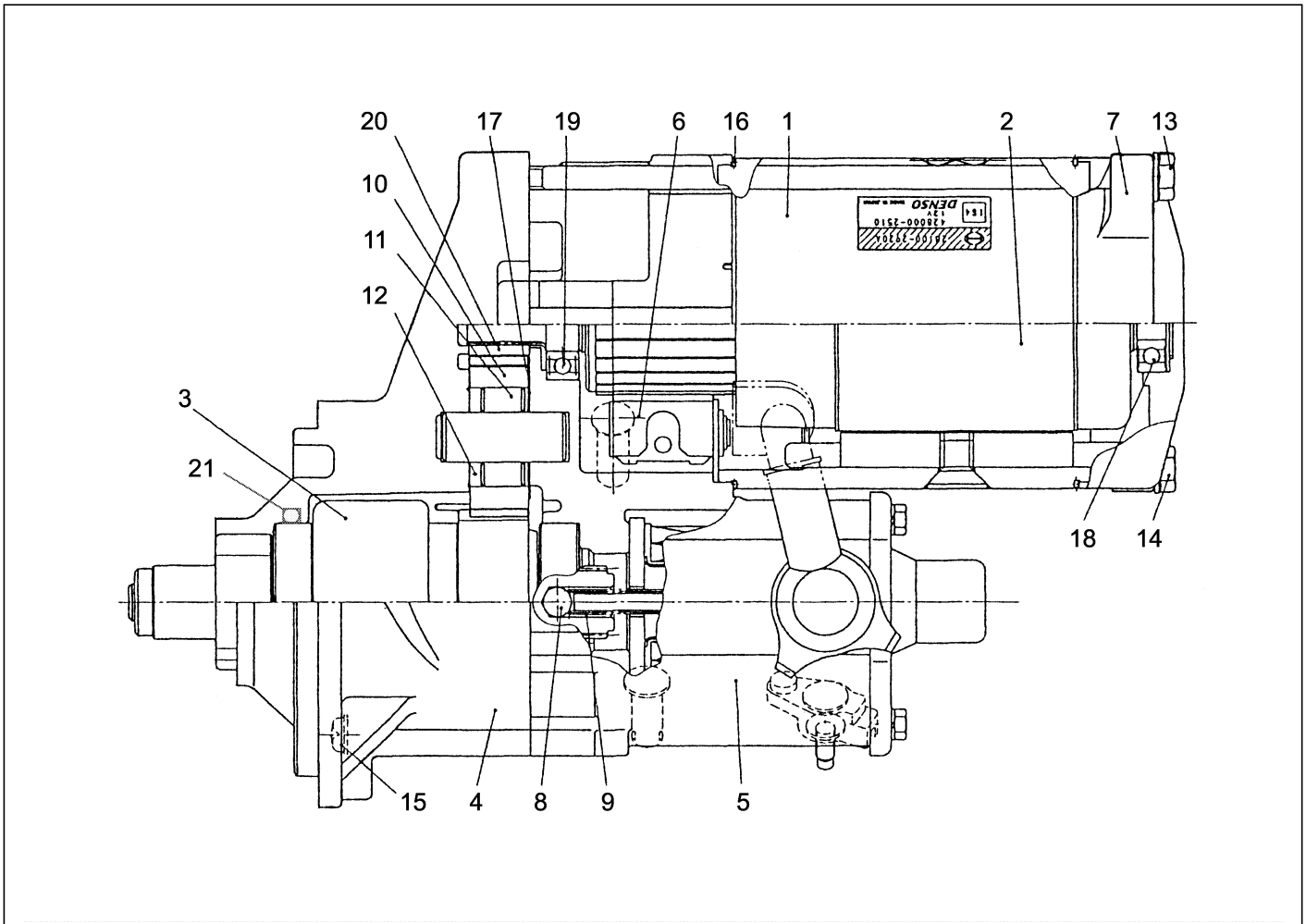
DATA AND SPECIFICATIONS

EN0110612I200001

Type	Reduction gear type
Rated output	12 V, 4.8 kW
Number of teeth of pinion	11
Module	3
Rotating direction	Clockwise (Seen from pinion side)

DESCRIPTION

EN0110612C100001



SAPH011061200001

1	Yoke assy	12	Retainer
2	Amature assy	13	Through bolt
3	Clutch sub-assy	14	Through bolt
4	Housing	15	Screw
5	Magnetic switch assy	16	Seal
6	Brush holder assy	17	Snap retainer
7	End frame	18	Ball bearing
8	Steel ball	19	Ball bearing
9	Coil spring	20	Pinion
10	Pinion	21	O-ring
11	Clutch roller		

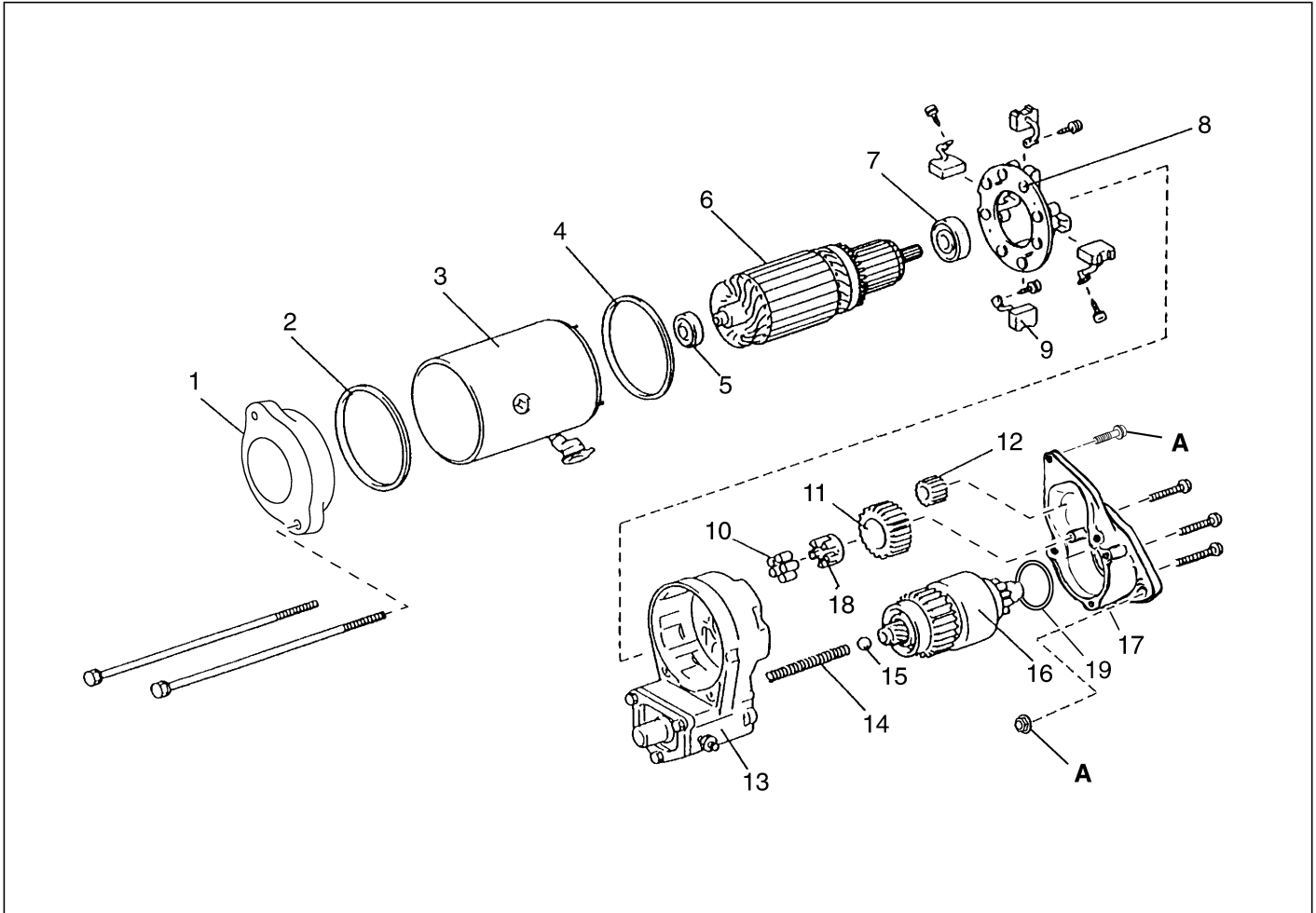
TROUBLESHOOTING

EN0110612F300001

Symptom	Possible cause	Remedy/Prevention
Engine does not crank, or cranks slowly. (Starter switch)	Poor contact	Clean or replace contacts.
Engine does not crank, or cranks slowly. (Battery)	Discharged battery	Charge.
	Short circuited between electrodes	Replace battery.
	Poor contact at battery terminal	Clean or retighten.
Engine does not crank, or cranks slowly. (Engine oil)	Improper viscosity oil	Change oil.
Engine does not crank, or cranks slowly. (Magnetic switch)	Poor contact caused by burnt contact plate	Clean or replace contact plate.
	Contact plate worn out	Repair.
	Holding coil disconnected (Overrunning clutch moves back and forth)	Replace field coil.
	Pull-in coil disconnected or short circuited	Replace.
Engine does not crank, or cranks slowly. (Starter relay)	Defective or poor contact	Repair or replace.
Engine does not crank, or cranks slowly. (Starter)	Brush worn out	Replace.
	Commutator burnt out	Correct on lathe.
	Commutator worn out	Correct by undercutting.
	Field winding shorted or grounded	Rewind or replace.
	Armature winding shorted or grounded	Replace armature.
	Insufficient brush spring tension	Replace brush spring.
	Poor contact between magnetic switch and field windings	Repair.
	Armature contact pole core because of worn bearing bushing or bent armature shaft	Replace bearing brush or armature.
Engine does not crank while starter is running in good condition. (Overrunning clutch)	Overrunning clutch malfunction	Replace.
	Pinion teeth worn out	Replace.
	Poor sliding of spline teeth	Remove foreign particles, dirt or replace.
Starter does not stop running. (Starter switch)	Contacts keep closing	Replace.
	Key switch sticks	Replace.
	Overrunning clutch sticks to armature	Repair or replace overrunning or armature.
Starter does not stop running. (Starter relay)	Contacts keep closing	Repair or replace.

COMPONENT LOCATOR

EN0110612D100001



SAPH011061200052

- 1 Starter end frame
- 2 O-ring
- 3 Yoke
- 4 O-ring
- 5 Rear bearing
- 6 Armature
- 7 Front bearing
- 8 Brush holder
- 9 Brush
- 10 Roller

- 11 Idler gear
- 12 Drive gear
- 13 Magnetic switch
- 14 Return spring
- 15 Steel ball
- 16 Overrunning clutch
- 17 Starter housing
- 18 Retainer
- 19 O-ring

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A	55 {560, 40}
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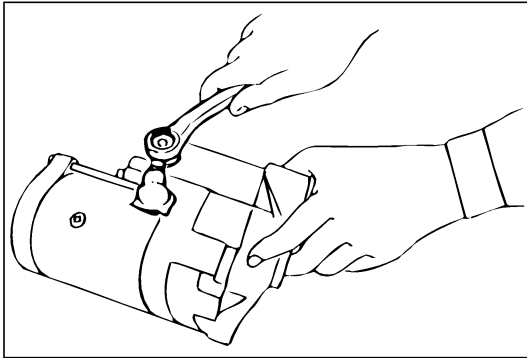
OVERHAUL

EN0110612H200001

IMPORTANT POINTS - DISASSEMBLY

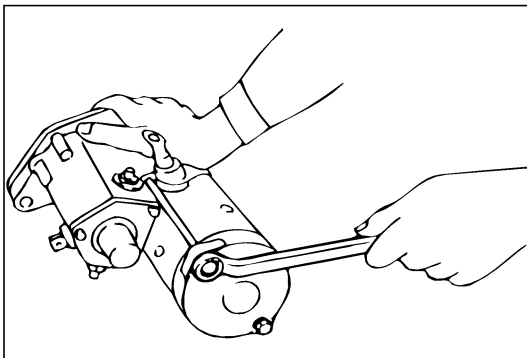
1. REMOVAL OF THE YOKE WITH ARMATURE.

- (1) Remove the nut, and disconnect the lead wire from the magnetic switch terminal.



SAPH011061200003

- (2) Remove the two through bolts.



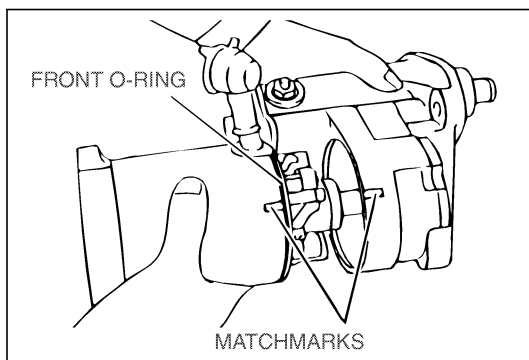
SAPH011061200004

- (3) Pull out yoke with the armature.

NOTICE

Applying matchmarks to the yoke and starter housing before removing the yoke will make it easier to reinstall the yoke.

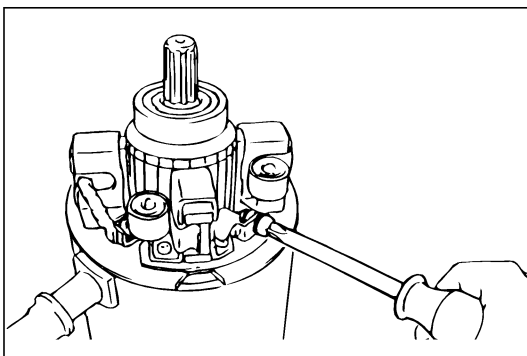
- (4) Remove the front O-ring from the yoke.



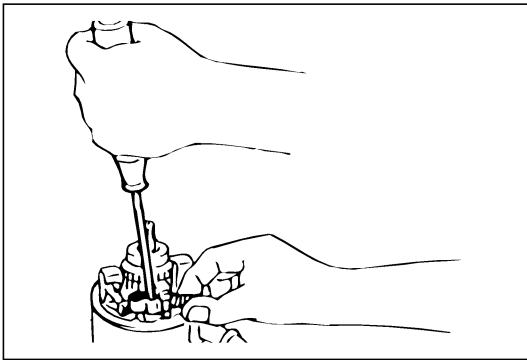
SAPH011061200005

2. REMOVAL OF BRUSHES AND BRUSH HOLDER

- (1) Remove the four screws.

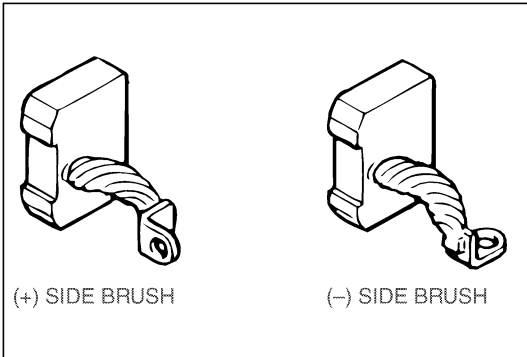


SAPH011061200006



SAPH011061200007

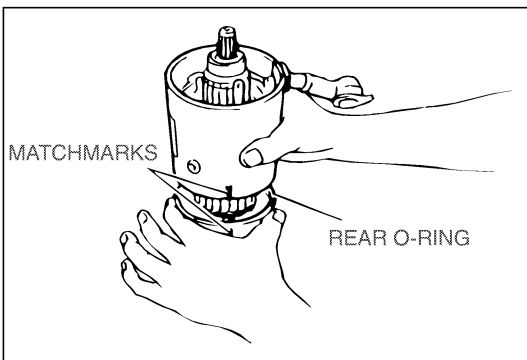
- (2) Using a screwdriver, hold the spring back and disconnect the brush from the holder.
- (3) Disconnect the four brushes and remove the brush holder.



SAPH011061200008

NOTICE

The brushes differ for the positive (+) and negative (-) sides. When you reinstall them, make sure that you install them on the correct side.



SAPH011061200009

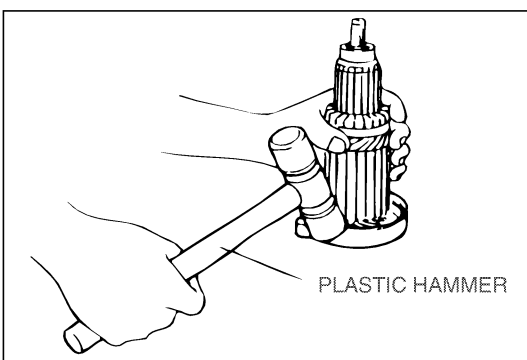
3. REMOVE THE YOKE AND ARMATURE FROM THE STARTER END FRAME.

- (1) Remove the yoke from the starter end frame.

NOTICE

Applying matchmarks to the yoke and starter end frame before removing the yoke will make it easier to reinstall the yoke.

- (2) Remove the rear O-ring from the yoke.

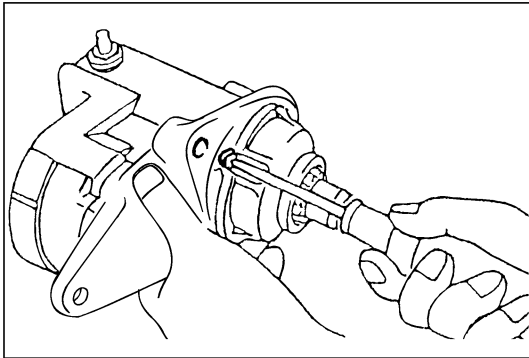


SAPH011061200010

- (3) Using a plastic hammer, tap the frame end to remove the armature from the starter end frame.

4. REMOVAL OF THE MAGNETIC SWITCH

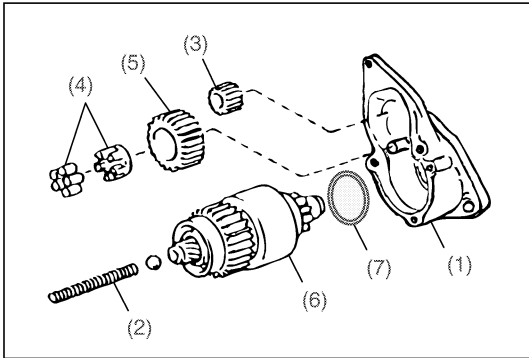
- (1) Remove the three mounting screws.



SAPH011061200011

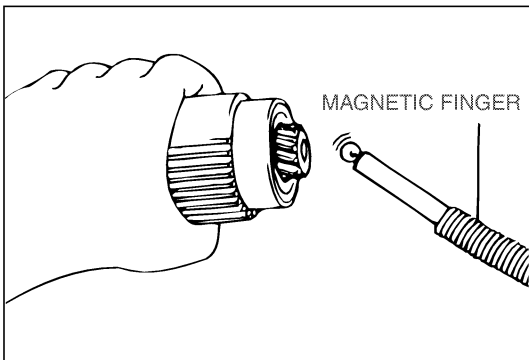
- (2) Remove the following parts from the magnetic switch:

- (1) Starter housing
- (2) Return spring
- (3) Drive gear
- (4) Retainer and rollers
- (5) Idle gear
- (6) Overrunning clutch
- (7) O-ring



SAPH011061200012

- (3) Using a magnetic finger, remove the steel ball from the clutch shaft hole.



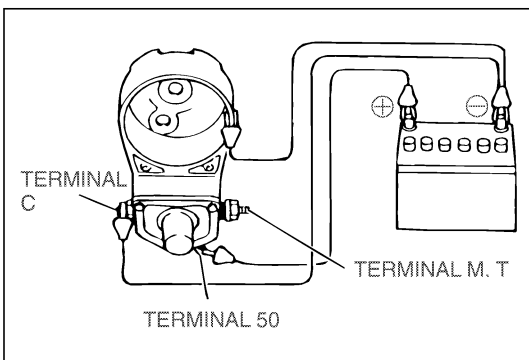
SAPH011061200013

MAGNETIC SWITCH TEST**NOTICE**

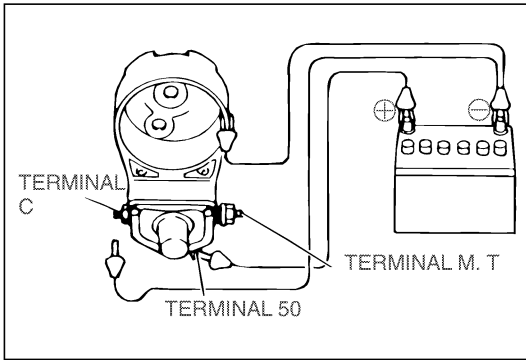
- The following tests should be performed without the armature assembly.
- Each test should be performed for a short time (3 to 5 sec.) to prevent the magnetic switch winding from burning.
- Each test should be performed with the specified voltage applied.

1. PULL-IN TEST

- (1) Connect the test leads as shown in the figure. When connecting terminal C and M. T are closed, the pinion should jump out.



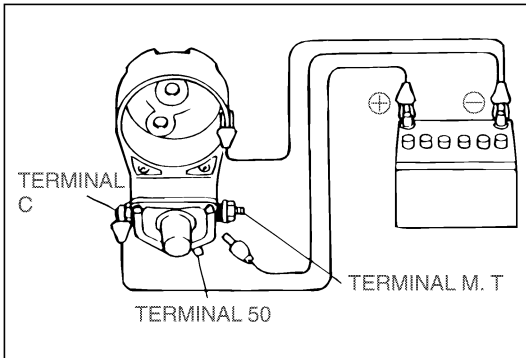
SAPH011061200014



SAPH011061200015

2. HOLD-IN TEST

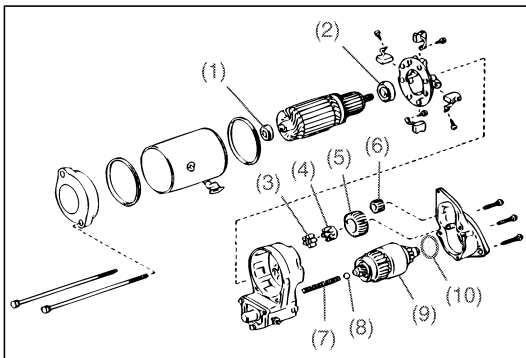
- (1) With the same condition as in the pull-in test, open the connecting terminal C.
The pinion should remain in the jumped out position.



SAPH011061200016

3. RETURN TEST

- (1) With the same condition as in the hold-in test, open the connecting terminal 50.
The pinion should return immediately.



SAPH011061200017

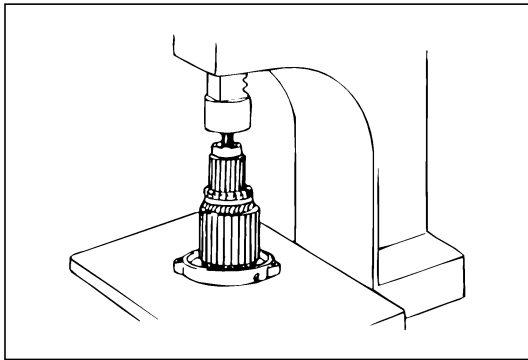
IMPORTANT POINTS - ASSEMBLY

NOTICE

Reverse the order of disassembly to reassemble the starter. However, attention should be paid to the following operations.

1. LUBRICATION

- (1) Before reassembling, apply the recommended grease to the following:
[Apply Nippondenso No. 50 grease or equivalent (Esso beacon 325)].
 - (1) **Rear bearing**
 - (2) **Front bearing**
 - (3) **Roller**
 - (4) **Retainer**
 - (5) **Idle gear**
 - (6) **Drive gear**
 - (7) **Return spring**
 - (8) **Steel ball**
 - (9) **Overrunning clutch**
 - (10) **O-ring**

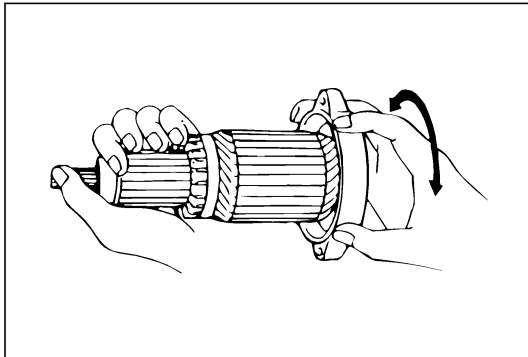


SAPH011061200018

2. INSTALLATION OF ARMATURE

NOTICE

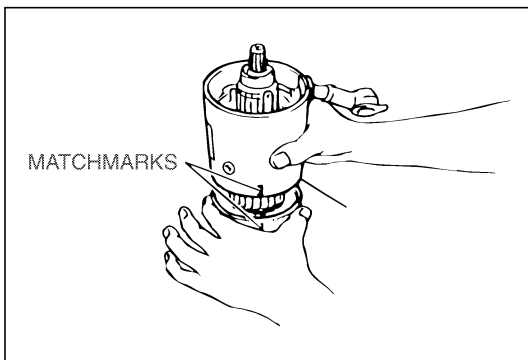
- Use high-temperature grease to lubricate the bearings and gears when assembling the starter.
- Apply grease to the armature bearings, and using a press, press the armature into the starter end frame.



SAPH011061200019

NOTICE

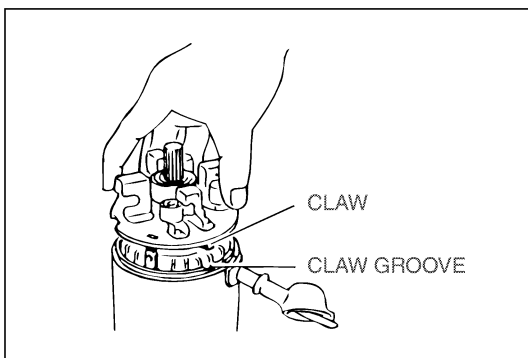
Rotate the starter end frame and check that the armature is pressed straight into it. If the armature is pressed in crookedly, it will later make it difficult to assemble the starter housing.



SAPH011061200020

3. INSTALLATION OF YOKE

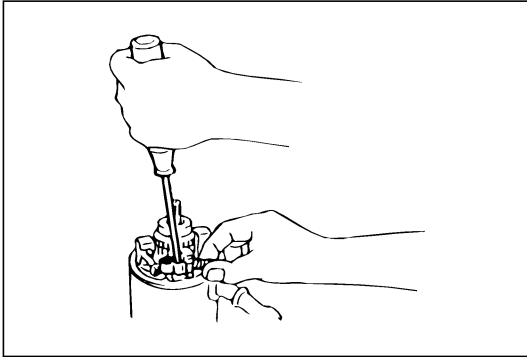
- (1) Install a new O-ring to groove of the yoke.
- (2) While matching the matchmarks, install the yoke and starter end frame.



SAPH011061200021

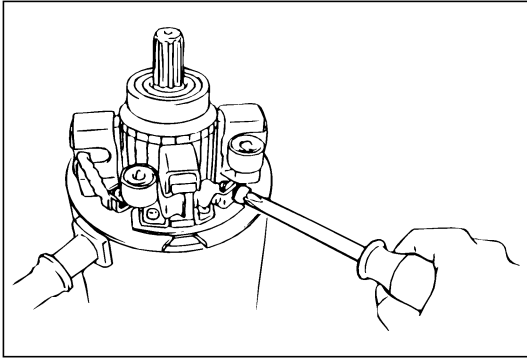
4. INSTALLATION OF BRUSHES

- (1) Align the claw of the brush holder with the claw groove of the yoke.
- (2) Place the brush holder onto the yoke.



SAPH011061200022

- (3) Using a screwdriver, hold the brush spring back and connect the brush into the brush holder.
Connect the four brushes.

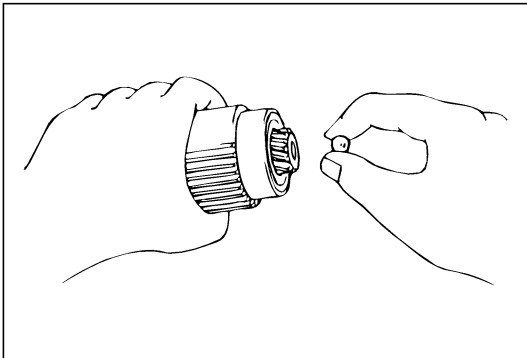


SAPH011061200023

- (4) Install the lead wires with the four screws.

NOTICE

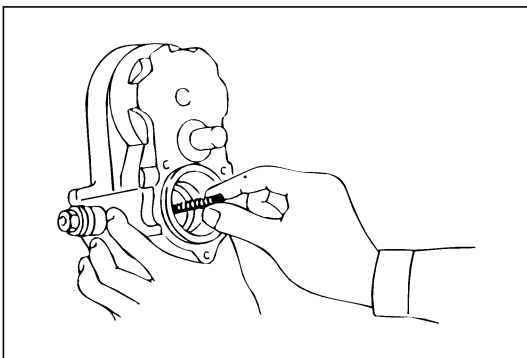
- Check that the positive (+) lead wires are not grounded.
- Take care not to damage them or get oil on them.



SAPH011061200024

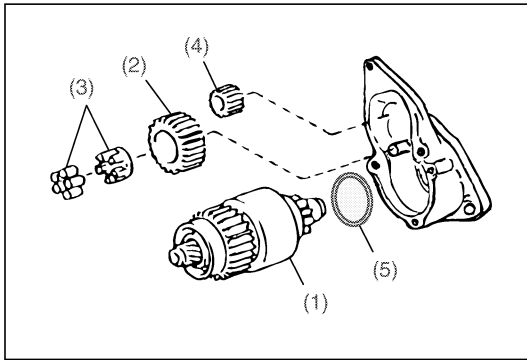
5. INSTALLATION OF MAGNETIC SWITCH

- (1) Apply grease to the steel ball.
(2) Insert the steel ball into the overrunning clutch shaft hole.



SAPH011061200025

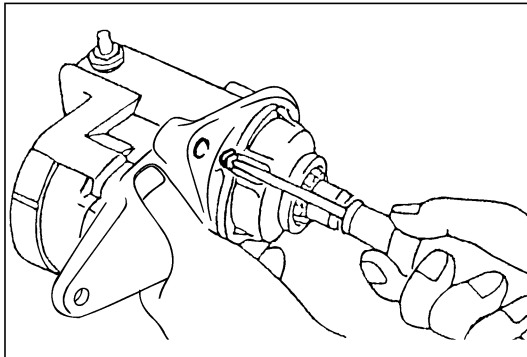
- (3) Apply grease to the return spring.
(4) Insert the return spring into the magnetic switch hole.



SAPH011061200026

(5) Place the following parts in position on the starter housing:

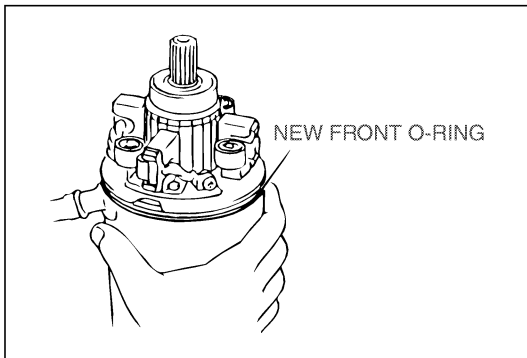
- (1) **Overrunning clutch**
- (2) **Idle gear**
- (3) **Retainer and rollers**
- (4) **Drive gear**
- (5) **O-ring**



SAPH011061200027

(6) Install the O-ring to the starter housing.

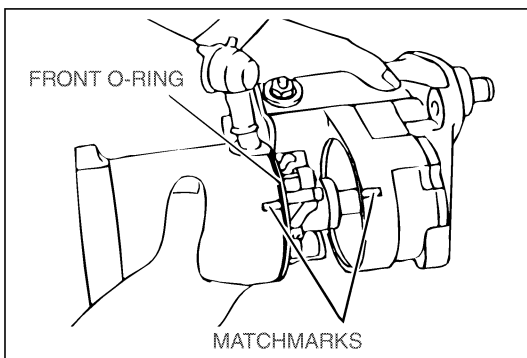
(7) Assemble the starter housing and magnetic switch assembly and install the three screws.



SAPH011061200028

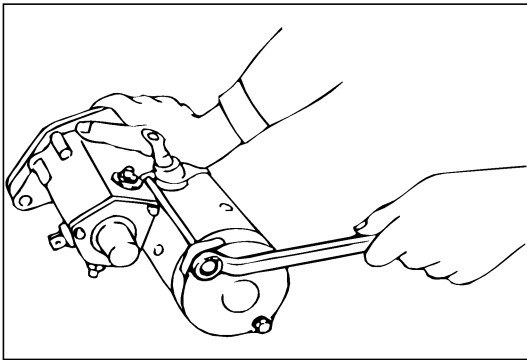
6. INSTALLATION OF YOKE AND ARMATURE

(1) Place a new front O-ring in position on the yoke.



SAPH011061200029

(2) Match up the matchmarks on the yoke and starter housing.

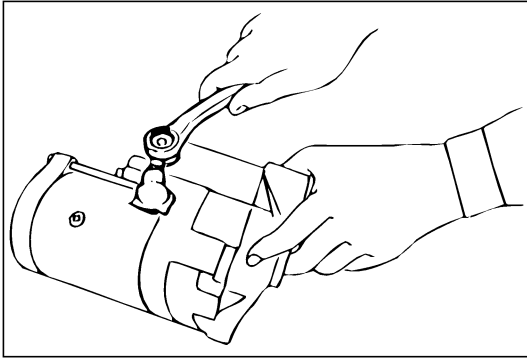


SAPH011061200030

- (3) Install the yoke and armature assembly with the two through bolts.

Tightening Torque:

11-18 N·m {110-180 kgf·cm, 8.0-13 lbf·ft}

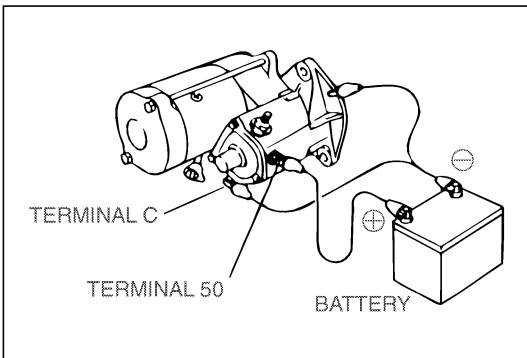


SAPH011061200031

- (4) Connect the lead wire to terminal C, and install the nut.

Tightening Torque:

18-25 N·m {180-250 kgf·cm, 13-18 lbf·ft}



SAPH011061200032

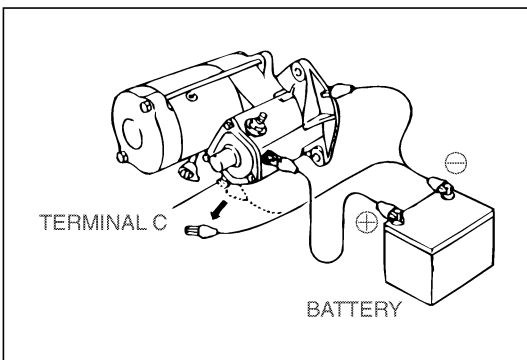
IMPORTANT POINTS - INSPECTION

NOTICE

These tests must be performed within 3 to 5 seconds to avoid burning out the coil.

1. PERFORM PULL-IN TEST.

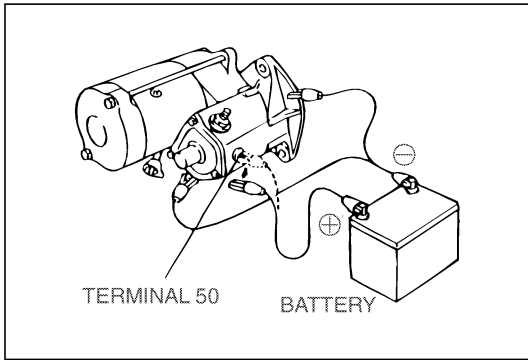
- (1) Disconnect the field coil lead wire from the terminal C.
- (2) Connect battery to the magnetic switch as shown.
- (3) Check that the pinion gear moves outward.
- (4) If the pinion gear does not move, replace the magnetic switch.



SAPH011061200033

2. PERFORMANCE HOLD-IN TEST.

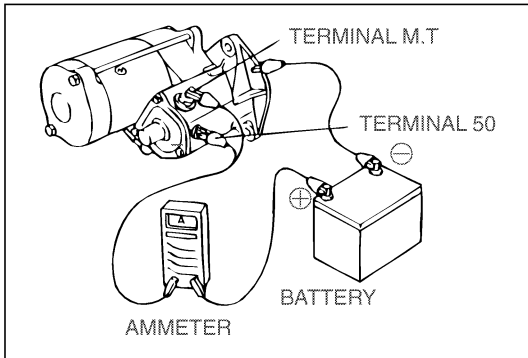
- (1) While connected as above with the pinion gear out, disconnect the negative (-) lead from terminal C.
- (2) Check that the pinion gear remains out.
- (3) If the pinion gear returns inward, replace the magnetic switch.



SAPH011061200034

3. INSPECTION PLUNGER RETURN. (Solenoid Coil Balance Check)

- (1) Disconnect the positive (+) lead from the terminal 50.
- (2) Check that the pinion gear returns inward.
- (3) If the pinion gear does not return, replace the magnetic switch.



SAPH011061200035

4. PERFORM NO-LOAD PERFORMANCE TEST.

- (1) Connect battery and ammeter to the starter as shown.
- (2) Check that the starter rotates smoothly and steadily with the pinion gear moving out. Check the reading on the ammeter.

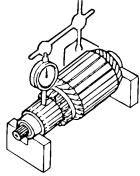
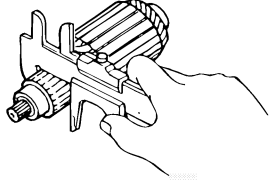
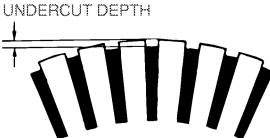
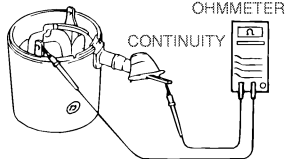
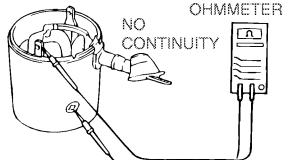
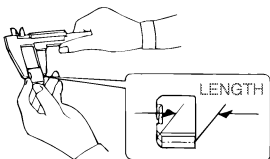

**Standard amperage:
220 A or less/12 V**

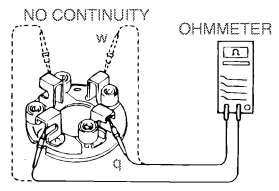

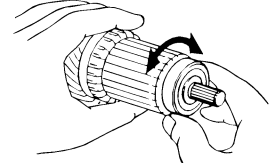
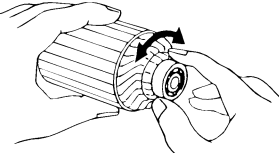
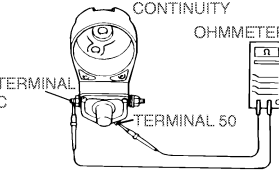
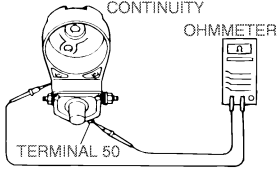
INSPECTION AND REPAIR

EN0110612H300001

Unit: mm {in.}

Inspection item	Standard	Limit	Remedy	Inspection procedure
Continuity between the segments of the commutator	Continuity	—	Replace.	<p>Measure</p> <p>OHMMETER CONTINUITY</p>
No continuity between the connector and armature coil core.	No continuity	—	Replace.	<p>Measure</p> <p>OHMMETER</p>
Armature short circuit test (Using a growler tester)	If the iron piece does not vibrate, the armature is good.	—	Replace.	<p>Measure</p> <p>HACKSAW BLADE GROWLER TESTER</p>

Inspection item	Standard	Limit	Remedy	Inspection procedure
Measure the circle run-out	—	0.05 mm {0.0020 in}	Replace.	Measure 
Outside diameter of the commutator	43.0 {1.693}	42.0 {1.654}	Replace.	Measure 
Depth between the mica and the commutator (Under cut depth)	0.7-0.9 {0.028-0.035}	Less than 0.7 {0.028}	Replace or repair.	Measure UNDERCUT DEPTH 
Continuity between the field coil end and the read wire.	Continuity	—	Replace.	Measure 
No continuity between the field coil end and yoke out side	No continuity	—	Replace.	Measure 
Brush length	21.0 {0.827}	14.0 {0.551}	Replace.	Measure 
Brush spring load	3,500-4,500 g {123.5-158.7 oz}	—	Replace.	Measure 

Inspection item	Standard	Limit	Remedy	Inspection procedure
Insulation between the brush and brush holder	No continuity	—	Replace.	<p>Measure</p> 
Rotating of pinion	—	—	Replace.	<p>Visual check</p> 
Rotating of needle roller front bearing	—	Sticks or does not rotate	Replace.	<p>Visual check</p> 
Rotating of needle roller rear bearing	—	Sticks or does not rotate	Replace.	<p>Visual check</p> 
Continuity between terminals 50 and C	Continuity	—	Replace.	<p>Measure</p> 
Continuity between terminal 50 and the switch body	Continuity	—	Replace.	<p>Measure</p> 

AIR COMPRESSOR (J08E: 154 cm³)

EN13-001

AIR COMPRESSOR.....	EN13-2
DATA AND SPECIFICATIONS	EN13-2
DESCRIPTION	EN13-2
TROUBLESHOOTING	EN13-3
COMPONENT LOCATOR.....	EN13-4
SPECIAL TOOL	EN13-6
OVERHAUL	EN13-7
INSPECTION AND REPAIR	EN13-15

AIR COMPRESSOR

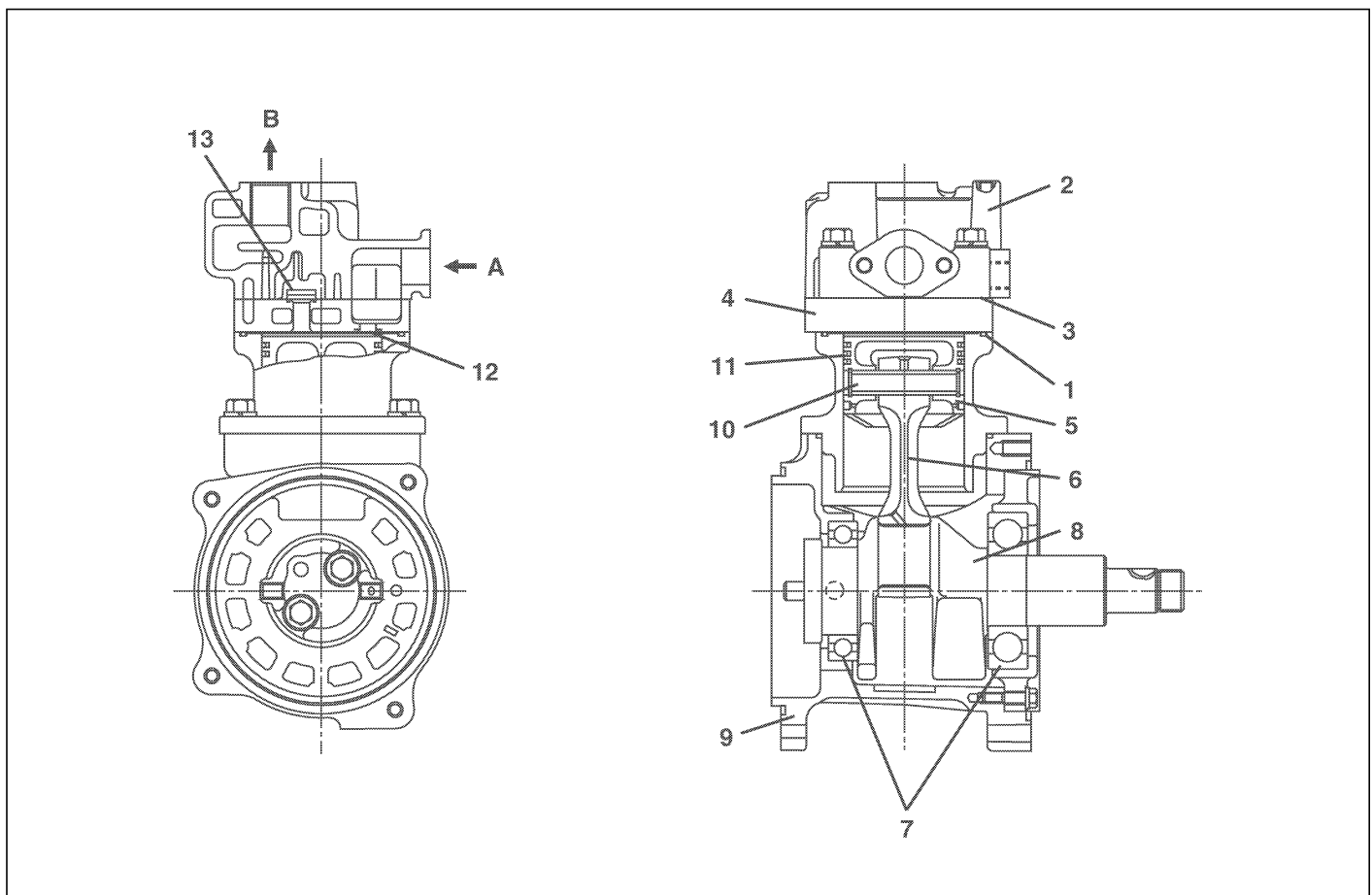
DATA AND SPECIFICATIONS

EN0110613I200001

Type	Reciprocating, single cylinder
Discharge amount	154cm ³ {9.4 cu.in.}
Bore x stroke	70 mm x 40 mm {2.76 in. x 1.57 in.}
Lubrication system	Forced feed lubrication
Cooling system	Forced water-circulated

DESCRIPTION

EN0110613C100001



SAPH011061300001

1	O-ring	9	Crankcase
2	Cylinder head assembly	10	Piston pin
3	Gasket	11	Piston ring
4	Valve seat	12	Suction valve
5	Piston	13	Delivery valve
6	Connecting rod	A	Suction
7	Bearing	B	Delivery
8	Crankshaft		

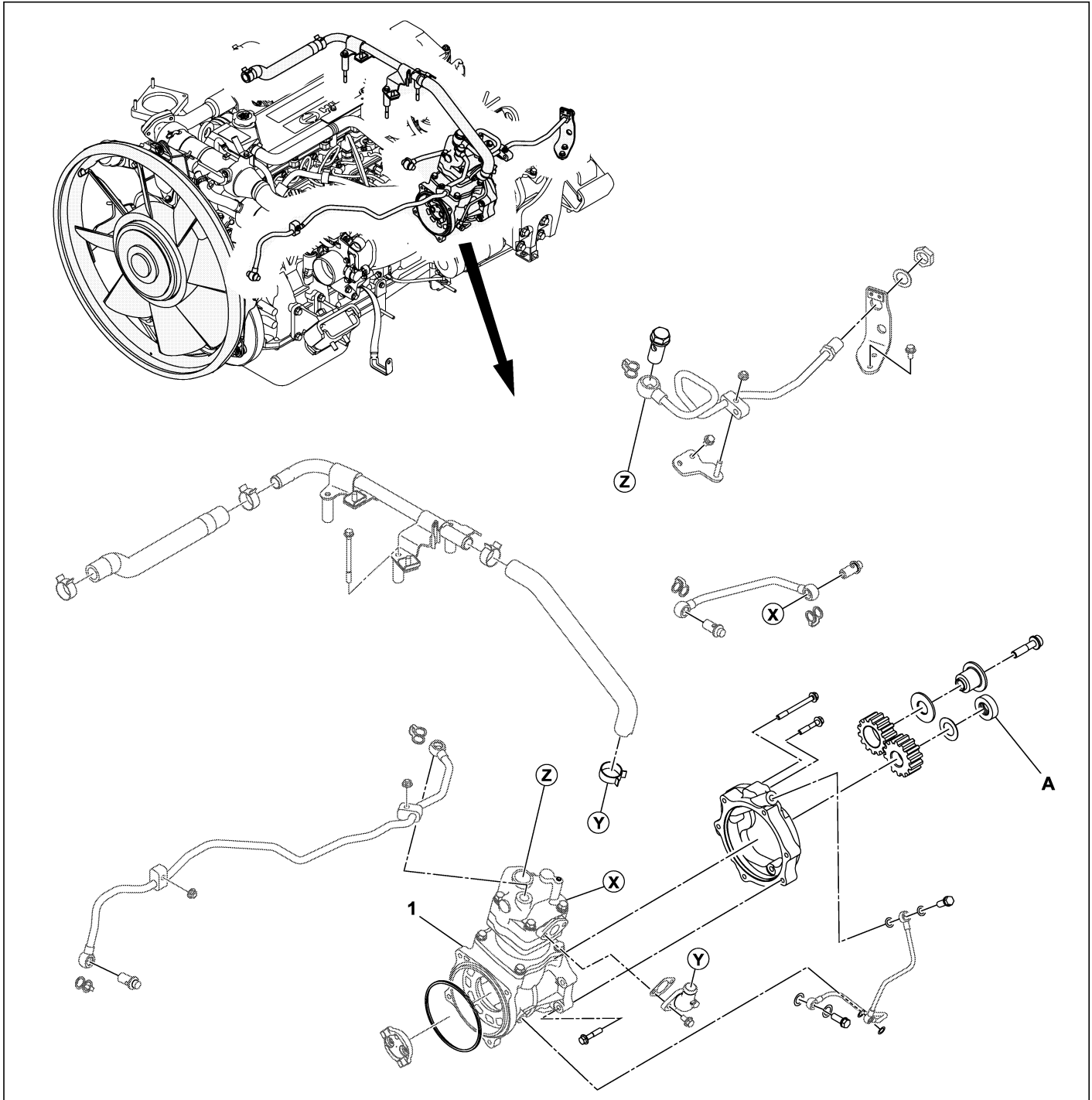
TROUBLESHOOTING

EN0110613F300001

Symptom	Possible cause	Remedy/Prevention
Charging efficiency dropped (Valve)	Abnormal wear, damage, or poor contact	Replace.
Charging efficiency dropped (Piston, Cylinder liner and piston rings)	Worn piston and cylinder liner	Replace.
	Seized piston	Replace (piston, piston rings and cylinder liner).
	Worn or broken piston ring	Replace.
Charging efficiency dropped (Air pipe and joints)	Leakage of high-pressure air	Replace or tighten pipe joint.
	Clogged air pipe	Replace.
Charging efficiency dropped (Air cleaner)	Clogged element	Clean or replace element.
Noisy operation (Piston)	Wear of piston pin boss or piston pin	Replace.
	Seized, damaged or worn connecting rod small end	Replace.
	Worn piston or cylinder liner	Replace.
	Damaged or seized piston	Replace.
	Foreign particles on the top surface of piston	Clean or replace.
Noisy operation (Bearing)	Damaged, or worn ball bearing and/or connecting rod bearing	Replace.
Excessive carbon or oil in the compressor cylinder head or discharge line (Piston ring)	Worn, sticking or broken piston rings	Replace piston rings and/or cylinder liner.
	Insufficient piston ring tension	Replace piston rings and/or cylinder liner.
	Malfunction of piston rings	Replace piston rings and/or cylinder liner.
Excessive carbon or oil in the compressor cylinder head or discharge line (Cylinder liner and piston rings)	Worn cylinder liner and piston rings	Replace.

COMPONENT LOCATOR

EN0110613D100001



SAPH011061300002

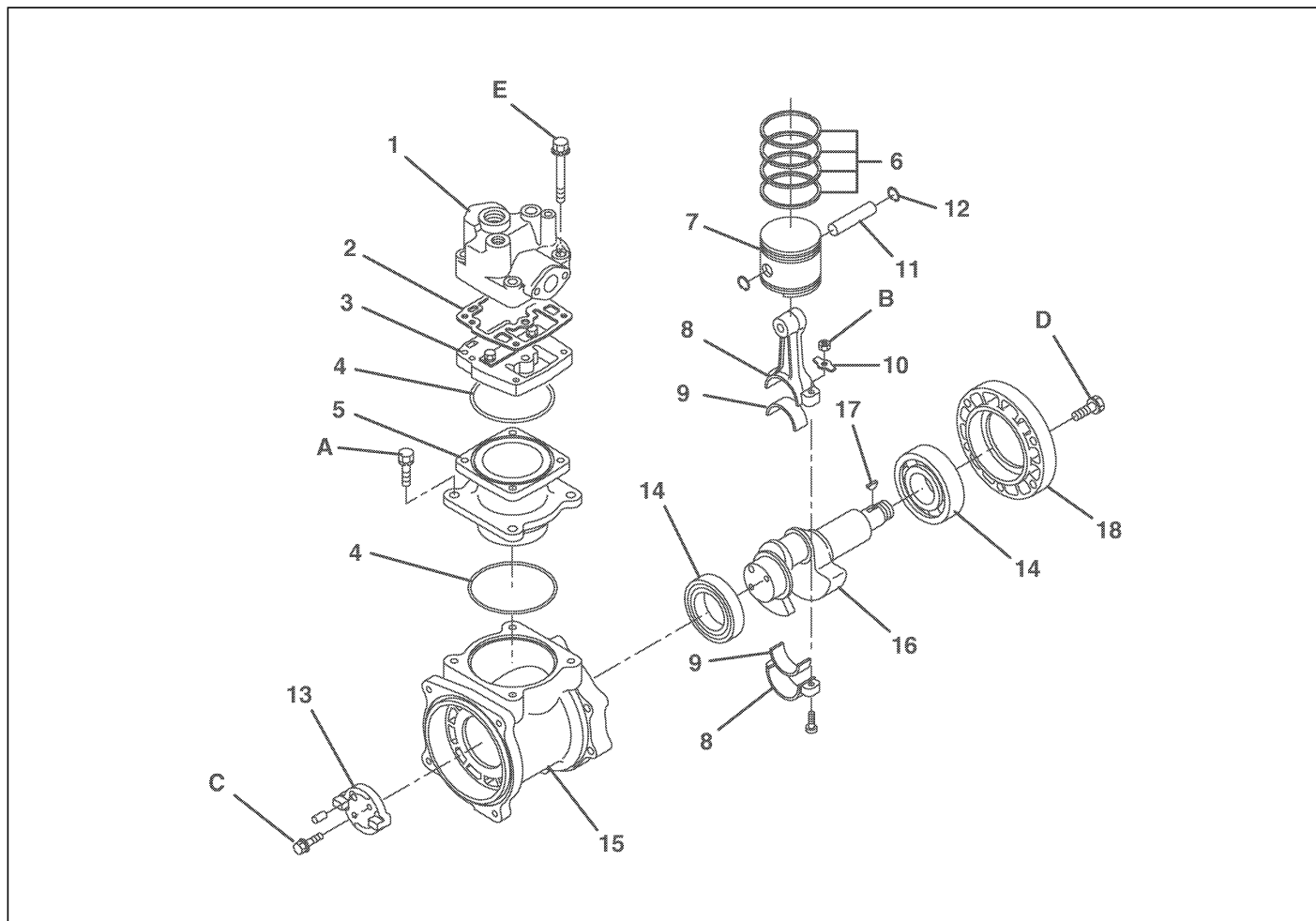
1 Air compressor	
------------------	--

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A 353 {3,600, 260} #	
----------------------	--

#= Apply oil to the threads and seat surface before tightening.



SAPH011061300003

1	Cylinder head	10	Lock washer
2	Gasket	11	Piston pin
3	Valve seat	12	Retainer ring
4	O-ring	13	Coupling
5	Cylinder liner	14	Ball bearing
6	Piston ring	15	Cylinder block
7	Piston	16	Crankshaft
8	Connecting rod	17	Woodruff key
9	Connecting rod bearing	18	Bearing holder

Tightening torque

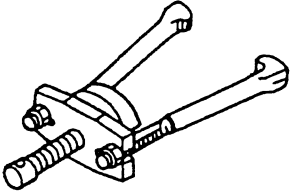
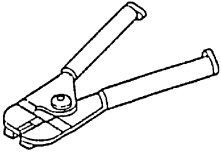
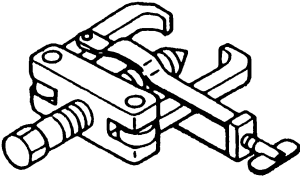
Unit: N·m {kgf·cm, lbf·ft}

A	25-30 {255-305, 19-22}	D	6-7.5 {61-76, 4.4-5.5}
B	23-26 {235-265, 17-19}	E	30-35 {306-356, 23-25}
C	30-36 {305-367, 22-26}		

SPECIAL TOOL

EN0110613K100001

Prior to starting an air compressor overhaul, it is necessary to have these special tools.

Illustration	Part number	Tool name	Remarks
	S0965-01310	PULLER ASSEMBLY	
	S0944-01060	PISTON RING EXPANDER	
	S0965-01101	BEARING PULLER	

OVERHAUL

EN0110613H200001

IMPORTANT POINTS - DISMOUNTING

1. REMOVE THE SUPPLY PUMP.

- (1) Refer to the chapter "FUEL SYSTEM".

2. REMOVE THE AIR COMPRESSOR.

- (1) Remove the six air compressor mounting bolts and remove the air compressor without applying excessive force.

NOTICE

Excessive force to the air compressor may damage the mounting spigot or may cause oil leakage due to flaking of liquid gasket between the flywheel housing and plate.

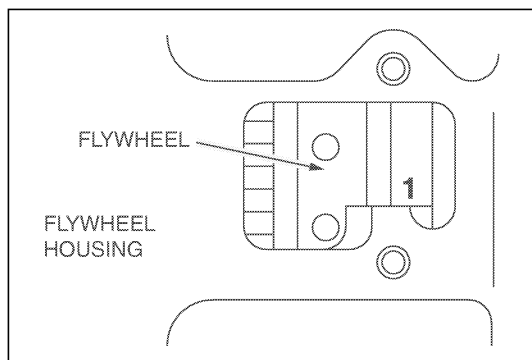
IMPORTANT POINTS - MOUNTING

1. INSTALLATION PROCEDURES

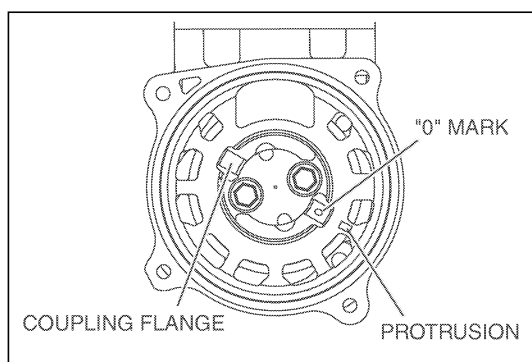
- (1) Fit the No.1 cylinder to the Top Dead Center.

NOTICE

Refer to the section "ENGINE TUNEUP" in the chapter "ENGINE INTRODUCTION (J08E)".



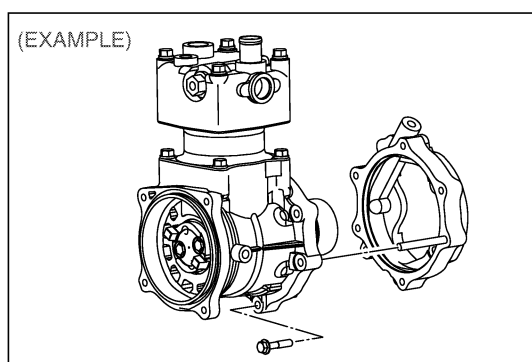
SAPH011061300007



SAPH011061300008

- (2) Align the aligning mark "O" on the top of coupling flange with protrusion on the compressor housing.

- (3) Insert the O-ring into the O-ring groove of the air compressor of bearing holder side.



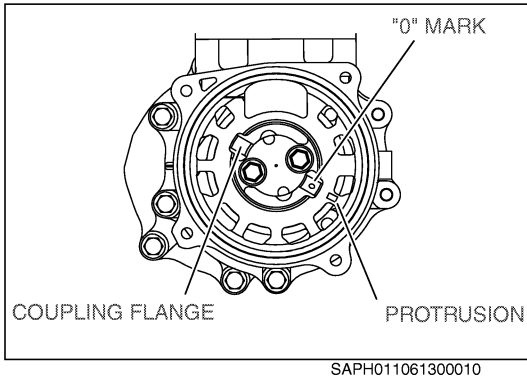
SAPH011061300009

- (4) Place a guide stud bolt (M8 x 1.25, length: 50 mm {1.968 in.} or more) in the flywheel housing as shown in the figure and insert the compressor onto the stud bolt.

- (5) Tighten the mounting bolts (other than the stud bolt) then remove the stud bolt. Insert a bolt in the place of the stud bolt.

Tightening Torque:

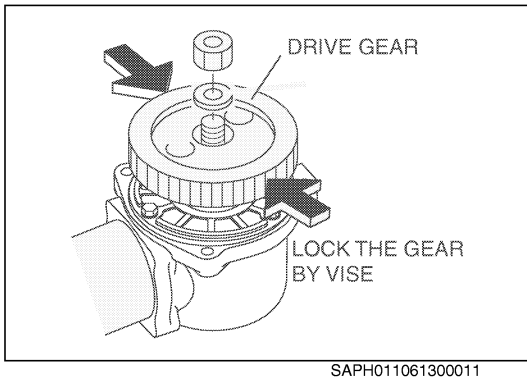
28.5 N·m {290 kgf·cm, 20 lbf·ft}



- (6) Make sure that the aligning mark "0" on the top of the coupling flange is aligning with protrusion on the compressor housing.

2. INSTALL THE SUPPLY PUMP.

- (1) Refer to the chapter "FUEL SYSTEM".



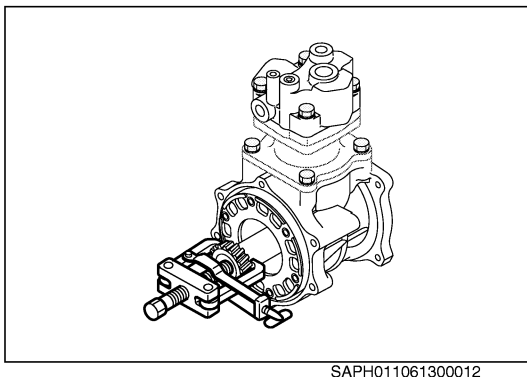
IMPORTANT POINTS - DISASSEMBLY

1. REMOVE THE DRIVE GEAR.

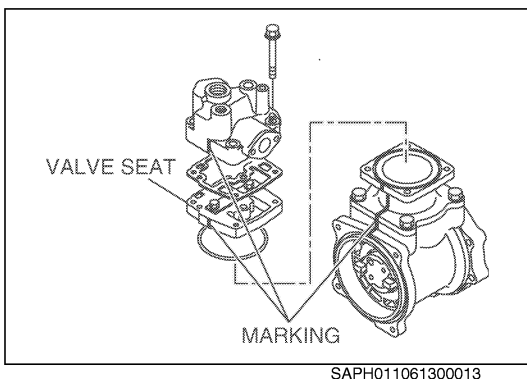
- (1) Remove the lock nut from the compressor drive gear.

NOTICE

If the spread is insufficient, the drive gear will be damaged when loosening the nut.



- (2) Pull the drive gear from the crankshaft, then remove the woodruff key.
SST: Bearing puller (S0965-01101)

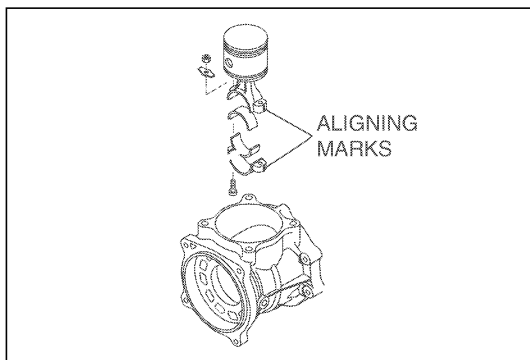


2. REMOVE THE CYLINDER HEAD, GASKET, VALVE SEAT AND O-RING.

- (1) Remove the cylinder head, gasket, valve seat and o-ring.

NOTICE

- Put the marking through the cylinder head to the cylinder liner.
- Do not disassemble the valve seat.



SAPH011061300014

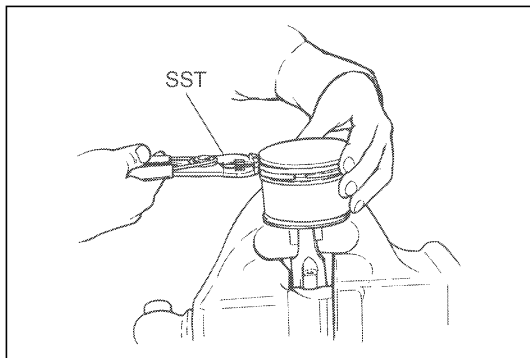
3. REMOVE THE CONNECTING ROD WITH THE PISTON.

- (1) Rotate the crankshaft to the top dead center position.
- (2) Spread the staking of the nut completely with a chisel, then loosen the nut.

NOTICE

Put the aligning marks to the connecting rod and the cap.

- (3) Remove the connecting rod with piston.



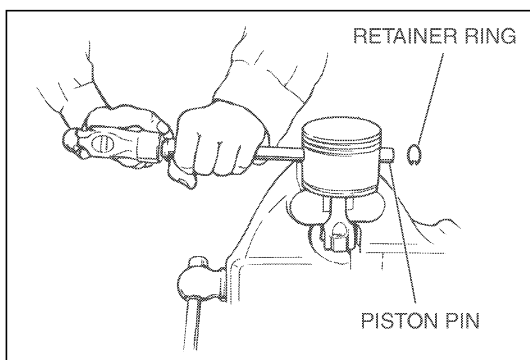
SAPH011061300015

4. REMOVE THE PISTON RINGS.

- (1) Remove the piston rings.
SST: Piston ring expander (S0944-01060)

NOTICE

- Handle the piston rings carefully because they are made of a special casting which is easily broken.
- When reusing the piston rings, first arrange them face up and in the correct installation sequence in order to prevent installing them incorrectly.



SAPH011061300016

5. REMOVE THE PISTON.

- (1) Remove the retainer rings installed on both ends of the piston, using retainer ring pliers.

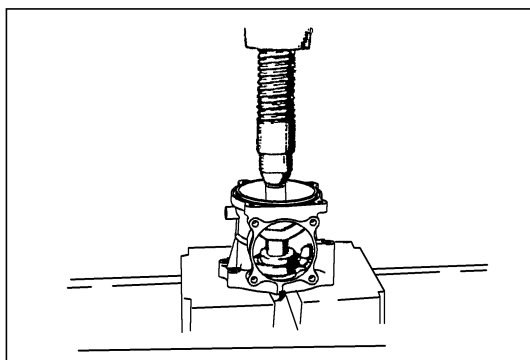
⚠ WARNING

Wear a pair of safety goggles, because the retainer rings may spring out the groove at the time of removal.

- (2) Strike out the piston pin.

NOTICE

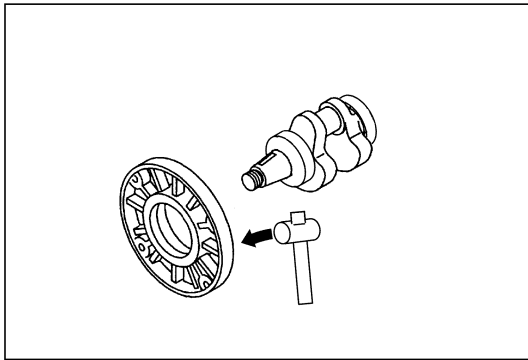
Warm up the piston first in hot water, 80-90°C {176-194°F}, for approximately 5 minutes before removing the piston pin.



SAPH011061300017

6. REMOVE THE CRANKSHAFT.

- (1) Remove the coupling.
- (2) Remove the bearing holder fitting bolts.
- (3) Using a press, remove the crankshaft with bearing holder.



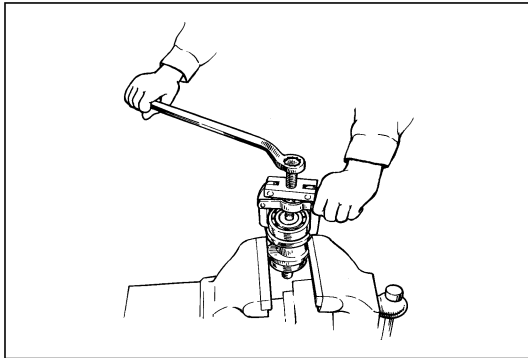
SAPH011061300018

7. REMOVE THE BEARING HOLDER.

- (1) Strike the circumference of the holder lightly with a plastic hammer or a mallet and remove the holder.

NOTICE

Be careful not to damage the bearing holder.



SAPH011061300019

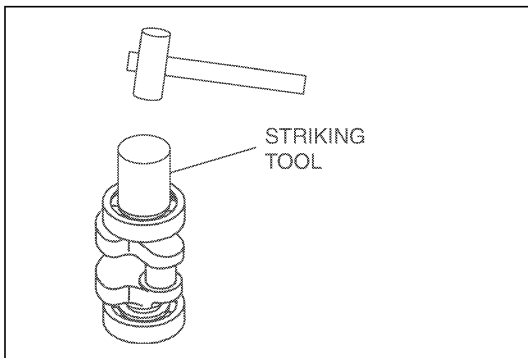
8. REMOVE THE BALL BEARING.

- (1) Using the special tool, remove the ball bearing from the end of the crankshaft.

SST:

Bearing puller (S0965-01101, for supply pump side)

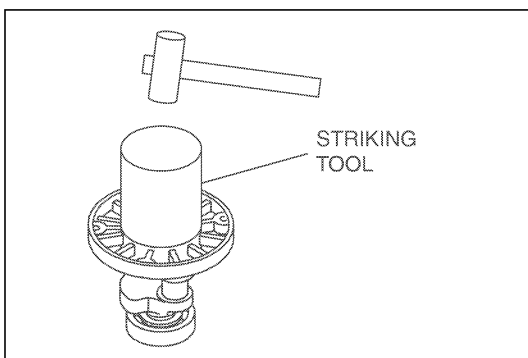
Puller assembly (S0965-01310, for drive gear side)



SAPH011061300020

IMPORTANT POINTS - ASSEMBLY**1. INSTALL THE BALL BEARING.**

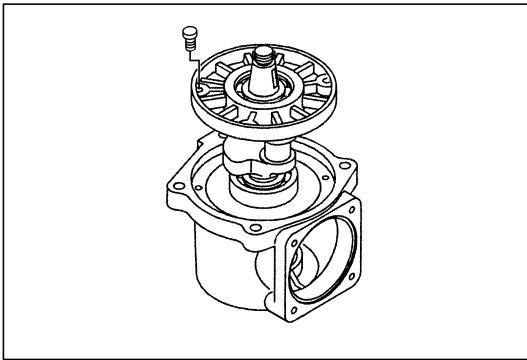
- (1) Install the ball bearing.



SAPH011061300021

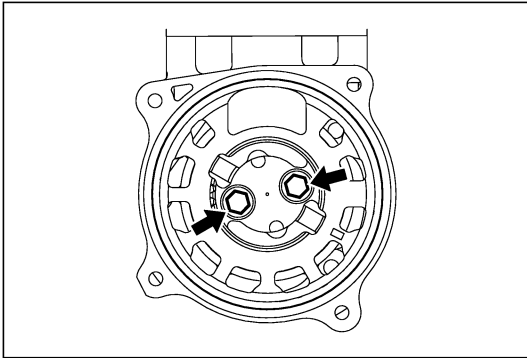
2. INSTALL THE CRANKSHAFT.

- (1) Using a copper hammer, install the crankshaft to the bearing holder.



SAPH011061300022

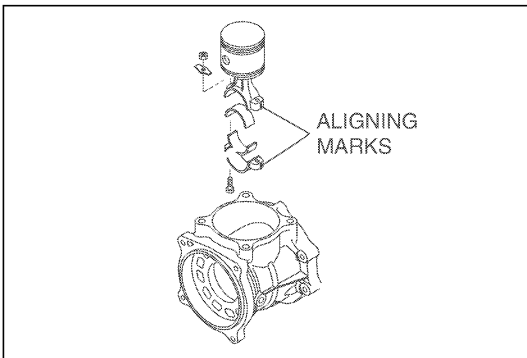
- (2) Install the crankshaft and bearing holder in the crankcase.
- (3) Tighten the bearing holder fitting bolt.



SAPH011061300023

3. INSTALL THE COUPLING.

- (1) Install the coupling.



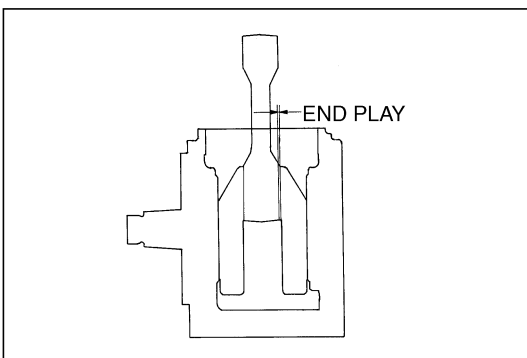
SAPH011061300024

4. INSTALL THE CONNECTING ROD AND MEASURE THE END PLAY.

NOTICE

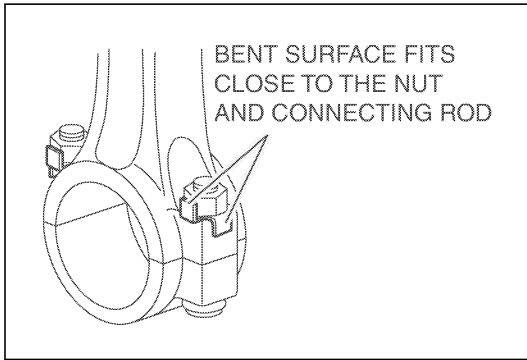
- Be sure to align the aligning mark.
- Apply engine oil to the bearing.

- (1) Apply engine oil to the thread before installing the connecting rod bolt.



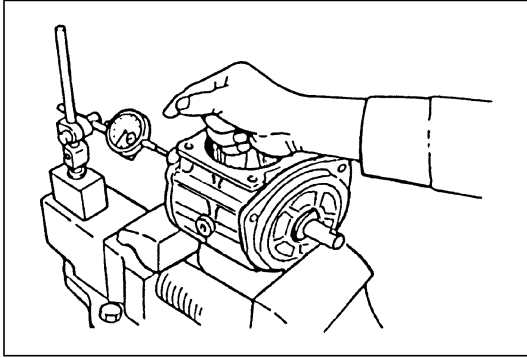
SAPH011061300025

- (2) Measure the connecting rod end play.
Assembly standard: 0.2-0.4 mm {0.008-0.015 in.}
Limit: 0.5 mm {0.02 in.}



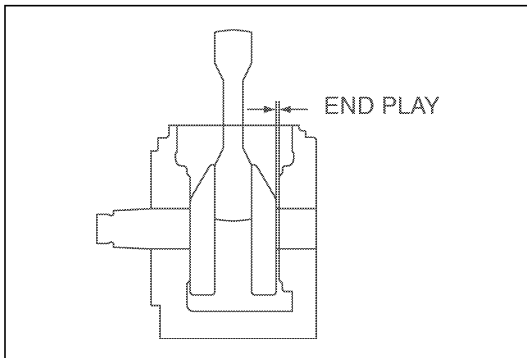
SAPH011061300026

- (3) Lock the nut with a lock washer.

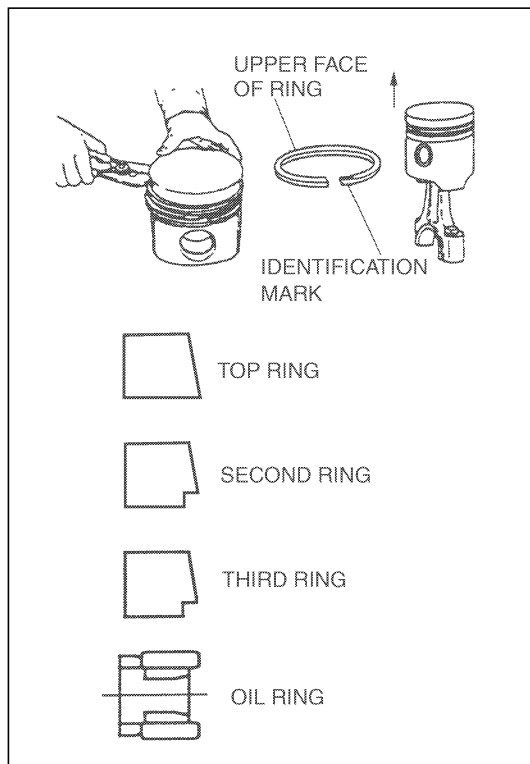


SAPH011061300027

5. **MEASURE THE END PLAY OF THE CRANKSHAFT.**
Assembly standard: 0-0.6 mm {0-0.023 in.}
Limit: 1.0 mm {0.039 in.}



SAPH011061300028



SAPH011061300029

6. ASSEMBLE THE PISTON.

NOTICE

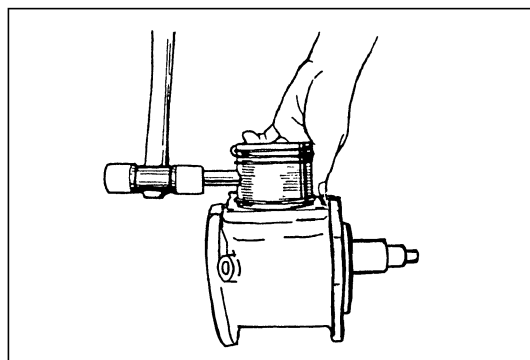
Assemble the various parts after applying engine oil to the sliding parts.

- (1) When installing the piston rings on the piston, ensure that the piston skirt is at the bottom, and use the special tool.

SST: Piston ring expander (S0944-01060)

NOTICE

Install the piston rings with the identification mark at the top of the ring facing up.



SAPH011061300030

7. ASSEMBLE THE PISTON AND CONNECTING ROD.

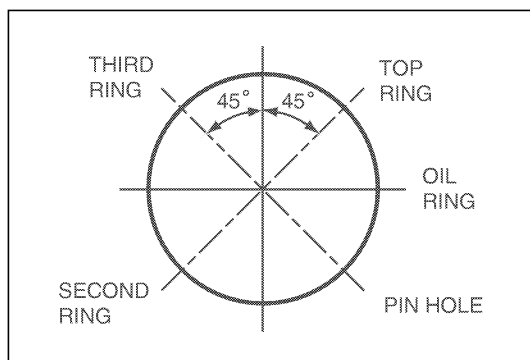
NOTICE

Warm up the piston first in hot water, to 80-90°C {176-194°F}, for approximately 5 minutes.

- (1) Install the retainer ring at one end of the piston holes.
- (2) Apply engine oil to the piston pin.
- (3) Fix the piston and connecting rod by inserting the pin.
- (4) Fit the new retainer ring at the other end.

⚠ WARNING

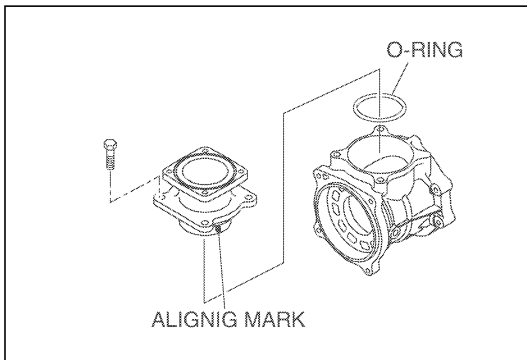
The retainer ring may spring out of the groove during assembly. Wear a pair of safety goggles during assembly.



SAPH011061300031

8. INSTALL THE CYLINDER LINER AND CYLINDER HEAD.

- (1) Rotate the crankshaft to the top dead center position.
- (2) Arrange the piston rings so that their gaps are equally spaced.

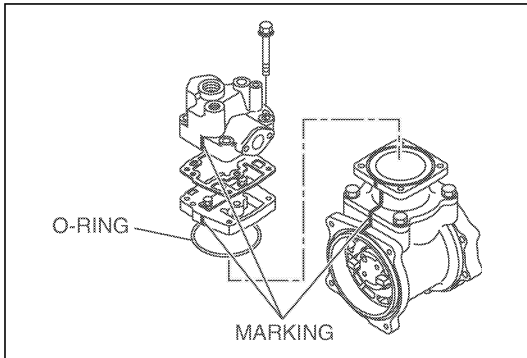


SAPH011061300032

(3) Install the cylinder liner.

NOTICE

- **Align the aligning marks.**
- **Do not twist the O-ring when installing.**

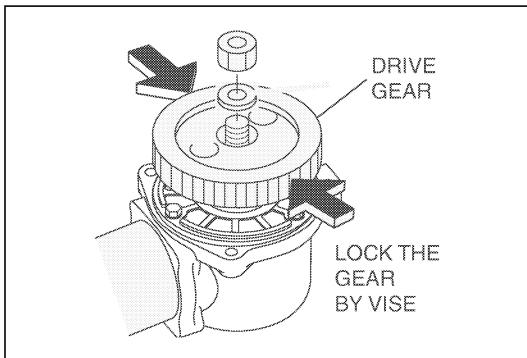


SAPH011061300033

(4) Install the cylinder head.

NOTICE

- **Align the aligning marks.**
- **Do not twist the O-ring when installing.**



SAPH011061300034

9. INSTALL THE DRIVE GEAR.

- (1) Install the key to the crankshaft.
- (2) Insert the drive gear.
- (3) Insert the collar and lock nut.

Tightening Torque:

353 N·m {3,600 kgf·cm, 260 lbf·ft}

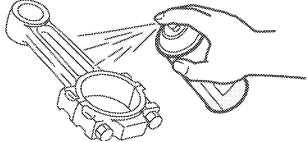
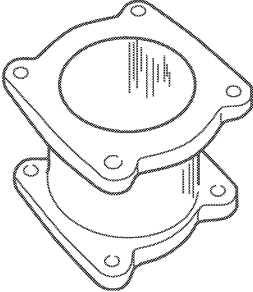
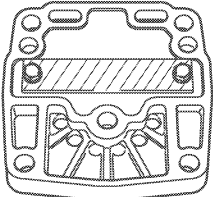
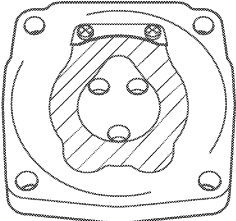
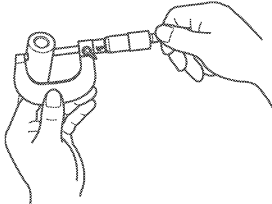
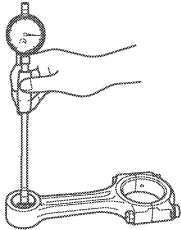
NOTICE

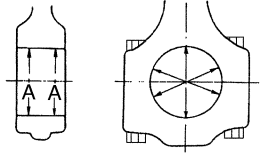
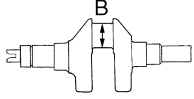
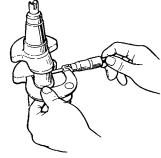
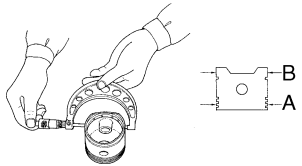
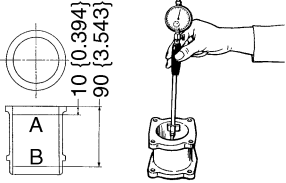
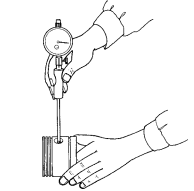
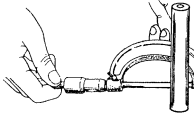
Apply oil to the threads and seat surface before tightening.

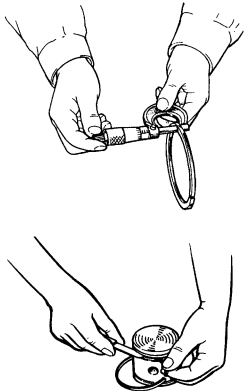
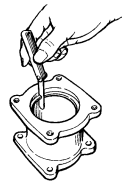
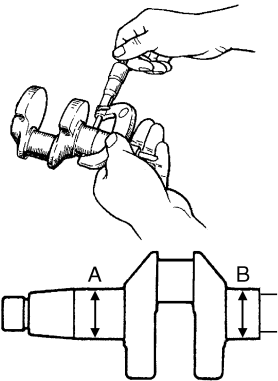
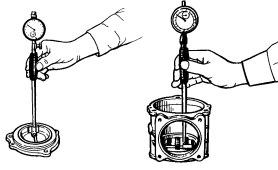
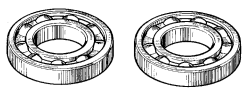
INSPECTION AND REPAIR

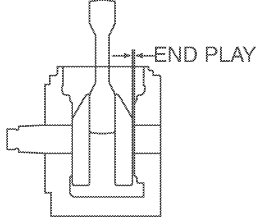
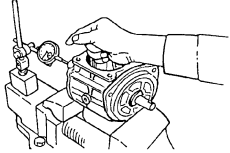
EN0110613H300001

Unit: mm {in.}

Inspection item	Standard	Limit	Remedy	Inspection procedure
Cracks or defects of the connecting rod	—	—	Replace.	Visual check 
Damage and scratches of the cylinder liner	—	—	Replace.	Visual check 
Worn or damaged delivery valve	—	—	Replace valve seat.	Visual check 
Worn or damaged suction valve	—	—	Replace valve seat.	Visual check 
Outside diameter of piston pin	14.0 {0.551}	—	Replace piston pin or connecting rod.	Measure  
Clearance between the piston pin and connecting rod	0.016-0.044 {0.0007-0.0017}	0.07 {0.0028}		

Inspection item	Standard	Limit	Remedy	Inspection procedure
Inside diameter of the connecting rod (with bearings): A #Tighten the bearing cap to the specified torque	34 {1.339}	—	Replace connecting rod bearing.	
Outside diameter of the crank pin: B	34 {1.339}	—		
Oil clearance between the connecting rod and the crank pin: C # Oil clearance C= A-B	0.017-0.083 {0.0007-0.0032}	0.1 {0.0039}		
Outside diameter of the piston (Measure at A and B)	70 {2.756}	—	Replace piston or cylinder liner.	Measure 
Inside diameter of the cylinder liner (Measure at A and B)	70 {2.756}	—		
Clearance between the piston and the cylinder liner	A: 0.18-0.245 {0.0071-0.0096} B: 0.084-0.144 {0.0033-0.0056}	0.285 {0.0112} 0.184 {0.0072}		
Inside diameter of the piston pin hole: A	14.0 {0.551}	—	Replace piston or piston pin.	Measure 
Outer diameter of the piston pin: B	14.0 {0.551}	—		
Clearance between the piston pin hole and the piston pin: C # Clearance C= A-B	0-0.026 {0-0.0010}	0.08 {0.0031}		

Inspection item		Standard	Limit	Remedy	Inspection procedure
Clearance between the ring groove and the piston ring	Top, second ring	0.005-0.040 {0.0002-0.0016}	0.08 {0.0031}	Replace piston or piston ring.	Measure 
	Second, third ring	0.1-0.3 {0.0040-0.0118}	1.0 {0.0394}		
Piston ring gap: compression ring	Top ring	0.15-0.35 {0.0060-0.0137}	1.0 {0.0394}	Replace.	Measure 
	Second, third ring	0.1-0.3 {0.0040-0.0118}	1.0 {0.0394}		
Outside diameter of the crankshaft journal		A: 40.002-40.013 {1.5749-1.5753}	39.995 {1.575}	Replace.	Measure 
		B: 50.002-50.011 {1.9686-1.9689}	49.995 {1.968}		
Inside diameter of the bearing holder	Cylinder block	80 {3.1496}	80.04 {3.151}	Replace.	Measure 
	Bearing holder	90 {3.543}	90.04 {3.545}		
Worn or damaged bearing		—	—	Replace.	Visual check 

Inspection item	Standard	Limit	Remedy	Inspection procedure
Connecting rod end play	0.2-0.4 {0.0079-0.0157}	0.5 {0.0197}	Replace connecting rod or crankshaft.	Measure 
Crankshaft end play	0-0.6 {0-0.023}	1.0 {0.039}	Replace crankshaft bearing.	Measure 

AIR COMPRESSOR (J08E: 227 cm³)

EN13-002

AIR COMPRESSOR	EN13-2
DATA AND SPECIFICATIONS	EN13-2
DESCRIPTION	EN13-3
TROUBLESHOOTING	EN13-4
COMPONENT LOCATOR.....	EN13-5
SPECIAL TOOL	EN13-7
OVERHAUL	EN13-7
INSPECTION AND REPAIR	EN13-16

AIR COMPRESSOR

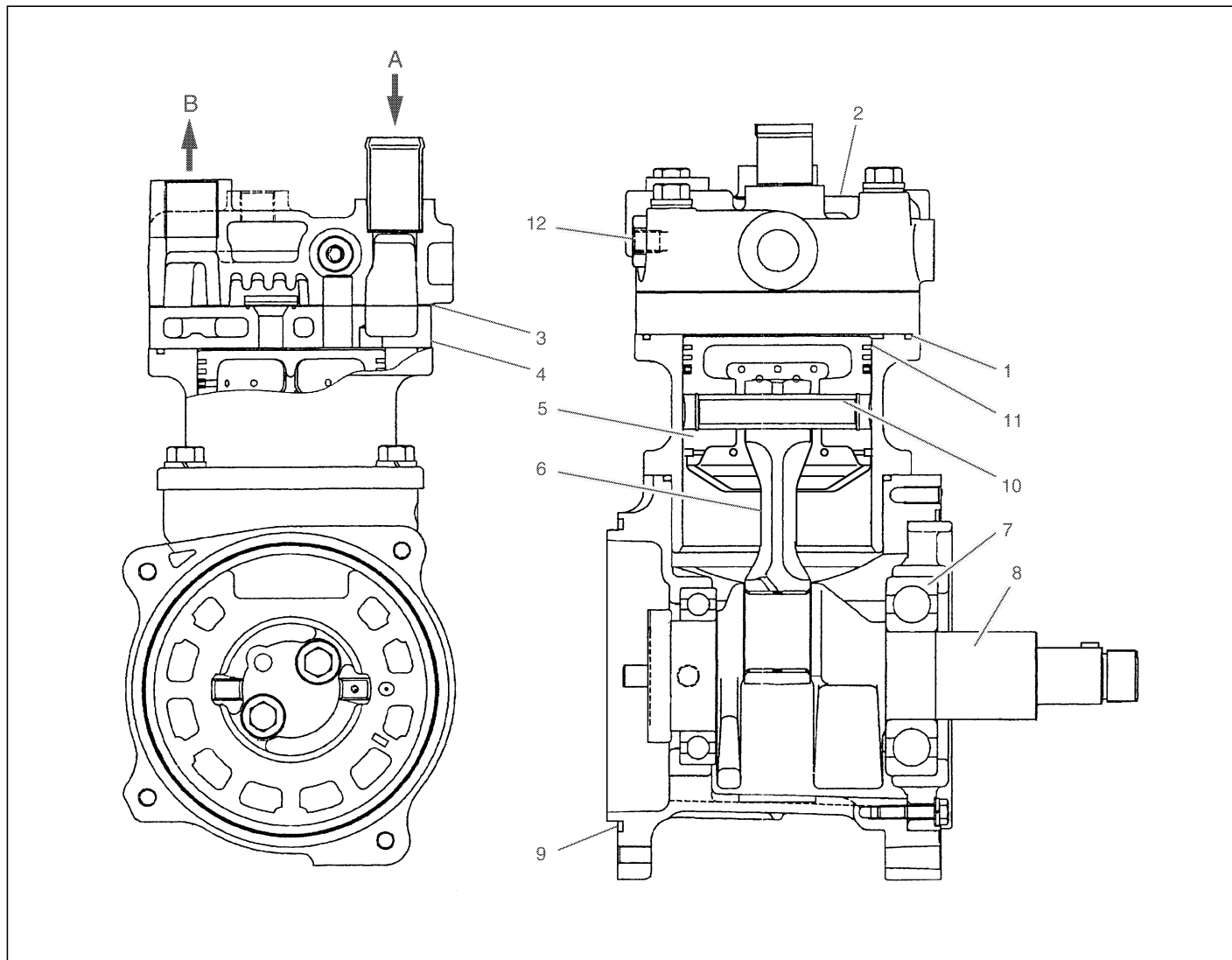
DATA AND SPECIFICATIONS

EN01Z0113I200001

Type	Reciprocating, single cylinder
Discharge amount	227 cm ³ {13.9 cu.in.}
Bore x stroke	85 mm x 40 mm {3.35 in. x 1.57 in.}
Lubrication system	Forced feed lubrication
Cooling system	Forced water-circulated

DESCRIPTION

EN01Z0113C100001



SAPH01Z011300001

1	O-ring	8	Crankshaft
2	Cylinder head assembly	9	Crankcase
3	Gasket	10	Piston pin
4	Valve seat	11	Piston ring
5	Piston	12	Unloader valve
6	Connecting rod	A	Suction
7	Bearing	B	Delivery

TROUBLESHOOTING

EN01Z0113F300001

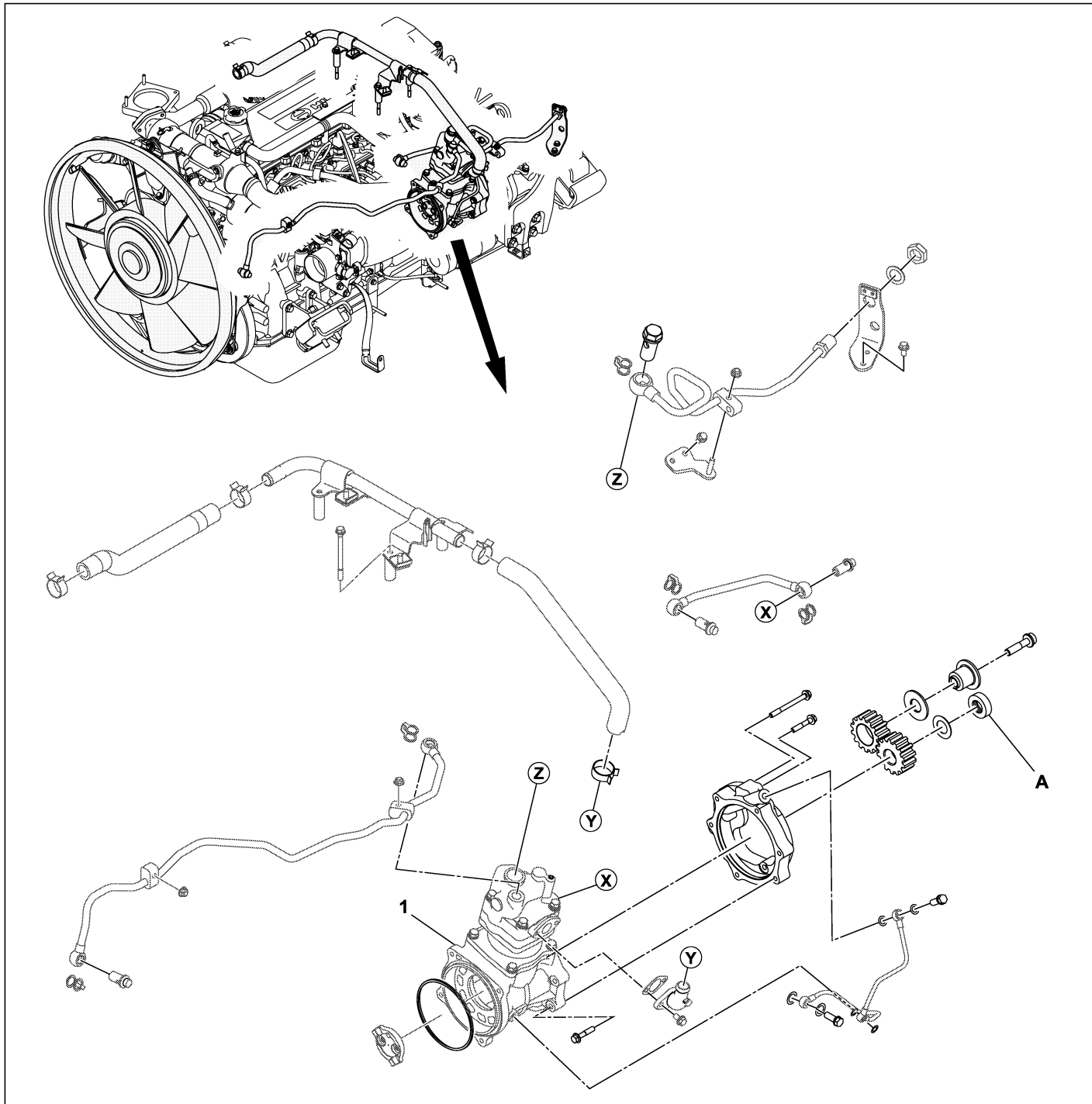
Symptom	Possible cause	Remedy/Prevention
Charging efficiency dropped (Valve)	Abnormal wear, damage, or poor contact	Replace.
Charging efficiency dropped (Piston, Cylinder liner and piston rings)	Worn piston and cylinder liner	Replace.
	Seized piston	Replace (piston, piston rings and cylinder liner).
	Worn or broken piston ring	Replace.
Charging efficiency dropped (Air pipe and joints)	Leakage of high-pressure air	Replace or tighten pipe joint.
	Clogged air pipe	Replace.
Charging efficiency dropped (Air cleaner)	Clogged element	Clean or replace element.

Symptom	Possible cause	Remedy/Prevention
Noisy operation (Piston)	Wear of piston pin boss or piston pin	Replace.
	Seized, damaged or worn connecting rod small end	Replace.
	Worn piston or cylinder liner	Replace.
	Damaged or seized piston	Replace.
	Foreign particles on the top surface of piston	Clean or replace.
Noisy operation (Bearing)	Damaged, or worn ball bearing and/or connecting rod bearing	Replace.

Symptom	Possible cause	Remedy/Prevention
Excessive carbon or oil in the compressor cylinder head or discharge line (Piston ring)	Worn, sticking or broken piston rings	Replace piston rings and/or cylinder liner.
	Insufficient piston ring tension	Replace piston rings and/or cylinder liner.
	Malfunction of piston rings	Replace piston rings and/or cylinder liner.
Excessive carbon or oil in the compressor cylinder head or discharge line (Cylinder liner and piston rings)	Worn cylinder liner and piston rings	Replace.

COMPONENT LOCATOR

EN01Z0113D100001



SAPH01Z011300002

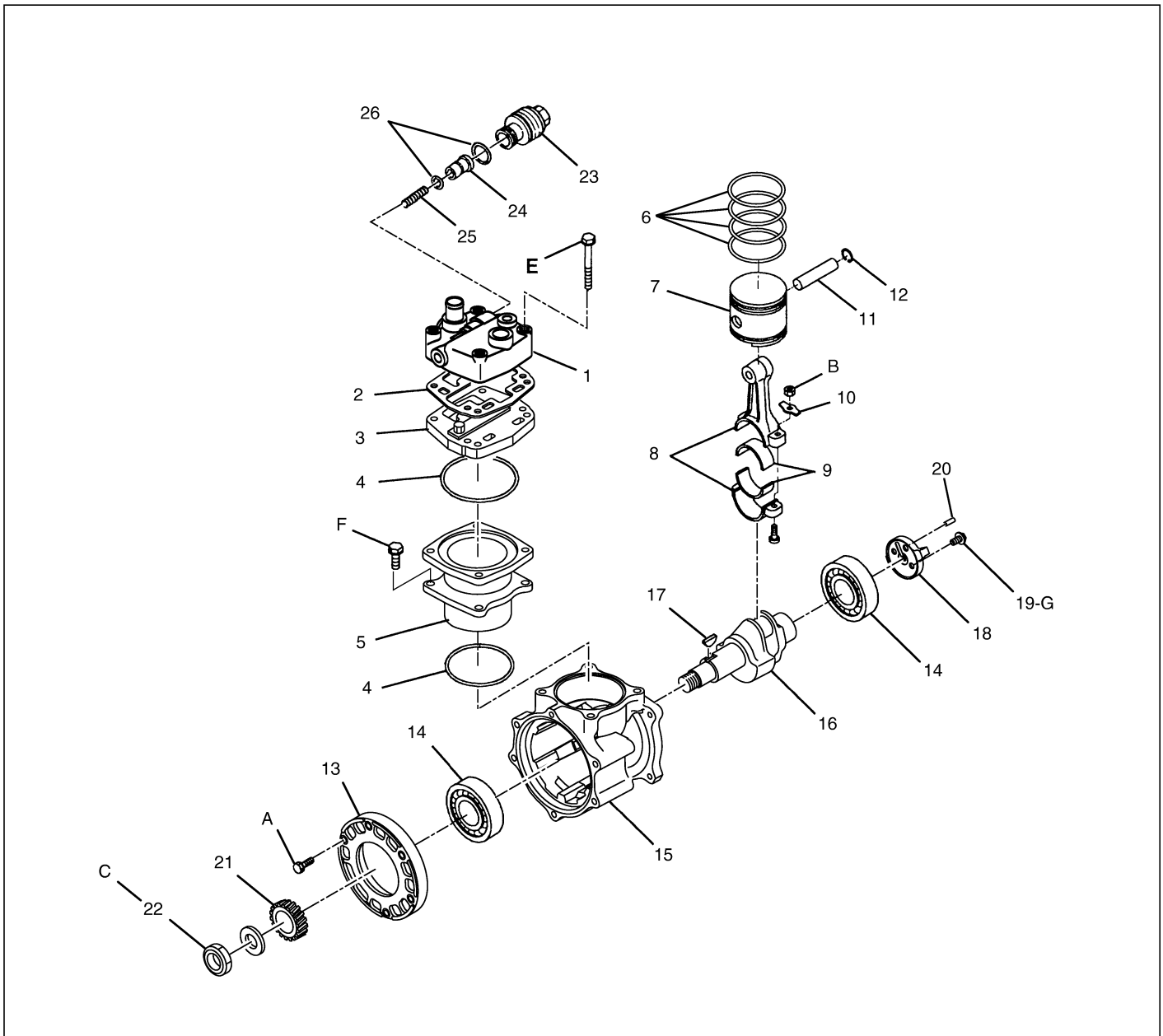
1 Air compressor	
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Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A 353 {3,600, 260} #	
----------------------	--

#= Apply oil to the threads and seat surface before tightening.



SAPH01Z011300003

1	Cylinder head	14	Ball bearing
2	Gasket	15	Cylinder block
3	Valve seat	16	Crankshaft
4	O-ring	17	Woodruff key
5	Cylinder liner	18	Coupling
6	Piston ring	19	Coupling bolt
7	Piston	20	Pin
8	Connecting rod	21	Drive gear
9	Connecting rod bearing	22	Lock nut
10	Lock washer	23	Unloader valve assy
11	Piston pin	24	Unloader valve piston
12	Retainer ring	25	Spring
13	Bearing holder	26	O-ring

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

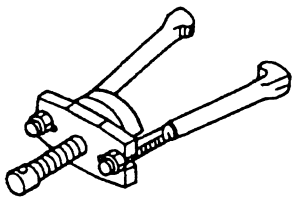
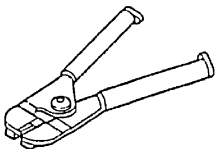
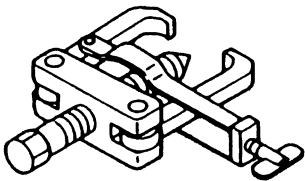
A	6.0-7.5 {61-77, 4.5-5.6}	E	29-34 {296-347, 22-25}
B	23-26 {235-265, 17-19}	F	25-29 {255-296, 19-22}
C	353 {3,600, 260} #	G	30-36 {305-367, 22-27}

#= Apply oil to the threads and seat surfaces before tightening.

SPECIAL TOOL

EN01Z0113K10001

Prior to starting an air compressor overhaul, it is necessary to have these special tools.

Illustration	Part number	Tool name	Remarks
	S0965-01310	PULLER ASSEMBLY	
	S0944-01060	PISTON RING EXPANDER	
	S0965-01101	PULLER	

OVERHAUL

EN01Z0113H20001

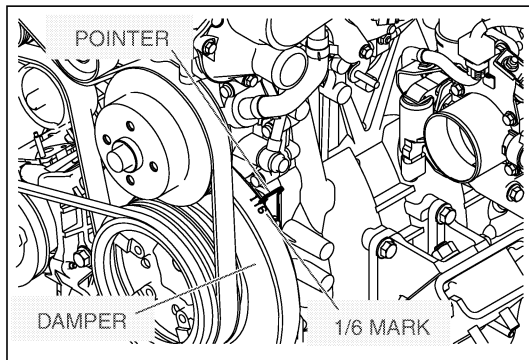
IMPORTANT POINTS - DISMOUNTING**1. REMOVE THE SUPPLY PUMP**

(1) Refer to CHAPTER FUEL SYSTEM

2. REMOVE THE AIR COMPRESSOR

(1) Remove the six air compressor mounting bolts and remove the air compressor without applying excessive force.

NOTICE**Excessive force to the air compressor may damage the mounting spigot or may cause oil leakage due to flaking of liquid gasket between the flywheel housing and plate.**



SAPH01Z011300007

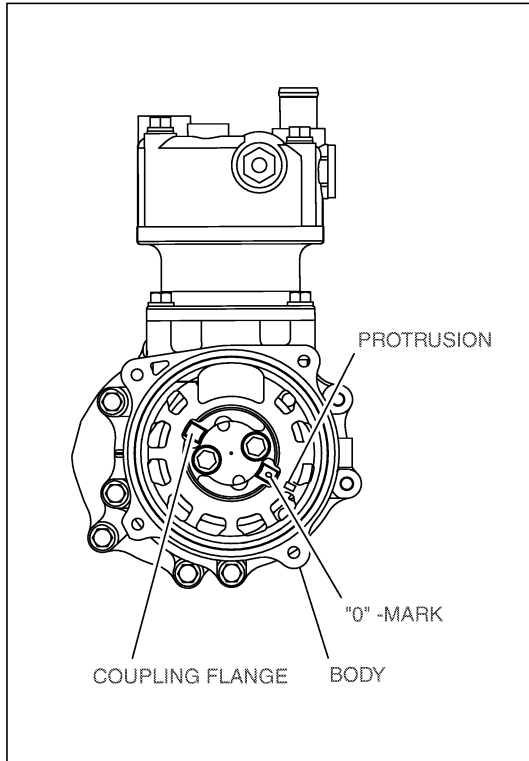
IMPORTANT POINTS - MOUNTING

1. INSTALLATION PROCEDURES.

- (1) Fit the No.1 cylinder to the Top Dead Center.

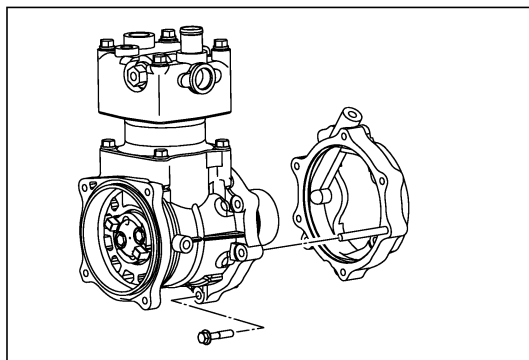
NOTICE

Refer to **ENGINE TUNEUP** of **CHAPTER ENGINE INTRODUCTION**



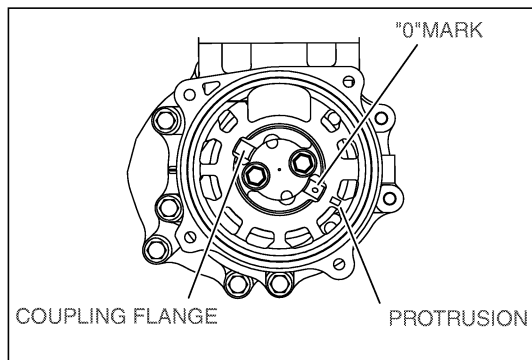
SAPH01Z011300008

- (2) Align the aligning mark "0" on the top of coupling flange with protrusion on the compressor housing.
- (3) Insert the O-ring in to the O-ring groove of the air compressor of bearing holder side.



SAPH01Z011300009

- (4) Place a guide stud bolt (M8 x 1.25, length: 50 mm {1.968 in.} or more) in the flywheel housing as shown in the figure and insert the compressor onto the stud bolt.
- (5) Tighten the mounting bolts (other than the stud bolt) then remove the stud bolt. Insert a bolt in the place of the stud bolt.

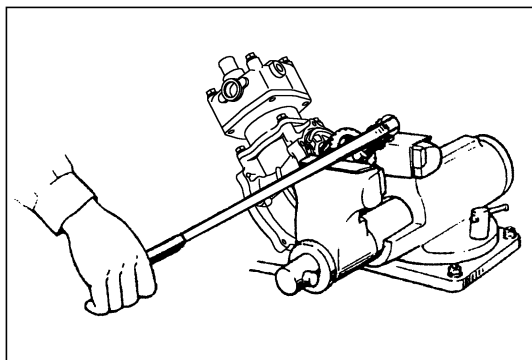


SAPH01Z011300010

- (6) Make sure that the aligning mark "O" on the top of coupling flange is aligned with protrusion on the compressor housing.

2. INSTALL THE SUPPLY PUMP AND AIR COMPRESSOR.

- (1) Refer to CHAPTER FUEL SYSTEM.



SAPH01Z011300011

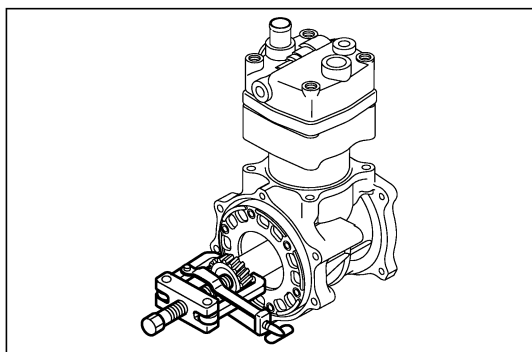
IMPORTANT POINTS - DISASSEMBLY

1. REMOVE THE DRIVE GEAR.

- (1) Remove the lock nut from the compressor drive gear.

NOTICE

If the spread is insufficient, the drive gear will be damaged when loosening the nut.



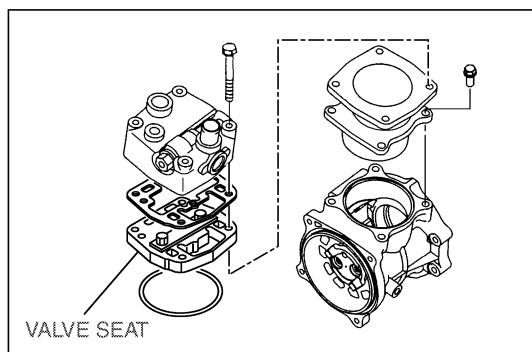
SAPH01Z011300012

- (2) Using the special tool, remove the drive gear from the crankshaft, then remove the woodruff key.

SST: Puller (S0965-01101)

- (3) Using the special tool, remove the ball bearing from the end of crankshaft.

SST: Puller assembly (S0965-01310)



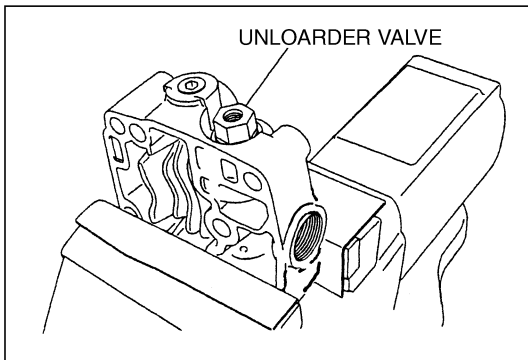
SAPH01Z011300013

2. REMOVE THE CYLINDER HEAD, GASKET, VALVE SEAT AND O-RING.

- (1) Remove the cylinder head, gasket, valve seat and O-ring.

NOTICE

- Put the marking through the cylinder head to the cylinder liner.
- Do not disassemble the valve seat.



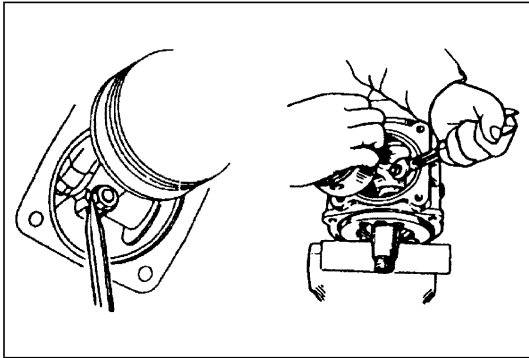
SAPH01Z011300014

3. REMOVE THE UNLOADER VALVE.

- (1) Remove the unloader valve from the cylinder head.

NOTICE

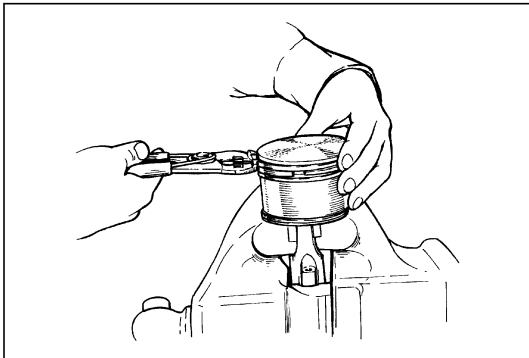
Take care not to damage the gasket seal surface when fixing the cylinder head in a vise.



SAPH01Z011300015

4. REMOVE THE CONNECTING ROD WITH THE PISTON.

- (1) Rotate the crankshaft to the top dead center position.
- (2) Spread the staking of the nut completely with a chisel, then loosen the nut.
- (3) Remove the connecting rod with piston.



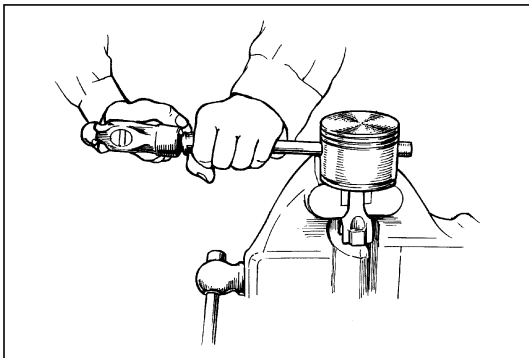
SAPH01Z011300016

5. REMOVE THE PISTON RINGS.

- (1) Remove the piston rings.
SST: Piston ring expander (S0944-01060)

NOTICE

- Handle the piston rings carefully because they are made of a special casting which is easily broken.
- When reusing the piston rings, first arrange them face up and in the correct installation sequence in order to prevent installing them incorrectly.



SAPH01Z011300017

6. REMOVE THE PISTON.

- (1) Remove the retainer rings installed on both ends of the piston, using retainer ring pliers.

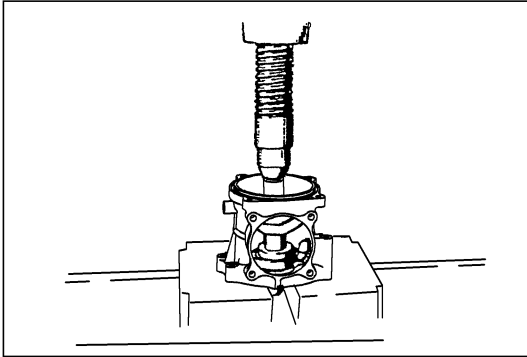
⚠ CAUTION

Wear a pair of safety goggles, because the retainer rings may spring out the groove at the time of removal.

- (2) Strike out the piston pin.

NOTICE

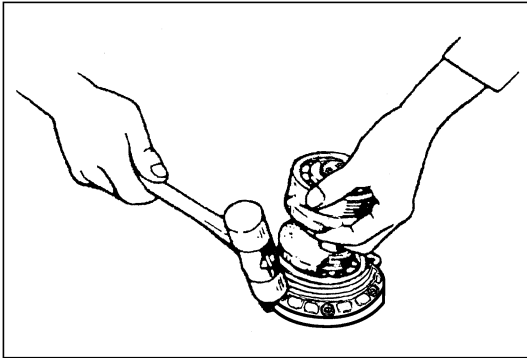
Warm up the piston first in hot water, 80-90°C {176-194°F}, for approximately 5 minutes before removing the piston pin.



SAPH01Z011300018

7. REMOVE THE CRANKSHAFT.

- (1) Remove the coupling 2 bolts
- (2) Remove the coupling.
- (3) Remove the bearing holder fitting bolts.
- (4) Using a press, remove the crankshaft with bearing holder.



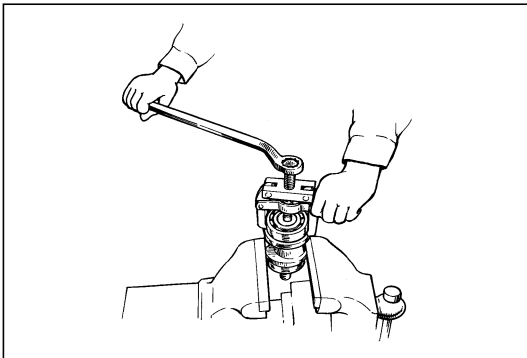
SAPH01Z011300019

8. REMOVE THE BEARING HOLDER.

- (1) Strike the circumference of the holder lightly with a plastic hammer or a mallet and remove the holder.

NOTICE

Be careful not to damage the bearing holder.

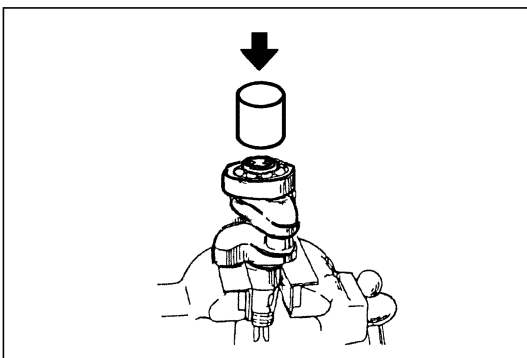


SAPH01Z011300020

9. REMOVE THE BALL BEARING. (SUPPLY PUMP SIDE)

- (1) Using the special tool, remove the 2 ball bearings from the end of the crankshaft.

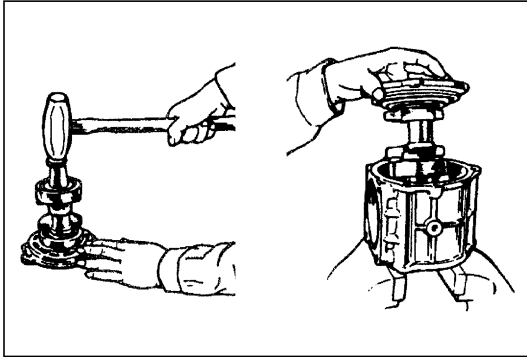
SST: Puller (S0965-01101)



SAPH01Z011300021

IMPORTANT POINTS - ASSEMBLY**1. INSTALL THE BALL BEARING.**

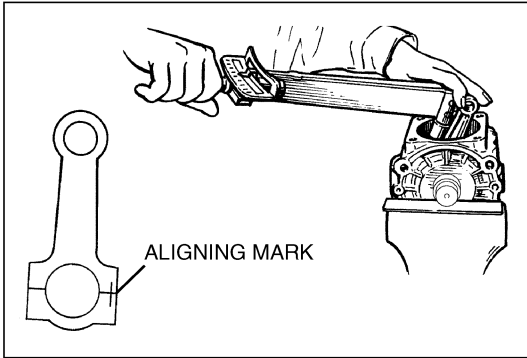
- (1) Install the 2 ball bearings using a press.



SAPH01Z011300022

2. INSTALL THE CRANKSHAFT.

- (1) Using a copper hammer, install the crankshaft to the bearing holder.
- (2) Install the crankshaft and bearing holder in the crankcase.
- (3) Tighten the bearing holder fitting bolt.
- (4) Install the coupling with the 2 bolts

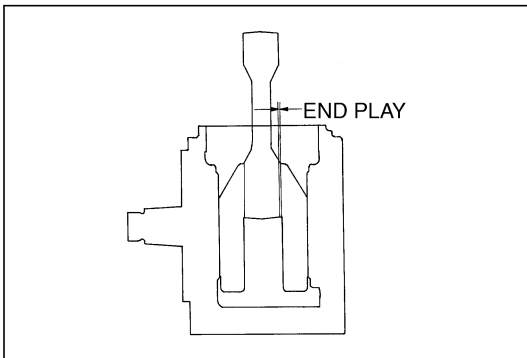


SAPH01Z011300023

3. INSTALL THE CONNECTING ROD AND MEASURE THE END PLAY.

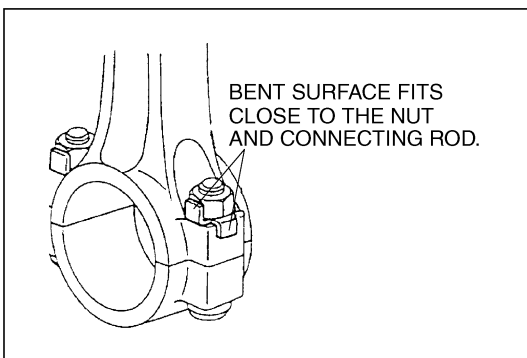
NOTICE

- Be sure to align the aligning mark.
 - Apply engine oil to the bearing.
- (1) Apply engine oil to the thread before installing the connecting rod bolt.



