SEN00169-05

Shop Manual

ENGINE

114E-3 SERIES

KOMATSU

Engine

114E-3 Series

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Composition of shop manual

The contents of this shop manual are shown together with Form No. in a list.

Note 1: Always keep the latest version of this manual in accordance with this list and utilize accordingly.
The marks shown to the right of Form No. denote the following:
○: New issue (to be filed additionally) ●: Revision (to be replaced for each Form No.)

Note 2: This shop manual can be supplied for each Form No.

Note 3: To file this shop manual in the special binder for management, handle it as follows:
- Place a divider on the top of each section in the file after matching the Tub No. with No. indicated next to each Section Name shown in the table below:
- File overview and other materials in sections in the order shown below and utilize them accordingly.

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KOMATSU 114E-3 Series Diesel engine

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Engine

114E-3 Series

00 Index and foreword

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Safety notice

(Rev. 2007/03)

Important safety notice

Proper service and repair are extremely important for safe machine operation. The service and repair techniques recommended by Komatsu and described in this manual are both effective and safe. Some of these techniques require the use of tools specially designed by Komatsu for the specific purpose.

To prevent injury to workers, the symbol ⚠ is used to mark safety precautions in this manual. The cautions accompanying these symbols should always be followed carefully. If any dangerous situation arises or may possibly arise, first consider safety, and take the necessary actions to deal with the situation.

1. General precautions

⚠ **Mistakes in operation are extremely dangerous. Read the Operation and Maintenance Manual carefully before operating the machine.**

1) Before carrying out any greasing or repairs, read all the safety plates stuck to the machine. For the locations of the safety plates and detailed explanation of precautions, see the Operation and Maintenance Manual.
2) Decide a place in the repair workshop to keep tools and removed parts. Always keep the tools and parts in their correct places. Always keep the work area clean and make sure that there is no dirt, water, or oil on the floor. Smoke only in the areas provided for smoking. Never smoke while working.
3) When carrying out any operation, always wear safety shoes and helmet. Do not wear loose work clothes, or clothes with buttons missing.
   - Always wear safety glasses when hitting parts with a hammer.
   - Always wear safety glasses when grinding parts with a grinder, etc.
4) When carrying out any operation with 2 or more workers, always agree on the operating procedure before starting. Always inform your fellow workers before starting any step of the operation. Before starting work, hang UNDER REPAIR warning signs in the operator's compartment.
5) Only qualified workers must carry out work and operation which require license or qualification.
6) Keep all tools in good condition, learn the correct way to use them, and use the proper ones of them. Before starting work, thoroughly check the tools, machine, forklift, service car, etc.
7) If welding repairs are needed, always have a trained and experienced welder carry out the work. When carrying out welding work, always wear welding gloves, apron, shielding goggles, cap and other clothes suited for welding work.
8) Before starting work, warm up your body thoroughly to start work under good condition.

Safety points

1	Good arrangement
2	Correct work clothes
3	Following work standard
4	Making and checking signs
5	Prohibition of operation and handling by unlicensed workers
6	Safety check before starting work
7	Wearing protective goggles (for cleaning or grinding work)
8	Wearing shielding goggles and protectors (for welding work)
9	Good physical condition and preparation
10	Precautions against work which you are not used to or you are used to too much

2. Preparations for work

1) Before adding oil or making any repairs, park the machine on hard and level ground, and apply the parking brake and block the wheels or tracks to prevent the machine from moving.
2) Before starting work, lower the work equipment (blade, ripper, bucket, etc.) to the ground. If this is not possible, insert the lock pin or use blocks to prevent the work equipment from falling. In addition, be sure to lock all the control levers and hang warning signs on them.

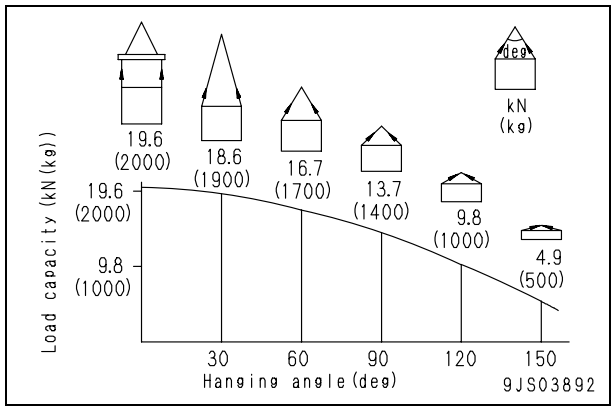
3) When disassembling or assembling, support the machine with blocks, jacks, or stands before starting work.
4) Remove all mud and oil from the steps or other places used to get on and off the machine. Always use the handrails, ladders or steps when getting on or off the machine. Never jump on or off the machine. If it is impossible to use the handrails, ladders or steps, use a stand to provide safe footing.

3. Precautions during work

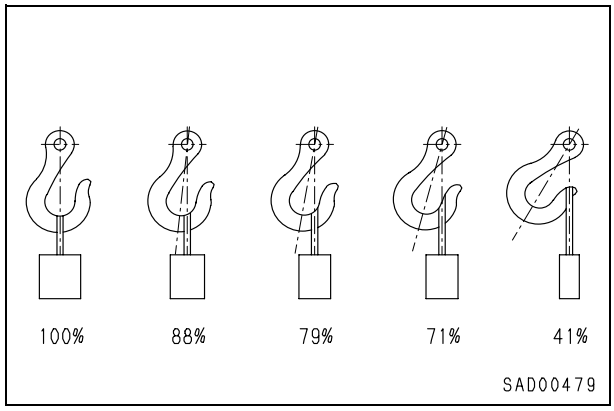
1) Before disconnecting or removing components of the oil, water, or air circuits, first release the pressure completely from the circuit. When removing the oil filler cap, a drain plug, or an oil pressure pickup plug, loosen it slowly to prevent the oil from spurting out.
2) The coolant and oil in the circuits are hot when the engine is stopped, so be careful not to get scalded. Wait for the oil and coolant to cool before carrying out any work on the oil or water circuits.
3) Before starting work, stop the engine. When working on or around a rotating part, in particular, stop the engine. When checking the machine without stopping the engine (measuring oil pressure, revolving speed, temperature, etc.), take extreme care not to get rolled or caught in rotating parts or moving parts.
4) Before starting work, remove the leads from the battery. Always remove the lead from the negative (–) terminal first.
5) When raising a heavy component (heavier than 25 kg), use a hoist or crane. Before starting work, check that the slings (wire ropes, chains, and hooks) are free from damage. Always use slings which have ample capacity and install them to proper places. Operate the hoist or crane slowly to prevent the component from hitting any other part. Do not work with any part still raised by the hoist or crane.
6) When removing a cover which is under internal pressure or under pressure from a spring, always leave 2 bolts in diagonal positions. Loosen those bolts gradually and alternately to release the pressure, and then remove the cover.
7) When removing components, be careful not to break or damage the electrical wiring. Damaged wiring may cause electrical fires.
8) When removing piping, stop the fuel or oil from spilling out. If any fuel or oil drips onto the floor, wipe it up immediately. Fuel or oil on the floor can cause you to slip and can even start fires.
9) As a general rule, do not use gasoline to wash parts. Do not use it to clean electrical parts, in particular.
10) Be sure to assemble all parts again in their original places. Replace any damaged parts and parts which must not be reused with new parts. When installing hoses and wires, be sure that they will not be damaged by contact with other parts when the machine is operated.
11) When installing high pressure hoses, make sure that they are not twisted. Damaged tubes are dangerous, so be extremely careful when installing tubes for high pressure circuits. In addition, check that connecting parts are correctly installed.
12) When assembling or installing parts, always tighten them to the specified torques. When installing protective parts such as guards, or parts which vibrate violently or rotate at high speed, be particularly careful to check that they are installed correctly.
13) When aligning 2 holes, never insert your fingers or hand. Be careful not to get your fingers caught in a hole.
14) When measuring hydraulic pressure, check that the measuring tools are correctly assembled.
15) Take care when removing or installing the tracks of track-type machines. When removing the track, the track separates suddenly, so never let anyone stand at either end of the track.
16) If the engine is operated for a long time in a place which is not ventilated well, you may suffer from gas poisoning. Accordingly, open the windows and doors to ventilate well.

4. Precautions for sling work and making signs

1) Only one appointed worker must make signs and co-workers must communicate with each other frequently. The appointed sign maker must make specified signs clearly at a place where he is seen well from the operator's seat and where he can see the working condition easily. The sign maker must always stand in front of the load and guide the operator safely.
   - Do not stand under the load.
   - Do not step on the load.
2) Check the slings before starting sling work.
3) Keep putting on gloves during sling work. (Put on leather gloves, if available.)
4) Measure the weight of the load by the eye and check its center of gravity.
5) Use proper sling according to the weight of the load and method of slinging. If too thick wire ropes are used to sling a light load, the load may slip and fall.
6) Do not sling a load with 1 wire rope alone. If it is slung so, it may rotate and may slip out of the rope. Install 2 or more wire ropes symmetrically.
   ⚠ Slinging with 1 rope may cause turning of the load during hoisting, untwisting of the rope, or slipping of the rope from its original winding position on the load, which can result in a dangerous accident.
7) Limit the hanging angle to 60°, as a rule. Do not sling a heavy load with ropes forming a wide hanging angle from the hook. When hoisting a load with 2 or more ropes, the force subjected to each rope will increase with the hanging angle. The table below shows the variation of allowable load in kN {kg} when hoisting is made with 2 ropes, each of which is allowed to sling up to 9.8 kN {1,000 kg} vertically, at various hanging angles. When the 2 ropes sling a load vertically, up to 19.6 kN {2,000 kg} of total weight can be suspended. This weight is reduced to 9.8 kN {1,000 kg} when the 2 ropes make a hanging angle of 120°. If the 2 ropes sling a 19.6 kN {2,000 kg} load at a lifting angle of 150°, each of them is subjected to a force as large as 39.2 kN {4,000 kg}.



8) When installing wire ropes to an angular load, apply pads to protect the wire ropes. If the load is slippery, apply proper material to prevent the wire rope from slipping.
9) Use the specified eyebolts and fix wire ropes, chains, etc. to them with shackles, etc.
10) Apply wire ropes to the middle portion of the hook.
    - Slinging near the tip of the hook may cause the rope to slip off the hook during hoisting. The hook has the maximum strength at the middle portion.



11) Do not use twisted or kinked wire ropes.
12) When lifting up a load, observe the following.
    - Wind in the crane slowly until wire ropes are stretched. When settling the wire ropes with the hand, do not grasp them but press them from above. If you grasp them, your fingers may be caught.
    - After the wire ropes are stretched, stop the crane and check the condition of the slung load, wire ropes, and pads.

- If the load is unstable or the wire rope or chains are twisted, lower the load and lift it up again.
- Do not lift up the load slantingly.

13) When lifting down a load, observe the following.
- When lifting down a load, stop it temporarily at 30 cm above the floor, and then lower it slowly.
- Check that the load is stable, and then remove the sling.
- Remove kinks and dirt from the wire ropes and chains used for the sling work, and put them in the specified place.

5. Precautions for using mobile crane

★ Read the Operation and Maintenance Manual of the crane carefully in advance and operate the crane safely.

6. Precautions for using overhead hoist crane

⚠ **When raising a heavy part (heavier than 25 kg), use a hoist, etc. In Disassembly and assembly, the weight of a part heavier than 25 kg is indicated after the mark of .**

1) Before starting work, inspect the wire ropes, brake, clutch, controller, rails, over wind stop device, electric shock prevention earth leakage breaker, crane collision prevention device, and power application warning lamp, and check safety.
2) Observe the signs for sling work.
3) Operate the hoist at a safe place.
4) Check the direction indicator plates (east, west, south, and north) and the directions of the control buttons without fail.
5) Do not sling a load slantingly. Do not move the crane while the slung load is swinging.
6) Do not raise or lower a load while the crane is moving longitudinally or laterally.
7) Do not drag a sling.
8) When lifting up a load, stop it just after it leaves the ground and check safety, and then lift it up.
9) Consider the travel route in advance and lift up a load to a safe height.
10) Place the control switch on a position where it will not be an obstacle to work and passage.
11) After operating the hoist, do not swing the control switch.
12) Remember the position of the main switch so that you can turn off the power immediately in an emergency.
13) If the hoist stops because of a power failure, turn the power switch OFF. When turning on a switch which was turned OFF by the electric shock prevention earth leakage breaker, check that the devices related to that switch are not in operation state.
14) If you find an obstacle around the hoist, stop the operation.
15) After finishing the work, stop the hoist at the specified position and raise the hook to at least 2 m above the floor. Do not leave the sling installed to the hook.

7. Selecting wire ropes

1) Select adequate ropes depending on the weight of parts to be hoisted, referring to the table below.

Wire ropes
(Standard “Z” twist ropes without galvanizing)
(JIS G3525, No. 6, Type 6X37-A)

Nominal diameter of rope	Allowable load	
mm	kN	ton
10	8.8	0.9
12	12.7	1.3
14	17.3	1.7
16	22.6	2.3
18	28.6	2.9
20	35.3	3.6
25	55.3	5.6
30	79.6	8.1
40	141.6	14.4
50	221.6	22.6
60	318.3	32.4

★ The allowable load is one-sixth of the breaking strength of the rope used (Safety coefficient: 6).

8. Precautions for disconnecting and connecting hoses and tubes in air conditioner circuit

1) Disconnection

⚠ **Collect the air conditioner refrigerant (R134a) from the air conditioner circuit in advance.**

★ Ask professional traders for collecting and filling operation of refrigerant (R134a).

★ Never release the refrigerant (R134a) to the atmosphere.

⚠ **If the refrigerant gas (R134a) gets in your eyes, you may lose your sight. Accordingly, when collecting or filling it, you must be qualified for handling the refrigerant and put on protective goggles.**

2) Connection

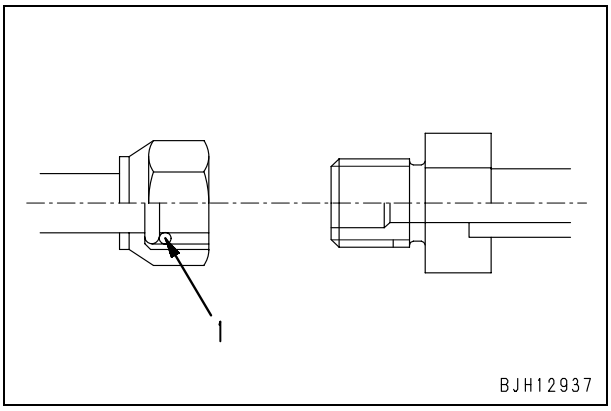
1] When installing the air conditioner circuit hoses and tubes, take care that dirt, dust, water, etc. will not enter them.

2] When connecting the air conditioner hoses and tubes, check that O-rings (1) are fitted to their joints.

3] Check that each O-ring is not damaged or deteriorated.

4] When connecting the refrigerant piping, apply compressor oil for refrigerant (R134a) **(DENSO: ND-OIL8, ZEXEL: ZXL100PG (equivalent to PAG46))** to its O-rings.

★ Example of O-ring (Fitted to every joint of hoses and tubes)



★ For tightening torque, see the precautions for installation in each section of "Disassembly and assembly".

How to read the shop manual

- Some attachments and optional parts in this shop manual may not be delivered to certain areas. If one of them is required, consult KOMATSU distributors.
- Materials and specifications are subject to change without notice.
- Shop manuals are divided into the “Chassis volume” and “Engine volume”. For the engine unit, see the engine volume of the engine model mounted on the machine.

1. Composition of shop manual

This shop manual contains the necessary technical information for services performed in a workshop. For ease of understanding, the manual is divided into the following sections.

00. Index and foreword

This section explains the shop manuals list, table of contents, safety, and basic information.

01. Specification

This section explains the specifications of the machine.

10. Structure, function and maintenance standard

This section explains the structure, function, and maintenance standard values of each component. The structure and function sub-section explains the structure and function of each component. It serves not only to give an understanding of the structure, but also serves as reference material for troubleshooting. The maintenance standard sub-section explains the criteria and remedies for disassembly and service.

20. Standard value table

This section explains the standard values for new machine and judgement criteria for testing, adjusting, and troubleshooting. This standard value table is used to check the standard values in testing and adjusting and to judge parts in troubleshooting.

30. Testing and adjusting

This section explains measuring instruments and measuring methods for testing and adjusting, and method of adjusting each part. The standard values and judgement criteria for testing and adjusting are explained in Testing and adjusting.

40. Troubleshooting

This section explains how to find out failed parts and how to repair them. The troubleshooting is divided by failure modes. The “S mode” of the troubleshooting related to the engine may be also explained in the Chassis volume and Engine volume. In this case, see the Chassis volume.

50. Disassembly and assembly

This section explains the special tools and procedures for removing, installing, disassembling, and assembling each component, as well as precautions for them. In addition, tightening torque and quantity and weight of coating material, oil, grease, and coolant necessary for the work are also explained.

90. Diagrams and drawings (chassis volume)/Repair and replacement of parts (engine volume)

- Chassis volume
  This section gives hydraulic circuit diagrams and electrical circuit diagrams.
- Engine volume
  This section explains the method of reproducing, repairing, and replacing parts.

2. Revision and distribution

Any additions, revisions, or other change of notices will be sent to KOMATSU distributors. Get the most up-to-date information before you start any work.

3. Filing method

File by the brochures in the correct order of the form number printed in the shop manual composition table.

- **Revised edition mark**
  When a manual is revised, the ones and tens digits of the form number of each brochure is increased by 1. (Example: 00, 01, 02 …)

- **Revisions**
  Revised brochures are shown in the shop manual composition table.

4. Symbols

Important safety and quality portions are marked with the following symbols so that the shop manual will be used practically.

Symbol	Item	Remarks
	Safety	Special safety precautions are necessary when performing work.
★	Caution	Special technical precautions or other precautions for preserving standards are necessary when performing work.
	Weight	Weight of parts of component or parts. Caution necessary when selecting hoisting wire, or when working posture is important, etc.
	Tightening torque	Places that require special attention for tightening torque during assembly.
	Coat	Places to be coated with adhesives, etc. during assembly.
	Oil, coolant	Places where oil, etc. must be added, and capacity.
	Drain	Places where oil, etc. must be drained, and quantity to be drained.

5. Units

In this shop manual, the units are indicated with International System of units (SI). For reference, conventionally used Gravitational System of units is indicated in parentheses { }.

Explanation of terms for maintenance standard

The maintenance standard values necessary for judgment of products and parts are described by the following terms.

1. Standard size and tolerance

- To be accurate, the finishing size of parts is a little different from one to another.
- To specify a finishing size of a part, a temporary standard size is set and an allowable difference from that size is indicated.
- The above size set temporarily is called the “standard size” and the range of difference from the standard size is called the “tolerance”.
- The tolerance with the symbols of + or – is indicated on the right side of the standard size.

Example:

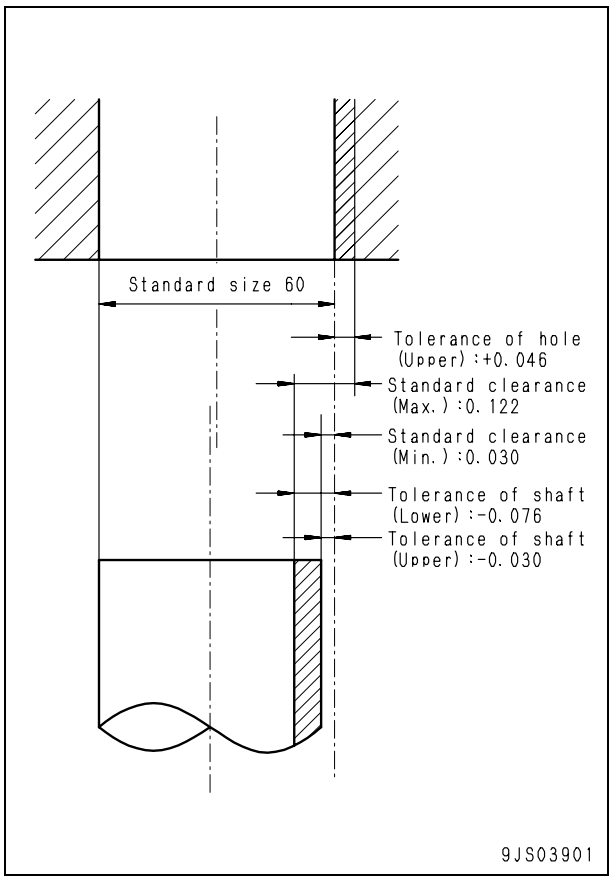
Standard size	Tolerance
120	–0.022 –0.126

★ The tolerance may be indicated in the text and a table as [standard size (upper limit of tolerance/lower limit of tolerance)].
Example) 120 (–0.022/–0.126)

- Usually, the size of a hole and the size of the shaft to be fitted to that hole are indicated by the same standard size and different tolerances of the hole and shaft. The tightness of fit is decided by the tolerance.
- Indication of size of rotating shaft and hole and relationship drawing of them

Example:

Standard size	Tolerance	
	Shaft	Hole
60	–0.030 –0.076	+0.046 0



2. Standard clearance and standard value

- The clearance made when new parts are assembled is called the “standard clearance“, which is indicated by the range from the minimum clearance to the maximum clearance.
- When some parts are repaired, the clearance is generally adjusted to the standard clearance.
- A value of performance and function of new products or equivalent is called the “standard value“, which is indicated by a range or a target value.
- When some parts are repaired, the value of performance/function is set to the standard value.

3. Standard interference

- When the diameter of a hole of a part shown in the given standard size and tolerance table is smaller than that of the mating shaft, the difference between those diameters is called the “interference”.
- The range (A – B) from the difference (A) between the minimum size of the shaft and the maximum size of the hole to the difference (B) between the maximum size of the shaft and the minimum size of the hole is the “standard interference”.
- After repairing or replacing some parts, measure the size of their hole and shaft and check that the interference is in the standard range.

4. Repair limit and allowable value

- The size of a part changes because of wear and deformation while it is used. The limit of changed size is called the “repair limit”.
- If a part is worn to the repair limit must be replaced or repaired.
- The performance and function of a product lowers while it is used. A value below which the product can be used without causing a problem is called the “allowable value”.
- If a product is worn to the allowable value, it must be checked or repaired. Since the permissible value is estimated from various tests or experiences in most cases, however, it must be judged after considering the operating condition and customer's requirement.

5. Clearance limit

- Parts can be used until the clearance between them is increased to a certain limit. The limit at which those parts cannot be used is called the “clearance limit”.
- If the clearance between the parts exceeds the clearance limit, they must be replaced or repaired.

6. Interference limit

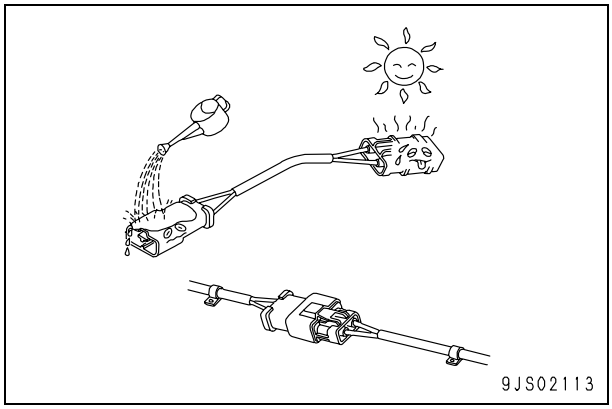
- The allowable maximum interference between the hole of a part and the shaft of another part to be assembled is called the “interference limit”.
- The interference limit shows the repair limit of the part of smaller tolerance.
- If the interference between the parts exceeds the interference limit, they must be replaced or repaired.

Handling of electric equipment and hydraulic component

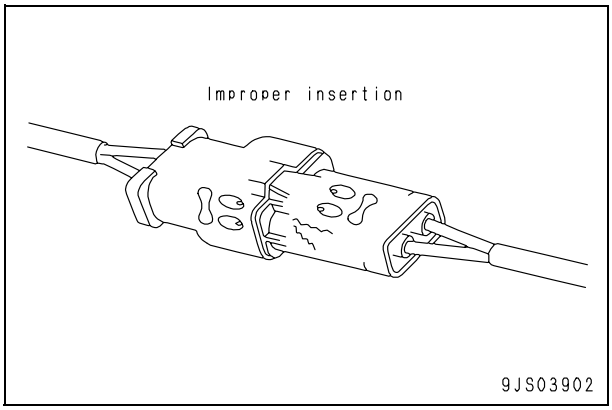
To maintain the performance of the machine over a long period, and to prevent failures or other troubles before they occur, correct “operation“, “maintenance and inspection“, “troubleshooting“, and “repairs” must be carried out. This section deals particularly with correct repair procedures for mechatronics and is aimed at improving the quality of repairs. For this purpose, it gives sections on “Handling electric equipment” and “Handling hydraulic equipment” (particularly gear oil and hydraulic oil).

Points to remember when handling electric equipment

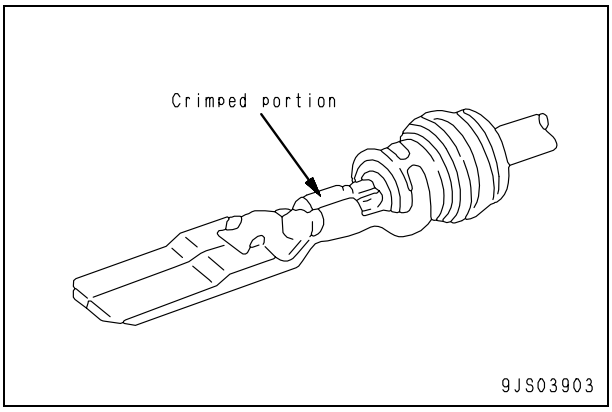
1. **Handling wiring harnesses and connectors**
   Wiring harnesses consist of wiring connecting one component to another component, connectors used for connecting and disconnecting one wire from another wire, and protectors or tubes used for protecting the wiring.
   Compared with other electrical components fitted in boxes or cases, wiring harnesses are more likely to be affected by the direct effects of rain, water, heat, or vibration. Furthermore, during inspection and repair operations, they are frequently removed and installed again, so they are likely to suffer deformation or damage. For this reason, it is necessary to be extremely careful when handling wiring harnesses.



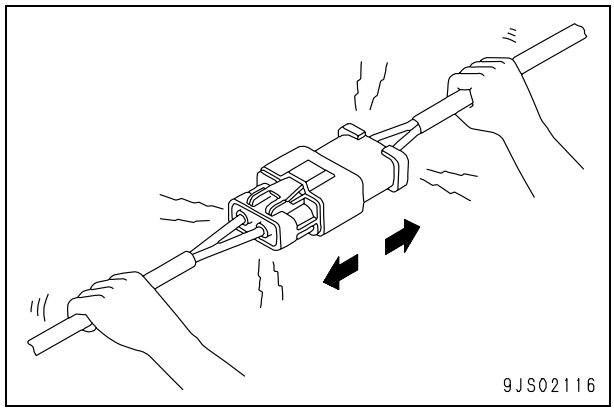
2. **Main failures occurring in wiring harness**
   1) Defective contact of connectors (defective contact between male and female)
      Problems with defective contact are likely to occur because the male connector is not properly inserted into the female connector, or because one or both of the connectors is deformed or the position is not correctly aligned, or because there is corrosion or oxidization of the contact surfaces. The corroded or oxidized contact surfaces may become shiny again (and contact may become normal) by connecting and disconnecting the connector about 10 times.



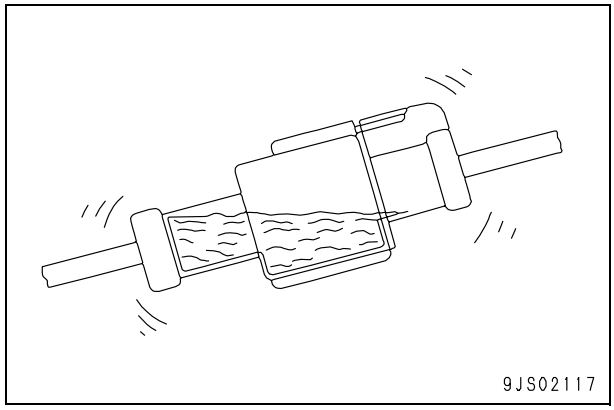
   2) Defective crimping or soldering of connectors
      The pins of the male and female connectors are in contact at the crimped terminal or soldered portion, but if there is excessive force brought to bear on the wiring, the plating at the joint will peel and cause improper connection or breakage.



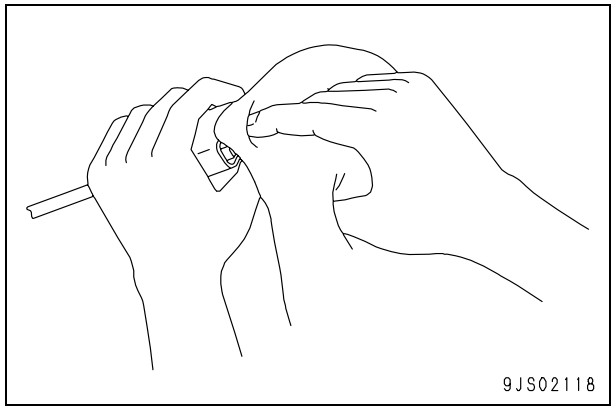
3) Disconnections in wiring
If the wiring is held and the connectors are pulled apart, or components are lifted with a crane with the wiring still connected, or a heavy object hits the wiring, the crimping of the connector may separate, or the soldering may be damaged, or the wiring may be broken.



4) High-pressure water entering connector
The connector is designed to make it difficult for water to enter (drip-proof structure), but if high-pressure water is sprayed directly on the connector, water may enter the connector, depending on the direction of the water jet. Accordingly, take care not to splash water over the connector. The connector is designed to prevent water from entering, but at the same time, if water does enter, it is difficult for it to be drained. Therefore, if water should get into the connector, the pins will be short-circuited by the water, so if any water gets in, immediately dry the connector or take other appropriate action before passing electricity through it.



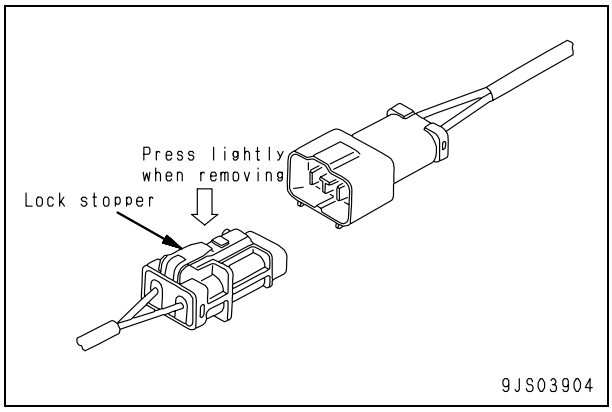
5) Oil or dirt stuck to connector
If oil or grease are stuck to the connector and an oil film is formed on the mating surface between the male and female pins, the oil will not let the electricity pass, so there will be defective contact. If there is oil or grease stuck to the connector, wipe it off with a dry cloth or blow it dry with compressed air and spray it with a contact restorer.
★ When wiping the mating portion of the connector, be careful not to use excessive force or deform the pins.
★ If there is oil or water in the compressed air, the contacts will become even dirtier, so remove the oil and water from the compressed air completely before cleaning with compressed air.



3. Removing, installing, and drying connectors and wiring harnesses

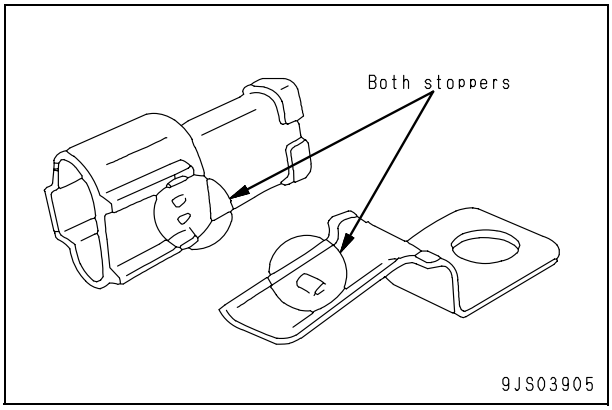
1) Disconnecting connectors

1] Hold the connectors when disconnecting.
When disconnecting the connectors, hold the connectors. For connectors held by a screw, loosen the screw fully, then hold the male and female connectors in each hand and pull apart. For connectors which have a lock stopper, press down the stopper with your thumb and pull the connectors apart.
★ Never pull with one hand.

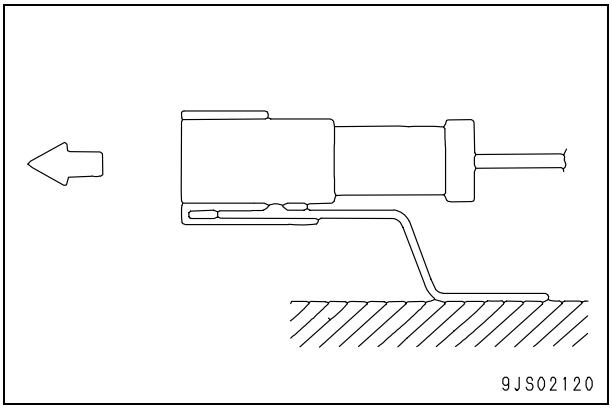


2] When removing from clips

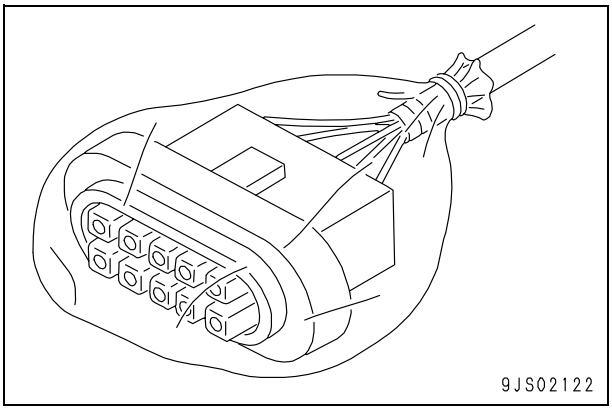
- Both of the connector and clip have stoppers, which are engaged with each other when the connector is installed.



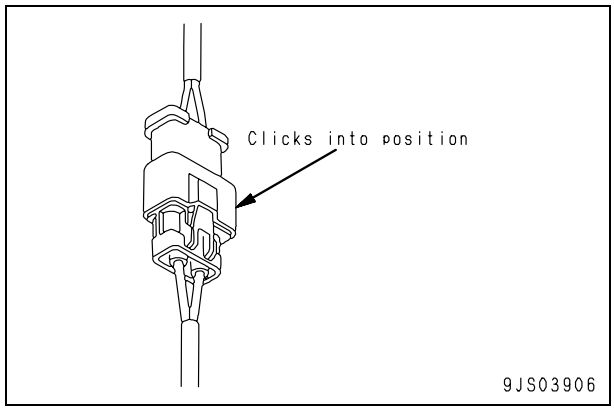
- When removing a connector from a clip, pull the connector in a parallel direction to the clip for removing stoppers.
★ If the connector is twisted up and down or to the left or right, the housing may break.

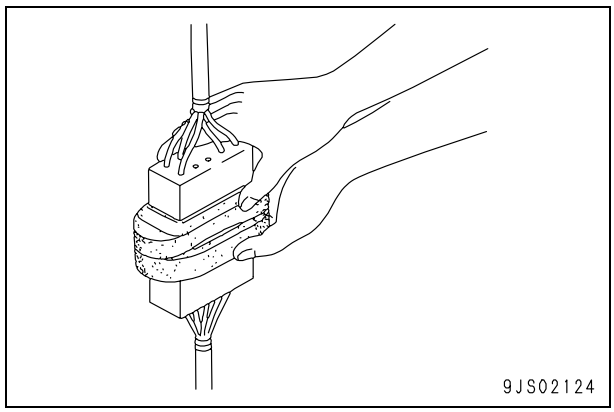


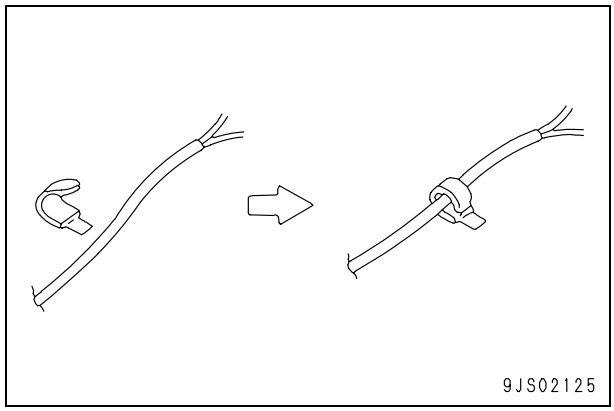
3] Action to take after removing connectors
After removing any connector, cover it with a vinyl bag to prevent any dust, dirt, oil, or water from getting in the connector portion.
★ If the machine is left disassembled for a long time, it is particularly easy for improper contact to occur, so always cover the connector.



2) Connecting connectors
   1] Check the connector visually.
   Check that there is no oil, dirt, or water stuck to the connector pins (mating portion).
   Check that there is no deformation, defective contact, corrosion, or damage to the connector pins.
   Check that there is no damage or breakage to the outside of the connector.
   ★ If there is any oil, water, or dirt stuck to the connector, wipe it off with a dry cloth. If any water has got inside the connector, warm the inside of the wiring with a dryer, but be careful not to make it too hot as this will cause short circuits.
   ★ If there is any damage or breakage, replace the connector.
   2] Fix the connector securely.
   Align the position of the connector correctly, and then insert it securely. For connectors with the lock stopper, push in the connector until the stopper clicks into position.
   3] Correct any protrusion of the boot and any misalignment of the wiring harness.
   For connectors fitted with boots, correct any protrusion of the boot. In addition, if the wiring harness is misaligned, or the clamp is out of position, adjust it to its correct position.
   ★ If the connector cannot be corrected easily, remove the clamp and adjust the position.
   ● If the connector clamp has been removed, be sure to return it to its original position. Check also that there are no loose clamps.

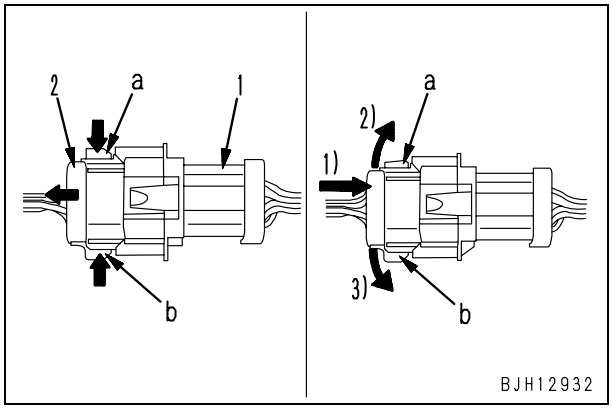




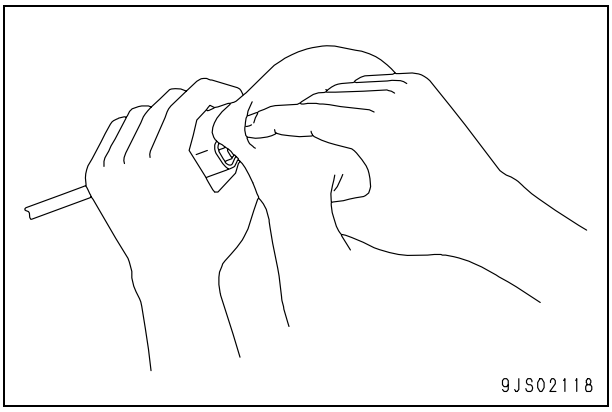


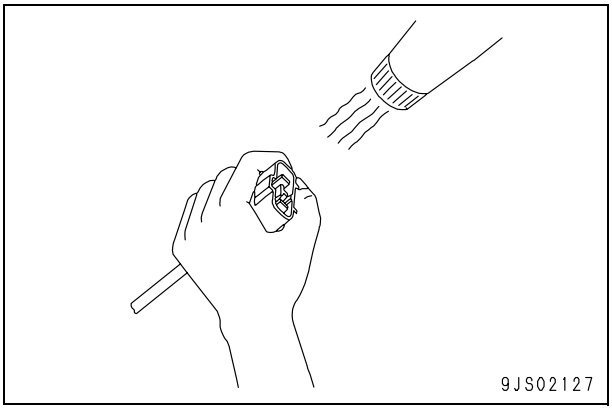
3) Heavy duty wire connector (DT 8-pole, 12-pole)
Disconnection (Left of figure)
While pressing both sides of locks (a) and (b), pull out female connector (2).
Connection (Right of figure)
1] Push in female connector (2) horizontally until the lock clicks.
Arrow: 1)
2] Since locks (a) and (b) may not be set completely, push in female connector (2) while moving it up and down until the locks are set normally.
Arrow: 1), 2), 3)
★ Right of figure: Lock (a) is pulled down (not set completely) and lock (b) is set completely.
(1): Male connector
(2): Female connector
(a), (b): Locks

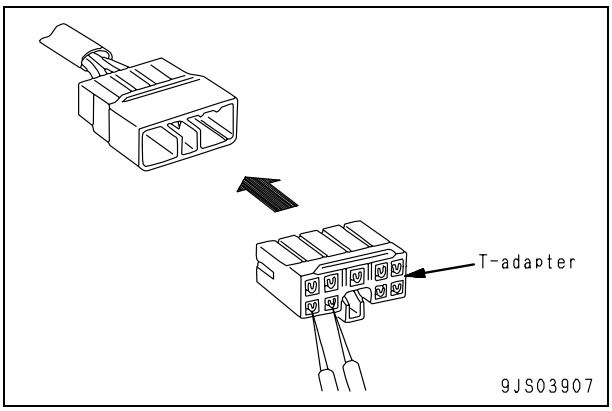
- Disconnection
- Connection (Example of incomplete setting of (a))



4) Drying wiring harness
If there is any oil or dirt on the wiring harness, wipe it off with a dry cloth. Avoid washing it in water or using steam. If the connector must be washed in water, do not use high-pressure water or steam directly on the wiring harness. If water gets directly on the connector, do as follows.
   1] Disconnect the connector and wipe off the water with a dry cloth.
      ★ If the connector is blown dry with compressed air, there is the risk that oil in the air may cause defective contact, so remove all oil and water from the compressed air before blowing with air.
   2] Dry the inside of the connector with a dryer.
      If water gets inside the connector, use a dryer to dry the connector.
      ★ Hot air from the dryer can be used, but regulate the time that the hot air is used in order not to make the connector or related parts too hot, as this will cause deformation or damage to the connector.
   3] Carry out a continuity test on the connector.
      After drying, leave the wiring harness disconnected and carry out a continuity test to check for any short circuits between pins caused by water.
      ★ After completely drying the connector, blow it with contact restorer and reassemble.

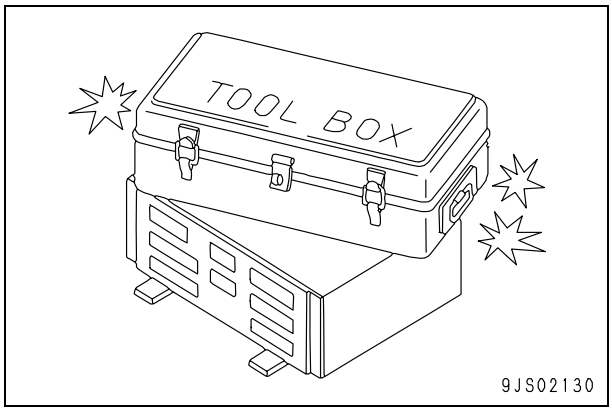


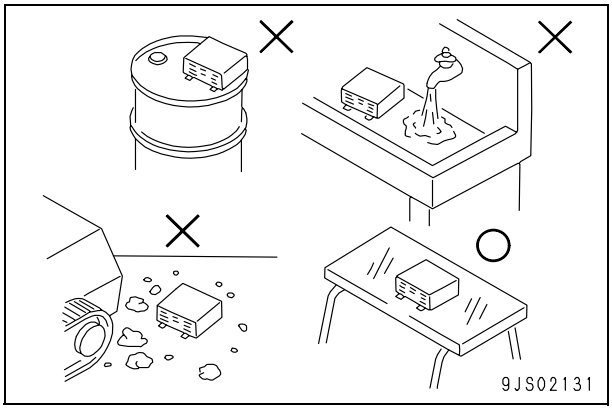




4. Handling controller

1) The controller contains a microcomputer and electronic control circuits. These control all of the electronic circuits on the machine, so be extremely careful when handling the controller.
2) Do not place objects on top of the controller.
3) Cover the control connectors with tape or a vinyl bag. Never touch the connector contacts with your hand.
4) During rainy weather, do not leave the controller in a place where it is exposed to rain.
5) Do not place the controller on oil, water, or soil, or in any hot place, even for a short time. (Place it on a suitable dry stand).
6) Precautions when carrying out arc welding
When carrying out arc welding on the body, disconnect all wiring harness connectors connected to the controller. Fit an arc welding ground close to the welding point.





5. Points to remember when troubleshooting electric circuits

1) Always turn the power OFF before disconnecting or connecting connectors.
2) Before carrying out troubleshooting, check that all the related connectors are properly inserted.
   ★ Disconnect and connect the related connectors several times to check.
3) Always connect any disconnected connectors before going on to the next step.
   ★ If the power is turned ON with the connectors still disconnected, unnecessary abnormality displays will be generated.
4) When carrying out troubleshooting of circuits (measuring the voltage, resistance, continuity, or current), move the related wiring and connectors several times and check that there is no change in the reading of the tester.
   ★ If there is any change, there is probably defective contact in that circuit.

Points to remember when handling hydraulic equipment

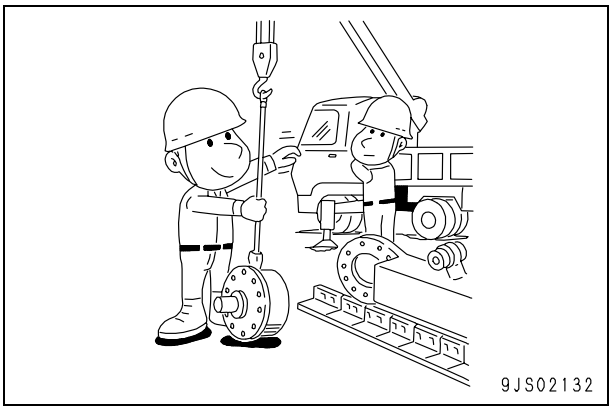
With the increase in pressure and precision of hydraulic equipment, the most common cause of failure is dirt (foreign material) in the hydraulic circuit. When adding hydraulic oil, or when disassembling or assembling hydraulic equipment, it is necessary to be particularly careful.

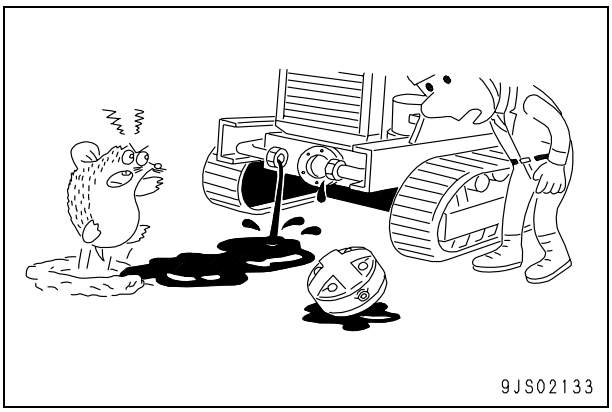
1. **Be careful of the operating environment.**
   Avoid adding hydraulic oil, replacing filters, or repairing the machine in rain or high winds, or places where there is a lot of dust.

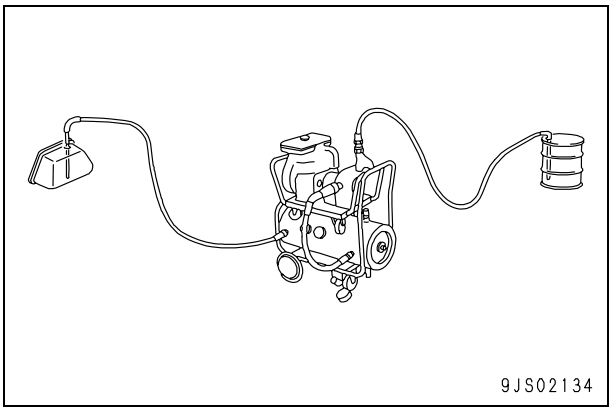
2. **Disassembly and maintenance work in the field**
   If disassembly or maintenance work is carried out on hydraulic equipment in the field, there is danger of dust entering the equipment. It is also difficult to check the performance after repairs, so it is desirable to use unit exchange. Disassembly and maintenance of hydraulic equipment should be carried out in a specially prepared dustproof workshop, and the performance should be checked with special test equipment.

3. **Sealing openings**
   After any piping or equipment is removed, the openings should be sealed with caps, tapes, or vinyl bags to prevent any dirt or dust from entering. If the opening is left open or is blocked with a rag, there is danger of dirt entering or of the surrounding area being made dirty by leaking oil so never do this. Do not simply drain oil out onto the ground, but collect it and ask the customer to dispose of it, or take it back with you for disposal.

4. **Do not let any dirt or dust get in during refilling operations**
   Be careful not to let any dirt or dust get in when refilling with hydraulic oil. Always keep the oil filler and the area around it clean, and also use clean pumps and oil containers. If an oil cleaning device is used, it is possible to filter out the dirt that has collected during storage, so this is an even more effective method.





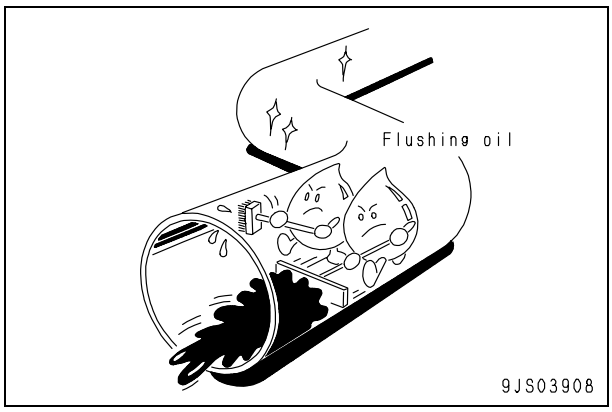


5. Change hydraulic oil when the temperature is high

When hydraulic oil or other oil is warm, it flows easily. In addition, the sludge can also be drained out easily from the circuit together with the oil, so it is best to change the oil when it is still warm. When changing the oil, as much as possible of the old hydraulic oil must be drained out. (Drain the oil from the hydraulic tank; also drain the oil from the filter and from the drain plug in the circuit.) If any old oil is left, the contaminants and sludge in it will mix with the new oil and will shorten the life of the hydraulic oil.

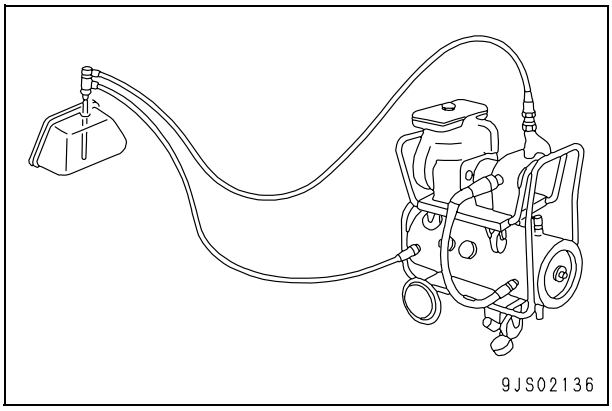
6. Flushing operations

After disassembling and assembling the equipment, or changing the oil, use flushing oil to remove the contaminants, sludge, and old oil from the hydraulic circuit. Normally, flushing is carried out twice: primary flushing is carried out with flushing oil, and secondary flushing is carried out with the specified hydraulic oil.



7. Cleaning operations

After repairing the hydraulic equipment (pump, control valve, etc.) or when running the machine, carry out oil cleaning to remove the sludge or contaminants in the hydraulic oil circuit. The oil cleaning equipment is used to remove the ultra fine (about 3 μ) particles that the filter built in the hydraulic equipment cannot remove, so it is an extremely effective device.



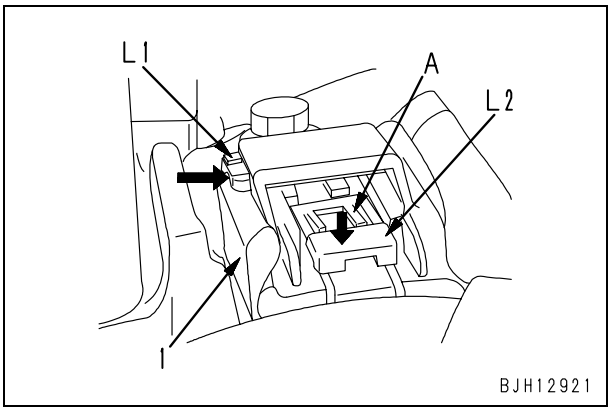
Handling of connectors newly used for engines

★ Mainly, following engines are object for following connectors.
- 107E-1
- 114E-3
- 125E-5
- 140E-5
- 170E-5
- 12V140E-3

1. Slide lock type (FRAMATOME-3, FRAMATOME-2)
- 107 – 170, 12V140 engines
  - Various pressure sensors and NE speed sensor

  Examples)
  Intake air pressure in intake manifold: PIM (125, 170, 12V140 engines)
  Oil pressure sensor: POIL (125, 170, 12V140 engines)
  Oil pressure switch (107, 114 engines)
  Ne speed sensor of flywheel housing: NE (107 – 170, 12V140 engines)
  Ambient pressure sensor: PAMB (125, 170, 12V140 engines)

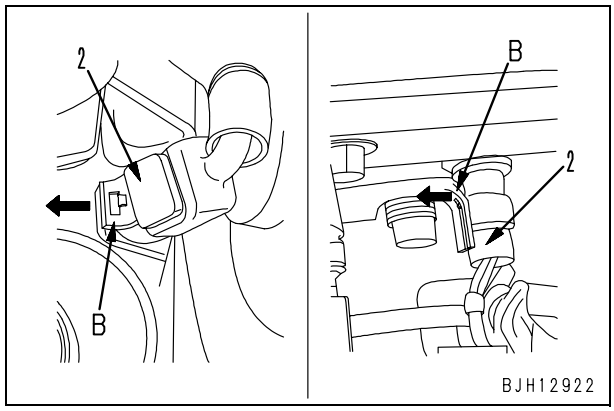
Disconnect connector (1) according to the following procedure.
1) Slide lock (L1) to the right.
2) While pressing lock (L2), pull out connector (1) toward you.
   ★ Even if lock (L2) is pressed, connector (1) cannot be pulled out toward you, if part A does not float. In this case, float part A with a small screwdriver while press lock (L2), and then pull out connector (1) toward you.



2. Pull lock type (PACKARD-2)
- 107 – 170, 12V140 engine
  - Various temperature sensors

Example)
Intake air temperature sensor in intake manifold: TIM
Fuel temperature sensor: TFUEL
Oil temperature sensor: TOIL
Coolant temperature sensor: TWTR, etc.

Disconnect the connector by pulling lock (B) (on the wiring harness side) of connector (2) outward.



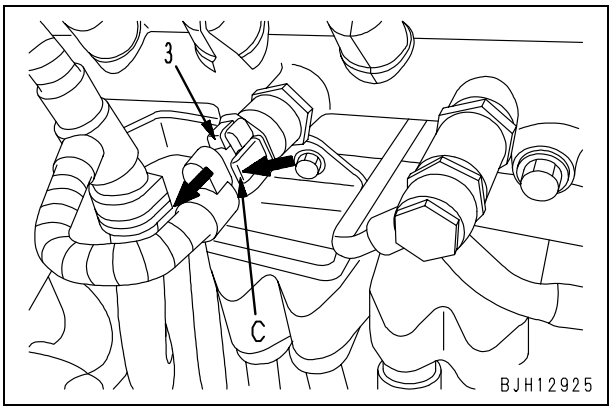
3. Push lock type

- 107, 114 engines
  Example)
  Fuel pressure sensor in common rail
  (**BOSCH-03**)

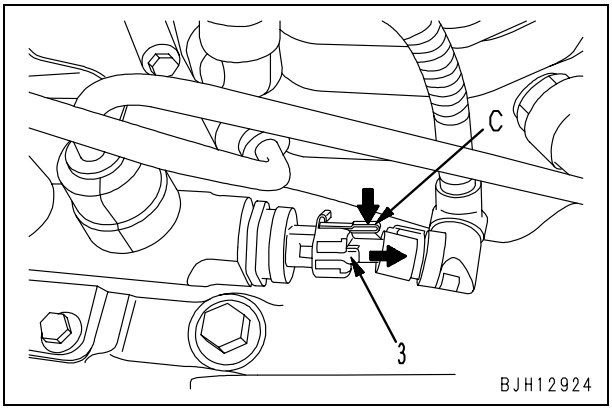
Disconnect connector (3) according to the following procedure.

1) While pressing lock (C), pull out connector (3) in the direction of the arrow.

- 114 engine

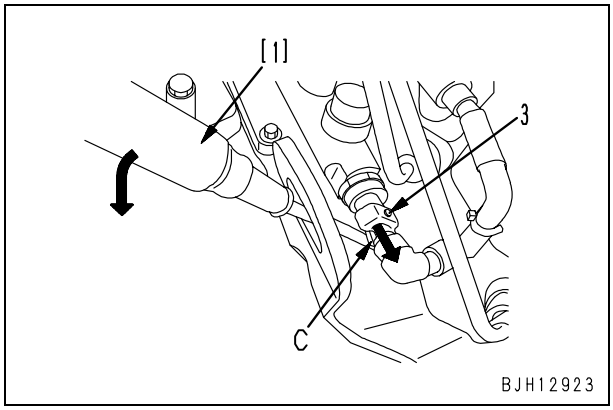


- 107 engine



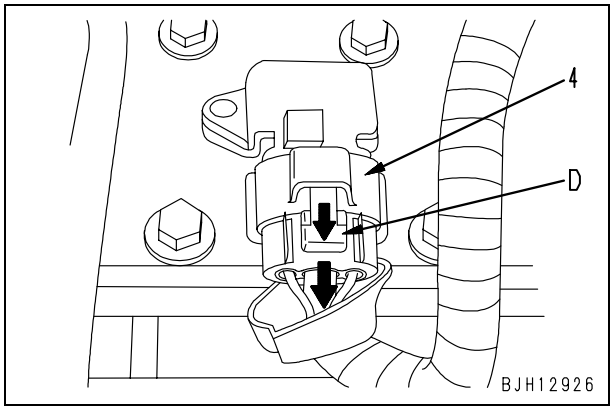
★ If the lock is on the underside, use flat-head screwdriver [1] since you cannot insert your fingers.

2) While pressing up lock (C) of the connector with flat-head screwdriver [1], pull out connector (3) in the direction of the arrow.



- 107, 114 engine
  Example)
  Intake air pressure/temperature sensor in intake manifold
  (**SUMITOMO-04**)

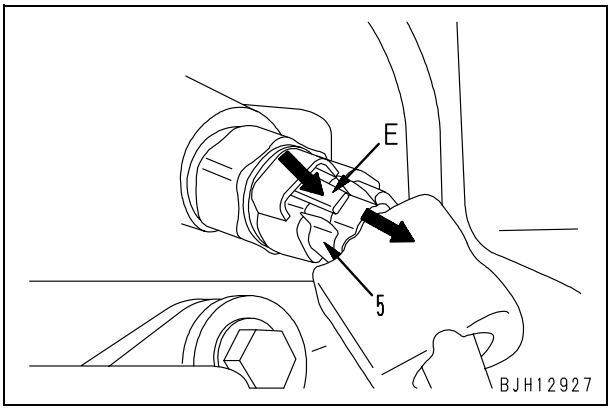
3) While pressing lock (D), pull out connector (4) in the direction of the arrow.



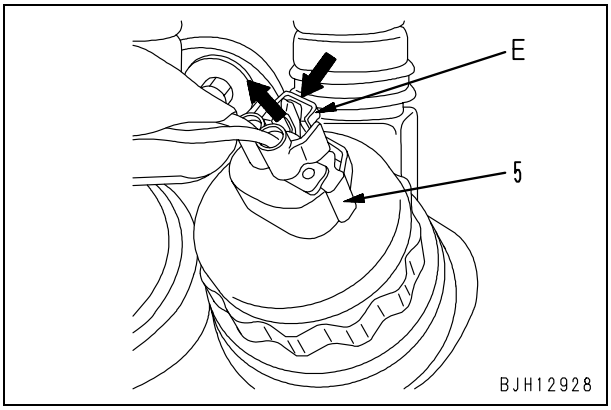
- 125 – 170, 12V140 engine

4) While pressing lock (E) of the connector, pullout connector (5) in the direction of the arrow.

Example)
Fuel pressure in common rail: PFUEL etc. (**AMP-3**)

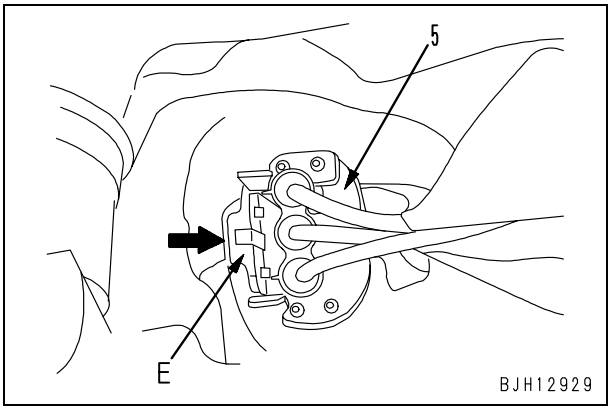


Example)
Injection pressure control valve of fuel supply pump: PCV (**SUMITOMO-2**)



Example)
Speed sensor of fuel supply pump: G (**SUMITOMO-3**)

★ Pull the connector straight up.



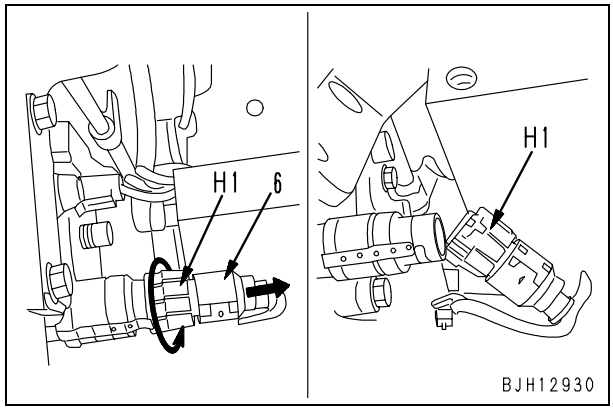
4. Turn-housing type (Round green connector)

- 140 engine

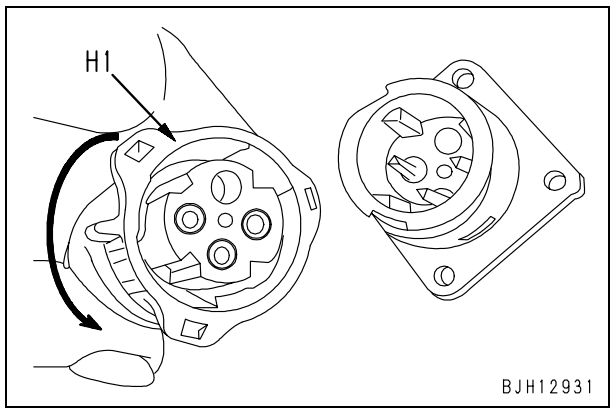
Example)
Intake air pressure sensor in intake manifold (CANNON-04): PIM etc.

1) Disconnect connector (6) according to the following procedure.
   1] Turn housing (H1) in the direction of the arrow.
      ★ When connector is unlocked, housing (H1) becomes heavy to turn.
   2] Pull out housing (H1) in the direction of the arrow.

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



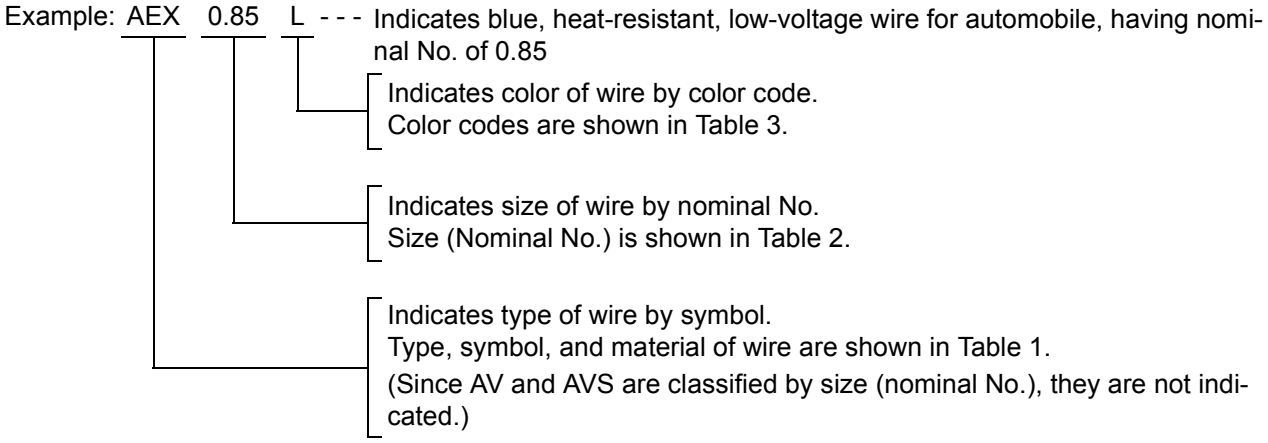
2) Connect the connector according to the following procedure.
   1] Insert the connector to the end, while setting its groove.
   2] Turn housing (H1) in the direction of the arrow until it “clicks”.



How to read electric wire code

★ The information about the wires unique to each machine model is described in Troubleshooting section, Relational information of troubleshooting.

In the electric circuit diagram, the material, thickness, and color of each electric wire are indicated by symbols. The electric wire code is helpful in understanding the electric circuit diagram.



1. Type, symbol, and material

AV and AVS are different in only thickness and outside diameter of the cover. AEX is similar to AV in thickness and outside diameter of AEX and different from AV and AVS in material of the cover.

(Table 1)

Type	Symbol	Material		Using temperature range (°C)	Example of use
Low-voltage wire for automobile	AV	Conductor	Annealed copper for electric appliance	–30 to +60	General wiring (Nominal No. 5 and above)
		Insulator	Soft polyvinyl chloride		
Thin-cover low-voltage wire for automobile	AVS	Conductor	Annealed copper for electric appliance		General wiring (Nominal No. 3 and below)
		Insulator	Soft polyvinyl chloride		
Heat-resistant low-voltage wire for automobile	AEX	Conductor	Annealed copper for electric appliance	–50 to +110	General wiring in extremely cold district, wiring at high-temperature place
		Insulator	Heat-resistant crosslinked polyethylene		

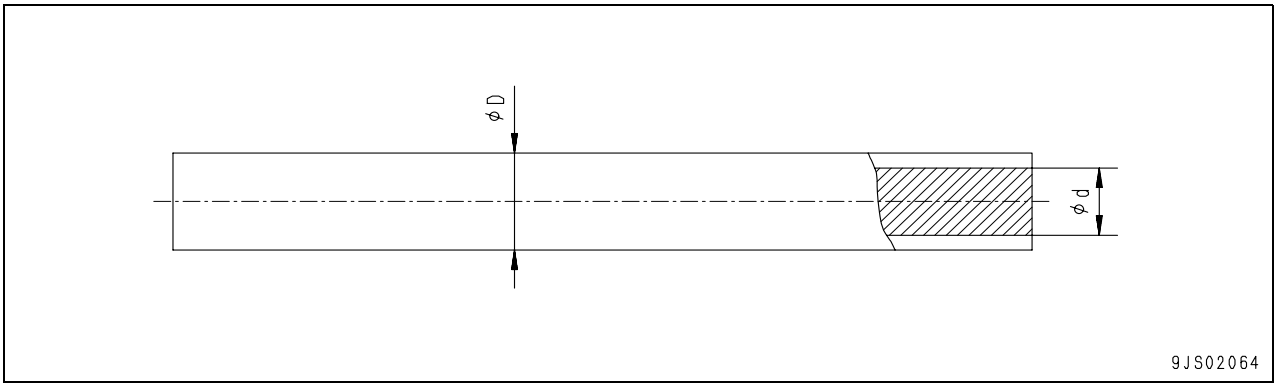
2. Dimensions

(Table 2)

Nominal No.			0.5f	(0.5)	0.75f	(0.85)	1.25f	(1.25)	2f	2	3f	3	5
Conductor		Number of strands/Diameter of strand	20/0.18	7/0.32	30/0.18	11/0.32	50/0.18	16/0.32	37/0.26	26/0.32	58/0.26	41/0.32	65/0.32
		Sectional area (mm^2)	0.51	0.56	0.76	0.88	1.27	1.29	1.96	2.09	3.08	3.30	5.23
		d (approx.)	1.0		1.2		1.5		1.9	1.9	2.3	2.4	3.0
Cover D	AVS	Standard	2.0		2.2		2.5		2.9	2.9	3.5	3.6	–
	AV	Standard	–		–		–		–	–	–	–	4.6
	AEX	Standard	2.0		2.2		2.7		3.0	3.1	–	3.8	4.6

Nominal No.			8	15	20	30	40	50	60	85	100
Conductor		Number of strands/Diameter of strand	50/0.45	84/0.45	41/0.80	70/0.80	85/0.80	108/0.80	127/0.80	169/0.80	217/0.80
		Sectional area (mm^2)	7.95	13.36	20.61	35.19	42.73	54.29	63.84	84.96	109.1
		d (approx.)	3.7	4.8	6.0	8.0	8.6	9.8	10.4	12.0	13.6
Cover D	AVS	Standard	–	–	–	–	–	–	–	–	–
	AV	Standard	5.5	7.0	8.2	10.8	11.4	13.0	13.6	16.0	17.6
	AEX	Standard	5.3	7.0	8.2	10.8	11.4	13.0	13.6	16.0	17.6

"f" of nominal No. denotes flexible".



3. Color codes table

(Table 3)

Color Code	Color of wire	Color Code	Color of wire
B	Black	LgW	Light green & White
Br	Brown	LgY	Light green & Yellow
BrB	Brown & Black	LR	Blue & Red
BrR	Brown & Red	LW	Blue & White
BrW	Brown & White	LY	Blue & Yellow
BrY	Brown & Yellow	O	Orange
Ch	Charcoal	P	Pink
Dg	Dark green	R	Red
G	Green	RB	Red & Black
GB	Green & Black	RG	Red & Green
GL	Green & Blue	RL	Red & Blue
Gr	Gray	RW	Red & White
GR	Green & Red	RY	Red & Yellow
GW	Green & White	Sb	Sky Blue
GY	Green & Yellow	Y	Yellow
L	Blue	YB	Yellow & Black
LB	Blue & Black	YG	Yellow &Green
Lg	Light green	YL	Yellow & Blue
LgB	Light green & Black	YR	Yellow & Red
LgR	Light green & Red	YW	Yellow & White

Remarks: In a color code consisting of 2 colors, the first color is the color of the background and the second color is the color of the marking.
Example: “GW” means that the background is Green and marking is White.

4. Types of circuits and color codes

(Table 4)

Type of wire		AVS or AV						AEX	
Type of circuit	Charge	R	WG	–	–	–	–	R	–
	Ground	B	–	–	–	–	–	B	–
	Start	R	–	–	–	–	–	R	–
	Light	RW	RB	RY	RG	RL	–	D	–
	Instrument	Y	YR	YB	YG	YL	YW	Y	Gr
	Signal	G	GW	GR	GY	GB	GL	G	Br
	Others	L	LW	LR	LY	LB	–	L	–
		Br	BrW	BrR	BrY	BrB	–	–	–
		Lg	LgR	LgY	LgB	LgW	–	–	–
		O	–	–	–	–	–	–	–
		Gr	–	–	–	–	–	–	–
		P	–	–	–	–	–	–	–
		Sb	–	–	–	–	–	–	–
		Dg	–	–	–	–	–	–	–
		Ch	–	–	–	–	–	–	–

Precautions when carrying out operation

[When carrying out removal or installation (disassembly or assembly) of units, be sure to follow the general precautions given below when carrying out the operation.]

1. Precautions when carrying out removal work

- If the coolant contains antifreeze, dispose of it correctly.
- After disconnecting hoses or tubes, cover them or fit plugs to prevent dirt or dust from entering.
- When draining oil, prepare a container of adequate size to catch the oil.
- Confirm the match marks showing the installation position, and make match marks in the necessary places before removal to prevent any mistake when assembling.
- To prevent any excessive force from being applied to the wiring, always hold the connectors when disconnecting the connectors. Do not pull the wires.
- Fit wires and hoses with tags to show their installation position to prevent any mistake when installing.
- Check the number and thickness of the shims, and keep in a safe place.
- When raising components, be sure to use lifting equipment of ample strength.
- When using forcing screws to remove any components, tighten the forcing screws uniformly in turn.
- Before removing any unit, clean the surrounding area and fit a cover to prevent any dust or dirt from entering after removal.

★ Precautions when handling piping during disassembly
Fit the following plugs into the piping after disconnecting it during disassembly operations.

1) Face seal type hoses and tubes

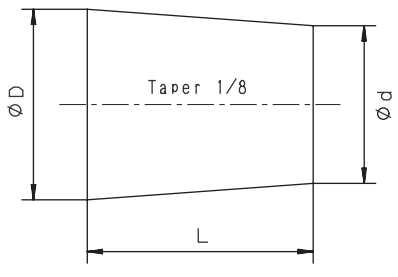
Nominal number	Plug (nut end)	Sleeve nut (elbow end)
02	07376-70210	02789-20210
03	07376-70315	02789-20315
04	07376-70422	02789-20422
05	07376-70522	02789-20522
06	07376-70628	02789-20628
10	07376-71034	07221-21034
12	07376-71234	07221-21234

2) Split flange type hoses and tubes

Nominal number	Flange (hose end)	Sleeve head (tube end)	Split flange
04	07379-00400	07378-10400	07371-30400
05	07379-00500	07378-10500	07371-30500

3) If the part is not under hydraulic pressure, the following corks can be used.

Nominal number	Part Number	Dimensions		
		D	d	L
06	07049-00608	6	5	8
08	07049-00811	8	6.5	11
10	07049-01012	10	8.5	12
12	07049-01215	12	10	15
14	07049-01418	14	11.5	18
16	07049-01620	16	13.5	20
18	07049-01822	18	15	22
20	07049-02025	20	17	25
22	07049-02228	22	18.5	28
24	07049-02430	24	20	30
27	07049-02734	27	22.5	34



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2. Precautions when carrying out installation work

- Tighten all bolts and nuts (sleeve nuts) to the specified (KES) torque.
- Install the hoses without twisting or interference and fix them with intermediate clamps, if there are any.
- Replace all gaskets, O-rings, cotter pins, and lock plates with new parts.
- Bend the cotter pins and lock plates securely.
- When coating with adhesive, clean the part and remove all oil and grease, then coat the threaded portion with 2 – 3 drops of adhesive.
- When coating with gasket sealant, clean the surface and remove all oil and grease, check that there is no dirt or damage, then coat uniformly with gasket sealant.
- Clean all parts, and correct any damage, dents, burrs, or rust.
- Coat rotating parts and sliding parts with engine oil.
- When press fitting parts, coat the surface with anti-friction compound (LM-P).
- After fitting snap rings, check that the snap ring is fitted securely in the ring groove.
- When connecting wiring connectors, clean the connector to remove all oil, dirt, or water, then connect securely.
- When using eyebolts, check that there is no deformation or deterioration, screw them in fully, and align the direction of the hook.
- When tightening split flanges, tighten uniformly in turn to prevent excessive tightening on one side.

★ When operating the hydraulic cylinders for the first time after reassembling cylinders, pumps and other hydraulic equipment removed for repair, always bleed the air as follows:
  1) Start the engine and run at low idle.
  2) Operate the work equipment control lever to operate the hydraulic cylinder 4 – 5 times, stopping the cylinder 100 mm from the end of its stroke.
  3) Next, operate the hydraulic cylinder 3 – 4 times to the end of its stroke.
  4) After doing this, run the engine at normal speed.

★ When using the machine for the first time after repair or long storage, follow the same procedure.

3. Precautions when completing the operation

1) Refilling with coolant, oil and grease
   - If the coolant has been drained, tighten the drain valve, and add coolant to the specified level. Run the engine to circulate the coolant through the system. Then check the coolant level again.
   - If the hydraulic equipment has been removed and installed again, add engine oil to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.
   - If the piping or hydraulic equipment have been removed, always bleed the air from the system after reassembling the parts.
     ★ For details, see Testing and adjusting, “Bleeding air”.
   - Add the specified amount of grease (molybdenum disulphide grease) to the work equipment parts.
2) Checking cylinder head and manifolds for looseness
   Check the cylinder head and intake and exhaust manifold for looseness.
   If any part is loosened, retighten it.
   - For the tightening torque, see “Disassembly and assembly”.
3) Checking engine piping for damage and looseness
   Intake and exhaust system
   Check the piping for damage, the mounting bolts and nuts for looseness, and the joints for air suction and exhaust gas leakage.
   If any part is loosened or damaged, retighten or repair it.
   Cooling system
   Check the piping for damage, the mounting bolts and nuts for looseness, and the joints for coolant leakage.
   If any part is loosened or damaged, retighten or repair it.
   Fuel system
   Check the piping for damage, the mounting bolts and nuts for looseness, and the joints for fuel leakage.
   If any part is loosened or damaged, retighten or repair it.

4) Checking muffler and exhaust pipe for damage and looseness
   1] Visually check the muffler, exhaust pipe and their mounting parts for a crack and damage.
      If any part is damaged, replace it.
   2] Check the mounting bolts and nuts of the muffler, exhaust pipe and their mounting parts for looseness.
      If any bolt or nut is loosened, retighten it.
5) Checking muffler function
   Check the muffler for abnormal sound and sound different from that of a new muffler.
   If any abnormal sound is heard, repair the muffler, referring to “Troubleshooting” and “Disassembly and assembly”.

Method of disassembling and connecting push-pull type coupler

⚠ Before carrying out the following work, loosen the oil filler cap of the hydraulic tank gradually to release the residual pressure from the hydraulic tank.

⚠ Even if the residual pressure is released from the hydraulic tank, some hydraulic oil flows out when the hose is disconnected. Accordingly, prepare an oil receiving container.

Type 1

1. Disconnection

1) Hold adapter (1) and push hose joint (2) into mating adapter (3). (Fig. 1)
   - ★ The adapter can be pushed in about 3.5 mm.
   - ★ Do not hold rubber cap portion (4).
2) After hose joint (2) is pushed into adapter (3), press rubber cap portion (4) against adapter (3) until it clicks. (Fig. 2)
3) Hold hose adapter (1) or hose (5) and pull it out. (Fig. 3)
   - ★ Since some hydraulic oil flows out, prepare an oil receiving container.

Fig. 1

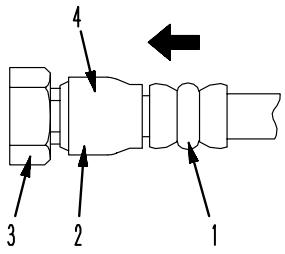


Fig. 2

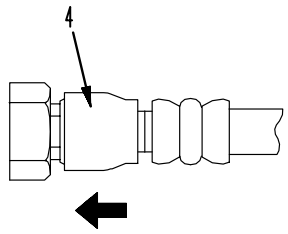
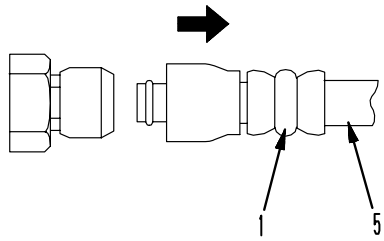


Fig. 3



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2. Connection

1) Hold hose adapter (1) or hose (5) and insert it in mating adapter (3), aligning them with each other. (Fig. 4)
   - ★ Do not hold rubber cap portion (4).
2) After inserting the hose in the mating adapter perfectly, pull it back to check its connecting condition. (Fig. 5)
   - ★ When the hose is pulled back, the rubber cap portion moves toward the hose about 3.5 mm. This does not indicate abnormality, however.

Fig. 4

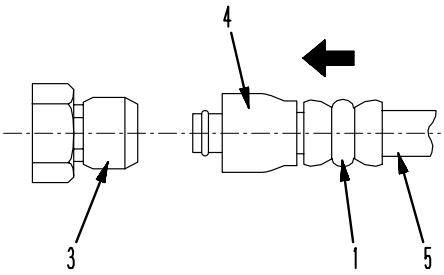
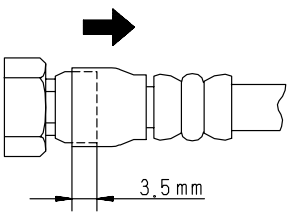


Fig. 5

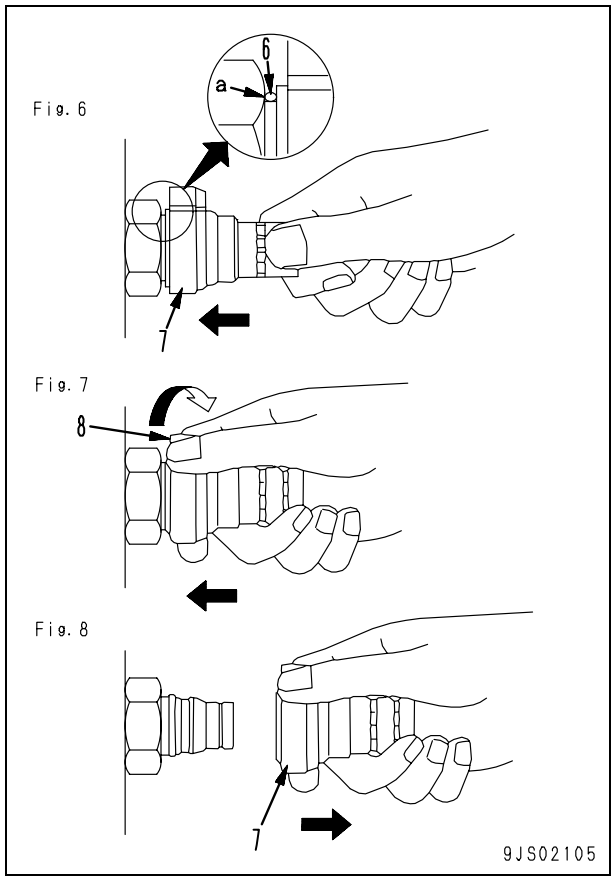


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Type 2

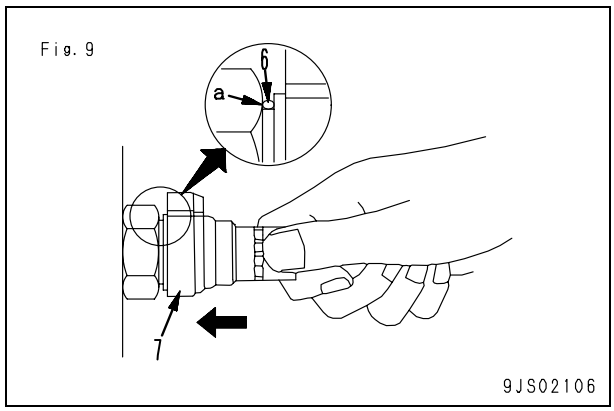
1. Disconnection

1) Hold the tightening portion and push body (7) straight until sliding prevention ring (6) contacts contact surface (a) of the hexagonal portion at the male end. (Fig. 6)
2) While holding the condition of Step 1), turn lever (8) to the right (clockwise). (Fig. 7)
3) While holding the condition of Steps 1) and 2), pull out whole body (7) to disconnect it. (Fig. 8)



2. Connection

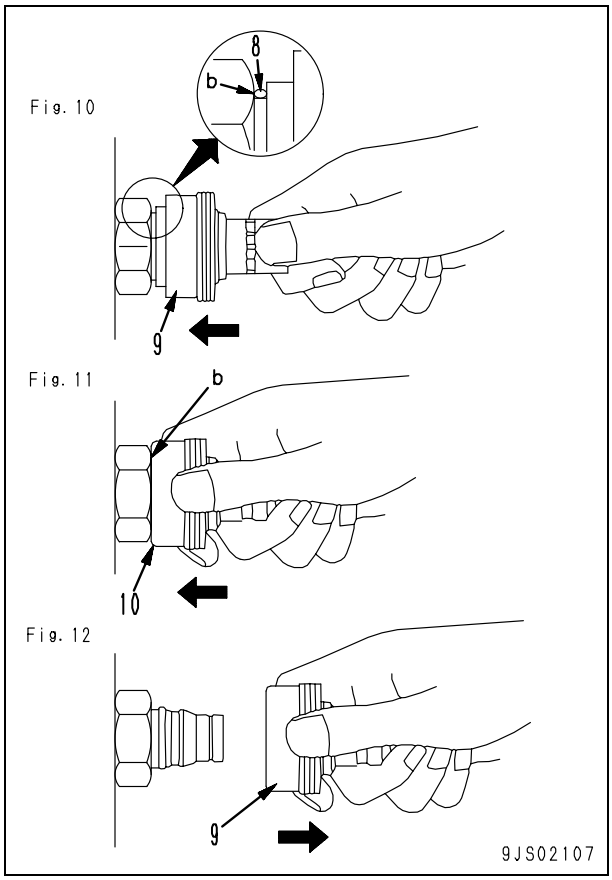
- Hold the tightening portion and push body (7) straight until sliding prevention ring (6) contacts contact surface (a) of the hexagonal portion at the male end. (Fig. 9)



Type 3

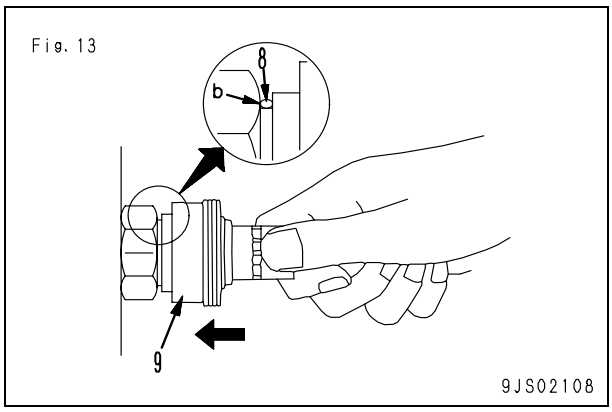
1. Disconnection

1) Hold the tightening portion and push body (9) straight until sliding prevention ring (8) contacts contact surface (b) of the hexagonal portion at the male end. (Fig. 10)
2) While holding the condition of Step 1), push cover (10) straight until it contacts contact surface (b) of the hexagonal portion at the male end. (Fig. 11)
3) While holding the condition of Steps 1) and 2), pull out whole body (9) to disconnect it. (Fig. 12)



2. Connection

- Hold the tightening portion and push body (9) straight until the sliding prevention ring contacts contact surface (b) of the hexagonal portion at the male end. (Fig. 13)



Standard tightening torque table

1. Table of tightening torques for bolts and nuts
   ★ Unless there are special instructions, tighten metric nuts and bolts to the torque below. (When using torque wrench)

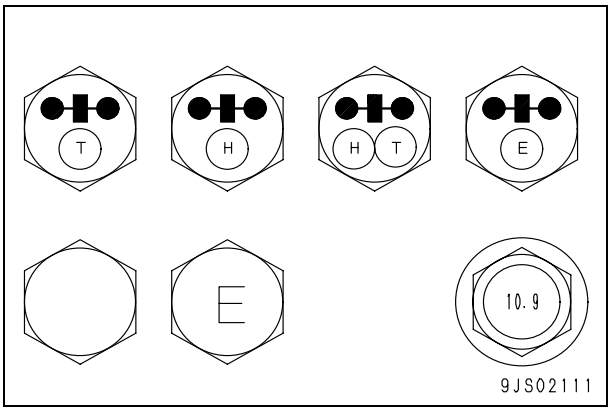
   ★ The following table corresponds to the bolts in Fig. A.

Thread diameter of bolt	Width across flats	Tightening torque	
mm	mm	Nm	kgm
6	10	11.8 – 14.7	1.2 – 1.5
8	13	27 – 34	2.8 – 3.5
10	17	59 – 74	6.0 – 7.5
12	19	98 – 123	10.0 – 12.5
14	22	153 – 190	15.5 – 19.5
16	24	235 – 285	23.5 – 29.5
18	27	320 – 400	33.0 – 41.0
20	30	455 – 565	46.5 – 58.0
22	32	610 – 765	62.5 – 78.0
24	36	785 – 980	80.0 – 100.0
27	41	1,150 – 1,440	118 – 147
30	46	1,520 – 1,910	155 – 195
33	50	1,960 – 2,450	200 – 250
36	55	2,450 – 3,040	250 – 310
39	60	2,890 – 3,630	295 – 370

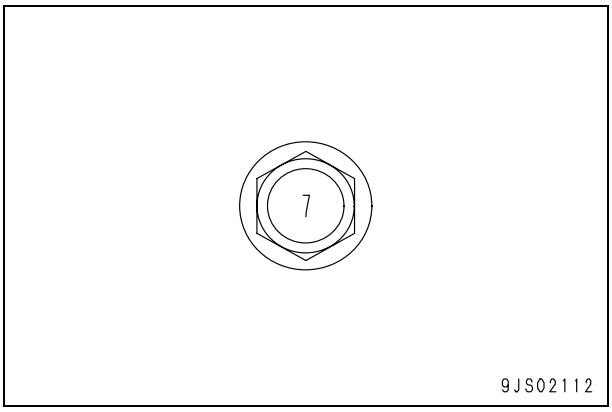
   ★ The following table corresponds to the bolts in Fig. B.

Thread diameter of bolt	Width across flats	Tightening torque	
mm	mm	Nm	kgm
6	10	5.9 – 9.8	0.6 – 1.0
8	13	13.7 – 23.5	1.4 – 2.4
10	14	34.3 – 46.1	3.5 – 4.7
12	27	74.5 – 90.2	7.6 – 9.2

★ Fig. A



★ Fig. B



2. Table of tightening torques for split flange bolts

★ Unless there are special instructions, tighten split flange bolts to the torque below.

Thread diameter of bolt	Width across flats	Tightening torque	
mm	mm	Nm	kgm
10	14	59 – 74	6.0 – 7.5
12	17	98 – 123	10.0 – 12.5
16	22	235 – 285	23.5 – 29.5

3. Table of tightening torques for O-ring boss piping joints

★ Unless there are special instructions, tighten O-ring boss piping joints to the torque below.

Nominal No.	Thread diameter	Width across flats	Tightening torque Nm {kgm}	
	mm	mm	Range	Target
02	14	Varies depending on type of connector.	35 – 63 { 3.5 – 6.5}	44 { 4.5}
03,04	20		84 – 132 { 8.5 – 13.5}	103 {10.5}
05,06	24		128 – 186 {13.0 – 19.0}	157 {16.0}
10,12	33		363 – 480 {37.0 – 49.0}	422 {43.0}
14	42		746 – 1,010 {76.0 – 103}	883 {90.0}

4. Table of tightening torques for O-ring boss plugs

★ Unless there are special instructions, tighten O-ring boss plugs to the torque below.

