SEN06060-01

Shop Manual

ENGINE

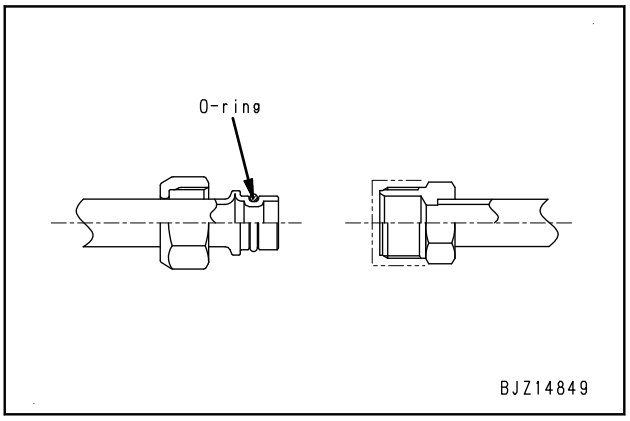
95E -6 SERIES

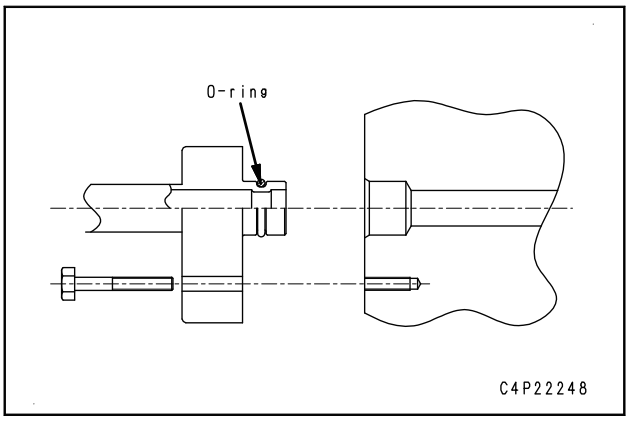
KOMATSU

Manufacturer	Part name
DENSO	ND-OIL8
VALEO THERMAL SYSTEMS	ZXL100PG (equivalent to PAG46)
SANDEN	SP-10

- When tightening nuts of the air conditioner hoses and tubes, be sure to use 2 wrenches. Use one wrench to fix and tighten the nut with the other wrench to the specified torque (Use a torque wrench for tightening).

★ Example of fitting of O-ring
- An O-ring is fitted to every joint of the air conditioner piping.





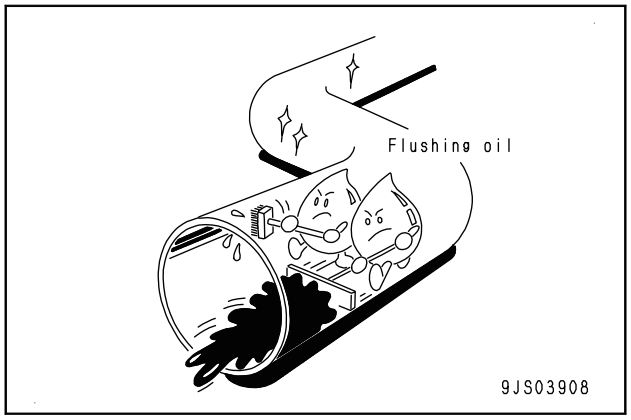
For tightening torques, see "Others", "Precautions for disconnection and connection of air conditioner piping".

Precautions to prevent fire *(ALL-0000-17B-K-03-A)*

- **Fire caused by fuel, oil, coolant or window washer fluid**
  Do not bring any flame or fire close to flammable substances such as fuel, oil, coolant or window washer fluid.There is danger that they may catch fire. Always observe the following.
  - Do not smoke or use any flame near fuel or other flammable substances.
  - Shut down the engine before adding fuel.
  - Do not leave the machine when adding fuel or oil.
  - Tighten all the fuel and oil caps securely.
  - Be careful not to spill fuel on overheated surfaces or on parts of the electrical system.
  - After adding fuel or oil, wipe up any spilled fuel or oil.
  - Put greasy rags and other flammable materials into a safe container to maintain safety at the workplace.
  - When washing parts with oil, use a non-flammable oil. Do not use diesel oil or gasoline.There is danger that they may catch fire.

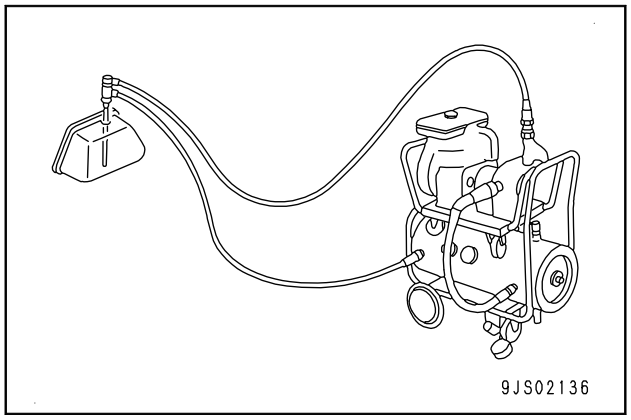
Flushing operations

- After disassembling the equipment or when changing the hydraulic oil with new one, flush the system to remove the contaminant and sludge left in the hydraulic circuit as well as the oil which includes them. Normally, flushing is performed twice. Primary flushing is performed by use of the flushing oil and the secondary flushing is performed by use of the specified hydraulic oil.



Cleaning operations

- After repairing the hydraulic equipment (pump, control valve, etc.) or when the machine is in operation, perform oil cleaning to remove the sludge or contaminant in the hydraulic oil circuit. The oil cleaning equipment can remove the ultra fine (approximately 3 μm) particles that the filter built in the hydraulic equipment can not remove. So, it is an extremely effective device.

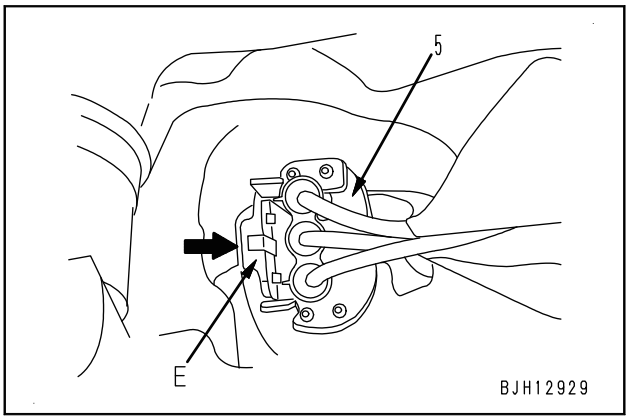


(SUMITOMO-3)

Disconnection

1. While pressing lock (E), pull out connector (5) in the direction of the arrow.

   ★ Pull the connector straight up.



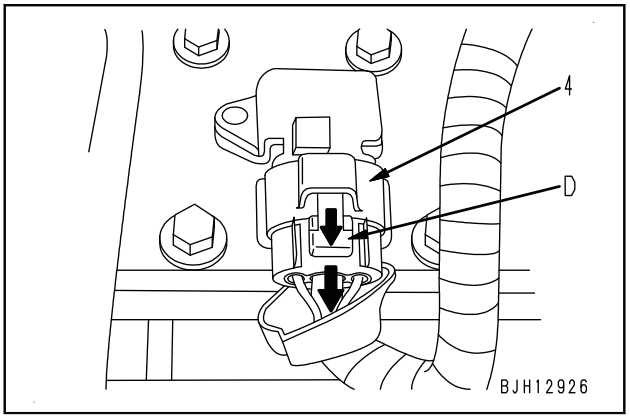
Connection

1. Insert the connector securely until a click is heard.

(SUMITOMO-4)

Disconnection

1. While pressing lock (D), pull out connector (4) in the direction of the arrow.



Connection

1. Insert the connector securely until a click is heard.

Turn-housing type (Round green connector) (CANNON-4)

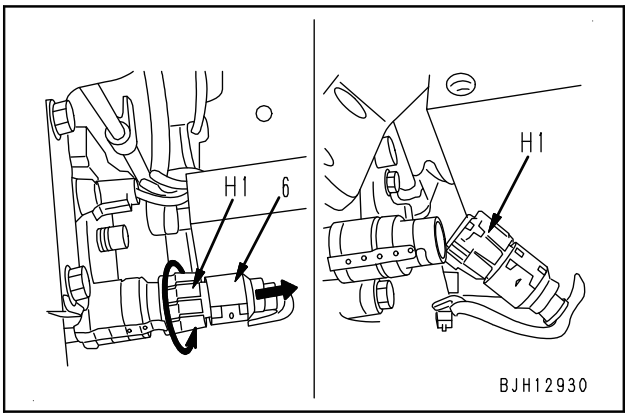
Disconnection

1. Turn housing (H1) in the direction of the arrow.

   ★ Unlock the connector by turning housing (H1). When the lock is release the housing is felt tight to turn.

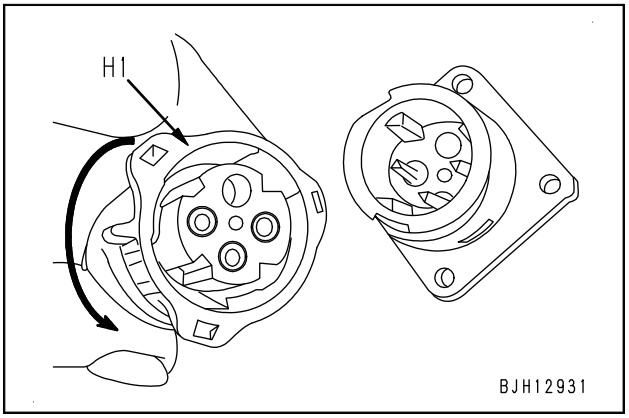
2. Pull out housing (H1) in the direction of the arrow.

   ★ Housing (H1) is left on the wiring harness side.



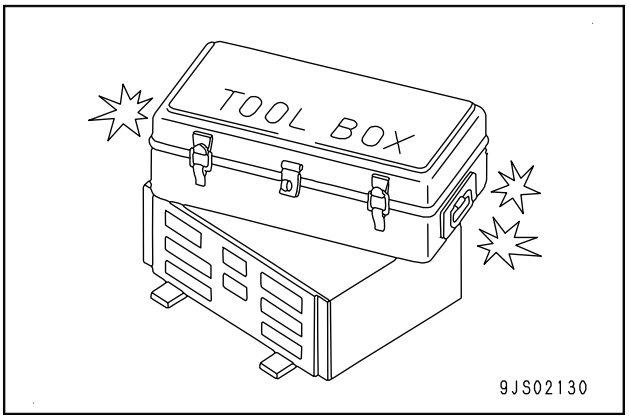
Connection

1. Insert the connector to the end while aligning its grove to the other.
2. Turn housing (H1) in the direction of the arrow until it "clicks".



Handling controller

- The electronic circuits for control including the microcomputers are assembled in the controller. These electronic circuits in the controller must be handled with care as they control the machine.
- Do not place objects on top of the controller.