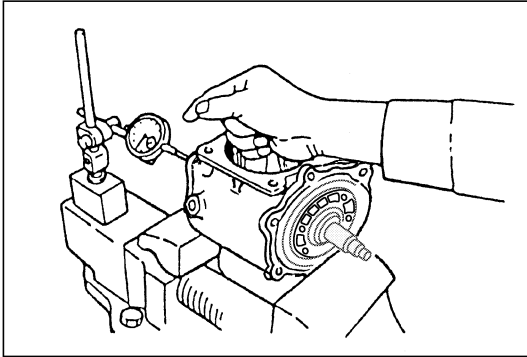
SAPH01Z011300024

- (2) Measure the connecting rod end play.
Assembly standard: 0.2-0.4 {0.008-0.015 in.}
Limit: 0.5 mm {0.02 in.}



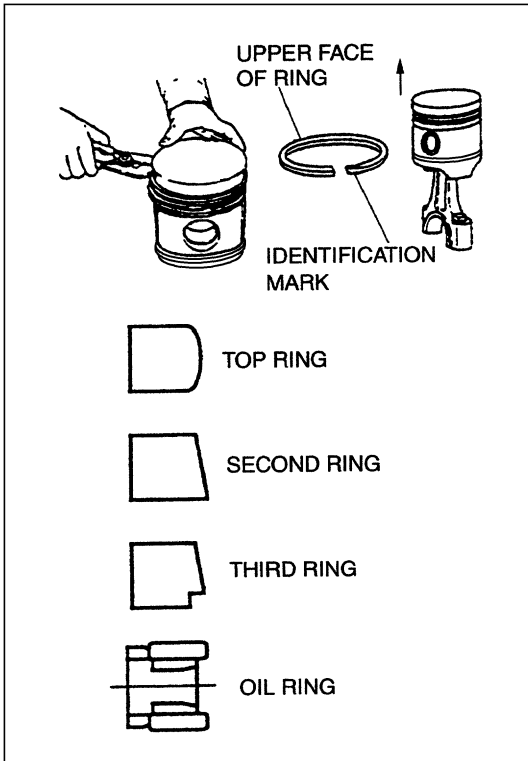
SAPH01Z011300025

- (3) Lock the nut with a lock washer.



SAPH01Z011300026

4. **MEASURE THE END PLAY OF THE CRANKSHAFT.**
Assembly standard: 0.016-0.626 mm {0.0006-0.0246 in.}
Limit: 0.8 mm {0.0315 in.}



SAPH01Z011300027

5. ASSEMBLE THE PISTON.

NOTICE

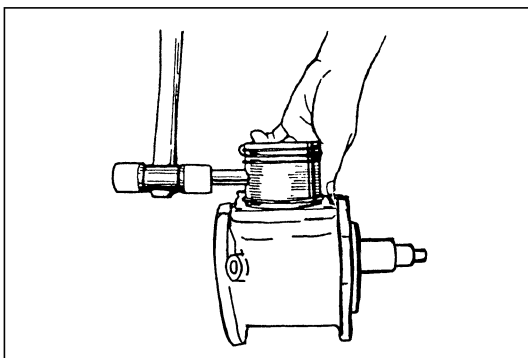
Assemble the various parts after applying engine oil to the sliding parts.

- (1) When installing the piston rings on the piston, ensure that the piston skirt is at the bottom, and use the special tool.

SST: Piston ring expander (S0944-01060)

NOTICE

Install the piston rings with the identification mark at the top of the ring facing up.



SAPH01Z011300028

6. ASSEMBLE THE PISTON AND CONNECTING ROD.

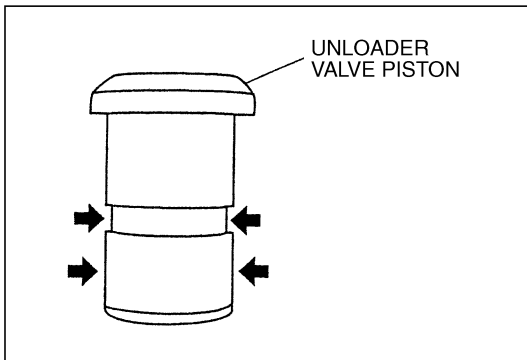
NOTICE

Warm up the piston first in hot water, to 80-90°C {176-194°F}, for approximately 5 minutes.

- (1) Install the retainer ring at one end of the piston holes.
- (2) Apply engine oil to the piston pin.
- (3) Fix the piston and connecting rod by inserting the pin.
- (4) Fit the new retainer ring at the other end.

⚠ CAUTION

The retainer ring may spring out of the groove during assembly. Wear a pair of safety goggles during assembly.



SAPH01Z011300029

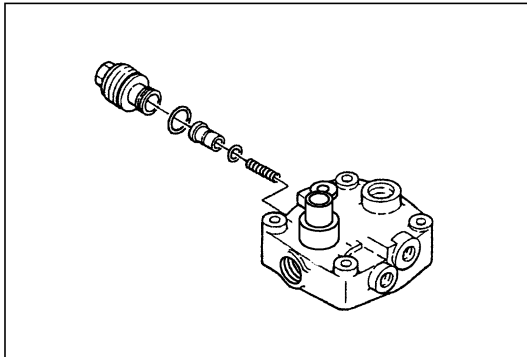
7. INSTALL THE UNLOADER VALVE

- (1) Apply silicone grease to the O-ring groove of the unloader valve piston and the O-ring.

Application quantity: 0.2-0.3 g

NOTICE

Apply to the O-ring, the O-ring groove, and the entire sliding circumference of the piston.

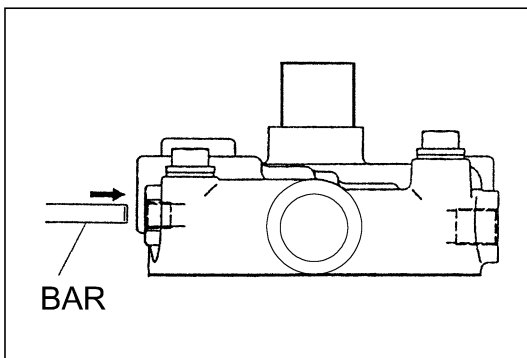


SAPH01Z011300030

- (2) Install the valve spring and unloader valve piston with O-ring
- (3) Install the unloader valve assy from the front side of the cylinder head and tighten the unloader valve assy to the specified torque.

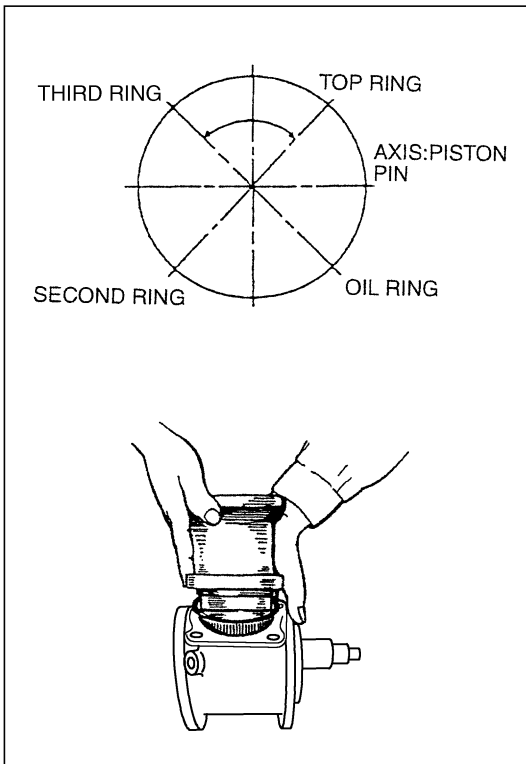
Tightening Torque:

118-138 N·m {1,200-1,400 kgf·cm, 87-100 lbf·ft}



SAPH01Z011300031

- (4) Push the unloader valve from the front side with a bar, and check that the unloader valve and valve spring move smoothly.



SAPH01Z011300032

8. INSTALL THE CYLINDER LINER AND CYLINDER HEAD.**NOTICE**

Do not twist the O-ring when installing it on the cylinder liner and cylinder head.

- (1) Rotate the crankshaft to the top dead center position.
- (2) Arrange the piston rings so that their gaps are equally spaced.
- (3) Install the cylinder liner and cylinder head.

9. INSTALL THE DRIVE GEAR.

- (1) Install the key to the crankshaft.
- (2) Insert the drive gear.
- (3) Insert the collar and lock nut.

Tightening Torque:

353 N·m {3,600 kgf·cm, 260 lbf·ft}

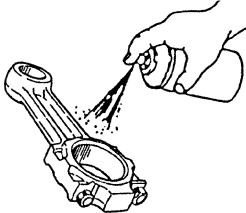
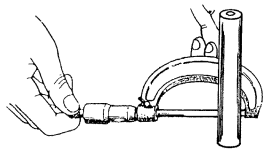
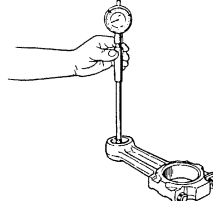
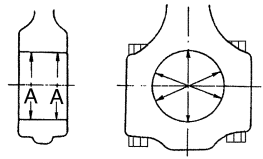
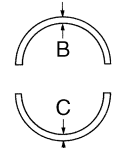
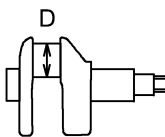
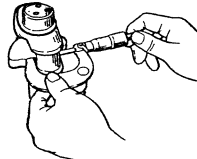
NOTICE

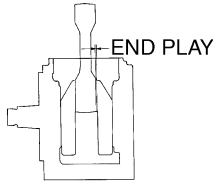
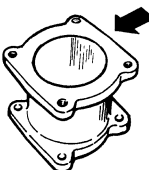
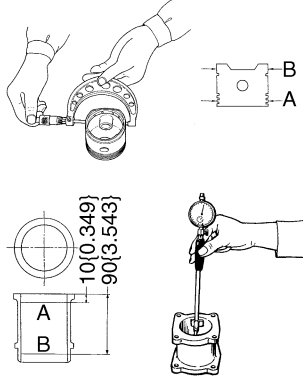
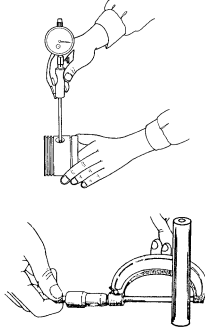
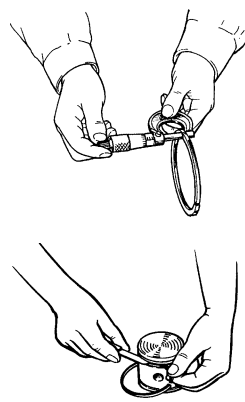
Apply oil to the threads and seat surface before tightening.

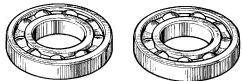
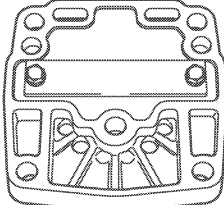
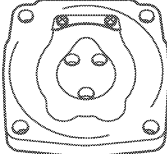

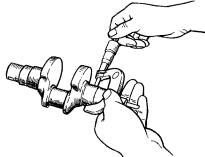
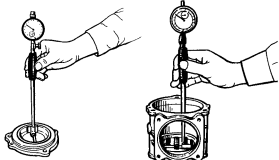
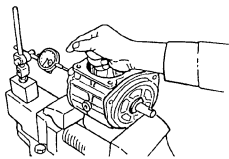
INSPECTION AND REPAIR

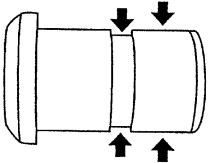
EN01Z0113H300001

Unit: mm {in.}

Inspection item	Standard	Limit	Remedy	Inspection procedure
Cracks or defects of the connecting rod	—	—	Replace.	Visual check 
Outside diameter of piston pin	18.0 {0.709}	—	Replace.	Measure  
Clearance between the piston pin and connecting rod	0.016-0.044 {0.0007-0.0017}	0.07 {0.0028}		
Inside diameter of the connecting rod (without bearings): A #Tighten the bearing cap to the specified torque	37 {1.457}	—	Replace.	   
Thickness of the connecting rod bearing: B,C	1.51 {0.0594}	—		
Outside diameter of the crank pin: D	34 {1.339}	—		
Oil clearance between the connecting rod and the crank pin: E # Oil clearance E= A-(B+C+D)	0.017-0.083 {0.0007-0.0032}	0.1 {0.0039}		

Inspection item		Standard	Limit	Remedy	Inspection procedure
Connecting rod end play		0.2-0.4 {0.0079-0.0157}	0.5 {0.0197}	Replace connecting rod or crankshaft.	 END PLAY
Damage and scratches of the cylinder liner		—	—	Replace.	Visual check 
Outside diameter of the piston		85 {3.3464}	—	Replace.	Measure 
Inside diameter of the cylinder liner		85 {3.3464}	—		
Clearance between the piston and the cylinder liner		A:0.18-0.245 {0.0071-0.0096}	0.28 {0.0110}		
		B:0.09-0.155 {0.0035-0.0061}	0.18 {0.0071}		
Clearance between the piston pin hole and the piston pin		0-0.028 {0-0.0011}	0.08 {0.0031}	Replace.	Measure 
Outer diameter of the piston pin		18 {0.708}	—		
Piston ring thickness	Compression ring	3.0	—	Replace.	Measure 
	Oil ring	4.0 {0.1575}	—		
Piston ring groove	Compression ring	3.0	—		
	Oil ring	4.0 {0.1575}	—		
Clearance between the ring groove and the compression ring		0.01-0.045 {0.0004-0.0018}	0.08 {0.0031}		

Inspection item		Standard	Limit	Remedy	Inspection procedure
Worn or damaged bearing		—	—	Replace.	Visual check 
Worn or damaged delivery valve		—	—	Replace valve seat.	Visual check 
Worn or damaged suction valve		—	—	Replace valve seat.	Visual check 
Piston ring gap: compression ring, oil ring	Top	0.3-0.5	1.0{0.0394}	Replace.	Measure 
	Second, Third	0.1-0.3 {0.0040-0.0119}			
	Oil ring	—	—		
Outside diameter of the crankshaft journal	Drive side	40.002-40.013 {1.5749-1.575}	39.995 {1.5746}	Replace.	Measure 
	Opposite drive side	50.002-50.013 {1.969-1.969}	49.995 {1.9683}		
Inside diameter of the bearing holder	Cylinder block	80 {3.1496}	80.000 {3.1496}	Replace.	Measure 
	Bearing holder	90.0 {3.5433}	90.000 {3.5433}		
Crankshaft end play		0.016-0.626 {0.0006-0.0246}	0.8 {0.0315}	Replace crankshaft bearing	Measure 

Inspection item	Standard	Limit	Remedy	Inspection procedure
Wear or damage of the unloader valve piston	—	—	Replace.	Visual check 

ENGINE CONTROL (J08E)

EN16-001

ACCELERATOR PEDAL.....EN16-2

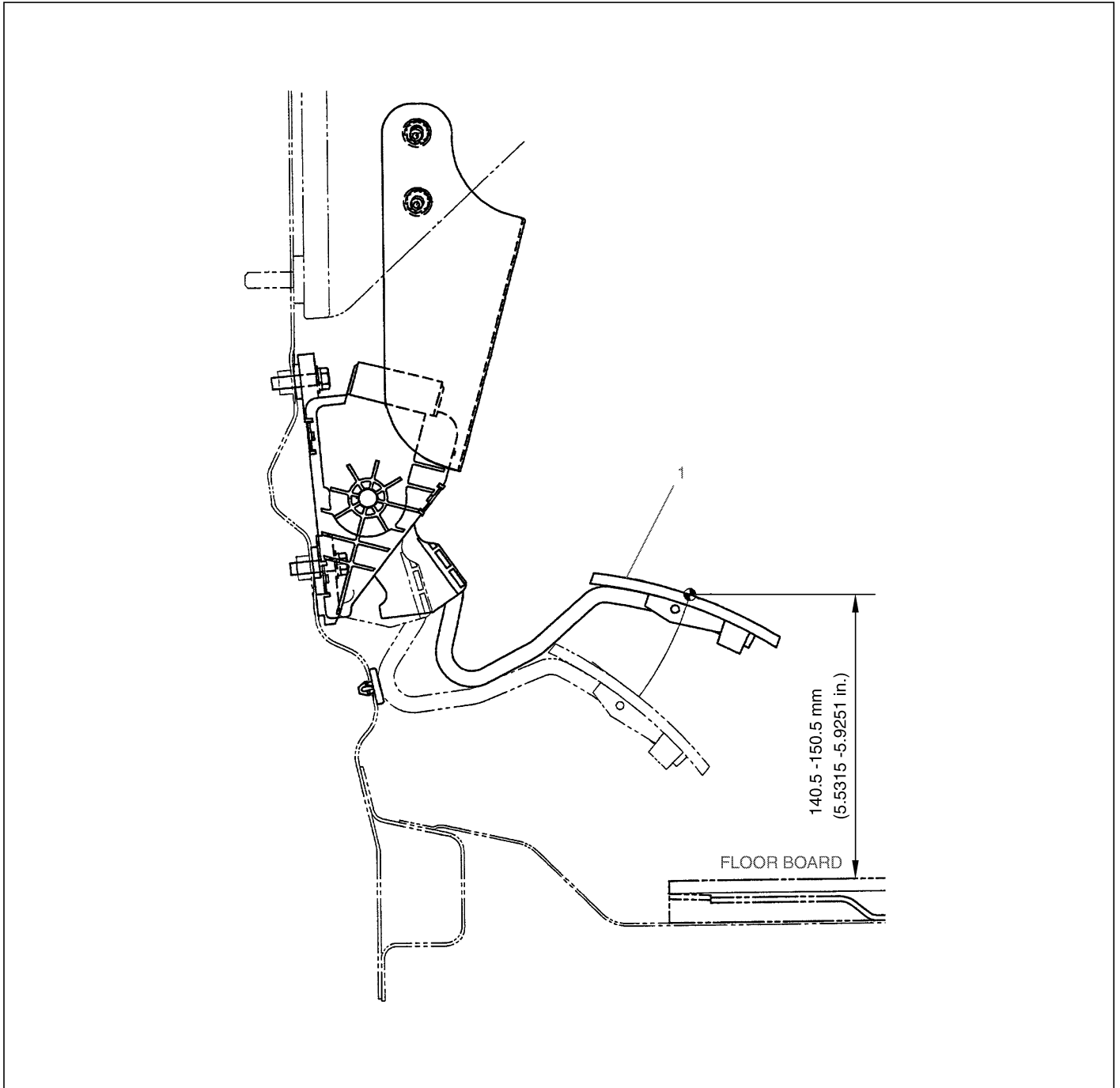
DESCRIPTION EN16-2



ACCELERATOR PEDAL

DESCRIPTION

EN0110616F200001



SAPH011061600001

1 Accelerator pedal assy	
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FUEL CONTROL (J08E)

DN02-001

COMMON RAIL FUEL INJECTION SYSTEM

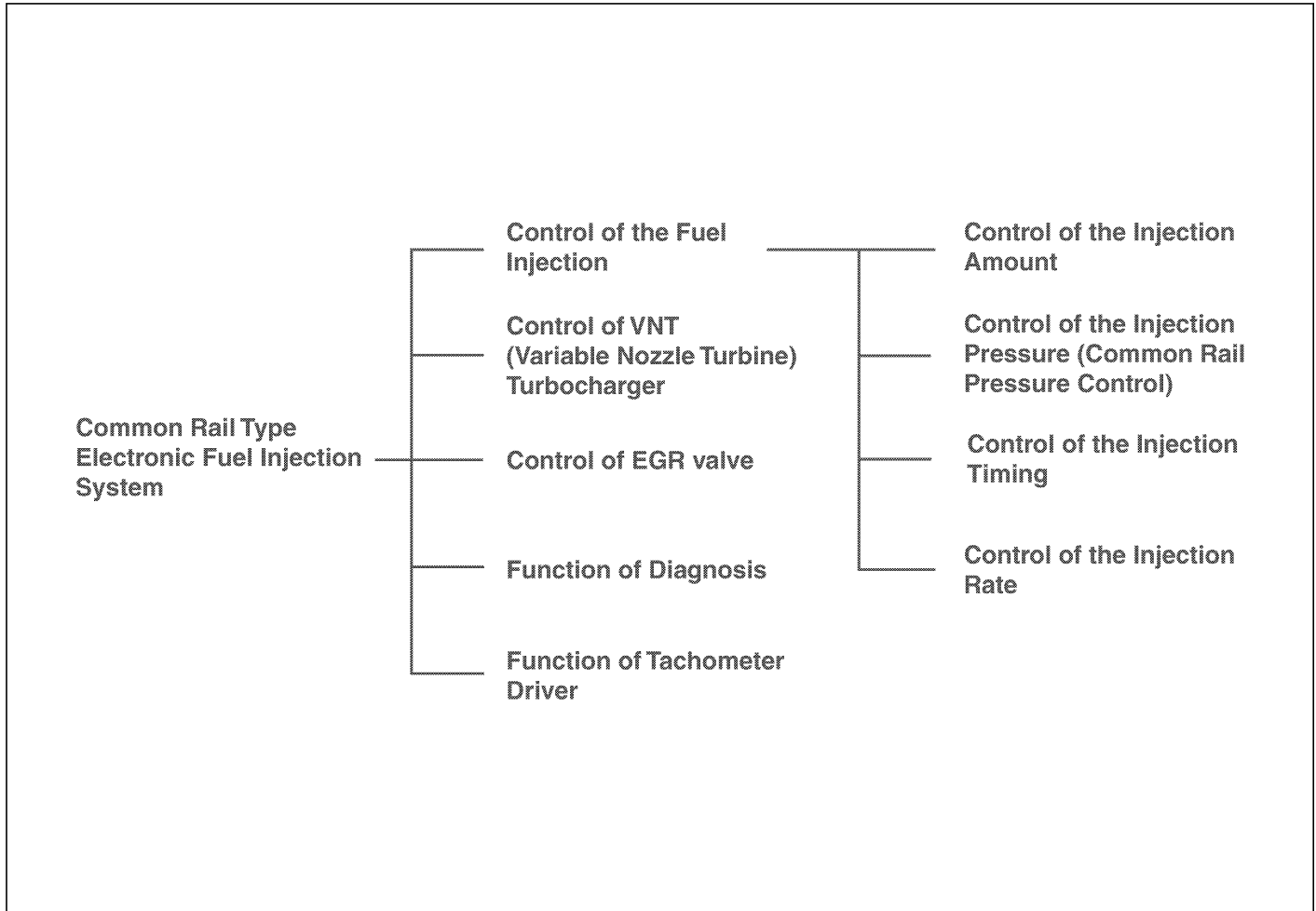
.....	DN02-2	AIR INTAKE PREHEATER RELAY	DN02-65
OVERVIEW	DN02-2	SUCTION CONTROL VALVE (SCV)	DN02-66
COMPONENT LOCATOR.....	DN02-3	EGR (CHECK BY HINO-DX).....	DN02-68
DIAGRAM	DN02-7	EGR ACTUATOR 1, 2.....	DN02-69
PRECAUTIONS	DN02-8	VNT (VARIABLE NOZZLE TURBINE)	
INSPECTION.....	DN02-17	TURBOCHARGER CONTROLLER	DN02-71
DIAGNOSIS USING		TURBOCHARGER OVER BOOST	DN02-72
THE PC DIAGNOSIS TOOL	DN02-18	AIR FLOW SENSOR.....	DN02-73
INSPECTION OF AIR FLOW SENSOR		INTAKE AIR TEMPERATURE SENSOR	DN02-75
(CHECK/ADJUSTMENT OF AIR INTAKE		DPR (CHECK BY HINO-DX).....	DN02-76
VOLUME BY HINO-DX).....	DN02-27	DPR BACKPRESSURE SENSOR	
CHECK THE ECU		(CHECK BY HINO-DX).....	DN02-77
POWER SUPPLY VOLTAGE.....	DN02-28	DPR BACKPRESSURE SENSOR	
CHECK THE GROUND	DN02-29	DN02-78
ENGINE SPEED MAIN SENSOR.....	DN02-30	DPR EXHAUST GAS	
ENGINE SPEED SUB SENSOR	DN02-32	TEMPERATURE SENSOR 1, 2.....	DN02-80
ENGINE SPEED		DPR EXHAUST GAS	
MAIN AND SUB SENSOR.....	DN02-33	TEMPERATURE SENSOR 1.....	DN02-81
COOLANT TEMPERATURE SENSOR.....	DN02-34	DPR EXHAUST GAS	
FUEL TEMPERATURE SENSOR.....	DN02-35	TEMPERATURE SENSOR 2.....	DN02-82
STARTER SWITCH	DN02-36	DIESEL THROTTLE VALVE	DN02-83
BOOST PRESSURE SENSOR	DN02-37	DIESEL THROTTLE VALVE	
ACCELERATOR SENSOR 1	DN02-39	(CHECK BY HINO-DX).....	DN02-85
ACCELERATOR SENSOR 2	DN02-41	DIESEL THROTTLE VALVE	
ACCELERATOR SENSOR 1 & 2	DN02-43	OPENING SENSOR.....	DN02-86
THROTTLE CONTROL.....	DN02-44	EXHAUST BRAKE MAGNETIC VALVE.....	DN02-88
VEHICLE SPEED SENSOR	DN02-46	MAIN RELAY	DN02-89
COMMON RAIL PRESSURE SENSOR	DN02-48	BRAKE SWITCH	DN02-90
COMMON RAIL PRESSURE		INJECTOR CORRECTION DATA.....	DN02-93
CONTROL SYSTEM.....	DN02-50	CAN	
COMMON RAIL PRESSURE AND		(CONTROLLER AREA NETWORK).....	DN02-94
SUPPLY PUMP.....	DN02-51	ENGINE OIL PRESSURE	DN02-95
COMMON RAIL PRESSURE		ACCELERATOR SENSOR	
FIXED OUTPUT	DN02-52	(FOR OPERATION OF P.T.O.).....	DN02-96
CYLINDER CONTRIBUTION/BALANCE.....	DN02-53	CLUTCH SWITCH.....	DN02-99
INJECTOR SOLENOID VALVE		ENGINE SPEED SUB SENSOR	
SYSTEM BREAKING	DN02-55	(PULSE)	DN02-100
INJECTOR SOLENOID VALVE DRIVING		ENGINE SPEED MAIN SENSOR	
SYSTEM +B SHORT- CIRCUIT	DN02-58	(PULSE)	DN02-102
INJECTOR SOLENOID VALVE DRIVING		NEUTRAL SWITCH.....	DN02-104
SYSTEM GND SHORT-CIRCUIT	DN02-60	SUPPLY PUMP	DN02-105
ECU	DN02-62	FUEL CUT RELAY.....	DN02-106
ENGINE OVERRUN	DN02-63	WATER IN FUEL	DN02-108
ENGINE OVERHEAT	DN02-64		

COMMON RAIL FUEL INJECTION SYSTEM

OVERVIEW

EN1610602F200001

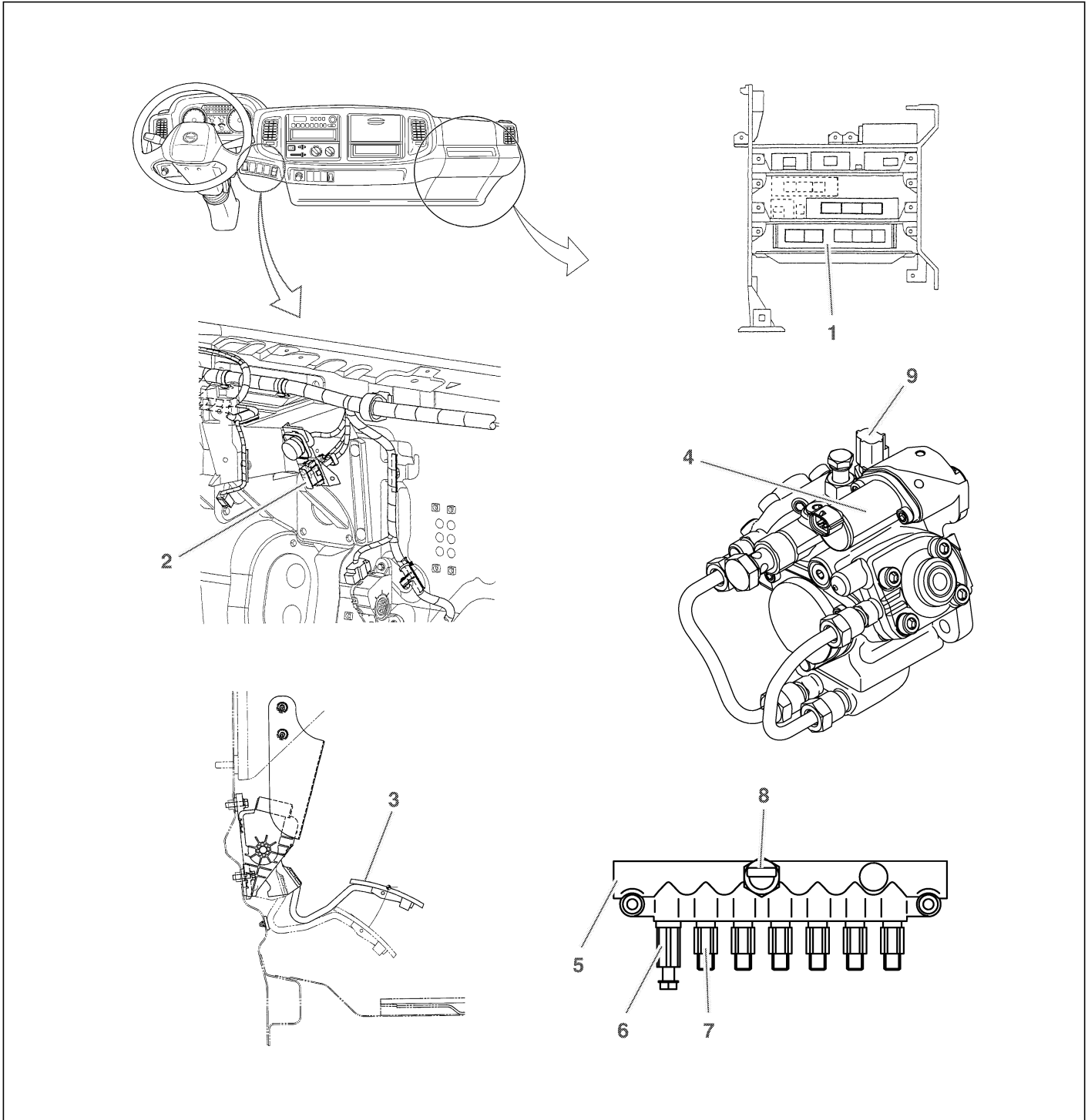
The Common Rail Fuel Injection System has a lot of control functions than the conventional injection pump system. These functions are controlled by the ECU (Electronic Control Unit).



SAPH161060200001

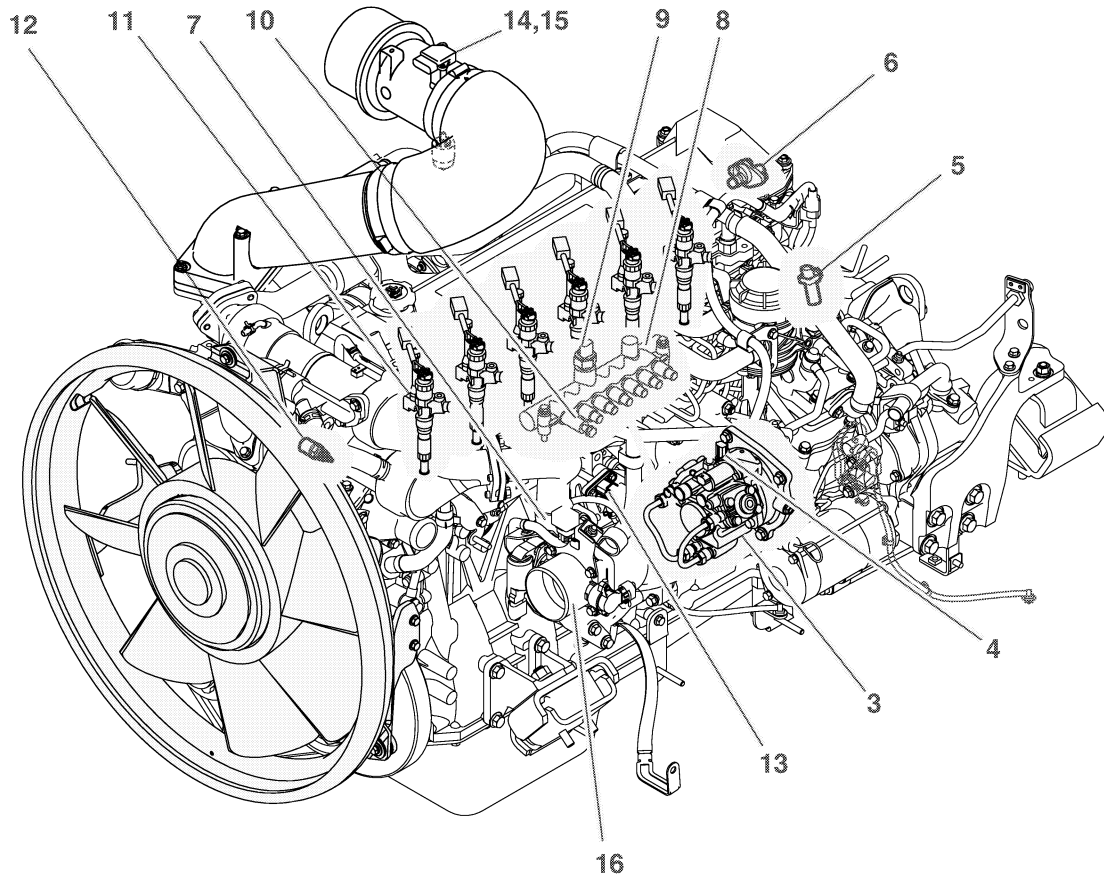
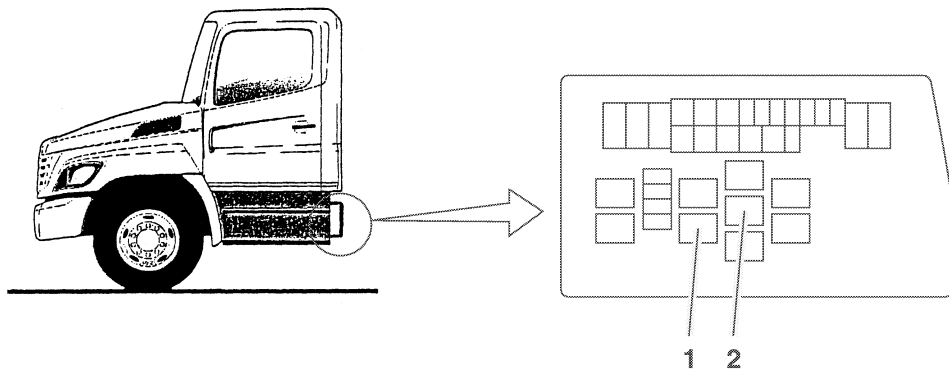
COMPONENT LOCATOR

EN1610602F200002



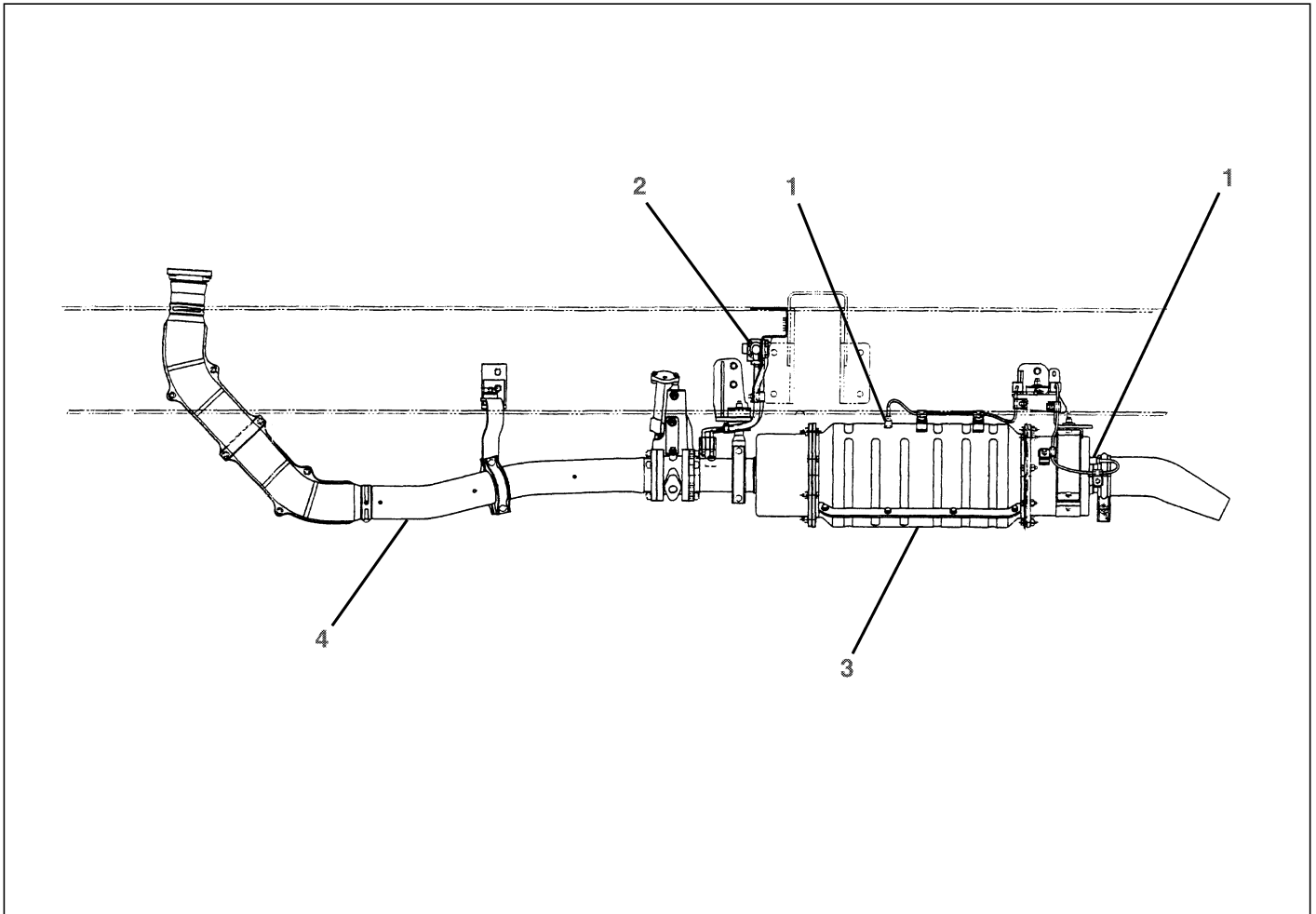
SAPH161060200002

1	Common rail fuel injection system ECU	6	Pressure limiter
2	Engine ECU diagnosis connector	7	Flow damper
3	Accelerator pedal (with sensor)	8	Pressure sensor
4	Suction control valve	9	Fuel temperature sensor
5	Common rail		



SAPH161060200003

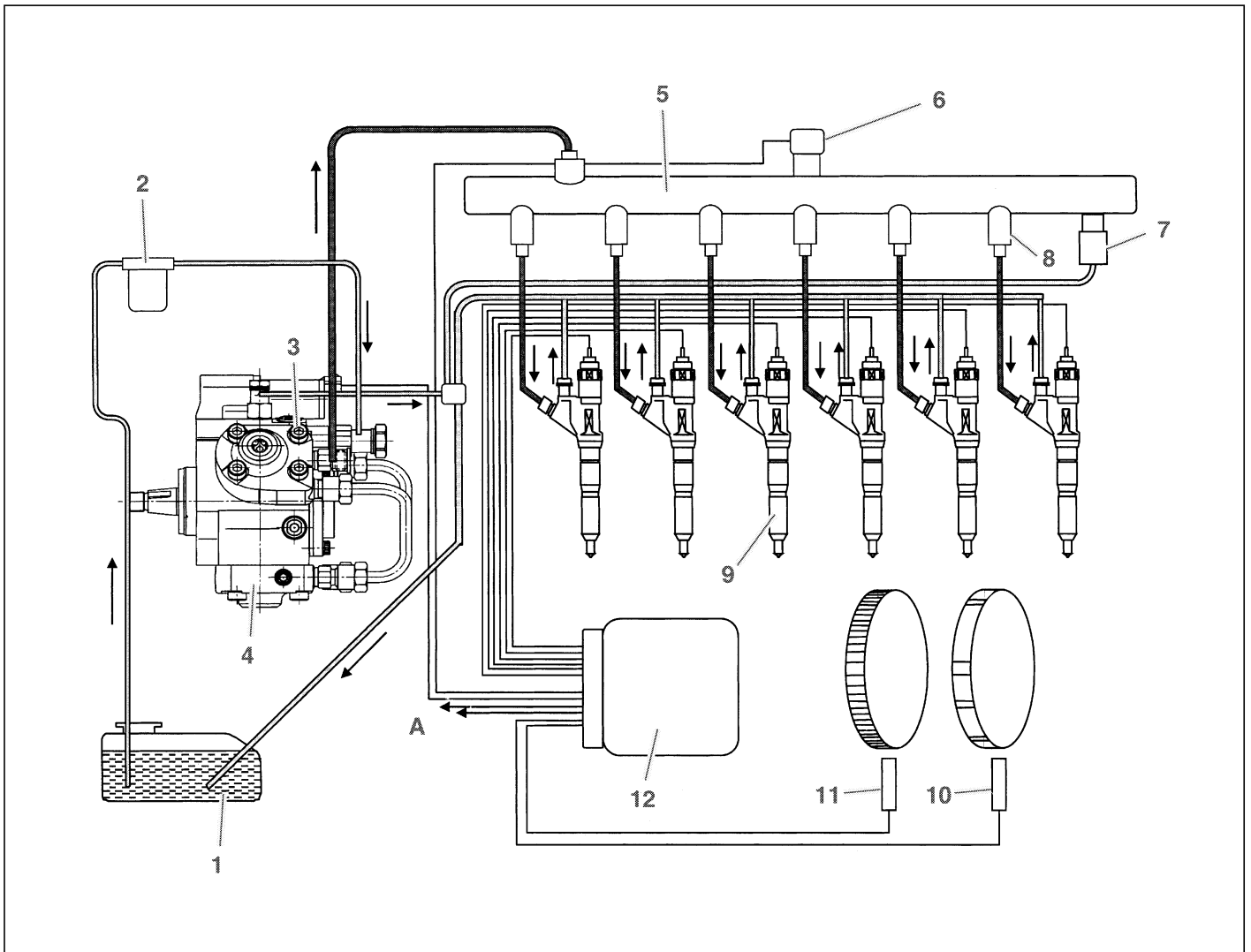
1	ECU main relay	9	Common rail pressure sensor
2	Actuator relay	10	Common rail pressure limiter
3	Supply pump	11	Injector
4	Fuel temperature sensor	12	Coolant temperature sensor
5	Engine speed main sensor	13	Boost pressure sensor
6	Engine speed sub sensor	14	Air flow meter
7	EGR valve	15	Intake temperature
8	Common rail	16	Diesel throttle valve



SAPH161060200004

1	Exhaust temperature sensor
2	Backpressure sensor

3	DPR-cleaner
4	Exhaust pipe

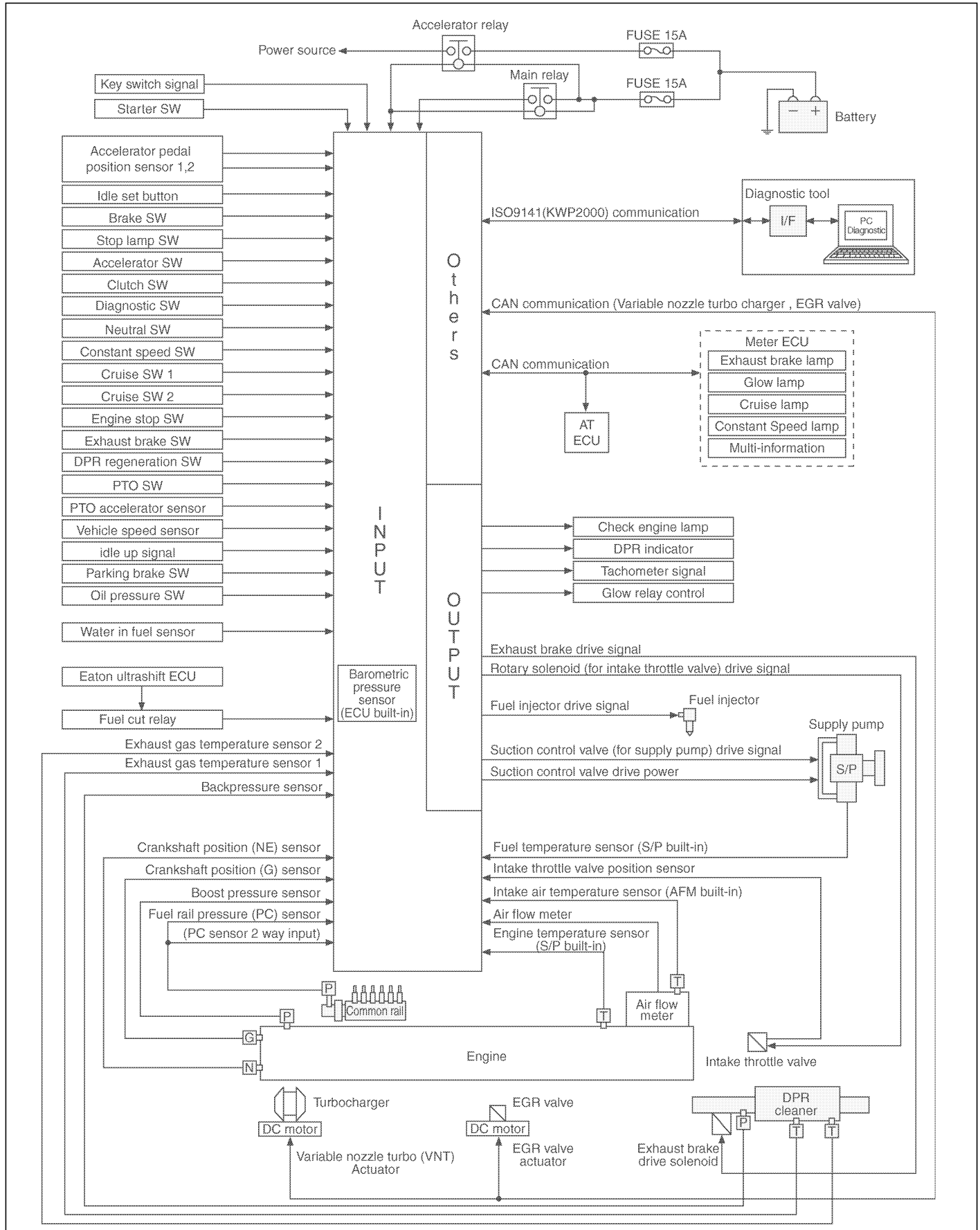


SAPH161060200005

1	Fuel tank	8	Flow damper
2	Fuel filter	9	Injector
3	Suction control valve	10	Engine speed sub sensor
4	Supply pump	11	Engine speed main sensor
5	Common rail	12	ECU
6	Pressure sensor	A	To sensors (Additional information)
7	Pressure limiter		

DIAGRAM

EN1610602F200003



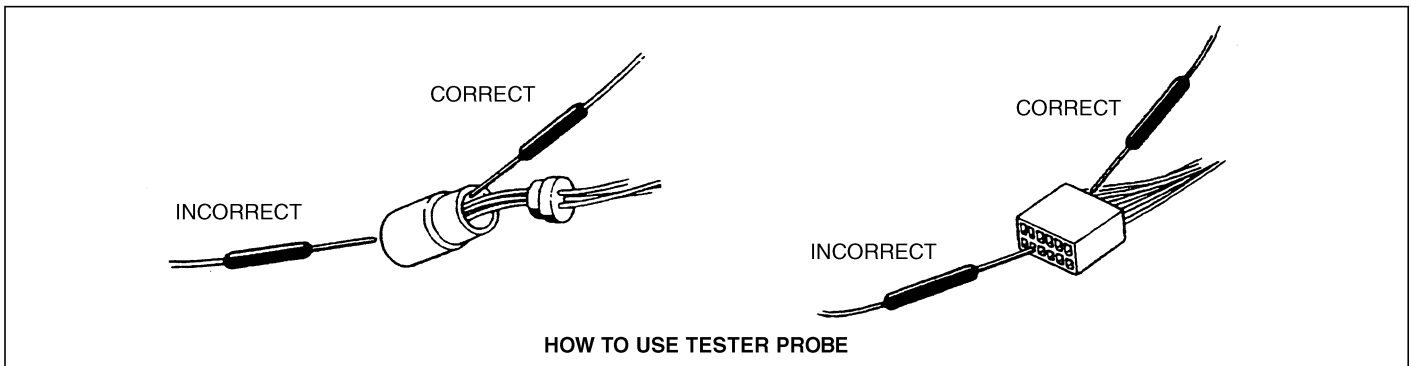
PRECAUTIONS

EN1610602F200004

⚠ WARNING

Approximately 110 V is generated for the injector drive actuation system. For this reason, electrical shock may result if the injector drive circuit is touched directly by hand. Turn the starter switch to the LOCK position if it is necessary to check or repair the computer, harnesses, or connectors.

1. **BE CAREFUL NOT TO LET DIRT OR DUST GET INSIDE THE ACTUATOR OR MAGNETIC VALVES.**
2. **HARNESS WIRE CONNECTOR.**
 - (1) Multi-contact connectors suitable for the small electrical signals of electronic circuitry are used for wiring connections to the sensors, actuator and control unit. Be very careful when handling them.
 - Before disconnecting any connectors, make sure that the starter switch is in the "LOCK" position.
 - When disconnecting connectors, try to pull them out in a straight line, disengaging the lock and holding onto the housing.
 - Do not try to disconnect connectors by gripping the wires or twisting them, as this could bend the contacts.
 - Do not disconnect connectors unnecessarily.
 - When using a circuit tester, apply the tester probe to the harness wire side only. Never stick the tester probe into the holes on the connector terminal side, as this could cause poor contacts when the connector is reconnected.



SAPH161060200007

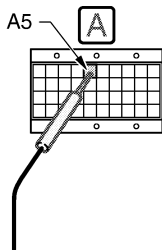
- Do not let water, oil or dust get on the connector when it is disconnected, as this could cause poor contacts when the connector is reconnected.
 - Do not open the control unit cover. It could malfunction if dust or water gets inside.
 - Take care to ensure that water, oil or dust do not get on or inside parts.
 - When connecting in connectors, push them in all the way and make sure that the lock engages.
3. **ERASING THE MALFUNCTION MEMORY STORED IN THE PAST, CHECK THE CURRENT MALFUNCTION BY PERFORMING A DIAGNOSIS OF THE PRESENT MALFUNCTION AGAIN.**

4. AFTER COMPLETING THE MALFUNCTION ANALYSIS, ERASE THE MALFUNCTION MEMORY STORED IN THE PAST. OTHERWISE, THE MALFUNCTION LAMP IN THE DISPLAY WILL REMAIN LIT.
5. CONNECTOR DRAWING, ALL OF WHICH HAS A VIEW TO BE SEEN FROM THE CONNECTION SIDE, INSERT THE TESTING LEAD FROM THE BACKSIDE.
6. USING A CIRCUIT TESTER
 - Use a circuit tester with an internal resistance of 100 kΩ or greater in the voltage measuring range.
7. USING A SIGNAL CHECK HARNESS
 - To prevent breakage of the ECU connector, connect the signal check harness and perform measuring by bringing the test lead into contact with the signal check harness side (contact box).

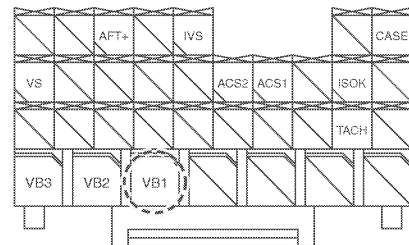
NOTICE

The terminal numbers in the text and in the illustrations correspond to the table on the next page (computer pin assignment) as shown below.

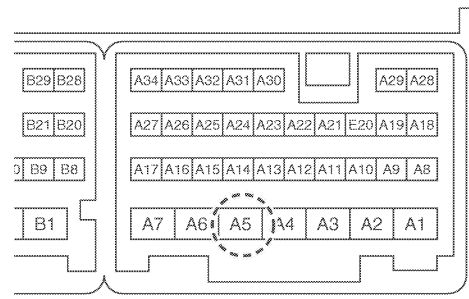
EXAMPLE:
 ECU: A5 TERMINAL ↔
 SIGNAL CHECK HARNESS
 CONTACT BOX:
 A5 TERMINAL



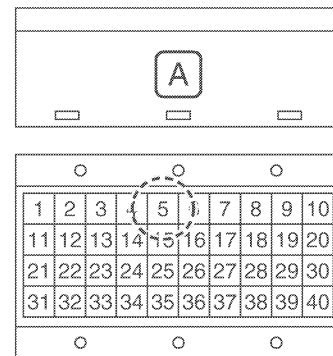
COMPUTER (ECU)
 TERMINAL SIGNAL

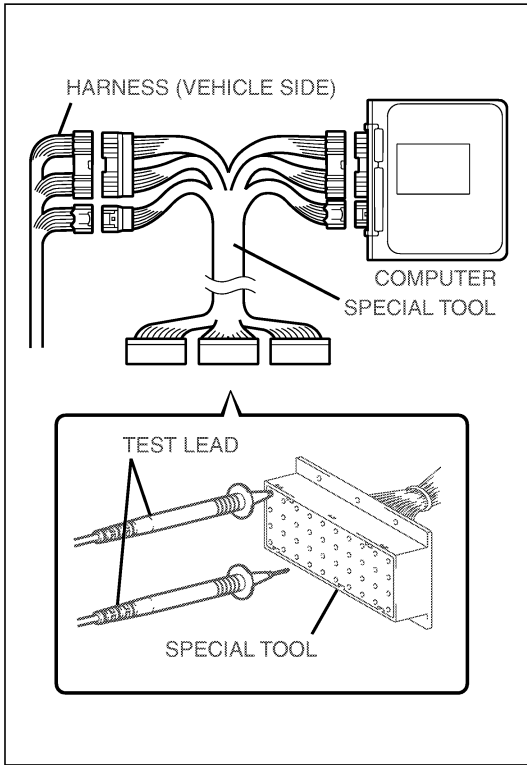


COMPUTER (ECU)
 TERMINAL No.



SIGNAL CHECK
 HARNESS
 (CONTACT BOX)



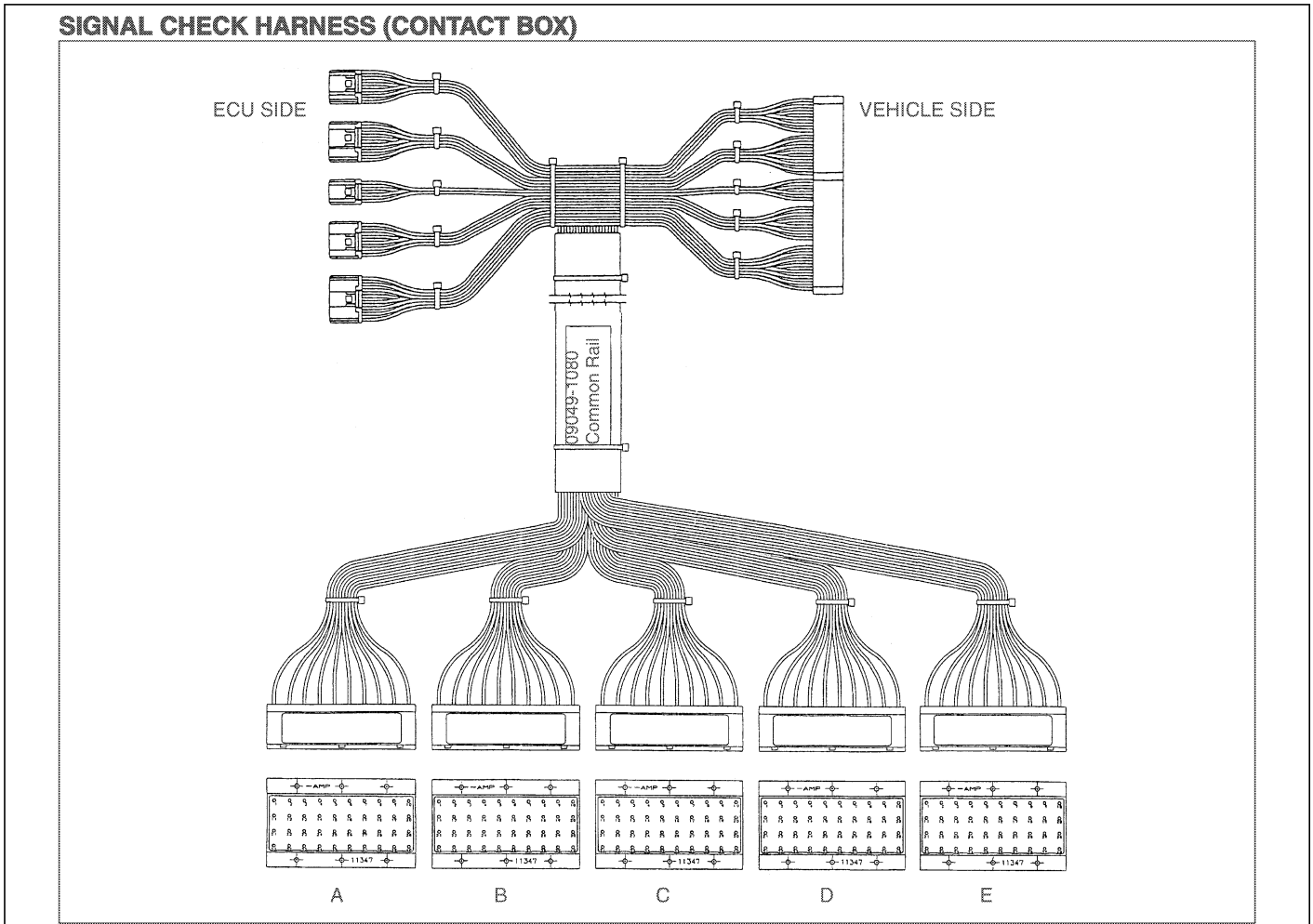


SAPH16106020009

8. CONNECT THE SIGNAL CHECK HARNESS.

- (1) Disconnect the connectors from the ECU.
 - (2) Connect a signal check harness to the vehicle harness and the ECU.
- SST: Signal check harness (09049-1080)**

(3) COMPUTER (ECU) PIN ASSIGNMENT



SAPH161060200010

9. RADIO INSTALLATION

- There is a danger that the control unit might malfunction if a high output radio transmitter (over 50W) is installed in the vehicle.

10. USING A QUICK CHARGER

- Disconnect both battery terminals before using a quick charger.

11. AIR CONDITIONER INSTALLATION

- Be careful not to scratch or damage the engine, chassis or the harness inside the cab when installing an air conditioner. Also, make sure to reattach afterward any connectors that were disconnected during the installation process.

12. PERFORMING ELECTRIC WELDING

- Disconnect connector to the control unit before performing any electric welding.

13. OTHER

- Make sure to check the other connectors before connecting them in to prevent incorrect connections.
- Be careful not to allow the connectors to become soiled with dust, water, fuel or oil when performing inspections or removing and replacing parts.

COMPUTER (ECU) PIN CONNECTION

•The terminal number in the table below correspond with the contact box of signal check harness

No.	CONTACT BOX (A)		CONTACT BOX (B)	
	Signal	Connection destination	Signal	Connection destination
1			+BF2	Actuator power relay
2			EBMV	U2 exhaust brake relay
3				
4				
5	VB1	ECU main relay	NESD	Engine speed main sensor shield ground
6	VB2	ECU main relay	NE1+	Engine speed main sensor +
7	VB3	ECU main relay	NE1-	Engine speed main sensor -
8				
9	TACH	Tachometer		
10	DTR+	Diesel throttle valve		
11				
12			SSWS	Fuse U2 (M)
13				
14			ST	Starter relay
15			EBSW	Wiper and retarder switch
16			STOP	Engine stop switch
17				

COMPUTER (ECU) PIN CONNECTION				
•The terminal number in the table below correspond with the contact box of signal check harness				
No.	CONTACT BOX (A)		CONTACT BOX (B)	
	Signal	Connection destination	Signal	Connection destination
18			PCS	Fuel cut relay
19	ISOK	Diagnosis connector	BSW2	Brake switch
20			AGD4	Throttle control and accelerator sensor 1
21	ACS1	Accelerator sensor 1	AGD5	Accelerator sensor 2
22	ACS2	Accelerator sensor 2	SWSS	Fuse U2 (M)
23	ASCS	PTO accelerator sensor	AVC4	Throttle control and accelerator sensor 1
24	EXPS	Exhaust gas pressure sensor		
25	EXT+	Exhaust gas temperature sensor 1		
26	EX2+	Exhaust gas temperature sensor 2	CRSW	Cruise control main switch
27	VS	Vehicle speed pulse converter	BSW1	Stop and turn ECU
28	CASE	Cab ground		
29				
30	IVS	Throttle control signal		
31	DTS1	Diesel throttle valve sensor	AVC5	Accelerator sensor 2
32	AFT+	Air flow sensor	NUSW	Manual transmission: Neutral switch Automatic transmission 3000RDS: starter relay and ECU 2200RDS, 2500RDS: Neutral relay
33				
34			DGSW	Diagnosis switch
35			FFWS	Fuel filter water level sensor
36				
37				
38				
39				
40				

COMPUTER (ECU) PIN CONNECTION

•The terminal number in the table below correspond with the contact box of signal check harness

No.	CONTACT BOX (C)		CONTACT BOX (D)	
	Signal	Connection destination	Signal	Connection destination
1	GRY1	Heater relay	PGD1	Cab ground
2	GRY2	Heater relay	INJ1	No.1 Fuel injector
3	CGD1	Cab ground	INJ2	No.2 Fuel injector
4	CGD2	Cab ground	INJ3	No.3 Fuel injector
5	MRL1	ECU main relay	IJ1+	No.1,2,3 Fuel injector
6	MRL2	ECU main relay	I1+S	No.1,2,3 Fuel injector
7	+BF1	Actuator power relay		
8	CLSW	Clutch switch		
9				
10	SET	Cruise control set switch (Set)		
11				
12				
13	CE/G	Check engine warning light		
14				
15	DPR	DPR refresh switch		
16				
17			AGD6	Air flow sensor
18	PKSW	Cab ground		
19			G3+	Sub engine speed sensor
20	PTO	PTO signal	PCR1	Common rail pressure sensor
21			AFSG	Air flow sensor
22			AVC3	Diesel throttle valve sensor
23	RES	Cruise control set switch (Resume)		
24			AVC2	Common rail pressure sensor
25	DPSW	DPR refresh switch	AVC1	Boost sensor
26	CA2H	Diagnosis connector		
27	CA2L	Diagnosis connector	PIM	Boost sensor
28	OLSW	Engine oil pressure switch		
29				
30			GGND	Sub engine speed sensor
31			PCR2	Common rail pressure sensor
32			GVCC	Sub engine speed sensor

COMPUTER (ECU) PIN CONNECTION				
•The terminal number in the table below correspond with the contact box of signal check harness				
No.	CONTACT BOX (C)		CONTACT BOX (D)	
	Signal	Connection destination	Signal	Connection destination
33			AGD1	Boost sensor and common rail pressure sensor
34			AGD2	Coolant temperature sensor, fuel temperature sensor and air flow sensor
35			AGD3	Diesel throttle valve sensor
36				
37				
38				
39				
40				

COMPUTER (ECU) PIN CONNECTION		
• The terminal number in the table below correspond with the contact box of signal check harness		
No.	CONTACT BOX (E)	
	Signal	Connection destination
1	INJ4	No.4 Fuel injector
2	INJ6	No.6 Fuel injector
3	INJ5	No.5 Fuel injector
4	PGD2	Cab ground
5	PGD3	Cab ground
6	IJ2+	No.4,5,6 Fuel injector
7	I2+S	No.4,5,6 Fuel injector
8	SCVL	Suction control valve
9	SCVL	Suction control valve
10	SCVH	Suction control valve
11	SCVH	Suction control valve
12		
13		
14		
15		
16		
17		
18		

COMPUTER (ECU) PIN CONNECTION		
<ul style="list-style-type: none"> The terminal number in the table below correspond with the contact box of signal check harness 		
No.	CONTACT BOX (E)	
	Signal	Connection destination
19	THW+	Coolant temperature sensor
20		
21	CANH	VNT control
22	CANL	VNT control
23		
24		
25		
26		
27	THF+	Fuel temperature sensor
28		
29		
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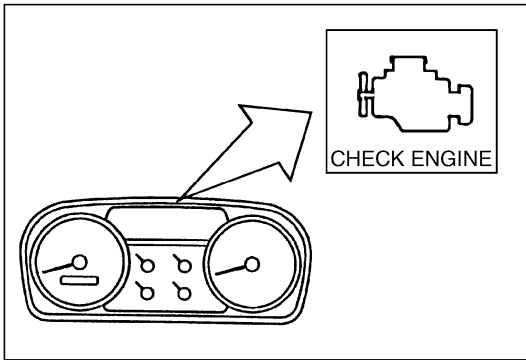
INSPECTION

EN1610602F200005

CHECK ENGINE LAMP STATUS

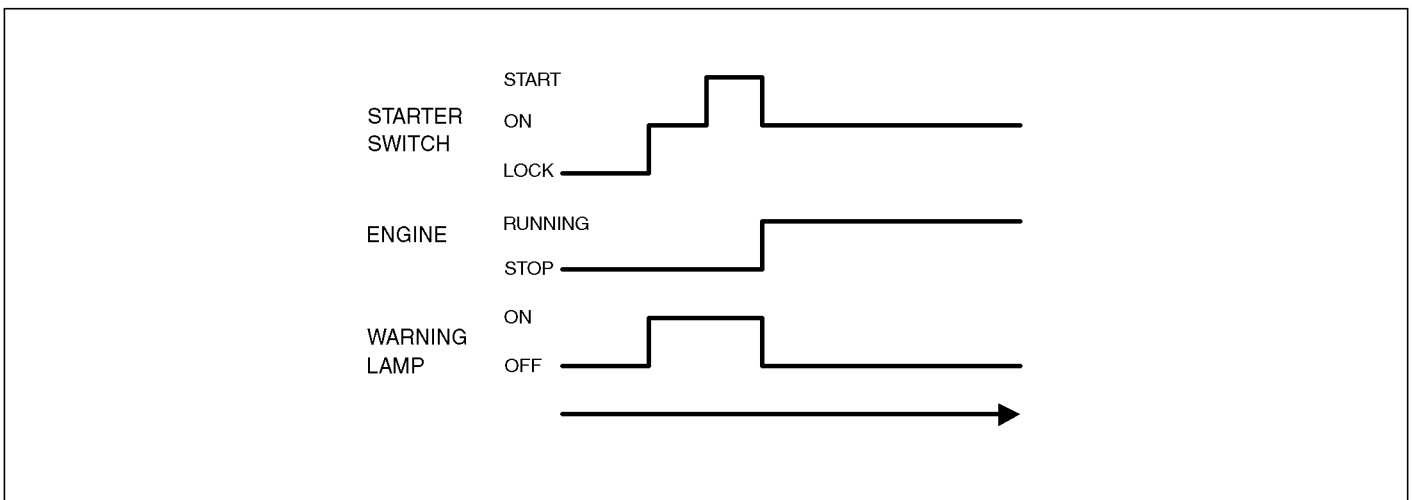
1. INSPECTION PROCEDURE

- (1) Turn the starter switch to the ON position (do not start the engine) and confirm that the Check Engine Lamp in the indicator area lights up.
- (2) Start the engine.
- (3) If the engine is normal, the Check Engine Lamp goes out.
- (4) If the Check Engine Lamp does not go out, the system is abnormal. Check the system according to diagnosis on the following page.



SAPH161060200012

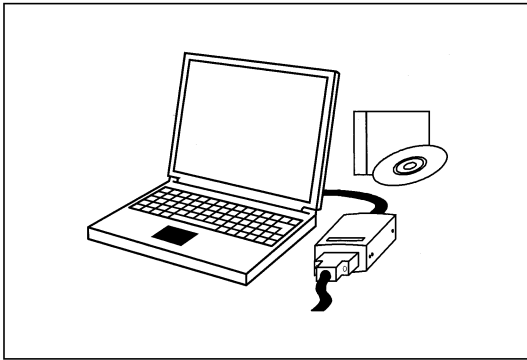
CHECK ENGINE LAMP ILLUMINATION PATTERN



SAPH161060200013

DIAGNOSIS USING THE PC DIAGNOSIS TOOL

EN1610602F200006



SAPH161060200014

1. DIAGNOSIS TOOL

- Trouble diagnosis can be performed using the PC diagnosis tool. By connection to the diagnosis connector, the trouble location is indicated.

SST:

Communication interface assembly (09993-E9070)

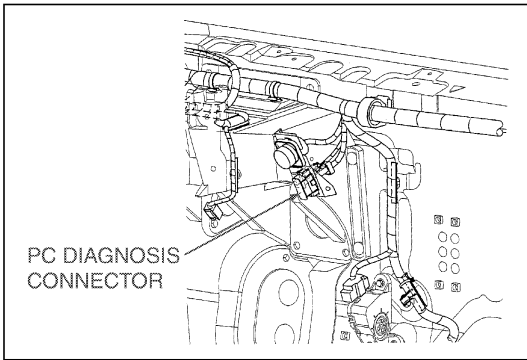
Cable communication (09042-1220)

Diagnosis software: HINO Diagnostic eXplorer (DX).

Reprogramming software: HINO Reprog Manager.

NOTICE

Only ECU reprogramming can be performed by authorized HINO dealer.



SAPH161060200015

2. CONNECT THE PC DIAGNOSIS TOOL

- (1) Turn the starter switch on the "LOCK" position.
- (2) Connect the PC DIAGNOSIS TOOL.

DIAGNOSTIC TROUBLE CODE (DTC) TABLE				
CHECK ENGINE WARNING LIGHT	DTC NO.	DIAGNOSIS ITEM	INSPECTION ITEM	REFER PAGE
Light	P0045	VNT turbocharger controller malfunction	<ul style="list-style-type: none"> • ECU (ECU connector) • Wire harness • Turbocharger 	DN02-71
Light	P0087	Lack of forced feed in supply pump	<ul style="list-style-type: none"> • Fuel leakage; by HINO-DX • Common rail pressure; by HINO-DX • Common rail pressure sensor • Wire harness 	DN02-51
Light	P0088	Excessive common rail pressure	<ul style="list-style-type: none"> • Fuel leakage; by HINO-DX • Common rail pressure; by HINO-DX • Common rail pressure sensor • ECU (ECU connector) • Wire harness 	DN02-50
Light	P0088	Excessive common rail pressure, supply pump excess forced feed	<ul style="list-style-type: none"> • Fuel leakage; by HINO-DX • Common rail pressure; by HINO-DX • Common rail pressure sensor 	DN02-51
Light	P0102	Air flow sensor circuit low input	<ul style="list-style-type: none"> • Air flow sensor • Wire harness • ECU (ECU connector) 	DN02-73
Light	P0103	Air flow sensor circuit high input	<ul style="list-style-type: none"> • Air flow sensor • Wire harness • ECU (ECU connector) 	DN02-73
Light	P0108	Boost pressure sensor circuit high input	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • Boost pressure sensor 	DN02-37
Light	P0112	Intake air temperature sensor circuit low input	<ul style="list-style-type: none"> • Wire harness • Intake air temperature sensor • ECU (ECU connector) 	DN02-75
Light	P0113	Intake air temperature sensor circuit high input	<ul style="list-style-type: none"> • Wire harness • Intake air temperature sensor • ECU (ECU connector) 	DN02-75
Light	P0117	Coolant temperature sensor circuit low input	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • Coolant temperature sensor 	DN02-34
Light	P0118	Coolant temperature sensor circuit high input	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • Coolant temperature sensor 	DN02-34

DIAGNOSTIC TROUBLE CODE (DTC) TABLE				
CHECK ENGINE WARNING LIGHT	DTC NO.	DIAGNOSIS ITEM	INSPECTION ITEM	REFER PAGE
Light	P0182	Fuel temperature sensor circuit low input	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • Fuel temperature sensor 	DN02-35
Light	P0183	Fuel temperature sensor circuit high input	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • Fuel temperature sensor 	DN02-35
Light	P0191	Common rail pressure sensor malfunction	<ul style="list-style-type: none"> • Common rail pressure sensor • Wire harness • ECU (ECU connector) 	DN02-48, 52
Light	P0192	Common rail pressure sensor circuit low input	<ul style="list-style-type: none"> • ECU (ECU connector) • Wire harness • Common rail pressure sensor 	DN02-48
Light	P0193	Common rail pressure sensor circuit high input	<ul style="list-style-type: none"> • ECU (ECU connector) • Wire harness • Common rail pressure sensor 	DN02-48
Light	P0200	ECU charge circuit high input	<ul style="list-style-type: none"> • ECU (ECU connector) 	DN02-62
Light	P0201	Injector circuit malfunction -cylinder 1	<ul style="list-style-type: none"> • ECU (ECU connector) • Wire harness • Injector 	DN02-55
Light	P0202	Injector circuit malfunction -cylinder 2	<ul style="list-style-type: none"> • ECU (ECU connector) • Wire harness • Injector 	DN02-55
Light	P0203	Injector circuit malfunction -cylinder 3	<ul style="list-style-type: none"> • ECU (ECU connector) • Wire harness • Injector 	DN02-55
Light	P0204	Injector circuit malfunction -cylinder 4	<ul style="list-style-type: none"> • ECU (ECU connector) • Wire harness • Injector 	DN02-55
Light	P0205	Injector circuit malfunction -cylinder 5	<ul style="list-style-type: none"> • ECU (ECU connector) • Wire harness • Injector 	DN02-55
Light	P0206	Injector circuit malfunction -cylinder 6	<ul style="list-style-type: none"> • ECU (ECU connector) • Wire harness • Injector 	DN02-55
Light	P0217	Engine overheat	<ul style="list-style-type: none"> • ECU (ECU connector) • Coolant temperature sensor • Engine cooling system 	DN02-64
No light	P0219	Engine overrun	—	DN02-63

DIAGNOSTIC TROUBLE CODE (DTC) TABLE				
CHECK ENGINE WARNING LIGHT	DTC NO.	DIAGNOSIS ITEM	INSPECTION ITEM	REFER PAGE
No light	P0234	Turbocharger over boost	<ul style="list-style-type: none"> • ECU (ECU connector) • Turbocharger system 	DN02-72
Light	P0237	Boost sensor circuit low input	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • Boost pressure sensor 	DN02-37
No light	P0263	Cylinder 1 contribution/balance fault	<ul style="list-style-type: none"> • Flow damper • Injector • Fuel filter • Injection pipe • ECU (ECU connector) 	DN02-53
No light	P0266	Cylinder 2 contribution/balance fault	<ul style="list-style-type: none"> • Flow damper • Injector • Fuel filter • Injection pipe • ECU (ECU connector) 	DN02-53
No light	P0269	Cylinder 3 contribution/balance fault	<ul style="list-style-type: none"> • Flow damper • Injector • Fuel filter • Injection pipe • ECU (ECU connector) 	DN02-53
No light	P0272	Cylinder 4 contribution/balance fault	<ul style="list-style-type: none"> • Flow damper • Injector • Fuel filter • Injection pipe • ECU (ECU connector) 	DN02-53
No light	P0275	Cylinder 5 contribution/balance fault	<ul style="list-style-type: none"> • Flow damper • Injector • Fuel filter • Injection pipe • ECU (ECU connector) 	DN02-53
No light	P0278	Cylinder 6 contribution/balance fault	<ul style="list-style-type: none"> • Flow damper • Injector • Fuel filter • Injection pipe • ECU (ECU connector) 	DN02-53
Light	P0335	Engine speed main sensor circuit malfunction	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • Engine speed main sensor 	DN02-30, 33
Light	P0340	Engine speed sub sensor circuit malfunction	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • Engine speed sub sensor 	DN02-32, 33

DIAGNOSTIC TROUBLE CODE (DTC) TABLE				
CHECK ENGINE WARNING LIGHT	DTC NO.	DIAGNOSIS ITEM	INSPECTION ITEM	REFER PAGE
Light	P0122	Diesel throttle valve-opening sensor low input	<ul style="list-style-type: none"> • Diesel throttle valve-opening sensor • ECU (ECU connector) • Wire harness 	DN02-86
Light	P0123	Diesel throttle valve-opening sensor high input	<ul style="list-style-type: none"> • Diesel throttle valve-opening sensor • ECU (ECU connector) • Wire harness 	DN02-86
Light	P2101	Diesel throttle valve sticking	<ul style="list-style-type: none"> • Diesel throttle valve • ECU (ECU connector) 	DN02-85
Light	P0400	Abnormal flow amount of EGR	<ul style="list-style-type: none"> • EGR; by HINO-DX • EGR valve • Wire harness 	DN02-68
Light	P0545	DPR exhaust gas temperature sensor 1 malfunction (Low input)	<ul style="list-style-type: none"> • DPR exhaust gas temperature sensor • ECU (ECU connector) • Wire harness 	DN02-81
Light	P0546	DPR exhaust gas temperature sensor 1 malfunction (High input)	<ul style="list-style-type: none"> • DPR exhaust gas temperature sensor • ECU (ECU connector) • Wire harness 	DN02-81
Light	P1426	Abnormality of backpressure sensor characteristic	<ul style="list-style-type: none"> • Backpressure sensor • Wire harness 	DN02-77
Light	P1427	DPR backpressure sensor malfunction (Low input)	<ul style="list-style-type: none"> • Backpressure sensor • ECU (ECU connector) • Wire harness 	DN02-78
Light	P1428	DPR backpressure sensor malfunction (High input)	<ul style="list-style-type: none"> • Backpressure sensor • ECU (ECU connector) • Wire harness 	DN02-78
Light	P1458	EGR actuator malfunction (Serious)	<ul style="list-style-type: none"> • EGR; by HINO-DX • EGR valve • Wire harness 	DN02-69
Light	P1459	EGR actuator malfunction (Slight)	<ul style="list-style-type: none"> • EGR; by HINO-DX • EGR valve • Wire harness 	DN02-69
No light	P1681	Exhaust brake magnetic valve malfunction (Open circuit, ground line short)	<ul style="list-style-type: none"> • Exhaust brake magnetic valve • ECU (ECU connector) • Wire harness 	DN02-88
No light	P1682	Exhaust brake magnetic valve malfunction (Power source line short)	<ul style="list-style-type: none"> • Exhaust brake magnetic valve • ECU (ECU connector) • Wire harness 	DN02-88

DIAGNOSTIC TROUBLE CODE (DTC) TABLE				
CHECK ENGINE WARNING LIGHT	DTC NO.	DIAGNOSIS ITEM	INSPECTION ITEM	REFER PAGE
Light	P2002	DPR system malfunction	<ul style="list-style-type: none"> • DPR system; by HINO-DX • Exhaust brake 	DN02-76
Light	P2032	DPR exhaust gas temperature sensor 2 malfunction (Low input)	<ul style="list-style-type: none"> • Exhaust gas temperature sensor 2 • ECU (ECU connector) • Wire harness 	DN02-82
Light	P2033	DPR exhaust gas temperature sensor 2 malfunction (High input)	<ul style="list-style-type: none"> • Exhaust gas temperature sensor 2 • ECU (ECU connector) • Wire harness 	DN02-82
Light	P2080	Abnormality of exhaust gas temperature sensor 1 characteristic	<ul style="list-style-type: none"> • Exhaust gas temperature sensor 1 • Wire harness 	DN02-80
Light	P2084	Abnormality of exhaust gas temperature sensor 2 characteristic	<ul style="list-style-type: none"> • Exhaust gas temperature sensor 2 • Wire harness 	DN02-80
Light	P2100	Diesel throttle valve malfunction (GND short)	<ul style="list-style-type: none"> • Diesel throttle valve • ECU (ECU connector) • Wire harness 	DN02-83
No light	P2103	Diesel throttle valve malfunction (Open circuit or VB short)	<ul style="list-style-type: none"> • Diesel throttle valve • ECU (ECU connector) • Wire harness 	DN02-83
No light	P0500	Vehicle speed sensor circuit low input	<ul style="list-style-type: none"> • ECU (ECU connector) • Wire harness • Vehicle speed sensor 	DN02-46
No light	P0501	Vehicle speed sensor circuit high input	<ul style="list-style-type: none"> • ECU (ECU connector) • Wire harness • Vehicle speed sensor • Pulse converter 	DN02-46
No light	P0504	Brake switch malfunction	<ul style="list-style-type: none"> • Brake switch • Stop light switch • Wire harness 	DN02-90
Light	P0524	Engine oil pressure low	<ul style="list-style-type: none"> • Engine oil • Wire harness • Engine oil pressure switch • ECU (ECU connector) 	DN02-95
No light	P0540	Preheat circuit malfunction	<ul style="list-style-type: none"> • ECU (ECU connector) • Heater relay • Wire harness 	DN02-65
Light	P0605	Flash ROM error	<ul style="list-style-type: none"> • ECU (ECU connector) 	DN02-62

DIAGNOSTIC TROUBLE CODE (DTC) TABLE				
CHECK ENGINE WARNING LIGHT	DTC NO.	DIAGNOSIS ITEM	INSPECTION ITEM	REFER PAGE
Light	P0606	CPU malfunction (Hard detection)	• ECU (ECU connector)	DN02-62
Light	P0607	Monitoring IC malfunction in CPU	• ECU (ECU connector)	DN02-62
Light	P0611	ECU charge circuit malfunction	• ECU (ECU connector)	DN02-62
No light	P0617	Starter signal malfunction	• Wire harness • Starter signal • ECU (ECU connector)	DN02-36
Light	P0628	SCV malfunction	• Supply pump • Wire harness • ECU (ECU connector)	DN02-66
Light	P0629	SCV out put short to BATT	• Supply pump • Wire harness • ECU (ECU connector)	DN02-66
Light	P0686	Main relay malfunction	• Main relay • Wire harness • ECU (ECU connector)	DN02-89
No light	P1133	P.T.O. accelerator sensor circuit high input	• Wire harness • ECU (ECU connector) • Accelerator sensor	DN02-96
No light	P1143	Throttle control malfunction	• ECU (ECU connector) • Wire harness • Throttle control	DN02-44
Light	P1211	Injector common 1 short to GND	• Wire harness • Injector • ECU (ECU connector)	DN02-60
Light	P1212	Injector common 1 short to BATT	• Wire harness • Injector • ECU (ECU connector)	DN02-58
Light	P1214	Injector common 2 short to GND	• Wire harness • Injector • ECU (ECU connector)	DN02-60
Light	P1215	Injector common 2 short to BATT	• Wire harness • Injector • ECU (ECU connector)	DN02-58
Light	P1601	Injector correction data conformily error	• ECU (ECU connector)	DN02-93
Light	P2120	Accelerator sensor 1 and 2 malfunction	• Wire harness • ECU (ECU connector) • Accelerator sensor	DN02-39, 41, 43

DIAGNOSTIC TROUBLE CODE (DTC) TABLE				
CHECK ENGINE WARNING LIGHT	DTC NO.	DIAGNOSIS ITEM	INSPECTION ITEM	REFER PAGE
Light	P2122	Accelerator sensor circuit 1 low voltage	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • Accelerator sensor 	DN02-39, 43
Light	P2123	Accelerator sensor circuit 1 high voltage	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • Accelerator sensor 	DN02-39, 43
Light	P2127	Accelerator sensor circuit 2 low voltage	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • Accelerator sensor 	DN02-41, 43
Light	P2128	Accelerator sensor circuit 2 high voltage	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • Accelerator sensor 	DN02-41, 43
Light	P2228	Atmospheric pressure sensor circuit low input	<ul style="list-style-type: none"> • ECU (ECU connector) 	DN02-62
Light	P2229	Atmospheric pressure sensor circuit high input	<ul style="list-style-type: none"> • ECU (ECU connector) 	DN02-62
Light	U0073	CAN malfunction (Engine)	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • VNT turbocharger • EGR 	DN02-69, 71
No light	U0101	Communication error (Transmission)	<ul style="list-style-type: none"> • Wire harness • ATM ECU • ECU (ECU connector) 	DN02-94
Light	U1122	CAN communication malfunction (EGR)	<ul style="list-style-type: none"> • EGR; by HINO-DX • EGR valve • Wire harness 	DN02-69
Light	U1001	CAN communication malfunction (Vehicle)	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) 	DN02-94
Light	U0155	CAN communication malfunction (Meter)	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • Meter 	DN02-94
Light	U1123	CAN communication malfunction (VNT)	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • VNT turbocharger 	DN02-71
Light	P0704	Clutch switch malfunction	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • Clutch switch 	DN02-99
Light	P0341	Engine speed sub sensor pulse abnormal	<ul style="list-style-type: none"> • Wire harness • ECU (ECU connector) • Engine speed sub sensor 	DN02-100

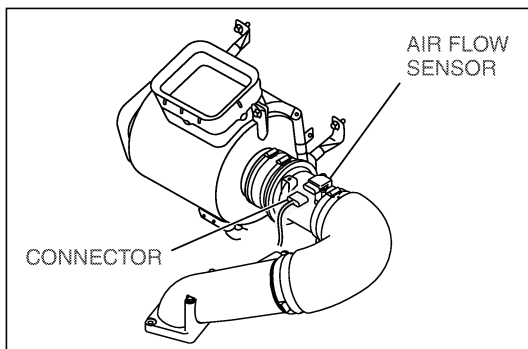
DIAGNOSTIC TROUBLE CODE (DTC) TABLE				
CHECK ENGINE WARNING LIGHT	DTC NO.	DIAGNOSIS ITEM	INSPECTION ITEM	REFER PAGE
Light	P0336	Engine speed main sensor pulse abnormal	<ul style="list-style-type: none"> Wire harness ECU (ECU connector) Engine speed main sensor 	DN02-102
Light	P0850	Neutral switch malfunction	<ul style="list-style-type: none"> Wire harness ECU (ECU connector) Neutral switch 	DN02-104
No light	P2635	Supply pump SCV sticking	<ul style="list-style-type: none"> Supply pump: by HINO-DX ECU (ECU connector) 	DN02-105
Light		Supply pump malfunction (Insufficient flow)		
		Supply pump abnormal high pressure record		
No light	P1676	Fuel cut relay malfunction	<ul style="list-style-type: none"> Wire harness ECU (ECU connector) Fuel cut relay Eaton UltraShift ECU 	DN02-106
No light	P2269	Water in fuel condition	<ul style="list-style-type: none"> Fuel filter Wire harness ECU (ECU connector) 	DN02-108

NOTICE

- It is necessary to reset the ECU default value using the diagnosis tool at the time of supply pump service replacement. In addition, the ECU has a function enabling it to learn the performance of the supply pump at the time of ECU service replacement, so ensure sufficient time (several minutes) is available.
- When an injector is newly installed in a vehicle, it is necessary to enter the ID codes in the engine ECU using the Diagnostic tool.

INSPECTION OF AIR FLOW SENSOR (CHECK/ADJUSTMENT OF AIR INTAKE VOLUME BY HINO-DX)

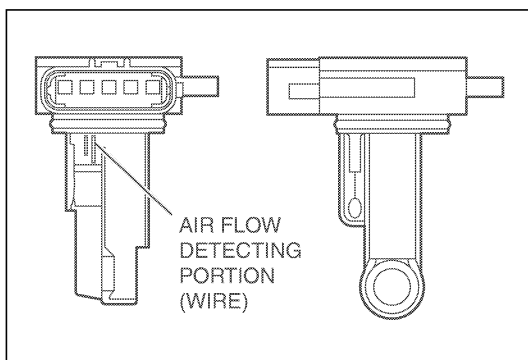
EN1610602F200007



SAPH161060200016

1. INSPECTION OF AIR FLOW SENSOR.

- (1) Clean or replace it with a new air cleaner before checking under this method. Or, prepare a new air flow sensor, separate from the one installed on the vehicle.
- (2) Connect the PC DIAGNOSIS TOOL (HINO-DX).
- (3) Following the air intake volume measurement by HINO-DX, gauge air intake volume under NMR (No Load Maximum Revolution) with "Air flow sensor installed on the vehicle". ...**(A)**
- (4) Confirming a safety around the engine, entirely warmed up, stabilize the revolution by depressing the accelerator pedal from its idling condition (keep depressing the accelerator pedal).
Under the same condition, read out "Engine Revolution per min. (rpm)" and "Air intake volume (g/sec.)" from the PC screen.
- (5) After stopping engine and locking the starter key, remove air flow sensor unit from air cleaner case by removing off air flow sensor connector.
- (6) Make sure to fit the connector after installing "New air flow sensor" prepared.
- (7) Gauge air intake volume as the above (3) with "New air flow sensor". ...**(B)**
- (8) Judgement against deterioration of air flow sensor performance.
 - a. When checked air flow volume with "Air flow sensor installed on the vehicle", which is 10 % lower than the one detected by a "New air flow sensor" (Refer to the calculation form listed below), a "New air flow sensor" should remain installed on the vehicle to complete this check due to the fact that the original one installed was deteriorated.
Calculation form: $\{(B)-(A)\} / (B) \times 100 > 10$
 - b. When the both air flow sensors identical flow volume, it means that "Air flow sensor installed on the vehicle" is functioning correctly. So, you can complete the check by swapping air flow sensor for its installation on the vehicle.



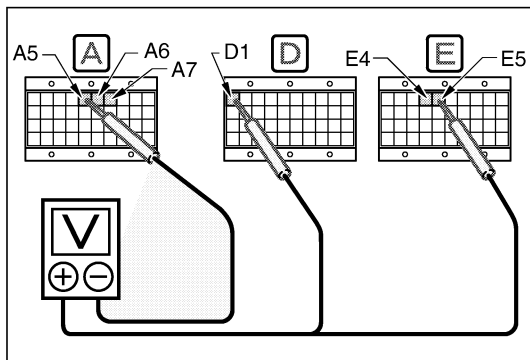
SAPH161060200017

NOTICE

- **Air flow detecting portion (Wire) is accurately machined, which is very fragile. Therefore, work carefully not to make direct touch by hand with the same detection portion.**
- **Don't put on excessive torque thereon when tightening bolt (M4) installing air flow sensor.**
Tightening Torque:
1.68 N·m {17 kgf·cm, 1.24 lbf·ft}
- **In case that the check result is not within specified area under this method, replace the air flow sensor with a new one.**

CHECK THE ECU POWER SUPPLY VOLTAGE

EN1610602F200008

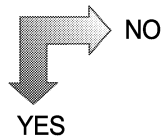


SAPH161060200018

1. CHECK THE VOLTAGE BETWEEN TERMINALS.

- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Set the starter switch to "ON".
- (3) Measure the voltage between VB1 (A5), VB2 (A6), VB3 (A7) and PGD1 (D1), PGD2 (E4), PGD3 (E5) terminals of ECU connector (vehicle harness side).

Standard: More than 10 V

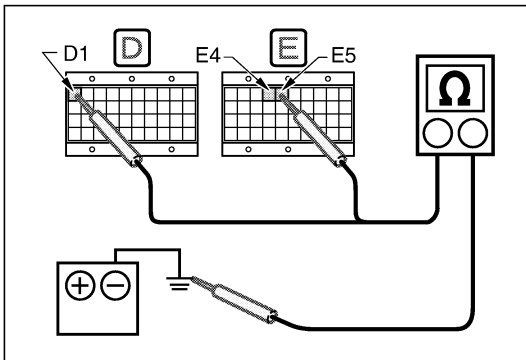


- 0 V: Fuse blows, harness malfunction, ground malfunction.
- Less than 10 V: Battery retrogradation, ground malfunction.

Normal

CHECK THE GROUND

EN1610602F200009

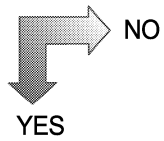


SAPH161060200019

1. CHECK THE RESISTANCE BETWEEN TERMINALS.

- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Disconnect the signal check harness connector on the ECU side.
- (3) Measure the resistance between PGD1 (D1), PGD2 (E4), PGD3 (E5) and battery (-) terminals.

Standard: Less than 1 Ω



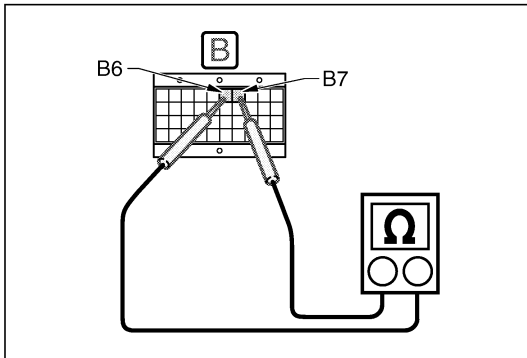
Ground harness disconnection, bad contact of terminal.

Normal

ENGINE SPEED MAIN SENSOR

EN1610602F200010

DTC	P0335	Engine speed main sensor circuit malfunction
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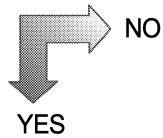


SAPH161060200020

1. CHECK THE RESISTANCE BETWEEN TERMINALS.

- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Disconnect the signal check harness connector on the ECU side.
- (3) Measure the resistance between NE1+ (B6) and NE1- (B7) terminals of ECU connector (vehicle harness side).

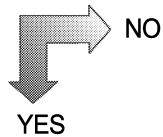
Standard: 108.5 — 142.5 Ω at 20°C {68°F}



Proceed to 3

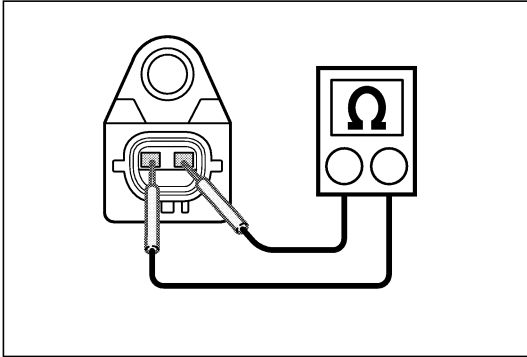
2. RECHECK THE DTC.

- (1) Connect the signal check harness connector on the ECU side.
- (2) Erase the DTC.
- (3) Check the DTC.



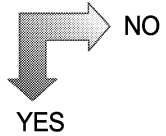
- Bad contact of ECU connectors
- Malfunction of ECU
- Malfunction of harness (Short circuit)

Normal



SAPH161060200021

- 3. CHECK THE ENGINE SPEED MAIN SENSOR.**
- (1) Disconnect the connectors of engine speed main sensor.
 - (2) Measure the resistance between terminals of engine speed main sensor.
- Standard: 108.5 — 142.5 Ω at 20°C {68°F}**



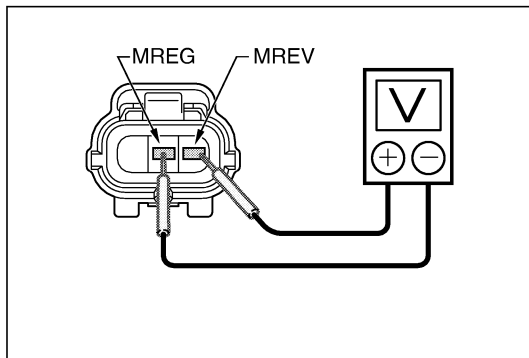
Malfunction of engine speed main sensor

- Harness disconnection
- Bad contact of connectors

ENGINE SPEED SUB SENSOR

EN1610602F200011

DTC	P0340	Engine speed sub sensor circuit malfunction
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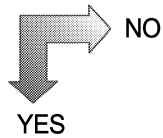


SAPH161060200022

1. CHECK THE VOLTAGE BETWEEN SENSOR TERMINALS.

- (1) Disconnect the connector of the engine speed sub sensor.
- (2) Set the starter to "ON" position.
- (3) Measure the voltage between MREG terminal and MREV terminal of engine speed sub sensor connector. (Vehicle harness side)

Standard: 4.5 — 5.5 V



- Bad contact of ECU connectors
- Malfunction of ECU
- Malfunction of harness (Short circuit)

Malfunction of engine speed sub sensor

ENGINE SPEED MAIN AND SUB SENSOR

EN1610602F200012

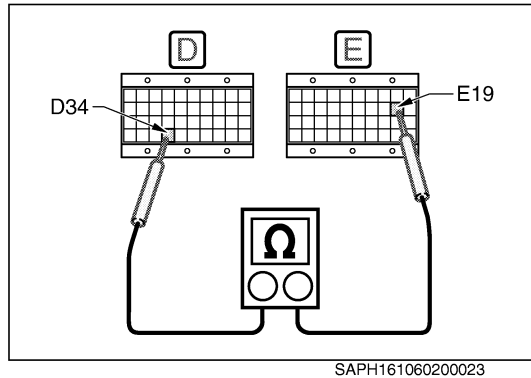
DTC	P0335	Engine speed main sensor circuit malfunction
DTC	P0340	Engine speed sub sensor circuit malfunction

- 1. MAKE SURE TO INSPECT IT IN ACCORDANCE WITH THE CONTENTS OF DTC P0335 AND P0340.**

COOLANT TEMPERATURE SENSOR

EN1610602F200013

DTC	P0117	Coolant temperature sensor circuit low input
DTC	P0118	Coolant temperature sensor circuit high input



1. CHECK THE RESISTANCE BETWEEN TERMINALS.

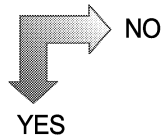
- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Disconnect the signal check harness connector on the ECU side.
- (3) Measure the resistance between THW+ (E19) and AGD2 (D34) terminals of ECU connector (vehicle harness side).

HINT

Measure the resistance under any of the following conditions.

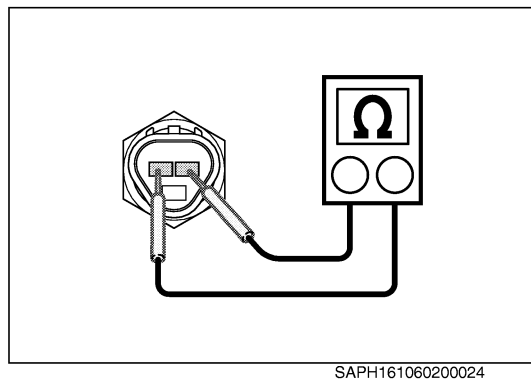
Standard:

- 2.45 k Ω at 20°C {68°F}
- 1.15 k Ω at 40°C {104°F}
- 584 Ω at 60°C {140°F}
- 318 Ω at 80°C {176°F}



Proceed to 2

- Malfunction of ECU
- Malfunction of ECU connectors
- Malfunction of harness (Short circuit)



2. CHECK THE COOLANT TEMPERATURE SENSOR.

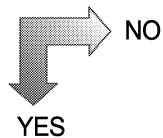
- (1) Disconnect the connector of coolant temperature sensor.
- (2) Measure the resistance of the coolant temperature sensor.

HINT

Measure the resistance under any of the following conditions.

Standard:

- 2.45 k Ω at 20°C {68°F}
- 1.15 k Ω at 40°C {104°F}
- 584 Ω at 60°C {140°F}
- 318 Ω at 80°C {176°F}



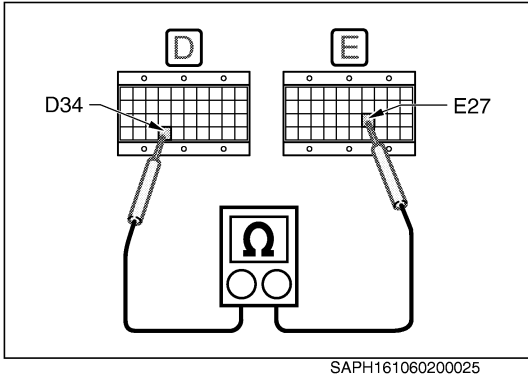
Malfunction of coolant temperature sensor

- Harness disconnection
- Malfunction of connectors
- Bad contact of connectors

FUEL TEMPERATURE SENSOR

EN1610602F200014

DTC	P0182	Fuel temperature sensor circuit low input
DTC	P0183	Fuel temperature sensor circuit high input



1. CHECK THE RESISTANCE BETWEEN TERMINALS.

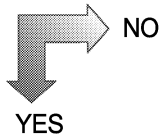
- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Disconnect the signal check harness connector on the ECU side.
- (3) Measure the resistance between THF+ (E27) and AGD2 (D34) terminals of ECU connector (vehicle harness side).

HINT

Measure the resistance under any of the following conditions.

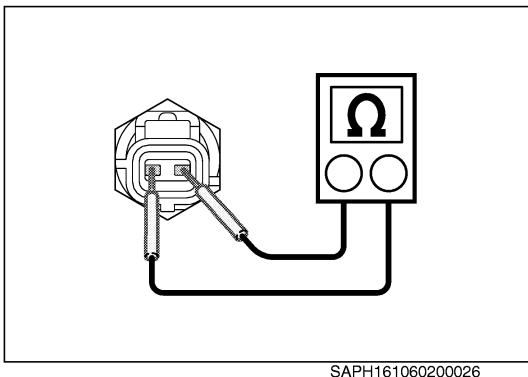
Standard:

- 2.45 kΩ at 20°C {68°F}
- 1.15 kΩ at 40°C {104°F}
- 584 Ω at 60°C {140°F}
- 318 Ω at 80°C {176°F}



Proceed to 2

- Malfunction of ECU
- Malfunction of ECU connectors
- Malfunction of harness (Short circuit)



2. CHECK THE FUEL TEMPERATURE SENSOR.

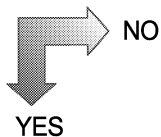
- (1) Disconnect the connector of fuel temperature sensor.
- (2) Measure the resistance of the fuel temperature sensor.

HINT

Measure the resistance under any of the following conditions.

Standard:

- 2.45 kΩ at 20°C {68°F}
- 1.15 kΩ at 40°C {104°F}
- 584 Ω at 60°C {140°F}
- 318 Ω at 80°C {176°F}



Malfunction of fuel temperature sensor

- Harness disconnection
- Malfunction of connectors
- Bad contact of connectors

STARTER SWITCH

EN1610602F200015

DTC	P0617	Starter signal malfunction
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1. CHECK THE VOLTAGE BETWEEN TERMINALS.

⚠ WARNING

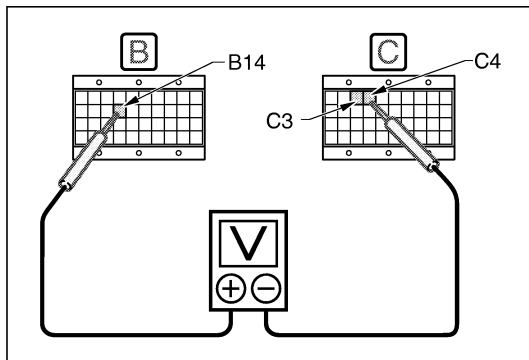
Make sure that transmission is in neutral position.

- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Disconnect the signal check harness connector on the ECU side.
- (3) Measure the voltage between ST (B14) and CGD (C3 and C4) terminals of ECU connectors (vehicle harness side).

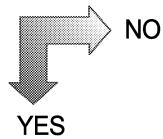
Standard:

Starter switch "LOCK": 0 V

Starter switch "START": 12 V



SAPH161060200027



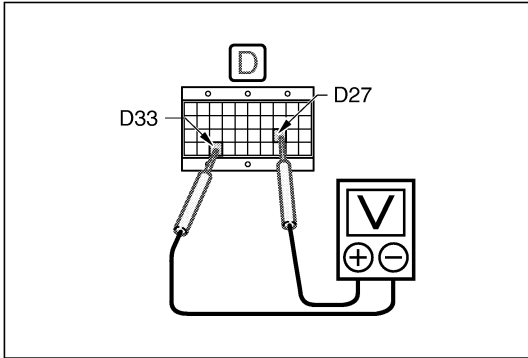
Malfunction of harness

- Malfunction of ECU
- Malfunction of ECU connectors
- Bad contact of ECU connectors

BOOST PRESSURE SENSOR

EN1610602F200016

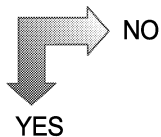
DTC	P0108	Boost pressure sensor circuit high input
DTC	P0237	Boost pressure sensor circuit low input



1. CHECK THE VOLTAGE BETWEEN TERMINALS.

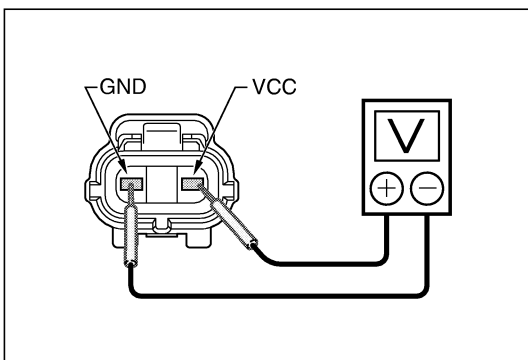
- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Set the starter switch to "ON" (ECU connectors remain connected and the engine is stopped).
- (3) Measure the voltage between PIM (D27) and AGD1 (D33) terminals of ECU connector (vehicle harness side).

Standard: 0.2 — 4.8 V



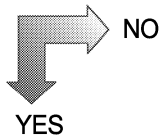
Proceed to (4)

- Malfunction of ECU
- Malfunction of ECU connectors
- Malfunction of harness

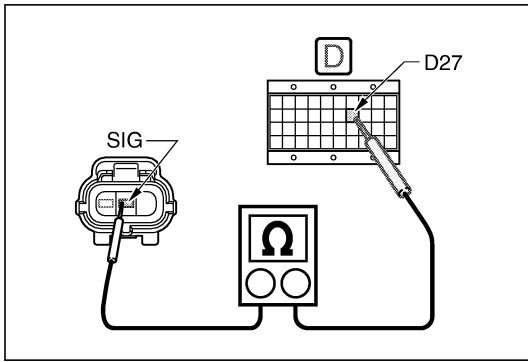


- (4) Set the starter switch to "LOCK" (ECU connectors remain connected).
- (5) Tilt the hood and disconnect the connector of boost pressure sensor.
- (6) Set the stater switch to "ON". (Engine is stopped.)
- (7) Measure the voltage between terminals of boost pressure sensor (vehicle harness side).

Standard: 4.5 — 5.5 V



Proceed to 2 - (3)

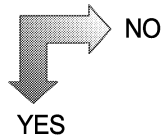


SAPH161060200030

2. CHECK THE RESISTANCE BETWEEN TERMINALS.

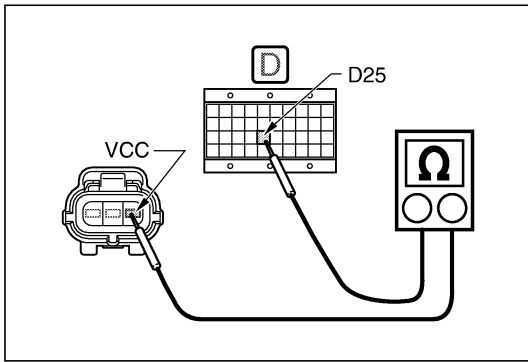
- (1) Set the starter switch to "LOCK" and disconnect the connectors of ECU.
- (2) Measure the resistance between the terminal PIM (D27) of the signal check harness and SIG terminal of boost pressure sensor connector (vehicle harness side).

Standard: Less than 2 Ω



NO
Malfunction of harness

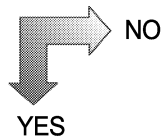
YES
Bad contact of harness connector



SAPH161060200031

- (3) Set the starter switch to "LOCK" and disconnect the connectors of ECU.
- (4) Measure the resistance between AVC1 (D25) terminals of ECU connector (vehicle harness side) and VCC terminal of boost pressure sensor (vehicle harness side).

Standard: Less than 2 Ω



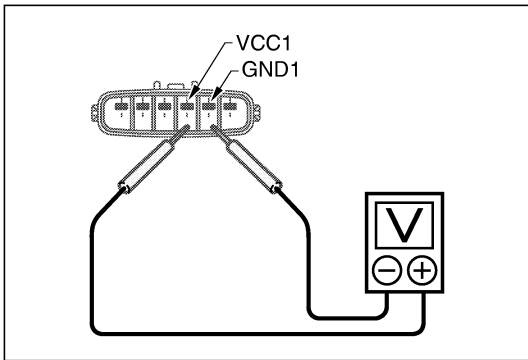
NO
Malfunction of harness

- YES
- Malfunction of ECU
 - Bad contact of harness connector
 - Malfunction of boost pressure sensor

ACCELERATOR SENSOR 1

EN1610602F200017

DTC	P2120	Accelerator sensor 1 and 2 malfunction
DTC	P2122	Accelerator sensor circuit 1 low voltage
DTC	P2123	Accelerator sensor circuit 1 high voltage



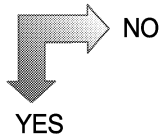
SAPH161060200032

1. CHECK THE VOLTAGE BETWEEN TERMINALS.

- (1) Disconnect the connector of the accelerator sensor (ECU connectors remain connected).
- (2) Set the starter switch to "ON" (The engine is stopped).
- (3) Measure the voltage between VCC1 and GND1 terminals of accelerator sensor (vehicle harness side).

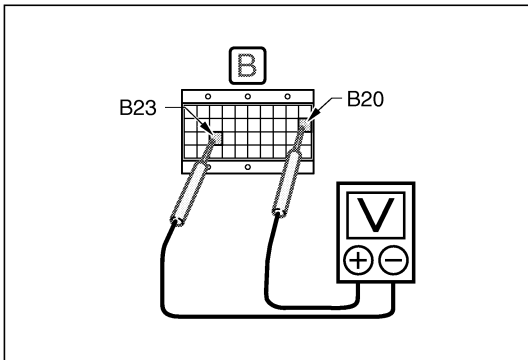
Standard: 4.5 — 5.5 V

(After measurement, turn the starter switch to "LOCK" position.)



Proceed to (4)

Proceed to (7)

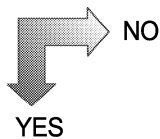


SAPH161060200033

- (4) ECU connectors remain connected and the connector of the accelerator sensor remain disconnected.
- (5) Set the starter switch to "ON" (The engine is stopped).
- (6) Measure the voltage between AVC4 (B23) and AGD4 (B20) terminals of ECU connector (vehicle harness side).

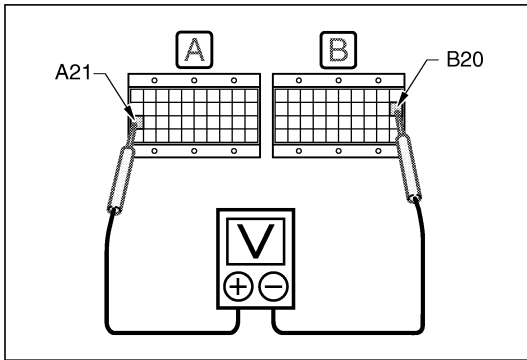
Standard: 4.5 — 5.5 V

(After measurement, turn the starter switch to "LOCK" position.)



- Malfunction of ECU
- Malfunction of ECU connectors

Malfunction of harness

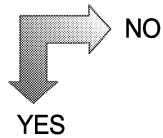


SAPH161060200034

- (7) Connect the connector of the accelerator sensor.
- (8) Set the starter switch to "ON" (The engine is stopped).
- (9) Measure the voltage between ASC1 (A21) and AGD4 (B20) terminals of ECU connector (vehicle harness side).

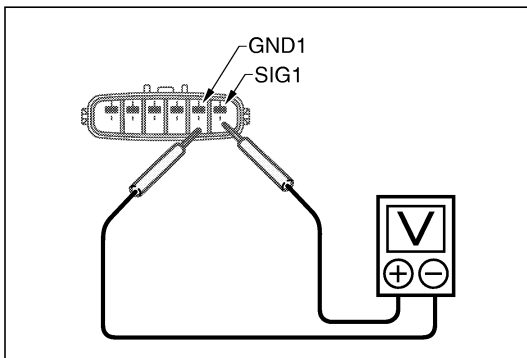
Standard:**0.7 — 1.0 V: Release the accelerator pedal.****3.0 — 3.5 V: Depress the accelerator pedal fully.**

(After measurement, turn the starter switch to "LOCK" position.)



Proceed to (10)

- Malfunction of ECU
- Malfunction of ECU connectors

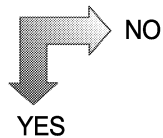


SAPH161060200035

- (10) Connector of accelerator sensor remain connected.
- (11) Set the starter switch to "ON" (The engine is stopped).
- (12) Measure the voltage between SIG1 and GND1 terminals of accelerator sensor (vehicle harness side).

Standard:**0.7 — 1.0 V: Release the accelerator pedal.****3.0 — 3.5 V: Depress the accelerator pedal fully.**

(After measurement, turn the starter switch to "LOCK" position.)



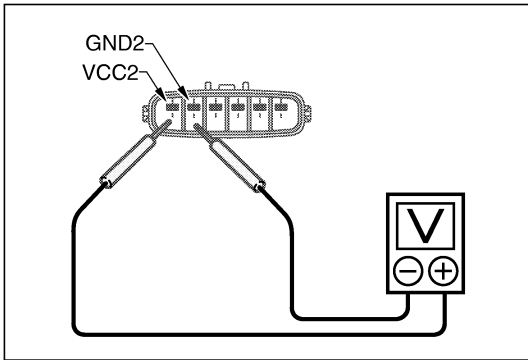
Malfunction of accelerator sensor

Harness disconnection or short circuit

ACCELERATOR SENSOR 2

EN1610602F200018

DTC	P2120	Accelerator sensor 1 and 2 malfunction
DTC	P2127	Accelerator sensor circuit 2 low voltage
DTC	P2128	Accelerator sensor circuit 2 high voltage

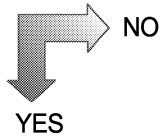


1. CHECK THE VOLTAGE BETWEEN TERMINALS.

- (1) Disconnect the connector of the accelerator sensor (ECU connectors remain connected).
- (2) Set the starter switch to "ON" (The engine is stopped).
- (3) Measure the voltage between the terminals VCC2 and GND2 terminals of accelerator sensor (vehicle harness side).

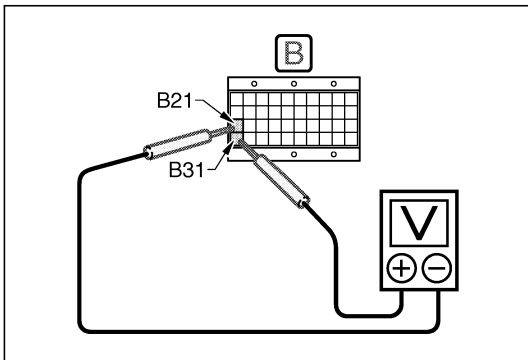
Standard: 4.5 — 5.5 V

(After measurement, turn the starter switch to "LOCK" position.)



Proceed to (4)

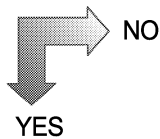
Proceed to (7)



- (4) ECU connectors remain connected and the connector of the accelerator sensor remain disconnected.
- (5) Set the starter switch to "ON" (The engine is stopped).
- (6) Measure the voltage between AVC5 (B31) and AGD5 (B21) terminals of ECU connector (vehicle harness side).

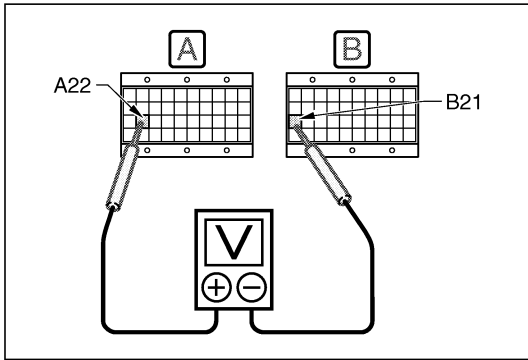
Standard: 4.5 — 5.5 V

(After measurement, turn the starter switch to "LOCK" position.)



- Malfunction of ECU
- Malfunction of ECU connectors

Malfunction of harness



SAPH161060200038

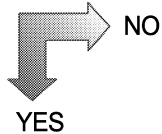
- (7) Connect the connector of the accelerator sensor.
- (8) Set the starter switch to "ON" (The engine is stopped).
- (9) Measure the voltage between ASC2 (A22) and AGD5 (B21) terminals of ECU connector (vehicle harness side).

Standard:

1.5 — 1.8 V: Release the accelerator pedal.

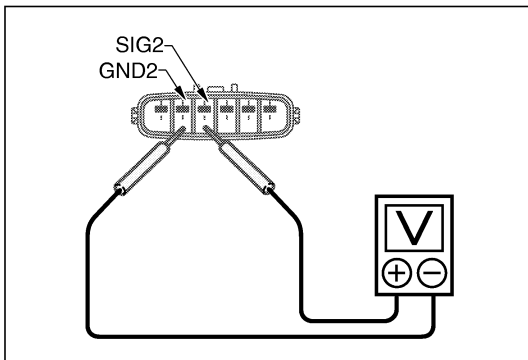
3.8 — 4.3 V: Depress the accelerator pedal fully.

(After measurement, turn the starter switch to "LOCK" position.)



Proceed to (10)

- Malfunction of ECU
- Malfunction of ECU connectors



SAPH161060200039

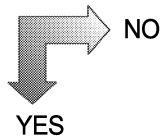
- (10) Connect the connector of the accelerator sensor.
- (11) Set the starter switch to "ON" (The engine is stopped).
- (12) Measure the voltage between SIG2 and GND2 terminals of accelerator sensor (vehicle harness side).

Standard:

1.5 — 1.8 V: Release the accelerator pedal.

3.8 — 4.3 V: Depress the accelerator pedal fully.

(After measurement, turn the starter switch to "LOCK" position.)



Malfunction of accelerator sensor

Harness disconnection or short circuit

ACCELERATOR SENSOR 1 & 2

EN1610602F200019

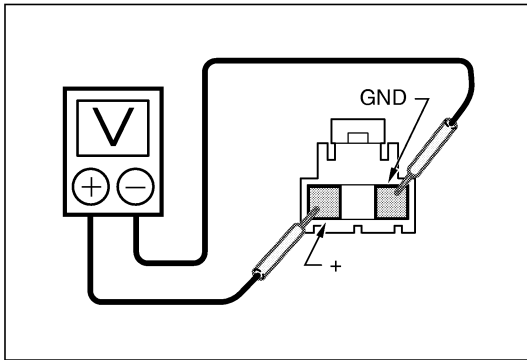
DTC	P2120	Accelerator sensor 1 and 2 malfunction
DTC	P2122	Accelerator sensor circuit 1 low voltage
DTC	P2123	Accelerator sensor circuit 1 high voltage
DTC	P2127	Accelerator sensor circuit 2 low voltage
DTC	P2128	Accelerator sensor circuit 2 high voltage

- 1. MAKE SURE TO INSPECT IT IN ACCORDANCE WITH THE CONTENTS OF DTC P2120, P2122, P2123, P2127 AND P2128.**

THROTTLE CONTROL

EN1610602F200020

DTC	P1143	Throttle control malfunction
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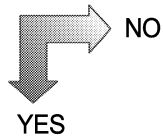
SAPH161060200040

1. CHECK THE VOLTAGE BETWEEN TERMINALS.

- (1) Disconnect the connector of throttle control (ECU connectors remain connected).
- (2) Set the starter switch to "ON" (The engine is stopped).
- (3) Measure the voltage between + and GND terminals of throttle control connectors (vehicle harness side).

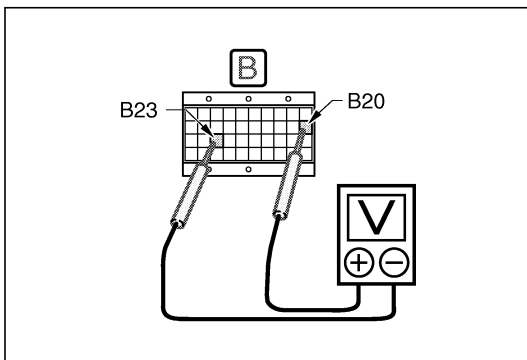
Standard: 4.5 — 5.5 V

(After measurement, turn the starter switch to "LOCK" position.)