Nominal No.	Thread diameter	Width across flats	Tightening torque Nm {kgm}	
	mm	mm	Range	Target
08	8	14	5.88 – 8.82 {0.6 – 0.9}	7.35 {0.75}
10	10	17	9.81 – 12.74 {1.0 – 1.3}	11.27 {1.15}
12	12	19	14.7 – 19.6 {1.5 – 2.0}	17.64 {1.8}
14	14	22	19.6 – 24.5 {2.0 – 2.5}	22.54 {2.3}
16	16	24	24.5 – 34.3 {2.5 – 3.5}	29.4 {3.0}
18	18	27	34.3 – 44.1 {3.5 – 4.5}	39.2 {4.0}
20	20	30	44.1 – 53.9 {4.5 – 5.5}	49.0 {5.0}
24	24	32	58.8 – 78.4 {6.0 – 8.0}	68.6 {7.0}
30	30	32	93.1 – 122.5 { 9.5 – 12.5}	107.8 {11.0}
33	33	–	107.8 – 147.0 {11.0 – 15.0}	127.4 {13.0}
36	36	36	127.4 – 176.4 {13.0 – 18.0}	151.9 {15.5}
42	42	–	181.3 – 240.1 {18.5 – 24.5}	210.7 {21.5}
52	52	–	274.4 – 367.5 {28.0 – 37.5}	323.4 {33.0}

5. Table of tightening torques for hoses (taper seal type and face seal type)

★ Unless there are special instructions, tighten the hoses (taper seal type and face seal type) to the torque below.

★ Apply the following torque when the threads are coated (wet) with engine oil.

Nominal No. of hose	Width across flats	Tightening torque Nm {kgm}		Taper seal	Face seal	
		Range	Target	Thread size (mm)	Nominal No. - Number of threads, type of thread	Thread diameter (mm) (Reference)
02	19	34 – 54 { 3.5 – 5.5}	44 { 4.5}	–	9/16-18UN	14.3
		34 – 63 { 3.5 – 6.5}		14	–	–
03	22	54 – 93 { 5.5 – 9.5}	74 { 7.5}	–	11/16-16UN	17.5
	24	59 – 98 { 6.0 – 10.0}	78 { 8.0}	18	–	–
04	27	84 – 132 { 8.5 – 13.5}	103 {10.5}	22	13/16-16UN	20.6
05	32	128 – 186 {13.0 – 19.0}	157 {16.0}	24	1-14UNS	25.4
06	36	177 – 245 {18.0 – 25.0}	216 {22.0}	30	1-3/16-12UN	30.2
(10)	41	177 – 245 {18.0 – 25.0}	216 {22.0}	33	–	–
(12)	46	197 – 294 {20.0 – 30.0}	245 {25.0}	36	–	–
(14)	55	246 – 343 {25.0 – 35.0}	294 {30.0}	42	–	–

6. Table of tightening torques for 102, 107 and 114 engine series (Bolts and nuts)

★ Unless there are special instructions, tighten the metric bolts and nuts of the 102, 107 and 114 engine series to the torque below.

Thread size	Tightening torque	
	Bolts and nuts	
mm	Nm	kgm
6	10 ± 2	1.02 ± 0.20
8	24 ± 4	2.45 ± 0.41
10	43 ± 6	4.38 ± 0.61
12	77 ± 12	7.85 ± 1.22
14	—	—

7. Table of tightening torques for 102, 107 and 114 engine series (Eye joints)

★ Unless there are special instructions, tighten the metric eye joints of the 102, 107 and 114 engine series to the torque below.

Thread size	Tightening torque	
mm	Nm	kgm
6	8 ± 2	0.81 ± 0.20
8	10 ± 2	1.02 ± 0.20
10	12 ± 2	1.22 ± 0.20
12	24 ± 4	2.45 ± 0.41
14	36 ± 5	3.67 ± 0.51

8. Table of tightening torques for 102, 107 and 114 engine series (Taper screws)

★ Unless there are special instructions, tighten the taper screws (unit: inch) of the 102, 107 and 114 engine series to the torque below.

Thread size	Tightening torque	
inch	Nm	kgm
1/16	3 ± 1	0.31 ± 0.10
1/8	8 ± 2	0.81 ± 0.20
1/4	12 ± 2	1.22 ± 0.20
3/8	15 ± 2	1.53 ± 0.20
1/2	24 ± 4	2.45 ± 0.41
3/4	36 ± 5	3.67 ± 0.51
1	60 ± 9	6.12 ± 0.92

Conversion table

Method of using the conversion table

The conversion table in this section is provided to enable simple conversion of figures. For details of the method of using the conversion table, see the example given below.

Example: Method of using the conversion table to convert from millimeters to inches

1. Convert 55 mm into inches.

1) Locate the number 50 in the vertical column at the left side, take this as (A), and then draw a horizontal line from (A).
2) Locate the number 5 in the row across the top, take this as (B), then draw a perpendicular line down from (B).
3) Take the point where the 2 lines cross as (C). This point (C) gives the value when converting from millimeters to inches. Therefore, 55 mm = 2.165 inches.

2. Convert 550 mm into inches.

1) The number 550 does not appear in the table, so divide it by 10 (move the decimal point one place to the left) to convert it to 55 mm.
2) Carry out the same procedure as above to convert 55 mm to 2.165 inches.
3) The original value (550 mm) was divided by 10, so multiply 2.165 inches by 10 (move the decimal point one place to the right) to return to the original value. This gives 550 mm = 21.65 inches.

Millimeters to inches

(B)

1 mm = 0.03937 in

	0	1	2	3	4	5	6	7	8	9
0	0	0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.536
40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
						(C)				
50	1.969	2.008	2.047	2.087	2.126	2.165	2.205	2.244	2.283	2.323
60	2.362	2.402	2.441	2.480	2.520	2.559	2.598	2.638	2.677	2.717
70	2.756	2.795	2.835	2.874	2.913	2.953	2.992	3.032	3.071	3.110
80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

(A)

Millimeters to inches

1 mm = 0.03937 in

	0	1	2	3	4	5	6	7	8	9
0	0	0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.536
40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
50	1.969	2.008	2.047	2.087	2.126	2.165	2.205	2.244	2.283	2.323
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80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

Kilogram to pound

1 kg = 2.2046 lb

	0	1	2	3	4	5	6	7	8	9
0	0	2.20	4.41	6.61	8.82	11.02	13.23	15.43	17.64	19.84
10	22.05	24.25	26.46	28.66	30.86	33.07	35.27	37.48	39.68	41.89
20	44.09	46.30	48.50	50.71	51.91	55.12	57.32	59.53	61.73	63.93
30	66.14	68.34	70.55	72.75	74.96	77.16	79.37	81.57	83.78	85.98
40	88.18	90.39	92.59	94.80	97.00	99.21	101.41	103.62	105.82	108.03
50	110.23	112.44	114.64	116.85	119.05	121.25	123.46	125.66	127.87	130.07
60	132.28	134.48	136.69	138.89	141.10	143.30	145.51	147.71	149.91	152.12
70	154.32	156.53	158.73	160.94	163.14	165.35	167.55	169.76	171.96	174.17
80	176.37	178.57	180.78	182.98	185.19	187.39	189.60	191.80	194.01	196.21
90	198.42	200.62	202.83	205.03	207.24	209.44	211.64	213.85	216.05	218.26

Liters to U.S. Gallons

1 ℓ = 0.2642 U.S.Gal

	0	1	2	3	4	5	6	7	8	9
0	0	0.264	0.528	0.793	1.057	1.321	1.585	1.849	2.113	2.378
10	2.642	2.906	3.170	3.434	3.698	3.963	4.227	4.491	4.755	5.019
20	5.283	5.548	5.812	6.076	6.340	6.604	6.869	7.133	7.397	7.661
30	7.925	8.189	8.454	8.718	8.982	9.246	9.510	9.774	10.039	10.303
40	10.567	10.831	11.095	11.359	11.624	11.888	12.152	12.416	12.680	12.944
50	13.209	13.473	13.737	14.001	14.265	14.529	14.795	15.058	15.322	15.586
60	15.850	16.115	16.379	16.643	16.907	17.171	17.435	17.700	17.964	18.228
70	18.492	18.756	19.020	19.285	19.549	19.813	20.077	20.341	20.605	20.870
80	21.134	21.398	21.662	21.926	22.190	22.455	22.719	22.983	23.247	23.511
90	23.775	24.040	24.304	24.568	24.832	25.096	25.361	25.625	25.889	26.153

Liters to U.K. Gallons

1 ℓ = 0.21997 U.K.Gal

	0	1	2	3	4	5	6	7	8	9
0	0	0.220	0.440	0.660	0.880	1.100	1.320	1.540	1.760	1.980
10	2.200	2.420	2.640	2.860	3.080	3.300	3.520	3.740	3.950	4.179
20	4.399	4.619	4.839	5.059	5.279	5.499	5.719	5.939	6.159	6.379
30	6.599	6.819	7.039	7.259	7.479	7.699	7.919	8.139	8.359	8.579
40	8.799	9.019	9.239	9.459	9.679	9.899	10.119	10.339	10.559	10.778
50	10.998	11.281	11.438	11.658	11.878	12.098	12.318	12.528	12.758	12.978
60	13.198	13.418	13.638	13.858	14.078	14.298	14.518	14.738	14.958	15.178
70	15.398	15.618	15.838	16.058	16.278	16.498	16.718	16.938	17.158	17.378
80	17.598	17.818	18.037	18.257	18.477	18.697	18.917	19.137	19.357	19.577
90	19.797	20.017	20.237	20.457	20.677	20.897	21.117	21.337	21.557	21.777

kgm to ft.lb

1 kgm = 7.233 ft.lb

	0	1	2	3	4	5	6	7	8	9
0	0	7.2	14.5	21.7	28.9	36.2	43.4	50.6	57.9	65.1
10	72.3	79.6	86.8	94.0	101.3	108.5	115.7	123.0	130.2	137.4
20	144.7	151.9	159.1	166.4	173.6	180.8	188.1	195.3	202.5	209.8
30	217.0	224.2	231.5	238.7	245.9	253.2	260.4	267.6	274.9	282.1
40	289.3	296.6	303.8	311.0	318.3	325.5	332.7	340.0	347.2	354.4
50	361.7	368.9	376.1	383.4	390.6	397.8	405.1	412.3	419.5	426.8
60	434.0	441.2	448.5	455.7	462.9	470.2	477.4	484.6	491.8	499.1
70	506.3	513.5	520.8	528.0	535.2	542.5	549.7	556.9	564.2	571.4
80	578.6	585.9	593.1	600.3	607.6	614.8	622.0	629.3	636.5	643.7
90	651.0	658.2	665.4	672.7	679.9	687.1	694.4	701.6	708.8	716.1
100	723.3	730.5	737.8	745.0	752.2	759.5	766.7	773.9	781.2	788.4
110	795.6	802.9	810.1	817.3	824.6	831.8	839.0	846.3	853.5	860.7
120	868.0	875.2	882.4	889.7	896.9	904.1	911.4	918.6	925.8	933.1
130	940.3	947.5	954.8	962.0	969.2	976.5	983.7	990.9	998.2	1005.4
140	1012.6	1019.9	1027.1	1034.3	1041.5	1048.8	1056.0	1063.2	1070.5	1077.7
150	1084.9	1092.2	1099.4	1106.6	1113.9	1121.1	1128.3	1135.6	1142.8	1150.0
160	1157.3	1164.5	1171.7	1179.0	1186.2	1193.4	1200.7	1207.9	1215.1	1222.4
170	1129.6	1236.8	1244.1	1251.3	1258.5	1265.8	1273.0	1280.1	1287.5	1294.7
180	1301.9	1309.2	1316.4	1323.6	1330.9	1338.1	1345.3	1352.6	1359.8	1367.0
190	1374.3	1381.5	1388.7	1396.0	1403.2	1410.4	1417.7	1424.9	1432.1	1439.4

kg/cm^2 to lb/in^2

1 kg/cm^2 = 14.2233 lb/in^2

	0	1	2	3	4	5	6	7	8	9
0	0	14.2	28.4	42.7	56.9	71.1	85.3	99.6	113.8	128.0
10	142.2	156.5	170.7	184.9	199.1	213.4	227.6	241.8	256.0	270.2
20	284.5	298.7	312.9	327.1	341.4	355.6	369.8	384.0	398.3	412.5
30	426.7	440.9	455.1	469.4	483.6	497.8	512.0	526.3	540.5	554.7
40	568.9	583.2	597.4	611.6	625.8	640.1	654.3	668.5	682.7	696.9
50	711.2	725.4	739.6	753.8	768.1	782.3	796.5	810.7	825.0	839.2
60	853.4	867.6	881.8	896.1	910.3	924.5	938.7	953.0	967.2	981.4
70	995.6	1,010	1,024	1,038	1,053	1,067	1,081	1,095	1,109	1,124
80	1,138	1,152	1,166	1,181	1,195	1,209	1,223	1,237	1,252	1,266
90	1,280	1,294	1,309	1,323	1,337	1,351	1,365	1,380	1,394	1,408
100	1,422	1,437	1,451	1,465	1,479	1,493	1,508	1,522	1,536	1,550
110	1,565	1,579	1,593	1,607	1,621	1,636	1,650	1,664	1,678	1,693
120	1,707	1,721	1,735	1,749	1,764	1,778	1,792	1,806	1,821	1,835
130	1,849	1,863	1,877	1,892	1,906	1,920	1,934	1,949	1,963	1,977
140	1,991	2,005	2,020	2,034	2,048	2,062	2,077	2,091	2,105	2,119
150	2,134	2,148	2,162	2,176	2,190	2,205	2,219	2,233	2,247	2,262
160	2,276	2,290	2,304	2,318	2,333	2,347	2,361	2,375	2,389	2,404
170	2,418	2,432	2,446	2,460	2,475	2,489	2,503	2,518	2,532	2,546
180	2,560	2,574	2,589	2,603	2,617	2,631	2,646	2,660	2,674	2,688
190	2,702	2,717	2,731	2,745	2,759	2,773	2,788	2,802	2,816	2,830
200	2,845	2,859	2,873	2,887	2,901	2,916	2,930	2,944	2,958	2,973
210	2,987	3,001	3,015	3,030	3,044	3,058	3,072	3,086	3,101	3,115
220	3,129	3,143	3,158	3,172	3,186	3,200	3,214	3,229	3,243	3,257
230	3,271	3,286	3,300	3,314	3,328	3,343	3,357	3,371	3,385	3,399
240	3,414	3,428	3,442	3,456	3,470	3,485	3,499	3,513	3,527	3,542

Temperature

Fahrenheit-Centigrade conversion: A simple way to convert a Fahrenheit temperature reading into a Centigrade temperature reading or vice versa is to enter the accompanying table in the center (boldface column) of figures. These figures refer to the temperature in either Fahrenheit or Centigrade degrees.
When convert from Fahrenheit to Centigrade degrees, consider the center column to be a table of Fahrenheit temperatures and read the corresponding Centigrade temperature in the column at the left.
When convert from Centigrade to Fahrenheit degrees, consider the center column to be a table of Centigrade values, and read the corresponding Fahrenheit temperature on the right.

1°C = 33.8°F

°C		°F	°C		°F	°C		°F	°C		°F
–40.4	**–40**	–40.0	–11.7	**11**	51.8	7.8	**46**	114.8	27.2	**81**	177.8
–37.2	**–35**	–31.0	–11.1	**12**	53.6	8.3	**47**	116.6	27.8	**82**	179.6
–34.4	**–30**	–22.0	–10.6	**13**	55.4	8.9	**48**	118.4	28.3	**83**	181.4
–31.7	**–25**	–13.0	–10.0	**14**	57.2	9.4	**49**	120.2	28.9	**84**	183.2
–28.9	**–20**	–4.0	–9.4	**15**	59.0	10.0	**50**	122.0	29.4	**85**	185.0
–28.3	**–19**	–2.2	–8.9	**16**	60.8	10.6	**51**	123.8	30.0	**86**	186.8
–27.8	**–18**	–0.4	–8.3	**17**	62.6	11.1	**52**	125.6	30.6	**87**	188.6
–27.2	**–17**	1.4	–7.8	**18**	64.4	11.7	**53**	127.4	31.1	**88**	190.4
–26.7	**–16**	3.2	–7.2	**19**	66.2	12.2	**54**	129.2	31.7	**89**	192.2
–26.1	**–15**	5.0	–6.7	**20**	68.0	12.8	**55**	131.0	32.2	**90**	194.0
–25.6	**–14**	6.8	–6.1	**21**	69.8	13.3	**56**	132.8	32.8	**91**	195.8
–25.0	**–13**	8.6	–5.6	**22**	71.6	13.9	**57**	134.6	33.3	**92**	197.6
–24.4	**–12**	10.4	–5.0	**23**	73.4	14.4	**58**	136.4	33.9	**93**	199.4
–23.9	**–11**	12.2	–4.4	**24**	75.2	15.0	**59**	138.2	34.4	**94**	201.2
–23.3	**–10**	14.0	–3.9	**25**	77.0	15.6	**60**	140.0	35.0	**95**	203.0
–22.8	**–9**	15.8	–3.3	**26**	78.8	16.1	**61**	141.8	35.6	**96**	204.8
–22.2	**–8**	17.6	–2.8	**27**	80.6	16.7	**62**	143.6	36.1	**97**	206.6
–21.7	**–7**	19.4	–2.2	**28**	82.4	17.2	**63**	145.4	36.7	**98**	208.4
–21.1	**–6**	21.2	–1.7	**29**	84.2	17.8	**64**	147.2	37.2	**99**	210.2
–20.6	**–5**	23.0	–1.1	**30**	86.0	18.3	**65**	149.0	37.8	**100**	212.0
–20.0	**–4**	24.8	–0.6	**31**	87.8	18.9	**66**	150.8	40.6	**105**	221.0
–19.4	**–3**	26.6	0	**32**	89.6	19.4	**67**	152.6	43.3	**110**	230.0
–18.9	**–2**	28.4	0.6	**33**	91.4	20.0	**68**	154.4	46.1	**115**	239.0
–18.3	**–1**	30.2	1.1	**34**	93.2	20.6	**69**	156.2	48.9	**120**	248.0
–17.8	**0**	32.0	1.7	**35**	95.0	21.1	**70**	158.0	51.7	**125**	257.0
–17.2	**1**	33.8	2.2	**36**	96.8	21.7	**71**	159.8	54.4	**130**	266.0
–16.7	**2**	35.6	2.8	**37**	98.6	22.2	**72**	161.6	57.2	**135**	275.0
–16.1	**3**	37.4	3.3	**38**	100.4	22.8	**73**	163.4	60.0	**140**	284.0
–15.6	**4**	39.2	3.9	**39**	102.2	23.3	**74**	165.2	62.7	**145**	293.0
–15.0	**5**	41.0	4.4	**40**	104.0	23.9	**75**	167.0	65.6	**150**	302.0
–14.4	**6**	42.8	5.0	**41**	105.8	24.4	**76**	168.8	68.3	**155**	311.0
–13.9	**7**	44.6	5.6	**42**	107.6	25.0	**77**	170.6	71.1	**160**	320.0
–13.3	**8**	46.4	6.1	**43**	109.4	25.6	**78**	172.4	73.9	**165**	329.0
–12.8	**9**	48.2	6.7	**44**	111.2	26.1	**79**	174.2	76.7	**170**	338.0
–12.2	**10**	50.0	7.2	**45**	113.0	26.7	**80**	176.0	79.4	**175**	347.0

KOMATSU 114E-3 Series Diesel engine

Form No. SEN00172-03

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Engine

114E-3 Series

01 Specification

Specification and technical data

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Specification and technical data

General

1. Applicable machine

Engine	Serial No.	Applicable machine	
SAA6D114E-3		PC300-7E0, PC300LC-7E0 PC350-7E0, PC350LC-7E0 PC300-8, PC300LC-8 PC350-8, PC350LC-8 WA430-6 D65EX-15E0, D65PX-15E0, D65WX-15E0 GD655-3E0, GD675-3E0	Hydraulic excavator Hydraulic excavator Hydraulic excavator Hydraulic excavator Wheel loader Bulldozer Motor grader

Specifications

Engine name			SAA6D114E-3
Applicable model			PC300-7E0, PC300LC-7E0 PC350-7E0, PC350LC-7E0
No. of cylinders – Bore × Stroke		mm	6 – 114 × 135
Total piston displacement		ℓ {cc}	8.27 {8,270}
Firing order		—	1–5–3–6–2–4
Dimensions	Overall length	mm	1,625
	Overall width	mm	1,004
	Overall height (excluding exhaust pipe)	mm	—
	Overall height (including exhaust pipe)	mm	1,601
Performance	Flywheel horsepower	kW{HP}/rpm	194 {260}/1,950 (Gross)
	Max. torque	Nm{kgm}/rpm	1,129 {115}/1,450 (Gross)
	High idle speed	rpm	2,050 ± 50
	Low idle speed	rpm	1,000 ± 25
	Min. fuel consumption ratio	g/kW·h {g/HP·h}	226 {168}
Dry weight		kg	865
Fuel injection system		—	HPCR
Fuel injection system control			Electronic control type
Lubricating oil amount (refill capacity)		ℓ	40 (35)
Coolant amount		ℓ	10.4
Alternator		—	24V, 35A, 60A (if equipped)
Starting motor		—	24V, 7.5kW, 11kW (if equipped)
Battery		—	12V, 120Ah/140Ah × 2
Turbocharger		—	HOLSET HX40W
Air compressor		—	—
Others		—	—

Engine name			SAA6D114E-3
Applicable model			PC300-8, PC300LC-8 PC350-8, PC350LC-8
No. of cylinders – Bore × Stroke		mm	6 – 114 × 135
Total piston displacement		ℓ {cc}	8.27 {8,270}
Firing order		—	1–5–3–6–2–4
Dimensions	Overall length	mm	1,625
	Overall width	mm	1,004
	Overall height (excluding exhaust pipe)	mm	—
	Overall height (including exhaust pipe)	mm	1,601
Performance	Flywheel horsepower	kW{HP}/rpm	194 {260}/1,950 (Gross)
	Max. torque	Nm{kgm}/rpm	1,129 {115}/1,450 (Gross)
	High idle speed	rpm	2,050 ± 50
	Low idle speed	rpm	1,000 ± 25
	Min. fuel consumption ratio	g/kW·h {g/HP·h}	226 {168}
Dry weight		kg	865
Fuel injection system		—	HPCR
Fuel injection system control			Electronic control type
Lubricating oil amount (refill capacity)		ℓ	40 (35)
Coolant amount		ℓ	10.4
Alternator		—	24V, 60A
Starting motor		—	24V, 7.5kW, 11kW (if equipped)
Battery		—	12V, 120Ah/140Ah × 2
Turbocharger		—	HOLSET HX40W
Air compressor		—	—
Others		—	—

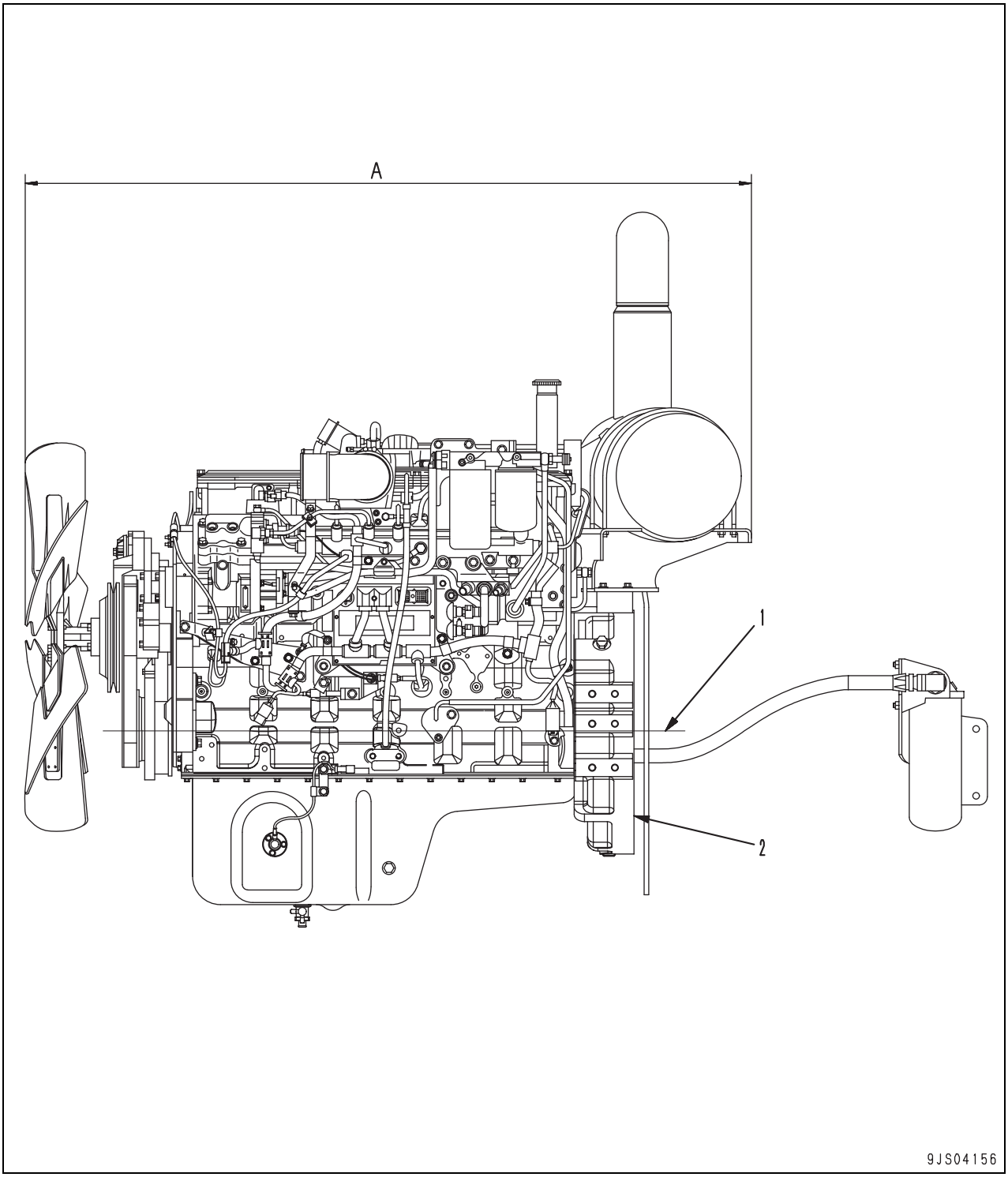
Engine name			SAA6D114E-3
Applicable model			WA430-6
No. of cylinders – Bore × Stroke		mm	6 – 114 × 135
Total piston displacement		ℓ {cc}	8.27 {8,270}
Firing order		—	1–5–3–6–2–4
Dimensions	Overall length	mm	1,135
	Overall width	mm	844
	Overall height (excluding exhaust pipe)	mm	—
	Overall height (including exhaust pipe)	mm	1,605
Performance	Flywheel horsepower	kW{HP}/rpm	173 {232}/2,100 (Gross)
	Max. torque	Nm{kgm}/rpm	1,020 {104}/1,450 (Gross)
	High idle speed	rpm	2,245 ± 50
	Low idle speed	rpm	765 ± 25
	Min. fuel consumption ratio	g/kW·h {g/HP·h}	235 {175}
Dry weight		kg	785
Fuel injection system		—	HPCR
Fuel injection system control			Electronic control type
Lubricating oil amount (refill capacity)		ℓ	37 (32)
Coolant amount		ℓ	10.4
Alternator		—	24V, 60A, 90A (if equipped)
Starting motor		—	24V, 7.5kW, 11kW (if equipped)
Battery		—	12V, 136Ah/140Ah × 2
Turbocharger		—	HOLSET HX40W
Air compressor		—	Equipped
Others		—	—

Engine name			SAA6D114E-3
Applicable model			D65EX-15E0, D65PX-15E0, D65WX-15E0
No. of cylinders – Bore × Stroke		mm	6 – 114 × 135
Total piston displacement		ℓ {cc}	8.27 {8,270}
Firing order		—	1–5–3–6–2–4
Dimensions	Overall length	mm	1,189
	Overall width	mm	909
	Overall height (excluding exhaust pipe)	mm	—
	Overall height (including exhaust pipe)	mm	1,532
Performance	Flywheel horsepower	kW{HP}/rpm	154 {206}/1,950 (Gross)
	Max. torque	Nm{kgm}/rpm	1,010 {103}/1,450 (Gross)
	High idle speed	rpm	2,030 ± 50
	Low idle speed	rpm	825 ± 25
	Min. fuel consumption ratio	g/kW·h {g/HP·h}	227 {169}
Dry weight		kg	860
Fuel injection system		—	HPCR
Fuel injection system control			Electronic control type
Lubricating oil amount (refill capacity)		ℓ	33 (28)
Coolant amount		ℓ	10.4
Alternator		—	24V, 60A, 90A (if equipped)
Starting motor		—	24V, 7.5kW, 11kW (if equipped)
Battery		—	12V, 112Ah/140Ah × 2
Turbocharger		—	HOLSET HX40W
Air compressor		—	—
Others		—	—

Engine name			SAA6D114E-3
Applicable model			GD655-3E0, GD675-3E0
No. of cylinders – Bore × Stroke		mm	6 – 114 × 135
Total piston displacement		ℓ {cc}	8.27 {8,270}
Firing order		—	1–5–3–6–2–4
Dimensions	Overall length	mm	1,128
	Overall width	mm	872
	Overall height (excluding exhaust pipe)	mm	—
	Overall height (including exhaust pipe)	mm	1,455
Performance	Flywheel horsepower	kW{HP}/rpm	154 {206}/1,900 (Gross)
	Max. torque	Nm{kgm}/rpm	990 {101}/1,450 (Gross)
	High idle speed	rpm	2,225 ± 50
	Low idle speed	rpm	825 ± 25
	Min. fuel consumption ratio	g/kW·h {g/HP·h}	232 {173}
Dry weight		kg	800
Fuel injection system		—	HPCR
Fuel injection system control			Electronic control type
Lubricating oil amount (refill capacity)		ℓ	30 (25)
Coolant amount		ℓ	10.4
Alternator		—	24V, 60A, 90A (if equipped)
Starting motor		—	24V, 7.5kW, 11kW (if equipped)
Battery		—	12V, 112Ah × 2
Turbocharger		—	HOLSET HX40W
Air compressor		—	—
Others		—	—

General view

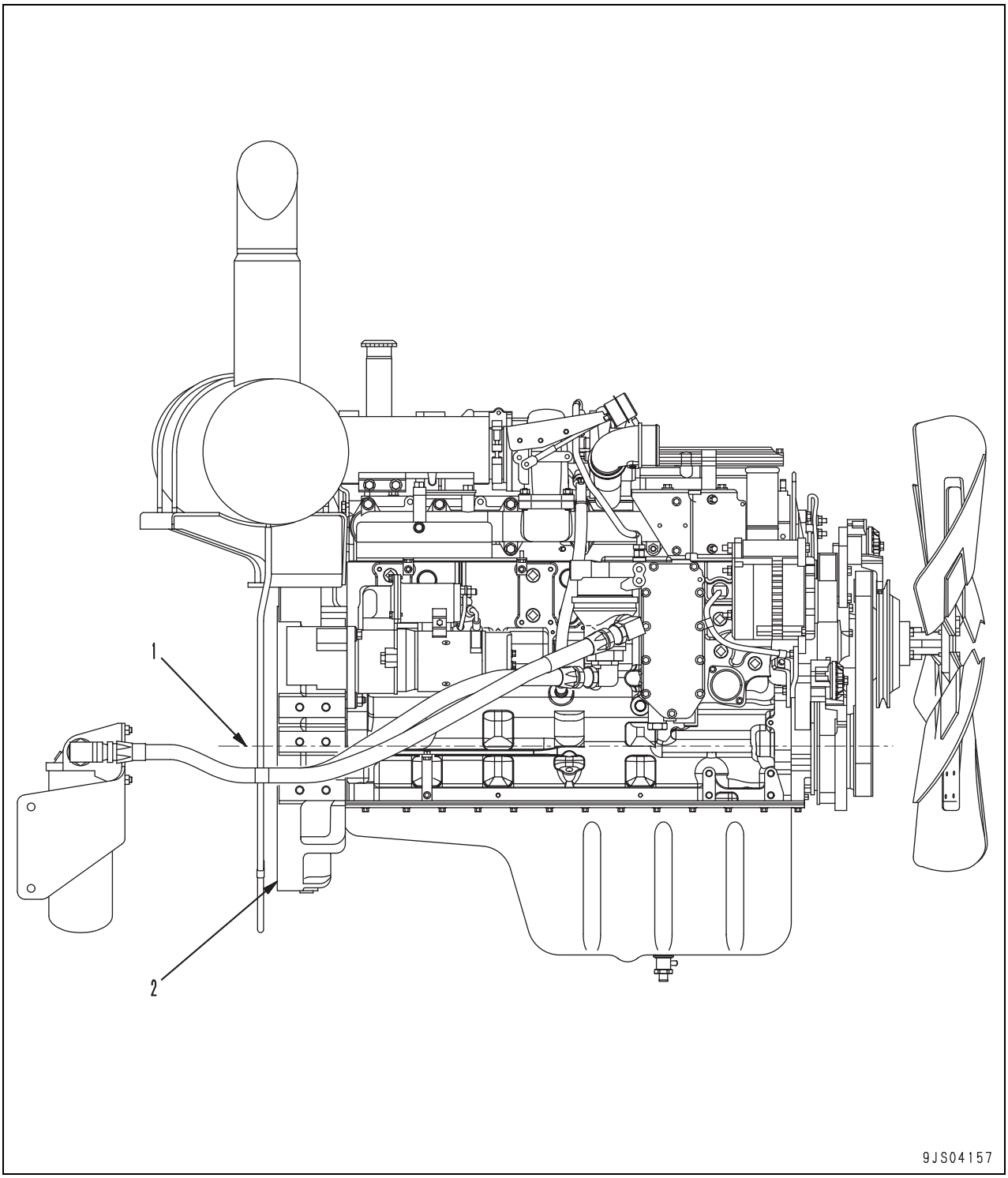
SAA6D114E-3 (Left side view of engine)
Machine model: PC300-7E0, PC300LC-7E0, PC350-7E0, PC350LC-7E0



★ The shape may differ according to the machine model.

1. Crankshaft center
2. Flywheel housing rear surface

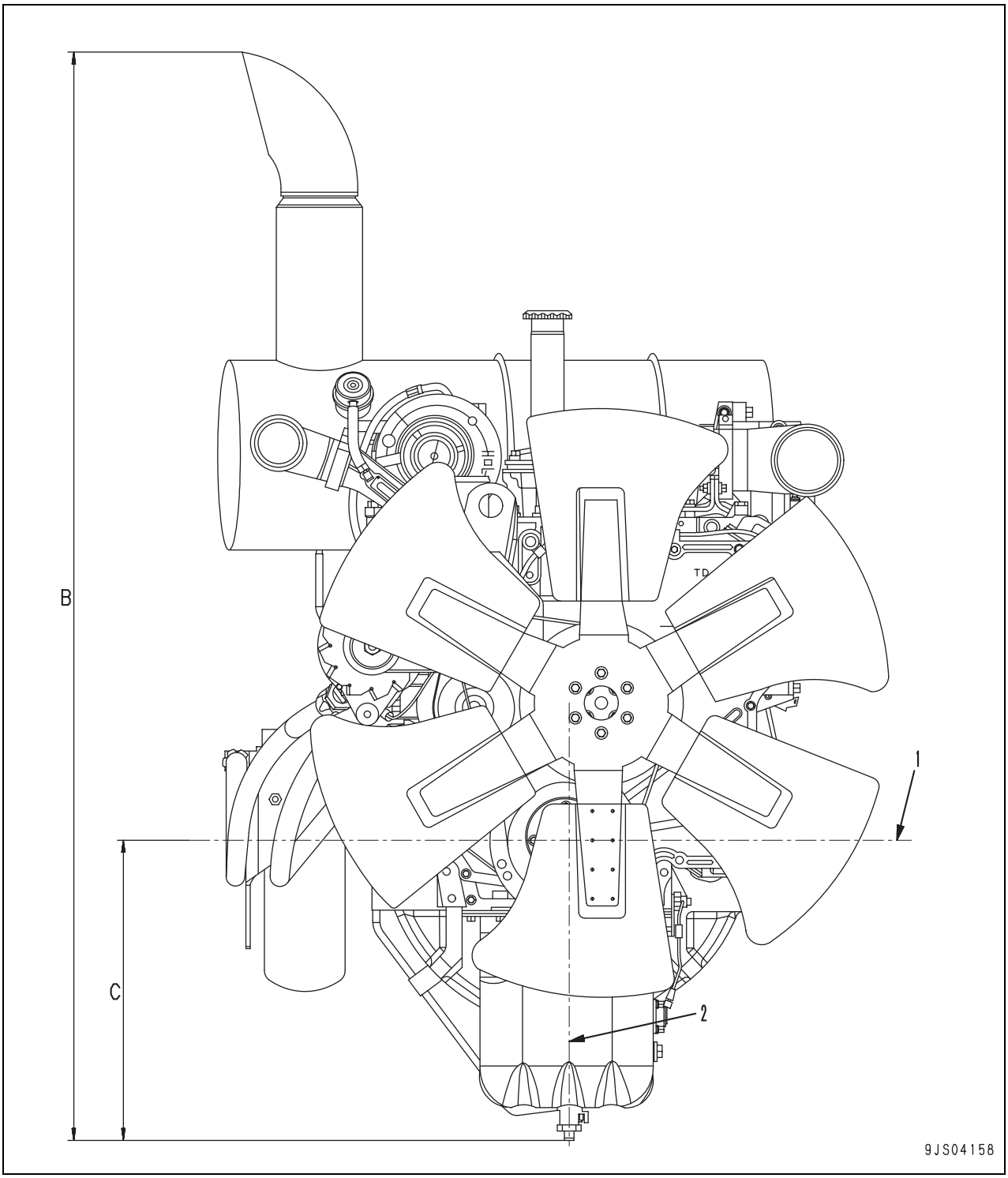
SAA6D114E-3 (Right side view of engine)
Machine model: PC300-7E0, PC300LC-7E0, PC350-7E0, PC350LC-7E0



★ The shape may differ according to the machine model.

1. Crankshaft center
2. Flywheel housing rear surface

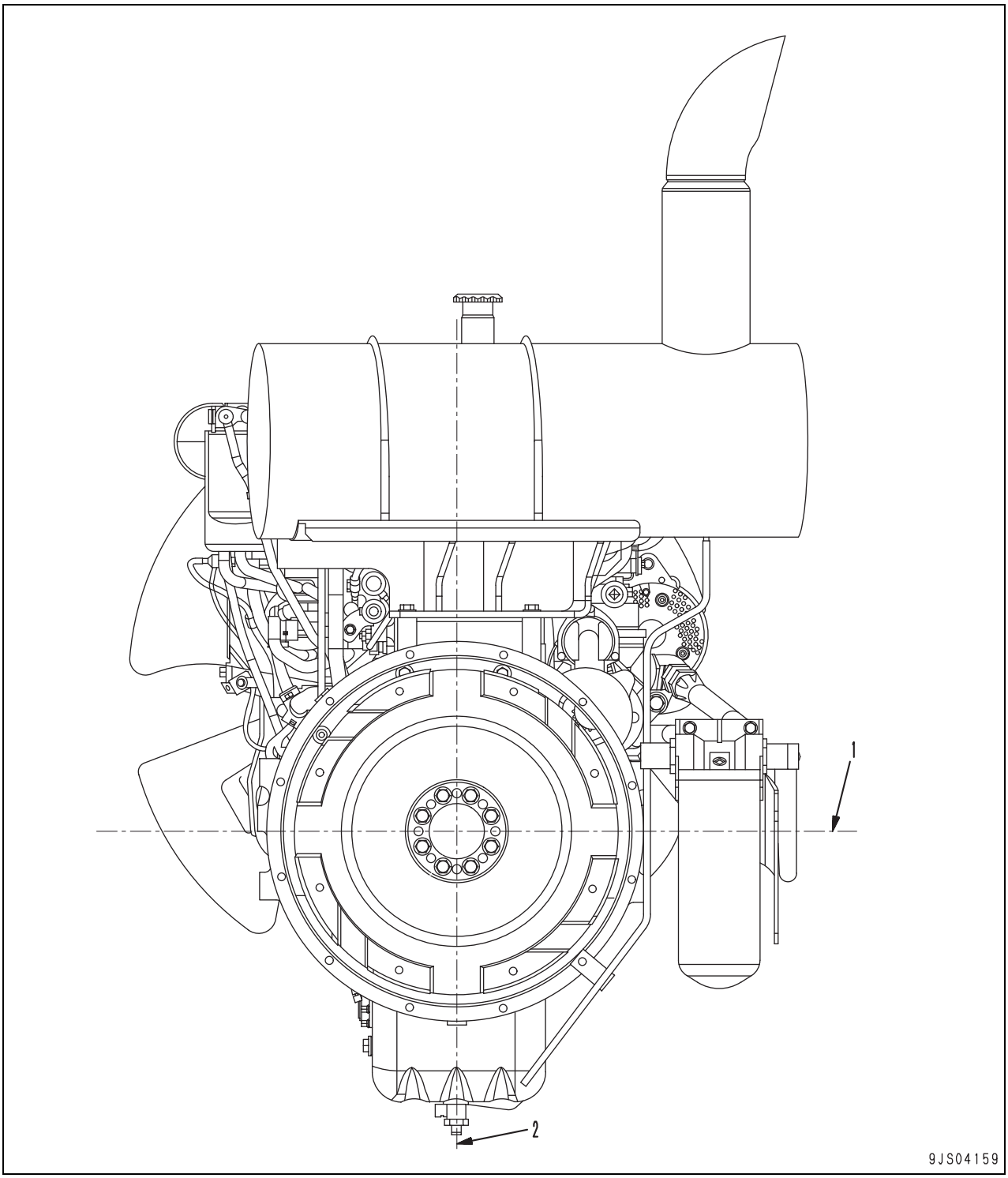
SAA6D114E-3 (Front view of engine)
Machine model: PC300-7E0, PC300LC-7E0, PC350-7E0, PC350LC-7E0



★ The shape may differ according to the machine model.

1. Crankshaft center
2. Cylinder center

SAA6D114E-3 (Rear view of engine)
Machine model: PC300-7E0, PC300LC-7E0, PC350-7E0, PC350LC-7E0



★ The shape may differ according to the machine model.

1. Crankshaft center
2. Cylinder center

Dimensions table

Unit: mm

Engine	Machine model	Dimension of each part		
		A	B	C
SAA6D114E-3	PC300-7E0, PC300LC-7E0 PC350-7E0, PC350LC-7E0 PC300-8, PC300LC-8 PC350-8, PC350LC-8	1,625	1,601	1,004
	WA430-6	1,135	1,605	844
	D65EX-15E0, D65PX-15E0, D65WX-15E0	1,189	1,532	909
	GD655-3E0, GD675-3E0	1,128	1,455	872

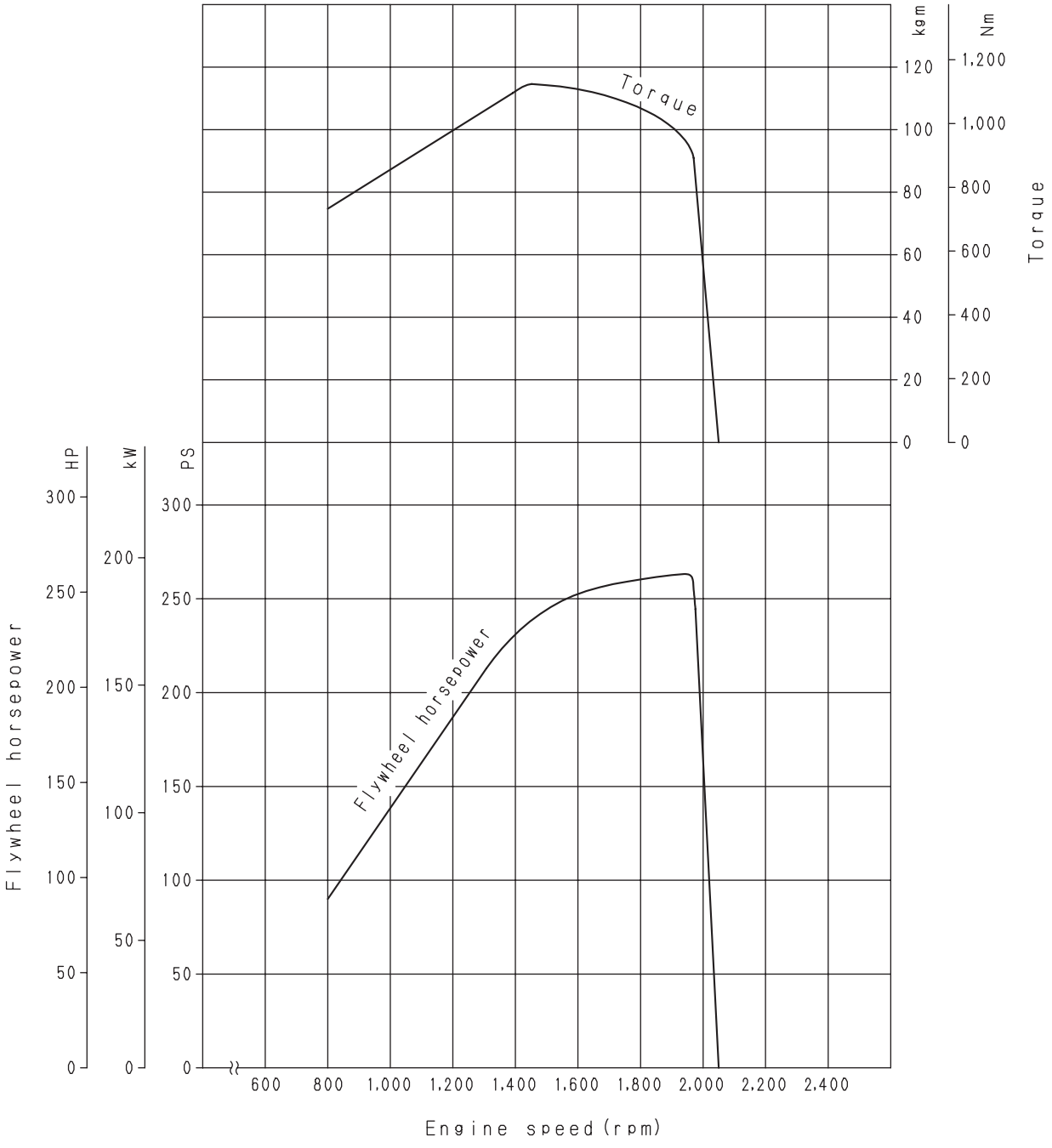
★ These dimensions are given for reference when the engine is set on a test bench.

Engine performance curves

Engine	Engine serial No.	Machine model	Page
SAA6D114E-3		PC300-7E0, PC300LC-7E0 PC350-7E0, PC350LC-7E0 PC300-8, PC300LC-8 PC350-8, PC350LC-8	14
		WA430-6	15
		D65EX-15E0, D65PX-15E0, D65WX-15E0	16
		GD655-3E0, GD675-3E0	17

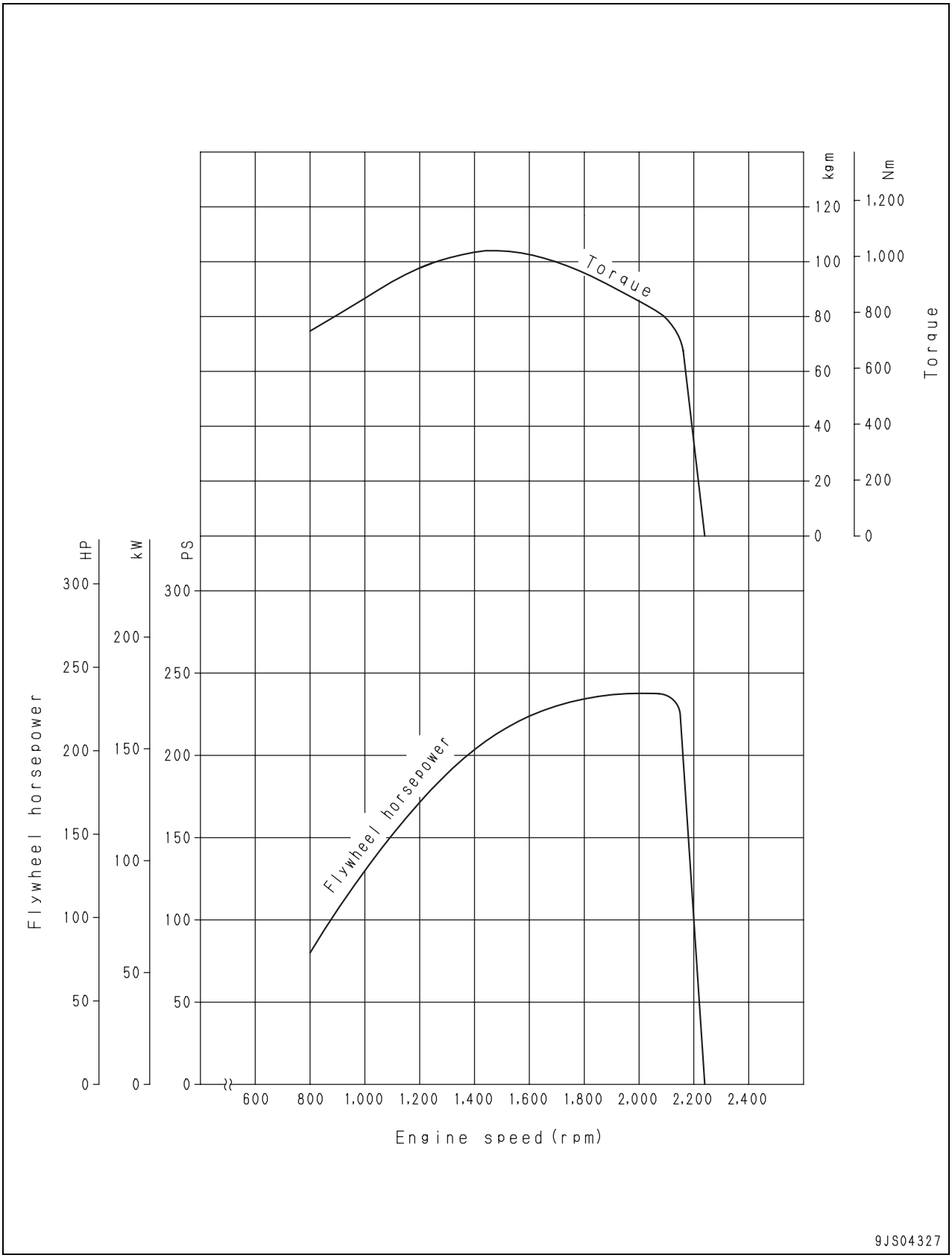
SAA6D114E-3
(Machine model: PC300-7E0, PC300LC-7E0, PC350-7E0, PC350LC-7E0, PC300-8, PC300LC-8, PC350-8, PC350LC-8)

Rated output: 194 kW {260 HP}/1,950 rpm (Gross)
Max. torque: 1,129 Nm {115 kgm}/1,450 rpm (Gross)



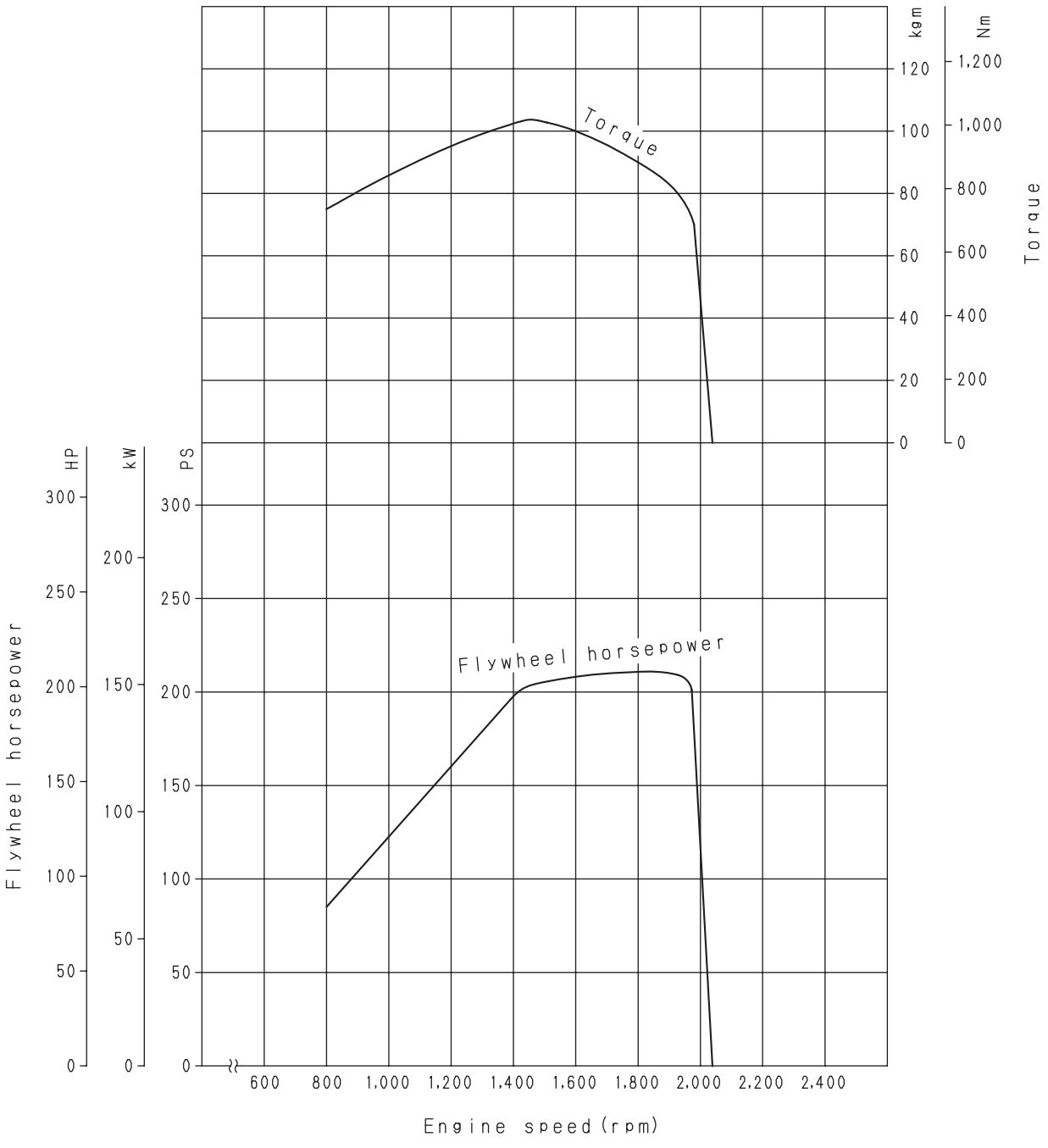
SAA6D114E-3 (Machine model: WA430-6)

Rated output: 173 kW {232 HP}/2,100 rpm (Gross)
Max. torque: 1,020 Nm {104 kgm}/1,450 rpm (Gross)



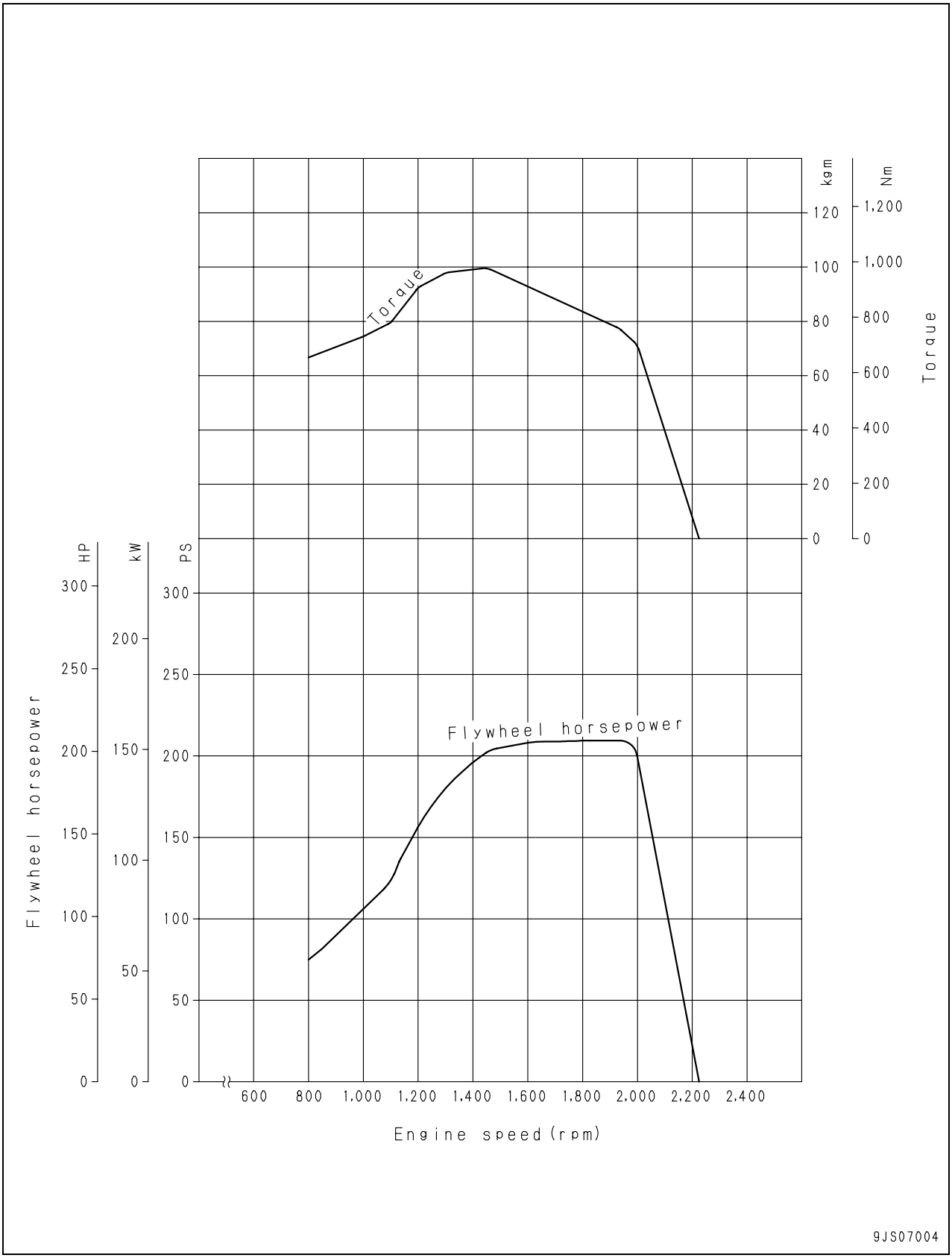
SAA6D114E-3 (Machine model: D65EX-15E0, D65PX-15E0, D65WX-15E0)

Rated output: 154 kW {206 HP}/1,950 rpm (Gross)
Max. torque: 1,010 Nm {103 kgm}/1,450 rpm (Gross)



SAA6D114E-3 (Machine model: GD655-3E0, GD675-3E0)

Rated output: 154 kW {206 HP}/1,900 rpm (Gross)
Max. torque: 990 Nm {101 kgm}/1,450 rpm (Gross)



KOMATSU 114E-3 Series Diesel engine

Form No. SEN00174-02

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Engine

114E-3 Series

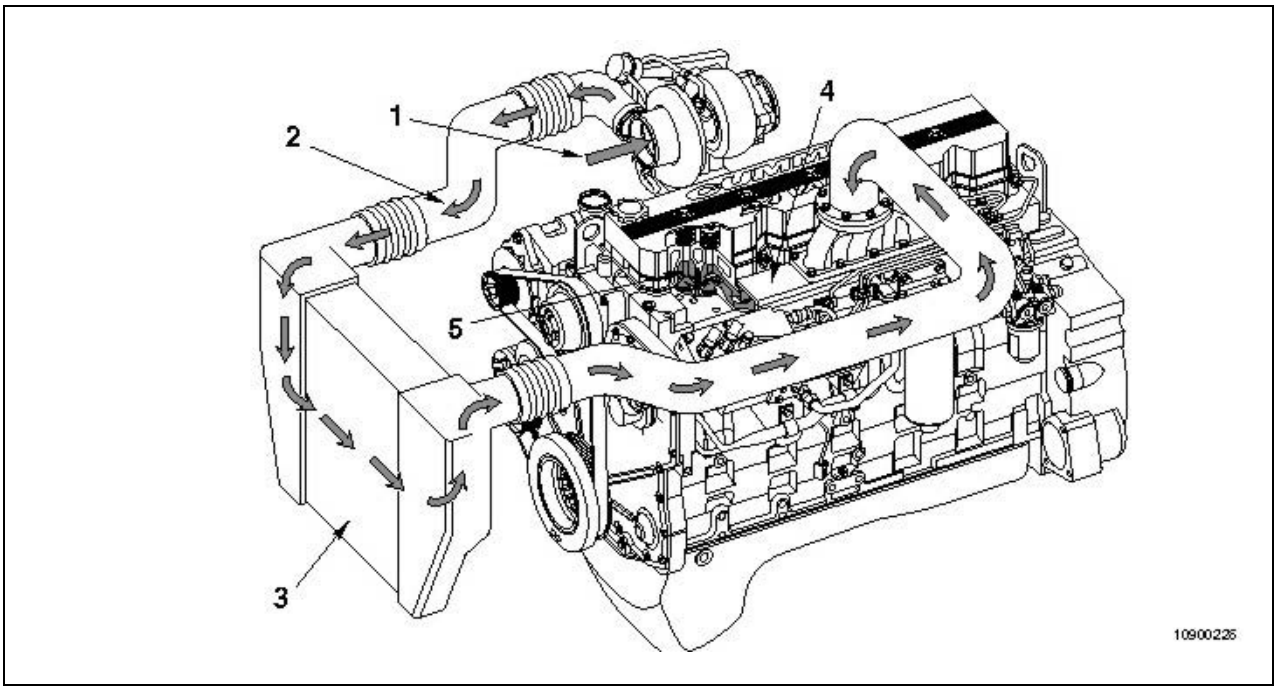
10 Structure, function and maintenance standard

Intake, exhaust system 2
Intake system 2
Exhaust system 3
Turbocharger 4
Lubricating oil system 7
Cooling system 9
Fuel system (common rail) 10
Maintenance standard 15
Turbocharger 15
Cylinder head 16
Cylinder block 18
Cylinder liner 20
Crankshaft 22
Piston, piston ring and piston pin 23
Connecting rod 24
Vibration damper 26
Timing gear 27
Camshaft 28
Valve and valve guide 30
Rocker arm, shaft and tappet 32
Flywheel and flywheel housing 34
Oil pump 36

Intake, exhaust system

Intake system

General Information



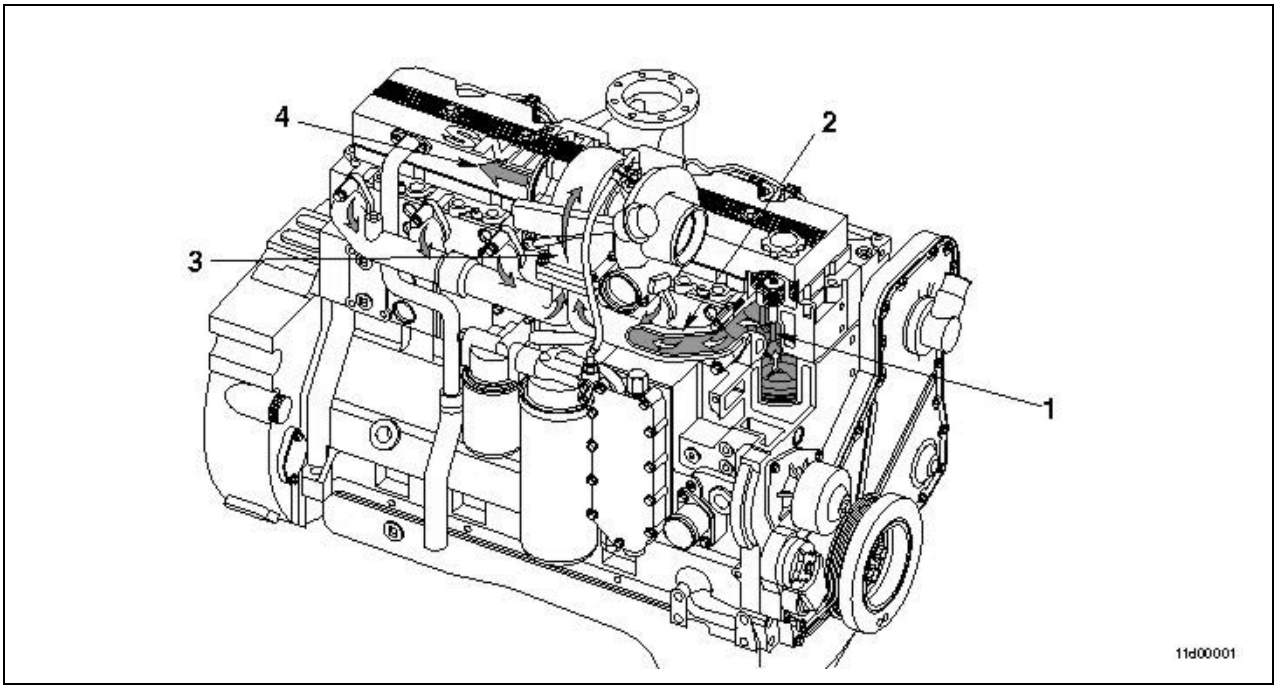
1. Intake air inlet to turbocharger
2. Turbocharger air to charge air cooler
3. Charge air cooler
4. Intake manifold (integral part of cylinder head)
5. Intake valve

The combustion air system on the engine consists of an air cleaner, intake air piping, turbocharger, charge air piping, charge air cooler (CAC), and intake air heater.

Air is drawn through the air cleaner and into the compressor side of the turbocharger (1). It is then forced through the CAC piping (2), to the CAC (3), the intake air heater (if applicable), and into the intake manifold (4). From the intake manifold, air is forced into the cylinders (5) and used for combustion.

Exhaust system

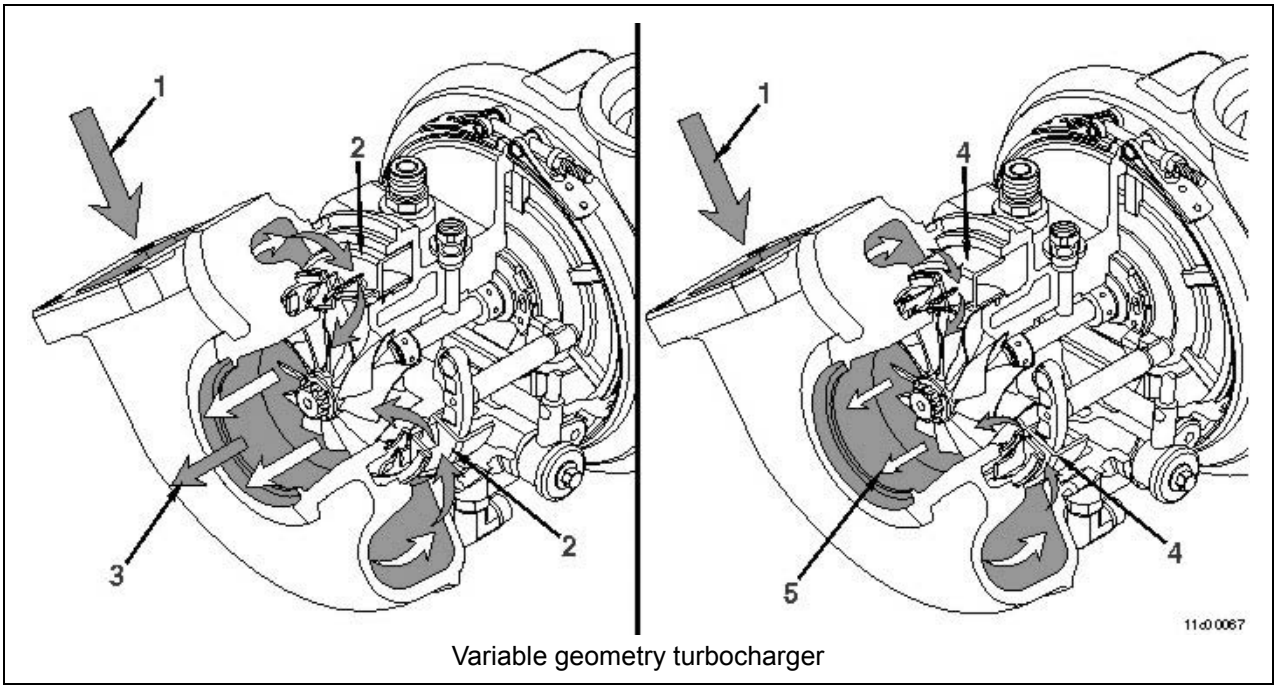
General Information



1. Exhaust valve
2. Exhaust manifold (pulse type)
3. Dual-entry turbocharger
4. Turbocharger exhaust outlet

Turbocharger

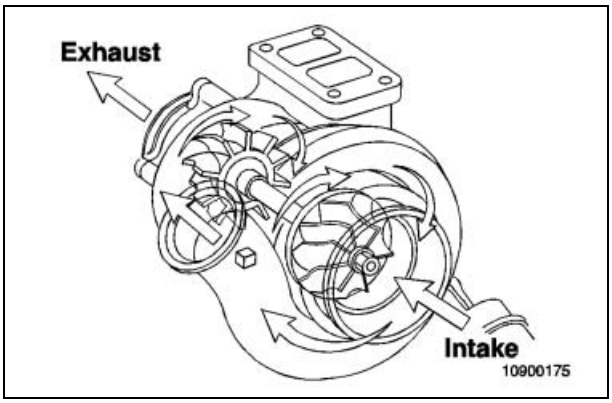
General Information



Variable geometry turbocharger

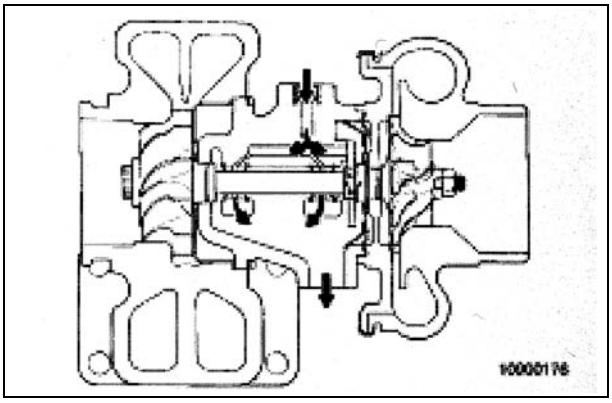
1. Exhaust in
2. Sliding nozzle open
3. Exhaust gas low velocity flow
4. Sliding nozzle closed
5. Exhaust gas high velocity flow

The turbocharger uses exhaust gas energy to turn the turbine wheel. The turbine wheel drives the compressor impeller that provides pressurized air to the engine for combustion. The additional air provided by the turbocharger allows more fuel to be injected to increase the power output from the engine.

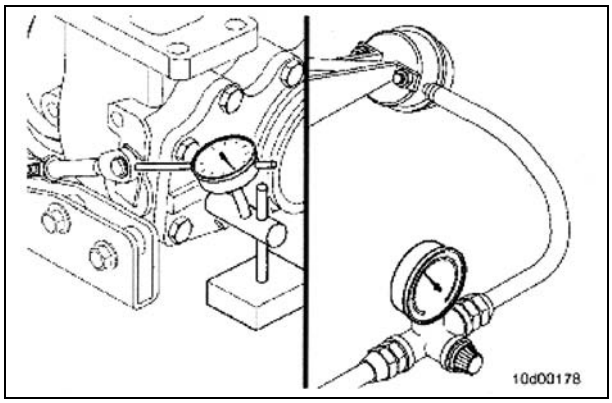


The turbine, compressor wheels, and shaft are supported by two rotating bearings in the bearing housing. Passages in the bearing housing direct filtered, pressurized engine oil to the shaft bearings and thrust bearings. The oil is used to lubricate and cool the rotating components. Oil then drains from the bearing housing to the engine sump, through the oil drain line.

★ An adequate supply of good, filtered oil is very important to the life of the turbocharger. Make sure that a high-quality oil is used and that it and the oil filter are changed according to maintenance recommendations.

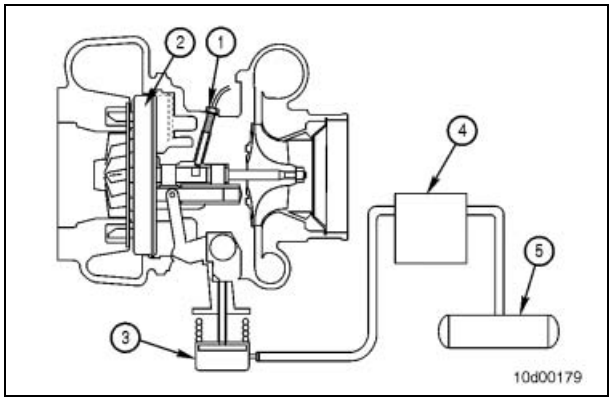


Wastegated turbochargers are used to optimize performance. The wastegated design allows maximum boost to be developed quickly while making sure that the turbocharger does not overspeed at higher engine rpm's.
Wastegate operation is controlled by an actuator that senses compressor pressure and balances it against a preset spring load. The wastegate valve is located in the turbine inlet passage. When open, it diverts a portion of the exhaust gas away from the turbine wheel, thereby controlling the shaft speed and boost.

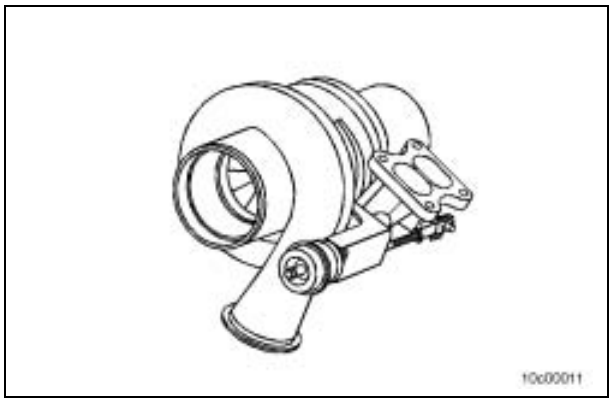


The variable geometry turbocharger functions as a standard turbocharger with the addition of the following:

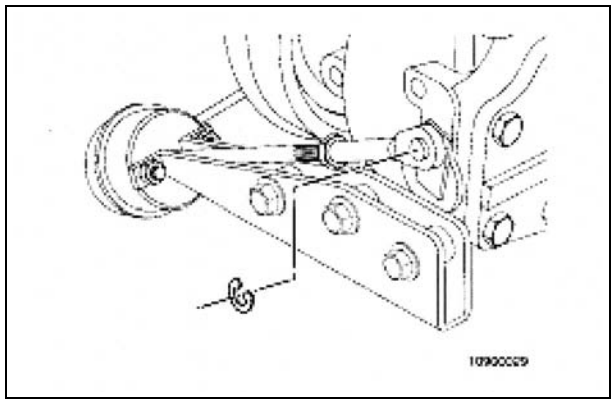
- A speed sensor (1) in the bearing housing to monitor turbocharger operation
- Water-cooled bearing housings (in addition to oil lubrication)
- The sliding nozzle (2) is actuated by a pneumatic actuator attached to the vehicle (brake) air supply system
- The pneumatic actuator (3) operated by an air control valve (4) and receives air from the air supply tank (5)
- When the variable geometry turbocharger mechanism opens, a noise can be heard as air is released from the actuator (3) through the control valve (4).



The wastegated turbocharger is a Holset Model HX40. It is comprised of a turbocharger, wastegate actuator, and wastegate valve in the turbine housing. A wastegated turbocharger provides improved response at low engine speeds without sacrificing turbocharger durability at high speeds. This is accomplished by allowing the exhaust gases to bypass the turbine wheel during certain modes of engine operation.
During low rpm operation, the turbocharger operates as a closed-system turbocharger where the gases' energy is transferred to the compressor wheel and used to compress intake air.
During high rpm operation however, the turbocharger becomes an open-system turbocharger and allows exhaust gas to bypass the turbine.
Since the exhaust gas is gated around the turbine wheel, less energy is absorbed through the turbine and transferred to the compressor, reducing the intake manifold pressures and turbine speeds.

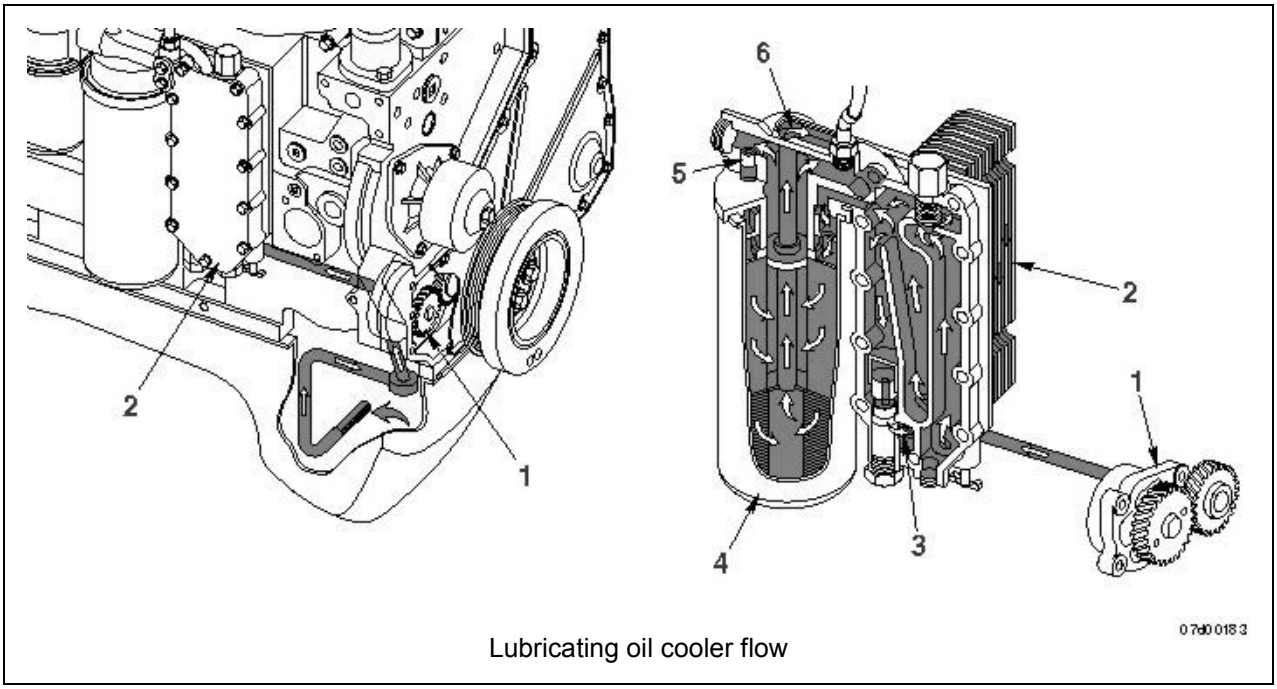


The wastegate actuator is mounted on the turbocharger and consists of a pressure canister, diaphragm, and rod. As the pressure changes in the canister, as dictated by the wastegate controller, the actuator rod adjusts the wastegate valve accordingly.
The wastegate valve is mounted inside the turbocharger in the turbine housing. As the valve opens, exhaust gas is allowed to bypass the turbine wheel, lowering turbine speed to adjust the intake manifold pressure.



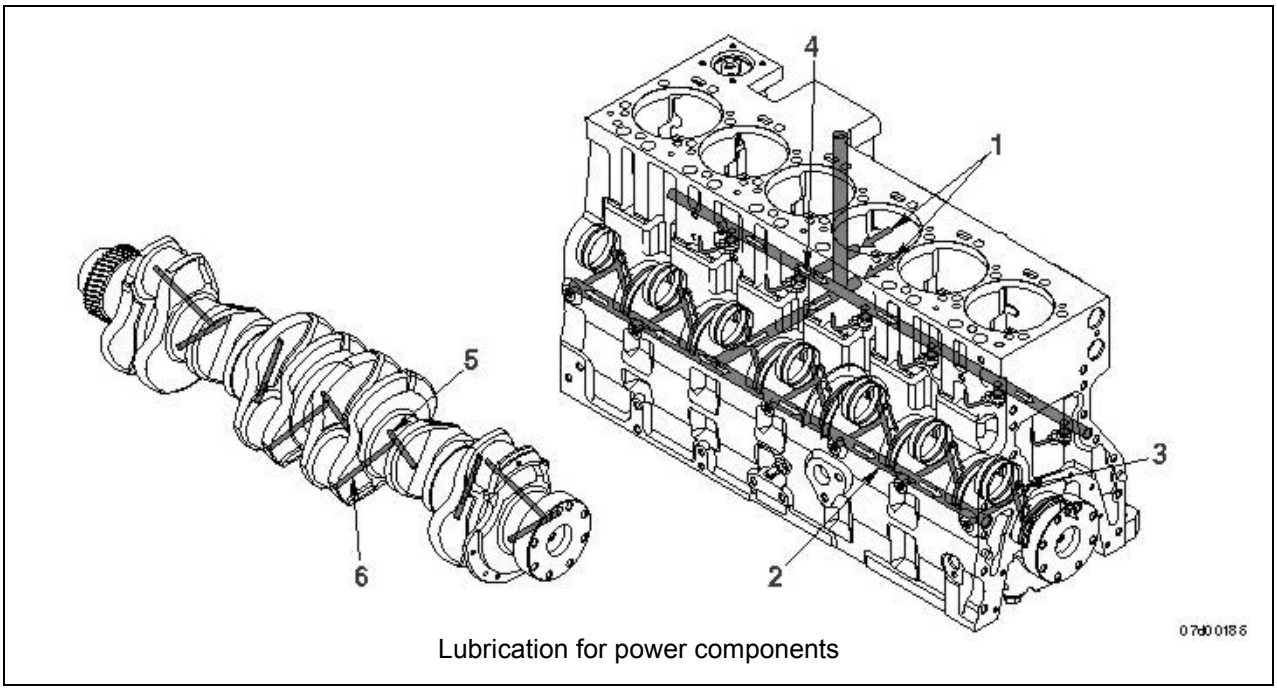
Lubricating oil system

General Information



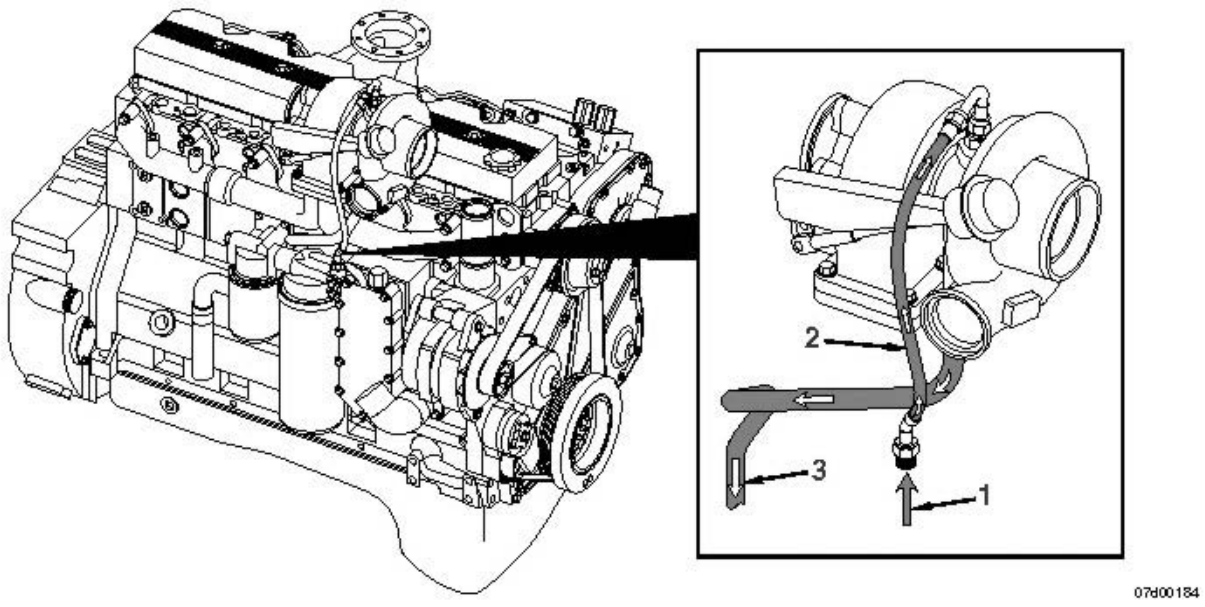
Lubricating oil cooler flow

1. Gerotor lubricating oil pump
2. Lubricating oil cooler
3. To lubricating oil pan
4. Full flow lubricating oil filter
5. Filter bypass valve
6. From lubricating oil filter



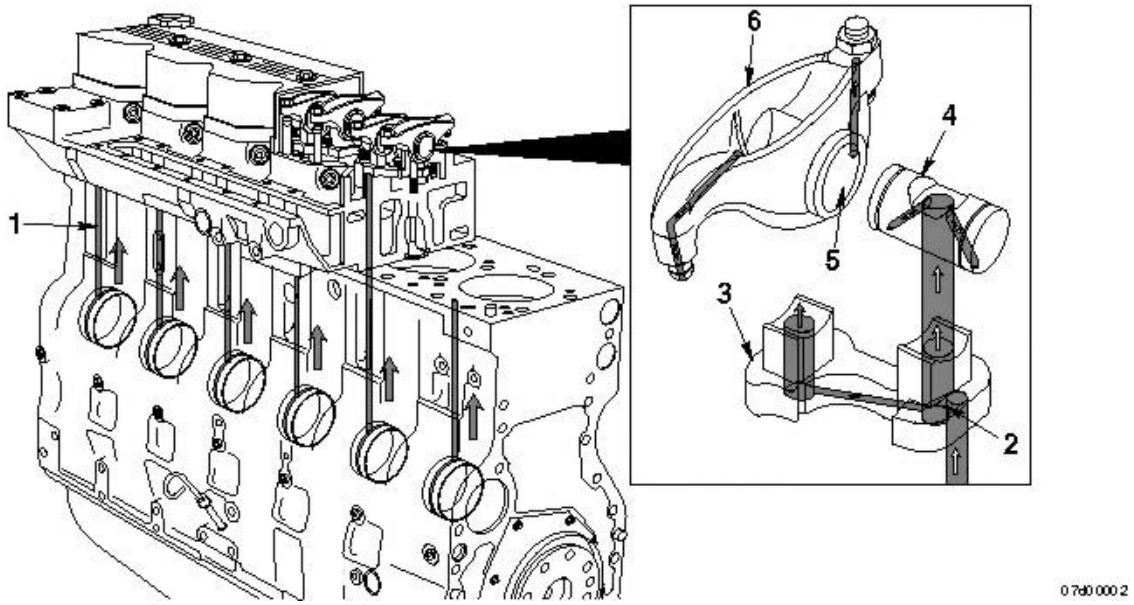
Lubrication for power components

1. From lubricating oil cooler
2. Main lubricating oil rifle
3. To camshaft
4. To piston cooling nozzle
5. From main lubricating oil rifle
6. To connecting rod bearing



Lubrication for turbocharger

1. Lubricating oil supply from filter
2. Turbocharger lubricating oil supply
3. Turbocharger lubricating oil drain

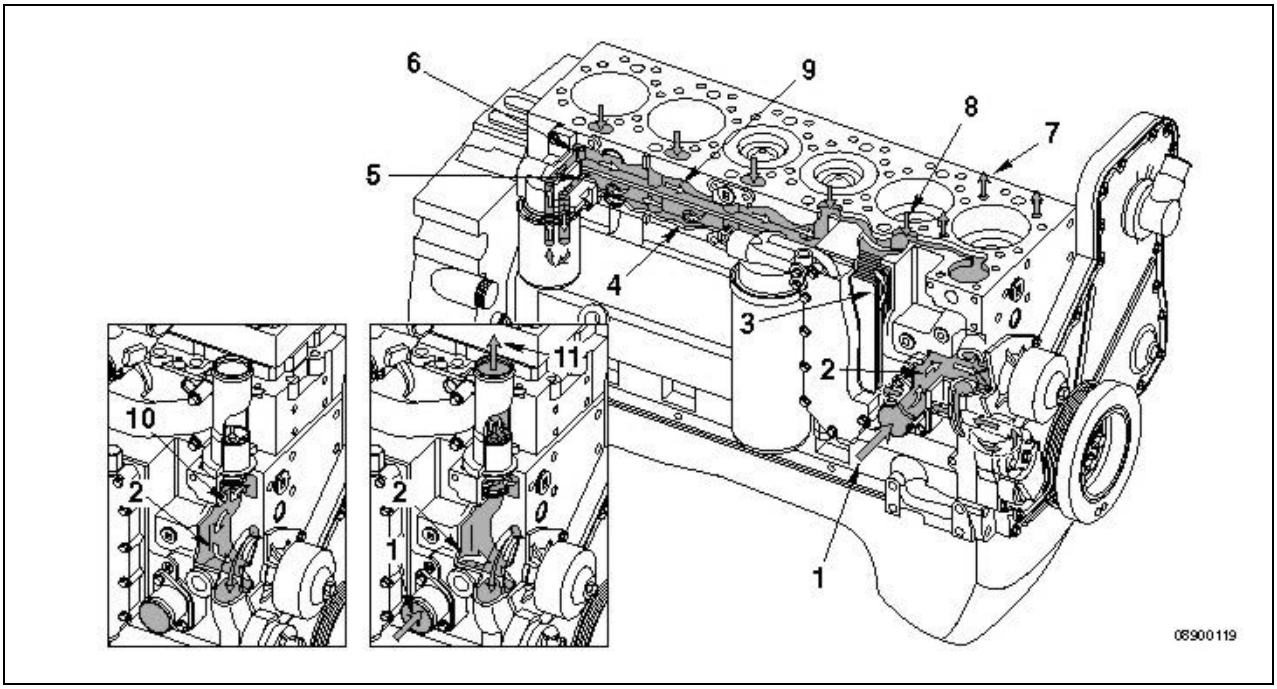


Lubrication for the overhead

1. From cam bushings
2. Transfer slot
3. Rocker lever support
4. Rocker lever shaft
5. Rocker lever bore
6. Rocker lever

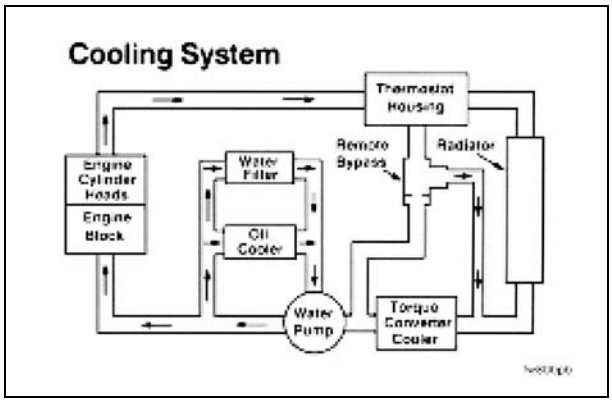
Cooling system

General Information



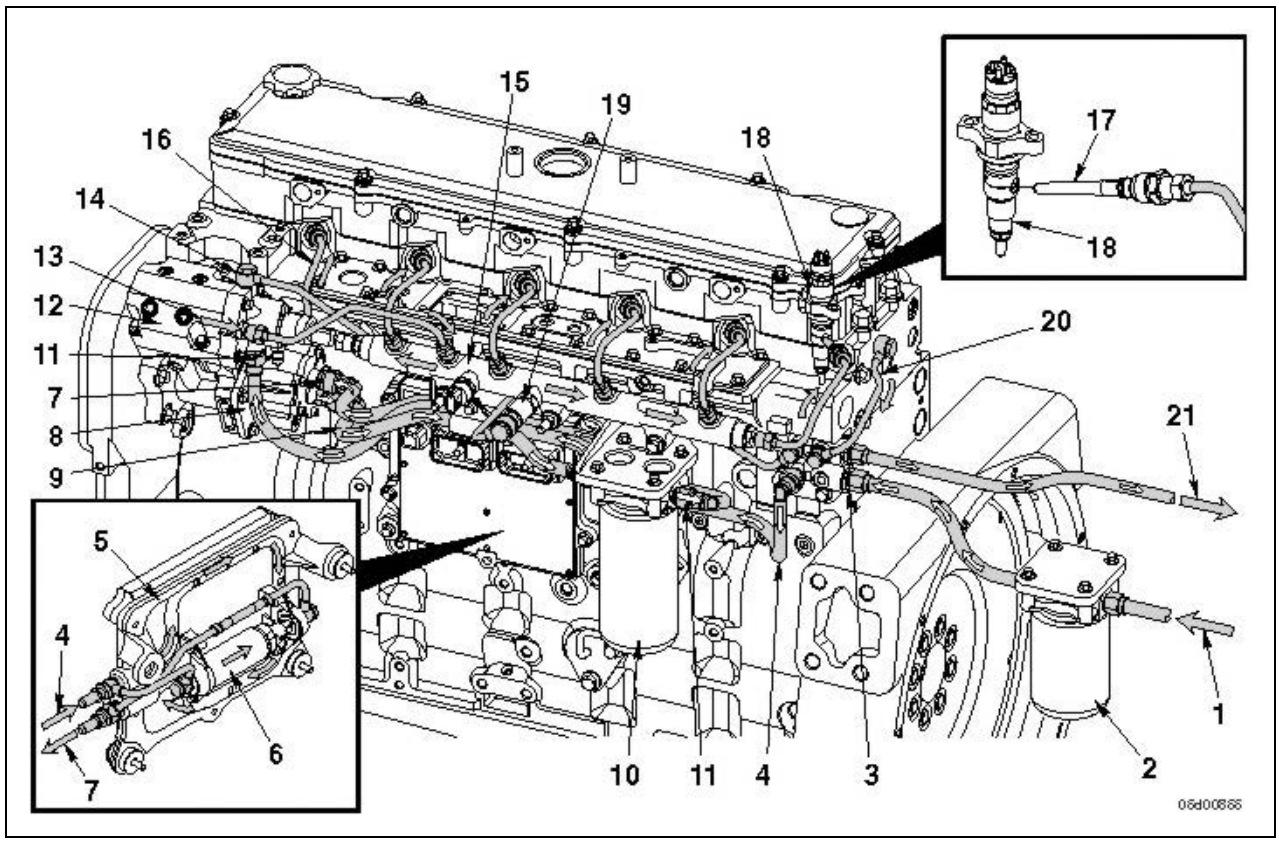
1. Coolant inlet from radiator
2. Water pump suction
3. Coolant flow through lubricating oil cooler
4. Block lower water manifold (to cylinders)
5. Coolant filter inlet (optional)
6. Coolant filter outlet (optional)
7. Coolant supply to cylinder head
8. Coolant return from cylinder head
9. Block upper water manifold
10. Thermostat bypass
11. Coolant return to radiator

Conventionally cooled engines with automatic transmissions typically use oil-to-water transmission torque converter coolers plumbed between the radiator and the engine water pump.
A torque converter cooling system with a remote bypass allows the torque converter to receive coolant flow when the thermostat is closed (engine cold).