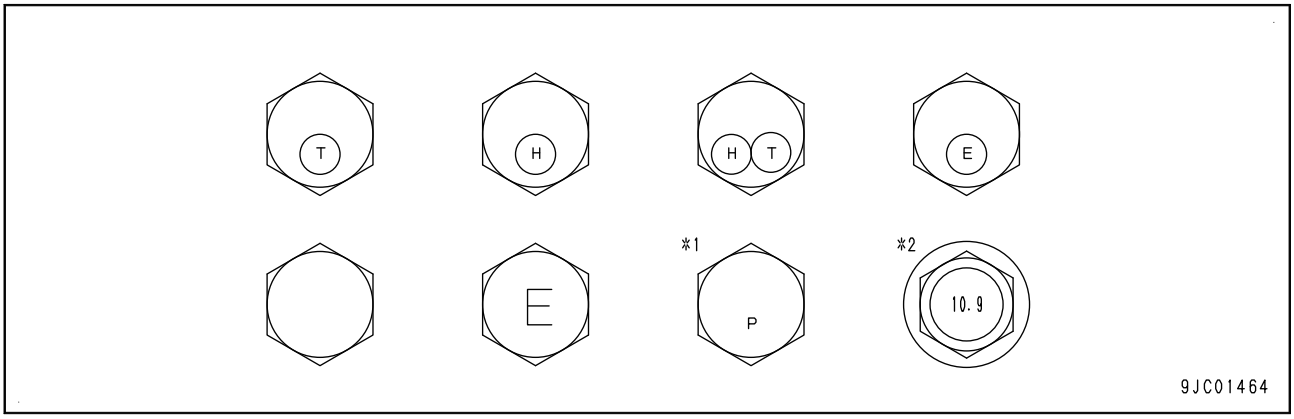
- Cover the control connectors with tape or a vinyl bag. Never touch the connector contacts.
- During rainy weather, do not leave the controller in a place where it is exposed to rain.
- Do not place the controller on oil, water, or soil, or in a place that can be heated to a high

Standard tightening torque table *(ALL-M140-03B-P-01-A)*

(Rev. 2012/10)

Table of tightening torque for bolts and nuts

Unless otherwise specified, tighten the metric bolts and nuts to the torque shown in the table below.



Thread diameter (mm)	Width across flats (mm)	Tightening torque (Nm {kgm})
6	10 (*2) 10	11.8 to 14.7 {1.2 to 1.5}
8	13 (*2) 12	27 to 34 {2.8 to 3.5}
10	17 (*1, *2) 14	59 to 74 {6.0 to 7.5}
12	19 (*1, *2) 17	98 to 123 {10.0 to 12.5}
14	22	157 to 196 {16 to 20}
16	24 (*1) 22	245 to 309 {25 to 31.5}
18	27	343 to 427 {35 to 43.5}
20	30	490 to 608 {50 to 62}
22	32	662 to 829 {67.5 to 84.5}
24	36	824 to 1,030 {84 to 105}
27	41	1,180 to 1,470 {120 to 150}
30	46	1,520 to 1,910 {155 to 195}
33	50	1,960 to 2,450 {200 to 250}
36	55	2,450 to 3,040 {250 to 310}
39	60	2,890 to 3,630 {295 to 370}

*1: Split flange bolt.

*2: Flanged bolt.

Abbreviation	Actual word spelled out
S/T	Steering
STRG	
SIG	Signal
SOL	Solenoid
STD	Standard
OPT	Option
OP	
PRESS	Pressure
SPEC	Specification
SW	Switch
TEMP	Temperature
T/C	Torque Converter
T/M	Transmission

MAF: Mass air flow and temperature sensor

PAMB: Ambient pressure sensor

PCCV: Crankcase pressure sensor

PIM: Intake manifold pressure sensor

POIL: Oil pressure switch

TIM: Intake manifold temperature sensor

TWTR: Coolant temperature sensor

VFT: Variable flow turbocharger

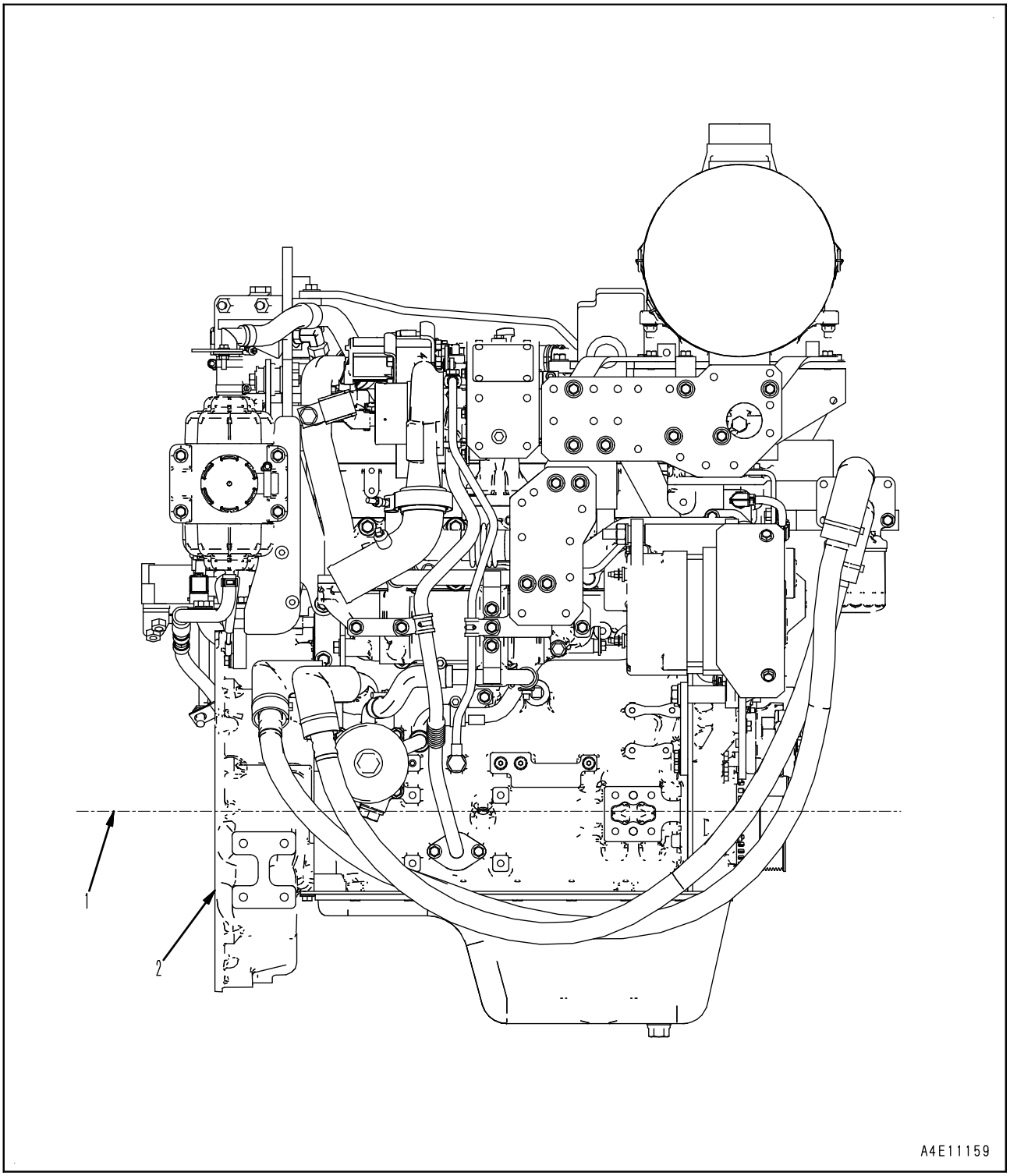
VFTV: Control actuator (electric)

- Tier4 is improved mainly over Tier3 in the following points.
  1. Employment of EGR (Exhaust Gas Recirculation) cooler (4) (reduction of NOx)
  2. Increase of intake air quantity in low engine speed range by changing turbocharger (VFT) speed (reduction of PM)
  3. Oxygen concentration control by EGR ratio control corresponding to operating condition attained by employing high-precision EGR valve (EGRV), mass air flow and temperature sensor (MAF), and engine controller, and by sensing condition of each part of EGR circuit (reduction of NOx and PM)
  4. Fine spraying of injected fuel by increasing common rail pressure and fuel injection pressure (reduction of PM)
  5. Internal circulation of blowby gas by employing blowby reductor (KCCV) (reduction of HC)
  6. Employment of oxidation catalyst (KDOC) muffler (reduction of HC and PM)
  7. Control of characteristic dispersion of injectors with engine controller (CM2250) (reduction of NOx, PM, and HC)
  8. Automatic control of fuel injection and VFT by recognizing high altitude with ambient pressure sensor (PAMB) (reduction of NOx and PM at high altitude)
  9. Employment of cylinder head having 4 valves (for each cylinder) (reduction of PM and fuel consumption)
  10. Improvement of piston combustion chamber (reduction of NOx, PM, and fuel consumption)

  *: PM (soot and other particulate matter), NOx (nitrogen oxides), HC (hydrocarbon)

Right side

★ The shape is subject to machine models.