Proceed to (4)

Proceed to (6)

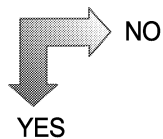


SAPH161060200041

- (4) Set the starter switch to "ON" (The engine is stopped).
- (5) Measure the voltage between AVC4 (B23) and AGD4 (B20) terminals of ECU connector (vehicle harness side).

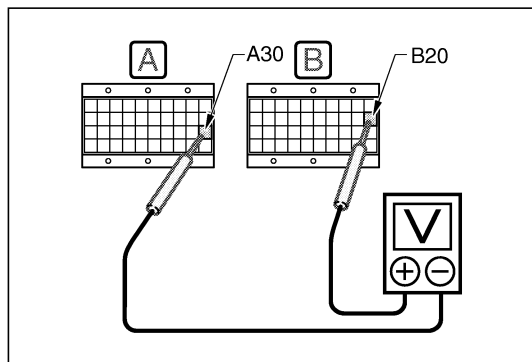
Standard: 4.5 — 5.5 V

(After measurement, turn the starter switch to "LOCK" position.)



- Malfunction of ECU
- Malfunction of ECU connectors

Harness disconnection



SAPH161060200042

- (6) Connect the connector of throttle control.
- (7) Set the starter switch to "ON" (The engine is stopped).
- (8) Measure the voltage between IVS (A30) and AGD4 (B20) terminals of ECU connector (vehicle harness side).

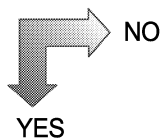
Standard:

APPROX. 0 V: Turn control knob to left fully

APPROX. 0.7 V: Turn control knob to left.

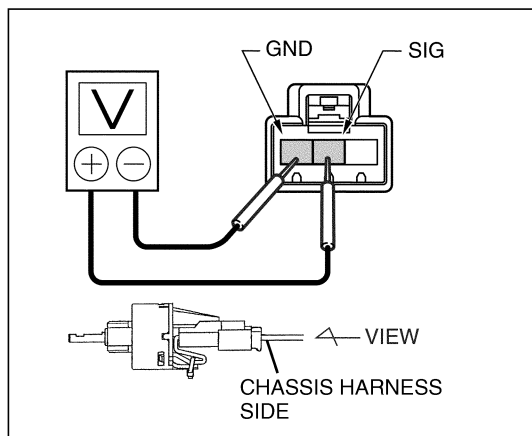
APPROX. 4.3 V: Turn control knob to right fully

(After measurement, turn the starter switch to "LOCK" position.)



NO
Proceed to (9)

- Malfunction of ECU
- Malfunction of ECU connectors



SAPH161060200043

- (9) Set the starter switch to "ON" (The engine is stopped).
- (10) Measure the voltage between SIG and GND terminals of throttle control connectors (chassis harness side).

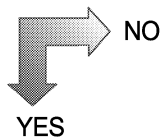
Standard:

APPROX. 0 V: Turn idle control knob to left fully

APPROX. 0.7 V: Turn idle control knob to left.

APPROX. 4.3 V: Turn idle control knob to right fully

(After measurement, turn the starter switch to "LOCK" position.)



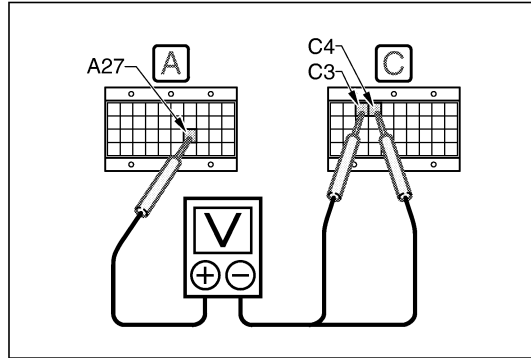
NO
Malfunction of throttle control

- Harness disconnection or short circuit

VEHICLE SPEED SENSOR

EN1610602F200021

DTC	P0500	Vehicle speed sensor circuit low input
DTC	P0501	Vehicle speed sensor circuit high input



1. CHECK THE VOLTAGE BETWEEN TERMINALS.

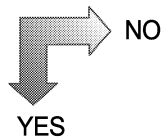
- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Start the engine.
- (3) Prepare the voltage measurement between VS (A27) and CGD (C3 and C4) terminals of ECU connector (vehicle harness side).
- (4) Measure the voltage while the vehicle starts to run at the speed of 10 km/h {6.2 miles/h}.

⚠ WARNING

Start the vehicle with caution to surroundings.

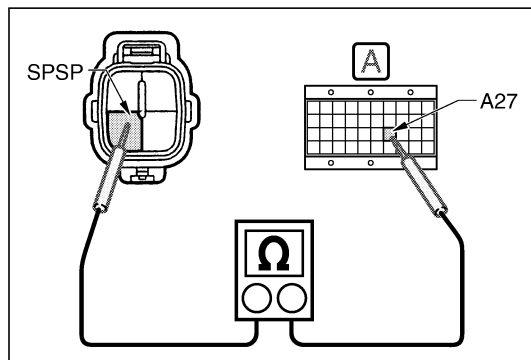
Standard: Pulse wave-shape by 12 V — 0 V

- (5) Stop the vehicle.



Proceed to 2

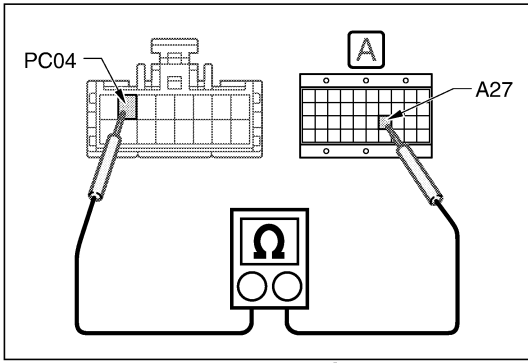
- Malfunction of ECU
- Bad contact of harness connector



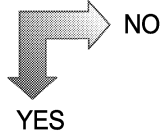
2. CHECK THE CONTINUITY BETWEEN TERMINALS.

- (1) Set the starter switch to "LOCK" and disconnect the connectors of ECU.
- (2) For vehicle equipped with AISIN automatic transmission.
 - a. Disconnect the connectors of vehicle speed sensor.
 - b. Measure the resistance between VS (A27) terminal of ECU connector (vehicle harness side) and SPSP terminal of vehicle speed sensor connectors (vehicle harness side).

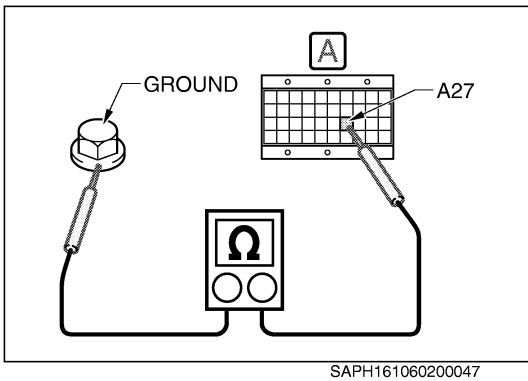
Standard: Less than 1 Ω



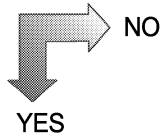
- (3) For vehicle equipped with EATON transmission and ALLISON automatic transmission.
- Disconnect the connectors of pulse converter.
 - Measure the resistance between VS (A27) terminal of ECU connector (vehicle harness side) and PC04 terminal of connectors (vehicle harness side).
Standard: Less than 1 Ω



Harness disconnection of vehicle speed sensor circuit



- Set the starter switch to "LOCK".
- ECU connectors remain connected.
- Measure the resistance between VS (A27) terminal of ECU connector (vehicle harness side) and ground.
Standard: ∞ Ω



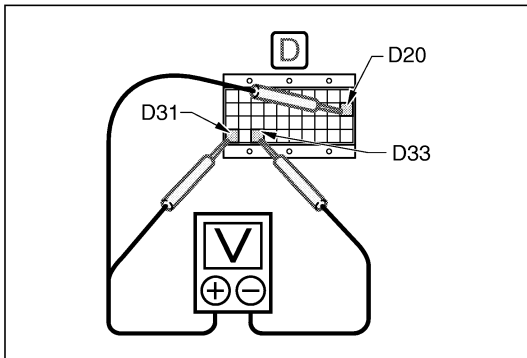
Short circuit due to vehicle speed sensor circuit connection to ground

Malfunction of vehicle speed sensor (The vehicle speed sensor should be solely checked. Erase the DTC and if displayed again the same code on the screen after testing, ECU should be replaced with a new one.)

COMMON RAIL PRESSURE SENSOR

EN1610602F200022

DTC	P0191	Common rail pressure sensor malfunction
DTC	P0192	Common rail pressure sensor circuit low input
DTC	P0193	Common rail pressure sensor circuit high input



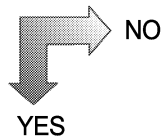
SAPH161060200048

1. CHECK THE VOLTAGE BETWEEN TERMINALS.

- (1) Set the starter switch to "ON" (ECU connectors remain connected and the engine is stopped).
- (2) Measure the voltage between PCR1 (D20), PCR2 (D31) and AGD 1 (D33) of ECU connector (ECU side).

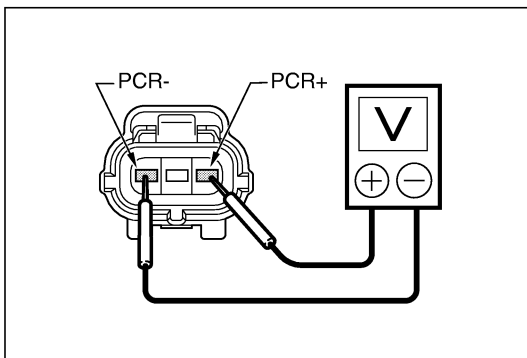
Standard: 0.7 — 4.7 V

(After measurement, turn the starter switch to "LOCK" position.)



Proceed to 2

- Malfunction of ECU
- Bad contact of harness connector

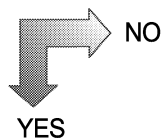


SAPH161060200049

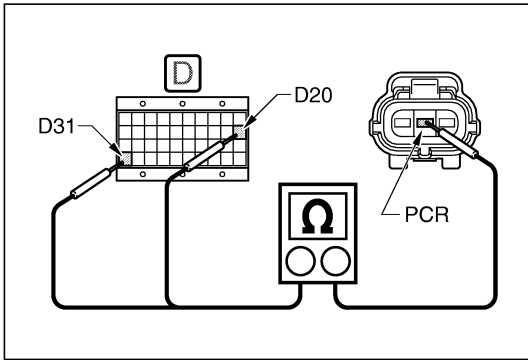
2. CHECK THE VOLTAGE BETWEEN TERMINALS.

- (1) Tilt the hood and disconnect the connector of common rail pressure sensor.
- (2) Measure the voltage between terminals of common rail pressure sensor (vehicle harness side).

Standard: 4.5 — 5.5V



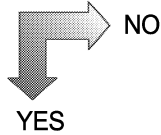
Proceed to (6)



SAPH161060200050

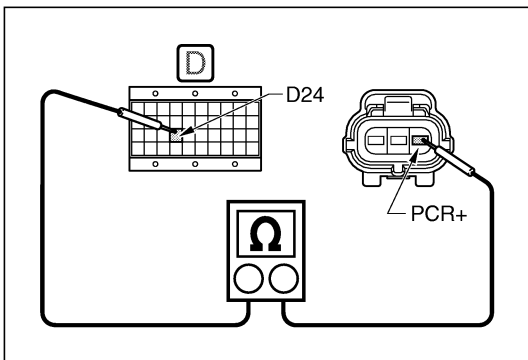
- (3) Turn the starter switch to "LOCK" position.
- (4) Disconnect the ECU connectors.
- (5) Measure the resistance between PCR (D20 and D31) terminals of ECU connector (vehicle harness side) and PCR terminal of common rail pressure sensor (vehicle harness side).

Standard: Less than 2 Ω



Malfunction of harness

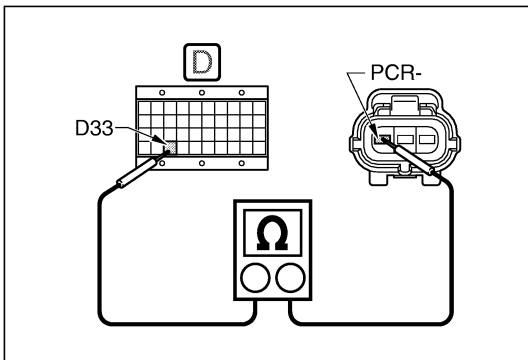
Bad contact of harness connector



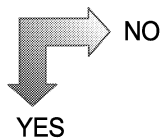
SAPH161060200051

- (6) Turn the starter switch to "LOCK" position.
- (7) Disconnect the ECU connectors.
- (8) Measure the resistance between AVC2 (D24) terminals and PCR+ terminal of common rail pressure sensor (Vehicle harness side), AGD1 (D33) terminal and PCR- terminal of common rail pressure sensor (Vehicle harness side).

Standard: Less than 2 Ω



SAPH161060200052



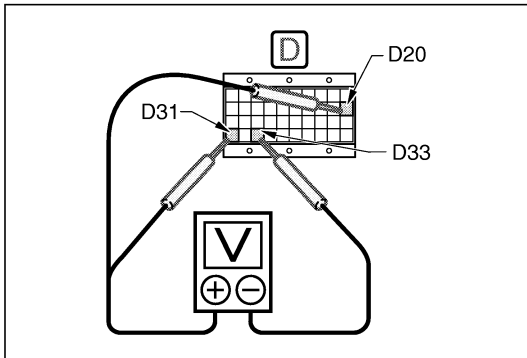
Malfunction of harness

- Malfunction of ECU
- Bad contact of harness connector

COMMON RAIL PRESSURE CONTROL SYSTEM

EN1610602F200023

DTC	P0088	Excessive common rail pressure
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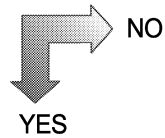
SAPH161060200053

1. CHECK THE VOLTAGE BETWEEN TERMINALS.

- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Set the starter switch to "ON" (ECU connectors remain connected).
- (3) Measure the voltage between PCR1 (D20), PCR2 (D31) and AGD1 (D33) terminals of ECU connector (vehicle harness side).

Standard: 3.6 — 4.7 V

(After measurement, turn the starter switch to "LOCK" position.)



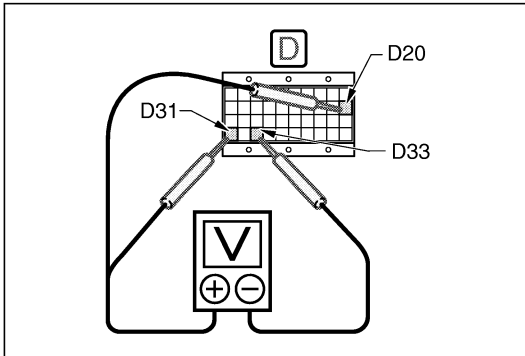
- Malfunction of ECU
 - Bad contact of harness connector
- (If the same code is again output after having erased the DTC memory, replace ECU. If there is no DTC, temporarily defective harness or connector would be possible. So, check the harness and connector.)

Malfunction of common rail pressure sensor

COMMON RAIL PRESSURE AND SUPPLY PUMP

EN1610602F200024

DTC	P0087	Lack of forced feed in supply pump
DTC	P0088	Excessive common rail pressure, supply pump excess forced feed

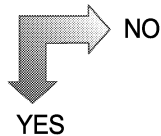


SAPH161060200054

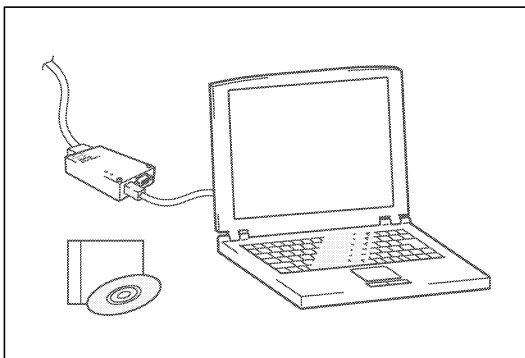
1. CHECK THE VOLTAGE BETWEEN TERMINALS.

- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Start the engine.
- (3) Perform warm-up until the coolant temperature gauge moves.
- (4) At engine speed idling. The target pressure (PFIN) = APPROX. 30 MPa {306 kgf/cm², 4,351 lbf/in.²} (APPROX. 1.5V)
- (5) Measure the voltage between PCR1 (D20), PCR2 (D31) and AGD1 (D33) terminals.

Standard: Less than 1.56V



Malfunction of common rail pressure sensor.



SAPH161060200055

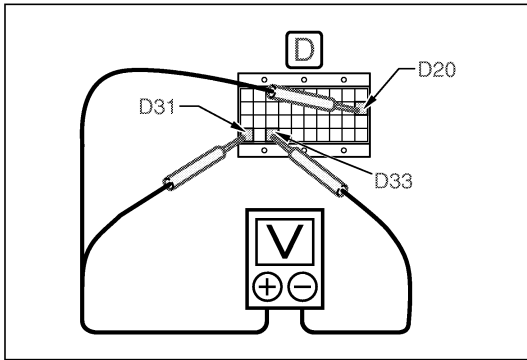
2. CHECK THE DTC.

- (1) Confirm that no other DTC is displayed. If another DTC is displayed repair that trouble and confirm that the DTC No. P0088, P0087 is displayed again. Especially in case of display DTC in regard to engine speed sensor (main and sub) system, perform repair so that these DTC are not displayed.
- (2) Confirm the injection timing of the supply pump. If installation has not been done at top dead center 0°, install correctly.
- (3) If the above check shows no abnormalities, erase the DTC and start the engine. If the same DTC is displayed again, malfunction of supply pump, malfunction of common rail pressure sensor system, and malfunction ECU can be assumed.

COMMON RAIL PRESSURE FIXED OUTPUT

EN1610602F200025

DTC	P0191	Common rail pressure sensor malfunction
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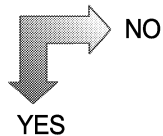


1. CHECK THE VOLTAGE BETWEEN TERMINALS.

- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Set the starter switch to "ON" (ECU connectors remain connected).
- (3) Measure the voltage between PCR1 (D20), PCR2 (D31) and AGD1 (D33) terminals of ECU connector (ECU side).

Standard: 0.9 — 1.1 V

(After measurement, turn the starter switch to "LOCK" position.)



NO

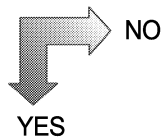
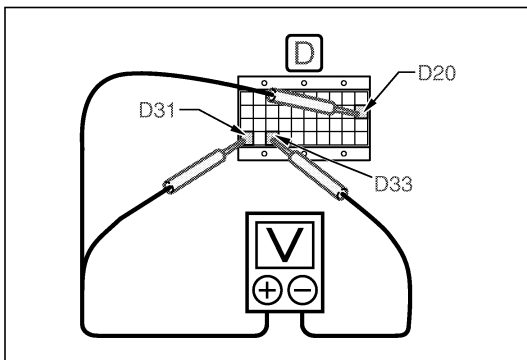
- Malfunction of ECU
- Bad contact of harness connector

- (4) Start the engine.
- (5) While measuring the voltage between PCR1 (D20), PCR2 (D31) and AGD1 (D33) terminals of ECU connector, repeat opening and closing full throttle.

Standard: The voltage changes. (1.0 to 3.2 V)

NOTICE

As DTC P0191 is displayed only when DTC P0192, P0193 are not detected, P0191 may be displayed after you have fixed P0192, P0193 that were previously displayed.



NO

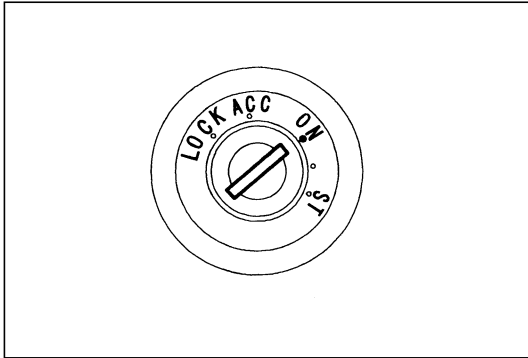
- Malfunction of common rail pressure sensor
- Bad contact of harness connector

- Malfunction of ECU
- Bad contact of harness connector

CYLINDER CONTRIBUTION/BALANCE

EN1610602F200026

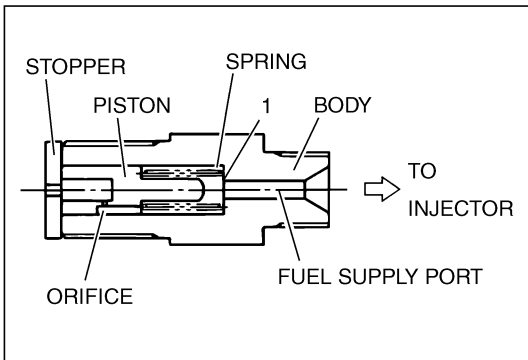
DTC	P0263	Cylinder 1 contribution/balance fault
DTC	P0266	Cylinder 2 contribution/balance fault
DTC	P0269	Cylinder 3 contribution/balance fault
DTC	P0272	Cylinder 4 contribution/balance fault
DTC	P0275	Cylinder 5 contribution/balance fault
DTC	P0278	Cylinder 6 contribution/balance fault



SAPH161060200058

1. CHECK THE FLOW DAMPER.

- (1) Turn the starter switch to "LOCK" position. Stop the engine.
- (2) Wait for about 30 seconds and then start the engine.
- (3) Perform warm-up until the coolant temperature becomes 60°C {140°F} or higher. And erase the DTC.

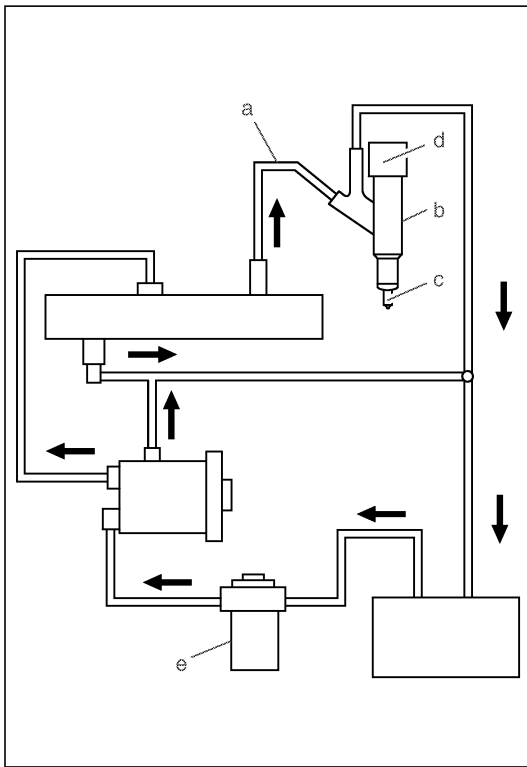


SAPH161060200059

- (4) If the same DTC is displayed again after erasing it, inspect the flow damper of displayed cylinder.

Inspection:

- a. When removing the flow damper from the common rail, check that the piston is not sticking in the body. If the piston sticks, replace the flow damper.
- b. Inspect the contact surface 1 between piston and fuel supply port. If there is wear and damage, replace the flow damper assembly.
- c. Inspect clogging on the piston orifice. Clean or replace the flow damper assembly.



SAPH161060200060

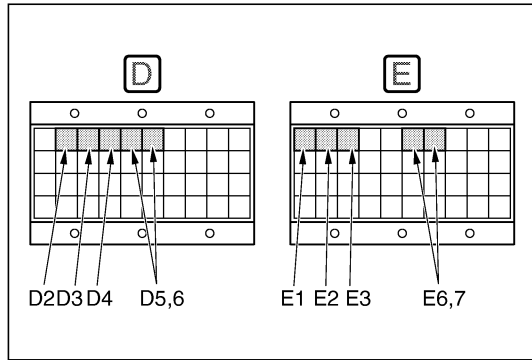
2. RECHECK THE DTC.

- (1) Check that the other DTC is not displayed.
 If the other DTC is displayed, repair the trouble.
 If the same DTC is displayed again, it is possibly from the following problems.
 - a. Excessive fuel flow will cause fuel leakage from injection pipe (between flow damper and injector) by bending, cracking and pipe connection looseness.
 → Check leakage.
 - b. Excessive or shortage fuel flow will cause an increase in the internal leakage of injector.
 → Check injector leakage using nozzle tester.
 - c. Excessive fuel flow will cause injector seat deflection.
 → Check injector nozzle seat using nozzle tester.
 - d. Excessive or shortage fuel flow will cause injector operation malfunction.
 → Check by replacing the injector.
 - e. Shortage fuel flow will cause clogging of the fuel supply system.
 → Check fuel filter.
- (2) The above problems can be diagnosed using the "Data Monitor" menu to determine the cylinder contribution quantity and "Activation Test" menu to stop the injector.

INJECTOR SOLENOID VALVE SYSTEM BREAKING

EN1610602F200027

DTC	P0201	Injector circuit malfunction -cylinder 1
DTC	P0202	Injector circuit malfunction -cylinder 2
DTC	P0203	Injector circuit malfunction -cylinder 3
DTC	P0204	Injector circuit malfunction -cylinder 4
DTC	P0205	Injector circuit malfunction -cylinder 5
DTC	P0206	Injector circuit malfunction -cylinder 6

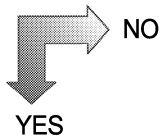


1. CHECK THE RESISTANCE BETWEEN TERMINALS.

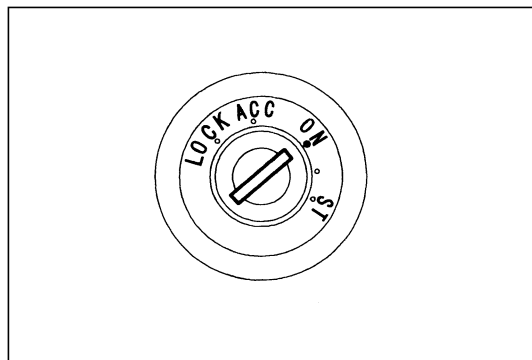
- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Disconnect the signal check harness connector on the ECU side.
- (3) Measure the resistance between the terminals of ECU connector (vehicle harness side).

DTC NO.	Failure position (Breaking position)	Terminals to measure the resistance
P0201	#1 Injector	INJ1 (D2) ↔ IJ1+ (D5) I1+S (D6)
P0202	#2 Injector	INJ2 (D3) ↔ IJ1+ (D5) I1+S (D6)
P0203	#3 Injector	INJ3 (D4) ↔ IJ1+ (D5) I1+S (D6)
P0204	#4 Injector	INJ4 (E1) ↔ IJ2+ (E6) I2+S (E7)
P0205	#5 Injector	INJ5 (E3) ↔ IJ2+ (E6) I2+S (E7)
P0206	#6 Injector	INJ6 (E2) ↔ IJ2+ (E6) I2+S (E7)

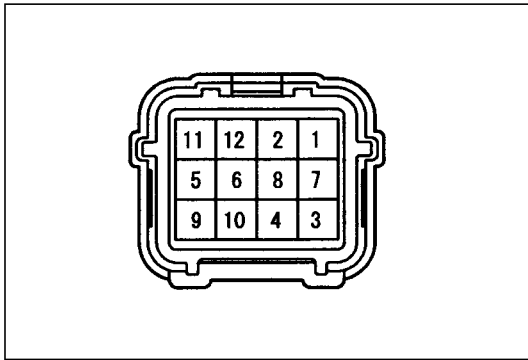
Standard: Less than 2 Ω



Proceed to (7)



- (4) This is ECU failure or defective contact of the connector. Restore all connectors and start the engine.
- (5) Erase the DTC.
- (6) Check the current failure. If the same DTC is displayed, replace ECU. If there is no DTC, then the connector contact would have been defective. As long as no DTC is displayed, there is no problem.
- (7) Tilt the hood. Disconnect the injector connector that is located at the front side of the cam housing.

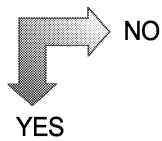


SAPH161060200063

- (8) Measure the resistance between the pins of the injector connector (male) at the cam housing side.

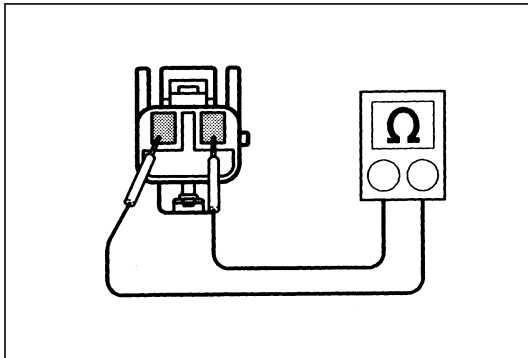
DTC NO.	Terminals to measure the resistance
P0201	9 ↔ 10
P0202	11 ↔ 12
P0203	7 ↔ 8
P0204	5 ↔ 6
P0205	1 ↔ 2
P0206	3 ↔ 4

Standard: Less than 2 Ω



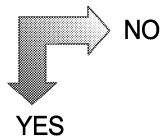
NO
Proceed to (9)

Harness disconnections (vehicle harness side)
(Check the harness between ECU and the injector connector.)



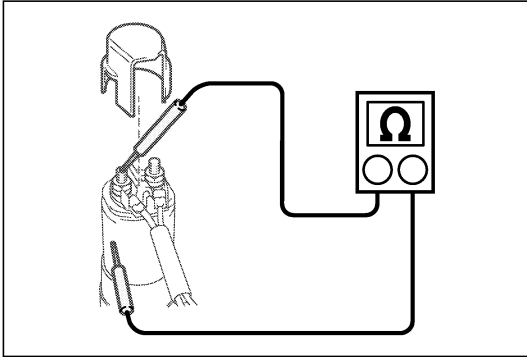
SAPH161060200064

- (9) Dismount the head cover.
(10) Disconnect the injector connector (injector side) of the cylinder displayed by DTC. Measure the resistance between the pins.
Standard: 0.35 — 0.55 Ω at 20°C {68°F}



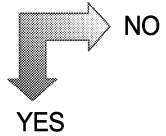
NO
Proceed to (11)

Bad contact of the connector or the harness in the head cover
(Check the connector or the harness in the head cover.)



SAPH161060200065

- (11) Remove the injector terminal cap of the cylinder display by DTC.
Measure the insulation resistance between the terminal and injector body.
Standard: More than 1000 M Ω



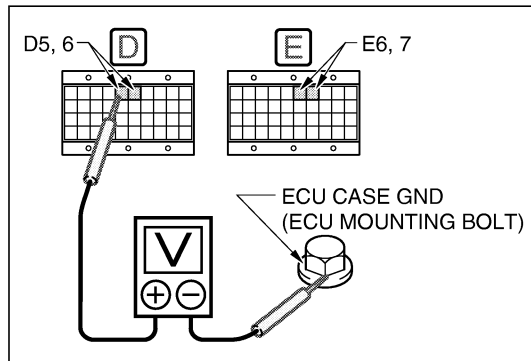
Injector coil disconnection (Replace the injector assembly.)

Injection harness disconnections (Replace the injector harness.)

INJECTOR SOLENOID VALVE DRIVING SYSTEM +B SHORT- CIRCUIT

EN1610602F200028

DTC	P1212	Injector common 1 short to BATT
DTC	P1215	Injector common 2 short to BATT



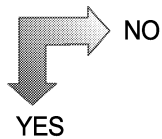
SAPH161060200066

1. CHECK THE VOLTAGE BETWEEN TERMINALS.

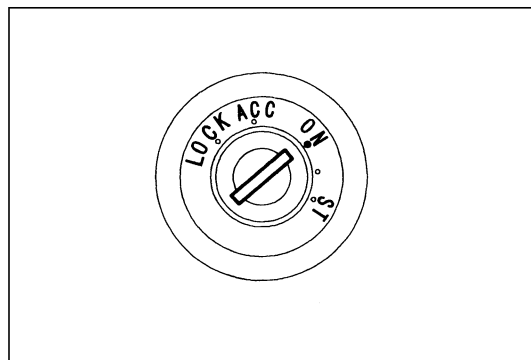
- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Turn "ON" the starter switch.
- (3) Measure the voltage between the terminals of ECU connector (vehicle harness side) and ECU case GND.

DTC NO.	Voltage measurement	
	+ side	- side
P1212	IJ1+ (D5) I1+S (D6)	ECU case GND
P1215	IJ2+ (E6) I2+S (E7)	ECU case GND

Standard: Less than 8 V

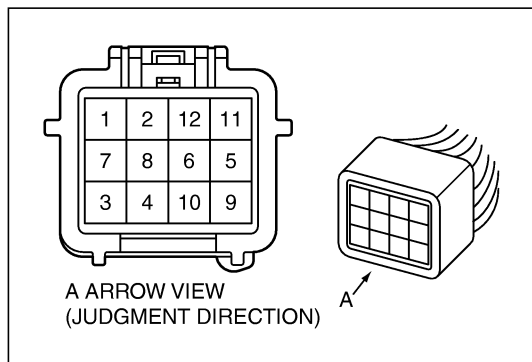


Proceed to (7)



SAPH161060200067

- (4) Turn the starter switch to "LOCK" position. Reconnect all the connectors.
- (5) Start the engine and erase the DTC.
- (6) If the same DTC is displayed, replace ECU. If no DTC is displayed, a temporary failure would have occurred.
- (7) Turn the starter switch to "LOCK" position.
- (8) Tilt the hood. Disconnect the injector connector that is located on the front side of the cam housing. Turn the starter switch to "ON" position.



(9) Measure the voltage between the pins of injector connector (vehicle harness side) and ECU case GND.

NOTICE

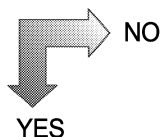
Measure the voltage of this connector from the connector terminals (female).

NOTICE

Do not damage the connector terminals.

DTC NO.	Failure position (breaking position)	Voltage measurement	
		+ side	- side
P1212	No.1 injector	10	ECU case GND
	No.2 injector	12	
	No.3 injector	8	
P1215	No.4 injector	6	ECU case GND
	No.5 injector	2	
	No.6 injector	4	

Standard: Less than 8 V



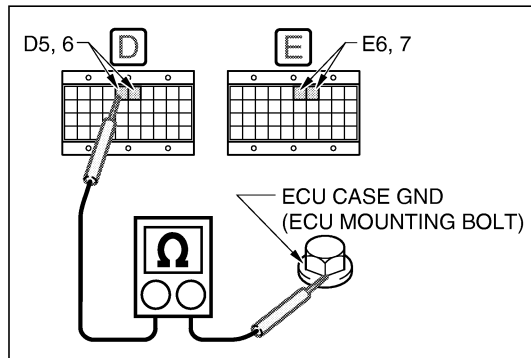
Malfunction of harness
(It is defective the harness which voltage value is out of the standard.)

Check the harness in the head cover.
(A short-circuit would occur between the harness in the head cover and the power source line.)

INJECTOR SOLENOID VALVE DRIVING SYSTEM GND SHORT-CIRCUIT

EN1610602F200029

DTC	P1211	Injector common 1 short to GND
DTC	P1214	Injector common 2 short to GND



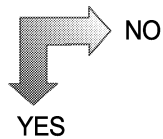
SAPH161060200069

1. CHECK THE RESISTANCE BETWEEN TERMINALS.

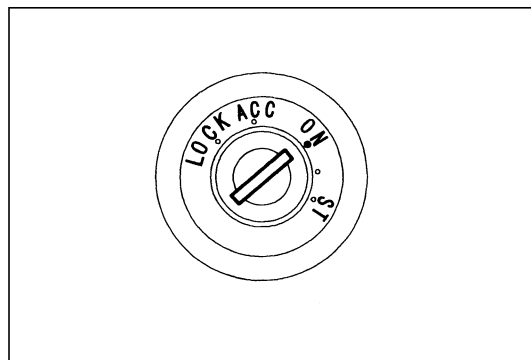
- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Disconnect the signal check harness connector on the ECU side.
- (3) Measure the resistance between the terminals of ECU connector (vehicle harness side).

DTC NO.	Resistance measurement	
	+ side	- side
P1211	IJ1+ (D5) I1+S (D6)	ECU case GND
P1214	IJ2+ (E6) I2+S (E7)	ECU case GND

Standard: $\infty \Omega$

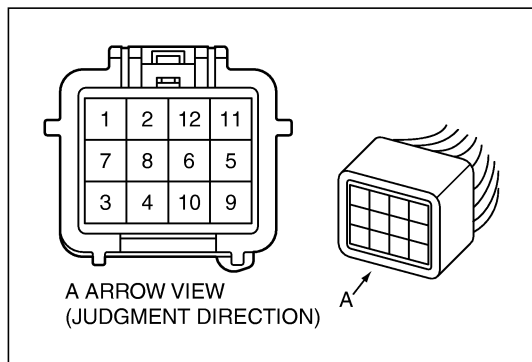


Proceed to (7)



SAPH161060200070

- (4) Turn the starter switch to "LOCK" position. Reconnect all the connectors.
- (5) Start the engine and erase the DTC.
- (6) If the same DTC is displayed, replace ECU. If no DTC is displayed, a temporary failure would have occurred.
- (7) Turn the starter switch to "LOCK" position (with all connectors of ECU disconnected).
- (8) Tilt the hood. Disconnect the injector connector that is located on the front side of the cam housing.



(9) Measure the resistance between the pins of injector connector (vehicle harness side) and ECU case GND.

NOTICE

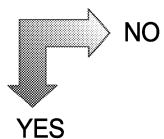
Measure the voltage of this connector from the connector terminals (female).

NOTICE

Do not damage the connector terminals.

DTC NO.	Failure position (breaking position)	Resistance measurement	
		+ side	- side
P1211	No.1 injector	9, 10	ECU case GND
	No.2 injector	11, 12	
	No.3 injector	7, 8	
P1214	No.4 injector	5, 6	ECU case GND
	No.5 injector	1, 2	
	No.6 injector	3, 4	

Standard: $\infty \Omega$



Malfunction of harness
(It is defective the harness which resistance value is out of the standard.)

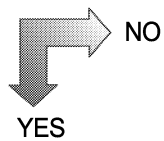
Check the harness in the head cover.
(A short-circuit would occur between the harness in the head cover and the GND line.)

ECU

EN1610602F200030

DTC	P0200	ECU charge circuit high input
DTC	P0605	Flash ROM error
DTC	P0606	CPU malfunction (Hard detection)
DTC	P0607	Monitoring IC malfunction in CPU
DTC	P0611	ECU charge circuit malfunction
DTC	P2228	Atmospheric pressure sensor circuit low input.
DTC	P2229	Atmospheric pressure sensor circuit high input.

1. After the starter switch is positioned on the "LOCK" once, it should be turned to "ON" position again.
2. After erasing the DTC, check that the same code is displayed again.



Malfunction of ECU.

Normal
(Temporary malfunction because of radio interference noise)

ENGINE OVERRUN

EN1610602F200031

DTC	P0219	Engine overrun
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1. The DTC will be displayed, once detected over 4,000 r/min. in the Engine revolution. Also, the fuel injection will be suspended during the DTC to be detected and the fuel injection will be resumed when Engine revolution goes down less than 3,800 r/min.

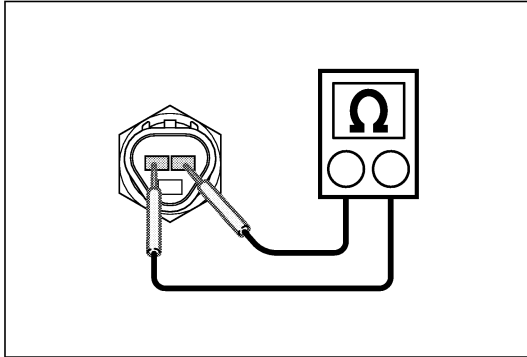
NOTICE

The DTC aim is not for detecting the Engine over-run under abnormal operation of the system, but for storing in memory the high revolution of the Engine. (For detection of wrong shifting, etc.) Also, there is a case in which "overrun" will be detected by misunderstanding the Engine revolution, with a noise to be generated by harness malfunction and its modification.

ENGINE OVERHEAT

EN1610602F200032

DTC	P0217	Engine overheat
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SAPH161060200024

1. CHECK THE COOLANT TEMPERATURE SENSOR.

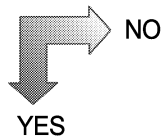
- (1) Set the starter switch to "LOCK".
- (2) Disconnect the connector of coolant temperature sensor.
- (3) Measure the resistance between terminals.

HINT

Measure the resistance under any of the following conditions.

Standard:

- 2.45 k Ω at 20°C {68°F}
- 1.15 k Ω at 40°C {104°F}
- 584 Ω at 60°C {140°F}
- 318 Ω at 80°C {176°F}



Malfunction of coolant temperature sensor

Malfunction of engine cooling system

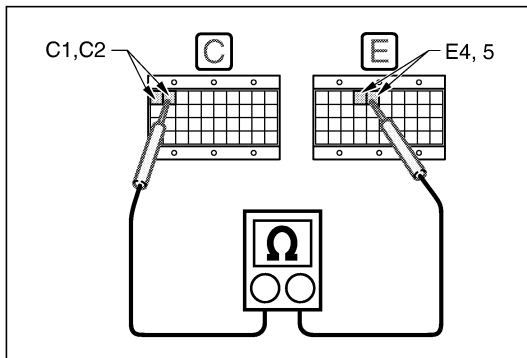
HINT

This code will be displayed when the coolant temperature sensor operates normally and coolant temperature ascends over 115°C {239°F}. Also, while the DTC is being detected, Max. volume of fuel injection will be limited and will return back to normal control volume when it descends less than 80°C {176°F}.

AIR INTAKE PREHEATER RELAY

EN1610602F200033

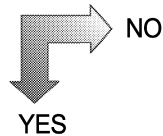
DTC	P0540	Preheat circuit malfunction
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1. CHECK THE RESISTANCE BETWEEN TERMINALS.

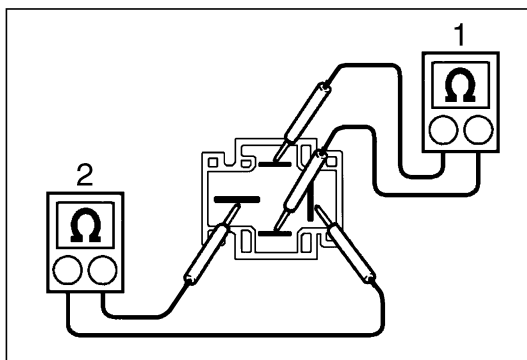
- (1) Set the starter switch to "LOCK" position and connect the signal check harness.
- (2) Disconnect the connector of the signal check harness (ECU side).
- (3) Measure the resistance between GRY (C1,C2) and PGD (E4, E5) terminals.

Standard: 64 — 96 Ω



Proceed to 2.

- Malfunction of ECU
- Malfunction of ECU connectors



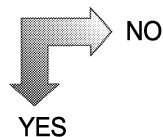
2. CHECK THE RESISTANCE OF PREHEATER RELAY.

- (1) Remove the preheater relay.
- (2) Measure the resistance between terminals of preheater relay.

Standard:

1. 64 — 96 Ω

2. $\infty \Omega$



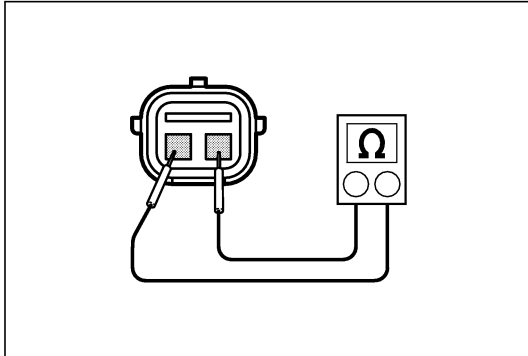
Malfunction of preheater relay

- Malfunction of harness
- Malfunction of connectors

SUCTION CONTROL VALVE (SCV)

EN1610602F200034

DTC	P0628	SCV malfunction
DTC	P0629	SCV out put short to BATT



SAPH161060200073

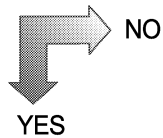
1. CHECK THE RESISTANCE OF SCV.

- (1) Set the starter switch to "LOCK" position.
- (2) Disconnect the harness of the SCV of the supply pump.
- (3) Measure the resistance between the terminals of SCV connector (SCV side).

Standard: 1.6–2.6 Ω at 20°C {68°F}

- (4) Measure the resistance of insulation between terminals and SCV body.

Standard: more than 100 M Ω at 20°C {68°F}



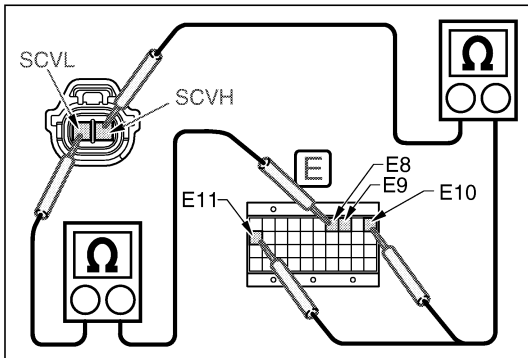
Malfunction of SCV (Replace the supply pump)

2. CHECK THE CONTINUITY BETWEEN TERMINALS.

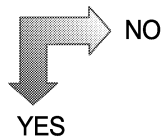
- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Disconnect the signal check harness connector on the ECU side.
- (3) Measure the resistance between SCVH (E10, E11) terminal of ECU connector (vehicle harness side) and SCVH terminal of SCV connectors (vehicle harness side).

In the same way, measure the resistance between SCVL (E8, E9) terminal of ECU connector and SCVL terminal of SCV connector.

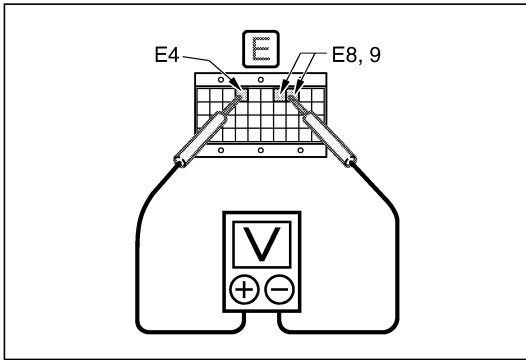
Standard: Less than 1 Ω



SAPH161060200074



- Harness disconnection
- Bad contact of harness connector



SAPH161060200075

3. CHECK THE VOLTAGE BETWEEN TERMINALS.

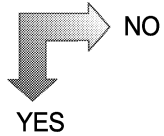
- (1) Connectors of signal check harness (ECU side).
- (2) Set the starter switch to "ON" (The engine is stopped).
- (3) Measure the voltage between PGD2 (E4) terminal and SCVL (E8, E9) terminals of ECU connectors (vehicle harness side)

Standard: Pulse wave-shape by 12 V — 0 V

(After measurement, turn the starter switch to "LOCK" position.)

NOTICE

Measure the voltage within 40 seconds after starter switch "ON".



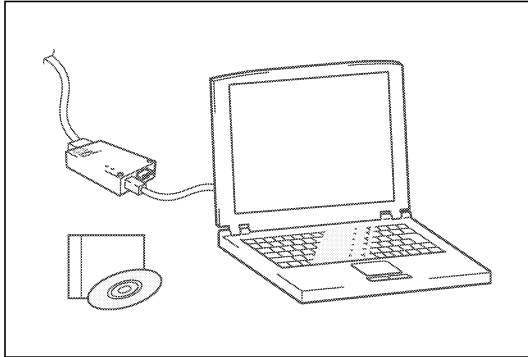
Malfunction of ECU connectors

Malfunction of ECU

EGR (CHECK BY HINO-DX)

EN1610602F200035

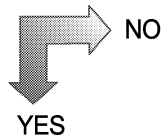
DTC No.	P0400	Abnormal flow amount of EGR
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SAPH161060200076

1. **CHECK THE EGR USING THE PC DIAGNOSIS TOOL (HINO-DX).**
 - (1) Confirm that no other DTC is displayed. If another DTC is displayed, repair that trouble and confirm that the DTC No. P0101 is displayed again. Especially in case of display DTC in regard to engine speed sensor (main and sub) system, perform repair so that these DTC are not displayed.
 - (2) Carry out "**INSPECTION OF AIR FLOW SENSOR (CHECK/ADJUSTMENT OF AIR INTAKE VOLUME BY HINO-DX)**", refer to **DN02-27**.
 - (3) Connect the PC DIAGNOSIS TOOL (HINO-DX).
 - (4) Set the starter switch to "ON".
 - (5) Confirm the EGR actuator malfunction (DTC No. P1458, P1459, U1122) is not displayed.
 - (6) Check the actual opening value is followed up by input value by activating the EGR valve.

Standard: Difference value is less than 5%



Malfunction of ECU.

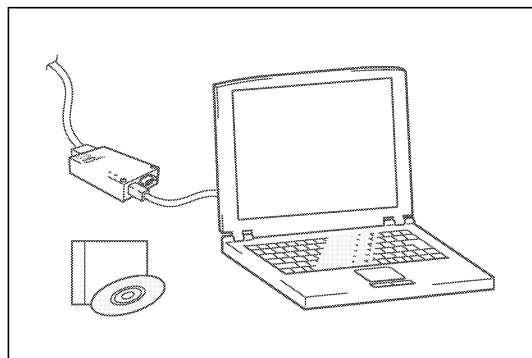
Normal.

- (7) If the above check shows no abnormalities, erase the DTC and start the engine. If the same DTC is displayed again, malfunction of air flow sensor can be assumed. Carry out the unit check of air flow sensor.

EGR ACTUATOR 1, 2

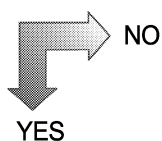
EN1610602F200036

DTC	P1458	EGR actuator malfunction
DTC	P1459	EGR actuator malfunction
DTC	U1122	CAN communication malfunction (EGR)
DTC	U0073	CAN malfunction



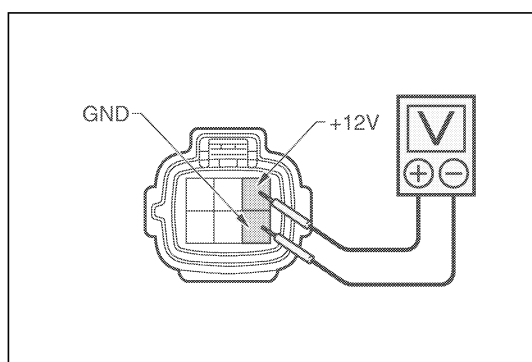
SAPH161060200077

- 1. CHECK THE EGR USING THE PC DIAGNOSIS TOOL (HINO-DX).**
 - Connect the PC DIAGNOSIS TOOL (HINO-DX).
 - Set the starter switch to "ON".
 - Confirm the EGR actuator malfunction (DTC No. P1458, 1459) and CAN communication malfunction (EGR) (DTC No. U1122) is not displayed.
 - Check the actual opening value is followed up by input value by activating the EGR valve.
Standard: Difference value is less than 5%



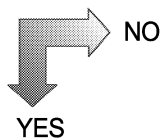
Proceed to 2

Normal

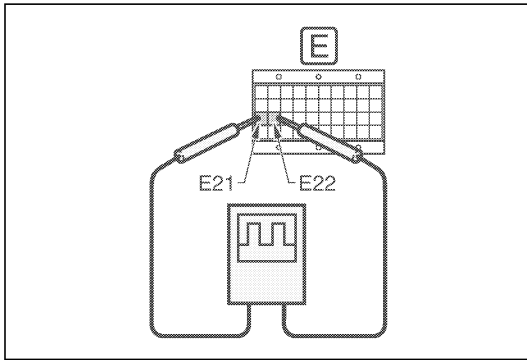


SAPH161060200078

- 2. CHECK THE VOLTAGE BETWEEN TERMINALS**
 - Set the starter switch to "LOCK" and disconnect the connector of EGR controller.
 - Set the starter switch to "ON".
 - Measure the voltage between EGRV (+12V) and EGRG (GND) terminals of EGR controller connector.
Standard: More than 10 V



Malfunction of harness

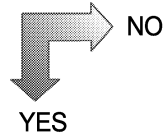


SAPH161060200079

3. CHECK THE VOLTAGE WAVE-SHAPE OF CAN COMMUNICATION TERMINALS.

- (1) Set the starter switch to "LOCK", connect the signal check harness and connector of EGR controller.
- (2) Set the starter switch to "ON".
- (3) Measure the voltage wave-shape between CANH (E21) and CANL (E22) terminals of the signal check harness.

Standard: 0 ↔ 5 V pulse wave



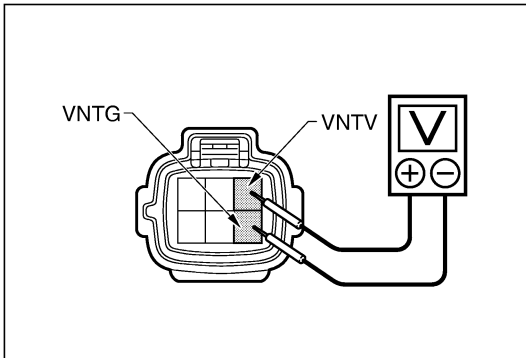
GDN or +12V short circuit

Malfunction of EGR controller

VNT (VARIABLE NOZZLE TURBINE) TURBOCHARGER CONTROLLER

EN1610602F200037

DTC	P0045	VNT turbocharger controller malfunction
DTC	U0073	CAN malfunction (Engine)
DTC	U1123	CAN communication malfunction (VNT)



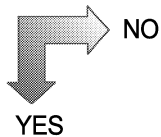
SAPH161060200080

1. CHECK THE VOLTAGE BETWEEN SENSOR TERMINALS.

- (1) Set the starter switch to "LOCK" position.
- (2) Disconnect the connectors of VNT controller.
- (3) Set the starter switch to "ON" position.
- (4) Measure the voltage between VNTV and VNTG terminals of VNTG connector (vehicle harness side).

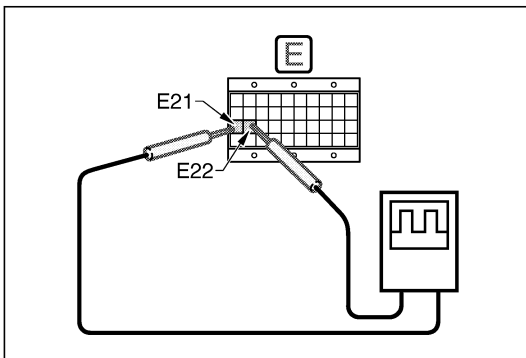
Standard: More than 10 V

(After measurement, turn the starter switch to "LOCK" position.)



Malfunction of harness

Proceed to 2

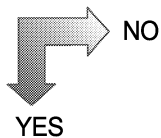


SAPH161060200081

2. CHECK THE VOLTAGE BETWEEN VNT ACTUATOR TERMINALS.

- (1) Set the starter switch to "LOCK" position.
- (2) Connect the connector of VNT controller.
- (3) Set the starter switch to "ON" position and measure the voltage between CANL (E22) and CANH (E21) terminals of signal check harness.

Standard: 0 ↔ 5 V pulse wave



Malfunction of VNT turbocharger controller

- Malfunction of ECU
- Malfunction of ECU connector

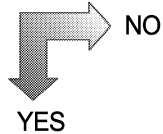
TURBOCHARGER OVER BOOST

EN1610602F200038

DTC	P0234	Turbocharger over boost
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1. CHECK THE VNT TURBOCHARGER CONTROLLER.

- (1) Set the starter switch to "ON" position.
- (2) Confirm the VNT turbocharger controller malfunction (DTC P0045, U0073, U1123) is not displayed.
- (3) Select the "VNT check" in the "Check function" menu.
- (4) Check the actual opening value is followed up by input value by activating the VNT turbocharger controller.

Standard: Difference value is less than 5%

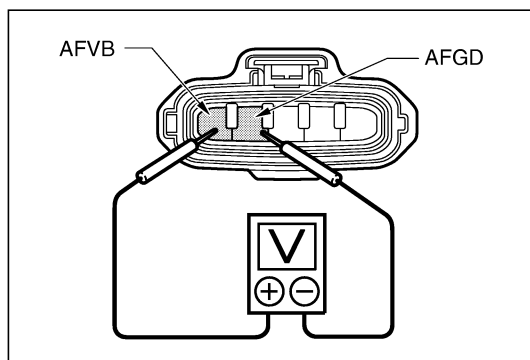
Malfunction of VNT turbocharger controller

Carry out diagnosis of the boost pressure sensor P0108 and P0237.

AIR FLOW SENSOR

EN1610602F200039

DTC	P0102	Air flow sensor circuit low input
DTC	P0103	Air flow sensor circuit high input

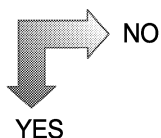


SAPH161060200082

1. CHECK THE VOLTAGE BETWEEN SENSOR TERMINALS.

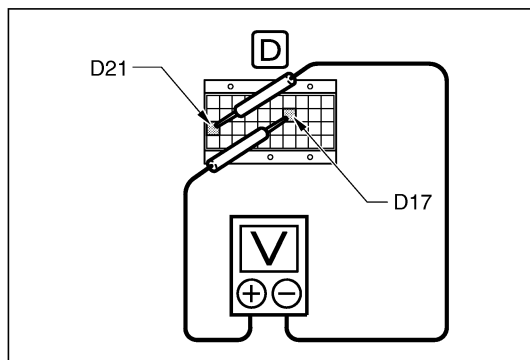
- (1) Disconnect the connector of the air flow sensor.
- (2) Set the starter to "ON" position.
- (3) Measure the voltage between AFVB and AFGD terminals of air flow sensor connector. (Vehicle harness side)

Standard: More than 10 V



Malfunction of harness

Proceed to 2

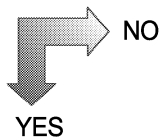


SAPH161060200083

2. CHECK THE VOLTAGE BETWEEN TERMINALS.

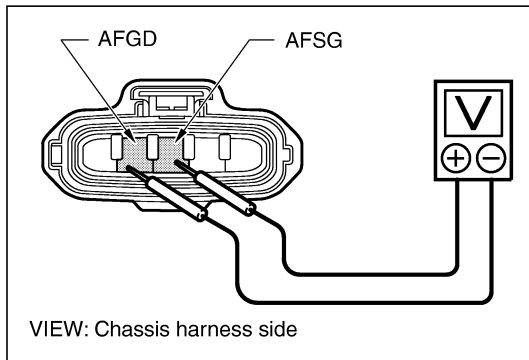
- (1) Set the starter switch "LOCK" position.
- (2) Connect the connector of air flow sensor.
- (3) Set the starter switch to "ON" position and measure the voltage between AFSG (D21) and AGD6 (D17) terminals of signal check harness.

Standard: 0.2 — 4.8 V



Proceed to 3

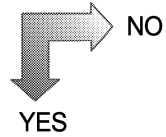
- Malfunction of ECU
- Malfunction of ECU connector



SAPH161060200084

3. CHECK THE VOLTAGE BETWEEN SENSOR TERMINALS

- (1) Air flow sensor connector remains connected.
- (2) Measure the voltage between AFGD and AFSG terminals of air flow sensor connector (vehicle harness side).

Standard: 0.2 — 4.8 V**(After measurement, turn the starter switch to "LOCK" position.)**

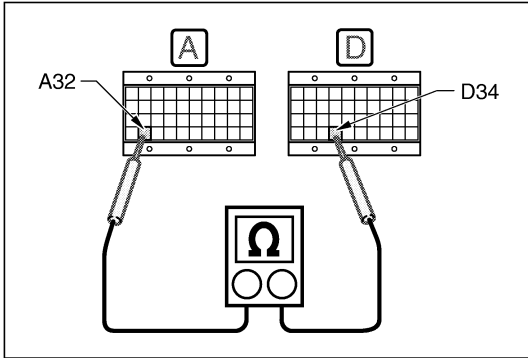
Malfunction of air flow sensor

Malfunction of harness

INTAKE AIR TEMPERATURE SENSOR

EN1610602F200040

DTC	P0112	Intake air temperature sensor circuit low input
DTC	P0113	Intake air temperature sensor circuit high input



1. CHECK THE RESISTANCE BETWEEN TERMINALS.

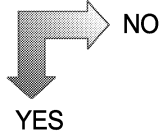
- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Disconnect the signal check harness connector on the ECU side.
- (3) Measure the resistance between AFT+ (A32) and AGD2 (D34) terminals of ECU connector (vehicle harness side).

HINT

Measure the resistance under any of the following conditions.

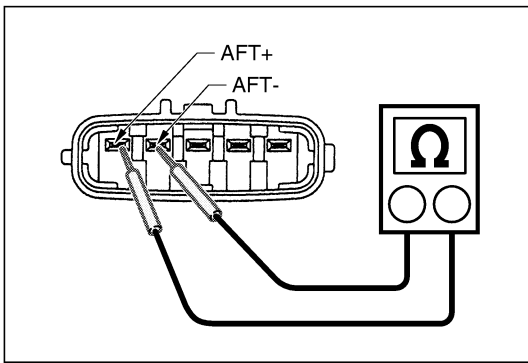
Standard:

- 13.6 — 18.4 kΩ at -20°C {-4°F}
- 2.21 — 2.69 kΩ at 20°C {68°F}
- 0.49 — 0.67 kΩ at 60°C {140°F}



Proceed to 2

- Malfunction of ECU
- Malfunction of ECU connectors
- Malfunction of harness (Short circuit)



2. CHECK THE INTAKE AIR TEMPERATURE SENSOR.

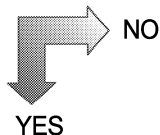
- (1) Disconnect the connector of intake air temperature (air flow) sensor.
- (2) Measure the resistance between AFT- and AFT+ terminals of the intake air temperature (air flow) sensor.

HINT

Measure the resistance under any of the following conditions.

Standard:

- 13.6 — 18.4 kΩ at -20°C {-4°F}
- 2.21 — 2.69 kΩ at 20°C {68°F}
- 0.49 — 0.67 kΩ at 60°C {140°F}



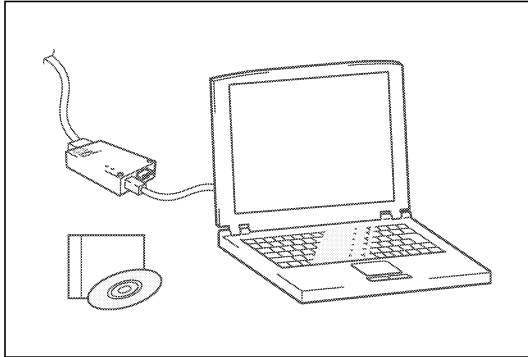
Malfunction of intake air temperature (air flow) sensor

- Harness disconnection
- Malfunction of connectors
- Bad contact of connectors

DPR (CHECK BY HINO-DX)

EN1610602F200041

DTC	P2002	DPR system malfunction
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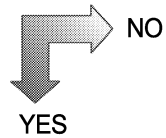


SAPH161060200087

1. CHECK THE DPR SYSTEM USING THE PC DIAGNOSIS TOOL (HINO-DX).

NOTICE

Refer to the item of "Exhaust brake" concerning the inspection method of DPR system.



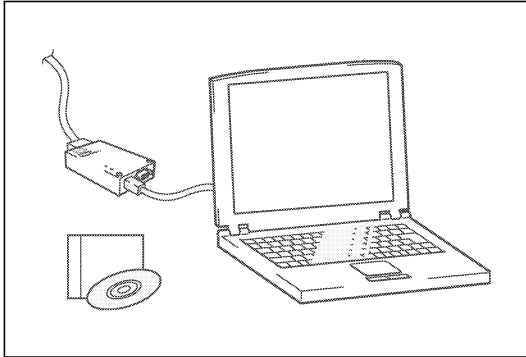
Check DPR

Malfunction of ECU

DPR BACKPRESSURE SENSOR (CHECK BY HINO-DX)

EN1610602F200042

DTC	P1426	DPR backpressure sensor characteristic abnormal
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SAPH161060200087

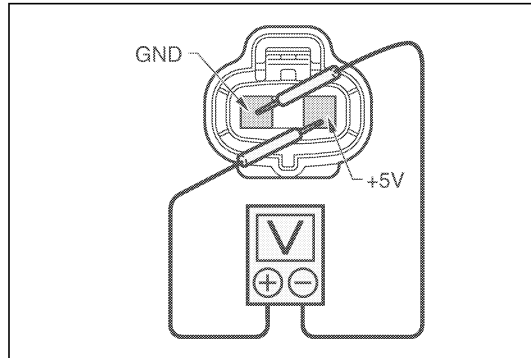
1. CHECK THE BACKPRESSURE USING THE PC DIAGNOSIS TOOL (HINO-DX).

- (1) Connect the PC DIAGNOSIS TOOL (HINO-DX).
- (2) Set the starter switch to "ON".
- (3) Confirm that no other DTC is displayed. If another DTC is displayed, repair that trouble and confirm that the DTC No. P1426 is displayed again.
- (4) Perform the backpressure check in DPR checking, and confirm the checking is complete normally.
- (5) If the above check shows no abnormalities, erase the DTC and start the engine. If the same DTC is displayed again, inspect the DPR.

DPR BACKPRESSURE SENSOR

EN1610602F200043

DTC	P1427	DPR backpressure sensor malfunction
DTC	P1428	DPR backpressure sensor malfunction

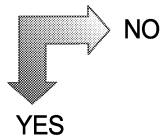


SAPH161060200088

1. CHECK THE VOLTAGE BETWEEN TERMINALS OF SENSOR

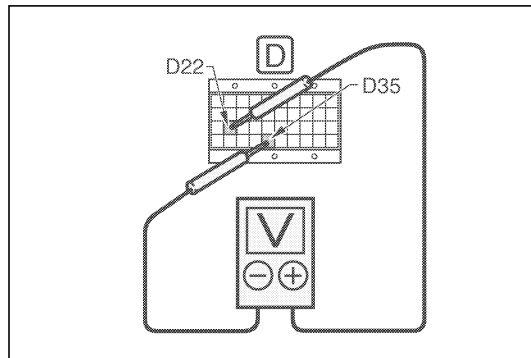
- (1) Set the starter switch to "LOCK", connect the signal check harness.
- (2) Disconnect the connector of DPR backpressure sensor.
- (3) Set the starter switch to "ON".
- (4) Measure the voltage between +5V and GND terminals of vehicle side connector of DPR backpressure sensor.

Standard: 5±0.5V



Proceed to 2

Proceed to 3

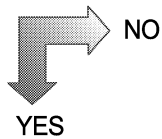


SAPH161060200089

2. CHECK THE VOLTAGE BETWEEN TERMINALS

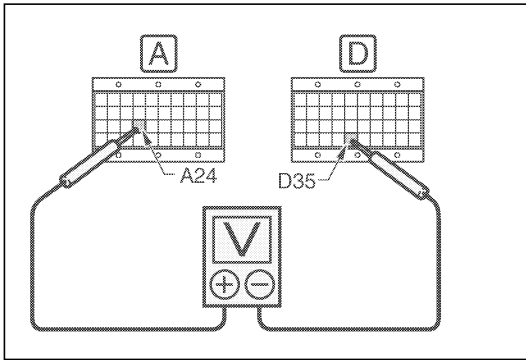
- (1) Measure the voltage between AGD3 (D35) and AVC3 (D22) terminals of signal check harness.

Standard: 5±0.5V



- Malfunction of ECU
- Malfunction of ECU connectors

Malfunction of harness

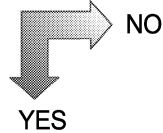


SAPH161060200090

3. CHECK THE VOLTAGE BETWEEN TERMINALS

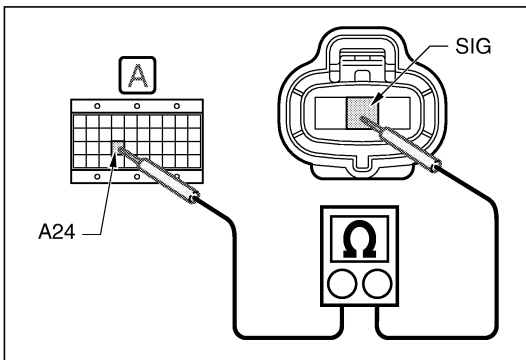
- (1) Set the starter switch to "LOCK", connect the connector of DPR backpressure sensor.
- (2) Set the starter switch to "ON".
- (3) Measure the voltage between EXPS (A24) and AGD3 (D35) terminals of signal check harness.

Standard: 0.2V — 4.8V



Proceed to 4

- Malfunction of ECU
- Malfunction of ECU connectors

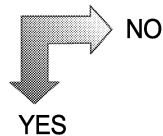


SAPH161060200091

4. CHECK THE CONTINUITY BETWEEN TERMINALS

- (1) Set the starter switch to "LOCK" and disconnect the connectors of ECU.
- (2) Disconnect the connectors of DPR backpressure sensor.
- (3) Measure the resistance between EXPS (A24) terminal of signal check harness and SIG terminal of DPR backpressure sensor connectors (vehicle harness side).

Standard: Less than 1 Ω



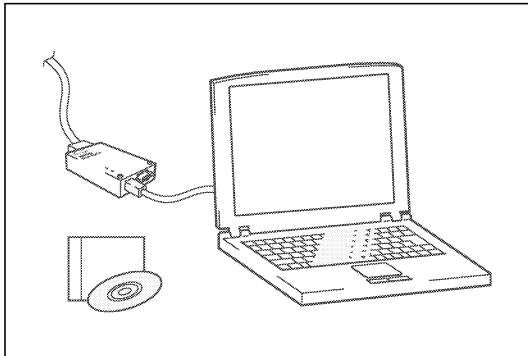
Malfunction of harness

Malfunction of DPR backpressure sensor

DPR EXHAUST GAS TEMPERATURE SENSOR 1, 2

EN1610602F200044

DTC	P2080	DPR exhaust gas temperature sensor 1 characteristic abnormal
DTC	P2084	DPR exhaust gas temperature sensor 2 characteristic abnormal



SAPH161060200087

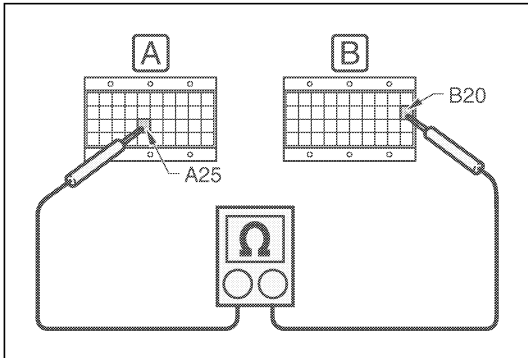
1. CHECK THE EXHAUST GAS TEMPERATURE SENSOR USING THE PC DIAGNOSIS TOOL (HINO-DX).

- (1) Connect the PC DIAGNOSIS TOOL (HINO-DX).
- (2) Set the starter switch to "ON".
- (3) Confirm that no other DTC is displayed. If another DTC is displayed, repair that trouble and confirm that the DTC No. P2080 or P2084 is displayed again.
- (4) Perform the manual forced reproduction in DPR checking, and confirm the checking is complete normally.
- (5) If the above check shows no abnormalities, erase the DTC and start the engine. If the same DTC is displayed again, inspect the DPR.

DPR EXHAUST GAS TEMPERATURE SENSOR 1

EN1610602F200045

DTC	P0545	DPR exhaust gas temperature sensor 1 malfunction (Low input)
DTC	P0546	DPR exhaust gas temperature sensor 1 malfunction (High input)



SAPH161060200092

1. CHECK THE RESISTANCE BETWEEN TERMINALS.

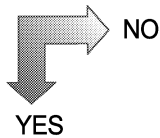
- (1) Set the starter switch to "LOCK", connect the signal check harness.
- (2) Disconnect the ECU side connector of signal check harness.
- (3) Measure the resistance between EXT+ (A25) and AGD4 (B20) terminals.

Standard: (Measure anyone point of below)

106 kΩ (at 50°C{122°F})

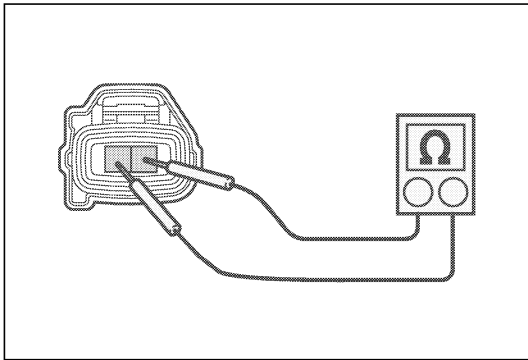
6.9 kΩ (at 200°C{392°F})

0.673 kΩ (at 500°C{932°F})



Proceed to 2

- Malfunction of ECU.
- Malfunction of harness connector.
- Short circuit of harness



SAPH161060200093

2. CHECK THE RESISTANCE BETWEEN SENSOR TERMINALS.

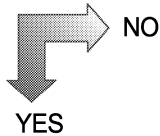
- (1) Disconnect the connector of exhaust gas temperature sensor 1.
- (2) Measure the resistance between a terminal and the other terminal of sensor side connector.

Standard: (Measure anyone point of below)

106 kΩ (at 50°C{122°F})

6.9 kΩ (at 200°C{392°F})

0.673 kΩ (at 500°C{932°F})



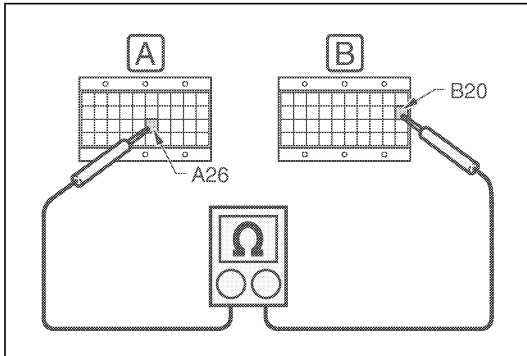
Malfunction of exhaust gas temperature sensor 1

- Open circuit of harness.
- Malfunction of harness connector.

DPR EXHAUST GAS TEMPERATURE SENSOR 2

EN1610602F200046

DTC	P2032	DPR exhaust gas temperature sensor 2 malfunction (Low input)
DTC	P2033	DPR exhaust gas temperature sensor 2 malfunction (High input)

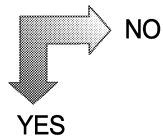


SAPH161060200094

1. CHECK THE RESISTANCE BETWEEN TERMINALS.

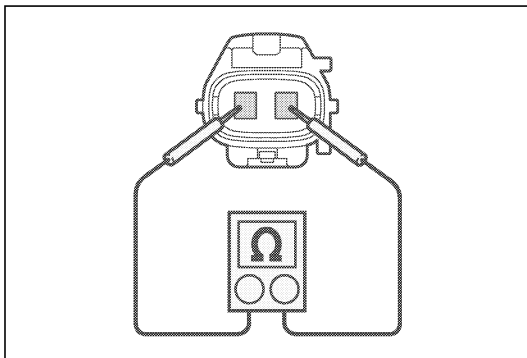
- (1) Set the starter switch to "LOCK", connect the signal check harness.
- (2) Disconnect the ECU side connector of signal check harness.
- (3) Measure the resistance between EXT+ (A26) and AGD4 (B20) terminals.

Standard: (Measure anyone point of below)
106 k Ω (at 50°C{122°F})
6.9 k Ω (at 200°C{392°F})



Proceed to 2

- Malfunction of ECU.
- Malfunction of harness connector.
- Short circuit of harness

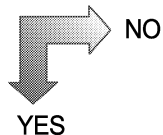


SAPH161060200095

2. CHECK THE RESISTANCE BETWEEN SENSOR TERMINALS.

- (1) Disconnect the connector of exhaust gas temperature sensor 2.
- (2) Measure the resistance between a terminal and the other terminal of sensor side connector.

Standard: (Measure anyone point of below)
106 k Ω (at 50°C{122°F})
6.9 k Ω (at 200°C{392°F})



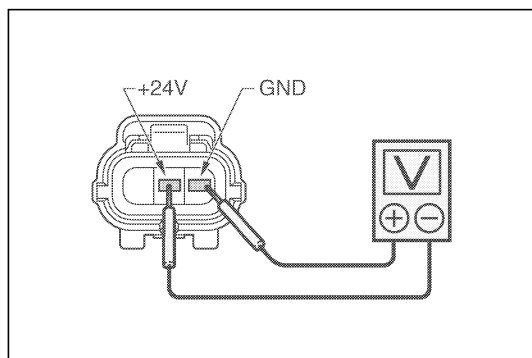
Malfunction of exhaust gas temperature sensor 2

- Open circuit of harness.
- Malfunction of harness connector.

DIESEL THROTTLE VALVE

EN1610602F200047

DTC	P2100	Diesel throttle valve malfunction (GND short)
DTC	P2103	Diesel throttle valve malfunction (Open circuit or VB short)

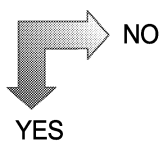


SAPH161060200096

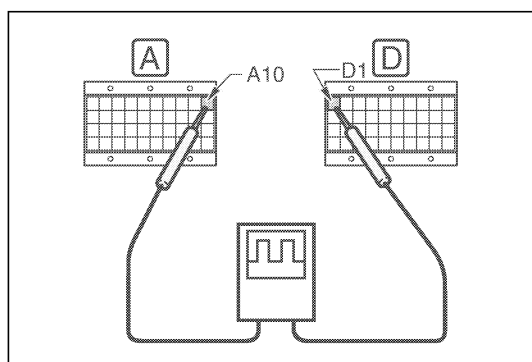
1. CHECK THE VOLTAGE BETWEEN TERMINALS

- (1) Set the starter switch to "LOCK", connect the signal check harness.
- (2) Set the starter switch to "ON".
- (3) Measure the voltage between +12V and GND terminals of vehicle side connector of diesel throttle valve.

Standard: More than 10 V



Malfunction of harness

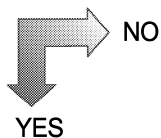


SAPH161060200097

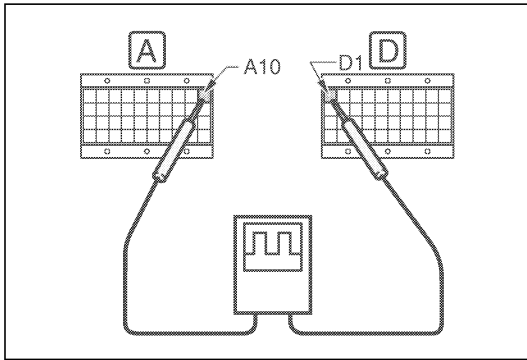
2. CHECK THE VOLTAGE WAVE-SHAPE BETWEEN TERMINALS

- (1) Leave the connector of diesel throttle valve connected.
- (2) Start the engine.
- (3) Measure the voltage between DTR+ (A10) and PGD1 (D1) terminals of signal check harness.
- (4) After checking, stop the engine.

Standard: 0 ↔ 5 V pulse wave



- Malfunction of ECU
- Malfunction of ECU connectors
- Malfunction of diesel throttle valve
- Malfunction of connector of diesel throttle valve

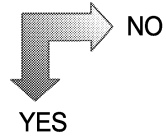


SAPH161060200097

3. CHECK THE VOLTAGE WAVE-SHAPE BETWEEN TERMINALS

- (1) Set the starter switch to "LOCK", disconnect the connector of diesel throttle valve.
- (2) Start the engine.
- (3) Measure the voltage wave-shape between (A10) and (D1) terminals of signal check harness.
- (4) After checking, stop the engine.

Standard: 0 ↔ 5 V pulse wave



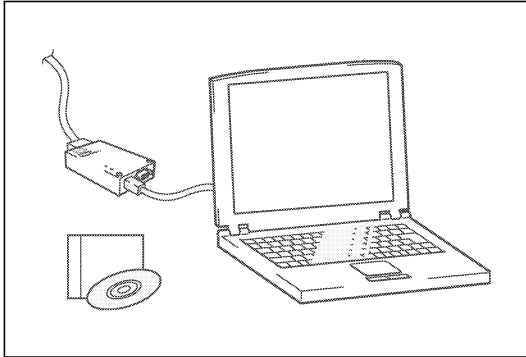
Connected malfunction of connector

Short circuit of harness

DIESEL THROTTLE VALVE (CHECK BY HINO-DX)

EN1610602F200048

DTC	P2101	Diesel throttle valve sticking
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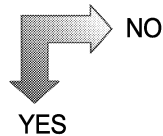


SAPH161060200087

1. CHECK THE DIESEL THROTTLE VALVE USING THE PC DIAGNOSIS TOOL (HINO-DX).

- (1) Connect the HINO-DX.
- (2) Set the starter switch to "ON"
- (3) Confirm DTC No. P2100, P2103 (Diesel throttle valve malfunction) and DTC No. P0122, P0123 (Diesel throttle valve opening sensor malfunction) are not displayed.
- (4) Confirm the actual opening value is followed up by input value by activating the diesel throttle valve.

Standard: Difference value is less than 5%



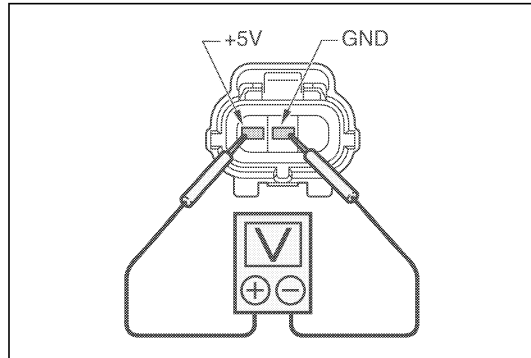
Malfunction of diesel throttle valve

Refer to "DIAGNOSIS USING THE PC DIAGNOSIS TOOL" DN02-18

DIESEL THROTTLE VALVE OPENING SENSOR

EN1610602F200049

DTC	P0122	Diesel throttle valve-opening sensor (Low input)
DTC	P0123	Diesel throttle valve-opening sensor (High input)

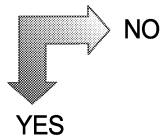


SAPH161060200098

1. CHECK THE VOLTAGE BETWEEN TERMINALS.

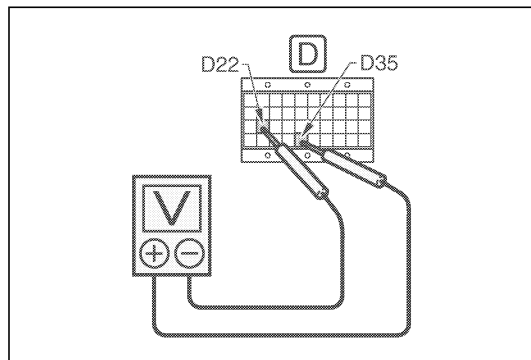
- (1) Set the starter switch to "LOCK", connect the signal check harness.
- (2) Disconnect the connector of diesel throttle valve opening sensor.
- (3) Set the starter switch to "ON".
- (4) Measure the voltage between +5V and GND terminals of vehicle side connector of diesel throttle valve-opening sensor.

Standard: 5±0.5 V



Proceed to 2

Proceed to 3

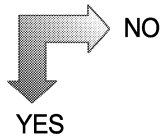


SAPH161060200099

2. CHECK THE VOLTAGE BETWEEN TERMINALS.

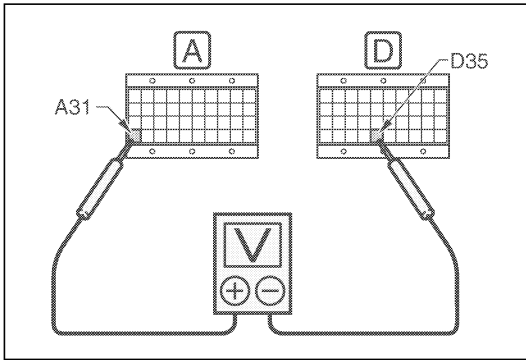
- (1) Measure the voltage between AVC3 (D22) and AGD3 (D35) terminals of signal check harness.

Standard: 5±0.5 V



- Malfunction of ECU
- Malfunction of ECU connectors

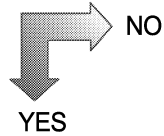
Malfunction of harness



SAPH161060200100

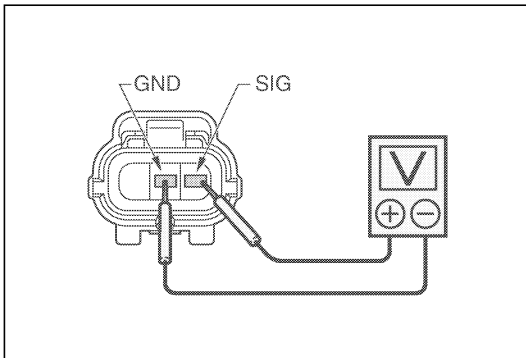
3. CHECK THE VOLTAGE BETWEEN TERMINALS.

- (1) Set the starter switch to "LOCK", connect the connector of diesel throttle valve-opening sensor.
- (2) Set the starter switch to "ON".
- (3) Measure the voltage between DTS1 (A31) and AGD3 (D35) terminals of signal check harness.

Standard: 0.5 — 4.5 V

Proceed to 4

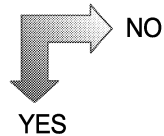
- Malfunction of ECU
- Malfunction of ECU connector



SAPH161060200101

4. CHECK THE VOLTAGE BETWEEN TERMINALS.

- (1) Leave the connector of diesel throttle valve-opening sensor connected.
- (2) Measure the voltage between SIG and GND terminals of vehicle side connector of diesel throttle valve-opening sensor.

Standard: 0.5 V — 4.5 V

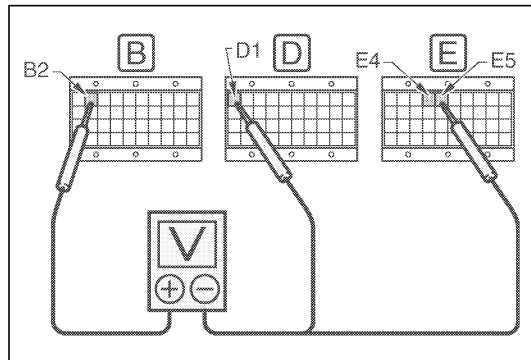
Malfunction of diesel throttle valve-opening sensor

Malfunction of harness

EXHAUST BRAKE MAGNETIC VALVE

EN1610602F200050

DTC No.	P1681	Exhaust brake magnetic valve malfunction (Open circuit, ground line short)
DTC No.	P1682	Exhaust brake magnetic valve malfunction (Power source line short)



SAPH161060200102

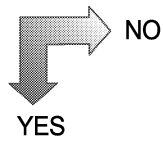
1. CHECK THE VOLTAGE BETWEEN TERMINALS.

- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Disconnect the signal check harness connector on the ECU side.
- (3) Set the starter switch to "ON" (The engine is stopped).
- (4) Measure the voltage between terminals.

+ side	- side
EBMV (B2)	PGD1 (D1), PGD2 (E4), PGD3 (E5)

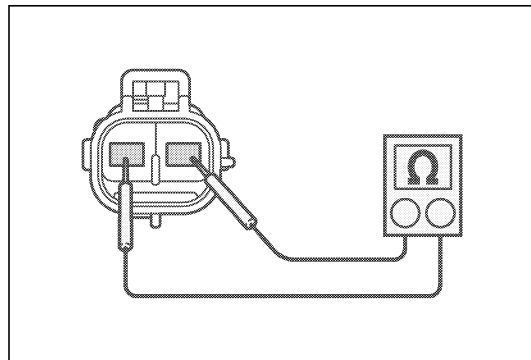
Standard: More than 19V

(After measurement, turn the starter switch to "LOCK" position.)



Proceed to 2.

- Malfunction of ECU.
- Malfunction of ECU connector.

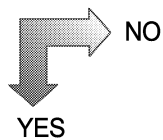


SAPH161060200103

2. CHECK THE EXHAUST BRAKE MAGNETIC VALVE.

- (1) Disconnect the connector of exhaust brake magnetic valve.
- (2) Measure the resistance between terminals (Exhaust brake magnetic valve side).

Standard: 35-45 Ω



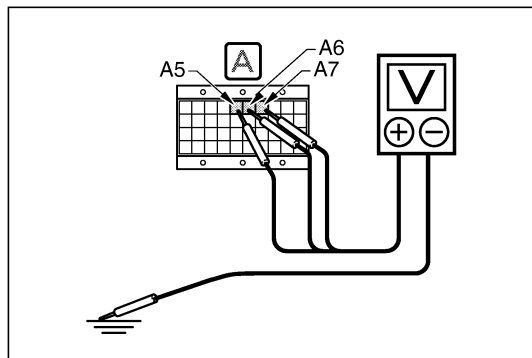
Malfunction of exhaust brake magnetic valve.

Malfunction of harness or connector.

MAIN RELAY

EN1610602F200051

DTC	P0686	Main relay malfunction
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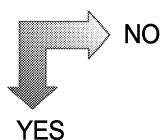


SAPH161060200104

1. CHECK THE VOLTAGE BETWEEN TERMINALS.

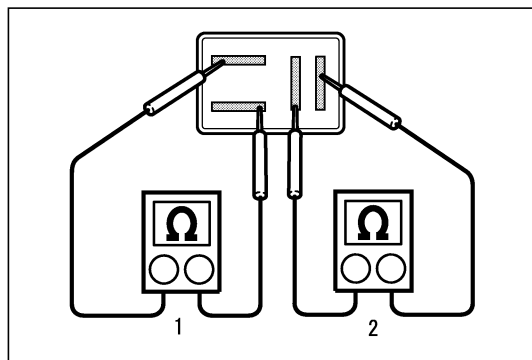
- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Set the starter to "ON" position.
- (3) Measure the voltage between VB1 (A5), VB2 (A6), VB3 (A7) terminal and Chassis GND.

Standard: More than 10 V



Proceed 2

- Malfunction of ECU
- Malfunction of ECU connectors



SAPH161060200105

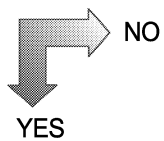
2. CHECK THE RESISTANCE BETWEEN RELAY TERMINALS.

- (1) Set the starter switch to "LOCK" and remove the main relay.
- (2) Measure the resistance between terminals.

Standard:

1. 111 Ω

2. ∞ Ω



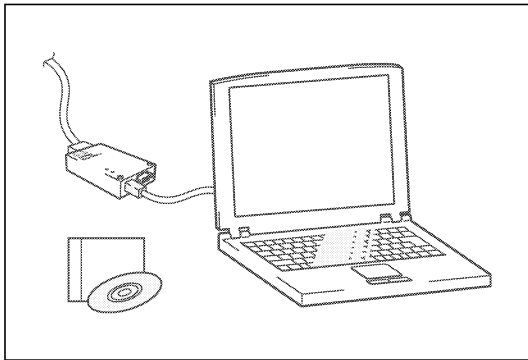
Malfunction of main relay

Malfunction of harness

BRAKE SWITCH

EN1610602F200052

DTC	P0504	Brake switch malfunction
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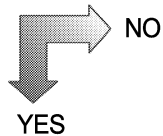
SAPH161060200087

1. CHECK THE BRAKE SWITCH USING THE PC DIAGNOSIS TOOL (HINO-DX).

- (1) Connect the PC DIAGNOSIS TOOL (HINO-DX).
- (2) Set the starter switch to "ON".
- (3) Confirm that no other DTC is displayed. If another DTC is displayed, repair that trouble and confirm that the DTC No. P0504 is displayed again.
- (4) Carry out diagnosis of brake switch and stop light switch.
- (5) Operate the brake pedal, and confirm the each signals are ON and OFF.

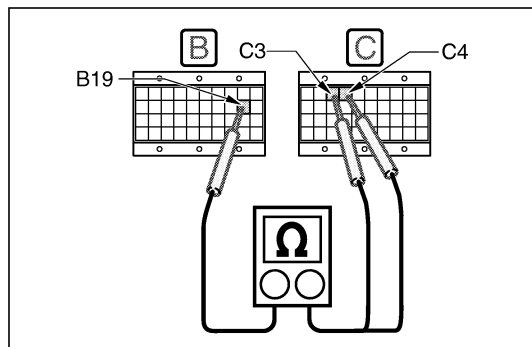
Depress the brake pedal: 1

Release the brake pedal: 0



Proceed to 2

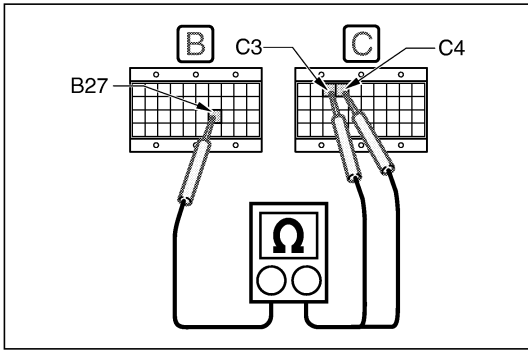
Normal



SAPH161060200106

2. CHECK THE VOLTAGE BETWEEN TERMINALS.

- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Set the starter switch to "ON".
- (3) Measure the voltage between terminals.
 Brake switch: between BSW2 (B19) and CGD1 (C3), CGD2(C4)
 Stop light switch: between BSW1 (B27) and CGD1 (C3), CGD2 (C4)



SAPH161060200107

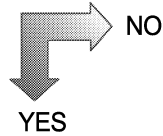
Standard:

Brake switch

More than 10 V: Relies the brake pedal
0 V: Depress the brake pedal

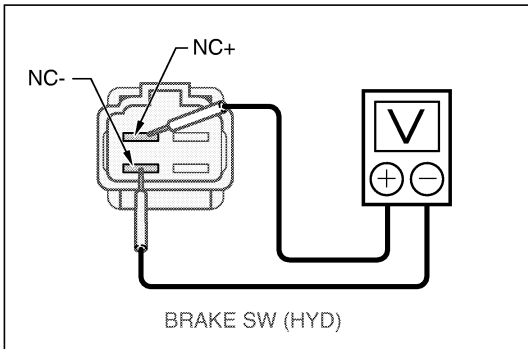
Stop light switch

More than 10 V: Depress the brake pedal
0 V: Relies the brake pedal



Proceed to 3

Malfunction of ECU



SAPH161060200108

3. CHECK THE RESISTANCE BETWEEN TERMINALS.

- (1) Set the starter switch to "LOCK".
- (2) Disconnect the connectors of brake switch and stop light switch.
- (3) Measure the resistance of terminals.

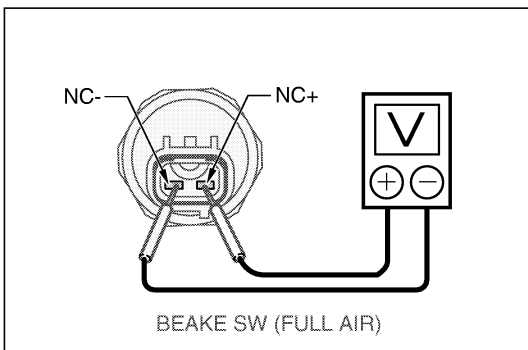
Standard:

Brake switch

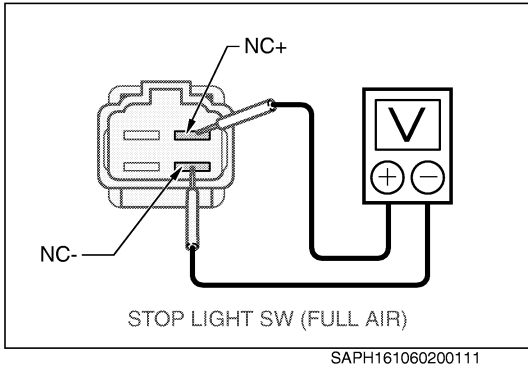
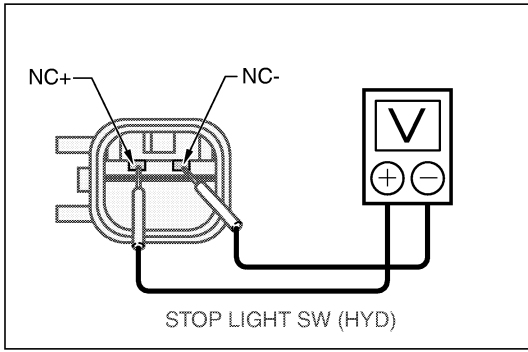
Less than 2 Ω: Relies the brake pedal
inf Ω: Depress the brake pedal

Stop light switch

Less than 2 Ω: Depress the brake pedal
inf Ω: Relies the brake pedal



SAPH161060200109



NO

YES

Malfunction of brake switch or stop light switch

Malfunction of harness

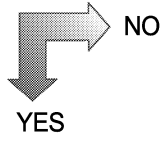
INJECTOR CORRECTION DATA

EN1610602F200053

DTC	P1601	Injector correction data conformity error
-----	-------	---

1. CHECK THE QR CODE.

(1) Read the QR codes using "Injector Calibration" menu.

Standard: Same as the installed injector or service record.

Re-input the QR codes

Replace the ECU

CAN (CONTROLLER AREA NETWORK)

EN1610602F200054

DTC	U0101	CAN communication error (Transmission)
DTC	U0155	CAN communication error (Meter)
DTC	U1001	CAN communication error (Vehicle)

1. CHECK THE COMMUNICATION LINE.

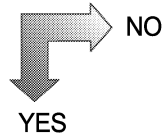
(Refer to workshop manual "Pub. No. S1-UNAE06A 2/2 or S1-CNAE06A 2/2" chapter "OTHERS DN06-001 (CAN COMMUNICATION)").

ENGINE OIL PRESSURE

EN1610602F200055

DTC	P0524	Engine oil pressure low
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1. CHECK THE ENGINE OIL LEVEL.

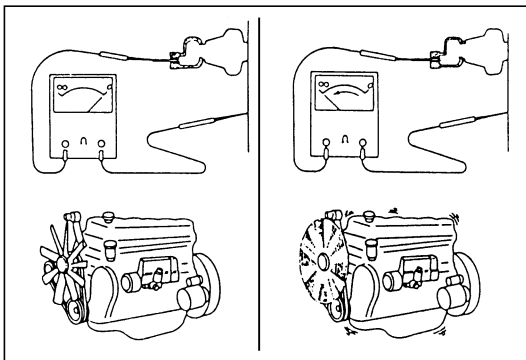


Check oil leakage and add oil

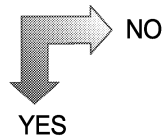
Proceed to 2

2. CHECK THE OPERATION OF THE OIL PRESSURE WARNING SWITCH.

- (1) Disconnect the connector.
- (2) Using an ohmmeter, check the continuity between the terminal and ground with the engine stopped (0Ω) and with the engine running ($\infty \Omega$).



SAPH161060200112



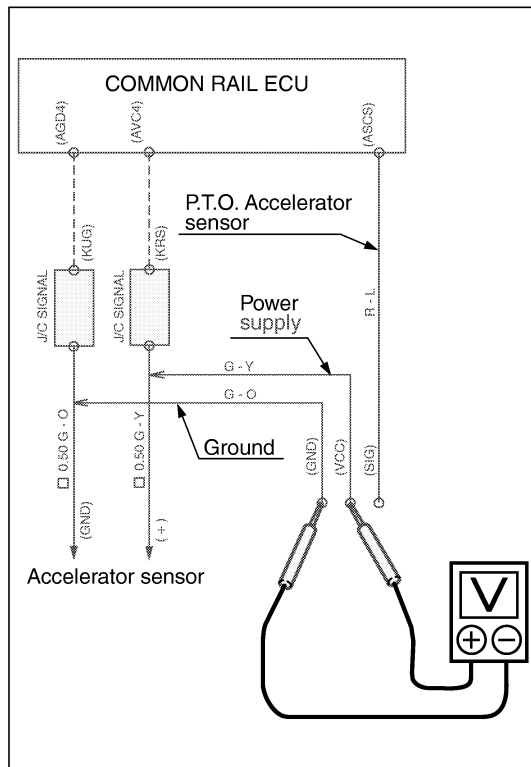
Malfunction of oil pressure switch

- Bad contact of ECU connectors
- Malfunction of ECU
- Malfunction of harness (Short circuit)

ACCELERATOR SENSOR (FOR OPERATION OF P.T.O.)

EN1610602F200056

DTC	P1133	P.T.O. accelerator sensor circuit high voltage
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SAPH161060200113

1. CHECK THE VOLTAGE BETWEEN TERMINALS.

- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Disconnect the connector of the accelerator sensor.
- (3) Set the starter switch to "ON" (The engine is stopped).
- (4) Measure the voltage between VCC and GND terminals of accelerator sensor (Vehicle harness side).

Standard: 4.5 — 5.5V

HINT

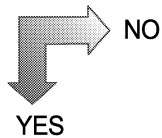
The P.T.O. accelerator sensor, harness and connector parts are used locally. And are installed by the body builder.

The measuring terminal is determined by the cab harness color.

R-L: Red with blue stripe color.

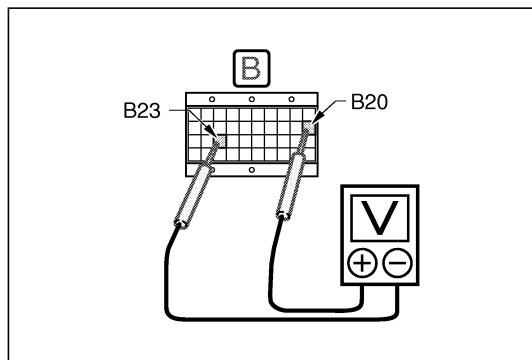
G-Y: Green with yellow stripe color.

G-O: Green with orange stripe color.



Proceed to (5)

Proceed to (6)

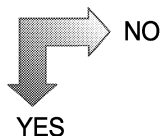


SAPH161060200114

(5) Measure the voltage between AVC4 (B23) and AGD4 (B20) terminals.

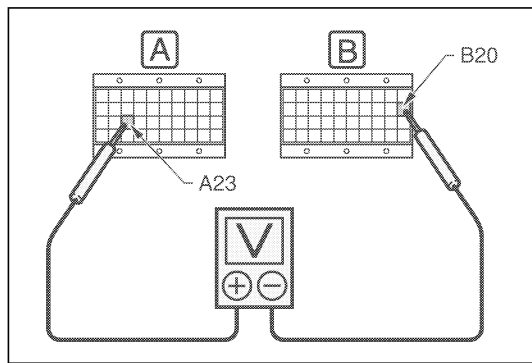
Standard: 4.5 — 5.5V

(After measurement, turn the starter switch to "LOCK" position.)



- Malfunction of ECU
- Malfunction of ECU connectors

Malfunction of harness



SAPH161060200115

(6) Connect the connector of the accelerator sensor.

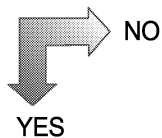
(7) Set the starter switch to "ON" (The engine is stopped).

(8) Measure the voltage between ASCS (A23) and AGD4 (B20) terminals.

Standard:

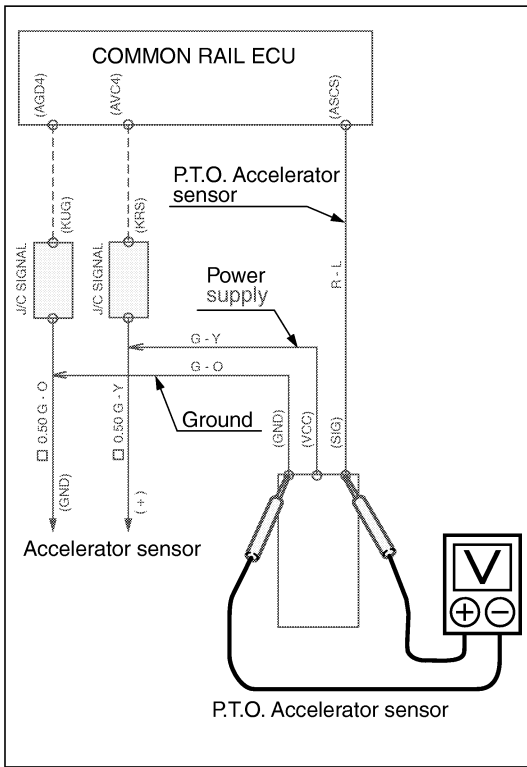
APPROX. 0.6 — 4.6V (Idle to full throttle)

(After measurement, turn the starter switch to "LOCK" position.)



Proceed to (9)

- Malfunction of ECU
- Malfunction of ECU connectors



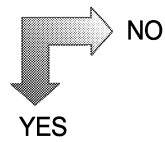
SAPH161060200116

- (9) Connect the connector of the accelerator sensor.
- (10) Set the starter switch to "ON" (The engine is stopped).
- (11) Measure the voltage between SIG and GND terminals of accelerator sensor (Vehicle harness side).

Standard:
APPROX. 0.6 — 4.6V (Idle to full throttle)

HINT
 The P.T.O. accelerator sensor, harness and connector parts are used locally. And are installed by the body builder.
 The measuring terminal is determined by the cab harness color.

R-L: Red with blue stripe color.
 G-Y: Green with yellow stripe color.
 G-O: Green with orange stripe color.



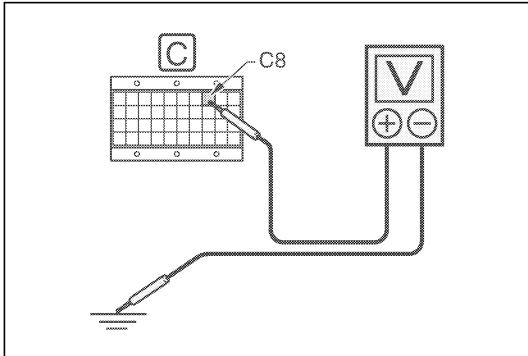
NO
 Malfunction of accelerator sensor

YES
 Harness disconnection or short circuit

CLUTCH SWITCH

EN1610602F200057

DTC	P0704	Clutch switch malfunction
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SAPH161060200117

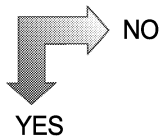
1. CHECK THE VOLTAGE BETWEEN TERMINAL AND GND.

- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Set the starter switch to "ON".
- (3) Measure the voltage between CLSW (C8) terminal and cab GND.

Standard:

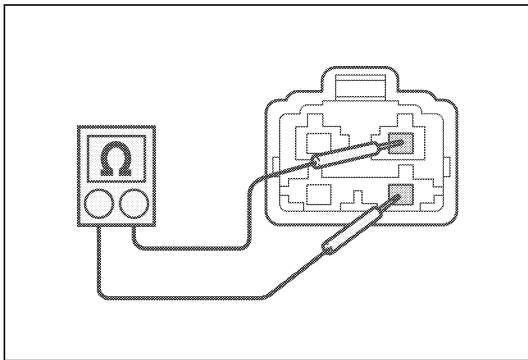
More than 10 V (Clutch pedal released)

0 V (Clutch pedal pressed)



Proceed to 2.

Malfunction of ECU.



SAPH161060200118

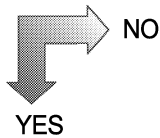
2. CHECK THE CLUTCH SWITCH.

- (1) Set the starter switch to "LOCK".
- (2) Disconnect the clutch switch connector.
- (3) Measure the resistance between clutch switch terminals.

Standard:

$\infty \Omega$ (Clutch switch not pressed)

Less than 1 Ω (Clutch switch pressed)



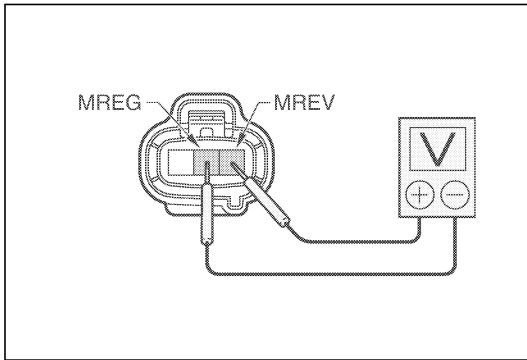
Malfunction of clutch switch.

Malfunction of harness.

ENGINE SPEED SUB SENSOR (PULSE)

EN1610602F200058

DTC	P0341	Engine speed sub sensor pulse abnormal
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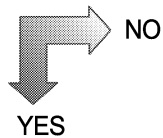


SAPH161060200119

1. CHECK THE VOLTAGE BETWEEN SENSOR TERMINALS.

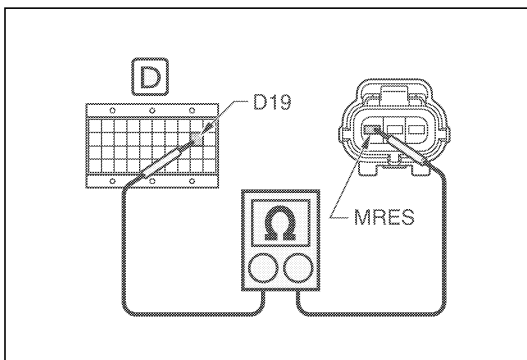
- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Disconnect the connector of the engine speed sub sensor.
- (3) Set the starter switch to "ON" (The engine is stopped)
- (4) Measure the voltage generation between MREV and MREG terminals of the engine speed sub sensor connector (Vehicle harness side).

Standard: 4.5-5.5V



Proceed to 2.

Proceed to 3.



SAPH161060200120

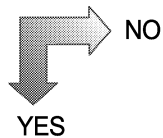
2. CHECK THE RESISTANCE BETWEEN RELAY TERMINALS.

- (1) Connector of engine sub sensor remain connected.
- (2) Measure the resistance between MRES terminal of the engine speed sub sensor connector (Vehicle harness side) and G3+ (D19) terminal.

Standard: Less than 2 Ω

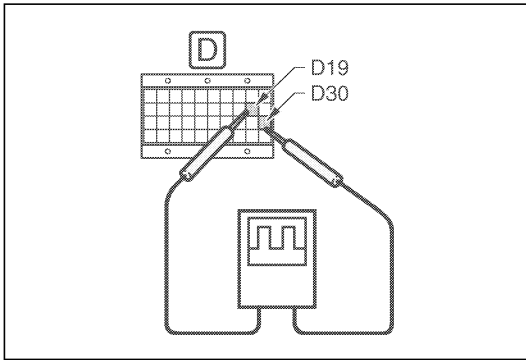
NOTICE

This figure is viewed from the coupling surface side.



Malfunction of harness.

Proceed to 3.



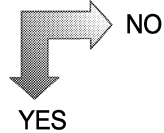
SAPH161060200121

3. CHECK THE INPUT PULSE GENERATION TO ENGINE ECU.

- (1) Connector of engine speed sub sensor remain connected.
- (2) Start the engine.
- (3) Measure the pulse generation between terminals G3+ (D19) and CGND (D30) terminals using an oscilloscope.

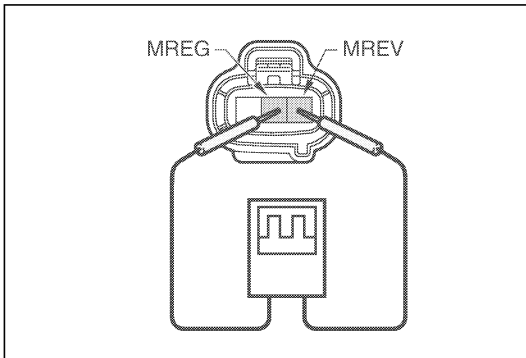
Standard: 7 pulse (Including extra signal pin)

- (4) After measurement, stop the engine.



Proceed to 4.

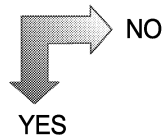
- Malfunction of ECU.
- Malfunction of ECU connectors.



SAPH161060200122

4. CHECK THE OUTPUT PULSE GENERATION FROM SENSOR.

- (1) Connector of engine speed main sensor remain connected.
- (2) Start the engine.
- (3) Measure the pulse generation between MREG and MREV terminals using an oscilloscope.

Standard: 7 pulse (Including extra signal pin)

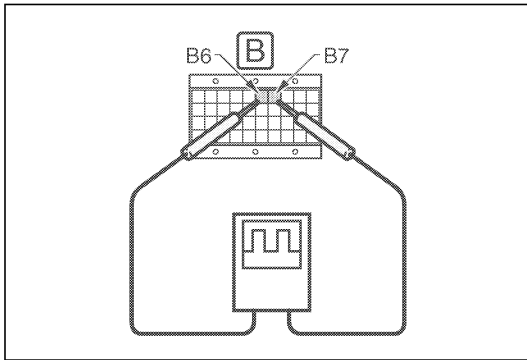
- Engine speed main sensor malfunction.
- Camshaft gear signal pin abnormal.

Bad contact of connector.

ENGINE SPEED MAIN SENSOR (PULSE)

EN1610602F200059

DTC	P0336	Engine speed main sensor pulse abnormal
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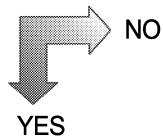
SAPH161060200123

1. CHECK THE INPUT PULSE GENERATION TO ENGINE ECU.

- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Start the engine.
- (3) Measure the pulse generation between NE1+ (B6) and NE1- (B7) terminals using an oscilloscope.

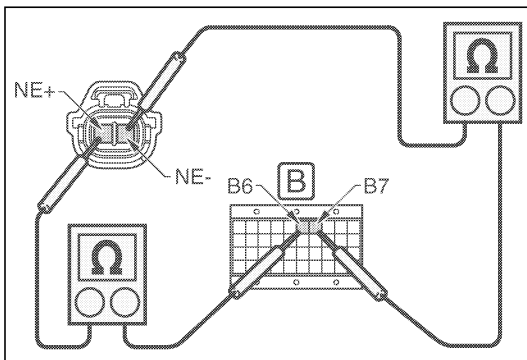
Standard: 56 pulse (Between non-signal holes)

- (4) After measurement, stop the engine.



Proceed to 2.

- Malfunction of ECU.
- Malfunction of ECU connectors.

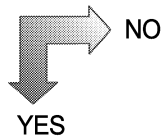


SAPH161060200124

2. CHECK THE RESISTANCE BETWEEN TERMINALS.

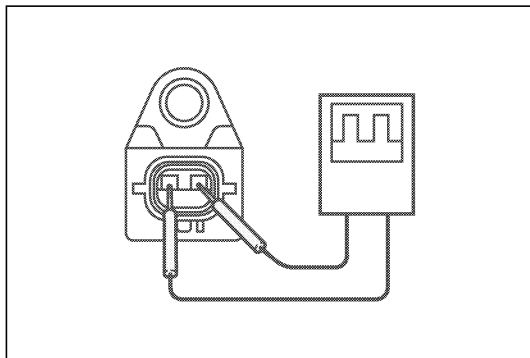
- (1) Connector of engine main sensor remains connected.
- (2) Measure the resistance between NE- main sensor connector (Vehicle harness side) and signal check harness NE1- (B7). In same way, measure the resistance between NE+ main sensor connector (Vehicle harness side) and signal check harness NE1+ (B6).

Standard: Less than 2 Ω



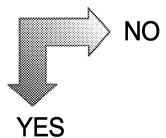
Malfunction of harness.

Proceed to 3.



SAPH161060200125

- 3. CHECK THE OUTPUT PULSE GENERATION FROM SENSOR.**
- (1) Connector of engine speed main sensor remains connected.
 - (2) Start the engine.
 - (3) Measure the pulse generation between terminals using an oscilloscope.
- Standard: 56 pulse (Between non-signal holes)**
- (4) After measurement, stop the engine.



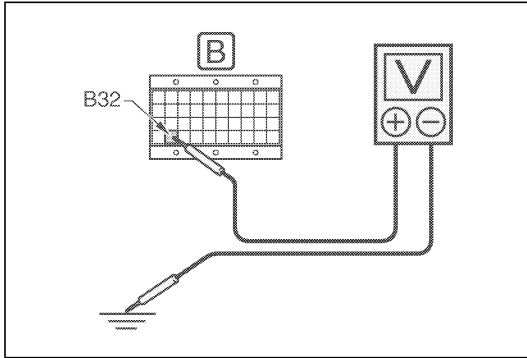
- Engine speed main sensor malfunction.
- Flywheel signal hole abnormal.

Bad contact of connector.

NEUTRAL SWITCH

EN1610602F200060

DTC	P0850	Neutral switch malfunction
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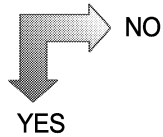
1. CHECK THE VOLTAGE BETWEEN TERMINAL AND GND.

- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Set the starter switch to "ON" (The engine is stopped).
- (3) Measure the voltage between NUSW terminal and chassis GND.

Standard:

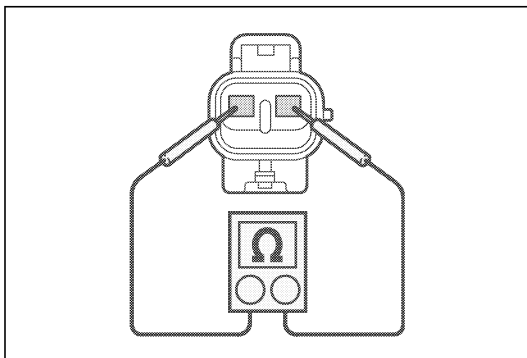
More than 10 V (Transmission: Neutral position)

0 V (Transmission: Not neutral position)



Proceed to 2.

Malfunction of ECU.



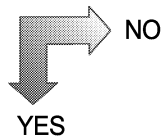
2. CHECK THE NEUTRAL SWITCH.

- (1) Set the starter switch to "LOCK".
- (2) Disconnect the connector of neutral switch.
- (3) Measure the resistance between terminals (Neutral switch side).

Standard:

$\infty \Omega$ (Neutral switch not pressed)

Less than 1 Ω (Neutral switch pressed)



Malfunction of neutral switch.

Malfunction of harness.

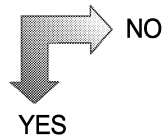
SUPPLY PUMP

EN1610602F200061

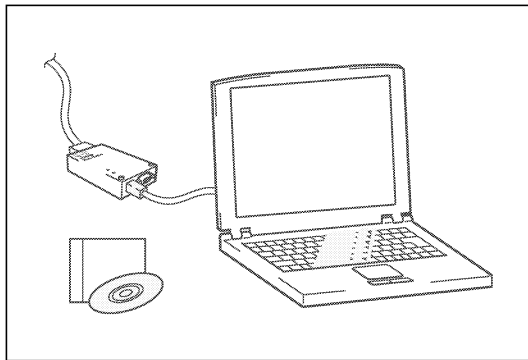
DTC	P2635	Supply pump SCV sticking
DTC	P2635	Supply pump malfunction
DTC	P2635	Supply pump abnormal high pressure record

1. CHECK THE SUPPLY PUMP.

- (1) Turn the starter switch to "LOCK" and stop the engine.
- (2) Wait for about 30 seconds and then start the engine.
- (3) Perform warm-up until the coolant temperature become 60°C {140°F} of higher. And erase the MC or DTC.
- (4) Confirm that the same MC or DTC is displayed again when raising engine revolution up to "No load max revolution" or racing engine.



Replace supply pump.



SAPH161060200128

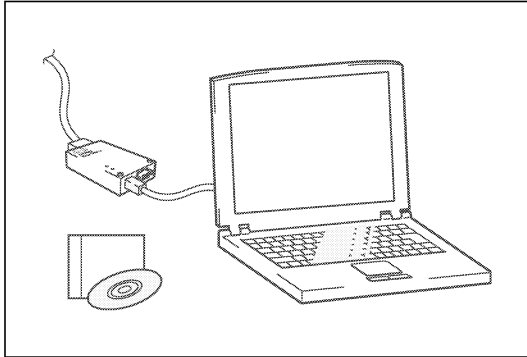
2. CHECK THE MC OR DTC.

- (1) Confirm that no other MC or DTC is displayed. If another MC or DTC is displayed repair that trouble and confirm that the MC No. 75, 77, 79 or DTC No.P2635 is displayed again. Especially in case of display MC or DTC in regard to engine speed sensor (main and sub) system, perform repair so that these MC or DTC are not displayed.
- (2) If the above check shows no abnormalities, erase the MC or DTC and start the engine. If the same MC or DTC is displayed again, malfunction of supply pump and malfunction ECU can be assumed.

FUEL CUT RELAY

EN1610602F200062

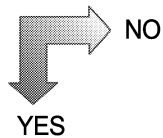
DTC	P1676	Fuel cut relay malfunction
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SAPH161060200087

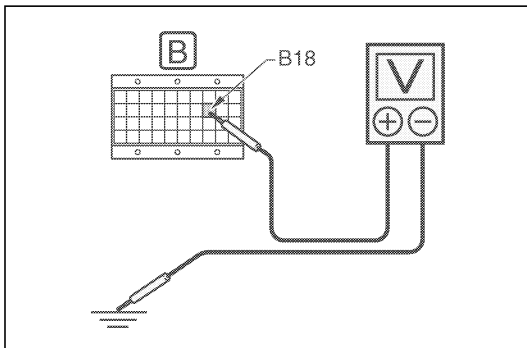
1. CHECK THE FUEL CUT RELAY USING THE PC DIAGNOSIS TOOL (HINO-DX).