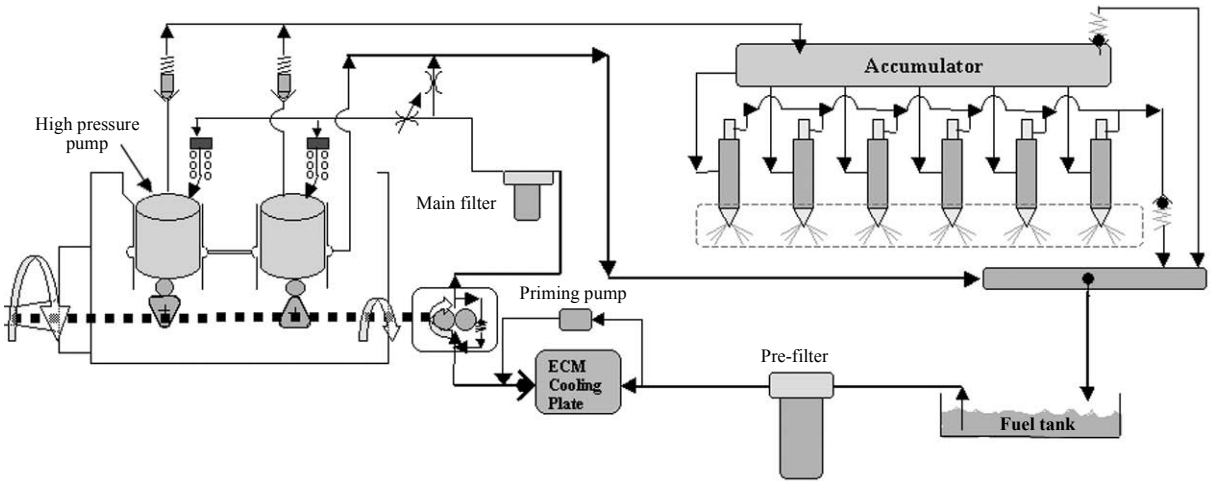


Fuel system (common rail)

General Information



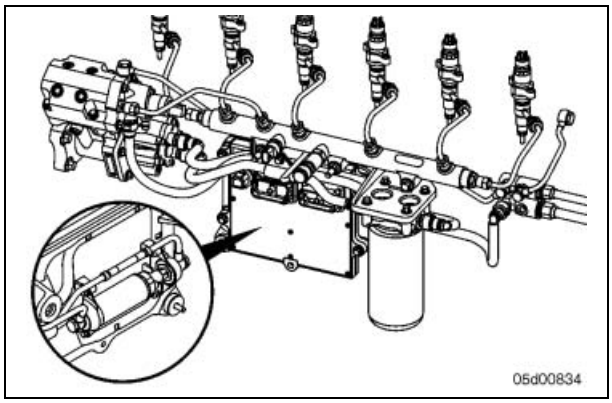
1. Fuel from supply tank
2. Fuel filter and water separator
3. OEM fuel supply connection
4. Fuel supply to ECM mounted fuel lift pump
5. ECM cooling plate
6. ECM mounted fuel lift pump
7. Fuel outlet from ECM mounted fuel lift pump
8. Fuel gear pump
9. Fuel from gear pump to fuel filter
10. Primary fuel filter
11. Fuel inlet to fuel pump actuator
12. High-pressure fuel pump
13. Fuel outlet from high-pressure pump
14. High-pressure pump drain flow connection
15. Fuel rail
16. High-pressure injector supply lines
17. High-pressure fuel connector
18. Fuel injector
19. Fuel pressure relief valve
20. Fuel injector drain flow line
21. Fuel return to supply tanks



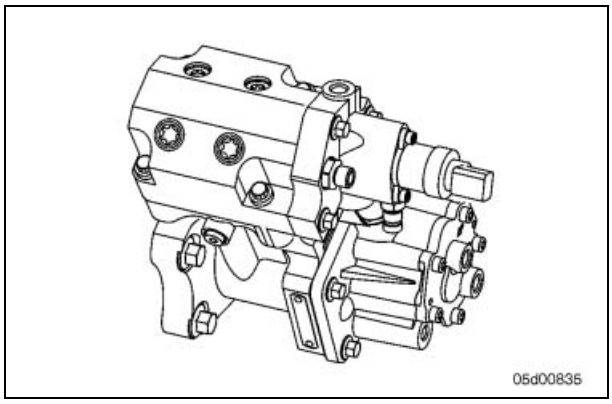
Common rail fuel system

Common rail fuel system

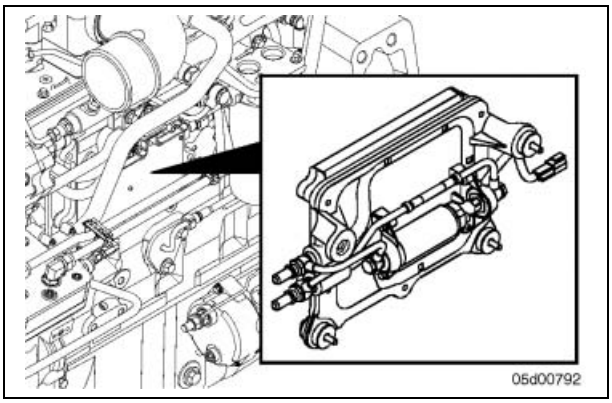
The Common Rail Fuel System is a high-pressure common rail injection system. A fuel rail is used to store pressurized fuel for fuel injection. There are four components that provide or receive input to the electronic control module (ECM). The ECM powers the electric fuel lift pump (located behind the ECM) for approximately 30 seconds at key on to make sure the fuel system is primed.
The normally open fuel pump actuator receives a PWM signal from the ECM to open or close in response to the signal from the fuel rail pressure. The injectors have individual solenoids. The ECM powers each injector individually to provide fueling to each cylinder.



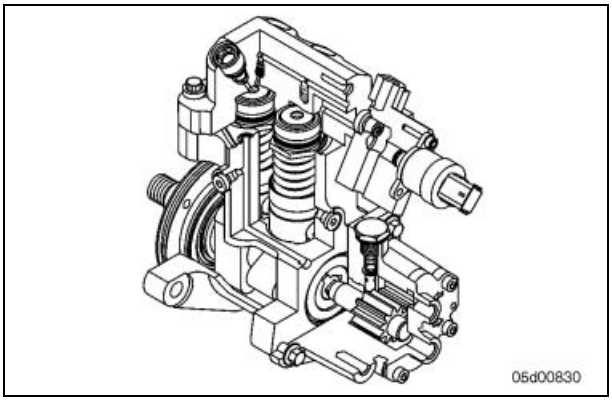
The high-pressure fuel pump can be divided into four distinct assemblies. They are the fuel gear pump, fuel pump actuator housing, cam housing, and high-pressure fuel pump head. Fuel flows through the gear pump to a 3-micron pressure side filter. After the pressure side filter, fuel enters the fuel pump actuator housing. The fuel pump actuator housing includes an air-bleed fitting and the fuel pump actuator.
Some fuel continuously returns to drain through the air-bleed orifice fitting. Fuel that is metered through the fuel pump actuator enters the high-pressure fuel pump head where it is pumped to fuel rail pressure and exits at the high-pressure outlet fitting.



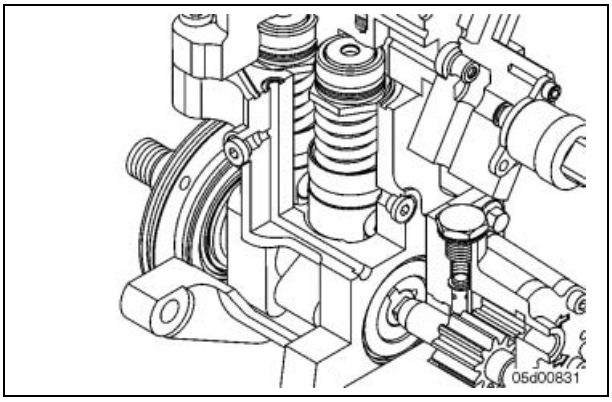
A lift pump is used for priming the pump at start-up. The lift pump runs for approximately 30 seconds after key on. Once the engine is started, the gear pump is able to maintain prime without any assistance from the lift pump.
The ECM and ECM cooling plate must be removed for access to the lift pump and lift pump fuel lines. This is accomplished by disconnecting the engine harnesses and the quick disconnect style fuel lines first. Removal of the ECM cooling plate capscrews allows the ECM, cooling plate, lift pump and lift pump plumbing to be removed as one assembly.



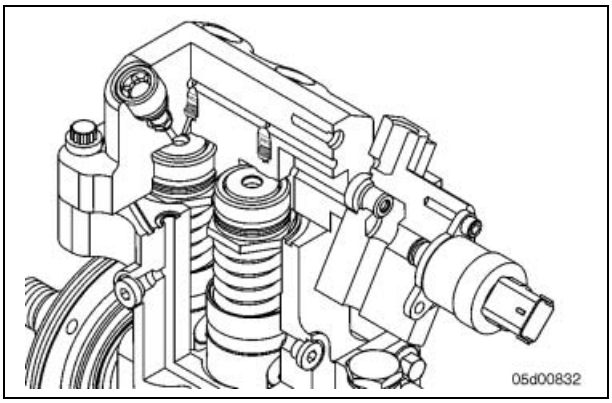
The gear pump output is routed to a 2-micron fuel filter. The filtered fuel returns to the fuel pump actuator housing.
The high-pressure pump is driven by the engine camshaft. The gear pump is driven by the pump camshaft through an internal coupling.



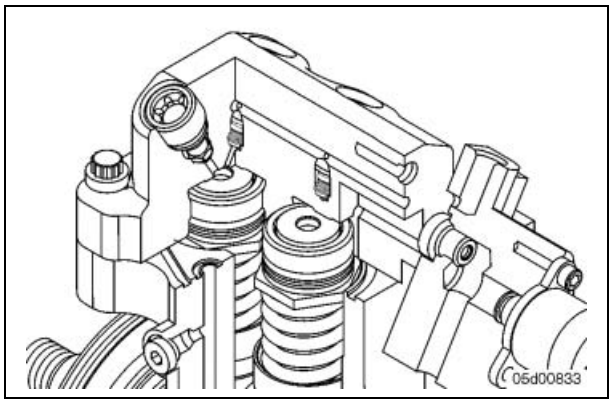
Each of the two pumping plungers is driven by a three lobed camshaft. The camshaft is located in the cam housing module by tapered roller bearings. The bearings that support the camshaft, as well as the tappets, rollers and camshaft itself are lubricated with engine oil. These are the only components in the pump lubricated with engine oil.
Engine oil to the high-pressure pump is supplied through a drilling in the engine gear housing. The oil passes from the engine gear housing to the high-pressure pump cam housing. A small O-ring in a recess on the back of the engine gear housing is used to seal this passage.



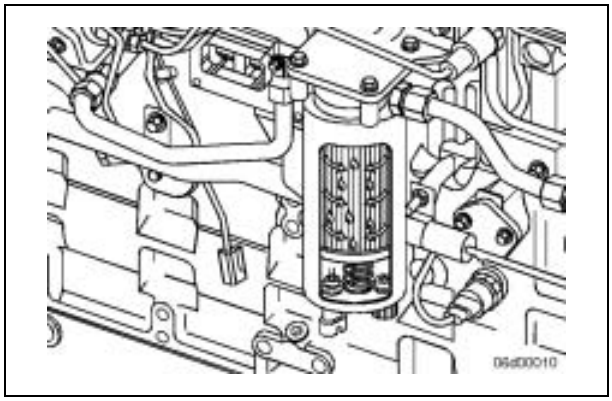
Pressurized fuel from the gear pump is supplied to the fuel pump actuator. The fuel pump actuator is opened or closed by the ECM to maintain the appropriate fuel rail pressure.
An air-bleed orifice fitting in the fuel pump actuator housing aids in purging air from the fuel supply. Because of the air-bleed orifice fitting, some fuel that is supplied by the gear pump will return to drain at all times.



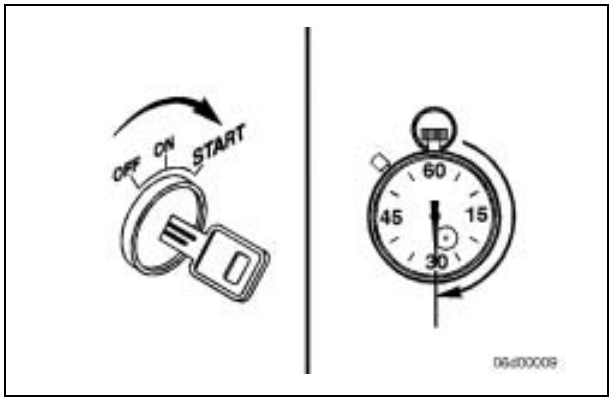
Fuel that is metered past the fuel pump actuator will enter inlet drilling in the high pressure fuel pump inlet drilling and pass the inlet check valve and fill the pumping chamber by pressing the pumping plunger downward.
When the camshaft pushes the pumping plunger upward, fuel will reach rail pressure and cause the outlet check valve to lift. Fuel will then enter the outlet drilling of the fuel pump and exit the high pressure fuel line to the fuel rail.



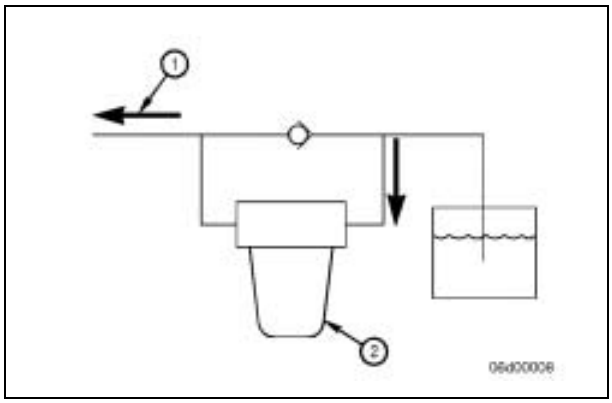
The fuel filter is a spin-on type.
Fuel flows around the outside of the filter and back up through the middle. The filtering media is a 10 micron Stratapore design for efficient debris removal. The filter also strips the water and collects it at the bottom of the filter to be drained daily.



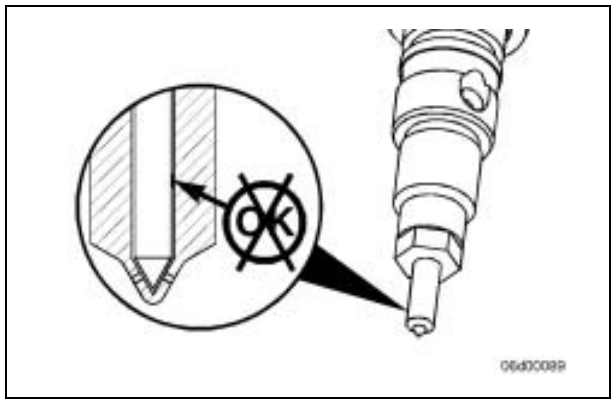
The lift pump will run for 30 seconds after the key is switched on to assist with fuel priming. The lift pump will run during cranking and while the engine is running until the 30 seconds has lapsed. The lift pump will shut off anytime the key is switched “OFF”. The 30 second timer is reset after each key switch cycle and ECM power down.



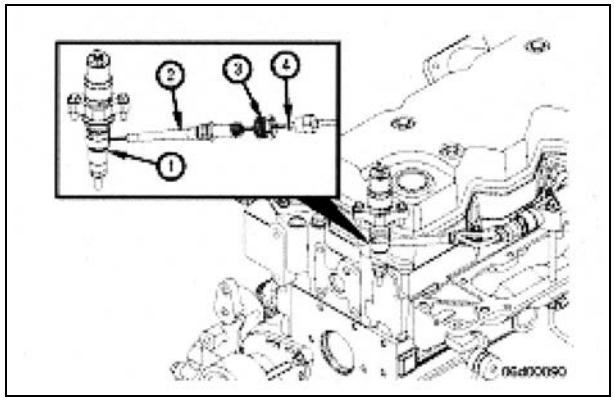
Once the engine is started, additional fuel is drawn through the lift pump head via the gear pump. A valve in the head opens when the gear pump requires more flow than the lift pump can provide or when the lift pump is shut off.



High-pressure common rail fuel systems use solenoid-actuated injectors. High-pressure fuel flows into the side of the injector. When the solenoid is activated, an internal needle lifts and fuel is injected. The clearances in the nozzle bore are extremely small and any dirt or contaminants will cause the injector to stick.
This is why it is important to clean around all fuel connections before servicing the fuel system. Also, cap or cover any open fuel connections before a fuel system repair is performed.

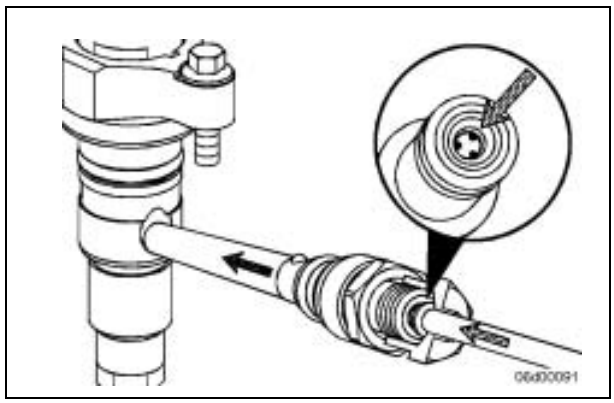


High-pressure fuel is supplied to the injector from the fuel rail by an injector supply line and a fuel connector. The fuel connector pushes against the injector body when the fuel connector nut is tightened. The injector supply line is then connected to the fuel connector.
The torque and sequence for this joint is critical. If the nut or line is undertightened, the surfaces will not seal and a high-pressure fuel leak will result. If the nut is overtightened, the connector and injector will deform and cause a high-pressure fuel leak. This leak will be inside the head and will not be visible. The result will be a fault code, low power, or no-start.



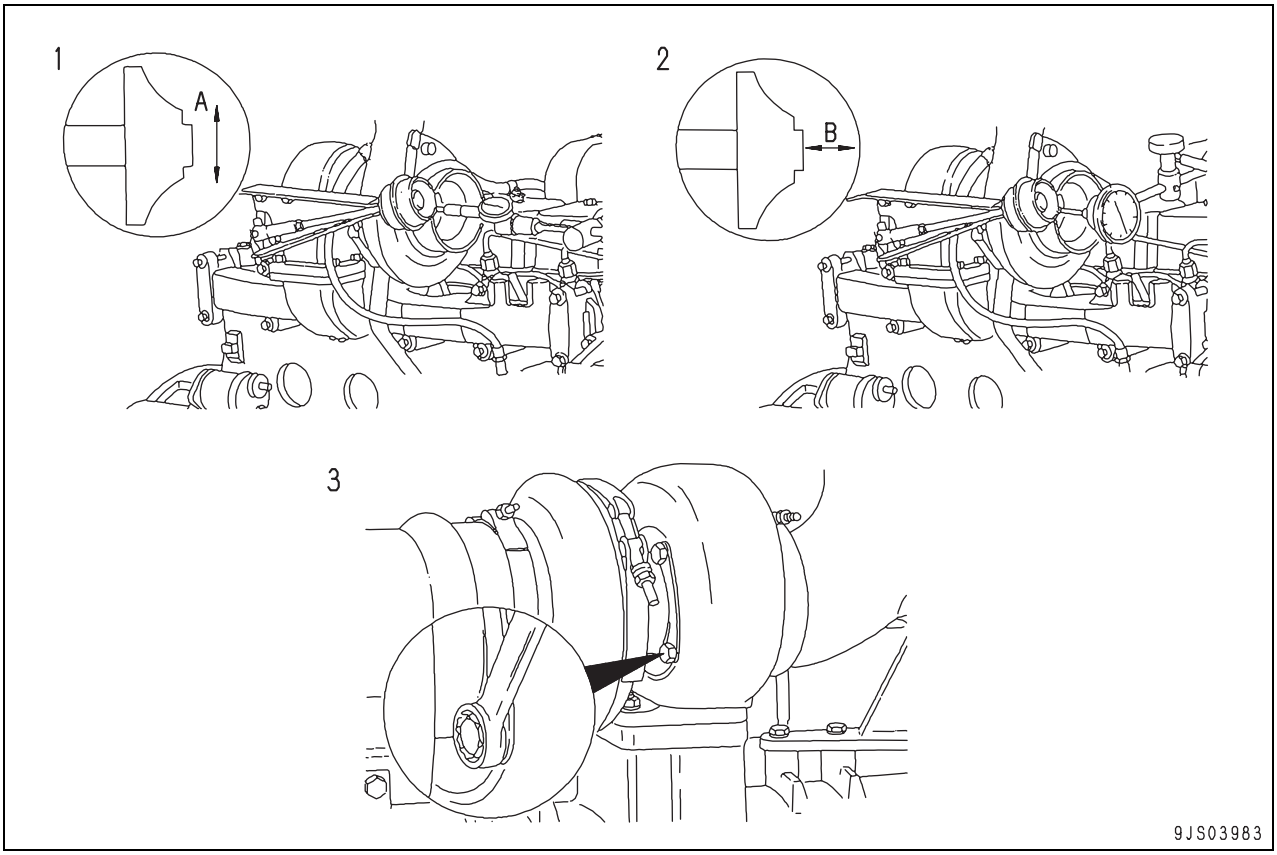
If the injector is not fully seated prior to the installation of the high-pressure connector, the joint will not seal.
The fuel connector contains an edge filter that breaks up small contaminants that enter the fuel system.

- ★ The edge filters are not a substitute for cleaning and covering all fuel system connections during repair.
- ★ Be sure to cap or cover all fuel fittings and ports.



Maintenance standard

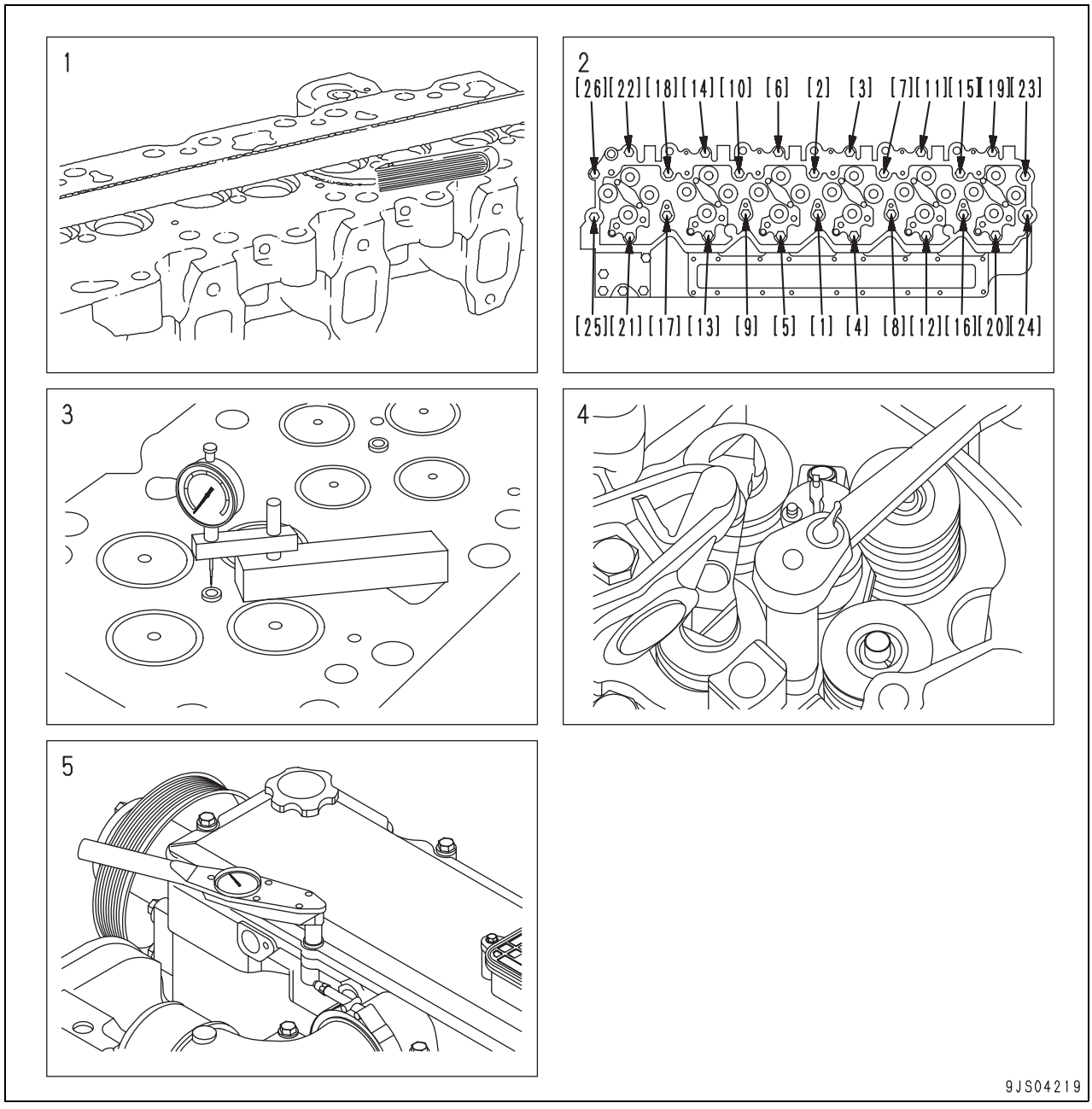
Turbocharger



Unit: mm

No.	Check item	Criteria	Remedy
1	Radial play (Play in radial direction)	0.330 – 0.508	Replace bearing parts
2	End play (Play in axial direction)	0.025 – 0.127	Replace thrust parts
3	Tightening torque of turbine housing bolt	Target (Nm {kgm})	Tighten
		26 {2.6}	

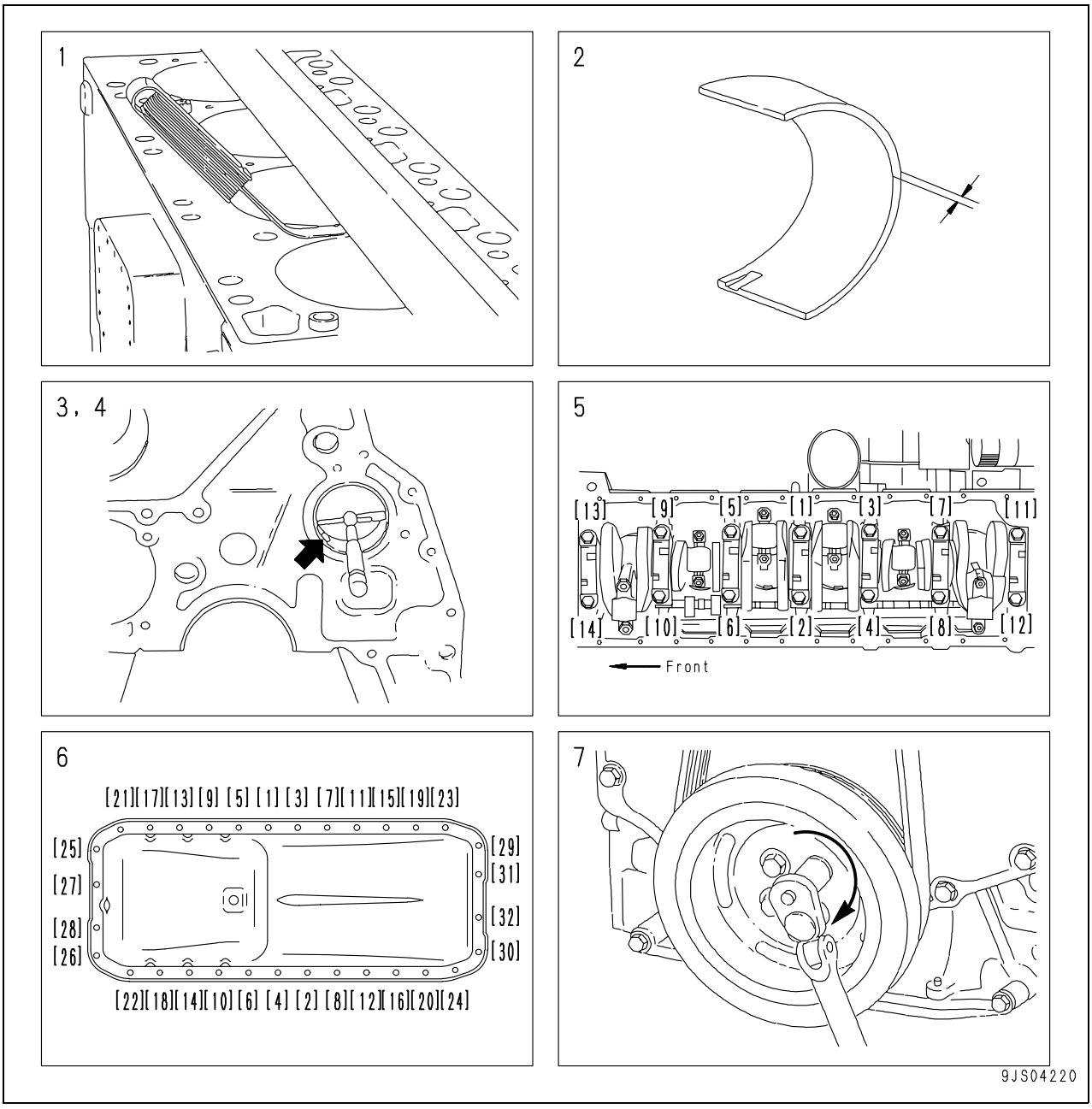
Cylinder head



Unit: mm

No.	Check item	Criteria		Remedy
1	Strain of cylinder head mounting face	End-to-End	Max. 0.203	Correct by grinding or replace
		Side-to-Side	Max. 0.075	
2	Tightening torque for cylinder head mounting bolt (Apply molybdenum disulfide or engine oil to threaded part)	Procedure	Target (Nm {kgm})	Tighten and retighten
		1st stage	150 {15.3}	
		2nd stage	Loosen	
		3rd stage	110 {11.2}	
		4th stage	110 {11.2}	
		5th stage	Retighten 120°	
3	Projection of nozzle	2.25 – 2.80		Replace nozzle or gasket
4	Tightening torque for injector holder mounting bolt	Target (Nm {kgm})		Tighten
		10 {1.0}		
5	Tightening torque for head cover mounting bolt	24 {2.4}		

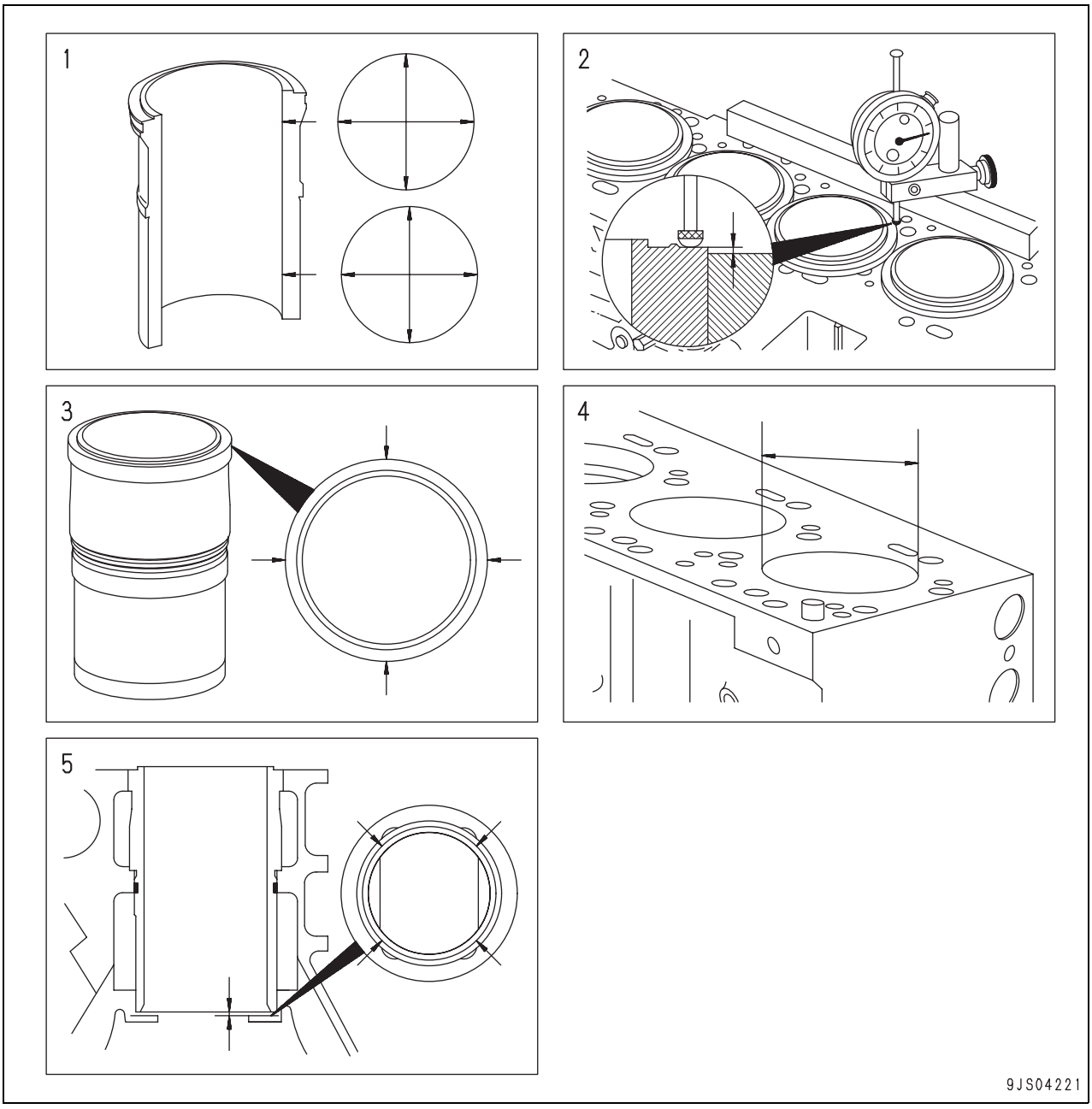
Cylinder block



Unit: mm

No.	Check item	Criteria		Remedy
1	Strain of cylinder head mounting face	End-to-End	Max. 0.075	Correct by grinding or replace
		Side-to-Side	Max. 0.075	
2	Thickness of main bearing metal	3.446 – 3.454		Replace bearing metal
3	Diameter of cam bushing mounting hole	Max. 64.013		Correct or replace block
4	Inside diameter of cam bushing	Max. 60.120		Replace cam bushing
5	Tightening torque for main cap mounting bolt (Apply engine oil to threads)	Procedure	Target (Nm {kgm})	Tighten and retighten
		1st stage	167 {17.0}	
		2nd stage	Loosen 360°	
		3rd stage	30.4 {3.1}	
		4th stage	50 {5.1}	
		5th stage	Retighten 120°	
6	Tightening torque for oil pan mounting bolt	Target (Nm {kgm})		Tighten
		28 {2.8}		
7	Tightening torque for crankshaft pulley mounting bolt	200 {20.4}		

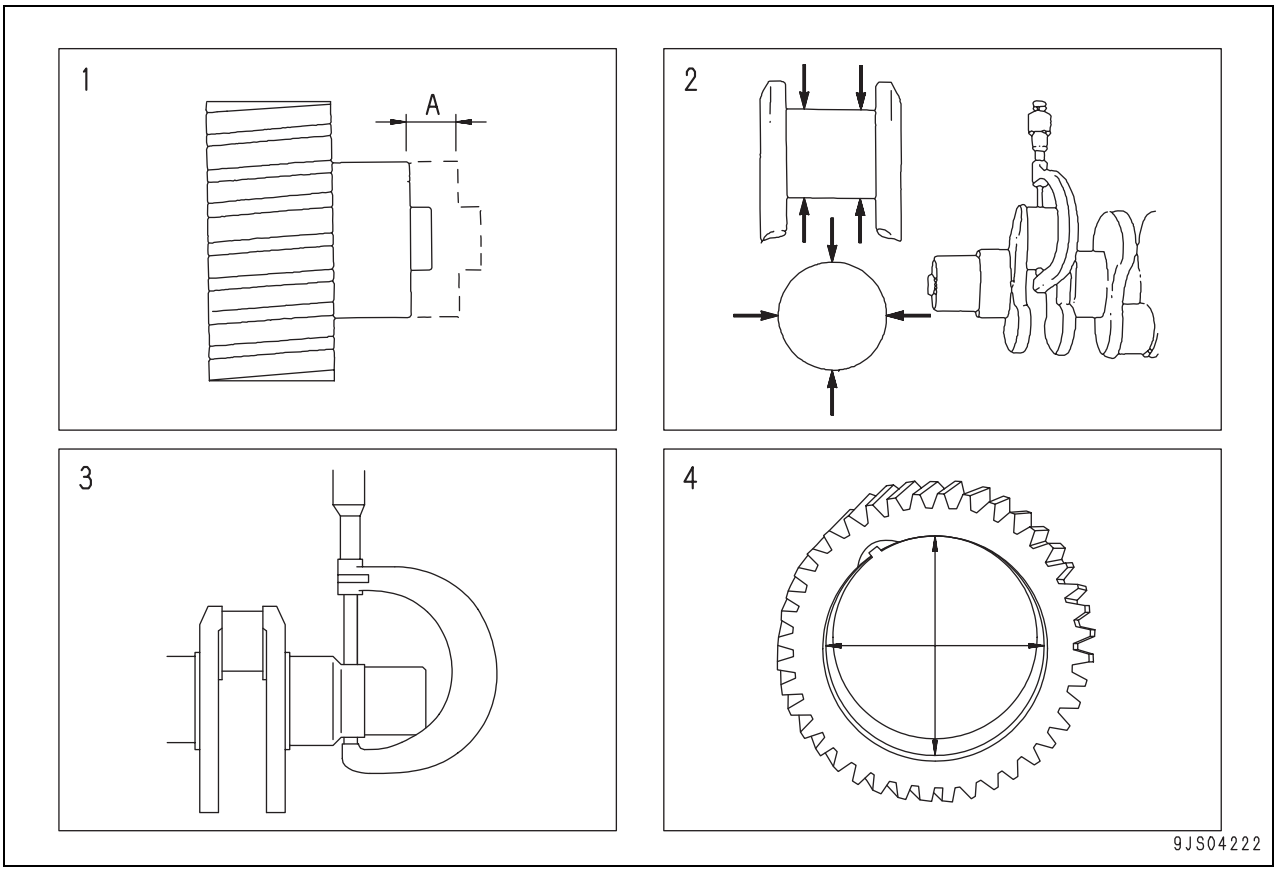
Cylinder liner



Unit: mm

No.	Check item	Criteria	Remedy
1	Inside diameter of cylinder liner	114.000 – 114.040	Replace cylinder liner
	Roundness of cylinder liner	Repair limit: 0.04	
	Taper of cylinder liner	Repair limit: 0.04	
2	Protrusion of cylinder liner	0.026 – 0.122	Replace cylinder liner or cylinder block
3	Outside diameter of cylinder liner	130.938 – 13.0958	Replace cylinder liner
4	Inside diameter of cylinder liner bore in cylinder block	130.900 – 13.0950	Replace cylinder liner or cylinder block
5	Clearance between cylinder liner and cylinder block	Min. 0.229	

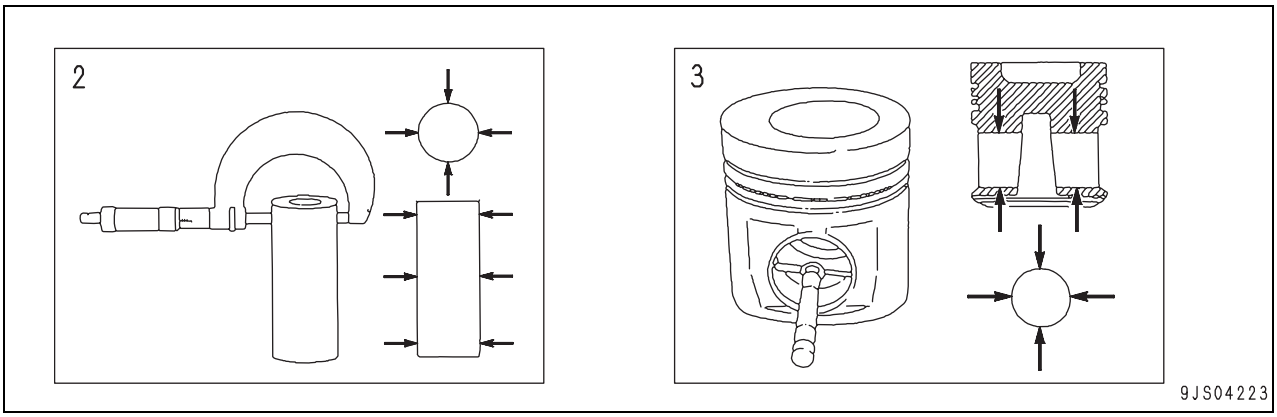
Crankshaft



Unit: mm

No.	Check item	Criteria	Remedy
1	End play	0.085 – 0.385	Replace thrust bearing metal or use oversize metal
2	Outside diameter of main journal	76.000 – 76.026	Use undersize journal or replace
	Roundness of main journal	Repair limit: 0.050	
	Taper of main journal	Max. 0.013	
	Clearance of main journal	0.038 – 0.116	Replace main bearing metal
3	Outside diameter of crankshaft gear journal	75.987 – 76.006	Use undersize crankshaft or replace
4	Inside diameter of crankshaft gear journal	75.898 – 75.923	

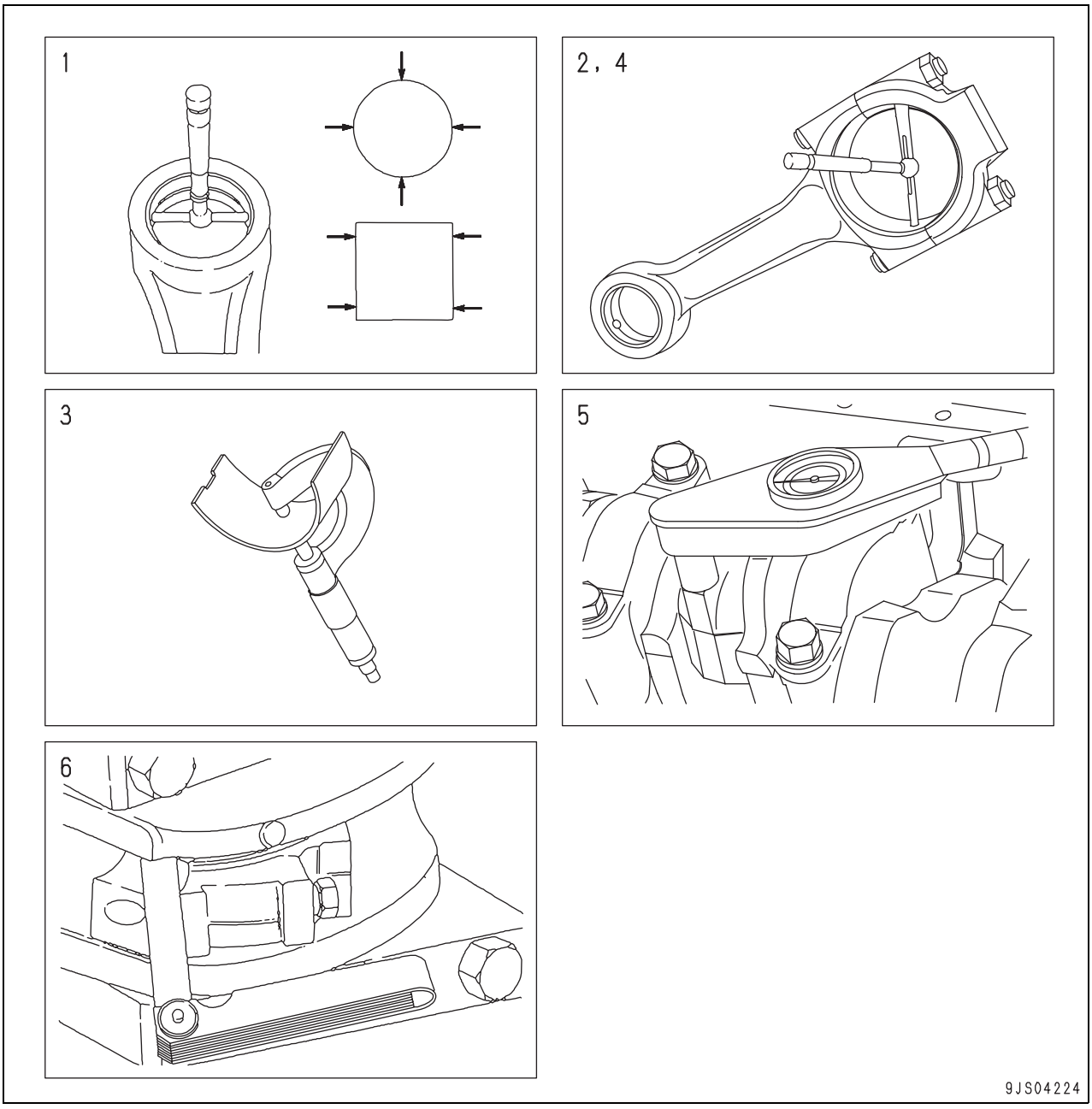
Piston, piston ring and piston pin



Unit: mm

No.	Check item	Criteria		Remedy
1	Clearance at piston ring end gap	Top ring	0.30 – 0.45	Replace piston ring or piston
		2nd ring	0.85 – 1.15	
		Oil ring	0.30 – 0.73	
2	Outside diameter of piston pin	44.997 – 45.003		Peplace piston or piston pin
3	Inside diameter of piston pin bore	45.006 – 45.012		

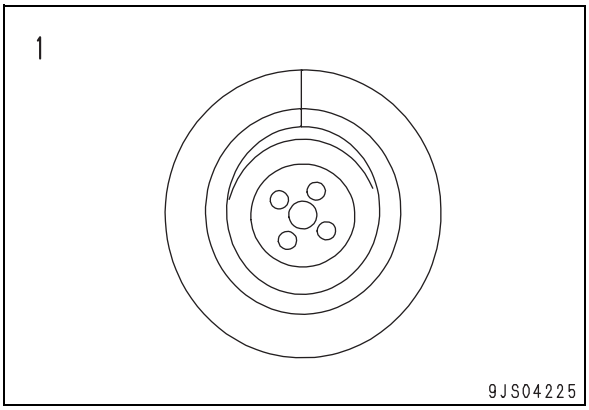
Connecting rod



Unit: mm

No.	Check item	Criteria		Remedy
1	Inside diameter of connecting rod bushing (when bushing is installed)	45.023 – 45.035		Replace bushing (spare part is semi-finished part)
2	Inside diameter of connecting rod bearing	76.045 – 76.095		Replace connecting rod bearing
3	Thickness of connecting rod bearing	2.459 – 2.471		
4	Inside diameter of connecting rod bearing mounting hole	80.987 – 81.013		Replace connecting rod
5	Tightening torque for connecting rod cap mounting bolt (Coat thread of bolt nut with engine oil)	Procedure	Target (Nm {kgm})	Tighten and retighten
		1st stage	60 {6.1}	
		2nd stage	Loosen	
		3rd stage	70 {7.1}	
		4th stage	Retighten 60°	
6	Side clearance of connecting rod	0.100 – 0.300		Replace connecting rod

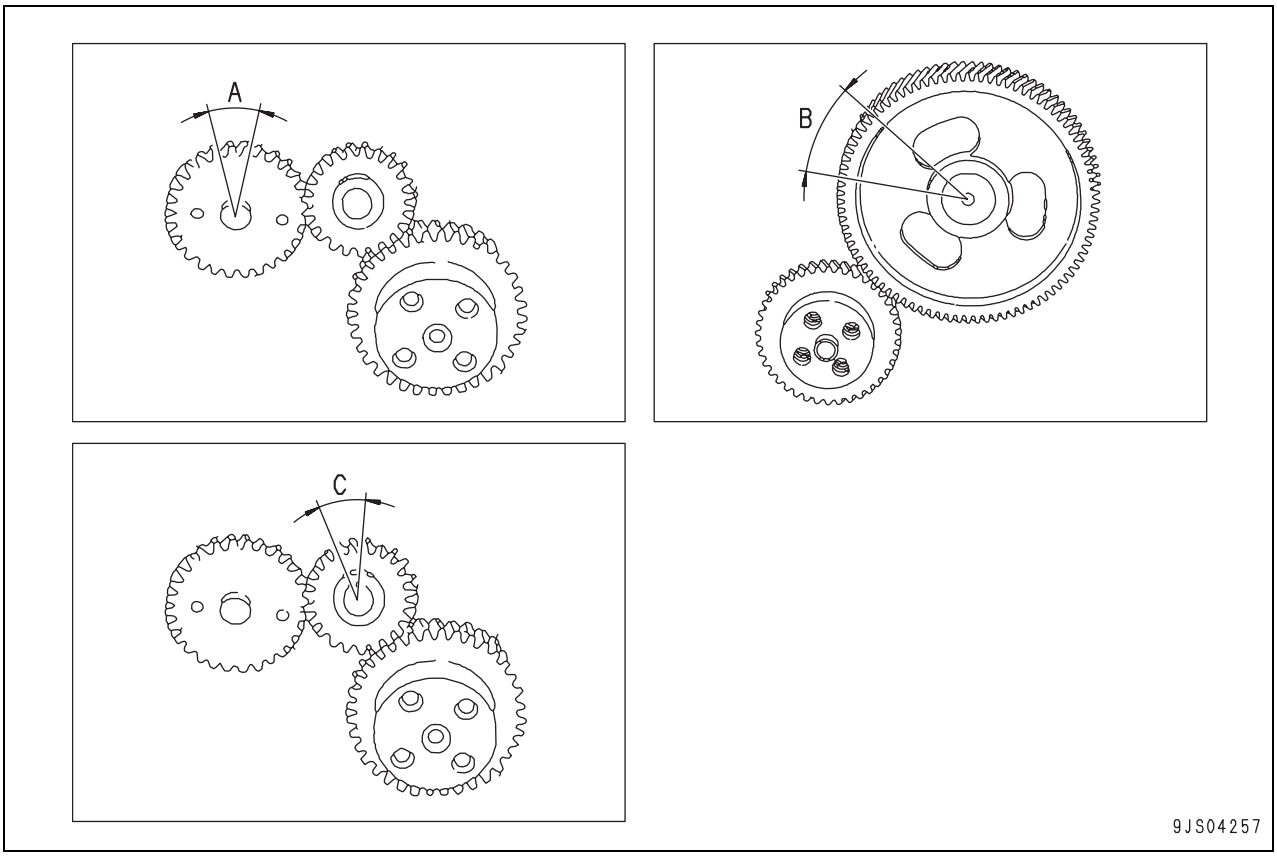
Vibration damper



Unit: mm

No.	Check item	Criteria	Remedy
1	Tightening torque of vibration damper	Target (Nm {kgm})	Tighten and retighten
		200 {20.4}	

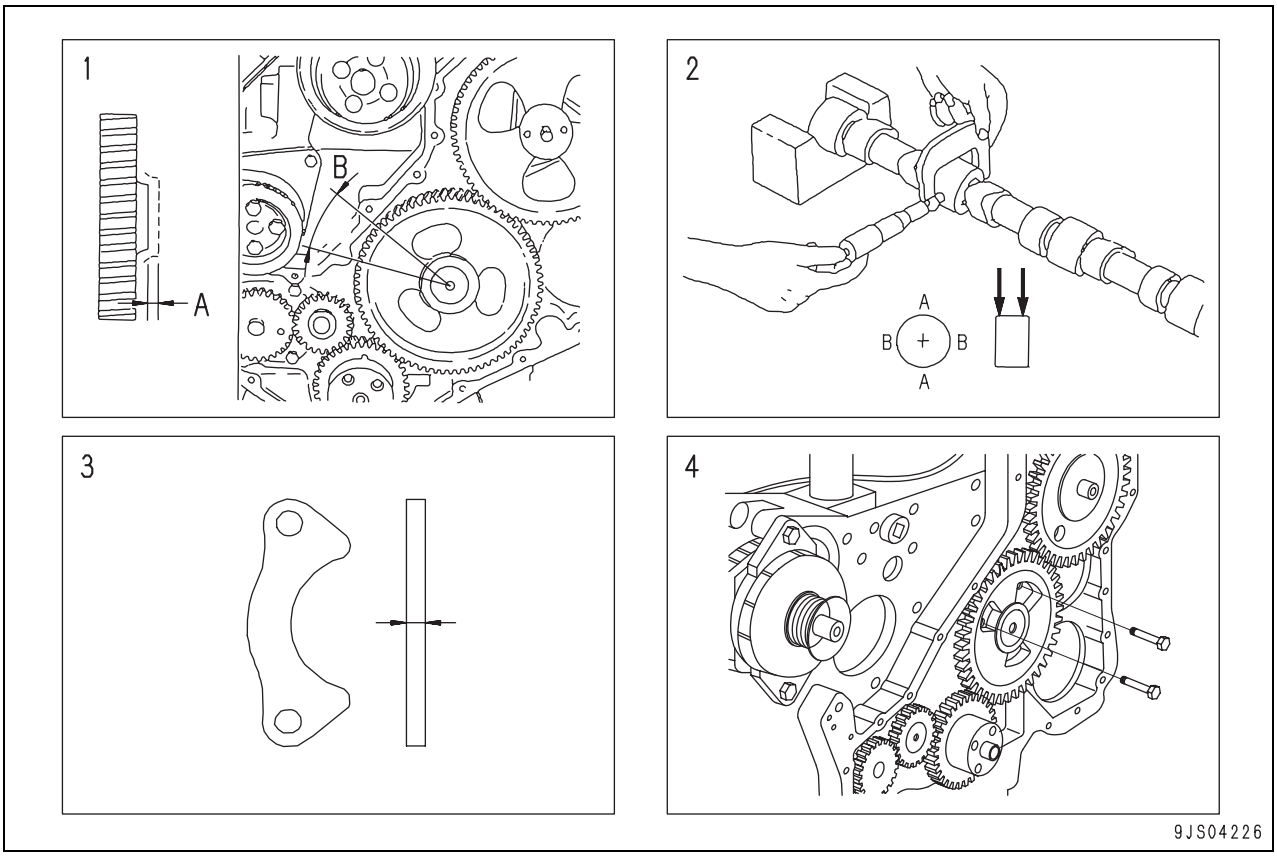
Timing gear



Unit: mm

No.	Check item	Criteria			Remedy
–	Backlash of each gear	A	Backlash of oil pump gear	0.08 – 0.33	Replace
		B	Backlash of camshaft gear	0.08 – 0.33	
		C	Backlash of oil pump idler gear	0.08 – 0.33	

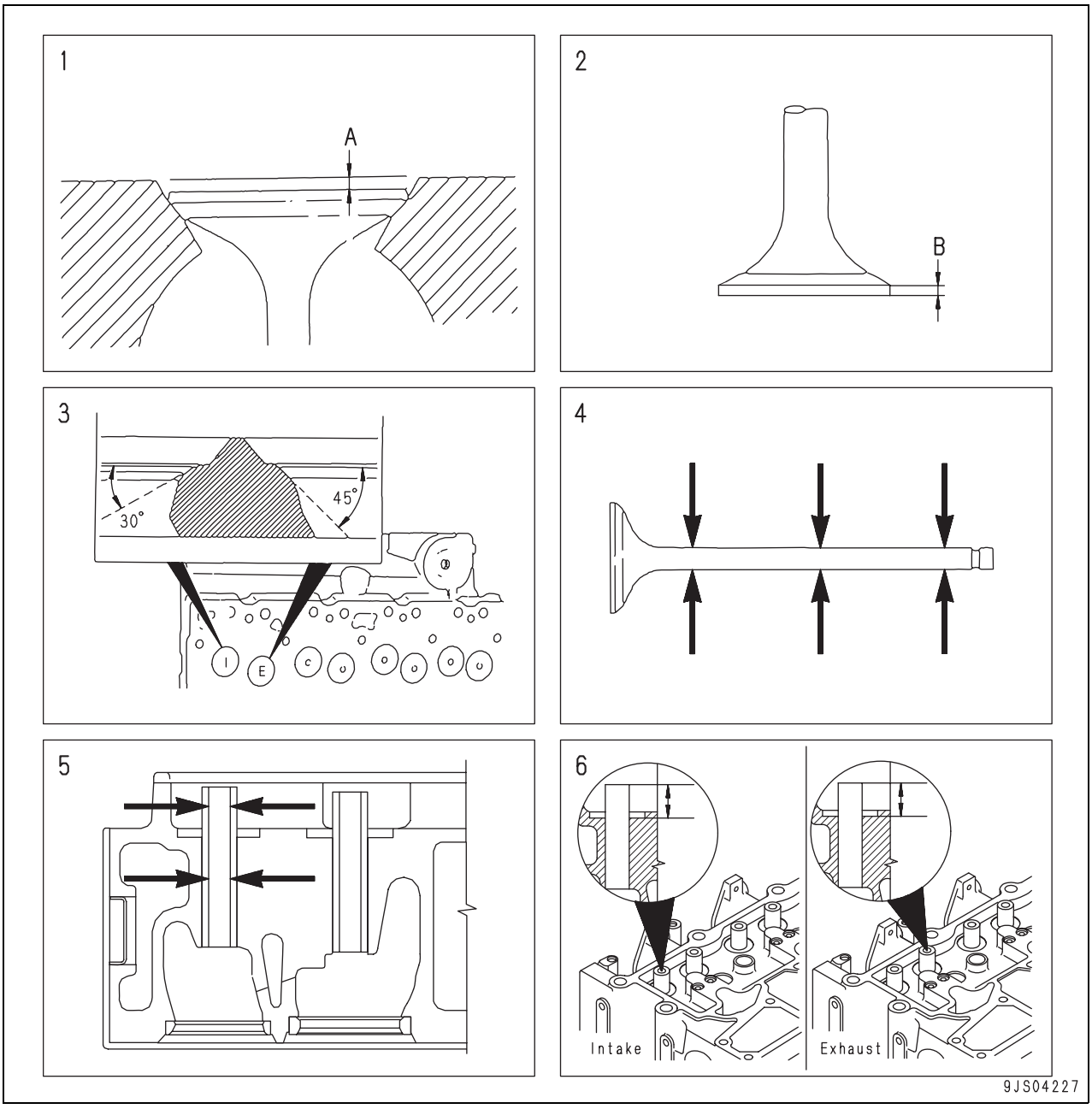
Camshaft



Unit: mm

No.	Check item	Criteria	Remedy
1	End play	0.12 – 0.50	Replace thrust plate
2	Outside diameter of camshaft bearing journal	59.962 – 60.013	Correct or replace
3	Thickness of camshaft thrust plate	9.40 – 9.60	Replace
4	Tightening torque of camshaft thrust plate mounting bolt	Target (Nm {kgm})	Tighten
		24 {2.4}	

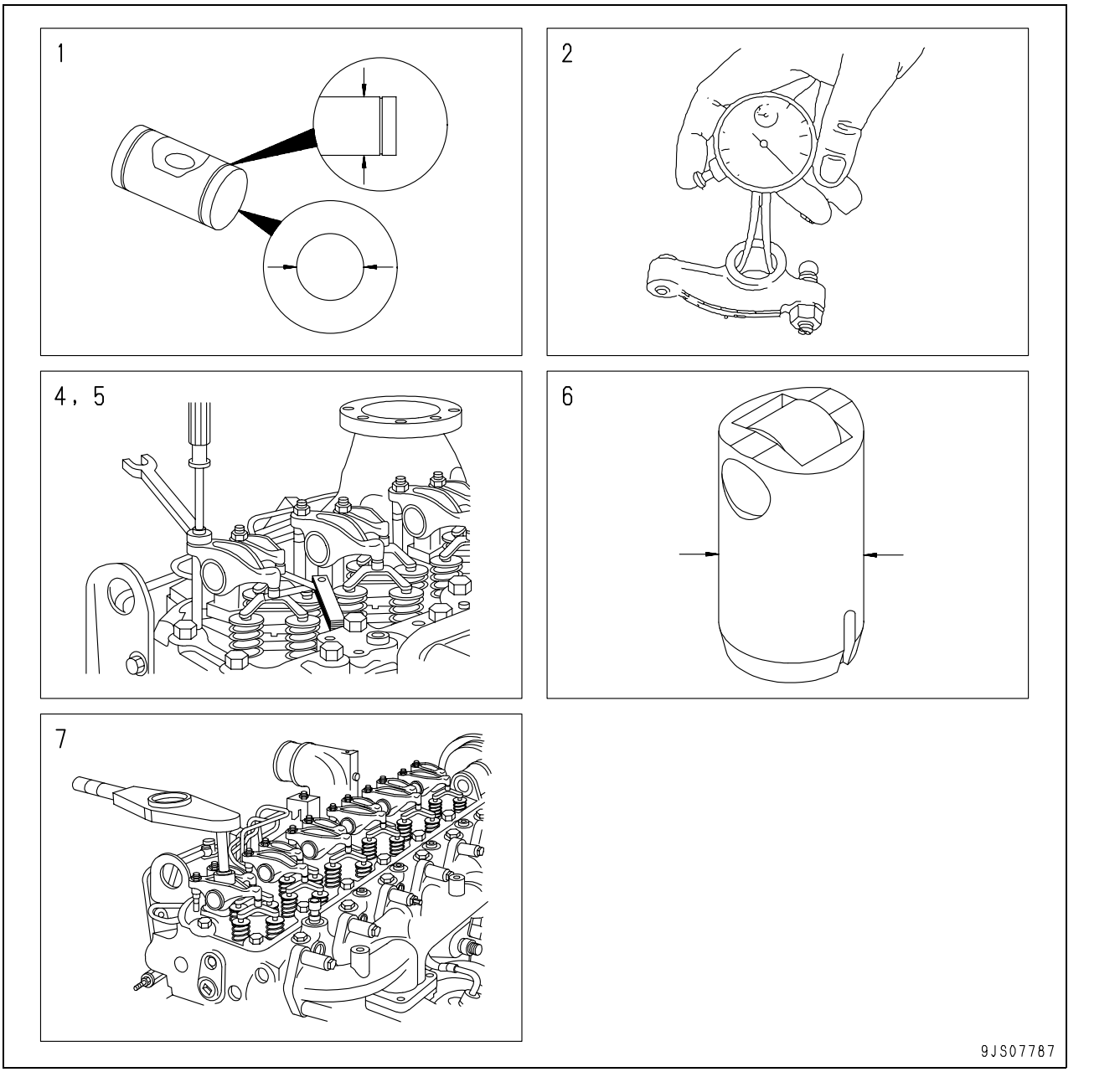
Valve and valve guide



Unit: mm

No.	Check item	Criteria			Remedy
1	Sunk depth (A) of valve	0.84 – 1.32			Replace valve or valve seat
2	Thickness (B) of valve head	Intake	Min. 2.20		Replace
		Exhaust	Min. 1.83		
3	Angle of valve seat	Valve	Angle	Repair limit	Correct or replace valve, valve seat
		Intake	30°	Judge condition of contact surface with vacuum test	
		Exhaust	45°		
4	Outside diameter of valve stem	7.96 – 7.98			Replace
5	Diameter of valve guide bore	8.019 – 8.071			
6	Clearance between valve guide and valve stem	13.15 – 13.65			Correct

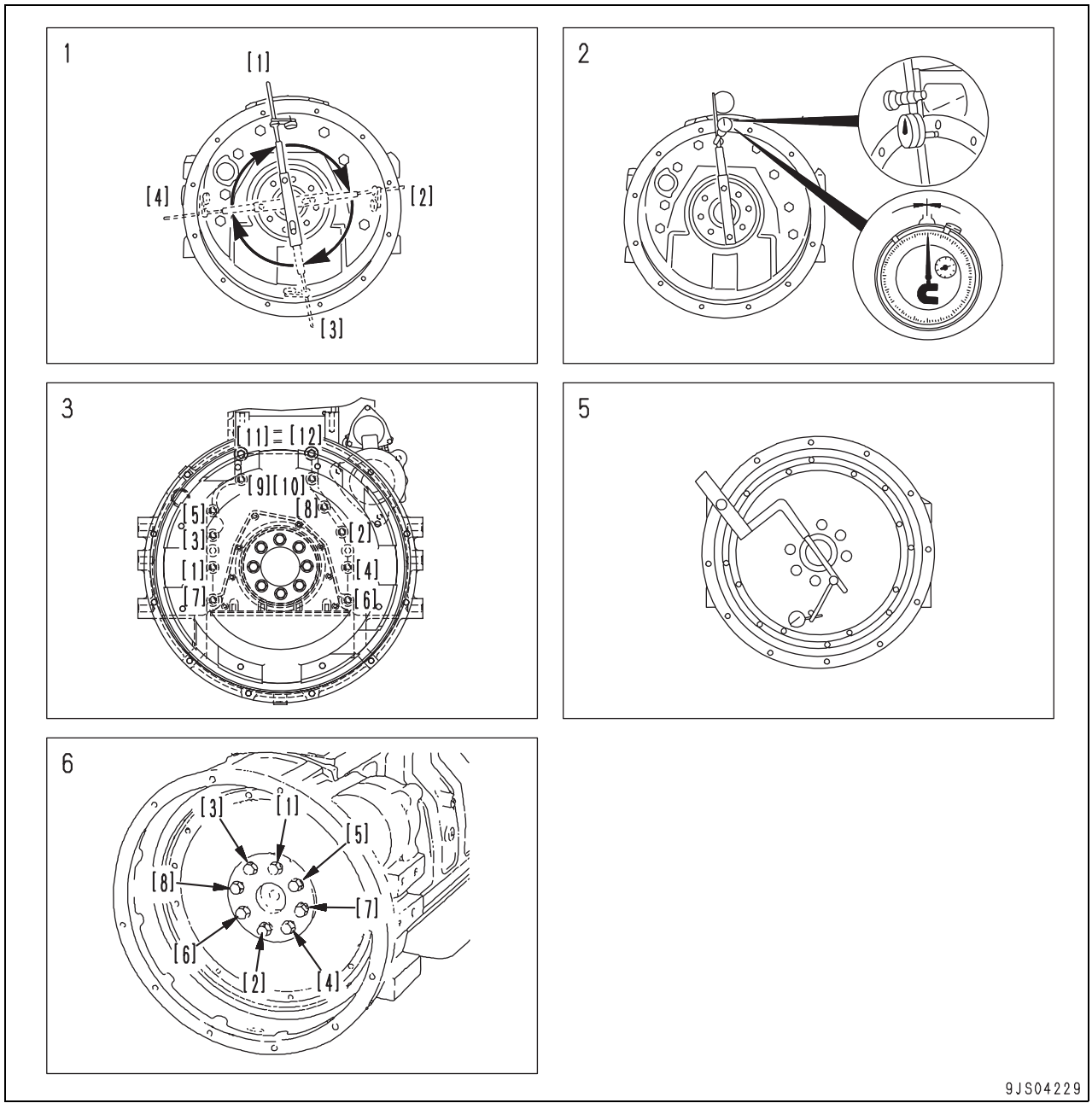
Rocker arm, shaft and tappet



Unit: mm

No.	Check item	Criteria		Remedy
1	Outside diameter of rocker arm shaft	Min. 21.965		Replace rocker arm shaft
2	Inner diameter of rocker arm shaft hole	Max. 22.027		Replace rocker arm
3	Clearance between rocker arm shaft and rocker arm	Max. 0.062		Replace rocker arm or shaft
4	Tightening torque of locknut for rocker arm adjustment screw	Target (Nm {kgm})		Tighten
		24 {2.5}		
5	Valve clearance (cold)	Valve	Repair limit	Adjust
		Intake	0.305	
		Exhaust	0.559	
6	Outside diameter of tappet	15.936 – 15.977		Replace tappet
7	Tightening torque of rocker arm mounting bolt	Target (Nm {kgm})		Tighten
		65 {6.6}		

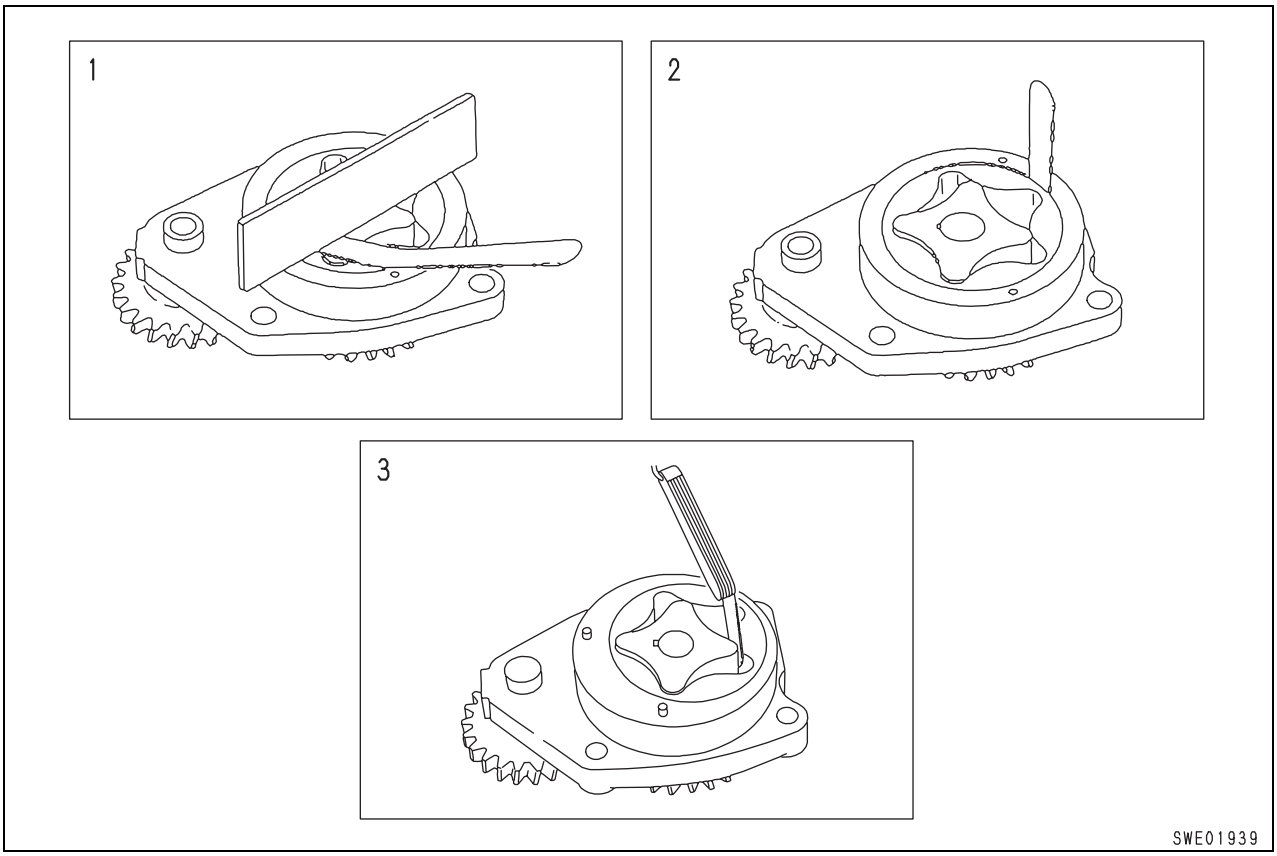
Flywheel and flywheel housing



Unit: mm

No.	Check item	Criteria		Remedy
1	Face runout of flywheel housing	Repair limit: 0.20		Reassemble, correct
2	Radial runout of flywheel housing	Repair limit: 0.20		
3	Tightening torque of flywheel housing mounting bolt	Target (Nm {kgm})		Tighten
		77 {7.85}		
4	Face runout of flywheel	Flywheel	Limit	Reassemble, correct
		For clutch	0.013 / ø25.4	
		For torque converter	Diameter (actual measurement) × 0.0005	
5	Radial runout of flywheel	Repair limit: 0.13		
6	Tightening torque of flywheel mounting bolt (Coat bolt thread with engine oil)	Target (Nm {kgm})		Tigthen and retighten
		137 {14.0}		

Oil pump



Unit: mm

No.	Check item	Criteria	Remedy
1	Clearance of rotor in axial direction	0.025 – 0.127	Replace oil pump
2	Clearance between outer rotor and body	0.178 – 0.381	
3	Clearance between outer rotor and inner rotor	0.025 – 0.178	
4	Tightening torque of oil pump mounting bolt	Target (Nm {kgm})	Tigthen and retighten
		24 {2.4}	

KOMATSU 114E-3 Series Diesel engine

Form No. SEN00176-02

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Engine

114E-3 Series

20 Standard value table
Standard service value table

Standard service value table 2
Standard value table for testing, adjusting and troubleshooting 2
Run-in standard and performance test criteria 6

Standard service value table

Standard value table for testing, adjusting and troubleshooting

Engine model				SAA6D114E-3	
Applicable machine				PC300, 300LC-7E0, PC350, 350LC-7E0 PC300, 300LC-8, PC350, 350LC-8	
	Item	Condition, etc	Unit	Standard value	Permissible value
Prerformance	Engine speed	High idle speed	rpm	2,050 ± 50	2,050 ± 50
		Low idle speed	rpm	1,000 ± 25	1,000 ± 25
	Necessary starting speed	At 0°C	rpm	—	—
		At –20°C	rpm	70	—
Intake and exhaust system	Intake resistance	At all speed	kPa {mmH_2O}	Max. 3.73 {Max. 380}	7.47 {762}
	Intake pressure (Air connector outlet)	At rated horsepower	kPa {mmHg}	135 – 175 {1,010 – 1,310}	100 {750}
	Exhaust pressure (Turbine inlet press.)	At rated horsepower	kPa {mmHg}	127 – 167 {950 – 1,250}	100 {750}
	Exhaust temperature (Turbine outlet temp.)	At all speed (at 20°C)	°C	Max. 600	Max. 650
	Exhaust gas color	At rated horsepower	%	Max. 1.0	Max. 2.0
		Quick acceleration (Low idle → high idle)		Max. 25	Max. 35
	Valve clearance	Intake valve	mm	0.305	0.152 – 0.559
		Exhaust valve	mm	0.559	0.381 – 0.813
Engine body	Compression pressure	Oil temperature: 40 – 60°C Engine speed: Min. 170 rpm	MPa {kg/cm^2}	Min. 2.6 {Min. 26.5}	2.1 {21.4}
	Blow-by pressure	At rated horsepower	kPa {mmH_2O}	Max. 1.57 {Max. 160}	Max. 2.55 {Max. 260}
Lubrication system	Oil pressure	At rated horsepower (Oil temperature: Min. 80°C) SAE15W-40	MPa {kg/cm^2}	0.34 – 0.59 {3.5 – 6.0}	0.21 {2.1}
		At low idle (Oil temperature: Min. 80°C) SAE15W-40	MPa {kg/cm^2}	Min. 0.15 {Min. 1.5}	0.08 {0.8}
	Oil temperature	At all speed (Oil in oil pan)	°C	80 – 110	120
	Oil consumption ratio	At continuous rated (Ratio to fuel consumption)	%	Max. 0.15	0.3
Cooling system	Radiator pressure valve	Opening pressure (Differential pressure)	kPa {kg/cm^2}	—	—
	Fan speed	At rated engine speed	rpm	1,346	—
	Fan and alternator belt tension	Deflects when pushed with a force of 98 N {10 kg}	mm	Auto-tensioner	—

Engine model				SAA6D114E-3	
Applicable machine				WA430-6	
	Item	Condition, etc	Unit	Standard value	Permissible value
Prerformance	Engine speed	High idle speed	rpm	2,245 ± 50	2,245 ± 50
		Low idle speed	rpm	765 ± 25	765 ± 25
	Necessary starting speed	At 0°C	rpm	—	—
		At –20°C	rpm	85	—
Intake and exhaust system	Intake resistance	At all speed	kPa {mmH2O}	Max. 3.73 {Max. 380}	7.47 {762}
	Intake pressure (Air connector outlet)	At rated horsepower	kPa {mmHg}	141 – 181 {1,060 – 1,360}	107 {800}
	Exhaust pressure (Turbine inlet press.)	At rated horsepower	kPa {mmHg}	140 – 180 {1,050 – 1,350}	113 {850}
	Exhaust temperature (Turbine outlet temp.)	At all speed (at 20°C)	°C	Max. 600	Max. 650
	Exhaust gas color	At rated horsepower	%	Max. 1.0	Max. 2.0
		Quick acceleration (Low idle → high idle)		Max. 25	Max. 35
	Valve clearance	Intake valve	mm	0.305	0.152 – 0.559
		Exhaust valve	mm	0.559	0.381 – 0.813
Engine body	Compression pressure	Oil temperature: 40 – 60°C Engine speed: Min. 170 rpm	MPa {kg/cm2}	Min. 2.6 {Min. 26.5}	2.1 {21.4}
	Blow-by pressure	At rated horsepower	kPa {mmH2O}	Max. 1.57 {Max. 160}	Max. 2.55 {Max. 260}
Lubrication system	Oil pressure	At rated horsepower (Oil temperature: Min. 80°C) SAE15W-40	MPa {kg/cm2}	0.34 – 0.59 {3.5 – 6.0}	0.21 {2.1}
		At low idle (Oil temperature: Min. 80°C) SAE15W-40	MPa {kg/cm2}	Min. 0.15 {Min. 1.5}	0.08 {0.8}
	Oil temperature	At all speed (Oil in oil pan)	°C	80 – 110	120
	Oil consumption ratio	At continuous rated (Ratio to fuel consumption)	%	Max. 0.15	0.3
Cooling system	Radiator pressure valve	Opening pressure (Differential pressure)	kPa {kg/cm2}	—	—
	Fan speed	At rated engine speed	rpm	— (Chassis side)	—
	Fan and alternator belt tension	Deflects when pushed with a force of 98 N {10 kg}	mm	Auto-tensioner	—

Engine model				SAA6D114E-3	
Applicable machine				D65EX-15E0, D65PX-15E0, D65WX-15E0	
	Item	Condition, etc	Unit	Standard value	Permissible value
Prerformance	Engine speed	High idle speed	rpm	2,030 ± 50	2,030 ± 50
		Low idle speed	rpm	825 ± 25	825 ± 25
	Necessary starting speed	At 0°C	rpm	—	—
		At –20°C	rpm	80	—
Intake and exhaust system	Intake resistance	At all speed	kPa {mmH2O}	Max. 3.73 {Max. 380}	7.47 {762}
	Intake pressure (Air connector outlet)	At rated horsepower	kPa {mmHg}	129 – 169 {970 – 1,270}	94.7 {710}
	Exhaust pressure (Turbine inlet press.)	At rated horsepower	kPa {mmHg}	117 – 157 {880 – 1,180}	90.7 {680}
	Exhaust temperature (Turbine outlet temp.)	At all speed (at 20°C)	°C	Max. 600	Max. 650
	Exhaust gas color	At rated horsepower	%	Max. 1.0	Max. 2.0
		Quick acceleration (Low idle → high idle)		Max. 25	Max. 35
	Valve clearance	Intake valve	mm	0.305	0.152 – 0.559
		Exhaust valve	mm	0.559	0.381 – 0.813
Engine body	Compression pressure	Oil temperature: 40 – 60°C Engine speed: Min. 170 rpm	MPa {kg/cm2}	Min. 2.6 {Min. 26.5}	2.1 {21.4}
	Blow-by pressure	At rated horsepower	kPa {mmH2O}	Max. 1.57 {Max. 160}	Max. 2.55 {Max. 260}
Lubrication system	Oil pressure	At rated horsepower (Oil temperature: Min. 80°C) SAE15W-40	MPa {kg/cm2}	0.34 – 0.59 {3.5 – 6.0}	0.21 {2.1}
		At low idle (Oil temperature: Min. 80°C) SAE15W-40	MPa {kg/cm2}	Min. 0.15 {Min. 1.5}	0.08 {0.8}
	Oil temperature	At all speed (Oil in oil pan)	°C	80 – 110	120
	Oil consumption ratio	At continuous rated (Ratio to fuel consumption)	%	Max. 0.15	0.3
Cooling system	Radiator pressure valve	Opening pressure (Differential pressure)	kPa {kg/cm2}	—	—
	Fan speed	At rated engine speed	rpm	— (Chassis side)	—
	Fan and alternator belt tension	Deflects when pushed with a force of 98 N {10 kg}	mm	Auto-tensioner	—

Engine model				SAA6D114E-3	
Applicable machine				GD655-3E0, GD675-3E0	
	Item	Condition, etc	Unit	Standard value	Permissible value
Prerformance	Engine speed	High idle speed	rpm	2,225 ± 50	2,050 ± 50
		Low idle speed	rpm	825 ± 25	1,000 ± 25
	Necessary starting speed	At 0°C	rpm	—	—
		At –20°C	rpm	—	—
Intake and exhaust system	Intake resistance	At all speed	kPa {mmH2O}	Max. 3.73 {Max. 380}	7.47 {762}
	Intake pressure (Air connector outlet)	At rated horsepower	kPa {mmHg}	135 – 175 {1,010 – 1,310}	100 {750}
	Exhaust pressure (Turbine inlet press.)	At rated horsepower	kPa {mmHg}	127 – 167 {950 – 1,250}	100 {750}
	Exhaust temperature (Turbine outlet temp.)	At all speed (at 20°C)	°C	Max. 600	Max. 650
	Exhaust gas color	At rated horsepower	%	Max. 1.0	Max. 2.0
		Quick acceleration (Low idle → high idle)		Max. 25	Max. 35
	Valve clearance	Intake valve	mm	0.305	0.152 – 0.559
		Exhaust valve	mm	0.559	0.381 – 0.813
Engine body	Compression pressure	Oil temperature: 40 – 60°C Engine speed: Min. 170 rpm	MPa {kg/cm2}	Min. 2.6 {Min. 26.5}	2.1 {21.4}
	Blow-by pressure	At rated horsepower	kPa {mmH2O}	Max. 1.57 {Max. 160}	Max. 2.55 {Max. 260}
Lubrication system	Oil pressure	At rated horsepower (Oil temperature: Min. 80°C) SAE15W-40	MPa {kg/cm2}	0.34 – 0.59 {3.5 – 6.0}	0.21 {2.1}
		At low idle (Oil temperature: Min. 80°C) SAE15W-40	MPa {kg/cm2}	Min. 0.15 {Min. 1.5}	0.08 {0.8}
	Oil temperature	At all speed (Oil in oil pan)	°C	80 – 110	120
	Oil consumption ratio	At continuous rated (Ratio to fuel consumption)	%	Max. 0.15	0.3
Cooling system	Radiator pressure valve	Opening pressure (Differential pressure)	kPa {kg/cm2}	—	—
	Fan speed	At rated engine speed	rpm	— (Chassis side)	—
	Fan and alternator belt tension	Deflects when pushed with a force of 98 N {10 kg}	mm	Auto-tensioner	—

Run-in standard and performance test criteria

Run-in standard

Engine		SAA6D114E-3				
Applicable machine		PC300, 300LC-7E0, PC350, 350LC-7E0 PC300, 300LC-8, PC350, 350LC-8				
Item		Procedure				
		1	2	3	4	5
Running time	min	2	10	2	3	10
Engine speed	rpm	1,000	1,000	1,200	1,600	1,950
Dynamometer load	N {kg}	0 {0}	98 {10}	245 {25}	637 {65}	1,294 {132}
Output	kW {HP}	0 {0}	7.4 {10}	22 {30}	76 {103}	194 {260}

★ The table gives the standard values for machines without fan.
★ The loads for the dynamometer are at an arm's length of 716 mm.

Performance test criteria

Engine		SAA6D114E-3			
Applicable machine		PC300, 300LC-7E0, PC350, 350LC-7E0 PC300, 300LC-8, PC350, 350LC-8			
Test item		Rated horsepower	Max. torque	High idle speed	Low idle speed
Specification value (Gross)	—	194 kW / 1,950 rpm {260 HP / 1,950 rpm}	1,129 Nm / 1,450 rpm {115 kgm / 1,450 rpm}	2,050 rpm	1,000 rpm
Speed	rpm	1,950	1,450	2,050	1,000
Dynamometer load	N {kg}	1,294 {132}	1,580 {161}	—	—
Output (Gross)	kW {HP}	194 {260}	—	—	—
Torque (Gross)	Nm {kgm}	—	1,129 {115}	—	—
Fuel consumption	sec/ 300cc	20	—	—	—
Coolant temperature	°C	83 – 95	83 – 95	83 – 95	83 – 95
Lubricating oil temperature	°C	80 – 110	80 – 110	80 – 110	80 – 110
Lubricating oil pressure	kPa {kg/cm^2}	0.34 – 0.59 {3.5 – 6.0}	—	—	Min. 0.15 {Min. 1.5}
Exhaust temperature	°C	Max. 700	Max. 750	—	—

★ This table shows the standard values using the JIS correction factor.
★ The output and torque values in the table are the standard values with the fan removed, so they are different from the specification values.
★ This table shows the standard values with an air cleaner installed, muffler installed, alternator under no load.
★ The dynamometer load shows the value for an arm length of 716 mm.
★ Use ASTM D975 diesel oil as the fuel.
★ Use SAE15W-40 as the lubricating oil.

Run-in standard

Engine		SAA6D114E-3				
Applicable machine		WA430-6				
Item		Procedure				
		1	2	3	4	5
Running time	min	2	10	2	3	10
Engine speed	rpm	765	1,000	1,200	1,600	2,100
Dynamometer load	N {kg}	0 {0}	98 {10}	245 {25}	637 {65}	1,097 {112}
Output	kW {HP}	0 {0}	7.4 {10}	22 {29.5}	76 {102}	173 {232}

★ The loads for the dynamometer are at an arm's length of 716 mm.

Performance test criteria

Engine		SAA6D114E-3			
Applicable machine		WA430-6			
Test item		Rated horsepower	Max. torque	High idle speed	Low idle speed
Specification value (Gross)	—	173 kW / 2,100 rpm {232 HP / 2,100 rpm}	1,020 Nm / 1,450 rpm {104 kgm / 1,450 rpm}	2,245 rpm	765 rpm
Speed	rpm	2,100	1,450	2,245	765
Dynamometer load	N {kg}	1,097 {112}	1,420 {145}	—	—
Output (Gross)	kW {HP}	173 {232}	—	—	—
Torque (Gross)	Nm {kgm}	—	1,020 {104}	—	—
Fuel consumption	sec/ 300cc	22	—	—	—
Coolant temperature	°C	75 – 94	75 – 94	75 – 94	75 – 94
Lubricating oil temperature	°C	80 – 110	80 – 110	80 – 110	80 – 110
Lubricating oil pressure	kPa {kg/cm^2}	0.34 – 0.59 {3.5 – 6.0}	—	—	Min. 0.15 {Min. 1.5}
Exhaust temperature	°C	Max. 700	Max. 750	—	—

★ This table shows the standard values using the JIS correction factor.
★ This table shows the standard values with an air cleaner installed, muffler installed, alternator under no load.
★ The dynamometer load shows the value for an arm length of 716 mm.
★ Use ASTM D975 diesel oil as the fuel.
★ Use SAE15W-40 as the lubricating oil.