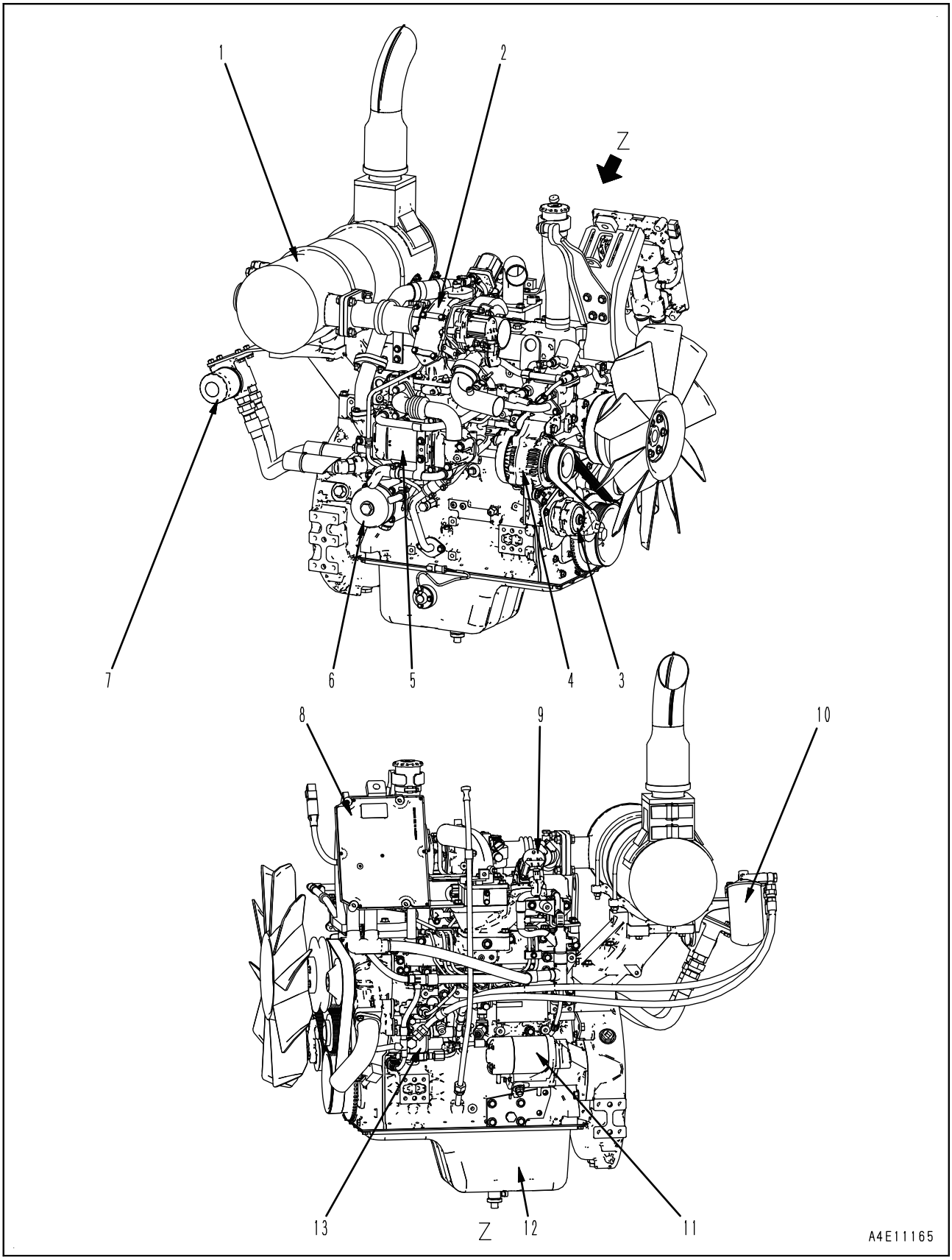


1. Center of crankshaft
2. Rear side of flywheel housing

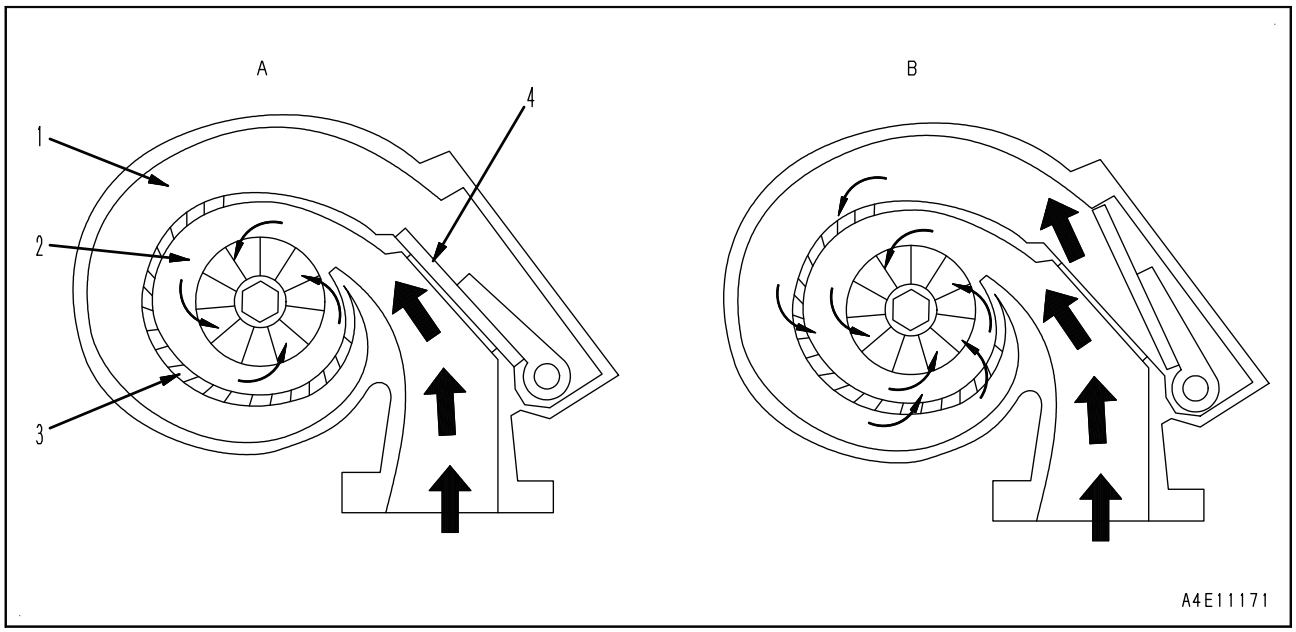
Components layout *(ALL-A000-001-K-04-A)*

Components layout drawing *(ENG95-A000-04D-K-00-A)*

★ The shape is subject to machine models.



Operation *(ENG95-AA10-044-K-00-A)*



1. Large scroll
2. Small scroll
3. Fixed vane
4. Flow control valve

A: When flow control valve is fully closed (small flow rate)

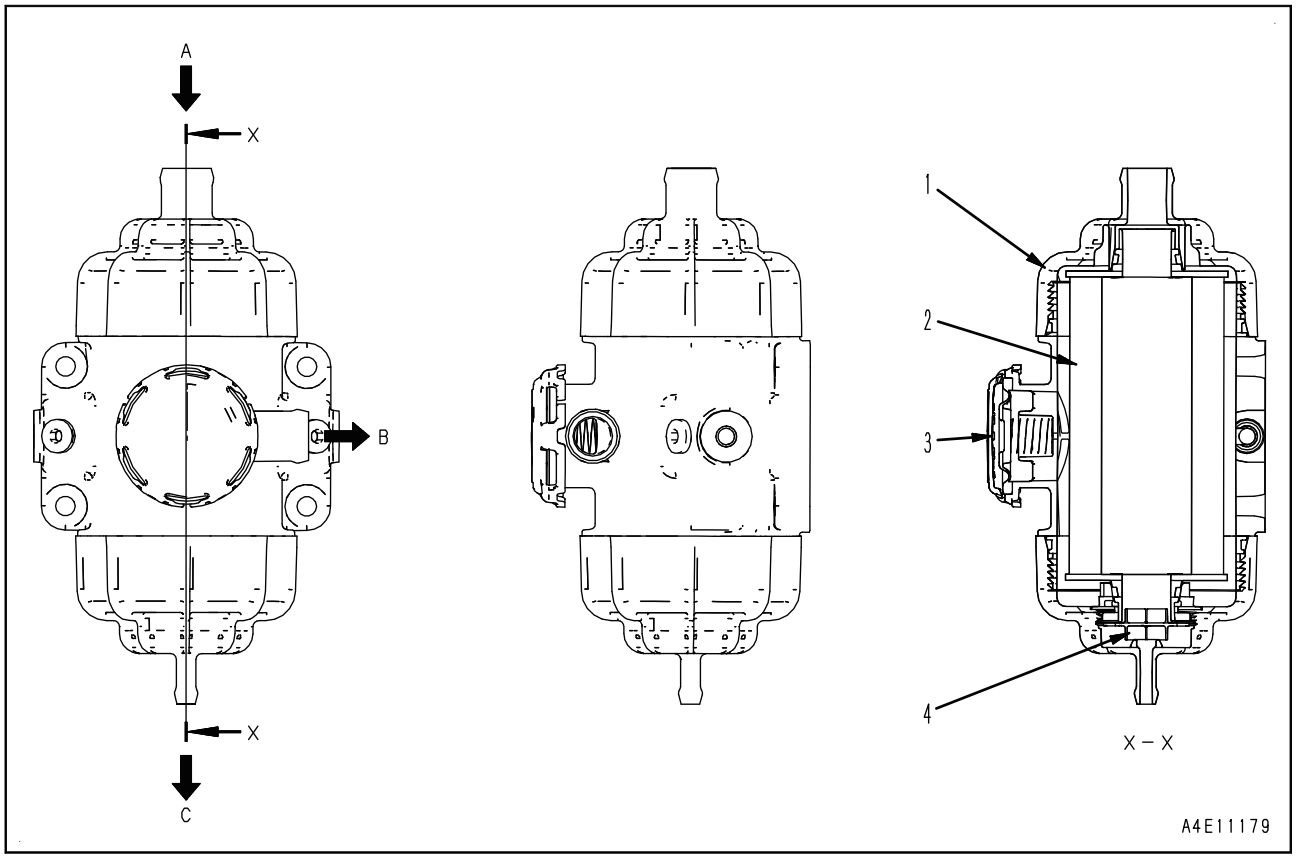
B: When flow control valve is fully open (large flow rate)

- The turbine housing of the VFT consists of large scroll (1) and small scroll (2).
- Fixed vane (3) is installed between large scroll (1) and small scroll (2) for flow rectification.
- The flow rate into large scroll (1) side is controlled by opening or closing the flow control valve (4).
- The position of the flow control valve (4) is controlled by the actuator which is driven by the command from the engine controller.

KCCV ventilator *(ENG95-A18H-041-K-00-A)*

★ KCCV: Abbreviation for KOMATSU Closed Crankcase Ventilation

★ The shape is subject to machine models.



1. Case
2. Filter
3. CDR valve
4. Relief valve

A: Blowby gas inlet (from breather)

B: Blowby gas outlet (to VFT intake side)

C: Oil drain port (to oil pan)