- (1) Connect the PC DIAGNOSIS TOOL (HINO-DX).
- (2) Set the starter switch to "ON".
- (3) Confirm the fuel cut relay is "ON".



Proceed to 2.

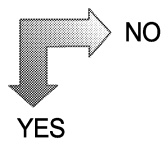
Check the Eaton UltraShift ECU.



SAPH161060200129

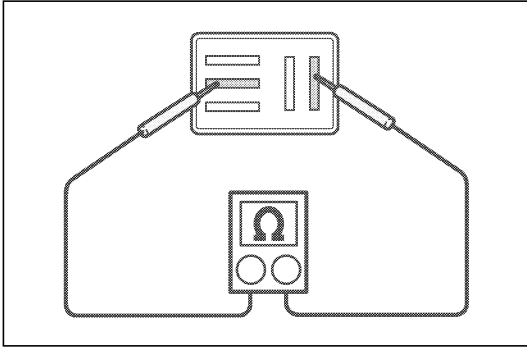
2. CHECK THE VOLTAGE BETWEEN TERMINALS.

- (1) Set the starter switch to "LOCK" and connect the signal check harness.
- (2) Set the starter to "ON" position.
- (3) Measure the voltage between PCS(B18) terminal and Chassis GND.
Standard: More than 10 V



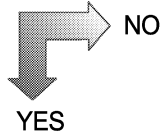
Proceed to 3.

- Malfunction of ECU.
- Malfunction of ECU connectors.



SAPH161060200130

- 3. CHECK THE RESISTANCE BETWEEN RELAY TERMINALS.**
- (1) Set the starter switch to "LOCK" and remove the fuel cut relay.
 - (2) Measure the resistance between terminals.
- Standard: Less than 1 Ω**



Malfunction of fuel cut relay.

- Check the Eaton UltraShift ECU.
- Malfunction of harness.

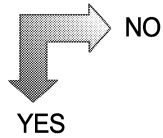
WATER IN FUEL

EN1610602F200063

DTC	P2269	Water in fuel condition
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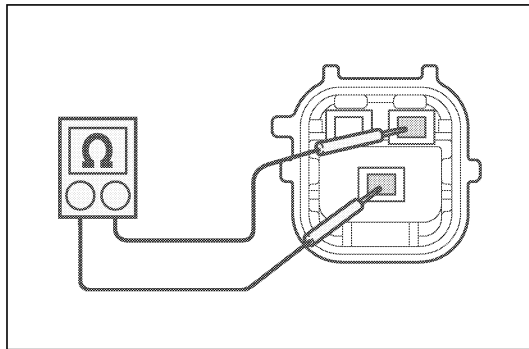
1. CHECK THE FUEL FILTER.

- (1) Confirm that the water is not accumulated in the fuel filter.



Drain the water.

Proceed to 2.



SAPH161060200131

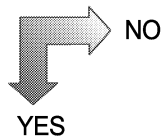
2. CHECK THE FUEL FILTER WATER LEVEL SENSOR.

- (1) Disconnect the connector of the fuel filter water level sensor.
 (2) Measure the resistance between terminals.

Standard:

$\infty \Omega$ (Without water in the fuel filter)

Less than 1Ω (Water accumulated in the fuel filter)



Malfunction of fuel filter water level sensor.

- Malfunction of ECU
- Malfunction of ECU connectors
- Malfunction of harness (Short)

Hino Motors Sales U.S.A., Inc.

4118 Bridge Street, Novi, MI 48375

Telephone: (248) 699-9300

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FOREWORD

Thank you very much for your purchasing of a Hino vehicle.

This manual contains many practical tips on operation, procedures for daily and periodic maintenance, and important information to help you enjoy safe and trouble-free operation of your vehicle. Please read this manual carefully and thoroughly.

New Vehicle Warranty




Your new vehicle is covered by the following Hino warranties.

- **New vehicle warranty**
- **Emission control systems warranty**
- **Noise emissions warranty**

 WARNING
--

Any modification of the vehicle or engine other than Hino specified maintenance can adversely affect the performance, safety and reliability of the vehicle, and can result in the breach of governmental regulations. It will also invalidate your Hino warranty.

Read very carefully those sections which have signs “”, “**WARNING**” and “**CAUTION**”. They are particularly important.

	In this manual, you will also see a circle with a slash through it. This means “Do not do this”, or “Do not let this happen”.
 WARNING	Items that can result in death or severe personal injury if handled improperly.
 CAUTION	Items that can result in personal injury and/or property damage, such as vehicle damage, if handled improperly.
NOTICE	This is a warning against anything which may cause damage to the vehicle or its equipment if the warning is ignored.

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This manual covers the Hino 6 and 4 cylinders diesel engines.

In cases where individual items vary, this fact is specifically noted in the text and illustrations, as shown below. Unless a portion of text is so noted, it applies to all vehicle engines.

Example:

● **Accessories: (If so equipped)**

Before operating your vehicle, check the engine model, and accessories, and then select the relevant items in the explanations of vehicle specifications accordingly. How to distinguish your engine model is described in 1-2 Vehicle Identification Number of SECTION 1, General Introduction.

This manual should be kept in your vehicle.

If the vehicle is sold, this manual should be given to the next owner, who will need the information contained.

All information and specifications in this manual are based upon the latest product information available at the time of printing.

Hino Motors, Ltd. reserves the right to make changes at any time without prior notice.

Read the entire manual before using vehicle.

Failure to follow instructions and safety precautions could result in death, serious injury and/or damage.

SERVICE ASSISTANCE

Be sure to consult your Hino dealer on any points of dissatisfaction with your Hino vehicle. The Hino dealer's service department has sufficient knowledge and the latest information on your Hino vehicle.

Moreover, the department has the necessary tools, equipment and parts to satisfy the needs for proper maintenance and repair.

If at any time you are dissatisfied with the dealer's service department, do the following to resolve your problem;

1. First, consult the management of the Hino dealer.
2. If you still are not satisfied, then contact the Hino Regional Sales Office at the following locations or the National Service Manager:

● U.S. DRIVERS / OWNERS

Regional Service Office of Hino Motors Sales U.S.A., Inc.
Phone (248) 699-9300
4118 Bridge Street, Novi, MI 48375

● CANADIAN DRIVERS / OWNERS

Regional Service Office of Hino Motors Canada, Ltd.
Phone (905) 670-3352
395 Ambassador Drive, Mississauga, Ontario L5T 2J3

If you contact Hino, be sure to include the following information.

- Name under which new vehicle was purchased, address and telephone number of purchaser.
- Vehicle model year and vehicle identification number (VIN).
- Vehicle delivery date and present mileage.
- Location where purchased.
- Details of the problem.

It is important that the Vehicle Identification Number (VIN) be recorded. The number is required to obtain information pertinent to this vehicle.

Vehicle Identification Number (VIN)

See page 1-3

VIN	
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CLEAN IDLE CERTIFIED LABEL FOR U.S.

Make sure that the following clean engine idling certified label is affixed to the outside of the left door.

By the CARB below, the label must be affixed there to prove that the new vehicle with diesel engine manufactured from Jan., 2008 conforms to this low.

**CARB § 1956.8. Exhaust Emission Standard and Test Procedure
(a) (b) Heavy-Duty Diesel Engine Idling Requirements**



AD-0589

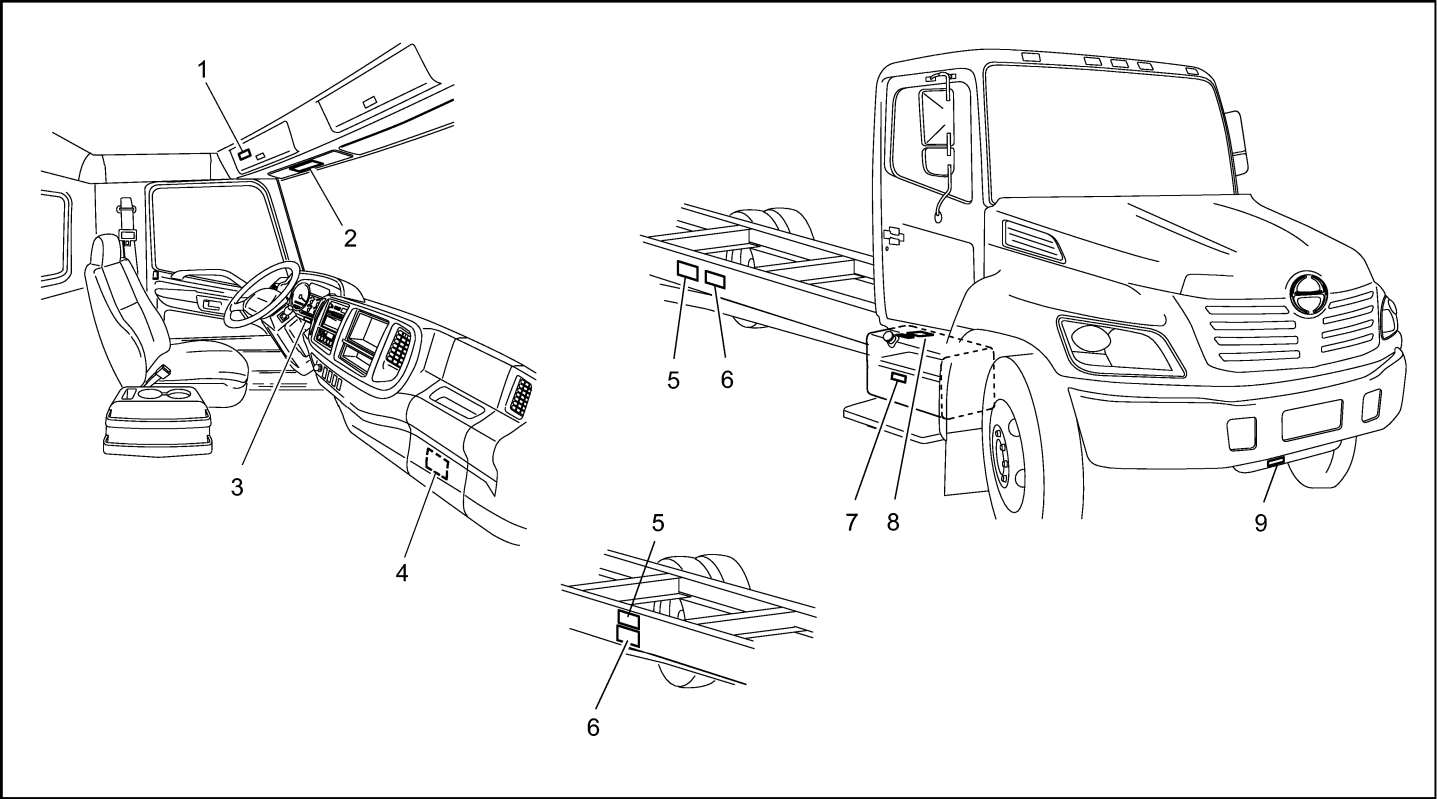
warning and caution labels

The warning and caution labels give important information. Be sure to read them before operating the vehicle. If any label is difficult to read due to be peeled off, scratched or damaged, please inform an authorized dealer.

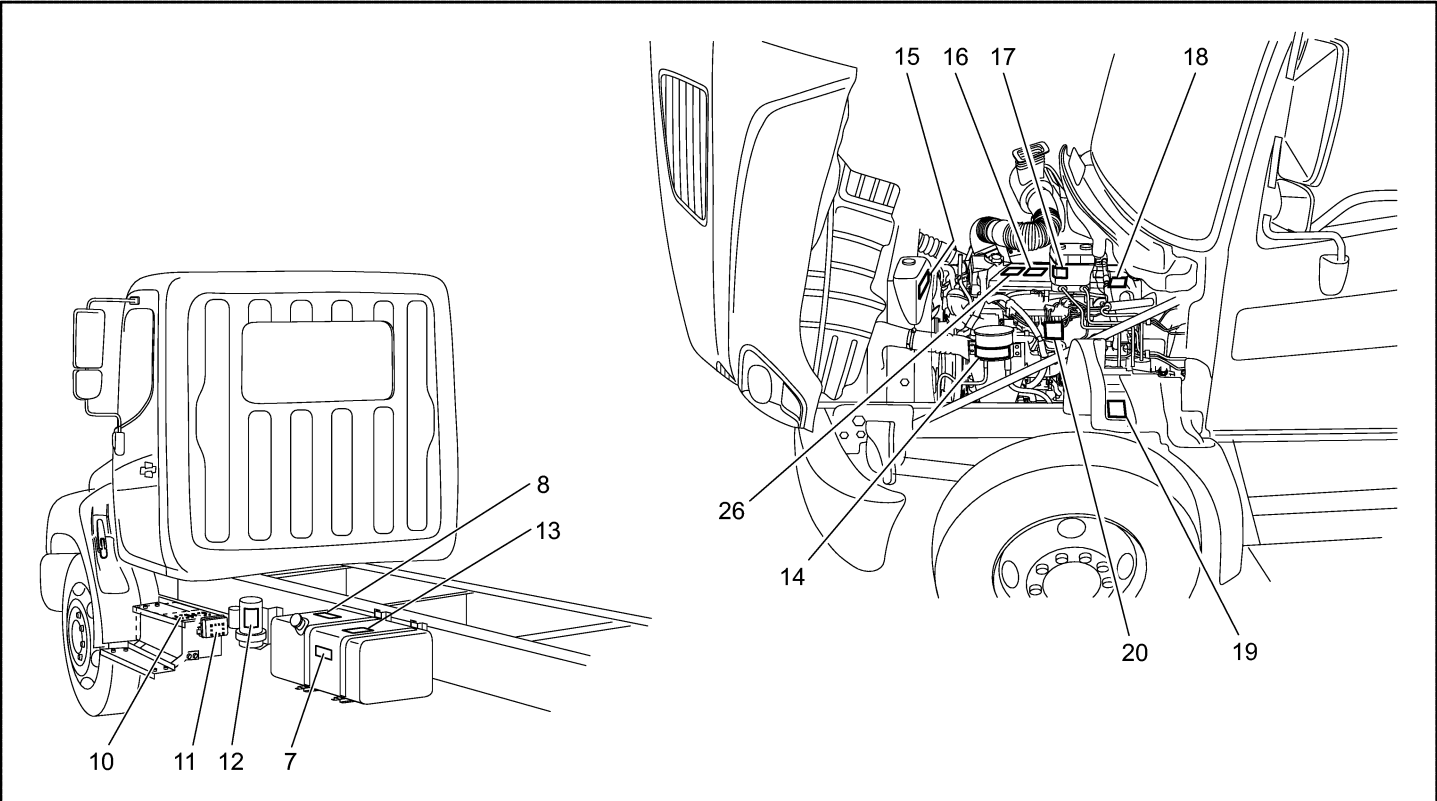
The labels are located in the cab and around the vehicle components as shown in the following pages. Regarding to the labels applied to the equipment mounted on the vehicle, please refer to the this manual supplied by the equipment manufacturer.

**CALIFORNIA Proposition 65 Warning
Diesel engine exhaust and some of its constituents are
known to the State of California to cause cancer, birth
defects, and other reproductive harm.**

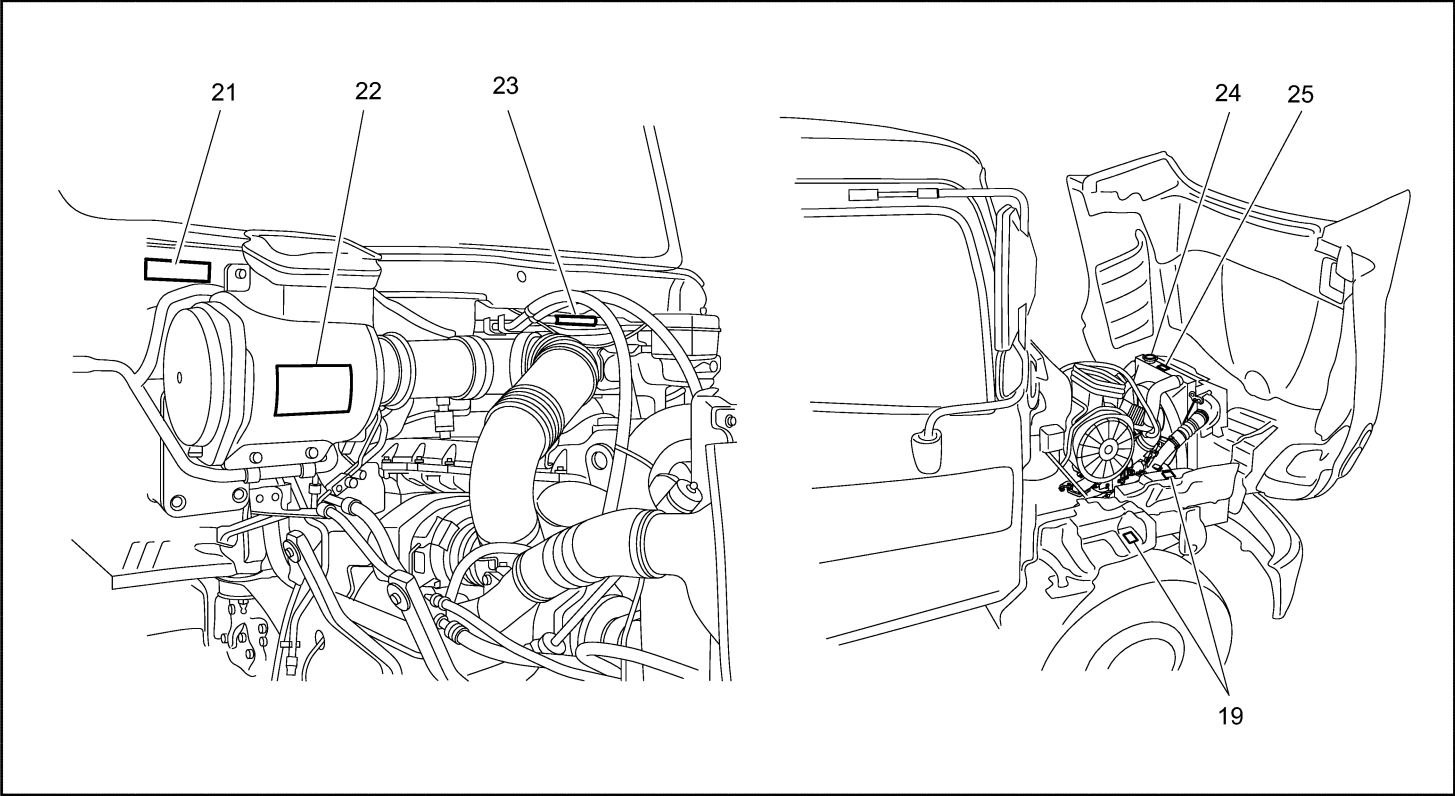
SAFETY LABELS



SAFETY LABELS





SAFETY LABELS



SAFETY LABELS

1. Diesel particulate active reduction system

 WARNING	 AVERTISSEMENT
Diesel Particulate Active Reduction System	Système de réduction de particules actives diesel
<p>IN ORDER TO MAINTAIN PROPER FUNCTION OF THE DIESEL PARTICULATE ACTIVE REDUCTION SYSTEM, FOLLOW THE INSPECTIONS BELOW AS SOON AS POSSIBLE BEFORE DRIVING 95 MILES (150 km) AFTER THE INDICATOR LIGHT STARTS TO FLASH, TO REDUCE THE RISK OF FIRE. BE SURE TO KEEP ANY FLAMMABLE MATERIAL AWAY FROM THE EXHAUST SYSTEM.</p> <p>1. Park the vehicle in a safe place. 2. Firmly apply the parking brake. 3. Place the gearshift in "Neutral" position. 4. Leave the engine running. 5. Confirm that no flammable material is around the exhaust system. 6. Push the switch button on which the indicator light is flashing. 7. Confirm that the flashing indicator light goes on and that the idling speed increases. 8. Wait and do not move the vehicle until the indicator light goes off and that the idling speed returns to normal level. 9. When the indicator light has gone off and the idling speed has returned to normal level, you can move the vehicle. * See Driver's / Owner's Manual for details.</p>	<p>AFIN DE MAINTENIR LE FONCTIONNEMENT APPROPRIÉ AU SYSTÈME DE RÉDUCTION DE PARTICULES ACTIVES DIESEL, SUIVRE LES INSTRUCTIONS INDICUÉES CI-DESSOUS DES QUE POSSIBLE AVANT DE CONDUIRE SUR UNE DISTANCE DE 150 km (95 MILES) APRÈS QUE LE VOYANT LUMINEUX AIT COMMENCÉ À CLIGNOTER, POUR RÉDUIRE LES RISQUES D'INCENDIE, FAIRE EN SORTIE DE MAINTENIR LES MATÉRIELS INFLAMMABLES À UNE DISTANCE DE SÉCURITÉ DU SYSTÈME D'ÉCHAPPEMENT.</p> <p>1. Stationner le véhicule dans un endroit sûr. 2. Serrer fermement le frein de stationnement. 3. Engager le levier de sélection des vitesses en position point mort "Neutral". 4. Laisser le moteur en marche. 5. Confirmer qu'aucun produit inflammable ne se trouve autour du système d'échappement. 6. Appuyer sur le bouton de commutation sur lequel le voyant lumineux clignote. 7. Confirmer que le voyant lumineux clignotant reste allumé et que le régime ralenti moteur augmente. 8. Attendre sans déplacer le véhicule jusqu'à ce que le voyant lumineux s'éteigne et que le régime ralenti moteur revienne au niveau normal. 9. Lorsque le voyant lumineux s'est éteint et que le régime ralenti moteur est revenu au niveau normal, il est alors possible de déplacer le véhicule. * Consulter le manuel du propriétaire / conducteur pour obtenir de plus amples détails à ce sujet.</p>

SAFETY LABELS

2. (1) Automatic transmission (The contents differ depending on vehicle model)

<p>AUTOMATIC TRANSMISSION OPERATING INFORMATION</p> <ol style="list-style-type: none"> ENGINE START PUT SELECTOR LEVER IN "P". DO NOT START ENGINE BY PUSHING OR TOWING THE VEHICLE. RANGE SELECTOR CONTROL. POSITION P OPERATING CONDITION R PARKING AND ENGINE STARTING REVERSE (COMPLETELY STOP THE VEHICLE BEFORE SHIFTING). N NEUTRAL (ENGINE STARTING) D NORMAL FORWARD DRIVING 2 ADDITIONAL ENGINE BRAKING Z LOW SPEED OPERATION AND GREATER ENGINE BRAKING 1 EXTRA HEAVY LOADS-MAXIMUM ENGINE BRAKING PARKING APPLY PARKING BRAKE FIRMLY AND PLACE THE SELECTOR INTO "P" POSITION. IN CASE OF PARKING THE VEHICLE ON A SLOPE OR OFF THE ROAD, BLOCK THE WHEELS IN ADDITION TO THE ABOVE. DO NOT APPLY PARKING BRAKE WHEN THE VEHICLE IS MOVING OTHERWISE THE TRANSMISSION COULD BE SEVERELY DAMAGED. TOWING BEFORE TOWING A DISABLED VEHICLE, REMOVE THE AXLE SHAFTS OR TOW WITH REAR WHEELS SUSPENDED. 	<p>UTILISATION DE LA BOÎTE DE VITESSES AUTOMATIQUE</p> <ol style="list-style-type: none"> DÉMARRAGE DU MOTEUR METTRE LE LEVIER DE VITESSES AU POINT MORT "P". NE PAS MARCHER LE MOTEUR EN POUSSANT OU EN REMORQUANT LE VÉHICULE. GRILLE DU LEVIER DE VITESSES POSITION P STATIONNEMENT ET DÉMARRAGE DU MOTEUR R MARCHÉ ARRIÈRE (LE VÉHICULE DOIT ÊTRE COMPLETEMENT ARRÊTÉ AVANT DE PASSER EN MARCHÉ ARRIÈRE) N POINT MORT (DÉMARRAGE DU MOTEUR) D OD POUR LA CONDUITE NORMALE FREN MOTEUR SUPPLÉMENTAIRE 2 POUR LA CONDUITE À VITESSES LENTES ET MELLEUR FREN MOTEUR 1 POUR LA CONDUITE LORSQUE LA CHARGE EST EXTRÊMEMENT LOURDE ET POUR OBTENIR UN FREN MOTEUR MAXIMUM STATIONNEMENT SERRER FERMEMENT LE FREIN DE STATIONNEMENT, PUIS METTRE LE LEVIER DE VITESSES AU POINT MORT "P". SI LE VÉHICULE EST STATIONNÉ DANS UNE PENTE ABRUPTÉ OU HORS ROUTE, CALER AUSSI LES ROUES. N'APPLIQUEZ PAS LE FREIN DE STATIONNEMENT LORSQUE LE CAMION ROULE CAR LA TRANSMISSION PEUT ÊTRE SEVEREMENT ENDOMMAGÉE. REMORQUAGE AVANT DE REMORQUER UN VÉHICULE EN PANNE, DÉPOSER LES ARBRES DE ROUE OU BIEN REMORQUER LE VÉHICULE AVEC SES ROUES ARRIÈRE LEVÉS DU SOL.
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or (2) UltraShift transmission (Automated mechanical transmission)

<p>AUTOMATED MECHANICAL TRANSMISSION OPERATING INFORMATION</p> <ol style="list-style-type: none"> ENGINE START SELECT "N" ON THE SHIFT CONTROL, AND SET THE PARKING BRAKES. SHIFT CONTROL POSITION POSITION R OPERATING (VEHICLE REVERSE, (VEHICLE SPEED IS LESS THAN 2MPH.) N SELECTS NEUTRAL. D AUTOMATICALLY SELECTS GEARS BETWEEN THE STARTING GEAR AND TOP GEAR. MANUAL HOLD CURRENT GEAR AND MANUALLY SELECT THE APPROPRIATE GEAR USING THE \blacktriangledown BUTTON. LOW DOWNSHIFTS AT THE EARLIEST OPPORTUNITY FOR MAXIMUM ENGINE BRAKING. \blacktriangledown USED IN THE MANUAL MODE TO SELECT UPSHIFTS AND DOWNSHIFTS. PARKING PLACE THE TRANSMISSION IN NEUTRAL, SET THE PARKING BRAKES, AND BLOCK THE WHEELS. TOWING IF THE VEHICLE IS TOWED WITH THE DRIVE WHEELS STILL IN CONTACT WITH THE ROAD SURFACE, REMOVE OR DISCONNECT THE AXLE SHAFTS. 	<p>INFORMATIONS CONCERNANT L'OPERATION DE LA TRANSMISSION MECANIQUE</p> <ol style="list-style-type: none"> DÉMARRAGE DU MOTEUR SELECTIONNER "N" (POINT MORT) SUR LA COMMANDE DE CHANGEMENT DE VITESSE ET METTRE LE FREIN DE STATIONNEMENT. POSITION DE LA COMMANDE DE CHANGEMENT DE VITESSE POSITION R OPERATION SELECTIONNE LA MARCHÉ ARRIÈRE (LA VITESSE DU VÉHICULE EST INFÉRIEURE À 2 MILLES/HR (3,2 KM/HR)). N SELECTIONNE LE POINT MORT. D SELECTIONNE AUTOMATIQUEMENT LES ENGRENAGES DE CHANGEMENT DE VITESSE ENTRE L'ENGRENAGE DE DÉMARRAGE ET L'ENGRENAGE SUPÉRIEUR. MANUAL MAINTIEN L'ENGRENAGE UTILISÉ ACTUELLEMENT ET PERMET DE SELECTIONNER MANUELLEMENT L'ENGRENAGE APPROPRIÉ AU MOYEN DE LA TOUCHE \blacktriangledown. LOW PASSE À LA PREMIÈRE OCCASION À LA VITESSE INFÉRIEURE POUR ASSURER UN FREINAGE MAXIMUM AU MOYEN DU FREIN-MOTEUR. \blacktriangledown UTILISÉ EN MODE MANUEL POUR SELECTIONNER LE PASSAGE À LA VITESSE SUPÉRIEURE OU À LA VITESSE INFÉRIEURE. STATIONNEMENT PLACER LE LEVIER DE TRANSMISSION DE VITESSE AU POINT MORT, METTRE LE FREIN DE STATIONNEMENT ET BLOQUER LES ROUES. REMORQUAGE SI LE VÉHICULE EST REMORQUÉ ALORS QUE LES ROUES MOTRICES SONT ENCORE EN CONTACT AVEC LA SURFACE DE LA CHAUSSEE, RETIRER OU DÉCONNECTER LES ARBRES INTERMÉDIAIRES.
---	---

3. Fuel

CAUTION USE ULTRA LOW SULFUR DIESEL FUEL ONLY

ATTENTION EMPLOYER UNIQUEMENT DU COMBUSTIBEL DIESEL ALUTRA BASSE TENEUR EN SOUFRE

4. Fuse

STARTER SWITCH		HEAD LAMP MAIN RELAY		HEAD LAMP DIM RELAY		HEAD LAMP MAIN RH		STARTER		WIPER		HORN		P-BATTI		SPARE FUSE		AIR DRYER	
15A		15A		10A		10A		10A		10A		5A		5A		20A		15A	
WIPER		HEAD LAMP MAIN LH		HEAD LAMP DIM RH		HEAD LAMP DIM LH		RADIO		POWER DOOR LOCK		ENG. ECU		METER		SPARE FUSE		BACK LAMP	
10A		10A		10A		10A		10A		5A		5A		5A		30A		15A	
20A		20A		15A		15A		10A		5A		5A		5A		3.0A		15A	
TAIL LAMP		SPARE (P-TAIL)		SPARE (P-IGN1)		SPARE (P-IGN2)		RELAY		RELAY		RELAY		RELAY		RELAY		RELAY	
10A		10A		10A		10A		RELAY		RELAY		RELAY		RELAY		RELAY		RELAY	
10A		10A		10A		10A		RELAY		RELAY		RELAY		RELAY		RELAY		RELAY	
FOG LAMP		DOMELAMP		ASIS/DUMP		RELAY		RELAY		RELAY		RELAY		RELAY		RELAY		RELAY	
10A		10A		10A		10A		RELAY		RELAY		RELAY		RELAY		RELAY		RELAY	
10A		10A		10A		10A		RELAY		RELAY		RELAY		RELAY		RELAY		RELAY	
10A		10A		10A		10A		RELAY		RELAY		RELAY		RELAY		RELAY		RELAY	
10A		10A		10A		10A		RELAY		RELAY		RELAY		RELAY		RELAY		RELAY	

ARRANGEMENT OF FUSE CONNECTORS : ↑ upward
DISTRIBUTION DE CONNECTEURS DE FUSIBLE : ↑ EN HAUT

CAUTION - ATTENTION
USE THE DESIGNATED FUSES ONLY.
UTILISEZ SEULEMENT LES FUSIBLES DESIGNÉS.

8 268 5 - E0E1 0

5. Suspension Spring U bolt

CAUTION

Suspension spring "U" bolt.

Re-torque all leaf spring "U" bolts at the first 1000-mile (1600km) inspection to prevent possible spring breakage.

CAUTION

Bride de ressort de suspension.

Toutes les brides de ressort doivent être resserrées à l'inspection des 1600km (1000-mile) afin d'empêcher une rupture possible du ressort.

76566-4500

SAFETY LABELS

6. Chassis frame

⚠ CAUTION
SIDE RAILS AND CROSS MEMBERS Ⓢ
1. Do not drill or cut any portion of the upper or lower flanges of the side rails or cross members. 2. Do not heat (such as welding) any portion of the side rails or cross member.
⚠ CAUTION
LONGERONS ET TRAVERSES Ⓢ
1. Ne pas percer ou couper toute partie des ailes superieure ou inferieure des longerons ou des traverses. 2. Ne pas chauffer (tel quen soudant) toute partie des longerons ou des traverses.
76588-4690

7. Fuel tank

⚠ CAUTION
USE ULTRA LOW SULFUR DIESEL FUEL ONLY Ⓢ
Use of improper fuel could cause the engine to fail.
⚠ ATTENTION
EMPLOYER UNIQUEMENT DU COMBUSTIBLE DIESEL A ULTRA BASSE TENEUR EN SOUFRE Ⓢ
L'utilisation d'un combustible inapproprié risque de faire tomber le moteur en panne.
74559-E0072

8. Fuel tank

Warning: Do not fill to more than 95% of liquid capacity	
Capacity Liquid Usable US Gallons 60 52	DIESEL FUEL ONLY MEETS ALL FMCSA SIDE-MOUNTED FUEL TANK REQUIREMENTS
Liters 227 197	Rev. B Mfg by: Fuel systems LLC
Part No. 771004600B	AM0103797M
	MFG. Date 07/04
Serial No. TS070402883	
Meets applicable FMCSA requirements and SAE R. P. J703	

9. Quick joint

(Allison Automatic transmission only)

	⚠ NOTICE
	▶ USE CLIPS TO ATTACH/DETACH OIL HOSES. (DO NOT REMOVE NUTS.) Ⓢ ▶ POUR LE BRANCHEMENT OU LE DÉBRANCHEMENT DU BOYAU D' HUILE, AGIR SUR LA PIÈCE DE RETENUE. (NE JAMAIS ÔTER L' ÉCROU.) Ⓢ

10. Battery

⚠ DANGER/POISON			
 SHIELD EYES EXPLOSIVE GASES CAN CAUSE BLINDNESS OR INJURY	 NO SPARKS - FLAMES - SMOKING	 SULFURIC ACID CAN CAUSE BLINDNESS OR SEVERE BURNS	 FLUSH EYES IMMEDIATELY WITH WATER GET MEDICAL HELP FAST
KEEP OUT OF THE REACH OF CHILDREN. DO NOT TIP. KEEP VENT CAPS TIGHT AND LEVEL.			

11. Fusible links

⚠ CAUTION
• USE THE DESIGNATED FUSIBLE LINKS, FUSES AND RELAYS ONLY.

12. Air dryer (NABCO only)

注意	PC. NO. 44830-3060
下記の場合、ドライヤーの内部点検を行って下さい。 尚本品の取扱いは、車両取扱説明書を御読み下さい。	
1) 1年又は、6万Km走行毎。 2) エアタンクドレンより水分がときどき排出されるか、オイルの排出が認められる場合。	
CAUTION	
Inspect the inside of dryer in such cases as paragraph 1) and 2). As to the handling of this product, kindly refer to the vehicle Service Manual.	
1) Every one year or 60,000km in run.	2) Water or oil is present in the air reservoir when check before running.

13. Sub fuel tank

NOTICE TO DEALERS Ⓢ
FOR VEHICLES WITH DUAL FUEL TANK ONLY
BE SURE TO REMOVE THE CAP FROM THE SUB-FUEL TANK BREATHER HOSE AFTER THE VEHICLE IS DELIVERED TO THE DEALER.
AVIS AUX CONCESSIONNAIRES Ⓢ
POUR LES VÉHICULES UNIQUEMENT ÉQUIPÉS D' UN DOUBLE RÉSERVOIR À COMBUSTIBLE
NE PAS OUBLIER DE RETIRER LE BOUCHON DE LA CONDUITE FLEXIBLE DE REMPLIR DU RÉSERVOIR À COMBUSTIBLE SECONDAIRE APRÈS QUE LE VÉHICULE AIT ÉTÉ LIVRÉ AU CONCESSIONNAIRE.
76566-5930

SAFETY LABELS

14. Power steering fluid reserve tank

CAUTION	ATTENTION
<p>Inspection and maintenance of power steering fluid</p> <ol style="list-style-type: none"> 1. Check the fluid level before starting the engine. 2. Intervals of the fluid change and the filter replacement; Initially, 3,000 miles (5,000 km). After that every 36,000 miles (60,000 km). 3. Recommended fluid; Automatic transmission fluid DEXRON II or its equivalents. 4. Do not let dust get in the fluid when filling or checking the fluid level. 	<p>Inspection et entretien du liquide de direction assistée</p> <ol style="list-style-type: none"> 1. Vérifier le niveau du liquide avant de mettre le moteur en marche. 2. Intervalles de vidange de liquide et de remplacement de filtre; La première fois, après 3.000 milles (5.000 km). Ensuite, tous les 36.000 milles (60.000 km). 3. Liquide recommandé; Liquide de boîte de vitesses automatique DEXRON II ou des produits équivalents. 4. Veiller à ne pas laisser de la poussière s'infiltrer dans le liquide au moment d'effectuer le remplissage et la vérification du niveau de liquide.

15. Engine coolant reserve tank

NOTICE

▶KEEP COOLANT LEVEL BETWEEN "FULL" AND "LOW" WHEN ENGINE IS COLD.
IN CASE OF THE OPERATION OF THE COOLANT LEVEL ALARM, COOLANT SHOULD BE ADDED TO THE RESERVE TANK AS WELL AS THE RADIATOR. FOR DETAILS REFER TO THE OWNERS MANUAL.

NOTICE

▶MAINTENIR LE NIVEAU DE L'EAU DE REFRIGERISSEMENT ENTRE "PLEIN" ET "BAS" QU'AND LE MOTEUR EST FROID.
EN CAS DE L'OPERATION DU SIGNAL DE L'ALARME, DEVRAIT ETRE AJOUTE DU LIQUIDE DE REFRIGERISSEMENT AU RESERVOIR DE SECOURS AUSSI BIEN QUE LE RADIATEUR.
POUR LES DETAILS FAITES REFERENCE AU MANUEL DES PROPRIETAIRES.

16. Fuel injector

WARNING

HIGH VOLTAGE

PLACE THE STARTER SWITCH ON "LOCK" POSITION WHEN CARRYING OUT THE JOB WITH THE CYLINDER HEAD COVER REMOVED. WHEN IT IS UNAVOIDABLE TO CARRY OUT YOUR JOB WITH THE STARTER SWITCH AT "ON" POSITION AND WITH THE CYLINDER HEAD COVER REMOVED. DO NOT TOUCH THE HARNESS UNDER THE CYLINDER HEAD COVER. IF YOU DO NOT FOLLOW THE WARNING AND THE INSTRUCTION, YOU MAY GET AN ELECTRIC SHOCK.

17. Brake fluid reserve tank (Hydraulic brake only)

WARNING

CLEAN FILLER CAP BEFORE REMOVING
USE ONLY DOT 3 FLUID

FROM A SEALED CONTAINER
REFILL TO BOTTOM OF RING
IF FLUID IS MORE THAN ONE
INCH BELOW BOTTOM OF RING

MINERAL OILS SUCH AS
POWER STEERING FLUID MUST NOT BE USED

AVERTISSEMENT

NETTOYER LE COUVERCLE AVANT DE
L'ENLEVER UTILISER SEULEMENT LE
FLUIDE DOT 3 PROVENANT
D'UN FLACON ETANCHE

REMETTRE DU LIQUIDE JUSQU' AU BAS DU
REPERE SI LE NIVEAU EST A PLUS
DE 25 MM SOUS CE REPERE

LES HUILES MINERALES COMME LE LIQUIDE DE
DIRECTION ASSISTEE NE DOIT PAS ETRE UTILISE

18. Clutch master cylinder

CAUTION
DO NOT GRIP

ATTENTION
NE PAS SERRER

19. Don't step

CAUTION

DON'T STEP

76562-77905

20. No step

警告 **警告**

CAUTION **ATTENTION**

足を乗せないで下さい。 请勿脚踏

Do not step on this part. ห้ามวางเท้า


No pas écraser le composant.

SAFETY LABELS

21. Air conditioner refrigerant

⚠ CAUTION REFRIGERANT UNDER HIGH PRESSURE	⚠ ATTENTION REFRIGERANT SOUS HAUTE PRESSION
Improper service methods may cause injury. Air conditioning system should be serviced by qualified personnel. See Repair Manual.	Un entretien incorrect peut provoquer des blessures. Le système de climatisation doit être entretenu par une personne qualifiée. Voir le manuel de réparation.
 	 
MFD. BY DENSO CORPORATION JAPAN.	FABRIQUE PAR DENSO CORPORATION JAPON.

22. Air cleaner

 Donaldson	Donaldson Endurance Radial Seal	Donaldson Part# Hino Part# EPG110346 17720-6400A Air Cleaner Filtro de Aire Filter à Air P185067 17801-3440A Primary filter Filtro de Aire Filter à Air
NOTICE	AVIS	
<ol style="list-style-type: none"> 1. Check air cleaner regularly according to the driver's handbook. 2. Replace filter when service indicator turns red. 3. Replace filters according to driver's handbook. 	<ol style="list-style-type: none"> 1. Inspecter régulièrement le filtre à air conformément au manuel et d'instruction et d'entretien. 2. Remplacer la cartouche quand l'indicateur de service vire au rouge. 3. Remplacer la cartouche conformément au manuel d'instruction et d'entretien. 	
<small>EP Part 622982; JP Part 208672 & 208676; AU Part 018672; BR Part 018672; CA Part 1346172; CH Part 018672; USA Part 177046; Singapore Part 018672-2; US Des 691302; DE geschaltete Motor 08823212; UK Reg. 257396; FR Mod Day 011602; CA (9) 021 6627; MX Reg. Diasono Ind 19857; IN Reg 1988 177046; others Inc. & parts; ©Donaldson Company, Inc. all rights reserved</small>		
<small>LAKE # 90673</small>	<small>Made in U.S.A.</small>	

23. Windshield wiper link

⚠ ATTENTION	⚠ CAUTION
Précaution pour les pièces en mouvement. Avant de procéder à l'inspection, commuter le contacteur du démarreur.	BE CAREFUL OF MOVING PARTS. TURN OFF THE STARTER SWITCH BEFORE INSPECTION.

24. Radiator cap



25. No step



26. Engine oil level

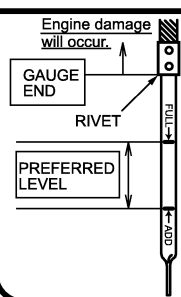
NOTICE	
	<p>Engine damage will occur. (P)</p> <p>Check engine oil level. If level is over the "FULL" mark, adjust oil level to the preferred area. When oil level becomes too high, engine damage will occur. Refer to the "OWNER'S MANUAL" for detail.</p> <p>Vérifier le niveau d'huile du moteur. Si le niveau est supérieur à la marque "FULL", régler le niveau d'huile à celui recommandé. Si le niveau d'huile devient très haut, le moteur risque d'être endommagé. Pour de plus amples détails, veuillez vous référer au "MANUEL DE L'UTILISATEUR".</p>

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- 1 GENERAL INTRODUCTION**
- 2 BEFORE DRIVING YOUR VEHICLE**
- 3 DRIVING YOUR VEHICLE**
- 4 OPERATION OF INSTRUMENTS AND CONTROLS**
- 5 IN AN EMERGENCY**
- 6 CORROSION PROTECTION AND APPEARANCE CARE**
- 7 MAINTENANCE**
- 8 REPORTING SAFETY DEFECTS**
- 9 INDEX**



Read entire manual before using vehicle. Failure to follow instructions and safety precautions could result in death, serious injury and/or damage.

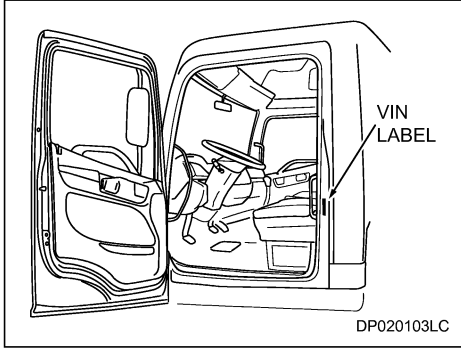
SECTION 1

GENERAL INTRODUCTION

VEHICLE IDENTIFICATION NUMBER	1-2
OVERLOADING	1-7
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DIESEL FUEL	1-8
PAINTING	1-8

Read entire manual before using vehicle. Failure to follow instructions and safety precautions could result in death, serious injury and/or damage.

VEHICLE IDENTIFICATION NUMBER

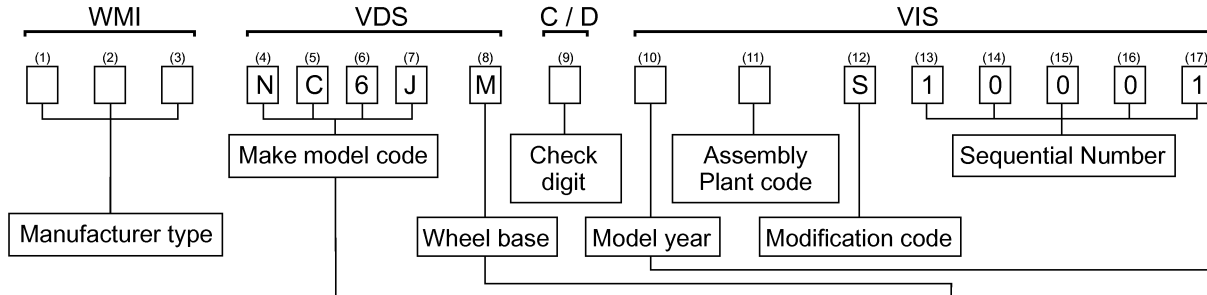


The Vehicle Identification Number (VIN) is shown on the VIN label.

The VIN label is affixed to the left pillar of the cab.

When you order replacement parts from an authorized Hino dealer, please refer to the information found on your VIN plate to facilitate proper service.

1. Vehicle Identification Number (VIN) Structure



Class	Model	Production Code	Engine	Brake Systems	Gross Vehicle Weight Rating	
					Lbs.	Kg
4	HINO 145	NA6J	J05D diesel engine	Hydraulic	14,001-14,500	6,350-6,577
	HINO 165	NB6J			14,501-16,000	6,578-7,257
5	HINO 185	NC6J	J08E diesel engine	Hydraulic	16,001-19,500	7,258-8,845
6	HINO 238	ND8J			19,501-23,000	8,846-10,433
	HINO 258	ND8J		Full Air	19,501-26,000	8,846-11,793
		NJ8J			Hydraulic	23,001-26,000
	HINO 268	NE8J		Full Air		Hydraulic
NJ8J		30,001-33,000			13,609-14,968	
7	HINO 308	NF8J	Full Air	Hydraulic	30,001-35,000	13,609-15,875
		NV8J			N/A	N/A
	HINO 338	NV8J		N/A	N/A	

Code	Length			
	HINO 145, 165, 185		HINO 238, 258, 268, 308, 338	
	in.	mm	in.	mm
F	147	3,734	--	--
G	--	--	152	3,861
J	169	4,293	175	4,445
K	183	4,648	--	--
L	--	--	187	4,750
M	201	5,105	205	5,207
N	--	--	212*	5,385*
P	--	--	217	5,512
R	--	--	235	5,969
T	--	--	253	6,426
V	--	--	271*	6,883*

Code	Year
8	2008
9	2009
A	2010
B	2011
C	2012
D	2013
E	2014
F	2015
G	2016

*Some models only

Vehicle identification number refer to the Workshop Manual for details.

2. Gross Vehicle Weight Rating (GVWR), Gross Axle capacity Weight Rating (GAWR) are given in below table.

Model	Tire size	GVWR (lbs.)	GAWR (lbs.)		GVWR (kg)	GAWR (kg)	
			Front	Rear		Front	Rear
HINO 145	215/85R16	14,050	5,360	9,880	6,370	2,430	4,480
HINO 165	225/70R19.5	16,000	6,250	11,000	7,250	2,830	4,990
HINO 185	225/70R19.5 (Transmission model: Eaton® FS4205)	18,000	6,250	13,000	8,170	2,830	5,900
	225/70R19.5 (Transmission model: Aisin® A450)	17,600	6,250	13,000	8,000	2,830	5,900
HINO 238	10R22.5	23,000	8,000	17,500	10,430	3,630	7,940
	11R22.5 (Transmission model: ALLISON 2200RDS)						
	11R22.5 (Transmission model: ALLISON 2200HS)						
	255/80R22.5						
HINO 258	245/70R19.5	25,500	8,000	17,500	11,570	3,630	7,940
HINO 268	11R22.5	25,950	8,000	19,000	11,770	3,630	8,620
	255/80R22.5		10,000	19,000	11,770	4,540	8,620
	255/70R22.5						
	295/75R22.5						
HINO 308	11R22.5	★33,000	12,000	21,000	14,950	5,440	9,530
	295/75R22.5						

Model	Tire size	GVWR (lbs.)	GAWR (lbs.)		GVWR (kg)	GAWR (kg)	
			Front	Rear		Front	Rear
HINO 338	11R22.5	25,950	10,000	21,000	11,770	4,540	9,530
		33,000	12,000	21,000	14,950	5,440	9,530
			10,000	23,000	14,950	4,540	10,430
		★35,000	12,000	23,000	15,870	5,440	10,430
	295/75R22.5	33,000	12,000	21,000	14,950	5,440	9,530

★: Models for CANADA only

**WARNING**

Your Hino truck equipped with an automatic six speed transmission has a speed limiter.

NEVER change the size of any tire on the truck, or the truck's rear axle gear ratio, without having your Hino dealer change the allowable speed limit on the truck's speed limiter. Changing the tire size or rear gear ratio without altering the speed limiter could cause excessive vibrations of the propeller shaft and severe damage to the transmission resulting in loss of control of the vehicle and resulting in an accident leading to death or serious personal injury.

**WARNING**

Overloading the vehicle by exceeding the GVWR can cause it to overturn resulting in serious injury or death. Read WARNING on next page.

OVERLOADING



WARNING

- **Overloading can cause an overturn resulting in serious injury, death and/or property damage.**
- **The gross vehicle weight (GVW) is the vehicle's total weight, including body, driver and passengers, cargo load, tools carried, etc., as well as any optional items of equipment placed on the vehicle after it has left the factory.**
- **The GVW must be equal to or less than the GVWR.**
- **The front and rear gross axle weights must be equal to or less than the front and rear GAWR's respectively.**
- **The vehicle is designed to provide satisfactory service assuming that the vehicle is loaded within the limits of the GVWR and the front and rear GAWR's.**
- **Since the GVWR and GAWR's are determined by taking into consideration the strength of all the vehicle components, as well as vehicle handling and stability, brake performance, etc., the addition of frame**

reinforcement and heavy duty springs does not increase any of the weight limits found on the Certification Label.

- **The GVWR and GAWR's indicate the maximum permissible weight. However, state and local laws which regulate weight limits must be followed.**
- **Any part of your vehicle which has been subjected to misuse is not covered by your new vehicle warranty. Any failure caused by overloading is regarded as misuse.**
- **The weight of cargo carried should be distributed properly over the front and rear axles, as well as equally on both sides of the center line.**

SERVICE ASSISTANCE

When maintenance service is necessary consult an authorized Hino dealer.

MAINTENANCE

Scheduled maintenance should be performed to help you enjoy safe and trouble-free operation of your vehicle. For further information, refer to SECTION 7.

DIESEL FUEL

Use ultra low sulfur diesel fuel only for vehicles equipped with a diesel engine. For details, refer to SECTION 7, FUEL SYSTEM on page 7-22.



CAUTION

- **Do not use fuel additives, agents for removal of water from the fuel, agents for improvement of the fuel efficiency.**
This can cause smoke generation or defects from defective sliding of the sliding surfaces lubricated by fuel system.
- **Do not install devices for improvement of the fuel efficiency inside the fuel tank.**
Wear particles, fragments from the installed devices (after-market parts) can cause defects of the fuel system.

PAINTING

1. As a rule, do not paint the chassis side because it has vital components such as brake hoses and harness couplings, which can easily change chemically.
2. Painting of cab and rear body:
The parts listed below are made of materials which can easily be damaged by thinner. When using thinner or solvents containing thinner when painting the cab or rear body, for example, observe the following points.
 - Be sure to properly mask the parts.
 - If paint should accidentally get on any of the parts listed below, use kerosene to remove it. Do not use thinner or solvents containing thinner.
 - Since it takes some time to remove paint with kerosene, first be sure to apply masking properly.
 - When parts have been removed before painting, replace them properly afterwards.

- Plastic parts may deform if the painting surface is heated during drying to more than 177°F (80°C). See chart on next page to identify plastic parts.
The manufacturer assumes no responsibility for damage or accidents arising from faulty replacement.

1. Parts:

NOTICE

- P - Plastic, R - Rubber: Use of thinners can produce cracks, fractures, etc.**
- S - Painted steel: Although made of steel, if paint thinners are used, the paint loses its shine.**
- O - Various materials: Use of thinner erases letters.**

No.	Part name	Remarks	Material
1	Emblem	↻ Top marks	P
2	Inner grip	Attached beside front pillar	P & S
3	Side turn signal lights		P
4	Clearance lights	Installed on both sides of the cab roof	P
5	Identification lights	Installed at the center front of the cab	P
6	Headlights		P
7	Rear combination lights	Installed at the rear end of the frame	P
8	Fuel filter with water separator	Installed at the rear of cab at on the left side of frame	P & S
9	Fender		P
10	Step		S
11	Splash board		P & S
12	Grille		P
13	Cooling fan	Engine part	P
14	Battery and cover (indicator component)	Indicator for checking fluid level	P
15	Mud guard		R
16	Rubber parts	Includes cooler hose if there is air-conditioned	R
17	Hood		P
18	Cab outer plate, front bumper		S
19	Caution plate		O
20	Wiper blade		R
21	Wiper cap	Pivot cover	P

SECTION 2

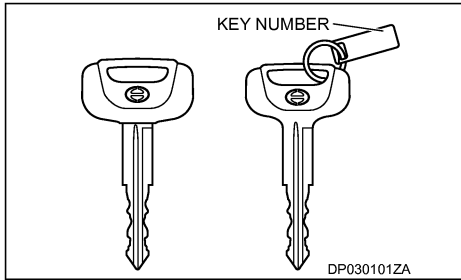
BEFORE DRIVING YOUR VEHICLE

KEY	2-2
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Read entire manual before using vehicle. Failure to follow instructions and safety precautions could result in death, serious injury and/or damage.

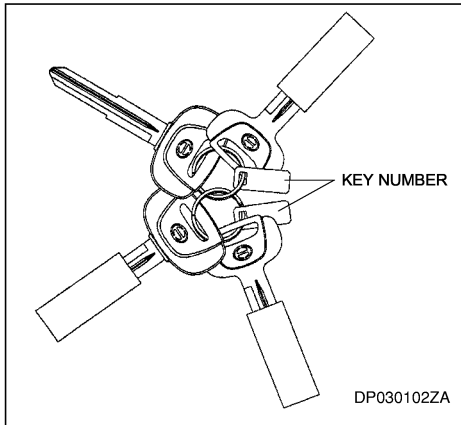
KEY

Standard



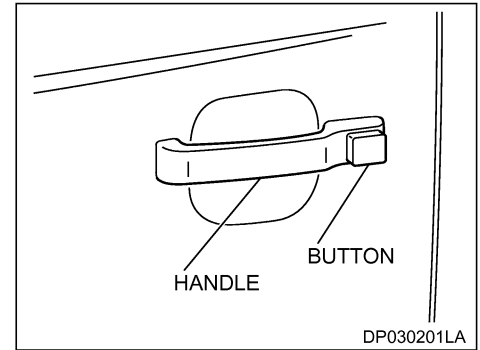
1. The same key is used for the starter switch and door locks.
2. Record your key number and keep the number in a safe place. If you should lose your key, a duplicate can be made by an authorized Hino dealer using the key number.

Option



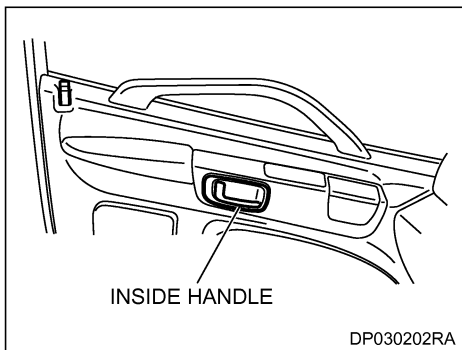
CAB DOOR HANDLES AND LOCKS

Opening doors



From the outside:

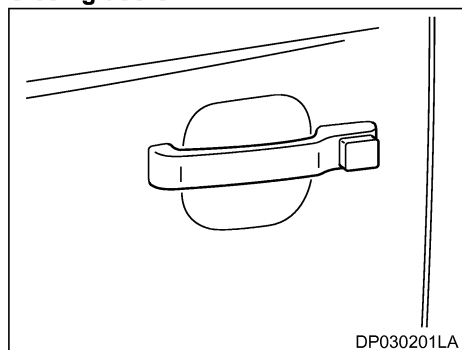
Push in the button at the end of the handle and, while holding the button in, pull the handle.



From the inside:

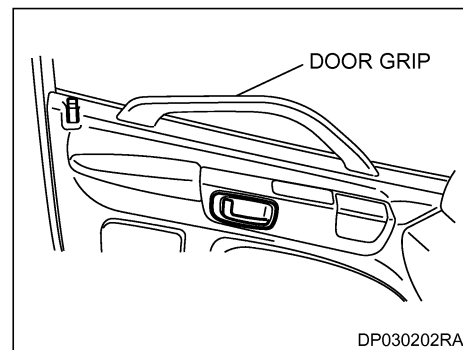
Pull the inside handle. Before opening the door from the inside, be sure that opening the door will not endanger traffic.

Closing doors



From the outside:

Push in the door while holding the handle.



From the inside:

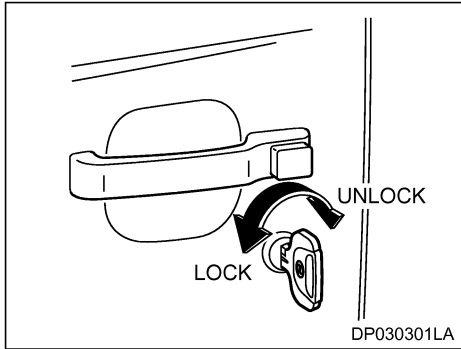
Pull on the door grips attached to the door.



WARNING

Use door grips to close door completely. Using other parts may not close door completely and could be dangerous.

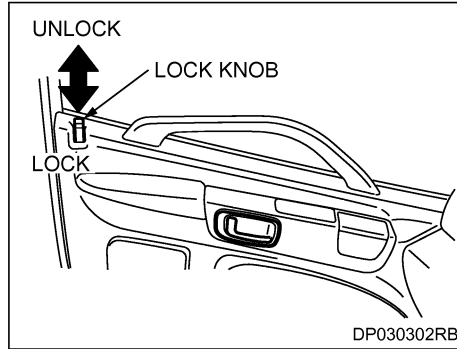
Locking doors



From the outside:

Turn the key towards the rear of the vehicle to unlock and towards the front to lock.

You can also lock the door without using the key. Push down the lock knob and close the door while holding the push button of the handle in. In this case be careful not to leave the key locked inside the cab.



From the inside:

Push down the lock knob after closing the door.

WARNING

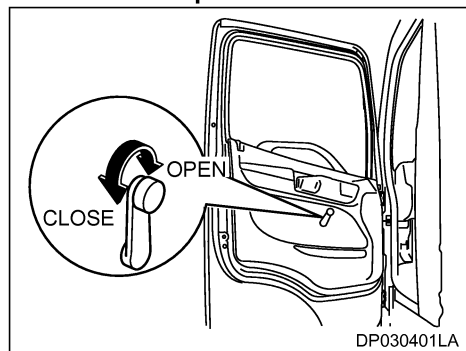
Have doors locked and use seat belts at all times while driving. Doing so will prevent occupants from being thrown from cab in an accident and will protect occupants from intruders.

Power door lock system

Locking and unlocking of the assistant's side door can be done by operating the lock knob or the key on the driver's seat side.

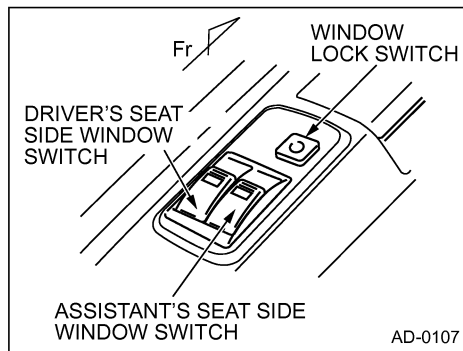
WINDOWS

Door windows operation



1. Manual operation

To lower door glass (driver's door), turn window regulator handle clockwise. To raise door glass, turn handle counterclockwise. Reverse this procedure for assistant's door.



2. Power windows (If so equipped)

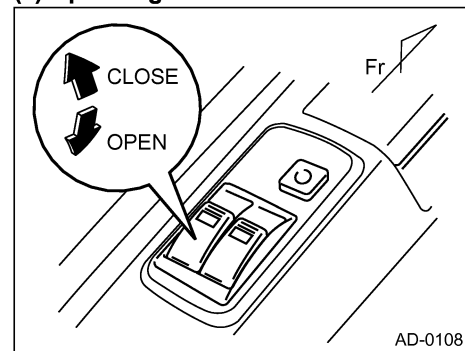
The windows can be operated with the switch on each door. The power windows work when the key is in the "ON" position.



WARNING

If vehicle is equipped with power windows, read and follow safety precautions on page 2-6.

(1) Operating the driver's window

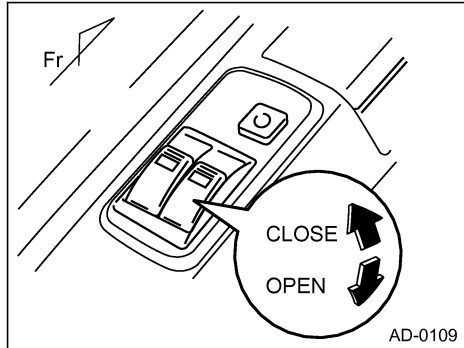


Use the switch on the driver's door. The window moves as long as you hold the switch.

To open: Lightly push down the switch.

To close: Lightly pull up the switch.

(2) Operating the assistant's window



Use the switch on the assistant's door or the driver's door that controls the assistant's window. The window moves as long as you hold the switch.

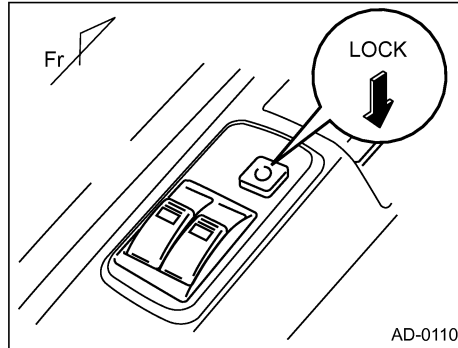
To open: Lightly push down the switch.

To close: Lightly pull up the switch.

NOTICE:

However, if the window lock switch is pushed to the "LOCK" position, the window does not operate, if the switch is pressed.

(3) Window lock switch

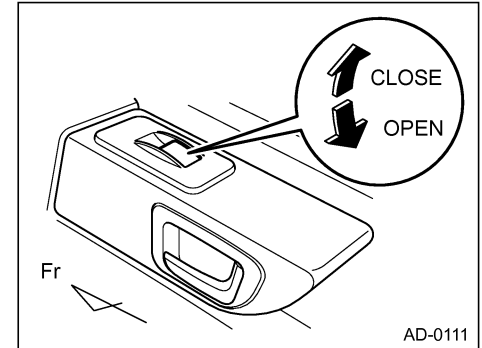


While you push in the window lock switch on the driver's door, the assistant's window cannot be operated.

NOTICE:

Be sure keep the switch in the "LOCK" position when carrying a child or when not operating the window.

Assistant's seat side switch



The window opens when the switch is pressed downwards and closes when pulled upwards. If you release your finger, it stops at the corresponding position.

NOTICE:

However, if the window lock switch is pushed to the "LOCK" position, the window does not operate, even if you press the switch.



WARNING

To avoid serious personal injury, you must do the following.

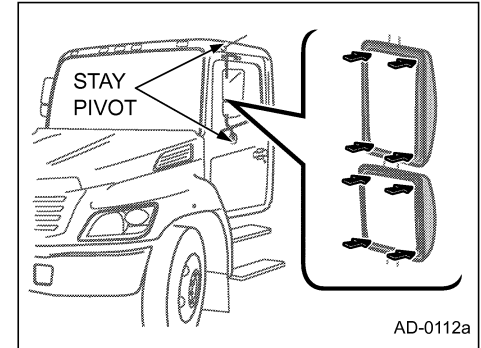
- If vehicle is equipped with power windows, follow these safety precautions to avoid serious injury or death:
- Before you close the windows, make sure no one's head, arm, or hand is in the path of the window.
- Do not leave small children alone in the vehicle, especially if the motor is running or starter key is inserted. At all times that children are in vehicle, push down window lock switch to prevent children from opening or closing windows.

PROTECTION AGAINST THEFT

You may lose both your vehicle and carrying cargo from vehicle theft. Protection against vehicle theft is your responsibility. To help prevent theft of your vehicle, observe at least the following precautions when you leave the vehicle.

- Close all the windows and lock.
- Lock all the doors.
- Take the key with you.
- Do not leave any article which may appear to be valuable in the cab.
- Park your vehicle in a lighted place.

OUTSIDE REAR VIEW MIRRORS



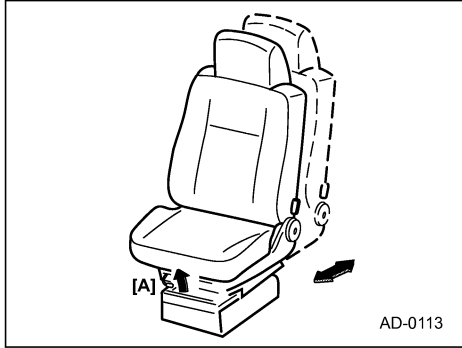
Adjust outside mirrors on both sides as necessary for optimum rear view when in your usual driving position. Keep the mirrors clean at all times.

Adjustment

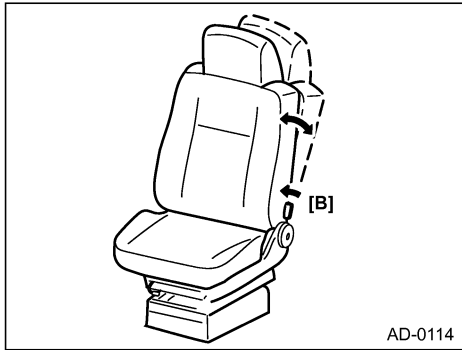
First, adjust the stay according to the body. Then make mirror adjustments by pushing the corners of the mirrors as shown in the above figure.

SEATS

Driver's and passenger's seats



AD-0113



AD-0114

1. Seat fore and aft (Driver's seat only)



To prevent loss of vehicle control, make all seat adjustments before moving vehicle.

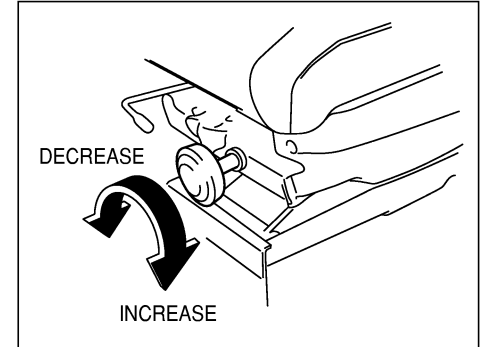
Pull the lever [A] up and while holding it, slide the seat forward or backward to the desired position. Release the lever to lock.

After this adjustment, try to move the seat forward and backward to make sure that it is locked securely.

2. Seat back angle

Pull the lever [B] beside the seat frontward to release the lock and lean back or forward to the desired angle. Then release the lever to lock.

Seat suspension (If so equipped)



Seat suspension may have been provided for the driver's seat as an option.

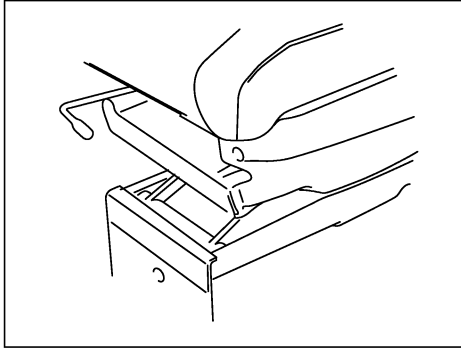
(1) Mechanical seat adjustment type [Hydraulic brake type]

Turn the dial and set the pointer to your weight.

(EXAMPLE)

Body weight	Dial graduation
140 lb	140
60 kg	60

SEAT BELTS

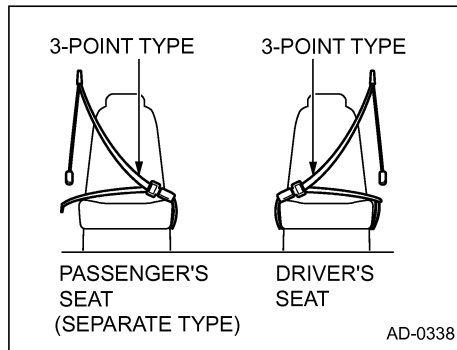
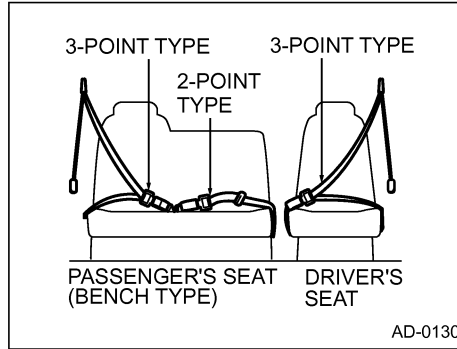


(2) Air suspension seat type

[Full air brake type]

[Hydraulic brake type: standard for driver's seat]

The air suspension seat allows to automatically adjust the height of the seat to your weight.



3-point type Seat belts

Seat belts with ELR are equipped with at the seats for driver as well as assistant.

HINT:

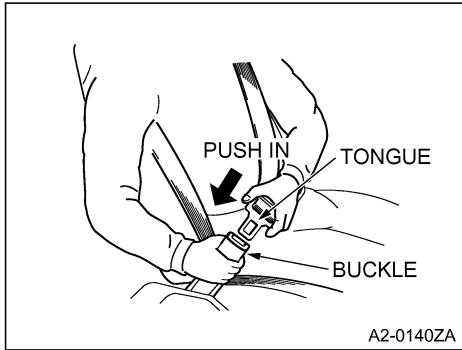
ELR (Emergency Locking Retractor):

- Under normal conditions, it will expand and contract freely, according to the body movement. However, the driver's and assistant's bodies will automatically be fixed to the seat and protected, in case of a caution.
- Pull out the seat belt slowly when you wish to use it. It may get caught half way if you try to pull it out suddenly and quickly. In this case, return the belt back to the original position and pull it out again slowly.

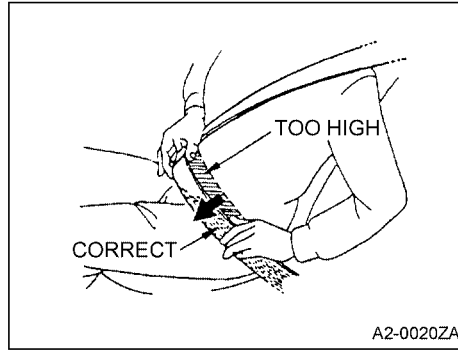


WARNING

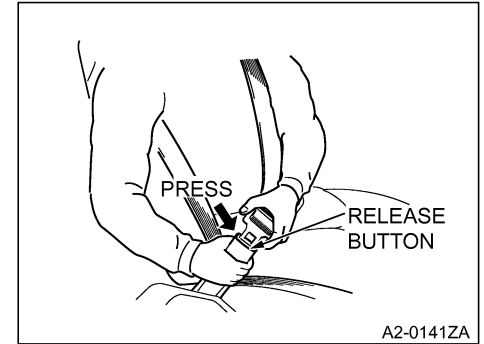
To help reduce the probability and severity of injury in an accident or sudden stop, all occupants should correctly use seat belts at all times while vehicle is moving. Read and follow all seat belt instructions.



- To fasten your belt, pull it out of the retractor and insert the tongue into the buckle.
- You will hear a click when the tongue locks into the buckle. Make sure that the connection is secure and the belt is not twisted. The seat belt length automatically adjusts to your size and the seat position.

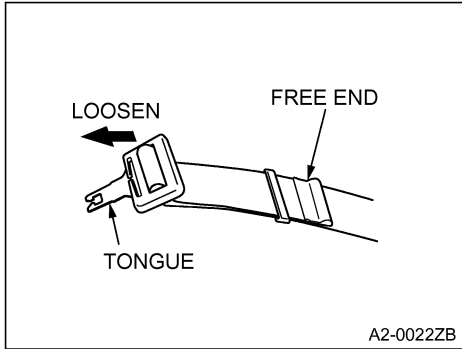


- The retractor will lock the belt during a sudden stop or on impact. At other times you can move easily.
- Adjust the position of the lap and shoulder belts.
- Position the lap belt as low as possible on your hips, not on your waist. Failure to do so increases the chance of injury due to sliding under the lap belt during an accident.
- For your safety, do not place the shoulder belt under your arm.

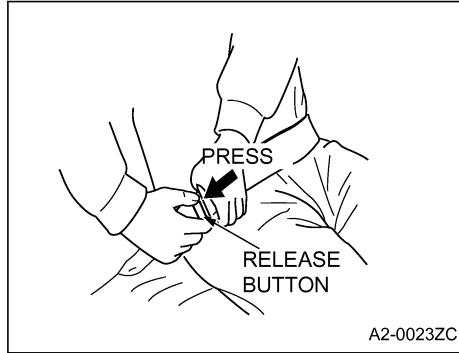


- To release the belt, press the buckle-release button and allow the belt to retract.
- If the belt does not fully retract, pull it out and check for kinks or twists. Then make sure that it remains untwisted as it retracts.

2-point type seat belts (If so equipped)



- To loosen the belt, hold the tongue at a right angle to the belt, as shown, and pull the tongue.
- To tighten the belt, pull the free end of the belt webbing and adjust it to fit your hips snugly (not on your waist).



- To reduce the chance of injury in an accident, the seat belt should fit snugly around your hips, not on your waist.
- To release the belt, press the buckle release button.
- When not using the seat belt, adjust the length of the belt so that it does not hang over onto the floor, properly insert the tongue into the buckle, and then arrange the belt on the seat.

[HINTS FOR USING SEAT BELTS]



To help reduce the probability and severity of injury in an accident or sudden stop, all occupants should correctly use seat belts at all times while vehicle is moving. Read and follow all seat belt instructions.

- To help reduce the possibility and/or the severity of injury in accidents or sudden stops, use the seat belts properly.
- **Pregnant women:**
Hino believes that a seat belt should be worn, but recommends that any pregnant woman first consult her for doctor advice before using a seat belt.
- **Injured persons:**
First, ask your doctor for advice. Hino recommends the use of the seat belt.

- **Children:**

- Children in vehicles should be restrained to help reduce the chance and/or severity of injury in accidents or sudden stops.
- For children who can sit on the seat by themselves, we recommend the use of the lap belt provided.

- **Infants:**

Child safety restraint systems are available. Hino recommends the use of a type which is suited to your vehicle. Be sure to read the manufacturer's instructions carefully before use.

- Never use a single belt for more than one adult or child at a time.
- Be careful not to damage the belt webbing and hardware by trapping them in the seats or doors.
- Check the seat belt system for damage periodically. Damaged parts should be replaced. Never modify the seat belt system.

- Keep the belts clean and dry. If they need to be cleaned, use a mild soap and lukewarm water solution. Do not bleach or dye the webbing, as this may weaken them considerably.
- Replace the belt assemblies if they have been subjected to severe impact during use in a collision.
- The driver and all assistants should wear their belts whenever the vehicle is moving.

Child restraint— —Child restraint precautions



WARNING

- **For effective protection in automobile accidents and sudden stops, children must be properly restrained, using a seat belt and child restraint system of a certain type depending on the age and size of the child.**
 - **Never hold a child on your lap. Holding a child in your arms is not a substitute for a child restraint system, and in an accident, the child can be crushed against the windshield and dashboard, or between you and the vehicle's interior.**
 - **Never place the same safety belt around you and a child.**

- **Make sure that you have complied with all installation instructions provided by the child restraint system manufacturer and that the system is properly secured. Do not use a child restraint system if it cannot be properly installed in accordance with the installation instructions provided by its manufacturer.**
If the child restraint system is not secured properly, death or serious injury to the child or other passengers may result in the event of a sudden stop or accident.
- **Make sure that the child restraint system is securely installed by pushing and pulling it in all directions after securing it with the vehicle's seat belt to the vehicle's front seat. If the child restraint system is not secured properly death or serious injury to the child or other passengers may result in the event of a sudden stop or an accident.**

- **Your vehicle's seat does not have any lower anchors or a top tether anchor to secure the child restraint system to the vehicle's seat. Do not use a child restraint system requiring a top tether hook and/or lower anchors to secure the child restraint system to the vehicle's seat. Such child restraint systems cannot be safely secured, which could cause death or serious injury to the child or other passengers in the event of a sudden stop or an accident.**
- **Never install a rear-facing infant seat (including a rear-facing positioned convertible seat) or a booster seat in the center seat of this vehicle (if your vehicle has a center seat). A rear-facing infant seat or a booster seat cannot be secured properly, and death or serious injury to the child or other passengers may result in the event of a sudden stop or accident. A rear-facing child seat or a booster seat may be used only with a lap and shoulder belt in the outboard seating position.**

Some child restraint systems are designed to be used only with a tether hook and lower anchor hooks and some are not.

This vehicle does not have a tether and lower anchors to secure a child restraint system. Child restraint systems which require the use of a tether and lower anchors cannot be safely secured in this vehicle. Do not use a child restraint system which requires a tether and lower anchors in this vehicle.

Child restraint systems which do not require tethers and lower anchors may be used in this vehicle.

You must use the seat belts provided with this vehicle to secure your child restraint system in this vehicle.

When securing a child restraint system using the seat belts, refer to installation instructions provided by the child restraint system manufacturer and the following instructions in this manual.

IMPORTANT: All States of the United States and the District of Columbia, Canada and all Provinces of Canada have laws applicable to the type of child restraint system which may be used for a child of a particular age, weight and height and the vehicle seating position in which the child restraint system may or may not be used. Always be sure to check your State, District, or Province and national law to make certain that you are following the laws of the State, District, Province or nation where you are using a child restraint system.

Always read the instructions and other information which accompany your child restraint system for information on the appropriate type of restraint for the size of your child.

In the United States, the National Highway Traffic Safety Administration (“NHTSA”) provides general guidelines for the type of restraint appropriate for children of certain ages and sizes on its website at www.nhtsa.dot.gov. The NHTSA website also provides other information regarding the installation of child restraints and the locations of State/Local Installation Stations.

In Canada, Transport Canada/Canada Transport provides information about keeping children safe on its website www.tc.gc.ca/en/tc-main.htm.

—Installation of child restraint system

1. Installation with 3-point type seat belt (Outboard Seat)



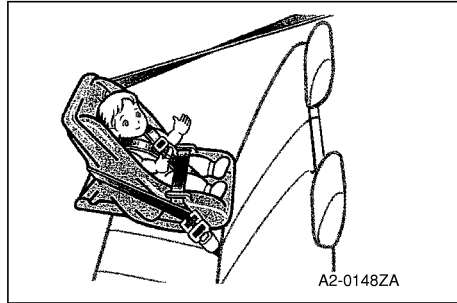
WARNING

- **Unless you have a seat belt locking clip designated by the manufacturer of the child restraint system (except for a booster seat), use the child restraint system only in the center seat (if your vehicle has a center seat). Otherwise, the seat belt will not secure the child restraint system, which could cause death or serious injury to the child or other passengers in the event of a sudden stop or an accident.**

- **A rear-facing child seat (including a rear-facing positioned convertible seat) or a booster seat may be used only with a lap and shoulder belt on the outboard seating position. Never install a rear-facing infant seat or a booster seat on the center seat of this vehicle (if your vehicle has a center seat). A rear-facing infant seat or a booster seat cannot be safely secured on the center seat of this vehicle, and death or serious injury to the child or other passengers may result in the event of a sudden stop or accident.**

For installation of a child restraint system (except for a booster seat) on the outboard seat of this vehicle, a seat belt locking clip is required. Locking clips are usually obtained where child restraint systems are sold.

If you do not have a seat belt locking clip, then use the child restraint system only in the center seat (if your vehicle has a center seat).



[Installation Procedure]

(A) REAR-FACING INFANT SEAT INSTALLATION

An infant seat must be used in rear-facing position only.

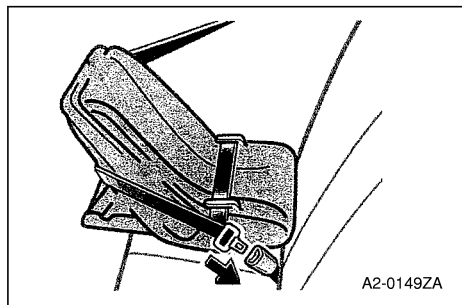
In the United States, the NHTSA recommends use of a rear facing infant seat for infants from birth to at least one year of age and to at least 20 pounds in weight. Be sure to check your local laws for the age and size of child appropriate for an infant rear facing child seat.

When installing, follow the child restraint system manufacturer's instruction about the applicable child's age and size as well as directions for installing the child restraint system.

The outboard seat position of your vehicle has a lap and shoulder belt equipped with an Emergency Locking Retractor (ELR). A seat belt equipped with an ELR requires a locking clip to install a child restraint system (except for a booster seat).

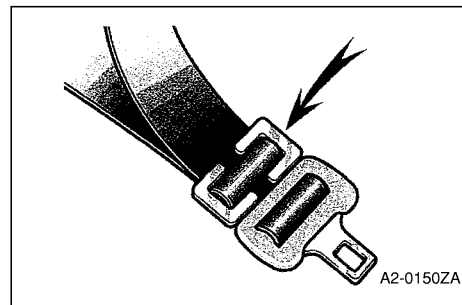
! WARNING

- **An infant should only ride facing the rear of the vehicle.**
- **After inserting the metal tongue of the seat belt latch plate, make sure the metal tongue and buckle are locked and that the lap and shoulder portions of the belt are not twisted.**
- **Do not insert coins, clips, etc. in the buckle as this may prevent you from properly latching the metal tongue and buckle.**
- **If the seat belt does not work properly, it cannot protect your child from death or serious injury. Contact any authorized Hino dealer, immediately. Do not install the child restraint system on the seat until the seat belt is repaired.**

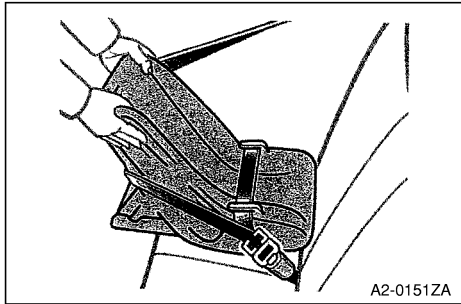


To install the infant seat:

1. Run the lap and shoulder belt through or around the infant seat following the instructions provided by its manufacturer. Insert the metal tongue of the seat belt latch plate into the seat belt buckle, taking care not to twist the belt. Pull any slack out of the lap portion of the belt so that the base of the child restraint is tight against the vehicle seat. Hold the lap and shoulder belt webbing at the latch plate in that position, and release the buckle.

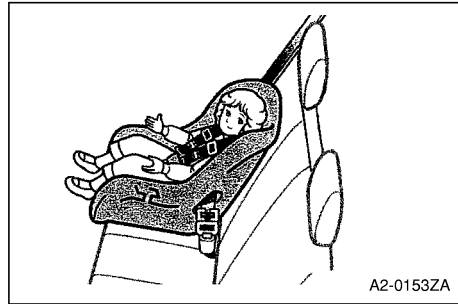


2. Keep holding the lap and shoulder belt webbing together, install a seat belt locking clip near the latch plate of the lap and shoulder belt by and thread the lap and shoulder webbing through the locking clip as depicted in the instructions which accompany the seat belt locking clip. Buckle the belt again. If the belt has any slack, release the buckle and start from "1" again .



! WARNING

Push and pull the child restraint system in different directions to be sure it is secure after securing it with the vehicle's seat belt to the vehicle's seat. Follow all the installation instructions provided by the child restraint system manufacturer.



(B) FORWARD-FACING CHILD SEAT INSTALLATION

A forward facing child seat must be used in a forward-facing position only.

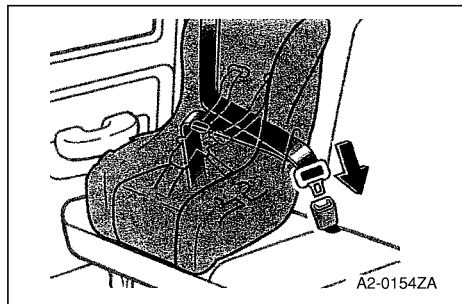
In the United States, the NHTSA recommends use of forward-facing child seat for toddlers from at least one year of age and at least 20 pounds in weight to about 4 years of age and 40 pounds. Be sure to check your local laws for the age and size of child appropriate for forward-facing child seat.

When installing, follow the child restraint system manufacturer's instruction about the applicable child's age and size as well as directions for installing the child restraint system.

The outboard seat position of your vehicle has lap and shoulder belt is equipped with an Emergency Locking Retractor (ELR). A seat belt equipped with an ELR belt requires a locking clip to install a forward-facing child restraint system (except for a booster seat).

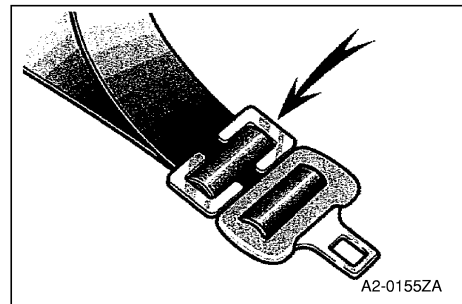
⚠ WARNING

- **After inserting the metal tongue of the seat belt latch plate, make sure the metal tongue and buckle are locked and that the lap and shoulder portions of the belt are not twisted.**
- **Do not insert coins, clips, etc. in the buckle as this may prevent you from properly latching the metal tongue and buckle.**
- **If the seat belt does not work properly, it cannot protect your child from death or serious injury. Contact any authorized Hino dealer immediately. Do not install the child restraint system on the seat until the seat belt is repaired.**

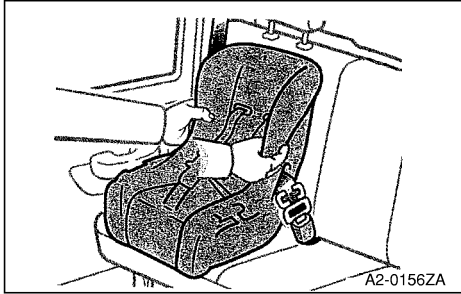


To install the forward-facing child seat:

1. Run the lap and shoulder belt through or around the forward-facing child seat following the instructions provided by its manufacturer. Insert the metal tongue of the seat belt latch plate into the seat belt buckle, taking care not to twist the belt. Pull any slack out of the lap portion of the belt so that the base of the child restraint is tight against the vehicle seat. Hold the lap and shoulder belt webbing at the latch plate in that position, and release the buckle.



2. Keep holding the lap and shoulder belt webbing together, install a seat belt locking clip near the latch plate of the lap and shoulder belt and thread the lap and shoulder webbing through the locking clip as depicted in the instructions which accompany the seat belt locking clip. Buckle the belt again. If the belt has any slack, release the buckle and start from "1" again .



(C) CONVERTIBLE SEAT INSTALLATION

On the outboard seat of this vehicle, a convertible seat may be used in forward-facing or rear-facing position depending on the age and size of the child. When installing, follow the manufacturer's instructions about the applicable age and size of the child as well as directions for installing the child restraint system.



WARNING

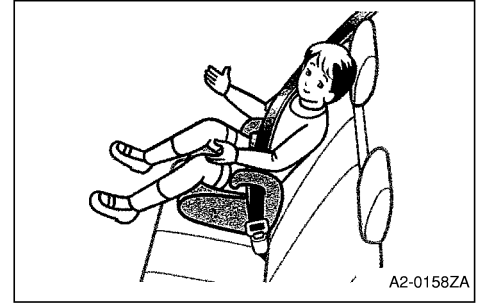
Push and pull the child restraint system in different directions to be sure it is secure after securing it with the vehicle's seat belt to the vehicle's seat. Follow all the installation instructions provided by the child restraint system manufacturer.



WARNING

Never install a convertible seat in rear-facing position on the center seat of this vehicle (if so equipped). The seat cannot be safely secured, and death or serious injury to the child or other passengers may result in the event of a sudden stop or accident.

See instructions and warnings for installing rearward-facing and forward-facing child seats on the outboard seat of this vehicle, above.



(D) BOOSTER SEAT INSTALLATION

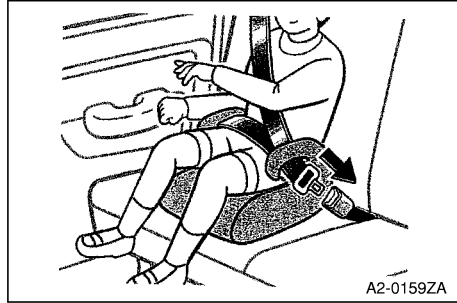
A booster seat is used in forward-facing position only.

In the United States, the NHTSA recommends use of a booster seat and lap and shoulder belt for children from about 4 years of age and 40 pounds to about 8 years of age and to a height of 4 feet 9 inches. Be sure to check your local laws for the age and size of child appropriate for a booster seat.

When installing, follow the child restraint system manufacturer's instruction about the applicable child's age and size as well as directions for installing the child restraint system.

 **WARNING**

Never use a locking clip when you install a booster seat. The seat belt cannot safely secure the child and the booster seat, and death or serious injury to the child or other passengers may result in the event of a sudden stop or accident.



To install the booster seat:

Place booster seat in the outboard seat position. Sit the child on the booster seat. Run the lap and shoulder belt through or around the booster seat following the instructions provided by its manufacturer. Insert the metal tongue of the seat belt latch plate into the seat belt buckle, taking care not to twist the belt.

 **WARNING**

- To avoid the possibility of death or serious injury:
 - Make sure the lap belt is positioned on the child's upper thighs. The lap belt should not be positioned on the top of the child's hips or across the child's abdomen.
 - Make sure the shoulder belt is correctly across the child's chest. The shoulder belt should cross the middle of the child's collarbone. It should not be positioned against the child's neck or off the child's shoulder.
 - If the lap and shoulder belt cannot be properly positioned on the child in a booster seat then the child should be placed in a forward-facing child seat.

- Always make sure the shoulder belt is positioned across the center of child's collarbone. The belt should be kept away from child's neck, but not falling off the child's shoulder. Failure to do so could reduce the amount of protection in an accident and cause death or serious injuries in a collision.
- Both high-positioned lap belts and loose-fitting belts could cause serious injuries due to sliding under the lap belt during a collision or other sudden stop. Keep the lap belt positioned on a child's upper thighs.
- For child's safety, do not place the shoulder belt under child's arm or behind the child's back.
- After inserting the metal tongue of the latch plate into the seat belt buckle, make sure the tongue and buckle are locked and that the lap and shoulder portions of the belt are not twisted.

- Do not insert coins, clips, etc. in the buckle as this may prevent you from properly latching the metal tongue and buckle.
- If the seat belt does not work properly, it cannot protect your child from death or serious injury. Contact any authorized Hino dealer immediately. Do not install the child restraint system until the seat belt is repaired.

2. Installation on with 2-point type seat belt (Center Seat, if so equipped)

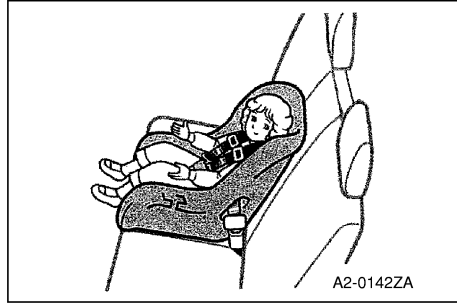
 **WARNING**

- Do not install a child restraint system of any type on the center seat if it prevents you from operating the gear shift lever or other controls.
- Never install a rear-facing infant seat (including a rear-facing positioned convertible seat) or a booster seat on the center seat of this vehicle (if so equipped). A rear-facing infant seat or a booster seat cannot be safely secured, and death or serious injury to the child or other passengers may result in the event of a sudden stop or accident. A rear-facing child seat or a booster seat may be used only with a lap and shoulder belt on the outboard seating position.

When securing a child restraint system with 2-point seat belt of the center seat, pull the excess webbing through the belts adjustment feature, then take the following steps:

1. Once installed, ensure that the child restraint system is securely installed by pushing and pulling it in all directions after the child seat has been secured to the seat by the lap belt. If it comes loose, turn the end of the seat belt with the adjustment feature over before re-buckling. The seat belt buckle should not be against the child restraint.
2. If the child restraint system is still not secured, install the child restraint system on the outboard seat in this vehicle.

The outboard seat position of your vehicle has a lap and shoulder belt equipped with an Emergency Locking Retractor (ELR). A seat belt equipped with an ELR requires a locking clip to install a child restraint system (except for a booster seat).



[Installation Procedure]

(A) FORWARD-FACING CHILD SEAT INSTALLATION

A forward facing child seat must be used in a forward-facing position only.

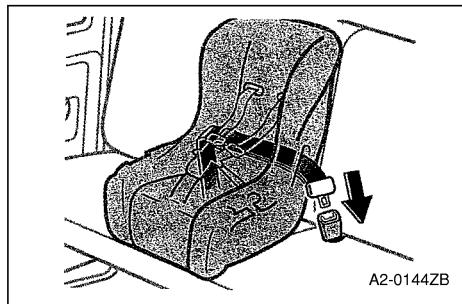
In the United States, the NHTSA recommends use of forward-facing infant seat for toddlers from at least one year of age and at least 20 pounds in weight to about 4 years of age and 40 pounds. Be sure to check your local laws for the age and size of child appropriate for forward-facing child seat.

When installing, follow the child restraint system manufacturer's instruction about the applicable child's age and size as well as directions for installing the child restraint system.



WARNING

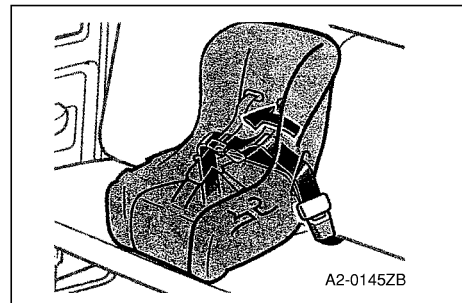
- After inserting the metal tongue of the latch plate into the buckle, make sure the tongue and buckle are locked and that the lap belt is not twisted.
- Do not insert coins, clips, etc. in the buckle as this may prevent you from properly latching the tongue and buckle.
- If the seat belt does not function normally, it cannot protect your child from death or serious injury. Contact any authorized Hino dealer immediately. Do not install the child restraint system on the seat until the seat belt is fixed.



A2-0144ZB

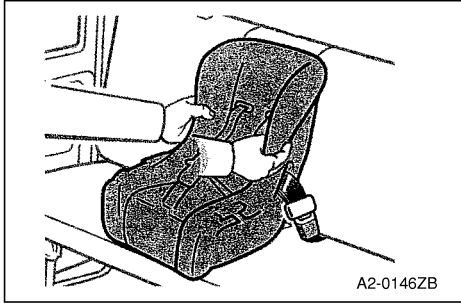
To install the forward-facing child seat:

1. Run the center lap belt through or around the forward facing seat following the instructions provided by its manufacturer. Insert the metal tongue of the seat belt latch plate into the seat belt buckle taking care not to twist the lap belt.



A2-0145ZB

2. While pressing the forward facing child seat firmly against the seat cushion and seatback, tighten the lap belt by pulling its free end to hold the forward facing child seat securely.



(B) CONVERTIBLE SEAT INSTALLATION

On the center seat of this vehicle, a convertible seat may be used in forward facing position only. When installing, follow the manufacturer's instructions about the applicable age and size of the child as well as directions for installing the child restraint system.

WARNING

Push and pull the forward facing child restraint system in different directions to be sure it is secure after securing it with the lap belt to the vehicle's seat. Follow all the installation instructions provided by its manufacturer.

WARNING

Never install a convertible seat in rear-facing position on the center seat of this vehicle. The convertible seat cannot be safely secured, and death or serious injury to the child or other passengers may result in the event of a sudden stop or accident.

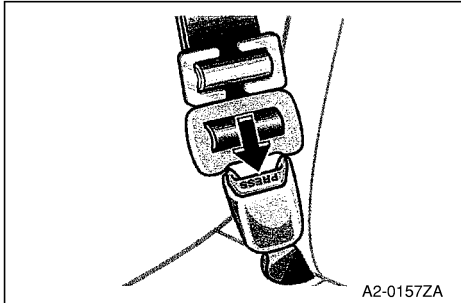
To install the convertible seat:

See instructions and warnings for installing forward facing child seats on the center seat, above.

WARNING

- **Keep the child restraint system properly secured with a seat belt if it is on the seat even if it is not in use. Do not store the restraint unsecured in the cabin.**
- **Otherwise, remove it from the vehicle. This will prevent it from injuring passengers in the event of a sudden stop or accident.**

—Removal of child restraint systems

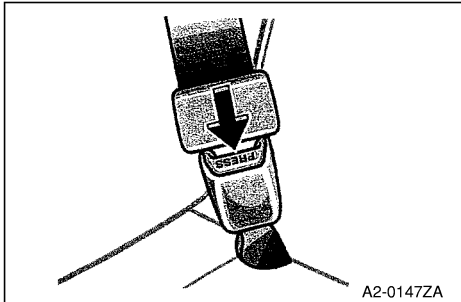


3-point type seat belt (Outboard Seat)

To remove the child restraint system, press the buckle release button and allow the belt to retract completely.

WARNING

Always remove the locking clip when the child restraint system is not installed.



**2-point type seat belt
(Center Seat, if so equipped)**

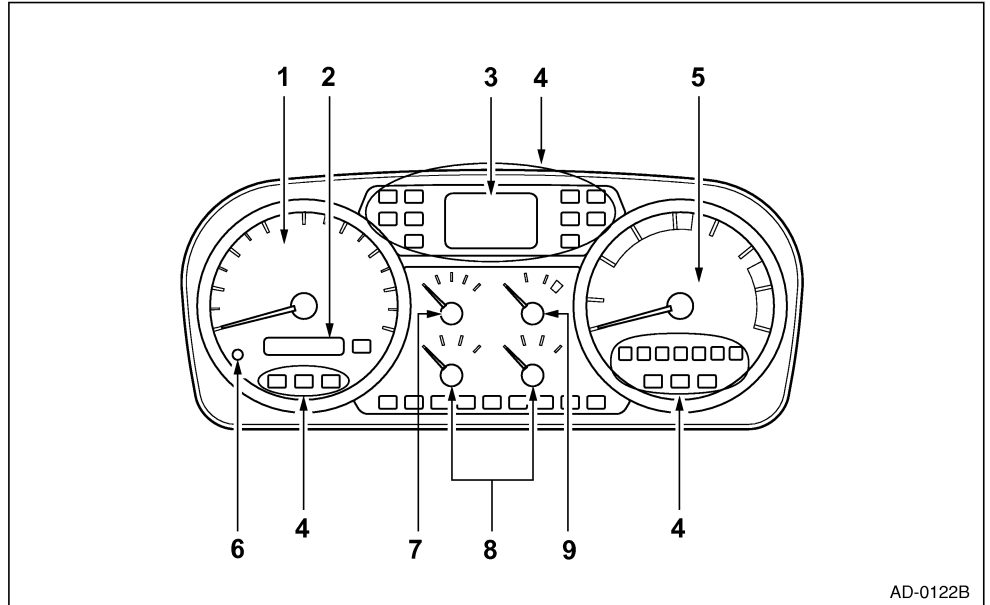
INSTRUMENT PANEL AND CONTROLS

The gauges and controls necessary to run your vehicle are mounted on the instrument panel.

IMPORTANT: For safe driving, do not place anything on driver's seat, dashboard or instrument panel that will obstruct driver's view of the instruments or the road.

Instrument panel

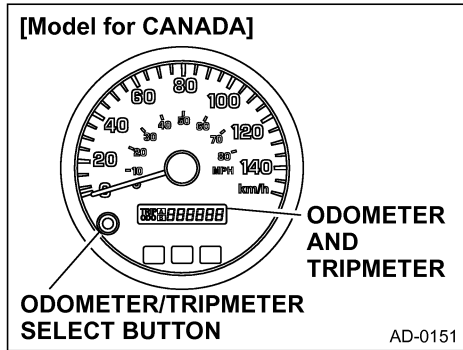
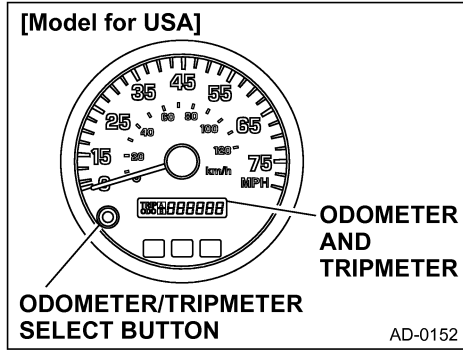
1. Speedometer
2. Odometer and Tripmeter
3. Information display
4. Warning and Indicator lights
5. Tachometer
6. Trip meter reset knob
7. Fuel gauge
8. Air pressure gauge
9. Coolant temperature gauge



AD-0122B

METER AND GAUGE

Speedometer, Odometer and Tripmeter



Speedometer

The speedometer indicates the vehicle's forward speed in miles per hour (MPH) and kilometers per hour (km/h).

Odometer and two tripmeters

This meter displays the odometer and two trip meters.

- **Odometer**

Shows the total distance the vehicle has been driven.

- **Two trip meters (TRIP A and TRIP B)**

Shows two different distances independently driven since the last time each trip meter was set to zero. You can use one trip meter to calculate the fuel economy and the other to measure the distance on each trip.

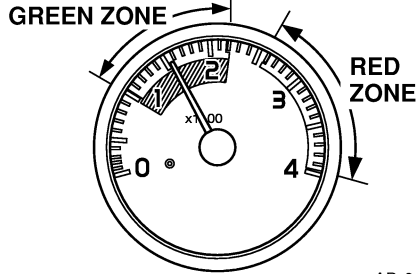


- **Trip meter reset**

Resets the two trip meters to zero, and also changes the meter display. To change the meter display, quickly push and release the button. The meter display changes in the order from the odometer to trip meter "TRIP A" to trip meter "TRIP B", then back to the odometer each time you push. To reset the trip meter "TRIP A" to zero, display the meter "TRIP A" reading, then push and hold the button until the meter is set to zero. The same process can be applied for resetting the trip meter "TRIP B".

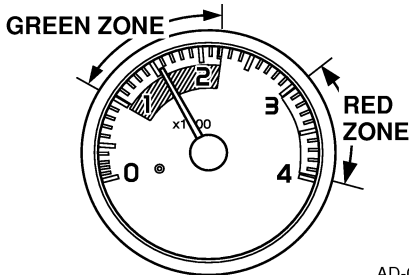
Tachometer

[Model for J08E engine]



AD-0153

[Model for J05D engine]



AD-0154

The tachometer indicates the engine speed in revolutions per minute (RPM, r/min.).

The green zone indicates the better engine speed for fuel economy.

The red zone indicates overrunning.

(J08E: Over 2,600RPM(r/min.)

(J05D: Over 3,000RPM(r/min.)



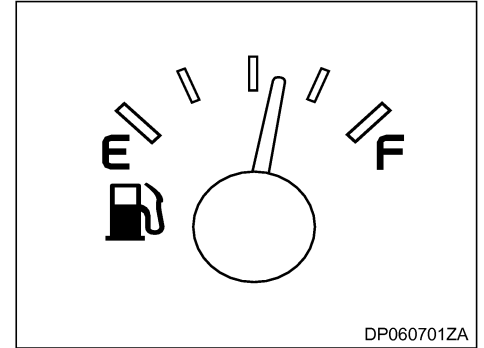
WARNING

Never drive with tachometer in red zone. In the red zone, you are exceeding the maximum permissible engine revolution. Doing so can cause severe engine and power damage and can result in serious injury and/or property damage.

HINT:

“OVERRUNNING” means the engine speed is exceeding the maximum permissible engine revolution. Operating the engine at this speed will impose excessive loads on different parts of the engine and will result in damage to the engine.

Fuel gauge



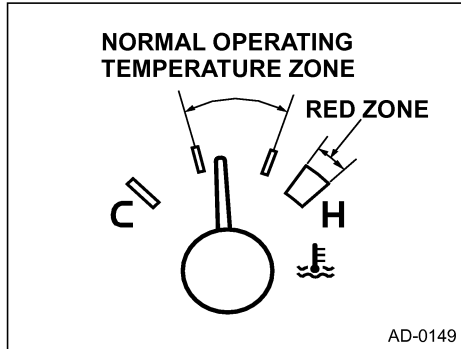
The fuel gauge indicates the approximate level of fuel in the fuel tank. It operates when the starter key is in the “ON” position. Fill the tank with diesel fuel when the pointer gets near the “E”.



CAUTION

To prevent damage to the engine, only use ultra low sulfur diesel fuel.

Coolant temperature gauge

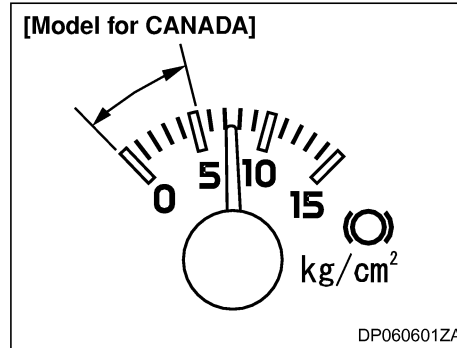
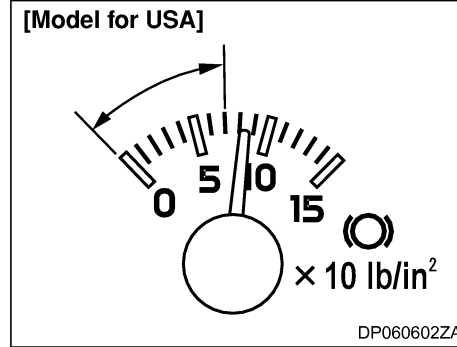


This gauge operates when the starter key is "ON" and indicates the engine coolant temperature. Normal operating temperature is indicated in the figure. The red zone indicates engine overheating. If the pointer is between normal and red zone while driving, you can continue to drive paying attention to the gauge.

 **CAUTION**

If the pointer is in the red zone or you notice the engine overheating, follow instructions in Section 5 OVERHEATING on page 5-10.

Air pressure gauge [Full air brake type]

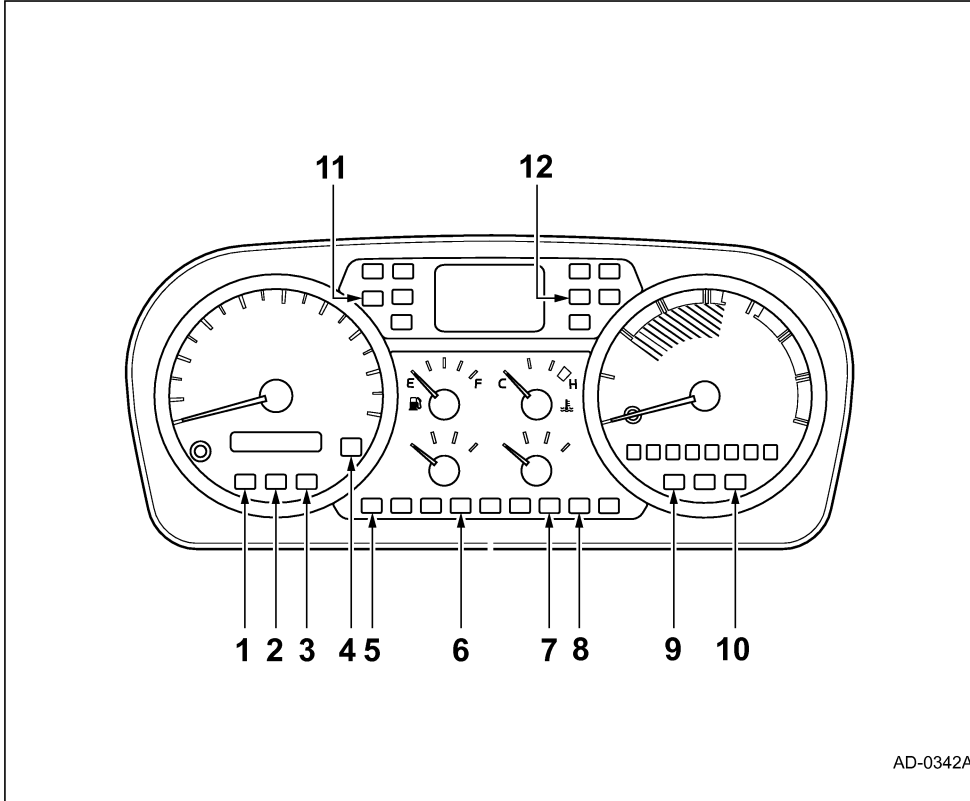


This gauge indicates the air pressure in the reserve tank of the service brake system. When the air pressure drops **below 65lb/in² (4.5kg/cm²) to 77lb/in² (5.3kg/cm²)**, the warning light on the instrument panel lights and the beep sounds. (The beep does not sound as long as the parking brake is applied.) If the warning light and beep come on while driving, pull off the road and stop the vehicle as soon as possible at a safe place. Have an authorized Hino dealer check and correct the malfunction. Continued driving without correction is extremely hazardous.

 **WARNING**















Low air pressure in the brake system could result in the brakes not working. Do not drive the vehicle until this malfunction is corrected by an authorized Hino dealer.

WARNING AND INDICATOR LIGHT



Warning light

Your vehicle is equipped with system warning lights on the instrument panel. These lights remain unlit if the related system is functioning normally. If a warning light remains unlit with the starter key in the "ON" position while the engine is not running, it indicates that the warning light is malfunctioning. After starting the engine, if it indicates a system malfunction and/or a beep sounds, it indicates a system malfunction. Stop the vehicle immediately and refer to the next page. Note that all warning lights will turn off if the starter key is turned to the "ACC" or "LOCK" position.

No.	Symbol	Function	If light comes on or gauge is too low or too high, do this	Refer to Page No
1	 	Parking brake	If parking brake is off, stop and check.	2-32
2	 	Brake pressure	Stop the vehicle, check and contact Hino dealer.	2-32
3		Air brake pressure	Stop the vehicle and contact Hino dealer.	2-32
4		Low fuel level	Fill up tank	2-33
5	 ABS	ABS line	Stop the vehicle and contact Hino dealer.	2-33
6		Coolant level	Coolant level too low. Fill up coolant in the reserve tank.	2-33
7		Automatic transmission fluid temperature	Stop the vehicle and check	2-34
8		Automatic transmission	Stop the vehicle and check	2-34
9		Engine oil pressure	Stop the vehicle and contact Hino dealer.	2-35
10		Engine electronics	Stop the vehicle and contact Hino dealer.	2-35
11		Fuel filter	Drain water	2-35, 7-66
12		Battery charge line	Stop the vehicle and check.	2-36

1. Parking brake warning light

With the parking brake applied and the key in the "ON" position, the parking brake warning light will come on.



CAUTION

The brake light is on when the parking brake is not completely released. To prevent damage to parking brake, release before driving.

2. Brake pressure warning light [Hydraulic brake type]

If light remains on after you start the engine, this may indicate a brake system failure. In this case, your brakes may not work. Do not drive the vehicle with this light on.

This light illuminates when the engine is off and the key is in the "ON" position.

3. Air brake pressure warning light [Full air brake type]

The light comes on when the starter key is turned to the "ON" position. If the air pressure system works properly, the light turn off after few seconds. The after warning light and beep are designed to come on when the air pressure in the air brakes gets to low.



CAUTION

If the warning light comes on and/or the beep sounds while driving, stop your vehicle at the nearest safe place. But remember that the stopping distance may be longer.

Have an authorized Hino dealer check and correct the malfunction before driving again.

After starting the engine do not drive your vehicle until the warning light has turned off and the beep has stopped sounding. The beep does not sound as long as the parking brake is applied.

4. Low fuel level warning light

The light comes on when the starter key is turned to the "ON" position. If the fuel level properly, the light turn off after few seconds. This light comes on when the fuel in the tank is nearly empty. Fill up the tank as soon as possible. On inclines or curves, due to the movement of fuel in the tank, the low fuel level warning light may come on earlier than usual.

5. Anti-Lock Brake System warning light

This light confirms that the Anti-Lock Brake System (ABS) is properly functioning. The light should come on briefly when the key is turned "ON" position. If the light comes on while driving or doesn't come on when starting the vehicle, you may have a problem with your ABS. Have your vehicle serviced immediately by an authorized Hino dealer.



WARNING

If the ABS light comes on while driving, there could be a problem with the ABS. Your regular service brakes will, however, work normally, but you should be careful and drive the vehicle in the same way that you would drive a vehicle without ABS. Have your vehicle inspected and serviced immediately at an authorized Hino dealer.

6. Coolant level warning light

The light comes on when the starter key is turned to the "ON" position. If the coolant level properly, the light turn off after few seconds. After the coolant level warning light comes on confirm the residual volume of coolant in the radiator. Check to see if coolant is leaking from the cooling system. If it is, do the following:

1. If the reserve tank is empty:
If the leakage of coolant is found, bring your vehicle to an authorized Hino dealer to have it checked and repaired.
If there is no leakage of coolant, wait until the engine and radiator have cooled down and replenish the radiator and/or the reserve tank.
2. If there is coolant in the reserve tank:
Bring your vehicle to an authorized Hino dealer to have it checked and repaired.



CAUTION

If the warning light comes on and/or the beep sounds while driving, pull off the road immediately and stop your vehicle carefully.

7. Automatic transmission fluid temperature warning light

This light indicates when the automatic transmission fluid temperature exceeds specified limits. If the transmission overheats during normal operations do the following. Check the fluid level in the transmission. Stop the vehicle and check the cooling system. If it appears to be functioning properly, run the engine at 1,200-1,500 RPM (r/min.) with the transmission in "N". This should reduce the transmission and engine temperatures to normal operating levels in 2 or 3 minutes. If temperatures does not decrease, reduce the engine RPM (r/min.). If high temperature in either the engine or transmission persists, stop the engine and have the overheating condition investigated by maintenance personnel. Have your contact by an authorized Hino dealer.

8. Check automatic transmission warning light (Allison 1000HS,1000RDS,2200HS,2200RDS,2500RDS,3000RDS)

Each time the starter key is turned to the "ON" position to check automatic transmission warning light.

It illuminates within one second, and then it goes off after a few seconds.

If the light does not illuminate when starting the engine, or if the light remains on after starting the engine, the transmission system should be checked immediately.

Illumination of the check automatic transmission warning light at any time after start-up indicates that a problem has been detected. The ECU will register a diagnostic code and shifts may be restricted. Depending on the severity of the problem, you may be able to continue operating the vehicle until you reach an authorized Hino dealer.

The ECU may not respond to shift selector requests since upshifts and downshifts may be restricted and direction changes may not occur.

9. Oil pressure warning light

The oil pressure warning light indicates that the engine oil pressure is not high enough for safe operation.



CAUTION

If the warning light comes on and/or the beep sounds while driving, pull off the road and stop the engine immediately. Have authorized Hino dealer check and correct it. Otherwise, continued driving can result in serious damage to the engine.

10. CHECK ENGINE warning light

This light shows whether the operating condition of the electronically controlled fuel injection system is normal or not.

Operation of the CHECK ENGINE warning light

- (1) The light comes on when the key is turned to "ON" or "START" position before starting the engine. If it doesn't light, either the light has burned out or there is a problem with the fuel system.
- (2) While the system is operating after starting the engine, it will go off. If this light comes on after starting the engine or while driving the vehicle, it is a sign that something abnormal has occurred.

NOTICE:

If something unusual has been found in the operations (1) and (2) above, have your vehicle checked and repaired at an authorized Hino dealer.

- Occurrence of system abnormality:
The warning light comes on. It is necessary to have your vehicle checked and repaired as quickly as possible.

11. Fuel filter warning light

The light comes on when the key is turned to the "ON" position. If the accumulated water level properly, the light turn off after few seconds.

This light warns you that the amount of accumulated water in the fuel filter has reached the specified level. If this light comes on, drain the accumulated water immediately. (See page 7-22 for FUEL SYSTEM)

NOTICE:

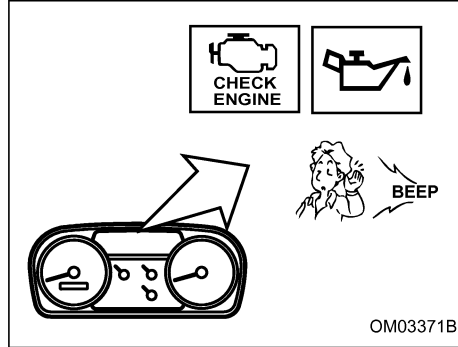
Never drive with this warning light turn on. Doing so will damage the engine.

12. Battery charge warning light

The battery charge warning light indicates the state of the battery charging circuit. When the key is turned to the “ON” position, the light comes on. It should go off when the engine is at idle speed or above. If it doesn't or it comes on while driving, stop the vehicle and have your vehicle checked and repaired at an authorized Hino dealer.

ENGINE SHUTDOWN (IF SO EQUIPPED)

Shutdown warning light or audible beep



Good practice calls for several minutes prior to shutdown, particularly after a long run where engine has been producing maximum horsepower and heat load. This allows heat to be dissipated from iron masses and evenly distributed throughout the various system. Vehicles may be equipped with an automatic shutdown system which stops the engine in the event of high coolant temperature or low engine oil pressure. A warning light on the instrument panel along with an audible beep will indicate high coolant temperature or low oil pressure.

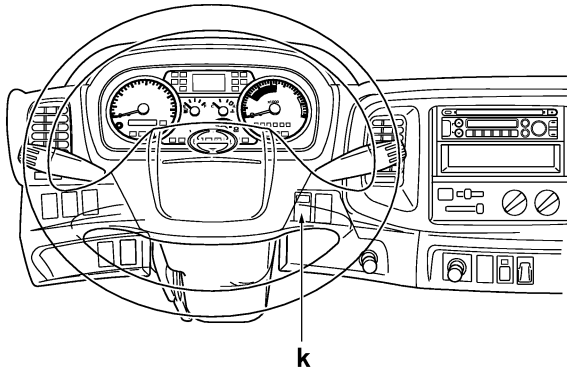
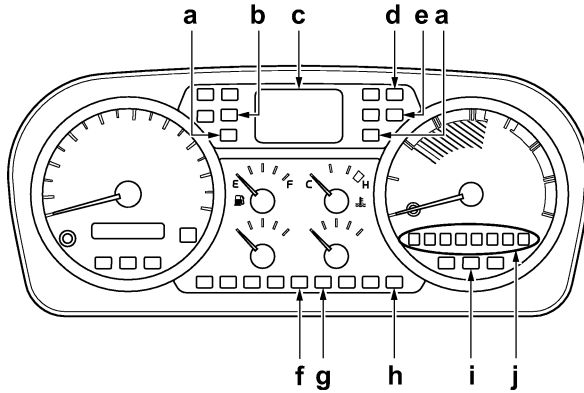
If the temperature and/or oil pressure continues to change beyond the warning point to a predetermined level, the engine will automatically shut down.

Vehicles equipped with the automatic shutdown system are also equipped with an override feature which will allow the engine to be restarted so that the vehicle can be moved, if mechanically capable. The engine should be run no longer than absolutely necessary. Activate the override system by turning the key to “LOCK” position. Then turn the key to the “START” position to restart the engine.

If the oil pressure low or coolant temperature high warnings activate, the engine will not run

NOTICE:








If the idle shutdown customizing function is needed, contact an authorized Hino dealer.