Run-in standard

Engine		SAA6D114E-3				
Applicable machine		D65EX-15E0, D65PX-15E0, D65WX-15E0				
Item		Procedure				
		1	2	3	4	5
Running time	min	2	10	2	3	10
Engine speed	rpm	825	1,000	1,200	1,600	1,950
Dynamometer load	N {kg}	0 {0}	98 {10}	245 {25}	637 {65}	1,058 {108}
Output	kW {HP}	0 {0}	7.4 {10}	22 {29.5}	76 {102}	154 {206}

★ The loads for the dynamometer are at an arm's length of 716 mm.

Performance test criteria

Engine		SAA6D114E-3			
Applicable machine		D65EX-15E0, D65PX-15E0, D65WX-15E0			
Test item		Rated horsepower	Max. torque	High idle speed	Low idle speed
Specification value (Gross)	—	154 kW / 1,950 rpm {206 HP / 1,950 rpm}	1,010 Nm / 1,450 rpm {103 kgm / 1,450 rpm}	2,030 rpm	825 rpm
Speed	rpm	1,950	1,450	2,030	825
Dynamometer load	N {kg}	1,058 {108}	1,410 {144}	—	—
Output (Gross)	kW {HP}	154 {206}	—	—	—
Torque (Gross)	Nm {kgm}	—	1,010 {103}	—	—
Fuel consumption	sec/ 300cc	26	—	—	—
Coolant temperature	°C	75 – 94	75 – 94	75 – 94	75 – 94
Lubricating oil temperature	°C	80 – 110	80 – 110	80 – 110	80 – 110
Lubricating oil pressure	kPa {kg/cm^2}	0.34 – 0.59 {3.5 – 6.0}	—	—	Min. 0.15 {Min. 1.5}
Exhaust temperature	°C	Max. 700	Max. 750	—	—

★ This table shows the standard values using the JIS correction factor.
★ This table shows the standard values with an air cleaner installed, muffler installed, alternator under no load.
★ The dynamometer load shows the value for an arm length of 716 mm.
★ Use ASTM D975 diesel oil as the fuel.
★ Use SAE15W-40 as the lubricating oil.

Run-in standard

Engine		SAA6D114E-3				
Applicable machine		GD655-3E0, GD675-3E0				
Item		Procedure				
		1	2	3	4	5
Running time	min	2	10	2	3	10
Engine speed	rpm	825	1,000	1,200	1,600	1,900
Dynamometer load	N {kg}	0 {0}	98 {10}	245 {25}	637 {65}	1,090 {111}
Output	kW {HP}	0 {0}	7.4 {10}	22 {29.5}	76 {102}	154 {206}

★ The loads for the dynamometer are at an arm's length of 716 mm.

Performance test criteria

Engine		SAA6D114E-3			
Applicable machine		GD655-3E0, GD675-3E0			
Test item		Rated horsepower	Max. torque	High idle speed	Low idle speed
Specification value (Gross)	—	154 kW / 1,900 rpm {206 HP / 1,900 rpm}	990 Nm / 1,450 rpm {101 kgm / 1,450 rpm}	2,225 rpm	825 rpm
Speed	rpm	1,900	1,450	2,225	825
Dynamometer load	N {kg}	1,090 {111}	1,380 {141}	—	—
Output (Gross)	kW {HP}	154 {206}	—	—	—
Torque (Gross)	Nm {kgm}	—	990 {101}	—	—
Fuel consumption	sec/ 300cc	25	—	—	—
Coolant temperature	°C	75 – 94	75 – 94	75 – 94	75 – 94
Lubricating oil temperature	°C	80 – 110	80 – 110	80 – 110	80 – 110
Lubricating oil pressure	kPa {kg/cm^2}	0.34 – 0.59 {3.5 – 6.0}	—	—	Min. 0.15 {Min. 1.5}
Exhaust temperature	°C	Max. 700	Max. 750	—	—

★ This table shows the standard values using the JIS correction factor.
★ This table shows the standard values with an air cleaner installed, muffler installed, alternator under no load.
★ The dynamometer load shows the value for an arm length of 716 mm.
★ Use ASTM D975 diesel oil as the fuel.
★ Use SAE15W-40 as the lubricating oil.

KOMATSU 114E-3 Series Diesel engine

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ENGINE

114E-3 Series

30 Testing and adjusting

Testing and adjusting

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Testing and adjusting

Testing and adjusting tools list

Testing and adjusting item	Symbol		Part No.	Part name	Q'ty	Remarks
Testing air boost pressure	A		799-201-2202	Boost gauge kit	1	–100 – 200 kPa {–760 – 1,500 mmHg}
			799-401-2220	Hose	1	I-coupler type (if necessary)
Adjusting valve clearance	C	1	795-799-1131	Gear	1	
		2	Commercially available	Clearance gauge	1	
Testing compression pressure	D	1	795-799-6700	Injector puller	1	
		2	795-502-1590	Gauge assembly	1	
		3	795-790-6110	Adapter	1	
		4	6754-11-3130	Gasket	1	
Testing blow-by pressure	E		799-201-1504	Blow-by checker	1	0 – 5 kPa {0 – 500 mmH_2O}
Testing oil pressure	F	1	799-101-5002	Hydraulic tester	1	Pressure gauge: 2.5, 6, 40, 60 MPa {25, 60, 400, 600 kg/cm^2}
		2	799-401-2320	Gauge	1	Pressure gauge: 1 MPa {10 kg/cm^2}
		3	6732-81-3170	Adapter	1	10 x 1.0 mm → R1/8
			6215-81-9710	O-ring	1	
Testing fuel pressure	G	1	799-101-5002	Hydraulic tester	1	Pressure gauge: 2.5, 6, 40, 60 MPa {25, 60, 400, 600 kg/cm^2}
			790-261-1204	Digital hydraulic tester	1	Pressure gauge: 60 MPa {600 kg/cm^2}
		2	6732-81-3170	Adapter	1	10 x 1.0 mm → R1/8
			6215-81-9710	O-ring	1	
		3	799-401-2320	Gauge	1	Pressure gauge: 1 MPa {10 kg/cm^2}
		4	795-790-6210	M10 computer check fitting	1	
		5	795-790-1500	Fuel vacuum gauge	1	Male: 7/8-14UNF – female: 7/8-14UNF
			799-201-1201		1	Male: 3/4-16UNF – female: 3/4-16UNF
Testing leakage from pressure limiter and return rate from injector	H	1	795-790-4800	Hose kit	1	
		2	795-790-6700	Adapter	1	
		3	Commercially available	Measuring cylinder	1	
Diagnosis sensor and harness	—		799-601-7400	T-adapter assembly	1	AMP040 Connector
			799-601-7500	T-adapter assembly	1	AMP040 Connector
			799-601-9000	T-adapter assembly	1	DT, HD30 Connector
			799-601-9300	T-adapter assembly	1	DRC26-40 (5 pins)
			799-601-7360	Adapter	1	Relay (5 pins)
			799-601-7310	T-adapter	1	AWP (12 poles)
			799-601-7070	T-adapter	1	AWP (16 poles)
			799-601-4100	T-adapter assembly	1	Connected with engine
			799-799-5530	• T-adapter	1	Engine coolant temperature
			799-601-4230	• T-adapter	1	Boost temperature/pressure sensor
			799-601-4130	• T-adapter	1	Ne sensor, CAM sensor
			799-601-4160	• T-adapter	1	Hydraulic pressure sensor
			799-601-4211	• T-adapter	1	Controller (50 poles)
			799-601-4220	• T-adapter	1	Controller (60 poles)
			799-601-4140	• T-adapter	1	Atmospheric pressure sensor
			799-601-4340	• T-adapter	1	Pump actuator
			799-601-4260	• T-adapter	1	Controller (4 poles)
			799-601-4190	• T-adapter	1	Common rail pressure sensor

Testing air boost pressure

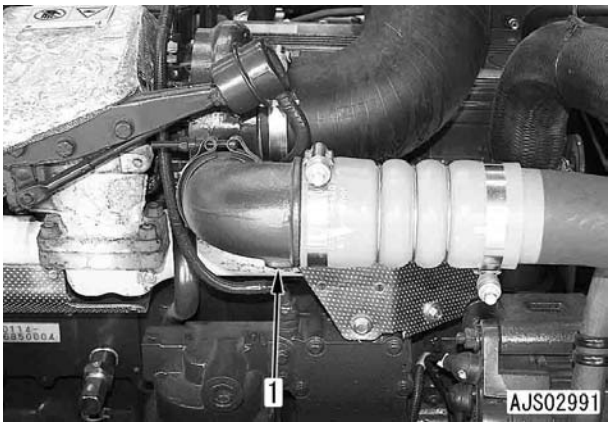
★ Testing tools for air boost pressure

Symbol	Part No.	Part name
A	799-201-2202	Boost gauge kit

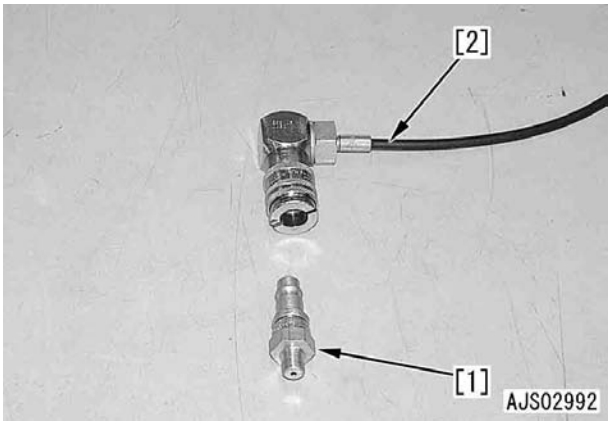
⚠ **Be careful not to touch any hot part when removing or installing the testing tools.**

★ The test point is subject to machine models.

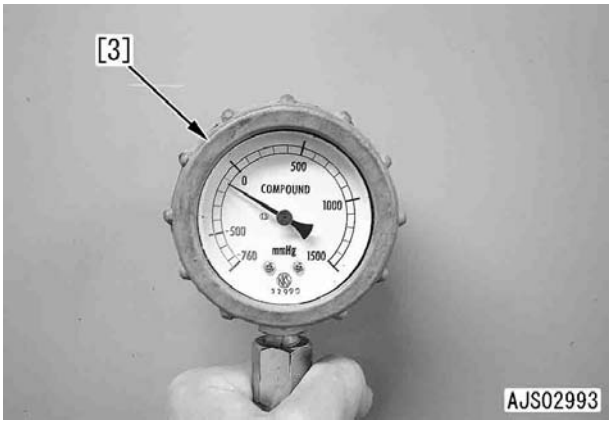
1. Remove air boost pressure pickup plug (1) between the turbocharger and aftercooler.



2. Install nipple [1] and hose [2] of boost gauge kit **A** and connect it to gauge [3].



3. Run the engine at the rated output and test the air boost pressure.
   ★ When testing with the engine mounted on the machine, test on the condition described in the shop manual for the machine.
   ★ Connect INSITE (troubleshooting kit) to the engine and measure air boost pressure between the aftercooler and intake manifold using the monitoring function.



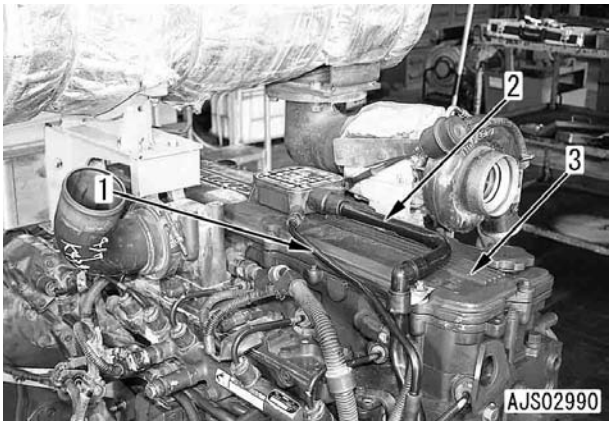
4. After finishing testing, remove the measuring tools and return the removed parts.

Adjusting valve clearance

★ Adjusting tools for valve clearance

Symbol		Part No.	Part name
C	1	795-799-1131	Gear
	2	Commercially available	Clearance gauge

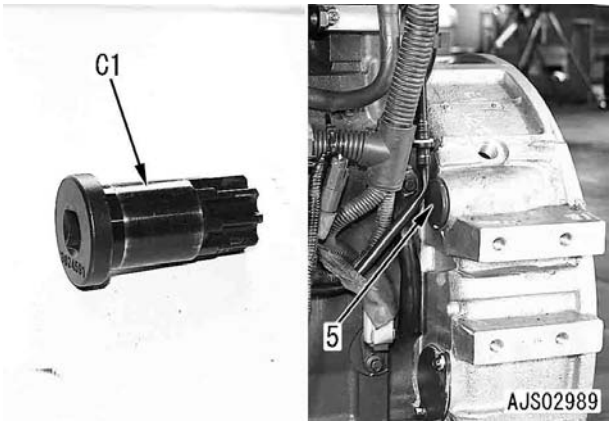
1. Disconnect breather tube (1) and blow-by tube (2), and remove cylinder head cover (3).



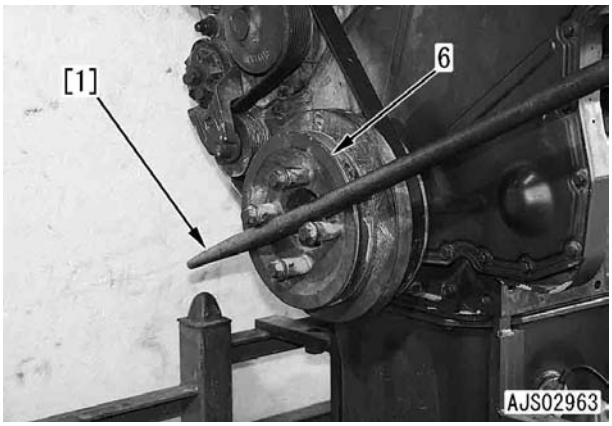
2. Remove cap (4).



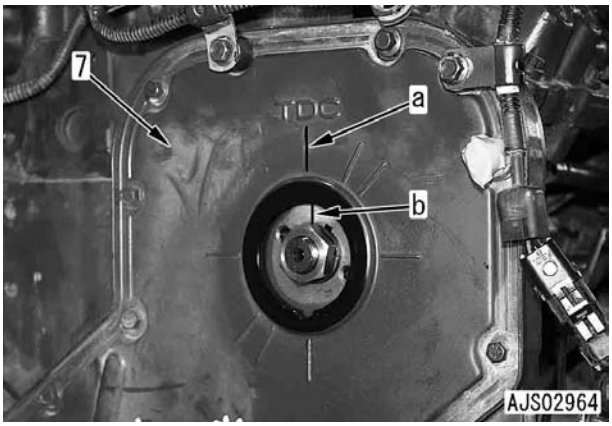
3. Move the No. 1 cylinder to the compression top dead center.
   1) Remove cap (5), insert gear **C1**, and rotate it forward.



★ Alternatively, you may fit a claw bar [1] on the bolts at the end of the crankshaft pulley (6) and rotate it.



   2) Align the TDC stamp line (a) of gear cover (7) with stamp line (b) of the supply pump gear.
      ★ The cylinder No. 1 is moved to the compression top dead center.



4. After placing the No. 1 cylinder at the compression top dead center, place a counter mark on the damper, and install a pointer to gear cover (7) using wire.

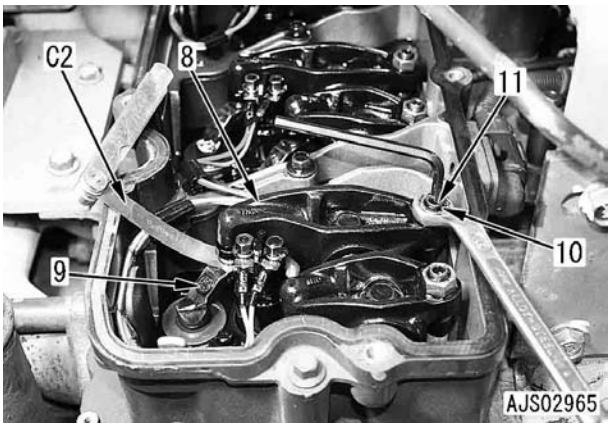
5. When the No. 1 cylinder is at the compression top dead center, adjust the valve clearance indicated by ● of the valve arrangement plan.

Valve arrangement

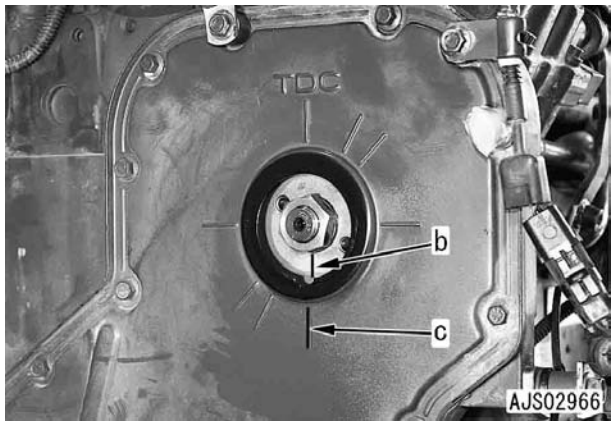
Cylinder No.	1	2	3	4	5	6
Exhaust valve	●	○	●	○	●	○
Intake valve	●	●	○	●	○	○

TDD00723

6. Adjust the valve clearance according to the following procedure.
   1) Insert clearance gauge **C2** into the clearance between rocker lever (8) and crosshead (9).
   2) Loosen locknut (10) and adjust valve clearance using adjustment screw (11).
      ★ With the clearance gauge inserted, turn the adjustment screw to a degree that you can move the clearance gauge **C2** lightly.
   3) Fix adjustment screw (11) and tighten locknut (10).
      Locknut:
      24 ± 4 Nm {2.45 ± 0.41 kgm}
      ★ After tightening the locknut, check the valve clearance again.



   4) Rotate the crankshaft forward 360°, precisely make alignment with the counter mark placed on Step 4, and adjust the valve clearance indicated by ○.
      ★ At this moment, the stamp line (b) of the fuel injection pump gear is aligned with the stamp line (c) right below.
   5) Adjust the valve indicated by the ○.
      ★ Firing order: 1–5–3–6–2–4
      ★ The adjustment method is the same as one indicated by ●.



7. After finishing adjustment, return the removed parts.
   Head cover assembly mounting bolt:
   11.8 ± 1.96 Nm {1.2 ± 0.2 kgm}

Testing compression pressure

★ Testing tools for compression pressure

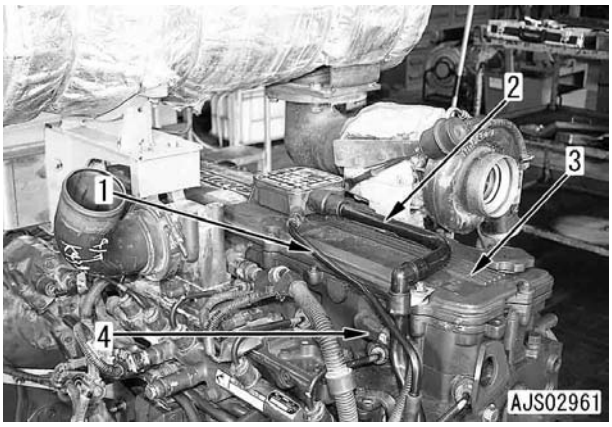
Symbol		Part No.	Part name
D	1	795-799-6700	Injector puller
	2	795-502-1590	Gauge assembly
	3	795-790-6110	Adapter
	4	6754-11-3130	Gasket

⚠ **When measuring the compression pressure, take care not to burn yourself on the exhaust manifold, muffler, etc. or get caught in a rotating part.**

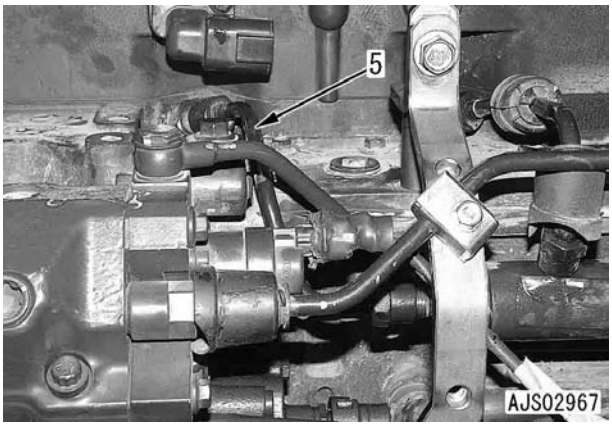
★ Measure the compression pressure after the engine is warmed up.
(Engine oil temperature: 40 – 60°C).

1. Disconnect breather tube (1) and blow-by tube (2), and remove head cover assembly (3).

2. Disconnect injector harness connectors (4) (at 6 places) and move the harnesses.



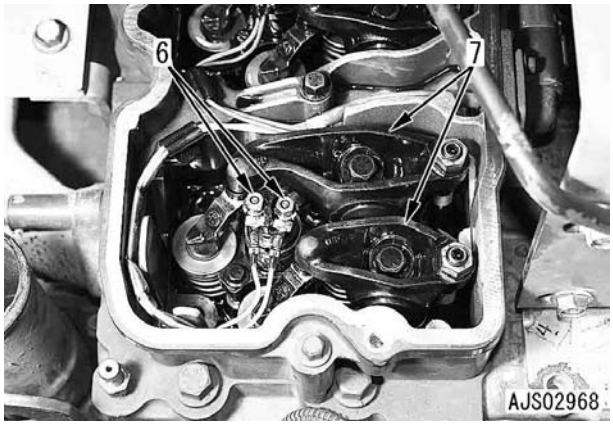
3. Disconnect fuel high-pressure tube (5).



4. Loosen injector terminal nut (6) and remove the terminal from the injector.

5. Move the cylinder to be tested to the compression top dead center.
★ See “Adjusting valve clearance”.

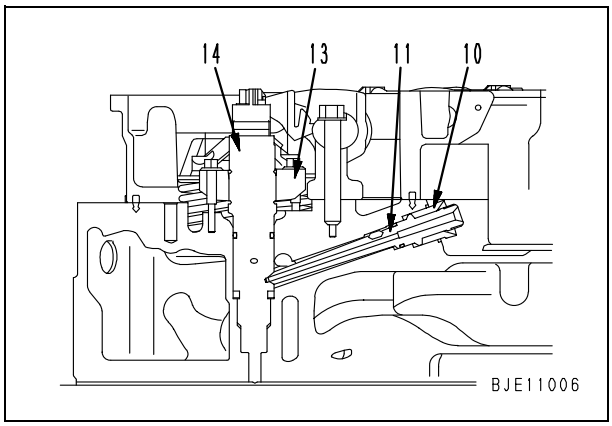
6. Remove rocker arm assembly (7).

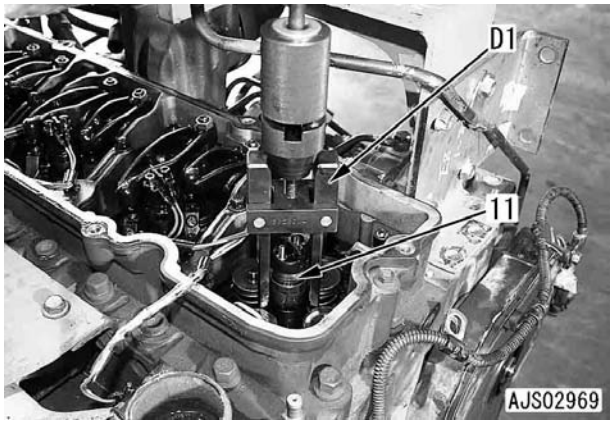


7. Remove retainer (10) and disconnect fuel inlet connector (11).

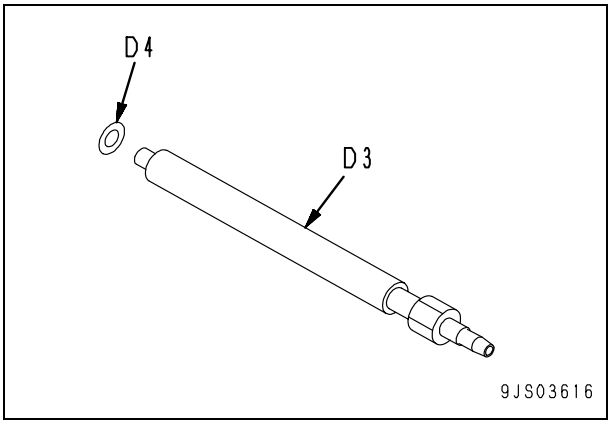
8. Remove holder (13).

9. Remove injector (14).
★ Remove the injector using puller **D1** and the impact of slide hammer.
★ Do not unclench the upper part of the injector.





10. Install gasket **D4** to the tip of adapter **D3** and connect it to the injector mount.



11. Fix adapter **D3** with the injector holder.
    - Holder mounting bolt
      1st time: **10 ± 2.0 Nm {1.0 ± 0.2 kgm}**
      2nd time: **41 ± 4 Nm {4.1 ± 0.4 kgm}**

12. Connect gauge assembly **D2** to adaptor **D3**.
    - ★ Apply a little amount of engine oil to the connecting parts of the adapter and gauge so that air will not leak easily.

13. Install rocker arm assembly.
    - Rocker arm assembly mounting bolt:
      64.7 ± 4.9 Nm {6.6 ± 0.5 kgm}

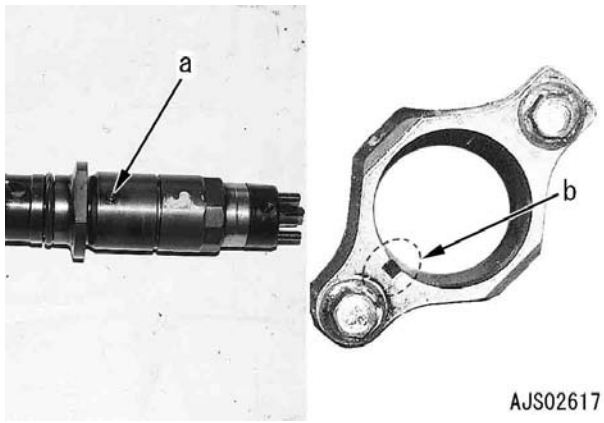
14. Adjust valve clearance.
    - ★ See “Adjusting valve clearance”.



15. Connect INSITE (troubleshooting kit) to the engine and set the engine in the no-injection cranking mode.
    - ★ When testing while the engine is mounted on the machine, set the engine in the no-injection cranking mode with the monitor panel.
    - ⚠ **If the engine is not set in the no-injection cranking mode, it will start during testing and will be dangerous. Accordingly, be sure to set the engine in this mode.**

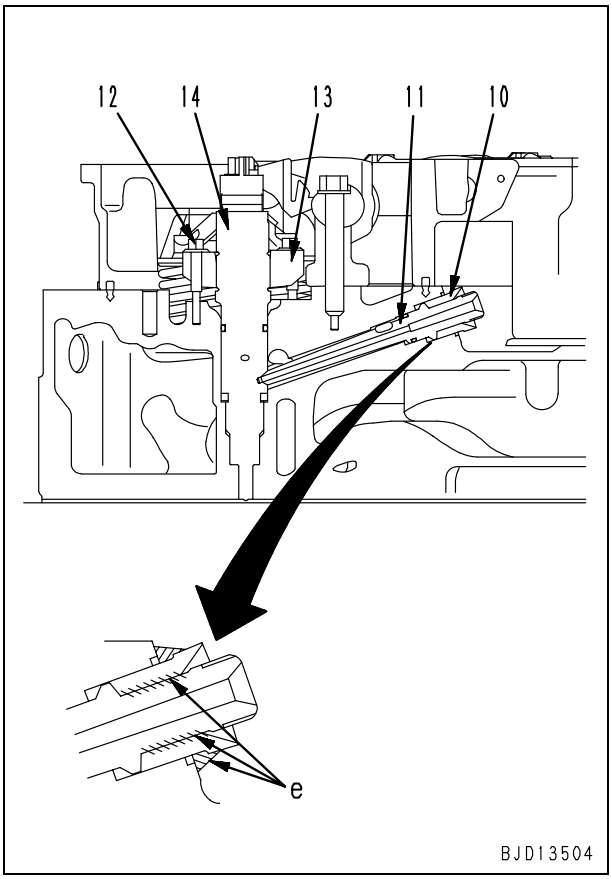
16. Rotate the engine with the starting motor and measure the compression pressure.
    - ★ Read the pressure gauge pointer when it is stabilized.

17. After finishing testing, remove the testing tools and return the removed parts.
    - ★ Install the injector and fuel high-pressure tube according to the following procedure.
    1) Mate protrusion (a) of the injector with notch (b) of the holder, and set the injector to the cylinder head.
       - ★ Set the injector with the above mating position toward the fuel inlet connector insertion side.

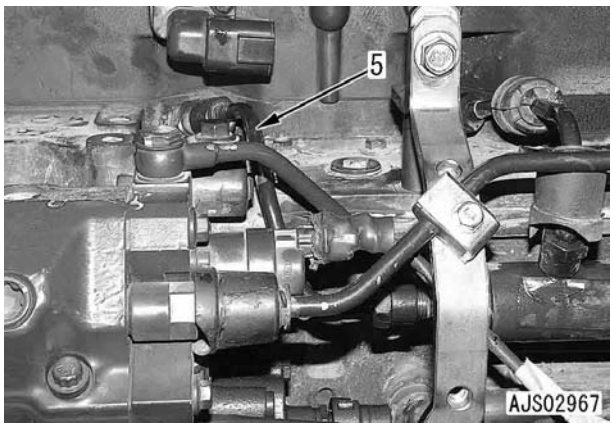


    2) Coat the O-ring of injector (14) and the mounting hole on the head with engine oil (EO15W-40).
    3) Assemble holder (13) on injector (14) then insert the assembly into the cylinder head with the fuel inlet hole of injector (14) on the intake manifold side.
    4) Tighten bolt (12) by three or four threads with hands.
    5) Coat the O-ring of inlet connector (11) and the mounting hole on the head with engine oil (EO15W-40).
    6) Install inlet connector (11) temporarily with retainer (10).
       - Retainer:
         15 ± 5.0 Nm {1.5 ± 0.5 kgm}

7) Tighten bolts (12) to the specified torque.
   ★ Tighten bolts diagonally so that the upper surface of holder (13) becomes parallel to the upper surface of the cylinder head.
   ● Maximum angle limit: 2.4°
   Bolt: **10 ± 2.0 Nm {1.0 ± 0.2 kgm}**
8) Tighten inlet connector (11) to the specified torque.
   Retainer (10):
   41 ± 4 Nm {4.1 ± 0.4 kgm}
   Apply the caulking compound (**e**) (hatched section) to retainer (10) and the cylinder head.
   Caulking compound:
   GE TOSHIBA SILICON TOSSEAL 381



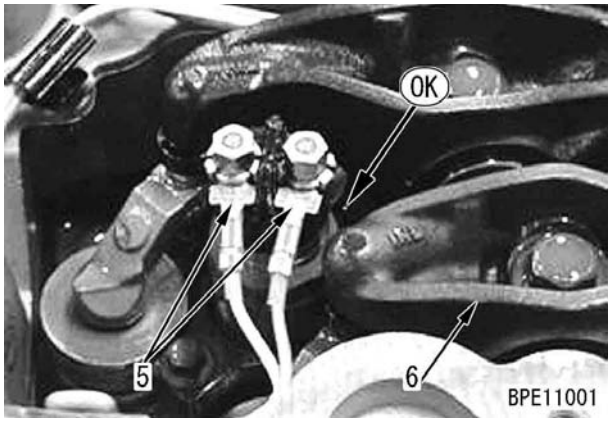
9) Install the fuel high-pressure piping (5).
   Sleeve nut:
   37.3 ± 4 Nm {3.8 ± 0.4 kgm}

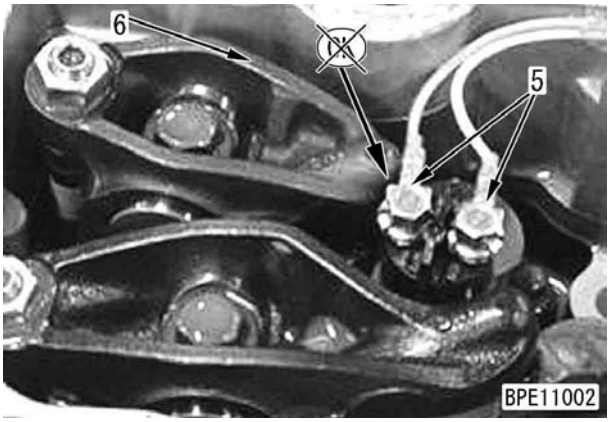


10) Install the rocker arm assembly (6).
   ★ Before tightening the mounting bolts, check that the adjustment screw ball is fitted in the push rod socket.
   Rocker arm assembly mounting bolt:
   64.7 ± 4.9 Nm {6.6 ± 0.5 kgm}

★ After installing the rocker arm assembly, adjust the valve clearance, referring to “Adjusting valve clearance”.

★ Install the injector wiring harness terminal (5) in a direction where it will not interfere with the rocker arm (6) which moves up and down.





★ Tighten the injector terminal nut with the following torque.

Terminal nut:

1.25 ± 0.25 Nm {0.13 ± 0.03 kgm}

★ Tighten the head cover with the following torque.

Head cover assembly mounting nut:

11.8 ± 1.96 Nm {1.2 ± 0.2 kgm}

Testing blow-by pressure

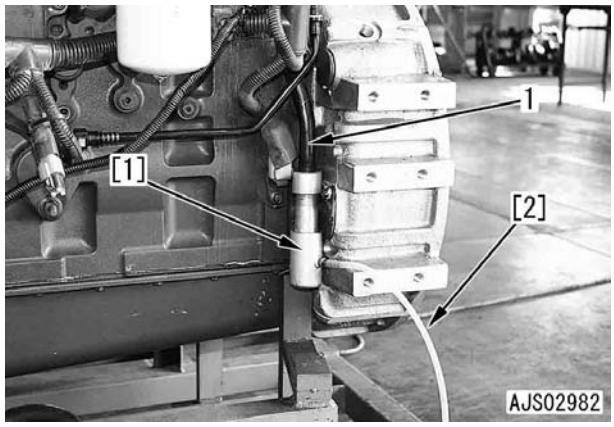
★ Testing tool for blow-by pressure

Symbol	Part No.	Part name
E	799-201-1504	Blow-by checker

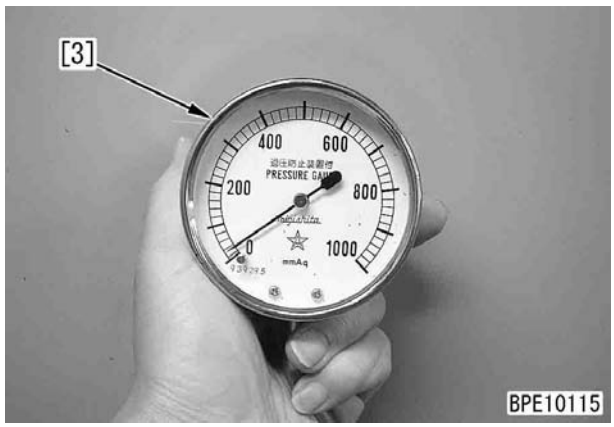
★ The test point is subject to machine models.

1. Install adapter [1] of blow-by checker **E** to the tip of blow-by hose (1).

2. Connect hose [2], and then connect it to adapter [1] and gauge [3].



3. Run the engine at the rated output and test the blow-by pressure.
   ★ When testing with the engine mounted on the machine, test on the condition described in the shop manual for the machine.



4. After finishing testing, remove the measuring tools and return the removed parts.

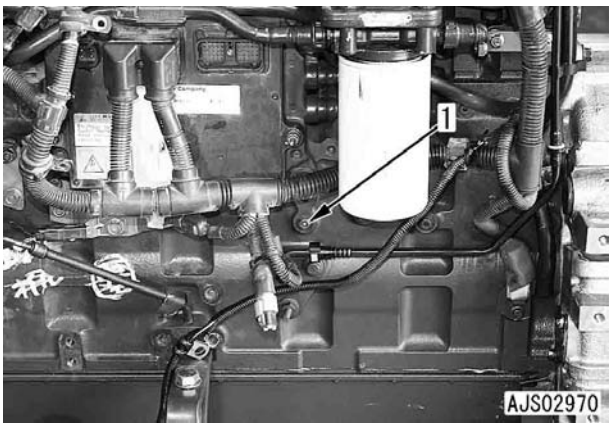
Testing oil pressure

★ Testing tools for oil pressure

Symbol		Part No.	Part name
F	1	799-101-5002	Hydraulic tester
	2	799-401-2320	Gauge: 1 MPa {10 kg/cm^2}
	3	6732-81-3170	Adapter (10 x 1.0 mm → R1/8)
		6215-81-9710	O-ring

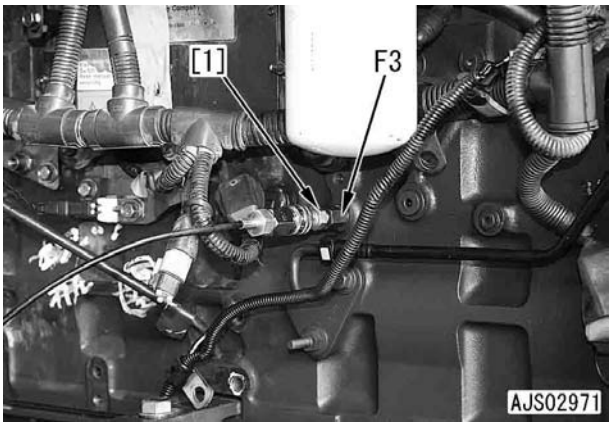
★ The test point is subject to machine models.

1. Remove oil pressure pickup plug (1).

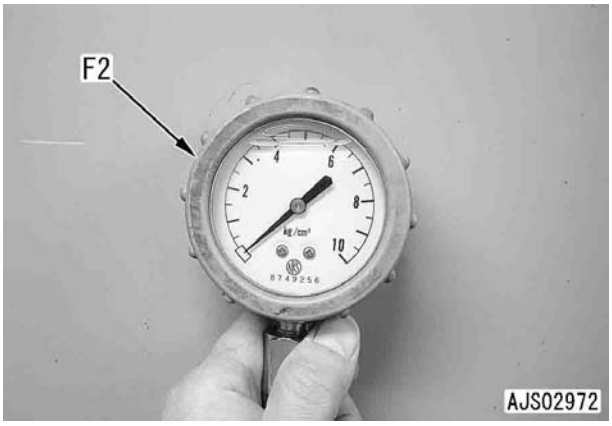


2. Install adapter **F3** and nipple [1] of hydraulic tester **F1** to the plug mount.

3. Connect the hose of hydraulic tester **F1** to nipple [1] and gauge **F2**.



4. Run the engine at the rated output and low idle and test the oil pressure.
   ★ When testing with the engine mounted on the machine, test on the condition described in the shop manual for the machine.



5. After finishing testing, remove the measuring tools and return the removed parts.

Handling fuel system parts

★ Precautions for testing and maintaining fuel system
The common rail fuel injection system (CRI) consists of more precise parts than the conventional fuel injection pump and nozzle. If foreign matter enters this system, it can cause a trouble.
When testing and maintaining the fuel system, take care more than the past. If dust, etc. sticks to any part, wash that part thoroughly with clean fuel.

★ Precautions for replacing fuel filter cartridge
Be sure to use the Komatsu genuine fuel filter cartridge.
Since the common rail fuel injection system (CRI) consists of more precise parts than the conventional fuel injection pump and nozzle, it employs a high-efficiency special filter to prevent foreign matter from entering it. If a filter other than the genuine one is used, the fuel system may have a trouble. Accordingly, never use such a filter.

Releasing residual pressure in fuel system

★ Pressure is generated in the low-pressure circuit and high-pressure circuit of the fuel system while the engine is running.
Low-pressure circuit:
Feed pump – Fuel filter – Fuel supply pump
High-pressure circuit:
Fuel supply pump – Common rail – Fuel injector

★ The pressure in both low-pressure circuit and high-pressure circuit lowers to a safety level automatically 30 seconds after the engine is stopped.

★ Before the fuel circuit is tested and its parts are removed, the residual pressure in the fuel circuit must be released completely. Accordingly, observe the following.

⚠ **Before testing the fuel system or removing its parts, wait at least 30 seconds after stopping the engine until the residual pressure in the fuel circuit is released. (Do not start the work just after stopping the engine since there is residual pressure.)**

Testing fuel pressure

★ Testing tools for fuel pressure

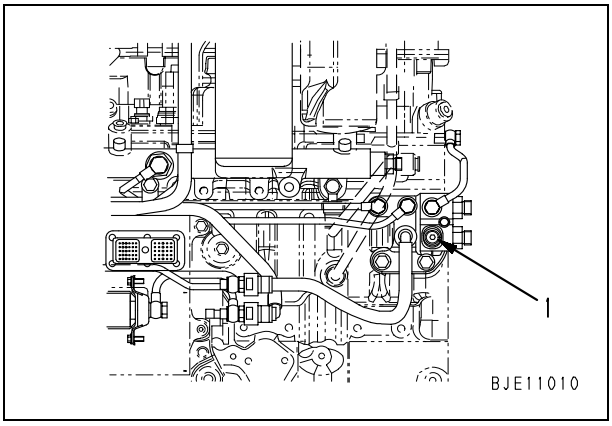
Symbol		Part No.	Part name
G	1	799-101-5002	Hydraulic tester
		790-261-1204	Digital hydraulic tester
	2	6732-81-3170	Adapter (10 x 1.0 mm → PT1/8)
		6215-81-9710	O-ring
	3	799-401-2320	Gauge: 1 MPa {10 kg/cm^2}
	4	795-790-6210	M10 computer check fitting
	5	795-790-1500	Fuel vacuum gauge
		799-201-1201	

★ Test only the fuel pressure in the negative pressure circuits from the fuel supply connector and feed pump and in the low-pressure circuit from the feed pump through the fuel main filter and supply pump.

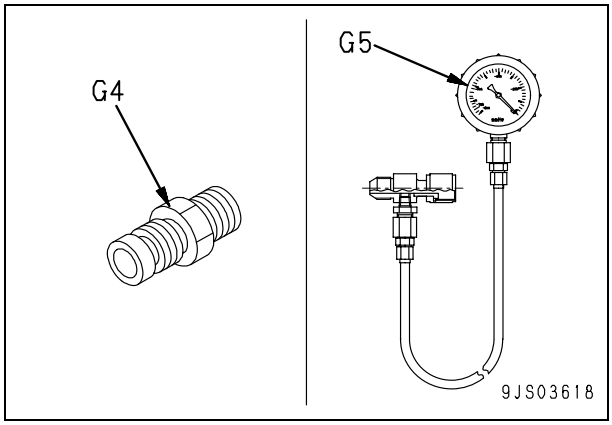
⚠ **Since the pressure in the high-pressure circuit from the fuel supply pump through the common rail to the injector is very high, it cannot be measured.**

1. Testing fuel negative pressure circuit pressure (fuel supply connector)

1) Remove fuel pressure pickup plug (1) from the fuel supply connector.



2) Connect M10 computer check fitting **G4** to fuel vacuum gauge **G5**.

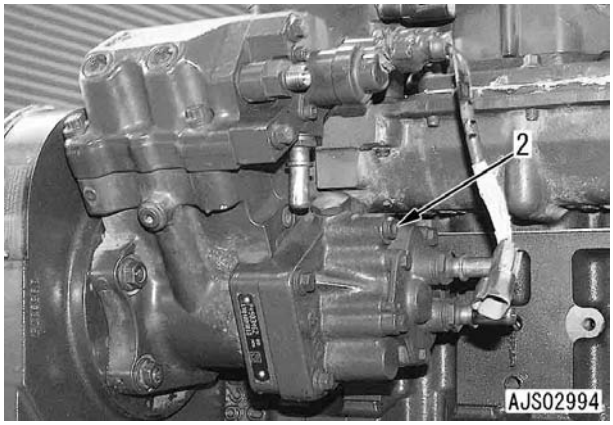


3) Run the engine at high idle and test the fuel negative pressure circuit pressure.
   ★ If the fuel negative pressure circuit pressure is in the following range, it is normal.
   - Standard value of fuel negative pressure circuit pressure (fuel supply connector):
     Max. 27.1 kPa {Max. 203 mmHg}

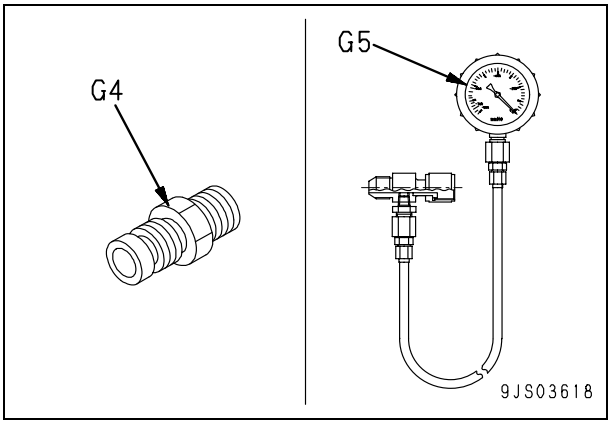
4) After finishing testing, remove the testing tools and return the removed parts.
   Fuel pressure pickup plug:
   20 – 22 Nm {2.0 – 2.2 kgm}

2. Testing fuel negative pressure circuit pressure (supply pump)

1) Remove fuel pressure pickup plug (2) from the supply pump.



2) Connect M10 computer check fitting **G4** to fuel vacuum gauge **G5**.

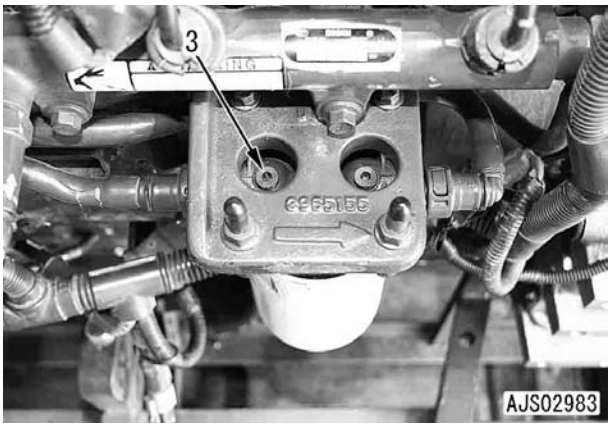


3) Run the engine at high idle and test the fuel negative pressure circuit pressure.
   ★ If the fuel negative pressure circuit pressure is in the following range, it is normal.
   ● Standard value of fuel negative pressure circuit pressure (supply pump):
   Max. 33.9 kPa {Max. 254 mmHg}

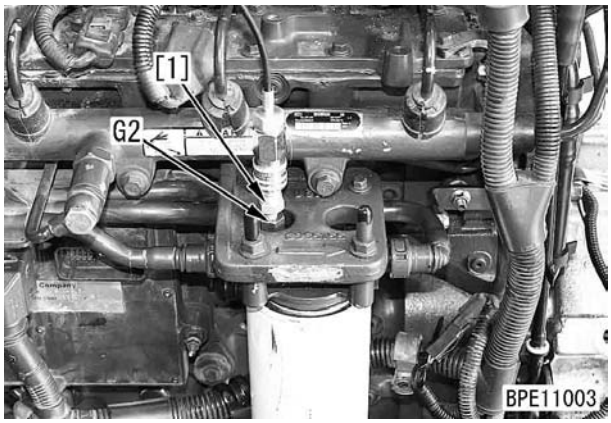
4) After finishing testing, remove the testing tools and return the removed parts.
   Fuel pressure pickup plug:
   20 – 22 Nm {2.0 – 2.2 kgm}

3. Testing fuel low-pressure circuit pressure (fuel filter inlet side)

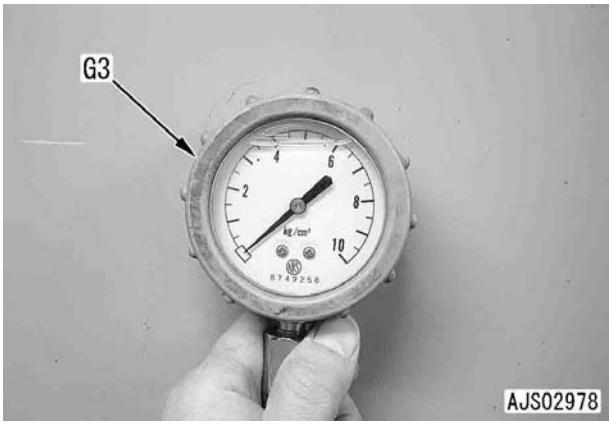
1) Remove fuel pressure pickup plug (3) from the fuel main filter inlet side.



2) Install adapter **G2** and nipple [1] of hydraulic tester **G1** and connect it to gauge **G3**.



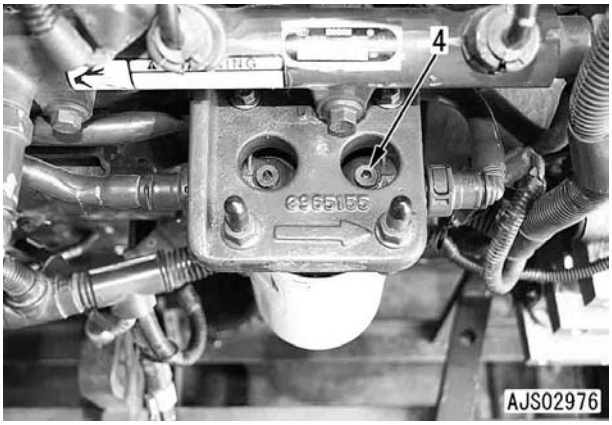
3) Measure fuel low-pressure circuit pressure when cranking the engine.
   ★ If the fuel low-pressure circuit pressure (at the fuel filter inlet side) is in the following range, it is normal.
   ● Standard value of fuel low-pressure circuit pressure (fuel filter inlet side):
   Min. 0.14 MPa {Min. 1.4 kg/cm^2}
   ⚠ **To protect the starting motor, do not continuously crank the engine more than 30 seconds.**



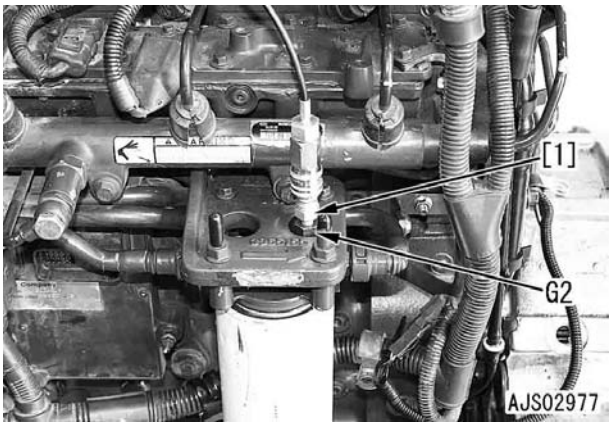
4) After finishing testing, remove the testing tools and return the removed parts.
   Fuel pressure pickup plug:
   20 – 22 Nm {2.0 – 2.2 kgm}

4. Testing fuel low-pressure circuit pressure (fuel filter outlet side)

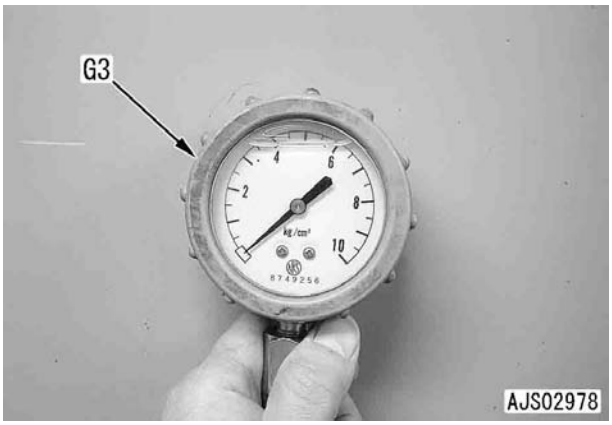
1) Remove fuel pressure pickup plug (4) from the fuel main filter outlet side.



2) Install adapter **G2** and nipple [1] of hydraulic tester **G1** and connect it to gauge **G3**.



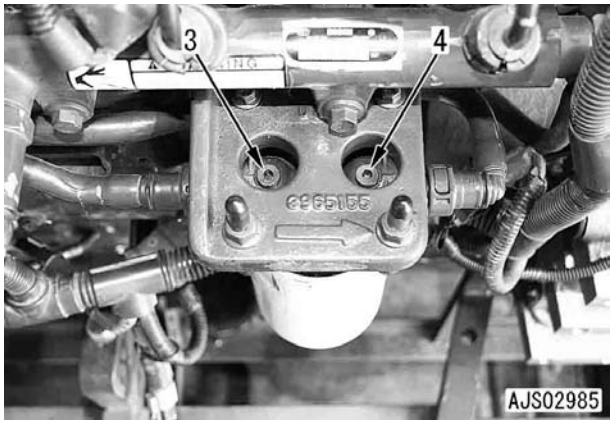
3) Run the engine at high idle and measure the fuel low-pressure circuit pressure.
   - ★ If the fuel low-pressure circuit pressure (at the fuel filter outlet side) is in the following range, it is normal.
   - ● Standard value of fuel low-pressure circuit pressure (fuel filter outlet side):
     Min. 0.48 MPa {Min. 4.9 kg/cm^2}



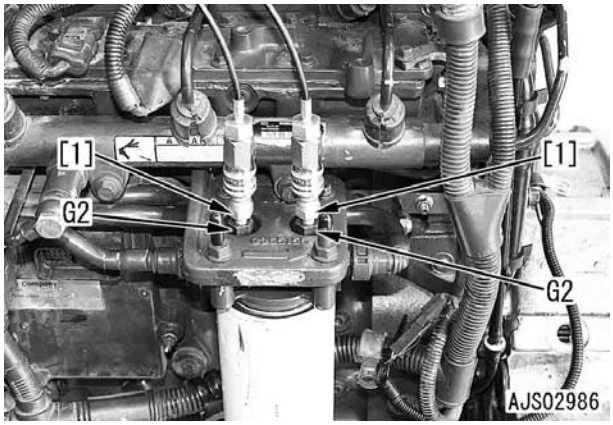
4) After finishing testing, remove the testing tools and return the removed parts.
   Fuel pressure pickup plug:
   20 – 22 Nm {2.0 – 2.2 kgm}

5. Testing difference of pressure in front and rear part of fuel filter

1) Remove fuel pressure pickup plug (3) from the fuel main filter inlet side and fuel pressure pickup plug (4) from the outlet side.

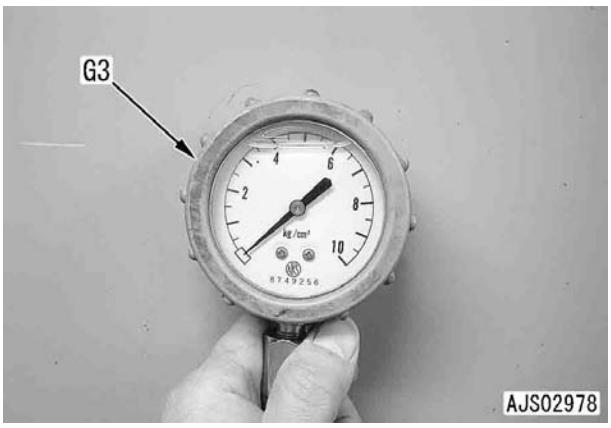


2) Install adapter **G2** and nipple [1] of hydraulic tester **G1** and connect it to gauge **G3**.



3) Run the engine at high idle and measure the difference of pressure in front and rear part of fuel filter.
   - ● Drop of fuel low-pressure circuit pressure =
     Fuel filter inlet pressure – Fuel filter outlet pressure
   - ★ If the drop of fuel low-pressure circuit pressure is in the following range, it is normal.
   - ● Standard value of drop of fuel low-pressure circuit pressure:
     Max. 0.14 MPa {Max. 1.4 kg/cm^2}

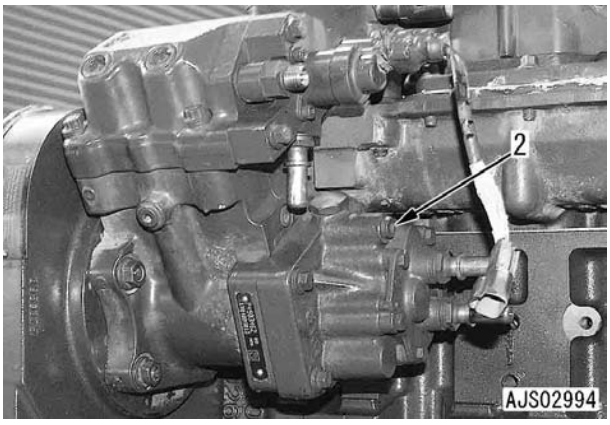
★ If the drop exceeds the standard value, clogging of the fuel filter is suspected.



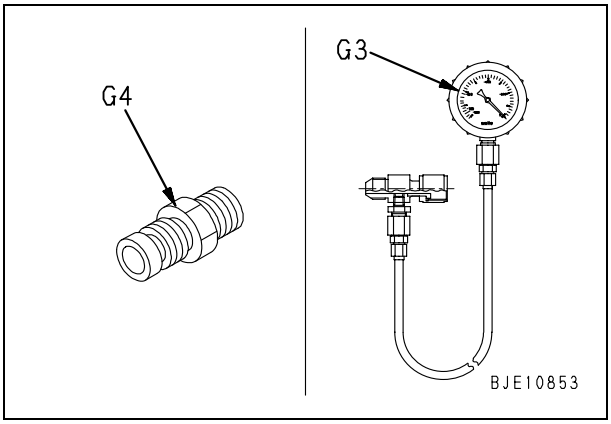
4) After finishing testing, remove the testing tools and return the removed parts.
Fuel pressure pickup plug:
20 – 22 Nm {2.0 – 2.2 kgm}

6. Testing fuel lift pump outlet pressure (supply pump section)

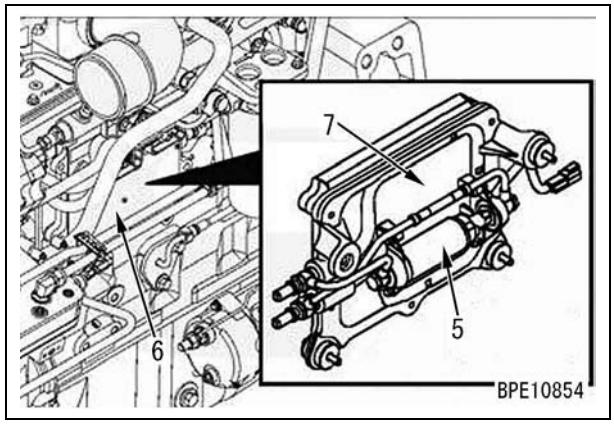
1) Remove fuel pressure pickup plug (2) of the supply pump.



2) Connect M10 computer check fitting **G4** to gauge **G3**.



3) Turn the starting switch ON, operate fuel lift pump (5), and measure the fuel lift pump outlet pressure.
Reference: Fuel lift pump (5) is installed to cooling plate (7) on the back side of engine controller (6).

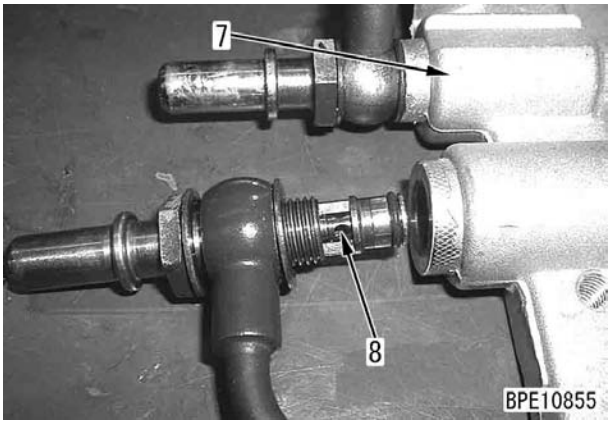


★ The fuel lift pump operates for 30 seconds after the starting switch is turned ON and then stops. Measure the pressure while the pump is operating.

★ If the fuel lift pump outlet pressure is in the following standard range, it is normal.
- Standard fuel lift pump outlet pressure (supply pump section):
Min. 34 kPa {0.35 kg/cm^2}

★ If the fuel lift pump outlet pressure is not in the standard range, perform the following checks.
- Check that fuel is in the fuel lift pump.
- If fuel is not in the fuel lift pump just after the fuel filter is replaced or a fuel system part is removed and returned, operate the fuel lift pump 3 – 4 times with the starting switch to bleed air from the fuel circuit and fill the pump with fuel and then measure the outlet pressure again.

- If the fuel lift pump outlet pressure is not in the standard range while fuel is in the fuel lift pump, remove check valve (8) of engine controller cooling plate (7) and check to see if the valve is seized.



4) After finishing measurement, remove the measuring instruments and return the removed parts.
   Fuel pressure pickup plug:
   20 – 22 Nm {2.0 – 2.2 kgm}

Reduced cylinder mode operation

★ Reduced cylinder mode operation means to run the engine with the fuel injectors of 1 or more cylinders disabled electrically to reduce the number of effective cylinders. The purposes and effects of this operation are as follows.

1. This operation is used to find out a cylinder which does not output power normally (or, combustion in it is abnormal).
2. When a cylinder is selected for the reduced cylinder mode operation, if the engine speed and output do not change from the normal operation (all-cylinder operation), that cylinder has 1 or more defects.
   The possible defects are as follows.
   - Leakage of compression through cylinder head gasket
   - Defective injection
   - Defective piston, piston ring, and cylinder liner
   - Defective valve mechanism (Moving valve system)
   - Defect in electrical system
3. Since the common rail fuel injection system controls the injector of each cylinder electronically, the operator can perform the reduced cylinder mode operation easily with switches to find out a defective cylinder.
   ★ Perform the reduced cylinder mode operation with the engine mounted on the machine or connected to INSITE (troubleshooting kit).
   Before performing, see Testing method in the shop manual for the machine or INSITE (troubleshooting kit).

No-injection cranking

★ No-injection cranking means to crank the engine with the starting motor while all the injections are stopped electrically. The purpose and effect of this operation are as follows.
Before the engine is started after it or the engine has been stored for a long period, the no-injection cranking is performed to lubricate the engine parts and protect them from seizure.

★ Perform the no-injection cranking mode operation with the engine mounted on the machine or connected to INSITE (troubleshooting kit).
Before performing, see Testing method in the shop manual for the machine or INSITE (troubleshooting kit).

Testing leakage from pressure limiter and return rate from injector

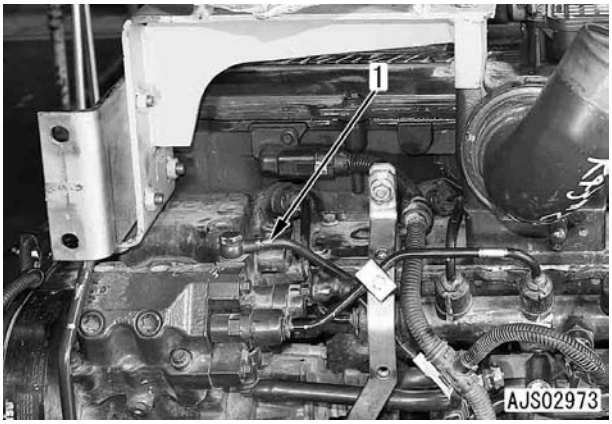
★ Testing tools for leakage from pressure limiter and return rate from injector

Symbol		Part No.	Part name
H	1	795-790-4800	Hose kit
	2	795-790-6700	Adapter
	3	Commercially available	Measuring cylinder

⚠ **Stop the machine on level ground and make the work equipment touch down on the ground.**

1. Testing supply pump return rate

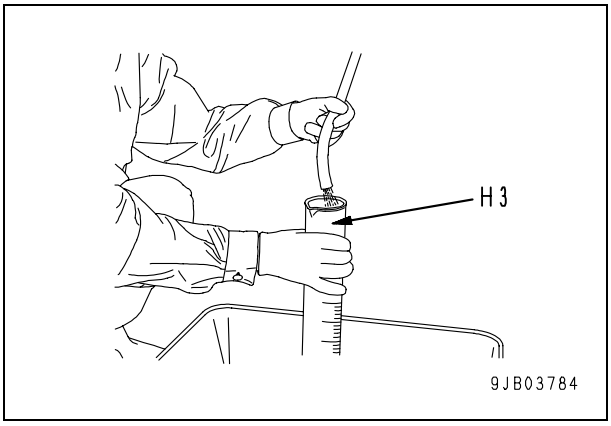
1) Disconnect return tube (1) of the supply pump.



2) Connect hose kit **H1** to the supply pump side, and insert its tip into measuring cylinder **H3**.
3) Connect adapter **H2** to the fuel return connector side to block fuel leakage.
4) Connect INSITE (troubleshooting kit) to the engine and set it so that it can check the engine speed.
5) When the engine can be started, set “High Pressure Leak Test” by INSITE (troubleshooting kit).
   ★ By making setting as above, the fuel high-pressure line at low idle is set to 150 MPa {1,500 kg/cm^2}.
6) Run the engine at low idle and test the return rate from the supply pump.
   ★ If the return rate from the supply pump is in the following range, it is normal.

Cranking	Max. 200 cc/30 sec.
Low idle	Max. 300 cc/30 sec.

⚠ **When the engine cannot run, you may test it by cranking the engine with the starting motor. To protect the starting motor, do not continuously crank the engine 30 seconds or more.**

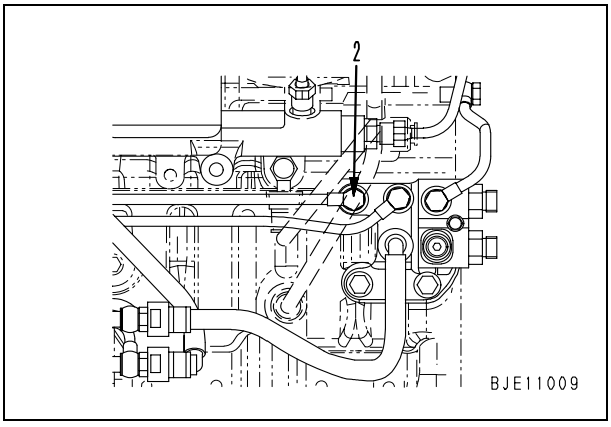


7) After finishing testing, remove the testing tools and return the removed parts.
   Joint bolt (M14):
   36 ± 5 Nm {3.67 ± 0.51 kgm}

2. Testing leakage from pressure limiter

★ If error code [449], [CA449] or [2311], [CA2311] is indicated, carry out troubleshooting for it first.

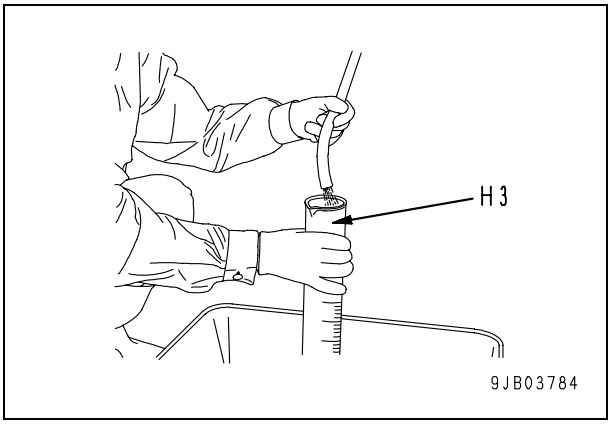
1) Remove return tube joint bolt (2) of the pressure limiter.



2) Connect hose kit **H1** to the hole of removed joint bolt (2) and put its end in measuring cylinder **H3**.
3) Connect adapter **H2** to the return tube joint on the cylinder block side to prevent the fuel from leaking.

4) Connect INSITE (troubleshooting kit) to the engine and set it so that it can check the engine speed.
   ★ When testing with the engine mounted on the machine, set the real-time monitor so that you can check the engine speed.
5) Run the engine at low idle and test the return rate from the pressure limiter.
   ★ If the leakage from the pressure limiter is in the following range, it is normal.

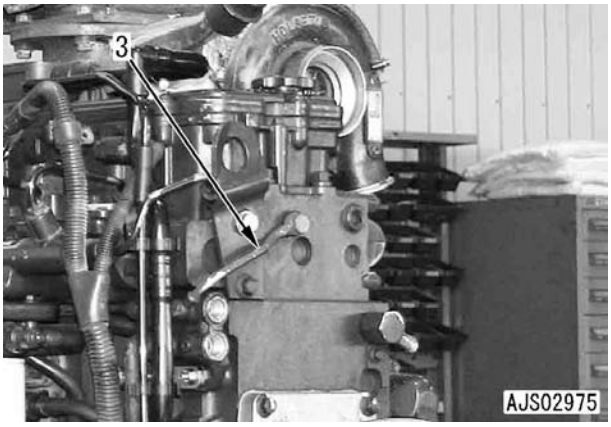
Low idle	Below 30 drops/60 sec.



6) After finishing testing, remove the testing tools and return the removed parts.
   Joint bolt (M12):
   24 ± 4 Nm {2.45 ± 0.41 kgm}

3. Testing return rate from injector

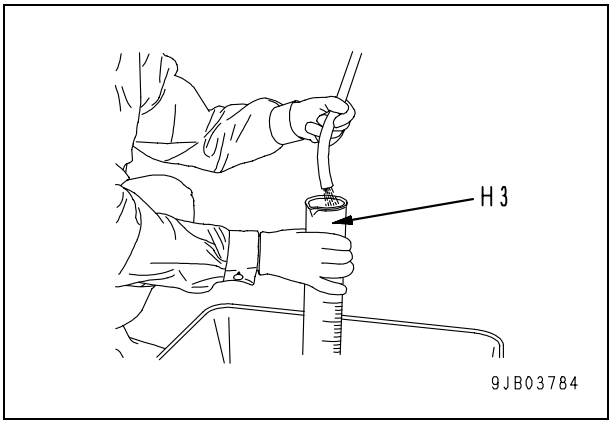
1) Remove return tube (3) of the injector.



2) Connect hose kit **H1** to the cylinder head side, and insert its tip into measuring cylinder **H3**.
3) Connect adapter **H2** to the return tube joint connecting part at the cylinder block side to block fuel leakage.
4) Connect INSITE (troubleshooting kit) to the engine and set it so that it can check the engine speed.
5) When the engine can be started, set “High Pressure Leak Test” by INSITE (troubleshooting kit).
   ★ By making setting as above, the fuel high-pressure line at low idle is set to 150 MPa {1,500 kg/cm^2}.
6) Run the engine at low idle and test the return rate from the injector.
   ★ If the return rate from the injector is in the following range, it is normal.

Cranking	Max. 100 cc/30 sec.
Low idle	Max. 300 cc/45 sec.

⚠ When the engine cannot run, you may test it by cranking the engine with the starting motor. To protect the starting motor, do not continuously crank the engine 30 seconds or more.

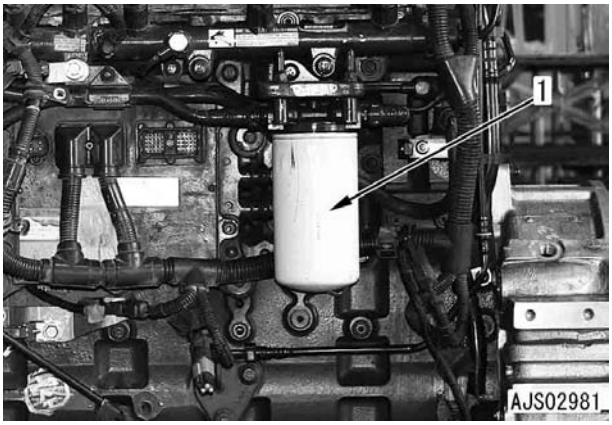


7) After finishing testing, remove the testing tools and return the removed parts.
   Joint bolt (M12):
   24 ± 4 Nm {2.45 ± 0.41 kgm}

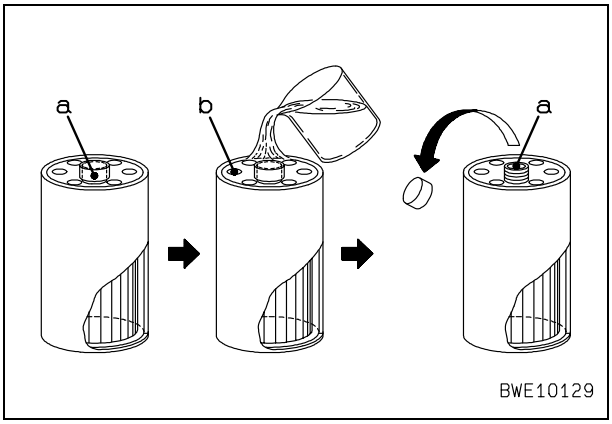
Bleeding air from fuel circuit

★ If fuel is used up or if a fuel circuit part is removed and installed, bleed air from the fuel circuit using the electric priming pump according to the following procedure.

1. If fuel main filter (1) is removed and installed or replaced, install it back without filling fuel into the fuel main filter.



2. Remove fuel pre-filter (on the machine) and fill it with fuel.
   - ★ Fill the fuel filter with clean fuel and take care that dirt will not enter it.
   - ★ Check that the cap is fitted to part (a) (central hole) of the fuel pre-filter, and then add fuel through part (b) (holes around the central hole).
   - ★ After filling the fuel pre-filter with fuel, remove the cap from part (a).
   - ★ If clean fuel is not available, do not remove the fuel pre-filter but fill it with the fuel by operating priming pump.
   - ★ Do not add fuel to fuel main filter (1) from outside.



3. Fill up the fuel tank with fuel.

4. Keep the starting switch at the ON position for 30 seconds and keep it at the OFF position for 10 seconds.

5. Repeat Step 3 above four times.

6. Start the engine with the starting motor.
   - ★ The air in the high-pressure circuit is bled automatically if the engine is cranked.
   - ★ If the engine does not start, there may be still air in the low-pressure circuit. In this case, repeat the above procedure from step 2.
   - ★ Operating the machine with air left in the fuel circuit may cause an fuel system error (449/CA449, 559/CA559). If either error occurs, run the engine at low idle after performing the above steps, and continue engine operation approximately 3 minutes. When air is bled from the fuel circuit, engine speed becomes stable and the error indication disappears.

Testing fuel system for leakage

⚠ **Very high pressure is generated in the high-pressure circuit of the fuel system. If fuel leaks while the engine is running, it is dangerous since it can catch fire.**
After testing the fuel system or removing its parts, test it for fuel leakage according to the following procedure.

★ Clean and degrease the engine and the parts around it in advance so that you can test it easily for fuel leakage.

1. Spray color checker (developer) over the fuel supply pump, common rail, fuel injector, and joints of the high-pressure piping.

2. Run the engine at speed below 1,000 rpm and stop it after its speed is stabilized.

3. Inspect the fuel piping and devices for fuel leakage.
   ★ Check mainly around the high-pressure circuit parts coated with the color checker for fuel leakage.
   ★ If any fuel leakage is detected, repair it and inspect again from step 2.

4. Run the engine at low idle.

5. Inspect the fuel piping and devices for fuel leakage.
   ★ Check mainly around the high-pressure circuit parts coated with the color checker for fuel leakage.
   ★ If any fuel leakage is detected, repair it and inspect again from step 2.

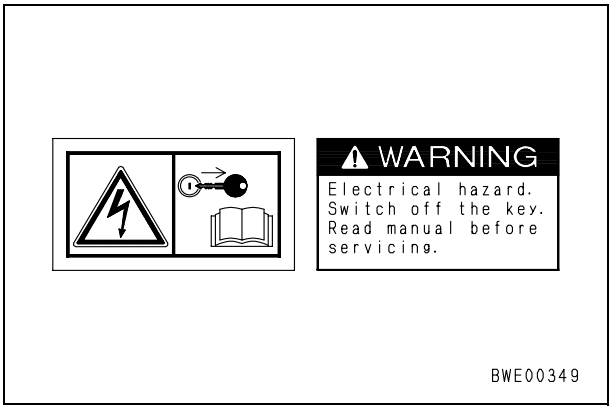
6. Run the engine at high idle.

7. Inspect the fuel piping and devices for fuel leakage.
   ★ Check mainly around the high-pressure circuit parts coated with the color checker for fuel leakage.
   ★ If any fuel leakage is detected, repair it and inspect again from step 2.

8. Run the engine at high idle and load it.
   ★ When checking while the components to be checked are mounted on the machine, stall the torque converter or relieve the hydraulic pump.

9. Inspect the fuel piping and devices for fuel leakage.
   ★ Check mainly around the high-pressure circuit parts coated with the color checker for fuel leakage.
   ★ If any fuel leakage is detected, repair it and inspect again from step 2.
   ★ If no fuel leakage is detected, check is completed.

Handling controller high-voltage circuit



⚠ **The engine controller uses a high-voltage circuit to drive the fuel injector.**
Accordingly, the high-voltage circuit is connected to the wiring harnesses and connectors between the engine controller and injector.

★ Normally, the engine controller keeps outputting the high voltage to the injector only while the engine is running and stops outputting when the engine stops.

⚠ **If you touch the high-voltage circuit directly, you may get an electric shock. To avoid this, observe the following precautions when testing.**

1. The following connectors are used in the high-voltage circuit.
   - Engine controller connector: **J1**
   - Injector intermediate connector:
     INJ CYL 1&2, INJ CYL 3&4, INJ CYL 5&6
   - Injector head terminal (in head cover)

2. When disconnecting or connecting a connector related to the high-voltage circuit, be sure to turn the starting switch OFF.

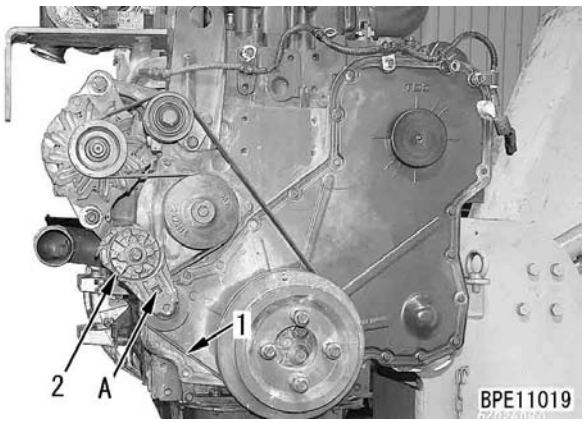
3. If a T-adapter is inserted in or connected to a connector related to the high-voltage circuit for troubleshooting, do not start the engine.
   ★ You may turn the starting switch to the OFF or ON position but must not turn it to the START position.

Replacing alternator belt

★ The auto-tensioner is provided for the alternator belt. Thus, testing and adjustment of the belt is usually no necessary.

★ Disconnect air conditioner compressor belt before replacing the alternator belt.

1. Insert a wrench to the portion (A) (width across flats □ 12.7 mm) of the tensioner assembly (2), and rotate it to the opposite to the winding-up direction to decrease the alternator belt (1) tension.
   ⚠ **Make sure that the wrench is secured at the portion (A) before rotating it. (The spring of the tensioner assembly (2) is strong. If the wrench is loosely inserted, the wrench may accidentally come off while being rotated and it is extremely dangerous.)**
   ⚠ **After removing the alternator belt (1), return the tensioner assembly (2) slowly with care.**
   ⚠ **Be careful not to get your fingers caught between the pulley and alternator belt (1) during work.**



2. Replace the alternator belt (1).
   - Check each pulley for breakage and crack.

KOMATSU 114E-3 Series Diesel engine

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ENGINE

114E-3 Series

40 Troubleshooting

General information on troubleshooting

General information on troubleshooting 2
Points on troubleshooting 2
Error and failure code table 3
Information in troubleshooting table 6

General information on troubleshooting

Points on troubleshooting

- ⚠ **Stop the machine in a level place, and check that the safety pin, blocks, and parking brake are securely fitted.**
- ⚠ **When carrying out the operation with 2 or more workers, keep strictly to the agreed signals, and do not allow any unauthorized person to come near.**
- ⚠ **If the radiator cap is removed when the engine is hot, hot coolant may spurt out and cause burns, so wait for the engine to cool down before starting troubleshooting.**
- ⚠ **Be extremely careful not to touch any hot parts or to get caught in any rotating parts.**
- ⚠ **When disconnecting wiring, always disconnect the negative (–) terminal of the battery first.**
- ⚠ **When removing the plug or cap from a location which is under pressure from oil, water, or air, always release the internal pressure first. When installing measuring equipment, be sure to connect it properly.**

The aim of troubleshooting is to pinpoint the basic cause of the failure, to carry out repairs swiftly, and to prevent reoccurrence of the failure. When carrying out troubleshooting, and important point is of course to understand the structure and function. However, a short cut to effective troubleshooting is to ask the operator various questions to form some idea of possible causes of the failure that would produce the reported symptoms.

1. **Do not rush at disassembling the machine even if a failure occurs.**
   Otherwise,
   - Parts that have no connection with the failure or other unnecessary parts will be disassembled.
   - It will become impossible to find the cause of the failure.

   It will also cause a waste of manhours, parts, or oil or grease, and at the same time, will also lose the confidence of the user or operator. For this reason, when carrying out troubleshooting, it is necessary to carry out thorough prior investigation and to carry out troubleshooting in accordance with the fixed procedure.
2. **Questions to users and operators**
   1) Have any other problems occurred apart from the problem that has been reported?
   2) Was there anything strange about the machine before the failure occurred?
   3) Did the failure occur suddenly, or were there problems with the machine condition before this?
   4) Under what conditions did the failure occur?
   5) Had any repairs been carried out before the failure? When were these repairs carried out?
   6) Has the same kind of failure occurred before?
3. **Inspections before troubleshooting**
   1) Is there any sign of irregularities of the machine?
   2) Make checks before starting day's work.
   3) Make checks of other items.
   4) Check other maintenance items which can be visually checked and are considered necessary.
4. **Confirmation of failure**
   Confirm the degree of failure on your own to verify if it is a real failure and the machine is handled or operated improperly.
   ★ When operating the machine to reenact the troubleshooting symptoms, do not carry out any investigation or measurement that may make the problem worse.
5. **Troubleshooting**
   Pinpoint high possibility causes according to the results of examinations and inspections of items 2 to 4, and find the failure location based on the troubleshooting table or troubleshooting flow (chart).
   ★ The basic procedure for troubleshooting is as follows.
      1] Start from the simple points.
      2] Start from the most likely points.
      3] Investigate other related parts or information.
6. **Radical countermeasures against failure cause**
   Even if the immediate problem is removed, a similar failure will reoccur unless its root cause is removed. To prevent reoccurrence, examine the reason of the failure cause occurrence and remove the root cause.

Error and failure code table

INSITE error code	Machine failure code	Failure phenomenon	Reference document No.
111	CA111	Engine Controller Internal Failure	Troubleshooting of electrical system (E-mode), Part 1 SEN00459-01
115	CA115	Eng. Ne and Bkup Speed Sensor Error	
122	CA122	Charge Air Press Sensor High Error	
123	CA123	Charge Air Press Sensor Low Error	
131	CA131	Throttle Sensor High Error	
132	CA132	Throttle Sensor Low Error	
144	CA144	Coolant Temp. Sensor High Error	
145	CA145	Coolant Temp. Sensor Low Error	
153	CA153	Charge Air Temp. Sensor High Error	
154	CA154	Charge Air Temp. Sensor Low Error	
155	CA155	Charge Air Press. High Speed Derate	
187	CA187	Sensor Sup. 2 Volt. Low Error	
221	CA221	Ambient Air Press. Sensor High Error	
222	CA222	Ambient Air Press. Sensor Low Error	
227	CA227	Abnormally high level in sensor power supply 2 circuit	
234	CA234	Eng. Overspeed	
238	CA238	Ne Speed Sensor Sup. Volt. Error	
271	CA271	IMV (IMA) Short Error	
272	CA272	IMV (IMA) Open Error	
281	CA281	High pressure pump error	
322	CA322	Injector No. 1 System Open/Short Error	
323	CA323	Injector No. 5 System Open/Short Error	
324	CA324	Injector No. 3 System Open/Short Error	
325	CA325	Injector No. 6 System Open/Short Error	
331	CA331	Injector No. 2 System Open/Short Error	
332	CA332	Injector No. 4 System Open/Short Error	
342	CA342	Engine Controller Data Matching Error	
351	CA351	INJ. Drive Circuit Error	Troubleshooting of electrical system (E-mode), Part 2 SEN00460-01
352	CA352	Sensor Sup. 1 Volt. Low Error	
386	CA386	Sensor Sup. 1 Volt. High Error	
428	CA428	Water Sensor High Level Error	
429	CA429	Water Sensor Low Level Error	
431	CA431	Idle Validation Switch Error	
432	CA432	Idle Validation Process Error	
435	CA435	Eng. Oil Switch Error	
441	CA441	Supply Voltage Low Error	
442	CA442	Supply Voltage High Error	
449	CA449	Rail Press. High Error 2	
451	CA451	Rail Press. Sensor High Error	
452	CA452	Rail Press. Sensor Low Error	
488	CA488	Charge Air Temp. High Torque Derate	
553	CA553	Rail Press. High Error 1	

INSITE error code	Machine failure code	Failure phenomenon	Reference document No.
559	CA559	Rail Press Low Error	Troubleshooting of electrical system (E-mode), Part 2 SEN00460-01
689	CA689	Eng. Ne Speed Sensor Error	
731	CA731	Eng. Bkup Speed Sensor Phase Error	
757	CA757	All Engine Controller Data Lost Error	
778	CA778	Eng. Bkup Speed Sensor Error	
1633	CA1633	KOMNET Error	
2185	CA2185	Throttle Sens. Sup. Volt. High Error	
2186	CA2186	Throttle Sens. Sup. Volt. Low Error	
2249	CA2249	Rail Press very Low Error	
2265	CA2265	Abnormally high level in electric lift pump	
2266	CA2266	Abnormally low level in electric lift pump	
2311	CA2311	IMV (IMA) Solenoid Error	
2555	CA2555	Intake Air Heater Relay Supply Voltage Low Error	
2556	CA2556	Intake Air Heater Relay Supply Voltage High Error	
—	B@BAZG	Eng. Oil Press. Low Speed Derate	
—	B@BAZG	Eng. Oil Press Low Torque Derate	
—	B@BCNS	Eng. Overheat	

★ Error code of INSITE:
3- or 4-digit error code displayed on INSITE when a failure occurrence condition is confirmed using INSITE.

★ Machine failure code:
An error code of 5 or 6 digits displayed on the machine monitor when the occurrence condition of the failure is confirmed with the machine monitor, etc. on the machine side.

Information in troubleshooting table

★ The following information is summarized in the troubleshooting table and the related electrical circuit diagram. Before carrying out troubleshooting, understand that information fully.

Error code	Failure code	Trouble	
Display on INSITE	**Display on applicable machine**	Trouble	**Problem that appears on engine**
Contents of trouble	**Contents of trouble detected by engine controller**		
Action of controller	**Action taken by engine controller to protect system or devices when engine controller detects trouble**		
Problem that appears on machine	**Problem that appears on engine as result of action taken by engine controller (shown above)**		
Related information	**Information related to detected trouble or troubleshooting**		

	Causes		Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	1 2 3 4	Possible causes of trouble (Given numbers are reference numbers, which do not indicate priority)	**<Contents of description>** **• Standard value in normal state to judge possible causes** **• Remarks on judgment** **<Troubles in wiring harness>** **• Disconnection** **Connector is connected imperfectly or wiring harness is broken.** **• Ground fault** **Wiring harness which is not connected to chassis ground circuit is in contact with chassis ground circuit.** **• Hot short** **Wiring harness which is not connected to power source (24 V) circuit is in contact with power source (24 V) circuit.** **• Short circuit** **Independent wiring harnesses are in contact with each other abnormally.** **<Precautions for troubleshooting>** **(1) Method of indicating connector No. and handling of T-adapter** **Insert or connect T-adapter as explained below for troubleshooting, unless otherwise specified.** **• If connector No. has no marks of “male” and “female”, disconnect connector and insert T-adapters in both male side and female side.** **• If connector No. has marks of “male” and “female”, disconnect connector and connect T-adapter to only male side or female side.** **(2) Entry order of pin Nos. and handling of tester leads** **Connect positive (+) lead and negative (–) lead of tester as explained below for troubleshooting, unless otherwise specified.** **• Connect positive (+) lead to pin No. or wiring harness entered on front side.** **• Connect negative (–) lead to pin No. or wiring harness entered on rear side.**

Related circuit diagram

This drawing is a part of the electric circuit diagram related to troubleshooting.
• Connector No.: Indicates (Model – Number of pins) and (Color).

KOMATSU 114E-3 Series Diesel engine

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ENGINE

114E-3 Series

40 Troubleshooting

Troubleshooting of electrical system (E-mode), Part 1

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Troubleshooting of electrical system (E-mode), Part 1

E-1 Code [111/CA111] Engine Controller Internal Failure

Error code	Failure code	Trouble	Abnormality in engine Controller
111	**CA111**		
Contents of trouble	• Abnormality occurred in memory of engine controller or power supply circuit.		
Action of controller	• None in particular.		
Problem that appears on machine	• Engine stops during operations and engine cannot be started.		
Related information			

Possible causes and standard value in normal state	Causes		Standard value in normal state/Remarks on troubleshooting
	1	Defective engine controller	Carry out troubleshooting for failure code [CA757].

E-2 Code [115/CA115] Eng. Ne and Bkup Speed Sensor Error

Error code	Failure code	Trouble	Abnormality in engine Ne, Bkup speed sensor
115	**CA115**		
Contents of trouble	• Abnormality occurred in signals of engine Ne speed sensor and engine Bkup speed sensor circuit.		
Action of controller			
Problem that appears on machine	• Engine stops • Engine does not start		
Related information	• Method of reproducing failure code: Start engine.		