Function *(ENG95-A18H-042-K-00-A)*

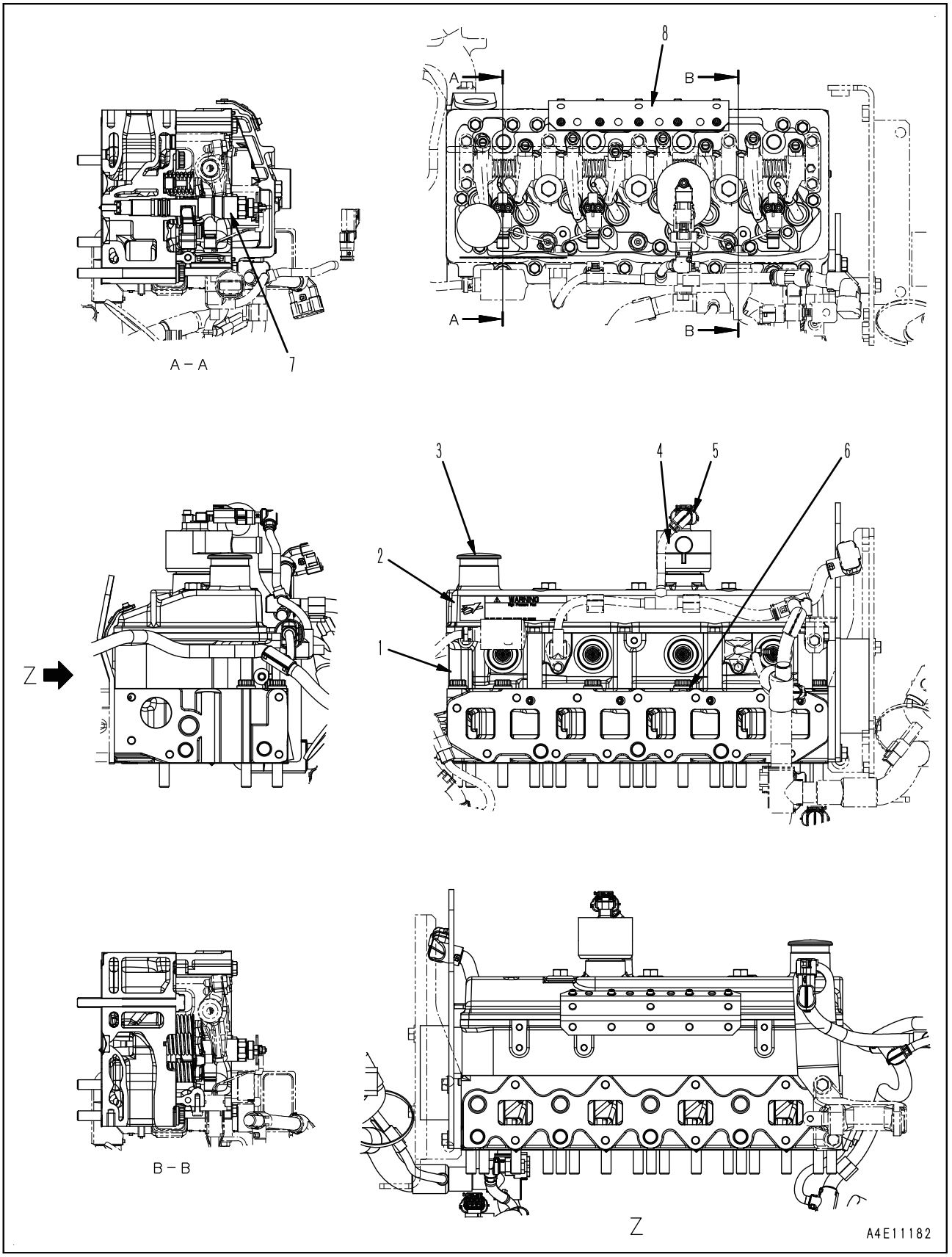
- If the blowby gas is returned to the intake side of the VFT, the crankcase pressure becomes negative and dust may be sucked in through the crankshaft seal. To prevent this, the blowby pressure is controlled by using the CDR valve (regulator valve) and crankcase pressure sensor.
- If the filter of the KCCV ventilator is clogged, the crankcase pressure increases to cause oil leakage. To prevent this, the crankcase pressure sensor (installed separately) senses clogging of the filter.
- There are 2 types of the filter; one is the top load type (taken out upward) and the other is the bottom load type (taken out downward).

Operation *(ENG95-A18H-044-K-00-A)*

- Blowby gas enters (A) and engine oil mist is separated when it flows through filter (2).
- The separated oil flows along the case wall to oil drain port (C), and then flows into the oil pan.
- When the crankcase pressure becomes negative, the CDR valve operates to prevent the crankcase pressure from becoming excessively negative.
- The crankcase pressure sensor senses the blowby gas pressure (crankcase pressure).
- If the engine controller judges from the value sensed by the crankcase pressure sensor that the filter is clogged, it displays failure code CA555 and then displays CA556 if the pressure increases further.

Cylinder head *(ENG95-A100-041-K-00-A)*

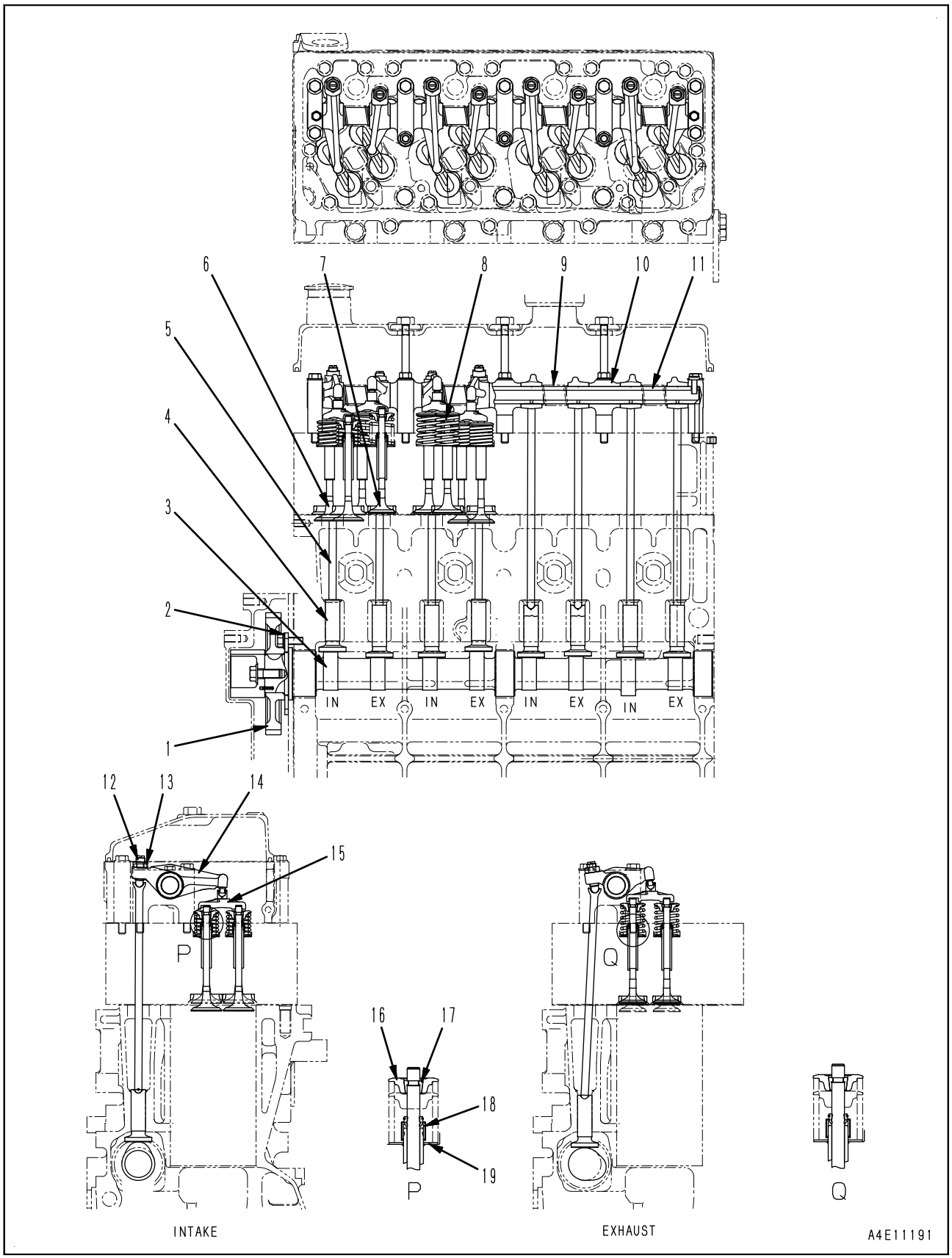
★ The shape is subject to machine models.



1. Cylinder head
2. Cylinder head cover

Valve system *(ENG95-A700-041-K-00-A)*

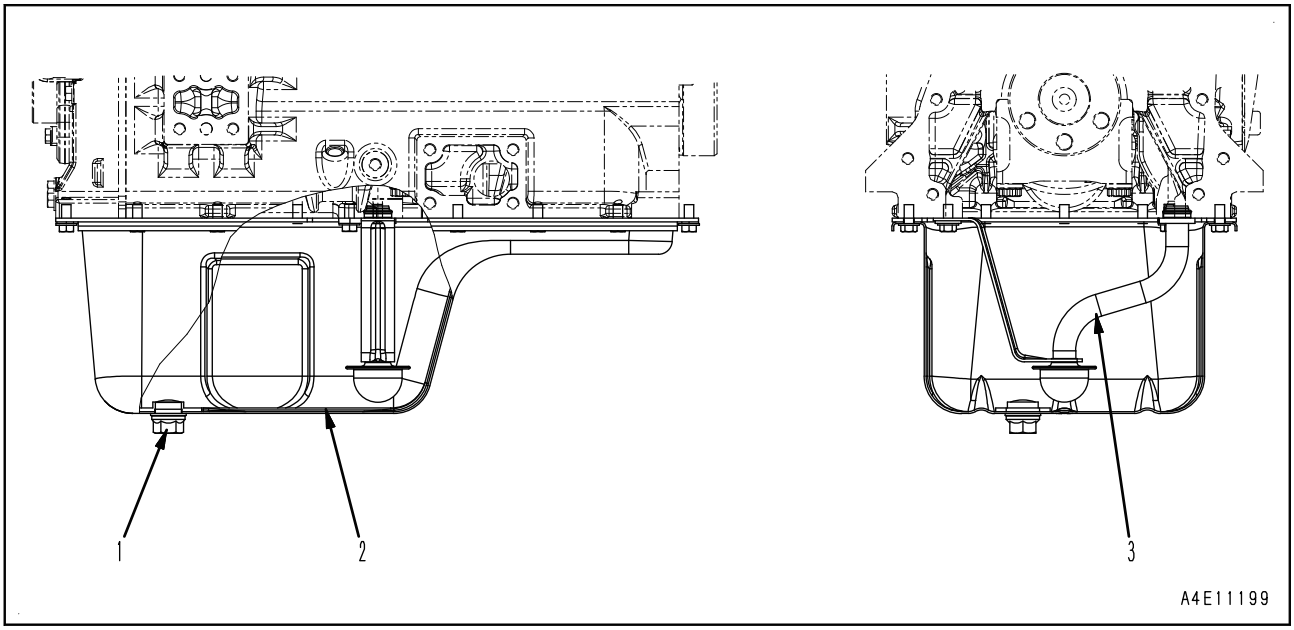
★ The shape is subject to machine models.