Indicator lights

- a. Turn signal or hazard lights
- b. Headlight high beam light
- c. Information display
- d. Pre-heater light
- e. Exhaust brake
- f. DPR indicator light
- g. Constant speed cruise control light
- h. Automatic transmission inhibit lights
- i. O/D OFF light
- j. Automatic transmission select position lights
- k. UltraShift transmission gear display

AD-0556

No.	Symbol	Indication	Refer to Page
a		The turn signal or hazard lights are operating.	2-39
b		The headlight high beam is turned on.	2-39
c		The “Information display” has been enabled.	2-39
d		The glow plugs are heating.	2-39
e		The “Exhaust brake” or “DPR regeneration” has been enabled.	2-39
f		The DPR manual regeneration has been enabled.	2-39, 2-71
g		The “Cruise control” has been enabled (amber), or engaged (yellow-green)	2-39
h	INHIBIT	The automatic transmission operation is being inhibited and range shifts being requested by the operator may not occur.	2-39
i	O/D OFF	The overdrive range of the automatic transmission is not being used.	2-40
j	P* R N OD* D 5* 4* 3* 2 1	The automatic transmission has been engaged in this select position. (*The symbol is different depending on the vehicle model.)	2-40
k	R N 6 5 4 3 2 1, ↑ ↓, --, CA, F, **, PD	<ul style="list-style-type: none"> • The UltraShift transmission has been engaged in this select position. (R, N, 6, 5, 4, 3, 2, 1) • Arrows ↑ or ↓: The transmission position is waiting to verify increased or decreased. • --: It has been locked in gear. • C or A flashing mark: The driver is abusing clutch and it is getting too hot. • F: It has some faults in the transmission system. • **: Bus communications are not active. • PD: Transmission is put in Product Diagnostic Mode. 	2-40

Indicator lights

a. Turn signal indicator lights

The turn signal indicator lights on the instrument panel flash when the turn signals or hazard lights are operating. (See page 2-46)

b. Headlight high beam indicator light

The headlight beam indicator light on the instrument panel lights when the headlight high beam is turned on or the passing switch lever is pulled up. (See page 2-46)

c. Information display

The INFORMATION DISPLAY alerts the driver to the condition of the vehicle, driving factors including fuel consumption, trip mileage and operation time, the vehicle's maintenance schedule and important cautionary messages. (See page 2-55 to 2-67)

d. Pre-heater indicator light

The pre-heater indicator light comes on when the glow plugs are heating. The light will go off, when the glow plugs are hot enough. (See page 3-19)

e. Exhaust brake indicator light

Exhaust brake indicator light is lit whenever the "ON" switch on the exhaust brake lever is pulled down and/or operating the DPR manual regeneration. (See page 2-47)

f. DPR indicator light

DPR indicator light flash, when the cleaning of the DPR cleaner is necessary. When DPR indicator light starts to flash, follow instructions on page 2-69.

g. Constant speed cruise light

Constant speed cruise light (orange in color) is lit whenever the "ON" switch on the "Cruise control" is pushed for more than 0.5 seconds. Cruise start when the set button is pressed and the cruise light color is change the orange to yellow-green. (See page 2-48 to 2-52)

h. INHIBIT indicator light

**[Model: HINO 238, 258, 268, 308]
Allison 1000HS , 1000RDS ,
2200HS , 2200RDS , 2500RDS**

On models equipped with automatic transmission. This indicates that transmission operation is being inhibited and that range shifts being requested by the operator may not occur. When certain operating conditions are detected by the ECU the controls will command the transmission to be locked in the range currently in use. If the torque converter clutch is applied when the condition is detected, the clutch will be disengaged concurrently with the activation of the INHIBIT light.

i. O/D OFF indicator light

[Model: HINO 145, 165 and 185 with Aisin 450 type automatic transmission models]

On models equipped with automatic transmission, the indicator light comes on when the overdrive switch installed on the transmission selector is in the off position.

Overdrive will not operate even if you select the automatic transmission is in "D" position, unless engine RPM (r/min) is excessive.

(See page 2-87)

**The a problem has been detected
(After the problem has been detected)**

Illumination of the check automatic transmission warning light at any time after start-up indicates that a problem has been detected. The ECU will register a diagnostic code and shifts may be restricted. Depending on the severity of the problem, you may be able to continue operating the vehicle until you reach an authorized Hino dealer. The ECU may not respond to shift selector requests since upshifts and downshifts may be restricted and direction changes may not occur.

j. Select position indicator lights

[Model: Automatic transmission models]

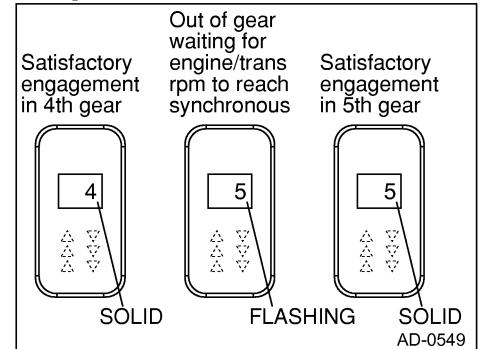
On models equipped with automatic transmission, the indicator lights indicate that the automatic transmission has been selected to this position. (See page 2-83 to 2-90)

k. Gear Display

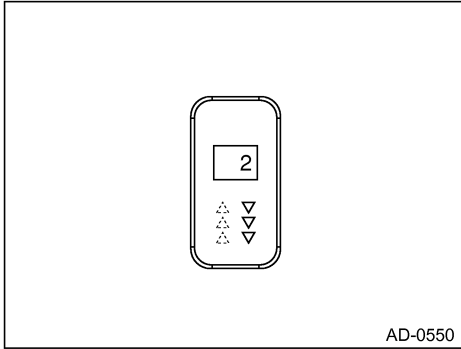
[Model: HINO 258, 268, 338 with Ultra-Shift transmission]

1. The Gear Display shows the current gear position of the transmission.

The Gear Display will flash the target gear position of the transmission when in neutral during a shift.

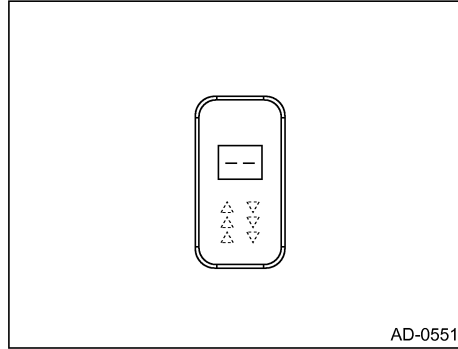


Down arrows on the Gear Display indicate the transmission is waiting to verify decreased input shaft speed, before a gear engagement from Neutral can be completed.



2. Locked in gear

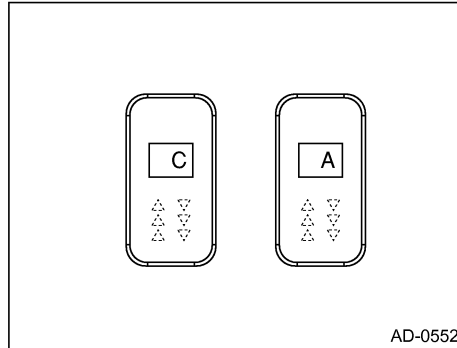
The “Double DASH” indicates the transmission may be torque locked in gear.



If the truck is shut down or stalls in gear, the UltraShift may become locked in gear. The transmission will attempt to get to Neutral during the next power up if the shifter is in Neutral. If Neutral is achieved, a solid “N” appears on the Gear Display. If Neutral can not be achieved, a “Double DASH” will appear on the display and the engine will not start. If a dash appears during power up and the lever is in Neutral try the following:

- (1) Select Neutral, "N." Turn the key OFF and let the transmission power down for at least 2 minutes.
- (2) Depress the brake pedal.
- (3) Release the parking brake.
- (4) Select Neutral.
- (5) Turn the key to the ON position.
- (6) The transmission will attempt to shift into Neutral once you turn the key ON, but you may have to slightly release the brake pedal to help let the torque off the drive line.
- (7) Once it reaches Neutral a solid "N" will appear on the Gear Display and the truck will start. If a dash still appears after this procedure take the vehicle to a local service center.

3. Clutch Protection



Even though this truck does not have a clutch pedal, it still has a mechanical clutch. As the driver slowly increases and decreases engine rpm from a stop, the clutch is engaging and disengaging, just like slipping the clutch with a manual transmission.

If the vehicle is operated for long periods between engine idle and 1000 rpm during take off, the driver is slipping the clutch which gets the clutch HOT. If the clutch starts to get too hot, a warning tone will sound and a "C" and then an "A" will flash on the gear display (**Clutch Abuse**). This is an indication that the driver is abusing the clutch and it is getting too hot to operate - potentially resulting in a failure.

If a "C" and then an "A" shows on the gear display during vehicle operation, stop the vehicle for at least two minutes and let the clutch cool down. Continuing operation with the "C" and "A" flashing on the gear display will cause the clutch to become even hotter and/or limit the engine to idle speed until the clutch cools (approximately 3 minutes). Repeated incidents of clutch abuse may cause the clutch to fail and render the truck immobile, resulting in extended down time.

Below are some examples of situations that may initiate clutch abuse, and instructions on how to avoid them:

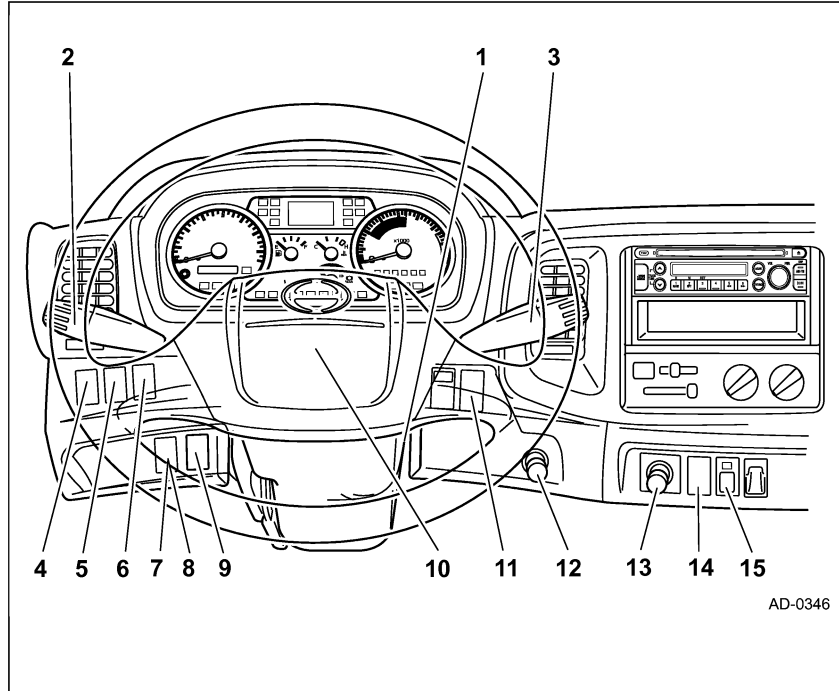
Example	How to Avoid
Holding on hills using the throttle rather than the service brake	Use the service brakes to hold on the hill. To start moving, apply the throttle and release the brakes as you feel the truck start to pull.
Moving trailer tandems	Be sure to always start off in 1st gear when moving forward, and Reverse when moving backwards.
Hooking up a trailer	Always be sure the trailer is high enough to back under. Use Reverse.

4. Product Diagnostic Mode “PD”

In the event the transmission is put in Product Diagnostic Mode, a “PD” will be displayed on the gear display, and the **truck will not start**. Use the following procedure to exit Product Diagnostic Mode:

- (1) Select Neutral “N” and turn the key off.
- (2) Wait at least 2 minutes.
- (3) Turn the key on and power the system up.
- (4) Verify there is an “N” on the gear display.
- (5) Start the engine.

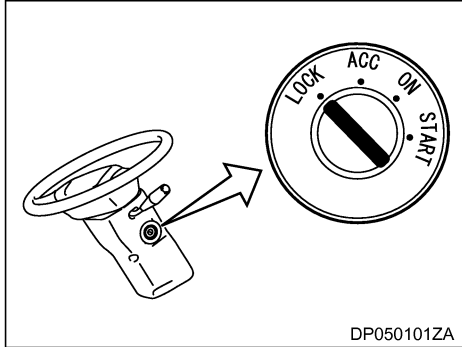
SWITCHES AND BUTTONS



No.	Switch and buttons	Refer to page No.
1	Key with steering lock	2-43
2	Combination lighting switch (Lighting, beam control and turn signal)	2-45
3	Combination switch (Windshield wiper control and washer switch, exhaust brake switch and hazard switch)	2-47
4	Cruise control set button	2-49
5	Cruise control main switch	2-49
6	Rheostat light control switch	2-53
7	Van light switch (If so equipped)	2-53
8	Air suspension dump switch (If so equipped)	2-53
9	Information display control switch	2-55
10	Electric horn	2-67
11	Air horn (If so equipped)	2-67
12	Idle set knob (If so equipped)	2-68
13	Cigarette lighter	2-69
14	Mirror heater switch (If so equipped)	2-69
15	DPR manual regeneration switch	2-69

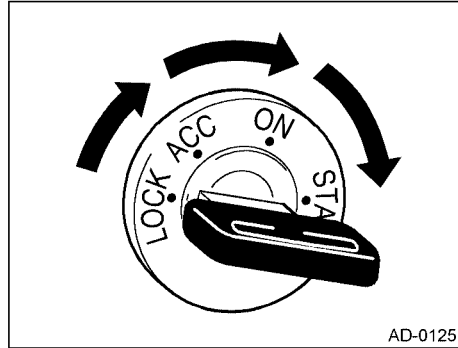
1. KEY

(1) Key with steering lock



Insert the key fully. You may turn the key to the “ACC”, “ON”, “START” position.

(2) “LOCK” position



In the “LOCK” position, the steering wheel locks. The key cannot be inserted or removed at any other position. Turn the key while pressing to set it at “LOCK” position. Then pull out the key.

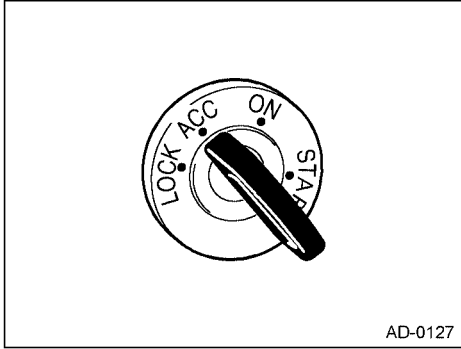
CAUTION

Never move the vehicle after removing the key or while the key is in the “LOCK” position. This operation is extremely dangerous because the steering wheel is locked and the vehicle cannot be steered.

NOTICE:

- If the key will not turn to or from the “LOCK” position, turn the steering wheel slightly clockwise or counterclockwise, and the key can then be turned easily.
- After the engine is stopped, always set the key to the “LOCK” position. If the key is clockwise in the “ON” or “ACC” position the batteries will begin to discharge, and this may result in difficulty later in starting the engine.

(3)“ACC” (ACCESSORY) position

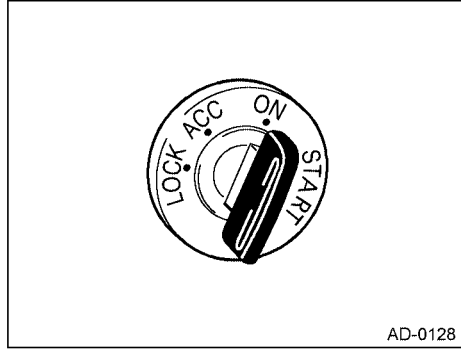


Turning the key to the first position closes the accessory equipment circuit (such as the cigarette lighter and audio), but does not close the starter, preheating warning device and charging circuits.

NOTICE:

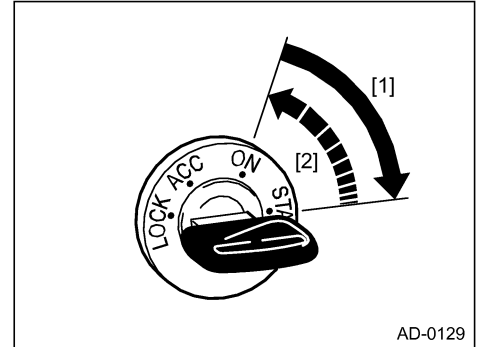
To stop the engine, rotate the key counterclockwise to the “ACC” or “LOCK” position.

(4)“ON” position



Turning the key to the second position closes all electrical circuits except the starter circuits.

(5)“START” position



- (1)Turning the key to this position energizes the starter allowing the starter to crank the engine.
- (2)The key automatically returns to the “ON” position when released.

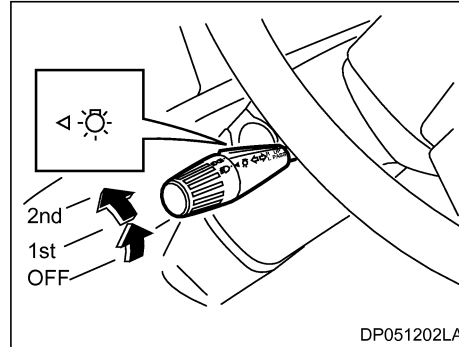
⚠ CAUTION

Do not turn the key to “START” position after the engine has started. This could cause damage to the starter and/or engine.

(3) Warning and indicator lights will come on. When the key is in the "ON" position, abnormalities of each part and operation of devices etc. are displayed with priority over the normal display.

2. Combination lighting switch

(1) Lighting switch



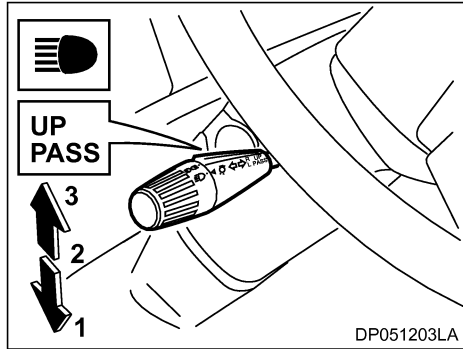
Light	Switch position		
	OFF	1st	2nd
Instrument panel			
Clearance	×	○	○
Tail lights			
License plate			
Headlights	×	×	○
Day time running lights	○	○	×

- When turned counterclockwise to the "1st" position, the clearance lights, identification lights, side marker lights, tail lights, license plate lights and instrument lights are turned on.
- When turned counterclockwise to the "2nd" position, the headlights are turned on in addition to the above lights.
- The day time running lights are turned on when the parking brake is released and the lighting switch to the "OFF" or the "1st" position. When turned to the "2nd" position, the day time running lights are turned off in addition to the above lights.

NOTICE:

To prevent the battery from being discharged, do not leave the lights on for a long period when the engine is not running.

(2) Beam control switch



The beam control switch operates in the following manner:

High beam - Push down (Position 1)

The head lights come on at high beam. The high beam indicator light comes on while the high beam is used.

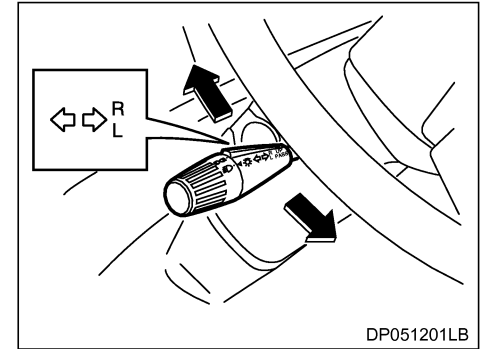
Low beam (Position 2)

Pull the lever toward you for low beam. The high beam indicator light turns off.

Passing - Pull up (Position 3)

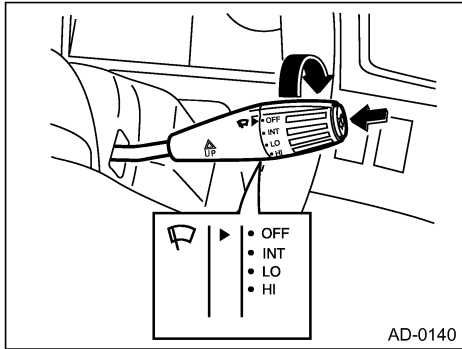
The high beam headlight will stay lit as long as the lever is held up. The passing position can be used even when the beam control switch is in the "OFF" position.

(3) Turn signal switch



The turn signal switch is actuated by pulling the switch down toward you for a left turn, or pushing up for a right turn. The turn signal indicator light in the instrument panel will flash in the direction of the turn being signalled even when key is in the "LOCK" or "ACC" position. The switch lever is of the self-cancelling type.

3. Combination switch



(1)Windshield wiper control switch

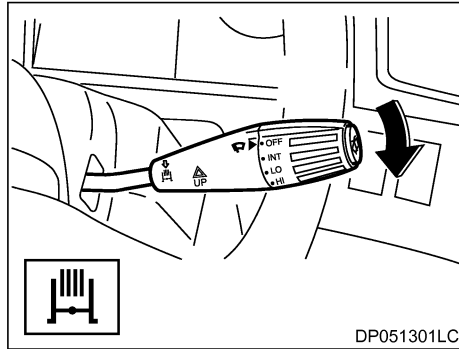
The windshield wiper switch has four positions, HI, LO, INT (Intermittent) and OFF. Select the switch position appropriate to the weather conditions.

(2)Windshield washer switch

To operate the washer, push the switch button. The washer solution is sprayed on the windshield while the washer button is pushed.

Do not operate the washer button continuously for more than 15 seconds.

(3)Exhaust brake switch



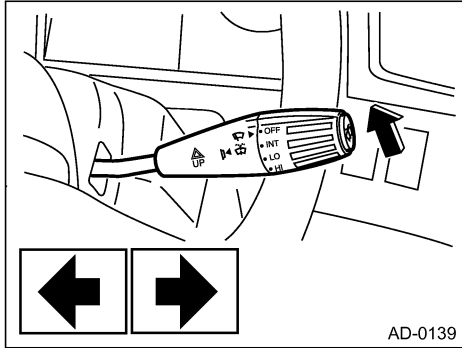
To operate the exhaust brake, pull the lever toward you. This will apply the brakes as the accelerator pedal is released.

The indicator light on the instrument panel shows the exhaust brake is ready for the operation. The exhaust brake enhances the normal engine braking effect and helps reduce foot brake applications. Use it when driving down a steep or long grade with heavy loads or when slowing down from high speed.

While driving with exhaust brake, the exhaust brake will be temporarily cancelled automatically in the following cases. (The exhaust brake indicator light will not be lit.)

- When the clutch pedal is depressed.
- When shifting to neutral has been done.
- When the ABS is turned on.

(4) Hazard light switch



The switch marked with “▲” controls the hazard lights independently of the key. The hazard light switch should be used to warn other drivers of your emergency stop as all the turn signals will flash when the lever is pulled up. Always try to stop off the road if possible.

4. Cruise control

Outline

“Cruise control” is a system for electronically controlling the speed of the vehicle. When the speed of the vehicle is set by use of the “Cruise control”, the vehicle will continue to operate at the speed set even when the driver’s foot is taken off of the accelerator pedal. The purpose of the “Cruise control” system is to reduce driver fatigue.

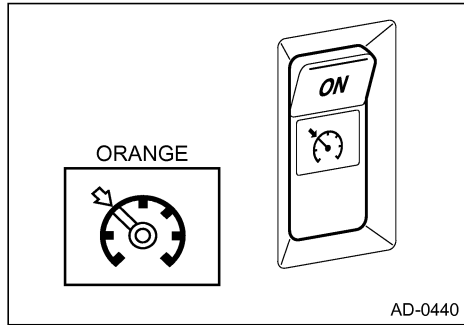
“Cruise control” should be used whenever the driver wishes to travel at a constant speed for long intervals such as when driving on interstate highways.

WARNING

- **Never use the “Cruise control” under any of the following roads conditions. Use of the “Cruise control” under those conditions could result in an accident causing serious injury or death.**

- **Never use the “Cruise control” if the roadway is slippery because of ice, snow, water, and oil or because of any other reason. The tires of the vehicle may spin and the driver may lose control resulting in an accident.**
- **Never use the “Cruise control” on steep downhill grades. Engine braking may be insufficient to be effective in slowing the vehicle and the “set” speed may be exceeded resulting in an accident.**
- **Never use the “Cruise control” in traffic situations that require frequent acceleration and deceleration such as on roadways where there is a great deal of traffic and where there are sharp curves. The driver will be unable to set the “Cruise control” at a speed suitable for the road conditions and an accident could result.**

5. Cruise control main switch

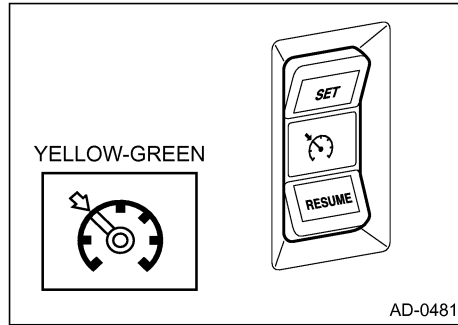


Press the main switch "ON".
(Press for at least 0.5 sec.)
The constant speed cruise light (orange in color) is lit.

CAUTION

Always keep "Cruise control" in OFF position and light off when not in use.

Cruise control set button



Cruise starts when the set button is pressed and released after the desired speed has been reached by normal acceleration. (The vehicle will continue to run at the set speed even when the foot is taken off the accelerator pedal.) After start of system operation, the cruise light (yellow-green) will come on and indicate that the cruise control is working.

CAUTION

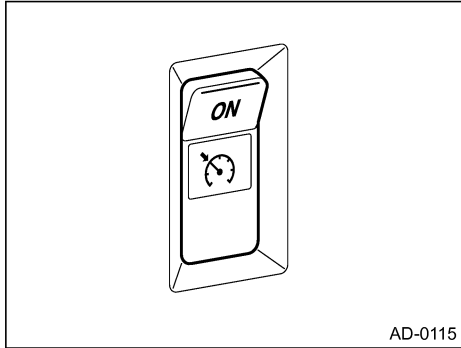
Never set the "Cruise control" at a speed in excess of the legal speed limit. The "Cruise control" is capable of being set at speeds in excess of 31MPH (50km/h).

(1)Depressing the accelerator while cruise control is on

When you need to accelerate with cruise control on to pass another vehicle or to respond to a dangerous situation, simply press on the accelerator for more speed. You will speed up unless the vehicle is already at full power such as on an uphill road."

When the foot is taken off the accelerator pedal, the vehicle will return to the original speed you set for cruise control.

(2) Temporary cancellation

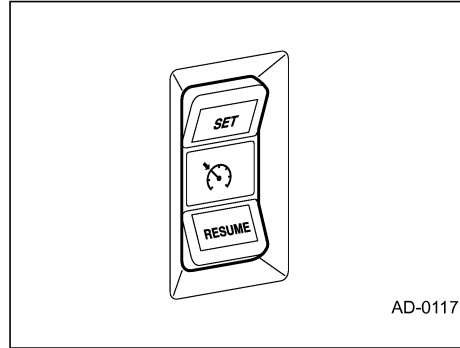


While driving with cruise control, the cruise mode will be temporarily cancelled automatically in the following cases. (The cruise light color will change yellow-green to orange if lit.)

- When the exhaust brake is turned on.
- When the brake pedal is depressed.
- When the clutch pedal is depressed.
- When shifting to neutral has been done.
- When the vehicle speed has dropped to 28 MPH (45 km/h) or lower.

In the above cases, the resume function can be used to easily return to automatic cruise control at the original speed.

(3) Resuming cruise control



Press the “RESUME” button while cruising and take your foot off the accelerator pedal. (The cruise light will not light and the vehicle will return to the original speed.)

● Changing the set speed

<Increase>

Press the “RESUME” button for at least 0.7 sec. The vehicle will accelerate. Release the “RESUME” button when the desired speed has been reached.

- Push: Vehicle speed can be adjusted every 0.6 MPH (1 km/h).
- Hold: Vehicle speed can be increased automatically.



CAUTION

Never set the “Cruise control” at a speed in excess of the legal speed limit.

<Deceleration>

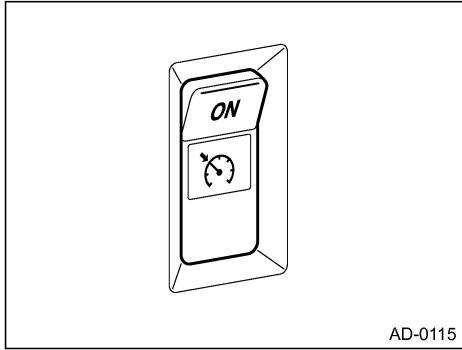
Press the SET button continuously. The vehicle will decelerate. Release the SET button when the desired speed has been reached.

- Push: Vehicle speed can be adjusted every 0.6 MPH (1 km/h).
- Hold: Vehicle speed can be decreased automatically.

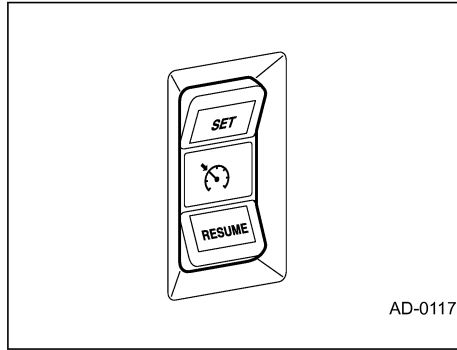
NOTICE:

- **The set speed also can be changed according to the following method.**
- **Use the accelerator pedal or the brake pedal to change to the desired speed and then press the set button.**

(4) Cancellation of cruise mode

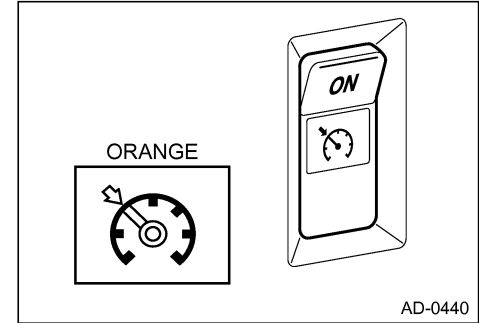


Cruise mode is cancelled when the ON side of the main switch is pressed 0.5 sec or longer until indicator light is not lit. When the engine has stopped.



WARNING

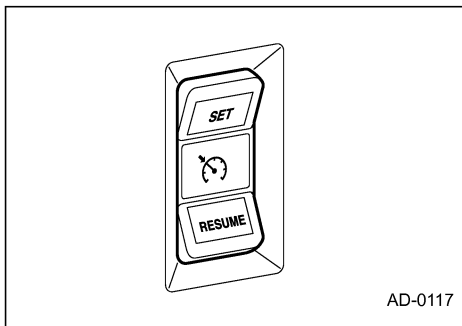
Always set the "Cruise control" to the off position when it is not in use. If the "Cruise control" is left in the "ON" position, the "Cruise control" can be engaged when the "set" button is touched by mistake.



Adjustment of idling speed

The idling speed can be set with a cruise control main switch and cruise control set button,

When the cruise control main switch is pressed for at least 0.5 sec, indicator light (orange in color) will come on and you can adjust idling speed while the cruise control main switch is Pressed.



● Adjusting the idling speed

<To increase idling speed>

Press the "RESUME" button for at least 0.7sec. Release the "RESUME" button when the desired idling speed has been reached.

You can increase the idling speed as follows:

1. As you push the "RESUME" button, engine idling speed can be increased every 50RPM(r/min.).
2. While you hold the "RESUME" button pressed, engine idling speed can be kept increased.

<To decrease idling speed>

Press the "SET" button continuously. The idling speed will decrease. Release the SET button when the desired idling speed has been reached.

You can decrease the idling speed as follows:

1. As you push the "SET" button, engine idling speed can be decreased every 50RPM(r/min.).
2. While you hold the "SET" button pressed, engine idling speed can be kept decreased.

Temporary cancellation

Adjustment of idling speed will be temporarily cancelled automatically in the following cases.

- 1)When the cruise main switch is turned off.
- 2)When the brake pedal is depressed.
- 3)When the clutch pedal is depressed.
- 4)When shifting to neutral has been done.
- 5)When the parking brake is released.

6)When the exhaust brake is turned on.

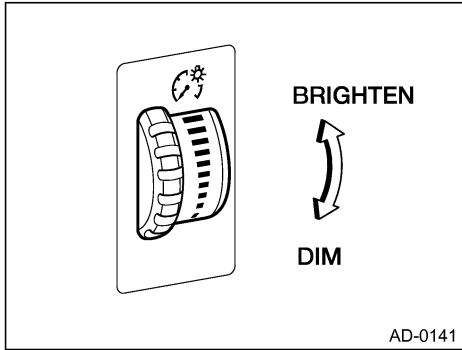
7)When the PTO switch is turned on.

8)When the vehicle is moving.

9)When the idle set knob is turned.

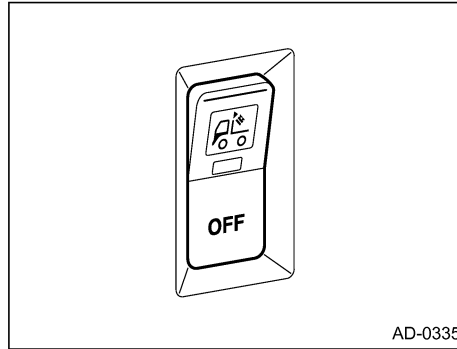
In the above cases (No.2 to No.8), the resume function can be used to easily return to idling speed.

6. Rheostat light control switch (If so equipped)



The brightness of the instrument panel lights can be adjusted by turning the control switch. Turning the switch downward, the lights will dim gradually and at the end will turn off. Adjust the brightness to be safe and suitable for driving.

7. Van light switch (If so equipped)

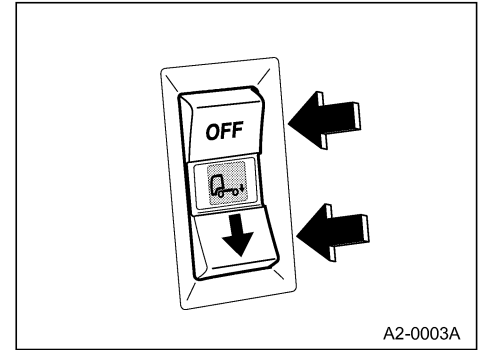


This switch is used for working in the van or at night. When the switch is pushed, the indicator light comes on and the van light turns on. Be sure to turn it off when work is completed.

NOTICE:

- Be sure to switch it to “OFF” after using it.
- Do not use the van light switch while the engine is stopped. The battery will be discharged and the engine will not start again.

8. Air suspension dump switch (If so equipped)



This switch is used for workability when loading and unloading by lowering the height of the rear-end of the vehicle.

WARNING

When operating the this device, the height of the rear-end of the vehicle is lowered and vehicle slightly moves back and forth.

To avoid personal injury and/or property damage, follow the instructions below before operating the this device,

PREPARATION BEFORE OPERATION

- (1) Park the vehicle on a level place on a hard surface.
- (2) Apply the parking brake securely and place the gearshift lever to the "NEUTRAL" position.
- (3) Make sure that there are no persons and obstacles around/under the vehicle.
- (4) Make sure that the air pressure gauge reads the following pressure:
Lift up: 880 - 980 kPa {9.0 - 10/0 kgf/cm²}
Down: More than 600 kPa {5.9 kgf/cm²}
This device consumes compressed air. Keep the engine running while using the this device to avoid losing air pressure.

HOW TO OPERATE

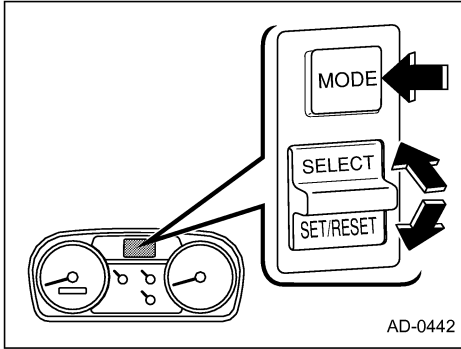
- Push the "↓" switch To lower the height of the rear-end of the vehicle.
- Push the "OFF" switch To restore the height.

The height of the rear-end of the vehicle is lowered when the "↓" switch is pushed.

This device will be cancelled automatically in the following causes.

- When the key is turn to LOCK and ACC position.
- When the parking brake is released.

9. Information display control switch



NOTICE:

- Turning the key to the “ON” position engages the Information Display and shows the last message.
- Pushing the “MODE” button repeatedly permits scrolling through the different items that can be displayed. (See page 2-46)
- Pushing the “SELECT” button upward permits scrolling through the different aspects of a particular “MODE”.

- Pushing the “MODE” and “SELECT” buttons together turns off the Information Display.
- Pushing and holding the “SET/RESET” button downward permits certain displayed data to be reset, such as the Maintenance Schedule.

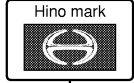
The INFORMATION DISPLAY shows two different groups of information.

- Vehicle conditions and driving factors.
This group includes the trip meter, fuel consumption monitor, cruise control setting speed, average speed, operation time, the DPR system, vehicle and engine maintenance information, and the self diagnosis system.
- Warning and Cautionary Information.
Warning and cautionary information will be automatically shown, even when the Information Display is “OFF”. If such a warning or caution appears, immediate attention is required.
(Examples)
“DPR MANUAL REGENERATE
REQUIRED”.

The following flow chart explains the way the Information Display provides you with data. If the system had previously been shut off the first screen you will be the Hino Trademark. Otherwise, you will see the previously displayed message.

Information Display Operation Diagram

(*Starter key ON)



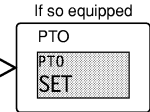
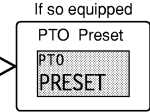
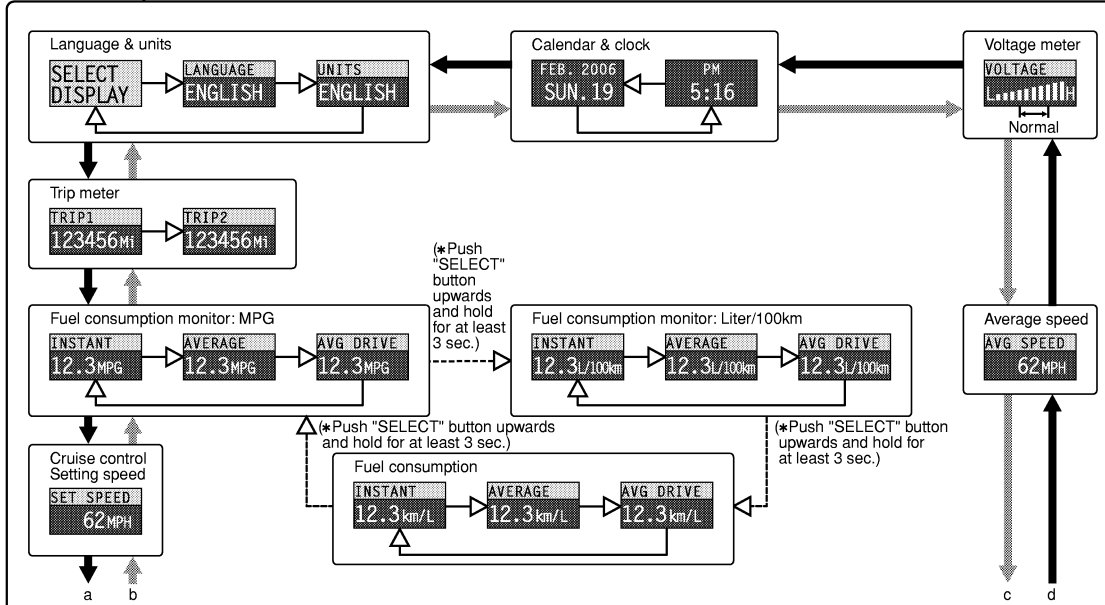
2 sec. display

The system remembers last display at each function.
 → Push "MODE " button
 ⇨ Push "MODE "& "SET/RESET" at the same time

⇨ Push up "SELECT " button
 ⇨ Other : Those displays are broken in automatically

Information display

After break in displays, returns to last display automatically.

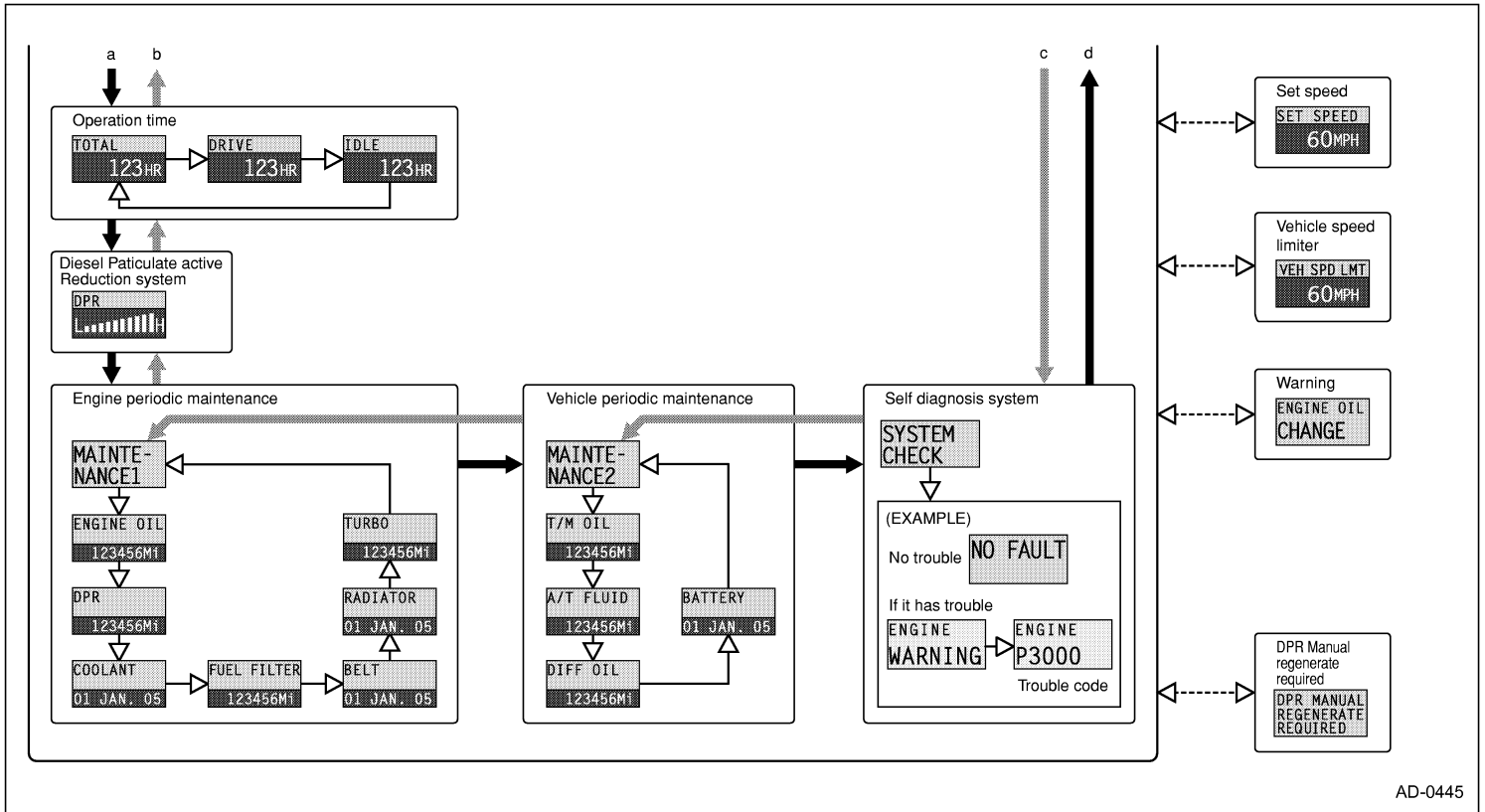


a b

c d

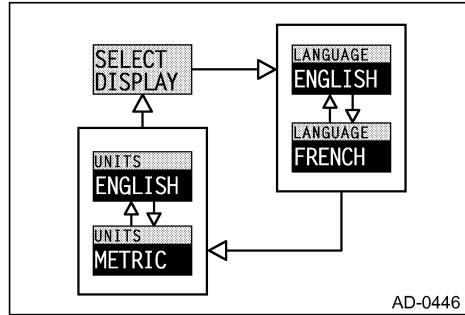
AD-0444D

(Continue)



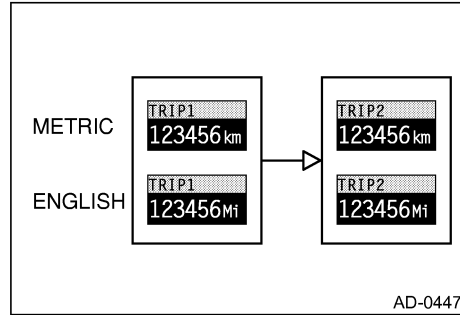
Operation method

(1) Language and Units



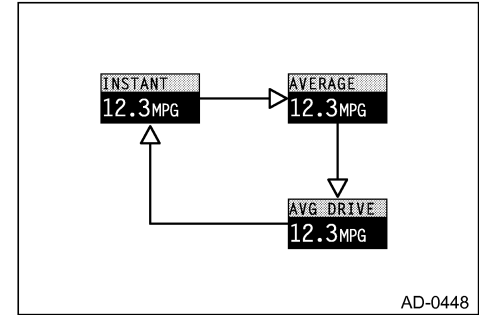
- Push “SELECT” button when is shown. Display shows .
- Then push and hold “SELECT” button for at least 3 sec. ENGLISH display flashes. Push “SELECT” or “SET/RESET” button, display changes from ENGLISH to FRENCH or set language.
- After setting language, push “SELECT” button, display shows . In the same way, set UNITS.
- Push “MODE” button, display changes to TRIP mode.

(2) Trip meter

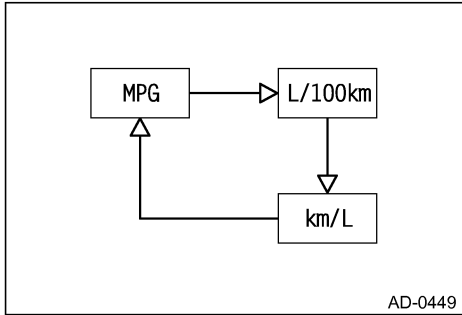


- Initial display is .
- Push “SELECT” button, display shows .
- If changing the trip meter to zero, push “SET/RESET” button for more than 1 sec.
- Push “MODE” button, display changes to Fuel consumption monitor.

(3) Fuel consumption monitor

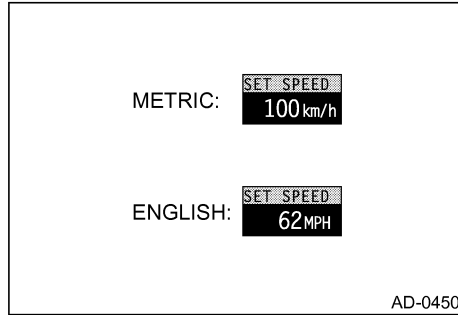


- Initial display is INSTANT.
- INSTANT means instantaneous fuel consumption.
- Push “SELECT” button, display changes to AVERAGE fuel consumption. (include vehicle stopping)
- Once more push “SELECT” button, display changes to AVG DRIVE Average fuel consumption. (vehicle driving only)
- If driving distance of calculating consumption is reset to zero, push “SET/RESET” button for more than 1 sec.



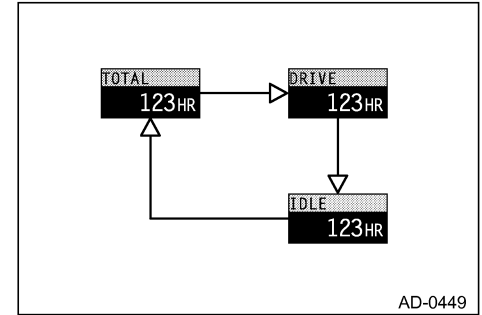
- Push and hold “SELECT” button for at least 3 sec., you are able to change units of fuel consumption.
- Push “MODE” button, display changes to Setting speed.

(4)Setting speed



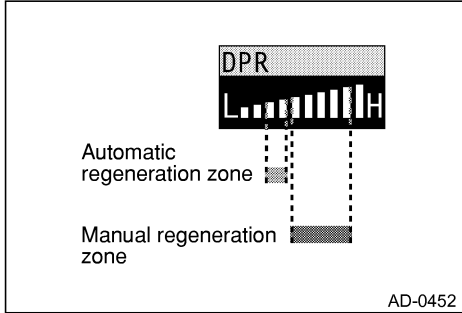
- This display shows setting speed for cruise control.
- Push “MODE” button, display changes to Operation time.


(5)Operation time



- This display shows running time of the engine or driving time of the vehicle.
- If resetting this counter to zero, push “SET/RESET” button for more than 1 sec.
- TOTAL shows the time from engine start to stop.
- DRIVE or IDLE shows the time of driving or stopping between engine start and stop.

(6)DPR (Diesel particulate active reduction system)

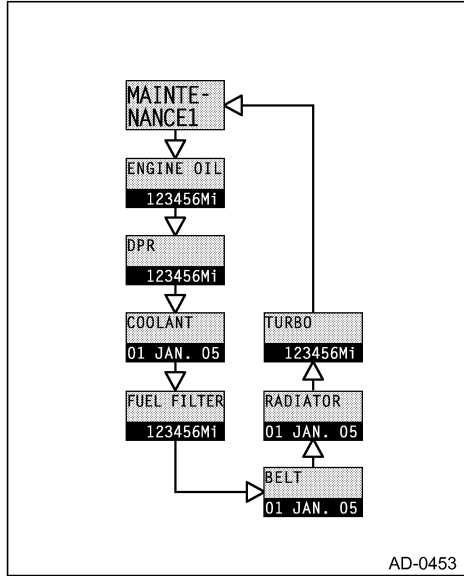


- This display shows the amount of particulate matter in the DPR cleaner.
- When the gauge reading reaches the 5th bar, both the DPR indicator light  (See page 2-35) and the indicator light of the DPR manual regeneration switch (See page 2-69) start to flash continuously, and the display shows "DPR MANUAL REGENERATE REQUIRED". (See page 2-67)

In such a case, park the vehicle in a safe place, push the DPR switch button and cleaning starts. (See page 2-69)

- Every time the number of bars increases in the manual regeneration zone, the buzzer buzzes. When the gauge reading reaches the 9th bar, the buzzer buzzes continuously. When the gauge reading reaches the 10th bar, the CHECK ENGINE warning light (See page 2-28) will come on, and the engine output will be limited. When the CHECK ENGINE warning light comes on, it is necessary to have your vehicle checked and repaired as soon as possible at an authorized Hino dealer.

(7) Engine periodical maintenance

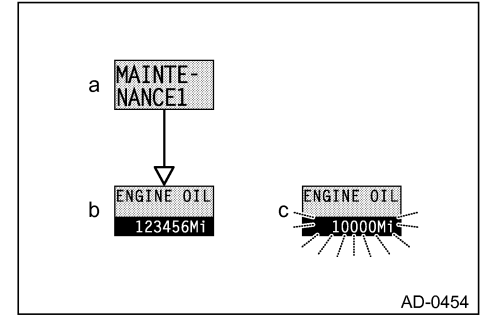


This function describes preventive engine maintenance procedures that can prevent engine malfunction.

Using this system, you can set the time to inspect the engine and replace engine parts.

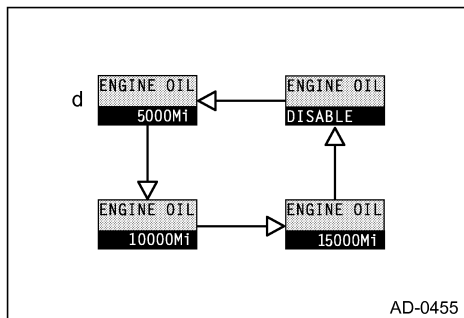
- Initial display is MAINTENANCE1.
- Push “SELECT” button, display changes in the order of Engine oil, DPR, Coolant, Fuel filter, Belt, Radiator and Turbo-charger overhaul.
- Push and hold “SELECT” button for more than 3 sec. on each item, and you are able to set the recommended period or distance.
- Push and hold “MODE” and “SET/RESET” button at the same time for more than 3 sec., will reset to “zero”. The interval setting value of DPR maintenance cannot be changed. To reset the value, consult an authorized Hino dealer.

Setting method



example: Change the engine oil

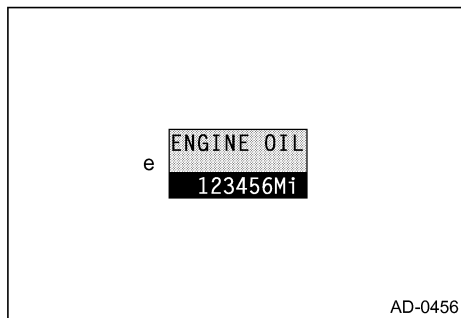
- Push “MODE” button, display shows MAINTENANCE1.
- Push “SELECT” button, to display which is to be set item.
- Push and hold “SELECT” button for more than 3 sec. The lower display flashes. (last setting value is shown.)



d. Push “SELECT” button, select the setting value. (see next page) If you push “MODE” button, setting value does not change and display returns to the display “b”.

NOTICE:

If you select a setting value that is smaller than the present accumulated distance, when the key is in “ON” position, then the display will show the advice of maintenance.



e. Push “SET/RESET” button, selected value is set. (Display shows the present accumulated distance.)

NOTICE:

- Display timing of maintenance advice is set up by the following.

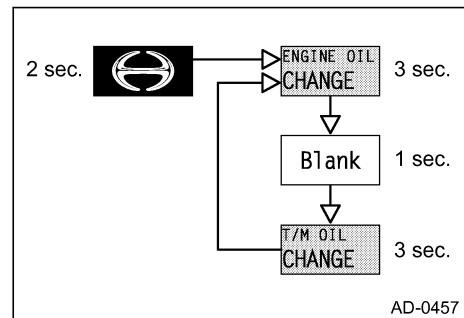
In case of distance display:

621 mile (1000 km) before setting distance

In case of period display:

1 month before setting period

- 1.5n case of set “APR.” for radiator inspection period, display shows in April (between 1. Apr. and 30. April)












- When the key is turned to “ON” position,





is shown for 2 sec. Then maintenance advice is shown repeatedly for 3 sec. until vehicle speed reaches 12.4 MPH [20 km/h]).

Setting value chart for maintenance

Setting item	Setting value	
ENGINE OIL CHANGE INTERVAL 	5,000km 8,000km 10,000km 13,000km 15,000km 20,000km 25,000km 30,000km DISABLE	3,000Mile 5,000Mile 6,000Mile 7,000Mile 8,000Mile 9,000Mile 10,000Mile 15,000Mile 20,000Mile DISABLE
TRANSMISSION GEAR OIL CHANGE INTERVAL 	5,000km 8,000km 16,000km 40,000km 80,000km 96,000km 160,000km 400,000km 640,000km 800,000km DISABLE	3,000Mile 5,000Mile 10,000Mile 25,000Mile 50,000Mile 60,000Mile 100,000Mile 250,000Mile 400,000Mile 500,000Mile DISABLE
* Including UltraShift transmission		
AUTOMATIC TRANSMISSION FLUID CHANGE INTERVAL 	5,000km 8,000km 16,000km 20,000km 40,000km 80,000km 120,000km 160,000km 240,000km 480,000km DISABLE	3,000Mile 5,000Mile 10,000Mile 12,000Mile 24,000Mile 25,000Mile 50,000Mile 75,000Mile 100,000Mile 150,000Mile 300,000Mile DISABLE

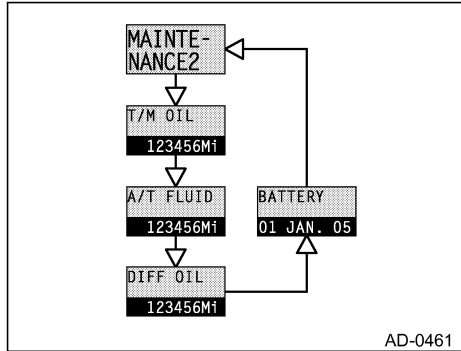
Setting item	Setting value	
DIFFERENTIAL GEAR OIL CHANGE INTERVAL 	40,000km 80,000km 160,000km 400,000km DISABLE	25,000Mile 50,000Mile 100,000Mile 250,000Mile DISABLE
COOLANT CHANGE INTERVAL 	6, 12, 24, 36, 48, 60 Months DISABLE	
FUEL FILTER CHANGE INTERVAL 	20,000km 30,000km 40,000km 50,000km 60,000km DISABLE	10,000Mile 20,000Mile 30,000Mile 40,000Mile DISABLE
BELT CHECK INTERVAL 	6, 12, 18, 24 Months DISABLE	
BATTERY INSPECTION INTERVAL 	4, 6, 12 Months DISABLE	
RADIATOR INSPECTION INTERVAL 	JAN, FEB, MAR, APR, MAY, JUN, JUL, AUG, SEP, OCT, NOV, DEC DISABLE	

Setting item	Setting value	
TURBO CHARGER INSPECTION INTERVAL 	120,000km 240,000km 360,000km 500,000km DISABLE	72,000Mile 144,000Mile 215,000Mile 310,000Mile DISABLE
DPR MAINTENANCE INTERVAL 	320,000km	200,000Mile

NOTICE:

**DPR MAINTENANCE display is automatically displayed.
The setting value of DPR maintenance cannot be changed. To reset the value consult an authorized Hino dealer.**

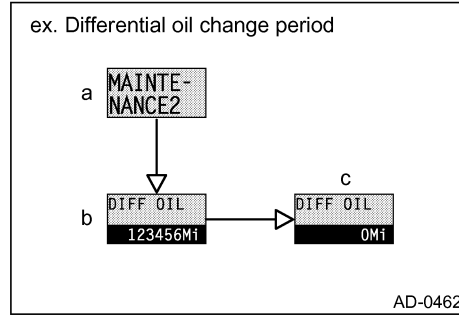
(8) Vehicle periodical maintenance



AD-0461

- Initial display is **MAINTENANCE2**.
- Push "SELECT" button, display changes in the order of T/M (Manual transmission or UltraShift transmission) oil, A/T (Automatic transmission) fluid, DIFF (Differential gear) oil and Battery.

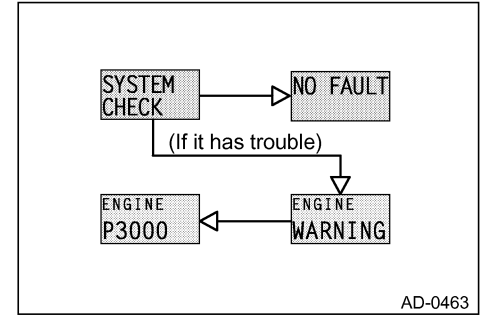
Reset procedure



AD-0462

- Push "MODE" button, display shows **MAINTENANCE2**.
- Push "SELECT" button several times, show the resetting item display.
- Push and hold "MODE" and "SET/RESET" button at the same time for more than 3 sec., accumulate distance is reset to zero. In case of coolant maintenance, display is reset on the day of operation.

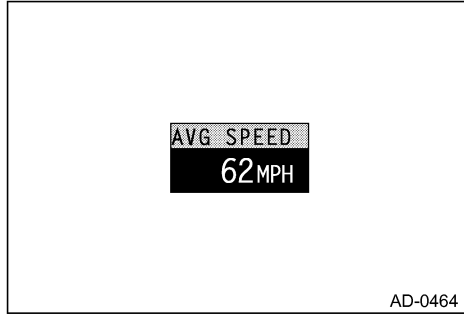
(9) Self diagnosis system



AD-0463

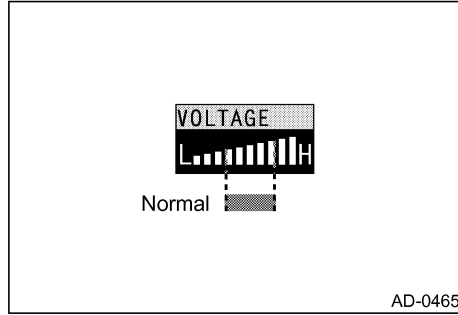
- If the vehicle has fault, display shows the trouble code.
- Push "SELECT" button, display shows **NO FAULT** in case of no trouble code. If it has trouble code, display shows fault item.
- If display shows trouble warning, Immediately get your vehicle checked and repaired at an authorized Hino dealer.
- In case of **ENGINE WARNING** displayed, push and hold "SELECT" button for at least 3 sec. until the display shows trouble code.

(10)Average speed



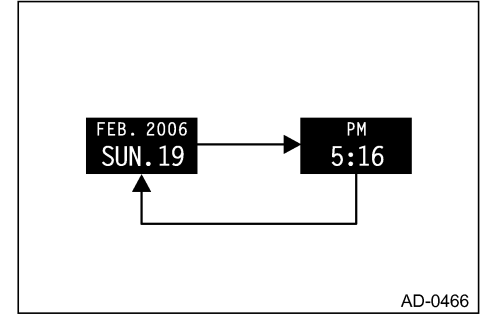
- Push “MODE” button, display shows AVERAGE SPEED.
- Push “SET/RESET” button for more than 1 sec., AVERAGE SPEED is reset to zero.
- Push “MODE” button, display changes to Voltage meter.

(11)Voltage meter



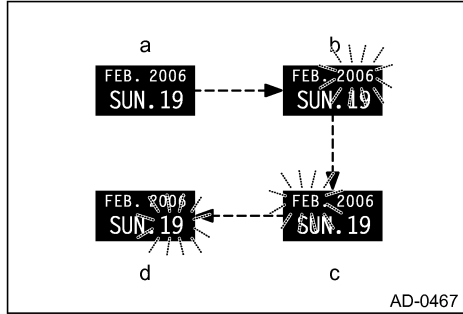
- Between 4th and 8th bar, voltage is normal.
L:Discharge
H:Over-charge
- Push “MODE” button, display changes to calendar and clock.

(12)Calendar and clock



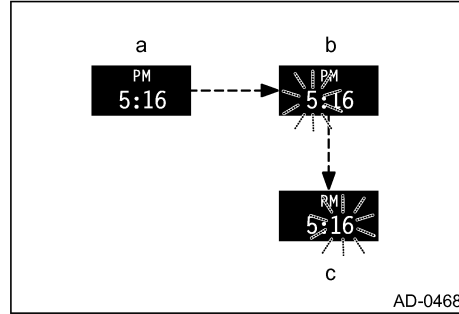
- Push “SELECT” button, display is changeable (calendar ↔ clock)
NOTICE:
 - If calendar (date) or clock are not correct, adjust in the following way.
 - If the battery or the fuse is removed, this system remembers the last day when you turned off the key.
 - If you set the year, month and day, day of the week is set automatically.

Set calendar



- Show calendar display.
- Push “SET/REST” button for more than 1 sec., ‘year’ is flashing. Push “SELECT” button to adjust ‘year’. Push and hold “SELECT” button to fast forward.
- Push “SET/RESET” button, ‘month’ flashes. Push “SELECT” button to adjust ‘month’.
- In the same way, adjust the ‘day’.
- After setting the calendar, push “SET/RESET” button, flashing stops and calendar is set.

Set clock

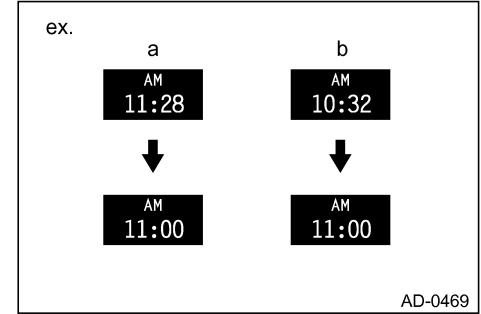


- Push “MODE” button for the clock display.
- Push “SET/REST” button for more than 1 sec., the hour is flashing. Push “SELECT” button and adjust the hour. Push and hold “SELECT” button to fast forward.
- Push “SET/RESET” button, ‘minute’ flashes. Push “SELECT” button and adjust ‘minute’. After correcting the clock, push “SET/RESET” button, flashing stops and clock is set.

NOTICE:



If the battery or fuse is removed, display shows “AM 1:00”. Reset clock.

Resetting the clock



- ex.
- Push and hold “MODE” button for more than 1 sec.
 - Release “MODE” button when you hear the time signal. The clock is reset to the hour setting.
- ex.a.00~29 min.: cut down
b.30~59 min.: raise to unit

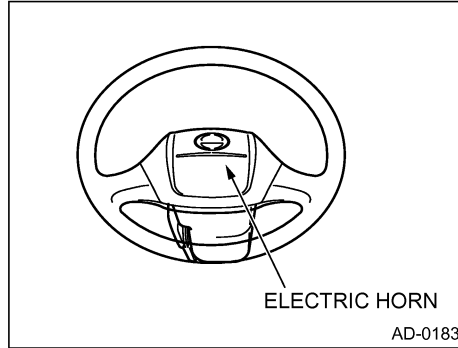
(13)Warning display

Display	Warning Display remarks
	Engine control system has malfunction. This is important and must be addressed immediately.
	DPR cleaner needs to be manually regenerated.

NOTICE:

- **The display shows DPR MANUAL REGENERATE REQUIRED with the buzzer sound when DPR cleaner needs to be manually regenerated.**
- **See page 2-50 and 2-59 for the manual regeneration of DPR.**

10.Horn



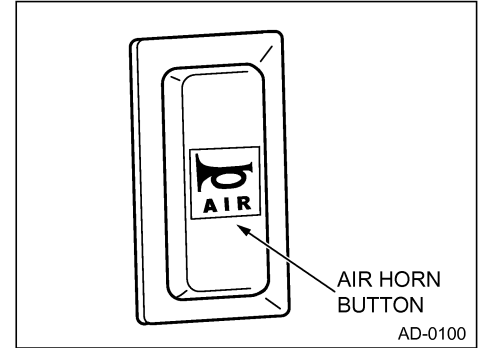
Some areas have Local Noise Control Laws regulating horn use.

If your vehicle has both an electric and air horn, use the electric horn within city limits and the air horn outside city limits.

Electric horn

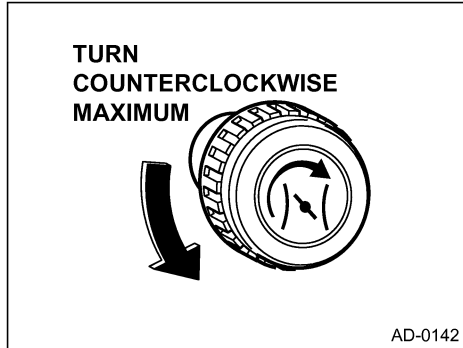
The switch of electric horn is mounted in the center of the steering wheel. Press on center of steering wheel to blow electric horn.

11.Air horn (If so equipped)



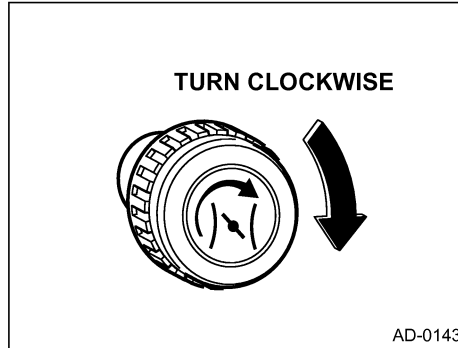
The switch of air horn is mounted in the instrument panel. Press on button to blow air horn.

12. Idle set knob



The automatic adjustment of idling speed

- When the knob is turned all the way in the counterclockwise direction, automatic idling mode will be reached, and the engine idling speed will be adjusted automatically according to the temperature of the engine coolant.
- Normally, this should be turned all the way in the counterclockwise direction.



The manual adjustment of engine idling speed.

- When the knob is turned in the clockwise direction, the mode changes from automatic idling mode to manual adjustment mode, the engine speed will increase and adjustment will become possible.
- The standard idling speed is 750RPM (r/min).
- If the engine speed is set higher than the standard idling speed, sudden starting of the vehicle, increased fuel consumption and a shortened life of the clutch may occur.



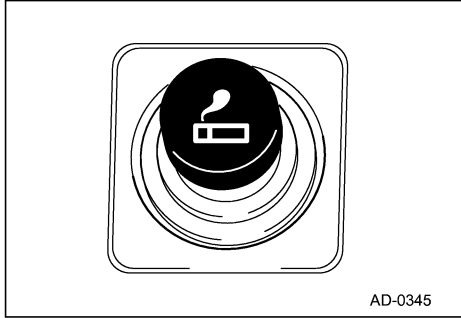
WARNING

- Driving with the “Idle set knob” set to any speed higher than “standard idling speed” is dangerous and could cause the vehicle to suddenly accelerate, even when the vehicle is stopped with the engine running. Sudden acceleration could result in an accident causing serious injury or death.
- Turn the knob carefully, or the engine speed may increase too quickly.

NOTICE:

Setting the idle speed higher than standard may cause increased fuel consumption and a shortened clutch life.

13. Cigarette lighter

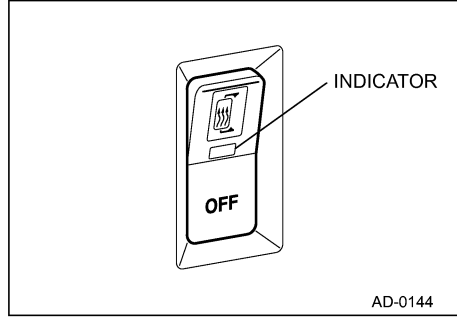


To operate the cigarette lighter, push the cigarette lighter in. It will pop out in about 15 seconds when it is ready to be used. Always wait a few minutes before using the lighter again.

CAUTION

- Never hold the cigarette lighter in. If the cigarette lighter does not pop out after 15 seconds has elapsed with the lighter pushed in, pull it out manually. Do not leave the vehicle with the lighter pushed in.
- Use genuine Hino cigarette lighters or equivalents as replacements.

14. Mirror heater switch (If so equipped)

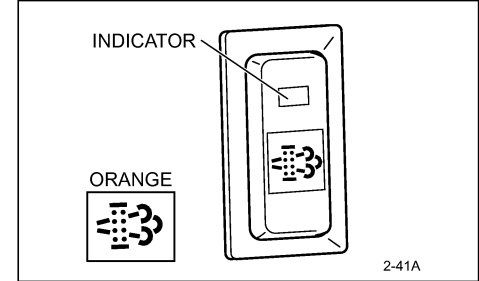


This switch is used to get rid of frost and fogging of the mirrors. When the switch is pushed, the indicator light comes on and the rear-view mirrors are warmed.


NOTICE:

- Be sure to switch it to “OFF” after using it.
- Do not use the mirror heater switch while the engine is stopped. The battery will be discharged and the engine will not start again.

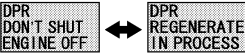


15. DPR manual regeneration switch



DPR is an abbreviation for Diesel Particulate active Reduction system, This is the manual regeneration switch for cleaning, the soot collected from exhaust gas in order to maintain the proper functioning of DPR.

Refer to DPR indicator light “” for the operation procedure. (See page 2-61)


Information display

Display	Display remarks
	DPR regenerate on time.
	DPR remaining for few mimit.
	DPR regenerate completed.

NOTICE:

The DPR system automatically regenerates when the quantity of soot collected in the DPR cleaner exceeds a specific quantity. This prevents an abnormal accumulation of soot and keeps the DPR cleaner in good condition. Use of high-performance catalyst and an electronically controlled common rail fuel injection system has made it possible to burn (regenerate) the soot while driving.


- (1) Use ultra-low sulfur diesel fuel only. Diesel fuel which contains less than 15 ppm (0.0015%) by volume of sulfur.

 CAUTION
Use ultra-low sulfur diesel fuel (sulfur content: Less than 15 ppm). When fuel other than the specified fuel is used, this may damage the engine, the exhaust gas purifier, etc.

- (2) Use only the specified brand of (recommended) engine oil.

 CAUTION
It is recommended to use only the specified (recommended) brand of engine oil to maintain the function of the exhaust gas purifier for a long time.

- (3) Do not modify the tailpipe.

 CAUTION
Do not modify the tailpipe in any way. Doing so could diminish the effectiveness of the DPR cleaner and cause damage.

- (4) Vehicles equipped with DPR automatically regenerate the soot collected in the DPR cleaner.

NOTICE:

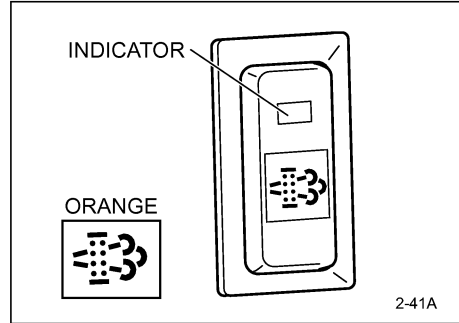
- In order to regenerate soot collected in the DPR cleaner, the idling speed increases and the cleaning operates when the vehicle is stopped in cleaning mode at a orange light or similar.
- When idling for extended period of time the idle speed may increase to prevent the discharge of white smoke.
- Depending on the operating conditions, the regeneration of the soot collected in the DPR cleaner may not be completed. In such a case, the DPR cleaner indicator light in the switch and on the instrument panel will flash. Press the DPR switch and soot burning (regeneration) will take place.

(5) Vehicles equipped with DPR have the following characteristics.

NOTICE:

- After purification by the exhaust gas purifier, the exhaust gas will have a different odor than the odor a diesel vehicle without a DPR.
- It is normal to see white smoke discharged from the tailpipe at the time the engine is started. It is only water vapor.
- It is normal to see white smoke discharged from around the muffler at the time of soot burning (regeneration). The white smoke is only the discharge of water vapor, which has collected around the muffler.

Manual regeneration



! WARNING

- Never park the vehicle near any flammable material, including high grass or leaves, during manual regeneration. Extreme heat from the exhaust outlet could cause a fire resulting in personal injury and property damage.
- Always keep all flammable materials away from the DPR cleaner, exhaust pipe and tail pipes.

- Never touch the DPR cleaner, exhaust pipe or tail pipe during regeneration. Severe burns other personal injuries could occur.

! CAUTION

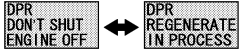


- Proper functioning of the DPR requires beginning the manual regeneration procedure as soon as possible before driving 95 miles (150km) after the indicator light starts to flash. Failure to begin the procedure could result in engine damage.
- Always turn the PTO switch off in a vehicle equipped with a PTO prior to beginning the manual regeneration procedure.
- Never drive the vehicle during manual regeneration.

Do the following prior to beginning manual regeneration.

- (1) Park the vehicle in a safe place, away from all flammable materials, including high grass or leaves.

- (2) Apply the parking brake firmly.
- (3) Shift the gear lever in the “Park” (automatic) or “Neutral” (manual) position.
- (4) Run the engine at idle speed. Never stop the engine during manual regeneration.
- (5) Push the DPR manual regeneration switch where the indicator light is flashing.
<Cleaning start>

Information display.

Display	Display remarks
	DPR regenerate on time.
	DPR remaining for few mimit.
	DPR regenerate completed.

- (6) Confirm that the flashing indicator light is turned on and that idle speed has increased.
- (7) The exhaust brake is automatically turned on.

- (8) Make certain no one touches the DPR cleaner, exhaust pipes and tail pipes during regeneration.
- (9) Wait 15 to 20 minutes for manual regeneration to be completed.
- (10) After the indicator light goes off, turn off the exhaust brake. Idle speed will decrease to normal, cleaning has been completed and the vehicle can now be driven safely.

NOTICE:

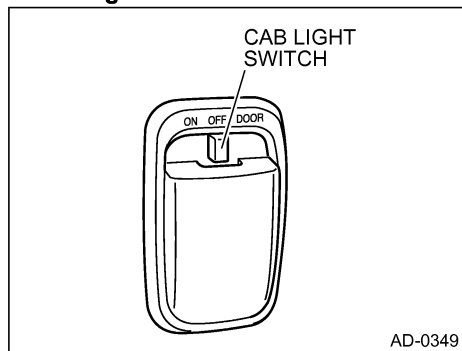
- Manual regeneration is available possible after the engine has been started and the DPR indicator light has flashed for 10 seconds.
- If you start driving before cleaning has been completed, the DPR indicator light will flash again.
- If you continue to drive until the DPR gage reaches the 10th bar (See page 2-50), the CHECK ENGINE warning light (See page 2-18) will come on, and the engine out will be limited resulting in decreased acceleration.

- Manual regeneration will be completed in 15 - 20 minutes in most cases when just after driving. However, it could be taken about 30 minutes under low temperature, and after long time engine stop condition. It could be something abnormal has occurred. If it will not be completed over 40 minutes, that case CHECK ENGINE warning light come on, contact an authorized Hino Dealer.

 WARNING
<p>Have your vehicle checked as soon as possible at an authorized Hino dealer.</p>

ACCESSORIES

1. Cab light switch

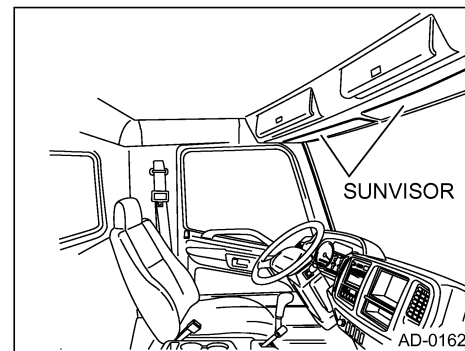


When the switch is in the “DOOR” position, the cab light will go on and off when either door is opened or closed. To turn on the light when the doors are closed, turn the switch to “ON”. To keep the light off even when a door is open, move the light switch to “OFF”.

The following occurrences are not indications of abnormalities.

- (1) During automatic regeneration the idle speed may change and exhaust brake may operate if the vehicle is stopped while driving. When idling for extended period of time the idle speed may increase to prevent the discharge of white smoke.
- (2) White smoke means that water vapor is being discharged. This stops naturally when the exhaust temperature rises sufficiently. White smoke continues to be discharged when ultra low-sulfur diesel fuel with 15 ppm (0.0015%) or lower is not being used.
- (3) The exhaust gas smells differently from that of conventional diesel vehicles. The smell is different because the exhaust gas is cleaned by the DPR.

2. Sun visor

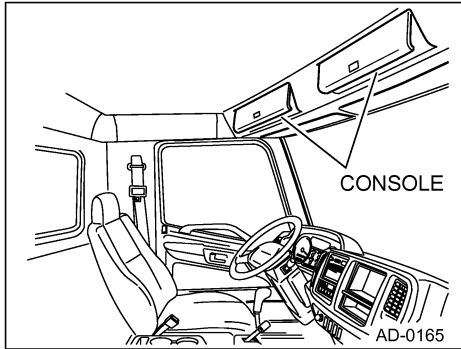


The sun visor protects your eyes from direct rays. Change the angle of the visor to suit conditions. It can also be used as a side visor by swinging it against the door window.

NOTICE:

When not using the sun visor as a side visor, keep it forward and latched.

3. Overhead console



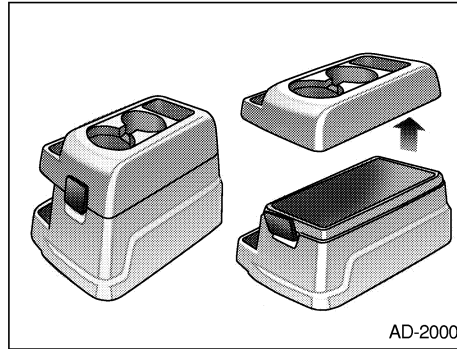
CAUTION

Do not place heavy or unstable objects in overhead consoles. They may fall when vehicle is moving and cause injury or interfere with safe driving.

NOTICE:

Keep the cover of overhead console closed while driving. If it is open while driving, the hinge or locking mechanism may be damaged.

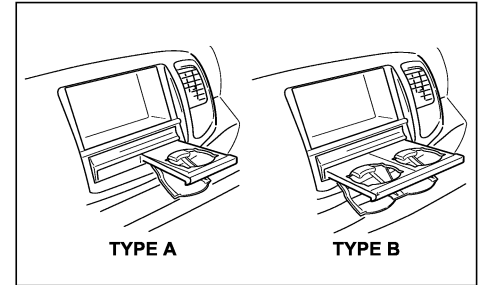
4. Center console and drink holder



NOTICE:

- Be careful not to spill hot drinks when using the drink holder.
- The drink holder should be used for capped bottles only.
- Keep the cover of center console closed while driving. If it is open while driving, the locking hook may be damaged.

5. Cup holder



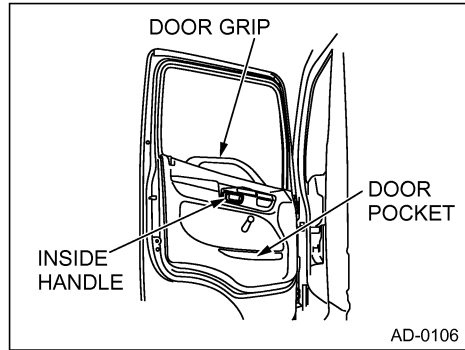
The cup holder designed for holding cup(s) or drink-can(s) securely.

To use the cup holder, pull it out completely.

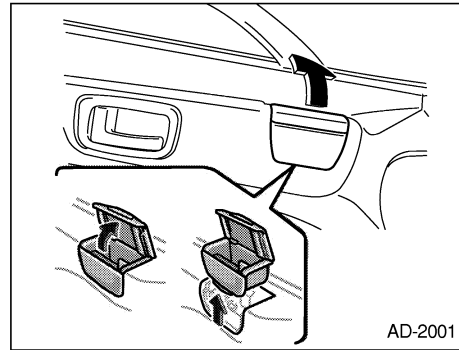
CAUTION

- Do not place anything else other than cup(s) or drink-can(s) in the cup holder, as such items may be thrown about in the cab and possibly injure people in the vehicle during sudden braking or in an accident.
- To reduce the chance of injury in case of an accident or sudden stop while driving, keep the cup holder closed when it is not in use.

6. Door pocket



7. Ashtray



When finished with your cigarette, thoroughly extinguish it in the ashtray to prevent other cigarette butts from catching fire. After using the ashtray, close the cover in completely. To remove the ashtray, pull it upward as shown in the illustration.

CAUTION

To reduce the chance of injury in case of an accident or sudden stop while driving, always push the ashtray back in completely after using.

SELECTOR AND PEDAL CONTROL

1. 1. Manual transmission

The transmission has six-forward or five-forward speeds and one reverse. Use 1st gear to start from a standstill. The shift pattern is shown in the shift knob. When shifting between “5th and 6th” or “4th and 5th” gears, the shift lever should be held to the right to prevent mis-shifting. Mis-shifting can cause the engine to run at too high an RPM (r/min.). Shift the lever after having fully depressed the clutch pedal.

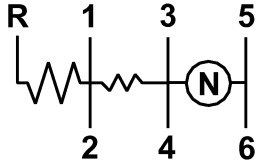
Apply synchromesh gears

Transmission	Synchromesh
6 speeds FS5406A, FS6406A	1st to 6th
5 speeds FS4205A	2nd to 5th

Before driving your vehicle, study the shift pattern and shifting procedure thoroughly. When the lever is shifted into reverse “R” position, the backup lights come on automatically.

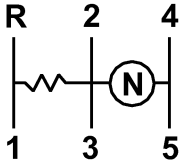
(1) Gearshift lever (Selector lever)

[Model: HINO 258, 268, 308, 338]



AD-0169

[Model: HINO 165, 185]



AD-0170

2. UltraShift transmission

(1) Warnings & Cautions

WARNING

- Read the entire driver instructions before operating this transmission. (Refer also to Eaton (Fuller) UltraShift transmission “Driver Instructions” for details.)
- Before starting a vehicle always be seated in the driver's seat, select “N” on the shift control, and set the parking brakes.
- If engine cranks in any gear other than Neutral, service your vehicle immediately!
- Before working on a vehicle, parking the vehicle, or leaving the cab with the engine running, place the transmission in Neutral, set the parking brakes, and block the wheels.
- For safety reasons, always engage the service brakes prior to selecting gear positions from “N”.

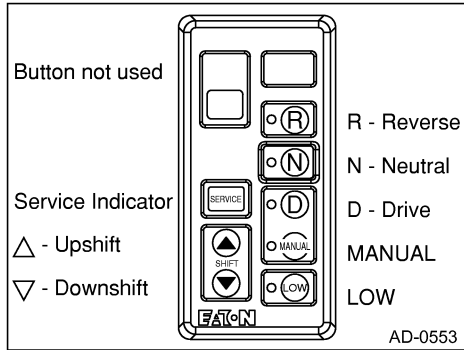
CAUTION

- Do not release the parking brake or attempt to select a gear until the air pressure is at the correct level.
- Battery (+) and (-) must be disconnected prior to any type of welding on any UltraShift™ equipped vehicle.

NOTICE:

- It is a requirement that the driver of a commercial vehicle specified under paragraph A sections 1-6 of FMCSA regulation 392.10 need only cross railroad grade crossings in a gear that permits the vehicle to complete the crossing without a change of gears.
- This can only be achieved by utilizing the Manual “M” mode. Please refer to pages 2-70 for correct manual mode operation.

(2)Shift Console Positions



- R Selects Reverse gear once vehicle speed is less than 2 mph.
- N Selects Neutral
- D Selects the default starting gear and automatically selects gears between the starting gear and top gear.

Manual

Allows the driver to hold current gear and manually select the appropriate gear for road conditions using the up/down buttons. MANUAL mode should be used whenever the driver wants to select the shifts instead of letting UltraShift select them automatically. For example, when the driver is moving around the yard, over railroad tracks, or on steep grades. (See the “Manual Mode” section for more details.)

Low

Transmission downshifts at the earliest opportunity for maximum engine braking.

Service

The service indicator alerts the driver of potential transmission problems.

Up / Down Buttons

Used in the MANUAL mode to select upshifts and downshifts, if available.



WARNING

UltraShift™ initiates upshifts from “MANUAL” and “LOW” for engine over speed protection.

(3) Start-up and Power Down

Start-up

- a. Turn the ignition key to “ON” and allow the UltraShift to power-up.
 - Engine cranking is delayed until the transmission power-up is complete and the gear display shows a solid “N”.
- b. Start the engine.
- c. Apply service brake.
 - If the service brake is not applied while selecting a starting gear, the initial start gear will not be found and the driver will have to **re-select** Neutral and press the brake while re-selecting the desired mode.
- d. Select the desired mode and starting gear on the shift console.

NOTICE:

Medium Duty transmissions only allow a 1st gear start option.



CAUTION

When selecting the mode, never depress the accelerator or the vehicle may suddenly result in an accident.

- e. Release the vehicle parking brakes.
- f. Release service brake and apply accelerator.
 - The transmission is not intended to provide hill-hold capability. The service brakes should be used to stop and hold the vehicle on an incline. To prevent the vehicle from rolling when starting on an incline, place both feet on the brake pedal before sliding the right foot to the throttle pedal. Gradually back off the brake while applying as little throttle as necessary to move along the incline.

Power Down

- a. Select Neutral on the shift control.
 - If gear display does not show solid “N”, neutral has not yet been obtained.
- NOTICE:**
- Neutral should always be reached before UltraShift power down is performed except in cases of emergency.**
- b. Set the vehicle parking brakes.
 - c. Turn off the ignition key and allow the engine to shut down.

(4)Driving Tips

Skip Shifting

Performed in MANUAL by pressing the shift button more than once. Refer to the MANUAL mode section for detailed information.

NOTICE:

Skip shifts are not always available for Medium-Duty transmissions.

Optimal Engine Braking

The LOW mode can be selected while moving. This initiates downshifts as soon as possible at a higher rpm. Refer to the Low mode section for detailed information.

Skid Conditions

If a skid condition occurs, the UltraShift senses the vehicle speed dropping rapidly. In this case, the UltraShift delays downshifting. To prevent automatic shifts under hazardous road conditions Manual mode should be selected.

Cruise Control

The UltraShift is totally compatible with cruise control. If a shift is required while cruise control is active, cruise is temporarily interrupted while the shift is performed and then automatically resumed after the shift.

Manual Mode

In Manual mode, UltraShift allows the driver to hold current gear and manually select the appropriate gear for road conditions using the up/down buttons. Manual mode should be used whenever the driver wants to select the shifts instead of letting UltraShift select them automatically. Examples include when the driver is moving around the yard, over railroad tracks, or on steep grades.

Load Based Shifting

In Drive, the UltraShift will adapt to the changing conditions of the vehicle. Right after power-up or after changing loads, UltraShift needs to learn the new conditions. While learning, it may hold a gear instead of upshifting. Simply push the Up button to start the upshift. It may take three or four shifts for the UltraShift to learn the new conditions. After that it will handle upshifts and downshift automatically.

Coast Mode

When coasting to a stop in lower gears with your foot off the throttle, Ultra-Shift may not finish downshifting until the driver gets back on the throttle. The system will automatically track vehicle and engine speed during this time and engage the appropriate gear when the throttle is re-applied. This is normal operation for the UltraShift when in Drive "D" mode only.

(5)Reverse Mode

The vehicle should be stopped before Reverse is selected. If the driver requests Reverse above 2 mph, the shift is not performed until the speed has dropped below 2 mph.

Each time Reverse is selected from Neutral, the default Reverse gear is engaged.

(6)Drive Mode

In Drive mode, all upshifts and downshifts are performed automatically based on vehicle and transmission conditions.

The driver can advance a shift (by about 75 rpm) by pressing the proper up/ down button (up for upshifts, down for downshifts) when the transmission is within 75 rpm of the load based shift point.

The Gear Display shows the status of the shift:

- The current gear is displayed solid.
- At the start of the shift, the current gear is displayed solid until the transmission is pulled to the neutral position.
- While the transmission is in neutral and synchronizing for the target gear, the target gear is flashed.
- When the shift is complete, the new current gear is displayed solid.

(7)MANUAL Mode

MANUAL mode should be used when the driver wants to select the shifts instead of letting UltraShift select them automatically. For example, when the driver is moving around the yard, over railroad tracks, on steep grades, or slippery surfaces.

Selecting MANUAL from Neutral:

- If MANUAL mode is selected from a stop, the starting gear is maintained - no automatic shifts are performed, except for conditions noted below.
- The driver can request shifts using the proper up/down button (up for upshifts, down for downshifts). The upshift or downshift is performed by the UltraShift provided the resulting engine speed is not outside of defined limits. For upshifts, the resulting engine speed must be greater than 900 rpm; for downshifts, the resulting engine speed must be less than engine rated speed.

Selecting MANUAL from Drive or LOW while moving:

- If MANUAL mode is selected while moving, the current gear is maintained - no shifts are performed, except for conditions noted below.
- As described above, the driver can request shifts using the proper up/down button (up for upshifts, down for downshifts) within the same limits described.

Transmission Manual Override:

- If the vehicle is being back driven (vehicle coasting and being pushed by the load) and the engine is approaching a higher than normal level (approximately 300 rpm above rated speed), the UltraShift overrides the MANUAL position and performs an upshift to prevent engine damage.
- If the gear being maintained is higher than the starting gear and the engine is lugged excessively causing the clutch to disengage, the UltraShift system will override the MANUAL mode and shift to the best available gear if the driver depresses the throttle pedal.



CAUTION

Do not use excessively the foot brake. If you use the foot brake excessively on the downhill, the brake may be overheated and lose the braking force. It is dangerous.

HINT:

- **If the vehicle speed is relatively high to the gear selected manually, sometimes shifting down the gear cannot be made to prevent engine overrun. In this case, depress the brake pedal to slow down the vehicle speed.**
- **“OVERRUNNING” means the engine speed is exceeding the maximum permissible engine revolution. Operating the engine at this speed will impose excessive loads on different parts of the engine and will result in the damage to the engine.**

(8) LOW or 1 Mode

LOW mode should be used any time you want to maximize engine braking and minimize the use of the brake pedal. For example, when driving down long grades or when coming to a stop.

Selecting LOW from Neutral :

- If LOW mode is selected from Neutral while stopped, the starting gear is always the lowest available gear. The starting gear cannot be changed in LOW mode.
- If LOW mode is selected from Neutral while stopped, the lowest available gear is maintained - no shifts are performed, except for conditions noted below.

NOTICE:

- **1st gear is the only start gear available in LOW mode for Medium Duty transmissions.**
- **LOW mode can be used while climbing steep grades to achieve higher downshift points (transmission will downshift sooner).**

Selecting LOW from Drive or MANUAL while moving:


- If LOW mode is selected while moving, no upshifts are performed, except for override conditions noted below.
- Downshifts are performed at higher rpm's than normal to enhance engine braking. The downshift point is chosen so engine speed after the shift is about 50 rpm below engine rated speed.

Transmission LOW Override

- If the vehicle is being back driven (vehicle coasting and being pushed by the load) and the engine is approaching a higher than normal level (approximately 300 rpm above rated speed), the UltraShift overrides the LOW position and performs an upshift to prevent engine damage.
- If the gear being maintained is higher than the starting gear, and the driver depresses the throttle pedal, the UltraShift system will override the LOW mode and shift to the best available gear if the engine lugs excessively.

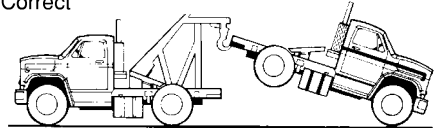
(9) Vehicle Towing

When towing the vehicle, the output shaft of the transmission must not be allowed to spin or turn. If the vehicle is towed with the drive wheels still in contact with the road surface, the vehicle axle shafts or drive-line must be removed or disconnected.


 **WARNING**

Serious Internal transmission damage can result from improper vehicle towing.

Correct



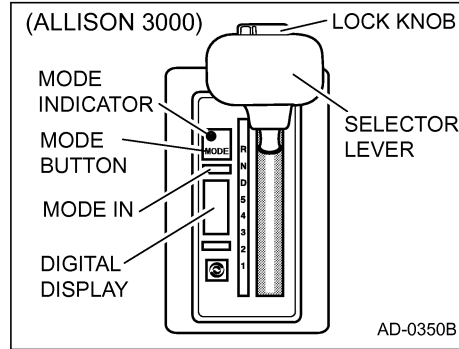
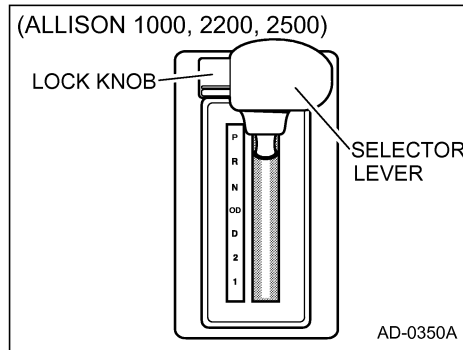
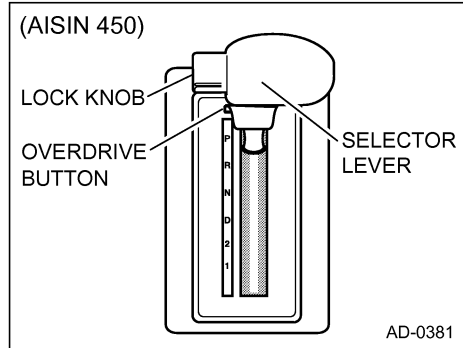
INCORRECT



AD-0554

3. Automatic transmission

(1) Selector lever



NOTICE:

DIGITAL DISPLAY

The first number displayed is highest forward range available and second number is range attained in selected position.

Visually check to confirm range selected. If display is flashing, shift is inhibited.

The automatic transmission is equipped with a starter safety switch which allows engine starting only when the selector lever is in the "N" (Neutral) or "P" (Parking) position. When shifting the selector lever to the desired position, you have to press the button of the selector lever before the lever can move as shown on the below.

NOTICE:

For Allison Automatic Transmissions refer also to separate Allison Transmission Operator's Manual.

Aisin 450 and Allison 1000HS, 1000RDS, 2200HS, 2200RDS Transmission with Park Pawl Mechanism

A park pawl, which is standard on the Aisin 450 and Allison 1000HS, 1000RDS, 2200HS, 2200RDS transmission, effectively grounds the output shaft, thereby preventing rotation of the drive line. If the vehicle is stationary, selecting the "P" (Park) position on the shift selector places the transmission in "N" (Neutral) and engages the park pawl (always use with the Park brake).

If you attempt to engage “P” position while vehicle is in motion (1 mph, 2 km/hr) or higher, the park pawl mechanism will ratchet, and will not hold the truck.

 **CAUTION**

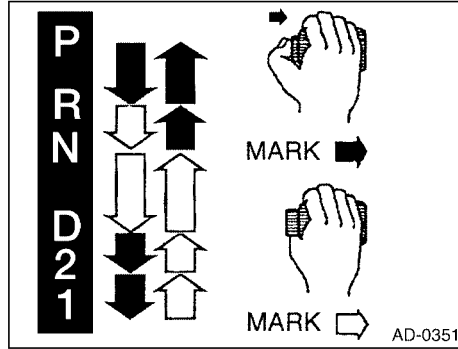
- When the engine revolution is high (for example, immediately after starting the engine), moving the selector lever to “D” or “R” without holding down the brake pedal may result in a sudden acceleration of the vehicle.
- When starting the vehicle, always depress the brake pedal and then move the selector lever from “N” or “P” to “D” or “R”.

NOTICE:

WHAT IS THE CREEP PHENOMENON:

This is when the vehicle starts to move slowly without depressing the accelerator pedal when the selector lever is at the driving position and the engine idling speed is high.

[Model: HINO 145, 165, 185] AISIN 450

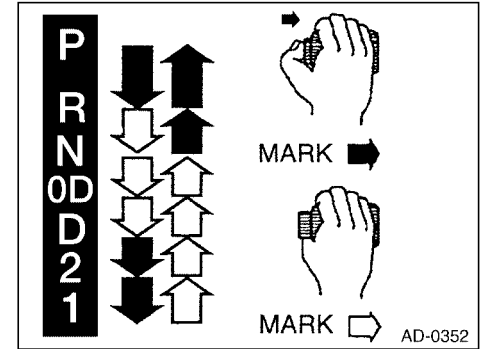


[Model: HINO 238, 258, 268]

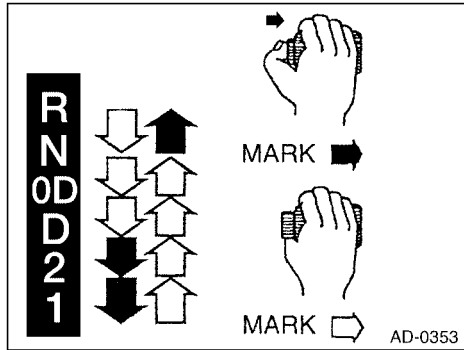
Allison 2200HS, 2200RDS

[Model: HINO 165, 185]

Allison 1000HS, 1000RDS



[Model: HINO 268, 308] Allison 2500RDS



(2) Operation of the selector lever

When changing gears, only use the lock knob as illustrated above.

CAUTION

Do not push in the lock knob during (⇔) operation. Doing so might make you mistakenly move the lever to “R” or “D” and result in an accident.

“P” Parking

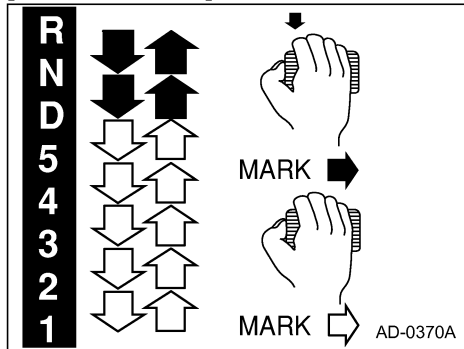
When parking a vehicle equipped with both “P” Park position and apply the parking brake.

CAUTION

Always fully set the parking brake. Do not use selector lever instead of parking brake. To avoid sudden, unexpected vehicle movement and possible personal injury or death, perform the following:

- A Bring the vehicle to a complete stop.

[Model: HINO 338] Allison 3000RDS



- Put transmission selector in “P” Park (for Aisin 450 and Allison 2200HS, 2200RDS, 1000HS, 1000RDS transmission) or “N” Neutral.

- For the Aisin 450 and the Allison 2200HS, 2200RDS, 1000HS, 1000RDS transmission, slowly lift foot from brake pedal to engage transmission park pawl mechanism.

- Apply the Park brake and ensure that it is holding properly. (For the Aisin 450 and the Allison 2200HS, 2200RDS, 1000HS, 1000RDS transmission do not rely solely upon the parking mechanism of the transmission).

- Turn off engine when you leave vehicle. Never leave the vehicle unattended with engine running.

“R” Reverse

The “R” position is used for driving backward.

Wait until the vehicle has completely stopped before shifting between “R” and the other positions.

The back buzzer will sound, when put the lever in the “R” position.

“N” Neutral

Put the lever in the “N” position, when starting or warming up the engine.

The lever must also be in “N”, when operating the PTO (power take-off), with the vehicle stationary.

NOTICE:

The engine should not start in any position other than “N” or “P”.

If the engine can be started while the selector lever is in a position other than “N” or “P”, the “safety switch” must be defective. In this case, take the vehicle to an authorized Hino dealer.

“D” Drive

[MODEL HINO 145, 165, 185, 238, 258, 268, 308]

This is the selector position for additional engine brake. The transmission is set in first gear at starting and automatically shifts into second, third and fourth gears as you depress the accelerator pedal, depending on the load and speed desired.

[MODEL 338]

This is the selector position for normal driving. The transmission is set in first gear at starting and automatically shifts into second, third, fourth, fifth and sixth gears as you depress the accelerator pedal, depending on the load and speed desired.

“3” Third, “4” Fourth and “5” Fifth

The “3”, “4” and “5” position is used for driving in urban and suburban areas at medium speed. The transmission starts in first gear and automatically shifts to second and third (and fourth) gears, as driving conditions require.

“2” Second

The “2” position is used for driving in congested traffic at low speed. The transmission starts in first gear and automatically shifts into second, as conditions require. It is also used when using the engine for braking while descending hills.

“1” First

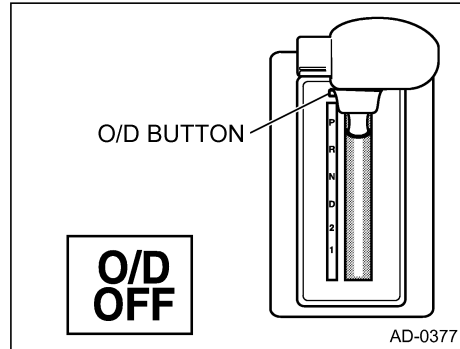
The “1” position corresponds to the low gear of manually-shifted transmission. It is used for climbing especially steep hills and negotiating off-road terrain.

Refer to the Aisin or Allison Automatic Transmission “Operation Handbook” for details.

NOTICE:

- As the automatic transmission is provided with a LOCK-UP function, LOCK-UP operated once the specific speed is exceeded, slipping of the torque converter is prevented, and a running performance to that of a vehicle with manual transmission will be obtained.
- LOCK-UP function provided with automatic transmission improves the driving performance.
- Vehicle speed may vary depending upon vehicle condition.

**(3)“O/D” Overdrive selection button
[Model: HINO 145, 165, 185 with Aisin
automatic transmission]**



Switch to “ON” by pushing the button and “OFF” by pushing it again, which are indicated in the instrument panel.

For normal driving, you should put “ON” the overdrive (O/D) button. With the “D” position, the speed can be controlled from 1st to 4th speed automatically.

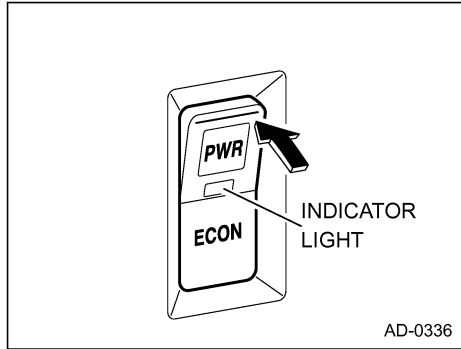
When you put “OFF” the switch, the overdrive off light is turned on, the speed can be controlled from 1st to 3rd speed automatically.

For driving on a slope, you should put “OFF” the switch.

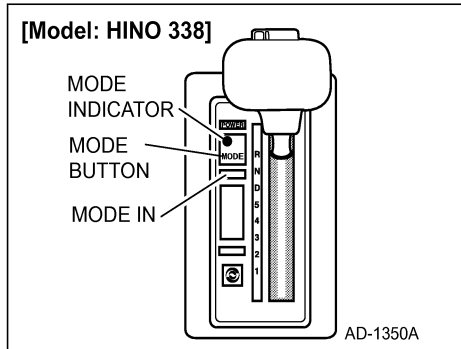
For downhill driving, apply the effectiveness of the engine brake.

For uphill driving, you can enjoy smooth driving with a few changes of speed.

(4) Driving mode selection switch



AD-0336



AD-1350A

[Model: HINO 238, 258, 268, 308 with Allison automatic transmission except 3000RDS]

Push the "PWR" mode button to shift to power mode lighting up the mode ON display. Push the "ECON" mode button to return to economy mode switching the light off.

[Model: HINO 338 with 3000RDS]

Push the mode button to shift to power mode lighting up the mode ON display. Push again to return to economy mode switching off the mode ON display.

● Power mode:

Use this mode when driving uphill, when you have a heavy load, or when you need to accelerate.

● Economy mode:

Use this mode when driving without a load or driving on a level road with a light load.

(5) Starting the vehicle and under normal driving conditions

- First, press down on the brake. Otherwise, if the selector lever is moved, the vehicle may start to creep. Depress the brake pedal securely to prevent the vehicle from moving.
- Shift the selector lever to "OD", "D", "5", "4", "3", "2", "1" or "R" position.



CAUTION

When moving the selector lever, never depress the accelerator or the vehicle may move suddenly resulting in an accident.

- Release the parking brake lever and then the brake pedal.
- Depress slowly the accelerator pedal. The gear changes automatically according to the vehicle speed and load.



CAUTION

If you do, the engine cannot act as a brake and it may result in an accident. Also, you cannot accelerate in “N”.

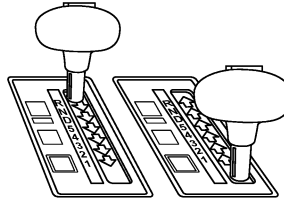
NOTICE:

Operating the selector lever

- To shift the selector lever from reverse to forward or forward to reverse, shift it always after the vehicle has stopped. Also check visually the lever position.
- To escape from the mud, shift the lever from “OD” or “D” to “N” and from “R” to “N” one after another.
- Do not run the engine at high speed while depressing the brake pedal with the selector lever at the position other than “N”.
See page 2-32 for “Check automatic transmission warning light”.

(6)Manual shift driving

(EXAMPLE)



DP052609LA

You can shift the automatic transmission as you would a manual transmission.

Driving on the sloping road

When driving uphill, move the selector from “D” to “1” depending on the slope and load. When driving downhill, move from “D” to “1” according to the need to slow down using the engine as a brake.



CAUTION

Do not use excessively the foot brake. If you use the foot brake excessively on the downhill, the brake may be overheated and lose the braking force. It is dangerous.

HINT:

- If the vehicle speed is relatively high to the gear selected manually, sometimes shifting down the gear cannot be made to prevent engine overrun. In this case, depress the brake pedal to slow down the vehicle speed.
- “**OVERRUNNING**” means the engine speed is exceeding the maximum permissible engine revolution. Operating the engine at this speed will impose excessive loads on different parts of the engine and will result in the damage to the engine.

(7) Stopping the vehicle

Keep the selector lever at “D” position and securely depress the brake pedal with your right foot. If you stop your vehicle on a slope, apply the parking brake.

When you are stopping for a long time, move the selector lever to “N” (Allison 2500RDS & 3000RDS model) or “P” (Aisin 450 & Allison 1000HS, 1000RDS, 2200HS, 2200RDS model), depress the brake pedal, and apply the parking brake.

(8) Parking the vehicle

- Shift the selector lever to “N” or “P” position while holding down the brake pedal.
- Apply the parking brake securely.
- Release the brake pedal and stop the engine. When parking the vehicle on a sloping road, always lock the wheels by wheel stoppers.

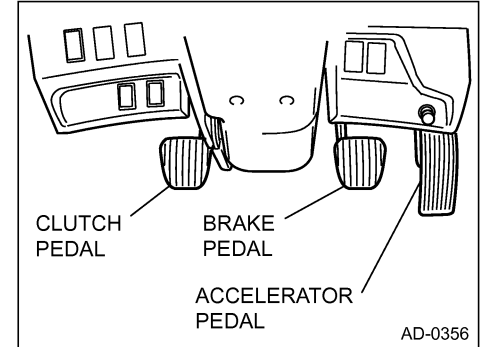


CAUTION

CAUTION FOR TOWING THE VEHICLE

- To tow an automatic transmission vehicle, lift the rear wheels.
- To tow this vehicle with a wire rope without lifting the rear wheels, first dismount the propeller shaft. Otherwise, the transmission may over-heat.
- You cannot start an automatic transmission vehicle's engine by pulling or pushing the vehicle.

4. Accelerator pedal



The accelerator pedal connected to the fuel system controls acceleration by pressing down on the pedal. Release pedal for deceleration.

5.Brake pedal

An hydraulic power brake system or full air brake system is installed in the vehicle. The service brake is applied according to the brake pedal stroke.

Hydraulic power brake system

Disc type brake with split system plumbing are used on all hydraulic power brake equipped chassis. A Hydraulic power brake system is the hydraulic assist system that utilizes the hydraulic power steering pump to assist the driver by reducing the driver-applied force required at the brake pedal. The system also has an electrically powered back-up power assist in the event of a malfunction in the hydraulic power pump system or loss of engine power.

6.Clutch pedal

On vehicles with manual transmission, a clutch pedal is used to engage or disengage the clutch, which connects or disconnects the engine from the power train.

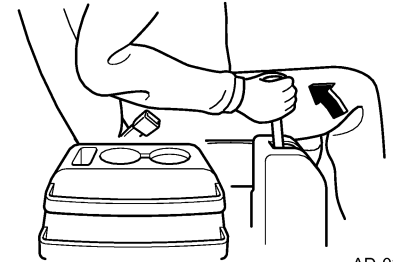


WARNING

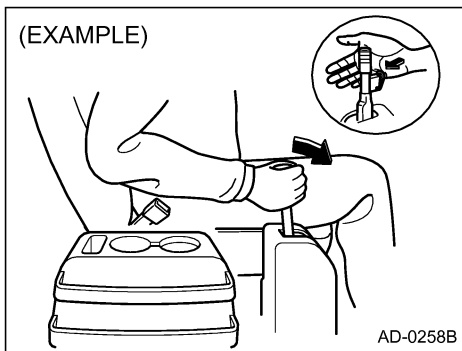
- **Be careful not to allow any objects such as cans or debris to be on the floor of the vehicle so that they could get caught under the brake pedal or clutch pedal and prevent the driver from braking or changing gears. Remove all cans and objects under the seat and the brake pedal.**
- **Pay attention not to be caught by the floor mat or any debris between the brake pedal and the floor. It can be a cause of brake dragging.**

7.Parking brake lever (Toggle type) [Hydraulic brake type]

(EXAMPLE)



To apply the parking brake:
Pull up the lever and the brake will be applied at the transmission output shaft by way of cable and linkage.

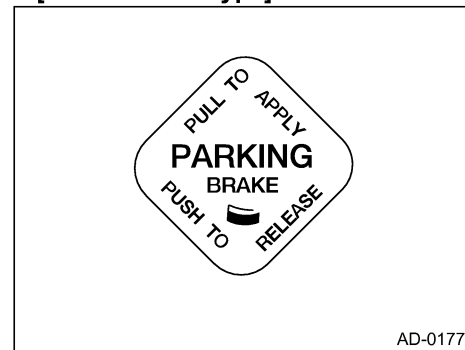


To release the parking brake:
Push in the lever release button. Then, while holding the button in, push the lever down all the way.

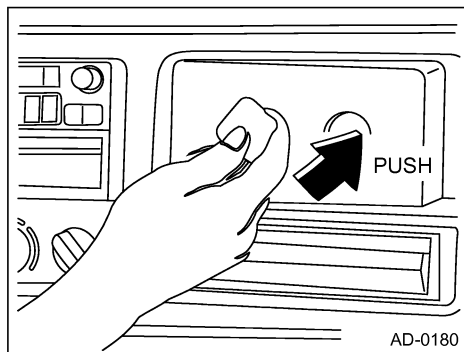
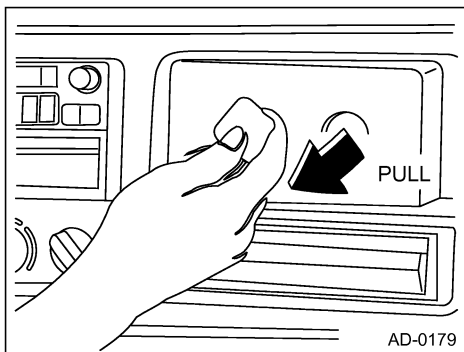
 **WARNING**

- **Avoid applying the parking brake while driving except for emergency purpose. Using of the parking brake while driving will make the rear wheel lock up and the vehicle will be unstable. Doing so can result in a serious accident.**
- **After using the parking brake in an emergency, inspect it to be sure it hasn't malfunctioned.**
- **Do not drive with the parking brake applied. This can cause accelerated abrasion and overheating of the brake components which can result in reduced braking effectiveness or a fire.**
- **When parking the vehicle, apply the parking brake firmly and make sure that your vehicle holds in place.**
- **When parking on a slope, apply the parking brake firmly and block all the wheels.**

**8. Parking brake control knob
[Full air brake type]**



A powerful coil spring mechanically applies the rear axle brake shoes whenever air pressure against the spring is released.

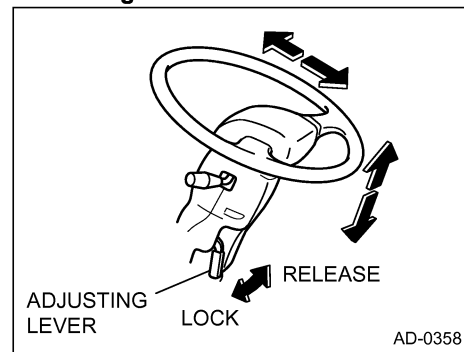


To apply the parking brake, pull the parking brake control knob out. This exhausts the air from the spring brakes. Use the parking brake control knob for parking purposes only. If the supply pressure to this valve is reduced to 35 - 45 lb/in² (2.4 - 3.2 kg/cm²), the parking brake control knob pops out automatically, applying the parking brakes.

! WARNING

Use of the parking brake knob with the vehicle in motion will cause full unmodulated brake application, which could cause personal injury due to wheel lock up.

9. Steering wheel



The height and the tilt angle of the steering wheel can be adjusted to select a suitable driving position.

- a. Release the adjusting lever and move the steering wheel up or down and tilt forward or backward as desired.
- b. After adjustment, lock the adjusting lever.

! WARNING

- After adjustment, securely lock the adjusting lever. An insufficient locking of the adjusting lever will cause excessive steering wheel play and this hinders the operation of the steering wheel.
- Be sure to adjust the steering position while the vehicle is parked. This can cause the driver to lose control and result in personal injury and/or property damage.
- Do not keep the steering wheel fully turned for prolonged periods of time. This can cause damage to the power steering system.

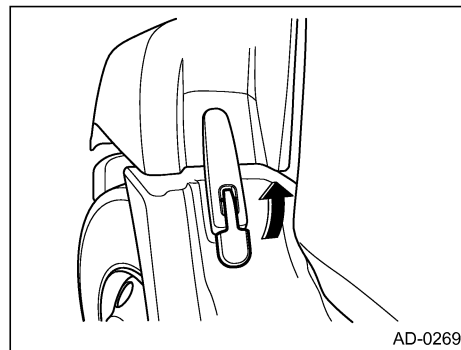
Your vehicle is equipped with power assist steering. If the power steering system stops functioning because of a stalled engine or other malfunction, the vehicle can still be steered manually, but it requires much greater effort. If the steering malfunctions while driving, pull off the road immediately and stop the vehicle carefully. Have an authorized Hino dealer check and correct it.

ENGINE HOOD

Opening hood

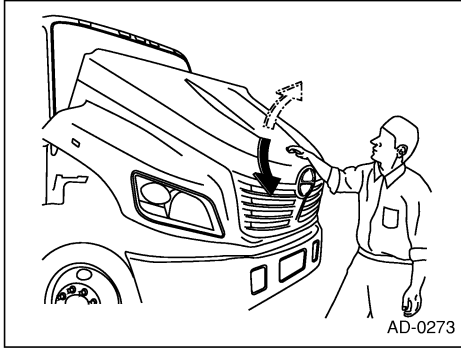
! WARNING

- Ensure ample space around the hood before commencing this operation.
- Never park your vehicle on a slope or hill when opening the hood. Raising or lowering a hood while the vehicle is parked on a slope or hill can cause property damage and/or personal injury. Lowering a hood while so parked may prevent the hood latches from working properly.
- If the vehicle is equipped with automatic transmission, place the selector lever in the “N” neutral position or “P” parking position and block all the wheels.
- Make sure there are no obstacles above the hood.
- To avoid serious burns, keep away from hot metal parts such as the engine, radiator and exhaust pipe.

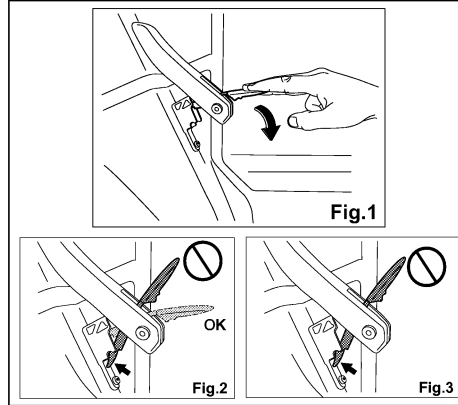


1. Parking the vehicle on a level surface.
2. Stop the engine, set the parking brake, shift the transmission lever to the neutral position and remove the key.
3. Pull up the left and right hood latches, releasing the hood.
4. Lift up the hood.

Closing hood



1. Grasp the hood.
2. Close the hood slowly.
3. Lock the left and right hood latches.
4. Make sure that both hold-down latches are fully engaged before operating the vehicle.



NOTICE:

- Lock at the position of Fig.1 when you fix hood latches.
- There is a possibility that the hood latch and/or latch base is damaged when fixing at the position of Fig.3.

WARNING

- Before closing the hood, make sure that there is no one around the engine or beneath the hood. Also make sure that hand tools, gloves, waste etc. are not left on or around the engine.
- When the hood weight is heavy or adjustment of the torsion bar is not proper, the hood could come down with great force. Therefore be careful there is no one beneath the hood when it is lowered.
- If the engine is running, stop the engine by turning the key counter-clockwise.

SECTION 3

DRIVING YOUR VEHICLE

DAILY INSPECTION	3-2
NEW VEHICLE BREAKING-IN	3-18
STARTING THE ENGINE	3-19
DRIVING	3-20
AFTER DRIVING	3-28
HANDLING IN COLD WEATHER	3-29
STARTING THE ENGINE AFTER PROLONGED VEHICLE STORAGE .	3-30
ENGINE SHUTDOWN (If so equipped).....	3-31

Read entire manual before using vehicle. Failure to follow instructions and safety precautions could result in death, serious injury and/or damage.

DAILY INSPECTION



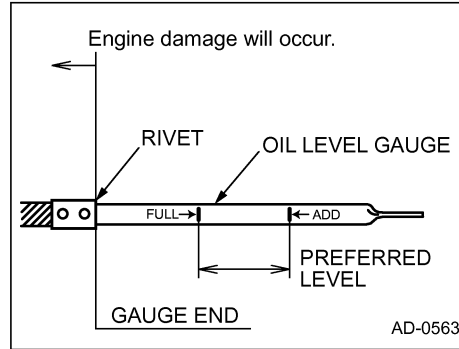
WARNING

Perform this daily inspection each day before driving. Be sure to make any necessary repairs and adjustments before using the vehicle. For normal maintenance, see Section 7. Failure to keep this vehicle in good repair could cause an accident resulting in serious injury, death, or property damage.

NOTICE:

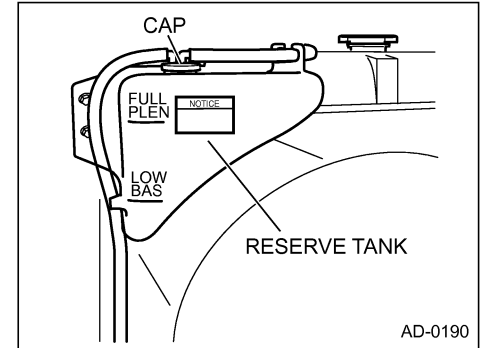
If level is over the “FULL” mark, adjust oil level to the preferred area. When oil level becomes too high, engine damage will occur.

Before starting the engine Engine oil



Check the engine oil level and check the engine for leaks.

Coolant

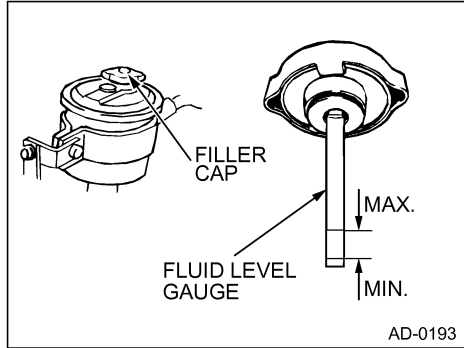


Do not open the radiator cap since replenishment of the coolant takes place through the reserve tank. Check coolant level at the reserve tank. If the coolant level is low, first check to see that there is no leakage of the cooling system and add coolant up to “FULL” line.

NOTICE:

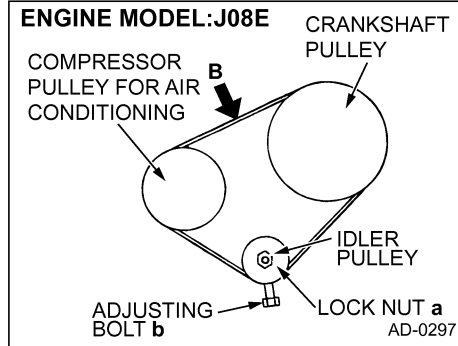
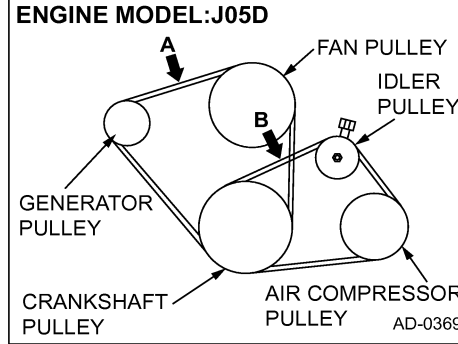
Keep coolant level between “FULL” and “LOW” when engine is cold. In case of the operation of the coolant level alarm, coolant should be added to the reserve take as well as the radiator.