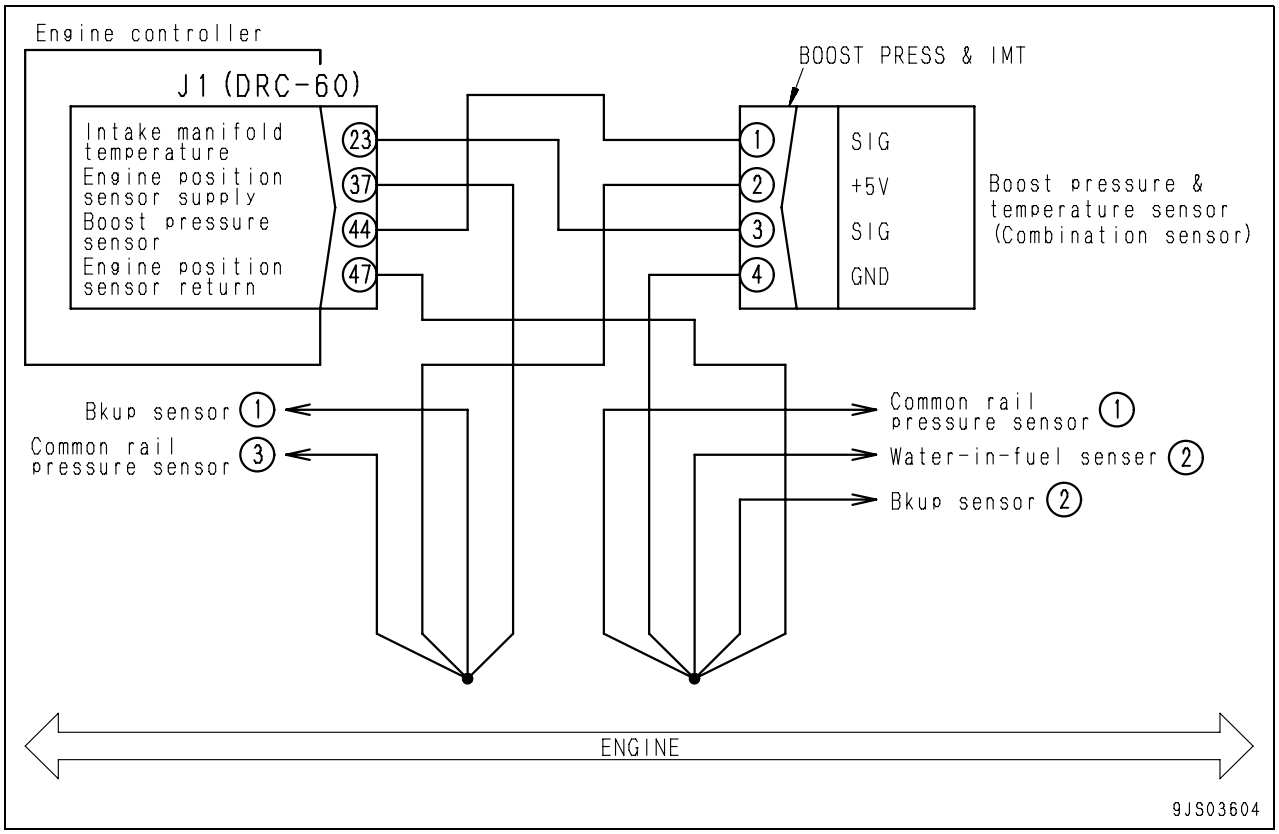
Possible causes and standard value in normal state	Causes		Standard value in normal state/Remarks on troubleshooting
	1	Defective connection of sensor connector	Check Ne speed sensor and Bkup speed sensor directory for defective connection (wrong connection).

E-3 Code [122/CA122] Charge Air Press Sensor High Error

Error code	Failure code	Trouble	Abnormally high level in charge pressure sensor
122	**CA122**		
Contents of trouble	• High voltage is detected in pressure signal circuit of boost pressure sensor and temperature sensor.		
Action of controller	• Fixes charge pressure (101 kPa {1.03 kg/cm^2}) and continues operation.		
Problem that appears on machine	• Engine output drops.		
Related information	• Method of reproducing failure code: Starting switch ON.		

	Causes		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective sensor power supply 2 system	If failure code [**CA227**] is indicated simultaneously, carry out troubleshooting for it first.		
	2	Defective [pressure signal circuit] of boost pressure sensor, temperature sensor	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			BOOST PRESS & IMT		Voltage
			Between (1) – (4)	Power supply	4.75 – 5.25 V
			Voltage is measured with wiring harness connected. Accordingly, if voltage is abnormal, check wiring harness and controller, too, for another cause of trouble, and then judge.		
	3	Hot short (Short circuit with 5 V, 24 V circuit) in wiring harness	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Wiring harness between J1 (female) (44) – BOOST PRESS & IMT (female) (1)	Voltage	Max. 1 V
	4	Short circuit in wiring harness (With another wiring harness)	★ Troubleshoot with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between J1 (female) (44) – BOOST PRESS & IMT (female) (1) and between J1 (female) (37) – BOOST PRESS & IMT (female) (2)	Resistance	Min. 100 kΩ
	5	Defective wiring harness connector	Connecting parts among boost pressure sensor, temperature sensor, engine wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation		
	6	Defective engine controller	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			J1		Voltage
			Between (37) – (47)	Power supply	4.75 – 5.25 V

Circuit diagram related to boost pressure, temperature sensor (combination sensor)

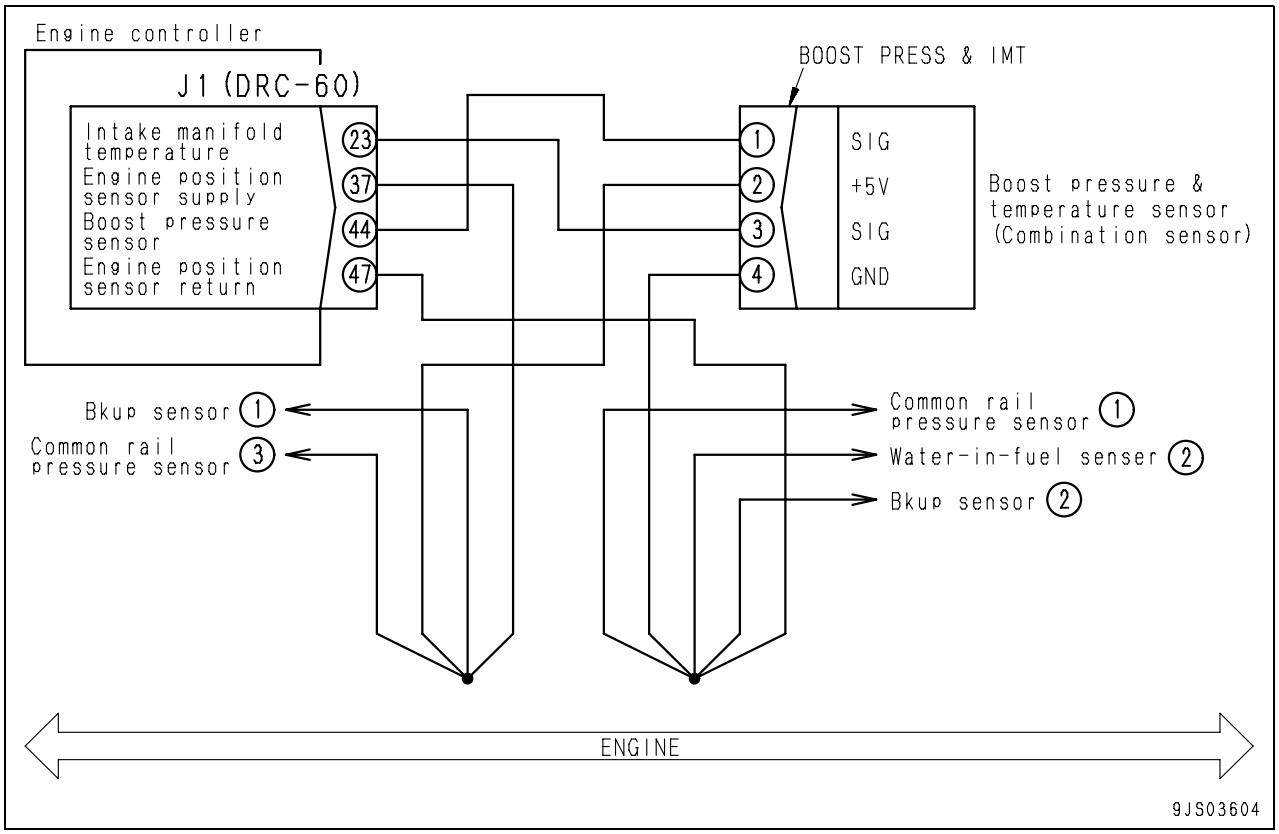


E-4 Code [123/CA123] Charge Air Press Sensor Low Error

Error code	Failure code	Trouble	Abnormally low level in charge pressure sensor
123	**CA123**		
Contents of trouble	• Low voltage is detected in pressure signal circuit of boost pressure sensor and temperature sensor.		
Action of controller	• Fixes charge pressure (101 kPa {1.03 kg/cm^2}) and continues operation.		
Problem that appears on machine	• Engine output drops.		
Related information	• Method of reproducing failure code: Starting switch ON.		

	Causes		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective sensor power supply 2 system	If failure code [**CA187**] is indicated simultaneously, carry out troubleshooting for it first.		
	2	Defective [pressure signal circuit] of boost pressure sensor, temperature sensor	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			BOOST PRESS & IMT		Voltage
			Between (1) – (4)	Power supply	4.75 – 5.25 V
			Voltage is measured with wiring harness connected. Accordingly, if voltage is abnormal, check wiring harness and controller, too, for another cause of trouble, and then judge.		
	3	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between J1 (female) (44) – BOOST PRESS & IMT (female) (1)	Resistance	Min. 100 kΩ
	4	Short circuit in wiring harness (With another wiring harness)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between J1 (female) (44) – BOOST PRESS & IMT (female) (1) and between J1 (female) (47) – BOOST PRESS & IMT (female) (4)	Resistance	Min. 100 kΩ
	5	Defective wiring harness connector	Connecting parts among boost pressure sensor, temperature sensor, engine wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation		
	6	Defective engine controller	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			J1		Voltage
			Between (37) – (47)	Power supply	4.75 – 5.25 V

Circuit diagram related to boost pressure, temperature sensor (combination sensor)

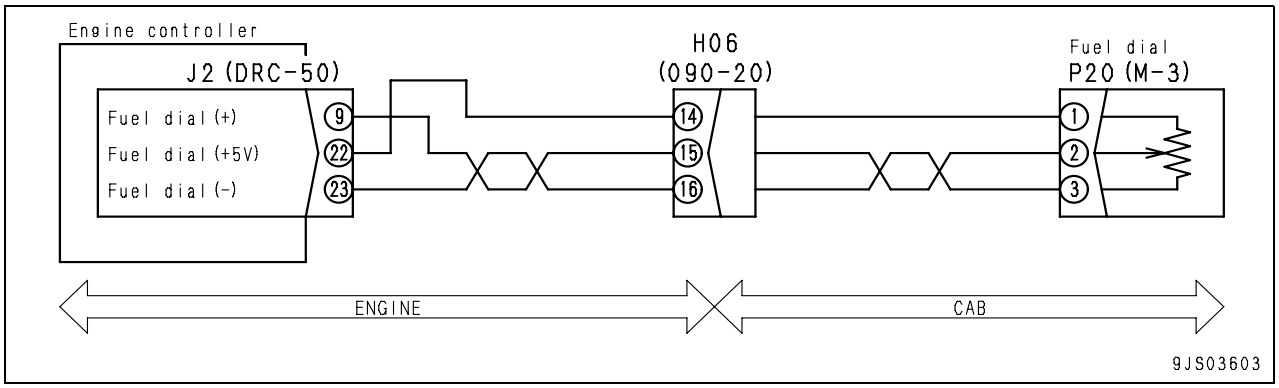


E-5 Code [131/CA131] Throttle Sensor High Error

Error code	Failure code	Trouble	Abnormally high level in throttle sensor power
131	**CA131**		
Contents of trouble	• High voltage is detected in fuel control dial signal circuit.		
Action of controller	• Depends on machine model.		
Problem that appears on machine	• Depends on machine model.		
Related information	• Method of reproducing failure code: Starting switch ON.		

	Causes		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective throttle sensor power supply system	If failure code [**CA2185**] is indicated simultaneously, carry out troubleshooting for it first.		
	2	Defective fuel control dial	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			P20		Voltage
			Between (1) – (3)	Power supply	4.75 – 5.25 V
			Voltage is measured with wiring harness connected. Accordingly, if voltage is abnormal, check wiring harness and controller, too, for another cause of trouble, and then judge.		
	3	Hot short (Short circuit with 5 V, 24 V circuit) in wiring harness	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Wiring harness between J2 (female) (9) – P20 (female) (2)	Voltage	Max. 1 V
	4	Short circuit in wiring harness (With another wiring harness)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between J2 (female) (9) – P20 (female) (2) and between J2 (female) (22) – P20 (female) (1)	Resistance	Min. 100 kΩ
	5	Defective wiring harness connector	Connecting parts among fuel control dial, engine unit wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation		
	6	Defective engine controller	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			J2		Voltage
			Between (22) – (23)	Power supply	4.75 – 5.25 V

Circuit diagram related to fuel control dial

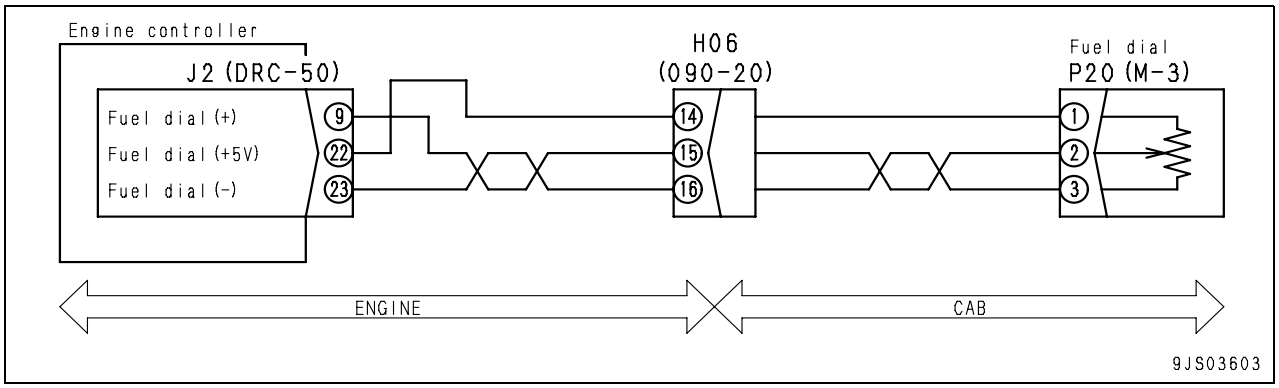


E-6 Code [132/CA132] Throttle Sensor Low Error

Error code	Failure code	Trouble	Abnormally low level in throttle sensor power
132	**CA132**		
Contents of trouble	• Low voltage is detected in fuel control dial signal circuit.		
Action of controller	• Depends on machine model.		
Problem that appears on machine	• Depends on machine model.		
Related information	• Method of reproducing failure code: Starting switch ON.		

	Causes		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective throttle sensor power supply system	If failure code [**CA2186**] is indicated simultaneously, carry out troubleshooting for it first.			
	2	Defective fuel control dial	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			P20		Voltage	
			Between (1) – (3)	Power supply	4.75 – 5.25 V	
			Voltage is measured with wiring harness connected. Accordingly, if voltage is abnormal, check wiring harness and controller, too, for another cause of trouble, and then judge.			
	3	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between J2 (female) (9) – P20 (female) (2)		Resistance	Min. 100 kΩ
	4	Short circuit in wiring harness (With another wiring harness)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between J2 (female) (9) – P20 (female) (2) and between J2 (female) (23) – P20 (female) (3)		Resistance	Min. 100 kΩ
	5	Defective wiring harness connector	Connecting parts among fuel control dial, engine unit wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation			
	6	Defective engine controller	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			J2		Voltage	
			Between (22) – (23)	Power supply	4.75 – 5.25 V	

Circuit diagram related to fuel control dial

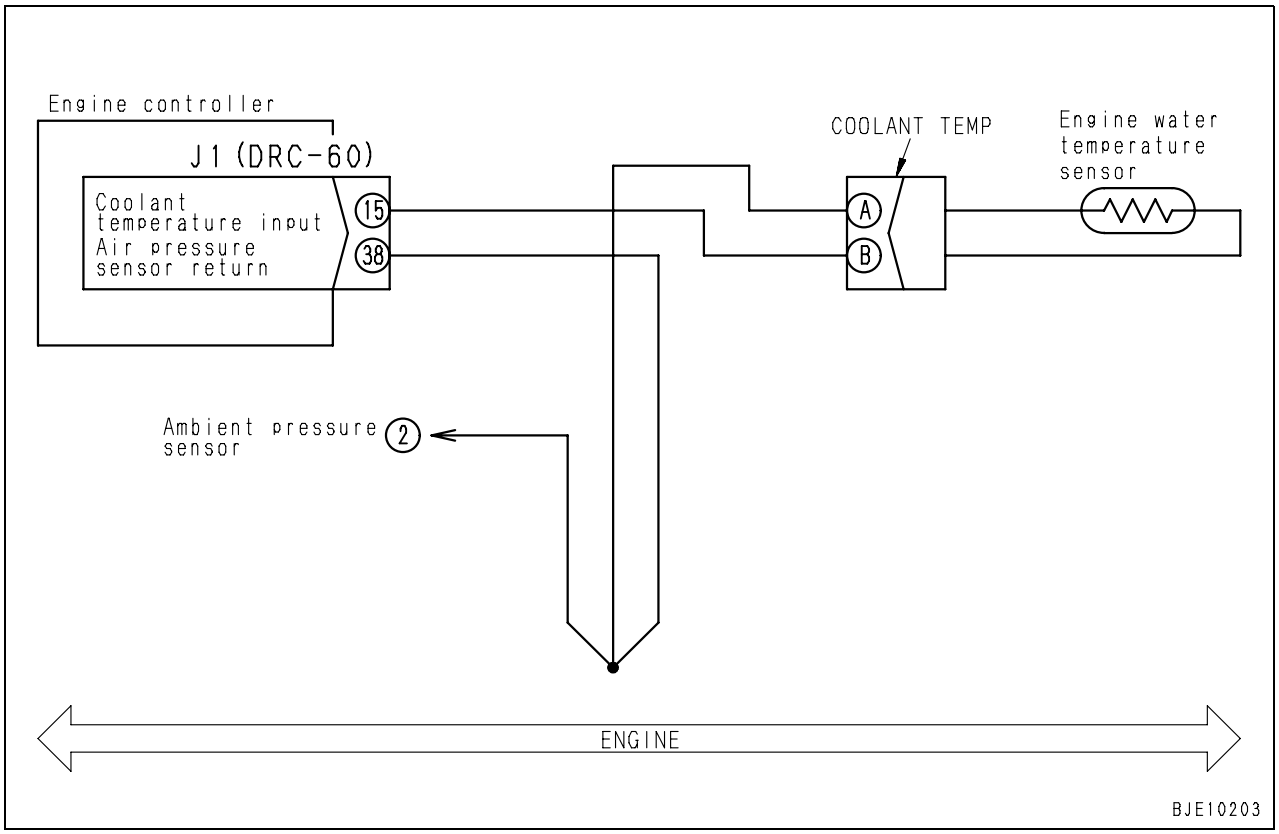


E-7 Code [144/CA144] Coolant Temp. Sensor High Error

Error code	Failure code	Trouble	Abnormally high level in coolant Temperature
144	**CA144**		
Contents of trouble	• High voltage is detected in coolant temperature sensor signal circuit.		
Action of controller	• Fixes coolant temperature and continues operation.		
Problem that appears on machine	• Exhaust smoke is white • Overheat prevention function does not function.		
Related information	• Method of reproducing failure code: Starting switch ON.		

	Causes		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective coolant temperature sensor	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			COOLANT TEMP (male)	Coolant temperature	Resistance	
			Between (A) – (B)	0°C	30 – 37 kΩ	
				25°C	9.3 – 10.7 kΩ	
				50°C	3.2 – 3.8 kΩ	
				80°C	1.0 – 1.3 kΩ	
				95°C	700 – 800 Ω	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between J1 (female) (15) – COOLANT TEMP (female) (B)		Resistance	Max. 10 Ω
			Wiring harness between J1 (female) (38) – COOLANT TEMP (female) (A)		Resistance	Max. 10 Ω
	3	Short circuit in wiring harness (With another wiring harness)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness among all pins between J1 (female) (15) – J1 (female) (With all connectors of wiring harness disconnected)		Resistance	Min. 100 kΩ
	4	Defective wiring harness connector	Connecting parts among coolant temperature sensor, engine wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation			
	5	Defective engine controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			J1 (female)	Coolant temperature	Resistance	
			Between (15) – (38)	0°C	30 – 37 kΩ	
				25°C	9.3 – 10.7 kΩ	
				50°C	3.2 – 3.8 kΩ	
				80°C	1.0 – 1.3 kΩ	
				95°C	700 – 800 Ω	

Circuit diagram related to coolant temperature sensor

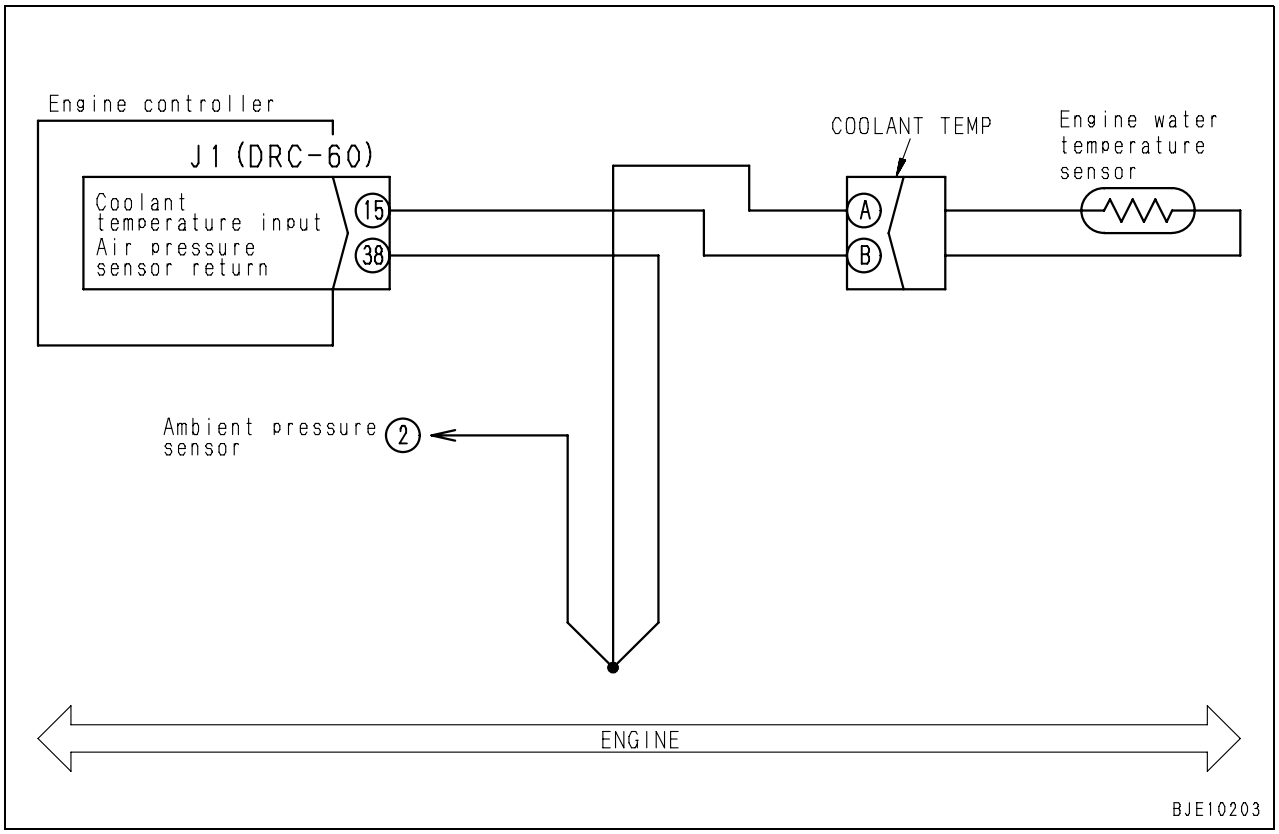


E-8 Code [145/CA145] Coolant Temp. Sensor Low Error

Error code	Failure code	Trouble	Abnormally low level in coolant temperature
145	**CA145**		
Contents of trouble	• Low voltage is detected in coolant temperature sensor signal circuit.		
Action of controller	• Fixes coolant temperature and continues operation.		
Problem that appears on machine	• Exhaust smoke is white • Overheat prevention function does not function.		
Related information	• Method of reproducing failure code: Starting switch ON.		

	Causes		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective coolant temperature sensor	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			COOLANT TEMP (male)	Coolant temperature	Resistance	
			Between (A) – (B)	0°C	30 – 37 kΩ	
				25°C	9.3 – 10.7 kΩ	
				50°C	3.2 – 3.8 kΩ	
				80°C	1.0 – 1.3 kΩ	
				95°C	700 – 800 Ω	
			Between (B) – chassis ground	All range	Min. 100 kΩ	
	2	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between J1 (female) (15) – COOLANT TEMP (female) (B)		Resistance	Min. 100 kΩ
	3	Short circuit in wiring harness (With another wiring harness)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness among all pins between J1 (female) (15) – J1 (female) (With all connectors of wiring harness disconnected)		Resistance	Min. 100 kΩ
	4	Defective wiring harness connector	Connecting parts among coolant temperature sensor, engine wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation			
	5	Defective engine controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			J1 (female)	Coolant temperature	Resistance	
			Between (15) – (38)	0°C	30 – 37 kΩ	
				25°C	9.3 – 10.7 kΩ	
				50°C	3.2 – 3.8 kΩ	
				80°C	1.0 – 1.3 kΩ	
				95°C	700 – 800 Ω	
			Between (15) – chassis ground	All range	Min. 100 kΩ	

Circuit diagram related to coolant temperature sensor

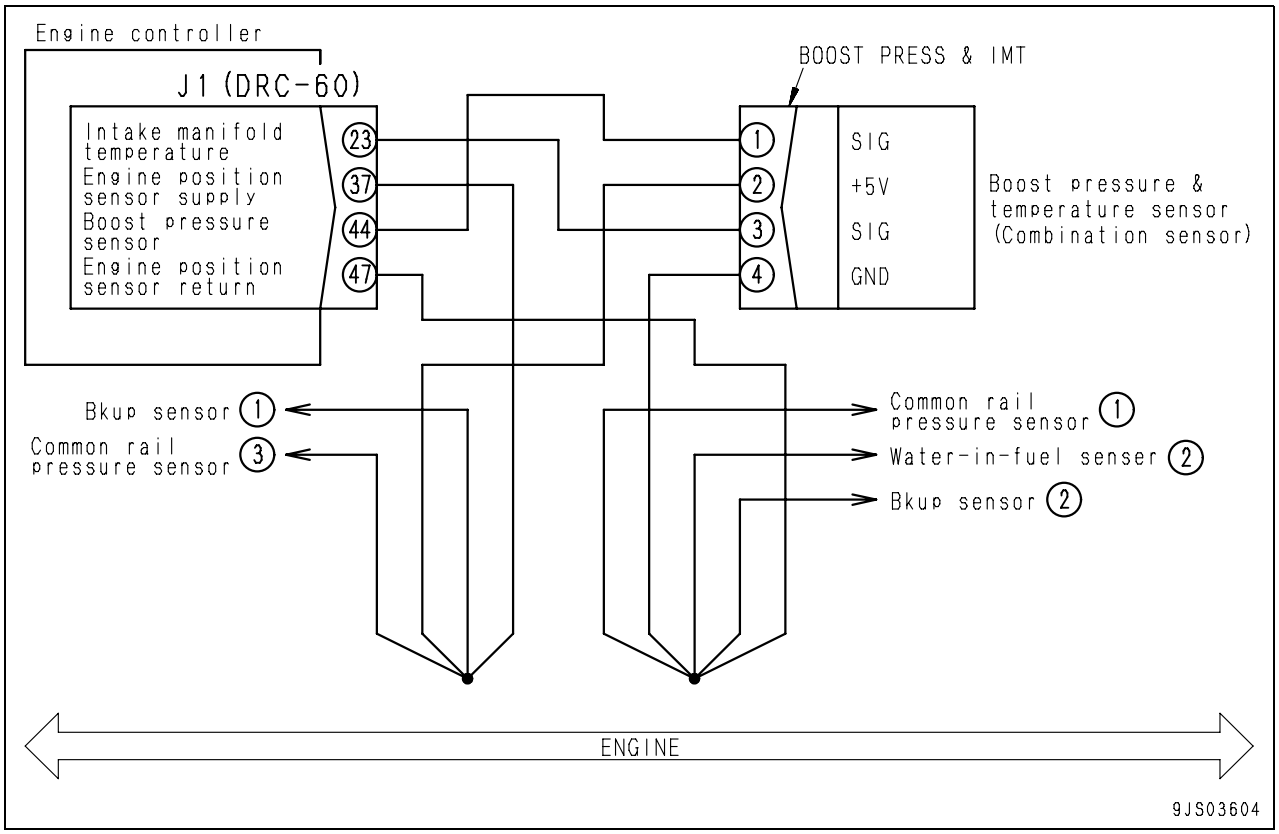


E-9 Code [153/CA153] Charge Air Temp. Sensor High Error

Error code	Failure code	Trouble	Abnormally high level in charge temperature
153	**CA153**		
Contents of trouble	• High voltage is detected in temperature signal circuit of boost pressure sensor and temperature sensor.		
Action of controller	• Fixes charge temperature (46°C) and continues operation.		
Problem that appears on machine	• Exhaust smoke is white • Boost temperature-based engine protection function does not function.		
Related information	• Method of reproducing failure code: Starting switch ON.		

	Causes		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective [temperature signal circuit] of boost pressure sensor, temperature sensor	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			BOOST PRESS & IMT (male)	Charge temperature	Resistance	
			Between (A) – (B)	0°C	29 – 36 kΩ	
				25°C	9 – 11 kΩ	
				40°C	4.9 – 5.8 kΩ	
				100°C	600 – 700 Ω	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between J1 (female) (23) – BOOST PRESS & IMT (female) (3)		Resistance	Max. 10 Ω
			Wiring harness between J1 (female) (47) – BOOST PRESS & IMT (female) (4)		Resistance	Max. 10 Ω
	3	Short circuit in wiring harness (With another wiring harness)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness among all pins between J1 (female) (23) – J1 (female) (With all connectors of wiring harness disconnected)		Resistance	Min. 100 kΩ
	4	Defective wiring harness connector	Connecting parts among boost pressure sensor, temperature sensor, engine wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation			
	5	Defective engine controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			J1 (female)	Charge temperature	Resistance	
			Between (23) – (47)	0°C	29 – 36 kΩ	
				25°C	9 – 11 kΩ	
				40°C	4.9 – 5.8 kΩ	
				100°C	600 – 700 Ω	

Circuit diagram related to boost pressure, temperature sensor (combination sensor)

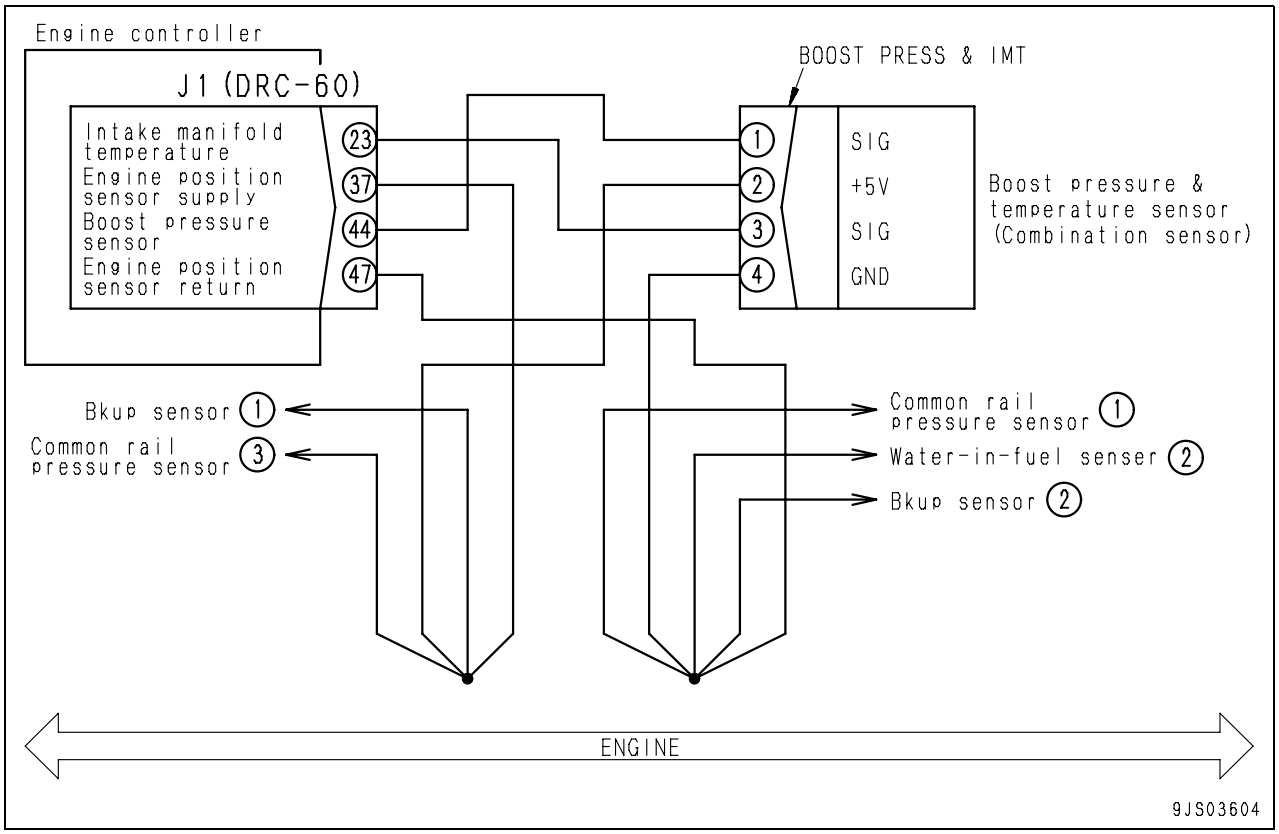


E-10 Code [154/CA154] Charge Air Temp. Sensor Low Error

Error code	Failure code	Trouble	Abnormally low level in charge temperature
154	**CA154**		
Contents of trouble	• Low voltage is detected in temperature signal circuit of boost pressure sensor and temperature sensor.		
Action of controller	• Fixes charge temperature (46°C) and continues operation.		
Problem that appears on machine	• Exhaust smoke is white • Boost temperature-based engine protection function does not function.		
Related information	• Method of reproducing failure code: Starting switch ON.		

	Causes		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective [temperature signal circuit] of boost pressure sensor, temperature sensor	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			BOOST PRESS & IMT (male)	Charge temperature	Resistance	
			Between (A) – (B)	0°C	29 – 36 kΩ	
				25°C	9 – 11 kΩ	
				40°C	4.9 – 5.8 kΩ	
				100°C	600 – 700 Ω	
			Between (3) – chassis ground	All range	Min. 100 kΩ	
	2	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between J1 (female) (23) – BOOST PRESS & IMT (female) (3)		Resistance	Min. 100 kΩ
	3	Short circuit in wiring harness (With another wiring harness)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness among all pins between J1 (female) (23) – J1 (female) (With all connectors of wiring harness disconnected)		Resistance	Min. 100 kΩ
	4	Defective wiring harness connector	Connecting parts among boost pressure sensor, temperature sensor, engine wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation			
	5	Defective engine controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			J1 (female)	Charge temperature	Resistance	
			Between (23) – (47)	0°C	29 – 36 kΩ	
				25°C	9 – 11 kΩ	
				40°C	4.9 – 5.8 kΩ	
				100°C	600 – 700 Ω	
			Between (23) – chassis ground	All range	Min. 100 kΩ	

Circuit diagram related to boost pressure, temperature sensor (combination sensor)



E-11 Code [155/CA155] Charge Air Press. High Speed Derate

Error code	Failure code	Trouble	Derating of speed by abnormally high charge temperature
155	**CA155**		
Contents of trouble	• Temperature signal of boost pressure sensor and temperature sensor is above upper control limit.		
Action of controller	• Limits output and continues operation.		
Problem that appears on machine	• Engine stops • Output drops.		
Related information	—		

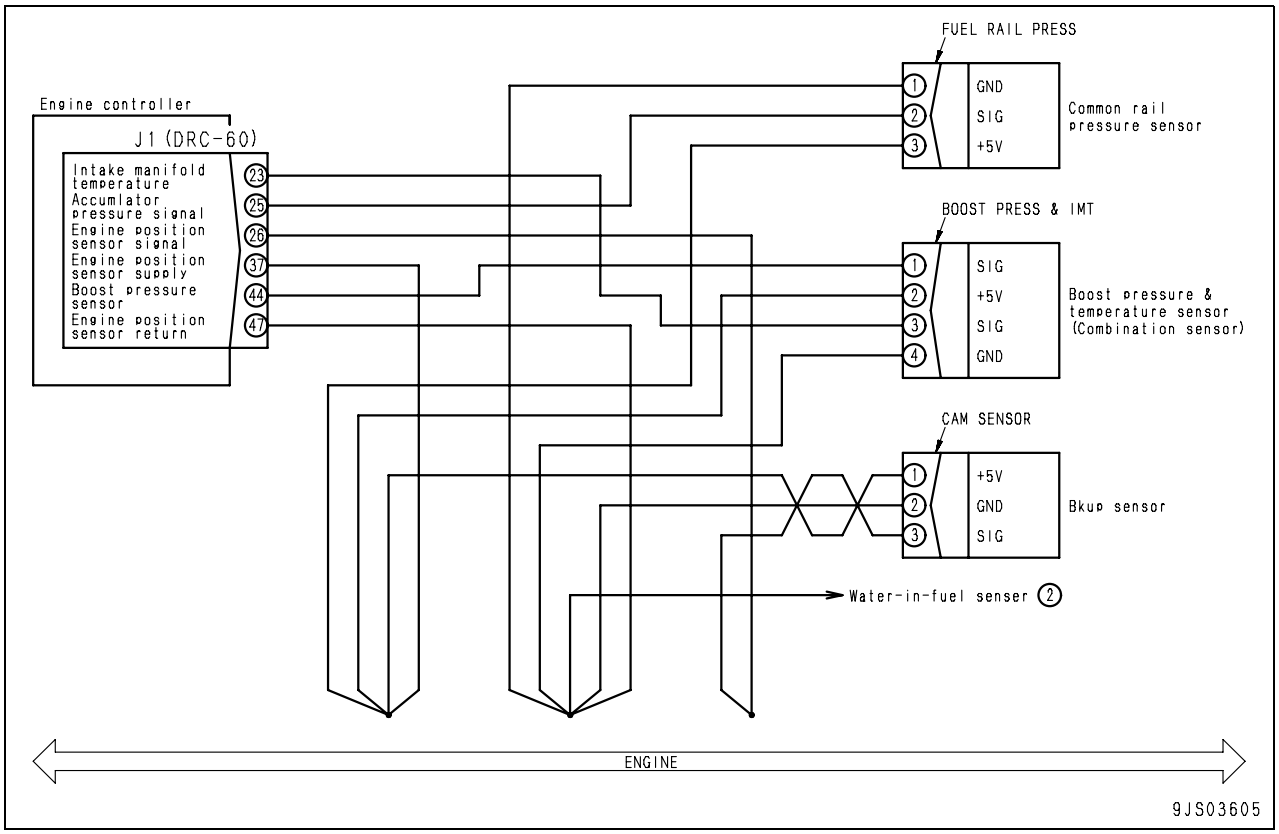
		Causes	Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	1	Drop in cooling performance of aftercooler	Inspect following directly. • Loose, broken fan belt • Lack of cooling air • Clogged aftercooler fin
	2	Abnormally high temperature at turbocharger outlet	Inspect related parts directly.
	3	Defective engine controller	If causes 1 and 2 are not detected, engine controller may be defective. (Since trouble is in system, troubleshooting cannot be carried out.)

E-12 Code [187/CA187] Sensor Sup. 2 Volt. Low Error

Error code	Failure code	Trouble	Abnormally low level in sensor power supply 2
187	**CA187**		
Contents of trouble	• Low voltage is detected in sensor power supply 2 circuit.		
Action of controller	• Fixes charge pressure and charge temperature, and continues operation. • Limits output and continues operation.		
Problem that appears on machine	• Engine output drops.		
Related information	• Method of reproducing failure code: Starting switch ON.		

<table>
<tr><td rowspan="7">Possible causes and standard value in normal state</td><td colspan="2">Causes</td><td colspan="3">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td rowspan="5">1</td><td rowspan="5">Defective sensor or wiring harness</td><td colspan="3">★ Disconnect connector with starting switch OFF, then turn starting switch ON and carry out troubleshooting.</td></tr>
<tr><td rowspan="4">Disconnect devices at right in order. If mark E of failure code disappears after reproduction operation is conducted, that device or wiring harness has a defect in it.</td><td>Boost pressure, temperature sensor</td><td>BOOST PRESS & IMT</td></tr>
<tr><td>Common rail pressure sensor</td><td>FUEL RAIL PRESS</td></tr>
<tr><td>Bkup sensor</td><td>CAM SENSOR</td></tr>
<tr><td>Engine wiring harness</td><td>J1</td></tr>
<tr><td>2</td><td>Defective wiring harness connector</td><td colspan="3">Connecting parts among each sensor, engine wiring harness, and engine controller are suspected. Inspect them directly.
• Loose connector, broken lock, broken seal
• Corrosive, bent, broken, forced-in, or extended pin
• Humidity in connector, entry of dirt or dust, poor insulation</td></tr>
<tr><td>3</td><td>Defective engine controller</td><td colspan="3">If causes 1 and 2 are not detected, engine controller may be defective. (Since trouble is in system, troubleshooting cannot be carried out.)</td></tr>
</table>

Circuit diagram related to sensor power supply 2

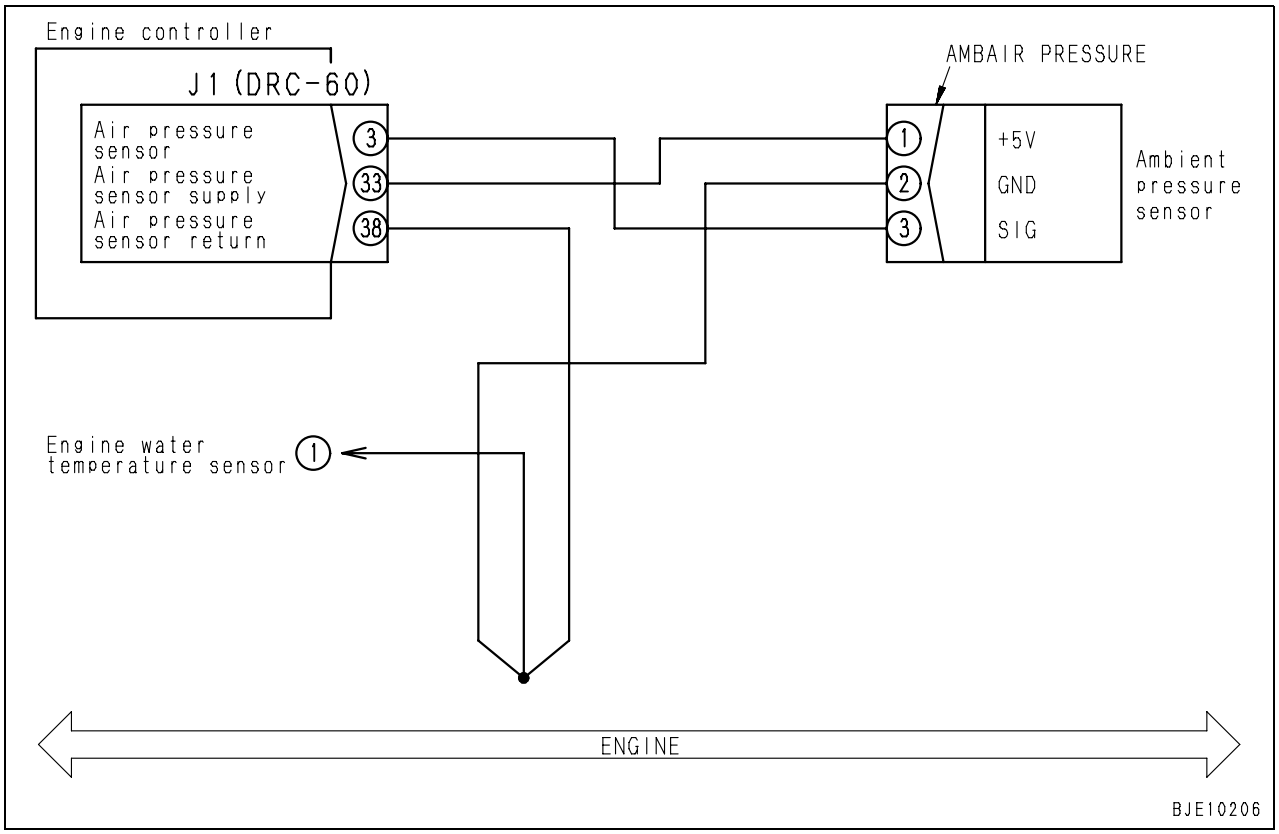


E-13 Code [221/CA221] Ambient Air Press. Sensor High Error

Error code	Failure code	Trouble	Abnormally high level in atompspheric
221	**CA221**		
Contents of trouble	• High voltage is detected in atmospheric pressure sensor		
Action of controller	• Fixes atmospheric pressure and continues operation.		
Problem that appears on machine	• Engine output drops. • Starting performance is poor.		
Related information	• Method of reproducing failure code: Starting switch ON.		

	Causes		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective sensor power supply 1 system	If failure code [**CA386**] is indicated simultaneously, carry out troubleshooting for it first.		
	2	Defective atmospheric pressure sensor	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			AMBAIR PRESSURE		Voltage
			Between (1) – (2)	Power supply	4.75 – 5.25 V
			Voltage is measured with wiring harness connected. Accordingly, if voltage is abnormal, check wiring harness and controller, too, for another cause of trouble, and then judge.		
	3	Hot short (Short circuit with 5V, 24V circuit) in wiring harness	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Wiring harness between J1 (female) (3) – AMBAIR PRESSURE (female) (3)	Voltage	Max. 1 V
	4	Short circuit in wiring harness (With another wiring harness)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between J1 (female) (3) – AMBAIR PRESSURE (female) (3) and J1 (female) (33) – AMBAIR PRESSURE (female) (1)	Resistance	Min. 100 kΩ
	5	Defective wiring harness connector	Connecting parts among atmospheric pressure sensor, engine wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation		
	6	Defective engine controller	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			J1		Voltage
			Between (33) – (38)	Power supply	4.75 – 5.25 V

Circuit diagram related to atmospheric pressure sensor

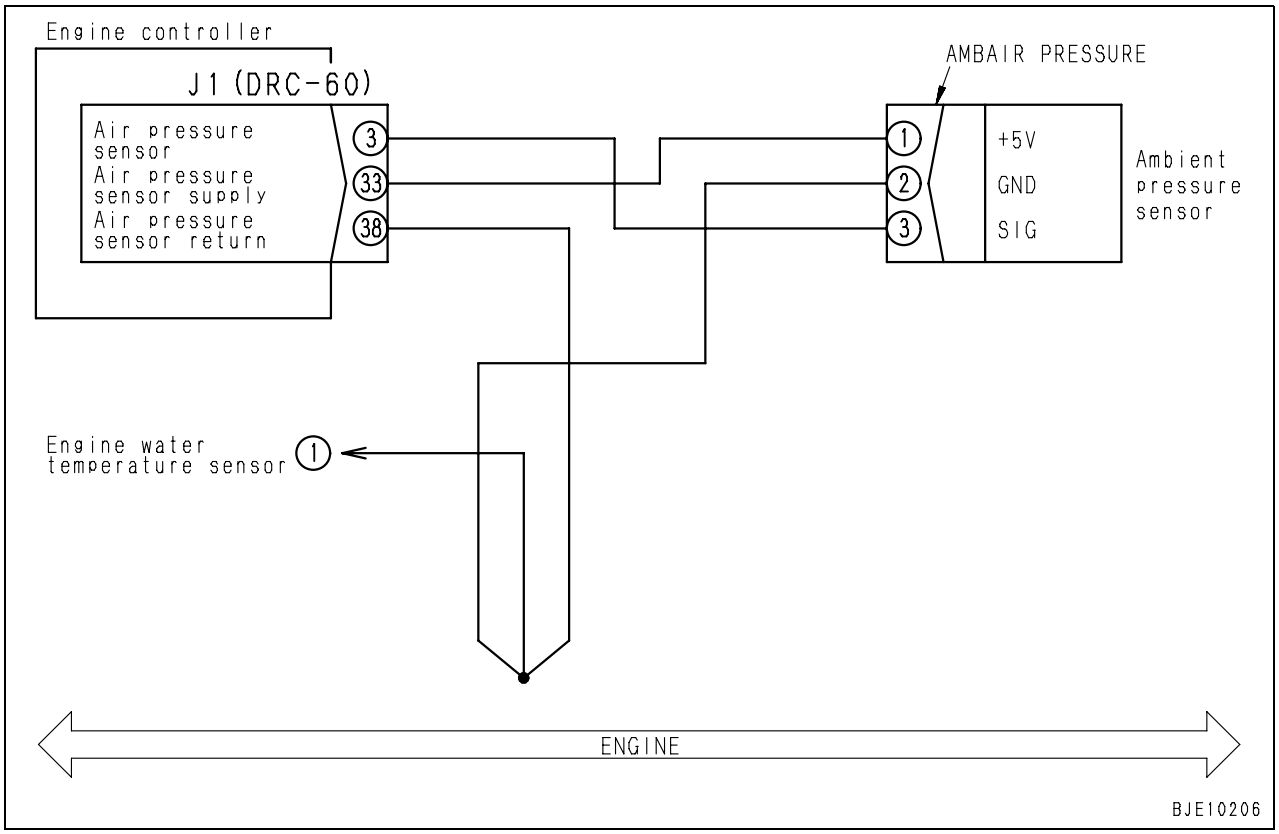


E-14 Code [222/CA222] Ambient Air Press. Sensor Low Error

Error code	Failure code	Trouble	Abnormally low level in atompspheric pressure sensor
222	**CA222**		
Contents of trouble	• Low voltage is detected in atmospheric pressure sensor		
Action of controller	• Fixes atmospheric pressure and continues operation.		
Problem that appears on machine	• Engine output drops. • Starting performance is poor.		
Related information	• Method of reproducing failure code: Starting switch ON.		

	Causes		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective sensor power supply 1 system	If failure code [**CA352**] is indicated simultaneously, carry out troubleshooting for it first.			
	2	Defective atmospheric pressure sensor	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			AMBAIR PRESSURE		Voltage	
			Between (1) – (2)	Power supply	4.75 – 5.25 V	
			Voltage is measured with wiring harness connected. Accordingly, if voltage is abnormal, check wiring harness and controller, too, for another cause of trouble, and then judge.			
	3	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between J1 (female) (3) – AMBAIR PRESSURE (female) (3)		Resistance	Min. 100 kΩ
	4	Short circuit in wiring harness (With another wiring harness)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between J1 (female) (3) – AMBAIR PRESSURE (female) (3) and J1 (female) (38) – AMBAIR PRESSURE (female) (2)		Resistance	Min. 100 kΩ
	5	Defective wiring harness connector	Connecting parts among atmospheric pressure sensor, engine wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation			
	6	Defective engine controller	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			J1		Voltage	
			Between (33) – (38)	Power supply	4.75 – 5.25 V	

Circuit diagram related to atmospheric pressure sensor

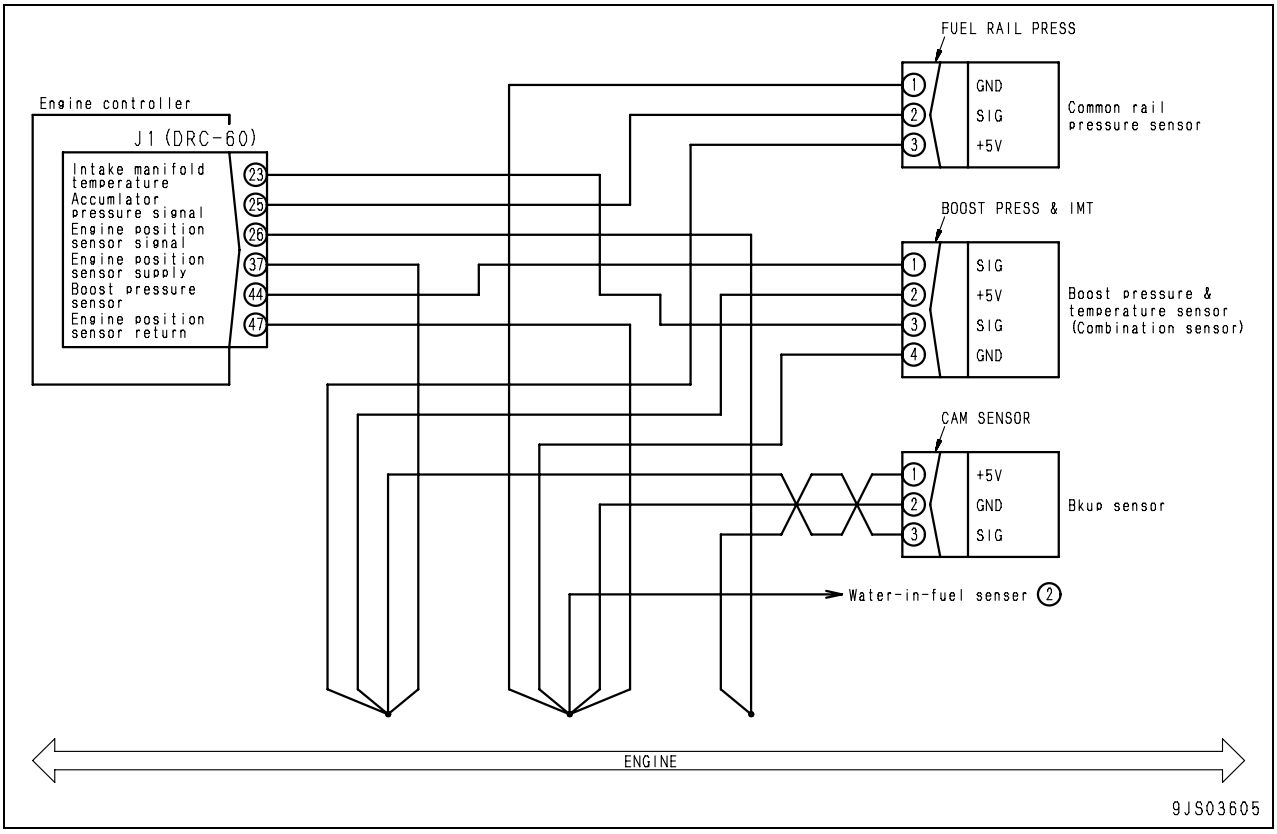


E-15 Code [227/CA227] Abnormally high level in sensor power supply 2 circuit

Error code	Failure code	Trouble	Abnormally high level in sensor power supply 2
227	**CA227**		
Contents of trouble	• High voltage is detected in sensor power supply 2 circuit.		
Action of controller	• Fixes charge pressure and charge temperature, and continues operation. • Limits output and continues operation.		
Problem that appears on machine	• Engine output drops.		
Related information	• Method of reproducing failure code: Starting switch ON.		

Possible causes and standard value in normal state	Causes		Standard value in normal state/Remarks on troubleshooting
	1	Defective wiring harness connector	Connecting parts among each sensor, engine wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation
	2	Defective engine controller	If cause 1 is not detected, engine controller may be defective. (Since trouble is in system, troubleshooting cannot be carried out.)

Circuit diagram related to sensor power supply 2



E-16 Code [234/CA234] Eng. Overspeed

Error code	Failure code	Trouble	Engine overspeed
234	**CA234**		
Contents of trouble	• Engine speed is above upper control limit.		
Action of controller	• Stops injection of injector until engine speed drops to normal level.		
Problem that appears on machine	• Engine speed fluctuates.		
Related information	• Method of reproducing failure code: Start engine and run it at high idle.		

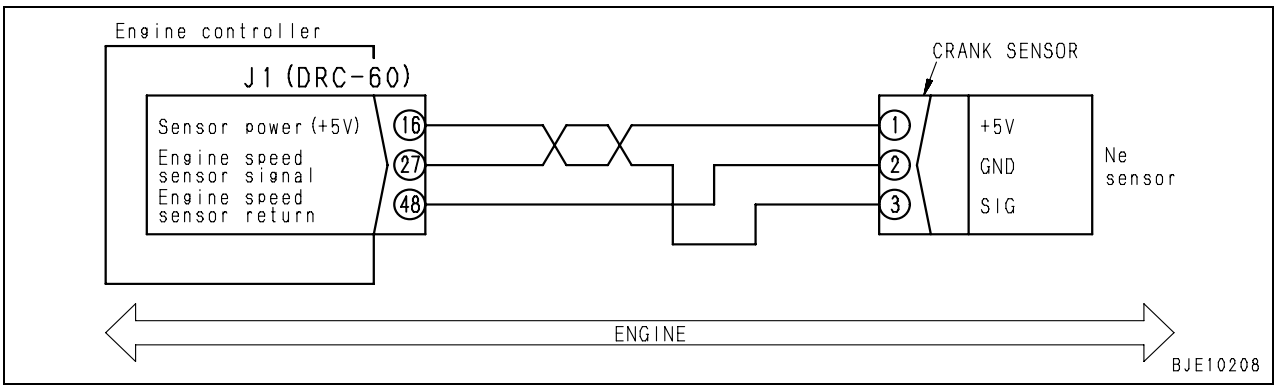
	Causes		Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	1	Use of improper fuel	Check fuel used directly
	2	Improper way of use	Way of use may be improper. Teach proper way of use to operator.
	3	Defective engine controller	If causes 1 and 2 is not detected, engine controller may be defective. (Since trouble is in system, troubleshooting cannot be carried out.)

E-17 Code [238/CA238] Ne Speed Sensor Sup. Volt. Error

Error code	Failure code	Trouble	Abnormality in Ne speed sensor power supply
238	**CA238**		
Contents of trouble	• Low voltage is detected in engine Ne speed sensor power supply circuit.		
Action of controller	• Controls Ne speed sensor with signals of Bkup speed sensor.		
Problem that appears on machine	• Starting performance is poor • There is hunting from engine.		
Related information	• Method of reproducing failure code: Starting switch ON.		

		Causes	Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective sensor or wiring harness	★ Disconnect connector with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Disconnect devices at right in order. If mark E of failure code disappears after reproduction operation is conducted, that device or wiring harness has a defect in it.	Ne speed sensor	CRANK SENSOR
				Engine wiring harness	J1
	2	Defective wiring harness connector	Connecting parts among each sensor, engine wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation		

Circuit diagram related to engine Ne speed sensor

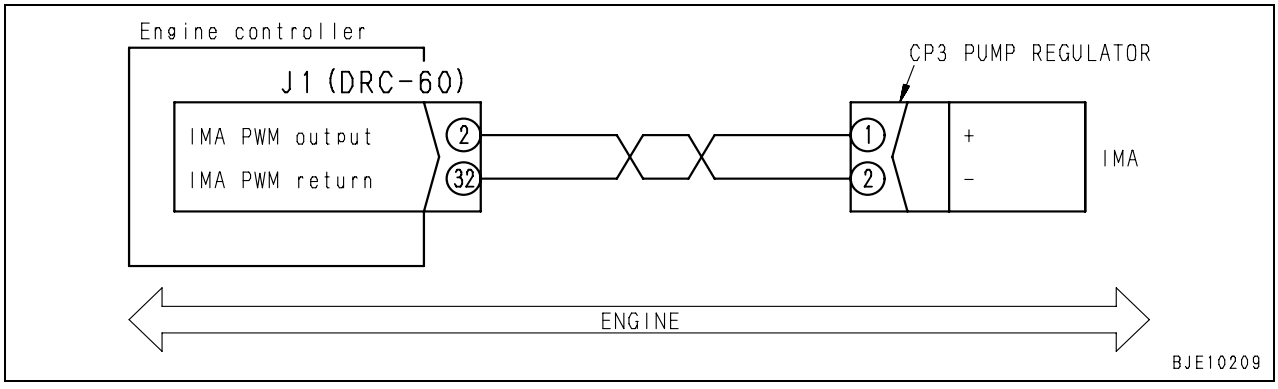


E-18 Code [271/CA271] IMV (IMA) Short Error

Error code	Failure code	Trouble	Short circuit in IMV (IMA)
271	**CA271**		
Contents of trouble	• There is short circuit in supply pump actuator drive circuit.		
Action of controller	• None in particular.		
Problem that appears on machine	• Engine speed does not rise from low idle. • Engine output drops. • Common rail fuel pressure is above command value.		
Related information	• Method of reproducing failure code: Starting switch ON.		

	Causes		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective supply pump actuator	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CP3 PUMP REGULATOR (Male)	Resistance	
			Between (1) – chassis ground	Min. 100 kΩ	
	2	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between J1 (female) (2) – CP3 PUMP REGULATOR (female) (1)	Resistance	Min. 100 kΩ
	3	Short circuit in wiring harness (with another wiring harness)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness among all pins between J1 (female) (2) – J1 (female) (With all connectors of wiring harness disconnected)	Resistance	Min. 100 kΩ
	4	Defective wiring harness connector	Connecting parts among supply pump actuator, engine wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation		
	5	Defective engine controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			J1 (Female)	Resistance	
			Between (2) – chassis ground	Min. 100 kΩ	

Circuit diagram related to supply pump actuator (metering unit)

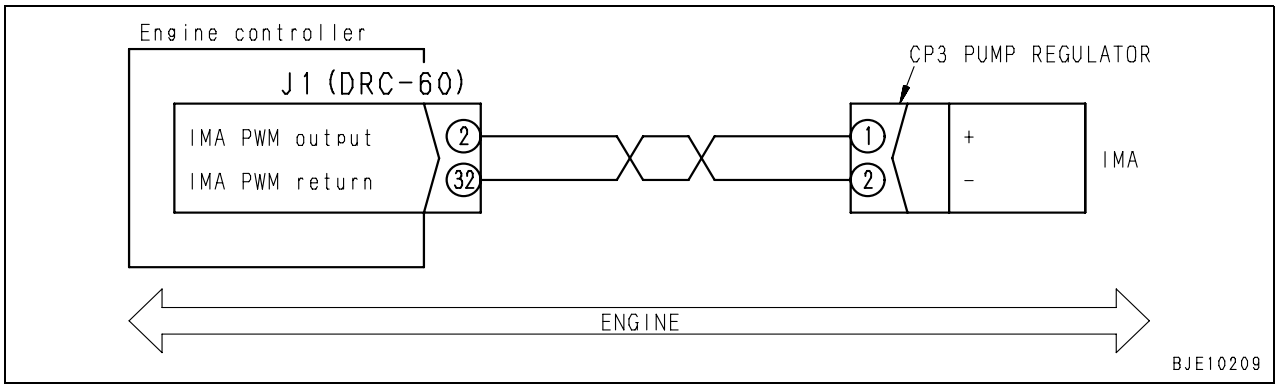


E-19 Code [272/CA272] IMV (IMA) Open Error

Error code	Failure code	Trouble	Disconnection in IMV (IMA)
272	**CA272**		
Contents of trouble	• There is disconnection in supply pump actuator drive circuit.		
Action of controller	• None in particular.		
Problem that appears on machine	• Engine speed runs, but in unstable condition. • Common rail fuel pressure is above command value.		
Related information	• Method of reproducing failure code: Starting switch ON.		

	Causes		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective supply pump actuator	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			CP3 PUMP REGULATOR (Male)	Resistance		
			Between (1) – (2)	Max. 5 Ω		
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between J1 (female) (2) – CP3 PUMP REGULATOR (female) (1)	Resistance	Max. 10 Ω	
			Wiring harness between J1 (female) (32) – CP3 PUMP REGULATOR (female) (2)	Resistance	Max. 10 Ω	
	3	Hot short (Short circuit with 24V circuit) in wiring harness	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			Wiring harness between J1 (female) (2) – CP3 PUMP REGULATOR (female) (1)	Voltage	Max. 3 V	
	4	Short circuit in wiring harness (with another wiring harness)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness among all pins between J1 (female) (2) – J1 (female) (With all connectors of wiring harness disconnected)	Resistance	Min. 100 kΩ	
	5	Defective wiring harness connector	Connecting parts among supply pump actuator, engine wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation			
	6	Defective engine controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			J1 (Female)	Resistance		
			Between (2) – (32)	Max. 5 Ω		

Circuit diagram related to supply pump actuator (metering unit)



E-20 Code [281/CA281] High pressure pump error

Error code	Failure code	Trouble	High pressure pump error
281	**CA281**		
Contents of trouble	• Response of fuel force feed is poor due to high pressure pump mechanical system error.		
Action of controller	• None in particular.		
Problem that appears on machine	• Engine does not start. Engine runs, but in unstable condition. • Pressure of high-pressure fuel at front side is different from that at rear side.		
Related information	• Method of reproducing failure code: Start engine.		

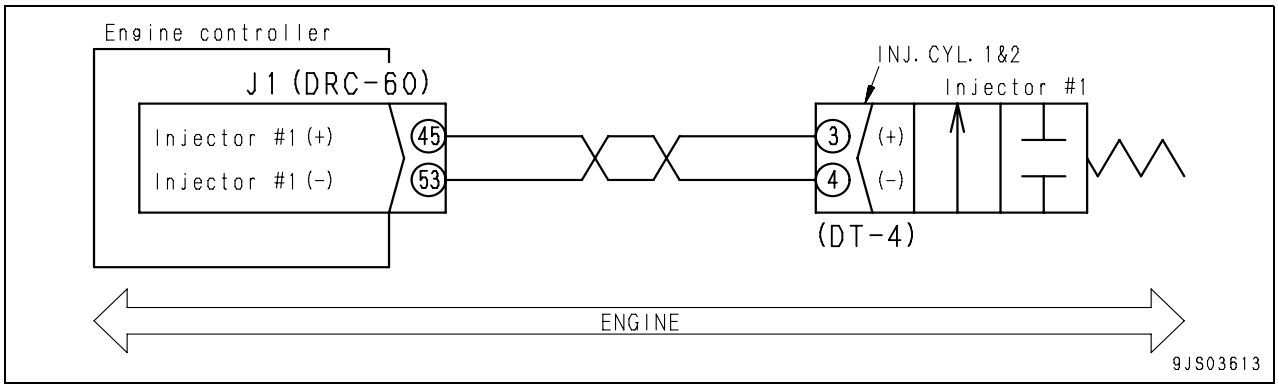
	Causes		Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	1	Air in fuel circuit	Bleed air from the fuel circuit. See Testing and adjusting, “Bleeding air from fuel circuit.”
	2	Defective wiring harness connector	Connecting parts among common rail pressure sensor, engine wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation
	3	Defective engine controller	If causes 1 and 2 are not detected, engine controller may be defective. (Since trouble is in system, troubleshooting cannot be carried out.)

E-21 Code [322/CA322] Injector No. 1 System Open/Short Error

Error code	Failure code	Trouble	Disconnection, short circuit in injector No. 1
322	**CA322**		
Contents of trouble	• There is disconnection or short circuit in drive circuit of injector No. 1.		
Action of controller	• None in particular.		
Problem that appears on machine	• There is irregular combustion or hunting. • Output drops.		
Related information	• Method of reproducing failure code: Start engine.		

	Causes		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective injector No. 1	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			INJ CYL 1 & 2 (Male)	Resistance		
			Between (3) – (4)	Max. 2 Ω		
			Between (3) – chassis ground	Min. 100 kΩ		
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between J1 (female) (45) – INJ CYL 1 & 2 (female) (3)	Resistance	Max. 2 Ω	
			Wiring harness between J1 (female) (53) – INJ CYL 1 & 2 (female) (4)	Resistance	Max. 2 Ω	
	3	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between J1 (female) (45) – INJ CYL 1 & 2 (female) (3)	Resistance	Max. 2 Ω	
	4	Short circuit in wiring harness (With another wiring harness)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness among all pins between J1 (female) (45) – J1 (female) (With all connectors of wiring harness disconnected)	Resistance	Min. 100 kΩ	
			Wiring harness among all pins between J1 (female) (53) – J1 (female) (With all connectors of wiring harness disconnected)	Resistance	Min. 100 kΩ	
	5	Defective wiring harness connector	Connecting parts among injector No. 1, engine wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation			
	6	Defective injector or wiring harness of another cylinder	If any other failure codes related to injector are displayed, carry out troubleshooting for them first.			
	7	Defective engine controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			J1 (female)	Resistance		
			Between (45) – (53)	Max. 2 Ω		
			Between (45) – chassis ground	Min. 100 kΩ		

Circuit diagram related to injector No. 1

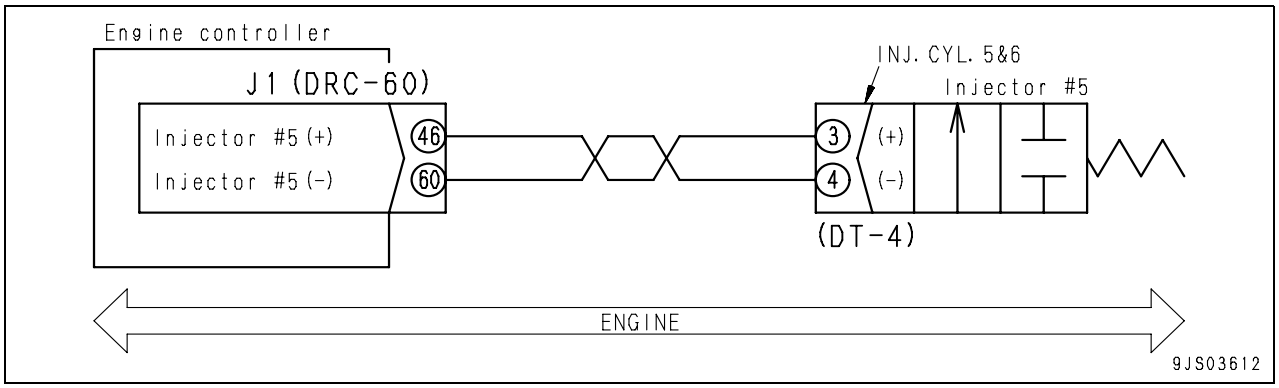


E-22 Code [323/CA323] Injector No. 5 System Open/Short Error

Error code	Failure code	Trouble	Disconnection, short circuit in injector No. 5
323	**CA323**		
Contents of trouble	• There is disconnection or short circuit in drive circuit of injector No. 5.		
Action of controller	• None in particular.		
Problem that appears on machine	• There is irregular combustion or hunting. • Output drops.		
Related information	• Method of reproducing failure code: Start engine.		

	Causes		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective injector No. 5	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			INJ CYL 5 & 6 (Male)	Resistance		
			Between (3) – (4)	Max. 2 Ω		
			Between (3) – chassis ground	Min. 100 kΩ		
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between J1 (female) (46) – INJ CYL 5 & 6 (female) (3)	Resistance	Max. 2 Ω	
			Wiring harness between J1 (female) (60) – INJ CYL 5 & 6 (female) (4)	Resistance	Max. 2 Ω	
	3	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between J1 (female) (46) – INJ CYL 5 & 6 (female) (3)	Resistance	Max. 2 Ω	
	4	Short circuit in wiring harness (With another wiring harness)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness among all pins between J1 (female) (46) – J1 (female) (With all connectors of wiring harness disconnected)	Resistance	Min. 100 kΩ	
			Wiring harness among all pins between J1 (female) (60) – J1 (female) (With all connectors of wiring harness disconnected)	Resistance	Min. 100 kΩ	
	5	Defective wiring harness connector	Connecting parts among injector No. 5, engine wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation			
	6	Defective injector or wiring harness of another cylinder	If any other failure codes related to injector are displayed, carry out troubleshooting for them first.			
	7	Defective engine controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			J1 (female)	Resistance		
			Between (46) – (60)	Max. 2 Ω		
			Between (46) – chassis ground	Min. 100 kΩ		

Circuit diagram related to injector No. 5

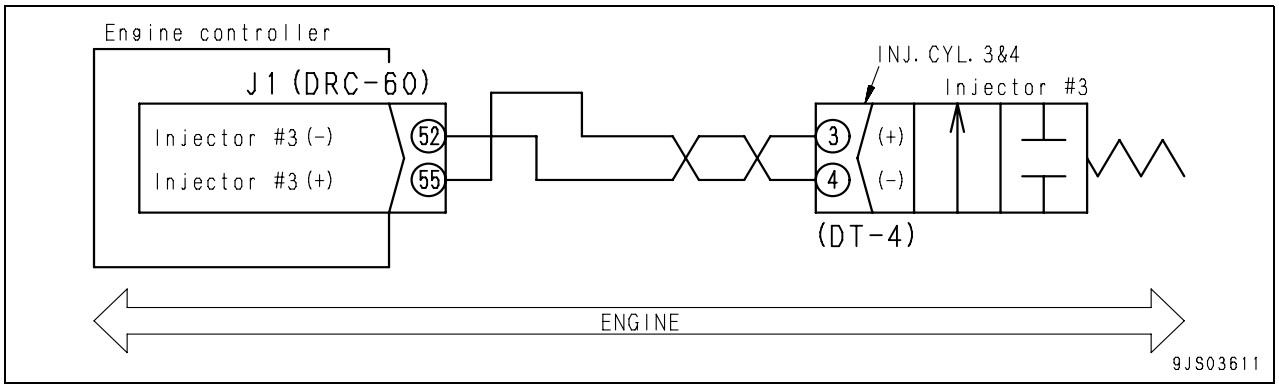


E-23 Code [324/CA324] Injector No. 3 System Open/Short Error

Error code	Failure code	Trouble	Disconnection, short circuit in injector No. 3
324	**CA324**		
Contents of trouble	• There is disconnection or short circuit in drive circuit of injector No. 3.		
Action of controller	• None in particular.		
Problem that appears on machine	• There is irregular combustion or hunting. • Output drops.		
Related information	• Method of reproducing failure code: Start engine.		

	Causes		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective injector No. 3	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			INJ CYL 3 & 4 (Male)	Resistance		
			Between (3) – (4)	Max. 2 Ω		
			Between (3) – chassis ground	Min. 100 kΩ		
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between J1 (female) (55) – INJ CYL 3 & 4 (female) (3)	Resistance	Max. 2 Ω	
			Wiring harness between J1 (female) (52) – INJ CYL 3 & 4 (female) (4)	Resistance	Max. 2 Ω	
	3	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between J1 (female) (55) – INJ CYL 3 & 4 (female) (3)	Resistance	Max. 2 Ω	
	4	Short circuit in wiring harness (With another wiring harness)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness among all pins between J1 (female) (55) – J1 (female) (With all connectors of wiring harness disconnected)	Resistance	Min. 100 kΩ	
			Wiring harness among all pins between J1 (female) (52) – J1 (female) (With all connectors of wiring harness disconnected)	Resistance	Min. 100 kΩ	
	5	Defective wiring harness connector	Connecting parts among injector No. 3, engine wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation			
	6	Defective injector or wiring harness of another cylinder	If any other failure codes related to injector are displayed, carry out troubleshooting for them first.			
	7	Defective engine controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			J1 (female)	Resistance		
			Between (55) – (52)	Max. 2 Ω		
			Between (55) – chassis ground	Min. 100 kΩ		

Circuit diagram related to injector No. 3

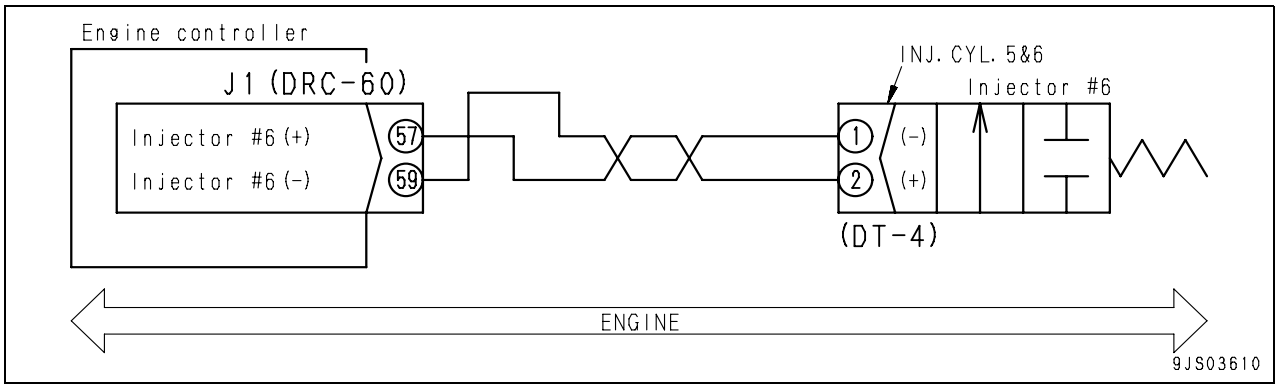


E-24 Code [325/CA325] Injector No. 6 System Open/Short Error

Error code	Failure code	Trouble	Disconnection, short circuit in injector No. 6
325	**CA325**		
Contents of trouble	• There is disconnection or short circuit in drive circuit of injector No. 6.		
Action of controller	• None in particular.		
Problem that appears on machine	• There is irregular combustion or hunting.		
Related information	• Method of reproducing failure code: Start engine.		

	Causes		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective injector No. 6	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			INJ CYL 5 & 6 (Male)	Resistance		
			Between (1) – (2)	Max. 2 Ω		
			Between (2) – chassis ground	Min. 100 kΩ		
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between J1 (female) (57) – INJ CYL 5 & 6 (female) (2)	Resistance	Max. 2 Ω	
			Wiring harness between J1 (female) (59) – INJ CYL 5 & 6 (female) (1)	Resistance	Max. 2 Ω	
	3	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between J1 (female) (57) – INJ CYL 5 & 6 (female) (2)	Resistance	Max. 2 Ω	
	4	Short circuit in wiring harness (With another wiring harness)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness among all pins between J1 (female) (57) – J1 (female) (With all connectors of wiring harness disconnected)	Resistance	Min. 100 kΩ	
			Wiring harness among all pins between J1 (female) (59) – J1 (female) (With all connectors of wiring harness disconnected)	Resistance	Min. 100 kΩ	
	5	Defective wiring harness connector	Connecting parts among injector No. 6, engine wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation			
	6	Defective injector or wiring harness of another cylinder	If any other failure codes related to injector are displayed, carry out troubleshooting for them first.			
	7	Defective engine controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			J1 (female)	Resistance		
			Between (57) – (59)	Max. 2 Ω		
			Between (57) – chassis ground	Min. 100 kΩ		

Circuit diagram related to injector No. 6

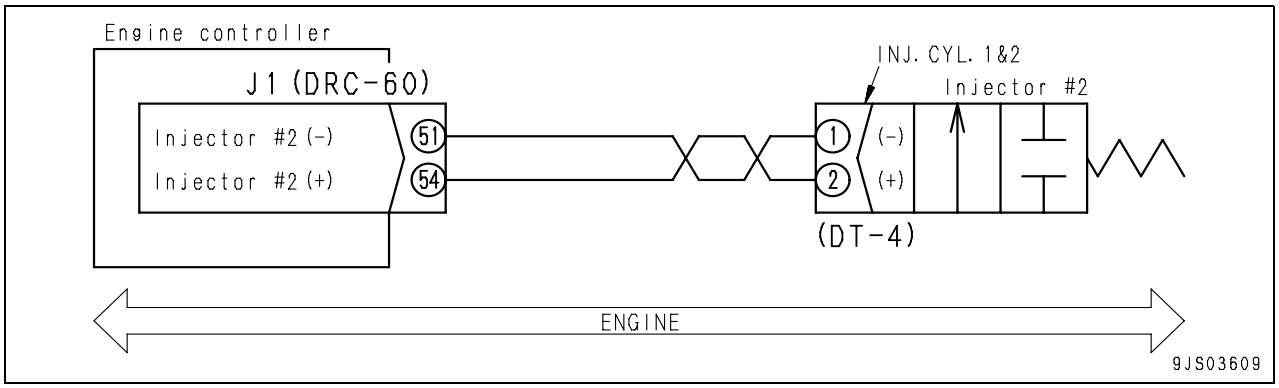


E-25 Code [331/CA331] Injector No. 2 System Open/Short Error

Error code	Failure code	Trouble	Disconnection, short circuit in injector No. 2
331	**CA331**		
Contents of trouble	• There is disconnection or short circuit in drive circuit of injector No. 2.		
Action of controller	• None in particular.		
Problem that appears on machine	• There is irregular combustion or hunting. • Output drops.		
Related information	• Method of reproducing failure code: Start engine.		

	Causes		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective injector No. 2	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			INJ CYL 1 & 2 (Male)	Resistance		
			Between (1) – (2)	Max. 2 Ω		
			Between (2) – chassis ground	Min. 100 kΩ		
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between J1 (female) (54) – INJ CYL 1 & 2 (female) (2)	Resistance	Max. 2 Ω	
			Wiring harness between J1 (female) (51) – INJ CYL 1 & 2 (female) (1)	Resistance	Max. 2 Ω	
	3	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between J1 (female) (54) – INJ CYL 1 & 2 (female) (2)	Resistance	Max. 2 Ω	
	4	Short circuit in wiring harness (With another wiring harness)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness among all pins between J1 (female) (54) – J1 (female) (With all connectors of wiring harness disconnected)	Resistance	Min. 100 kΩ	
			Wiring harness among all pins between J1 (female) (51) – J1 (female) (With all connectors of wiring harness disconnected)	Resistance	Min. 100 kΩ	
	5	Defective wiring harness connector	Connecting parts among injector No. 2, engine wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation			
	6	Defective injector or wiring harness of another cylinder	If any other failure codes related to injector are displayed, carry out troubleshooting for them first.			
	7	Defective engine controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			J1 (female)	Resistance		
			Between (54) – (51)	Max. 2 Ω		
			Between (54) – chassis ground	Min. 100 kΩ		

Circuit diagram related to injector No. 2

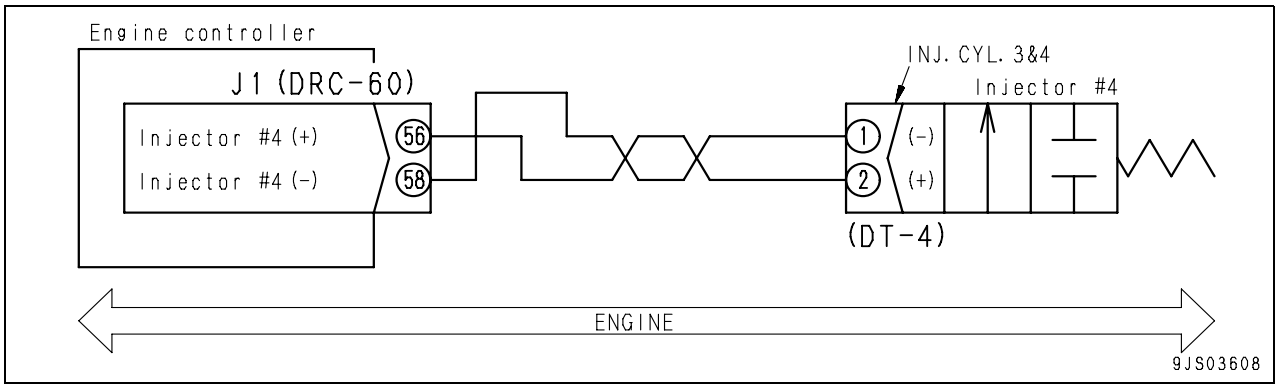


E-26 Code [332/CA332] Injector No. 4 System Open/Short Error

Error code	Failure code	Trouble	Disconnection, short circuit in injector No. 4
332	**CA332**		
Contents of trouble	• There is disconnection or short circuit in drive circuit of injector No. 4.		
Action of controller	• None in particular.		
Problem that appears on machine	• There is irregular combustion or hunting. • Output drops.		
Related information	• Method of reproducing failure code: Start engine.		

	Causes		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective injector No. 4	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			INJ CYL 3 & 4 (Male)	Resistance		
			Between (1) – (2)	Max. 2 Ω		
			Between (2) – chassis ground	Min. 100 kΩ		
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between J1 (female) (56) – INJ CYL 3 & 4 (female) (2)	Resistance	Max. 2 Ω	
			Wiring harness between J1 (female) (58) – INJ CYL 3 & 4 (female) (1)	Resistance	Max. 2 Ω	
	3	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between J1 (female) (56) – INJ CYL 3 & 4 (female) (2)	Resistance	Max. 2 Ω	
	4	Short circuit in wiring harness (With another wiring harness)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness among all pins between J1 (female) (56) – J1 (female) (With all connectors of wiring harness disconnected)	Resistance	Min. 100 kΩ	
			Wiring harness among all pins between J1 (female) (58) – J1 (female) (With all connectors of wiring harness disconnected)	Resistance	Min. 100 kΩ	
	5	Defective wiring harness connector	Connecting parts among injector No. 4, engine wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation			
	6	Defective injector or wiring harness of another cylinder	If any other failure codes related to injector are displayed, carry out troubleshooting for them first.			
	7	Defective engine controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			J1 (female)	Resistance		
			Between (56) – (58)	Max. 2 Ω		
			Between (56) – chassis ground	Min. 100 kΩ		

Circuit diagram related to injector No. 4



E-27 Code [342/CA342] Engine Controller Data Matching Error

Error code	Failure code	Trouble	Matching error in engine controller data
342	**CA342**		
Contents of trouble	• Matching error occurred in engine controller data.		
Action of controller	• None in particular.		
Problem that appears on machine	• Normal operation or engine stops and engine cannot be started.		
Related information	• Method of reproducing failure code: Starting switch ON.		

Possible causes and standard value in normal state	Causes		Standard value in normal state/Remarks on troubleshooting
	1	Defective related system	If another failure code is indicated, carry out troubleshooting for it.
	2	Defective engine controller	Carry out troubleshooting for failure code [CA757]

KOMATSU 114E-3 Series Diesel engine

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ENGINE

114E-3 Series

40 Troubleshooting

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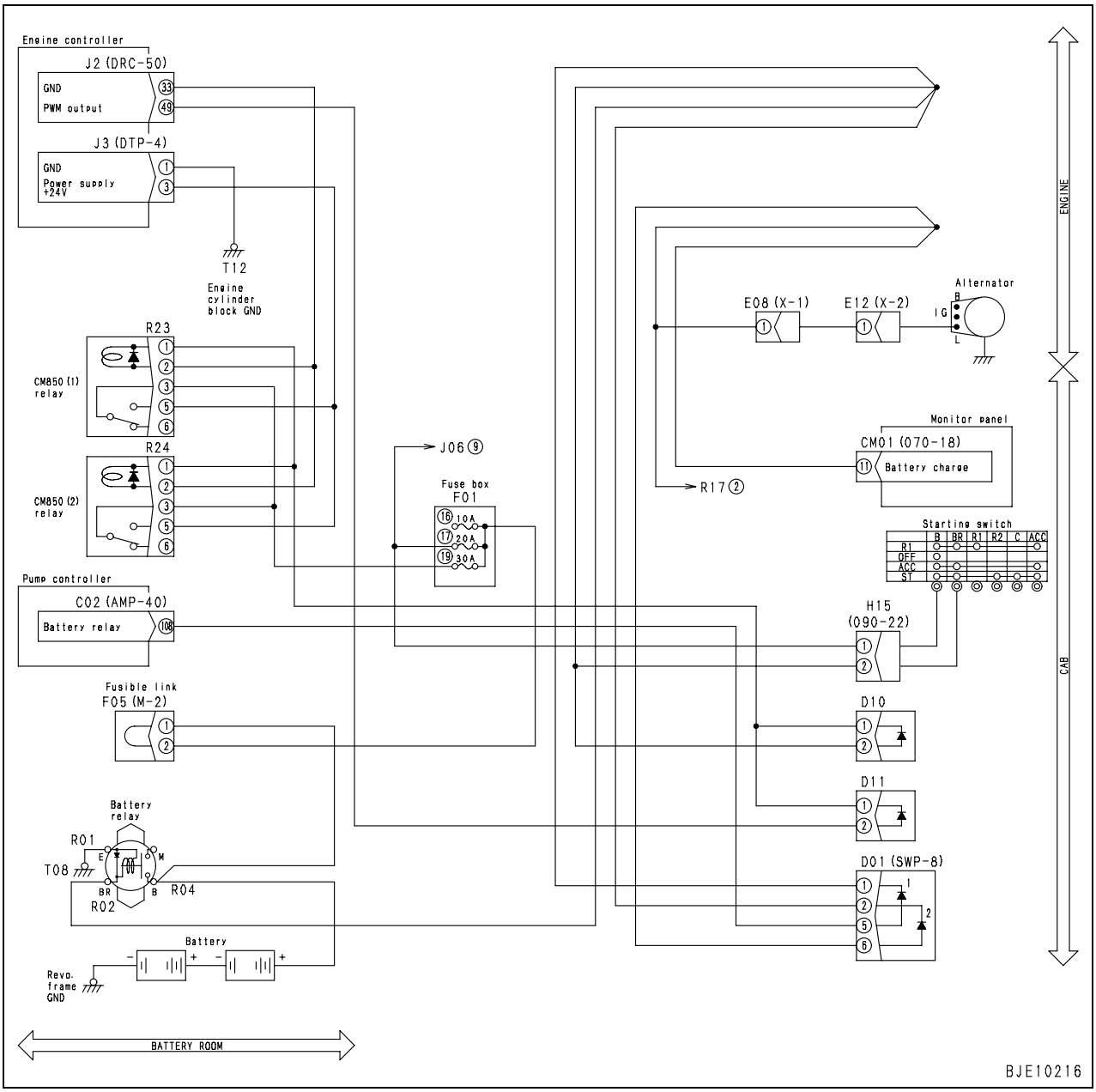
Troubleshooting of electrical system (E-mode), Part 2

E-28 Code [351/CA351] INJ. Drive Circuit Error

Error code	Failure code	Trouble	Abnormality in injector drive circuit
351	**CA351**		
Contents of trouble	• Abnormality occurred in injector drive power supply circuit.		
Action of controller	• Limits output and continues operation.		
Problem that appears on machine	• Exhaust smoke is black • There is irregular combustion. • Engine output drops. • Engine does not start		
Related information	• Method of reproducing failure code: Start engine.		

	Causes		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective related system	If another failure code is indicated, carry out troubleshooting for it.		
	2	Defective fuse No. 19	If fuse is burnt out, circuit probably has ground fault.		
	3	Defective relay for engine controller power supply	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Replace relays for engine controller power supply (R23, R24) with other relays. If mark E of failure code disappears after reproduction operation is conducted, that relay has a defect.		
	4	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between F01-19 – R23, R24 (female) (3)	Resistance	Max. 0.5 Ω
			Wiring harness between R23, R24 (female) (5) – J3 (female) (3)	Resistance	Max. 0.5 Ω
			Wiring harness between J3 (female) (1) – chassis ground (T12)	Resistance	Max. 10 Ω
	5	Defective engine controller	If causes 1 – 4 are not detected, engine controller may be defective. (Since trouble is in system, troubleshooting cannot be carried out.)		