1. Cam gear (number of teeth: 52)
2. Thrust plate

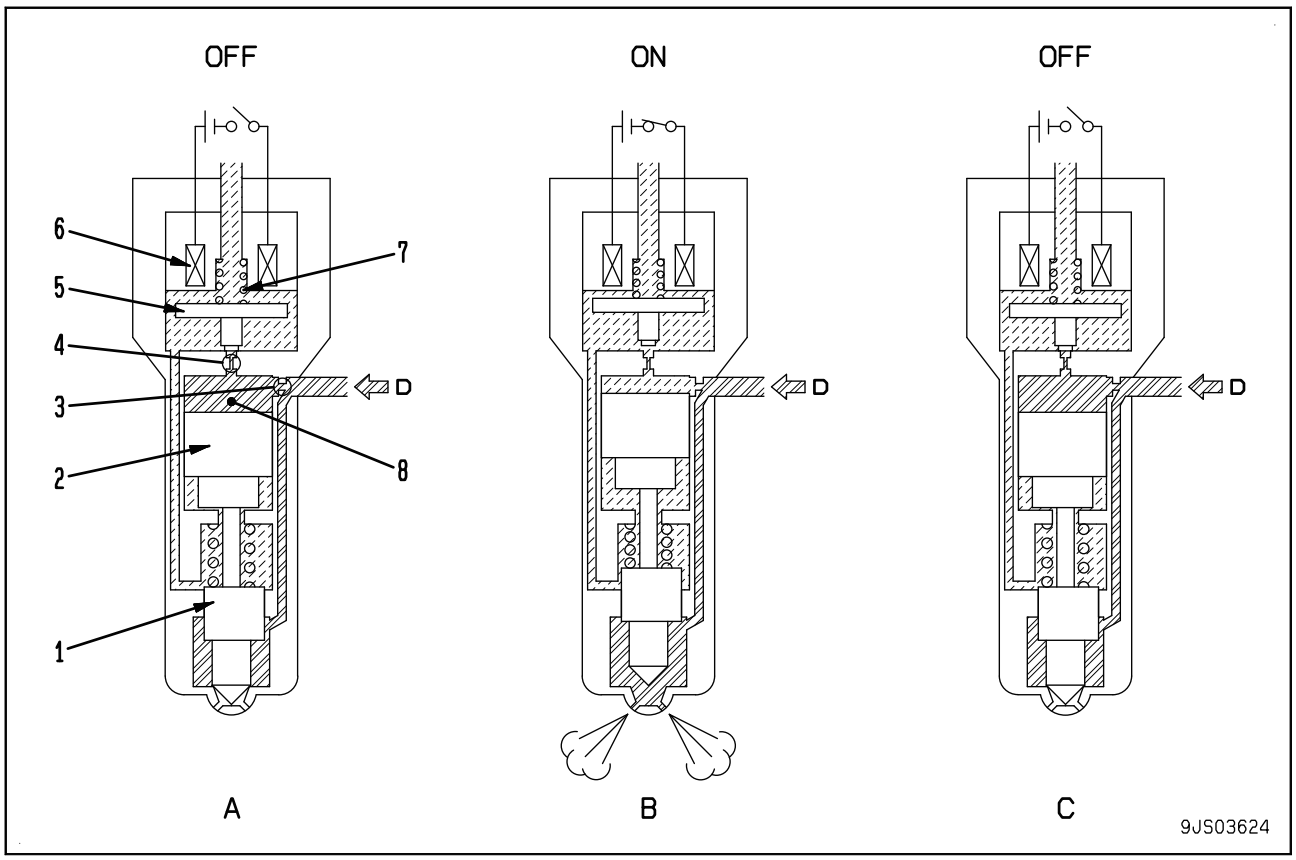
Oil pan *(ENG95-AB20-041-K-00-A)*

★ The shape is subject to machine models.



1. Drain plug
2. Oil pan
3. Oil suction pipe (with strainer)

- The injector consists of the traditional nozzle section, orifice to control the fuel injection rate, hydraulic piston, and 2-way solenoid valve.



A: When fuel is not injected
B: When fuel injection is started
C: When fuel injection is finished
D: From common rail
1. Nozzle
2. Control piston
3. Orifice (IN)
4. Orifice (OUT)
5. Valve body
6. Solenoid
7. Spring
8. Pressure control chamber

Specifications *(ENG95-AE60-030-K-00-A)*

- Model: G3 manufactured by DENSO

Operation *(ENG125-AE60-044-K-00-A)*

1) When fuel is not injected (A)

- When solenoid (6) is not energized, valve body (5) is pushed down by spring (7).
- Since the high-pressure fuel is applied from the common rail to pressure control chamber (8), nozzle (1) is closed and the fuel is not injected.

2) When fuel injection is started (B)

- When solenoid (6) is energized, valve body (5) is pulled up by the electromagnetic force and the fuel passage opens.
- Since the fuel in pressure control chamber (8) flows out through orifices (3) and (4), nozzle (1) rises and fuel injection pump starts.

B: Secondary valve open

L: Lift

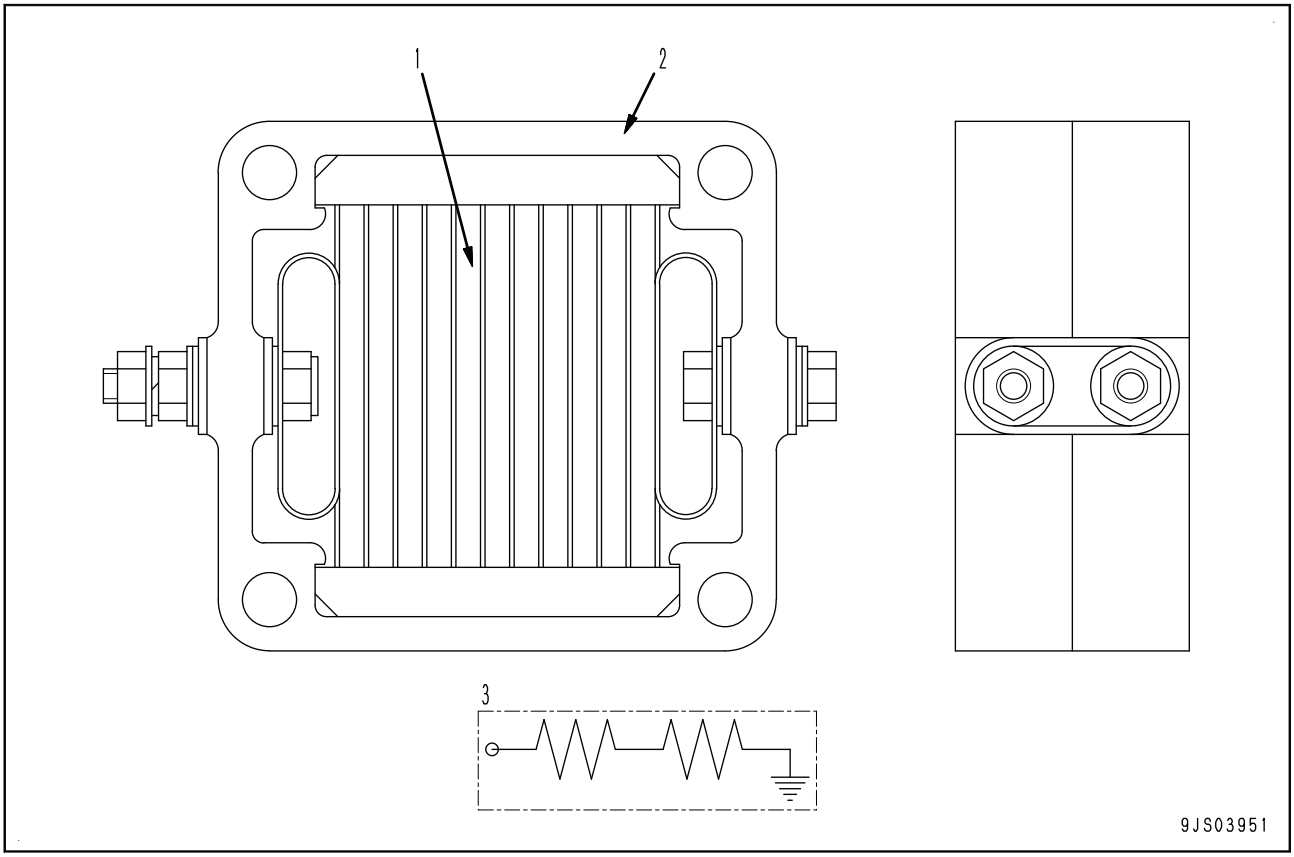
Q: Flow rate

The coolant flows as shown in the above lift-flow characteristics (reference graph). The flow change gradient low when the lift is low.

Accordingly, the flow rate fluctuation caused by hunting is reduced when the valve is open, and the thermal shock to the engine is reduced.

Intake air heater *(ENG95-AM51-041-K-00-A)*

★ The shape is subject to machine models.



1. Heater coil
2. Housing
3. Internal wiring diagram

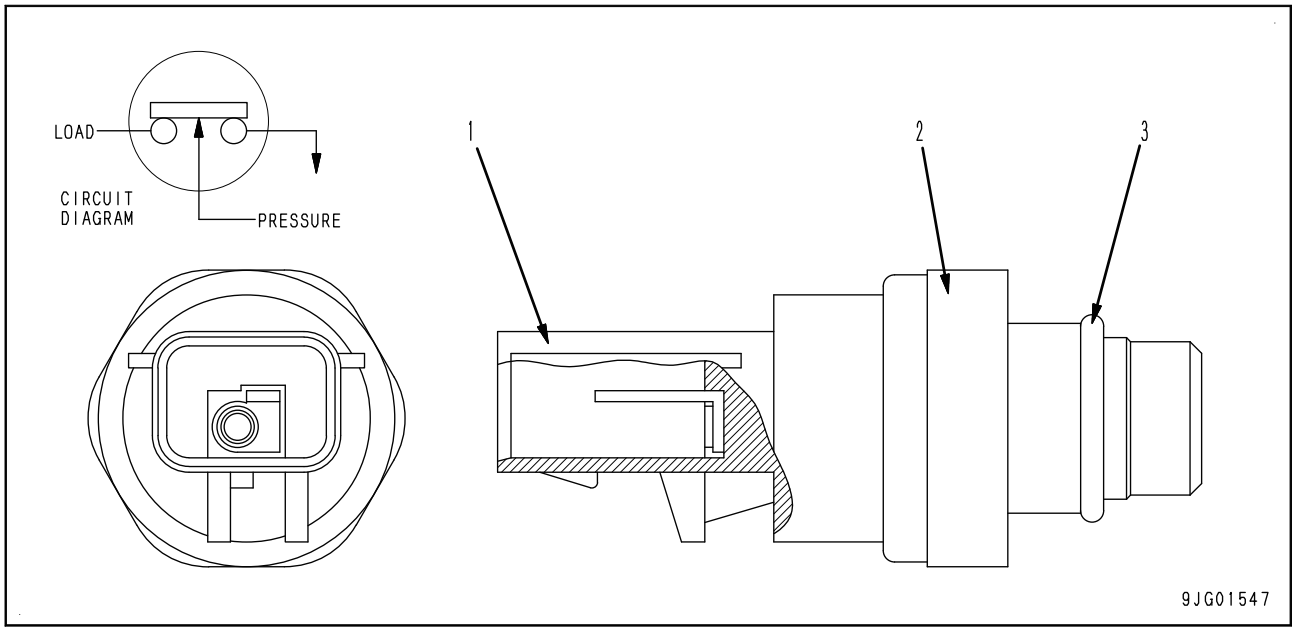
Specifications *(ENG95-AM51-030-K-00-A)*

- Type of heater: Electric intake air heater (ribbon heater)
- Rated voltage: 22 V (DC)
- Load current: 110 A

List of sensors *(ENG95-AK50-056-K-00-A)*

No.	Sensors	Connector label name
1	VFT motor (with built-in position sensor)	VFT
2	Crankcase pressure sensor	CCV
3	Coolant temperature sensor	TWTR
4	Bkup (camshaft) speed sensor	CAM
5	EGR valve motor (with built-in position sensor)	EGR/V
6	Charge (boost) pressure and temperature sensor	TMAP(PITM)
7	Ambient pressure sensor	PAMB
8	Common rail pressure sensor	PFUEL
9	Suction control valve	SCV
10	Engine oil pressure switch	POIL
11	Ne (crankshaft) speed sensor	NE
—	Mass air flow and temperature sensor	MAF

Engine oil pressure switch *(PC-ABK6-041-K-00-A)*



1. Connector
2. Sensor
3. O-ring

Specifications *(PC220-ABK6-030-K-00-A)*

Contact type: Normally closed

Function *(ENG95-ABK6-042-K-00-A)*

- This oil pressure sensor is installed to the cylinder block, senses the engine oil pressure, and turns "ON" when the engine oil pressure decreases below the specified pressure.