Power steering



1. Remove the filler cap and wipe the attached fluid level gauge with a clean cloth.
2. Check the fluid level by screwing the cap back on and removing the cap again. When the fluid level is low, add fluid of same brand and type to the "MAX." fluid level mark.

Drive belts

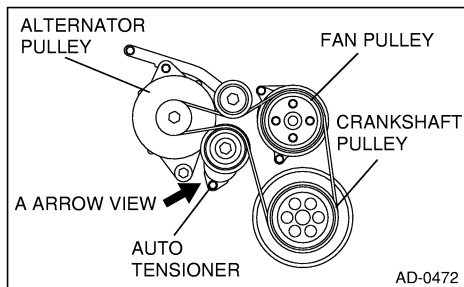


Check drive belts for proper tension on page 7-50. Also check the drive belts for damage. Replace them with new drive belts, if necessary.

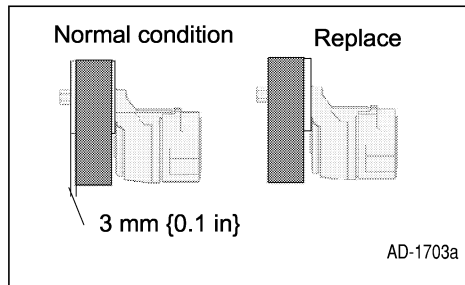
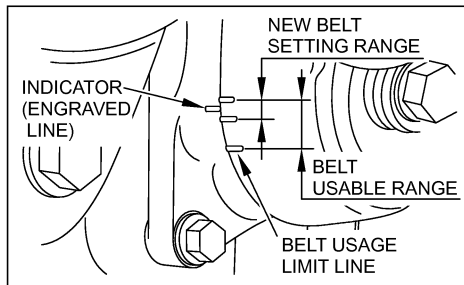
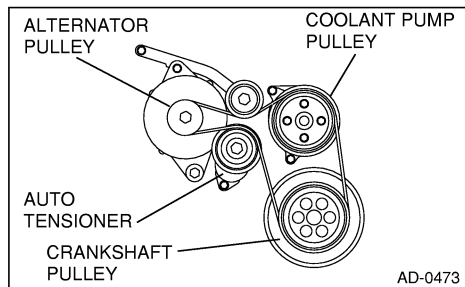
CAUTION

Make sure to stop the engine to inspect the drive belt. Do not touch or get close to turning parts while the engine is running. Your hands or clothes can get caught and you might be injured.

1. Stop the engine to inspect.
2. The belt tension of J08E engine is automatically adjusted by the auto-tensioner. So, the belt tension adjustment is unnecessary. However, it is necessary to confirm that the indicator (engraved line) of the belt tensioner is in the belt usable range by performing the visual check from the A position (A arrow view). Also, check the belt for damage at this time.



Auto tensioner



If the indicator (engraved line) is out of the belt usage limit line, or if the belt is damaged, replace the belt with a new one.

To inspect the auto-tensioner, push down the belt between the pulleys with a constant force. Check to see that the tension pulleys move with a constant speed.

Then release the belt and check to see that the tension pulleys return to the original position by the spring force.

The judgment when its auto-tensioner replace is as follows:

- If the pulleys do not move when pushing down the belt.
- If there are any abnormalities of pulleys motion.
- If the pulleys do not return when releasing the belt.

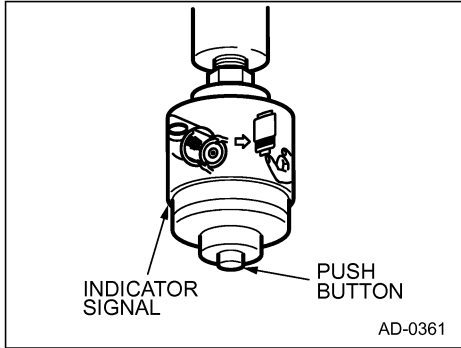
NOTICE:

A damper generating a large damping force in the contracting direction is built-in the spring part of the auto-tensioner. So, this has a construction difficulty to contract and easy to expand.

Engine compartment

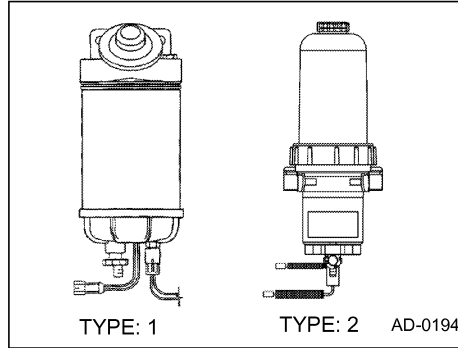
Be sure that no rags or waste paper are left in the engine compartment. Check the moving parts and exhaust system carefully.

Air cleaner service indicator



The air cleaner service indicator is installed near air cleaner. Check whether a red signal is shown on the service indicator for clogging of the air cleaner.

Fuel filter

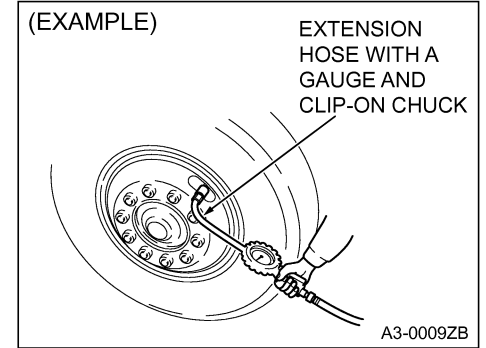


The fuel filter with water separator is at the left side frame of the cab back.

TYPE:1 RACOR®

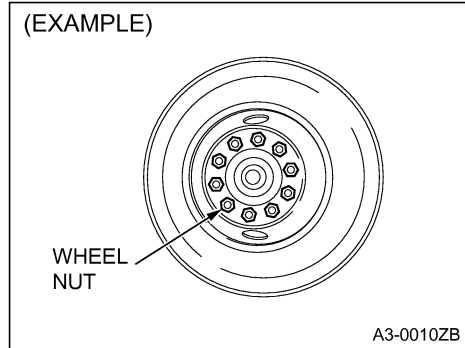
TYPE:2 DAVCO®

Tires



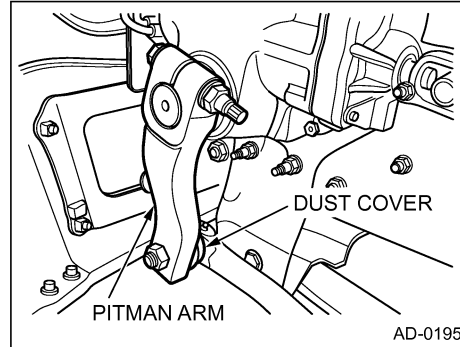
Check tires for proper air pressure, damage, and wear.

Wheel nuts



Be sure that all wheel nuts are in place and not loose. To check torque, refer to SECTION 7, "MAINTENANCE".

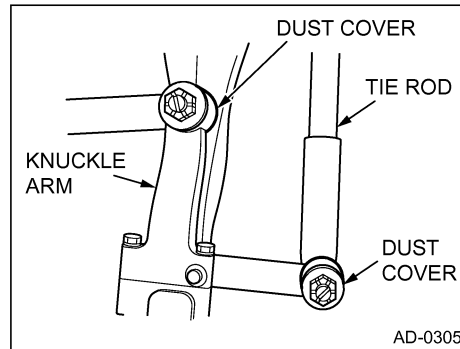
Steering linkage



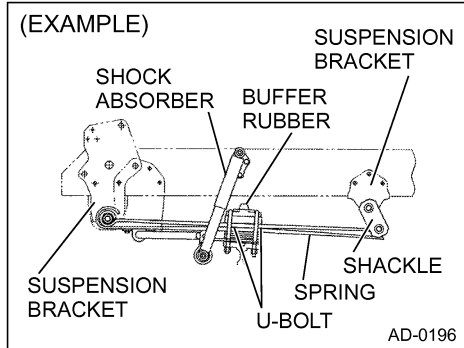
Check ball joints and dust covers for wear or damage. Check arms and rods for damage or loose mounting.

Brake lines

Check lines and hoses for damage, rubbing or leaks. Check the air leaks for valves, brake chambers etc. [Full air brake type]

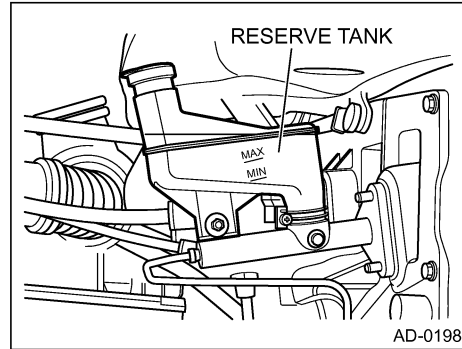


Suspension



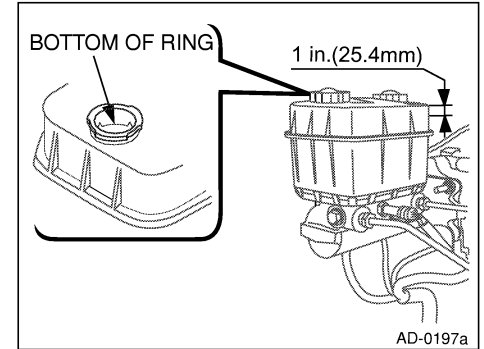
Check front and rear springs for damage. Be sure that U-bolts are not loose. Check for cracks in the suspension brackets and loose fasteners in the spring hangers and shackles. Check the shock absorber for loose fasteners and leaks.

Clutch fluid (Applicable for manual transmission)



Check the clutch fluid level. Check that the fluid reserve tank cap is securely tightened. The clutch fluid reserve tank is installed in the engine compartment. Check it after you open the hood.

Brake fluid reserve tank [Hydraulic brake type]

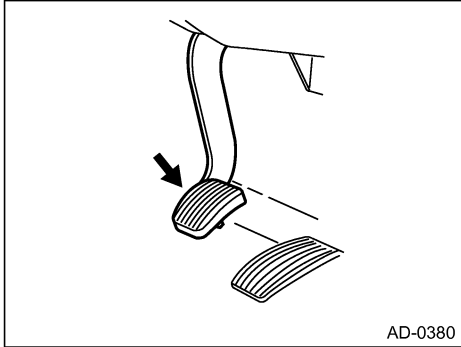


The brake fluid reserve tank is installed on the left side of the engine room. The brake fluid level shall be within the range of 1 in. (25.4 mm) below bottom of ring. Check the fluid level during your daily inspection and refill brake fluid if necessary.

CAUTION

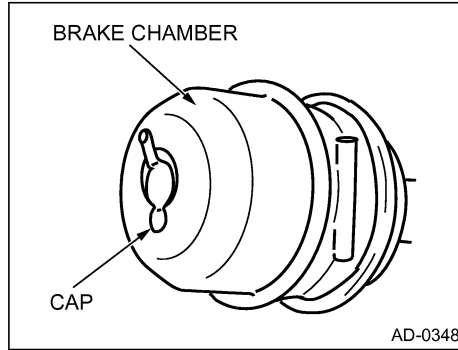
Remove the excess brake fluid from the reservoir when the worn brake pads are replaced, otherwise the brake fluid may overflow from the master cylinder reservoir.

**Brake pedal
[Hydraulic brake type]**



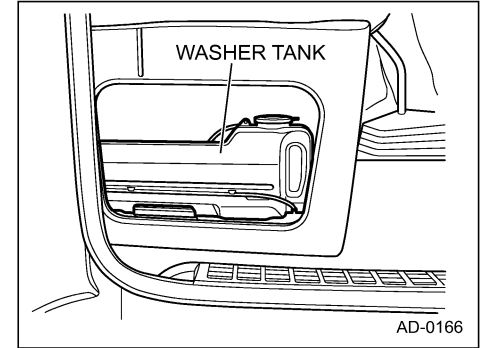
Test daily by listening for the electric motor operation while applying the brakes with starter key is in the "LOCK" position or "ON" position and engine is not operating.

**Parking brake
[Full air brake type]**



Check the brake chambers for damage. Check the parking brake air lines for damage. Check the mounting bolts for the brake chambers for tightness.

Windshield washer

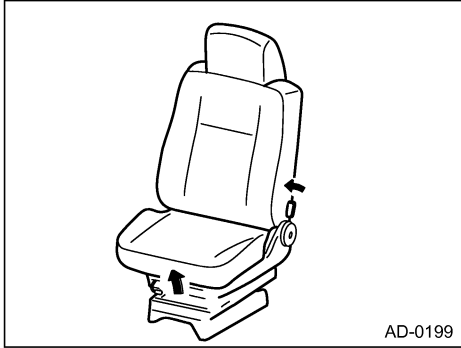


Check the washer solution level. Open the passenger door. The windshield washer tank is located on the side of the seat. To add washer solution, refer to page 7-65.

⚠ CAUTION

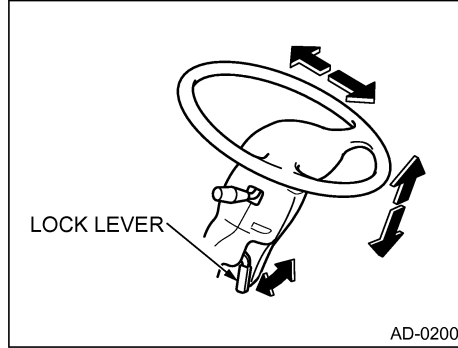
When getting into and getting out of the cab, do not apply force on the washer tank by putting your hands or legs on the tank.

Seat



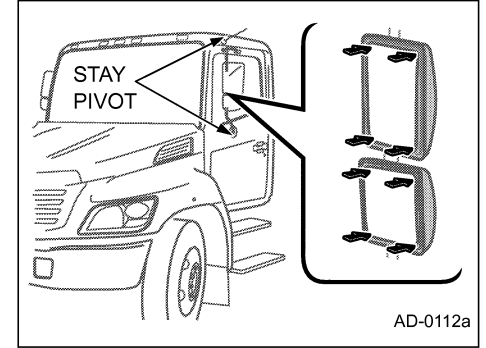
Adjust the seat position.

Steering wheel



Adjust the steering wheel to the desired position. After adjusting, lock the steering wheel by locking down the lock lever.

Mirrors



Check and adjust mirrors. Pay attention to the side mirrors when driving on narrow roads.

CAUTION

- The mirrors stick out from the vehicle body. Be careful not to hit objects or people when driving through a narrow road.
- Drive carefully when looking in rear view mirror.

Starting the engine

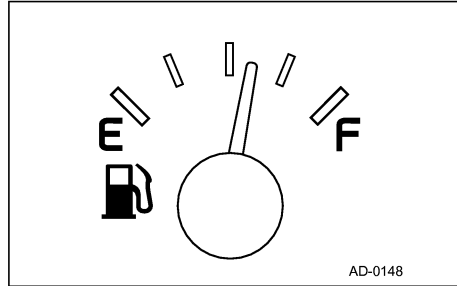
NOTICE:

Before starting the engine, apply the parking brake firmly and place the gearshift lever in neutral. If the vehicle is equipped with automatic transmission, place the selector lever in the “N” (Neutral) or “P” (Parking) position.

“CHECK ENGINE” warning light

When the key is in the “ON”, “START” position, the warning light (🚗) will come on if there is no failure in the light and circuit. Before starting the engine, use this as a check to see that the light is operable. If a light should not light up, refer to page 3-27, for warning lights.

Fuel gauge



Check that the fuel is filled up.

Emergency equipment

Check that emergency equipment is in place.

Brake pressure warning light

If the warning light (🚗 or 🚗) remains illuminated after engine start up, this indicates a system failure in the brake system. Stop the vehicle safely as soon as possible and seek service immediately. This light illuminates when the engine is off and the key is in the “ON” or “START” position.



WARNING

- Hydraulic brake systems are power assisted. Braking capabilities will be greatly reduced without engine assist. Do not move vehicle with the dead engine, as reduced braking capability may result in property damage, personal injury or damage.
- Do not drive if the electrical backup pump dose not cycle. To drive the vehicle without a properly operating pump could result in loss of brakes could cause an accident and result in property damage.

After starting the engine





WARNING

Exhaust gas - Carbon monoxide

- **Do not breathe exhaust fumes: they contain carbon monoxide.**
- **Carbon monoxide is colorless and odorless but very harmful.**
- **Inhaling the exhaust fumes can lead to unconsciousness and can be deadly.**
- **If you smell exhaust fumes in the cab, have the cause checked and corrected immediately. If you have to drive under such conditions, drive with all windows and rear ventilators open.**
- **In order to prevent carbon monoxide from entering the cab, inspection of the exhaust system, cab, and cab ventilation system should be performed by a competent technician.**
- **If anything is found to be wrong, have it corrected immediately by an authorized Hino dealer.**


Warning lights, meters and gauges

Parking brake warning light


Check that the parking brake warning light ( or ) is off while the parking brake is released.

Apply the parking brake after checking the warning light. When the starter key is in the "START" position, the light will come on, enabling the light to be checked.


Air pressure warning light [Full air brake type]

Check that the air pressure warning light () is off.


Oil pressure warning light

Check that the oil pressure warning light () is off.

Coolant level warning light

Check that the coolant level warning light () is off.


Battery charge warning light

Check that the battery charge warning light () is off.


Fuel filter warning light

Check that the fuel filter warning light () is off.

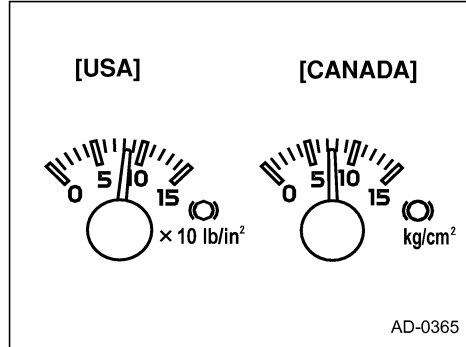
ABS warning light

Check that the ABS warning light (ABS or ) comes on once and then goes off.

Turn signal and hazard indicator lights

Check that the turn signal and hazard indicator lights () operate.

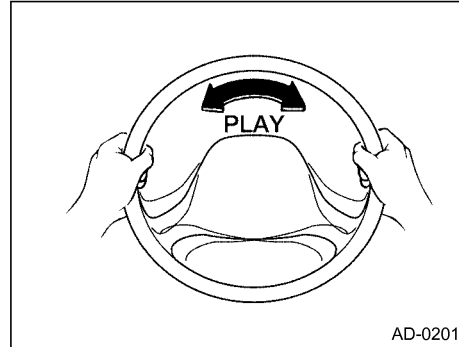
Air pressure gauge [Full air brake type]



Check that the air pressure gauge indicates normal operating pressure.

Switches, levers and controls

1. Steering wheel



The steering wheel play on the circumference is as follows:

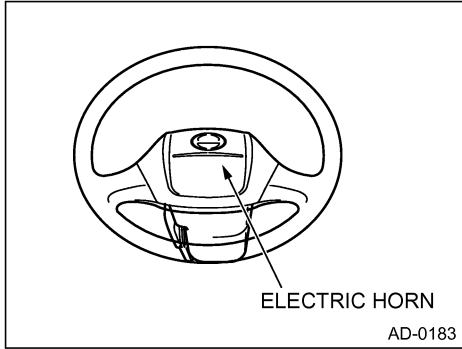
Standard	Limit
0 - 1.37 in (0 - 35 mm)	1.97 in (50 mm)

Check the steering wheel play with the front wheels directed straight ahead and by turning the steering wheel slightly to left and right. Always check the steering wheel play with engine running.

CAUTION

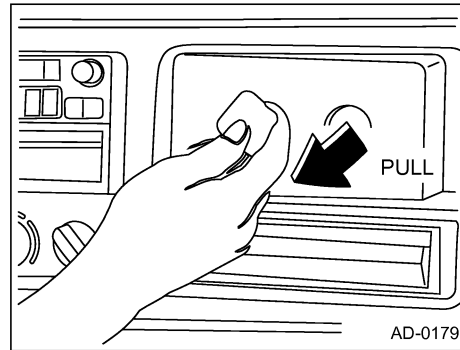
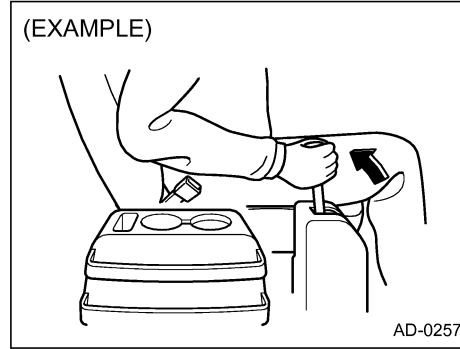
Excessive steering wheel play may adversely affect vehicle handling. This can result in personal injury and/or property damage. Consult an authorized Hino dealer.

2. Horn



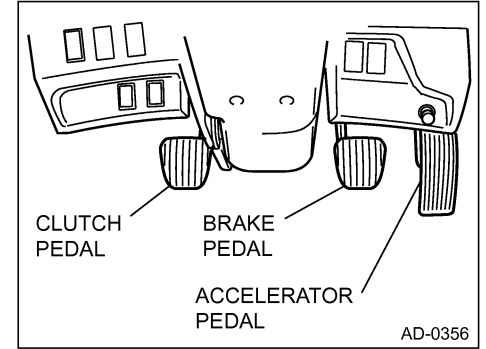
Check the horn function.

3. Parking brake



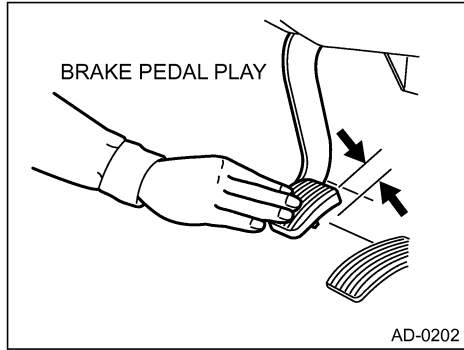
Check the parking brake function.

4. Accelerator pedal



Check that the accelerator pedal returns smoothly. Check the engine idling revolution.

5. Brake pedal

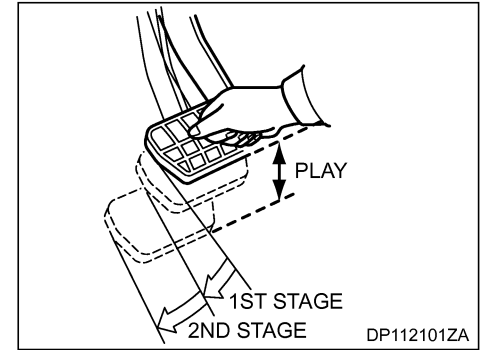


Check the brake pedal play by depressing the pedal by hand. Check that there is clearance between the brake pedal and the toe board when the brake pedal is fully depressed. When the depressed brake pedal is released, make sure that the sound of exhaust can be heard from the brake valve mounted underneath the cab floor. [Full air brake type]

WARNING

Regarding checks and adjustment of wheel brake lining wear, perform checks and adjustment according to SECTION 7, "MAINTENANCE". Under severe driving conditions, more frequent maintenance is required. Failure to properly adjust the brakes can result in personal injury and/or property damage.

6. Clutch pedal (Applicable for manual transmission)

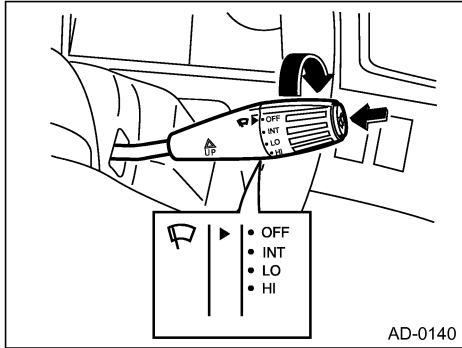


Depress the clutch pedal with fingers and you will feel resistance in two stages. The pedal stroke up to the 2nd stage of resistance is the pedal play. When the pedal play has reached the limit, have the pedal play adjusted at an authorized Hino dealer.

Clutch pedal play

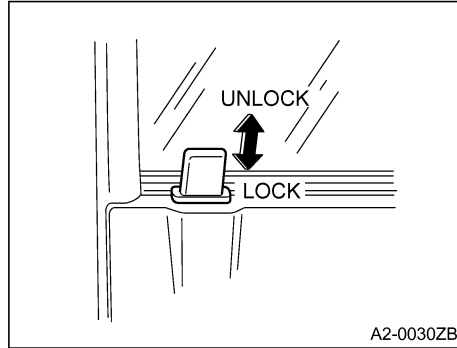
Model	Standard	Limit
HINO 165, 185	1.4 - 2.2 in (35 - 55 mm)	1.2 in (30 mm)
HINO 258, 268, 308, 338	1.7 - 2.3 in (44 - 59mm)	1.4 in (35 mm)

7. Windshield wiper and washer switch



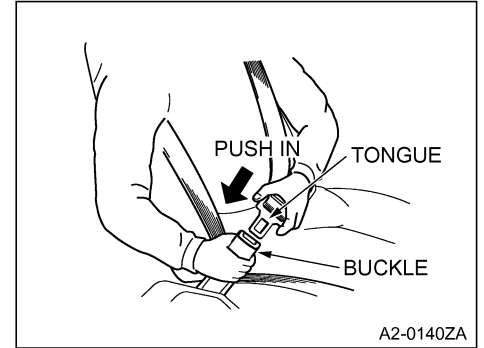
Check the windshield wiper and washer switch operation.

8. Door lock



Check door locks function.
About Power door lock system, refer to page 2-4.

Seat belts



Check seat belts for damage and mounting.

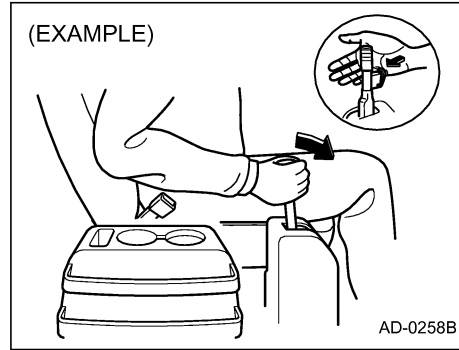
! WARNING

Do not drive vehicle if there is any damage. Have seat belts and mounting repaired.

Out side the cab

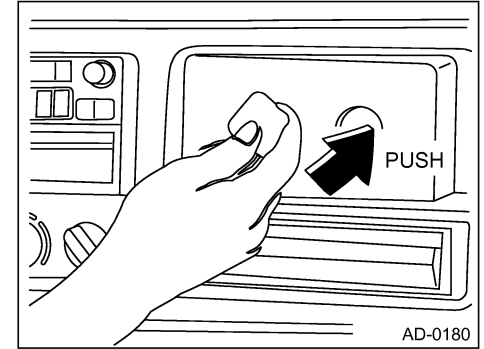
1. Look for leaks with the engine running.
(Fuel, lubricants, fluid, exhaust fumes, etc.)
2. Check that all the lights work.
3. Check the engine for unusual noises and the exhaust for smoke.

Before driving the vehicle Parking brake [Hydraulic brake type]



Release the parking brake lever.
(Be sure that the parking brake indicator light is off.)

[Full air brake type]



Push the parking brake control knob in.
(Be sure that the parking brake indicator light (Ⓟ or Ⓟ) is off.)

Check behind your vehicle for obstructions.

 **WARNING**

Do not drive in reverse without first carefully checking behind your vehicle for any persons or obstructions.

Right after driving the vehicle

Service brake

Test the brake at a speed of 3 mph (5 km/h) to 6 mph (10 km/h) in a safe area and make sure that the brakes are effective and do not pull to one side.

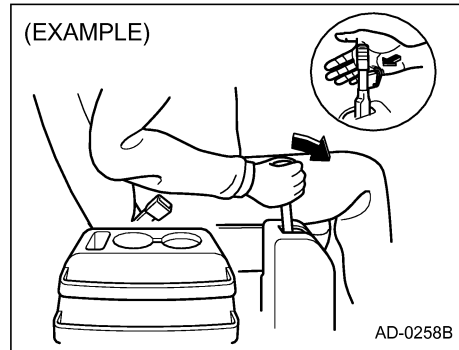
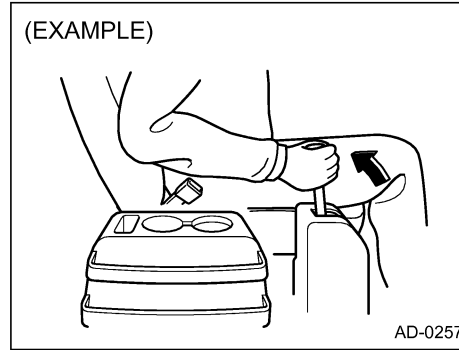
Steering wheel

Check the steering wheel for difficulty in handling, pulling to one side, etc.

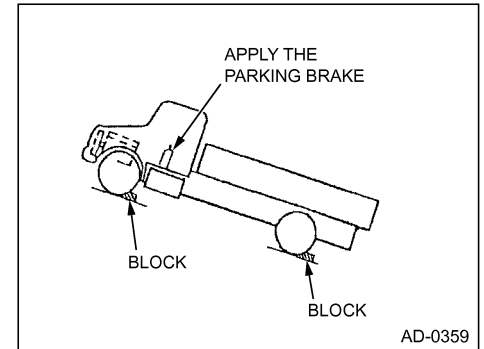
Other

Make sure that all the instruments are in good order.

Warning to park [Hydraulic brake type]



[Full air brake type]





WARNING

To lessen the risk of personal injury and/or property damage from vehicle movement, before leaving your vehicle, perform the following:

- **Apply the parking brake firmly. Make sure that your vehicle holds in place.**
- **In parking on a slope, block all the wheels.**

NEW VEHICLE BREAKING-IN

Breaking-in

A longer service life, better performance, and more economical operation of your vehicle will be determined mainly by good vehicle care with proper breaking-in.

Especially for the **first 600 miles (1,000 km)** the following care should be taken:

1. Warm up the engine before driving.
2. When you start a loaded vehicle, use 1st gear. When you go uphill, use an appropriate lower gear.
3. Full-throttle starting and harsh application of brakes should be avoided.
When the odometer reading reaches **2,500 miles (4,000 km), 5,000 miles (8,000 km) and 6,000 miles (10,000 km)**, your vehicle should be serviced according to SECTION 7, "MAINTENANCE".

Parking brake burnishing [Hydraulic brake type]

It is recommended that the following burnishing procedure be performed on new vehicles during the new vehicle breaking-in period.

Carry out the burnishing in a safe place.

1. Release parking brake and turn adjusting knob until pull resistance 40 lbs (8 kg).
2. Make ten (10) stops from 10MPH (16 km/h) on a dry, hard surface road using only parking brake to stop vehicle.
3. After each stop, release parking brake and drive vehicle at 20 MPH (32 km/h) for 2.5 miles (4 km) to cool the brake.
4. Readjust hand lever adjusting knob.
5. Then again check the parking brake lever stroke. Adjust if necessary referring to page 7-62.

STARTING THE ENGINE


Starting procedure

Apply the parking brake firmly.

1. Normal temperature conditions:

Depress the clutch pedal (Applicable for manual transmission) fully, and then turn the key to the “START” position.

2. Cold weather conditions (Vehicle with pre-heater system (if so equipped)):

- (1)When the water temperature is 32°F (0°C) or below, turn the key switch to “ON” position. The indicator light () turn on for five seconds and pre-heating is carried out. (When the water temperature is above 32°F (0°C), the indicator light doesn't turn on.
- (2)After the indicator light turns off, press the clutch pedal and accelerator pedal to the floor, turn the key switch within 3 seconds to the “START” position and start the engine. Power is intermittently applied to the glow plug for 90 seconds.

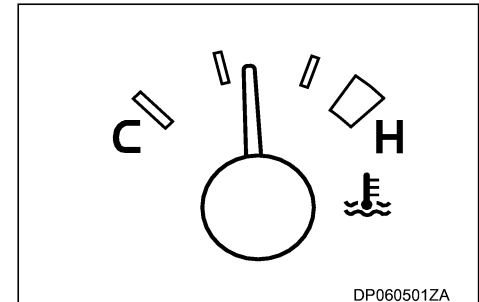
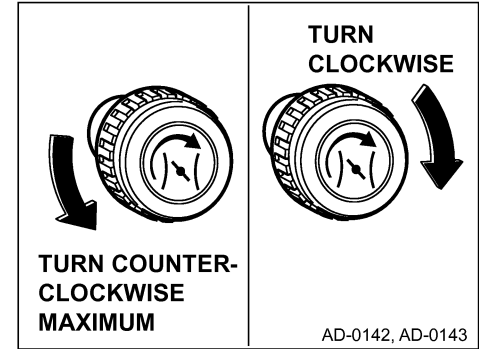
NOTICE:

- Turn the key to “ON” position before depressing the accelerator pedal. When the key is at “LOCK” or “ACC” position, the fuel system function for cold weather will not operate.
 - When the engine does not start on the first attempt, wait approximately 30 seconds before trying again.
 - Do not keep the starter engaged for more than 15 seconds at a time.
- (3)When the engine starts, make sure the gearshift position is still in neutral. If the vehicle is equipped with automatic transmission or UltraShift transmission, the selector is still in the “N” (Neutral) or “P” (Parking) position, and release the clutch pedal (Not available with automatic transmission or UltraShift transmission).

NOTICE:

After the engine starts, do not turn the key to the “START” position. This could cause damage to the starter motor and/or engine.

Inspection while at idling speed



To avoid shortening engine life, engine warm-up is necessary.

The automatic adjustment of engine idle speed.

When the knob is turned all the way to the left, automatic idle mode will be reached, and the engine idling speed will be adjusted automatically according to the coolant temperature.

- Non-adjustable, the engine idle knob should be turned all the way to the counterclockwise.
- When the knob is turned to the clockwise, the mode changes to manual adjustment mode.
- Engine warm-up is completed when the idle speed returns to low. Low idling speed is 750 RPM (r/min).

The manual adjustment of engine idle speed.

- When the engine has started, gradually release the accelerator pedal and set a slightly higher idle speed with the idle set knob.
- Perform warm-up operation until the needle of the coolant temperature gauge starts to move. When the needle of the coolant temperature gauge starts to move, return the idling set knob to adjust the low idle speed.

NOTICE:

Never drive with higher idle speed than standard. That could result in unnecessary fuel consumption and reduced clutch life.



WARNING

- Always set the idle set knob to low before starting to drive.
- Driving with a high idle speed could cause the vehicle to accelerate suddenly, even when the vehicle is stopped.

DRIVING



WARNING

- Never drive the vehicle with the engine stopped.
- Never drive with the clutch disengaged (Not applicable for applicable for with automatic transmission or UltraShift transmission).
- Never drive with the gearshift or selector position in neutral.

These are very hazardous conditions and can result in loss of vehicle control with resulting personal injury and/or property damage for one or more of the following reasons:

- When the engine is not running, the brake system will not function properly, and this can result in a longer stopping distance.
- The power steering system will not function, and much greater effort is needed to control the steering. If a malfunction occurs while driving, pull off the road immediately and stop the vehicle in a safe place. Check and correct the malfunction before resume driving. If the cause of the trouble is not clear, call an authorized Hino dealer.

Operation of manual transmission

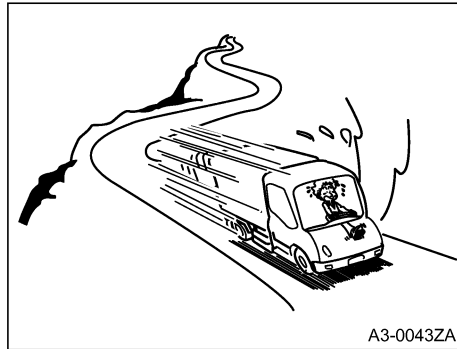
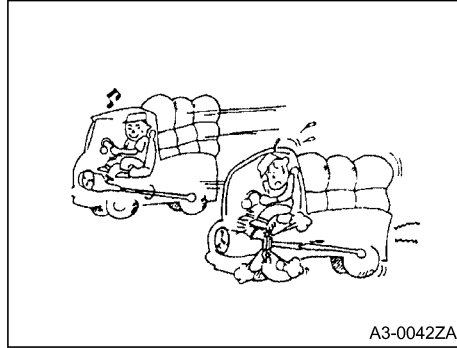
Use 1st (first) gear to start from a standstill and select the proper speed gear according to running conditions.

CAUTION

- To prevent damage from engine over-running, the maximum speeds for each gear, should not be exceeded. Be especially careful when down-shifting.
- Stop the vehicle before shifting into reverse from forward, or shifting into forward gear from reverse.

Using the clutch pedal (Applicable for manual transmission)

When starting the vehicle from a standstill or when shifting gears, sudden engagement of the clutch should be avoided. Also, clutch slippage can be caused by revving the engine excessively when starting the vehicle. These could cause damage to the power train.



NOTICE:

- Do not rest your foot on the clutch pedal while driving.
- Do not hold the vehicle on a slope with clutch slippage. This can cause premature clutch wear or failure.
- Always start with the proper gear.
- Excessive friction heat is the worst enemy of the clutch.
- Never coast with the clutch pedal pushed down. (Do not overrun the clutch)
- Never drive the vehicle with the sudden engagement of the clutch.
- Promptly report any unusual clutch operation to an authorized Hino dealer. (Proper maintenance should be performed without delay)
- Do not shift until the vehicle has reached proper speed.

Using the brake



WARNING

- Depressing the brake pedal fully should be avoided except in an emergency. Frequent full braking can severely shorten the life of tires, brake drums and linings, and other parts. Also full braking can cause skidding, especially when road is wet, and loss of vehicle control.
- “Fanning” (alternately applying and releasing) of the brake pedal will use up air reserve, and result in a decrease in braking power. [Full air brake type]

Braking on a downhill grade

- Before going down a long or steep hill, make sure that the brakes work properly by lightly applying the brake pedal.
- Be careful not to overrun the engine when downshifting.
- Do not apply the foot brake excessively. Frequent or continuous application of the brake will overheat the brake and cause fading of the brakes

and vapor lock (Hydraulic brake type). The service brake will then no longer work properly. When wheel brakes get wet.

- Driving through deep water may get the wheel brakes wet. With wet brakes, the stopping distance of your vehicle will be greater than normal.
- After driving through deep water, first make sure that there is no other vehicle around you and then apply the brakes lightly to see how they are working.
- If the brakes do not work well, apply the brakes lightly while driving your vehicle very carefully. Repeat this until the brakes work normally.



CAUTION

PRECAUTIONS WHEN DRIVING A VEHICLE EQUIPPED WITH ABS

- Be cautious in all hazardous driving situations, especially when driving on wet roadways, ice, snow, gravel or dirt.
- Always drive safely, taking into consideration the road and traffic conditions and the conditions of your tires, including tire type and tire wear. Always keep a safe distance from any vehicle being driven in front of you.
- Even with ABS, the braking distance on a wet road will be longer than on a dry road, and if the road surface is covered with ice, snow or gravel, the braking distance will be even greater.
- ABS functions only when one or more of your wheels slip as the result of applying the brake. Always brake firmly, never pump your brakes. ABS is not intended to function when starting, turning or accelerating your vehicle.

- Although ABS prevents wheel lock-up and assists the vehicle in coming to a stable stop during braking, it does not change the time you need to apply the brake pedal or the stopping distance of your vehicle.
- Pumping your brakes on a slippery or icy road will make the drive wheels lock-up and will make the vehicle unstable. In such a situation, disengage the clutch or set the shift lever to the “Neutral” position to stop the effect of the engine brake on the drive wheels. Continue to drive after setting the shift lever to the appropriate shift lever position.
- When the ABS activates, you may feel a slight vibration of the brake pedal. You may also feel a pull on the steering wheel. In addition, added noise may be generated. These conditions are not malfunctions of the ABS. Adjust your speed to the road and traffic conditions and drive safely.
- If the ABS activates, the vehicle's air consumption rate will be higher than usual. If the air pressure becomes low and the air pressure warning light

- comes on and a beep sounds, immediately stop the vehicle in a safe place. Begin driving again only after the return to normal air pressure. [Full air brake type]
- Before equipping the vehicle with tires that are not specified for this vehicle, consult an authorized Hino dealer. Improperly sized tires can negatively affect ABS functions.

How to load cargo

Do not load cargo in excess of the maximum load capacity.


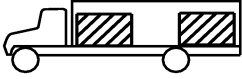
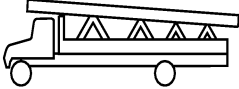
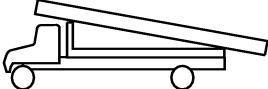
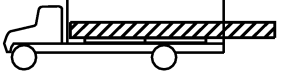
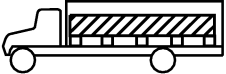
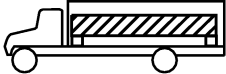






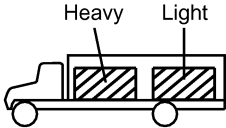
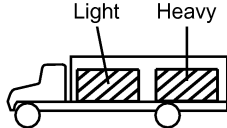
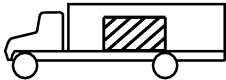
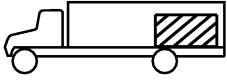
WARNING

Excessive or incorrect loading can cause instability, accelerated wear and tear, insufficient braking, and other problems. This can result in an accident and serious injury, death, or property damage.

NOTICE:

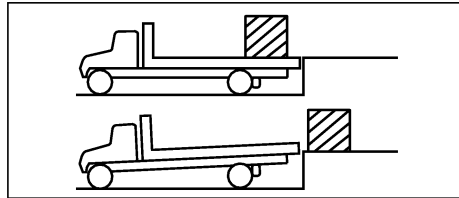
In case of heavy cargo. Due to the danger of sliding when braking or turning, cargo sliding must be prevented by cargo being fixed securely with wire cables.

Item	Recommendable loading	Improper loading
1. Avoid uncentered loading, and distribute the cargo uniformly.		
2. As far as possible, avoid projection of long objects beyond the rear end of the body. Avoid 2-point support at the cab guard and the rear end of the overhang.		
		
3. When load supports are used, use sufficient supports and position them properly.		
4. High and one-side loads should be avoided because of the danger of tilting when turning.		
5. Rope cargo securely. Heavy cargo especially must be fixed securely to the load carrying platform.		

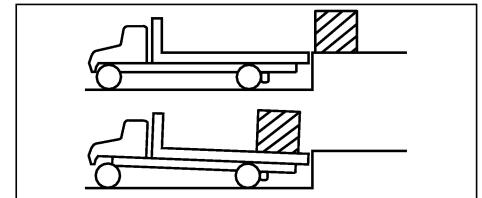
Item	Recommendable loading	Improper loading
<p>6. In the case of container vehicles, execute loading so that the load is greater toward the front axle.</p> <p>For example, when there are two containers, of which one is empty and the other full, the empty one must be loaded at the rear.</p>	<p>2 containers</p> 	
	<p>1 container</p> 	

Precaution for loading and unloading the vehicle equipped with air spring (If so equipped)

- The moment that a heavy load is loaded, the load carrying platform may sometimes rise temporarily due to the imbalance between supporting force of the air springs and the load. But the load carrying platform will return to its normal position in a few seconds by the action of vehicle height adjusting mechanism.



- The moment that a heavy load is loaded, the load carrying platform may sometimes come down temporarily due to the imbalance between supporting force of the air springs and the load. But the load carrying platform will return to its normal position in a few seconds by the action of vehicle height adjusting mechanism.



Steering

Before turning, reduce the vehicle's speed. Turning with the brakes applied should be avoided since it may cause accelerated wear on tires and loss of vehicle control on a wet or slippery road.

Engine overrunning

Be careful not to overrun the engine when downshifting. When downshifting on a downhill grade, apply wheel brakes and keep the vehicle speed within the maximum operating speed for each gear.



CAUTION

Warning for overrunning:

Overrunning of the engine is indicated by the pointer in the red zone of the tachometer. If this happens, reduce engine speed immediately.



WARNING

To reduce the risk of personal injury and/or vehicle damage, engine overrunning should be avoided.

Driving through a flooded area

NOTICE

Never drive the vehicle through a flooded area. If the water is deep enough to reach the bottom of the oil pan, this will cause failure of the cooling fan, slippage of the drive belts, or failure of the engine due to water sucked into the air.

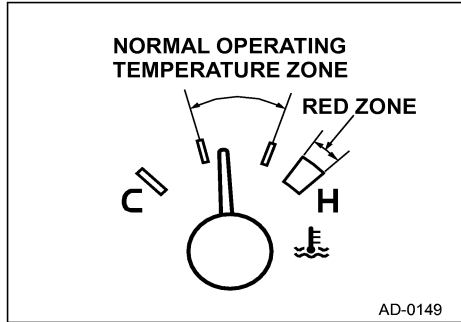
Windshield wiper and washer switch

NOTICE:

Remove ice or snow from the windshield and wiper blades before using the wipers. When the wipers are frozen to the windshield or lower windshield molding, thaw or loosen the wipers carefully so as not to damage the blades. Do not operate the wipers if the blades are frozen to the windshield glass since this could damage the wiper motor and wiper arms and blades.

In cold weather warm the windshield glass with the defroster before using the washer. This will help prevent icing which could obstruct your vision. Use washer fluid to prevent fluid from freezing and to help clean the windshield glass. However, do not use the type of washer fluid that damages paint or rubber. Follow the manufacturer's instructions for the proper concentration of washer fluid solution, refer to the page 7-65.

Coolant temperature gauge



The normal operating temperature zone is as shown in the figure. If the pointer is between normal and red zone while driving, you can continue to drive paying attention to the gauge.



CAUTION

If the gauge is in the red zone, stop the vehicle at a safe place and keep the engine running at idling speed to cool the coolant.

Do not shut off the engine at once. Refer to SECTION 5 for the countermeasure.

Warning lights

Your vehicle comes equipped with the following warning lights.

Normal display:

Display of trip meter, time, drive management, and other information.

Warning indication:

Abnormalities of each part and operation of devices etc. are displayed with priority over the normal display. When the key is set to "ON", the previously displayed contents will be displayed.

However, in case of abnormalities or operation of devices, they will be displayed with priority.

Check to see that the warning lights and indicator lights function normally. If the warning lights go off after starting the engine, they are functioning normally.

If the light does not light up the fuse may be broken. Check them and replace the broken parts with new ones.

If the light still does not light up after replacing the fuse, have your vehicle inspected and repaired an authorized Hino dealer.

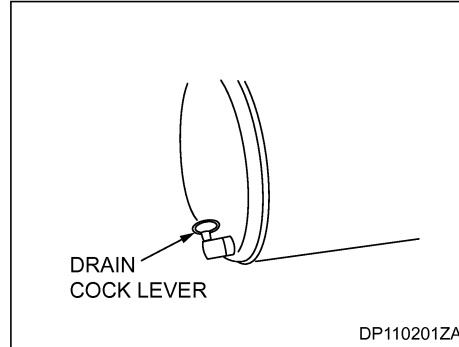
Check to see if the beep sounds when you turn the key to the "ON" position and the parking brake is released. If the beep does not sound on the above condition, have your vehicle inspected and repaired an authorized Hino dealer.

AFTER DRIVING

STOPPING THE ENGINE

1. Apply the parking brake firmly and place the gearshift lever in neutral (if the vehicle is equipped with automatic transmission or UltraShift transmission, place the selector in the "N" (Neutral) or "P" (Park) position).
2. Idle the engine for **3 to 5 minutes** before stopping the engine. Then turn the key to the "ACC" position to shut off the engine.
3. Turn the key while pushing to set it at the "LOCK" position. Then pull out the key.

Air tank

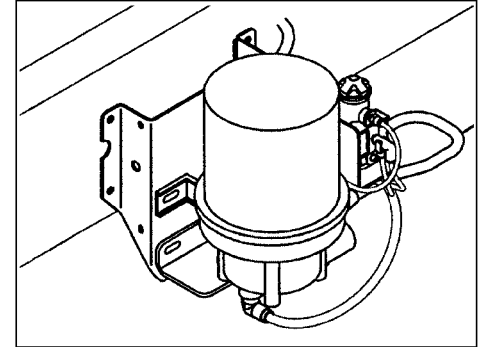


Drain water from the air tank by turning on the drain cock lever at the end of the driving day.

CAUTION

Drain water from air tank before using the vehicle each day and at the end of the day. Failure to drain this water, especially in cold weather, can result in frozen air lines which will cause lessened braking power.

Air dryer



Check the function of the dryer by opening the drain cocks of the reservoirs before and/or after the day's operation. If an unusual amount of water or oil is present, consult an authorized Hino dealer.

HANDLING IN COLD WEATHER

1. Starting the engine in cold weather

The diesel engine utilizes a compression ignition system and therefore starting the engine in cold weather may be difficult compared to a gasoline engine.

In order to facilitate cold weather starting, adhere to the following procedures.

2. Starting method



WARNING

Do not use ether to assist with starting since it is highly toxic and flammable and could cause a fire or explosion.

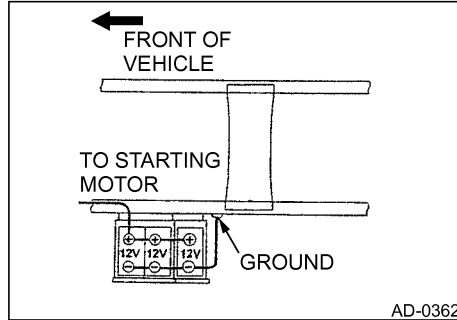
- (1)When the temperature goes **below 0°F (-18°C)**, Hino recommends the use of three batteries.

Battery cable fitting nuts

Torque:12 - 18N·m

(8.6 - 13ft·lbf, 120 - 180kgf·cm)

- (2)Use diesel fuel ASTM 2-D in cold weather, if necessary.



WARNING

- **This vehicle has a 12 volt, negative ground system. When installing three batteries in the vehicle, connect the three positive terminals of the batteries to the positive battery cable and the three negative terminals of the batteries to the ground cable as shown in the figure.**
- **Never connect positive and negative terminals to each other. When removing the battery ground at the time of inspection, maintenance, etc., ground cables must be removed.**

- (3)When the temperature is extremely low, installation of a coolant immersion heater into the engine block is recommended to warm up the coolant.

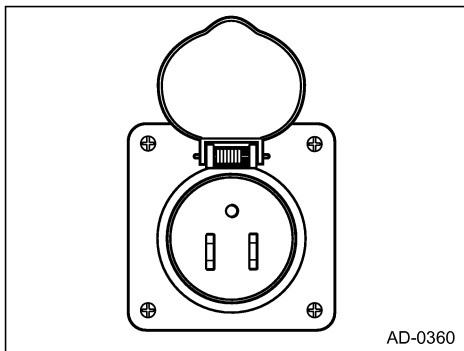
- (4)When a coolant immersion heater is used, carefully read the manufacturer's instructions.

3. Maintenance to facilitate cold weather starting

- (1)Check that there is no water in the fuel system. Water in the fuel system will freeze and make starting the engine impossible.
- (2)In cold weather, always fill the fuel tank to FULL, otherwise moisture could condense in the tank causing rust and making it impossible to start.

4. Engine block heater (If so equipped)

The socket for block heater is placed under the driver's seat side door.



NOTICE:

- First, put the harness in the socket of the chassis side and turn on power (120V)
- Before using it, remove all the rust and dirt. Any rust and water stuck to the terminal can trip the breaker.



CAUTION

Make sure to disconnect the power source plug outlet before starting the engine. Starting the engine without disconnecting it can cause the breakdown of the engine block heater.

STARTING THE ENGINE AFTER PROLONGED VEHICLE STORAGE

1. Check the engine, transmission, rear axle housing, brake for proper oil levels. Check the fluid levels for brake [Hydraulic brake type], clutch (Not applicable for automatic transmission) and power steering. Check the coolant level. Add oil, fluid or coolant if required.
2. Make sure that ground cables for both engine and battery are well grounded, and that the connections are clean and free of rust and corrosion. Check that the batteries are properly charged. Charge the batteries, if necessary.

Battery cable fitting nuts

Torque:

Battery to connector ϕ 8 mm
5.9 - 9.8 N·m (60 - 100 kgf·cm,

52 - 87 in·lbf)

Connector to cable ϕ 10 mm
12 - 18 N·m (120 - 180 kgf·cm,

8.7 - 13 in·lbf)

3. Apply the parking brake firmly. Place the gearshift lever in neutral (if the vehicle is equipped with automatic transmission, place the selector lever in the “N” (Neutral) or “P” (Parking) position).
4. Depress the clutch pedal fully (Not applicable for automatic transmission).
5. With the key in the “LOCK” position, disconnect the connector of the ECU to the engine stop. Then turn the key to the “START” position and allow the engine to crank until the oil pressure warning light goes off.

NOTICE:

Do not run the starter more than 10 seconds at a time.

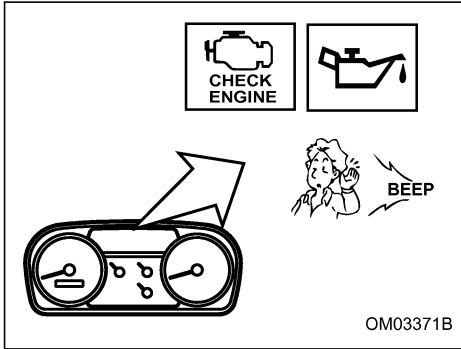
6. With the key in the “LOCK” position. When the engine starts, make sure the oil pressure warning light is off and then warm up the engine by running at low idle.

NOTICE:

If the oil pressure warning light does not go off, immediately stop the engine and have an authorized Hino dealer check and correct the situation.

ENGINE SHUTDOWN (IF SO EQUIPPED)

Shutdown warning light or audible beep



Good practice calls for several minutes prior to shutdown, particularly after a long run where engine has been producing maximum horsepower and heat load. This allows heat to be dissipated from iron masses and evenly distributed throughout the various system.

Vehicles may be equipped with an automatic shutdown system which stops the engine in the event of high coolant temperature or low engine oil pressure. A warning light on the instrument panel along with an audible beep will indicate high coolant temperature or low oil pressure.

If the temperature and/or oil pressure continues to change beyond the warning point to a predetermined level, the engine will automatically shut down.

Vehicles equipped with the automatic shutdown system are also equipped with an override feature which will allow the engine to be restarted so that the vehicle can be moved, if mechanically capable. The engine should be run no longer than absolutely necessary. Activate the override system by turning the key to "LOCK" position. Then turn the key to the "START" position to restart the engine. If the oil pressure low or coolant temperature high warnings activate, the engine will not run.

NOTICE:

If the idle shutdown customizing function is needed, consult an authorized Hino dealer.

SECTION 4

OPERATION OF INSTRUMENTS AND CONTROLS

AUDIO SYSTEM

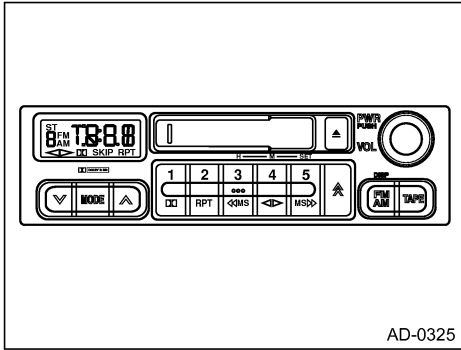
REFERENCE	4-2
USING YOUR AUDIO SYSTEM	4-2
AUDIO SYSTEM OPERATING HINTS	4-13
CLOCK	4-16

AIR FLOW, HEATING AND AIR CONDITIONER CONTROLS

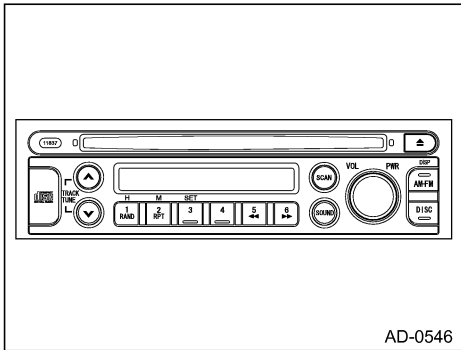
AIR FLOW SELECTOR SETTINGS	4-22
OPERATING TIPS	4-22
SIDE VENTS	4-24

Read entire manual before using vehicle. Failure to follow instructions and safety precautions could result in death, serious injury and/or damage.

AUDIO SYSTEM REFERENCE



FM-AM radio/cassette player



FM-AM radio/compact disc player

USING YOUR AUDIO SYSTEM

Some basics

This section describes some of the basic features on Hino audio systems. Some information may not pertain to your system.

Your audio system works when the starter key is in the "ACC" or "ON" position.

TURNING THE SYSTEM ON AND OFF

Push "PWR·VOL" to turn the audio system on and off.

Push "FM·AM", "TAPE" or "CD" to turn on that function without pushing "PWR·VOL".

You can turn on each player by inserting a cassette tape or compact disc.

You can turn off each player by ejecting the cassette tape or compact disc. If the audio system was previously off, then the entire audio system will be turned off when you eject the cassette tape or compact disc. If the another function was previously playing, it will come on again.

SWITCHING BETWEEN FUNCTIONS

Push "FM·AM", "TAPE" or "CD" if the system is already on but you want to switch from one function to another.

TONE AND BALANCE

For details about your system's tone and balance controls, see the description of your own system.

Tone

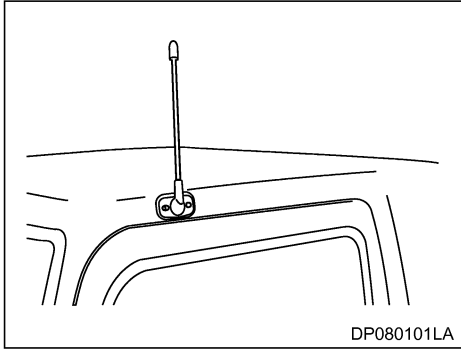
How good an audio program sounds to you is largely determined by the mix of the treble and bass levels. In fact, different kinds of music and vocal programs usually sound better with different mixes of treble and bass.

Balance

A good balance of the left and right stereo channels is also important.

Keep in mind that if you are listening to a stereo recording or broadcast, changing the right/left balance will increase the volume of one group of sounds while decreasing the volume of another.

RADIO ANTENNA



Erect the antenna when listening to the radio.

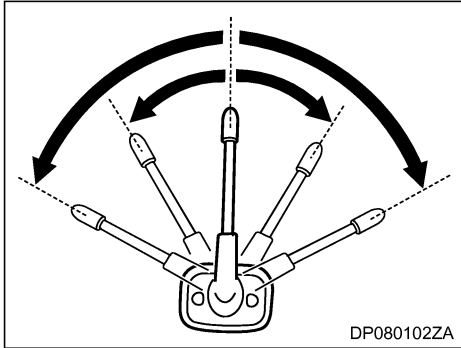
The antenna is installed on the upper side of the driver's side door.

The tilt angle of the antenna can be changed by 5 steps. Hold the lower portion of the antenna when tilting it.

The antenna is a removable screw-in type. When washing the vehicle in an automatic car wash, remove the antenna. Then put the rubber cap that came with the vehicle in the antenna hole. Replace the antenna after washing.

HINT:

The radio cannot operate at its full performance if the antenna is not upright.



CASSETTE PLAYER

When you insert a cassette, the exposed tape should face to the right.

NOTICE:

Do not oil any part of the player and do not insert anything other than cassette tapes into the slot, or the tape player may be damaged.

COMPACT DISC PLAYER

When you insert a disc, gently push it in with the label side up. (The player will automatically eject a disc if the label side is down.) The compact disc player will play from track 1 through the end of the disc. Then it will play from track 1 again.

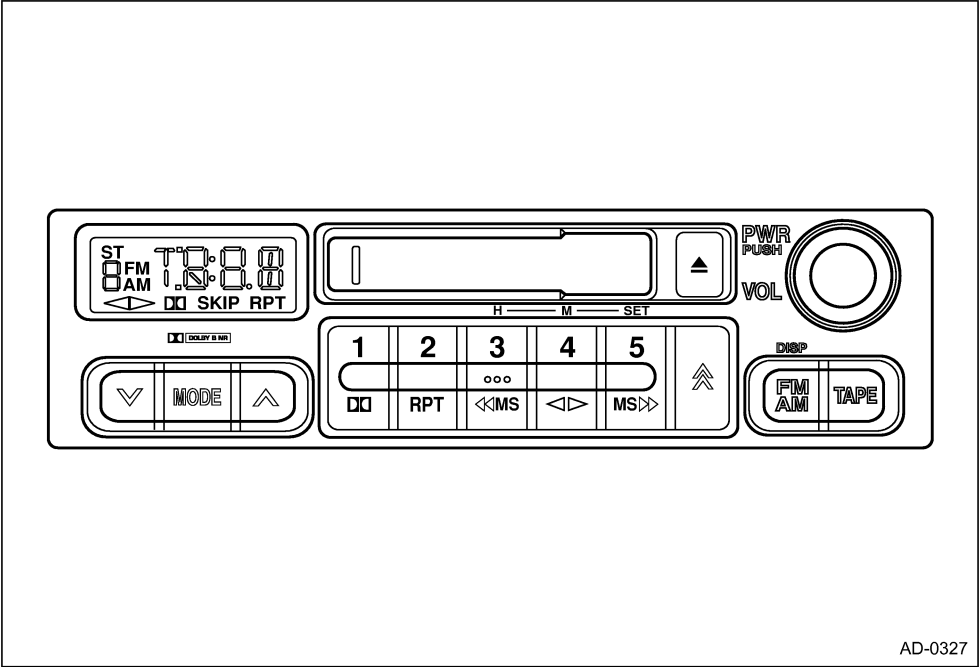
NOTICE:

Never try to disassemble or oil any part of the compact disc player. Do not insert anything except a compact disc into the slot.

The player is intended for use with 4.7 in.(12 cm) disc only.

FM-AM radio/cassette player

Details of specific buttons, controls and features are described in the alphabetical list that follows.



MODE(AUDIO CONTROL)

Manual tone adjustment function—

This knob is used to adjust the tone manually. For low-pitch tone adjustment, push “MODE” repeatedly until “BAS” appears on the display. Then turn the knob to suit your preference. The display will show the range from “B: -5” to “B: 5”. For high-pitch tone adjustment, push “MODE” repeatedly until “TRE” appears on the display. Then turn the knob to suit your preference. The display will show the range from “TR: -5” to “TR: 5”.

Sound balance adjustment function—

This knob is also used to adjust the sound balance between the right and left speakers. For left/right adjustment, push “MODE” repeatedly until “BAL” appears on the display. Then turn the knob to adjust the left/right balance. The display will show the range from “L:7” to “R:7”.

PWR.VOL (Power / Volume)

Push “PWR.VOL” to turn the audio system on and off. Turn “PWR.VOL” to adjust the volume. Turn “PWR.VOL” while pulling it to adjust the left or right balance.

FM·AM

If the audio system is off, you can turn on the radio by pushing “FM·AM”. Also, push “FM·AM” to switch from cassette operation to radio operation.

ST (Stereo reception) display

Your radio automatically changes to stereo reception when a stereo broadcast is received. “ST” appears on the display. If the signal becomes weak, the radio reduces the amount of channel separation to prevent the weak signal from creating noise. If the signal becomes extremely weak, the radio switches from stereo to mono reception.

SCAN (∧) RADIO

Quickly push and release “(∧)” Scan button. The radio will tune in the next preset station up the band, stay there for a few seconds, and then move to the next preset station.

To select a station, push “(∧)” a second time. To scan all the frequencies: Quickly push and release “(∧)”. The radio will find the next station up the station band, stay there for a few seconds, and then scan again. To select a station, push “(∧)” a second time.

Seeking ^“(up) or “v”(down)

In the seek mode, the radio finds and plays the next station up or down the station band. To seek a station, push and hold the “^” or “v” side until you hear a beep. Do this again to find another station.

Tuning “^” (up) or “v”(down)

Push and release the “^” (up) or “v” (down) side to step up or down the station band. (If you hear a beep, you held the button too long and the radio will go into the seek mode.)

1 2 3 4 5 (Preset buttons)

These buttons are used to preset and tune in radio stations. To preset a station to a button: Tune in the desired station (see Tuning). Push and hold down the button until you hear a beep-this will set the station to the button. "CH" will appear on the display. To tune in to a preset station: Push the button for the station you want. The button number and station frequency will appear on the display.

These systems can store FM and AM stations for each button (The display will show "FM" or "AM" when you push "FM·AM"). The preset station memory will be canceled out if the power source is interrupted (battery disconnected or fuse blown).

Cassette player

To scan the tracks, push "PS/AS" while operating the cassette player. The cassette player will play the next track for 10 seconds, then scan again. "PS/AS" will blink on the display. To select a track, push "PS/AS" or "TAPE" again. Push "TAPE" to stop scanning.

TAPE

Push "TAPE" to switch from radio to cassette operation.

▲ (Eject button)

Push this button to eject a cassette. After you turn the ignition to "LOCK", you will be able to eject and reinsert a cassette.

DOLBY® □□ B NR*

If you are listening to a tape that was recorded with Dolby® B Noise Reduction, push the "□□" button. The "□□ B" will appear on the display. Push the button again to turn off Dolby® B NR. The Dolby NR mode reduces tape noise by about 10 dB. For best sound reproduction, play your tapes with this button on or off according to the mode used for recording the tape.

*: Dolby noise reduction manufactured under license from Dolby Laboratories Licensing Corporation. "DOLBY" and the double D symbol □□ are trademarks of Dolby Laboratories Licensing Corporation.

◀▶ (Reverse/Fast forward buttons)

Push the fast forward button to fast forward a cassette tape. "FF" will blink on the display. Push the reverse button to rewind a tape. "REW" will blink on the display. To stop the tape while it is fast forwarding, push the fast forward button or "TAPE"; to stop the tape while it is rewinding, push the reverse button or "TAPE". If a tape side rewinds completely, the cassette player will stop and then play that same side. If a tape fast forwards completely, the cassette player will play the other side of the tape, using the auto-reverse feature.

◀◀MS/MS▶▶ (Track down/up buttons)

By using these buttons, you can skip up or down to a different track. You can skip up to nine tracks at a time. Push the track down or up button. "FF 1" or "REW 1" will appear on the display. Next, push the track down or up button until the number on the display reaches the number of tracks you want to skip.

If you push the button ten times, the skip feature will be turned off. When counting the number of tracks you want to skip back, remember to count the current track as well. For example, if you want to skip back to a song that is two tracks before the song you are listening to, push the track down button until "REW 3" appears on the display. If you push one track button more than you had intended, push the other button. The number of tracks will be reduced. The number of tracks you select is not valid if it is higher than the number of tracks remaining on the current cassette side.

After the beginning of the tape is reached, the player will automatically start playing the same side.

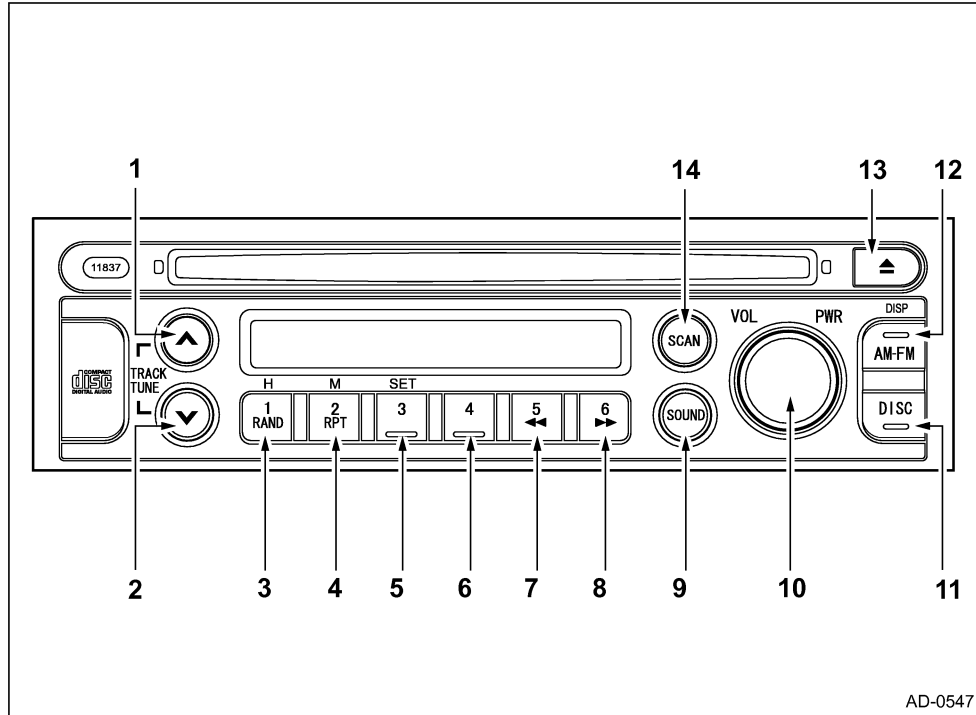
After the end of the tape is reached, the player will automatically reverse sides and start playing the other side.

There must be at least 3 seconds of blank space between tracks for the track down/up buttons to work correctly. In addition, the feature may not work well with some spoken word, live, or classical recordings.

Set clock function

Push "DISP" or "CLOCK" to set the clock. (For details, see "Clock" on page 4-16)

FM-AM radio/compact disc player



1. TRACK TUNE UP
2. TRACK TUNE DOWN
3. PRESET 1
4. PRESET 2
5. PRESET 3
6. PRESET 4
7. PRESET 5
8. PRESET 6
9. SOUND
10. VOLUME/POWER
11. DISC
12. AM / FM
13. EJECT
14. SCAN

VOLUME/POWER

- Set the starter key to “ACC” or “ON”.
When the button “VOL/PWR” is pressed, the power is switched on, and when it is pressed again, the power is switched off. However, the present time is displayed. This knob is also used to adjust the volume.
The volume increases when the knob “VOL/PWR” is turned clockwise and decreases when it is turned counterclockwise.
- When a mode button (“AM-FM” or “DISC”) is pressed while the power is off, the unit is switched directly to the respective mode.
- When the button “AM-FM” is pressed while the power is off, the radio mode is switched.
When a CD is in the unit and the button “DISC” is pressed while the power is off, the unit is switched to CD mode and playback starts.

SOUND AUDIO CONTROL (SOUND MODE SWITCHING)

- Each time the button “SOUND” is pressed, the audio mode is switched in the order shown below. (Normally the mode is volume mode.)
- This is used in combination with the knob “VOL/PWR”.

BASS → TREBLE → BALANCE
↑—————↓

- Sound Adjustment
 - (1) Press the button “SOUND” to set to “BAS” or “TRE”.
BAS: The bass sound can be adjusted.
TRE: The treble sound can be adjusted.
 - (2) Adjustment is possible by turning the knob “VOL/PWR” clockwise or counterclockwise.
Clockwise: The sound becomes stronger.
Counterclockwise: The sound becomes weaker.

- * Display is made in five steps to each side (-5 to +5).
Press “SOUND” repeatedly until “BAS” or “TRE” is displayed on the LCD. Then turn the knob to adjust to the desired sound.
- Balance Adjustment
 - (1) Press the button “SOUND” to set to “BAL”.
 - (2) Turn the knob “VOL/PWR” to adjust the volume balance between left and right speaker.
Clockwise: The volume of the right speaker increases.
Counterclockwise: The volume of the left speaker increases.
- * Display is made in seven steps to each side (L7 to R7).
Press “SOUND” repeatedly until “BAL” is displayed on the LCD. Then turn the knob to adjust to the desired balance.

AM-FM BAND SWITCHING

- Press the button “AM-FM” to switch the radio band.
When the button “AM-FM” is pressed, the reception band is switched in the following order.

FM1 → FM2 → AM
↑

“FM” or “AM” lights on the display.

The radio can be switched on by pressing “AM-FM” while the audio system is off.

Switching from disc operation to radio operation also can be done by pressing “AM-FM”.

- ST (stereo broadcast reception) Indication
When the radio receives a stereo broadcast, it switches automatically to stereo reception. “ST” lights. If the radio waves become weak, the channel separation is reduced to prevent noise occurrence. If the radio waves become extremely weak, the radio switches to monaural reception.

Tuning

- Manual Tuning (TUNE UP/DOWN)
The frequency is changed in single steps each time the “∨” side or the “∧” side of the button TRACK TUNE is pressed (for less than 0.8 sec).
One step is 10 kHz for AM and 0.2 MHz for FM.
- Auto Tuning (SEEK UP/DOWN)
When the “∨” side or the “∧” side of the button TRACK TUNE is pressed (for 0.8 to 1.4 sec), the frequency is changed automatically until a station is received, a short electronic sound is heard, tuning stops, and the frequency is displayed.
- Quick Tuning (Quick SEEK UP/DOWN)
When the “∨” side or the “∧” side of the button TRACK TUNE is pressed for 1.5 sec or longer, the frequency changes while stations are skipped. When the button is released, auto tuning starts (same as with pressing for 0.8 sec), and when a station is received, then tuning stops and the frequency is displayed.

- Preset Tuning (one-touch tuning) (Preset CH)
When the frequencies of favorite stations are preset (stored), the preset stations can be received by pressing one of the buttons “PRESET 1” to “PRESET 6” (for less than 1.7 sec).
- Station Presetting
A total of 18 stations can be stored with the buttons “PRESET 1” to “PRESET 6”, six stations each for AM, FM1, and FM2.
(1) Press the button “AM-FM” to select AM, FM1, or FM2.
(2) Use manual or automatic tuning (refer to Manual Tuning or Auto Tuning) to select a frequency to be preset, press the desired preset button (“PRESET 1” to “PRESET 6”) for at least 1.7 sec, and release it after a short electronic sound is heard. This completes presetting.

* When a new station is preset to a button already preset to a station, the old pre-setting is replaced by the new one.

Press the preset button to confirm that the desired station has been preset.

All stored frequencies are deleted when the unit or the battery is removed from the vehicle. In such a case, perform presetting again.

- **One-touch Tuning**

When a preset button is pressed (less than 1.7 sec), the station preset to that button is selected.

- **SCAN**

(1) When the button "SCAN" is pressed (for less than 0.8 sec), auto tuning mode is reached and the automatically tuned stations are received for 5 seconds each.

(2) When the button "SCAN" is pressed again (for 0.8 sec or longer) while a station is being received, scanning is cancelled and that station is received.

(3) When the button "SCAN" is pressed longer (for 0.8 sec or longer), the preset stations are received for 5 seconds each, and when it is pressed again, the station selected at that time remains selected.

CD OPERATION

- The unit is switched to CD mode when the button "DISC" is pressed. The lamp "CD" lights.

- Playback starts when a disc is inserted into the slot. The lamp "CD IN" flashes at the time of disc insertion/ejection. During playback, the track No. and the elapsed time are shown on the display.

- When the button "DISC" is pressed while a disc is in the unit, playback starts.

- To stop playback, press the button "VOL/PWR" or switch the mode by pressing the button "AM-FM" of the radio.

- When the starter key is switched to OFF during playback of a CD, playback stops, and when the starter key is switched to ON again, playback resumes from the stop position.

- EJECT

Press the button “▲” to eject a disc.

- Button TRACK TUNE UP/DOWN Cue

Each time the button “^” of TRACK TUNE is pressed during playback, the unit skips to the next track, and when the key “v” is pressed, the unit moves back.

- FAST DOWN/UP (Preset 5 “◀◀”/Preset 6 “▶▶”)

When the button PRESET 6 “▶▶” is pressed during playback, the track number increases rapidly, and when the button PRESET 5 “◀◀” is pressed, the track number decreases rapidly.

- RANDOM (PRESET 1)

(1)When the button “PRESET 1 RAND” is pressed during playback, the tracks are played in random order.

(2)When cueing is performed during random playback, random playback starts after the end of the present track.

(3)If rapid forward or rapid reverse is performed during random playback, random playback continues even after the present track has ended.

* The following operations cancel the function even during random playback.

(1)Pressing the button “RAND”. Switching between “ON” and “OFF” takes place each time the button is pressed.

(2)Pressing the button “SCAN”.

* When the button “RAND” is pressed during random repeat, only random is canceled.

- REPEAT (PRESET 2)

When the button “PRESET 2 RPT” is pressed during playback, the track being played will be played repeatedly.

* This function is canceled by the following operations.

- Pressing the button “RPT”.
- Pressing the button “SCAN”.

- SCAN

When the button “SCAN” is pressed during playback, from the next track on, all tracks will be played for the first five seconds.

* The following operations cancel this operation even during scan.

Pressing the button “SCAN”. Switching between “ON” and “OFF” takes place each time the button is pressed.

AUDIO SYSTEM OPERATING HINTS

NOTICE:

To ensure correct audio system operations:

- Be careful not to spill beverages over the audio system.
- Do not put anything other than a cassette tape or Compact Disc into the slot.
- The use of a cellular phone inside or near the vehicle may cause a noise from the speakers of the audio system which you are listening to. However, this does not indicate a malfunction.

RADIO RECEPTION

FM broadcasts have a range of about 40 km or 25 miles. When driving away from a station you may have to fine-tune your radio and turn up the volume as the station gets weaker. Because FM uses a line-of-sight signal, tall buildings or hills may sometimes block reception. These are all normal characteristics of FM reception and do not indicate any problem with the radio itself.

CARING FOR YOUR CASSETTE PLAYER AND TAPES

For high performance from your cassette player and tapes:

- Clean the tape head and other parts regularly.
- A dirty tape head or tape path can decrease sound quality and tangle your cassette tapes. The easiest way to clean them is by using a cleaning tape. (A wet type is recommended.)
- Use high-quality cassettes.
Low-quality cassette tapes can cause many problems, including poor sound, inconsistent playing speed, and constant auto-reversing. They can also get stuck or tangled in the cassette player.
- Do not use a cassette if it has been damaged or tangled or if its label is peeling off.
- Do not leave a cassette in the player if you are not listening to it, especially if it is hot outside.
- Store cassettes in their cases and out of direct sunlight.

- Avoid using cassettes with a total playing time longer than 100 minutes (50 minutes per side). The tape used in these cassettes is thin and could get stuck or tangled in the cassette player.

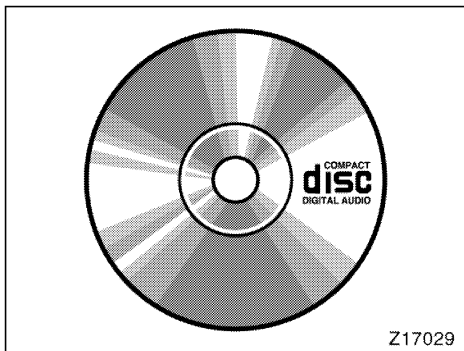
CARING FOR YOUR COMPACT DISC PLAYER AND DISC

- Extremely high temperatures can keep your compact disc player from working. On hot days, use the air conditioning to cool the vehicle interior before you listen to a disc.
- Bumpy roads or other vibrations may make your compact disc player skip.
- If moisture gets into your compact disc player, you may not hear any sound even though your compact disc player appears to be working. Remove the disc from the player and wait until it dries.



CAUTION

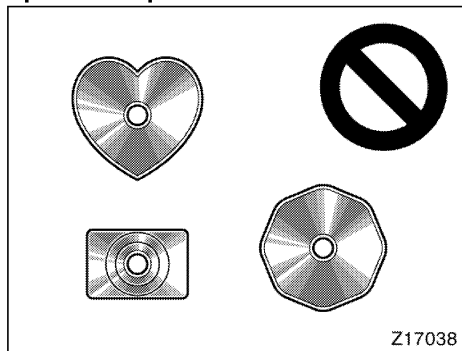
Compact disc players use an invisible laser beam which could cause hazardous radiation exposure if directed outside the unit. Be sure to operate the player correctly.



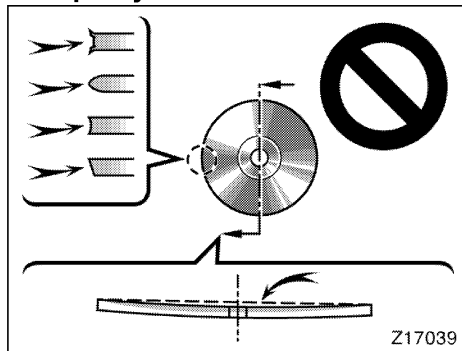
- Use only compact discs marked as shown above. The following products may not be playable on your compact disc player.

Copy-protected CD
 CD-R (CD-Recordable)
 CD-RW (CD-Re-writable)
 CD-ROM

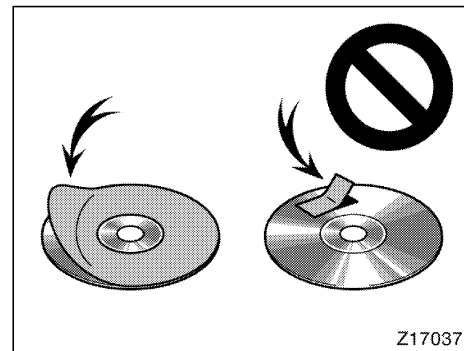
Special shaped discs



Low quality discs

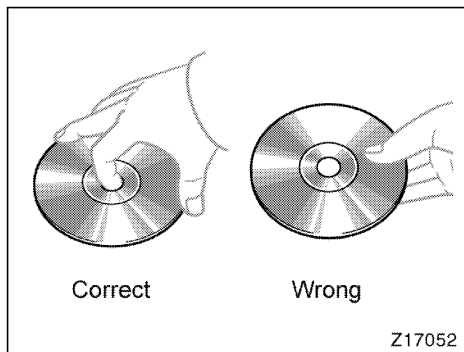


Labelled discs

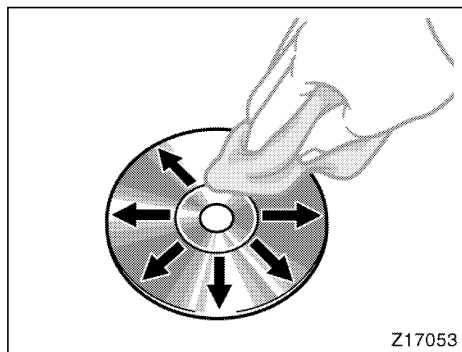


NOTICE:

To prevent damage to the player or changer, do not use special shaped, low quality or labeled discs such as those shown in the illustrations.

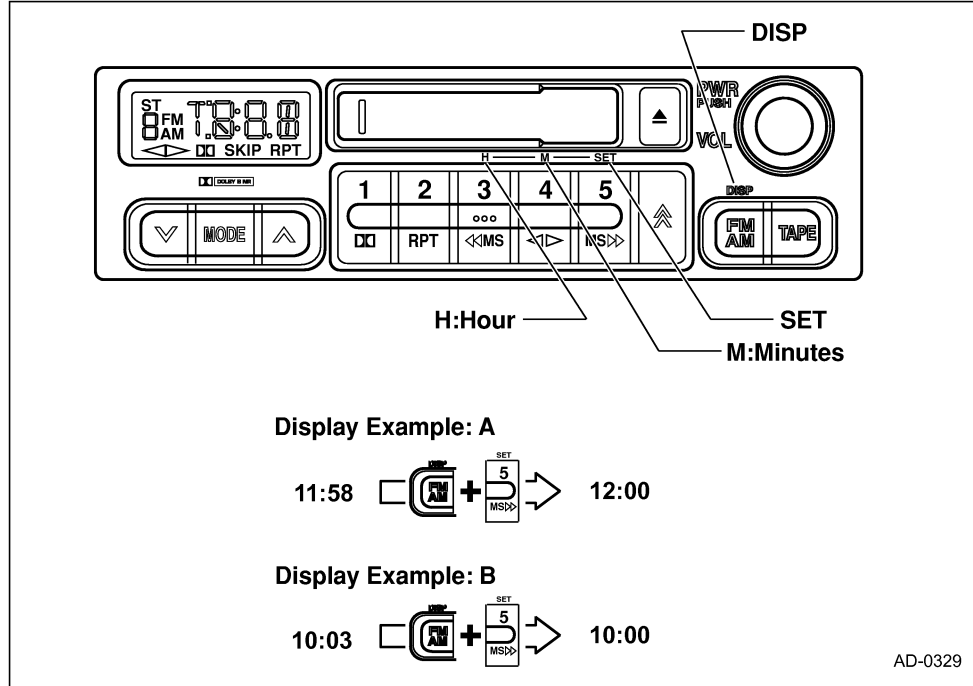


- Handle compact discs carefully, especially when you are inserting them. Hold them on the edge and do not bend them. Avoid getting fingerprints on them, particularly on the shiny side.
- Dirt, scrapes, warping, pin holes, or other disc damage could cause the player to skip or to repeat a section of a track. (To see a pin hole, hold the disc up to the light.)
- Remove discs from the compact disc player when you are not listening to them. Store them in their plastic cases away from moisture, heat, and direct sunlight.



To clean a compact disc: Wipe it with a soft, lint-free cloth that has been dampened with water. Wipe in a straight line from the center to the edge of the disc (not in circles). Dry it with another soft, lint-free cloth. Do not use a conventional record cleaner or anti-static device.

CLOCK



FM-AM radio/cassette player

Setting the Clock

Two kinds of clock adjustments are possible:

Manual Time Setting: Set hour and minute digits individually. Setting by Broadcast Time Signal: Set time using a broadcast time signal.

1. Manual Time Setting

Set the hour.

While holding the [DISP] button depressed, press the [H] button for about 0.5 seconds; the hour digit(s) will increment by one.

While holding the [DISP] button depressed, hold the [H] button depressed; the hour digit(s) will increment continuously.

Set the minutes

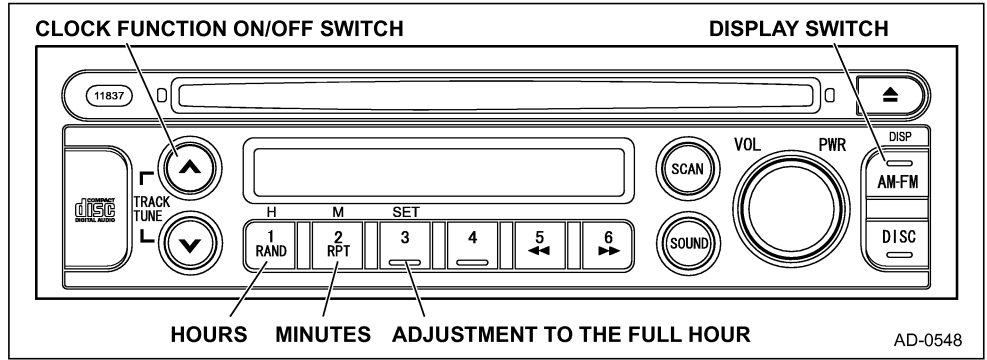
While holding the [DISP] button depressed, press the [M] button for about 0.5 seconds; the minutes digit(s) will increment by one.

While holding the [DISP] button depressed, hold the [M] button depressed; the minutes digit(s) will increment continuously.

2. Setting by broadcast Time Signal

When a radio station issues an hourly time signal (“chime”), hold the [DISP] button depressed and press the [SET] button; depending on the current display time, the clock display will be reset as follows:

- (1) If the time display shows between 30 and 59 minutes, the hours digits will increment by one and the minutes digits will be reset to 00. (See “Display Example A” in the illustration above.)
- (2) If the time display shows between 00 and 29 minutes, the minutes digits will be reset to 00. (See “Display Example B” in the illustration above.)



FM·AM radio/compact disc player

Setting the clock

Switching between clock display and mode display

Pressing the button “AM-FM” (for 1.7 sec or longer) switches to clock display.

Clock Function ON/OFF Switching

When the starter switch is set to “ACC” or “ON” and the player power is switched off, the clock function is switched ON and OFF by pressing the button “TUNE UP “^”” while pressing the button “PRESET 4”.

When the clock function is switched on, the clock display has priority. As clock adjustment is not possible when the clock function is left switched off, the clock function must be switched on before clock adjustment.

Setting the hours

When the button “PRESET 1/H” is pressed while pressing the button “AM-FM”, the hour value is increased by one.

However, time adjustment is not accepted during SCAN, P. SCAN, and SEEK operation.

When the button is pressed continuously for 0.5 sec or longer, the hour digit advances continuously every 0.25 sec.

Setting the Minutes

When the button “PRESET 2/M” is pressed while pressing the button “AM-FM”, the minutes are increased by one.

However, time adjustment is not accepted during SCAN, P. SCAN, and SEEK operation.

When the button is pressed continuously for 0.5 sec or longer, the minutes advance continuously every 0.1 sec.

Adjustment to the Full Hour

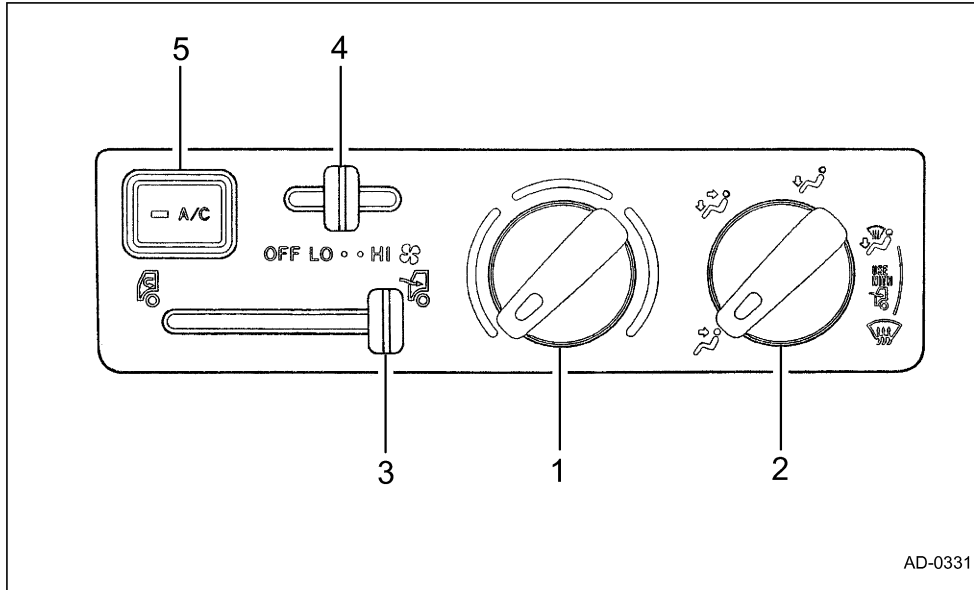
When the button “PRESET 3/SET” is pressed while pressing the button “AM-FM”, the time is adjusted at that moment to the full hour.

However, time adjustment is not accepted during SCAN, P. SCAN, and SEEK operation.

With adjustment to the full hour, minutes below 30 minutes are set to 00. (The hour value remains as it is.)

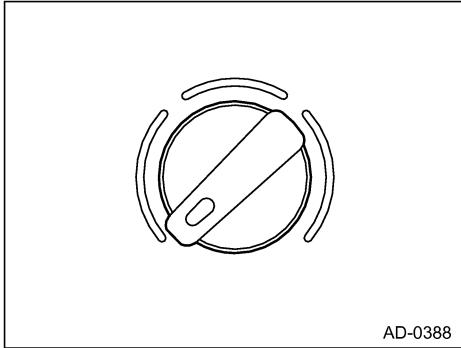
A minutes value from 30 minutes up becomes 00 and the hour value is increased by one.

AIR FLOW, HEATING AND AIR CONDITIONER CONTROLS



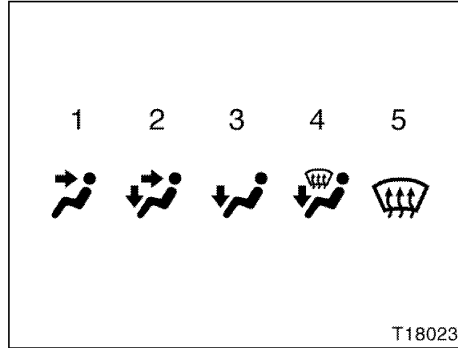
1. Temperature selector
2. Air flow selector
3. Air Intake selector
4. Fan speed selector
5. Air conditioner button (If so equipped)

1. Temperature selector



Move the lever to adjust the temperature—to the right to warm, to the left to cool.

2. Air flow selector




Move the lever to select the vents used for air flow.

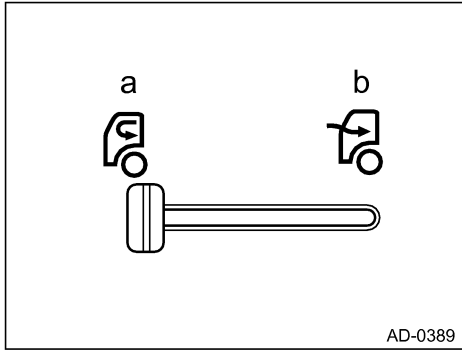
- (1)**Panel**—Air flows mainly from the instrument panel vents.
- (2)**Bi-level**—Air flows from both the floor vents and the instrument panel vents.
- (3)**Floor**—Air flows mainly from the floor vents.
- (4)**Floor/Windshield**—Air flows mainly from the floor vents and windshield vents.
- (5)**Windshield**—Air flows mainly from the windshield vents.

- For details about air flow selector settings, see “Air flow selector settings” described below.

HINT:

When the windshield (defroster) is used, Hino recommends the selector be set to FRESH . This is due to cloudy windshield cause by recirculation of air in the cab.

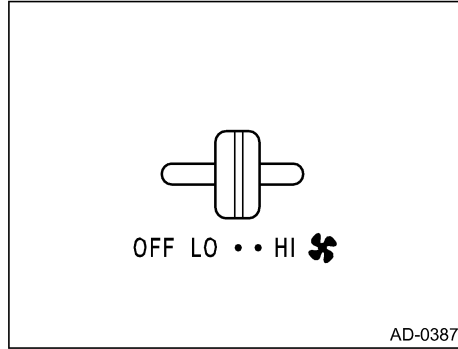
3. Air intake selector



Move the lever to select the air source.

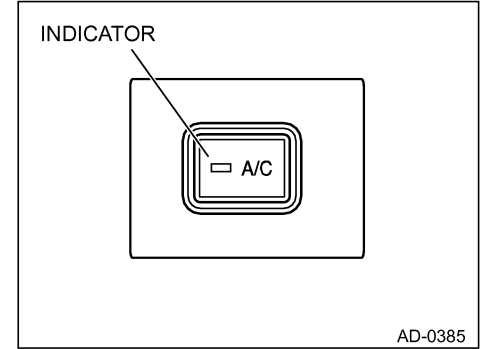
- a. **Recirculate**—Recirculates the air inside the vehicle.
- b. **Fresh**—Draws outside air into the system.

4. Fan speed selector



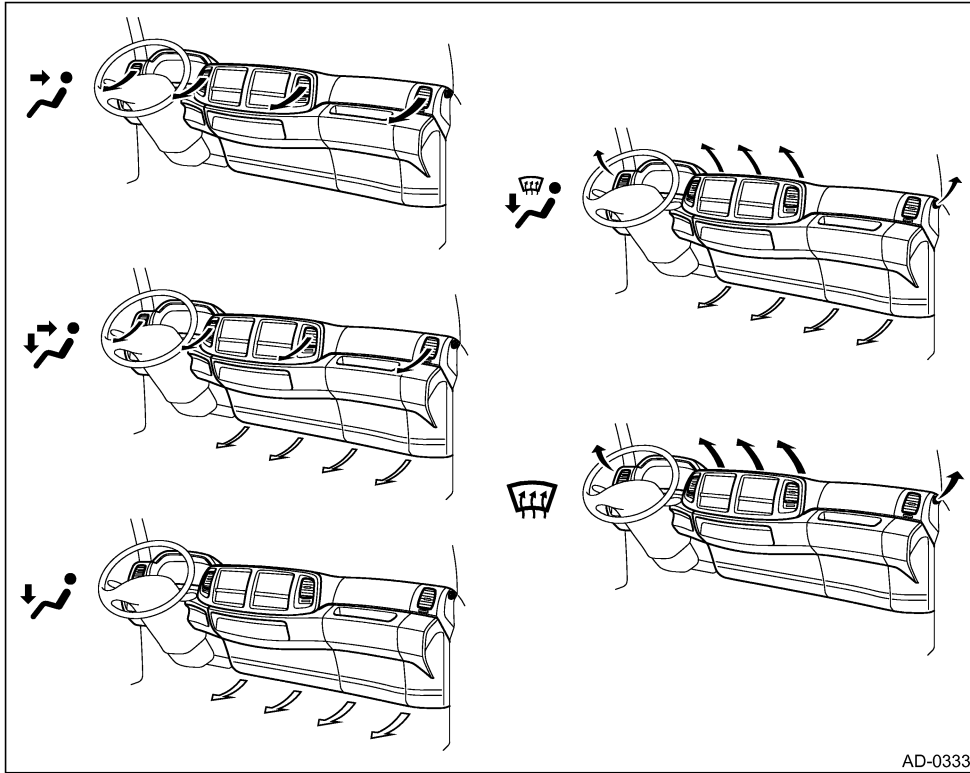
Move the lever to adjust the fan speed—to the right to increase, to the left to decrease.

5. “A/C” button (If so equipped)



To turn the air conditioning on, press the “A/C” button. The “A/C” button indicator will come on. To turn the air conditioning off, press the button again.

AIR FLOW SELECTOR SETTINGS



AD-0333

OPERATING TIPS

- To cool off your vehicle after it has been parked in the hot sun, drive with the windows open for a few minutes. This vents the hot air, allowing the air conditioning to cool the interior more quickly.
- Make sure the air intake grilles in front of the windshield are not blocked (by leaves or snow, for example).
- On humid days, do not blow cold air on the windshield. The windshield could fog up because of the difference in air temperature on the inside and outside of the windshield.
- Keep the area under the front seats clear to allow air to circulate throughout the vehicle.
- On cold days, set the fan speed to high for a minute to help clear the intake ducts of snow or moisture. This can reduce the amount of fogging on the windows.
- When driving on dusty roads, close all windows. If dust thrown up by the vehicle is still drawn into the vehicle after closing the windows, it is recommended that the air intake selector be set to FRESH and the fan selector to any setting except "OFF".

- If following another vehicle on a dusty road, or driving in windy and dusty conditions, it is recommended that the air intake selector be temporarily set to **RECIRCULATE**, which will close off the outside passage and prevent outside air and dust from entering the vehicle interior.

Heating

For best results, set controls to:

Fan speed—Any setting except “OFF”
Temperature—Towards **WARM** (red zone)
Air intake—**FRESH** (outside air)
Air flow—**FLOOR**
Air conditioning—**OFF**

- For quick heating, select recirculated air for a few minutes. To keep the windows from fogging, select fresh after the vehicle interior has been warmed.
- Press the “A/C” button on for dehumidified heating.

- Choose floor/windshield air flow to heat the vehicle interior while defrosting or defogging the windshield.

Cooling

For best results, set controls to:

Fan speed—Any setting except “OFF”
Temperature—Towards **COLD** (blue zone)
Air intake—**FRESH** (outside air)
Air flow—**PANEL**
Air conditioning—**ON**

- For quick cooling, move the air intake selector to recirculate for a few minutes.

Ventilation

For best results, set controls to:

Fan speed—Any setting except “OFF”
Temperature—Towards **COLD** (blue zone)
Air intake—**FRESH** (outside air)
Air flow—**PANEL**
Air conditioning—**OFF**

Defogging

The inside of the windshield
 For best results, set controls to:

Fan speed—Any setting except “OFF”
Temperature—Towards **WARM** (red zone) to heat; **COLD** (blue zone) to cool
Air intake—**FRESH** (outside air)
Air flow—**WINDSHIELD**
Air conditioning—**ON**

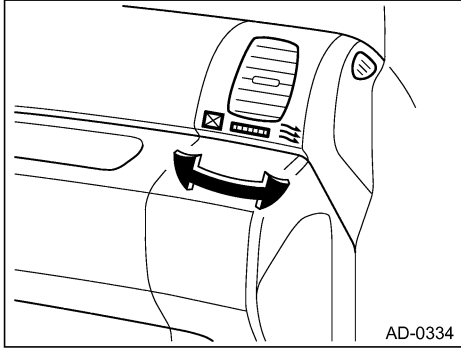
Defrosting

The outside of the windshield
 For best results, set controls to:

Fan speed—Any setting except “OFF”
Temperature—Towards **WARM** (red zone)
Air intake—**FRESH** (outside air)
Air flow—**WINDSHIELD**
Air conditioning—**OFF**

- To heat the vehicle interior while defrosting the windshield, choose floor/windshield air flow.

SIDE VENTS



AD-0334

If air flow control is not satisfactory, check the side vents. The side vents may be opened or closed as shown.

SECTION 5

IN AN EMERGENCY

EMERGENCY STARTING (JUMP STARTING)	5-2
PROCEDURE FOR JUMP STARTING	5-2
DAMAGED TIRE	5-4
TOWING	5-7
FREEING THE VEHICLE	5-9
HAZARD WARNING LIGHTS	5-9
OVERHEATING	5-10
JACK-UP THE VEHICLE	5-11
MECHANICAL RELEASE OPERATION OF PARKING BRAKE	5-13

Read entire manual before using vehicle. Failure to follow instructions and safety precautions could result in death, serious injury and/or damage.

EMERGENCY STARTING (JUMP STARTING)

If your vehicle's batteries have discharged, you can start the engine by jump starting.



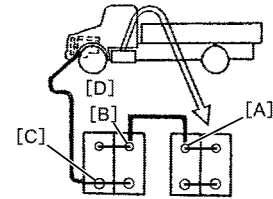
WARNING

- Since the battery produces explosive hydrogen gas, do not bring an open flame or electric sparks close to the battery.
- Always shield your eyes or wear safety goggles when working on batteries. Do not let electrolyte, which is sulfuric acid, come in contact with eyes, skin, or clothing. Since electrolyte is a corrosive acid, it can damage skin and clothing. If acid should contact your skin, eyes or clothing, thoroughly flush the contact area with water promptly and get medical treatment immediately.
- When working on the battery, be sure to remove any metal accessories from your arms. Do not lean over the battery.
- Use proper jumper cables.

- This vehicle has a 12 volt, negative ground system. Make sure that the other vehicle used for jump starting also has a 12 volt, negative ground system. Do not attempt to jump start when you are not sure of the voltage or ground of the other vehicle.

PROCEDURE FOR JUMP STARTING

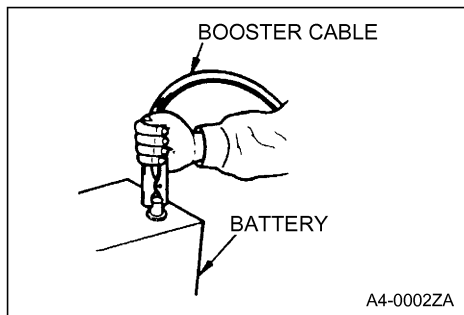
BOOSTER CABLE CONNECTIONS



BOOSTER BATTERY DISCHARGED BATTERY

A4-0001ZA

1. Shut off the engine on the vehicle which has the well charged (booster) batteries.
2. Connect the booster cables in the order as shown in the figure.
First, firmly connect one end of the red booster cable to the positive (+) terminal of the discharged battery [A], and then the other end to the positive (+) terminal of the booster battery [B].



3. Next, connect one end of the black booster cable firmly to the negative (-) terminal of the booster battery [C]. Finally, connect the other end to an engine ground well away from the discharged batteries [D].

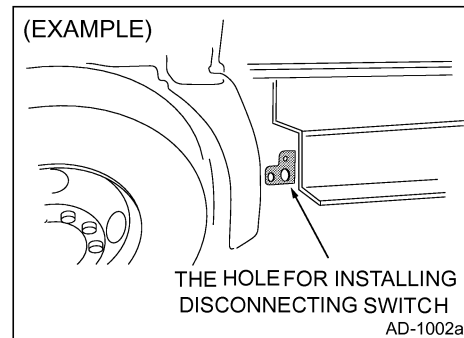
4. After completion of the connection, start the engine of the vehicle with the discharged batteries. If the engine is difficult to start in cold weather, first run the engine of the other vehicle for a while to fully charge its batteries. Then stop the engine of the other vehicle and start the engine of the vehicle with the discharged batteries.

5. After the engine has started, carefully remove the booster cables in reverse order while the engine is idling.

! WARNING

The engine should never be started by pushing or towing the vehicle. Since with the engine stopped, the effectiveness of the service brake system is seriously reduced and steering requires greater effort because the power steering does not work until the engine is running.

THE HOLE FOR INSTALLING DISCONNECTING SWITCH



6. When you use the battery disconnecting switch, you can use the hole for installation.

! WARNING

Never connect positive and negative terminals to each other. When removing the battery ground at the time of maintenance etc., ground cable must be removed.

DAMAGED TIRE



WARNING

Avoid full or panic braking if you have a flat tire while driving, since this may cause loss of vehicle control.

Cautiously stop your vehicle off the road paying attention to other traffic. Hold the steering wheel firmly and park the vehicle in a level and safe place. Apply the parking brake firmly, turn on the hazard warning light switch and stop the engine.

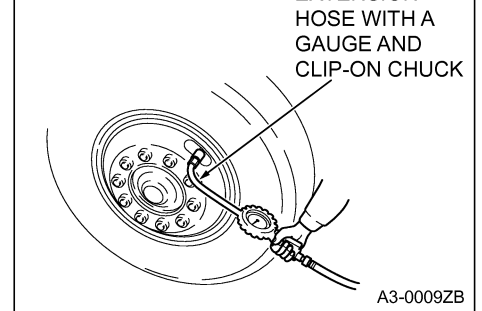
An inflated tire contains air under high pressure. An inflated tire and wheel can be dangerous if misused, and can result in personal injury and/or property damage. The maintenance of a damaged tire and wheel requires the use of proper tools, safe equipment, and tire service experts. If you have a flat tire or other tire damage, have tire service experts do the repair.

If you have to make repairs on tires or wheels without such help, observe the following precautions to help prevent personal injury and/or property damage.

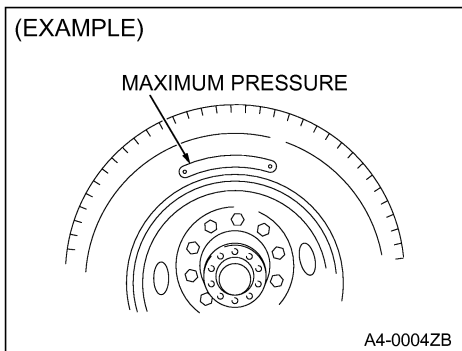
TIRE CHECK

1. When deflating the tire by removing the valve core, the air, under great pressure, escapes forcefully. Always wear safety glasses to protect your face and eyes and keep your face away from the tire when working on the tire.
2. Always disassemble the tire and wheel and check them for any damage before re-inflating the tire. This is particularly necessary if the tire was run flat or under inflated.

(EXAMPLE)



3. Always use an extension hose with a gauge and clip-on chuck so that you can stand aside during inflation.
4. Always inflate the tire to the proper pressure according to the tire manufacturer's recommended cold inflation pressure.



! WARNING

Never inflate the tire above the maximum pressure shown on the sidewall of the tire.

1. If you are not familiar with the proper procedures of check and repair, do not try to make any repairs, but ask tire service experts for help.

REMOVAL AND INSTALLATION OF WHEELS

! WARNING

Removal of wheels from the vehicle should be performed on a level place and on a hard surface. The changing of the wheels on an incline or on soft ground is hazardous and should not be performed, since this can result in personal injury and/or property damage.

Removal of wheel

1. Apply the parking brake firmly, and block the wheel which is diagonally opposite to the flat tire.
2. Loosen the wheel nuts slightly by using a socket wrench.

NOTICE:

[Model: HINO 145]

Wheel hub bolts and nuts on the right side of the vehicle have right-hand threads, and wheel hub bolts and nuts on the left side of the vehicle have left-hand threads.

3. Remove the wheel nuts and the tire.

[Model: HINO 145]

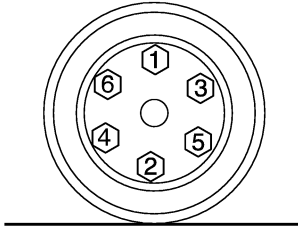
In the case of dual rear wheel removal, first remove the outer wheel nuts and the outer wheel. Then remove the inner wheel nuts and the inner wheel.

Installation

Before installation, clean the mounting surface of the disc wheel and the wheel hub or the brake drum [Full air brake type], the wheel nut seats [Model: HINO 145] and the hub bolts and nuts. A loose wheel mounting can result from these parts not being cleaned. Check the wheel hub bolts and nuts for wear of the threads or damage and the wheel disc for any crack or bend. Replace the part if you find any of these conditions.

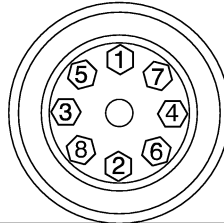
1. With the wheel hub bolts aligned with the holes of the wheel, lift the wheel up with a tire lever and mount it over the hub bolts.
2. Carefully rotating the wheel, install the nuts and tighten manually. Make sure that the hub bolts are centered in the holes.

[Model HINO 145]



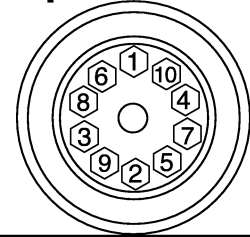
AD-0324

[MODEL HINO 165,185,258LP(ND)]



AD-0209A

[MODEL HINO 238, 258LP(NJ),
268, 308, 338]



D12-32-12ZB

3. Tighten all the nuts to their specified torque with a socket wrench.

[Model: HINO 145]

Torque: 390 - 470N·m

(290 - 347lbf·ft, 4,000 - 4,800kgf·cm)

[Model: HINO 165,185]

Torque: 215 - 235N·m

(160 - 175lbf·ft, 2,200 - 2,400kgf·cm)

[Model: HINO 258 LP(ND)]

Torque: 610 - 680N·m

(450 - 500lbf·ft, 6,200 - 6,900kgf·cm)

NOICE:

When tightening the wheel nuts, remove dirt and other foreign material from the thread, apply engine oil or grease to the threads of the hub bolts and wheel nuts, and to the crowns of the wheel nuts, and then tighten the nuts.

[Model: HINO 238,258LP(NJ),
268,308,338]

Torque: 610 - 680N·m

(450 - 500lbf·ft, 6,200 - 6,900kgf·cm)

NOTICE:

The proper tightening sequence is shown in the figure on the left. Go through the sequence three times, gradually and evenly increasing the torque on each nut each time until the specified torque is reached. Be sure to use the crisscross method as shown in the figure.

TOWING

FOR DUAL REAR WHEEL

[Model: HINO 145]

1. Install the inner wheel. Tighten all the inner nuts according to the above-mentioned procedures.
2. Then install the outer wheel and tighten all the outer nuts according to the above-mentioned procedures.

[Model: Except for HINO 145]

Install the inner wheel and outer wheel. Tighten all the nuts according to the above-mentioned procedures.



WARNING

- **When towing your vehicle, observe all state (Provincial in Canada) and local laws.**
- **Your vehicle should be towed by a professional towing service, using proper equipment. And a safety chain must be used.**
- **When being towed, always place the gearshift lever in the Neutral position (if the vehicle is equipped with automatic transmission or UltraShift transmission, place the selector in the “N” (Neutral) or “P” (Parking) position) and release the parking brake completely. [Full air brake type] If for any reason, the air system fails and the parking brake can no longer be released by air pressure, release the parking brake in accordance with MECHANICAL RELEASE OPERATION OF PARKING BRAKE, on page 5-13. (After towing the vehicle, be sure to have it restored to former condition by an authorized Hino dealer).**
- **Unload your vehicle.**

Use a professional towing service when the vehicle has to be towed and be sure they do the following:

1. Make sure that the both right and left rear axle shaft of the vehicle to be towed is removed before it is towed.
2. Use a tow-bar in towing the vehicle. Make a slow start to minimize shock.
3. Make sure that the engine of the towed vehicle is kept running. If the engine is off, no compressed air will be available for the brakes. [Full air brake type] This is dangerous, as the brake system does not function at all. In addition, the power steering system will not function. The steering wheel, therefore, will become unusually hard to turn, making it impossible to control the vehicle properly.
4. Make sure that the starter key is kept in the “ON” position.

5. If the engine of the towed vehicle is defective, make sure that the vehicle is towed by a vehicle designed for that purpose. Make sure that it is not towed by any other vehicle, as it can be very dangerous.
6. When the differential gear or rear axle shaft is defective, remove both right and left rear axle shaft. Note that the engine brake and parking brake can not be applied, as the axle shaft is removed beforehand.
7. Towing speed shall be less than 18 MPH (30 km/h).

FRONT END TOWING (With front wheels raised off the ground)

When towing from the front end with the front wheels raised off the ground remove the rear axle shafts to protect the transmission and differential gears from being damaged. The hub openings should be covered to prevent the loss of axle lubricant or the entry of dirt or foreign matter.

After being towed, check and refill the rear axle housing with lubricant if necessary.



CAUTION

In order to protect the front license plate and bumper, remove the license plate together with bracket, fit a protection bar against the lower edge of the bumper, and put a wood block under the frame near the No.1 cross member when attaching the chain. Never lift or tow the vehicle if the chain is in direct contact with the bumper.

REAR END TOWING

When being towed with the rear wheels raised off the ground, fasten and secure the steering wheel in a straight ahead position.

FREEING THE VEHICLE



WARNING

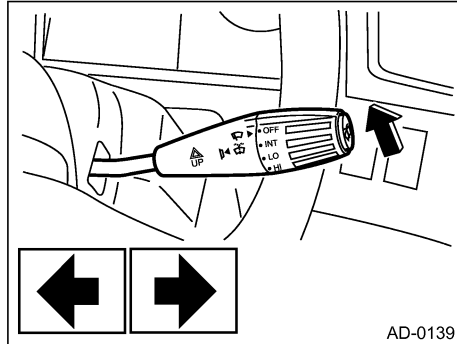
Do not spin wheels excessively. Excessive wheel spin may cause damage to the power train including the transmission, rear axle, and tires and can result in personal injury and/or property damage.

Wheel spin reduces the tractive force of the vehicle. When your vehicle gets stuck in loose sand, mud, snow or ice, wheel spin should be kept to a minimum by not unnecessarily pressing down on the accelerator pedal.

For manual transmission models, shift the gearshift lever alternately from “second” to “reverse” and rock your vehicle back and forth.

For automatic transmission models, shift the selector lever alternately from “D” to “R”.

HAZARD WARNING LIGHTS



WARNING

- **If a warning light comes on or beep sounds while driving, pull off the road, stop your vehicle immediately, and put on the hazard lights.**
- **Use these hazard lights whenever your vehicle might be obstructing traffic or is on the side of the road.**

To operate, pull up the lever switch. All the turn signal lights will flash independently of the starter key position and at the same time the turn signal indicator lights will also flash.

- The turn signal light does not work when the hazard lights are turned on.
- To turn off the flashers, pull up the switch again.

NOTICE:

Do not add additional turn signal lights. Consult an authorized Hino dealer if additions are necessary. To avoid shortening battery life, engine warm-up is necessary.

OVERHEATING



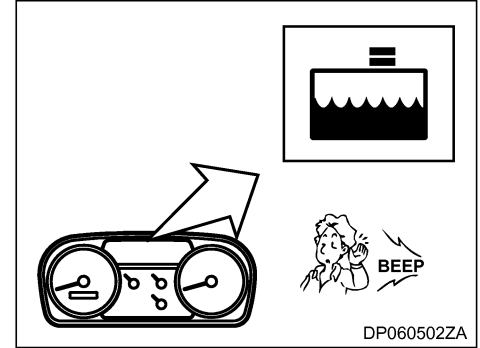
WARNING

**The radiator cap should not be removed while the engine and cooling system are still hot.
If the radiator cap is removed right after the engine is shut off, scalding fluid and steam may blow out under pressure and cause serious burn injuries.**

If overheating of the cooling system (indicated by the coolant temperature gauge being in the red zone) occurs due to severe operation conditions (such as climbing a long hill on a very hot day), take the following measures.

- Pull off the road and stop the vehicle in a safe place. Apply the parking brake firmly and place the gearshift lever in the neutral position (if the vehicle is equipped with automatic transmission, place the selector lever in the “N” (Neutral) or “P” (Parking) position).
- Keep the engine running at idling speed. Check for the cause using the instructions mentioned below. If repair work is required, consult an authorized Hino dealer.

**See whether the warning light is on
If the warning light is on**



1. Shortage of coolant

Check hoses and connections for cracks, loose clamps or leaks.
Repair if necessary.

2. No leak

Add coolant to the cooling system. Refer to Section 7 on page 7-49, for check coolant level. After refill, check whether the warning light goes off. If the warning light goes off you can resume driving.

JACK-UP THE VEHICLE

If the warning light is off

1. Check the fan for slippage of the drive belts. Check the radiator core for any clogging. Adjust, repair, or clean if necessary.
2. If these are in good order, the temperature will return to normal with the engine running at idling speed. You can then continue driving.
3. If the temperature does not return to normal with the engine running at idling speed, repair work is required.



CAUTION

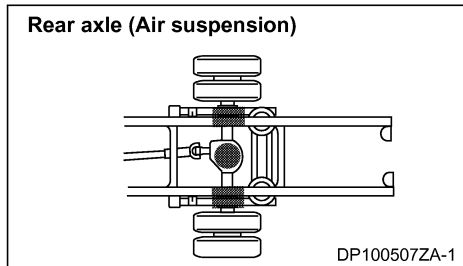
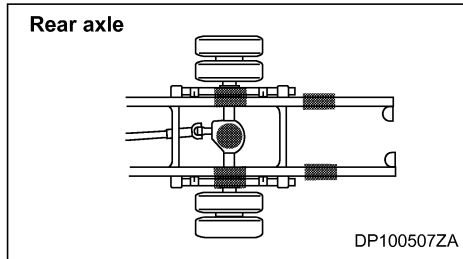
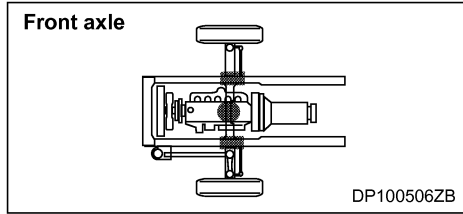
WARNING

Improper jacking up of the vehicle can result in serious injury or death. Read and follow all of these instructions.

- When jacking up the vehicle, do not place your body under the vehicle. Doing so could result in death or serious injury.
- Do not work under vehicle after it has been jacked up without placing the vehicle on jack stands or other appropriate steady supports.
- Securely apply the parking brake and properly block the other tires with wheel stoppers.
- When changing tires always park the vehicle on solid, level ground. Never attempt to change tires on soft ground or on a slope. This is very dangerous and can lead to sudden slipping of the jack which may result in personal injury and/or property damage.

- Place the jack at the proper jacking location at the lower surface of the axle (see diagram on next page). Using any other point could result in the vehicle falling off the jack.
- If oil etc. is sticking to the jack-up point, wipe it off completely before applying the jack.
- Do not start engine while jacking up the vehicle.
- When it is necessary to have the vehicle jacked up for a long time, place jack supports or other appropriate under the vehicle.
- Do not use more than two jacking up the vehicle.
- Do not raise the jack higher than necessary.
- Do not place anything on top or below the jack when jack up the vehicle.
- The jack provided with the vehicle is specifically for that vehicle. And do not use any other jack with this vehicle.

JACK-UP POINT



Changing the front tires when flat



CAUTION

Place the jack at the specific point shown in the diagrams for the front and rear axle. Setting the jack at any other point may result in the failure of the jack to work properly and the vehicle falling.

When changing a front tire that is flat, the front axle is often too low to the ground for the jack to fit under the normal jack-up point. In this case use the following procedure using solid timber etc.

1. Place wheel stoppers in front of and at the back of both left and right rear tires.
2. Place the jack under the leaf spring just in front of the front axle and jack-up the axle. Make sure that the jack is as close to the axle as possible.



CAUTION

The underside of the leaf is curved. So, be careful when placing the wood under the axle.

3. Insert a strong, solid timber under the front axle.



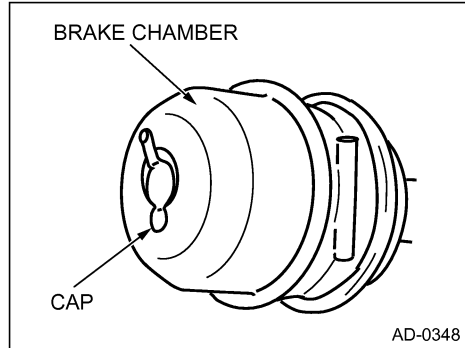
CAUTION

For greater stability of the solid timber, support the axle with the wider side of the timber.