Circuit diagram related to engine controller power supply

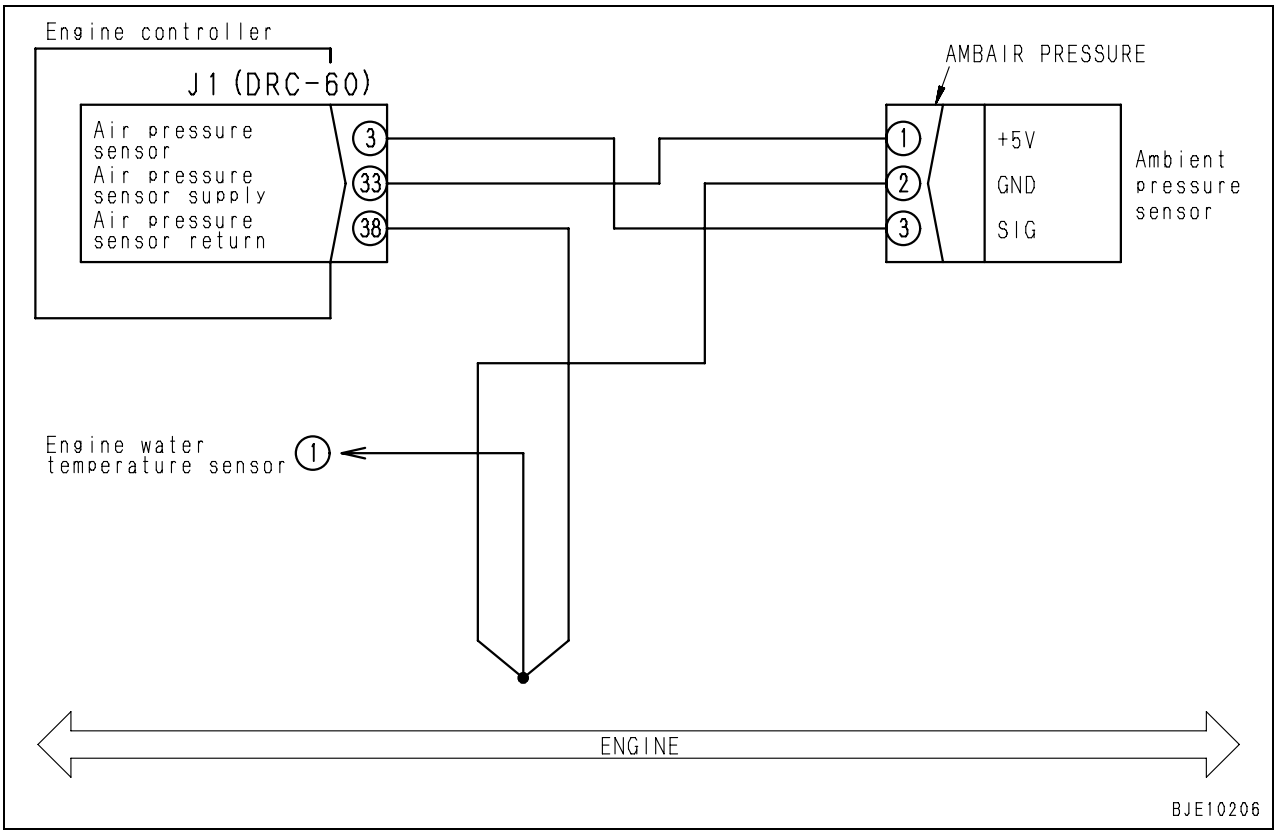


E-29 Code [352/CA352] Sensor Sup. 1 Volt. Low Error

Error code	Failure code	Trouble	Abnormally low level in sensor power supply 1 circuit
352	**CA352**		
Contents of trouble	• Low voltage is detected in sensor power supply 1 circuit.		
Action of controller	• Fixes atmospheric pressure and continues operation.		
Problem that appears on machine	• Engine output drops. • Starting performance is poor.		
Related information	• Method of reproducing failure code: Starting switch ON.		

	Causes		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective sensor or wiring harness	★ Disconnect connector with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Disconnect devices at right in order. If mark E of failure code disappears after reproduction operation is conducted, that device or wiring harness has a defect in it.	Atmospheric pressure sensor	AMBAIR PRESSURE
				Engine wiring harness	J1
	2	Defective wiring harness connector	Connecting parts among atmospheric pressure sensor, engine wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation		
	3	Defective engine controller	If causes 1 and 2 are not detected, engine controller may be defective. (Since trouble is in system, troubleshooting cannot be carried out.)		

Circuit diagram related to sensor power supply 1

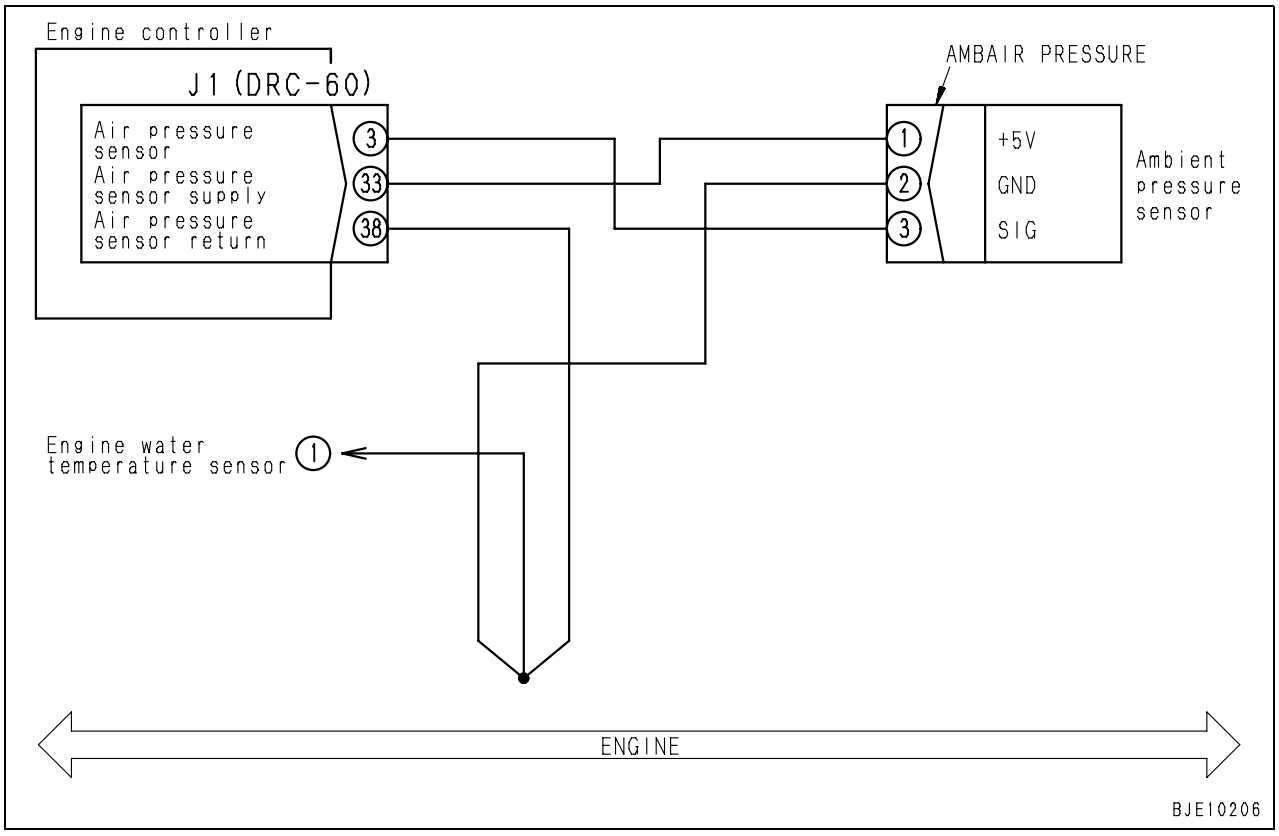


E-30 Code [386/CA386] Sensor Sup. 1 Volt. High Error

Error code	Failure code	Trouble	Abnormally high level in sensor power supply 1 circuit
386	**CA386**		
Contents of trouble	• High voltage is detected in sensor power supply 1 circuit.		
Action of controller	• Fixes atmospheric pressure and continues operation.		
Problem that appears on machine	• Engine output drops. • Starting performance is poor.		
Related information	• Method of reproducing failure code: Starting switch ON.		

Possible causes and standard value in normal state		Causes	Standard value in normal state/Remarks on troubleshooting
	1	Defective wiring harness connector	Connecting parts among atmospheric pressure sensor, engine wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation
	2	Defective engine controller	If cause 1 is not detected, engine controller may be defective. (Since trouble is in system, troubleshooting cannot be carried out.)

Circuit diagram related to sensor power supply 1

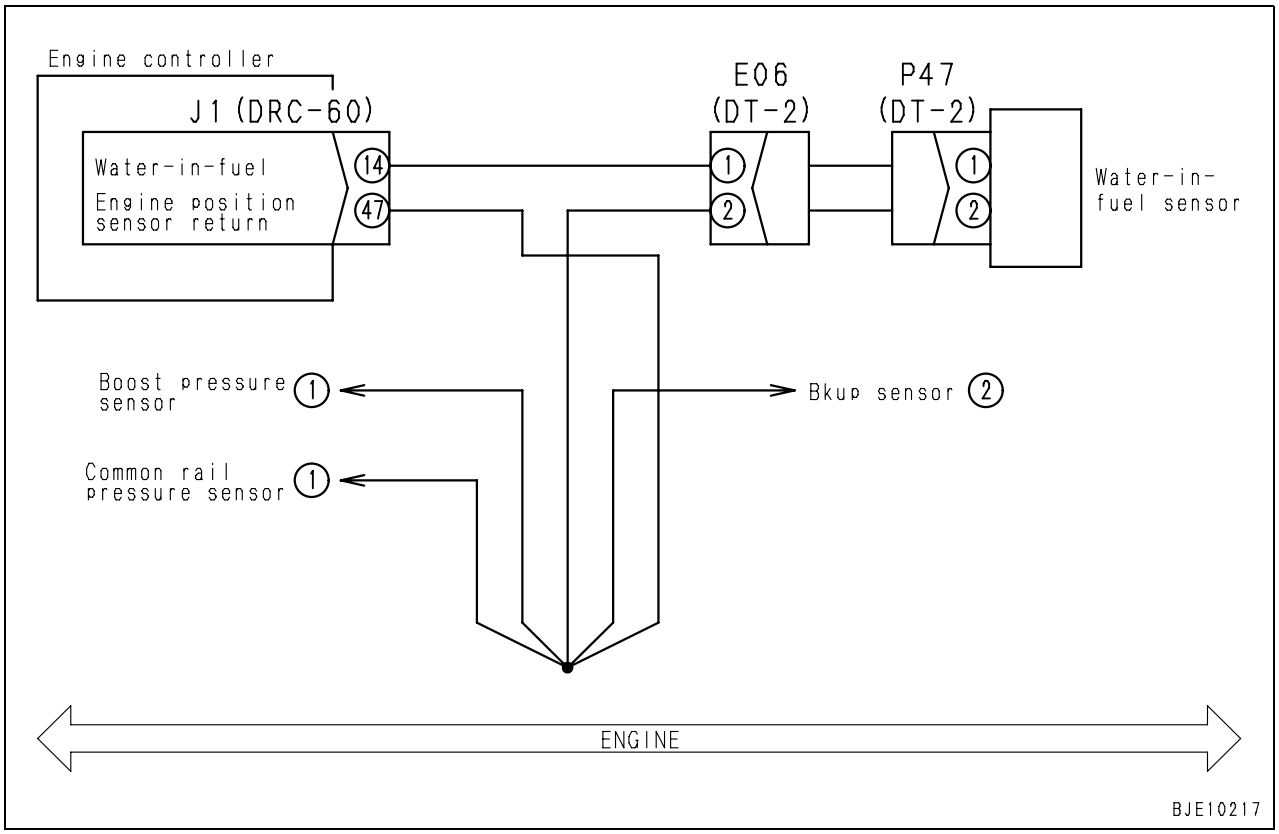


E-31 Code [428/CA428] Water Sensor High Level Error

Error code	Failure code	Trouble	Abnormally high level in water sensor
428	**CA428**		
Contents of trouble	• High voltage occurred in water-in-fuel sensor		
Action of controller	• None in particular.		
Problem that appears on machine	• Water separator monitor does not indicate normally.		
Related information	• Method of reproducing failure code: Starting switch ON.		

Possible causes and standard value in normal state	Causes		Standard value in normal state/Remarks on troubleshooting			
	1	Defective water-in-fuel sensor	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			P47 (female)	Resistance		
			Between (1) – (2)	Max. 10 Ω		
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between J1 (female) (14) – P47 (male) (1)	Resistance	Max. 10 Ω	
			Wiring harness between J1 (female) (47) – P47 (male) (2)	Resistance	Max. 10 Ω	
	3	Short circuit in wiring harness (With another wiring harness)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness among all pins between J1 (female) (14) – J1 (female) (With all connectors of wiring harness disconnected)	Resistance	Min. 100 kΩ	
	4	Defective wiring harness connector	Connecting parts among water-in-fuel sensor, engine wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation			
	5	Defective engine controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			J1 (female)	Resistance		
			Between (14) – (47)	Max. 10 Ω		

Circuit diagram related to water-in-fuel sensor

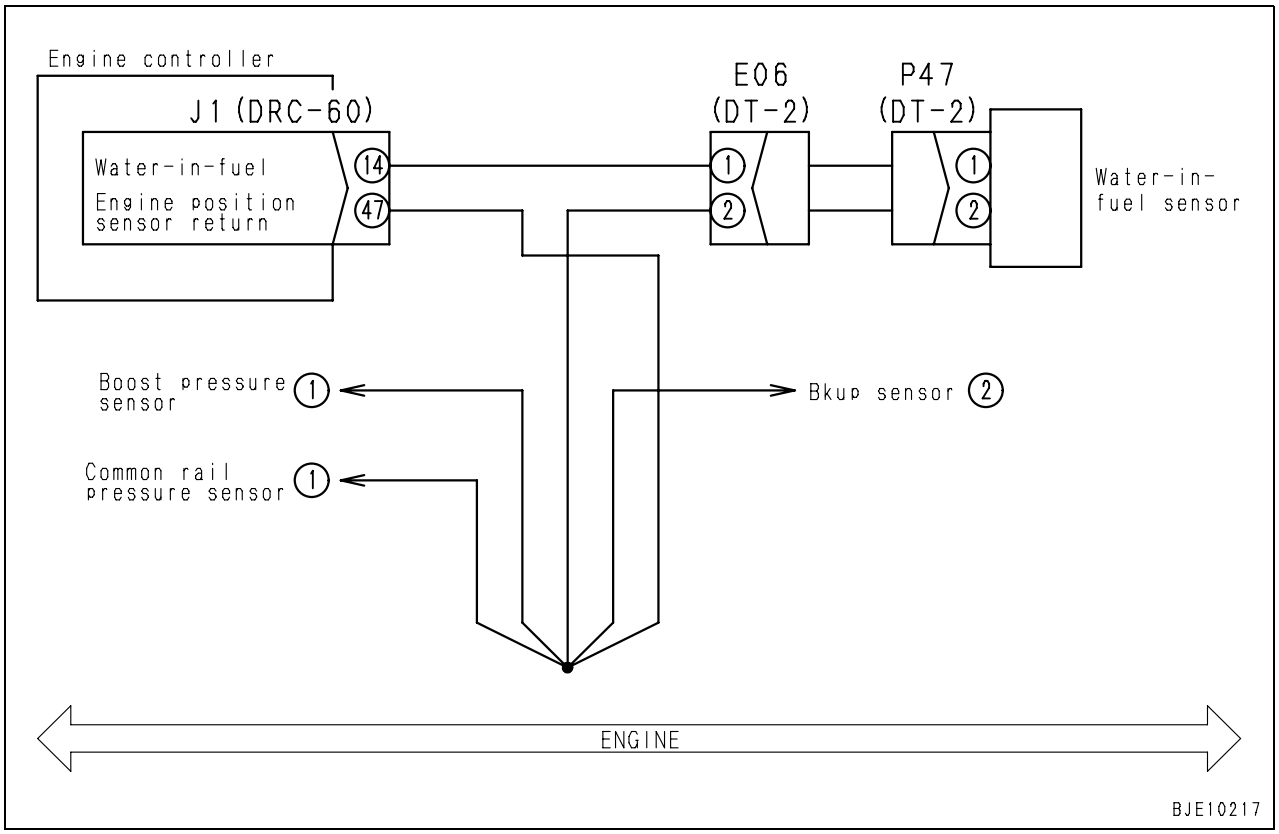


E-32 Code [429/CA429] Water Sensor Low Level Error

Error code	Failure code	Trouble	Abnormally low level in water sensor
429	**CA429**		
Contents of trouble	• Low voltage occurred in water-in-fuel sensor		
Action of controller	• None in particular.		
Problem that appears on machine	• Water separator monitor does not indicate normally.		
Related information	• Method of reproducing failure code: Starting switch ON.		

	Causes		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective water-in-fuel sensor	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			P47 (female)	Resistance	
			Between (1) – (2)	Max. 10 Ω	
			Between (1) – chassis ground	Min. 100 kΩ	
	2	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between J1 (female) (14) – P47 (male) (1)	Resistance	Min. 100 kΩ
	3	Short circuit in wiring harness (With another wiring harness)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness among all pins between J1 (female) (14) – J1 (female) (With all connectors of wiring harness disconnected)	Resistance	Min. 100 kΩ
	4	Defective wiring harness connector	Connecting parts among water-in-fuel sensor, engine wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation		
	5	Defective engine controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			J1 (female)	Resistance	
			Between (14) – (47)	Max. 10 Ω	
			Between (14) – chassis ground	Min. 100 kΩ	

Circuit diagram related to water-in-fuel sensor

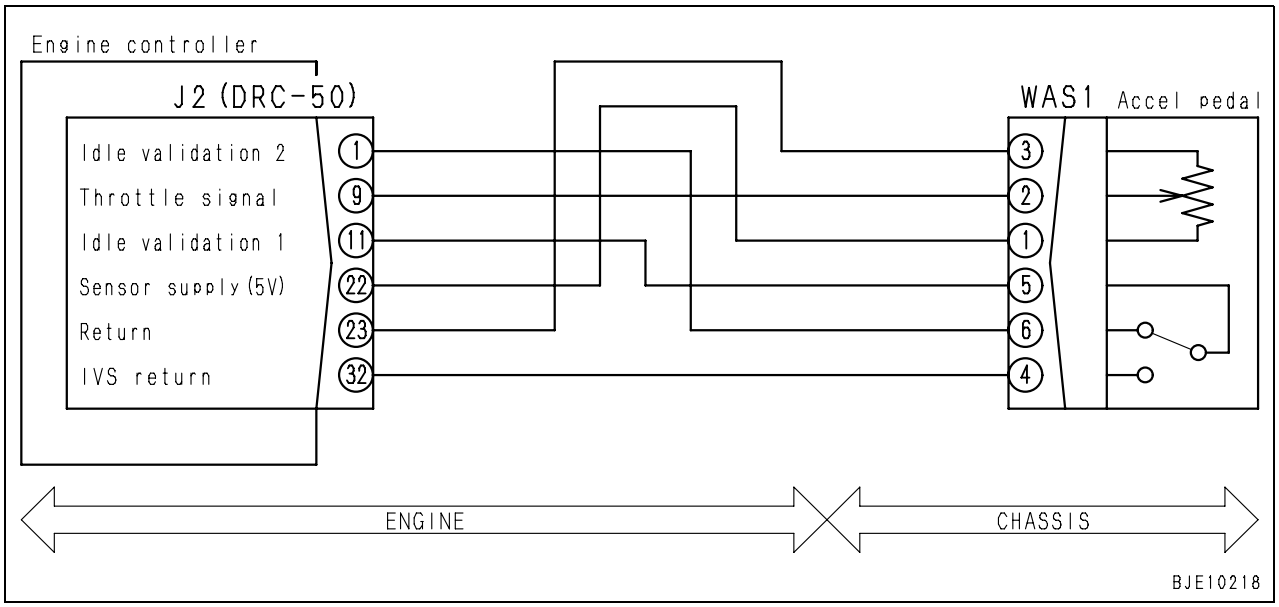


E-33 Code [431/CA431] Idle Validation Switch Error

Error code	Failure code	Trouble	Abnormality in idle validation switch
431	**CA431**		
Contents of trouble	• Abnormality occurred in idle validation switch circuit		
Action of controller	• Sets throttle angle to certain value and continues operation (depending on each model).		
Problem that appears on machine	• Engine speed may not rise from low idle.		
Related information	• Method of reproducing failure code: Starting switch ON, accelerator ON.		

	Causes		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective accelerator pedal	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			WAS1 (Male)	Accelerator pedal	Resistance	
			Between (5) – (4)	Release	Max. 1 Ω	
				Press	Min. 1 MΩ	
			Between (6) – (4)	Release	Min. 1 MΩ	
				Press	Max. 1 Ω	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between J2 (female) (11) – WAS1 (female) (5)		Resistance	Max. 10 Ω
			Wiring harness between J2 (female) (1) – WAS1 (female) (6)		Resistance	Max. 10 Ω
			Wiring harness between J2 (female) (32) – WAS1 (female) (4)		Resistance	Max. 10 Ω
	3	Short circuit in wiring harness (With another wiring harness)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness among all pins between J2 (female) (11) – J2 (female) (With also WAS1 disconnected)		Resistance	Min. 100 kΩ
			Wiring harness among all pins between J2 (female) (1) – J2 (female) (With also WAS1 disconnected)		Resistance	Min. 100 kΩ
	4	Defective wiring harness connector	Connecting parts among accelerator pedal, engine unit wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation			
	5	Defective engine controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			J2 (Female)	Accelerator pedal	Resistance	
			Between (11) – (32)	Release	Max. 1 Ω	
				Press	Min. 1 MΩ	
			Between (1) – (32)	Release	Min. 1 MΩ	
				Press	Max. 1 Ω	

Circuit diagram related to accelerator pedal

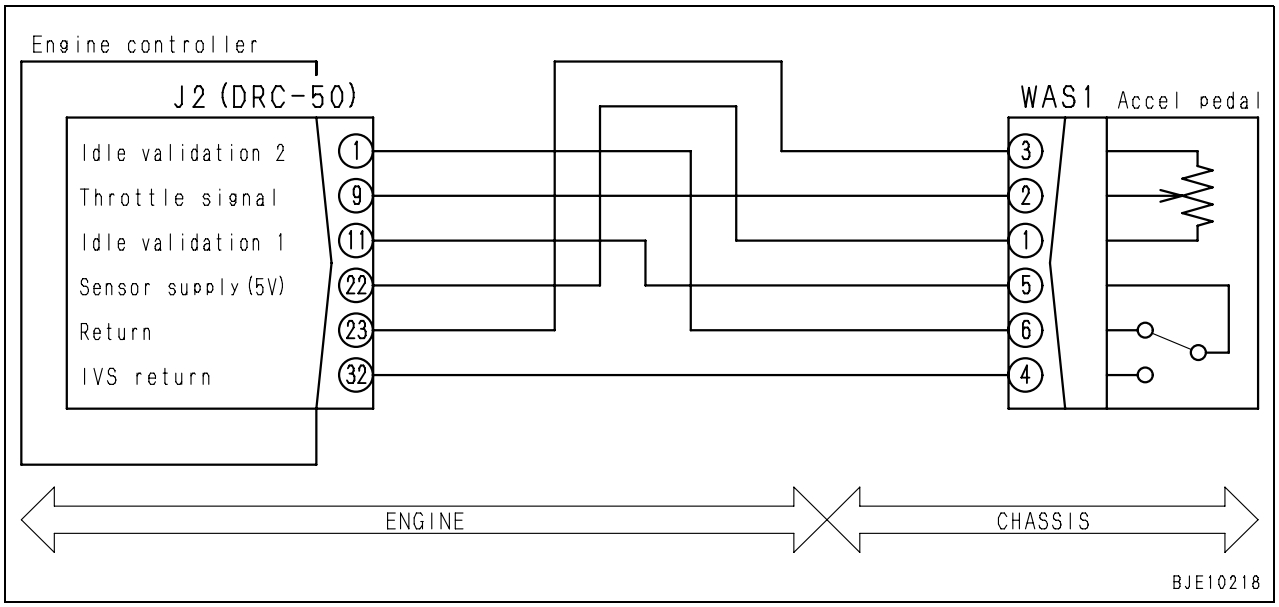


E-34 Code [432/CA432] Idle Validation Process Error

Error code	Failure code	Trouble	Abnormality in processing of idle validation processing
432	**CA432**		
Contents of trouble	• Abnormality occurred in processing of idle validation switch circuit.		
Action of controller	• Sets throttle angle to certain value and continues operation (depending on each model).		
Problem that appears on machine	• Engine speed may not rise from low idle.		
Related information	• Method of reproducing failure code: Starting switch ON, accelerator ON.		

	Causes		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective accelerator pedal	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			WAS1 (Male)	Accelerator pedal	Resistance	
			Between (2) – (1)	Release	1.5 – 3.0 kΩ	
				Press	0.25 – 1.5 kΩ	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between J2 (female) (22) – WAS1 (female) (1)		Resistance	Max. 10 Ω
			Wiring harness between J2 (female) (9) – WAS1 (female) (2)		Resistance	Max. 10 Ω
	3	Short circuit in wiring harness (With another wiring harness)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness among all pins between J2 (female) (22) – J2 (female) (With also WAS1 disconnected)		Resistance	Min. 100 kΩ
			Wiring harness among all pins between J2 (female) (9) – J2 (female) (With also WAS1 disconnected)		Resistance	Min. 100 kΩ
	4	Defective wiring harness connector	Connecting parts among accelerator pedal, engine unit wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation			
	5	Defective engine controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			J2 (Female)	Accelerator pedal	Resistance	
			Between (22) – (9)	Release	1.5 – 3.0 kΩ	
				Press	0.25 – 1.5 kΩ	

Circuit diagram related to accelerator pedal

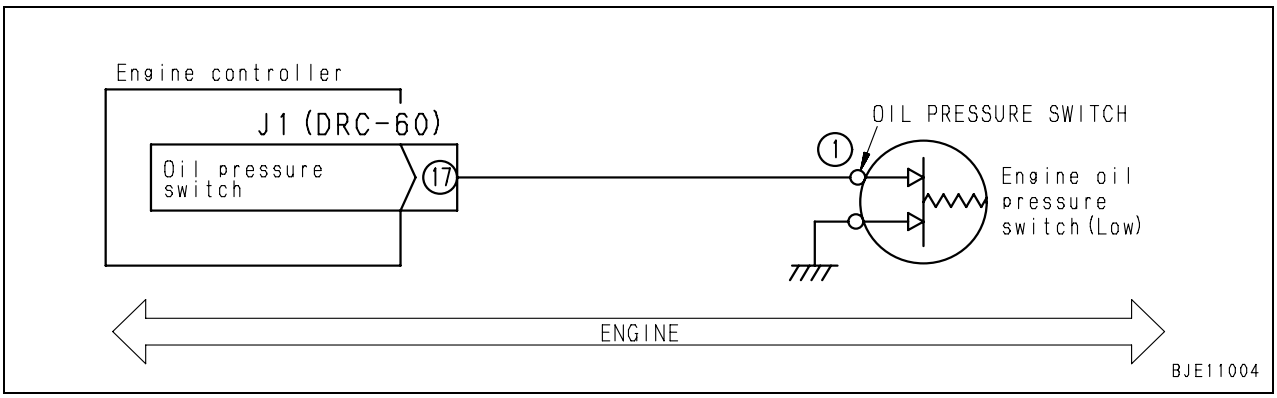


E-35 Code [435/CA435] Eng. Oil Switch Error

Error code	Failure code	Trouble	Abnormality in engine oil pressure switch
435	**CA435**		
Contents of trouble	• Abnormality occurred in engine oil pressure switch signal circuit.		
Action of controller	• None in particular.		
Problem that appears on machine	• Engine oil pressure switch-based engine protection function does not function.		
Related information	• Method of reproducing failure code: Starting switch ON or start engine		

	Causes		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective engine oil pressure switch	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			OIL PRESSURE SWITCH (male)	Resistance	
			Between (1) – body	Max. 10 Ω	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between J1 (female) (17) – OIL PRESSURE SWITCH (female) (1)	Resistance	Max. 10 Ω
	3	Short circuit in wiring harness (With another wiring harness)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness among all pins between J1 (female) (17) – J1 (female) (With all connectors of wiring harness disconnected)	Resistance	Min. 100 kΩ
	4	Defective wiring harness connector	Connecting parts among engine oil pressure switch, engine wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation		
	5	Defective engine controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			OIL PRESSURE SWITCH (male)	Resistance	
			Between (1) – body	Max. 10 Ω	

Circuit diagram related to engine oil pressure switch



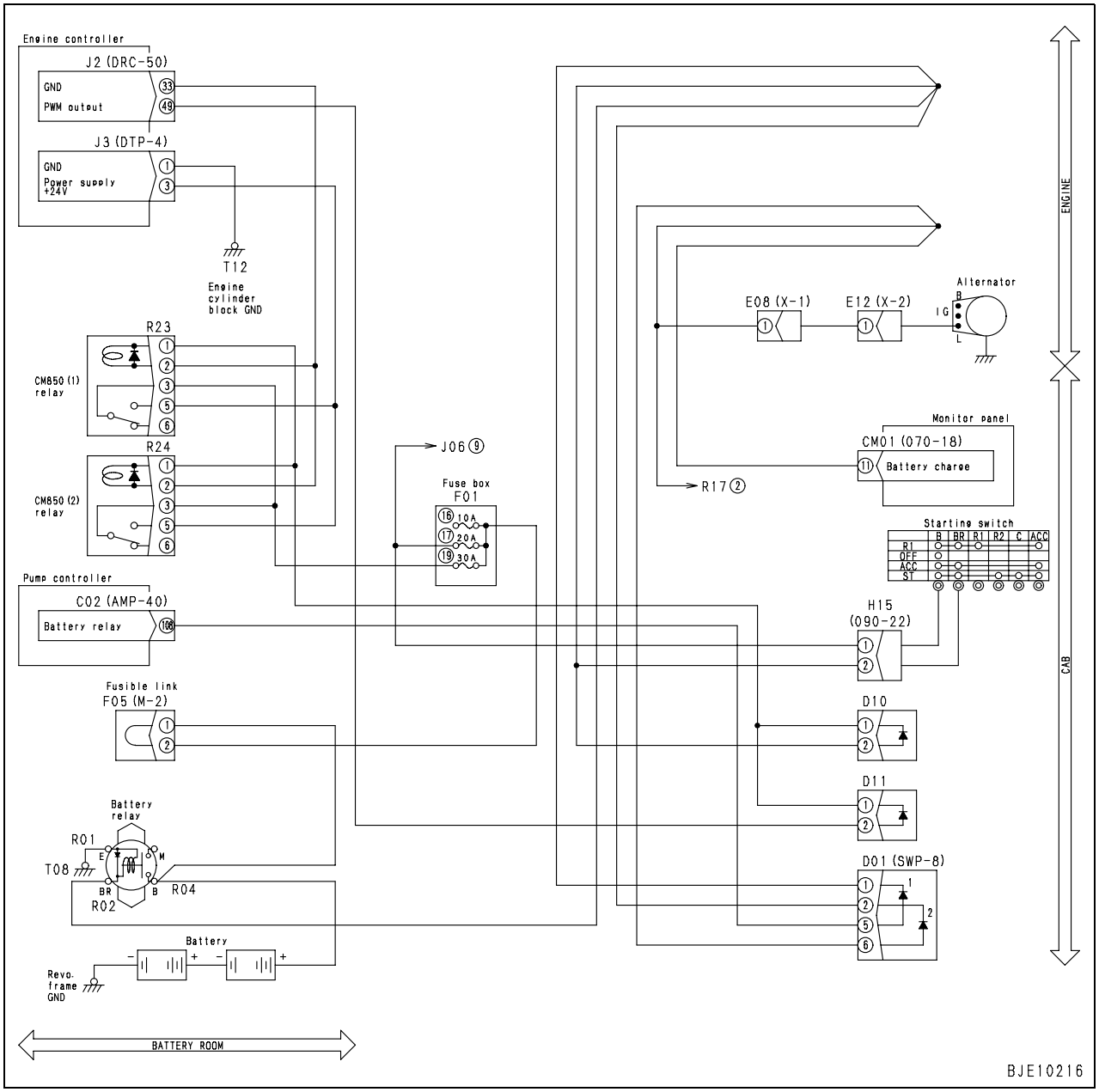
E-36 Code [441/CA441] Supply Voltage Low Error

Error code	Failure code	Trouble	Abnormally low power supply voltage
441	**CA441**		
Contents of trouble	• Low voltage occurred in controller power supply circuit.		
Action of controller	• None in particular.		
Problem that appears on machine	• Engine stops • Starting performance is poor		
Related information	• Method of reproducing failure code: Starting switch ON.		

	Causes		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Loose, corroded battery terminal	Inspect battery terminal directly for loose and corrosion.		
	2	Defective battery voltage	★ Prepare with starting switch OFF, then turn starting switch OFF and START and carry out troubleshooting.		
			Battery (1 piece)	Starting switch	Voltage
			Between (+) – (–) terminals	OFF	Min. 12 V
				START	Min. 6.2 V
	3	Defective fuse No. 19	If fuse is burnt out, circuit probably has ground fault. (See cause 6.)		
	4	Defective relay for engine controller power supply	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Replace relays for engine controller power supply (R23, R24) with other relays. If mark E of failure code disappears after reproduction operation is conducted, that relay has a defect.		
	5	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between F01-19 – R23, R24 (female) (3)	Resistance	Max. 10 Ω
			Wiring harness between R23, R24 (female) (5) – J3 (female) (3)	Resistance	Max. 10 Ω
			Wiring harness between J3 (female) (1) – chassis ground (T12)	Resistance	Max. 10 Ω
	6	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between F01-19 – R23, R24 (female) (3) and chassis ground	Resistance	Min. 100 kΩ
			Wiring harness between R23, R24 (female) (5) – J3 (female) (3) and chassis ground	Resistance	Max. 10 Ω
	7	Short circuit in wiring harness (With another wiring harness)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness among all pins between J3 (female) (3) – J3 (female) (1) (With battery terminal disconnected)	Resistance	Min. 100 kΩ
			Wiring harness among all pins between J3 (female) (3) – J2 (female) (With battery terminal disconnected)	Resistance	Min. 100 kΩ
			Wiring harness among all pins between J3 (female) (1) – J2 (female) (With battery terminal disconnected)	Resistance	Min. 100 kΩ
	8	Defective wiring harness connector	Connecting parts among fuse No. 19, engine unit wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation		

Possible causes and standard value in normal state	Causes		Standard value in normal state/Remarks on troubleshooting		
			★ Prepare with starting switch OFF, then turn starting switch ON and START and carry out troubleshooting.		
	9	Defective engine controller	J3 (Female)	Starting switch	Voltage
			Between (3) – (1)	ON	Min. 24 V
				START	Min. 12 V

Circuit diagram related to engine controller power supply

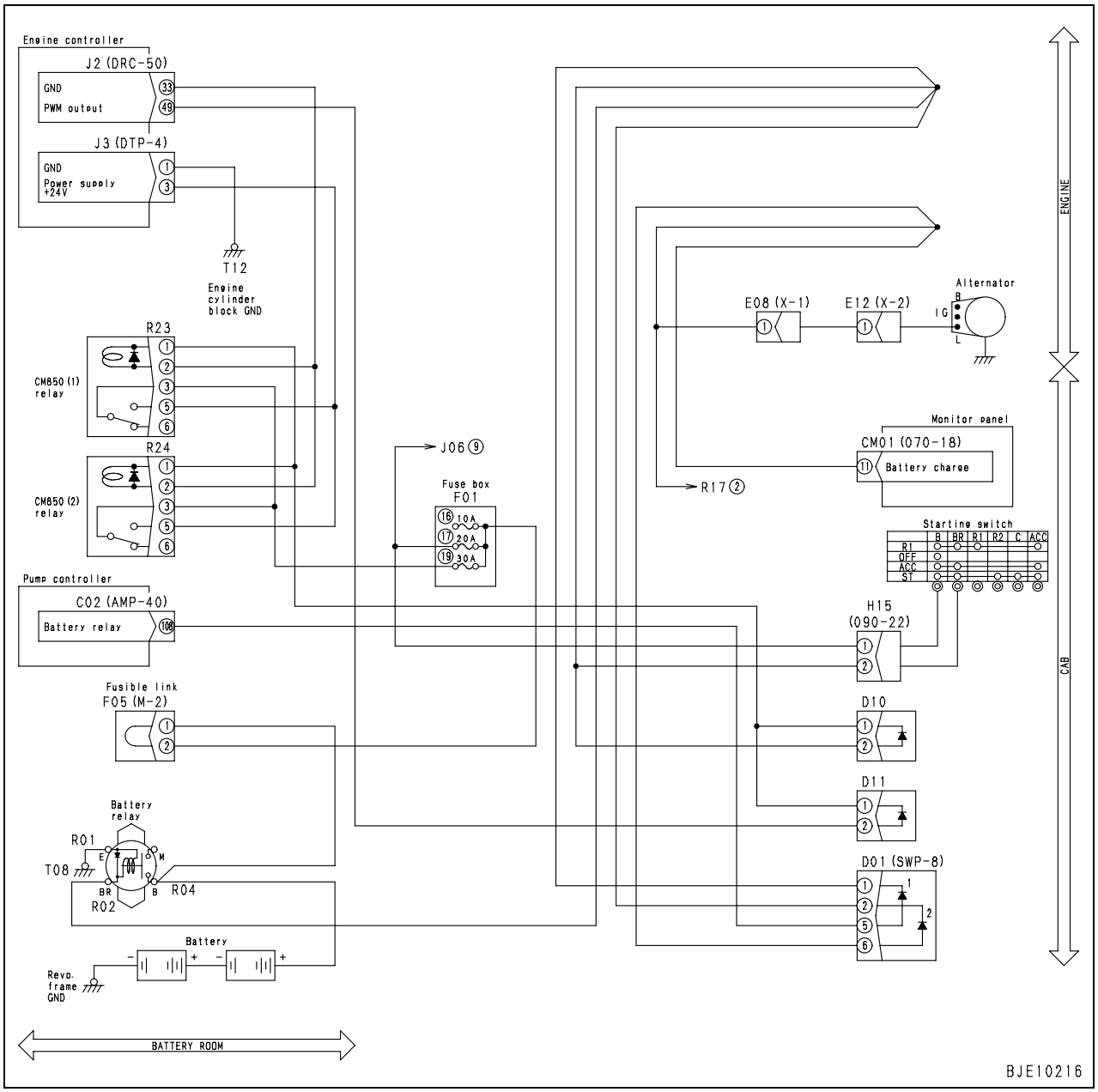


E-37 Code [442/CA442] Supply Voltage High Error

Error code	Failure code	Trouble	Abnormally high power supply voltage
442	**CA442**		
Contents of trouble	• High voltage (min. 36 V) occurred in controller power supply circuit.		
Action of controller	• None in particular.		
Problem that appears on machine	• Engine may stop.		
Related information	• Method of reproducing failure code: Starting switch ON.		

	Causes		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective battery voltage	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Battery	Voltage	
			Between (+) – (–) terminals	Max. 32 V	
	2	Defective alternator	★ Prepare with starting switch OFF, then start the engine and carry out troubleshooting.		
			E12 (Male)	Engine speed	Voltage
			Between (1) – chassis ground	Min. medium speed	27.5 – 29.5 V
	3	Defective engine controller	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			J3 (Female)	Voltage	
			Between (3) – (1)	Max. 32 V	

Circuit diagram related to engine controller power supply



E-38 Code [449/CA449] Rail Press. High Error 2

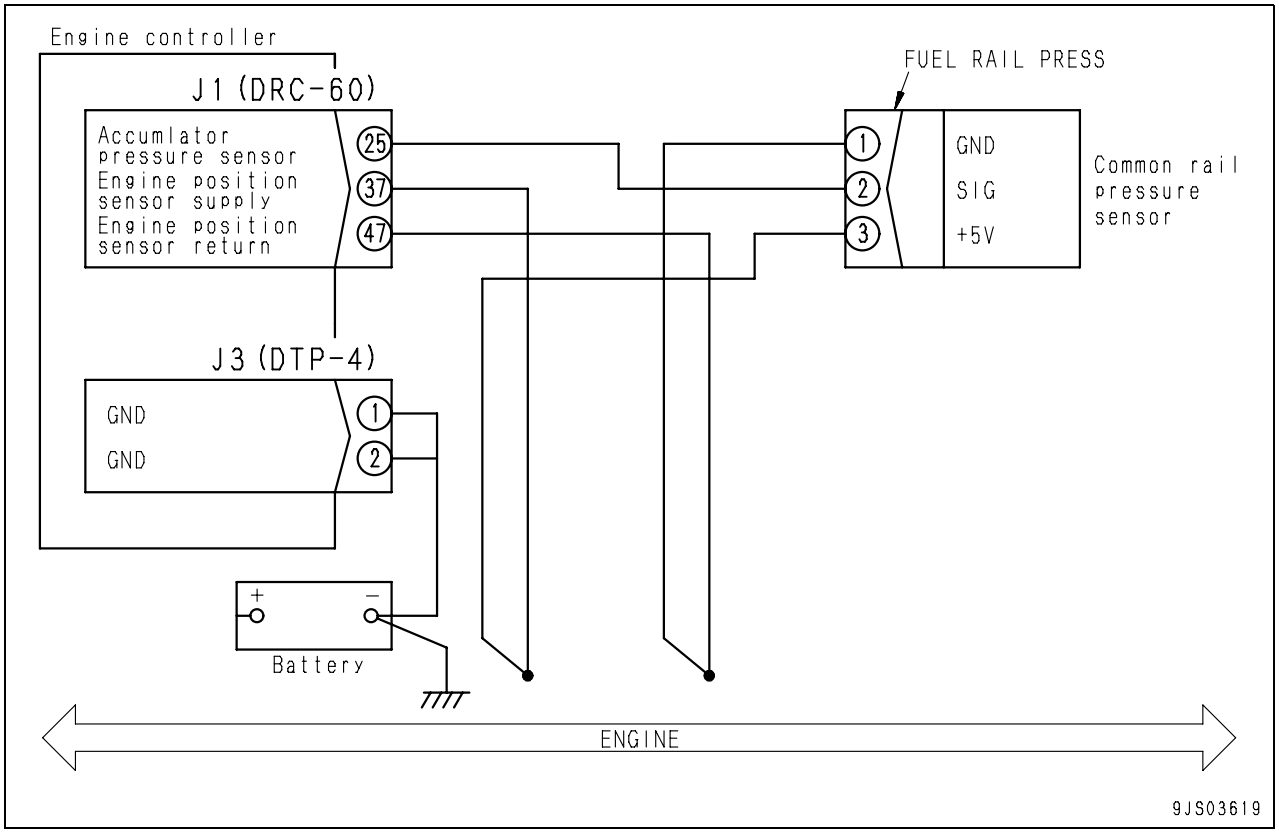
Error code	Failure code	Trouble	Abnormally high common rail pressure 2
449	**CA449**		
Contents of trouble	• Voltage (2) in common rail circuit is abnormally high.		
Action of controller	• Limits output and continues operation.		
Problem that appears on machine	• Engine output drops.		
Related information	• Method of reproducing failure code: Start engine.		

	Causes		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective related system	If another failure code is indicated, carry out troubleshooting for it.		
	2	Air in low-pressure circuit	Inspect it for air entry directly according to the following procedure. 1) Remove pressure pickup plug (outlet side) from fuel main filter. 2) Operate feed pump of fuel pre-fuel filter. 3) Inspect fuel and air from pressure pickup plug for leakage level. • If this error occurs during bleeding air after replacement of the fuel filter, air left in the fuel circuit is suspected. Continue engine operation at low idle approximately 3 minutes. When air is bled from the fuel circuit, engine speed becomes stable and the error indication disappears.		
	3	Defective fuel low-pressure circuit device	★ For check of pressure in fuel low-pressure circuit, see Testing and adjusting, “Testing fuel pressure.” • Measure at fuel filter outlet side.		
			Pressure in fuel low-pressure circuit	At high idle (When engine can be started)	Min. 0.48 MPa {Min. 4.9 kg/cm^2}
			★ For check of pressure in fuel low-pressure circuit, see Testing and adjusting, “Testing fuel pressure.” • Measure at fuel filter inlet and outlet sides. • Difference of pressure in front and rear part of filter = Fuel filter inlet pressure – Fuel filter outlet pressure		
			Difference of pressure in front and rear part of filter	At high idle	Max. 0.14 MPa {Max. 1.4 kg/cm^2}
			★ For check of fuel suction pressure, see Testing and adjusting, “Testing fuel pressure.” • Measure at gear pump fuel inlet side of supply pump.		
			Fuel suction circuit pressure (Gear pump side)	At high idle	Max. 33.9 kPa {Max. 254 mmHg}
			★ For check of fuel suction pressure, see Testing and adjusting, “Testing fuel pressure.” • Measure at fuel connector side.		
			Fuel suction circuit pressure (Fuel connector side)	At high idle	Max. 27.1 kPa {Max. 203 mmHg}
	4	Defective fuel cooler	★ Inspect fuel tube of fuel cooler for fuel leakage, O-ring and seal washer for damage, and check valve for clogging or damage directly.		
	5	Defective common rail pressure sensor	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Monitoring on INSITE	Monitoring information	
			Common rail pressure	Condition when engine stopped	0 ± 0.39 MPa {0 ± 4 kg/cm^2}

<table>
<tr><td rowspan="11">Possible causes and standard value in normal state</td><td colspan="2">Causes</td><td colspan="3">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td>6</td><td>Defective O-ring of supply pump actuator</td><td colspan="3">★ Inspect O-ring directly for breakage.</td></tr>
<tr><td rowspan="4">7</td><td rowspan="4">Defective supply pump actuator</td><td colspan="3">★ Prepare with starting switch OFF (connect INSITE), then turn starting switch ON and carry out troubleshooting.</td></tr>
<tr><td>Monitoring on INSITE</td><td colspan="2">Monitoring information</td></tr>
<tr><td>Common rail pressure</td><td>Condition when engine stopped</td><td>0 ± 0.39 MPa {0 ± 4 kg/cm^2}</td></tr>
<tr><td colspan="3">★ Prepare with starting switch OFF (connect INSITE), then start engine and carry out troubleshooting.
• Measure after running engine at idle at least 1 minute.</td></tr>
<tr><td rowspan="2">8</td><td rowspan="2">Defective wiring harness connector</td><td>Monitoring on INSITE</td><td colspan="2">Monitoring information</td></tr>
<tr><td>Common rail pressure</td><td>At low idle</td><td>1.96 MPa {20 kg/cm^2}</td></tr>
<tr><td rowspan="2">9</td><td rowspan="2">Defective wiring harness of engine controller GND</td><td colspan="3">Connection of common rail fuel pressure sensor connector or supply pump actuator is suspected. Inspect it directly.
• Loose connector, broken lock, broken seal
• Corrosive, bent, broken, forced-in, or extended pin
• Humidity in connector, entry of dirt or dust, poor insulation</td></tr>
<tr><td colspan="3">★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.</td></tr>
<tr><td>10</td><td>Defective supply pump</td><td colspan="3">If causes 1 – 9 are not detected, supply pump may be defective.</td></tr>
</table>

<table>
<tr><td>J3 (female)</td><td>Resistance</td></tr>
<tr><td>Between (1) (2) – chassis ground</td><td>Max. 10 Ω</td></tr>
</table>

Circuit diagram related to common rail pressure sensor and engine controller GND line

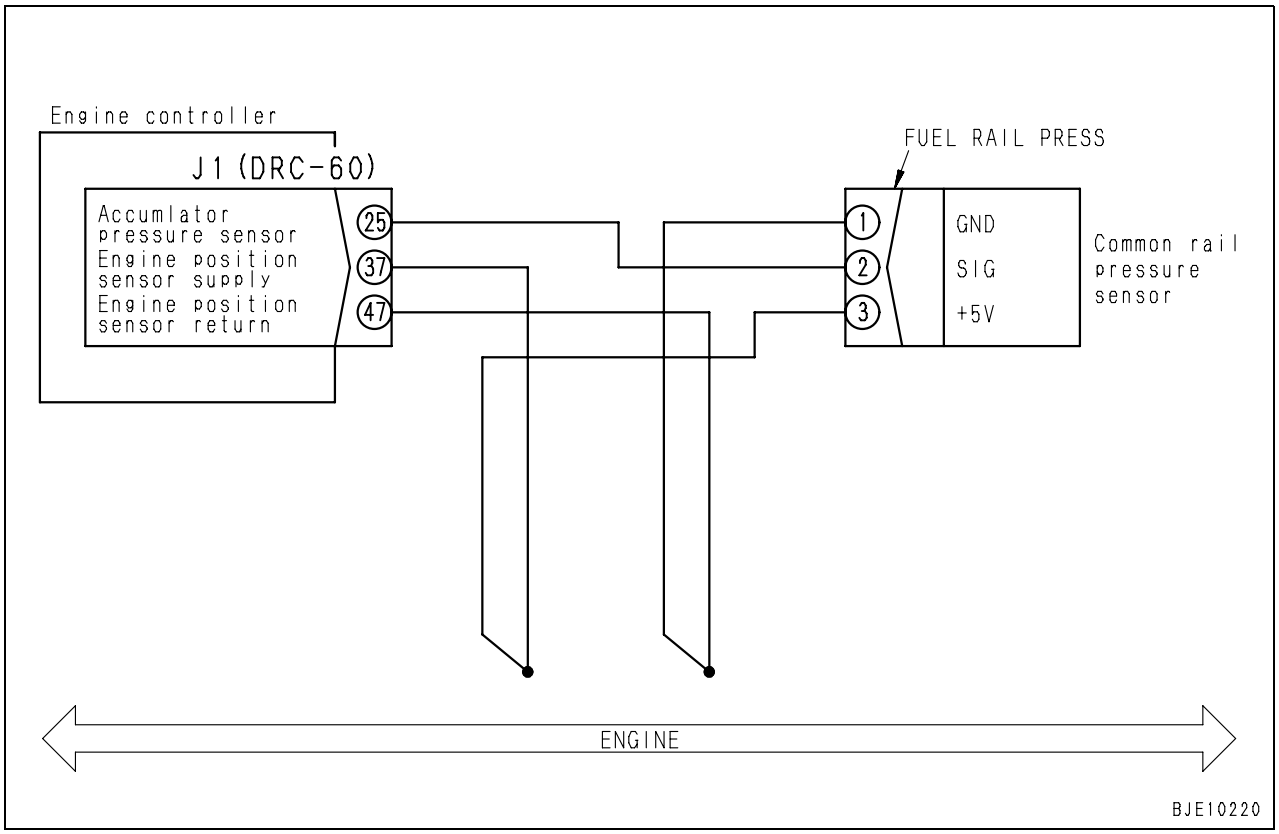


E-39 Code [451/CA451] Rail Press. Sensor High Error

Error code	Failure code	Trouble	Abnormally high level in common rail pressure sensor
451	**CA451**		
Contents of trouble	• High voltage occurred in common rail pressure sensor.		
Action of controller	• Limits output and continues operation.		
Problem that appears on machine	• Engine speed or output drops. • Engine does not start		
Related information	• Method of reproducing failure code: Starting switch ON.		

		Causes	Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective sensor power supply 2 system	If failure code [**CA227**] is indicated simultaneously, carry out troubleshooting for it first.		
	2	Defective common rail pressure sensor	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			FUEL RAIL PRESS		Voltage
			Between (3) – (1)	Power supply	4.75 – 5.25 V
			Voltage is measured with wiring harness connected. Accordingly, if voltage is abnormal, check wiring harness and controller, too, for another cause of trouble, and then judge.		
	3	Hot short (Short circuit with 5 V, 24 V circuit) in wiring harness	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Wiring harness between J1 (female) (25) – FUEL RAIL PRESS (female) (2)	Voltage	Max. 1 V
	4	Short circuit in wiring harness (With another wiring harness)	★ Troubleshoot with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between J1 (female) (25) – FUEL RAIL PRESS (female) (2) and J1 (female) (37) – FUEL RAIL PRESS (female) (3)	Resistance	Min. 100 kΩ
	5	Defective wiring harness connector	Connecting parts among common rail pressure sensor, engine wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation		
	6	Defective engine controller	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			J1		Voltage
			Between (37) – (47)	Power supply	4.75 – 5.25 V

Circuit diagram related to common rail pressure sensor

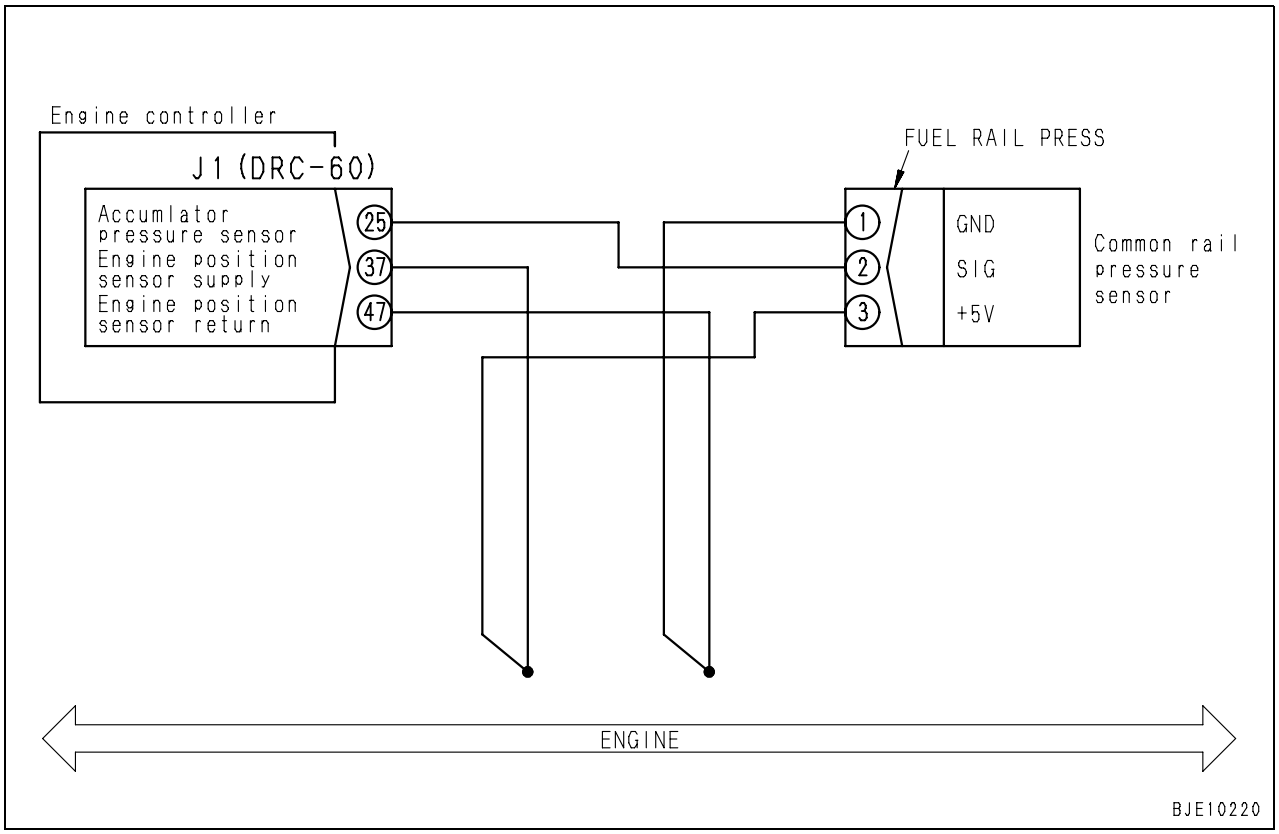


E-40 Code [452/CA452] Rail Press. Sensor Low Error

Error code	Failure code	Trouble	Abnormally low level in common rail pressure sensor
452	**CA452**		
Contents of trouble	• Low voltage occurred in common rail pressure sensor.		
Action of controller	• Limits output and continues operation.		
Problem that appears on machine	• Engine speed or output drops. • Engine does not start		
Related information	• Method of reproducing failure code: Starting switch ON.		

	Causes		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective sensor power supply 2 system	If failure code [**CA187**] is indicated simultaneously, carry out troubleshooting for it first.		
	2	Defective common rail pressure sensor	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			FUEL RAIL PRESS		Voltage
			Between (3) – (1)	Power supply	4.75 – 5.25 V
			Voltage is measured with wiring harness connected. Accordingly, if voltage is abnormal, check wiring harness and controller, too, for another cause of trouble, and then judge.		
	3	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between J1 (female) (25) – FUEL RAIL PRESS (female) (2)	Resistance	Min. 100 kΩ
	4	Short circuit in wiring harness (With another wiring harness)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between J1 (female) (25) – FUEL RAIL PRESS (female) (2) and J1 (female) (47) – FUEL RAIL PRESS (female) (1)	Resistance	Min. 100 kΩ
	5	Defective wiring harness connector	Connecting parts among common rail pressure sensor, engine wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation		
	6	Defective engine controller	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			J1		Voltage
			Between (37) – (47)	Power supply	4.75 – 5.25 V

Circuit diagram related to common rail pressure sensor



E-41 Code [488/CA488] Charge Air Temp. High Torque Derate

Error code	Failure code	Trouble	Derating of torque by abnormally high charge temperature
488	**CA488**		
Contents of trouble	• Temperature signal of boost pressure sensor and temperature sensor is above upper control limit.		
Action of controller	• Limits output and continues operation.		
Problem that appears on machine	• Output drops.		
Related information	• Method of reproducing failure code: Start engine.		

		Causes	Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	1	Drop in cooling performance of aftercooler	Inspect following directly. • Loose, broken fan belt • Lack of cooling air • Clogged aftercooler fin
	2	Abnormally high temperature at turbocharger outlet	Inspect related parts directly.
	3	Defective engine controller	If causes 1 and 2 are not detected, engine controller may be defective. (Since trouble is in system, troubleshooting cannot be carried out.)

E-42 Code [553/CA553] Rail Press. High Error 1

Error code	Failure code	Trouble	Abnormally high level in common rail pressure sensor 1
553	**CA553**		
Contents of trouble	• Voltage (1) in common rail circuit is abnormally high.		
Action of controller	• None in particular.		
Problem that appears on machine	• Engine sound becomes larger under no load or light load. • Engine output drops.		
Related information	• Method of reproducing failure code: Start engine.		

		Causes	Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	1	Defective related system	If another failure code is indicated, carry out troubleshooting for it.
	2	Defective connection of ground terminal	Inspect following directly for connection of ground terminal. • Ground terminal (battery (–)) of machine main unit. • Ground terminal of engine • Ground terminal of engine controller • Ground terminal of starting motor
	3	Broken O-ring of supply pump actuator	Inspect O-ring directly for breakage.

E-43 Code [559/CA559] Rail Press Low Error

Error code	Failure code	Trouble	No-pressure feed by supply pump 1 (Engine controller system)
559	**CA559**		
Contents of trouble	• No-pressure feed (1) occurred in common rail circuit.		
Action of controller	• None in particular.		
Problem that appears on machine	• Engine does not start or starting performance is poor • Exhaust smoke is black. • Engine output drops.		
Related information	• Method of reproducing failure code: Start engine.		

	Causes		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Fuel leakage to outside	Inspect for fuel leakage directly (visual inspection at engine low idle).		
	2	Defective low-pressure circuit device	★ For check of pressure in fuel low-pressure circuit, see Testing and adjusting, “Testing fuel pressure.” • Measure pressure at the fuel filter inlet side. • Cranking speed: Min. 150 rpm		
			Pressure in fuel low-pressure circuit	Cranking	Min. 0.14 MPa {Min. 1.4 kg/cm^2}
			★ For check of pressure in fuel low-pressure circuit, see Testing and adjusting, “Testing fuel pressure.” • Measure at fuel filter outlet side.		
			Pressure in fuel low-pressure circuit	At high idle	Min. 0.48 MPa {Min. 4.9 kg/cm^2}
			★ For check of pressure in fuel low-pressure circuit, see Testing and adjusting, “Testing fuel pressure.” • Measure at fuel filter inlet and outlet sides. • Difference of pressure in front and rear part of filter = Fuel filter inlet pressure – Fuel filter outlet pressure		
			Difference of pressure in front and rear part of filter	At high idle	Max. 0.14 MPa {Max. 1.4 kg/cm^2}
			★ For check of fuel suction pressure, see Testing and adjusting, “Testing fuel pressure.” • Measure at gear pump fuel inlet side of supply pump.		
			Fuel suction circuit pressure (Gear pump side)	At high idle	Max. 33.9 kPa {Max. 254 mmHg}
			★ For check of fuel suction pressure, see Testing and adjusting, “Testing fuel pressure.” • Measure at fuel connector side.		
			Fuel suction circuit pressure (Fuel connector side)	At high idle	Max. 27.1 kPa {Max. 203 mmHg}
	3	Defective injector (High-pressure piping in head included)	★ For testing of return rate from injector, see Testing and adjusting, “Testing leakage from pressure limiter and return rate from injector.”		
			Return rate from injector	Cranking (When engine cannot be started)	Max. 100 cc/ 30 sec.
				At low idle (When engine can be started)	Max. 300 cc/ 45 sec.

<table>
<tr><td rowspan="8">Possible causes and standard value in normal state</td><td colspan="2">Causes</td><td colspan="3">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td rowspan="3">4</td><td rowspan="3">Defective supply pump</td><td colspan="3">★ For testing of return rate from supply pump, see Testing and adjusting, “Testing leakage from pressure limiter and return rate from injector.”</td></tr>
<tr><td rowspan="2">Return rate from supply pump</td><td>Cranking (When engine cannot be started)</td><td>Max. 200 cc/ 30 sec.</td></tr>
<tr><td>At low idle (When engine can be started)</td><td>Max. 300 cc/ 30 sec.</td></tr>
<tr><td rowspan="2">5</td><td rowspan="2">Defective pressure limiter</td><td colspan="3">★ For testing of leakage from pressure limiter, see Testing and adjusting, “Testing leakage from pressure limiter and return rate from injector.”</td></tr>
<tr><td>Leakage from pressure limiter</td><td>At low idle</td><td>Below 30 drops/ 60 sec.</td></tr>
<tr><td>6</td><td>Defects in supply pump plunger</td><td colspan="3">★ Remove supply pump head, and inspect plunger for damage directly.</td></tr>
<tr><td>7</td><td>Air in low-pressure circuit</td><td colspan="3">Inspect it for air entry directly according to the following procedure.
1) Remove pressure pickup plug (outlet side) from fuel main filter.
2) Operate feed pump of fuel pre-fuel filter.
3) Inspect fuel and air from pressure pickup plug for leakage level.
• If this error occurs during bleeding air after replacement of the fuel filter, air left in the fuel circuit is suspected. Continue engine operation at low idle approximately 3 minutes. When air is bled from the fuel circuit, engine speed becomes stable and the error indication disappears.</td></tr>
</table>

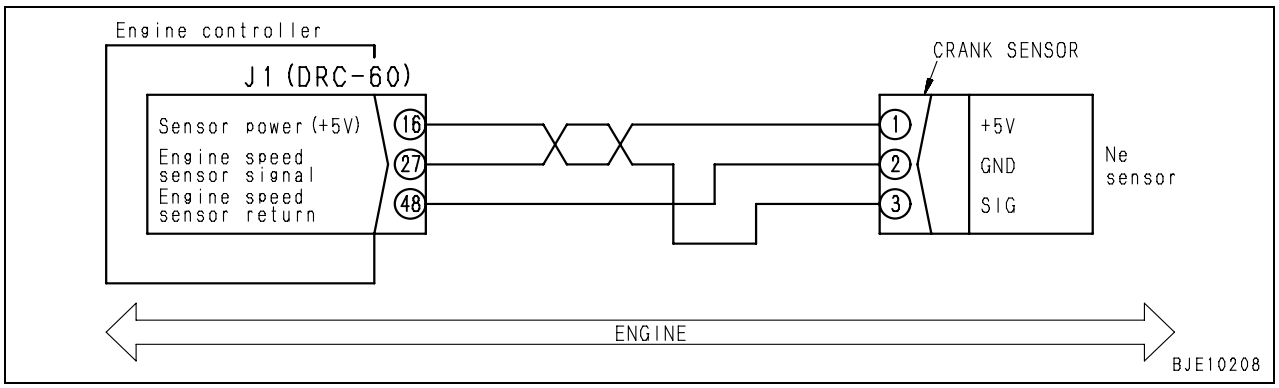
E-44 Code [689/CA689] Eng. Ne Speed Sensor Error

Error code	Failure code	Trouble	Abnormality in engine Ne speed sensor
689	**CA689**		
Contents of trouble	• Abnormality occurred in signals from engine Ne speed sensor.		
Action of controller	• Controls Ne speed sensor with signals of Bkup speed sensor.		
Problem that appears on machine	• There is hunting from engine. • Starting performance is poor • Engine output drops.		
Related information	• Method of reproducing failure code: Start engine.		

		Causes	Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective Ne speed sensor power supply system	If failure code [**CA238**] is indicated simultaneously, carry out troubleshooting for it first.		
	2	Defective engine Ne speed sensor	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			CRANK SENSOR		Voltage
			Between (1) – (2)	Power supply	4.75 – 5.25 V
			Voltage is measured with wiring harness connected. Accordingly, if voltage is abnormal, check wiring harness and controller, too, for another cause of trouble, and then judge.		
	3	Broken engine Ne speed sensor or defective clearance	Inspect engine Ne speed sensor for breakage or clearance.		
	4	Broken rotation sensing flywheel	Inspect it for breakage directly.		
	5	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between J1 (female) (27) – CRANK SENSOR (female) (3)	Resistance	Max. 10 Ω
	6	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between J1 (female) (27) – CRANK SENSOR (female) (3) and chassis ground	Resistance	Min. 100 kΩ
	7	Hot short (Short circuit with 5V, 24V circuit) in wiring harness	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Wiring harness between J1 (female) (27) – CRANK SENSOR (female) (3) and chassis ground	Voltage	Max. 1 V
	8	Short circuit in wiring harness (With another wiring harness)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between J1 (female) (27) – CRANK SENSOR (female) (3) and J1 (female) (16) – CRANK SENSOR (female) (1)	Resistance	Min. 100 kΩ
			Wiring harness between J1 (female) (27) – CRANK SENSOR (female) (3) and J1 (female) (48) – CRANK SENSOR (female) (2)	Resistance	Min. 100 kΩ
	9	Defective wiring harness connector	Connecting parts among engine Ne speed sensor, engine wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation		

Possible causes and standard value in normal state	Causes		Standard value in normal state/Remarks on troubleshooting		
	10	Defective engine controller	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			J1		Voltage
			Between (16) – (48)	Power supply	4.75 – 5.25 V

Circuit diagram related to engine Ne speed sensor



E-45 Code [731/CA731] Eng. Bkup Speed Sensor Phase Error

Error code	Failure code	Trouble	Abnormality in engine Bkup speed sensor phase
731	**CA731**		
Contents of trouble	• Abnormal phase is detected in signals of engine Ne speed sensor and engine Bkup speed sensor.		
Action of controller	• Controls with signals of engine Ne speed sensor.		
Problem that appears on machine	• Engine does not start or is difficult to start. • Idle speed is unstable. • Exhaust smoke is black.		
Related information	• Method of reproducing failure code: Start engine.		

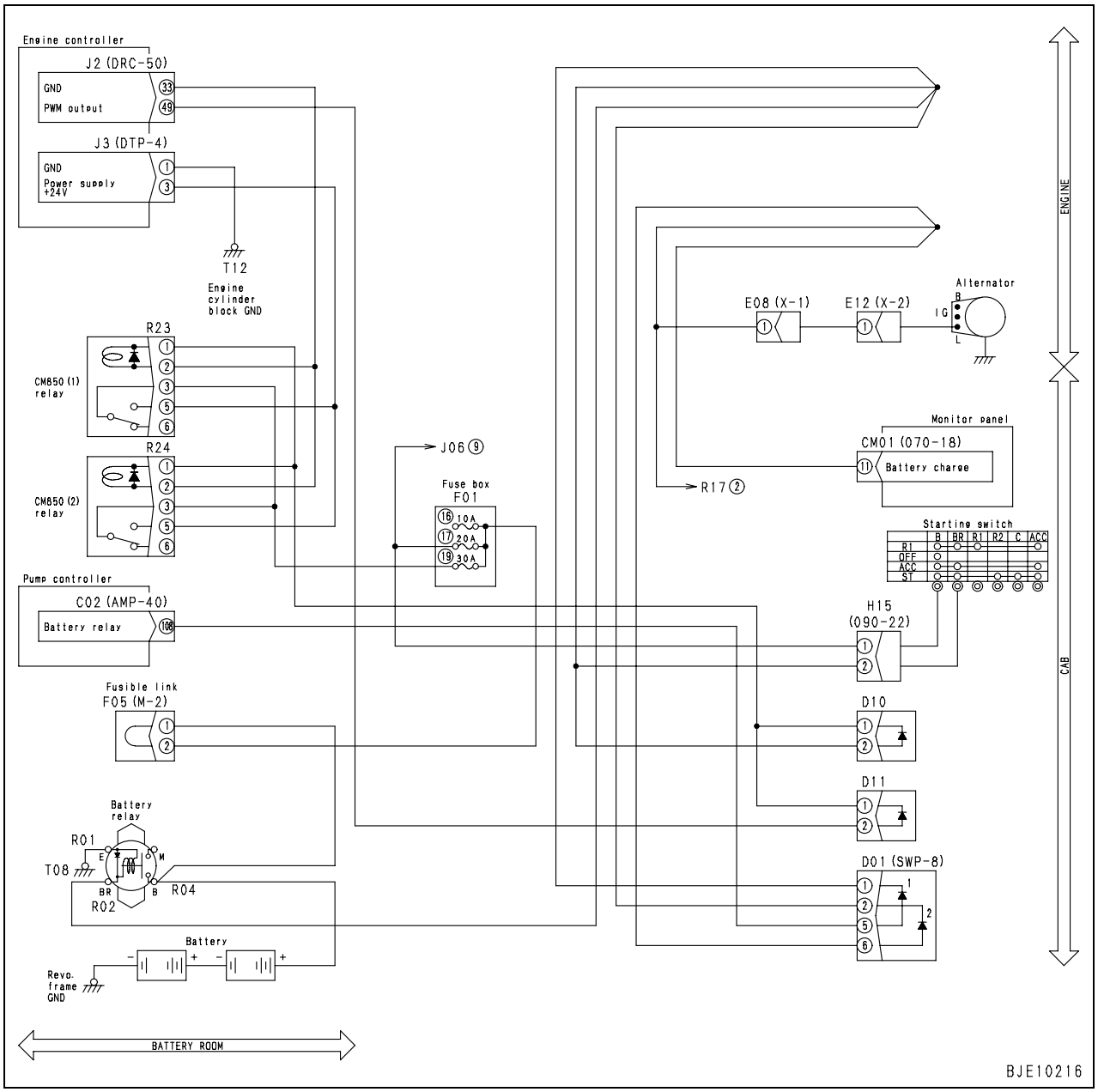
		Causes	Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	1	Broken engine Ne speed sensor	Inspect engine Ne speed sensor for breakage directly.
	2	Broken engine Bkup speed sensor	Inspect engine Bkup speed sensor for breakage directly.
	3	Defective or broken mount of rotation sensing ring on crankshaft side	Inspect it for defect or breakage according to the following procedure. 1) Set No. 1 cylinder to compression top dead center (align stamping mark). 2) If center of speed sensor ring notch is at end of Ne speed sensor, speed sensor ring is installed normally.
	4	Defective or broken mount of rotation sensing ring on camshaft side	Inspect rotation sensing gear for defect or breakage according to the following procedure. 1) Set No. 1 cylinder to compression top dead center (align stamping mark). 2) Remove Bkup speed sensor. 3) If groove of rotation sensing gear side can be seen through sensor mounting hole, it is mounted normally.
	5	Defective timing between crankshaft and camshaft	Inspect crankshaft and camshaft for timing directly.
	6	Defective connection of ground terminal	Inspect following directly for connection of ground terminal. • Ground terminal (battery (–)) of machine main unit. • Ground terminal of engine • Ground terminal of engine controller • Ground terminal of starting motor

E-46 Code [757/CA757] All Engine Controller Data Lost Error

Error code	Failure code	Trouble	Loss of all data in engine controller
757	**CA757**		
Contents of trouble	• All data in engine controller are lost.		
Action of controller	• None in particular.		
Problem that appears on machine	• Engine stops and sometimes cannot be started. • Monitoring function of machine monitor (engine controller system) may not work normally.		
Related information	• Method of reproducing failure code: Starting switch ON.		

Possible causes and standard value in normal state	Causes		Standard value in normal state/Remarks on troubleshooting			
	1	Defective related system	If another failure code is indicated, carry out troubleshooting for it.			
	2	Loose or corroded battery terminal	Inspect battery terminal directly for loose and corrosion.			
	3	Defective battery voltage	★ Prepare with starting switch OFF, then turn starting switch OFF and START and carry out troubleshooting.			
			Battery (1 piece)	Starting switch	Voltage	
			Between (+) – (–) terminals	OFF	Min. 12 V	
				START	Min. 6.2 V	
	4	Defective fuse No. 19	If fuse is burnt out, circuit probably has ground fault.			
	5	Defective relay for engine controller power supply	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			Replace relays for engine controller power supply (R23, R24) with other relays. If mark E of failure code disappears after reproduction operation is conducted, that relay has a defect.			
	6	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between F01-19 – R23, R24 (female) (3)		Resistance	Max. 10 Ω
			Wiring harness between R23, R24 (female) (5) – J3 (female) (3)		Resistance	Max. 10 Ω
			Wiring harness between J3 (female) (1) – chassis ground (T12)		Resistance	Max. 10 Ω
	7	Defective wiring harness connector	Connecting parts among fuse No. 19, engine unit wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation			
	8	Defective engine controller	★ Prepare with starting switch OFF, then turn starting switch ON and START and carry out troubleshooting.			
			J3 (female)	Starting switch	Voltage	
			Between (3) – (1)	ON	Min. 24 V	
				START	Min. 12 V	

Circuit diagram related to engine controller power supply



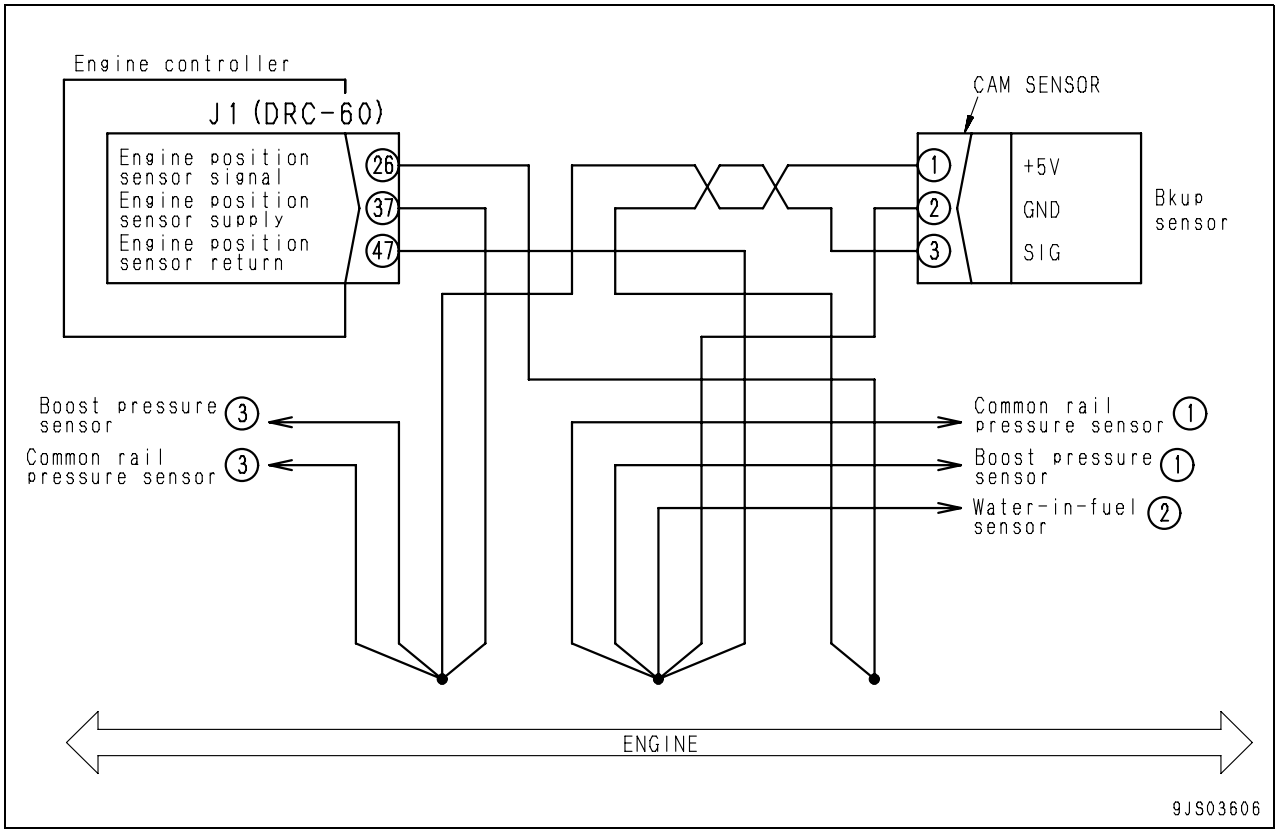
E-47 Code [778/CA778] Eng. Bkup Speed Sensor Error

Error code	Failure code	Trouble	Abnormality in engine Bkup speed sensor
778	**CA778**		
Contents of trouble	• Abnormality is detected in signals of engine Bkup speed sensor.		
Action of controller	• Controls with signals of Ne speed sensor.		
Problem that appears on machine	• Starting performance is poor • Output drops.		
Related information	• Method of reproducing failure code: Start engine.		

	Causes		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective sensor power supply 2 system	If failure code [**CA187**] is indicated simultaneously, carry out troubleshooting for it first.		
	2	Defective engine Bkup speed sensor	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			CAM SENSOR		Voltage
			Between (1) – (2)	Power supply	4.75 – 5.25 V
			Voltage is measured with wiring harness connected. Accordingly, if voltage is abnormal, check wiring harness and controller, too, for another cause of trouble, and then judge.		
	3	Broken engine Bkup speed sensor or defective clearance	Inspect engine Bkup speed sensor directly for breakage or clearance.		
	4	Broken rotation sensing ring	Inspect it for breakage directly.		
	5	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between J1 (female) (26) – CAM SENSOR (female) (3)	Resistance	Max. 10 Ω
	6	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between J1 (female) (26) – CAM SENSOR (female) (3)	Resistance	Min. 100 kΩ
	7	Hot short (Short circuit with 5V, 24V circuit) in wiring harness	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Wiring harness between J1 (female) (26) – CAM SENSOR (female) (3)	Voltage	Max. 1 V
	8	Short circuit in wiring harness (With another wiring harness)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between J1 (female) (26) – CAM SENSOR (female) (3) and J1 (female) (37) – CAM SENSOR (female) (1)	Resistance	Min. 100 kΩ
			Wiring harness between J1 (female) (26) – CAM SENSOR (female) (3) and J1 (female) (47) – CAM SENSOR (female) (2)	Resistance	Min. 100 kΩ
	9	Defective wiring harness connector	Connecting parts among engine Bkup speed sensor, engine wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation		

Possible causes and standard value in normal state	Causes		Standard value in normal state/Remarks on troubleshooting		
	10	Defective engine controller	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			J1		Voltage
			Between (37) – (47)	Power supply	4.75 – 5.25 V

Circuit diagram related to engine Bkup speed sensor

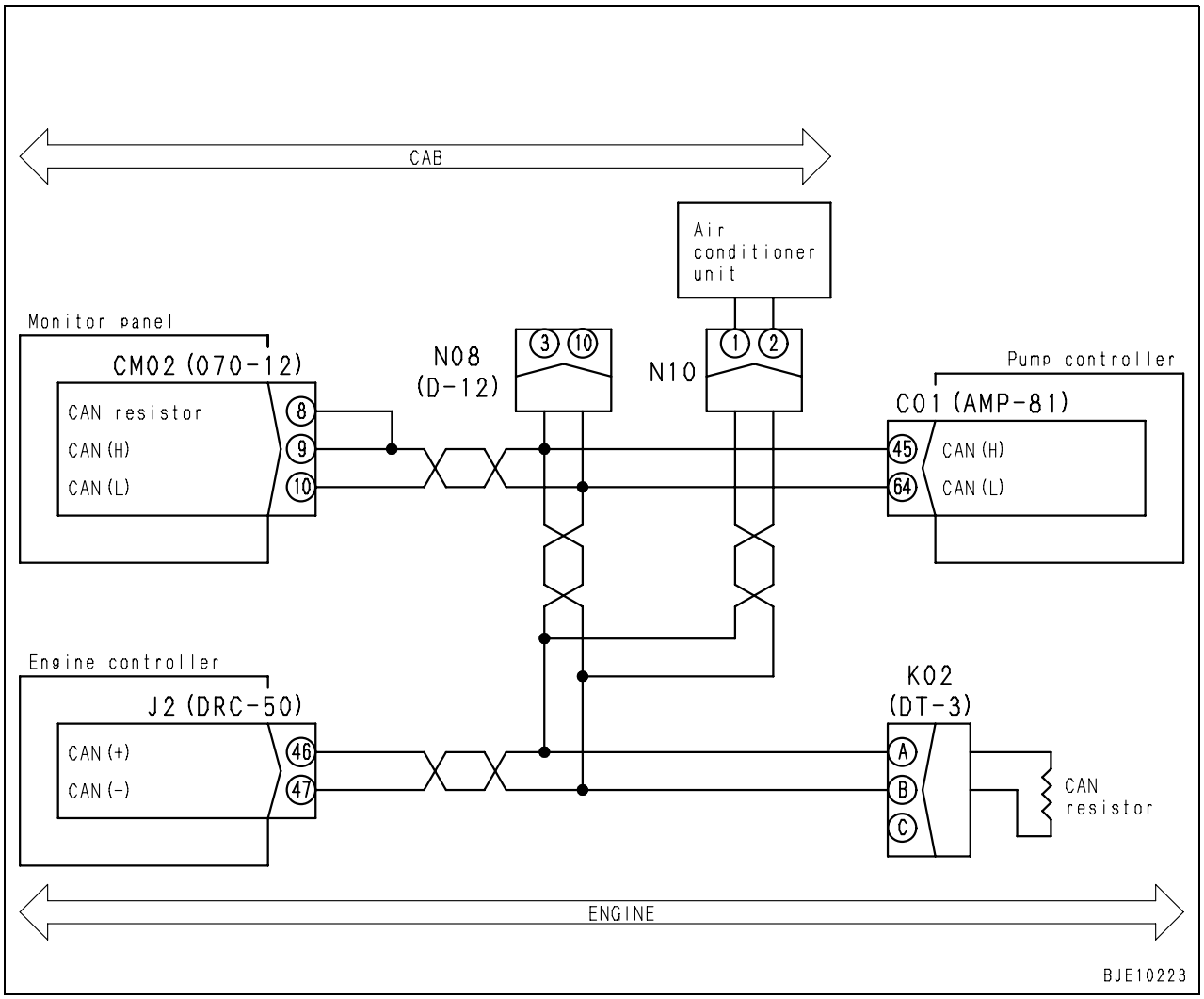


E-48 Code [1633/CA1633] KOMNET Error

Error code	Failure code	Trouble	Abnormality in KOMNET
1633	**CA1633**		
Contents of trouble	• Engine controller detected abnormality in KOMNET communication circuit to controllers on applicable machine side.		
Action of controller	• Depends on machine model. • If problem is removed, system is returned to normal operating state.		
Problem that appears on machine	• KOMNET communication information may not be transmitted correctly to cause incorrect operation of machine. (Problem depends on failure occurrence location.)		
Related information	• Method of reproducing failure code: Starting switch ON.		

	Causes		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CM02 (female) (8) (9) – C01 (female) (45), – J2 (female) (46), – K02 (female) (A)	Resistance	Max. 1 Ω
			Wiring harness between CM02 (female) (10) – C01 (female) (64), – J2 (female) (47), – K02 (female) (B)	Resistance	Max. 1 Ω
	2	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CM02 (female) (8) (9) – C01 (female) (45), – J2 (female) (46), – K02 (female) (A), – N08 (male) (3)	Resistance	Min. 1 MΩ
			Wiring harness between CM02 (female) (10) – C01 (female) (64), – J2 (female) (47), – K02 (female) (B), – N08 (male) (10)	Resistance	Min. 1 MΩ
	3	Hot short (Short circuit with 24V circuit) in wiring harness	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Wiring harness between CM02 (female) (8) (9) – C01 (female) (45), – J2 (female) (46), – K02 (female) (A), – N08 (male) (3)	Voltage	Max. 5.5 V
			Wiring harness between CM02 (female) (10) – C01 (female) (64), – J2 (female) (47), – K02 (female) (B), – N08 (male) (10)	Voltage	Max. 5.5 V
	4	Defective CAN terminal resistance (Internal short circuit, disconnection)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			K02 (male)	Resistance	
			Between (A) – (B)	47 – 67 Ω	
	5	Defective pump controller	If causes 1 – 4 are not detected, engine controller may be defective. (Since trouble is in system, troubleshooting cannot be carried out.)		

Circuit diagram related to CAN communication

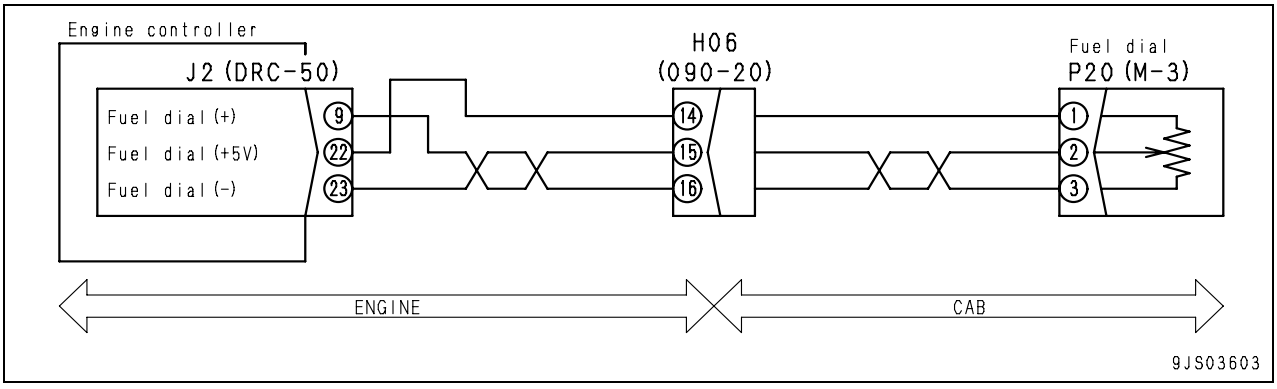


E-49 Code [2185/CA2185] Throttle Sens. Sup. Volt. High Error

Error code	Failure code	Trouble	Abnormally high level in throttle sensor
2185	**CA2185**		
Contents of trouble	• High voltage (min. 5.25 V) occurred in throttle sensor power supply circuit.		
Action of controller	• Depends on machine model.		
Problem that appears on machine	• Depends on machine model.		
Related information	• Method of reproducing failure code: Starting switch ON.		

	Causes		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state			★ Troubleshoot with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
	1	Short circuit in wiring harness (With another wiring harness)	Wiring harness among all pins between J2 (female) (22) – J2 (female) (With P20 disconnected)	Resistance	Min. 100 kΩ
			Between J2 (female) (22) – J3 (female) (3) (With P20 disconnected)	Resistance	Min. 100 kΩ
	2	Defective wiring harness connector	Connecting parts among fuel control dial, engine unit wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation		
	3	Defective engine controller	If causes 1 and 2 are not detected, engine controller may be defective. (Since trouble is in system, troubleshooting cannot be carried out.)		

Circuit diagram related to fuel control dial

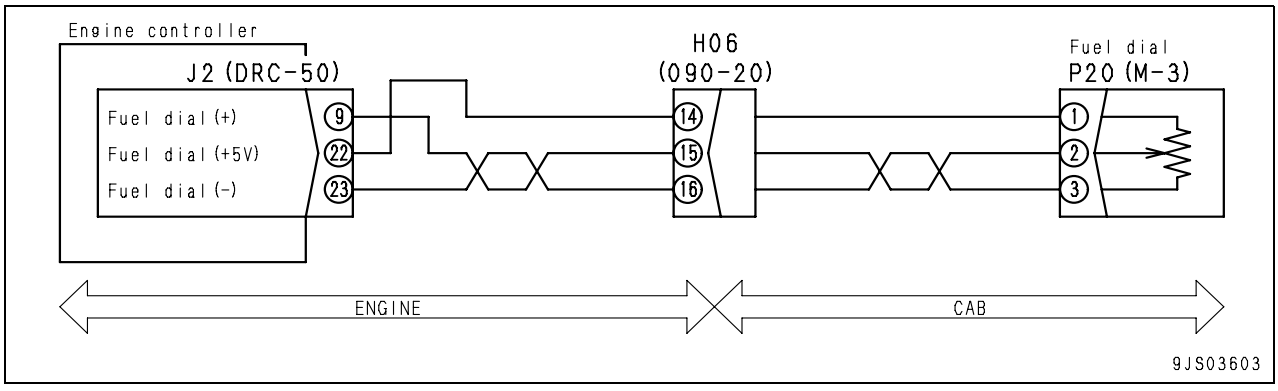


E-50 Code [2186/CA2186] Throttle Sens. Sup. Volt. Low Error

Error code	Failure code	Trouble	Abnormally low level in throttle sensor power supply
2186	**CA2186**		
Contents of trouble	• Low voltage occurred in throttle sensor power supply circuit.		
Action of controller	• Depends on machine model.		
Problem that appears on machine	• Depends on machine model.		
Related information	• Method of reproducing failure code: Starting switch ON.		

	Causes		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Ground fault in wiring harness (Short circuit with GND circuit)	★ Troubleshoot with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between J2 (female) (22) – P20 (female) (1)	Resistance	Min. 100 kΩ
	2	Short circuit in wiring harness (With another wiring harness)	★ Troubleshoot with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness among all pins between J2 (female) (9) – J2 (female) (With P20 disconnected)	Resistance	Min. 100 kΩ
	3	Defective wiring harness connector	Connecting parts among fuel control dial, engine unit wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation		
	4	Defective engine controller	If causes 1 – 3 are not detected, engine controller may be defective. (Since trouble is in system, troubleshooting cannot be carried out.)		

Circuit diagram related to fuel control dial



E-51 Code [2249/CA2249] Rail Press very Low Error

Error code	Failure code	Trouble	No-pressure feed by supply pump 2
2249	**CA2249**		
Contents of trouble	• No-pressure feed (2) occurred in common rail circuit.		
Action of controller	• Limits output and continues operation.		
Problem that appears on machine	• Starting performance is poor • Exhaust smoke is black. • Output drops.		
Related information	• Method of reproducing failure code: Start engine.		