Standard service value table *(ALL-A000-001-K-00-A)*

Standard value table for engine *(ENG107-A000-033-K-00-A)*

Applicable machine: PC138USLC-10 *(ENG95-A000-033-K-00-A)*

Performance

Engine				SAA4D95LE–6	
Item	Measurement condition		Unit	Standard value for new machine	Repair limit
Engine speed	• Coolant temperature: 75 to 94 °C	High idle	rpm	2,150 ± 60	2,150 ± 60
		Low idle		1,100 ± 50	1,100 ± 50

Air intake and exhaust system

Engine				SAA4D95LE–6	
Item	Measurement condition		Unit	Standard value for new machine	Repair limit
Air intake resistance	Whole speed range		kPa {mmH $_2$O}	Max. 3.73 {380}	Max. 7.47 {762}
Boost pressure	At rated horsepower		kPa {mmHg}	-	-
Exhaust gas temperature	Whole speed range (20 °C)		°C	Max. 650	Max. 700
Exhaust gas color	• Coolant temperature: 75 to 94 °C • After kept for 5 seconds at normal condition	Exhaust pipe outlet	Bosch index	Max. 0.5	Max. 2.0
Valve clearance	Intake valve		mm	0.35	-
	Exhaust valve			0.50	-

Main body

Engine			SAA4D95LE–6	
Item	Measurement condition	Unit	Standard value for new machine	Repair limit
Compression pressure	Engine oil temperature: 40 to 60 °C Engine speed: 200 to 250 rpm	MPa {kg/cm^2}	Min. 2.9 {30}	Min. 2.0 {20}
Blowby pressure	At rated horsepower (when KCCV is disconnected)	kPa {mmH$_2$O}	Max. 0.98 {100}	Max. 1.47 {150}

Related information on disassembly and assembly *(ALL-3851-001-A-00-A)*

How to read this manual *(ALL-0320-011-A-00-A)*

(Rev.2013.05)

Removal and installation of □□□□ assembly
Special tools

- The special tools required for removal and installation work are described in the list as symbols such as A1, ..., X1. Part number, part name, necessity, and quantity are described.
- Mark used in the column of necessity are explained below.
  ■: Tools are not substituted, must always be equipped (used).
  ●: Tools extremely useful if available or tools that can be substituted with commercially available tools.
- For details and the sketches of the special tools, see "Special tool list" and "Sketches of special tools."

Removal

- In "Removal" section, the work procedures, precautions and know-how to do the work, and the amount of oil and coolant to be drained are described.
- The general tools required for "Removal" are listed as [1], [2], ..., without description of part number, part name, and quantity.
- Marks used in "Removal" section are explained below.

⚠ : This mark shows safety-related precautions which must be followed when performing the work.

★ : This mark gives knowledge or precautions when performing the work.

[*1]: This mark indicates that knowledge or precautions for the assembly installation work are given in the "Installation" section.


: This mark shows the amount of oil or coolant to be drained.


: This mark shows the weight of the part or equipment.

Installation

- The work procedure of "Installation" is in the reversed order to removal unless otherwise specified.
- For knowledge and precautions required for "Installation", a [*1] mark is assigned to the "Removal" work procedure to indicate the work item of the installation knowledge or precaution.
- The general tools required for "Installation" are listed as [1], [2], ..., without description of part number, part name, and quantity.
- Marks used in "Installation" section are explained below.

⚠ : This mark shows safety-related precautions which must be followed when performing the work.

★ : This mark gives knowledge or precautions when performing the work.


: This mark shows the weight of the part or equipment.


: This mark shows a specific coating agent to be used.


: This mark shows the specified tightening torque.


: This mark shows the amount of oil or coolant to be added.

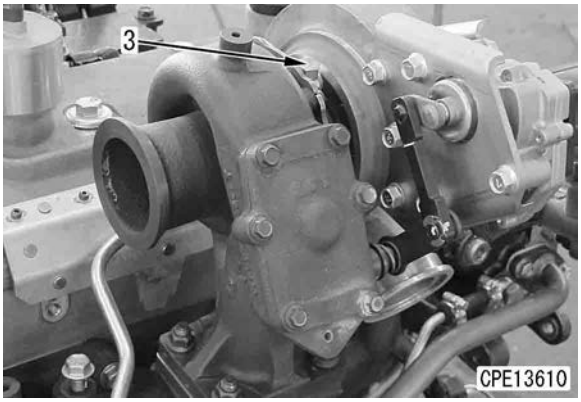
- **For details of oil or coolant to be added after installation, see Specification "Table of fuel, coolant and lubricants".**

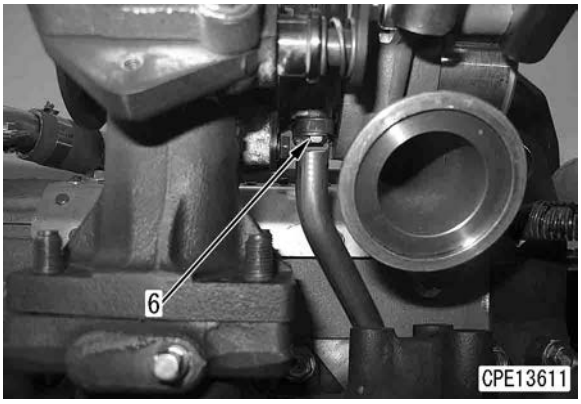
Disassembly and assembly of □□□□ assembly
Special tools

- The special tools required for disassembly and assembly work are described in the list as symbols such as A1, ..., X1. Part number, part name, necessity, and quantity are described.
- Mark used in the column of necessity are explained below.
  ■: Tools are not substituted, must always be equipped (used).
  ●: Tools extremely useful if available or tools that can be substituted with commercially available tools.
- For details and the sketches of the special tools, see "Special tool list" and "Sketches of special tools."

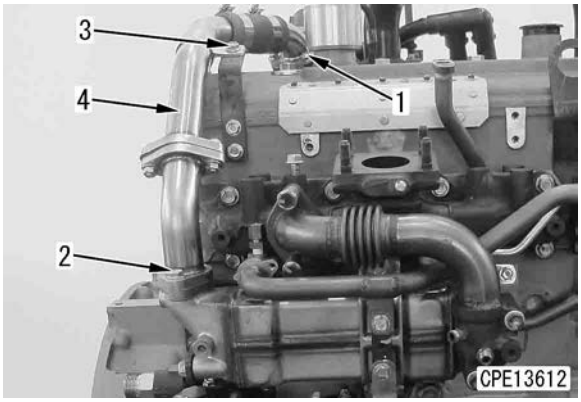
Disassembly

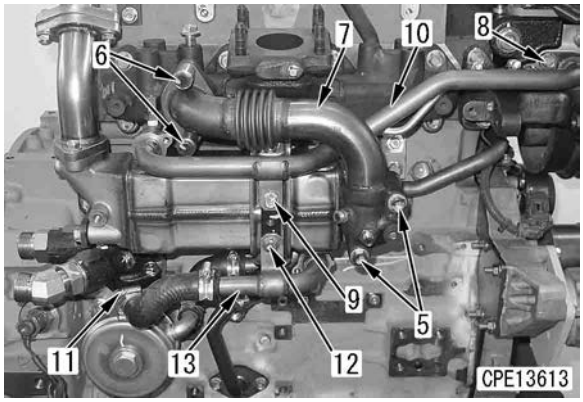
- "Disassembly" describes the work procedure as well as the precautions, knowledge, and drain amounts of oil and coolant required for the work.
- The general tools required for "Disassembly" are listed as [1], [2], ..., without description of part number, part name, and quantity.

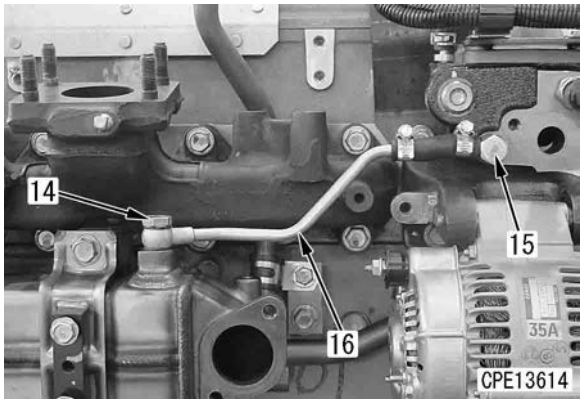




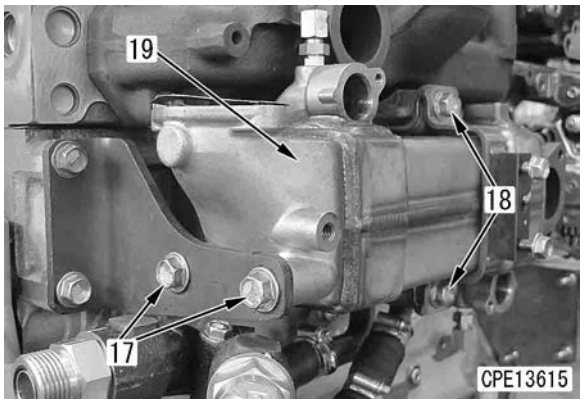
9. EGR cooler assembly
   1) Remove mounting bolts (1) (3 pieces), mounting bolts (2) (2 pieces), and clamping bolt (3). Remove tube (4).
   2) Remove mounting bolts (5) and (6), and then remove tube (7).
   3) Remove mounting bolts (8) (2 pieces), mounting bolt (9), and then remove tube (10).
   4) Remove hose clamp (11), bolt (12), and tube (13).
   5) Remove joint bolts (14) and (15), and then remove tube (16).



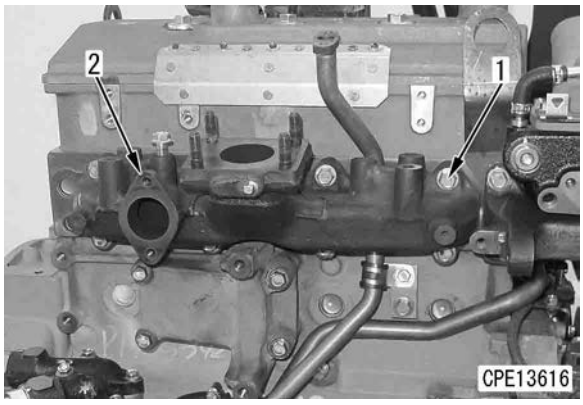




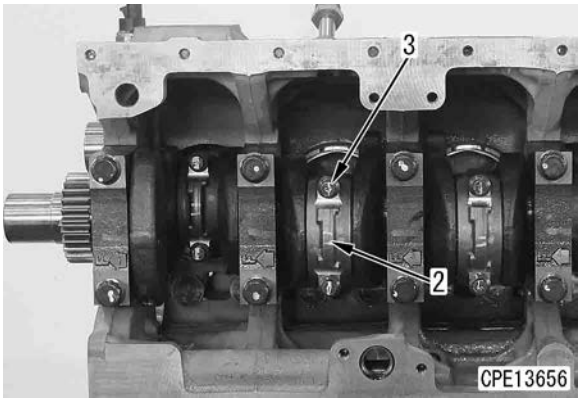
   6) Remove mounting bolts (17) and (18), and remove EGR cooler (19).