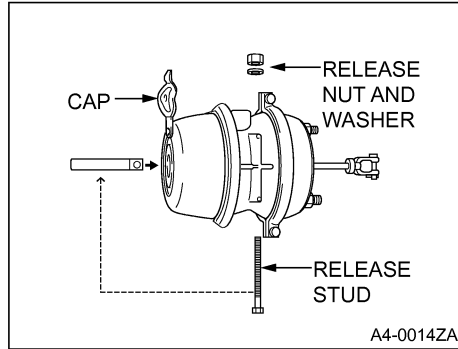
4. Slightly lower the jack until the front axle is securely supported by the timber and then lower the jack.
5. Next, move the jack to the jack-up point and jack-up the axle high enough to remove the tire.

MECHANICAL RELEASE OPERATION OF PARKING BRAKE

[Wheel parking brake type]

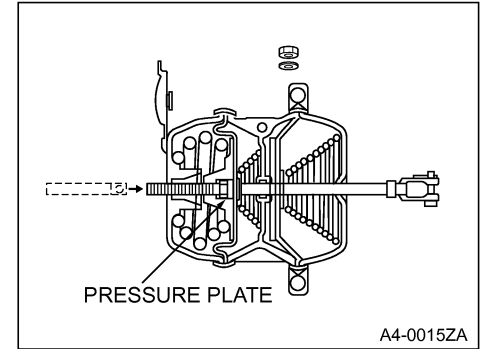


If, for any reason, the air system fails and the brake can no longer be released by air pressure, remove the cap from the spring chamber. Remove the release stud assembly from the side pocket by removing the release nut and washer from the release stud and sliding the release stud out.

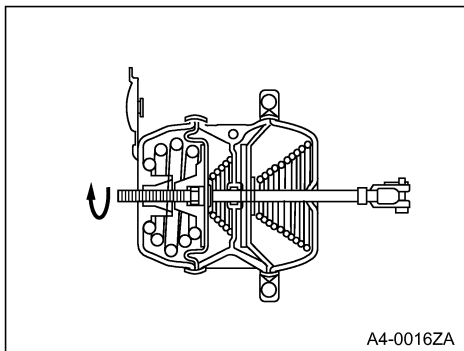


CAUTION

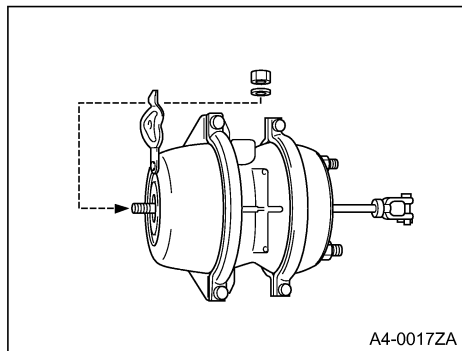
Always block the wheels before manually releasing the parking brake.



Insert the release stud through the opening (where cap was removed) in the spring chamber and insert it until it bottoms out.



Turn the release stud **1/4 turn** clockwise and pull the stud out to lock the formed end into the piston.



Assemble the release stud washer and nut on the release stud.

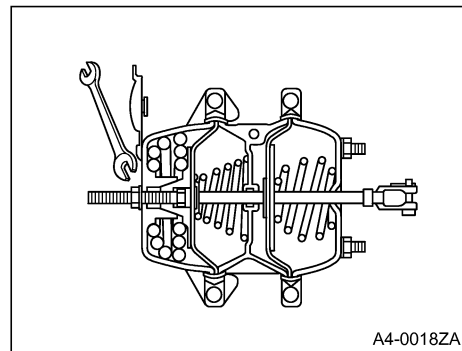
Turn the release stud assembly nut with a hand wrench until the compression spring is fully caged. While doing so, check visually to make certain the push rod is retracting while tightening the release stud assembly nut.

Do not force the release stud assembly with over-torque.

S-Cam Type Maximum torque:

67.8 N·m (50 lbf·ft, 691 kgf·cm)

The spring brake has now been mechanically released.



! WARNING

The spring cylinder in the brake chamber contains a highly loaded spring. Disassembly of the cylinder should only be performed by an authorized Hino dealer.

SECTION 6

CORROSION PROTECTION AND APPEARANCE CARE

INTERIOR CLEANING	6-2
CORROSION PROTECTION	6-4

Read entire manual before using vehicle. Failure to follow instructions and safety precautions could result in death, serious injury and/or damage.

INTERIOR CLEANING

CLEANING INTERIOR

Since the interior trim is made of vinyl and plastics, use appropriate cleaners.

Vinyl upholstery may be cleaned with a mild soap or detergent and water.

1. Remove dust and loose dirt from the vinyl upholstery with a vacuum cleaner or a soft brush.
2. Wipe the vinyl trim with a sponge or soft cloth soaked with a mild soap or detergent and water.
3. After leaving it wet for a few minutes, wipe and remove the dirt and the detergent from the vinyl trim with a clean damp cloth. Let dry.
4. Repeat this procedure if needed.
5. Commercial foaming type vinyl cleaners are also useful.

NOTICE:

Always follow the manufacturer's instructions when detergents or vinyl cleaners are used.



CAUTION

Do not pour water inside the cab for cleaning the interior. Pouring water on the audio system and the electrical components can cause a malfunction.



WARNING

Solvents (thinner, gasoline, benzene, etc.) should not be used for cleaning since these vapors can be harmful to the human body and are highly flammable. They can also attack plastics and rubber products.

CLEANING SEAT BELTS

Seat belts may be cleaned with mild soap and lukewarm water.

1. Wipe the belt webbing using a sponge or soft cloth soaked with mild soap or detergent and lukewarm water.
2. Dry the cleaned belts completely before reusing them.

NOTICE:

The belts should not be bleached, dyed or cleaned with gasoline, thinner, or solvent, since these may greatly weaken the belts.

CLEANING WINDOWS

Glass may be cleaned with a commercial household glass cleaner.

Follow the manufacturer's instructions when using a glass cleaner.

NOTICE:

Do not use abrasive cleaners since they may cause scratches. When using a spray cleaner, take care not to spray other parts. If other parts are sprayed wipe them off with a soft damp cloth as quickly as possible.

EXTERIOR CLEANING

CAB CLEANING

To keep your vehicle looking new regular washing and polishing are very helpful.

The cab exterior can be cleaned through the following procedure.

- 1) Wash the hood and cab with plain water rubbing gently with a soft cloth, a sponge, or a soft brush.
- 2) If the dirt cannot be removed only with water, also use a mild soap.
- 3) Thoroughly rinse to flush away any detergent before it dries.
- 4) Wipe off the hood and cab to remove excess water and dry it.



CAUTION

Do not use hot water for cleaning as it can result in personal injury and/or property damage.

NOTICE:

Do not wash the hood and cab in the direct sunlight since this may cause water spots on the coated surface.

Waxing should be done according to the following:

- 1) Before waxing, wash and dry the hood and cab according to the above procedures.
- 2) Remove road tar deposits from the surface by wiping gently with a turpentine or kerosene soaked soft cloth.



WARNING

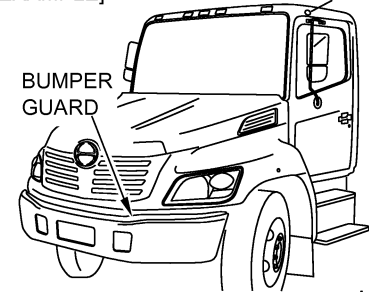
Do not use volatile and flammable solvents such as gasoline, thinner, etc. These could cause fire and explosion.



CAUTION

Be careful you don't slip when stepping on the front bumper.

[EXAMPLE]



AD-0386



WARNING

Do not step or lean on front bumper guard as it can result in personal injury and/or property damage.

NOTICE:

Use a good quality wax and follow the manufacturer's instructions.

UNDERBODY CLEANING

Regular washing of the underside of the vehicle is very important in maintaining proper condition of the vehicle.

Washing of the underside of the vehicle should be performed according to the following:

- 1) Use running water to flush away dirt and other foreign matter accumulated on the underside of the vehicle.
- 2) Pay particular attention to thoroughly clean all areas where mud and dirt can accumulate.

NOTICE:

- If you use a high-pressure washer, be careful not to damage the painted surface.
- Do not direct water onto any electrical components.
- Be careful not to get water on the inside of the air intake pipe when washing the chassis.

CORROSION PROTECTION

Corrosion protection should be maintained according to the following points.

Wash the vehicle to remove all salt.

This is particularly important when the vehicle is operated on salted roads in the winter or in a coastal area. Salt contained in mud and snow which accumulate on the underside of the cab and chassis can accelerate corrosion. When this occurs wash off the mud and snow immediately.

NOTICE:

- Corrosion is accelerated by salts, calcium chloride, ice melting agents, etc. left on the coated surface. Wash frequently when vehicle is exposed to such substances.
- Since insects, tree sap, bird droppings, fertilizer, soot, industrial pollutants, etc. may also damage the paint of the vehicle and accelerate corrosion, wash the vehicle immediately to remove these deposits.
- Promptly repair any damage or scratches on painted surfaces.
- Use touch up paint where appropriate.

- Dampness or accumulated dirt under the floor mats can cause corrosion of the metal floor pan. Check under the floor mats frequently and clean and/or dry when necessary.

SECTION 7

MAINTENANCE

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Read entire manual before using vehicle. Failure to follow instructions and safety precautions could result in death, serious injury and/or damage.

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CLEAN AIR ACT

Heavy-duty engine rebuilding practices.

§ 86.004-40

The provisions of this section are applicable to heavy-duty engines subject to model year 2004 or later standards and are applicable to the process of engine rebuilding (or rebuilding a portion of an engine or engine system). The process of engine rebuilding generally includes disassembly, replacement of multiple parts due to wear, and reassembly, and also may include the removal of the engine from the vehicle and other acts associated with rebuilding an engine. Any deviation from the provisions contained in this section is a prohibited act under section 203(a) (3) of the Clean Air Act (42 U.S.C. 7522(a) (3)).

1. When rebuilding an engine, portions of an engine, or an engine system, there must be a reasonable technical basis for knowing that the resultant engine is equivalent, from an emissions standpoint, to a certified configuration (i.e., tolerances, calibrations, specifications) and the model year(s) of the resulting engine configuration must be identified. A reasonable basis would exist if:

- A. Parts installed, whether the parts are new, used, or rebuilt, are such that a person familiar with the design and function of motor vehicle engines would reasonably believe that the parts perform the same function with respect to emissions control as the original parts; and
- B. Any parameter adjustment or design element change is made only:
 - a. In accordance with the original engine manufacturer's instructions; or
 - b. Where data or other reasonable technical basis exists that such parameter adjustment or design element change, when performed on the engine or similar engines, is not expected to adversely affect in-use emissions.
2. When an engine is being rebuilt and remains installed or is reinstalled in the same vehicle, it must be rebuilt to a configuration of the same or later model year as the original engine. When an engine is being replaced, the replacement engine must be an engine of (or rebuilt to) a configuration of the same or later model year as the original engine.

3. At time of rebuild, emissions-related codes or signals from on-board monitoring systems may not be erased or reset without diagnosing and responding appropriately to the diagnostic codes, regardless of whether the systems are installed to satisfy requirements in § 86.004-25 or for other reasons and regardless of form or interface. Diagnostic systems must be free of all such codes when the rebuilt engine is returned to service. Such signals may not be rendered inoperative during the rebuilding process.
4. When conducting a rebuild without removing the engine from the vehicle, or during the installation of a rebuilt engine, all critical emissions-related components listed in § 86.004-25(2) not otherwise addressed by paragraphs (1) through (3) of this section must be checked and cleaned, adjusted, repaired, or replaced as necessary, following manufacturer recommended practices.

5. Records shall be kept by parties conducting activities included in paragraphs (1) through (4) of this section. The records shall include at minimum the mileage and/or hours at time of rebuild, a listing of work performed on the engine and emissions-related control components including a listing of parts and components used, engine parameter adjustments, emissions-related codes or signals responded to and reset, and work performed under paragraph (4) of this section.

A. Parties may keep records in whatever format or system they choose as long as the records are understandable to an EPA enforcement officer or can be otherwise provided to an EPA enforcement officer in an understandable format when requested.

B. Parties are not required to keep records of information that is not reasonably available through normal business practices including information on activities not conducted by themselves or information that they cannot reasonably access.

C. Parties may keep records of their rebuilding practices for an engine family rather than on each individual engine rebuilt in cases where those rebuild practices are followed routinely.

D. Records must be kept for a minimum of two years after the engine is rebuilt.

Maintenance instructions § 86.007-38

(i) For each new diesel-fueled engine subject to the standards prescribed in § 86.007-11, as applicable, the manufacturer shall furnish or cause to be furnished to the ultimate purchaser a statement that **“This engine must be operated only with ultra low-sulfur diesel fuel (meeting EPA specifications for highway diesel fuel, including a 15ppm sulfur cap)”**.

GENERAL PRECAUTIONS

Some recommended and standard maintenance services for your vehicle are mentioned in this section. When performing maintenance on your vehicle be careful not to get injured by improper work.

If you have any questions about performing maintenance, consult an authorized Hino dealer.



WARNING

Failure to properly or completely perform recommended and standard maintenance on your vehicle can cause a vehicle accident or malfunction resulting in serious injury, death or property damage.



WARNING

When working on your vehicle, to prevent injury or damage, follow all of the safety precautions shown below.

Failure to properly or completely perform recommended and standard maintenance on your vehicle can cause a vehicle accident or malfunction resulting in serious injury, death or property damage.

- When working on your vehicle, observe the following general precautions to prevent personal injury and/or property damage in addition to the particular NOTICE or CAUTION or WARNINGS. Always wear safety glasses or goggles to protect your eyes.

Most threaded fasteners are metric.
Be careful not to mix with threaded fasteners using the inch system.

- Remove rings, watches, ties, loose hanging jewelry and loose clothing before starting work on the vehicle.
- Bind long hair securely behind the head.
- Apply the parking brake firmly and block the wheels when working on the vehicle.
- Use safety stands to support the vehicle whenever you need to work under it. It is dangerous to work under a vehicle supported only by a jack.
- To avoid serious burns, keep yourself away from hot metal parts such as the engine, exhaust manifold, radiator, muffler, exhaust pipe and tail pipe.
- Keep yourself, your clothing and your tools away from moving parts such as the cooling fan and drive belts when the engine is running.
- Always stop the engine and turn off the starter key unless the operation requires the engine running. Removing the key from the switch is recommended.
- If it is necessary to run the engine after the hood is raised (tilted), make sure that the parking brake is firmly applied, the wheels are blocked, and the gearshift lever is in the neutral position (if the vehicle is equipped with automatic transmission, place the selector lever in the “N” (Neutral) or “P” (Parking) position) before starting the engine.
- Run the engine only in a well-ventilated area to avoid inhaling of carbon monoxide.
- Do not smoke while working on the vehicle since fuel and gases from the battery are flammable.
- Take utmost care when working on the battery. It contains corrosive sulfuric acid.
- Large electric current flows through the battery cable and starter cable. Be careful not to cause a short which can result in personal injury and/or property damage.

- **Be careful not to leave any tool in the engine compartment. The tool may be hit by moving parts and can cause personal injury.**
- **Be careful not to damage lines and hoses by stepping or standing on them.**
- **Be careful you don't slip when you stand on the front bumper.**

SCOPE OF REGULAR MAINTENANCE

Maintenance requirements

1. Regular maintenance is very important to keep the vehicle trouble-free, and operating economically and with safety.
2. Regular maintenance is composed of **Daily inspection** which should be performed both before and after daily operation of the vehicle and **Scheduled Maintenance** which is carried out at the indicated intervals, mileage or period.
3. **Please note that the New Vehicle Warranty, Noise Emission Control System, and Exhaust Emission Control System require that proper maintenance be performed according to schedule.**

Maintenance schedule

1. Refer to TABLE 1, "RECOMMENDED MAINTENANCE SERVICE" for maintenance items which require scheduled maintenance.
2. Maintenance involving relatively simple and easy maintenance procedures is mentioned in this section. As to other items than the above, refer to the **Workshop Manual**.
3. Maintenance intervals in the following table are shown in the odometer readings and/or time intervals. As these maintenance intervals are set for normal driving conditions, **if the vehicle is used under more severe driving conditions, maintenance service must be performed more frequently.**

Service quality

1. The quality of maintenance your vehicle receives is very important for your vehicle to function properly and to operate safely and economically.
2. It is recommended that you take your vehicle to an authorized Hino dealer for service.
3. The use of proper tools, the use of the special tools developed by Hino, and the use of parts and accessories which have the same standard of quality as the original equipment parts, are very important for high quality service.
4. Genuine Hino parts and accessories have the same standard of quality as the original equipment parts.

TABLE 1
RECOMMENDED MAINTENANCE SERVICE

NOTICE:

- The maintenance items and intervals listed in this table are based on assuming that the vehicle is being operated under normal driving conditions. Normal driving conditions mean that the vehicle carries passengers and cargo within the GVWR and GAWR's specified on the Certification Label, and runs on normal road surfaces within legal speed limits at least several miles daily.
- Under severe driving conditions, maintenance should be performed more frequently than listed in this table.
- Be sure to observe the FIRST "1,000 MILES (1,600 km)", "3,000 MILES (5,000 km)", and "5,000 MILES(8,000 km)", items for both new vehicles and after major overhauling.
- Maintenance should be performed according to intervals of miles or months, whichever comes first.

-
- The maintenance items related to the EXHAUST EMISSION CONTROL SYSTEM are marked with *.
 - A maintenance record for the NOISE EMISSION CONTROL is attached at the end of Section 7. The maintenance record should always be kept whenever maintenance on the NOISE EMISSION CONTROL is performed.
-

TABLE 1 RECOMMENDED MAINTENANCE SERVICE

Maintenance operations:

A = Check and adjust if necessary; **I** = Inspect, clean and correct or replace as necessary;
L = Lubricate; **R** = Replace or change; **T** = Tighten to specified torque

SERVICE INTERVALS: (Odometer reading or months, whichever comes first.)	Odometer ranging Miles (x 1,000) Kilometers (x 1,000)	Every													Months (every)	
		First	3	6	9	10	12	15	18	20	24	30	36	50		72
MAINTENANCE ITEMS		5	10	15	16	20	25	30	32	40	50	60	80	120		
ENGINE																
Valve Clearance															A	24
*Engine compression pressure															A	36
*Engine mounting															A	36
FUEL SYSTEM																
*Fuel filter										R						6
Fuel hose and pipe (Fuel filter to supply pump, Fuel tank to fuel filter, Engine to fuel tank)						A									R	R:36
LUBRICATING SYSTEM																
J05D	With Hino genuine motor oil	Type 1	R	R: Every 8,000 miles {13,000 km}												6
		Type 2	R	R												6
*Engine oil and oil filter	With non genuine motor oil	Type 1	R	R												2
		Type 2	R	R												2
J08E	With Hino genuine motor oil	Type 1	R	R: Every 15,000 miles {20,000 km}												6
		Type 2	R	R: Every 20,000 miles {30,000 km}												6
*Engine oil and oil filter	With non genuine motor oil	Type 1	R	R: Every 7,000 miles {10,000 km}												2
		Type 2	R	R: Every 10,000 miles {15,000 km}												2
Type1/Type2: Type of operation details refer to page 7-25																

Maintenance operations:

A = Check and adjust if necessary; **I** = Inspect, clean and correct or replace as necessary;
L = Lubricate; **R** = Replace or change; **T** = Tighten to specified torque

SERVICE INTERVALS: (Odometer reading or months, whichever comes first.)	Odometer ranging														Months (every)	
	First		Every													
	Miles (x 1,000)		3	6	9	10	12	15	18	20	24	30	36	50		72
	Kilometers (x 1,000)		5	10	15	16	20	25	30	32	40	50	60	80	120	
MAINTENANCE ITEMS																
COOLING SYSTEM																
Coolant (Hino genuine Long Life Coolant used)			R: Every 360,000miles {600,000 km}												36	
*Cooling fan															I	12
*Drive belts			Initial inspection at first 6,000 miles {10,000 km}												R	12
*Radiator and heater hoses and clamps															A	12
AIR INTAKE AND EXHAUST SYSTEM																
*Air cleaner element															R	12
Intake air hose and clamps															R	24
*Intercooler body					A											6
*Intercooler hoses															I	24
Turbo charger rotor operation															I	24
Exhaust pipe and muffler attachment loose and damage					I											12
DPR cleaner			I: Every 200,000miles {320,000 km}												-	
CLUTCH FOR MANUAL ADJUST TYPE																
Clutch fluid leakage and damage									A							6
Clutch release sleeve and shaft			L													1
Clutch facing wear			A													2
Clutch housing and flywheel housing bolt														T		12
Clutch hose														R		12

Maintenance operations:

A = Check and adjust if necessary; **I** = Inspect, clean and correct or replace as necessary;
L = Lubricate; **R** = Replace or change; **T** = Tighten to specified torque

SERVICE INTERVALS: (Odometer reading or months, whichever comes first.)	Odometer ranging		Every															Months (every)
	Miles (x 1,000)	Kilometers (x 1,000)	3	6	9	10	12	15	18	20	24	30	36	50	72	500		
MAINTENANCE ITEMS																		
CLUTCH FOR AUTOMATIC ADJUST TYPE (Solo® Clutch)																		
Clutch release sleeve and shaft					L													1
Clutch facing wear (Check the wear indicator)					A													2
Clutch housing and flywheel housing bolt																	T	12
Clutch hose																	R	12
Clutch fluid																	R	12
MANUAL TRANSMISSION																		
Transmission gear oil	R: First replace at 3,000 – 5,000 miles (5,000 – 8,000 km),																-	
(Eaton® FS-4205A,FS-5406A,FS-6406A)						I											R	12
ULTRASHIFT TRANSMISSION																		
Transmission gear oil	-																-	
(Eaton® FO-5406B,FO-6406B)						I											R	R:60

Maintenance operations:

A = Check and adjust if necessary; **I** = Inspect, clean and correct or replace as necessary;
L = Lubricate; **R** = Replace or change; **T** = Tighten to specified torque

SERVICE INTERVALS: (Odometer reading or months, whichever comes first.)	Odometer ranging		Every														Months (every)
	Miles (x 1,000)	Kilometers (x 1,000)	3	6	9	10	12	15	18	20	24	30	36	50	72	500	

AUTOMATIC TRANSMISSION

Automatic transmission fluid	Aisin® 450	R: First replace at 5,000 miles (8,000 km)																						
	Allison® 3000RDS				I								R					R:12						
	Allison® 2500RDS,2200RDS ,2200HS,1000RDS,1000HS	R: First replace at 5,000 miles (8,000 km)																						
Filter	Allison® 2500RDS,2200RDS ,2200HS,1000RDS,1000HS	R: First replace at 5,000 miles (8,000 km)																						
					I										R			R:24						
Internal sump filter	Allison® 3000RDS	R: First replace at 5,000 miles (8,000 km)														R								12
Fluid level, fluid leak and case damage			A																	1				
Transmission and mounting bolts																			T	12				
Shift linkage freely positioned by transmission detent																			A	12				

Maintenance operations:

A = Check and adjust if necessary; **I** = Inspect, clean and correct or replace as necessary;
L = Lubricate; **R** = Replace or change; **T** = Tighten to specified torque

SERVICE INTERVALS: (Odometer reading or months, whichever comes first.)	Odometer ranging		Every											Months (every)		
	Miles (x 1,000)	First	3	6	9	10	12	15	18	20	24	30	36		50	72
	Kilometers (x 1,000)	5	10	15	16	20	25	30	32	40	50	60	80		120	
MAINTENANCE ITEMS																
PROPELLER SHAFT																
Propeller shaft deflection													A		12	
Propeller shaft spline play													A		12	
Propeller shaft universal joint play													A		12	
Propeller shaft center bearing support													A		12	
Propeller shaft mounting bolts								T							12	
Sliding spline and center bearing seal damage													A		12	
Propeller shaft spline play			L												1	
Propeller shaft universal joints			L												1	
REAR AXLE																
Differential gear oil	R: Refer to page 7-35														12	
Axle housing breather								I							6	
Axle housing cracks, deformation and damage													I		12	
Axle shaft and mounting bolts								A							12	
FRONT AXLE																
Front axle lubricated (Oil)	R: Refer to page 7-34														12	
Front axle lubricated (Grease)	R: Refer to page 7-34														6	
Axle parts deformation, cracking, wear and tightness (Except for tie rod ball joint)													I		12	
Wheel bearing end play													I		12	
Wheel alignment and Turning angle													I		12	
Wheel bearing													I		12	

Maintenance operations:

A = Check and adjust if necessary; **I** = Inspect, clean and correct or replace as necessary;
L = Lubricate; **R** = Replace or change; **T** = Tighten to specified torque

SERVICE INTERVALS: (Odometer reading or months, whichever comes first.)	Odometer ranging		Every														Months (every)	
	Miles (x 1,000)	First	3	6	9	10	12	15	18	20	24	30	36	50	72			
	Kilometers (x 1,000)		5	10	15	16	20	25	30	32	40	50	60	80	120			
MAINTENANCE ITEMS																		
STEERING																		
Steering gear case mounting bolts																T	12	
Steering parts (steering gear, pitman arm, drag link and steering shaft)																I	12	
Tie rod and drag link ball joint			L													I	12	
Steering shaft spline and dust boot						L										I	12	
King pin, bush and thrust bearing									L							I	12	
Power steering function																A	12	
Power steering reserver tank strainer		I														R	12	
Power steering reserver tank filter and fluid		R												R			12	
Power steering rubber parts and hoses																	R	12
SERVICE BRAKE FOR HYDRAULIC TYPE																		
Leakage, damage and tightness			A															2
Brake pads and rotor wear and damage																I		4
Wheel brake internal parts																I		12
Deformation of back plate																A		12
Brake pipe and hose damage			A															2
Brake hose																R		12
Hydraulic booster function																A		12
Caliper piston seal and boot																R		12
ABS system function																A		12
Brake fluid																R		12

Maintenance operations:

A = Check and adjust if necessary; **I** = Inspect, clean and correct or replace as necessary;

L = Lubricate; R = Replace or change; T = Tighten to specified torque

SERVICE INTERVALS: (Odometer reading or months, whichever comes first.)	Odometer ranging		Every														Months (every)
	Miles (x 1,000)	First	3	6	9	10	12	15	18	20	24	30	36	50	72		
	Kilometers (x 1,000)	5	10	15	16	20	25	30	32	40	50	60	80	120			
MAINTENANCE ITEMS																	
SERVICE BRAKE FOR FULL AIR TYPE																	
Air leakage, damage and tightness				A												2	
Drum wear and damage													I			12	
Wheel brake internal parts													I			12	
Brake chamber rod stroke											A					3	
Automatic slack adjuster (Front and rear)				L							A			I		L:2 A:3 I:6	
Brake spider damage and deformation				L												I:12	
Brake spider bushing (front and rear) and brake camshaft bracket bushing (rear)				L												2	
Brake pipe and hose damage				A												A:2	
Brake hose													R			12	
Brake chamber diaphragm													R			12	
Brake valve and other valve rubber parts													R			12	
ABS system function													A			12	
ABS control valve															R	24	
Spring brake rubber parts												R				12	
Lining wear (Thickness)						A										4	
Brake valve, brake chamber and other valves function												A				12	
Air dryer function									A							6	

Maintenance operations:

A = Check and adjust if necessary; **I** = Inspect, clean and correct or replace as necessary;
L = Lubricate; **R** = Replace or change; **T** = Tighten to specified torque

SERVICE INTERVALS: (Odometer reading or months, whichever comes first.)	Odometer ranging		Every												Months (every)	
	Miles (x 1,000)	First	1	6	9	10	12	15	18	20	24	30	36	50		72
	Kilometers (x 1,000)	1.6	10	15	16	20	25	30	32	40	50	60	80	120		
MAINTENANCE ITEMS																
PARKING BRAKE FOR CENTER PARKING TYPE																
Lining wear and clearance between drum and lining													I		12	
Drum wear and damage													I		12	
Control lever wear and damage													I, L		12	
Control cable slack and damage					A										4	
Drum mounting nuts					T										4	
PARKING BRAKE FOR WHEEL PARKING TYPE																
Leakage, damage and tightness		A													2	
Control valve and relay valve function													I		12	
Control valve and relay valve rubber parts													R		12	
Spring brake chamber rubber parts													R		12	
WHEEL AND TIRE																
Wheel bearing turning torque													A		12	
Wheel bearing lock nut													A		12	
Wheel nut	T	A													2	
Wheel disc damage		A													2	

Maintenance operations:

A = Check and adjust if necessary; **I** = Inspect, clean and correct or replace as necessary;
L = Lubricate; **R** = Replace or change; **T** = Tighten to specified torque

SERVICE INTERVALS: (Odometer reading or months, whichever comes first.)	Odometer ranging		Every													Months (every)
	Miles (x 1,000)	First	1	6	9	10	12	15	18	20	24	30	36	50	72	
	Kilometers (x 1,000)		1.6	10	15	16	20	25	30	32	40	50	60	80	120	

MAINTENANCE ITEMS

SUSPENSION																
Leaf spring damage and deformation			A													2
Tightness of spring brackets									A							6
Spring pin and shackle pin wear													A			12
Tightness of spring pin fitting nut and lock nut			A													2
Shock absorber mounting			A													2
Spring pin and shackle pin (Front and rear)			L													2
Tightness of U-bolt and clip bands		A											A			12
Spring slide seat			L													2
Shock absorber function and damage													A			12
Transverse rod rubber bushing crack and looseness (Air Suspension)						A										-
Air bellows height (Air Suspension)													A			12
Leveling valve function (Air Suspension)													A			-

CHASSIS FRAME

Cracking and deformation of frame														I		12
Tightness of bolts														T		12

Maintenance operations:

A = Check and adjust if necessary; **I** = Inspect, clean and correct or replace as necessary;
L = Lubricate; **R** = Replace or change; **T** = Tighten to specified torque

SERVICE INTERVALS: (Odometer reading or months, whichever comes first.)	Odometer ranging		Every														Months (every)
	Miles (x 1,000)	First	1	6	9	10	12	15	18	20	24	30	36	50	72		
	Kilometers (x 1,000)	1.6	10	15	16	20	25	30	32	40	50	60	80	120			
MAINTENANCE ITEMS																	
ELECTRICAL EQUIPMENT																	
Battery terminal									I							6	
Battery charging						A										4	
Starter bearing grease													I			12	
Starter brush															I	24	
Wiring, connectors and clips tightness and damage													A			12	
Engine cylinder block heater harness terminal															I	24	
CAB																	
Rear cab mounting support bolts									A							6	
Rear cab mounting brackets, cushion rubber mounting bolt and nut									A							6	
AIR FLOW, HEATING AND AIR CONDITIONER																	
Refrigerant amount of air conditioner															I	12	
Air filter																1	
I: Every 3,000miles(5,000km)																	
NOISE EMISSION CONTROL MAINTENANCE SCHEDULE																	
High idling speed															A	12	
Cooling fan															A	12	
Air intake system hose and clamps						A										4	
Air cleaner element															R	12	
Exhaust manifolds mounting nuts															T	12	
Muffler with catalyst and exhaust pipe clamps									A							6	
Splash shields, under hood insulator															A	12	

NOISE EMISSION CONTROL

1. Noise emission control system

The following are the requirements of Federal noise emission standards for vehicles which have a gross vehicle weight rating (GVWR) in excess of **10,000 lbs. (4,536 kg)** to minimize deterioration of the noise emission control system during operation. The maintenance items on the noise emission control system are listed in TABLE 1 on page 7-17.

The noise emission control system warranty is mentioned in your service and warranty booklet.

NOTICE:

The Federal noise emission standards apply only to vehicles sold in the United States of America.

2. Tampering with the noise control system is prohibited.

Federal law prohibits the following acts or the causing thereof:

- (1) The removal or rendering inoperative by any person other than for purposes of maintenance, repair or replacement of any device or element of design incorporated into any new vehicle for the purpose of noise control, prior to its sale or delivery to the ultimate purchaser or while it is in use.
- (2) The use of the vehicle after such device or element of design has been removed or rendered inoperative by any person. Among those acts presumed to constitute tampering are the acts listed below.

A. Insulation

- Removal of splash shields or under hood insulation.

B. Engine

- Removal or rendering the engine control ECU governor inoperative so as to allow engine speed to exceed manufacturer specifications. Removal or rendering a soldered engine calibration chip of ECU.

3. Maintenance of noise emission control system

C. Cooling fan and fan drive

- Modification of the fan (outside diameter, number and/or shape of fan blades).
- Removal or rendering fan clutch inoperative.

D. Intake system

- Removal or modification of the air cleaner.
- Removal of the air induction system components.

E. Exhaust system

Removal or rendering inoperative the exhaust system components including muffler, exhaust pipe, and clamps.

- (1) Splash shield, under hood insulation

Check shields and under hood insulation for damage or looseness. Repair, replace or clean if necessary.

(2)Cooling fan

- Check the cooling fan for damage, and replace it when damaged.
- Check the cooling fan mounting bolts for looseness, and tighten them if necessary.

(3)Intake system

- Check the intake system components such as ducts, hoses, resonator air cleaner, intake manifold, clamps and fasteners for damage. Replace if necessary. Check to be sure that hose clamps and fasteners are tight.
- Check to be sure that the air cleaner dust cover is installed securely.
- Check the rubber gasket in the dust cover for deterioration. Replace if necessary.

(4)Exhaust system

Check the complete exhaust system.

Check for damage, missing or mispositioned parts, loose connections, open seams, holes, loose fasteners, or deformed or plugged outlets. Replace or tighten if necessary.

Inspect for leaks at various joint connections and tighten clamp. Make visual inspection for crack or holes in DPR cleaner and tail pipe. Always replace with Hino recommended parts. Tail pipe elbow or offset tail pipe orientation must not be changed from standard position as originally received.

To avoid abnormal changes in vehicle sound level, maintenance is necessary at the intervals shown in the maintenance schedules, and record on the inspection verification form provided. Please consult an authorized Hino dealer.

COOLING SYSTEM



CAUTION

If your cooling system overheats, refer to “OVERHEATING” in “IN AN EMERGENCY”, SECTION 5. Placing any load on the engine by continued operation with the engine overheated, even for a short time, can result in a fire, personal injury and/or property damage.

Your engine requires cooling and the coolant temperature must be maintained properly. When the engine runs too hot, it will result in engine damage. When the engine runs too cold, its combustion efficiency will decrease and its exhaust emission will deteriorate. The proper selection and use of long life coolant (LLC) are very important to prevent corrosion of the cooling system and clogging of the radiator. In cold weather it is necessary to protect the engine, radiator, and pipes from freezing.

Regular replacement of coolant

Every 36 months or 360,000mile [600,000km] whichever comes first, drain and flush used "Hino Genuine Long Life Coolant (LLC)" or equivalent, and fill the cooling system with a new long life coolant. Upon coolant change, be sure to change the coolant in the reserve tank at the same time.

Coolant type

"Hino Genuine Long Life Coolant" is your vehicle at factory fill, in order to avoid technical problems, only use "Hino Genuine Long Life Coolant" or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite, and non-borate coolant with long-life hybrid organic acid technology.

Please consult an authorized Hino dealer.

NOTICE:

- Do not use alcohol type antifreeze or plain water alone.
- Do not mix up the coolant, anti-freeze, antirust and non genuine LLC.

- Using only water may cause corrosion of the cooling system and engine parts and clogging of the radiator.



WARNING

Be careful not to spill LLC over the hot exhaust system which can cause fire, personal injury and/or property damage.

Precaution for handling Long Life Coolant



CAUTION

- Never drink Long Life Coolant, as it is toxic. If you drink it by mistake, immediately bring it up and then consult with your doctor.
- If the coolant gets into the eye, immediately rinse it away with fresh water and take medical treatment promptly.
- Keep the coolant away from a fire, as the coolant is flammable.
- Wash the coolant off with clean water and then with soap immediately when the coolant gets on to your skin or cloth.
- Tighten the coolant container cap and store it out of the reach of children.

NOTICE:

- Wash the coolant down with water immediately when the coolant adheres on the painted part of the vehicle. Do not replenish with water only, as it makes the concentration of Long Life Coolant thinner resulting in a deterioration of its effectiveness.
- The mixing ratio of Long Life Coolant and water should be from 50 % to 60 %. If the ratio is below 50% or over 60%, the effectiveness of antirust and freezing protection will deteriorate. Do not use more than 63% solution for better coolant performance.

Cooling system capacity:

Engine model	Transmission	US Qt	Liter
J05D	Manual	21.2	20.0
	Automatic	20.6	19.5
J08E	Manual	24.9	23.5
	Automatic	24.4	23.0


NOTICE:

Do not mix more than 60% or less than 50% LLC. Concentrations more than 63% result in a loss of engine performance. Concentrations below 50% result in a loss of corrosion protection.


Thermostat

The thermostat controls the coolant flow to the radiator, and thereby maintains the proper coolant temperature.

Radiator grille cover

 CAUTION
Use of a radiator grille cover may cause the cooling fan blades to break due to fatigue. This can result in personal injury and/or property damage.

Radiator cooling fan and rated speed of the engine

 CAUTION
Increase of the rated speed of the engine or fan speed by modifying the crankshaft or fan pulleys may cause the cooling fan blades to break due to fatigue which can result in personal injury. This constitutes tampering with the noise control system.

FUEL SYSTEM



CAUTION

Do not smoke when performing maintenance on the fuel system. Keep flame and heat away from the fuel system since the fuel is flammable. Any of these can result in personal injury and/or property damage due to fire.

Diesel fuel requirements

Use ultra-low sulfur fuel only. Diesel fuel only which contains less than 15 ppm (parts per million) by volume of sulfur.



CAUTION

The DPR* requires diesel fuel with a sulfur content of less than 15ppm (0.0015%) by weight. If the sulfur content is higher than 15ppm (0.0015%) by weight, the DPR system and engine may be damaged.

*DPR: Diesel Particulate active Reduction system

1. Use good quality ASTM 2-D

Expected temperature	Preferred fuel grade
Above +20°F(-7°C)	Grade Low Sulfur Grade 2-D S15
Below +20°F(-7°C)	Grade Low Sulfur Grade 1-D S15

Use diesel fuel with cetane number 45 or higher.

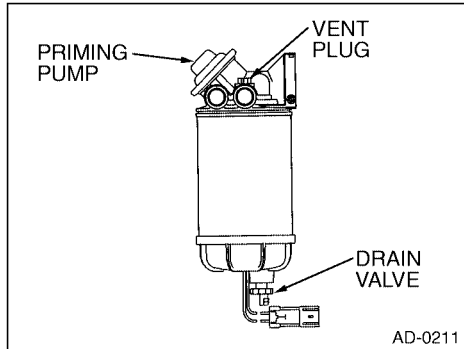
NOTICE:

- **Fuel additives should not be used.**
- **For prolonged idling operation, operation in temperatures below 32°F (0°C), or operation in high altitude areas (above 5,000 ft., 1,500 m), winterized 2-D may be used.**
- **If gasoline is put into the fuel tank by mistake, completely drain the fuel system to remove the gasoline.**

2. Keeping fuel clean and preventing water from entering the fuel system.

Feeding clean fuel to the engine depends both upon the supplier and the user. For example, when fuel is supplied from a corroded storage tank, the fuel should be filtered before it is put into the fuel tank of the vehicle. Water in fuel adversely affects the fuel injection system and engine. Water and dirt should be removed from fuel contaminated during storage. When filling the fuel tank in the rain or snow, care should be taken not to allow water in the fuel tank. Do not forget to screw on the fuel tank cap securely.

Fuel filter with water separator



The vehicle is equipped with a fuel filter and water separator. Fuel filters remove dirt and the water separator removes water from fuel.

NOTICE:

Failure to perform periodic maintenance can cause fuel filters to clog and the fuel supply to decrease or to stop.

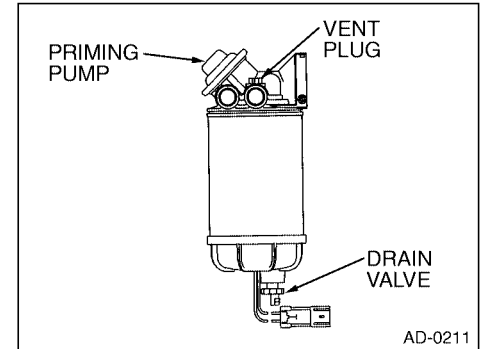
Periodic maintenance of the fuel filter should be performed. If the fuel is contaminated with dirt, more frequent maintenance on fuel filter is required as shown in TABLE 1. If you are not certain concerning the proper interval, contact an authorized Hino dealer. Use genuine Hino fuel filters or equivalent. Consult an authorized Hino dealer regarding the quality and interchangeability of fuel filters.



CAUTION

Using improper fuel filters can shorten the life of the engine and/or fuel injection system. Such fuel filters can become damaged or may leak fuel which can result in personal injury and/or property damage due to fire.

Air bleeding from fuel filter



RACOR® fuel filter

1. Loosen the air vent plug on the fuel filter.
2. Operate the priming pump until the air stops coming out from the vent plug. As fuel and air are forced out from the bleeder screw, carefully absorb the fuel with a cloth so that it does not splash.

NOTICE:

The vent plug should be tightened while the priming pump is operated. Wipe off any splashed fuel.

LUBRICATION

Lubrication of the vehicle with proper lubricants following appropriate procedures at correct intervals is very important for the maintenance of the vehicle. Lubrication of the vehicle according to TABLE 1 “RECOMMENDED MAINTENANCE SERVICE” and TABLE 7 “RECOMMENDED LUBRICANTS” is the driver’s / owner’s responsibility.

If the vehicle is used under severe operating conditions, the regular maintenance intervals should be shortened.

Waste oil disposal

Do not dispose of waste engine oil or other lubricants on the ground, into a sewer, river, or any similar place. Bring it to a used oil collection facility for recycling. If you have any problem regarding used oil disposal, contact to an authorized Hino dealer.

Engine oil and oil filters

3. Engine oil recommendations

To ensure excellent lubrication performance for your engine “Hino Genuine Motor Oil” or equivalent is available, which has been specifically tested and approved for all Hino engines. Please contact an authorized Hino dealer for further details about “Hino Genuine Motor Oil”.

According to the following instructions select and use the proper lubricant from a reliable supplier to enhance trouble-free operation and service life of the engine.

4. Oil grade:

API	CJ-4* ¹ , CI-4, CH-4, CF-4, CF
JASO	DH-2* ¹
ACEA	E-6* ¹ , E-5, E-4, E-3

*¹:HINO recommends to use engine oil designated **API CJ-4** grade for the proper function of the DPR (Diesel Particulate active Reduction) system, and use ultra low sulfur diesel fuel (0.0015% (15ppm) by weight) only and low-ash fuel must be less than 1% in weight.

It might have concerns about the ash needing Diesel Particulate Filter’s cleaning maintenance more often due to higher ash content, if not using CJ-4 grade engine oil.

A.Oil viscosity and relation between viscosity and temperature:

Oil viscosity is designated by SAE viscosity numbers. SAE30 is generally recommended. However, it is necessary to select a suitable oil viscosity based upon the range of temperature.

B.Selection by ambience temperature during operation

When the ambience temperature during operation is above 90°F (32°C), use SAE40 instead of SAE30.

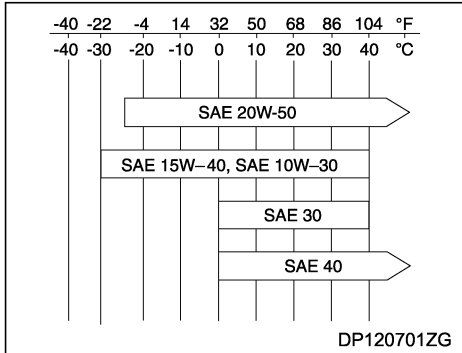
C.Selection by oil temperature when starting the engine

If the oil temperature at engine starting is below 32°F (0°C) and it is difficult to start with SAE30 use 15W40. When the temperature is below -9°F (-23°C), use SAE 10W/30 and an oil immersion heater should be used. Referring to page 3-29.

NOTICE:

Select the oil viscosity according to the diagram shown below, basing your selection on the maximum and the minimum ambience temperatures.

Viscosity recommendations (SAE)



D.Additives:

Engine oil additives or break-in oil should not be used.

5. Engine oil capacity (Drain and refill)

Engine model		US Qt	Liter
J05D	With filter	10.7	10.1
	Without filter	8.5	8.0
J08E	With filter	16.2	15.2
	Without filter	13.3	12.5

6. Replacement service interval oil and filter

The first replace of:
Hino genuine oil: 3,000 mile (5,000 km)

Periodic service interval:

Engine model	Type of operation	Hino Genuine oil	Non Genuine oil
J05D	Type 1	8,000 mile (13,000km)	6,000 mile (10,000 km)
	Type 2	9,000 mile (15,000km)	6,000 mile (10,000 km)
J08E	Type 1	15,000 mile (20,000 km)	7,000 mile (10,000 km)
	Type 2	20,000 mile (30,000 km)	10,000 mile (15,000 km)

7. Type of operation details

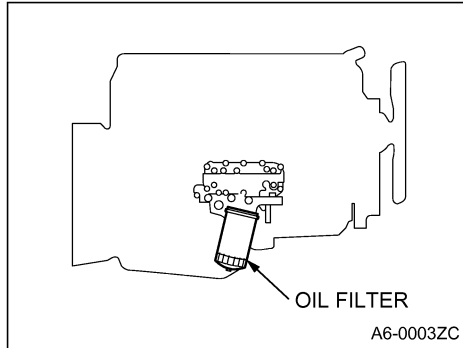
Type 1

- a. Un-paved road
- b. Dusty road
- c. Heavy long distance transport
- d. Mountain road operations
- e. Sort-haul distribution operations
- f. Construction operations (off-road)
- g. Light duty in city operations
- h. Monthly mileage up to 10,000 mile (16,000 km)

Type 2

- a. Light long duty distance transport
- b. Mainly on motor ways and express highways
- c. Monthly mileage over 10,000 mile (16,000 km)
- d. Paved and flat road operations

Oil filter



Use Hino genuine oil filters or equivalent quality parts which are compatible with your engine. Consult an authorized Hino dealer regarding the quality and interchangeability of the oil filter.



CAUTION

Using an improper oil filter may shorten engine life.



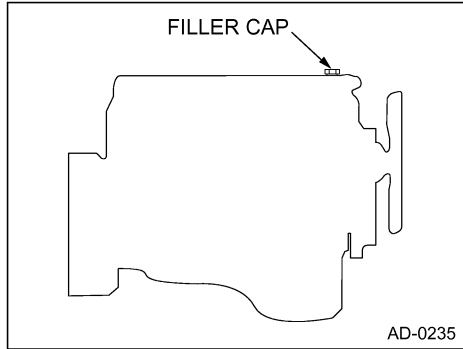
WARNING

- Always drain the fuel into a container and dispose of it properly. Be careful not to spill any of the fuel.
- If fuel is spilled on engine parts, wipe it off entirely. It is dangerous since it can cause a fire which can result in serious personal injury or death.
- Do not smoke when performing maintenance on the fuel system.
- Keep flame and heat away from the fuel system since the fuel is flammable and can cause a fire resulting in serious personal injury or death.
- Any of these can result in personal injury and/or property damage due to fire.
- Use the designated special tool and fuel filter wrench to tighten the fuel filter. Use of an ordinary tool (for example, chain-type tool) can scratch or dent the peripheral surface of the fuel filter. If the fuel filter is damaged, it can cause fuel to leak, thus resulting in a fire or other serious accidents

and can result in serious personal injury or death.

- After replacing the filter, inspect the external surface of the fuel filter for checking scratches and dents. It is dangerous to use a scratched or dented fuel filter, since it can cause fuel to leak and lead to a fire or other serious accidents and can result in serious personal injury or death.
- After replacement of the element, operate the engine for trial to check to see if there is any fuel leakage around the fuel filter. Fuel leakage can cause a fire and can result in serious personal injury or death.

Replace engine oil and filter

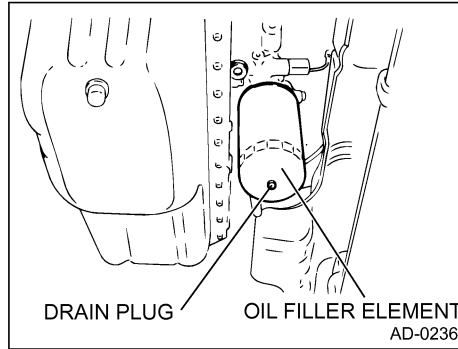


CAUTION

Doing replacement work while the engine is still hot can result in personal injury.

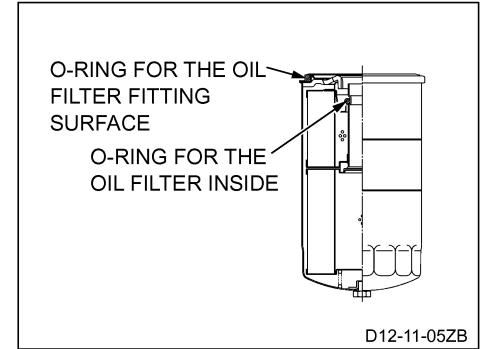
Replace engine oil and oil filter in the following manner:

a. Park the vehicle on level ground.



b. Remove the filler cap. Remove the drain plug of the oil pan and drain the engine oil. The used engine oil should be drained into an appropriate container. Remove any dirt or debris from around the oil filter.

c. Place a container for waste oil under the oil filter and then drain the oil by loosening the drain plug located at the lower part of the oil filter. Be sure to receive the oil in the container for the sake of safety and in order not to make the ground dirty

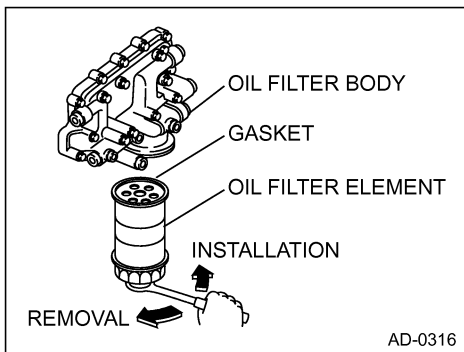


CAUTION

Just after driving, the engine oil is still hot and can burn you. Before changing or checking the oil, let it cool down until you can touch the oil without getting burned.

Remove the oil filter element by turning it to the left using an oil filter wrench of a specified special tool.

Part number of wrench
J08E: S09503-1110-B
J05D: S09503-1090-B



- d. Check that a O-ring for the oil filter fitting surface and a O-ring for the oil filter inside are not left at the side of the oil cooler case.
- e. Remove any dirt or debris such as dust, mud, etc. existing on the sealing face (contacting face of the element gasket) of the main body.

f. Apply oil to the gasket of the new oil filter element and install it by turning it lightly to the right by hand until it comes in contact with the sealing face of the main body. Use a new gasket contained in the element kit. When installing the oil filter, be careful not to damage it by twisting the gasket. Do not reuse the old element.

g. From this state, turn the filter element by 3/4 and/or 1 turn using the oil filter wrench.

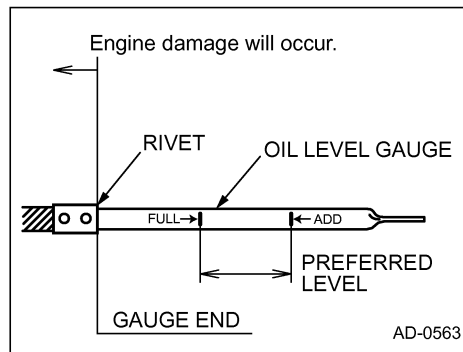
h. When adding engine oil, refer to TABLE 5 LUBRICANTS CAPACITY (Drain and refill) and then install the filler cap tightly.

i. Start the engine and check it for oil leaks.



CAUTION

After replacement of the oil filter, operate the engine to see if there is any oil leakage around the oil filter. Oil leakage can cause a fire.



- j. Since the oil level goes down after the oil filter and oil cooler are filled, stop the engine and wait about **10 minutes**. Recheck the level and fill to the "FULL" mark if necessary. Wipe any spilled oil off the engine. Do not run the engine with the oil level below the "ADD" mark, or with the filler cap and/or level gauge removed.

NOTICE:

When oil level becomes too high, engine damage will occur.

Transmission lubrication

Manual transmission

Model: FS-4205A, FS-5406A, FS-6406A

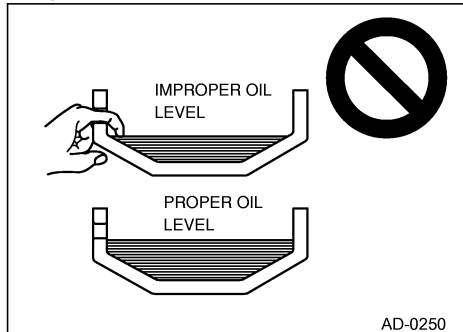
UltraShift transmission

Model: FO-5406B, FO-6406B

Proper lubrication procedures are the key to a good all-around maintenance program. If the oil is not doing its job, or if the oil level is ignored, all the maintenance procedures in the world are not going to keep the transmission running or assure long transmission life.

Eaton Fuller® transmissions are designed so that the internal parts operate in a bath of oil circulated by the motion of gears and shafts.

Proper oil level



Being able to reach the oil with your finger does not mean oil is at the proper level. When adding oil, never mix engine oil and gear oil in the same transmission.

Draining oil

Drain transmission while oil is warm. To drain oil remove the drain plug at bottom of case. Clean the drain plug before re-installing.

Refilling

Clean case around filler plug and remove plug from side of case. Fill transmission to the level with the bottom of the filler opening. If transmission has two filler openings, fill to the level of both openings. The exact amount of oil will depend on the transmission inclination and model. Do not over fill-this will cause oil to be forced out of the case through front bearing cover. When adding oil, types and brands of oil should not be inter-mixed because of possible incompatibility.

Torque:

Filler plug: 34 – 46 N·m

(25 – 35 lbf·ft, 350 – 470 kgf·cm)

Drain plug: 62 – 74 N·m

(45 – 55 lbf·ft, 635 – 755 kgf·cm)

Lubrication change and inspection

(1) for manual transmission

HIGHWAY USE	
First 3,000 to 5,000 miles(5,000 to 8,000 km)	Replace transmission oil on new units
Every 10,000 miles (16,000 km)	Inspect oil level. Check for leaks.
Every 50,000 miles (80,000 km)	Replace transmission oil.
OFF-HIGHWAY USE	
First 30 hours	Replace transmission oil on new units
Every 40 hours	Inspect oil level. Check for leaks.
Every 500 hours	Replace transmission oil where severe dirt conditions exist.
Every 1,000 hours	Replace transmission oil (Normal off-highway use).

Oil filter should be changed at each oil change on units equipped with optional external oil filter.

Recommended lubrications

(1) for manual transmission

Type	Grade (SAE)	Fahrenheit (Celsius) Ambience Temperature
Eaton approve synthetic transmission oil	50	All
Heavy duty engine oil MIL-L-2104D, API-CD, or Cat TO-4	50	Above 10°F (-12°C)
	40	Above 10°F (-12°C)
	30	Below 10°F (-12°C)
Automotive gear oil API-MT-1	80W-90	Above 10°F (-12°C)
	75W	Below 10°F (-12°C)
Additive and friction modifiers must not be introduced. Never mix engine oils and gear oils in the same transmission.		

The use of lubricants not meeting these requirements will affect warranty coverage.

Lubrication change and inspection

(2) for UltraShift transmission

HIGHWAY USE	
Every 12,000 miles (20,000 km)	Inspect oil level. Check for leaks.
Every 500,000 miles (800,000 km) or 5 years	Replace transmission oil.
OFF-HIGHWAY USE	
Every 50 hours	Inspect oil level. Check for leaks.
Every 2,000 hours or 5 years	Replace transmission oil (Normal off-highway use).

Recommended lubrications

(2) for UltraShift transmission

Type	Grade (SAE)	Fahrenheit (Celsius) Ambience Temperature
Mobil Delvac Synthetic Transmission Fluid 50, Shell SPIRAX GSX SAE 50, Eaton Approved Synthetic Transmission Oil, or equivalent. (refer to Eaton Lubrication Manual for detail)	50	All
Additive and friction modifiers must not be introduced. Never mix engine oils and gear oils in the same transmission.		

The use of lubricants not meeting these requirements will affect warranty coverage.

Automatic transmission**Model: AISIN® 450, ALLISON® 1000RDS, 1000HS, 2200RDS, 2200HS, 2500RDS, 3000RDS****Recommended lubrications-1**

Type	Grade (SAE)	Fahrenheit (Celsius) Ambience Temperature
Automatic transmission fluid	ATF DEXRON® III (Non-TES 295)	—

Fluid and filter change-1

AISIN® 450	
First 5,000 miles (8,000 km)	Replace automatic transmission fluid.
Every 10,000 miles (16,000 km)	Inspect fluid level. Check for leaks.
Every 25,000 miles (40,000 km) or every 12 month	Replace automatic transmission fluid and fluid filter.
ALLISON® 1000RDS, 1000HS, 2200RDS, 2200HS, 2500RDS	
First 5,000 miles (8,000 km)	Replace automatic transmission fluid filter on new units.
Every 10,000 miles (16,000 km)	Inspect fluid level. Check for leaks.
Every 50,000 miles (80,000 km) or every 24 month	Replace automatic transmission fluid and fluid filter.
ALLISON® 3000RDS	
First 5,000 miles (8,000 km)	Replace automatic transmission fluid filter on new units.
Every 10,000 miles (16,000 km)	Inspect fluid level. Check for leaks.
Every 25,000 miles (40,000 km) or every 12 month	Replace automatic transmission fluid and fluid filter.

Model: ALLISON® 1000RDS, 1000HS, 2200RDS, 2200HS, 2500RDS, 3000RDS

Recommended lubrications-2

Type	Grade (SAE)	Fahrenheit (Celsius) Ambience Temperature
Automatic transmission fluid	TranSynd™ (TES 295)	—

Fluid and filter change-2

ALLISON® 1000RDS, 1000HS, 2200RDS, 2200HS, 2500RDS	
First 5,000 miles (8,000 km)	Replace automatic transmission fluid filter on new units.
Every 10,000 miles (16,000 km)	Inspect fluid level. Check for leaks.
Every 50,000 miles (80,000 km) or every 24 month	Replace automatic transmission fluid filter.
Every 150,000 miles (240,000 km) or every 48 month	Replace automatic transmission fluid.
ALLISON® 3000RDS	
First 5,000 miles (8,000 km)	Replace automatic transmission fluid filter on new units.
Every 10,000 miles (16,000 km)	Inspect fluid level. Check for leaks.
Every 75,000 miles (120,000 km) or every 36 month	Replace automatic transmission fluid filter.
Every 3,000,000 miles (480,000 km) or every 48 month	Replace automatic transmission fluid.

NOTICEE:

New vehicles with a mixture of TranSynd. and DEXRON®III fluid must follow fluid/filter change recommendations for Allison approved Non-TES 295 fluids outlined in flow charts.

If the customer fills the transmission with Allison approved TES 295 fluid, the change recommendations of Allison approved Non-TES 295 fluids must be followed. Upon the next oil change, if the customer reinstalls TES 295, the fluid/filter change recommendations outlined in 100 percent TES 295 approved fluids must be followed.

Fluid exchanging machines are not recommended or recognized due to variation and inconsistencies that may not guarantee removal of 100 percent of the used fluid.

Front axle

Lubrication and maintenance operation front axle.

Lubrication

Read and observe all Caution and warning safety alerts below and those that precede instruction or procedures you will perform.



WARNING

Park the vehicle on a level surface. Block the wheel to prevent the vehicle from moving. Support the vehicle with safety stands. Do not work under a vehicle supported only by jacks. Jacks can slip and fall over. Serious personal injury and damage to components can result.

Front non-drive axle greasing intervals

Component	Interval
Ball studs on steering arm, tie-rod ends, and drag link ¹	6,000 miles (10,000 km) or once a year, whichever comes first
King pin and bushings, thrust bearings	18,000 miles (30,000 km) or once a year, whichever comes first

¹ Applied to ball studs on Easy Steer Plus axles. Sealed axles require inspection of the boot on the ball stud every 6,000 miles (10,000 km) for wear and damage. Service as necessary.

Wheel-end Axle Greasing intervals

Which ever comes first : Replacing Seals , Relining Brakes

Operation	Interval
On-Highway	30,000 miles (48,000 km)
On/Off-Highway and Off-Highway	Twice a year

Wheel-end Oil change intervals

Check oil level: 1,000 miles (1,600 km)

Component Whichever comes first: Seals replaced. Brakes relined

Operation	Interval
On-Highway	Whichever comes first: Seals replaced, brakes relined, 100,000 miles (160,000 km) or once a year
Off-Highway	Whichever comes first: Seals replaced, brakes relined, or once a year

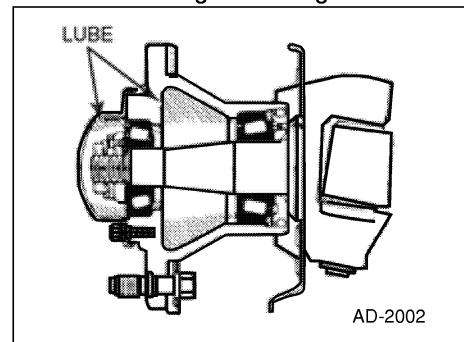
Grease-lubricated wheel bearing

axles with conventional wheel ends

NOTICE:

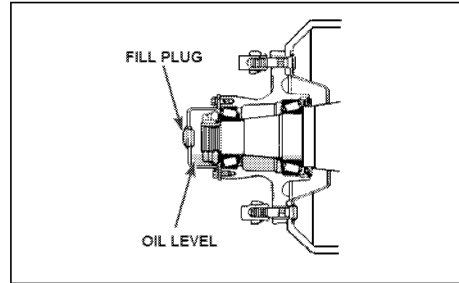
This procedure applies to hubs with grease-lubricated wheel bearings.

- Park the vehicle on a level surface. Block the wheels to keep the vehicle from moving.
- Remove the tire and wheel assembly. Remove and disassemble the hub.
- Remove the oil lubricant from all parts. Discard the seals. Inspect the wheel bearings for wear or damage. Replace worn or damaged bearings.



- d. Force the specified lubricant from the large end of the cones into the cavities between the rollers and cage. Pack the hub between the bearing cups with lubricant to the level of the smallest diameter of the cups.
- e. Install the inner and outer bearing cones into the cups in the hubs. The bearing cups must be pressed tight against the shoulder in the hubs.
- f. Install new wheel seals into the hubs.
- g. Install the hub and the wheel and tire assembly. Install the outer wheel bearing cone into the hub. Install the adjusting nut.
- h. Adjusting the wheel bearings

Oil-lubricated wheel bearing



axles with conventional wheel ends

NOTICE:

This procedure applies to hubs with oil-lubricated wheel bearings.

- a. Check the level on the cap. if the oil level is not at the specified level on the cap, remove the fill plug.
- b. Add the specified oil until the oil is at the specified level.

Differential gear oil

Wheel-end axle greasing intervals

Whichever comes first: Seals replaced.
Brakes relined

On-Highway	30,000 miles (48,000km)
On/Off Highway and off-Highway	Twice a year

Wheel-end Oil change intervals

Check oil level: 1,000 miles (1,600 km)

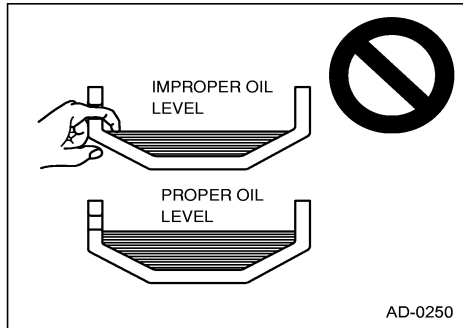
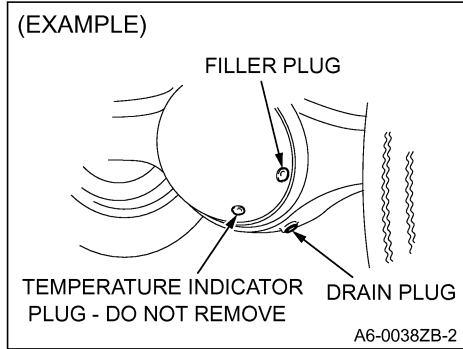
On-Highway operation

Whichever comes first: Seals replaced.
Brakes relined, 100,000 miles (160,000km) or once a year

Off-Highway operation

Whichever comes first: Seals replaced.
Brakes relined or once a year

Differential gear oil



Replace differential gear oil



Do not work on the differential carrier while it is still hot.

This can result in personal injury.

- Park the vehicle on level ground.
- Clean around the drain and filler plugs.
- Remove the filler plug.
- Remove the drain plug and drain the gear oil. The used gear oil should be drained into a suitable container.
- Clean the filler plug with a magnet and tighten it with a new gasket.
Torque: 4.7 – 6.5 N·m
(35 – 50 lbf·ft, 48 – 67 kgf·cm)
- Add gear oil up to the lower end of the filler plug hole.

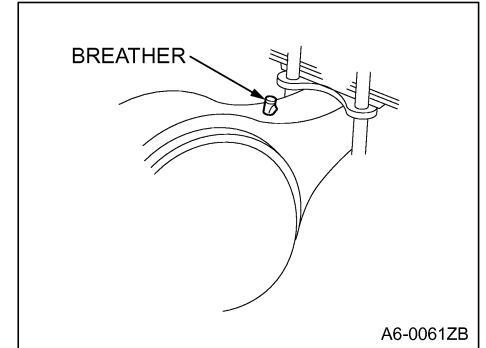
Gear oil: Refer to TABLE 7, "RECOMMENDED LUBRICANTS".

- Clean the filler plug with a magnet and tighten it with a new gasket.

Torque: 4.7 – 6.5 N·m

(35 – 50 lbf·ft, 48 – 67 kgf·cm)

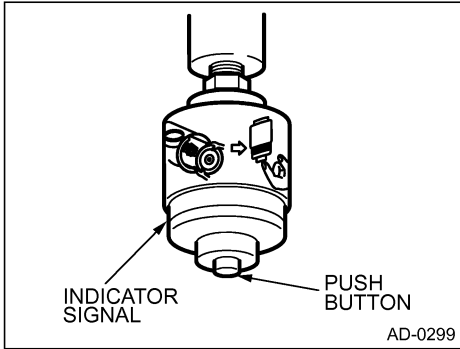
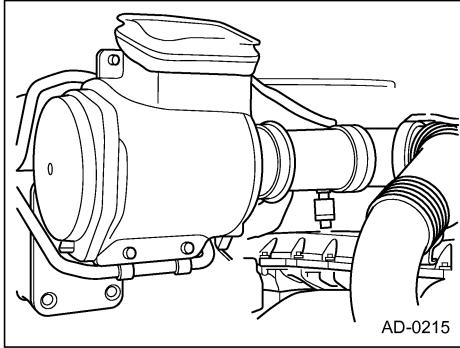
Check and clean axle housing breather



Clean the breather if necessary.

AIR INTAKE SYSTEM

Air cleaner maintenance



When the air cleaner element becomes excessively dirty, air flow is restricted and this leads to excessive exhaust smoke and loss of power. Check and replace the air cleaner element at specified intervals.

Replacement of element

Replace the element according to specified intervals. When the vehicle is operated in a dusty area, more frequent maintenance is required refer to page 7-53.

NOTICE:

Be sure to use Hino genuine air element or equivalent. Do not use an imitation element because it may aspirate dust due to a bad sealing by excessive aspirate.

ELECTRIC SYSTEM

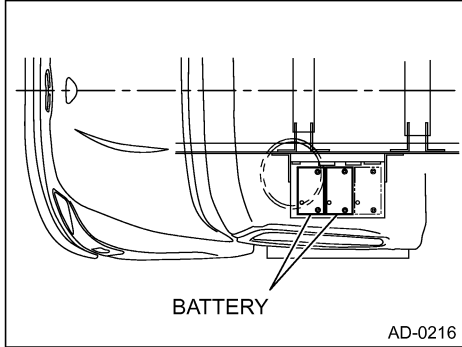
Check the complete wiring periodically for deterioration of insulation due to damage or being exposed to oil. It is the driver's / owner's responsibility to maintain it in good order to assure satisfactory and safe operation.



WARNING

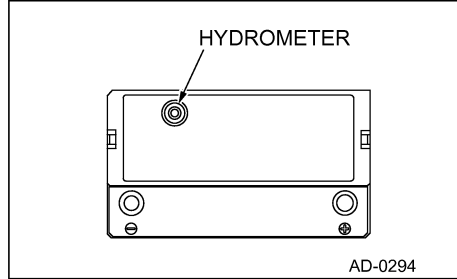
Observe the precautions mentioned in the Jump Starting, of SECTION 5, "IN AN EMERGENCY" on page 5-2. when working on or near the battery. The battery produces explosive gas and contains a corrosive sulfuric acid. A battery explosion, contact with electrolyte, or an electrical short can result in personal injury and/or property damage.

Battery (Maintenance-free battery)



Your vehicle is equipped with maintenance-free batteries installed on the brackets of the left side frame. The hydrometer on the top of the battery provides a guide regarding condition of the charge and the electrolyte level. When replacing, use the same model as the original battery or its equivalent.

Checking battery hydrometer (except AGM battery)



Check the battery condition by the hydrometer color.

1. Good condition

Green eye: EXIDE® battery

2. Charging necessary

Black eye: Have the battery checked by an authorized Hino dealer.

NOTICE:

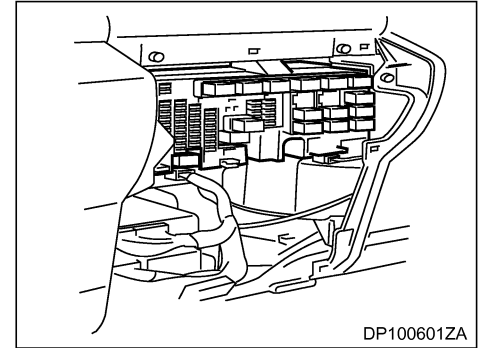
Do not refill the battery with water.

[AGM BATTERY]

Do not attempt to open vents.

Charge voltage limited to 14.6 Volts.

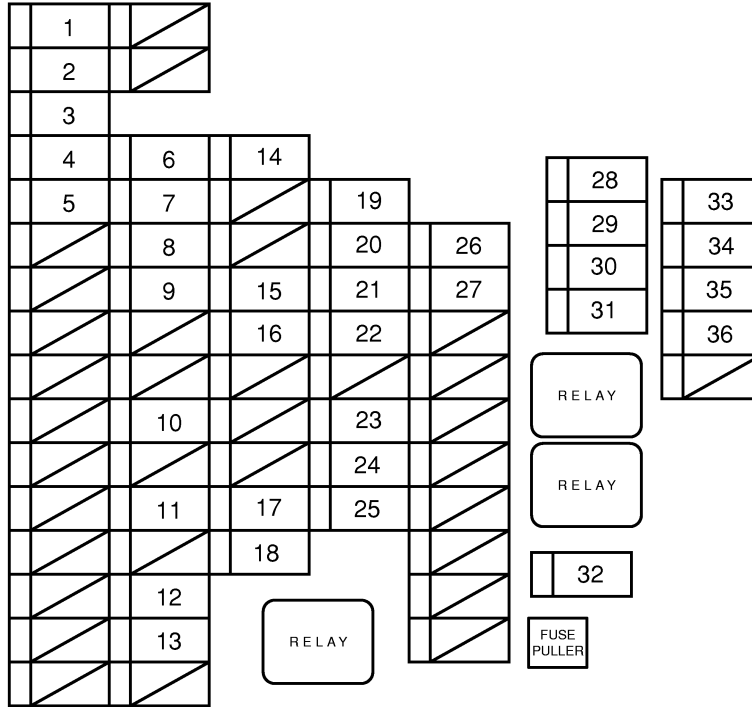
Fuses



The fuse block is located inside the dashboard in front of the assistant's seat. The cause of an overload current should be determined and corrected before a burnt out fuse is replaced.

Always replace with the correct fuse. Placing a wrong fuse can result in damage to electric units.

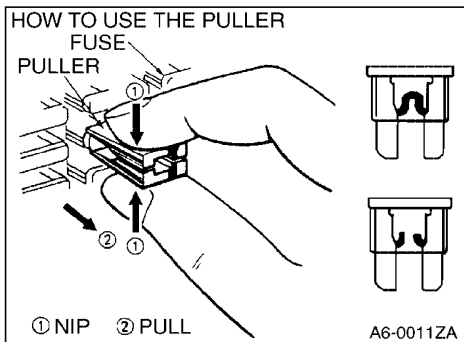
The amperage of each fuse is as follows.



AD-0219A

1. 10A Starter switch
2. 5A Head light main relay
3. 5A Head light dimmer relay
4. 5A Daytime running light
5. 15A Wiper
6. 10A Head light main RH
7. 10A Head light main LH
8. 10A Head light dimmer RH
9. 10A Head light dimmer LH
10. 20A Tail light
11. 15A Spare power for tail
12. 15A Fog light
13. 10A Body dome light/Air sus pension dump
14. 10A Starter
15. 15A Radio
16. 10A Power door lock
17. 10A Spare power for ignition 1
18. 10A Spare power for ignition 2
19. 10A Wiper
20. 10A Horn
21. 10A Meter
22. 5A Engine ECU
23. 10A Automatic transmission
UltraShift transmission
24. 5A ABS

- 25. 5A Brake
- 26. 5A Spare power for battery 1
- 27. No circuit
- 28. 5A Spare fuse
- 29. 10A Spare fuse
- 30. 15A Spare fuse
- 31. 20A Spare fuse
- 32. 30A Spare fuse
- 33. 15A Air dryer
- 34. 10A Back up light
- 35. 15A Mirror heater
- 36. 5A Air conditioner 1 /Power window



NOTICE:

Never use fuses with a capacity other than that specified.

Additional wiring

- As additional wiring from fuses or circuit breakers causes overheating, it must be avoided.
- For the additional installation of a radio or a spotlight, the terminals for its additional wiring are provided in the cab and on the chassis frame. Wiring should be done at an authorized Hino dealer.
- Loads which can be added are as follows:

**Always the power source to the cab.
: Max. 3.5A**

Tail linkage power source to the chassis frame: Max. 10.5A

Van light power source to the chassis frame: Max. 7A

Fog light power source to the cab: Max. 10.5A

Key linkage (ON position) power source to the cab and the chassis frame: Max. 7A

Fusible links

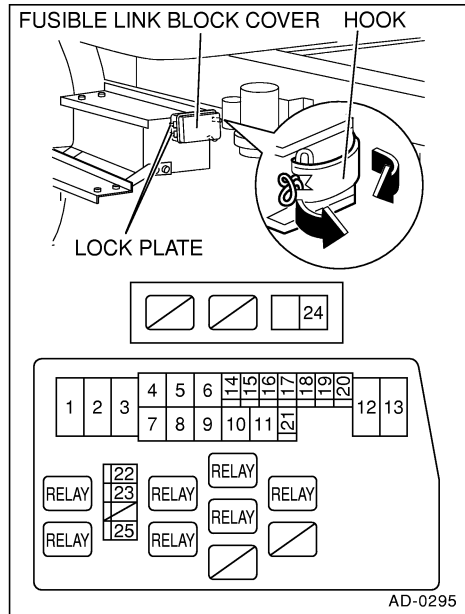
- The fusible links are installed in the fusible link block located on the back of the battery.
- The cause of an overload current should be determined and corrected before a melted fusible link is replaced.
- A melted fusible link can be determined by swelled or melted insulation of the link.

Each fusible link has a connector colored according to its capacity. Always replace with a proper fusible link.

Color of connector	Ampere	Quantity
Pink	FL30A (Cartridge type)	4
Green	FL40A (Cartridge type)	4
Yellow	FL60A (Cartridge type)	3
Purple	FL140A (Cartridge type)	2

How to remove the fusible block cover

- Release the hook by pushing the lock lever (3 points)
- Remove the block cover by pulling the lock plate.



Fusible link

- (1) 60A Tail light
- (2) 40A Heater
- (3) 140A Alternator
- (4) 60A Starter
- (5) 40A Head light
- (6) 40A Main 1
- (7) 30A Power window
- (8) 40A Main 2
- (9) 30A ABS
- (10) 30A Accessory
- (11) 40A Spare power & Van light
- (12) 60A Glow plug
- (13) 140A HYDRO MAX brake
Hydraulic brake models only

Fuse

- (14) 10A Stop light
- (15) 15A Turn signal light
- (16) 15A ABS for full air brake
30A ABS for hydraulic brake
- (17) 15A U2 main
- (18) 15A Room light
- (19) 15A U2 actuator
- (20) 10A AT(Automatic transmission)
- (21) 20A Fuel heater
- (22) 5A HYDRO MAX brake system
Hydraulic brake models only
- (23) 5A HYDRO MAX ABS system
Hydraulic brake models only
- (24) 40A MAIN3
- (25) 30A UltraShift Transmission

SERVICE BRAKE SYSTEM

Hydraulic brake type



CAUTION

A split hydraulic brake system is installed in the vehicle. If one of the two separate circuits fails for some reason, the vehicle can still be stopped with the other circuit, but the stopping distance will be much longer than normal. If you experience this, have an authorized Hino dealer check and correct it as soon as possible.

Regarding checks and adjustment of wheel brake pads wear, have the checks and adjustment performed according to TABLE 1 "RECOMMENDED MAINTENANCE SERVICE". Under severe driving conditions, more frequent maintenance is required. Maintenance on the wheel brake should be performed according to the daily inspection and maintenance schedule. If your vehicle is operated with frequent braking condition, check the service brake system more often.

Full air brake type



WARNING

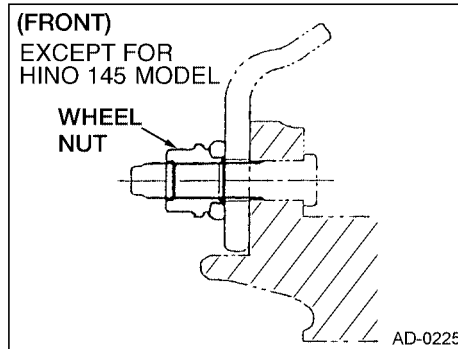
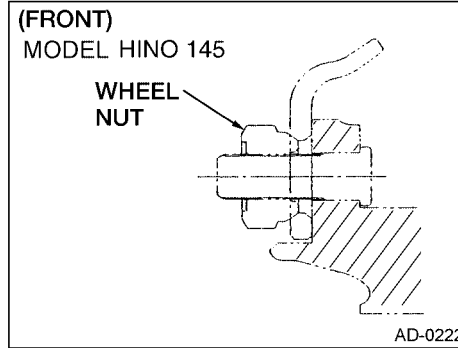
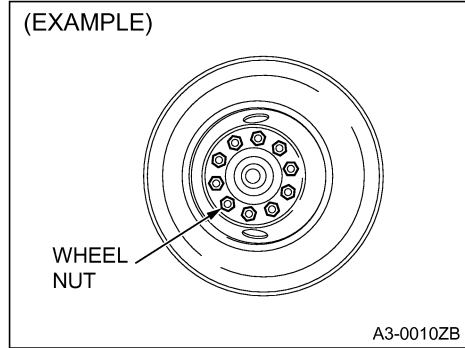
- **If the air pressure warning light comes on and/or the buzzer sounds while driving, pull off the road and stop your vehicle immediately. Have an authorized Hino dealer check and correct it.**
- **A split air brake system is installed in the vehicle. If one of the two separate circuits fails for some reason, the vehicle can still be stopped with the other circuit, but the stopping distance will be much longer than normal. If you experience this, have an authorized Hino dealer check and correct it as soon as possible.**
- **Perform checks to the wheel brake lining wear according to TABLE 1, "RECOMMENDED MAINTENANCE SERVICE".**
- **The wheel brakes of the vehicle with automatic slack adjuster will automatically be adjusted.**
- **The automatic slack adjusters should not be manually adjusted in an**

effort to correct excessive pushrod stroke, because this condition indicates that a problem exists with the automatic adjuster, with the installation of the adjuster, or with related foundation brake components, which manual adjustment will not fix.

- **Manual adjusting the automatic slack adjusters is a dangerous practice that could have serious consequences, because it gives the driver a false sense of security about the effectiveness of the brake, which are likely to go out of adjustment again soon.**
- **If any malfunction found ASA, have an authorized Hino dealer inspect and repair brakes. Under severe driving conditions, more frequent maintenance is required.**

Maintenance on the wheel brake should be performed according to the daily inspection and maintenance schedule. If your vehicle is operated with frequent braking condition, check the service brake system more often.

Wheel nuts and hub bolts



Check and tighten wheel nuts to their specified torque in accordance with daily inspection procedures.

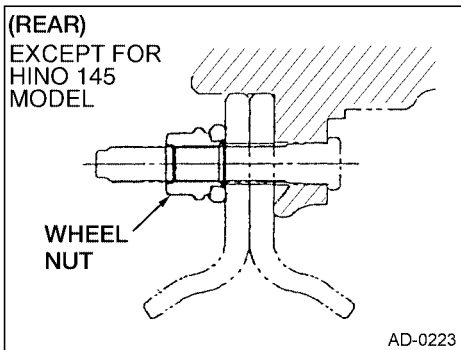
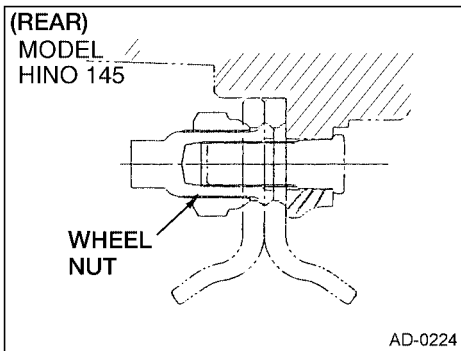
NOTICE:

When tightening the wheel nuts, remove dirt and other foreign material from the thread, apply engine oil or grease to the threads of the hub bolts and wheel nuts, and to the crowns of the wheel nuts, and then tighten the nuts. Wheel hub bolts and nuts on the right side of the vehicle have right-hand threads, and wheel hub bolts and nuts on the left side of the vehicle have left-hand threads.



WARNING

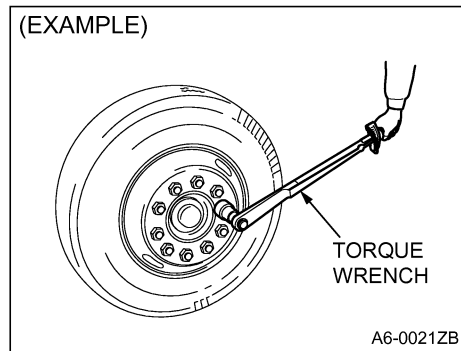
Do not drive with wheel nuts loosened. Driving with wheel nuts loosened may cause the wheel and nut to become damaged and the hub bolt to break due to fatigue. This can result in personal injury and/or property damage.



⚠ WARNING

Replace all hub bolts of the wheel when a single hub bolt breaks due to a loosely mounted wheel. Though it is not easily perceptible, other hub bolts also could be damaged due to fatigue. This can cause personal injury and/or property damage.

Replace hub bolts and wheel nuts with damaged threads. Replace wheels with damaged or deformed bolt holes. When the vehicle, wheels, or wheel nuts are new, the wheel nuts should be checked and tightened to specified torque at 100, 500, and 1,000 miles (160, 800, and 1,600 km) since they may not be well seated. Have an authorized Hino dealer check and tighten them. The tightening torque should be checked with a proper torque wrench.



Torque for wheel nuts:

[Model: HINO 145]
390 – 470 N·m
(290 – 347 lbf·ft., 4,000 – 4,800 kgf·cm)

[Model: HINO 165, 185]
215 – 235 N·m
(160 – 175 lbf·ft., 2,200 – 2,400 kgf·cm)

[Model: HINO 238, 258, 268, 308, 338]
610 – 680 N·m
(450 – 500 lbf·ft., 6,200 – 6,900 kgf·cm)

Tire



CAUTION

Worn or damaged tires should be replaced as soon as possible. Tires with worn tread tend to slip when cornering and decrease brake effectiveness. These can result in personal injury and/or property damage. Always use approved tire and rim combinations for diameters and contours.

Tires tend to slip when driving on wet, snowy and icy, or gravel roads. Vehicle speed should be controlled with regard to road conditions. When driving on wet or slushy roads, vehicle speed should be reduced because of possible hydroplaning.

Wheel and tire balancing

A tire and wheel assembly which is out of balance can cause uneven tread wear or vibration. In this case have an authorized Hino dealer check and correct it.

Tire inflation



CAUTION

- **Driving with an under inflated tire is very dangerous because it causes excessive heat build-up and can result in tire failure causing personal injury and/or property damage. Be sure to inflate tires to proper pressure according to the tire manufacturer's recommended cold inflation pressure.**
- **Inflation pressures should be checked and corrected using an extension hose with gauge and clip-on chuck while tires are cold. Tires heated from normal use will have higher pressures than the cold inflation pressures. Tire pressures should always be checked with an accurate gauge.**
- **Valve stem caps should always be used to keep a tight air seal and to keep out dirt and moisture.**
- **If a pressure loss is noticed at any pressure check, have an authorized Hino dealer determine the cause and correct it as soon as possible.**

Tires should be properly inflated according to the tire manufacture's recommended cold inflation pressure for the tire size, type, load range (ply rating) and axle loading typical for your operation. Be sure that the total load carried by front and rear tires does not exceed GAWR and GVWR of the vehicle. Replacement of tires or wheels requires tire experts. Consult an authorized Hino dealer.

Proper inflation pressure is the most important maintenance practice to insure safe vehicle operation and long life for the tires. Failure to maintain correct inflation pressure may result in sudden tire destructions, improper vehicle handling, and may cause rapid and irregular tire wear. Therefore, inflation pressure should be checked daily and always before long distance trips.

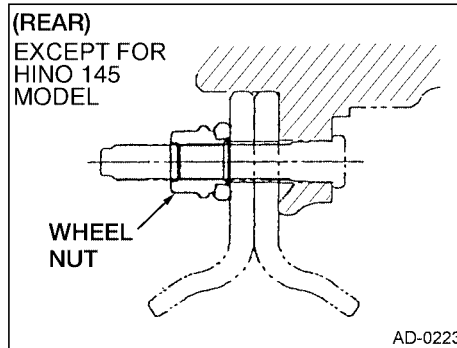
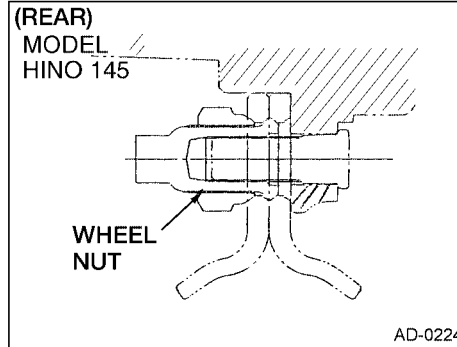
Wheel replacement recommendations

Wheels must be replaced when they become deformed or damaged or when the wheel nuts repeatedly loosen.



CAUTION

When replacing tires, use tires of the same size, construction, load range, and tread design as the original tires of your vehicle. Otherwise vehicle handling, brake performance, and riding comfort can be adversely affected and may result in personal injury and/or property damage due to loss of control. When the tire specifications are not clear, contact an authorized Hino dealer.

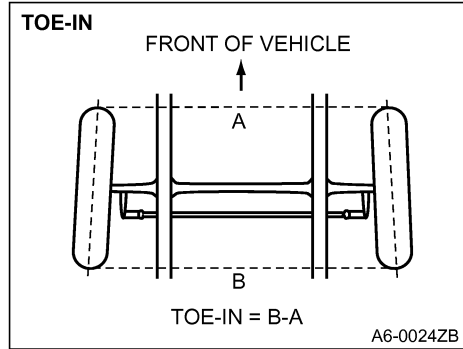


WARNING

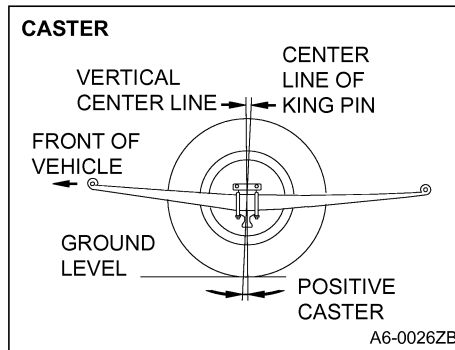
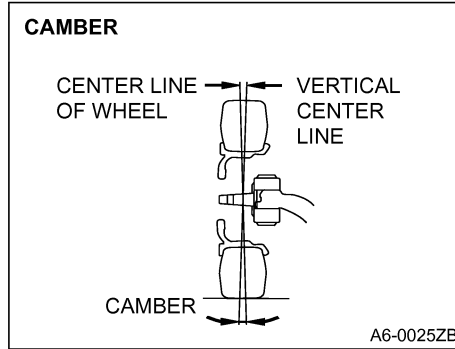
- Do not use damaged disc wheels which have been straightened or repaired by welding. Such wheels can break while driving because of reduced strength. This can result in personal injury and/or property damage due to loss of control.
- When replacing disc wheels, always use new disc wheels. Used disc wheels can suddenly fail without indication.
- When replacing a disc wheel, use the new disc wheel of the same size (diameter, width and offset), construction, load capacity and mounting dimensions as the Hino genuine disc wheel or equivalent. Check that the newly installed disc wheel does not interfere with the axle, suspension, or brake parts. An improper wheel may cause the loss of control, interference with suspension system, shorter life of wheel bearings, a tire coming off, etc. This can also result in personal injury and/or property damage.

FRONT AXLE ALIGNMENT

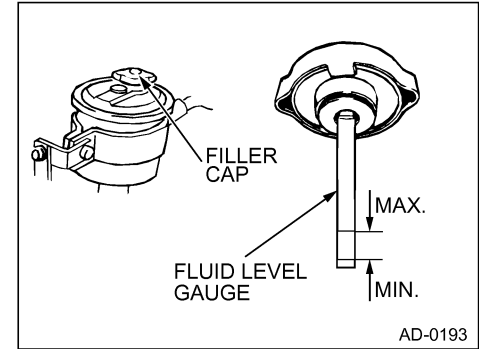
Alignment



Camber, toe-in, and caster are important factors for tire life and vehicle handling. Maintenance of the correct alignment in accordance with the scheduled maintenance is important. Improper alignment can cause abnormal tire wear, vibration, or steering difficulty.



POWER STEERING SYSTEM



CAUTION

- When adding the fluid to the reserve tank be careful not to contaminate fluid by letting dirt fall into the reserve tank.
- Fluid contaminated with dirt can result in a shorter pump life and can result in personal injury and/or property damage due to improper operation of relief valve, control valve etc.

MAINTENANCE PROCEDURES

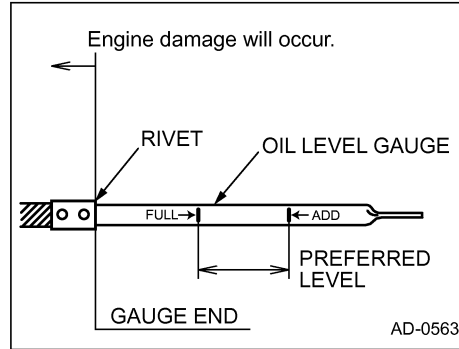
Daily inspection

The following daily maintenance should be performed to ensure efficient operation of the vehicle. Performing the daily maintenance is the operator's responsibility. Make it a habit to check these points every day before operating the vehicle.

NOTICE:

If level is over the "FULL" mark, adjust oil level to the preferred area. When oil level becomes too high, engine damage will occur.

Before starting the engine Check engine oil level



Check the level gauge for the engine oil with the vehicle parked on level ground. After the engine has been stopped, wait a minimum of 10 minutes before checking the level. Pull out the level gauge, wipe it with a clean cloth and put it back all the way. Pull out the gauge again and check the level. The oil level should be kept between the "FULL" and "ADD." marks.

Do not operate the vehicle with the oil level below the "ADD." mark. The quantity of oil indicated between marks is below. When the engine is cold, added oil will not reach the oil pan fast enough to provide a true indication of oil level.

	US Qt	Liters
J08E	3.6	3.4
J05D	2.9	2.7

Be careful not to overfill. Otherwise increased oil consumption or deterioration of the exhaust emission can result.

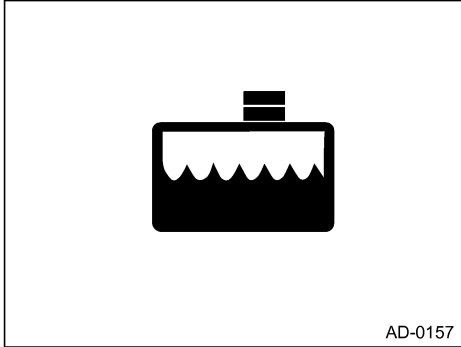


CAUTION

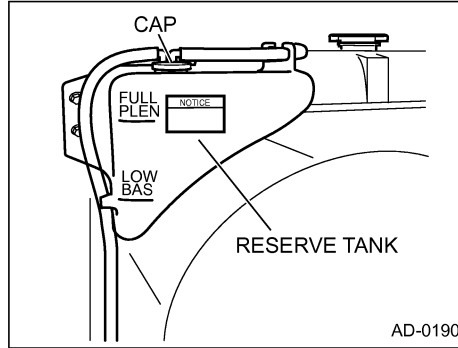
When adding oil, be careful not to spill oil. When the exhaust system is still hot, spilled oil on the hot exhaust system can cause personal injury and/or property damage due to fire. Do not spill oil on the electric system. If oil is spilled, carefully wipe it off with a cloth.

Replace the filler cap after adding oil. Install the level gauge securely.

Check coolant level



Check the coolant level warning light. The warning light comes on when the level is low.



Check the coolant level in the reserve tank. (Coolant is automatically supplied from the reserve tank if the coolant in the radiator is running low.) The coolant level should be between the "FULL" and "LOW" lines. If it is below the "LOW" line there is not sufficient coolant in the radiator. Check the radiator and reserve tank for leaks and then refill them.

NOTICE:

Wait until the engine and radiator are cool before checking the coolant level.

Open the reserve tank cap and pour in coolant until the "FULL" line is reached.

NOTICE:

Coolant will automatically be supplied from the reserve tank to the radiator. Do not remove the radiator cap.

A frequent or excessive need of coolant indicates possible leaks in the coolant system.

Consult an authorized Hino dealer.

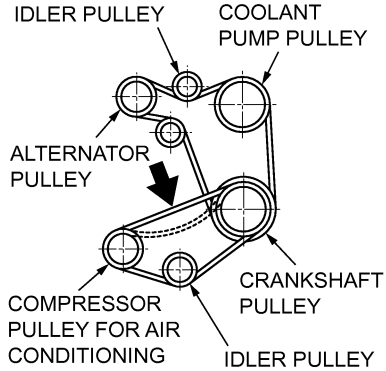
When replenishing coolant if LLC is being used, add the Hino genuine LLC in the same concentration as that used previously to ensure that an identical concentration of LLC is maintained.

NOTICE:

Long life coolant meet system requirements and has the ability to pile (sediment) up in the reserve tank. There is no influence in the function performance of Long life coolant.

Check drive belts

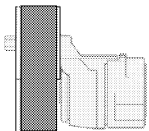
[MODEL: HINO 238, 258, 268, 308, 338]
ENGINE MODEL: J08E



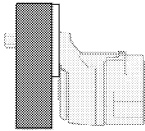
AD-0477

Normal condition

Replace

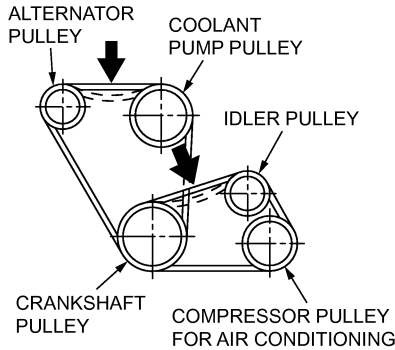


3 mm {0.1 in}



AD-0556

[MODEL: HINO 145, 165, 185]
ENGINE MODEL: J05D



AD-0192

- Check all drive belts for fraying, cracks, wear or oiliness and tension. Adjust or replace if necessary.
- With auto tensioner models
Check the drive belt position on pulley of auto tensioner.
If the drive belt is out at the pulley end, replace the belt with a new one.



CAUTION

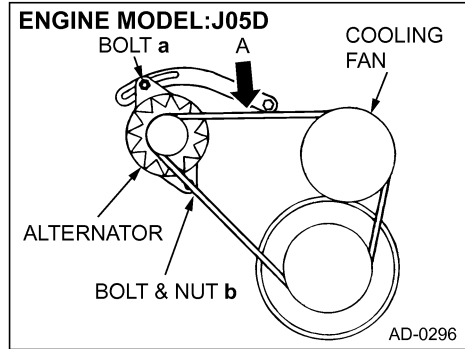
Keep the engine stopped during this check and adjustment. Moving parts such as the cooling fan and belts can result in personal injury.

Check belts for proper tension by applying pressure of 22 lbf (10 kgf) with your finger (or using special tool S0944-41210) midway between pulleys as shown in the figure. If necessary, adjust them to their specified tensions.

NOTICE:

When a new belt is installed or the tension is adjusted, run the engine for several minutes after installation or adjustment. Then check and adjust the tension again. Repeat this operation several times.

Adjusting procedure for drive belt
 [Model: HINO 146, 165, 185]



The cooling fan and the alternator drive belt.

a. Loosen the BOLT a and the NUT b.

Adjust belt to move the alternator in the specified deflection.

Belt deflection:

0.32 – 0.40 in. (8 – 10 mm)

Measuring point:

Point A and apply a load

b. After adjustment, securely tighten the BOLT a and the NUT b.

Tightening torque:

BOLT a

51.0 N·m (38 lbf-ft., 520 kgf-cm)

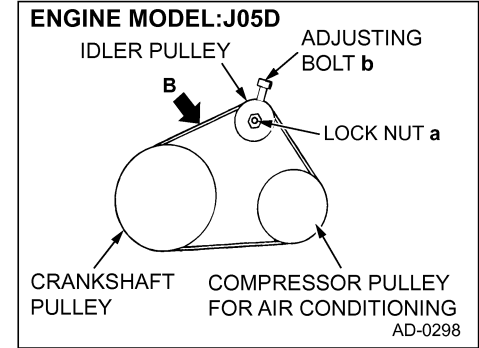
ADJUSTING BOLT and NUT b

83.4 N·m (61 lbf-ft., 850 kgf-cm)

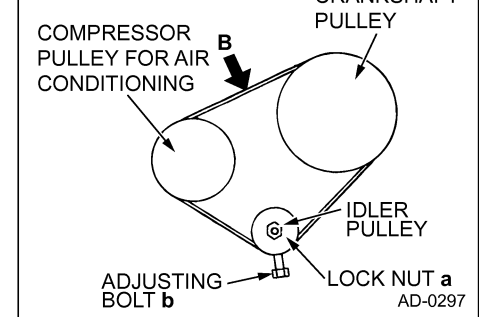
NOTICE:

Do not pry the alternator body directly with a lever, as it can damage the alternator.

Air Compressor drive belt



ENGINE MODEL: J08E



Compressor drive belt for air conditioning
a. Loosen the LOCK NUT **a** of the idler pulley.

b. Adjust the ADJUSTING BOLT **b** and adjust the deflection of the belt at measuring point **B** so that it comes within the standard range. The tension of the belt can be increased by turn the adjusting bolt **b** clockwise.

Belt deflection: 0.434 in. (11 mm)

Measuring point:

Point **B** and apply a load of **about 22 lb. (10 kg)**

c. After adjustment, securely tighten the lock nut **a** and adjust bolt **b**.

Tightening torque:

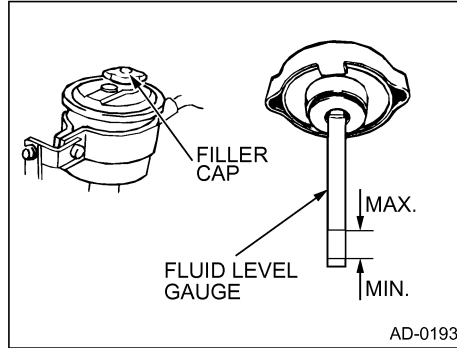
LOCK NUT **a**

41.2 N·m (30 lbf-ft., 420 kgf-cm)

ADJUSTING BOLT **b**

5.9 N·m (4.31 lbf-ft., 60 kgf-cm)

Check power steering fluid level



a. Be careful not to contaminate the fluid by letting dirt fall into the reserve tank when checking or adding fluid. An excessively low fluid level indicates possible leaks in the system. Consult an authorized Hino dealer and have them check and correct it.

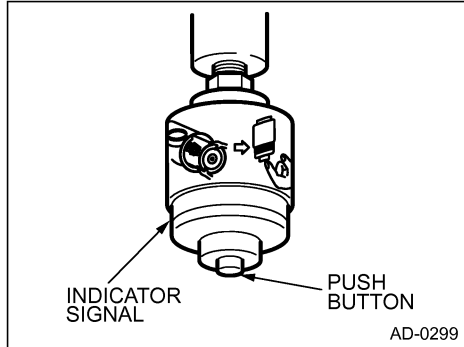


CAUTION

When the fluid level becomes low or the fluid gets contaminated with dirt, the power steering may not function properly. This can result in personal injury and/or property damage.

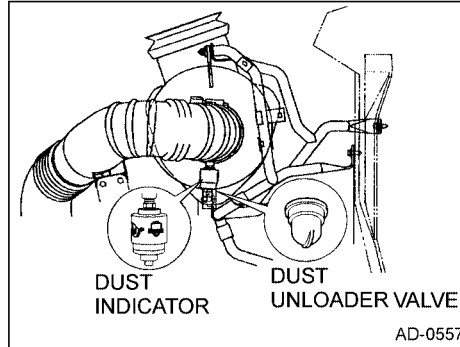
b. Remove the filler cap and wipe the attached fluid level gauge with a clean cloth. Check the fluid level by screwing the cap back on and removing the cap again. When the fluid level is low, add fluid of the same brand and type to the "MAX." fluid level mark. (For recommended fluid, referring to TABLE 7, "RECOMMENDED LUBRICANTS")
c. When fluid is added to the reserve tank, be sure to install the filler cap securely.

Check air cleaner service indicator



Check whether a red signal shows on the service indicator. When the red signal is shown, replace the air cleaner element. Refer to the maintenance schedule for periodical maintenance intervals.

Air cleaner

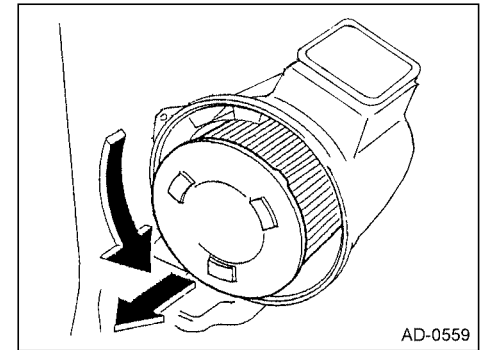
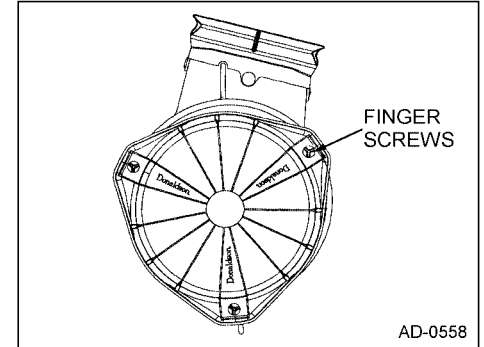


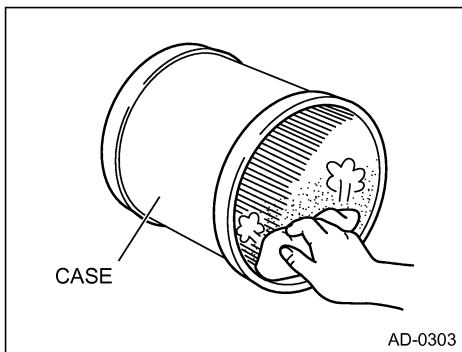
The air cleaner is equipped with a dust indicator to indicate if the element is clogged. It is also equipped with a dust unloader valve that collects and disposes of dust automatically.

Inspection

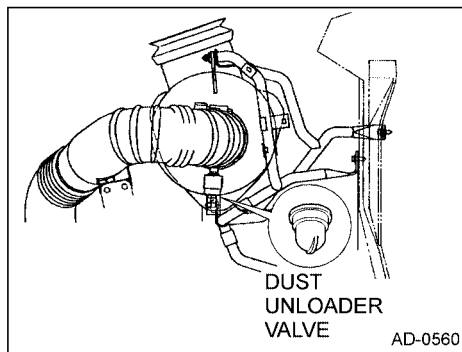
- a. Check to see if the color of the indicator signal has changed to "RED".
- b. If the color is "RED", it is abnormal. If it has changed to "RED", replace the element regardless of the running kilometerage.

Replacement of air cleaner





- a. Release the three finger screws and carefully remove the cover.
- b. Hold the outer projecting end of the element and turn slightly, then detach the element.
- c. Clean the cover and inside of the case with a clean, dry cloth.



- d. Clean the dust unloader valve. Be sure it is not broken or missing.

NOTICE:

If the dust unloader valve is broken or missing, water and dirt can easily enter the air cleaner. Install a new dust unloader valve.

- e. Check the rubber seal and hose for breakage and the clamps for looseness. If broken, replace it with a new part. If the clamps are loose, tighten them.
- f. Replace the element.

NOTICE:

Be sure to use genuine Hino element.

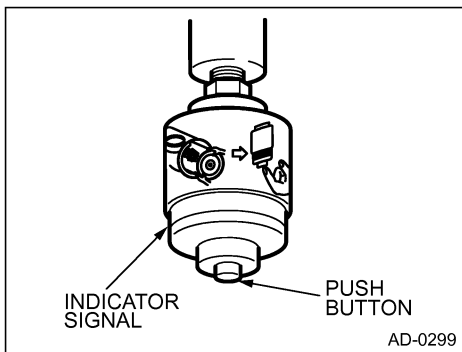
Do not use an imitation element because it may aspirate dust due to a bad seal or be damaged by excessive tightening.

- g. Reinstall the element in the reverse sequence of removal.
- h. Be sure that all three finger screws are tightened securely when replacing the element and housing cover. Install the rubber seal so that it may not be twisted.



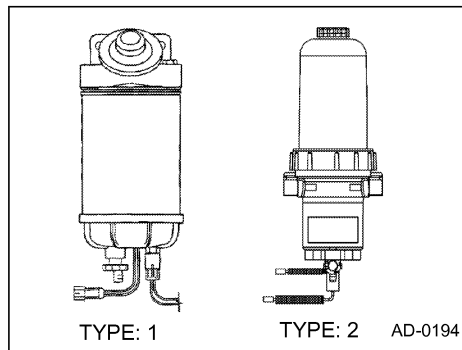
CAUTION

Failure to completely install the clamps may cause a defect in the element packing surface, allow dust into the engine, and cause premature wear of pistons and liners.



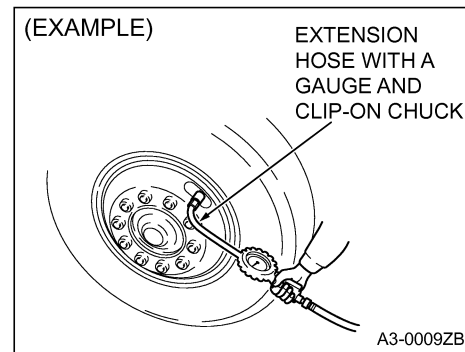
- i. After finish cleaning of the element, press the push button at the end of the indicator to reset.

Check and drain fuel filter with water separator



Check the fuel filter warning light. The warning light will turn on when water separator for accumulated water. Drain the water from the separator. For maintenance procedure, refer to page 7-81.

Check tires



Check tires for correct pressure using an extension hose with a gauge and clip-on chuck. Proper inflation pressure varies according to tire size and construction. Follow the tire manufacturer's recommended cold inflation pressure.

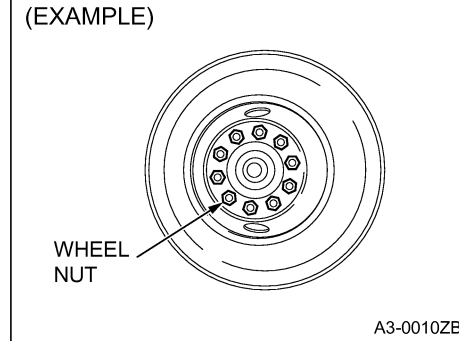


WARNING

Never inflate tires more than the maximum pressure shown on the sidewall of the tire. Overinflation can result in personal injury and/or property damage.

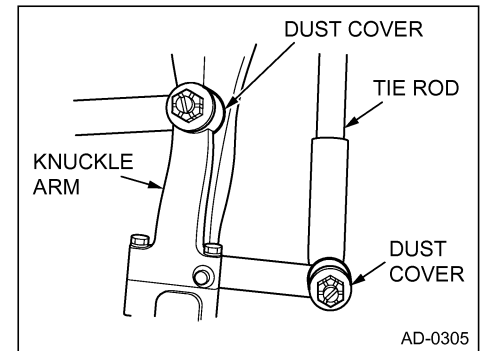
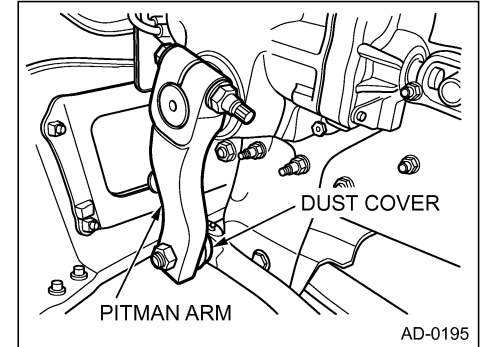
Visually check tires for damage, and excessive or abnormal wear. Replace if required. For replacing, consult an authorized Hino dealer.

Check and retighten wheel nuts



Check wheel nuts for tightness and to see if any are missing. Install new nuts if missing. Tighten wheel nuts with torque wrench to specified torque if necessary. For tightening method of wheel nuts, refer to page 7-43.

Check steering linkage



- a. Check rod and arm for damage cracks or damage.
- b. Check the four dust covers for cracks or damage.
- c. Replace if required. For replacing, contact an authorized Hino dealer.

Check and lubricate suspension

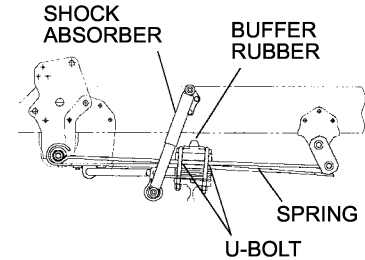
Check suspension for the following.

- a. Loose U-bolts
- b. Broken leaf or leaves
- c. Missing or loose clip band bolts
- d. Leaks from shock absorbers
- e. Damage on buffer rubbers
- f. Lack of lubrication on rear spring sliding and spring helper.

For above-mentioned a) to d), consult an authorized Hino dealer. For e), replace buffer rubbers if they are damaged.

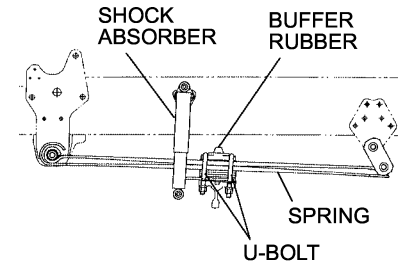
Front spring

[Model: HINO 145, 165, 185]



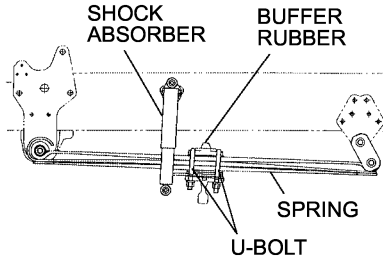
AD-0228

[Model: HINO 238, 258, 268]



AD-0229

[Model: HINO 308, 338]



AD-0230

Front U-bolts tightening torque:

[Model: HINO 145, 165, 185]

225 – 335 N·m

(165 – 247 lbf·ft., 2,280 – 3,420 kgf·cm)

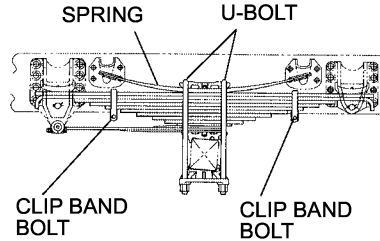
[Model: HINO 238, 258, 268, 308, 338]

370 – 475 N·m

(273 – 347 lbf·ft., 3,780 – 4,820 kgf·cm)

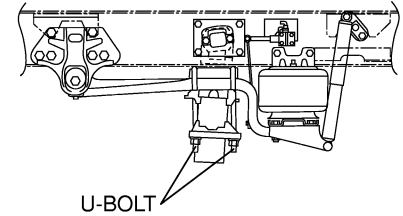
Rear axle

[Model: HINO 238, 258, 268, 308, 338]

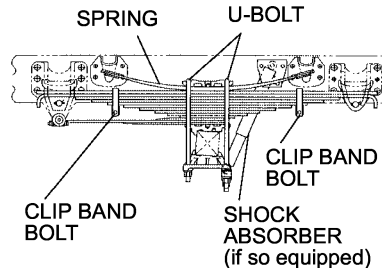


AD-0232

[Model: HINO 268, 338 Air suspension]



[Model: HINO 145, 165, 185]



AD-0231

Rear U-bolts tightening torque:

[Model: HINO 145, 165, 185]

390 – 585 N·m

(288 – 430 lbf·ft., 3,980 – 5,960 kgf·cm)

[Model: HINO 238, 258, 268, 308, 338]

490 – 735 N·m

(361 – 541 lbf·ft., 5,000 – 7,490 kgf·cm)

[Model: HINO 268, 338 Air suspension]

545 – 610 N·m

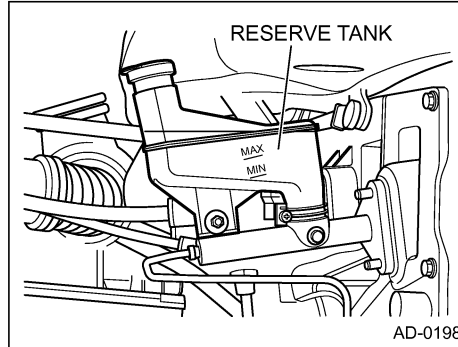
(400 – 450 lbf·ft., 5,560 – 6,220 kgf·cm)

Check brake lines and hoses

1. Check brake lines and hoses for damage, cracks or chafing. Also check brake lines and hoses for any interference or rubbing with the front wheels fully turned to the right and left.
2. Check lines and hoses for leaks.
3. Check the brake valve, brake chambers and other units for air leaks.[Full air brake type]
4. Repair or replace if necessary. For replacement, consult an authorized Hino dealer.

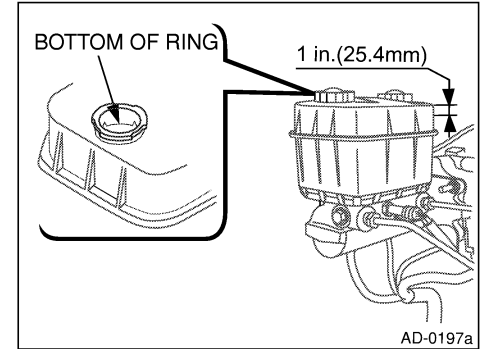
Check clutch fluid

(Not applicable for automatic transmission)



1. Check the clutch fluid reservoir for fluid level. The fluid level should be kept between the MAX. and MIN. marks. For fluid refer to TABLE 7 "RECOMMENDED LUBRICANTS".
2. Clutch fluid reserve tank. The clutch fluid reserve tank is installed in the engine room. Add clutch fluid up to MAX. mark level if required. An excessively low fluid level indicates possible leaks in the clutch systems. Contact an authorized Hino dealer have them correct it.

Check brake fluid [Hydraulic brake type]



1. Brake fluid reserve tank
The brake fluid reserve tank is installed on the left side in the engine room. The brake fluid level shall be within the range of 1 in. (25.4 mm) below bottom of ring. Check the fluid level during your daily inspection and refill brake fluid if necessary.
2. Do not mix the fluid with a different type. Mixed fluid may cause lowering of the boiling point and corrosion of brake parts. As to the fluid brand originally used, ask an authorized Hino dealer.

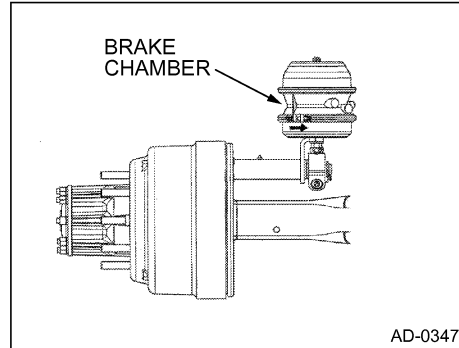
3. Wipe spilled fluid from coated or painted surface as soon as possible. Otherwise it can damage the coating or paint.
4. Install the reserve tank cap securely after adding fluid. An excessively low fluid level indicates possible leaks in the brake systems. Contact an authorized Hino dealer have them correct it.



WARNING

Remove the excess brake fluid from the reservoir when the worn brake pads are replaced, otherwise the brake fluid may overflow from the master cylinder reservoir.

Check parking brake [Full air brake type]



1. Check the brake chambers for damage.
2. Check the parking brake air lines for damage.
3. Check the mounting bolts for the brake chambers for tightness. Have an authorized Hino dealer correct, if necessary.

Check in the cab Check warning lights

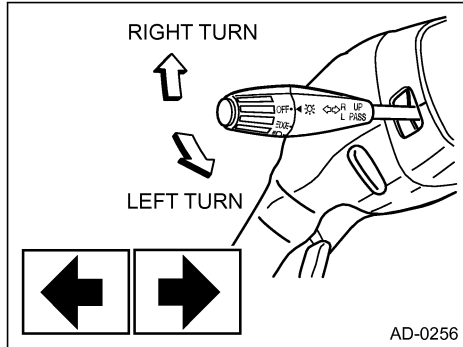
When the starter key is in the “START” position, the warning lights will light, if there is no failure in the lights and circuits. Before starting the engine, use it as a check to see that the lights are operable.



CAUTION

This can result in a possible malfunction of some part of the vehicle and cause injury or damage.

Check turn signal lights

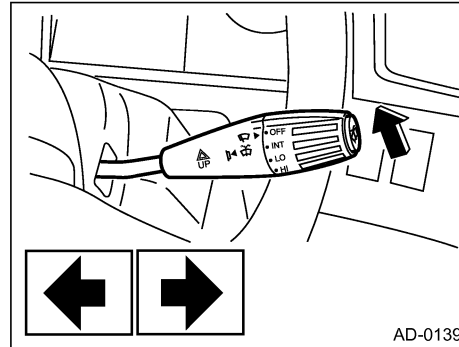


Move the turn signal switch lever toward you and push forward and check that the outside turn signal lights and the turn signal indicator lights on the instrument panel flash.

Flash rate: 75 – 95 flashes/minute

In this case the flash rate will not change when a light is burned-out. Replace it with the correct bulb immediately.

Check hazard lights

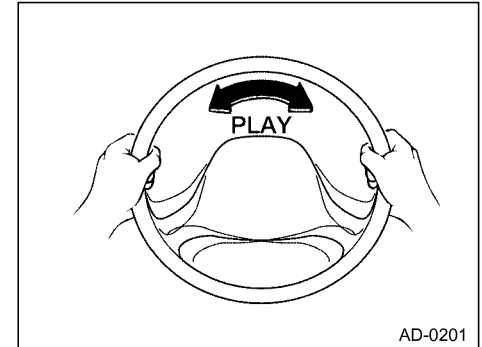


Pull up the hazard light lever and check that all the outside turn signal lights and indicator lights on the instrument panel flash. When the lever is pulled up again, the lights will go off.

Flash rate: 75 – 95 flashes/minute

In this case the flash rate will not change when a light is burned-out. Replace it with the correct bulb immediately.

Check steering wheel



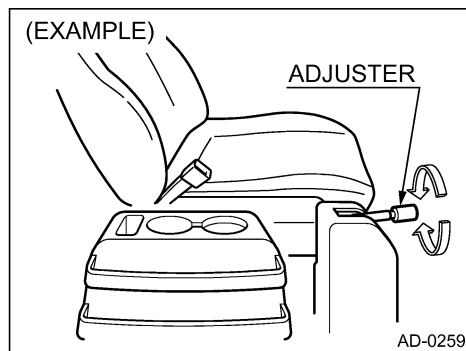
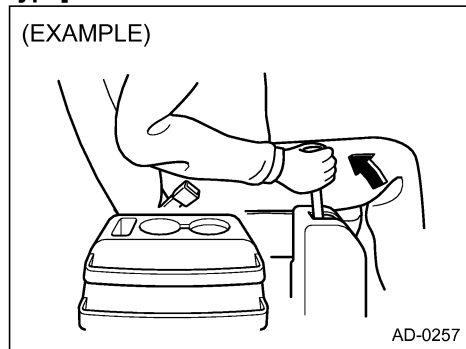
Check the steering wheel play with the front wheels directed straight ahead and the engine at idling.