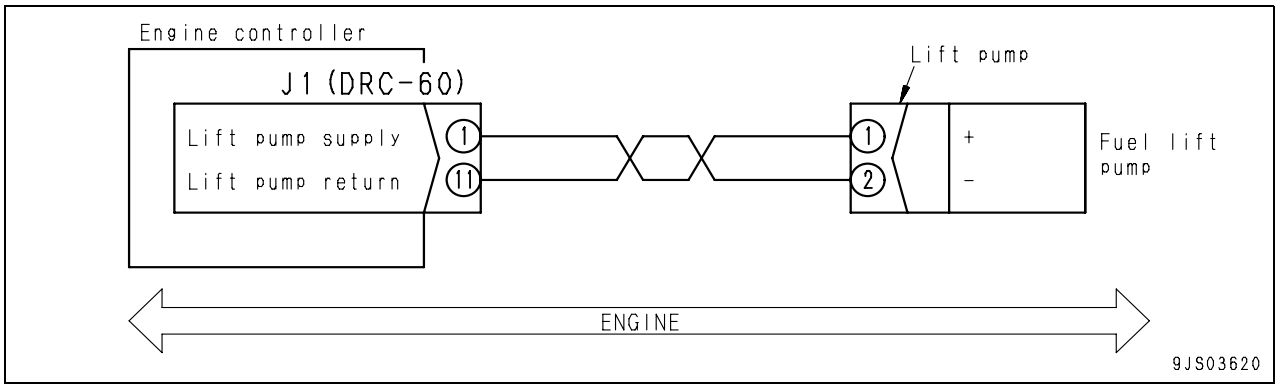
Possible causes and standard value in normal state	Causes	Standard value in normal state/Remarks on troubleshooting
	1	Carry out troubleshooting for failure code [**CA559**].

E-52 Code [2265/CA2265] Abnormally high level in electric lift pump

Error code	Failure code	Trouble	Abnormally high level in electric lift pump
2265	**CA2265**		
Contents of trouble	• There is disconnection in electric lift pump actuator drive circuit.		
Action of controller	• None in particular.		
Problem that appears on machine	• Starting performance is poor		
Related information	• Method of reproducing failure code: Starting switch ON.		

	Causes		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective electric lift pump (Internal short circuit, disconnection)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			LIFT PUMP (female)	Resistance		
			Between (1) – (2)	Max. 20 Ω		
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between J1 (female) (1) – LIFT PUMP (female) (1)	Resistance	Max. 10 Ω	
			Wiring harness between J1 (female) (11) – LIFT PUMP (female) (2)	Resistance	Max. 10 Ω	
	3	Hot short (Short circuit with 12 V circuit) in wiring harness	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			Wiring harness between J1 (female) (1) – LIFT PUMP (female) (1)	Voltage	Max. 6 V	
	4	Short circuit in wiring harness (With another wiring harness)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness among all pins between J1 (female) (1) – J1 (female) (With all connectors of wiring harness disconnected)	Resistance	Min. 100 kΩ	
	5	Defective wiring harness connector	Connecting parts among electric lift pump, engine wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation			
	6	Defective engine controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			J1 (female)	Resistance		
			Between (1) – (11)	Max. 20 Ω		

Circuit diagram related to electric lift pump actuator

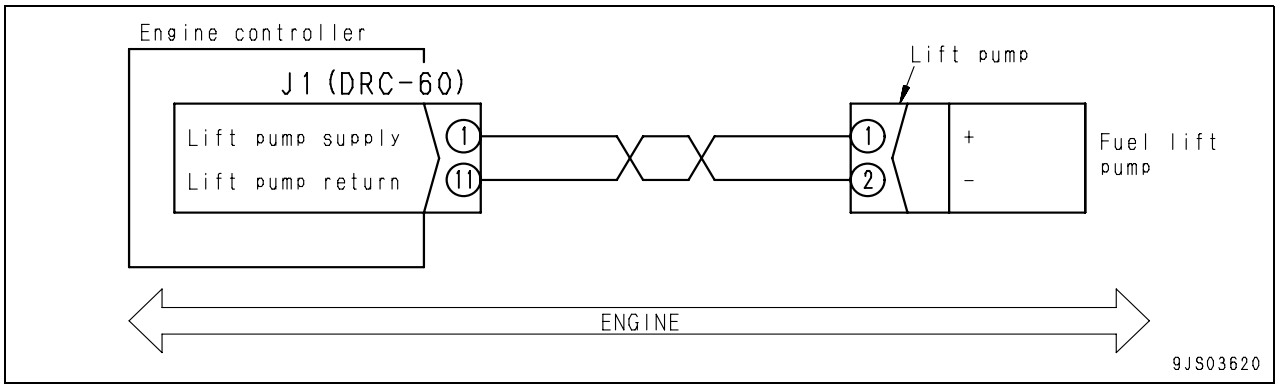


E-53 Code [2266/CA2266] Abnormally low level in electric lift pump

Error code	Failure code	Trouble	Abnormally low level in electric lift pump
2266	**CA2266**		
Contents of trouble	• There is short circuit in electric lift pump actuator drive circuit.		
Action of controller	• None in particular.		
Problem that appears on machine	• Starting performance is poor		
Related information	• Method of reproducing failure code: Starting switch ON.		

	Causes		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective electric lift pump (Internal short circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			LIFT PUMP (female)	Resistance		
			Between (1) – (2)	Max. 20 Ω		
			Between (1) – chassis ground	Min. 100 kΩ		
	2	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between J1 (female) (1) – LIFT PUMP (female) (1)	Resistance	Max. 100 kΩ	
	3	Hot short in wiring harness (Short circuit with 24 V circuit)	★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			Wiring harness between J1 (female) (1) – LIFT PUMP (female) (1) – chassis ground	Voltage	Max. 6 V	
	4	Short circuit in wiring harness (With another wiring harness)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness among all pins between J1 (female) (1) – J1 (female) (With all connectors of wiring harness disconnected)	Resistance	Min. 100 kΩ	
	5	Defective wiring harness connector	Connecting parts among electric lift pump, engine wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation			
	6	Defective engine controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			J1 (female)	Resistance		
			Between (1) – (11)	Max. 20 Ω		
			Between (1) – chassis ground	Min. 100 kΩ		

Circuit diagram related to electric lift pump actuator

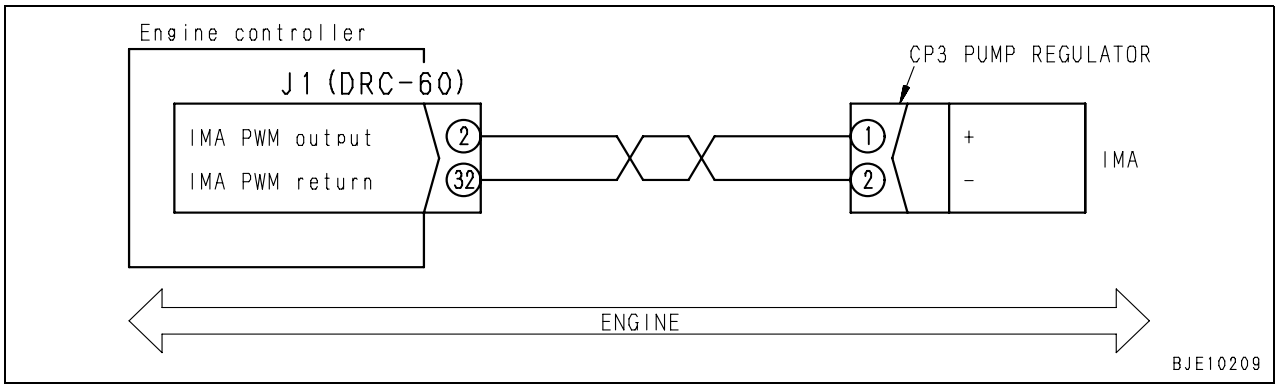


E-54 Code [2311/CA2311] IMV (IMA) Solenoid Error

Error code	Failure code	Trouble	Abnormality in IMV (IMA) solenoid
2311	**CA2311**		
Contents of trouble	• Resistance in supply pump actuator is abnormally high or low.		
Action of controller	• None in particular.		
Problem that appears on machine	• Engine output drops.		
Related information	• Method of reproducing failure code: Start engine.		

Possible causes and standard value in normal state	Causes		Standard value in normal state/Remarks on troubleshooting		
	1	Defective related system	If another failure code is indicated, carry out troubleshooting for it.		
	2	Defective supply pump actuator	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CP3 PUMP REGULATOR (Male)	Resistance	
			Between (1) – (2)	Max. 5 Ω	
			Between (1) – chassis ground	Min. 100 kΩ	
	3	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between J1 (female) (2) – CP3 PUMP REGULATOR (female) (1)	Resistance	Max. 5 Ω
			Wiring harness between J1 (female) (32) – CP3 PUMP REGULATOR (female) (2)	Resistance	Max. 5 Ω
	4	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between J1 (female) (2) – CP3 PUMP REGULATOR (female) (1)	Resistance	Min. 100 kΩ
	5	Defective wiring harness connector	Connecting parts among supply pump actuator, engine wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation		
	6	Defective engine controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			J1 (Female)	Resistance	
			Between (2) – (32)	Max. 5 Ω	
			Between (2) – chassis ground	Min. 100 kΩ	

Circuit diagram related to supply pump actuator (metering unit)

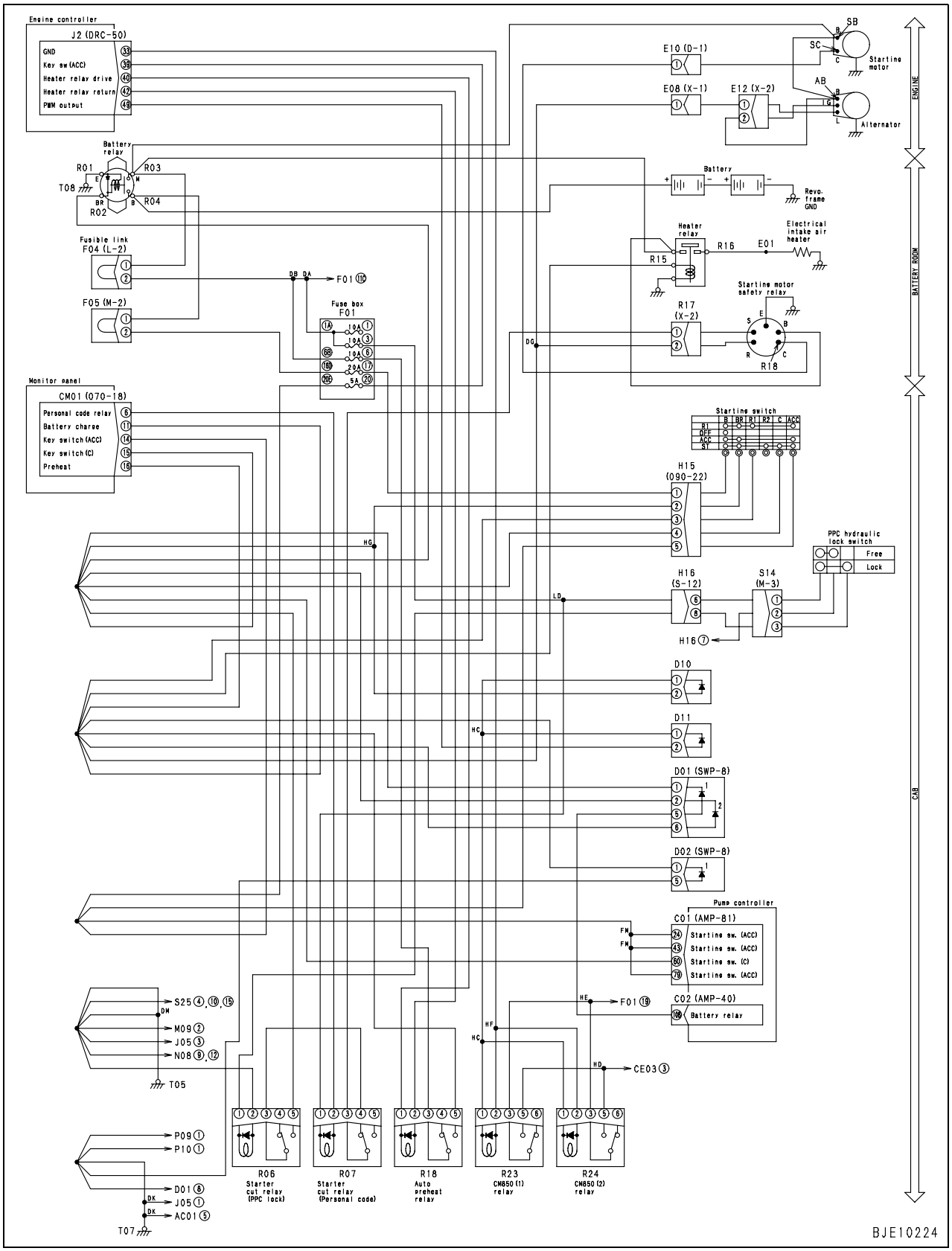


E-55 Code [2555/CA2555] Intake Air Heater Relay Supply Voltage Low Error

Error code	Failure code	Trouble	Disconnection in intake air heater relay
2555	**CA2555**		
Contents of trouble	• There is disconnection in intake air heater relay.		
Action of controller	• None in particular.		
Problem that appears on machine	• Intake air heater does not function (Poor starting performance, white exhaust smoke at low temperature)		
Related information	• Method of reproducing failure code: Starting switch ON when coolant temperature is –4°C or less.		

	Causes		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective auto preheat relay (Internal disconnection)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON. (Test relay unit).			
			R18 (male)	Resistance		
			Between (1) – (2)	300 – 600 Ω		
			★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting. (Test by replacing relay unit.)			
			Replace auto preheat relay (R18) with other relay. If mark E of failure code disappears after reproduction operation is conducted, that relay has a defect.			
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between J2 (female) (40) – R18 (female) (1)	Resistance	Max. 10 Ω	
			Wiring harness between J2 (female) (42) – R18 (female) (2)	Resistance	Max. 10 Ω	
	3	Short circuit in wiring harness (With another wiring harness)	★ Troubleshoot with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness among all pins between J2 (female) (40) – J2 (female) (With also R18 disconnected)	Resistance	Min. 100 kΩ	
	4	Defective wiring harness connector	Connecting parts among auto preheat relay, engine unit wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation			
	5	Defective engine controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			J2 (female)	Resistance		
			Between (40) – (42)	300 – 600 Ω		

Circuit diagram related to preheating, starting and charging engine

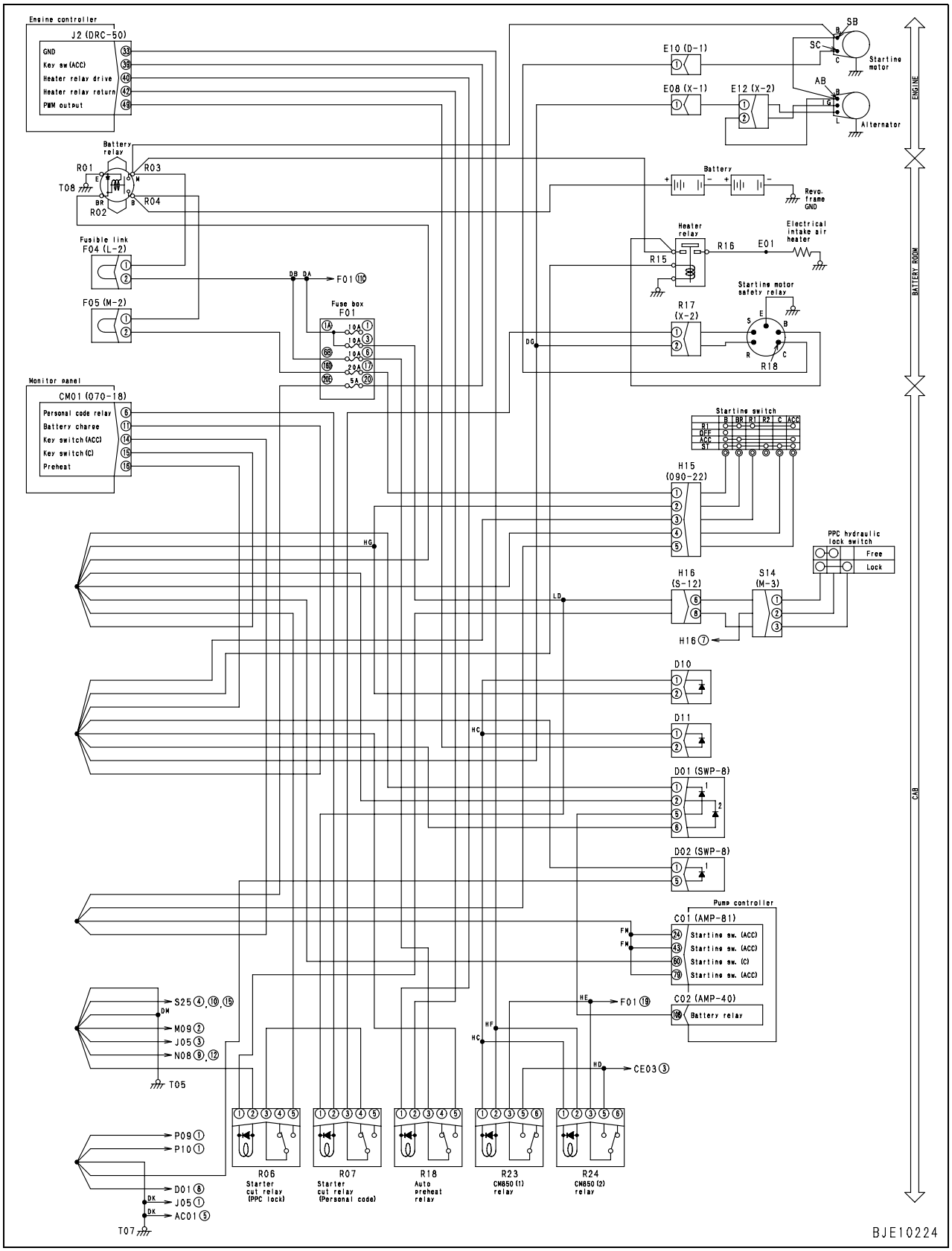


E-56 Code [2556/CA2556] Intake Air Heater Relay Supply Voltage High Error

Error code	Failure code	Trouble	Short circuit in intake air heater relay
2556	**CA2556**		
Contents of trouble	• There is short circuit in intake air heater relay.		
Action of controller	• None in particular.		
Problem that appears on machine	• Intake air heater does not function. (Poor starting performance, white exhaust smoke at low temperature)		
Related information	• Method of reproducing failure code: Starting switch ON when coolant temperature is –4°C or less.		

	Causes		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective auto preheat relay (Internal disconnection)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON. (Test relay unit).			
			R18 (male)	Resistance		
			Between (1) – (2)	300 – 600 Ω		
			★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting. (Test by replacing relay unit.)			
			Replace auto preheat relay (R18) with other relay. If mark E of failure code disappears after reproduction operation is conducted, that relay has a defect.			
	2	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between J2 (female) (40) – R18 (female) (1)	Resistance	Min. 100 kΩ	
	3	Short circuit in wiring harness (With another wiring harness)	★ Troubleshoot with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness among all pins between J2 (female) (40) – J2 (female) (With also R18 disconnected)	Resistance	Min. 100 kΩ	
	4	Defective wiring harness connector	Connecting parts among auto preheat relay, engine unit wiring harness, and engine controller are suspected. Inspect them directly. • Loose connector, broken lock, broken seal • Corrosive, bent, broken, forced-in, or extended pin • Humidity in connector, entry of dirt or dust, poor insulation			
	5	Defective engine controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			J2 (female)	Resistance		
			Between (40) – (42)	300 – 600 Ω		

Circuit diagram related to preheating, starting and charging engine



E-57 Code [---/B@BAZG] Eng. Oil Press. Low Speed Derate

Error code	Failure code	Trouble	Derating of speed by engine oil pressure reduction
---	**B@BAZG**		
Contents of trouble	• Engine oil pressure is below operating range.		
Action of controller	• Limits output and continues operation (Limits fuel injection rate and engine speed).		
Problem that appears on machine	• Output drops.		
Related information			

Possible causes and standard value in normal state	Causes		Standard value in normal state/Remarks on troubleshooting
	1	Carry out troubleshooting on machine side	This fault is indicated on only machine side when detected. Accordingly, contents of troubleshooting depend on machine model. See Shop manual for machine.

E-58 Code [---/B@BAZG] Eng. Oil Press Low Torque Derate

Error code	Failure code	Trouble	Derating of torque by engine oil pressure reduction
---	**B@BAZG**		
Contents of trouble	• Engine oil pressure is below operating range.		
Action of controller	• Limits output and continues operation (Limits fuel injection rate and engine speed).		
Problem that appears on machine	• Output drops.		
Related information			

Possible causes and standard value in normal state	Causes		Standard value in normal state/Remarks on troubleshooting
	1	Carry out troubleshooting on machine side	This fault is indicated on only machine side when detected. Accordingly, contents of troubleshooting depend on machine model. See Shop manual for machine.

E-59 Code [---/B@BCNS] Eng. Overheat

Error code	Failure code	Trouble	Engine overheat
---	**B@BCNS**		
Contents of trouble	• Engine coolant temperature is above operating range.		
Action of controller	• Limits output and continues operation.		
Problem that appears on machine	• Output drops.		
Related information			

Possible causes and standard value in normal state	Causes		Standard value in normal state/Remarks on troubleshooting
	1	Carry out troubleshooting on machine side	This fault is indicated on only machine side when detected. Accordingly, contents of troubleshooting depend on machine model. See Shop manual for machine.

KOMATSU 114E-3 Series Diesel engine

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ENGINE

114E-3 Series

40 Troubleshooting

Troubleshooting of mechanical system (S-mode)

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Troubleshooting of mechanical system (S-mode)

Method of using troubleshooting charts

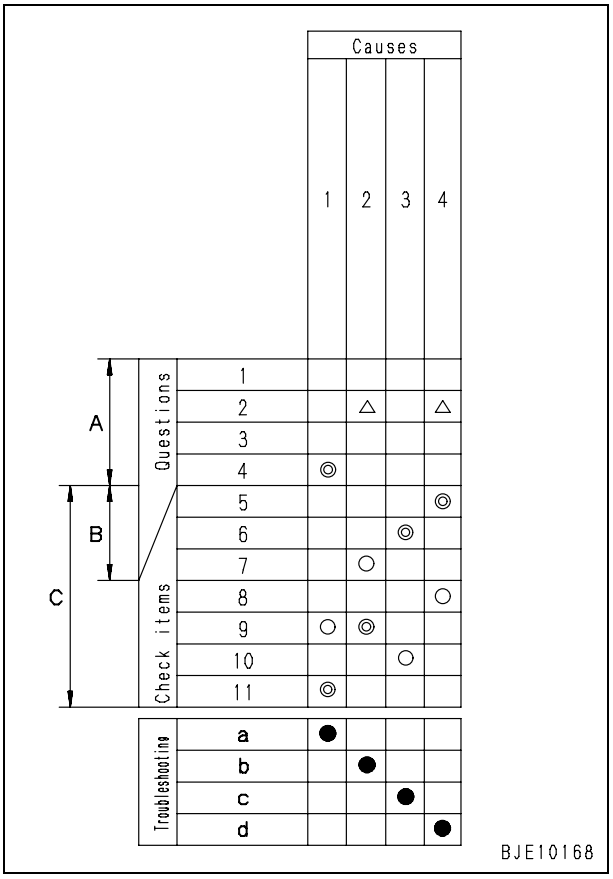
The troubleshooting chart consists of the “questions”, “check items”, “causes”, and “troubleshooting” blocks.
The questions and check items are used to pinpoint high probability causes by simple inspection or from phenomena without using troubleshooting tools.
Next, troubleshooting tools or direct inspection are applied to check the narrowed causes in order from the most probable one to make final confirmation according to the troubleshooting procedure.

[Questions]:
Items to be drawn from the user or operator.
They correspond to A and B in the chart on the right.
The items in A are basic ones.
The items in B can be drawn from the user or operator, depending on their level.

[Check items]:
Items to be simply checked by the serviceman to narrow down causes.
They correspond to C in the chart on the right.

[Causes]:
Items to be narrowed from the questions and check items.
The serviceman narrows down the probable causes from A, B, and C.

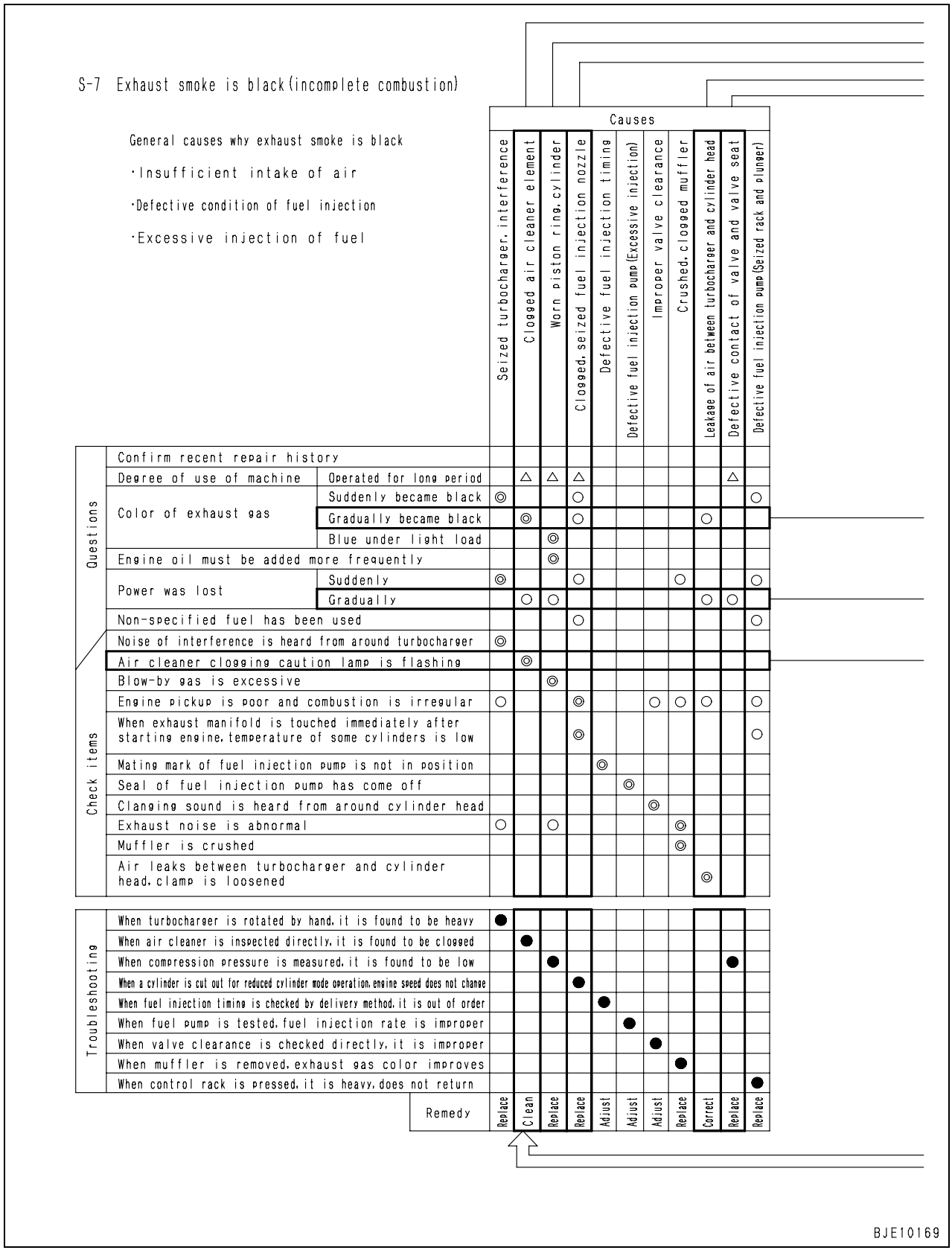
[Troubleshooting]:
Items to finally verify whether the narrowed down causes are undoubtedly the real causes using the troubleshooting tools and direct inspections.



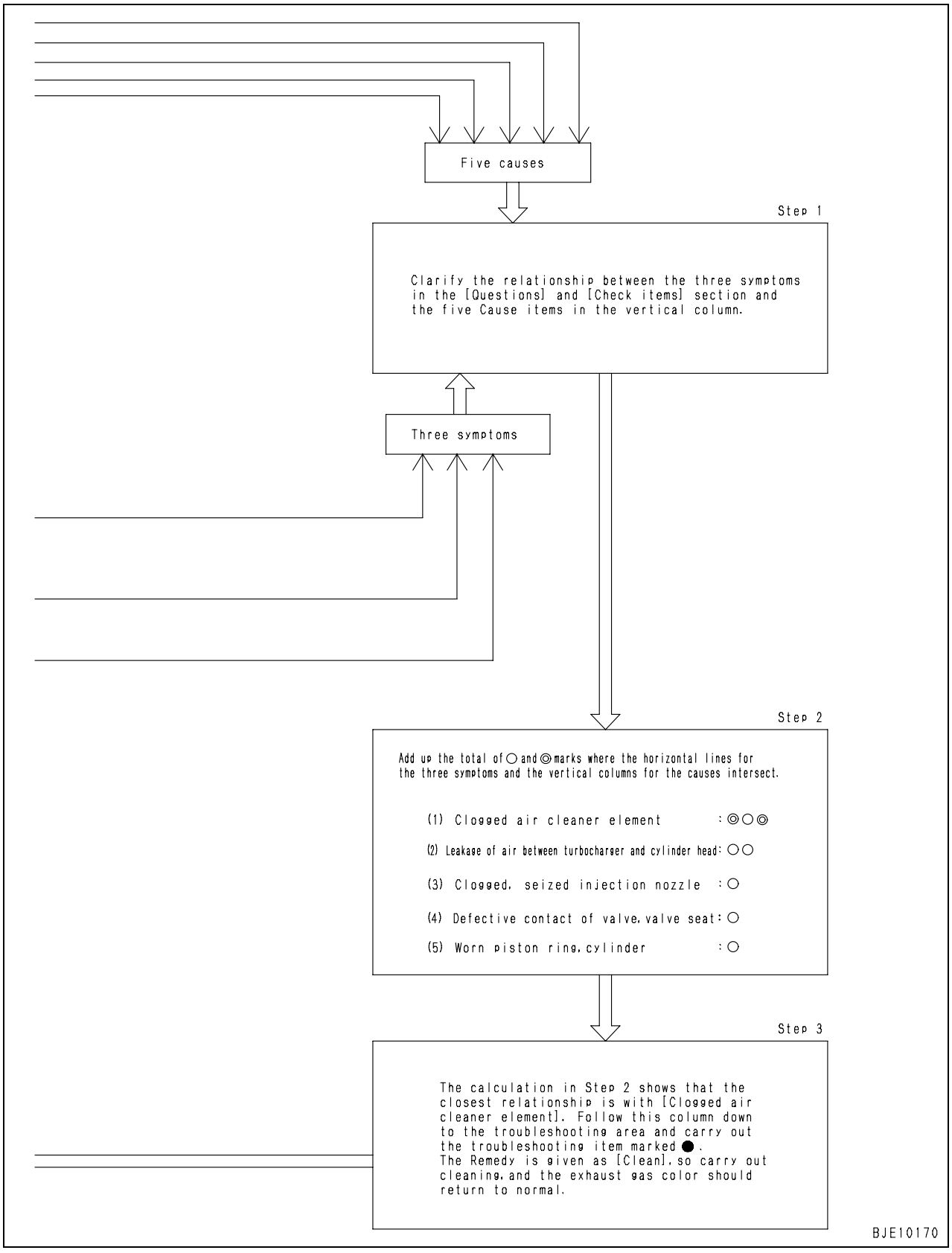
Items listed in the [Questions] and [Check items] and related to the [Causes] are marked with △, ○, or ◎.
△ : Causes to be referred to for questions and check items
○ : Causes related to questions and check items
◎ : Causes highly probable among ones marked with ○
★ When narrowing the “causes”, apply the items marked with ◎ before those marked with ○.
When narrowing the causes, do not apply the items marked with △. (If no items have other marks and the causes cannot be narrowed, however, you may apply them.)

<Example of troubleshooting> Exhaust smoke is black

Let us assume that [Clogged air cleaner] is taken to be the cause of black exhaust gas. 3 symptoms have causal relationship with this problem: [Color of exhaust gas gradually became black], [Power was lost gradually], and [Air cleaner clogging caution lamp is flashing].



If we look from these 3 symptoms to find the causes, we find that there is a relationship with 5 causes. Let us explain here the method of using this causal relationship to pinpoint the most probable cause.



S-1 Starting performance is poor

General causes why starting performance is poor
- Defective electrical system
- Insufficient supply of fuel
- Insufficient intake of air
- Improper selection of fuel

★ The common rail fuel injection system (CRI) recognizes the fuel injection timing electrically. Accordingly, even if the starting operation is carried out, the engine may not start until the crankshaft revolves 2 turns at maximum. This phenomenon does not indicate a trouble, however.

			Causes													
			Clogged air cleaner element	Defective contact of valve and valve seat	Worn piston ring, cylinder	Clogged air breather hole of fuel tank cap	Leaking or clogged fuel piping, entry of air	Clogged fuel filter, element	Stuck, seized supply pump plunger	Defective electric lift pump	Defective injector	Defective intake air heater system	Defective alternator (regulator section)	Defective alternator (generator section)	Defective or deteriorated battery
Questions	Confirm recent repair history														
	Degree of use of machine	Operated for long period	△					△							△
	Starting performance	Became worse gradually	○	◎	◎			○							
		Engine starts easily when warm										◎			◎
	Non-specified fuel is being used							○	○		○				
	Replacement of filters has not been carried out according to Operation and Maintenance Manual		◎					◎	○		○				
	Oil must be added more frequently				◎										
	When engine is preheated or when temperature is low, preheating monitor does not indicate normally (if installed)											◎			
	During operation, charge level monitor indicates abnormal charge (if monitor is installed)												◎	◎	
Check items	Dust indicator is red (if indicator is installed)		◎												
	Air breather hole of fuel tank cap is clogged					◎									
	Fuel is leaking from fuel piping						◎		○						
	Starting motor cranks engine slowly														◎
	While engine is cranked with starting motor,	If air bleeding plug of fuel filter is removed, fuel does not flow out						◎		○					
		If spill hose from injector is disconnected, little fuel spills							◎						
	When exhaust manifold is touched immediately after starting engine, temperature some cylinders is low										◎				
	Engine does not pick up smoothly and combustion is irregular			○	○						◎				
	There is hunting from engine (rotation is irregular)					○	◎	○		○					
	Blow-by gas is excessive				◎										
Troubleshooting	Inspect air cleaner directly		●												
	When compression pressure is measured, it is found to be low			●	●										
	Inspect fuel filter, strainer directly							●							
	Carry out troubleshooting according to “No-pressure feed by supply pump (*1)” in E-mode								●						
	Carry out troubleshooting according to “Abnormality in electric lift pump (*2)” in E-mode									●					
	When a cylinder is cut out for reduced cylinder mode operation, engine speed does not change										●				
	When starting switch is turned to HEAT, intake air heater mount does not become warm											●			
	Is voltage 20 – 30 V between alternator terminal B and terminal E with engine at low idle?	Yes											●		
		No												●	
	When specific gravity of electrolyte and voltage of battery are measured, they are low														●
		Remedy	Clean	Replace	Replace	Clean	Correct	Replace	Replace	Replace	Replace	Replace	Replace	Replace	Replace

*1: Code [559/CA559] and code [2249/CA2249] in E-mode
*2: Code [2265/CA2265] and code [2266/CA2266] in E-mode

S-2 Engine does not start

a) Engine does not turn

General causes why engine does not turn

- Seized parts inside engine
  See “S-4 Engine stops during operations
- Defective electrical system
- Problem in drive devices on applicable machine side
  Carry out troubleshooting for devices on applicable machine

			Causes							
			Broken flywheel ring gear	Defective or deteriorated battery	Defective connection of battery terminal	Defective battery relay	Defective starting switch	Defective safety relay	Defective starting motor (motor section)	Defective starting circuit wiring
Questions	Confirm recent repair history									
	Degree of use of machine	Operated for long period	△	△						
	Condition of horn when starting switch is turned ON	Horn does not sound			○		○			◎
		Horn volume is low		◎						
Check items	Battery electrolyte is low			◎						
	Battery terminal is loose				◎					
	When starting switch is turned ON, there is no operating sound from battery relay			○		◎				
	When starting switch is turned to START, starting pinion does not move out			○			○			◎
	When starting switch is turned to START, starting pinion moves out, but	Speed of rotation is low		◎						
		Makes grating noise	◎						◎	
		Soon disengages again						◎		
		Makes rattling noise and does not turn		○				○	○	
Troubleshooting	Inspect flywheel ring gear directly		●							Carry out troubleshooting on applicable machine
	When specific gravity of electrolyte and voltage of battery are measured, they are low			●						
	Turn starting switch OFF, connect cord, and carry out troubleshooting at ON	There is not voltage (20 – 30 V) between battery relay terminal B and terminal E				●				
		When terminal B and terminal C of starting switch are connected, engine starts					●			
		When terminal B and terminal C at safety relay outlet are connected, engine starts						●		
		Even if terminal B and terminal C at safety relay outlet are connected, engine does not start							●	
		When terminal at safety switch and terminal B at starting motor are connected, engine starts							●	
		Remedy	Replace	Replace	Correct	Replace	Replace	Replace	Replace	—

b) Engine turns but no exhaust smoke comes out

General causes why engine turns but no exhaust smoke comes out

- Fuel is not being supplied
- Supply of fuel is extremely small
- Improper selection of fuel (particularly in winter)

			Causes													
			Use of improper fuel	Insufficient fuel in tank	Clogged air breather hole of fuel tank cap	Leaking or clogged fuel piping, entry of air	Clogged fuel filter element	Seized, abnormally worm feed pump	Broken supply pump shaft	Stuck, seized supply pump plunger	Defective supply pump IMV (IMA)	Defective electric lift pump	Defective operation of overflow valve (Does not close)	Defective common rail pressure limiter	Defective fuel injector
Check items	Questions	Confirm recent repair history													
		Degree of use of machine — Operated for long period				△	△								
		Exhaust smoke suddenly stopped coming out (when starting again)						◎	○	◎	◎				△
		Replacement of filters has not been carried out according to Operation and Maintenance Manual					◎			△					○
	Check items	When fuel tank is inspected, it is found to be empty		◎											
		Air breather hole of fuel tank cap is clogged		○	◎										
		Rust and water are found when fuel tank is drained					○	△		△	△				
		When fuel filter is removed, there is not fuel in it	◎			◎						○			
		Fuel is leaking from fuel piping				◎									
		While engine is cranked with starting motor, — If air bleeding plug of fuel filter is removed, fuel does not flow out		○		○		◎	○			○			
		While engine is cranked with starting motor, — If spill hose from injector is disconnected, little fuel spills				○			◎	◎	◎				○
Troubleshooting		Inspect fuel filter directly					●								
		Inspect feed pump directly						●							
		Carry out troubleshooting according to “No-pressure feed by supply pump (*1)” in E-mode							●	●					
		Carry out troubleshooting according to “Abnormality in supply pump IMV (IMA) (*2)” in E-mode									●				
		Carry out troubleshooting according to “Abnormality in electric lift pump (*3)” in E-mode										●			
		Inspect overflow valve directly											●		
		Engine can be started in reduced cylinder mode													●
		Fuel flows out when pressure limiter return piping is disconnected												●	
		Remedy	Replace	Add	Clean	Correct	Replace	Replace	Replace	Replace	Replace	Replace	Replace	Replace	Replace

*1: Code [559/CA559] and code [2249/CA2249] in E-mode
*2: Code [271/CA271] and code [272/CA272] in E-mode
*3: Code [2265/CA2265] and code [2266/CA2266] in E-mode

c) Exhaust smoke comes out but engine does not start (fuel is being injected)

General causes why exhaust smoke comes out but engine does not start

- Lack of rotating force due to defective electrical system
- Insufficient supply of fuel
- Insufficient intake of air
- Improper selection of fuel

			Causes													
			Clogged air cleaner element	Worn dynamic valve system (Valve, rocker lever, etc.)	Worn piston ring, cylinder liner	Use of improper fuel	Clogged air breather hole of fuel tank cap	Leaking or clogged fuel system, entry of air	Clogging of fuel filter	Stuck, seized supply pump plunger	Defective electric lift pump	Clogged injector, defective spray	Defective, deteriorated battery	Defective coolant temperature sensor, wiring harness	Defective intake air heater system
Questions	Confirm recent repair history														
	Degree of use of machine	Operated for long period			△				△			△			
	Suddenly failed to start			◎						◎				○	
	Non-specified fuel is being used					◎				○		○			
	Replacement of filters has not been carried out according to Operation and Maintenance Manual		◎						◎						
	Oil must be added more frequently				◎										
	When engine is preheated or when temperature is low, preheating monitor does not indicate normally (if monitor is installed)														◎
Check items	Dust indicator is red (if indicator is installed)		◎												
	Air breather hole of fuel tank cap is clogged						○								
	Rust and water are found when fuel tank is drained								◎						
	When fuel filter is removed, there is not fuel in it					◎					○				
	Fuel is leaking from fuel piping							◎							
	Starting motor cranks engine slowly												◎		
	When engine is cranked, abnormal sound is generated around cylinder head			◎											
	While engine is cranked with starting motor,	If air bleeding plug of fuel filter is removed, fuel does not flow out				○			◎		○				
		If spill hose from injector is disconnected, little fuel spills								◎					
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low											◎			
Troubleshooting	Inspect air cleaner directly		●												
	Inspect dynamic valve system directly			●											
	When compression pressure is measured, it is found to be low				●										
	When air is bled from fuel system, air comes out							●							
	Inspect fuel filter directly								●						
	Carry out troubleshooting according to “No-pressure feed by supply pump (*1)” in E-mode									●					
	Carry out troubleshooting according to “Abnormality in electric lift pump (*2)” in E-mode										●				
	Engine can be started in reduced cylinder mode											●			
	When specific gravity of electrolyte and voltage of battery are measured, they are low												●		
	Coolant temperature gauge does not indicate normally (if coolant temperature gauge is installed)													●	
	When starting switch is turned to HEAT, intake air heater mount does not become warm														●
		Remedy	Clean	Replace	Replace	Replace	Clean	Correct	Replace	Replace	Replace	Replace	Replace	Replace	Replace	Replace

*1: Code [559/CA559] and code [2249/CA2249] in E-mode
*2: Code [2265/CA2265] and code [2266/CA2266] in E-mode

S-3 Engine does not pick up smoothly

General causes why engine does not pick up smoothly
- Insufficient intake of air
- Insufficient supply of fuel
- Defective spray condition of fuel
- Improper selection of fuel
- Controller is controlling in derate mode
  (limiting injection rate (output) because of an error in electrical system)

			Causes										
			Clogged air cleaner element	Defective contact of valve and valve seat	Improper valve clearance	Seized turbocharger, interference of turbocharger	Worn piston ring, cylinder liner	Clogged air breather hole of fuel tank cap	Leaking or clogged fuel piping, entry of air	Clogging of fuel filter	Stuck, seized supply pump plunger	Clogged injector, defective spray
Questions	Confirm recent repair history											
	Degree of use of machine	Operated for long period	△	△			△			△		
	Engine pick-up suddenly became worse					◎		○	○			○
	Non-specified fuel is being used									◎	◎	◎
	Replacement of filters has not been carried out according to Operation and Maintenance Manual		◎							◎		
	Oil must be added more frequently						◎					
Check items	Dust indicator is red (if indicator is installed)		◎									
	Air breather hole of fuel tank cap is clogged							◎				
	Rust and water are found when fuel tank is drained									◎		
	Fuel is leaking from fuel piping								◎			
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low										○	◎
	Exhaust smoke color	Blue under light load					◎					
		Black	◎	○		◎						◎
	When engine is cranked, abnormal sound is generated around cylinder head				◎							
	When engine is cranked, interference sound is generated around turbocharger					◎						
	High idle speed under no load is normal, but speed suddenly drops when load is applied							○		◎		
	There is hunting from engine (rotation is irregular)							○		○		○
	Blow-by gas is excessive						◎					
Troubleshooting	Inspect air cleaner directly		●									
	When compression pressure is measured, it is found to be low			●			●					
	Inspect valve clearance directly				●							
	When turbocharger is rotated by hand, it is found to be heavy					●						
	When air is bled from fuel system, air comes out								●			
	Inspect fuel filter, strainer directly									●		
	Carry out troubleshooting according to “No-pressure feed by supply pump (*1)” in E-mode										●	
	When a cylinder is cut out for reduced cylinder mode operation, engine speed does not change											●
		Remedy	Clean	Replace	Adjust	Replace	Replace	Clean	Correct	Replace	Replace	Replace

*1: Code [559/CA559] and code [2249/CA2249] in E-mode

S-4 Engine stops during operations

General causes why engine stops during operations
- Seized parts inside engine
- Insufficient supply of fuel
- There is overheating
- Problem in drive devices on applicable machine side
  Carry out troubleshooting for devices on applicable machine

			Causes												
			Broken dynamic valve system (valve, rocker arm, etc.)	Broken, seized piston, connecting rod	Broken, seized crankshaft bearing	Broken, seized gear train	Insufficient fuel in tank	Clogged air breather hole of fuel tank cap	Leaking, clogged fuel piping	Clogging of fuel filter	Broken, seized feed pump	Broken supply pump shaft	Stuck, seized supply pump plunger	Broken auxiliary equipment (pump, compressor, etc.)	Problem in drive devices on applicable machine side
Questions	Confirm recent repair history														
	Degree of use of machine	Operated for long period								△					
	Condition when engine stopped	Abnormal noise was heard and engine stopped suddenly	◎	◎	◎	◎					○	◎	○	◎	◎
		Engine overheated and stopped		◎	○									○	
		Engine stopped slowly					◎			○					
		There was hunting and engine stopped					◎	○		○	○				
	Non-specified fuel is being used									○	○		○		
	Replacement of filters has not been carried out according to Operation and Maintenance Manual									◎					
	Fuel level monitor indicates low level (if monitor is installed)						◎								
Check items	When fuel tank is inspected, it is found to be empty						◎								
	Air breather hole of fuel tank cap is clogged							◎							
	Fuel is leaking from fuel piping								◎						
	Rust and water are found when fuel tank is drained									◎					
	Metal particles are found when oil pan is drained		◎	◎	◎						○				
	When engine is cranked by hand	Does not turn at all		◎	◎										
		Turns in opposite direction	◎												
		Moves by amount of gear backlash				◎								◎	
		Supply pump shaft does not turn										◎			
	Engine turns, but stops when load is applied to machine														◎
Troubleshooting	Inspect dynamic valve system directly		●												Carry out troubleshooting on applicable machine
	Inspect piston, connecting rod directly			●											
	Inspect crankshaft bearing directly				●										
	Inspect gear train directly					●									
	Inspect fuel filter, strainer directly									●					
	Inspect feed pump directly										●				
	Carry out troubleshooting according to “No-pressure feed by supply pump (*1)” in E-mode											●	●		
	Engine rotates when pump auxiliary equipment (pump, compressor, etc.) is removed													●	
		Remedy	Replace	Replace	Replace	Replace	Add	Clean	Correct	Replace	Replace	Replace	Replace	Replace	—

*1: Code [559/CA559] and code [2249/CA2249] in E-mode

S-5 Engine does not rotate smoothly

General causes why engine does not rotate smoothly
- Air in fuel system
- Defective speed sensor (Error at degree that it is not indicated)

			Causes							
			Insufficient fuel in tank	Clogged air breather hole of fuel tank cap	Leaking or clogged fuel piping, entry of air	Clogging of fuel filter	Clogged injector, defective spray (dirt in injector)	Defective Ne speed sensor, wiring harness	Defective Bkup speed sensor, wiring harness
Questions	Confirm recent repair history								
	Degree of use of machine	Operated for long period				△			
	Condition of hunting	Occurs at a certain speed range						○	○
		Occurs at low idle			○	○	○	○	○
		Occurs even when speed is raised		○				○	○
		Occurs on slopes	◎						
	Replacement of filters has not been carried out according to Operation and Maintenance Manual					◎			
Check items	When fuel tank is inspected, it is found to be empty		◎						
	Air breather hole of fuel tank cap is clogged			◎					
	Rust and water are found when fuel tank is drained					○			
	Fuel is leaking from fuel piping				◎				
Troubleshooting	Inspect fuel filter, strainer directly					●			
	When a cylinder is cut out for reduced cylinder mode operation, engine speed does not change						●		
	Carry out troubleshooting according to “Abnormality in Ne speed sensor (*1)” in E-mode							●	
	Carry out troubleshooting according to “Abnormality in Bkup speed sensor (*2)” in E-mode								●
		Remedy	Add	Clean	Correct	Replace	Replace	Replace	Replace

*1: Code [689/CA689] in E-mode
*2: Code [778/CA778] in E-mode

S-6 Engine lacks output (or lacks power)

General causes why engine lacks output

- Insufficient intake of air
- Insufficient supply of fuel
- Defective spray condition of fuel
- Improper selection of fuel
- There is overheating
  See “S-14 Coolant temperature becomes too high (Overheating)“
- Controller is controlling in derate mode
  (limiting injection rate (output) because of an error in electrical system)

			Causes															
			Clogged air cleaner element	Air leakage from air intake piping	Seized turbocharger, interference of turbocharger	Defective contact of valve and valve seat	Improper valve clearance	Worn piston ring, cylinder liner	Clogged air breather hole of fuel tank cap	Leaking, clogged fuel piping	Clogging of fuel filter	Stuck, seized supply pump plunger	Clogged injector, defective spray (dirt in injector)	Defective drive of injector (signal, solenoid)	Defective installation of boost pressure sensor (air leakage)	Defective boost pressure sensor, wiring harness	Clogged fuel spill piping
Questions	Confirm recent repair history																	
	Degree of use of machine	Operated for long period	△			△		△			△							
	Power was lost	Suddenly		○	◎									○	○	○	○	
		Gradually	○			○		○			○		○		○			
	Non-specified fuel is being used										○	○	○					
	Replacement of filters has not been carried out according to Operation and Maintenance Manual		◎								◎							
	Oil must be added more frequently					○		○										
Check items	Dust indicator is red (if indicator is installed)		◎	◎														
	Air breather hole of fuel tank cap is clogged								◎									
	Fuel is leaking from fuel piping									◎								
	Output becomes insufficient after short stop of operation			◎														
	Exhaust smoke color	Black			◎		◎											
		Blue under light load						◎										
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low												◎	◎				
	When engine is cranked, interference sound is generated around turbocharger				◎													
	When engine is cranked, abnormal sound is generated around cylinder head						◎											
	High idle speed is too high													○				
	High idle speed under no load is normal, but speed suddenly drops when load is applied								○		◎	○	○					
	Engine does not pick up smoothly and combustion is irregular			◎	◎				○	○			◎					
	There is hunting from engine (rotation is irregular)								○	○	○		○	○				
	Blow-by gas is excessive				◎			◎										
Troubleshooting	Inspect air cleaner directly		●															
	Inspect air intake piping directly			●														
	When boost pressure is measured, it is found to be low		●	●	●													
	When compression pressure is measured, it is found to be low					●		●										
	Inspect valve clearance directly						●											
	Inspect fuel piping									●								
	Inspect fuel filter, strainer directly										●							
	Inspect spill port check valve directly																	●
	Carry out troubleshooting according to “No-pressure feed by supply pump (*1)” in E-mode											●						
	When a cylinder is cut out for reduced cylinder mode operation, engine speed does not change												●	●				
	Inspect boost pressure sensor mount directly														●			
	Carry out troubleshooting according to “Abnormality in boost pressure sensor (*2)” in E-mode															●		
		Remedy	Clean	Correct	Replace	Replace	Adjust	Replace	Clean	Correct	Replace	Replace	Replace	Replace	Correct	Replace	Replace	

*1: Code [559/CA559] and code [2249/CA2249] in E-mode
*2: Code [122/CA122] and code [123/CA123] in E-mode

S-7 Exhaust smoke is black (incomplete combustion)

General causes why exhaust smoke is black

- Insufficient intake of air
- Defective injection condition of fuel
- Improper selection of fuel
- There is overheating
  See “S-14 Coolant temperature becomes too high (Overheating)“
- Controller is controlling in derate mode
  (limiting injection rate (output) because of an error in electrical system)

			Causes												
			Clogged air cleaner element	Seized turbocharger, interference of turbocharger	Defective contact of valve and valve seat	Improper valve clearance	Leakage of air between turbocharger and cylinder head	Crushed, clogged muffler	Worn piston ring, cylinder liner	Stuck, seized supply pump plunger	Clogged, seized injector	Abnormally worn injector	Improper fuel injection pressure	Defective coolant temperature sensor, wiring harness
Questions	Confirm recent repair history													
	Degree of use of machine	Operated for long period	△		△				△		△			
	Exhaust smoke color	Suddenly became black		◎			◎			○	○	○		
		Gradually became black	◎				○				○			
		Blue under light load							◎					
	Non-specified fuel is being used									○	○			
	Oil must be added more frequently								◎					
	Power was lost	Suddenly		◎				○		○	○			
		Gradually	○		○		○		○					
Check items	Dust indicator is red (if indicator is installed)		◎											
	Muffler is crushed							◎						
	Air leaks between turbocharger and cylinder head, clamp is loosened						◎							
	Engine is operated in low-temperature mode at normal temperature												○	○
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low									○	◎			
	When engine is cranked, interference sound is generated around turbocharger			◎										
	When engine is cranked, abnormal sound is generated around cylinder head					◎								
	Torque converter stall speed or pump relief speed is high (Fuel is injected excessively)											○		
	Exhaust noise is abnormal			○				◎			○			
	Engine does not pick up smoothly and combustion is irregular			○		○	○	○		○	◎			
	Blow-by gas is excessive								◎					
	If spill hose from injector is disconnected, abnormally much fuel spills											◎		
Troubleshooting	Inspect air cleaner directly		●											
	When turbocharger is rotated by hand, it is found to be heavy			●										
	When compression pressure is measured, it is found to be low				●				●					
	Inspect valve clearance directly					●								
	When muffler is removed, exhaust sound improves							●						
	Carry out troubleshooting according to “No-pressure feed by supply pump (*1)” in E-mode									●		●		
	When a cylinder is cut out for reduced cylinder mode operation, engine speed does not change										●			
	Carry out troubleshooting according to “Abnormality in coolant temperature sensor (*2)” in E-mode													●
	Confirm with INSITE or with monitoring function on applicable machine side												●	
		Remedy	Clean	Replace	Replace	Adjust	Correct	Replace	Replace	Replace	Replace	Replace	Replace	Replace

*1: Code [559/CA559] and code [2249/CA2249] in E-mode
*2: Code [144/CA144] and code [145/CA145] in E-mode

S-8 Oil consumption is excessive (or exhaust smoke is blue)

General causes why oil consumption is excessive
- Abnormal consumption of oil
- Long-time operation of engine at low idle or high idle (Do not run engine at idle for more than 20 minutes continuously)
- External leakage of oil
- Wear of pats in lubrication system

			Causes														
			Dust sucked in from intake system	Worn, damaged valve (stem, guide, seal)	Turbocharger: Worn seal at turbocharger end	Turbocharger: Worn seal at blower end	Clogged breather, breather hose	Broken piston ring	Worn piston ring, cylinder liner	Worn, damaged rear oil seal	Broken oil cooler	Oil leakage from oil cooler	Oil leakage from oil filter	Oil leakage from oil piping	Oil leakage from oil drain plug	Oil leakage from oil pan, cylinder head, etc.
Questions	Confirm recent repair history																
Questions	Degree of use of machine	Operated for long period		△	△	△			△								
Questions	Oil consumption suddenly increased							◎			○						
Questions	Oil must be added more frequently								◎		○						
Questions	Oil becomes contaminated quickly						○	○	◎								
Check items	Outside of engine is dirty with oil											◎	◎	◎	◎	◎
Check items	There are loose piping clamps in intake system		◎														
Check items	Inside of turbocharger intake outlet pipe is dirty with oil					◎											
Check items	Inside of turbocharger exhaust outlet pipe is dirty with oil			○	◎												
Check items	There is oil in coolant										◎						
Check items	Oil level in clutch chamber or damper chamber is high									◎							
Check items	Exhaust smoke is blue under light load							◎	◎								
Check items	Amount of blow-by gas	Excessive		○		○		◎	◎								
Check items	Amount of blow-by gas	None					◎										
Troubleshooting	When intake manifold is removed, dust is found inside		●														
Troubleshooting	When intake manifold is removed, inside is found to be dirty abnormally			●													
Troubleshooting	Excessive play of turbocharger shaft				●	●											
Troubleshooting	Inspect breather and breather hose directly						●										
Troubleshooting	When compression pressure is measured, it is found to be low							●	●								
Troubleshooting	Inspect rear oil seal directly									●							
Troubleshooting	Pressure-tightness test of oil cooler shows there is leakage										●	●					
Troubleshooting	There is external leakage of oil from engine												●	●	●	●	
		Remedy	Correct	Replace	Replace	Replace	Clean	Replace	Replace	Replace	Replace	Replace	Correct	Correct	Correct	Correct	Correct

S-9 Oil becomes contaminated quickly

General causes why oil becomes contaminated quickly
- Entry of exhaust gas into oil due to internal wear
- Clogging of lubrication passage
- Use of improper fuel
- Use of improper oil
- Operation under excessive load

			Causes									
			Defective seal at turbocharger turbine end	Worn valve, valve guide	Worn piston ring, cylinder liner	Clogged breather, breather hose	Clogged oil cooler	Clogged oil filter	Defective oil filter safety valve	Clogged turbocharger lubrication drain tube	Exhaust smoke is bad	
Questions	Confirm recent repair history											
Questions	Degree of use of machine	Operated for long period	△	△	△							
Questions	Non-specified fuel is being used				○			○				
Questions	Oil must be added more frequently				◎							
Check items	Metal particles are found when oil filter is drained			○	○			◎				
Check items	Inside of exhaust pipe is dirty with oil			◎								
Check items	Engine oil temperature rises quickly						◎					
Check items	Exhaust smoke color	Blue under light load			◎							
Check items	Exhaust smoke color	Black									◎	
Check items	Amount of blow-by gas	Excessive	○	○	◎					○		
Check items	Amount of blow-by gas	None				◎						
Troubleshooting	Excessive play of turbocharger shaft		●									See S-7
Troubleshooting	When compression pressure is measured, it is found to be low			●	●							See S-7
Troubleshooting	Inspect breather and breather hose directly					●						See S-7
Troubleshooting	Inspect oil cooler directly						●					See S-7
Troubleshooting	Inspect oil filter directly							●				See S-7
Troubleshooting	Spring of oil filter safety valve is hitched or broken								●			See S-7
Troubleshooting	Inspect turbocharger lubrication drain tube directly									●		See S-7
		Remedy	Replace	Replace	Replace	Clean	Clean	Replace	Replace	Clean	—	

S-10 Fuel consumption is excessive

General causes why fuel consumption is excessive
- Leakage of fuel
- Defective condition of fuel injection (fuel pressure, injection timing)
- Excessive injection of fuel

			Causes							
			Fuel leakage inside head cover	Fuel leakage from fuel filter, piping, etc.	Defective feed pump oil seal	Defective supply pump plunger	Defective common rail pressure	Defective spray by injector	Defective operation of injector	Defective coolant temperature sensor, wiring harness
Questions	Confirm recent repair history									
	Degree of use of machine	Operated for long period			△	△		△		
	Condition of fuel consumption	More than for other machines of same model					○		○	○
		Gradually increased				○		○		
		Suddenly increased	○	○						
Check items	There is external leakage of fuel from engine			◎						
	Combustion is irregular							◎		
	Engine oil level rises and oil smells of diesel fuel		◎		◎					
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low							◎		
	Low idle speed is high								○	
	Torque converter stall speed or pump relief speed is high								○	
	Exhaust smoke color	Black					○	○		○
		White	○							
Troubleshooting	Remove head cover and inspect inside directly		●							
	Inspect feed pump oil seal directly				●					
	Carry out troubleshooting according to “No-pressure feed by supply pump (*1)” in E-mode					●				
	When a cylinder is cut out for reduced cylinder mode operation, engine speed does not change							●		
	If spill hose from injector is disconnected, much fuel spills								●	
	Carry out troubleshooting according to “Abnormality in coolant temperature sensor (*2)” in E-mode									●
	Confirm with INSITE or with monitoring function on applicable machine side						●			
		Remedy	Correct	Correct	Replace	Replace	Correct	Replace	Replace	Replace

*1: Code [559/CA559] and code [2249/CA2249] in E-mode
*2: Code [144/CA144] and code [145/CA145] in E-mode

S-11 Oil is in coolant (or coolant spurts back or coolant level goes down)

General causes why oil is in coolant
- Internal leakage in lubrication system
- Internal leakage in cooling system

			Causes				
			Broken cylinder head, head gasket	Cracks inside cylinder block	Holes caused by pitting	Broken oil cooler core, O-ring	Broken hydraulic oil cooler or power train oil cooler on applicable machine side
Questions	Confirm recent repair history						
	Degree of use of machine	Operated for long period			△	△	
	Oil level	Suddenly rose	○			○	○
		Gradually rose		○	○		
	Hard water is being used as coolant				○	○	
Check items	Oil level has risen and oil is milky			○	○	◎	
	There are excessive air bubbles in radiator, coolant spurts back		◎				
	Hydraulic oil or power train oil on applicable machine side is milky						◎
	When hydraulic oil or power train oil is drained, water is found						◎
Troubleshooting	Pressure-tightness test of cylinder head shows there is leakage		●				Carry out troubleshooting on applicable machine
	Inspect cylinder block, liner directly			●	●		
	Pressure-tightness test of oil cooler shows there is leakage					●	
		Remedy	Replace	Replace	Replace	Replace		

S-12 Oil pressure drops

General causes why oil pressure drops
- Leakage, clogging, wear of lubrication system
- Defective oil pressure control
- Improper selection of oil (improper viscosity)
- Deterioration of oil due to overheating

			Causes										
			Worn journal of bearing	Lack of oil in oil pan	Coolant, fuel in oil	Clogged strainer in oil pan	Clogged, broken pipe in oil pan	Defective oil pump	Defective regulator valve	Clogged oil filter	Leaking, crushed, clogged hydraulic piping	Defective oil level sensor, wiring harness
Questions	Confirm recent repair history											
	Degree of use of machine	Operated for long period	△					△		△		
	Oil pressure monitor indicates low oil pressure (if monitor is installed)								○	◎		
	Non-specified oil is being used		○							○		
	Replacement of filters has not been carried out according to Operation and Maintenance Manual									◎		
Check items	Oil pressure monitor (if installed)	Indicates pressure drop at low idle	◎									
		Indicates pressure drop at low, high idle		○		◎	◎	◎	○			
		Indicates pressure drop on slopes		◎								
		Sometimes indicates pressure drop							◎			○
	Oil level monitor indicates oil level drop (if monitor is installed)			◎								◎
	Oil level in oil pan is low			◎								
	External hydraulic piping is leaking, crushed										◎	
	Oil is milky or smells of diesel oil				◎							
	Metal particles are found when oil pan is drained		◎									
	Metal particles are found when oil filter is drained		◎					○				
Troubleshooting	Metal particles are found in oil filter		●		See S-13							
	Inspect oil pan strainer, pipe directly					●	●					
	Oil pump rotation is heavy, there is play in oil pump							●				
	Valve and spring of regulator valve are fatigued, damaged								●			
	Inspect oil filter directly									●		
	If oil level sensor is replaced, oil level monitor indicates normally											●
		Remedy	Replace	Add	—	Clean	Correct	Replace	Adjust	Replace	Correct	Replace

S-13 Oil level rises (Entry of coolant or fuel)

General causes why oil level rises
- Coolant in oil (milky)
- Fuel in oil (smells diluted diesel fuel)

★ If oil is in coolant, carry out troubleshooting for “S-11 Oil is in coolant“

			Causes								
			Broken cylinder head, head gasket	Broken injector, O-ring	Cracks inside cylinder block	Holes caused by pitting	Worn, damaged rear oil seal	Broken oil cooler core, O-ring	Defects in supply pump	Defective seal of auxiliary equipment (pump, compressor)
Questions	Confirm recent repair history									
	Degree of use of machine	Operated for long period		△		△	△			△
	Fuel must be added more frequently			◎					◎	
	Coolant must be added more frequently		○		○					
Check items	There is oil in coolant		○	○	○	○		◎		
	Oil smells of diesel fuel			◎					◎	
	Oil is milky		○			○				
	When engine is started, drops of water come from muffler		○							
	When radiator cap is removed and engine is run at low idle, an abnormal number of bubbles appears, or coolant spurts back		◎			○				
	Exhaust smoke is white			○						
	Oil level in clutch chamber or damper chamber is low						◎			
	Oil level in hydraulic tank of machine is low									◎
Troubleshooting	When compression pressure is measured, it is found to be low		●							
	Remove injector and inspect O-ring.			●						
	Inspect cylinder block, liner directly				●	●				
	Inspect rear oil seal directly						●			
	Pressure-tightness test of oil cooler shows there is leakage							●		
	Remove and inspect supply pump directly								●	
	Inspect seal of auxiliary equipment directly									●
		Remedy	Replace	Correct	Replace	Replace	Replace	Replace	Replace	Replace

S-14 Coolant temperature becomes too high (overheating)

General causes why coolant temperature becomes too high
- Lack of cooling air (deformation, damage of fan)
- Drop in heat dissipation efficiency
- Problem in coolant circulation system
- Rise in oil temperature in power train

Carry out troubleshooting on applicable machine

			Causes											
			Broken cylinder head, head gasket	Holes caused by pitting	Clogged, broken oil cooler	Lack of coolant	Broken water pump	Defective operation of thermostat	Clogged, crushed radiator fins	Clogged radiator core	Defective radiator cap (pressure valve)	Slipping fan belt, worn fan pulley	Defective coolant temperature gauge	Rise in power train oil temperature on applicable machine side
Questions	Confirm recent repair history													
	Degree of use of machine	Operated for long period	△	△					△	△				
	Condition of overheating	Suddenly overheated				○	◎					○		
		Always tends to overheat						○	◎	◎		○		
	Coolant temperature gauge (if installed)	Rises quickly				○		◎						
		Does not go down from red range											◎	
Check items	Radiator coolant level monitor indicates drop of coolant level (if monitor is installed)					◎								
	Engine oil level has risen, oil is milky			◎	○									
	Fan belt tension is low											◎		
	When fan pulley is turned, it has play						◎							
	Milky oil is floating on coolant				◎									
	There are excessive air bubbles in radiator, coolant spurts back		◎											
	When light bulb is held behind radiator core, no light passes through								◎					
	Radiator shroud, inside of underguard on applicable machine side are clogged with dirt or mud								◎			◎		
	Coolant is leaking because of cracks in hose or loose clamps					◎								
	Coolant flows out from radiator overflow hose										◎			
	Fan belt whines under sudden acceleration											◎		
	Power train oil temperature enters red range faster than engine coolant temperature (if oil temperature gauge and coolant temperature gauge are installed)													◎
Troubleshooting	When compression pressure is measured, it is found to be low		●											Carry out troubleshooting on applicable machine
	Inspect cylinder liner directly			●										
	Inspect oil cooler directly				●									
	Temperature difference between upper and lower tanks of radiator is large						●							
	When operation of thermostat is carried out, it does not open at cracking temperature							●						
	Temperature difference between upper and lower tanks of radiator is slight								●					
	Inspect radiator core directly									●				
	When operation of radiator cap is carried out, its cracking pressure is low										●			
	Inspect fan belt, pulley directly											●		
	When coolant temperature is measured, it is found to be normal												●	
		Remedy	Replace	Replace	Replace	Add	Replace	Replace	Correct	Correct	Replace	Correct	Replace	—

S-15 Abnormal noise is made

General causes why abnormal noise is made
- Abnormality due to defective parts
- Abnormal combustion
- Air sucked in from intake system

★ Judge if the noise is an internal noise or an external noise before starting troubleshooting.

★ The engine is operated in the low-temperature mode while it is not warmed up sufficiently. Accordingly, the engine sound becomes a little larger. This does not indicate abnormality, however.

★ When the engine is accelerated, it is operated in the acceleration mode and its sound becomes a little larger for up to about 3 seconds. This does not indicate abnormality, however.

			Causes												
			Leakage of air between turbocharger and cylinder head	Interference of turbocharger, seized turbocharger	Broken dynamic valve system (valve, rocker lever)	Defective inside of muffler (dividing board out of position)	Improper valve clearance	Excessive wear of piston ring, cylinder liner	Improper gear train backlash	Removed, seized bushing	Deformed cooling fan, loose fan belt, interference of fan belt	Clogged, seized injector	Dirt caught in injector	Improper fuel injection timing (abnormality in coolant temperature sensor, boost temperature sensor)
Questions	Confirm recent repair history													
	Degree of use of machine	Operated for long period						△						
	Abnormal noise	Gradually occurred						○			○			
		Suddenly occurred		○	○					○				
	Non-specified fuel is being used											○		
	Oil must be added more frequently							◎						
	Metal particles are found when oil filter is drained							◎		◎				
Check items	Air leaks between turbocharger and cylinder head		◎											
	When engine is cranked, interference sound is generated around turbocharger			◎										
	When engine is cranked, abnormal sound is generated around cylinder head				◎		◎							
	When engine is cranked, beat noise is generated around muffler					◎								
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low											◎	○	
	Exhaust smoke color	Blue under light load						◎						
		Black	○	◎			○							
	Engine does not pick up smoothly and combustion is irregular											◎		
	Abnormal noise is loud when engine is accelerated						○		○		○	○		
	Blow-by gas is excessive							◎						
Troubleshooting	When turbocharger is rotated by hand, it is found to be heavy			●										
	Inspect dynamic valve system directly				●									
	When muffler is removed, abnormal noise disappears					●								
	Inspect valve clearance directly						●							
	When compression pressure is measured, it is found to be low							●						
	Inspect gear train directly								●	●				
	Inspect fan and fan belt directly										●			
	When a cylinder is cut out for reduced cylinder mode operation, engine speed does not change											●	●	
	Abnormal noise is heard only when engine is started												●	
	Confirm with INSITE or with monitoring function on applicable machine side													●
		Remedy	Correct	Replace	Replace	Replace	Adjust	Replace	Replace	Replace	Correct	Replace	Replace	Replace

S-16 Vibration is excessive

General causes why vibration is excessive
- Defective parts (abnormal wear, breakage)
- Misalignment between engine and chassis
- Abnormal combustion

★ If abnormal noise is made and vibration is excessive, carry out troubleshooting for “S-15 Abnormal noise is made”, too.

			Causes								
			Stuck dynamic valve system (valve, rocker lever)	Worn main bearing, connecting rod bearing	Improper gear train backlash	Worn camshaft bushing	Improper fuel injection timing (abnormality in coolant temperature sensor, boost temperature sensor)	Loose engine mounting bolts, broken cushions	Misalignment between engine and devices on applicable machine side	Broken output shaft, parts in damper on applicable machine side
Questions / Check items	Confirm recent repair history									
	Degree of use of machine	Operated for long period		△		△		△		
	Condition of vibration	Suddenly increased	○							○
		Gradually increased		○		○		○		
	Non-specified oil is being used			○		○				
	Metal particles are found when oil filter is drained			◎		◎				
	Metal particles are found when oil pan is drained			◎		◎				
	Oil pressure is low at low idle			○		○				
	Vibration occurs at mid-range speed							○		○
	Vibration follows engine speed				○			○	○	○
	Exhaust smoke is black		◎				○			
Troubleshooting	Inspect dynamic valve system directly		●							
	Inspect main bearing and connecting rod bearing directly			●						
	Inspect gear train directly				●					
	Inspect camshaft bushing directly					●				
	Confirm with INSITE or with monitoring function on applicable machine side						●			
	Inspect engine mounting bolts and cushions directly							●		
	When alignment is checked, radial runout or facial runout is detected								●	
	Inspect output shaft or inside of damper directly									●
		Remedy	Replace	Replace	Replace	Replace	Replace	Replace	Adjust	Replace

KOMATSU 114E-3 Series Diesel engine

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ENGINE

114E-3 Series

50 Disassembly and assembly

General information on disassembly and assembly

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General information on disassembly and assembly

How to read this manual

Disassembly

- In Disassembly section, the work procedures, precautions and know-how for carrying out those procedures, and quantity of the oil and coolant drained are described.
- The meanings of the symbols used in Disassembly section are as follows.

⚠ **: Precautions related to safety in execution of work.**

★ : Know-how or precautions for work.

 : Quantity of oil or coolant drained.

 : Weight of part or component.

Assembly

- In Assembly section, the work procedures, precautions and know-how for carrying out those procedures, and quantity of the oil and coolant added are described.
- The meanings of the symbols used in Assembly section are as follows.

⚠ **: Precautions related to safety in execution of work.**

★ : Know-how or precautions for work.

 : Type of coating materials.

 : Tightening torque.

 : Quantity of oil or coolant to be added.

Coating materials list

(Rev. 2007/04)

★ The recommended coating materials such as adhesives, gasket sealants, and greases used for disassembly and assembly are listed below.
★ For coating materials not listed below, use the equivalent of products shown in this manual.

Category	Komatsu code	Part number	Q'ty	Container	Main features and applications
Adhesive	LT-1A	790-129-9030	150 g	Tube	• Used to prevent rubber gaskets, rubber cushions, and cork plugs from coming out.
	LT-1B	790-129-9050	20 g (2 pcs.)	Polyethylene container	• Used for plastic (except polyethylene, polypropylene, tetrafluoroethylene and vinyl chloride), rubber, metal, and non-metal parts which require immediate and strong adhesion.
	LT-2	09940-00030	50 g	Polyethylene container	• Features: Resistance to heat and chemicals. • Used to fix and seal bolts and plugs.
	LT-3	790-129-9060 (Set of adhesive and hardener)	Adhesive: 1 kg Hardener: 500 g	Can	• Used to stick and seal metal, glass, and plastics.
	LT-4	790-129-9040	250 g	Polyethylene container	• Used to seal plugs.
	Holtz MH 705	790-129-9120	75 g	Tube	• Heat-resistant seal used to repair engines.
	ThreeBond 1735	790-129-9140	50 g	Polyethylene container	• Quick-setting adhesive. • Setting time: Within 5 sec. to 3 min. • Used mainly to stick metals, rubbers, plastics, and woods.
	Aron-alpha 201	790-129-9130	2 g	Polyethylene container	• Quick-setting adhesive. • Quick-setting type. (max. strength is obtained after 30 minutes) • Used mainly to stick rubbers, plastics, and metals.
	Loctite 648-50	79A-129-9110	50 cc	Polyethylene container	• Features: Resistance to heat and chemicals. • Used for fitted portions used at high temperatures.
Gasket sealant	LG-1	790-129-9010	200 g	Tube	• Used to stick or seal gaskets and packings of power train case, etc.
	LG-5	790-129-9080	1 kg	Polyethylene container	• Used to seal various threaded portions, pipe joints, and flanges. • Used to seal tapered plugs, elbows, and nipples of hydraulic piping.
	LG-6	790-129-9020	200 g	Tube	• Features: Silicon-based heat and cold-resistant sealant. • Used to seal flange surfaces and threaded portions. • Used to seal oil pan, final drive case, etc.
	LG-7	790-129-9070	1 kg	Tube	• Features: Silicon-based quick-setting sealant. • Used to seal flywheel housing, intake manifold, oil pan, thermostat housing, etc.
	LG-8 ThreeBond 1207B	419-15-18131	100 g	Tube	• Features: Silicon-based, heat and cold-resistant, vibration-resistant, impact-resistant sealant. • Used to seal transfer case, etc.

Category	Komatsu code	Part number	Q'ty	Container	Main features and applications
Gasket sealant	LG-9 ThreeBond 1206D	790-129-9310	200 g	Tube	• Feature: Can be coated with paint. • Used for rough surfaces such as the circle gear top seal which does not need to be clamped, water resistance of the clearance at the welded area, etc.
	LG-10 ThreeBond 1206E	790-129-9320	200 g	Tube	• Feature: Can be coated with paint. • Used as lubricant/sealant when the radiator hoses are inserted.
	LG-11 ThreeBond 1121	790-129-9330	200 g	Tube	• Feature: Can be used together with gaskets. • Used for covers of the transmission case and steering case etc.
	ThreeBond 1211	790-129-9090	100 g	Tube	• Gasket sealant used to repair engine.
Molybdenum disulfide lubricant	LM-G	09940-00051	60 g	Can	• Used to lubricate sliding portions. (to prevent squeaking)
	LM-P	09940-00040	200 g	Tube	• Used to prevent scuffing and seizure of press-fitted portions, shrink-fitted portions, and threaded portions. • Used to lubricate linkages, bearings, etc.
Seizure prevention compound	LC-G NEVER-SEEZ	—	—	Can	• Feature: Seizure and scuffing prevention compound with metallic super-fine-grain, etc. • Used for the mounting bolt in the high temperature area of the exhaust manifold and the turbocharger, etc.
Grease	G2-LI G0-LI *: For cold district	SYG2-400LI SYG2-350LI SYG2-400LI-A SYG2-160LI SYGA-160CNLI SYG0-400LI-A (*) SYG0-160CNLI (*)	Various	Various	• Feature: Lithium grease with extreme pressure lubrication performance. • General purpose type.
	Molybdenum disulfide grease LM-G (G2-M)	SYG2-400M SYG2-400M-A SYGA-16CNM	400 g x 10 400 g x 20 16 kg	Bellows-type container Can	• Used for parts under heavy load. Caution: • Do not apply grease to rolling bearings like swing circle bearings, etc. and spline. • The grease should be applied to work equipment pins at their assembly only, not applied for greasing afterwards.
	Hyper White Grease G2-T, G0-T (*) *: For cold district	SYG2-400T-A SYG2-16CNT SYG0-400T-A (*) SYG0-16CNT (*)	400 g 16 kg	Bellows-type container Can	• Seizure resistance, heat resistance and water resistance higher than molybdenum disulfide grease. • Not conspicuous on machine since color is white.
	Biogrease G2-B, G2-BT (*) *: For use at high temperature and under high load	SYG2-400B SYGA-16CNB SYG2-400BT (*) SYGA-16CNBT (*)	400 g 16 kg	Bellows-type container Can	• Since this grease is decomposed by natural bacteria in short period, it has less effects on micro-organisms, animals, and plants.
	G2-S ThreeBond 1855	—	200 g	Tube	• Feature: Silicone grease with wide using temperature range, high resistance to thermal-oxidative degradation and performance to prevent deterioration of rubber and plastic parts. • Used for oil seals of the transmission, etc.

Category	Komatsu code	Part number	Q'ty	Container	Main features and applications	
Primer	SUNSTAR PAINT PRIMER 580 SUPER	417-926-3910	20 ml	Glass container	Adhesive for cab glass	• Used as primer for cab side. (Using limit: 4 months after date of manufacture)
	SUNSTAR GLASS PRIMER 580 SUPER		20 ml	Glass container		• Used as primer for glass side. (Using limit: 4 months after date of manufacture)
	SUNSTAR PAINT PRIMER 435-95	22M-54-27230	20 ml	Glass container		• Used as primer for painted surface on cab side. (Using limit: 4 months after date of manufacture)
	SUNSTAR GLASS PRIMER 435-41	22M-54-27240	150 ml	Can		• Used as primer for black ceramic-coated surface on glass side and for hard polycarbonate-coated surface. (Using limit: 4 months after date of manufacture)
	SUNSTAR SASH PRIMER GP-402	22M-54-27250	20 ml	Glass container		• Used as primer for sash (Almite). (Using limit: 4 months after date of manufacture)
Adhesive	SUNSTAR PENGUINE SEAL 580 SUPER “S” or “W”	417-926-3910	320 ml	Polyethylene container	Adhesive for cab glass	• “S” is used for high-temperature season and “W” for low-temperature season as adhesive for glass. (Using limit: 4 months after date of manufacture)
	Sika Japan, Sikaflex 256HV	20Y-54-39850	310 ml	Polyethylene container		• Used as adhesive for glass. (Using limit: 6 months after date of manufacture)
	SUNSTAR PENGUINE SUPER 560	22M-54-27210	320 ml	Ecocart (Special container)		• Used as adhesive for glass. (Using limit: 6 months after date of manufacture)
Caulking material	SUNSTAR PENGUINE SEAL No. 2505	417-926-3920	320 ml	Polyethylene container		• Used to seal joints of glass parts. (Using limit: 4 months after date of manufacture)
	SEKISUI SILICONE SEALANT	20Y-54-55130	333 ml	Polyethylene container		• Used to seal front window. (Using limit: 6 months after date of manufacture)
	GE TOSHIBA SILICONES TOSSEAL 381	22M-54-27220	333 ml	Cartridge		• Used to seal joint of glasses. Translucent white seal. (Using limit: 12 months after date of manufacture)

Special tools list

★ Tools with part number 79○T–○○○-○○○○ cannot be supplied (they must be locally manufactured)
★ Necessity : ■ ..... Cannot be substituted, should always be installed (used)
★ : ● ..... Extremely useful if available, can be substituted with commercially available parts
★ New/Remodel : N ..... Tools newly developed for this model and given new part Nos.
★ : R ..... Tools remodeled from tools already available for other models and given upgraded part Nos.
★ : Blank ..... Tools already available for other models, usable without any modification
★ Tools marked with ○ in the sketch column are tools introduced in the sketches of the special tools (See Sketches of special tools)
★ Nos. in the upper line of the Part No. column are KOMATSU part Nos. and those in the lower line are CUMMINS part Nos.

Work item	Sym-bol	Part No.	Part name	Necessity	Q'ty	New / Remodel	Sketch	Remarks
Disassembly and assembly of engine assembly	A	790-501-2001 795-799-1150	Repair stand	■	1			
	B	— 795-799-2280	Adapter	■	1			Special for KOMATSU repair stand Special for CUMMINS repair stand
Removal and installation of air intake valve and exhaust valve	C	795-102-2103 795-799-8800	Spring pusher	●	1			
Removal and installation of piston ring	D	795-100-2800	Piston ring tool	■	1			
Installation of piston	E	795-921-1100	Piston holder	■	1			ϕ75 – ϕ175 mm
Removal of injector	F	795-799-6700	Puller	■	1			
Angle tightening of bolt	J	790-331-1120 795-799-2240	Wrench (angle)	●	1			
Adjusting valve clearance	K	Commercially available	Clearance gauge	●	1			
Adjusting backlash and end play of gear	L	Commercially available	Dial gauge stand	●	1			
Removal of fuel inlet connector	M	795-799-8150	Remover	●	1			
Sling for engine assembly	N	795-799-9300	Lifting tool	●	1	N		
Removal and installation of supply pump	P	795-799-1390	Remover	●	1			
Removal and installation of cylinder head valve seal	Q	795-799-8910	Boot pliers	●	1	N		
Removal and installation of cylinder liner	R 1	795-799-2170	Liner puller	●	1			
	R 2	795-799-2310	Extension	●	1			
Installation of cylinder liner	S	795-799-2110	Cylinder liner driver	●	1			
Installation of front seal	T	795-799-8120	Oil seal driver	●	1	N		

Work item	Sym-bol	Part No.	Part name	Necessity	Q'ty	New / Remodel	Sketch	Remarks
Removal and installation of main bearing	U	795-799-2270	Remover and installer	●	1			
Rotating crankshaft	V	795-799-1131	Barring tool	●	1			
Tightening injector wiring harness nut	W	795-799-7110	Torque wrench	●	1			
Measuring cylinder head bolt length	X	795-790-2210	Gauge	●	1			
Installation of cylinder liner	Y	795-799-2190	Clamp set	●	1			

KOMATSU 114E-3 Series Diesel engine

Form No. SEN00462-01

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ENGINE

114E-3 Series

50 Disassembly and assembly

Disassembly and assembly, Part 1

Disassembly and assembly 2
General disassembly of engine 2

Disassembly and assembly

General disassembly of engine

★ The following disassembly procedure is for SAA6D114E-3. The shapes, quantities, locations, etc. of the parts depend on each applicable machine. Take care.

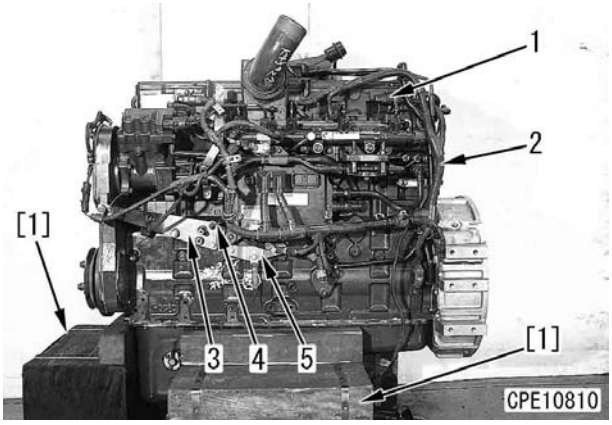
1. Preparation work

Before disassembling the engine, check its parts for cracking, damage, etc. and clean it generally and carefully for accurate inspection of its parts and quick disassembly and assembly.

★ Before cleaning the engine, carefully seal or remove the openings, electric parts, and wiring connectors so that water will not enter them.

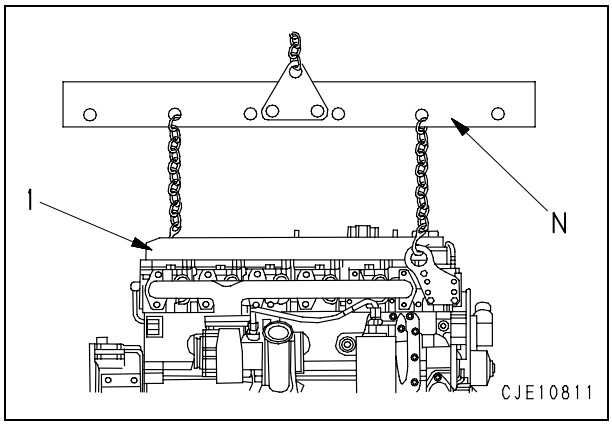
● Prepare stable engine stands (Blocks [1]) and secure engine assembly (1) on them so that it will not tip over.

1) Remove main wiring harness (2).
2) Remove plate (3).
   ● Disconnect controller ground wire (4).
3) Remove plate (5).
4) Remove the fuel filter.



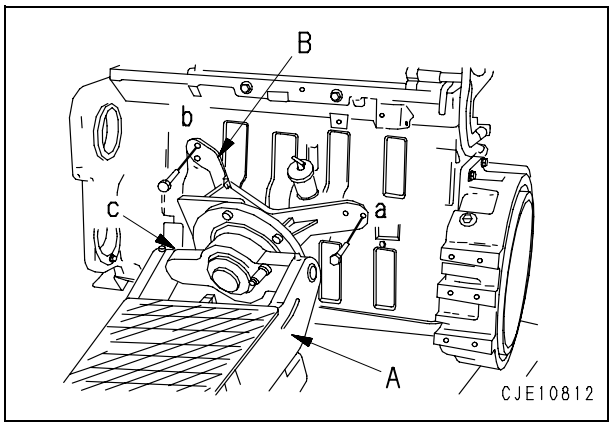
2. Installation to engine repair stand

1) Using tool **N**, sling engine assembly (1) and install it to repair stand **A**.
   Engine assembly: **Approx. 800 kg** (Weight depends on each applicable machine)



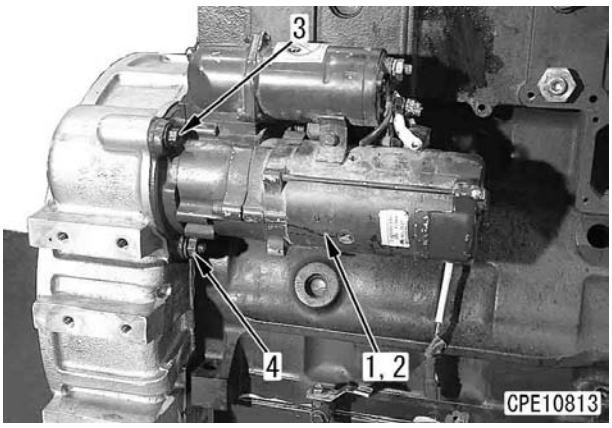
2) Install tool **B**.
   Mounting bolt on engine side

Position of bolt	Size of bolt	Tightening torque
a	M8	**24 ± 4 Nm {2.5 ± 0.4 kgm}**
b, c	M10	**43 ± 6 Nm {4.4 ± 0.6 kgm}**

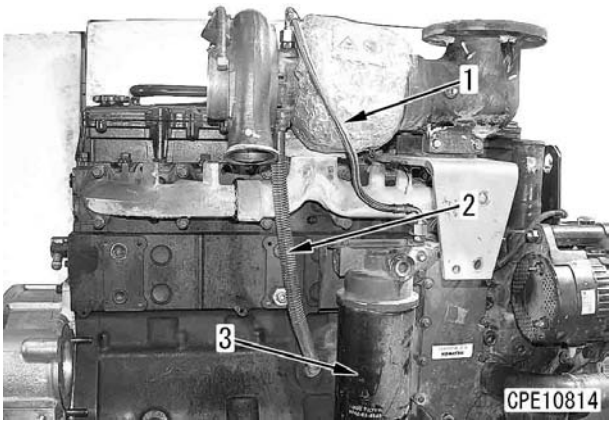


3) Drain the engine coolant and engine oil.
   Engine oil: **Approx. 24 ℓ**

3. Starting motor assembly
Remove mounting bolts (3), 2 nuts (4), starting motor assembly (1), and spacer (2).



4. Turbocharger lubrication hose and oil filter
1) Remove lubricating oil inlet hose (1).
2) Remove drain hose (2).
3) Remove oil filter (3).

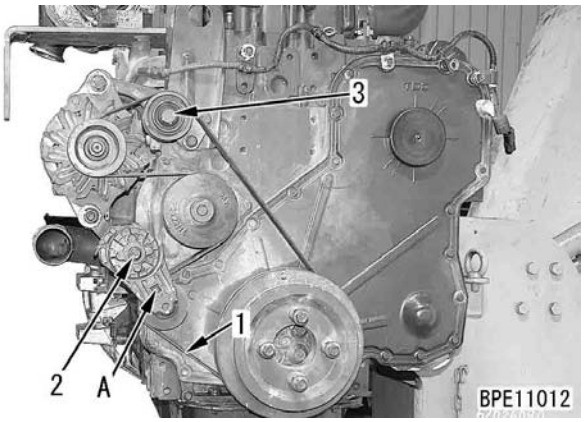


5. Alternator belt and idler roller
1) Remove alternator belt (1).
- Insert a wrench to the portion (A) (width across flats □ 12.7 mm) of the tensioner assembly (2), and rotate it to the opposite to the winding-up direction to decrease the alternator belt (1) tension.

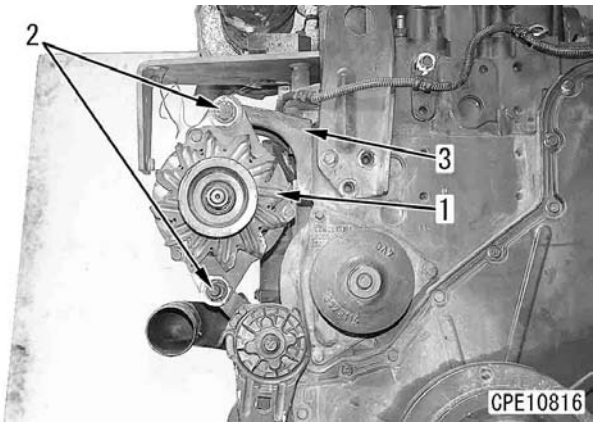
⚠ Make sure that the wrench is secured at the portion (A) before rotating it. (The spring of the tensioner assembly (2) is strong. If the wrench is loosely inserted, the wrench may accidentally come off while being rotated and it is extremely dangerous.)