10. Exhaust manifold assembly
    Remove mounting bolts (1) (8 pieces) and exhaust manifold (2).



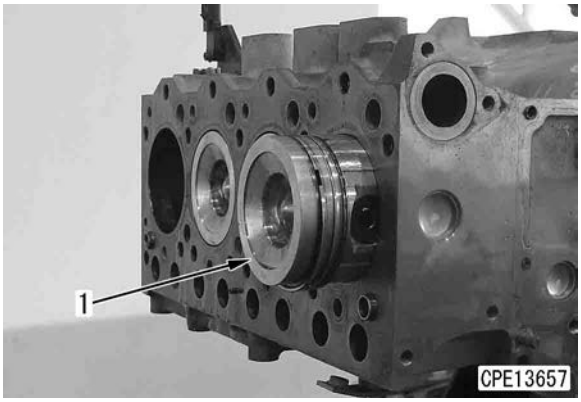
11. Oil cooler and adapter assembly



6) Use a wooden bar from oil pan side to push the piston skirt, support the piston at the cylinder head end, then push more from oil pan side and pull out piston and connecting rod assembly (1).

★ Remove from all cylinders in the same way.

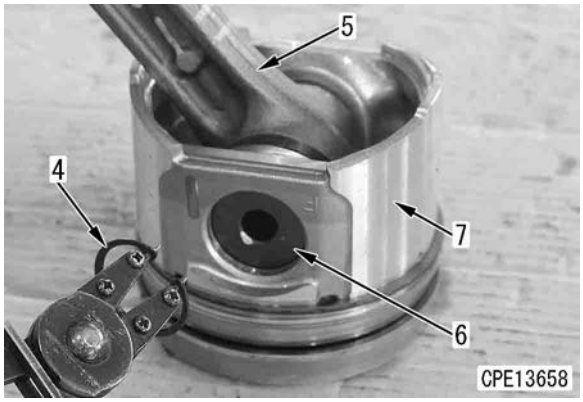
★ Be careful that the sliding surfaces of the pistons, connecting rod bearings, etc. are not damaged.



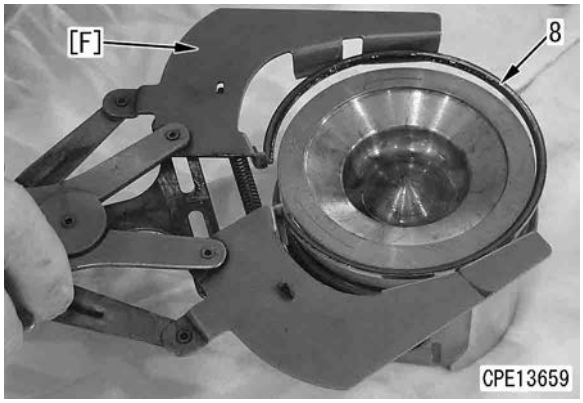
7) Disassemble piston and connecting rod assembly (1) according to the following procedure.

1] Remove snap ring (4).
2] Support connecting rod (5) with your hand, pull out piston pin (6) and disconnect piston (7) from the connecting rod.
3] Remove the snap ring on the opposite side.

★ If the piston pin cannot be pulled out, soak it in hot water, then pull it out.



4] By using tool F, remove piston ring (8) off the piston.

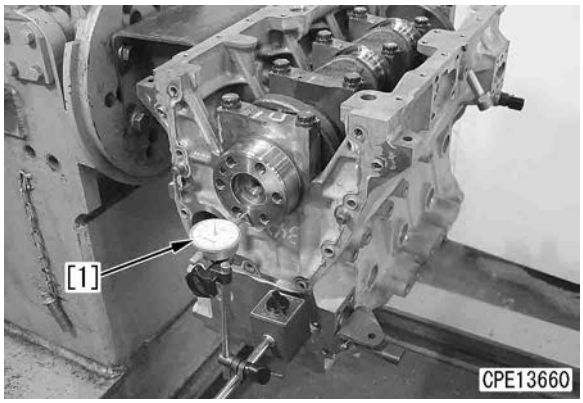


42.Main cap

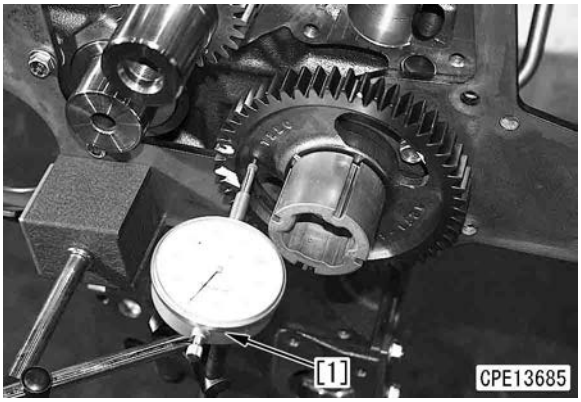
1) Measuring end play (play in axial direction)

1] Rotate the engine repair stand, and set the oil pan of engine assembly to come upward.
2] Measure the end play of crankshaft by using dial gauge [1].

★ The end play measurement is necessary for judging the wear of the thrust bearing and abnormal wear of the crankshaft, so measure it before removing the crankshaft.



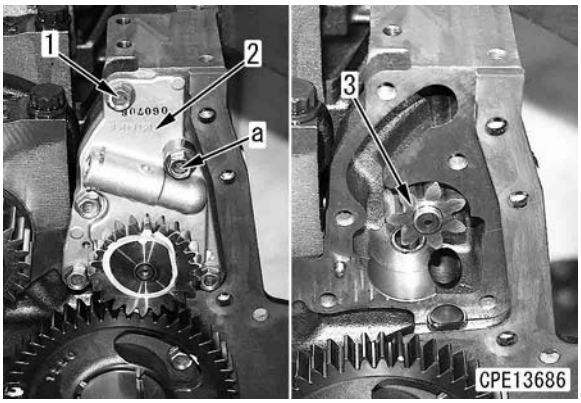
2) Remove mounting bolts (1) (10 pieces) of the main cap, then remove main caps (2) (5 pieces).



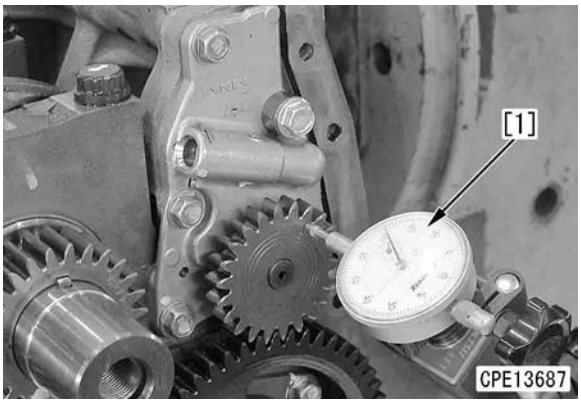
10.Oil pump assembly

1) Install driven gear (3) of the oil pump.
2) Install oil pump (2) and tighten mounting bolts (1).

★ Mounting bolts (a) have spacers.



3) Apply the probe of the dial gauge [1] to the end face of the oil pump gear and move the oil pump gear back and forth to measure the end play.
End play of oil pump gear: 0.02 to 0.07 mm



11.Idler gear

1) Align match marks on each gear and install idler gear (1).

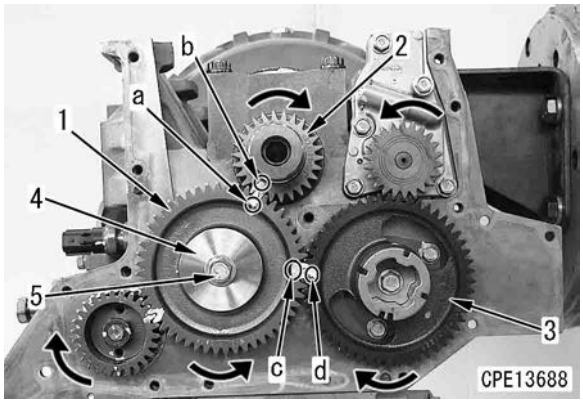
★ How to align the match marks

- Idler gear (1) and crankshaft gear (2): Match stamp mark "A" of gear (a) and stamp mark "A" of gear (b).
- Idler gear (1) and camshaft gear (3): Match stamp mark "B" of gear (c) and stamp mark "B" of gear (d).

2) Install washers (4) and tighten the idler gear mounting bolts (5).

Mounting bolt:
98.0 to 122.5 Nm {10.0 to 12.5 kgm}

★ Install the washer with its unchamfered face facing the gear.

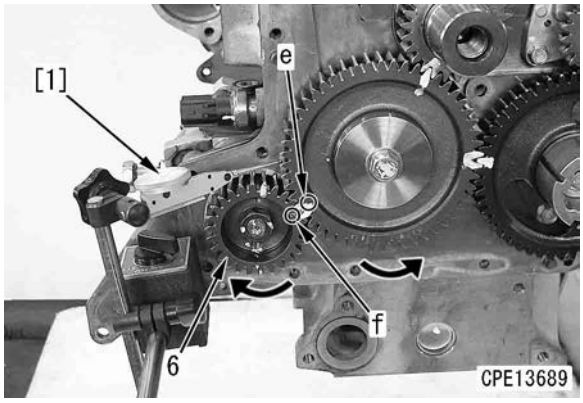


3) Apply the probe of the dial gauge [1] to the end face of the idler gear and move the idler gear back and forth to measure the end play.
End play of idler gear: 0.03 to 0.09 mm

4) Measuring backlash of each gear
Install supply pump assembly (6) loosely and measure the backlash of each gear by using dial gauge [1].

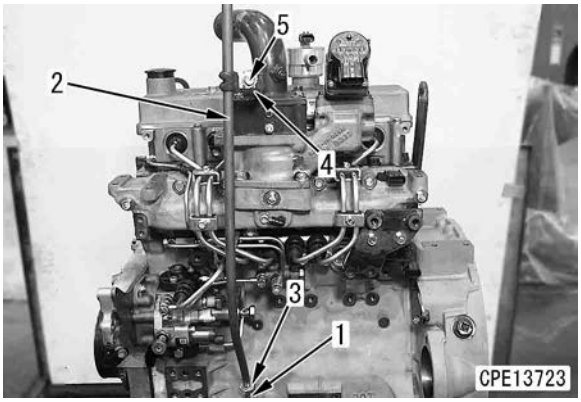
★ For installation of the supply pump assembly, see "Removal and installation of supply pump".

★ When the supply pump assembly is loosely installed, the matchmark of the gear must be matched to stamp mark "C" at part (e) and stamp mark "C" at part (f).