Standard play: 0 – 1.377 in. (0 – 35 mm)
Adjust the play if necessary.

WARNING

Excessive steering wheel play may adversely affect vehicle handling. This condition can result in an accident causing serious injury or death. Consult an authorized Hino dealer as soon as possible.

Check parking brake [Hydraulic brake type]



Check the parking brake lever pull resistance.

Standard pull resistance:

[Model: HINO 145, 165, 185 and HINO 238, 258, 268, 308 with automatic transmission]

49.6 – 60.6 lbf.(22.5 – 27.5 kg)

[Model HINO 165, 238, 258, 268, 308 with manual transmission]

71.6 – 82.7 lbf.(32.5 – 37.5 kg)

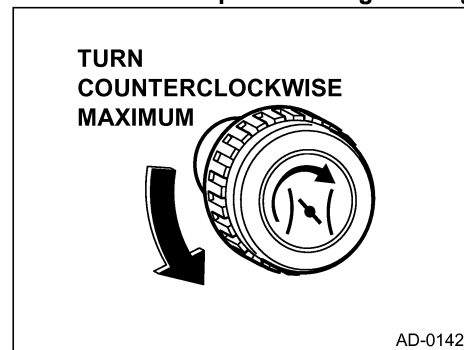
Adjustment is made by turning adjuster is turn to clockwise or count clockwise.



WARNING

Failure to have the parking brake lever adjusted may lead to an accident resulting in serious injury or death.

Check accelerator pedal and engine idling

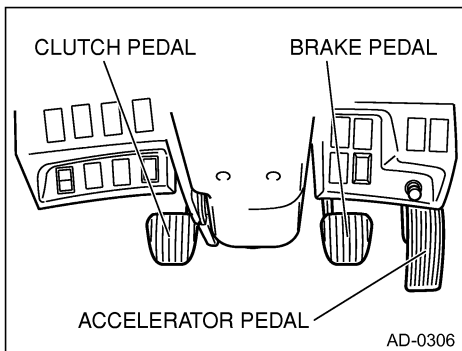


Check that the engine idling speed is smooth and that there are no irregularities when the throttle control knob is turned all the way to the counter clockwise.



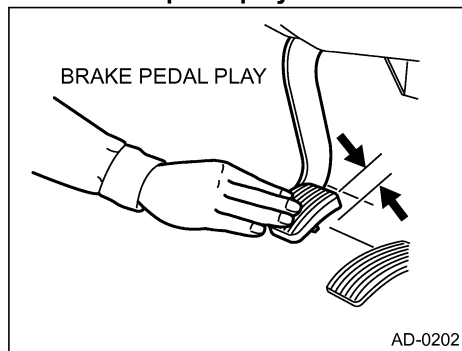
WARNING

Never use the throttle control knob while driving. Using the throttle control knob could adversely affect the ability of the vehicle to stop which could result in an accident causing serious injury or death.



Check the accelerator pedal for smooth operation. If the operation is not smooth, contact an authorized Hino dealer and have them correct it immediately.

Check brake pedal play and clearance



Check the brake pedal play by depressing the pedal by hand. Check that there is clearance between the brake pedal and the toe board when the brake pedal is fully depressed.

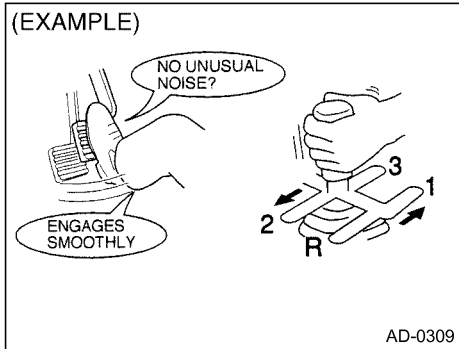
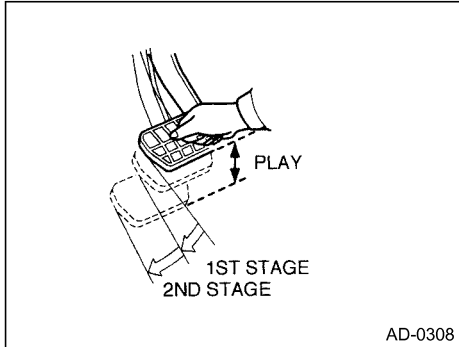
Standard play:
[Hydraulic brake type]
 0.118 – 0.472 in. (3 – 12 mm)
[Full air brake type]
 0.078 – 0.196 in. (2 – 5 mm)

WARNING

- Failure to perform the necessary brake adjustment can result in personal injury and/or property damage. Have an authorized Hino dealer adjust the brake.
- Checking on a slope is dangerous because the vehicle may start to move. Be sure to stop the vehicle on level ground and block the wheels with wheel stoppers before checking.

Check the clutch pedal play

(Applicable for manual transmission)



Depress the clutch pedal with fingers and you will feel resistance in 2 stages. The pedal stroke up to the 2nd stage of resistance is the pedal play.

Model	Standard	Limit
HINO 165, 185	1.4 – 2.2 in. (35 – 55 mm)	1.2 in. (30 mm)
HINO 258, 268, 308, 338	1.7 – 2.3 in. (44 – 59 mm)	1.4 in. (35 mm)

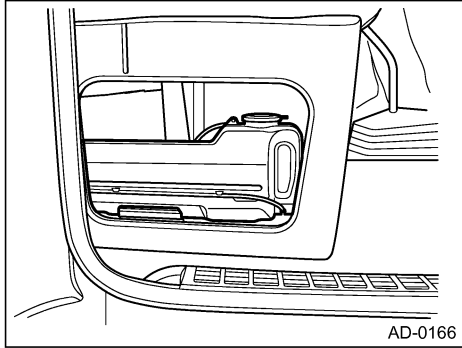
When the pedal play has reached the limit, have the pedal play adjusted at an authorized Hino dealer.

Clutch pedal operation

Check the clutch operation with the engine idling as follows:

1. Check to see that the clutch is not abnormally hard to depress and that there are no unusual noises when depressing the pedal.
2. Check to see that the gears can be shifted smoothly.
3. When releasing the clutch pedal in the normal gradual manner, the clutch should engage smoothly with no slippage or jolting.
4. If any trouble is found, have the clutch inspected and repaired at an authorized Hino dealer.

Check windshield washer



A. Inspection and adding the windshield washer to the tank.

- a. Open the assistant's seat side door. The windshield washer tank is installed in this side of the seat.
- b. Check the tank for solution level. If the level is low or the tank is empty, add washer solution.

CAUTION

When getting into and getting out of the cab, do not apply force on the washer tank by putting your hands or legs on the tank.

NOTICE:

The windshield spray nozzles are attached to the ends of the wiper arms.

B. Mixing the windshield washer solution.

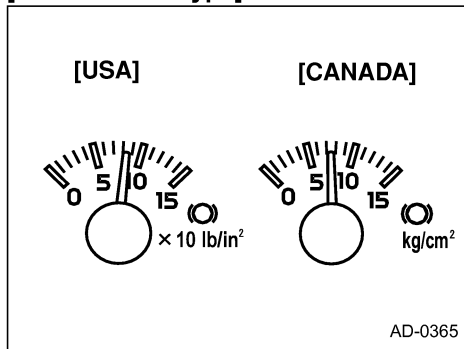
The solution's ratio of washer fluid to water should vary with the outside temperature to prevent freezing. Mix the solution according to the following table.

Season	Dilution	Solution Freezing Temperature
Normal	Washer fluid 1: Water 2	About 14.0°F (-10°C)
Winter	Washer fluid 1: Water 1	About -4°F (-20°C)
Severe cold	Washer fluid only	About -58°F (-50°C)

CAUTION

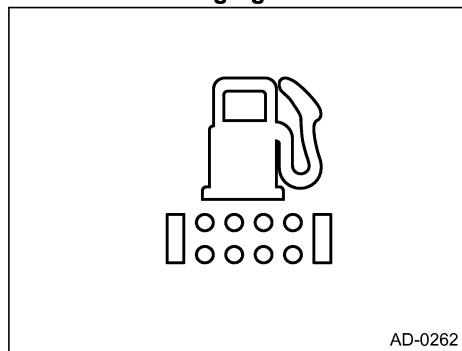
- The washer fluid contains a flammable solvent. Keep it away from open flames.
- Use the special washer fluid according to its instructions to prevent freezing of the washer system. Do not use antifreeze which may damage the painted surfaces of the vehicle.

Check air pressure gauge [Full air brake type]



Check that the air pressure gauge pointers are above **71 lb/in² (5 kg/cm²)** with the engine running. Then stop the engine and check the air pressure gauge for air pressure drop. If an air pressure drop is evident after leaving the vehicle as it is for one minute, it indicates a possible leak in the brake air system. Have an authorized Hino dealer correct it immediately.

Fuel filter warning light

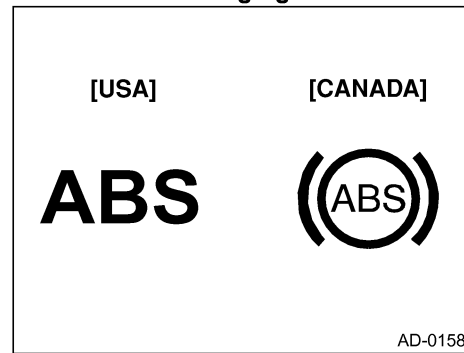


This light warns you that the amount of accumulated water in the fuel filter has reached the specified level.

CAUTION

Never drive the vehicle with the fuel filter warning light lit. Continued driving with water accumulated in the fuel filter will damage the fuel system.

Check ABS warning light



The major electrical components of the Anti-Lock Brake System (ABS) confirm proper function before and during the driving task. The ABS warning light will come on when you turn the starter key to the "ON" position. It stays on briefly and then turns off automatically. If the ABS light does not come on, have your vehicle inspected and serviced immediately at an authorized Hino dealer.



CAUTION

If the ABS light comes on while driving, there could be a problem with the ABS. Your regular service brakes will, however, work normally, but you should be careful and drive the vehicle in the same way that you would drive a vehicle without ABS. Have your vehicle inspected and serviced immediately at an authorized Hino dealer.

PERIODICAL MAINTENANCE

Scheduled maintenance procedures

The maintenance items mentioned in this section are relatively simple and easy.

If you have any question about maintenance service, contact an authorized Hino dealer. Refer to TABLE 1 "RECOMMENDED MAINTENANCE SERVICE" for maintenance items and intervals.

The numbers in parenthesis following the titles correspond to the numbers of each maintenance item in TABLE 1 "RECOMMENDED MAINTENANCE SERVICE."

First 3,000 – 5,000 miles (5,000 – 8,000 km) (Highway use)

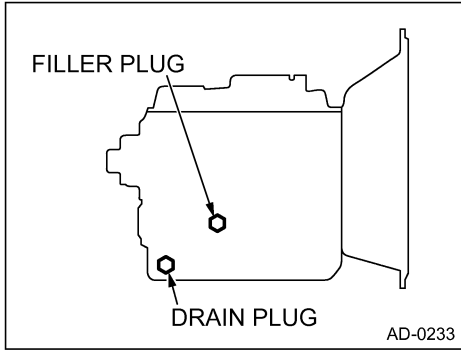
First 30 hours (Off-highway use)

1. Change manual transmission gear oil

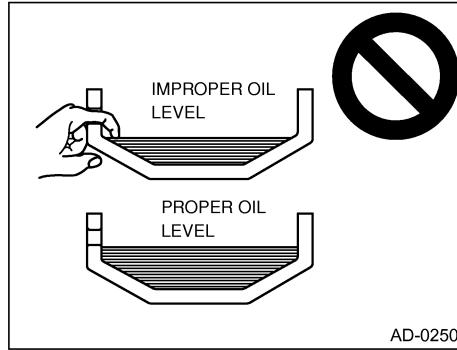


CAUTION

Do not work on the transmission while it is still hot. This can result in personal injury.



- a. Park the vehicle on level ground.
- b. Clean around the filler and drain plugs.
- c. Remove the filler plug.
- d. Remove the drain plug and drain.
The used gear oil should be drained into a suitable container.
- e. Clean the drain plug with a magnet and tighten the plug with a new gasket.
Torque: 62 – 74 N·m
(45 – 55 lbf-ft., 635 – 755 kgf-cm)




- f. Add gear oil up to the lower end of the filler plug hole.
Gear oil:
Refer to TABLE 7 "RECOMMENDED LUBRICANTS"
- g. Clean the filler plug with a magnet and tighten it with a new gasket.
Torque: 34 – 47 N·m
(25 – 35 lbf-ft., 350 – 480 kgf-cm)

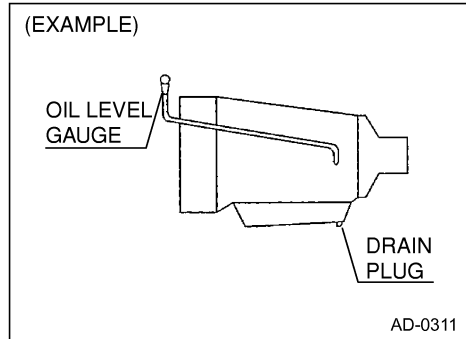
First 5,000 miles (8,000 km)

1. Change automatic transmission fluid and oil filter element

- For the proper automatic transmission fluid to use.
Refer to TABLE 7 "RECOMMENDED LUBRICANTS"

 CAUTION
Do not work on the transmission while it is still hot. This can result in personal injury.

2. Inspection and replenishment

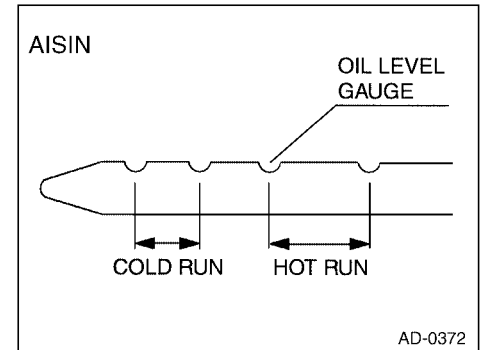
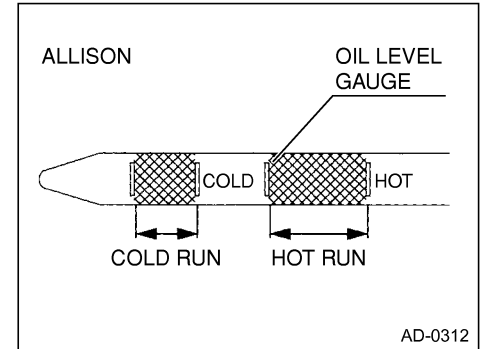


Fluid check procedure

- Clean around the end of the fill tube before removing the fluid level gauge. Dirt or foreign matter must not be permitted to enter the fluid system because it can cause valves to stick, cause undue wear of transmission parts, or clog passages.

- Always check the fluid level at least twice. Consistency is important in maintaining accuracy. If inconsistent readings persist, check the transmission breather and the vent hole (*1) in the fluid level gauge fill tube to ensure they are clean and free of debris. The vent hole (*1) is located on the underside of the fill tube just below the seal of the fluid level gauge cap.
- Check the fluid level by the following procedures and record any abnormal level on your maintenance records.

(*1): [MODEL: HINO 238, 258, 268, 308]



Cold check (Check the fluid level)

- The only purpose of the Cold check is to determine if the transmission has enough fluid to be safely operated until a Hot check can be made.
- Park the vehicle on a level surface and apply the parking brake.
- Run the engine for at least one minute. Shift to first and then to reverse to clear the hydraulic circuits of air. Then shift to neutral and allow the engine to idle. The sump temperature should be between 16 – 49°C {60 – 120°F}.
- After wiping the fluid level gauge clean, check the fluid level. If the fluid on the fluid level gauge is within the “COLD RUN” band, the level is satisfactory for operating the transmission until the fluid is hot enough to perform a HOT RUN check.
If the fluid level is not reach the “COLD RUN” band, add fluid as necessary to bring the level to within or more than of the “COLD RUN” band.

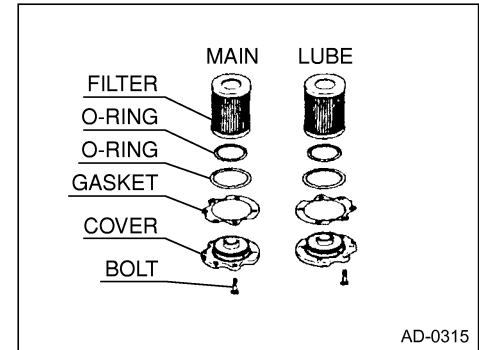
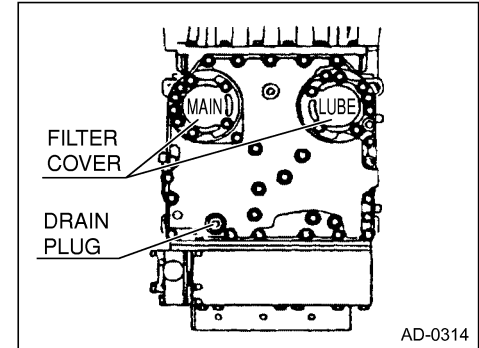
- Perform a hot check at the first opportunity after the normal operating sump temperature 71 – 93°C {160 – 200°F} is reached.

Hot check (Check the fluid level)

- The fluid must be hot to ensure an accurate check. The fluid level rises as temperature increases.
- Operate the vehicle about 10 minutes in the “D” (Drive) position until normal operating temperature is reached: 71 – 93°C {160 – 200°F} converter-out temperature.
- Park the vehicle on a level surface and place the selector lever in the “N” (Neutral) or “P” (Parking) position. Apply the parking brake and allow the engine to idle.
- After wiping the fluid level gauge clean, check the fluid level. The safe operating level is anywhere within the “HOT RUN” band on the fluid level gauge.
- If the level is not within this ban, add or drain fluid as necessary to bring the level to the top of the “HOT RUN” band.

Replacement procedure

[ALLISON® 3000RDS]



Have the automatic transmission fluid replaced at an authorized Hino dealer.

- (1) Place a container for drained fluid under the filter and remove the fluid filter.
- (2) Remove the filter.
- (3) Install the new filter.

Replace the O-ring with a new one contained in the element kit.

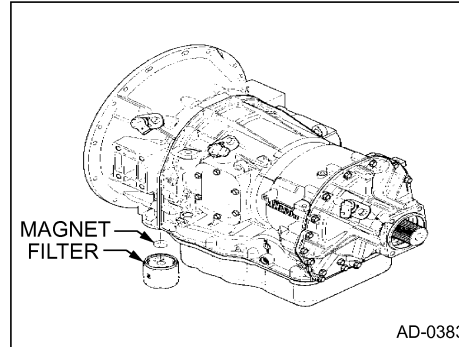
- When installing the O-ring, pay attention not to twist or damage the O-ring.
- Wipe off the spilled fluid thoroughly.

NOTICE:

Lubricate only the O-ring inside the filter cartridges.

- (4) After replacement of the filter, start the engine, check to see if there is any fluid leakage, perform a test drive of the vehicle, replenish fluid to each part, and then check the transmission gear fluid level.

[ALLISON® 1000HS, 1000RDS, 2200HS, 2200RDS, 2500RDS]



Place a container for drained fluid under the filter and remove the filter. Remove the filter. Clean the magnet and install the new filter. After replacement of the filter, start the engine, check to see if there is any fluid leakage, perform a test drive of the vehicle, replenish fluid to each part, and then check the transmission fluid level.

CAUTION

- Do not work on the transmission while it is still hot. This can result in personal injury.
- Containers or fillers that have been used to handle antifreeze or engine coolant solution must not be used for the transmission fluid. Antifreeze and coolant solutions contain ethylene glycol which, if introduced into the transmission, can cause the clutch plates to fail.

Have the filter replaced at an authorized Hino dealer, or Allison Service station.

Aisin automatic transmission has not a removable filter but involves a strainer.

First 2,500 miles (4,000 km)

The following items should be performed by an authorized Hino dealer.

1. Power steering reserve tank strainer
2. Power steering reserve tank filter
3. Power steering fluid
4. Tightness of U-bolts and clip bands

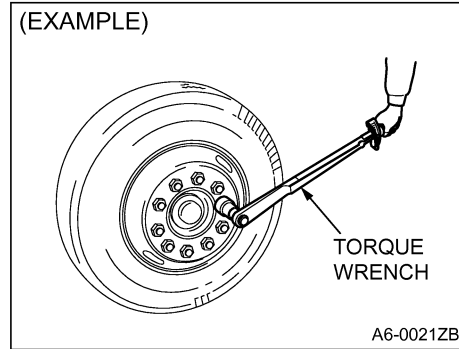
First 6,000 miles (10,000 km)

Check and adjust drive belts
[Model:HINO 145, 165, 185]

Check and adjust referring to page 7-50.

Every 1,000 miles (1,600 km)

Check wheel nut torque



Check and retighten wheel nuts to the specified torque with a torque wrench.

NOTICE:

When tightening the wheel nuts, remove dirt and other foreign material from the thread, apply engine oil or grease to the threads of the hub bolts and wheel nuts, and to the crowns of the wheel nuts, and then tighten the nuts.

WARNING

- Wheel hub bolts and nuts on the right side of the vehicle have right-handed threads, and wheel hub bolts and nuts on the left side of the vehicle have left-handed threads.
- Tighten the wheel nuts to the specified torque. Improperly tightened wheel nuts can cause the wheel to become loose and possibly fall off while you are driving. This can result in personal injury and/or property damage due to loss of vehicle control.

Tighten torque

[Model:HINO 145]

390 – 470 N·m (290 – 347 lbf·ft,
4,000 – 4,800 kgf·cm)

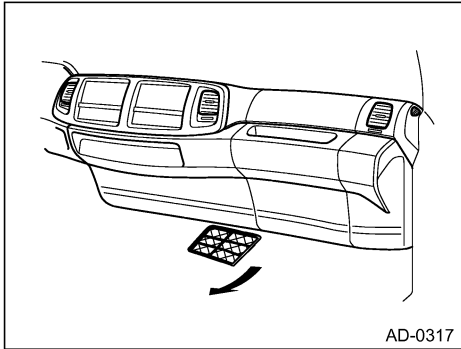
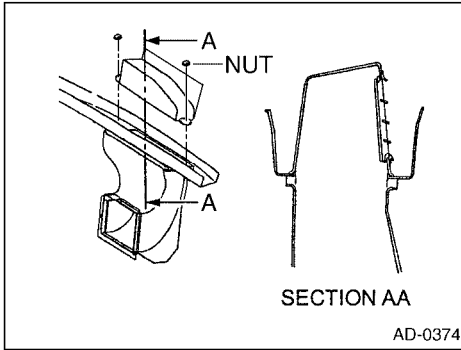
[Model:HINO 165, 185]

215 – 235 N·m (160 – 175 lbf·ft,
2,200 – 2,400 kgf·cm)

[Model:HINO 238, 258, 268, 308, 338]

610 – 680 N·m (450 – 500 lbf·ft,
6,200 – 6,900 kgf·cm)

Every 3,000 miles (5,000 km)
Clean air filter (For cab ventilator)



The vehicle is equipped with an outside air intake filter and an inside air intake filter.

These become dirty in the course of normal operation and should be cleaned periodically. Cleaning should be done by blowing air or running water through the filter from the inner side of the filter.

NOTICE:

If the air filter is clogged with dirt or dust, it will strain the air blower and lower the blower's efficiency. Clean the filter periodically so that the ventilator, heater and defroster work properly.

- Remove the outside air intake filter and then remove the inside air intake filter.
- Clean the filter with running water or blowing air.
- If washed with water, before installing the filters, wipe off water securely.
- When washing the inside to prevent water from splashing on the filter, push the recirculate switch on the control panel.

Every 6,000 miles (10,000 km)

1. Lubricate clutch release sleeve and shaft (Applicable for manual transmission)

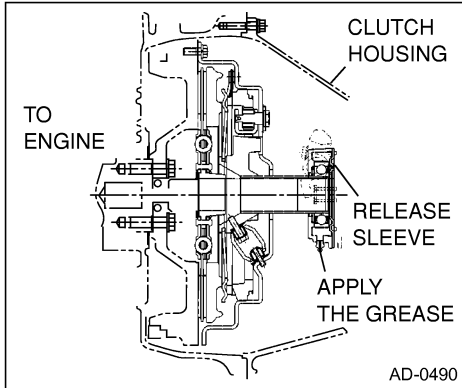
Grease:

Refer to TABLE 7, "RECOMMENDED LUBRICANTS"

Greasing point:

Refer to TABLE 8 "LUBRICATION CHART"

- Do not apply grease excessively. When greasing the shaft (both ends), the flow of old grease will come out from the clearance between the housing and the shaft. When greasing the release sleeve, the flow of old grease will come out from the face that contacts the release fork.
- It is visible by removing the cover from the housing.
- Wipe off excessive grease.



2. Lubricate propeller shaft spline
3. Lubricate propeller shaft universal joint
4. Lubricate brake automatic slack adjuster [Full air brake type]

At the same time, the clevis pin hole bushing of the automatic slack adjuster, the slide part with the clevis, and the clevis pin hole must be lubricated sufficiently.

Grease:

Refer to TABLE 7 "RECOMMENDED LUBRICANTS"

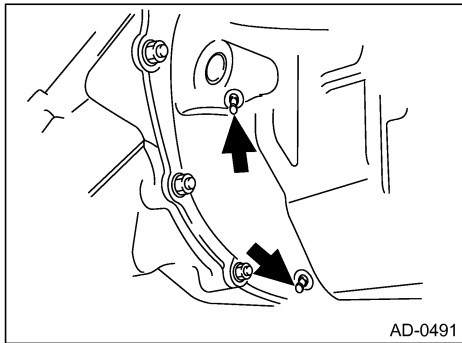
5. Lubricate brake spider bushing (Front and rear) and brake camshaft bracket bushing (Rear) [Full air brake type]

Grease:

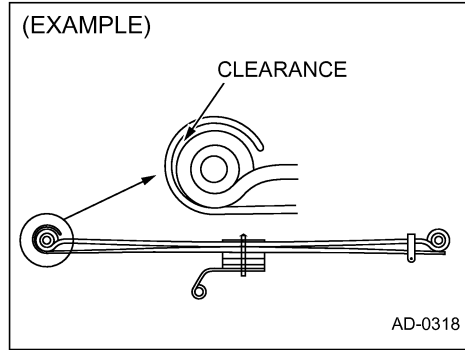
Refer to TABLE 7, "RECOMMENDED LUBRICANTS"

6. Check wheel disc damage

Check wheels for damage, cracks or bends. Refer to page 7-43.



7. Check leaf spring damage and deformation



- Check carefully for clearance between No.1 and No.2 leaves at the front eye. If there is no clearance, broken leaves are suspected.
- Visually check springs for cracks, broken leaves or leaves slipped out of place.
- Check for sagging springs without load. Consult an authorized Hino dealer if necessary. (See workshop manual for more details.)

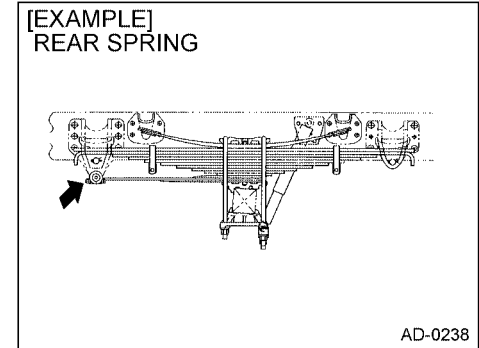
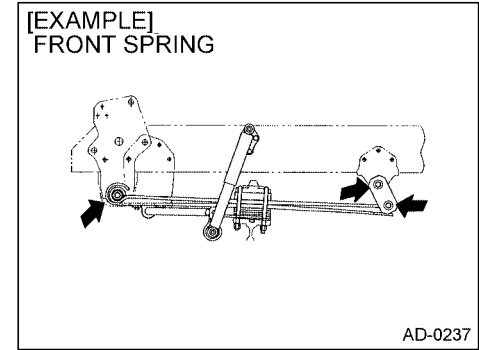
WARNING

Do not replace individual leaves of a damaged leaf spring assembly; replace the complete spring assembly. Visible damage (cracks or breaks) to one leaf causes hidden damage to other leaves. Replacement of only the visibly damaged part(s) is no assurance that the spring is safe. On front spring assemblies, if cracks or breaks exist in the two top leaves, a loss of vehicle control could occur. Failure to replace a damaged spring assembly could cause an accident resulting in serious personal injury or property damage.

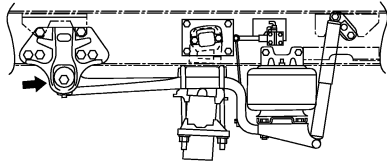
NOTICE:

On leaf suspensions, closely inspect each component of the leaf spring assemblies, including the brackets, U-bolts, and related parts.

8. Check and retighten spring pin fitting nut and lock nut



[EXAMPLE]
AIR SPRING



AD-0479

The points to be checked and retightened are shown with arrows in the figures.

Torque:

Front: 375 – 425 N·m

(278 – 315 lbf·ft, 3,840 – 4,350 kgf·cm)

Rear: 73 – 110 N·m

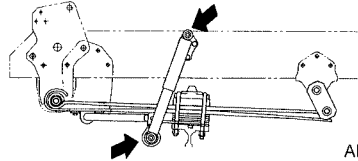
(54 – 80 lbf·ft, 745 – 1,110 kgf·cm)

Air spring: 500 – 600 N·m

(370 – 440 lbf·ft, 5,100 – 6,115 kgf·cm)

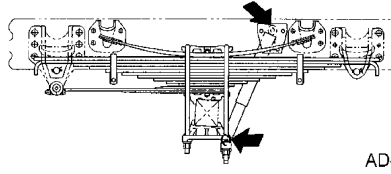
9. Check and retighten shock absorber mounting

[EXAMPLE]
FRONT SPRING



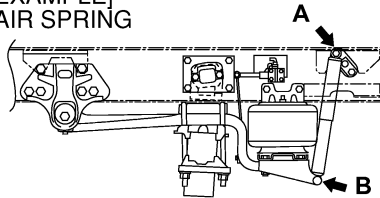
AD-0239

[EXAMPLE]
REAR SPRING



AD-0240

[EXAMPLE]
AIR SPRING



AD-0480

The points to be checked and retightened are shown with arrows in the figures on the left.

Tighten torque

Front:

[Model:HINO 145, 165, 185]

105 – 145 N·m

(79 – 108 lbf·ft, 1,090 – 1,500 kgf·cm)

[Model:HINO 238, 258, 268, 308 338]

170 – 225 N·m

(125 – 167 lbf·ft, 1,725 – 2,315 kgf·cm)

Rear:

[Model:HINO 145, 165, 185]

73 – 110 N·m

(54 – 80 lbf·ft, 745 – 1,110 kgf·cm)

[Model:HINO 238, 258, 268, 308 338]

180 – 240N·m

(133 – 177 lbf·ft, 1,840 – 2,450 kgf·cm)

[Model:HINO 238, 258, 268, 308, 338

Air suspension]

A: 68 – 95N·m

(50– 70 lbf·ft, 695 – 965 kgf·cm)

B: 215 – 245N·m

(159– 180 lbf·ft, 2,200 – 2,510 kgf·cm)

10. Lubricate spring pin and shackle pin (Front & Rear)

Grease:

Refer to TABLE 7 "RECOMMENDED LUBRICANTS"

Greasing point:

Refer to TABLE 8 "LUBRICATION CHART"

The following items should be performed only by an authorized Hino dealer.

11. Clutch facing wear (Not available with automatic transmission)

12. Tie rod ball joint and drag link ball joint

13. Steering shaft spline sliding

14. Service brake leakage, damage and tightness

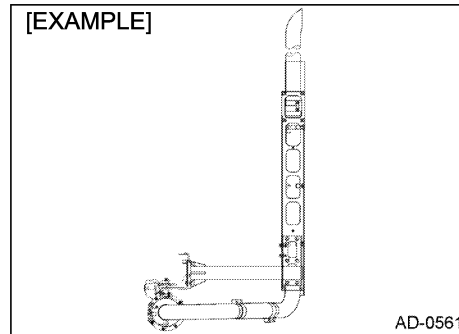
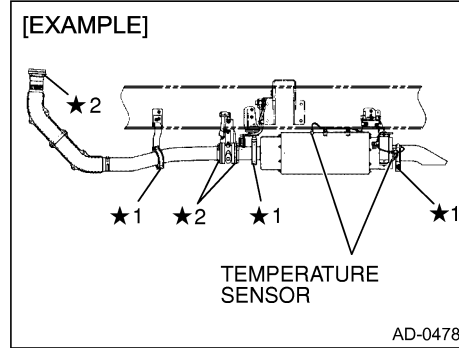
15. Service brake pipe and hose damage

16. Service brake lining wear (Thickness) [Full air brake type]

17. Parking brake air leakage, damage and tightness [Full air brake type]

Every 10,000 miles (16,000 km)

1. Inspect and retighten DPR cleaner, exhaust pipe and tail pipes



Inspect for leaks at various joint connections and tighten clamp. Make visual inspection for crack or holes in DPR cleaner and tail pipe. Always replace with Hino recommended parts.

Torque:

8 mm dia.

20 – 24 N·m
(15 – 17 lbf·ft,
205 – 240 kgf·cm)

10 mm dia.

46 – 56 N·m
(34 – 41 lbf·ft,
470 – 570 kgf·cm)

★1: 10 mm dia.

26.5 – 32.5 N·m
(20 – 24 lbf·ft,
270 – 330 kgf·cm)

★2: 10 mm dia.

65 – 75 N·m
(48 – 55 lbf·ft,
665 – 765 kgf·cm)

14 mm dia.

130 – 158 N·m
(96 – 116 lbf·ft,
1325 – 1610 kgf·cm)

Temperature sensor

25 – 35 N·m
(15 – 17 lbf·ft,
205 – 240 kgf·cm)

2. Check and add manual transmission



CAUTION

Do not work on the transmission while it is still hot. This can result in personal injury.

- Park the vehicle on level ground.
- Remove the filler plug and check the level.
- The oil should be at the lower end of the hole.
- Add if necessary.
- Tighten the filler plug.

**Filler plug Torque: 34 – 46 N·m
(25 – 35 lbf·ft, 350 – 470 kgf·cm)**

Transmission gear oil:
Refer to TABLE 7 “RECOMMENDED LUBRICANTS”

3. Check and add automatic transmission fluid.

For inspection and replenishment procedure, refer to page 7-68.

4. Lubricate clutch release sleeve and shaft (Solo[®] clutch)

Grease:

Refer to TABLE 7 “RECOMMENDED LUBRICANTS”

Greasing point:

Refer to TABLE 8 “LUBRICATION CHART”

For lubricate procedure, refer to page 7-73.

5. Check clutch facing wear (Solo[®] clutch)

6. Check the rubber bushing crack and looseness of transverse rod (Air suspension)

Every 12,000 miles (20,000 km)

1. Check fuel hoses and pipes

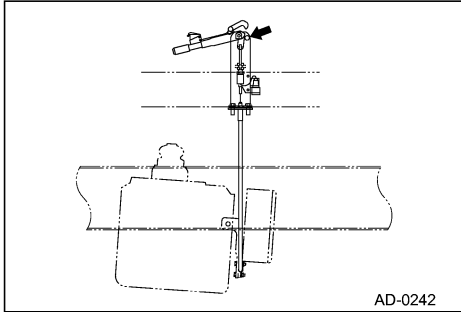
- Supply pump – Fuel filter
- Fuel tank – Fuel filter
- Fuel filter – Supply pump
- Engine – Fuel tank

- Check fuel hoses and pipes for damage. Replace if necessary.
- When installing fuel hoses be careful that they do not contact other parts.
- After replacement, always bleed the fuel system in accordance with page 7-23. Also check for leaks.

2. Check and retighten engine air intake hose and clamps

Check hose clamps of the air intake system and tighten if necessary. Check hoses for damage. Replace hoses if necessary.

3. Check parking brake control cable slack and damage [Hydraulic brake type]



Check the cable for damage and whether the cable connections to the linkage are tight. Replace or tighten if necessary. Lubricate the parking brake lock piston.

4. Lubricate steering shaft spline

Grease:

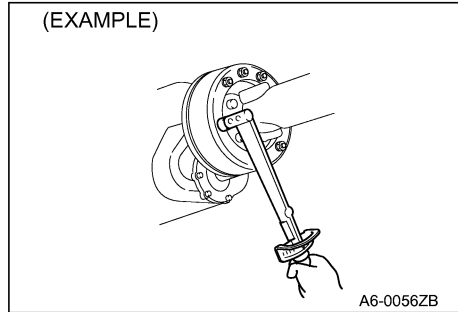
Refer to TABLE 7 "RECOMMENDED LUBRICANTS"

Greasing point:

Refer to TABLE 8 "LUBRICATION CHART"

5. Check and retighten parking brake drum mounting nuts

(EXAMPLE)



Check whether the parking brake drum mounting nuts are tight. Tighten if necessary.

Torque:

[Model: Except for HINO 145, 165, 185 with Aisin AT]

54 – 64 N·m

(40 – 48 lbf·ft, 551 – 663 kgf·cm)

[Model: HINO 145, 165, 185 with Aisin AT]

47.5 – 67.5 N·m

(35 – 50 lbf·ft, 484 – 688 kgf·cm)

AT: Available with automatic transmission
MT: Available with manual transmission

6. Check battery charging



When working on the battery, cautions on the batteries should be observed referring to page 7-38.

Maintenance-free battery

Follow the battery instructions, referring to the indicator on the battery. The following items should be performed by an authorized Hino dealer.

7. Service brake lining wear and clearance between drum and lining [Full air brake type]

8. Check and retighten engine cooling system, hose and clamp

Check hose clamps, and tighten if necessary. Check hoses for cracks, swelling or deterioration. Replace if necessary.

9. Check and add Ultrashift transmission gear oil



CAUTION

Do not work on the transmission while it is still hot. This can result in personal injury.

- Park the vehicle on level ground.
- Remove the filler plug and check the level.
- The oil should be at the lower end of the hole.
- Add if necessary.
- Tighten the filler plug.

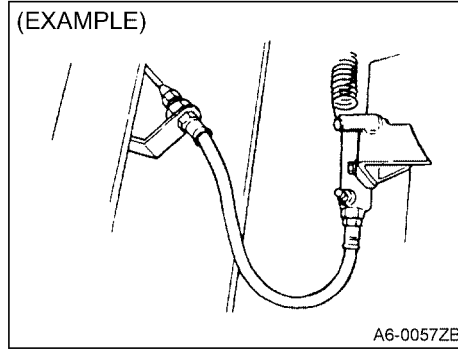
**Filler plug Torque: 34 – 46 N·m
(25 – 35 lbf·ft, 350 – 470 kgf·cm)**

Transmission gear oil:
Refer to TABLE 7 “RECOMMENDED LUBRICANTS”

Every 18,000 miles (30,000 km)

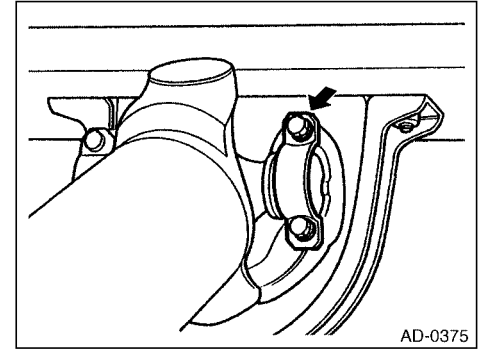
1. Check clutch line fluid leakage and damage (Not applicable for automatic transmission)

(EXAMPLE)



- Check lines and hoses for damage, rust or rubbing.
 - Check connections for fluid leaks.
 - Repair or replace if necessary.
- #### 2. Lubricate king ping, bush and thrust bearing.

3. Retighten propeller shaft mounting bolts



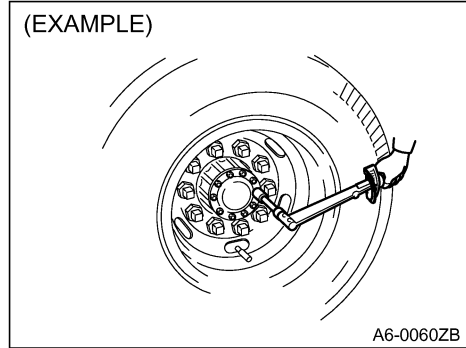
Refer to TABLE 3 “TIGHTENING TORQUE”



WARNING

Never allow grease and oil to adhere stamped straps, stamped strap bolts and bold holes. The grease and/or oil which adhere to the stamped retainer bolts, stamped straps, stamped strap bolts, damaged bearing retainers or used inferior grade bolts can cause driveline failure, which can result in separation of driveline from the vehicle. A separated driveline can result in death, serious personal injury or property damage.

4. Retighten axle shaft mounting bolts



Tighten wheel nuts with torque wrench to specified torque if necessary.

5. Check lubricate king pin

Grease:

Refer to TABLE 7 "RECOMMENDED LUBRICANTS"

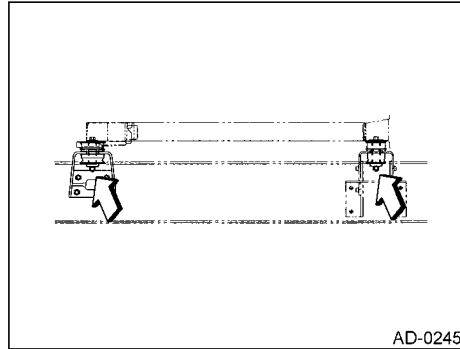
Greasing point:

Refer to TABLE 8 "LUBRICATION CHART"

6. Clean battery terminal

Clean the terminal referring to page 7-97.

7. Check and retighten rear cab mounting brackets, cushion rubber mounting bolts and nuts



**Torque: 213 – 227 N·m
(160 – 166 lbf·ft, 2,200 – 2,300 kgf·cm)**

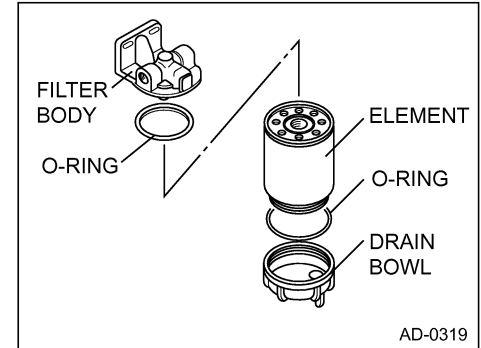
The following items should be performed by an authorized Hino dealer.

8. Air dryer function

9. Tightness of spring brackets

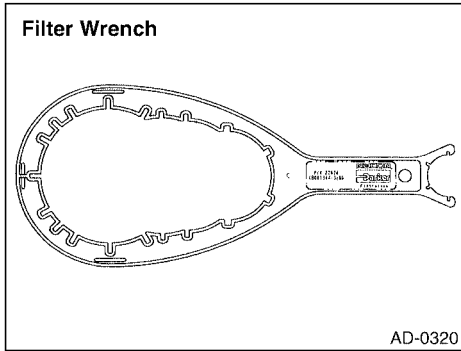
Every 20,000 miles (32,000 km)

1. Replace fuel filter



RACOR® fuel filter

- (1) Drain the unit of fuel. Follow "Drain water" instructions above.
- (2) Remove element with bowl from filter body. The bowl is reusable, do not damage or discard. (Filter wrench parts number: S09553-1050-A)
- (3) Separate element from bowl. Clean bowl and seal gland.



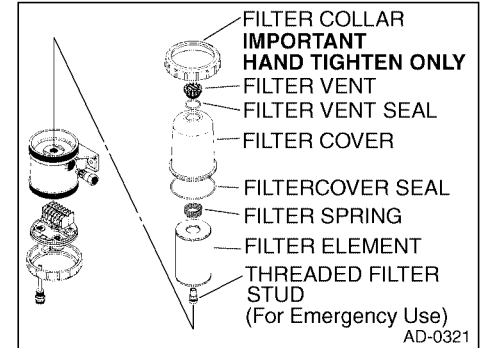
- (4) Lubricate new bowl seal with clean fuel or motor oil and place in bowl gland. (Bevel side up, if present)
- (5) Reinstall bowl to new element firmly by hand.
- (6) Lubricate new element seal and place in element top gland. (Bevel side up, if present)
- (7) Reinstall the element and bowl to the filter body and **tighten by hand only**.

(8) Air bleeds the fuel filter in accordance page 7-23.

(9) Start the engine and check the fuel system for leaks.

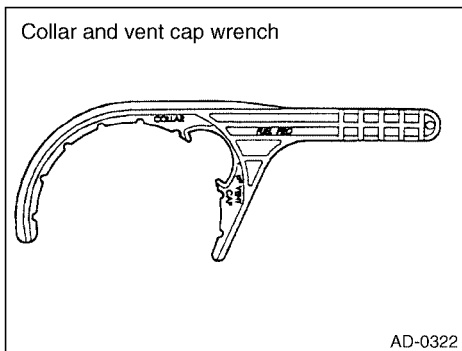
CAUTION

- **Be sure to drain the fuel into a container and dispose of it properly. Be careful not to spill any of the fuel.**
- **After replacing the element, operate the engine for a few minutes and check for fuel leakage from the filter. Fuel leakage can cause fires.**
- **Using improper fuel filters can shorten the life of the engine and/or fuel injection system. Such fuel filters can become damaged or may leak fuel which can result in personal injury and/or property damage due to fire.**



DAVCO® fuel filter

- (1) Drain the fuel level to below the collar. Follow Drain water instructions above.
- (2) Remove the Check to make sure the drain valve at the base of the Diesel Pro is closed. Discard the O-ring from the base of the cover. (Collar and vent cap wrench parts number: S0955-31040)



- (3) Remove the clear cover from the fuel processor by removing the wrench. (A new O-ring seal is supplied with the new filter.) Remove the filter element from the diesel Pro by pulling upward and twisting slightly. Be sure the sealing grommet is removed from the center stud.
- (4) Fill the fuel processor with clean diesel fuel through the elongated hole at the top. Do not fill through the center stud opening. This is the filtered fuel outlet to the fuel pump.

- (5) With the new filter sealing grommet (supplied with the filter) inserted into the base of the filter element, install the element on the processor center stud. After checking to make sure the new O-ring seal (supplied with the filter) at the base of the cover is in place, install the cover and collar. Hand tighten the collar until seated. **Do not use tools to tighten the collar.**

- (6) Remove the vent cap from the top of the clear cover by turning the vent cap counterclockwise. Fill the clear cover full of clean fuel. Make sure the new O-ring (supplied with the filter) is installed on the vent cap. Reinstall the cap and tighten by hand only.

- (7) Start the engine. When the lubrication system reaches its normal operating pressure, increase engine speed to high idle for 2 to 3 minutes.

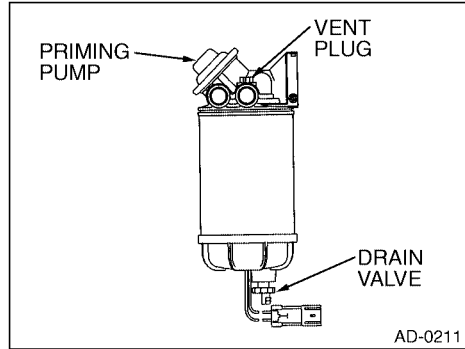
- (8) After the air is purged, and the engine is running, loosen the vent cap. When the fuel level fills to the top of collar, quickly tighten the vent cap.

NOTICE:

The clear filter cover will not fill completely during engine operation. It will gradually fill over time as the filter becomes clogged. The filter element dose not need to be changed until the fuel level has risen to the top of the filter element.

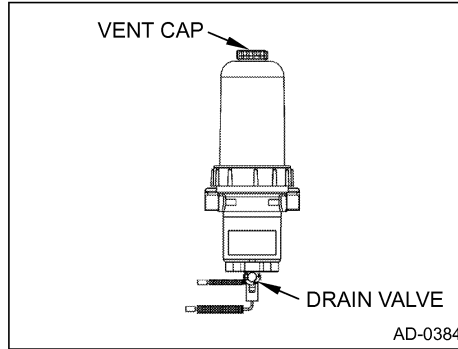
- Thoroughly wipe off any spilled fuel.
- Start the engine and check the fuel system for leaks.

2. Drain water



RACOR® fuel filter

- (1) Open drain valve and pump water out. Otherwise, open blow drain valve to evacuate water.
- (2) Close the drain valve.



DAVCO® fuel filter

- (1) Loose the vent cap and after open drain valve.
- (2) Collect water in to cup.
- (3) Allow any water to drain out, then close the drain valve and vent cap. (Drain minimum amount of fuel possible)

Every 24,000 miles (40,000 km)

The following items should be performed by at an authorized Hino dealer.

1. Change automatic transmission fluid [Aisin® 450, Allison 3000RDS]

⚠ CAUTION

Do not work on the transmission while it is still hot. This can result in personal injury.

For replacement procedure, refer to page 7-68.

2. Check brake chamber rod stroke [Full air brake type]

⚠ WARNING

- The wheel brakes of the vehicle with automatic slack adjuster will automatically be adjusted.

- **The automatic slack adjusters should not be manually adjusted in an effort to correct excessive pushrod stroke, because this condition indicates that a problem exists with the automatic adjuster, with the installation of the adjuster, or with related foundation brake components, which manual adjustment will not fix.**
 - **Manual adjusting the automatic slack adjusters is a dangerous practice that could have serious consequences, because it gives the driver a false sense of security about the effectiveness of the brake, which are likely to go out of adjustment again soon.**
 - **If any malfunction found ASA, have an authorized Hino dealer inspect and repair brakes. Under severe driving conditions, more frequent maintenance is required.**
- **Raise the air pressure to 100 p.s.i. (7 kg/cm²) by running the engine.**
 - **Depress the brake pedal fully.**

- **Measure the brake chamber stroke and make sure that it conforms to the standard values.**

Brake chamber rod stroke	Standard dimensions
On front axle	1.75 in. (44.5 mm)
On rear axle	2 in. (50.8 mm)

3. Automatic slack adjuster [Full air brake type]

Check condition of boot for cuts, tears, etc., and replace if necessary.

Every 30,000 miles (50,000 km) or every 12 months

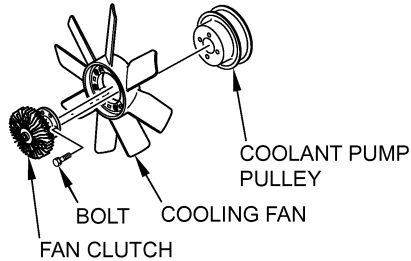
The following item should be performed by an authorized Hino dealer.

- 1. Inspect wheel bearing end play**
- 2. Inspect wheel alignment**
- 3. Inspect turning angle**
- 4. Inspect wheel bearing**
- 5. Wheel bearing grease (Front)**
- 6. Tighten steering gear case mounting bolts**
- 7. Inspect steering parts**
- 8. Inspect tie rod and drag link ball joint**
- 9. Inspect steering shaft spline and dust boots**
- 10. Inspect king pin, bush and thrust bearing**
- 11. Check power steering function**
- 12. Replace power steering reserve tank strainer**
- 13. Replace spring brake rubber parts**
- 14. Check brake valve, brake chamber and other air valve function**

Every 36,000 miles (60,000 km)

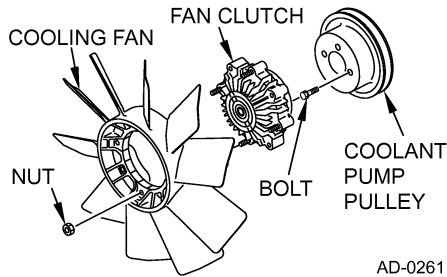
1. Check cooling fan

[Model: HINO 238, 258, 268, 308, 338]
ENGINE MODEL: J08E



AD-0260

[Model: HINO 145, 165, 185]
ENGINE MODEL: J05D



AD-0261

Torque:

Nut: 12 N·m (9.0 lbf·ft, 120 kgf·cm)

- a. Check the cooling fan for damage. Replace if necessary.
- b. Check that the fan mounting bolts are tight. Tighten if necessary.

Torque: 47 N·m (34.7 lbf·ft, 480 kgf·cm)

2. Replace air cleaner element

Replace the element refer to page 7-53.

3. Check and retighten exhaust manifolds mounting nuts

Torque:

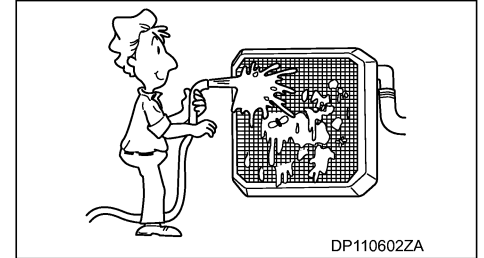
Upper: 60 N·m (44 lbf·ft, 620 kgf·cm)

Lower: 53 N·m (39 lbf·ft, 540 kgf·cm)

! WARNING

Do not loosen the drain plugs while the engine is still hot. If you do, scalding water can come out resulting in personal injury.

4. Clean intercooler body

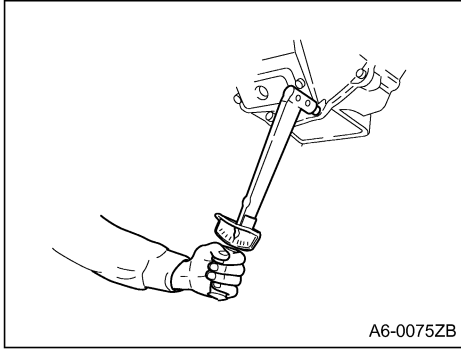


The intercooler is used to cool the overheated intake air charged by the turbocharger, and is installed at the front of the radiator. When mud, debris, etc. becomes attached to the front of the core, the passage of cooling air is impaired, so that such matter should be removed completely by washing with water. Deformed fins also can impair cooling, and should be repaired. Clean the inside by blowing with air when changing intercooler hoses.

NOTICE:

Do not use water to clean the inside of the intercooler body. Using water will cause engine trouble, etc. Please refer to the workshop manual for cleaning instructions.

5. Check and retighten clutch housing and flywheel housing bolts



Check the clutch housing bolts and retighten to specified torque.

FS-4205A, FS-5406A, FS6406A
FO-5406B, FO-6406B

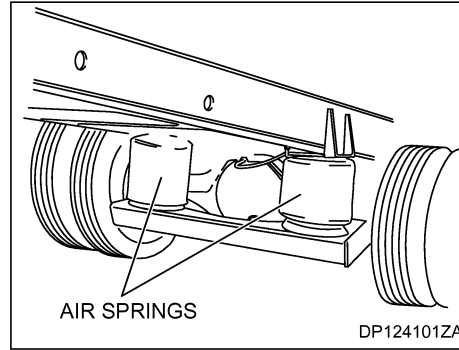
**Torque: 37.5 – 48.5 N·m
(28 – 35 lbf·ft., 382 – 494 kgf·cm)**

6. Check splash shields and under hood insulator

7. Air springs

a. CHECK OF AIR LEAKAGE

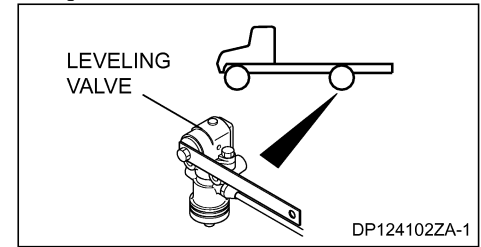
- Check if there is any leakage from the air pipes, or air springs.



- If the air pressure falls due to air leakage, etc., this may bring forth crushes or folds in the air springs.

b. CHECK THE FOLLOWING POINTS

- Check any looseness and/or damage at the mounting and connecting positions of the air springs.
- Check any looseness and/or damage at the leveling valve and the connecting section of the rear axle.



c. CHECK OF THE AIR SPRINGS

- Check the air springs for any eventual damages and cracks. If any damage or crack is found out, replace the air spring with a new one.
- Check if any sand or stones are embedded at the lower part of the air springs. If so, remove them carefully so as not to damage the air spring.



CAUTION

If you continue to drive your vehicle with sand, stones, etc. embedded, you may damage the air springs and this can be a cause of air leakage.

d. VEHICLE POSTURE

- Check if the load carrying platform comes down temporarily the moment that the vehicle is loaded and if it returns to almost the same vehicle height as that of an unloaded vehicle in a few seconds later.

NOTICE:

If the load carrying platform height does not return to almost the same height as that of unloaded condition, it is presumed that the leveling system and/or the air springs do not function properly.

In such a case, contact your nearest authorized HINO dealer to have your vehicle inspected or adjusted.

The following items should be performed by an authorized Hino dealer.

8. Replace drive belts

Replace the drive belts refer to page 7-50.

9. Radiator, heater hose and clamps

10. Clutch hose

11. Clutch fluid

12. Propeller shaft deflection

13. Propeller shaft spline play

14. Propeller shaft universal joint play

15. Propeller shaft center bearing support

16. Sliding spline and center bearing seal damage

17. Axle housing cracks, deformation and damage

18. Front axle beam deformation and cracking wear, and tightness

19. Wheel brake internal parts

20. Deformation of back plate [Full air brake type]

21. Brake hose

22. Brake hydraulic booster function

23. Brake valve and other valve function

24. Caliper piston seal and boot

25. Brake valve and other valve rubber parts

26. ABS system function

27. Brake fluid [Hydraulic brake type]

28. Brake chamber diaphragm [Full air brake type]

29. Center parking brake lining wear and clearance between drum and lining [Hydraulic brake type]

30. Center parking brake drum wear and damage [Hydraulic brake type]

31. Parking brake lever wear and damage [Hydraulic brake type]

32. Parking brake control valve and relay valve function [Full air brake type]

33. Parking brake control valve and relay valve rubber parts [Full air brake type]

34. Spring brake chamber rubber parts [Full air brake type]

- 35. Replace power steering reserve tank filter and fluid
- 36. Wheel bearing turning torque (Front and rear)
- 37. Wheel bearing lock nut tightness
- 38. Spring pin and shackle pin wear
- 39. Tightness of U-bolts and clip bands
- 40. Shock absorber function and damage
- 41. Cracking and deformation of frame
- 42. Tightness of bolts
- 43. Starter bearing grease
- 44. Wiring, connectors, and clips tightness and damage
- 45. Engine maximum speed (at full load)

Every 50,000 miles (80,000 km)

The following item should be performed by an authorized Hino dealer.

1. Check valve clearance
2. Replace transmission oil
 [Eaton® FS-4205A, FS-5406A, FS-6406A] for Highway use
 [Allison® 1000RDS, 1000HS, 2200RDS, 2200HS, 2500RDS]
3. Check service brake automatic slack adjuster [Full air brake type]
 - Remove the pawl nut, pawl spring and pawl. Examine the pawl for grease retention.
 - If the grease is in good condition, install the pawl and pressure relief fitting (or cap screw on early designs), lube through the grease fitting until the lube purges through the pressure relief fitting (or pawl slot on early designs).
 - If the grease is hardened or the pawl is dry and shows extreme wear, remove the pawl from the vehicle, disassemble it, clean and inspect the internal parts, and lube and install a new boot and seals.



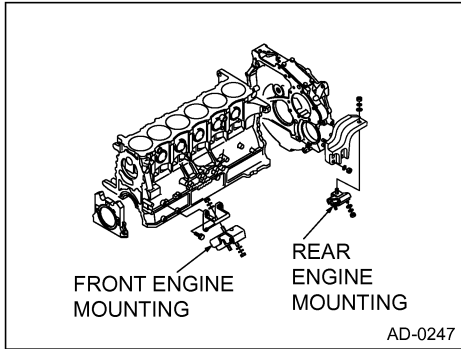
WARNING

- The automatic slack adjuster should not be manually adjusted in an effort to correct excessive pushrod stroke, because this condition indicates that problem exists with the automatic adjuster, with the installation of the adjuster, or with related foundation brake components, which manual adjustment will not fix.
- Manual adjusting the automatic slack adjusters is a dangerous practice that could have serious consequences, because it gives the driver a false sense of security about the effectiveness of the brakes, which are likely to go out of adjustment again soon.

Every 72,000 miles (120,000 km)

The following item should be performed by an authorized Hino dealer.

1. Check engine mounting



- a. Check front and rear engine mounting rubbers for cracks. Replace if necessary.
- b. Check that front and rear engine mounting nuts are tight. Tighten the nuts if necessary.

Torque:

[Model: HINO 145, 165, 185]

Front (Engine side):

132 N·m (98 lbf·ft, 1,350 kgf·cm)

Front (Chassis side):

88 N·m (65 lbf·ft, 900 kgf·cm)

Rear:

88 N·m (65 lbf·ft, 900 kgf·cm)

Rear (With ATM):

62 N·m (46 lbf·ft, 630 kgf·cm)

[Model: HINO 238, 258, 268, 308, 338]

Front (Engine side):

157 N·m (116 lbf·ft, 1,600 kgf·cm)

Front (Chassis side):

88 N·m (65 lbf·ft, 900 kgf·cm)

Rear:

88 N·m (65 lbf·ft, 900 kgf·cm)

2. Check and replace starter brush

Measure length of the starter brushes. If the lengths are shorter than service limit as shown below, replace all starter brushes.

	Standard	Service limit
J05D	0.807 in. (20.5 mm)	0.551 in. (14.0 mm)
J08E	0.827 in. (21.0 mm)	0.591 in. (15.0 mm)

3. Check engine cooling system hose and clamp
4. Replace intercooler hoses
5. Engine compression pressure
6. Turbo charger rotor operation
7. Steering sector shaft cracking
8. Replace power steering rubber parts and hoses
9. Check ABS control valve
10. On every brake overhauling [Full air brake type]
11. Service brake spider and mounting plate damage and deformation

At each reline period (If greater than 100,000 miles (160,000 km))

The following item should be performed by an authorized Hino dealer.

1. Service brake automatic slack adjuster [Full air brake type]

- Remove actuator, rod assembly and pawl nut.
- Clean and regrease actuator and pawl.
- Check internal condition. If satisfactory, reassemble. If unsatisfactory, overhaul slack by cleaning all parts, replacing seals and boot, and regreasing.

Every 200,000 miles (320,000 km)

The following items should be performed by an authorized Hino dealer.

1. Check DPR cleaner

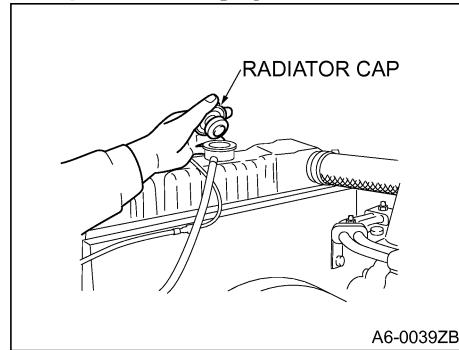
Every 360,000 miles (600,000 km)

The following items should be performed by an authorized Hino dealer.

1. Replace fuel hoses

- Fuel tank – Fuel filter
- Fuel filter – Supply pump
- Engine – Fuel tank

2. Replace cooling system



! WARNING

Do not remove the radiator cap while the engine and radiator are still hot. If the radiator cap is removed while the radiator is still hot, scalding water and steam under pressure can be blown out. This can result in personal injury.

a. Start and run the engine with the cap on until the upper radiator hose gets hot. This means that the thermostat is open and the coolant is circulating through the radiator.

b. Stop the engine. Remove the radiator cap after the engine has cooled.

Turn the cap gently counterclockwise until it stops. Do not depress the cap while turning.

Wait for the release of internal pressure. Turn the cap counterclockwise while depressing the cap and remove it.

! WARNING

Do not loosen the drain plugs while the engine is still hot. If you do, scalding water can come out resulting in personal injury.

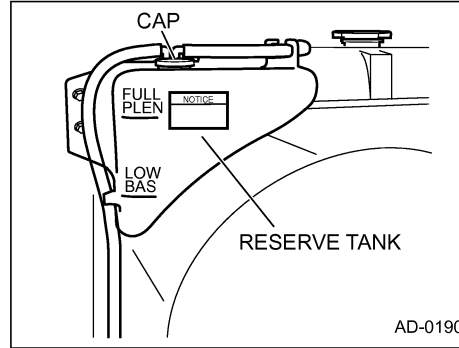
When the vehicle has overheated

If the engine overheats, the coolant level may be low in the radiator as well as in the reserve tank. Check to see that the engine is stopped and the coolant temperature is less than an adequate temperature. Stop the engine and then open the radiator cap (see page 7-95) and add the coolant to the top of the filler port. At that time, the coolant level should not lower. (Check it about for 5 seconds.) And tighten the radiator cap securely. Then, remove the reserve tank cap, add the coolant to the "FULL" line, and close the cap.

NOTICE:

The cooling system may be damaged by rust caused by the deterioration and the decreased concentration of the coolant, if the coolant is not replaced periodically.

How to replace the coolant (Draining)



CAUTION

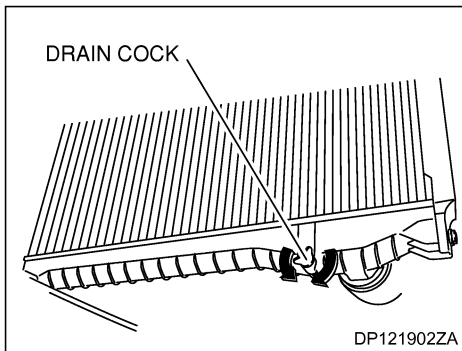
Observe the lawful and applicable method or the method for the protection of environment when disposing of coolant.

Replace the coolant when it is sufficiently cool.


1. Remove the cap of the reserve tank.
2. Remove the radiator cap.

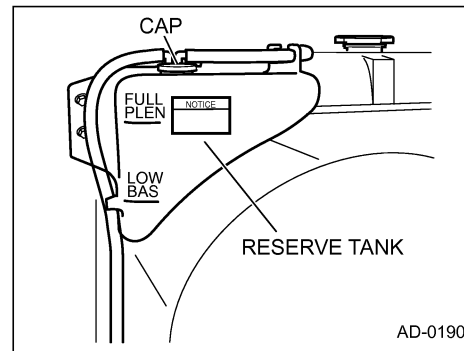
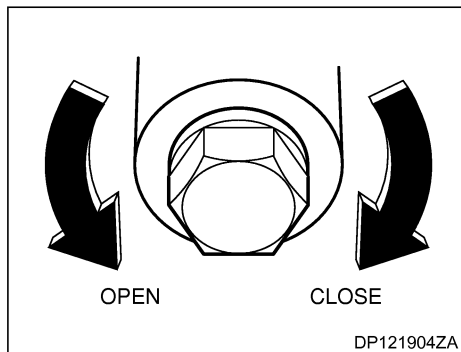
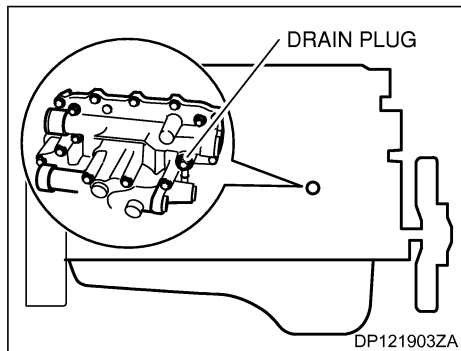
CAUTION

Never remove the radiator cap when the coolant temperature is high, as hot coolant or vapor will blow out from the inlet and you may be burned. Also never open the front panel at that moment.



3. Open the drain cock of the radiator and drain the coolant.

 CAUTION
<p>Do not turn the drain cock more than 5 full turns. If you turn it more, the coolant may gush out suddenly and you may be burned.</p>



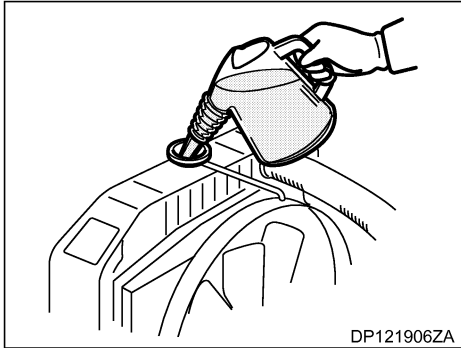
4. Open the drain plug of the engine and drain the coolant.

5. Remove the reserve tank. Remove 3 bolts, remove the reserve tank and drain the coolant in the reserve tank. After draining, securely install the reserve tank.

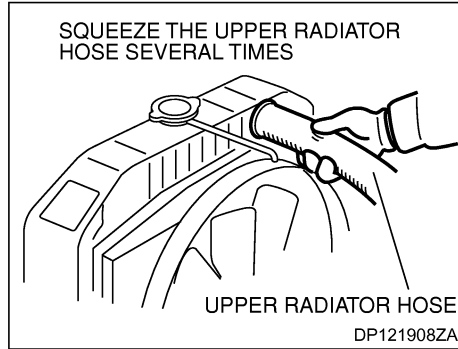
6. After completing draining, close the drain cock and the drain plug.

NOTICE:
Never drive without coolant after draining. This will cause a failure of the coolant pump and an engine burning.

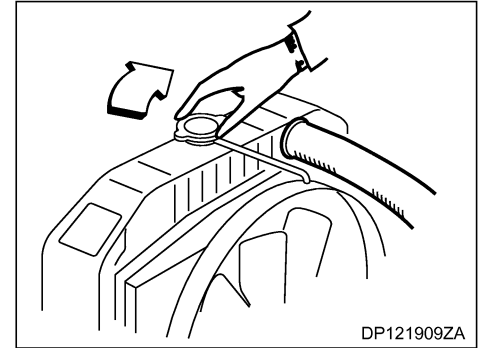
Replacement procedure



1. Pour the coolant (Long Life Coolant) slowly into the filler port of the radiator until it is full. Replenish the coolant slowly in order not to mix the air in it.



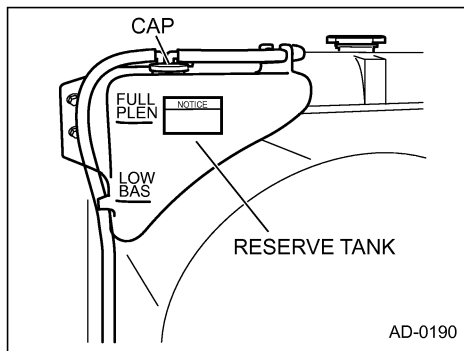
2. When the radiator is filled up to the opening, squeeze the upper radiator hose several times. Any air inside the hose will come out, and the coolant level will become lower. Then, pour in coolant again until it comes up to the radiator cap opening level.



3. Tighten the radiator cap securely. For details of closing the radiator cap operation, refer to page 7-96.

NOTICE:

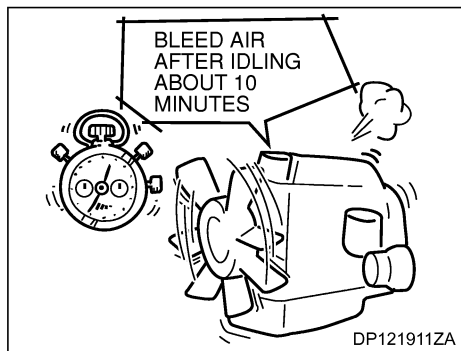
The cooling system may be damaged by rust caused by the deterioration and the decreased concentration of the coolant, if the coolant is not replaced periodically.



! WARNING

Do not remove the radiator cap while the engine and radiator are still hot. If the radiator cap is removed while the radiator is still hot, scalding water and steam under pressure can be blown out. This can result in serious burns.

4. Fill the coolant up to the "FULL" line of the reserve tank and close the cap.



5. In order to properly bleed air from the system, run the engine at a little higher than normal idling speed. Bring the temperature to the normal temperature range and run the engine for about 10 minutes.

NOTICE:

Air mixed into the coolant can cause overheating and coolant leakage from the coolant pump.

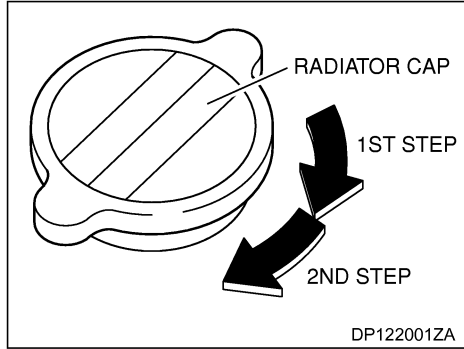
6. Stop the engine and after the engine is cooled, check the amount of coolant in the radiator and reserve tank. Then fill both with coolant to bring them to the proper levels.

7. After refilling, close the radiator cap and the reserve tank cap securely.

! CAUTION

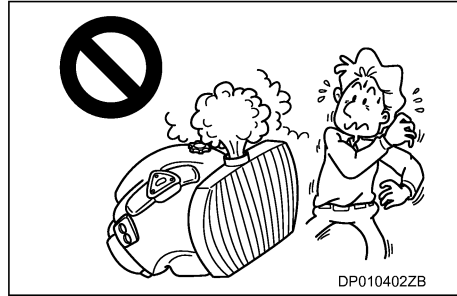
Never remove the radiator cap when the coolant temperature is high, as hot coolant or vapor will blow out from the inlet and you may be burned.

Radiator cap operation



As the radiator cap is of the pressure type, always close it tightly (2nd step) clockwise.

OPERATION WHEN ENGINE IS HOT



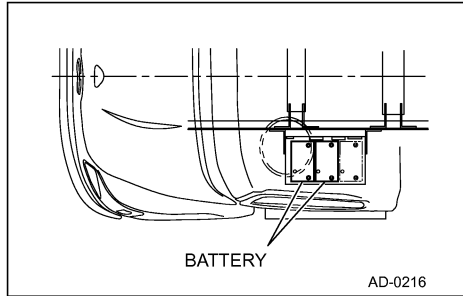
If you remove the radiator cap carelessly, hot coolant and vapor may spurt out and burn you. However, if it is necessary to remove the radiator cap for unavoidable reasons such as in an emergency, operate it according to the following procedure.

1. When the coolant temperature gauge indicates a point near the red zone, keep the engine running at an idling speed until the needle returns to around gauge.
2. Cover the cap with several layers of thick rags and loosen the cap slowly. If the spurting out of vapor is too strong, immediately tighten the cap and wait until the coolant temperature comes down.

Every 500,000 miles (800,000 km) or 60 months for Highway use

1. Replace UltraShift transmission oil [Eaton[®] FO-5406B, FO-6406B]

Every 6 months



1. Clean battery terminal

GREASE: TABLE 7 "RECOMMENDED LUBRICATIONS"

- Disconnect the battery cables from the battery terminals. Clean the terminals and the cable clamps with warm water [about 140°F (60°C)].
- Install the cables securely after drying them.
- Apply chassis grease to the terminals and clamps.
- Install the covers of the terminal securely.

2. Service brake automatic slack adjuster [Full air brake type]

Remove the pawl nut, pawl spring and pawl. Examine the pawl for grease retention. If the grease is in good condition, install the pawl and pressure relief fitting (or cap screw on early designs), lube through the grease fitting until the lube purges through the pressure relief fitting (or pawl slot on early designs).

If the grease is hardened or the pawl is dry and shows extreme wear, remove the pawl from the vehicle, disassemble it, clean and inspect the internal parts, and lube and install a new boot and seals.

Every 12 months

1. Check drive belts
2. Check radiator, heater hose and clamps
3. Replace Manual transmission oil
For replace procedures, refer to 7-67.
4. Check refrigerant amount of air conditioner

Every 24 months

1. Check and replace starter brush

Measure length of the starter brushes, if those length are sorter than service limit of below, replace all starter brushes.

	Standard	Service limit
J05D	0.807 in. (20.5 mm)	0.551 in. (14.0 mm)
J08E	0.827 in. (21.0 mm)	0.591 in. (15.0 mm)

2. Inspection intercooler hoses

When there is air leakage from the hose, the performance will drop, fuel consumption will increase, and engine trouble may also occur, so that they should be checked regularly for cracks on the outer circumstance, loosening of caulked parts, etc.

Every 36 months

- 1. Replace Hino genuine long life coolant**

For replace procedures, refer to 7-91.

Every 60 months

or Every 500,000 miles (800,000 km) for Highway use

or Every 2,000 hours for off-Highway use

- 1. Replace UltraShift transmission gear oil**

[Eaton® FO-5406B, FO-6406B]

TABLE 2 STANDARD ADJUSTMENT DIMENSIONS

No.	Item		Standard Dimensions
1	Valve clearance (Cold)	Inlet	0.0118 in. (0.30 mm)
		Exhaust	0.0177 in. (0.45 mm)
2	Injection timing		0°
3	Engine low idling speed		750 RPM(r/min)
4	Engine maximum speed (at full load)	Engine Model:J08E	2,600 RPM(r/min)
		Engine Model:J05D	3,000 RPM(r/min)
5	Drive belt (V-belt) tension	Engine Model:J05D	0.317 – 0.394 in. (8 – 10 mm)
6	Coolant temperature		176 – 212°F (80 – 100°C)
7	Clutch pedal height (Distance from the floor to the center top of the pedal) (Available with manual transmission)		8.07 – 8.46 in. (205 – 215 mm)
8	Clutch pedal stroke (Distance from the original to the depressed position) (Available with manual transmission)		8.07 – 8.46 in. (205 – 215 mm)
9	Clutch pedal play	Model:HINO 145, 165, 185	1.4 – 2.2 in. (35 – 55 mm)
		Model:HINO 238, 258, 268, 308, 338	1.7 – 2.3 in. (44 – 59 mm)
10	Wheel alignment toe in	Model:HINO 145, 165, 185	0.02 – 0.10 in. (0.5 – 2.5 mm)
		Model:HINO 238, 258LP 268 (8000 lbs front axle)	0.04 – 0.12 in. (1.0 – 3.0 mm)
		Model:HINO 268 (10000 lbs front axle), 308, 338	0.06 – 0.14 in. (1.5 – 3.5 mm)

No.	Item		Standard Dimensions	
11	Wheel alignment camber		3/16 – -11/16 deg	
12	Wheel alignment king pin angle		Model:Except for HINO 308, 338	
			Model:HINO 308, 338	
13	Wheel alignment caster		3 – 4°	
14	Knuckle turning angle		Inner turn	
			Model:HINO 145, 165, 185	51 – 53°
				Model:HINO 238, 258, 268, 308, 338
			Outer turn	Model:HINO 145, 165, 185
				Model:HINO 238, 258LP, 268 (8000 lbs front axle)
			Model:HINO 268 (10000 lbs front axle), 308, 338	
15	Steering wheel play		0 – 1.38 in. (0 – 35 mm)	
16	Brake pedal play		Hydraulic brake type	
			Full air brake type	
17	Brake chamber rod stroke (Maximum) (On front axle)		0.118 – 0.472 in. (3 – 12 mm)	
18	Brake chamber rod stroke (Maximum) (On rear axle)		Full air brake type	

No.	Item		Standard Dimensions		
19	Brake pad thickness	Standard	B-frame	0.61 in. (15.5 mm)	
			4-pad	0.73 in. (18.5 mm)	
		Limit	B-frame	0.125 in. (3.2 mm)	
			4-pad	0.125 in. (3.2 mm)	
20	Brake lining thickness	Standard	Front	0.73 in. (18.5 mm)	
			Rear	0.85 in. (21.6 mm)	
		Limit	Front	0.25 in. (6.3 mm)	
			Rear	0.25 in. (6.3 mm)	
21	Parking brake lever pull load [Hydraulic brake type]	Model:HINO 145, 165, 185		49.6 – 60.6 lbf (22.5 – 27.5 kgf)	
		Model:HINO 238, 258, 268, 308	Manual transmission		71.7 – 82.7 lbf (32.5 – 37.5 kgf)
			Automatic transmission		49.6 – 60.6 lbf (22.5 – 27.5 kgf)
22	Starter brush length	J05D	Standard	0.807 in. (20.5 mm)	
			Limit	0.551 in. (14.0 mm)	
		J08E	Standard	0.827 in. (21.0 mm)	
			Limit	0.591 in. (15.0 mm)	

TABLE 3 TIGHTENING TORQUE

For tightening torques for general purpose also refer to TABLE 4.

Tightening the bolt, apply engine oil to the threads and contact surface.

No.	Tightening Position			Tightening Torque			
				N·m	lbf·ft	kgf·cm	
1	Cylinder head bolt	Model: J05D	bolt length 4.96 in. (126 mm)	Bolt dai. & pitch 12 mm dia. P2	59+1/4 turn (90°) +1/4 turn (90°)	43+1/4 turn (90°) +1/4 turn (90°)	600+1/4 turn (90°) +1/4 turn (90°)
			6.14 in. (156 mm)		59+1/4 turn (90°) +3/8 turn (135°)	43+1/4 turn (90°) +3/8 turn (135°)	600+1/4 turn (90°) +3/8 turn (135°)
			7.36 in. (187 mm)		59+1/4 turn (90°) +1/2 turn (180°)	43+1/4 turn (90°) +1/2 turn (180°)	600+1/4 turn (90°) +1/2 turn (180°)
		Model: J08E	4.980 in. (126.5 mm)		59+1/4 turn (90°) +1/4 turn (90°)	43+1/4 turn (90°) +1/4 turn (90°)	600+1/4 turn (90°) +1/4 turn (90°)
2	Crankshaft main bearing cap bolt			14 mm dia. P2	69+1/4 turn (90°) +1/8 turn (45°)	51+1/4 turn (90°) +1/8 turn (45°)	700+1/4 turn (90°) +1/8 turn (45°)
3	Connecting rod nut			13 mm dia. P1.25	69+1/4 turn (90°) +1/8 turn (45°)	51+1/4 turn (90°) +1/8 turn (45°)	700+1/4 turn (90°) +1/8 turn (45°)
4	Camshaft gear bolt			12 mm dia. P1.5	59+1/4 turn (90°)	43+1/4 turn (90°)	600+1/4 turn (90°)
5	Front engine mounting bracket bolt			12 mm dia. P1.75	125	80	1,280
6	Cooling jet check valve			12 mm dia. P1.5	22	16	220
7	Torsional damper fitting bolt	Model: J05D	12 mm dia. P1.5	110	80	1,100	
		Model: J08E	12 mm dia. P1.5	120	87	1,200	

No.	Tightening Position		Tightening Torque			
			N·m	lbf·ft	kgf·cm	
8	Flywheel fitting bolt	14 mm dia. P1.5	185	137	1,900	
9	Flywheel housing bolt	10 mm dia. P1.5	37 – 49	28 – 36	380 – 500	
10	Main idle shaft fitting bolt	14 mm dia. P2	170	127	1,750	
11	Sub idle shaft fitting bolt	12 mm dia. P1.75	110	80	1,100	
12	Cam idle shaft fitting bolt	12 mm dia. P1.75	110	80	1,100	
13	Nozzle clamp fitting bolt	8 mm dia. P1.25	25	18	250	
14	Oil pan fitting bolt		29	22	300	
15	Oil pan drain plug	18 mm dia. P1.5	41	30	420	
16	Glow plug	12 mm dia. P1.25	25	18	250	
17	Glow plug harness fitting nut	4 mm dia. P0.7	1.5	1.1	15	
18	Cross-head adjust screw nut	8 mm dia. P1	25	18	250	
19	Rocker arm adjust screw nut	8 mm dia. P1	25	18	250	
20	Rocker support fitting bolt	Engine model:J05D	8 mm dia. P1.25	28	21	290
		Engine model:J08E	10 mm dia. P1.5	59	43	600
21	Cam bearing cap fitting bolt	Engine model:J05D	8 mm dia. P1.25	28	21	290
		Engine model:J08E	8 mm dia. P1.25	31	21	320
22	Exhaust manifold fitting nut	Down side	10 mm dai. P1.5	53	39	540

No.	Tightening Position			Tightening Torque			
				N·m	lbf·ft	kgf·cm	
23	Engine mounting fitting nut (Engine side)	Front	Engine model:J05D	14 mm dia. P1.5	132	98	1,350
			Engine model:J08E	16 mm dia. P1.5	155	116	1,600
	Rear		12 mm dia. P1.25	88	65	900	
24	Engine mounting fitting nut (Chassis side)			12 mm dia. P1.25	88	65	900
25	Air compressor gear fitting nut			24 mm dia. P1.5	355	260	3,600
26	Injection pipe (both and nipples)			14 mm dia. P1.5	39	29	400
27	Timing gear plate fitting nut			8 mm dia. P1.25	25	18	250
28	Alternator B terminal fitting nut		REMY	5/16-20UNC-2A THD	4.4	3.2	45
			DENSO	5/16-20UNC-2A THD	6.2	4.6	63
29	Alternator earth fitting nut		REMY	1/4-20UNC-2A THD	18	13.5	185
			DENSO	1/4-20UNC-2A THD	11	8.3	115
30	Alternator fitting nut (through bolt)			12 mm dia. P1.25	93	69	950
31	Starter B terminal fitting nut			10 mm dia. P1.5	21	14	200
32	Starter C terminal fitting nut			6 mm dia. P1.0	4.3	1.6	22
33	Rear end plate fitting bolt (torques)			10 mm dia. P1.5	55	41	560
34	Steering wheel				49 – 78	37 – 57	500 – 800
35	Parking brake drum mounting nut		Model:Except for HINO 145, 165,185 with Aisin AT		54 – 65	40 – 48	551 – 663
			Model:HINO 145, 165,185 with Aisin AT		47.5 – 67.5	35 – 50	484 – 688

No.	Tightening Position		Tightening Torque		
			N·m	lbf·ft	kgf·cm
36	Brake spider mounting bolt (Front and rear) [Full air brake type]		245 – 310	180 – 230	2,490 – 3,180
37	Brake mounting bolt [Hydraulic brake type]	5/8" – 18	260 – 340	190 – 250	2,630 – 3,460
		9/16" – 18	175 – 225	130 – 165	1,800 – 2,280
38	Wheel bearing end play		0.001 – 0.005	0.009 – 0.043	0.01 – 0.05
39	Axle shaft mounting bolt or nut	Model:HINO 145, 165	140 – 155	105 – 115	1,430 – 1,580
		Model:HINO 185	102 – 156	75 – 115	1,040 – 1,590
		Model:HINO 238, 258, 268	88 – 136	65 – 100	900 – 1,385
		Model:HINO 308, 338	203 – 312	150 – 230	2,070 – 3,180
40	Wheel nut	Model:HINO 145	390 – 470	290 – 347	4,000 – 4,800
		Model:HINO 165, 185	215 – 235	160 – 175	2,200 – 2,400
		Model:HINO 238, 258, 268, 308, 338	610 – 680	450 – 500	6,200 – 6,900
41	Front spring shackle pin nut		375 – 425	278 – 315	3,840 – 4,350
42	Rear spring pin lock nut	Model:HINO 145, 165, 185	73 – 110	54 – 80	745 – 1,110
		Model:HINO 238, 258, 268, 308, 338	73 – 110	54 – 80	745 – 1,110

No.	Tightening Position		Tightening Torque			
			N·m	lbf·ft	kgf·cm	
43	Spring U-bolt	Front	Model: HINO 145, 165, 185	225 – 335	165 – 247	2,280 – 3,420
			Model: HINO 238, 258, 268, 308, 338	370 – 475	273 – 347	3,780 – 4,820
	Rear	Model: HINO 145, 165, 185	390 – 585	288 – 430	3,980 – 5,960	
		Model: HINO 238, 258, 268, 308, 338	490 – 735	361 – 541	5,000 – 7,490	
		Air suspension	545 – 610	400 – 450	5,560 – 6,220	
44	Propeller shaft reamer bolt		Model: HINO 238, 268, 308 with MT	54 – 65	40 – 48	550 – 665
			Model: HINO 145, 165, 185 with AT	132 – 157	173 – 206	2,400 – 2,855
45	Propeller shaft center bearing holder mounting bolt		127.4 – 156.8	94 – 116	1,290 – 1,587	
47	Wiper arm nut		16.5 – 21	12.5 – 15.5	170 – 210	
48	Wiper pivot nut		11 – 15.5	8.1 – 11.5	111 – 160	
49	Battery terminal		8 mm dia	6 – 9	4.4 – 7.2	58 – 96
			10 mm dia	9.5 – 12	7.3 – 8.6	100 – 120
			3/8 mm dia	9.5 – 12	7.3 – 8.6	100 – 120
50	Tubeless tire air valve nut		10 – 12.5	7.3 – 10	100 – 130	

TABLE 4 BOLT TIGHTENING TORQUE CHART (FOR GENERAL PURPOSE)

Bolt diameter (mm)	Best tightening conditions. Even tightening area. Bolt, nut, coating, naked bolt, lubricant, etc.			Medium tightening conditions. Cast iron or aluminum tightening surfaces.			Poor tightening conditions. Tightening area having black coarse surface. Naked bolt or lubricant unavailable.		
	N·m	lbf·ft	kgf·cm	N·m	lbf·ft	kgf·cm	N·m	lbf·ft	kgf·cm
3	0.5 – 1	6 – 8.6 (lb.in)	7 – 10	1 – 1.5	8.7 – 12.1 (lb.in)	10 – 14	1.5 – 2	12.2 – 15.6 (lb.in)	14 – 18
4	1.5 – 2.5	14.8 – 21.6 (lb.in)	17 – 25	2.5 – 3	1.8 – 2.3	25 – 33	3 – 4	2.4 – 2.9	33 – 41
5	3.5 – 5	2.5 – 3.6	34 – 51	5 – 7	3.7 – 4.9	51 – 69	7 – 8.5	5 – 6.2	69 – 86
6	5.5 – 8.5	4 – 6.4	55 – 88	8 – 11	6 – 7.9	83 – 110	11 – 13.5	8 – 10	110 – 140
8	12.5 – 18.5	10 – 13	130 – 190	18.5 – 25	14 – 18	190 – 260	25 – 31	19 – 23	260 – 320
10	25 – 32	18 – 23	250 – 330	37 – 49	28 – 36	380 – 500	49 – 62	37 – 45	500 – 630
12	42 – 64	32 – 46	430 – 650	64 – 85	47 – 62	650 – 870	85 – 110	63 – 79	870 – 1,100
14	72 – 110	53 – 79	730 – 1,100	110 – 145	80 – 108	1,100 – 1,500	145 – 175	109 – 130	1,500 – 1,800
16	110 – 165	80 – 122	1,100 – 1,700	165 – 225	123 – 166	1,700 – 2,300	225 – 285	167 – 209	2,300 – 2,900
18	155 – 245	116 – 180	1,600 – 2,500	245 – 325	181 – 238	2,500 – 3,300	325 – 410	239 – 303	3,300 – 4,200
20	225 – 345	167 – 253	2,300 – 3,500	345 – 460	254 – 339	3,500 – 4,700	460 – 580	340 – 426	4,700 – 5,900
22	305 – 470	225 – 347	3,100 – 4,800	470 – 630	348 – 462	4,800 – 6,400	630 – 785	463 – 578	6,400 – 8,000
24	410 – 620	304 – 455	4,200 – 6,300	620 – 825	456 – 607	6,300 – 8,400	825 – 1,080	608 – 795	8,400 – 11,000
26	520 – 785	384 – 578	5,300 – 8,000	785 – 1,080	579 – 795	8,000 – 11,000	1,080 – 1,375	796 – 1,012	11,000 – 14,000
28	655 – 980	485 – 723	6,700 – 10,000	980 – 1,375	724 – 1,012	10,000 – 14,000	1,375 – 1,665	1,013 – 1,229	14,000 – 17,000
30	825 – 1,275	608 – 939	8,400 – 13,000	1,275 – 1,665	940 – 1,229	13,000 – 17,000	1,665 – 2,060	1,230 – 1,518	17,000 – 21,000

[For Engine only]

Bolt size (Bolt with washer)	The head number of “4” bolt			The head number of “7” and “8” bolt			The head number of “9” bolt		
	N·m	lbf·ft	kgf·cm	N·m	lbf·ft	kgf·cm	N·m	lbf·ft	kgf·cm
6 mm dia. P1	6	4.3	60	10	7.2	100	12.5	9	130
8 mm dia. P1.25	13.5	10	140	25	18	250	31	23	320
10 mm dia. P1.25	29	22	300	51	38	520	64	47	650
10 mm dia. P1.5	26	20	270	47	35	480	59	43	600
12 mm dia. P1.25	54	40	550	93	69	950	120	87	1,200
12 mm dia. P1.75	49	36	500	83	61	850	110	80	1,100
14 mm dia. P1.5	83	61	850	145	108	1,500	185	137	1,900
14 mm dia. P2	74	54	750	130	98	1,350	170	127	1,750

TABLE 5 LUBRICANTS CAPACITY

No.	Item		Approximate Capacity		
			US Qt	Liter	
1	Engine cylinder block	Engine model:J08E	With filter	16.2	15.2
			Without filter	13.3	12.5
		Engine model:J05D	With filter	10.7	10.1
			Without filter	8.5	8.0
2	Manual transmission gear case	FS-4205A (5-speed)	Model: HINO 165, 185	6.23	5.9
		FS-5406A (6-speed)	Model: HINO 258, 268, 308	9.8	9.2
		FS-6406A (6-speed)	Model: HINO 338	9.8	9.2
	UltraShift transmission gear case	FO-5406B (6-speed)	Model: HINO 258, 268	10.38	9.82
		FO-6406B (6-speed)	Model: HINO 338	10.38	9.82
	Automatic transmission gear case	Aisin® 450	Model: HINO 145, 165, 185	12.8	12.0
Allison® 1000HS, 1000RDS, 2200HS, 2200RDS,		Model: HINO 165, 185, 238, 258, 268, 308	15.5	14.5	
Allison® 3000RSD		Model: HINO 338	29.8	28.0	
3	Differential gear case	MS12-113	Model: HINO 145, 165	7.9	7.5
		RS13-120	Model: HINO 185	7.9	7.5
		RS17-145	Model: HINO 238, 258	16.9	15.9
		RS19-145	Model: HINO 268	16.7	15.7
		RS21-145	Model: HINO 308, 338	16.3	15.3
		RS23-160	Model: HINO 338	19.9	18.7

No.	Item		approximate Capacity	
			US Qt	Liter
4	Power steering fluid	Model HINO 145, 165, 185	2.44	2.3
		Model:HINO 238, 258, 268, 308	2.86	2.7
		Model:HINO 338, 268	2.65	2.5
5	Clutch fluid		0.32	0.3
6	Brake fluid [Hydraulic brake type]		3.17	3.0
7	Front wheel hub grease		12.3 oz. (350 g) one wheel (See workshop manual)	
8	Refrigerant of air conditioner		15.9 oz.	450 gr.

TABLE 6 PRESSURE

No.	Item		Pressure		
			MPa	lb/sq.in	kg/cm ²
1	Engine oil pressure At coolant temperature: 176°F (80°C) or more	Standard	0.05 – 0.49	7.11 – 71.10	0.5 – 5.0
		Limit	Less than 0.05	Less than 7.11	Less than 0.5
2	Engine compression At engine revolution:150 RPM(r/min)	Standard	2.94 – 3.14	425 – 455	30 – 32
		Limit	2.35	341	24
3	Air pressure	Air dryer type: NABCO®	0.78 – 0.88	113 – 128	7.95 – 8.97
		Air dryer type: Bendix®	0.72 – 0.86	105 – 125	7.38 – 8.79

TABLE 7 RECOMMENDED LUBRICANTS

No.	LUBRICANTS	POSITONS	ATMOSPHERIC TEMP.	S.A.E. NO.
1	Engine oil A.P.I: CJ-4, CI-4, CH-4, CF-4, CF JASO: DH-2 ACEA: E-6, E-5, E-4, E3 Refer to page 7-24 for detail.	Cylinder Block	-22°F – 100°F (-8°C – 38°C)	10W-40
			Above 32°F (0°C)	40
			32°F – 100°F (0°C – 39°C)	30
2	Eaton Approved Synthetic Transmission oil	Eaton fuller® FS-4205A, FS-5406A,FS-6406A	All	50
	Heavy duty engine oil MIL-L-2104D, API-CD, or Cat TO-4		Above 10°F (-12°C)	50
			Above 10°F (-12°C)	40
			Below 10°F (-12°C)	30
Automotive gear oil API-MT-1	Above 10°F (-12°C)	80W-90		
3	Mobil Delvac Synthetic Transmission Fluid 50, Shell SPIRAX GSZ SAE 50, Eaton Approved Synthetic Transmission oil, or equivalent	Eaton fuller® FO-5406B, FO-6406B	All	50
4	Automatic transmission fluid (ATF DEXRON® III) (Non-TES 295)	AISIN® 450 Allison® 1000HS, 1000RDS, 2200HS, 2200RDS, 2500RDS, 3000RDS	—	—
	Automatic transmission fluid (TranSyan™ (TES 295))	Allison® 1000HS, 1000RDS, 2200HS, 2200RDS, 2500RDS, 3000RDS	—	—

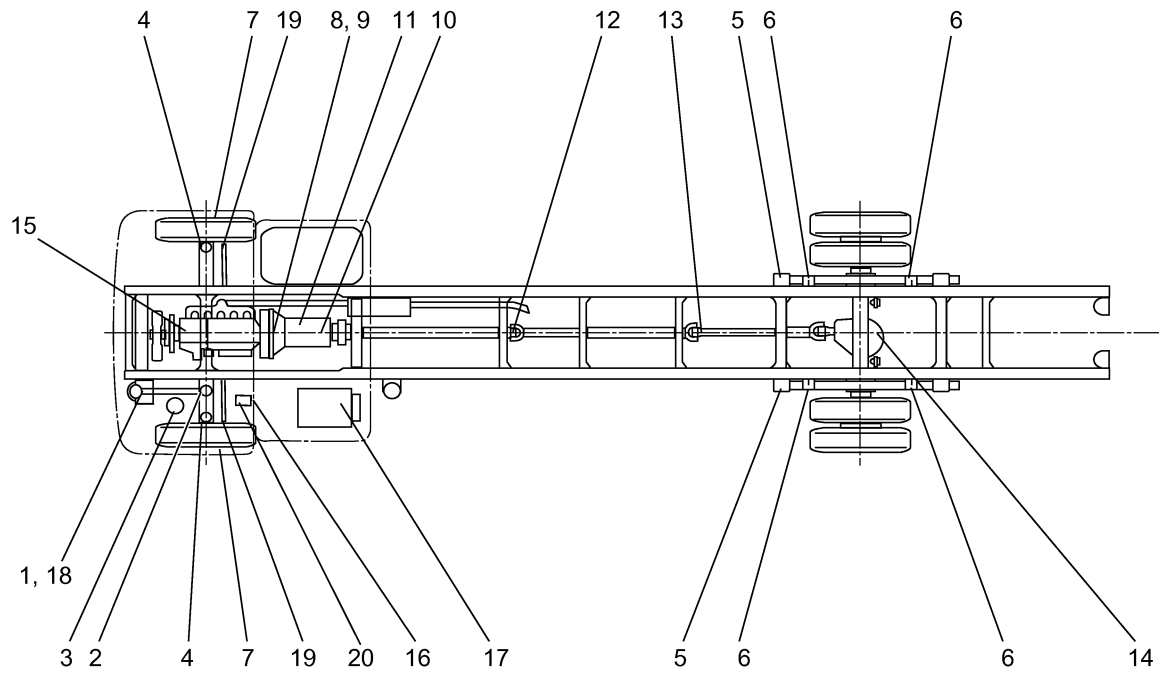
No.	LUBRICANTS	POSITONS	ATMOSPHERIC TEMP.	S.A.E. NO.
5	Axle lubricant Non- Extended Drain Lubricants (Petroleum with EP Additives) (A.P.I. GL-5) (MIL-PRF-2105E and SAE J2360)	Rear axle	Above +10°F (-12°C)	85W/140
			Above -15°F (-26°C)	85W/90
			Above -40°F (-40°C)	75W/90
			Above -10°F (-12°C) – -35°F (2°C)	75W
	Axle lubricant Extended Drain Lubricants (Petroleum with EP Additives) (A.P.I. GL-5) (MIL-PRF-2105E and SAE J2360)	Rear axle	Above -15°F (-26°C)	80W/90
			Above +15°F (-26°C)	80W/90
			Above -40°F (-40°C)	85W/90
			Above -40°F (-40°C)	75W/140
Above -10°F (-12°C) – -35°F (2°C)	75W/90			

No.	LUBRICANTS	POSITONS
6	Power steering fluid (Dexron® 2 or 3)	Integral Power Steering Gear
7	Brake and clutch fluid (DOT-3 or DOT-4)	Brake & Clutch
8	Wheel bearing grease (MIL-G-10924B/18709A) (N.L.G.I.'s No.2 Lithium-soap)	Wheel Bearing Propeller Shaft Universal Joint and Slip Joint
9	Heat resistance grease (MIL-G-22615/23549/21164) (N.L.G.I.'s No.2 or No.3)	Clutch Disc Hub Spline, T/M Main Drive Shaft Spline Q-Plus Brake (Retainer Clip, Anchor Pin, Roller (Journal only), Camshaft, Automatic Slack Adjuster, Clevis Pin) Parking Brake (Camshaft, Anchor Pin, Shoe web)
10	Special grease (Kluber glko)	B-Frame Disc Brake (Guide buss, Caliper body, Piston)
11	Starter grease (N.L.G.I.'s No.2 Lithium-soap)	Bushing, Clutch, Drive Shaft, Pinion Shaft Lever & Reduction Gear
12	Bearing grease (N.L.G.I.'s No.2 Lithium-soap)	Clutch Release Sleeve & release Shaft, Alternator Bearing, Starter Bearing
13	Chassis grease (MIL-G-17740) (N.L.G.I.'s No.1 Calcium or Lithium-soap)	Chassis Grease Fitting
14	Long life coolant	Engine, Radiator

No.	LUBRICANTS	POSITONS	SHEEL	MOBIL	EXXON
15	Lithium base disulfide molybdenum grease	Drag Link & Tie Rod Ball Joint	Retinax AM	Mobil Grease Special	Beacon Q2

TABLE 8 LUBRICATION CHART [Hydraulic brake type]

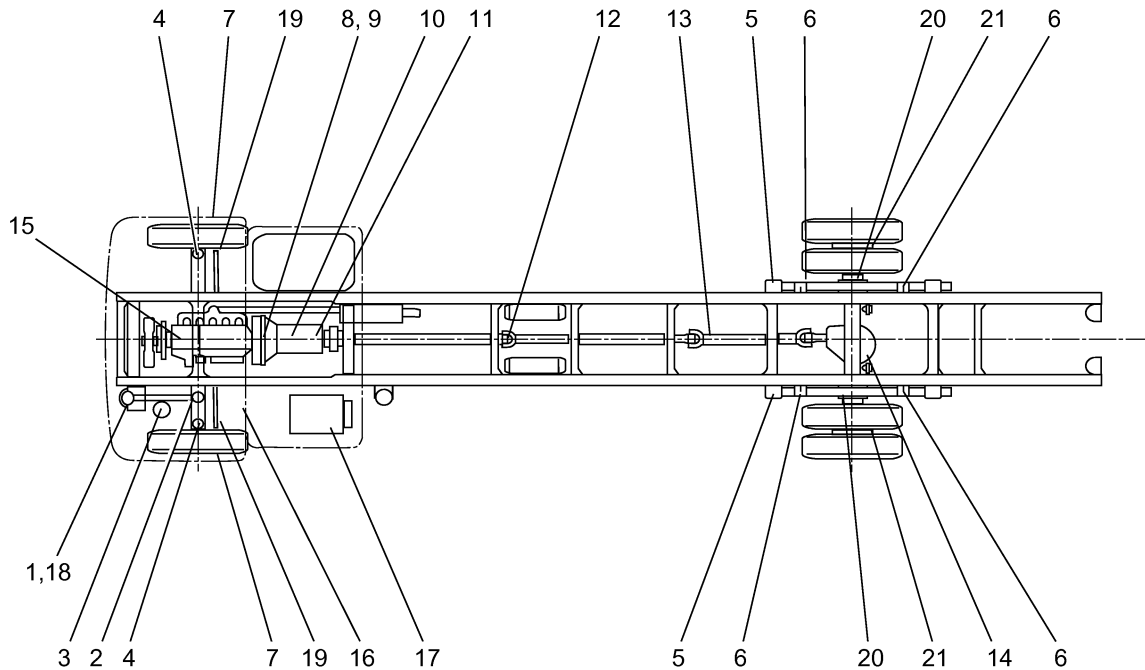
No.	Item	Lubrication position	Remarks	
1	Steering shaft slip joint and gear	2	Fill to fluid level gauge (Upper and lower)	
2	Steering dust boot	1		
3	Power steering fluid reserve tank	1		
4	Steering knuckle (king pin)	4		
5	Spring pin (Rear)	2		
6	Helper bracket	4		
7	Wheel bearing (Front)	2		
8	Clutch release sleeve (Applicable for manual transmission)	1		
9	Clutch release shaft (Applicable for manual transmission)	2		
10	Transmission gearshift lever	1		
11	Transmission	1		Fill to oil level of filler plug
12	Propeller shaft, U-joint	3 - 4		(Sliding yoke)
13	Propeller shaft, slip joint	1		
14	Rear axle	1		Fill to oil level of filler plug
15	Engine	1		Fill to "FULL" between "ADD" mark of level gauge
16	Clutch fluid reserve tank (Applicable for manual transmission)	1		Fill to "MAX" mark of reserve tank
17	Battery terminal	4 or 6		Apply the chassis grease (Each terminal)
18	Drag link ball joint	2		
19	Tie-rod ball joint	2		



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LUBRICATION CHART [Full air brake type]

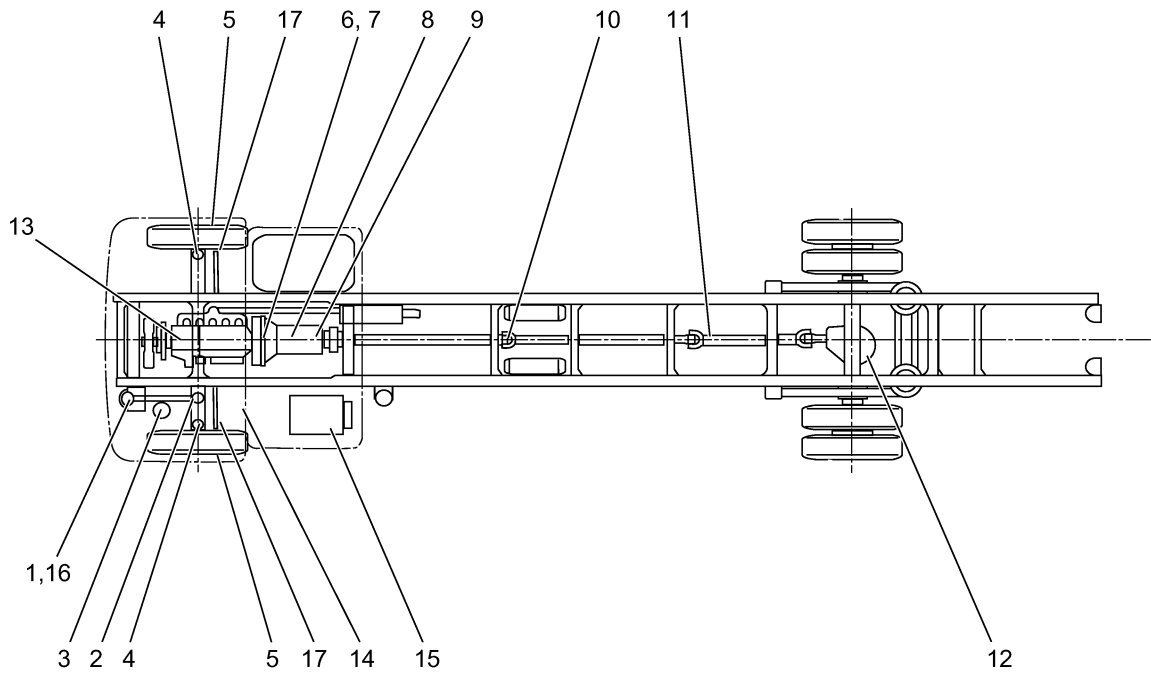
No.	Item	Lubrication position	Remarks
1	Steering shaft slip joint and gear	2	
2	Steering dust boots	1	
3	Power steering fluid reserve tank	1	Fill to fluid level gauge (Upper and lower)
4	Steering knuckle (king pin)	4	
5	Spring pin (Rear)	2	
6	Helper bracket	4	
7	Wheel bearing (Front)	2	
8	Clutch release sleeve (Applicable for manual transmission)	1	
9	Clutch release shaft (Applicable for manual transmission)	2	
10	Transmission gearshift lever	1	
11	Transmission	1	Fill to oil level of filler plug
12	Propeller shaft, U-joint	3-4	
13	Propeller shaft, slip joint	1	(Sliding yoke)
14	Rear axle	1	Fill to oil level of filler plug
15	Engine	1	Fill to "FULL" between "ADD" mark of level gauge
16	Clutch fluid reserve tank (Applicable for manual transmission)	1	Fill to "MAX" mark of reserve tank
17	Battery terminal	4 or 8	Apply the chassis grease (Each terminal)
18	Drag link ball joint	2	
19	Tie-rod ball joint	2	
20	Brake automatic slack adjuster (Front and Rear)	4	Apply the chassis grease (At the same time, the clevis pin hole busing of the automatic slack adjuster, the slide part with the clevis, and the clevis pin hole must be lubricated sufficiently).
21	Brake camshaft bracket bushing (Rear)	2	Apply the chassis grease



AD-0601

LUBRICATION CHART [Hydraulic brake type with Air Suspension]

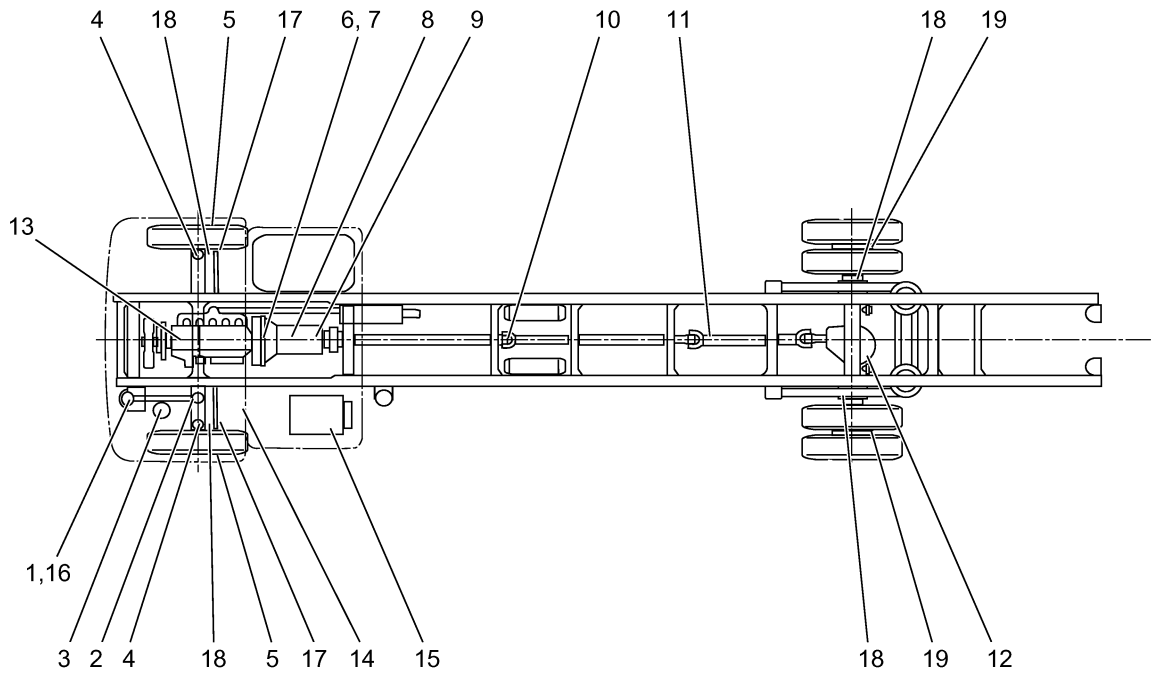
No.	Item	Lubrication position	Remarks
1	Steering shaft slip joint and gear	2	
2	Steering dust boots	1	
3	Power steering fluid reserve tank	1	Fill to fluid level gauge (Upper and lower)
4	Steering knuckle (king pin)	4	
5	Wheel bearing (Front)	2	
6	Clutch release sleeve (Applicable for manual transmission)	1	
7	Clutch release shaft (Applicable for manual transmission)	2	
8	Transmission gearshift lever	1	
9	Transmission	1	Fill to oil level of filler plug
10	Propeller shaft, U-joint	3-4	
11	Propeller shaft, slip joint	1	(Sliding yoke)
12	Rear axle	1	Fill to oil level of filler plug
13	Engine	1	Fill to "FULL" between "ADD" mark of level gauge
14	Clutch fluid reserve tank (Applicable for manual transmission)	1	Fill to "MAX" mark of reserve tank
15	Battery terminal	4 or 6	Apply the chassis grease (Each terminal)
16	Drag link ball joint	2	
17	Tie-rod ball joint	2	



AD-0602

LUBRICATION CHART [Full air brake type with Air Suspension]

No.	Item	Lubrication position	Remarks
1	Steering shaft slip joint and gear	2	
2	Steering dust boots	1	
3	Power steering fluid reserve tank	1	Fill to fluid level gauge (Upper and lower)
4	Steering knuckle (king pin)	4	
5	Wheel bearing (Front)	2	
6	Clutch release sleeve (Applicable for manual transmission)	1	
7	Clutch release shaft (Applicable for manual transmission)	2	
8	Transmission gearshift lever	1	
9	Transmission	1	Fill to oil level of filler plug
10	Propeller shaft, U-joint	3-4	
11	Propeller shaft, slip joint	1	(Sliding yoke)
12	Rear axle	1	Fill to oil level of filler plug
13	Engine	1	Fill to "FULL" between "ADD" mark of level gauge
14	Clutch fluid reserve tank (Applicable for manual transmission)	1	Fill to "MAX" mark of reserve tank
15	Battery terminal	4 or 8	Apply the chassis grease (Each terminal)
16	Drag link ball joint	2	
17	Tie-rod ball joint	2	
18	Brake automatic slack adjuster (Front and Rear)	4	Apply the chassis grease (At the same time, the clevis pin hole busing of the automatic slack adjuster, the slide part with the clevis, and the clevis pin hole must be lubricated sufficiently).
19	Brake camshaft bracket bushing (Rear)	2	Apply the chassis grease



AD-0603

TABLE 9 LIGHT BULB REPLACEMENT

Light bulb specifications

When replacing a bulb of your vehicle, perform the bulb replacement referring to the following notes and the lamp bulb specifications. If you have any questions, consult an authorized Hino dealer.

NOTICE:

When replacing a bulb, make sure that the starter key is in the “LOCK” position and the relevant light switch is in the “OFF” position. Use only a bulb with the same bulb number and wattage rating of 12 volt.

No.	Light bulb description	Bulb No.	Wattage
1	Head lights	HB2	60/55
2	Front turn signal lights	4157NAK	27
3	Front side turn lights	168	5.0
4	Front side marker lights	4157NAK	8.0
5	Clearance and identification lights	168	3.8
6	Rear combination lights	1156/1157	27/8
7	Cab (room) light	—	8.0
8	Heater control illumination light	74	1.4
9	Instrument panel warning and indicator lights	LED	3.8
10	Speedometer illumination lights	194	3.8
11	Tachometer illumination light	57	3.4
12	Air pressure illumination light	57	3.4

SECTION 8

REPORTING SAFETY DEFECTS

INTRODUCTION

REPORTING SAFETY DEFECTS (For U.S. Driver's / Owner's).... 8-2

NOISE CONTROL MAINTENANCE RECORD 8-3



REPORTING SAFETY DEFECTS (For U.S. Driver's / Owner's)

If you believe that your vehicle has a defect which could cause a crash or could cause injury or death, you should immediately inform the National Highway Traffic Safety Administration (NHTSA) in addition to notifying Hino Motors Sales U.S.A., Inc.

If the NHTSA receives similar complaints, it may open an investigation, and if it finds that a safety defect exists in a group of vehicles, it may order a recall and remedy campaign. However, the NHTSA cannot become involved in individual problems between you, your dealer, or Hino Motors Sales U.S.A., Inc.

To contact the NHTSA, you may call the Vehicle Safety Hotline toll-free at 1-888-327-4236 (TTY: 1-800-424-9153); go to <http://www.safercar.gov>; or write to: Administrator, NHTSA, 400 Seventh Street, SW., Washington, DC 20590. You can also obtain other information about motor vehicle safety from <http://www.safercar.gov>.

In addition, you may notify Hino Motors Sales U.S.A., Inc., with respect to your vehicle by calling Hino Motors Sales National Service Manager at (248) 699-9300.

NOISE CONTROL MAINTENANCE RECORD

VEHICLE IDENTIFICATION NO.: _____

<input type="checkbox"/> Injection timing
<input type="checkbox"/> High idle speed
<input type="checkbox"/> Injection pump fuel rate
<input type="checkbox"/> Cooling fan
<input type="checkbox"/> Air intake system hose and clamps
<input type="checkbox"/> Air cleaner
<input type="checkbox"/> Exhaust manifold mounting nuts tightness
<input type="checkbox"/> Exhaust muffler and exhaust pipe clamps
<input type="checkbox"/> Shields and insulator
MILES _____
KM _____
MONTHS _____
DATE _____
Performed by:
Signature _____
Dealer _____

<input type="checkbox"/> Injection timing
<input type="checkbox"/> High idle speed
<input type="checkbox"/> Injection pump fuel rate
<input type="checkbox"/> Cooling fan
<input type="checkbox"/> Air intake system hose and clamps
<input type="checkbox"/> Air cleaner
<input type="checkbox"/> Exhaust manifold mounting nuts tightness
<input type="checkbox"/> Exhaust muffler and exhaust pipe clamps
<input type="checkbox"/> Shields and insulator
MILES _____
KM _____
MONTHS _____
DATE _____
Performed by:
Signature _____
Dealer _____

<input type="checkbox"/> Injection timing
<input type="checkbox"/> High idle speed
<input type="checkbox"/> Injection pump fuel rate
<input type="checkbox"/> Cooling fan
<input type="checkbox"/> Air intake system hose and clamps
<input type="checkbox"/> Air cleaner
<input type="checkbox"/> Exhaust manifold mounting nuts tightness
<input type="checkbox"/> Exhaust muffler and exhaust pipe clamps
<input type="checkbox"/> Shields and insulator
MILES _____
KM _____
MONTHS _____
DATE _____
Performed by:
Signature _____
Dealer _____

- Injection timing
- High idle speed
- Injection pump fuel rate
- Cooling fan
- Air intake system hose and clamps
- Air cleaner
- Exhaust manifold mounting nuts tightness
- Exhaust muffler and exhaust pipe clamps
- Shields and insulator

MILES _____

KM _____

MONTHS _____

DATE _____

Performed by: _____

Signature _____

Dealer _____

- Injection timing
- High idle speed
- Injection pump fuel rate
- Cooling fan
- Air intake system hose and clamps
- Air cleaner
- Exhaust manifold mounting nuts tightness
- Exhaust muffler and exhaust pipe clamps
- Shields and insulator

MILES _____

KM _____

MONTHS _____

DATE _____

Performed by: _____

Signature _____

Dealer _____

- Injection timing
- High idle speed
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- Exhaust muffler and exhaust pipe clamps
- Shields and insulator

MILES _____

KM _____

MONTHS _____

DATE _____

Performed by: _____

Signature _____

Dealer _____

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 - Exhaust manifold mounting nuts tightness
 - Exhaust muffler and exhaust pipe clamps
 - Shields and insulator
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- MONTHS _____
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- Signature _____
- Dealer _____

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 - Injection pump fuel rate
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- MILES _____
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- MONTHS _____
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- Dealer _____

- Injection timing
 - High idle speed
 - Injection pump fuel rate
 - Cooling fan
 - Air intake system hose and clamps
 - Air cleaner
 - Exhaust manifold mounting nuts tightness
 - Exhaust muffler and exhaust pipe clamps
 - Shields and insulator
- MILES _____
- KM _____
- MONTHS _____
- DATE _____
- Performed by: _____
- Signature _____
- Dealer _____

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- If your vehicle needs to be towed 5-7
- Tips for driving during break-in period. 3-18
- How to start the engine 3-19
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Gas station information

- **Fuel type:** Diesel fuel, cetane number 45 or higher 7-22
Use ultra-low sulfur diesel fuel (Sulfur content: Less than 15ppm (0.0015%)by weight) only and low-ash fuel must be less than 1% in weight.
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