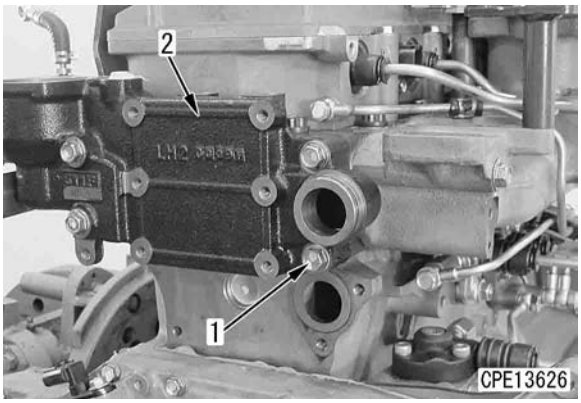


★ When measuring the backlash of each gear, fix the mating gear securely and move the other gear.

- Standard backlash values of each gear

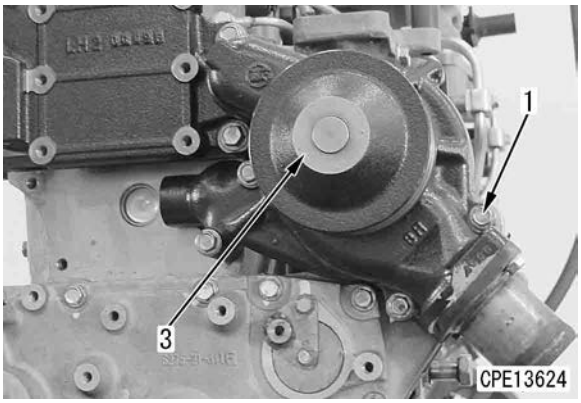


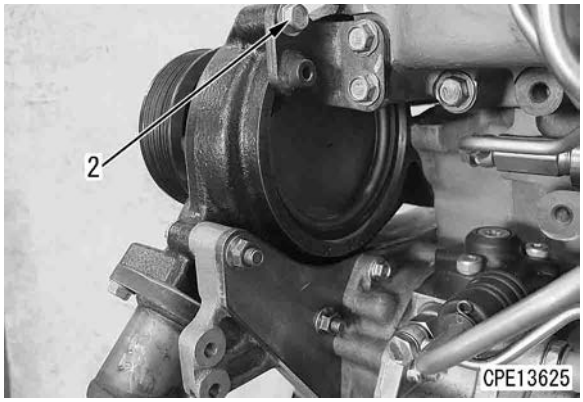
27.Thermostat housing
Install thermostat housing (2), and then tighten mounting bolts (1).



28.Water pump assembly
Install water pump (3) and tighten mounting bolts (1) (4 pieces) and mounting bolt (2).

★ Do not forcibly install it otherwise it may cause scratches or flaws to the O-ring.

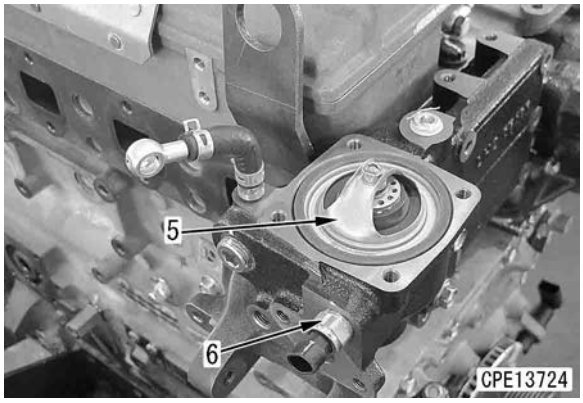




29.Coolant temperature sensor and thermostat
1) Install coolant temperature sensor (6).

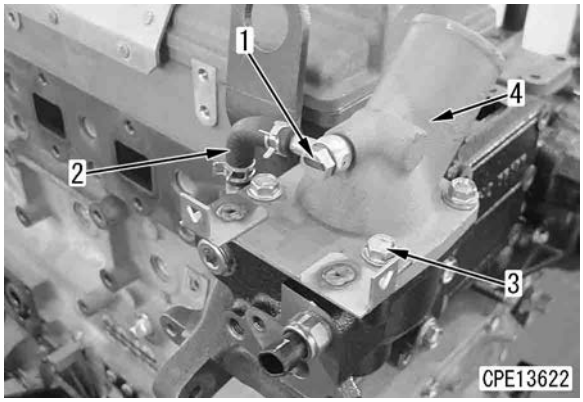
Coolant temperature sensor:
22.5 ± 2.9 Nm {2.3 ± 0.3 kgm}

2) Install thermostat (5).



3) Install coolant outlet connector (4) with mounting bolts (3).
4) Install hose (2) and tighten joint bolts (1).

Joint bolt:
9.8 to 12.7 Nm {1.0 to 1.3 kgm}



30.Bracket and wiring harness assembly
1) Install brackets (1) and (2).
2) Route wiring harness assembly (3) in specified position, connect the wiring harness connectors to their mating connectors, and then fix it with clamps.
3) Connect the following connectors.

Engine rear oil seal replacement procedure *(ENG107-A510-924-K-00-A)*

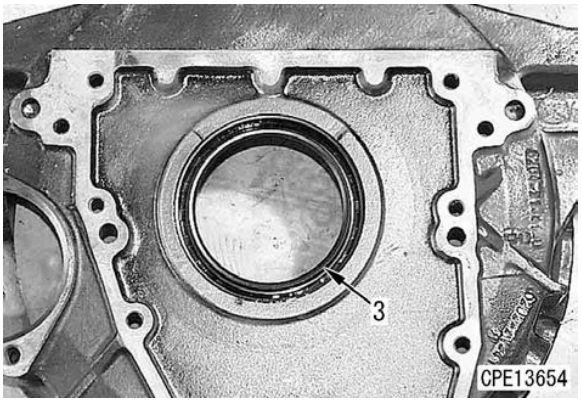
Removal *(ENG95-A510-520-K-00-A)*

★ For the work up to the removal of the flywheel, see the manual for the machine the engine is installed.

Screw a slide hammer, etc. in the metal ring of rear oil seal (2), and pull out the rear oil seal by using the the impact of the slide hammer.

★ Before pulling out the seal, drive the seal inward a little to separate it from the housing for easy removal.

★ Do not use a drill, etc. as metal chips may enter the engine.

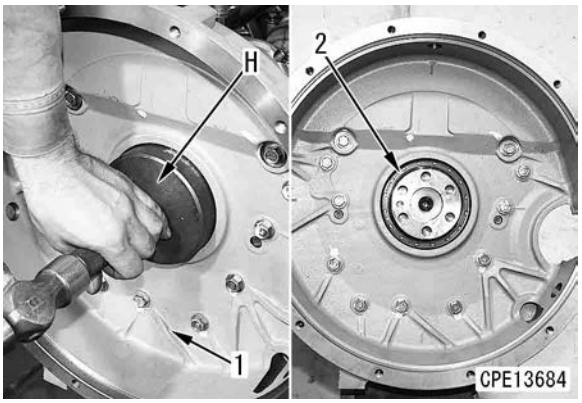


Installation *(ENG95-A510-720-K-00-A)*

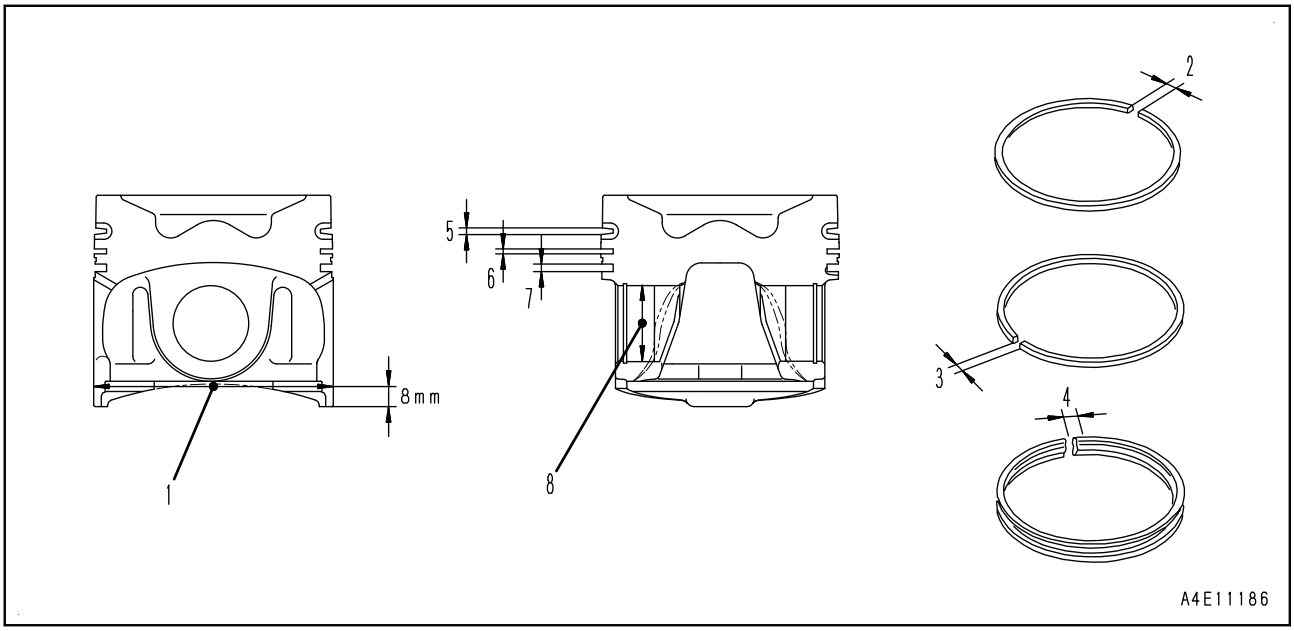
★ Before installing the rear oil seal, check that the end corner and the lip sliding surface of the crankshaft are free from a flaw, burr, fin, and rust.

1. Install rear oil seal (2) by using tool H.
2. After press fitting the rear oil seal, fill the space between oil seal lips with approximately 3 cc of grease.

Rear oil seal: Grease (G2-LI)



Piston *(ENG95-A580-034-K-00-A)*



Unit: mm

No.	Item	Criteria						Remedy
1	Outside diameter of piston (perpendicular to boss)		Standard dimension			Repair limit		Replace piston (Only S is supplied)
		STD	94.875			94.86		
		0.25 OS	95.125			95.11		
		0.50 OS	95.375			95.36		
2	Clearance on abutment joint of piston ring	Measuring location	Standard clearance			Allowable clearance		Replace piston ring
		Top ring	0.28 to 0.38			2.0		
3		Second ring	0.40 to 0.50			2.0		
4		Oil ring	0.20 to 0.40			1.5		
5	Clearance between piston ring groove and piston ring	Measuring location	Standard dimension	Tolerance		Standard clearance	Allowable clearance	Replace piston ring or piston
				Ring	Piston			
		Top ring	2.5	-0.01 -0.03	Judge by groove wear gauge (*1)			
6		Second ring	2	-0.01 -0.03	+0.05 +0.03	0.04 to 0.08	0.16	
7		Oil ring	2.5	-0.01 -0.03	+0.04 +0.02	0.03 to 0.07	0.15	
8	Clearance between piston and piston pin	Standard dimension	Tolerance			Standard clearance	Allowable clearance	Replace piston or piston pin
			Shaft	Hole				
		30	0 -0.006	+0.012 +0.004		0.04 to 0.018	0.05	

*1: Part No. of wear gauge 795-901-1130

★ OS: Oversize