⚠ After removing the alternator belt (1), return the tensioner assembly (2) slowly with care.

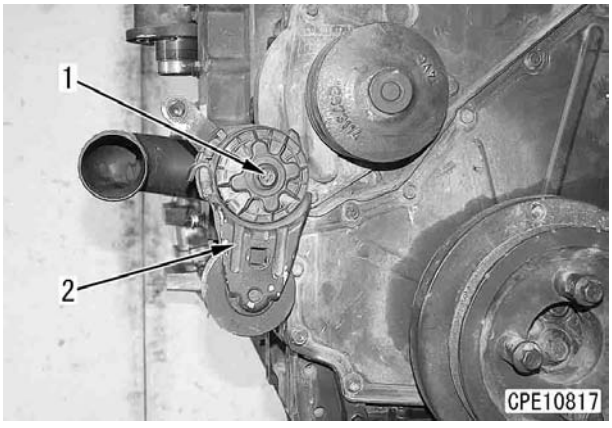
⚠ Be careful not to get your fingers caught between the pulley and alternator belt (1) during work.



6. Alternator
1) Remove mounting bolts (2) and alternator (1).
2) Remove bracket (3).



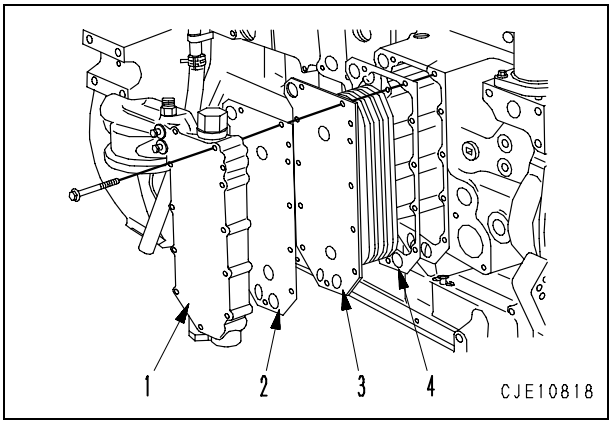
7. Belt tensioner
Remove mounting bolt (1) and belt tensioner (2).



8. Oil cooler

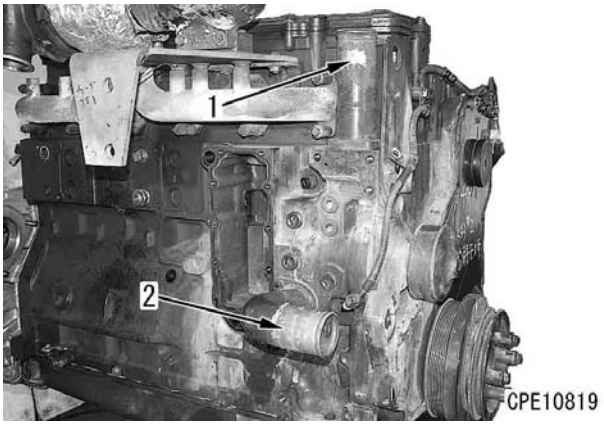
- Before removing the oil cooler, place an oil receiver under it.

1) Remove cover (1) and cover gasket (2).
2) Remove oil cooler (3) and cooler gasket (4).



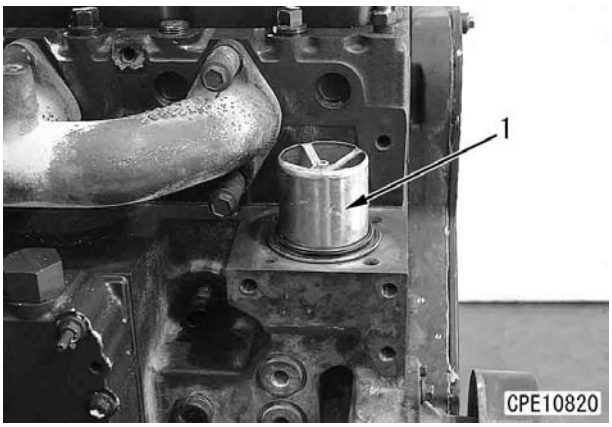
9. Coolant connector

1) Remove coolant outlet connector (1).
2) Remove coolant inlet connector (2).



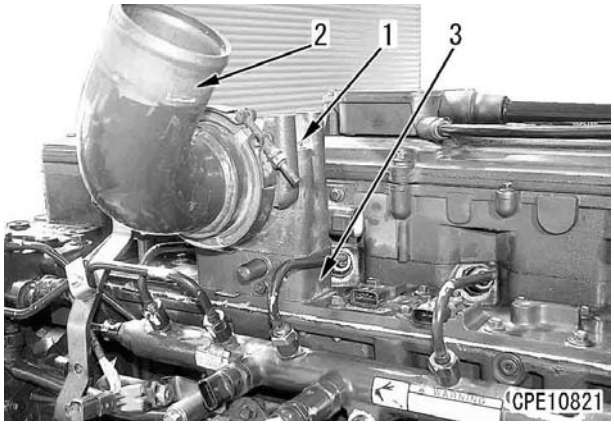
10. Thermostat

Remove thermostat (1).



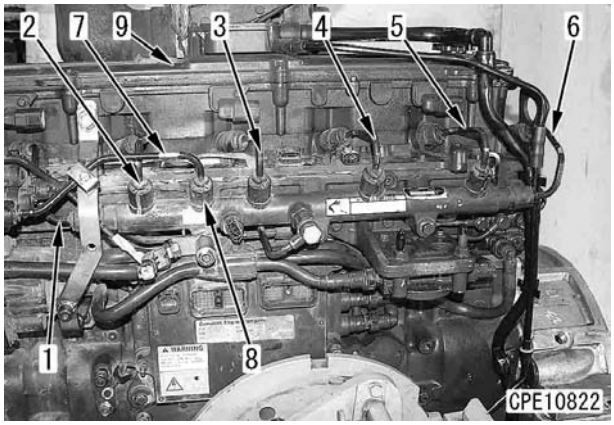
11. Electrical intake air heater and air intake connector

1) Remove 4 bolts (1) and air intake connector assembly (2).
2) Remove electrical intake air heater (3).

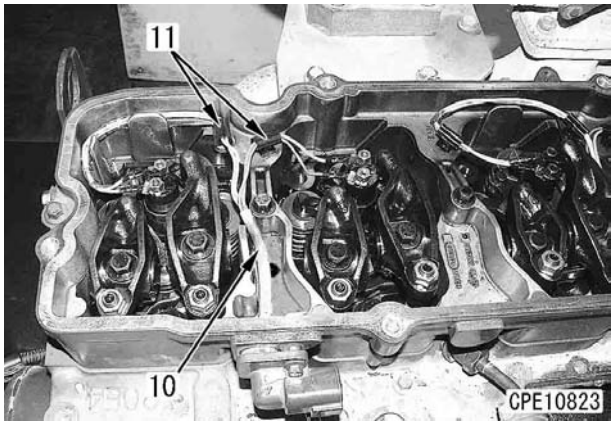


12. Fuel high-pressure pipe

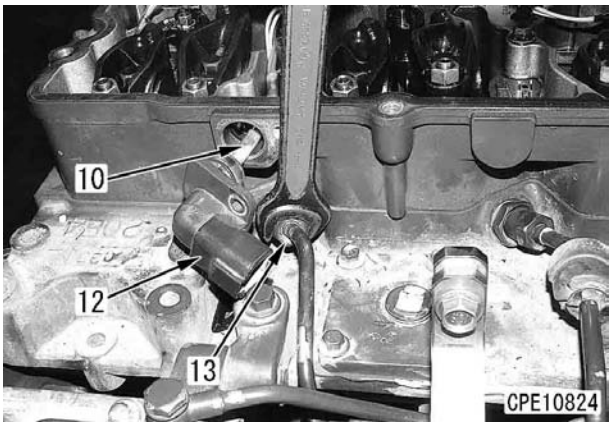
1) Remove bellows (8) from high-pressure pipes (1) – (6) and then remove high-pressure pipes.



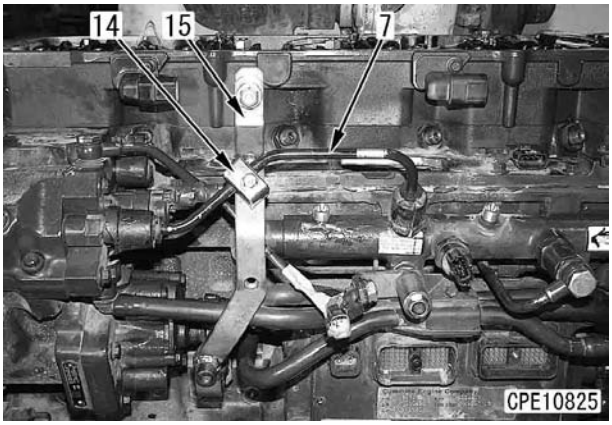
2) Removal of high-pressure pipes (1), (3), and (5)
   1] Remove head cover assembly (9).
   2] Disconnect clamp (11) of injector wiring harness (10).



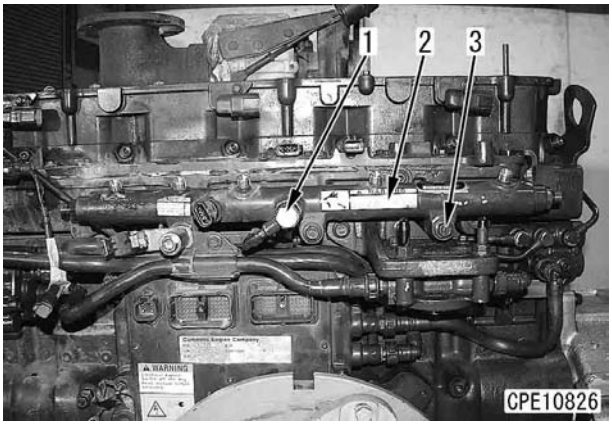
3] Disconnect connector (12), pull out wiring harness (10), and move connector (12) toward the front of the engine.
4] Remove pipe nut (13) on the injector side.



3) Removal of high-pressure pipe (7)
1] Remove clamp (14) and high-pressure pipe (7).
2] Remove stay (15).



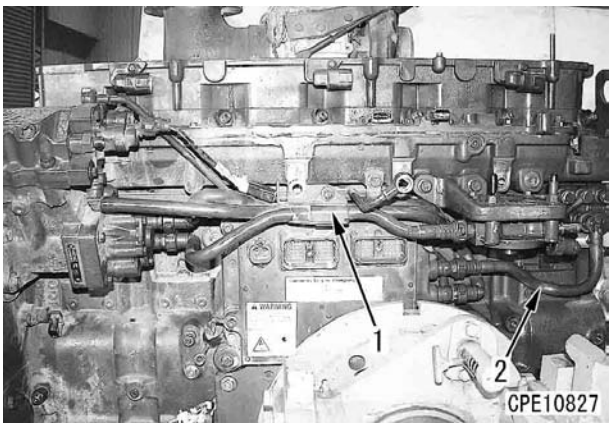
13. Common rail
1) Remove the joint bolt of fuel drain tube (1).
2) Remove mounting bolt (3) and common rail (2).



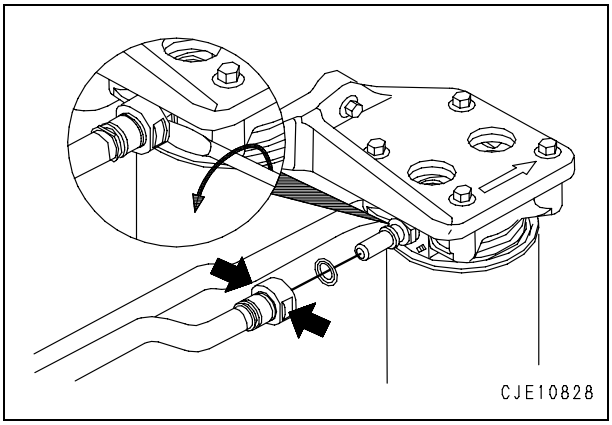
14. Removal of low-pressure hose

⚠ **The internal parts of the adapter may be damaged when the hose is removed. Accordingly, do not reuse the adapter but use new one when installing the hose again, as a rule.**

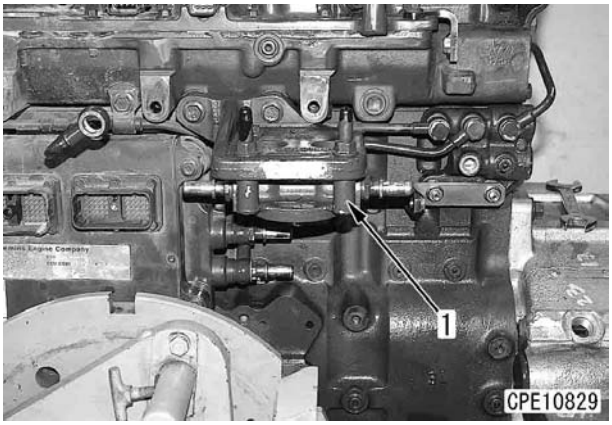
1) Remove low-pressure hose assembly (1).



2) Remove supply hose (2).
- Removal of hose
  While pressing the adapter (by the right and left sides) at the hose end, pry off the hose end face with a screwdriver.

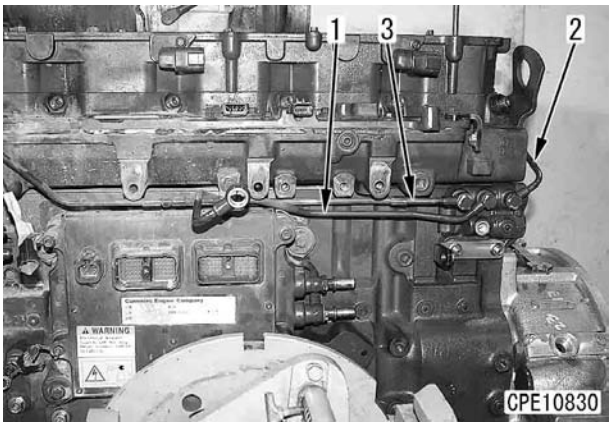


15. Fuel filter bracket
Remove fuel filter bracket assembly (1).



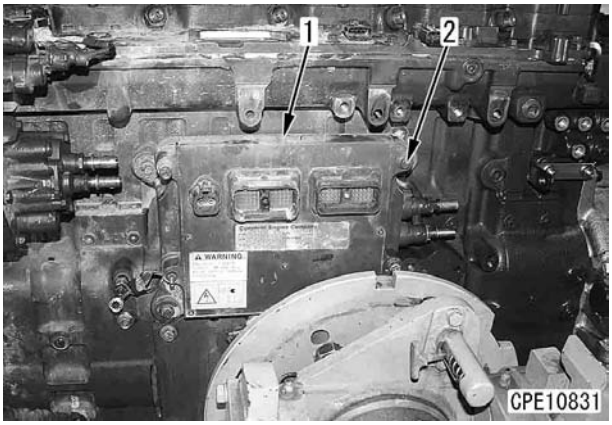
16. Removal of tubes

Remove drain tubes (1), (2), and (3).



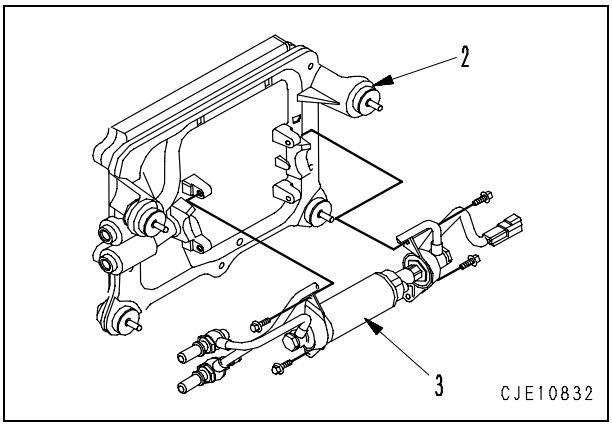
17. Main controller assembly

Remove mounting bolts (2) and main controller assembly (1).



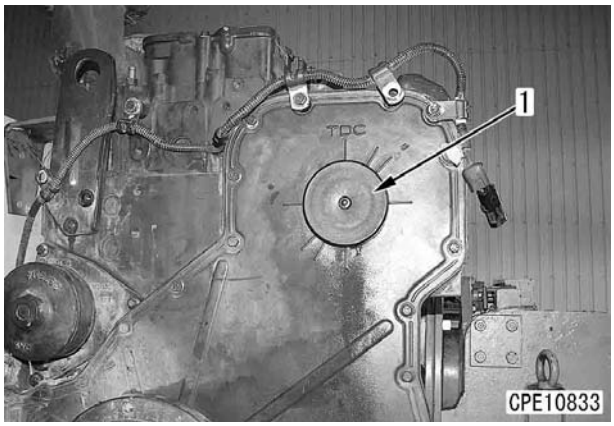
18. Fuel lift pump and main controller cooling plate

Remove fuel lift pump (3) on the back side of main controller cooling plate (2).



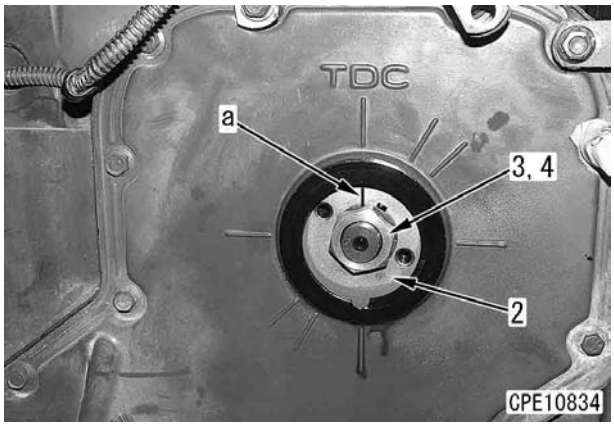
19. Fuel supply pump

1) Remove cap (1) of the front gear cover.

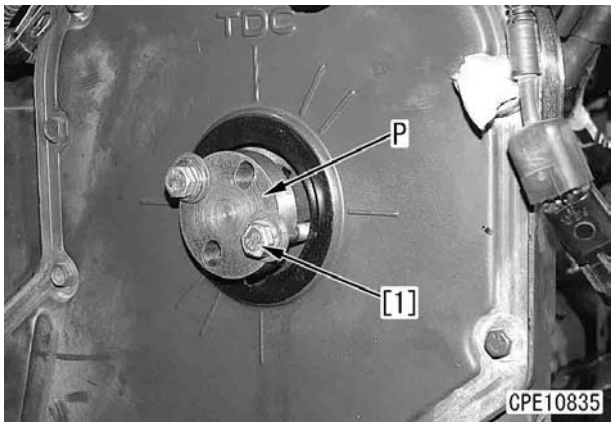


2) Rotate the crankshaft forward and set stamp (**a**) of supply pump gear (2) to the top to set the No. 1 cylinder to the top dead center (TDC).

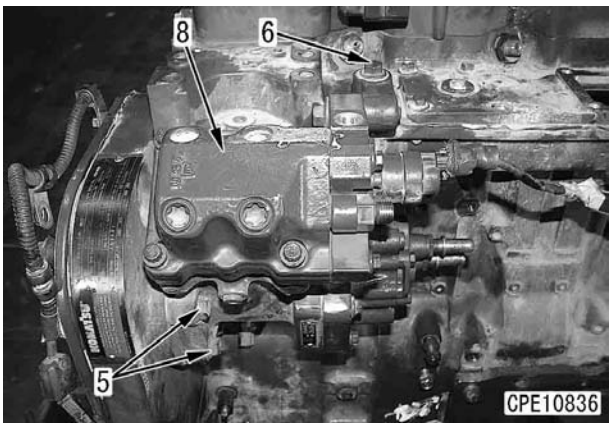
3) Remove nut (3) and washer (4).



4) Install tool **P** with bolt [1] (M8 × 1.25).

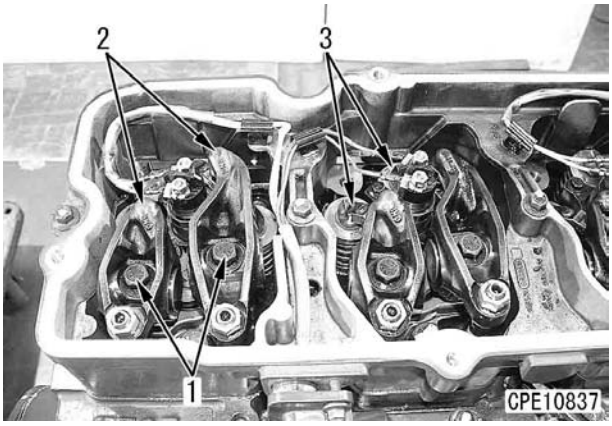


5) Remove 4 nuts (5) and 1 bolt (6).
6) Push in tool **P** installed in step 4) to remove supply pump assembly (7).

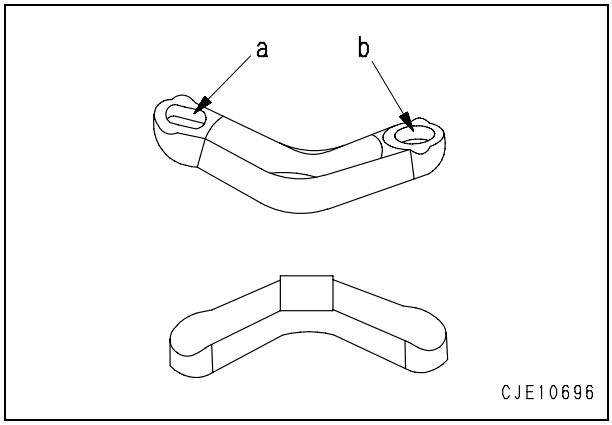


20. Rocker arm assembly and crosshead

1) Remove 12 bolts (1) and rocker arm assembly (2).
   ★ Loosen the locknut and then loosen the adjustment screw by 2 – 3 turns so that an excessive force will not be applied to the push rod when the rocker arm is installed.
2) Remove crosshead (3).



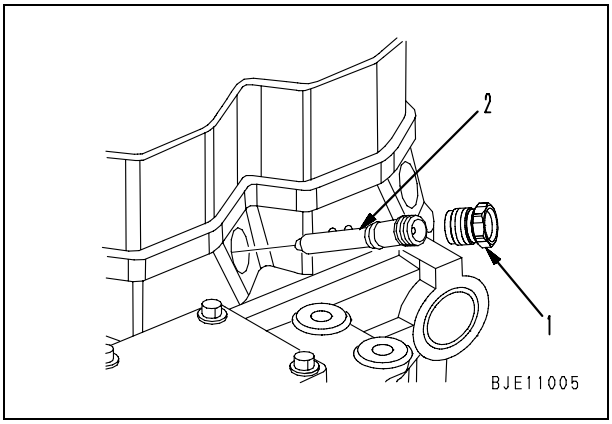
   ★ Record the position of each crosshead and the shapes of holes (**a**) and (**b**).



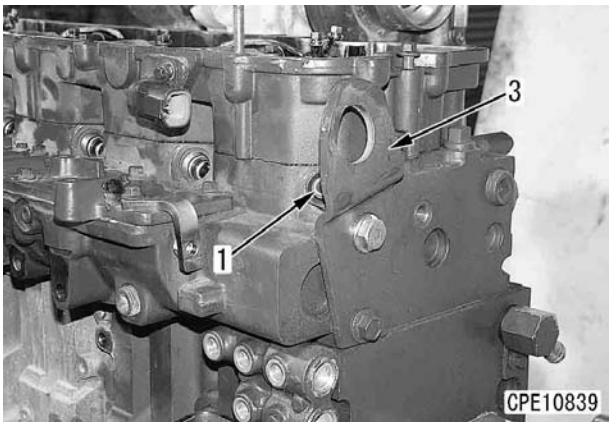
21. Fuel injector assembly

★ Before removing the inlet connector, remove all mud, etc. sticking around it so that mud, etc. will not enter the hole of the connector.

1) Remove retainers (1) and 6 inlet connectors (2).
   - Use tool **M** to remove the inlet connectors.

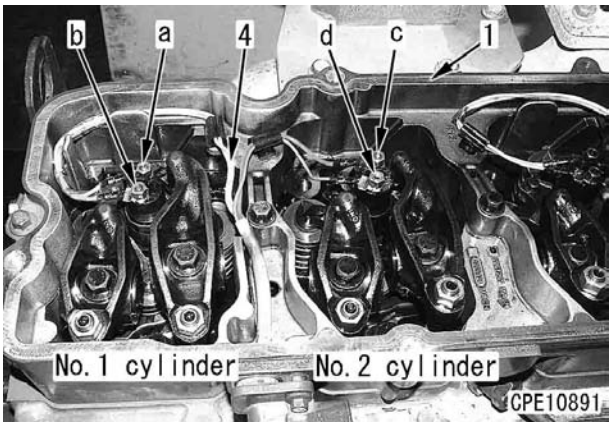


   - Before removing retainer (1) of the No. 6 cylinder, remove rear engine hanging plate (3).

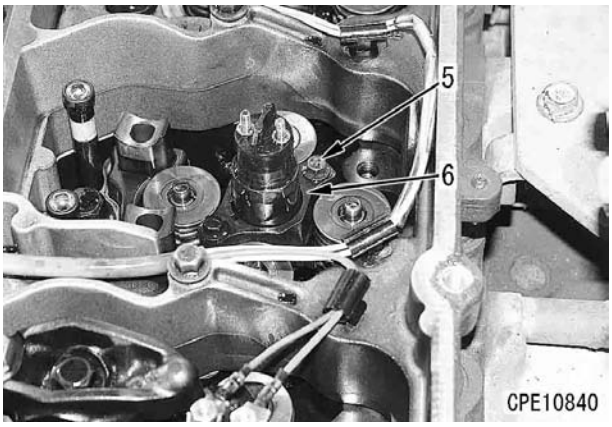


2) Disconnect wiring harness (4) from the injector.
★ Locations of wiring harnesses

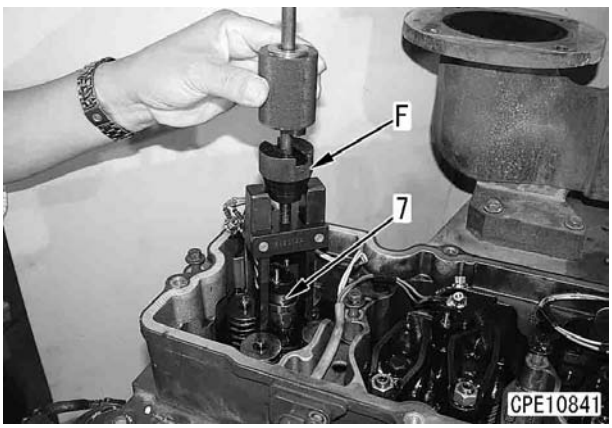
Color of cable		Cylinder No.	
a	Yellow	1, 3, 5	Right side
b	Orange		Left side
c	Red	2, 4, 6	Right side
d	Brown		Left side



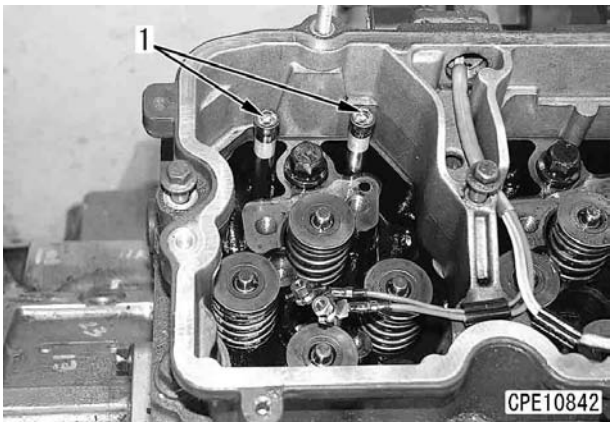
3) Remove bolt (5) and holder (6).



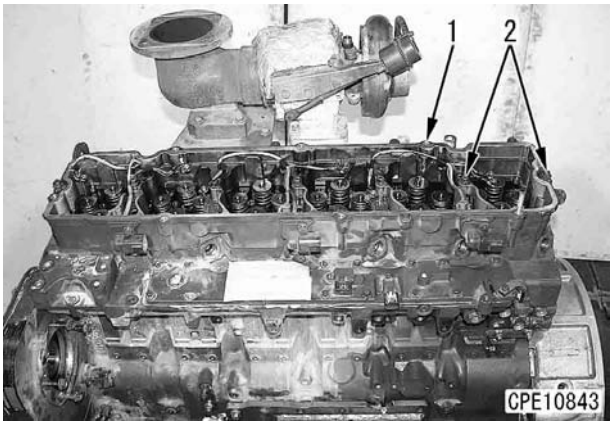
4) Using tool **F**, pull up injector (7).
★ Do not pry up the injector top.



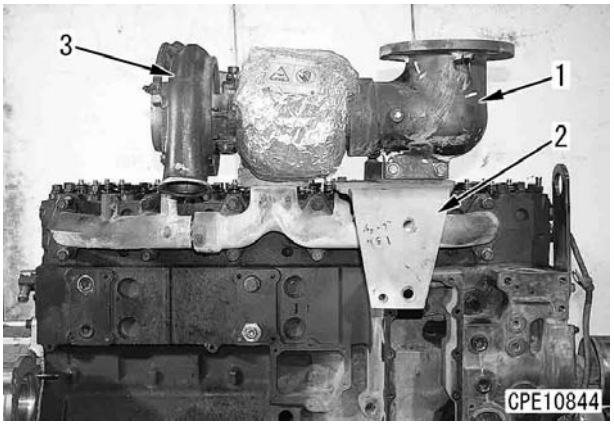
22. Push rod
Remove 12 push rods (1).



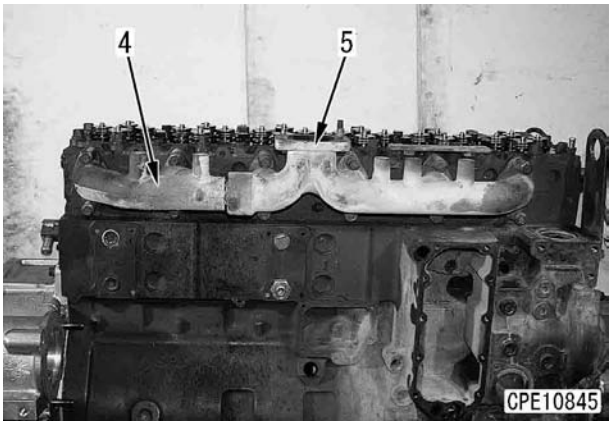
23. Rocker housing assembly
Remove 7 bolts (2) and rocker housing assembly (1).



24. Turbocharger and exhaust manifold
1) Remove tube (1).
2) Remove bracket (2).
3) Remove turbocharger assembly (3).

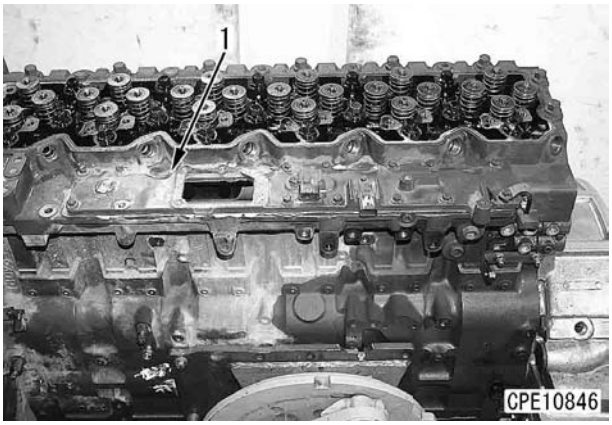


4) Remove exhaust manifolds (4) and (5).



25. Air intake manifold cover

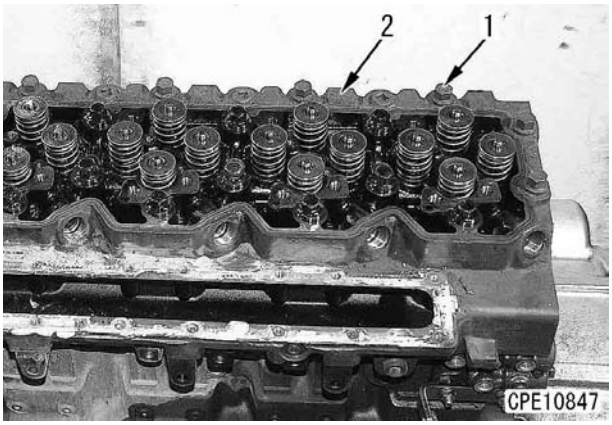
Remove air intake manifold cover (1).



26. Cylinder head assembly

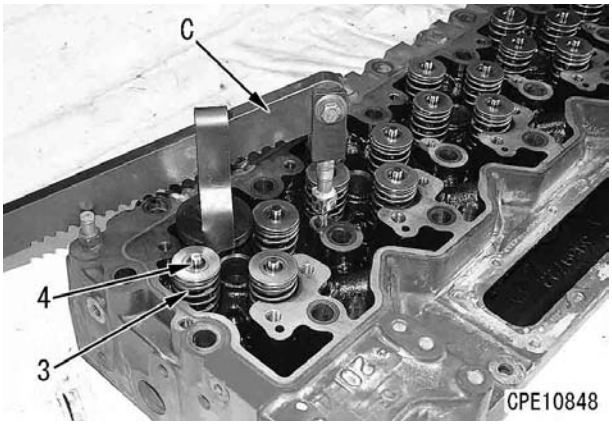
Remove 26 bolts (1) and cylinder head assembly (2).

Cylinder head assembly: **85 kg**

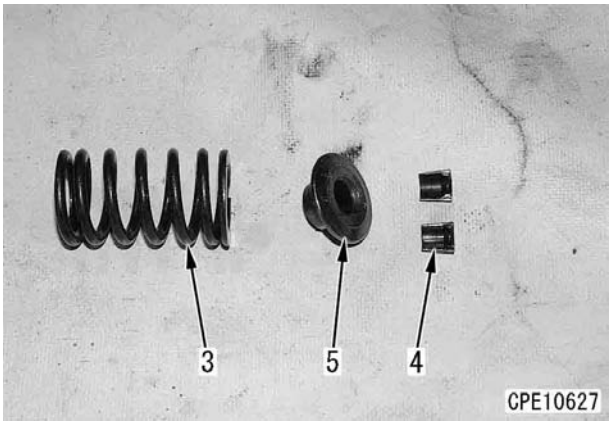


- Disassemble the cylinder head assembly according to the following procedure.

1) Using tool **C**, compress valve spring (3) and remove valve collet (4).

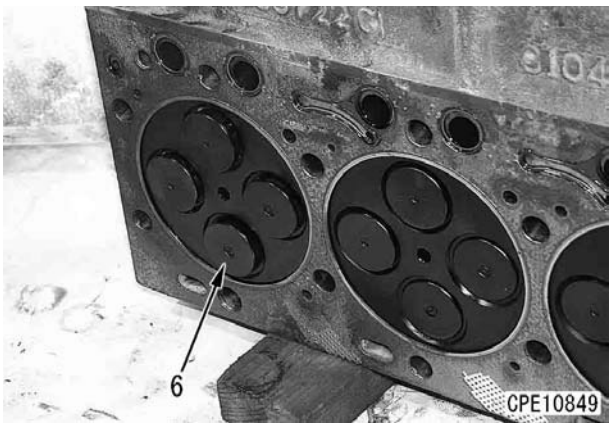


2) Remove upper seat (5) and valve spring (3).

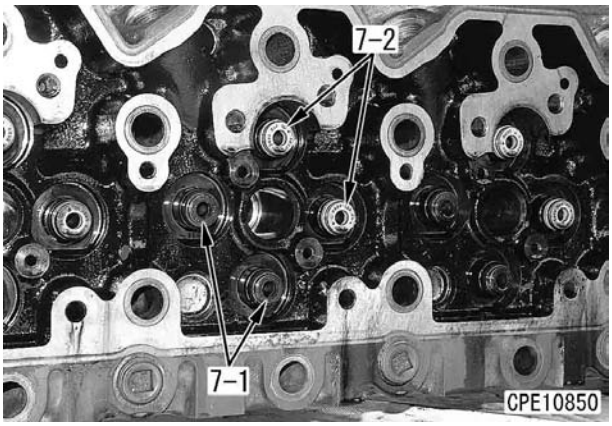


3) Raise the cylinder head assembly and pull out valve (6).

★ Make a mark on valve (6) so that it will be returned to the correct position of the cylinder head.

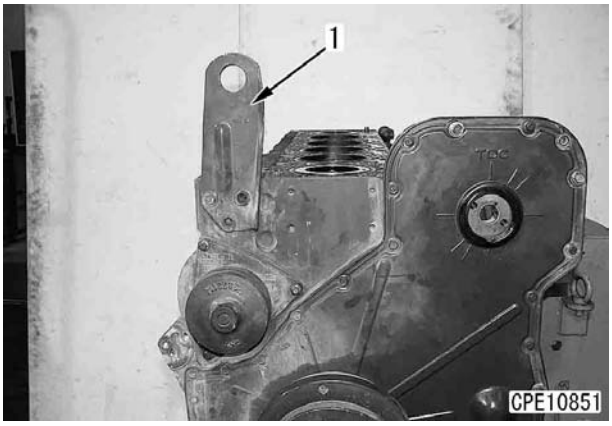


4) Remove valve seals (7-1) and (7-2) on the upper side of the head.
★ The valve seals are colored according to their locations.
- Exhaust valve: Black valve seal (7-1)
- Air intake valve: Blue valve seal (7-2)
- Use tool **Q** to remove the valve seals.

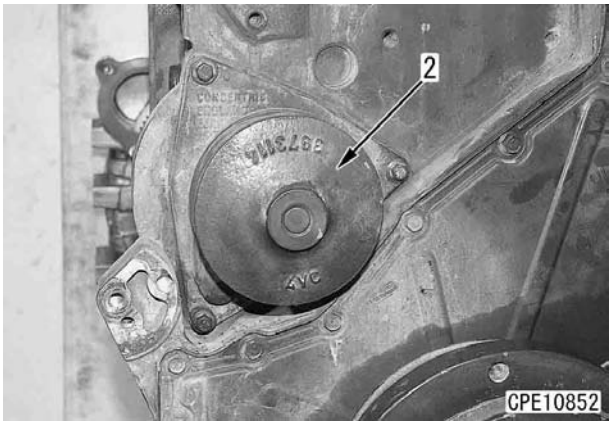


27. Front cover

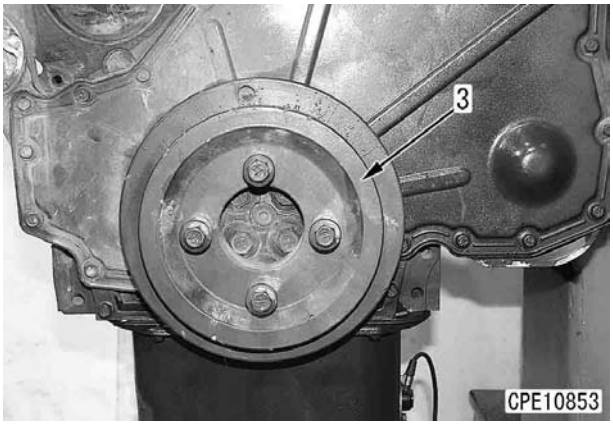
1) Remove engine front hanging plate (1).



2) Remove water pump (2).



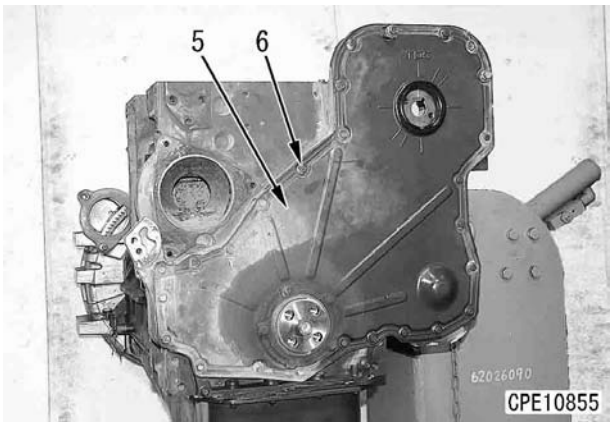
3) Remove pulley (3).



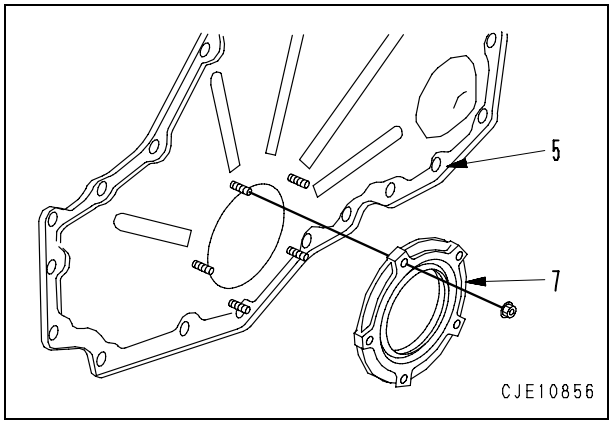
4) Remove vibration damper (4).



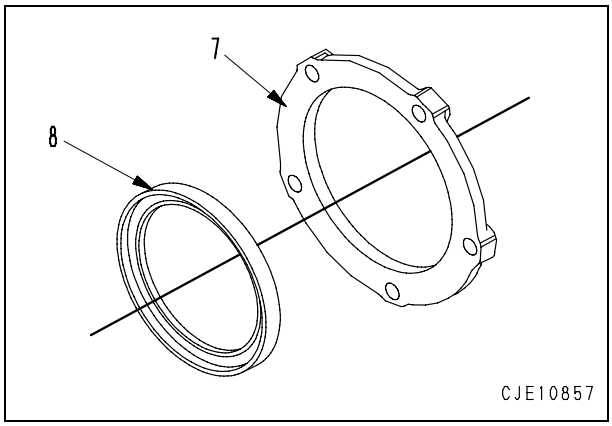
5) Remove 23 mounting bolts (6) and front cover (5).



1] Remove front seal carrier assembly (7).

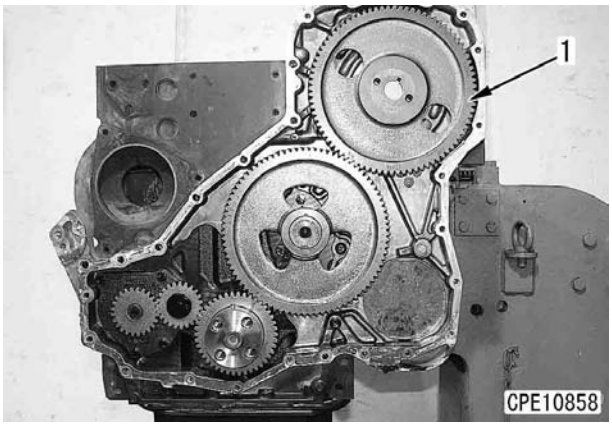


2] Remove front seal (8).



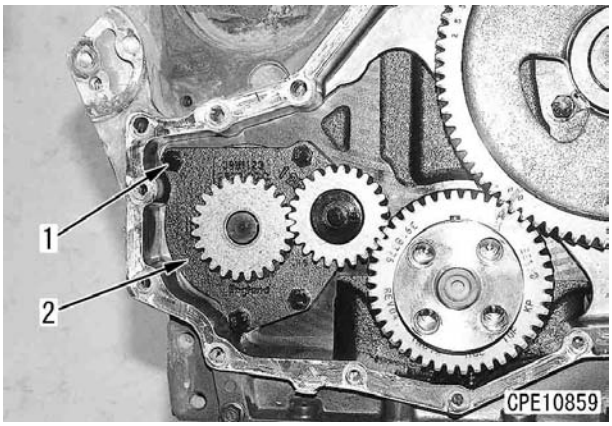
28. Supply pump drive gear

Remove supply pump drive gear (1).



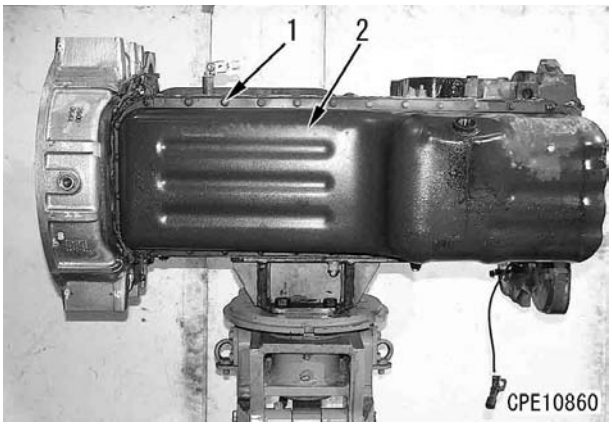
29. Oil pump assembly

Remove 4 bolts (1) and oil pump assembly (2).

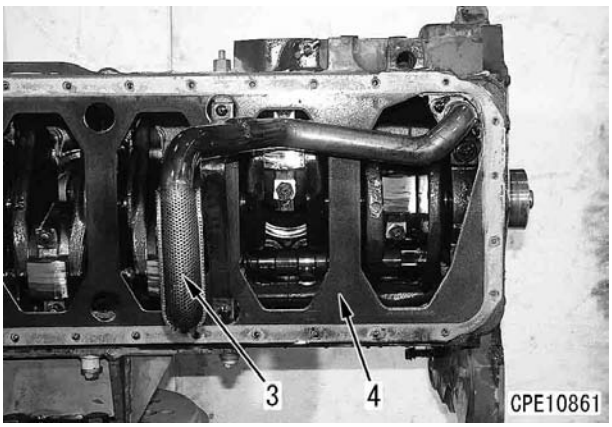


30. Oil pan

1) Remove 32 bolts (1) and oil pan (2).

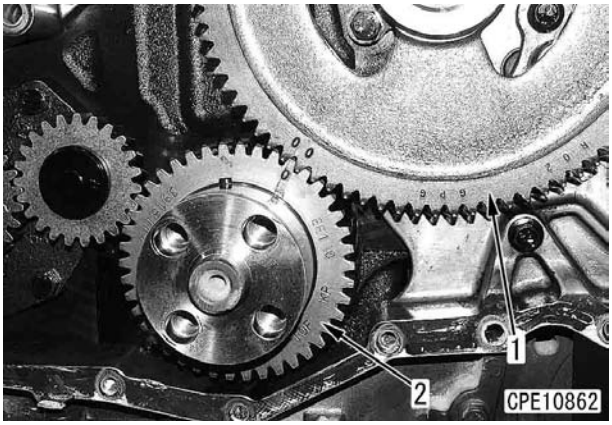


2) Remove suction tube (3) and bed plate (4).

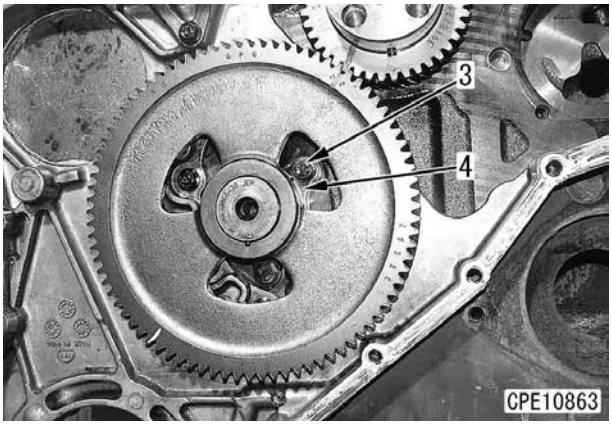


31. Camshaft

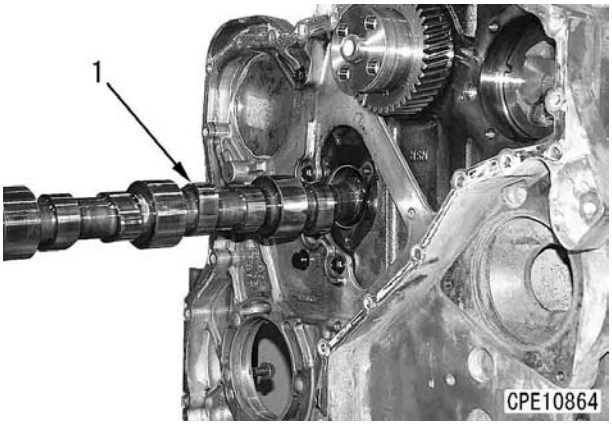
★ Rotate the crankshaft and set the mark of camshaft gear assembly (1) to the mark of crankshaft gear (2).



1) Remove bolts (3) and thrust plate (4).

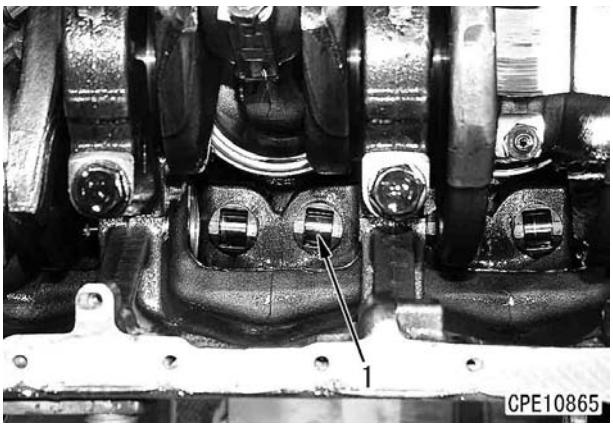


2) While turning the camshaft gear assembly (1), remove the camshaft.



32. Tappet

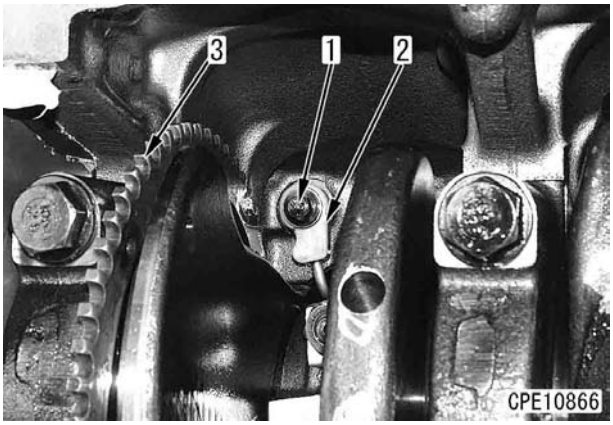
● Turn over the engine.
Remove 12 tappets (1).



33. Piston cooling nozzle

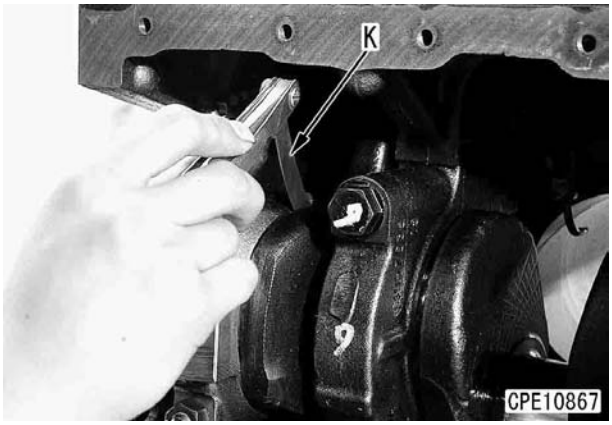
Remove bolts (1) and 6 piston cooling nozzles (2).

● Before removing the cooling nozzle of the No. 6 cylinder, remove speed sensor ring (3).

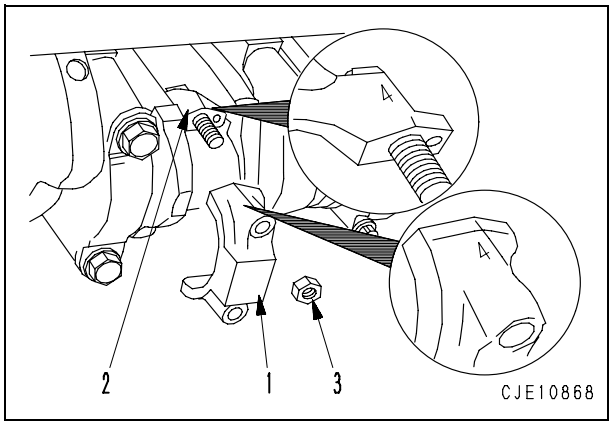


34. Piston and connecting rod assembly

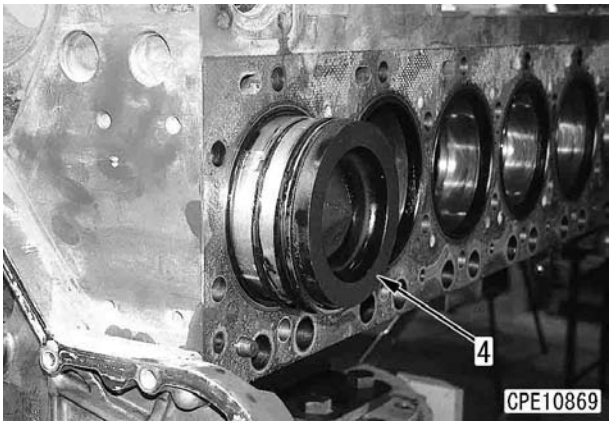
1) Rotate the crankshaft and bring the piston to be removed to the bottom dead center.
2) Scrub the carbon off the top wall of the liner with fine sandpaper.
   ★ Before removing the piston and connecting rod assembly, measure the side clearance between the connecting rod and crankshaft with tool **K**.



3) Make position marks on each connecting rod cap (1) and connecting rod (2), matching them to the cylinder.
4) Remove nuts (3).
5) Lightly hit mounting bolts of connecting rod cap (1) with a plastic hammer and remove connecting rod cap (1) and connecting rod bearing as a unit.

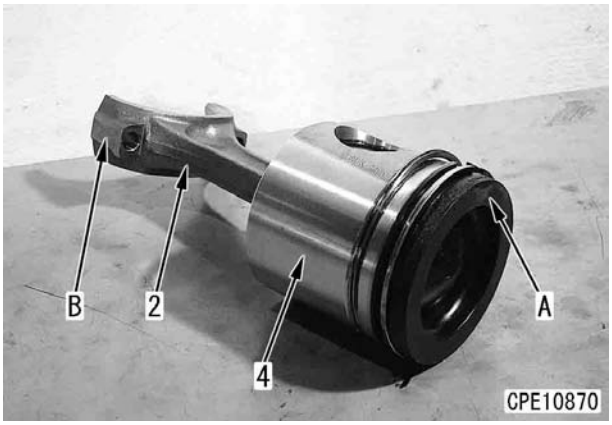


6) Push in and remove the piston and connecting rod assembly with a wood bar, etc. from the oil pan side, while supporting piston (4) on the cylinder head side.
   ★ Take care not to damage the inside of the cylinder with a corner of the connecting rod.
   ★ Make a cylinder No. mark on the piston.

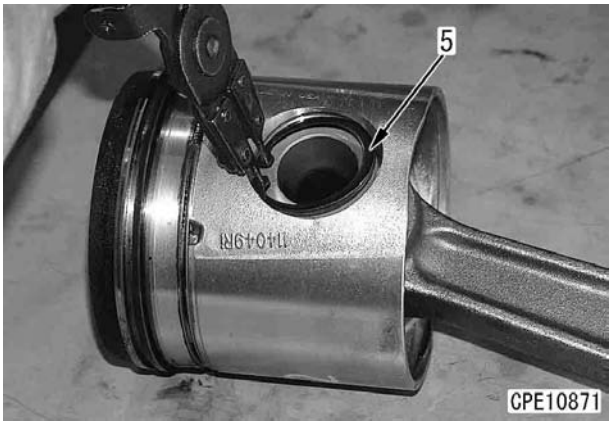


7) Remove the other piston and connecting rod assemblies according to the above procedure.
   ★ Take care not to damage the sliding portions of the pistons and bearings.

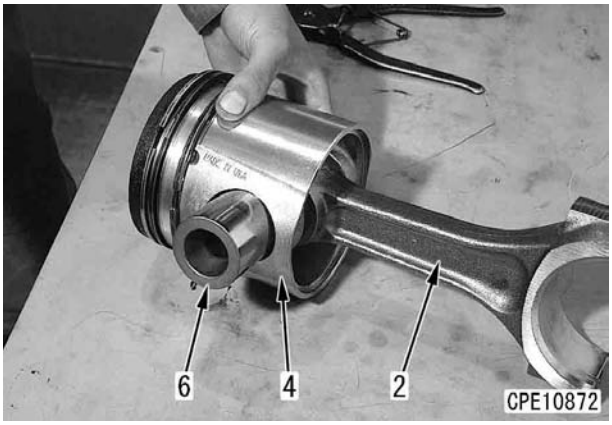
- Disassemble the piston and connecting rod assembly according to the following procedure.
  1] Check that there is the “counter mark” at part (**B**) of connecting rod (2) when the “FRONT” mark at part (**A**) of piston (4) is set up.



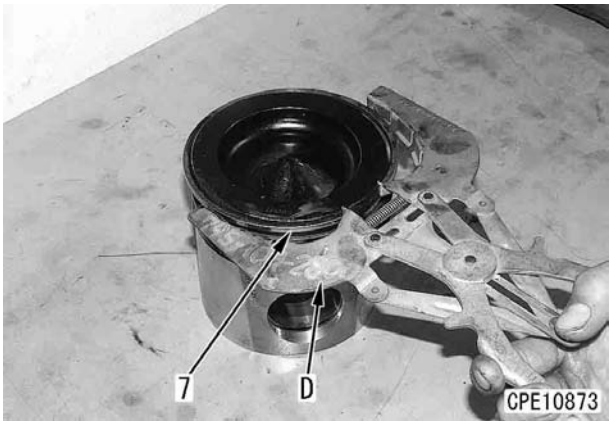
  2] Remove snap ring (5).



3] Remove pin (6) to disconnect piston (4) and connecting rod (2).
4] Remove the snap ring on the opposite side.



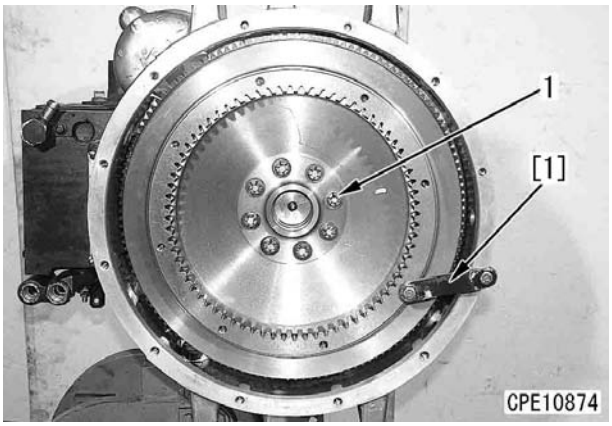
5] Using tool **D**, remove piston ring (7).



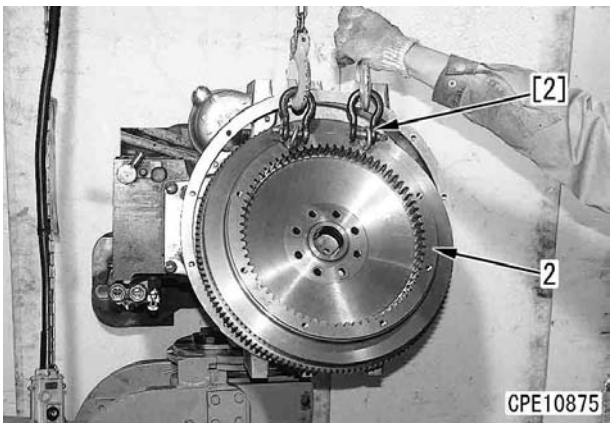
★ Keep the piston, connecting rod, bearing, piston rings, and piston pin by the cylinders.

35. Flywheel

1) Install lock plate [1] and remove mounting bolt (1).

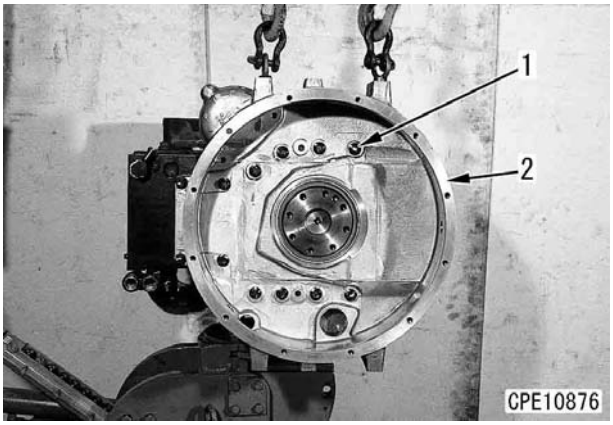


2) Install eyebolts [2] to flywheel (2) and lift off the flywheel.
Flywheel: **40 kg**



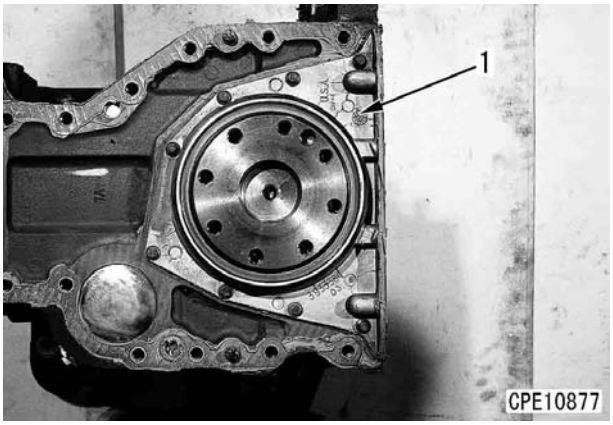
36. Flywheel housing

Remove 12 bolts (1) and flywheel housing (2).

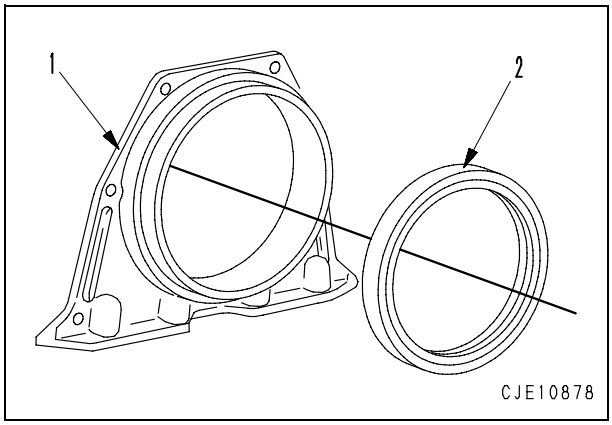


37. Rear seal housing

1) Remove seal housing (1).

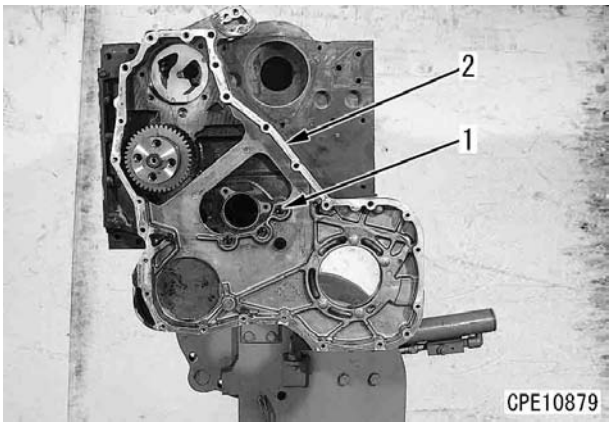


2) Remove rear oil seal (2).



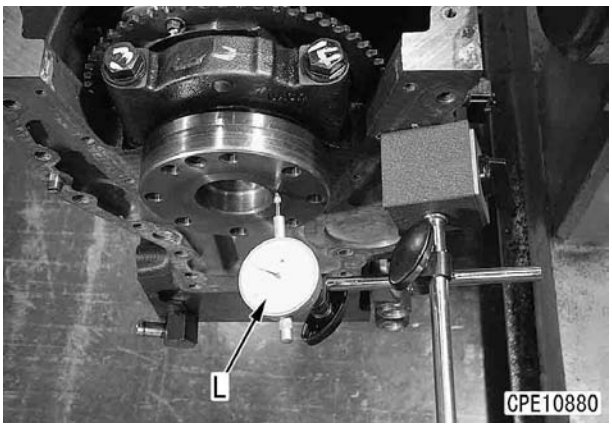
38. Gear housing

Remove 6 bolts (1) and gear housing (2).

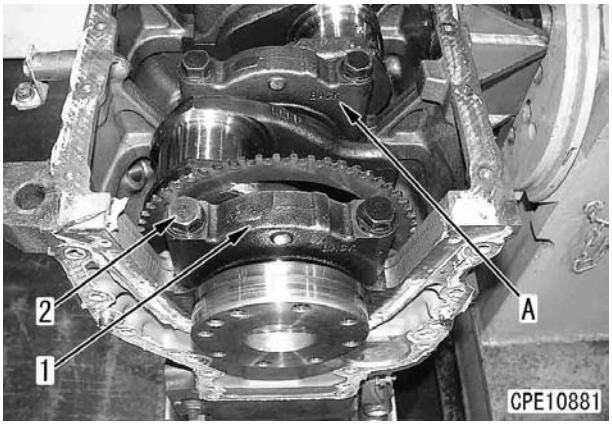


39. Crankshaft

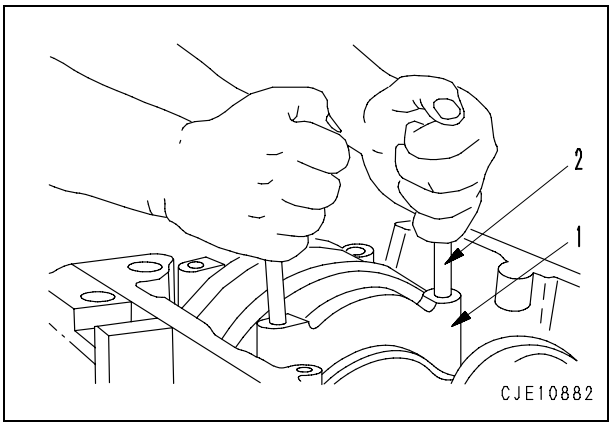
★ Before removing the crankshaft, measure its end play with tool **L**.



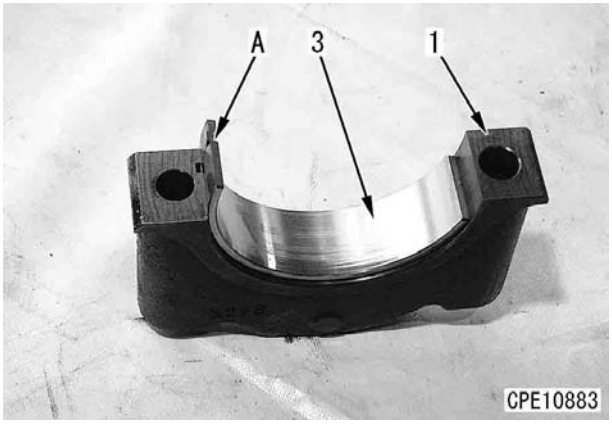
1) Remove mounting bolts (2) of main cap (1).
2) Mark the position No. on main cap (1).
   ★ Check that the embossed letters of “BACK” on side (**A**) of the main cap are directed toward the rear of the cylinder block.



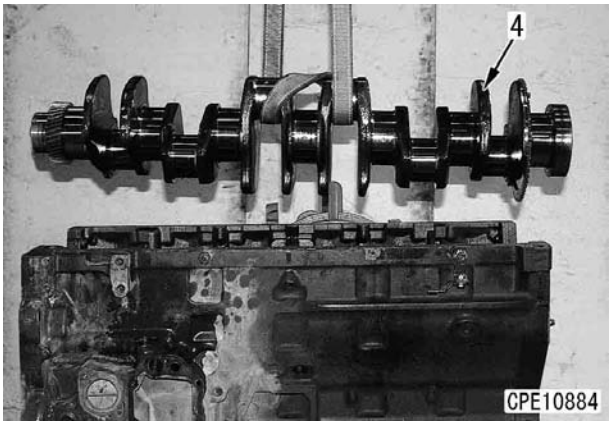
3) Insert bolts (2) in the bolt holes of main cap (1) and remove the main cap, while shaking it.



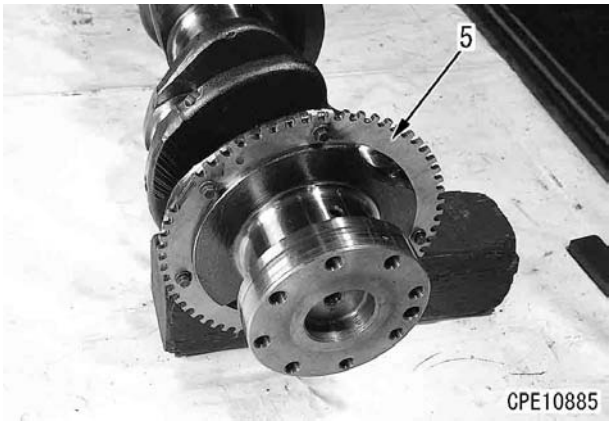
4) Remove lower bearing (3) from main cap (1).
   ★ Mark the position No. in part (**A**) of the claw of the removed bearing (Do not enter it in the sliding portion of the bearing).



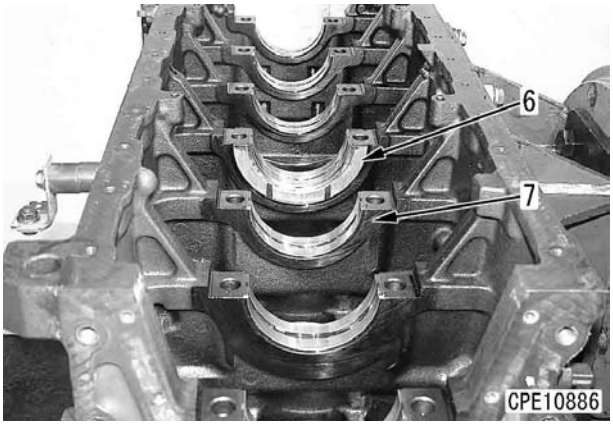
5) Using a nylon sling, lift off crankshaft (4).
★ When lifting up the crankshaft, take care not to hit it against the cylinder block.
★ Keep the crankshaft in a safe place so that its sliding portions will not be damaged.
Crankshaft: **80 kg**



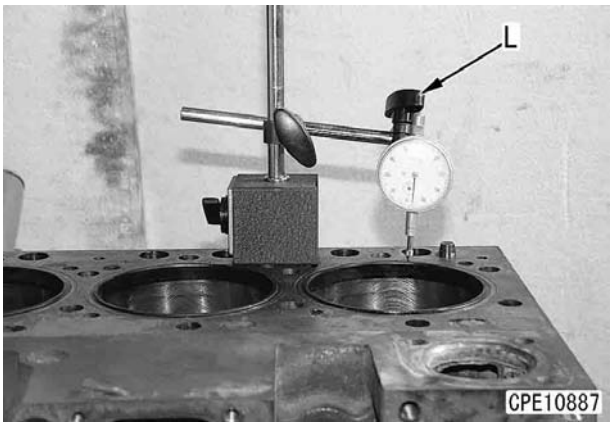
6) Remove speed sensor ring (5).



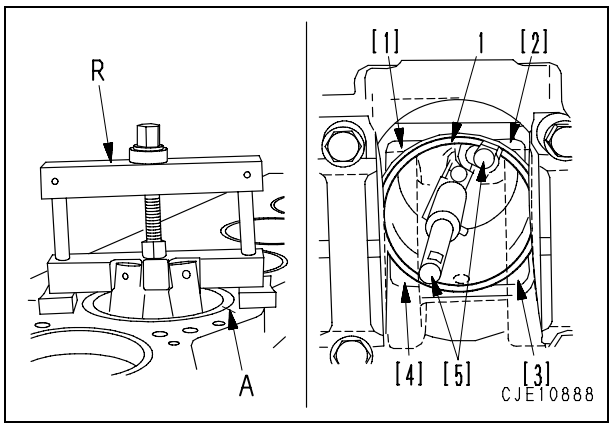
7) Remove 1 upper center thrust bearing (6) and 6 upper bearings (7).
★ Make the position marks on the main caps, upper bearings, and upper thrust bearings (in the claws of the bearings), and then keep them by the main caps so that they will not be damaged.



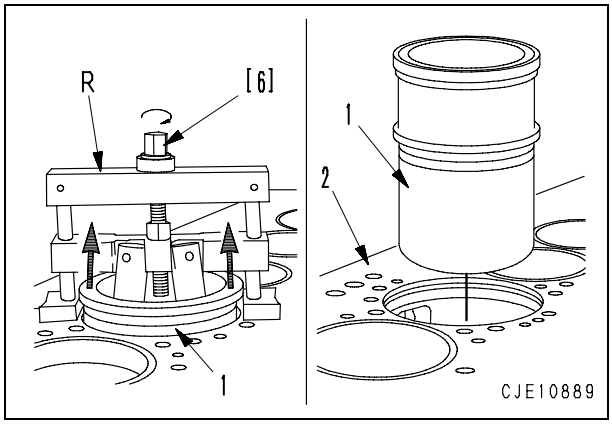
40. Cylinder liner
★ Before removing the cylinder liner, measure its projection with tool **L**.



1) Make mark (A) of the cylinder liner position and insert tool **R** from above the cylinder block.
★ Set arms [5] so that they will not touch supports [1], [2], [3], and [4] of cylinder liner (1).
★ Set tool **R** so that it will be at the center of the top of the cylinder liner.

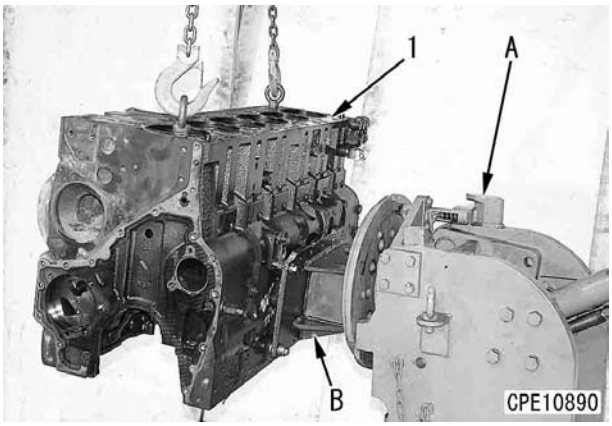


2) Turn jack bolt [6] of tool **R** clockwise to pull up cylinder liner (1) from cylinder block (2), and then remove cylinder liner (1) with both hands.
   ★ Mark the position No. on the removed cylinder liner.



41. Cylinder block

1) Remove cylinder block (1) from repair stand **A**.
   Cylinder block: **245 kg**
2) Remove tool **B**.



KOMATSU 114E-3 Series Diesel engine

Form No. SEN00463-01

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ENGINE

114E-3 Series

50 Disassembly and assembly

Disassembly and assembly, Part 2

Disassembly and assembly 2
General assembly of engine 2

Disassembly and assembly

General assembly of engine

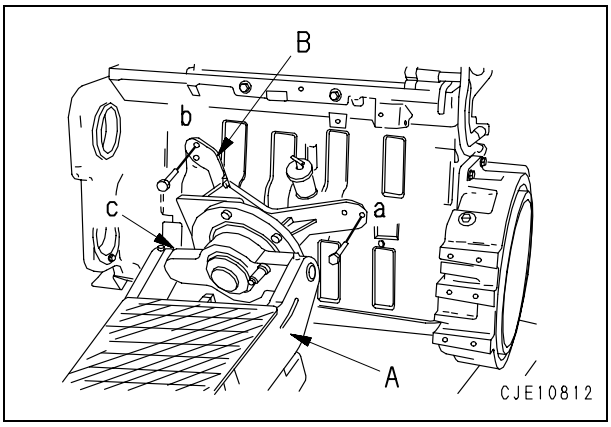
★ The following assembly procedures are for SAA6D114E-3. The shapes, quantities, locations, etc. of the parts depend on each applicable machine. Take care.
★ When reusing a part, be sure to install it to its original position.

1. Preparation work

1) Install tool **B**.
Mounting bolts on engine side

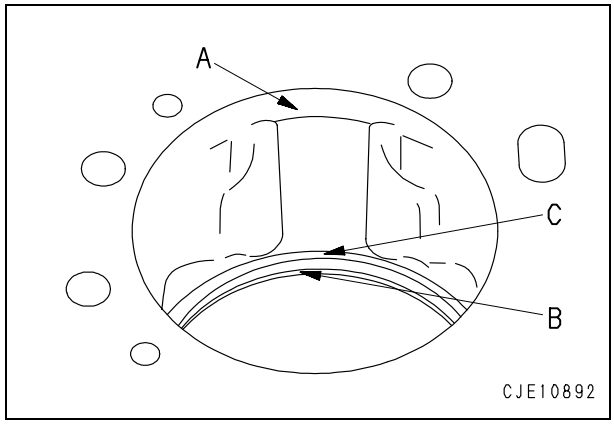
Position of bolt	Size of bolt	Tightening torque
a	M8	**24 ± 4 Nm {2.5 ± 0.4 kgm}**
b, c	M10	**43 ± 6 Nm {4.4 ± 0.6 kgm}**

2) Install the cylinder block to repair stand **A**.
Cylinder block: **245 kg**

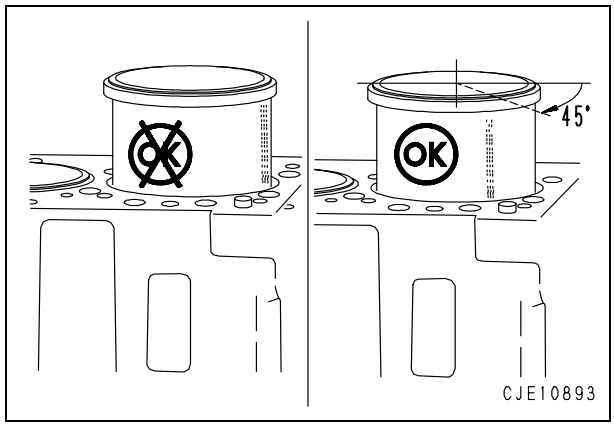


2. Cylinder liner

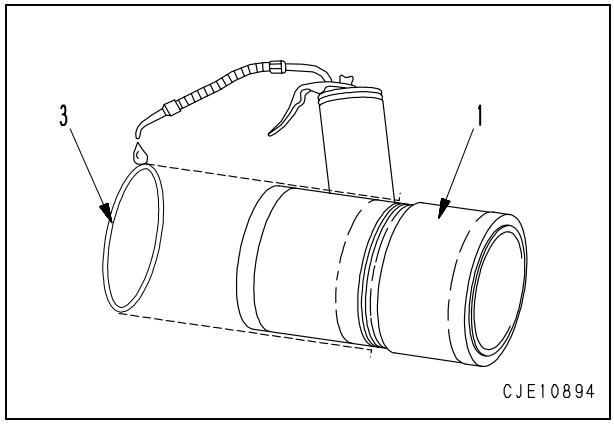
★ Before inserting the cylinder liner, clean it, remove all deposits and broken pieces from sealing faces (A), (B), and (C), and polish those faces until the machined surfaces appear. (Take care not to scrub too much.)
● Apply clean engine oil (EO15W-40) to faces (A) and (B).



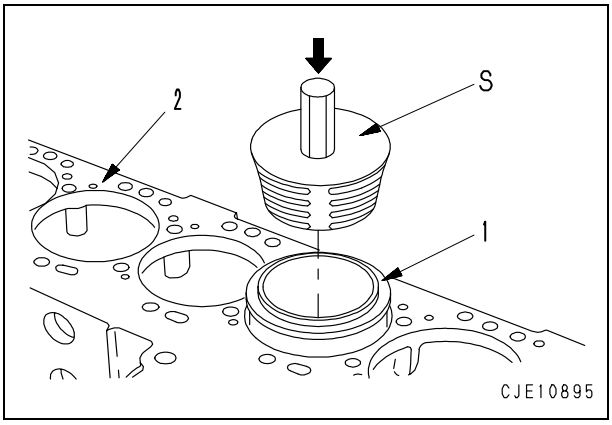
★ When reusing a cylinder liner, insert it in the cylinder where it was, turning it 45° from the original position. (Move the pitted surface of the cylinder liner from the position where it has been pitted.)



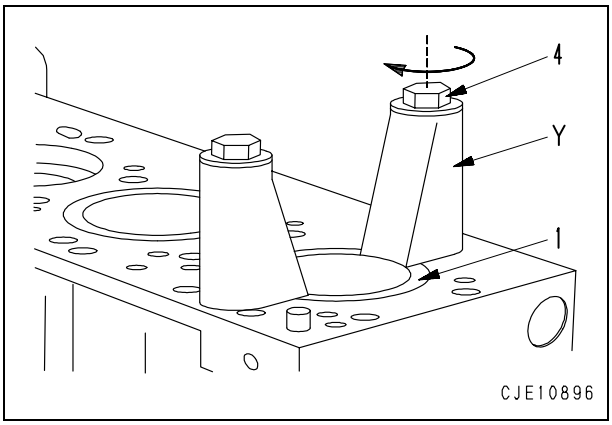
1) Apply engine oil (EO15W-40) to the O-ring sealing portion of cylinder liner (1).
★ Apply a little amount of oil just before inserting the cylinder liner.
2) Fit O-ring (3) to cylinder liner (1).
★ When fitting the O-ring, check that it is not twisted.



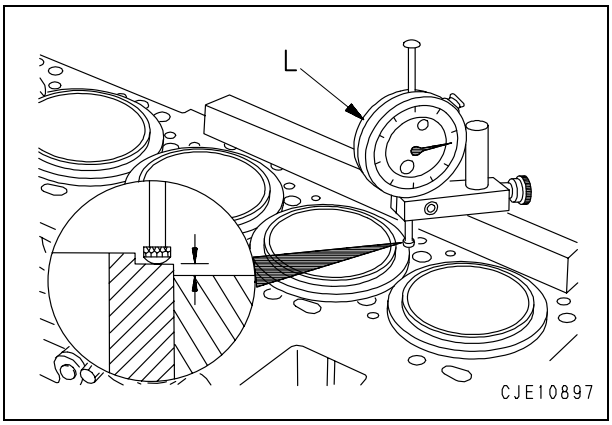
3) Push in cylinder liner (1) in cylinder block (2) with both hands.
   ★ If the cylinder liner does not enter the cylinder smoothly, the O-ring may be broken. In this case, check the cylinder block for burrs.
4) Using tool **S**, press fit cylinder liner (1).



5) Using tool **Y** and cylinder head mounting bolts (4), set cylinder liner (1).
   Tightening torque:
   68 ± 10 Nm {6.9 ± 1.0 kgm}



6) After press fitting the cylinder liner, measure the projection of the cylinder liner with tool **L**.
   ★ Measure the projection at 4 places equally spaced on the periphery.
   ★ Projection of liner: 0.026 – 0.122 mm

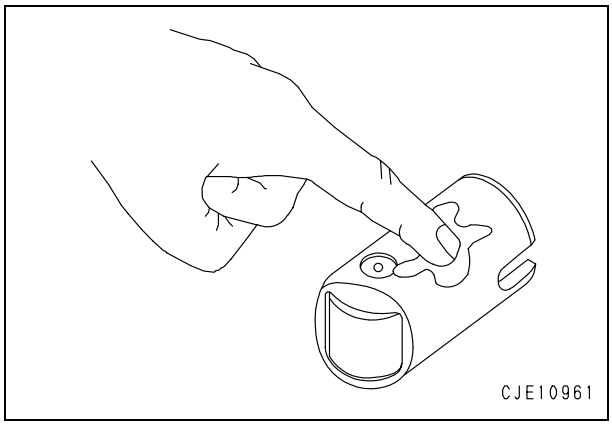


7) If the projection of the cylinder liner varies more than 0.025 mm in 180° of the periphery of the liner, repeat steps 5) and 6) and set the projection in the specified range.

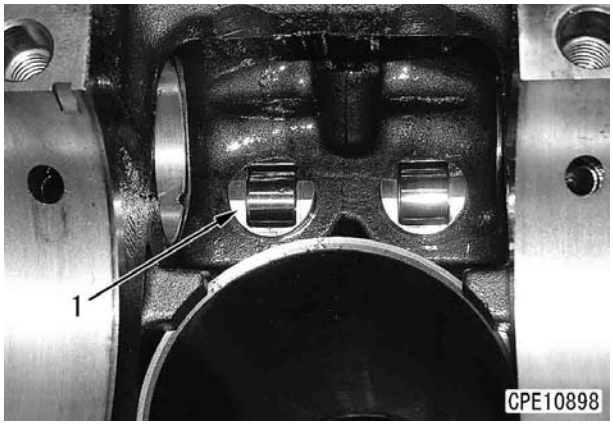
3. Tappet
- Turn over the cylinder block.

★ When reusing the camshaft and tappets, be sure to combine them as they were.
★ Do not install a used tappet to a new camshaft.

1) Apply engine oil (EO15W-40) to the tappet.



2) Install 12 tappets (1).



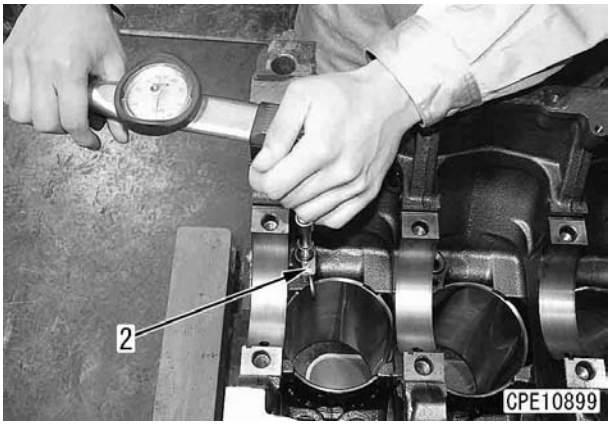
★ Do not turn the cylinder block more than 90°. If it is turned more than 90°, the tappets will be off the mounting holes.

4. Piston cooling nozzle

Set 6 piston cooling nozzles (2) and secure them with the mounting bolts.

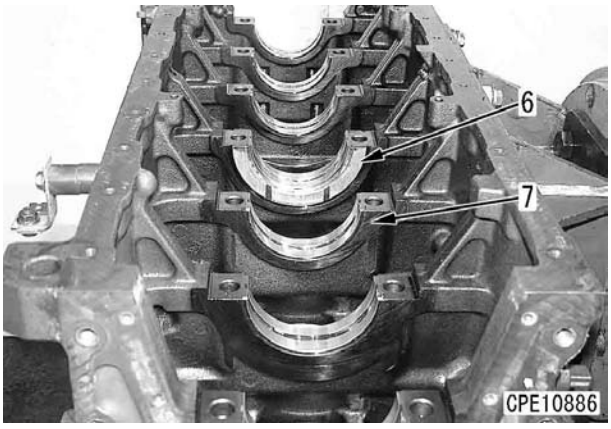
Mounting bolt:

27 ± 3 Nm {2.75 ± 0.3 kgm}



5. Crankshaft

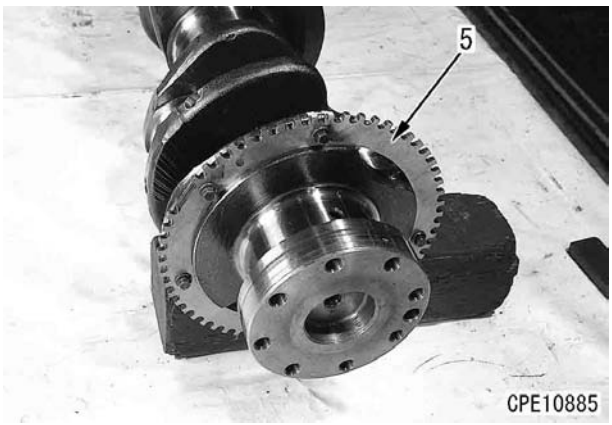
1) Install 6 upper bearings (7) and 1 upper thrust bearing (6).
   - ★ Set the projection of each bearing to the cut of the cylinder block.
   - ★ When installing the bearings, check that their back sides are free from foreign matter.
   - ★ Apply engine oil (EO15W-40) to the inside of the bearings. Do not apply it to the back side, however.
   - ★ When reusing the bearings, check the marks made on them when removed and install them to their original positions.



2) Install speed sensor ring (5).
   1] Use new bolts (Do not reuse the removed bolts).
   2] Tighten the bolts on the right side and left side alternately.

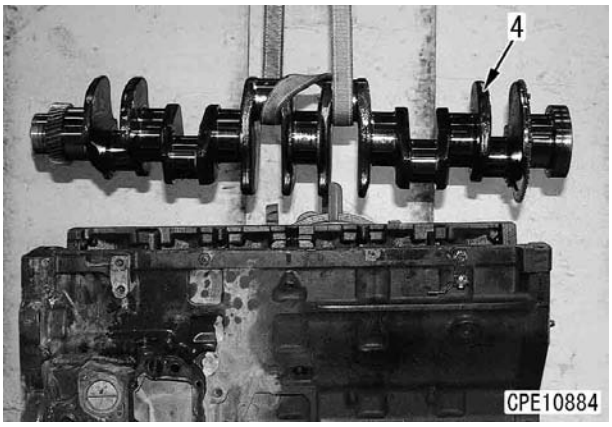
   Mounting bolt:

   8 ± 2 Nm {0.8 ± 0.2 kgm}

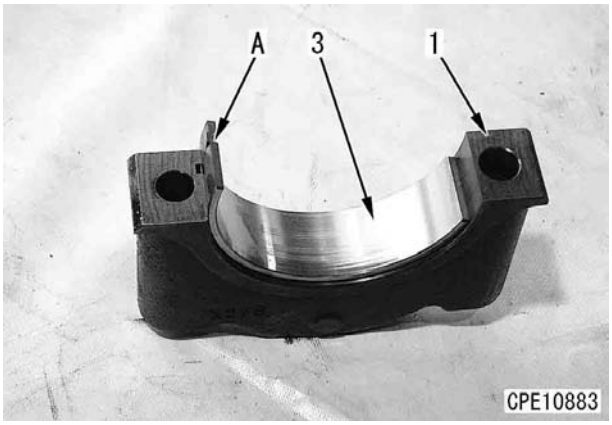


3) Using a nylon sling, lift up and install crankshaft (4).
   - ★ Take care not to damage the bearings.

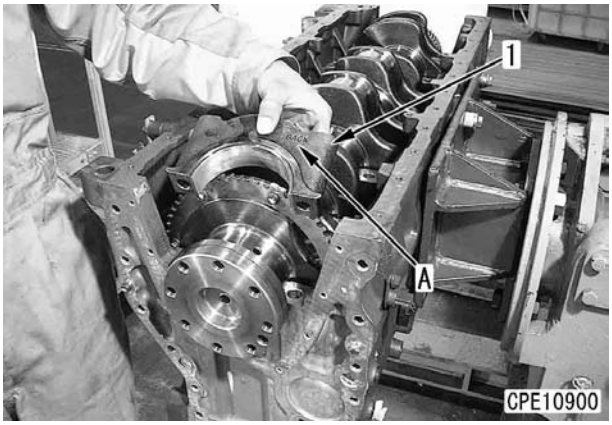
   Crankshaft: **80 kg**



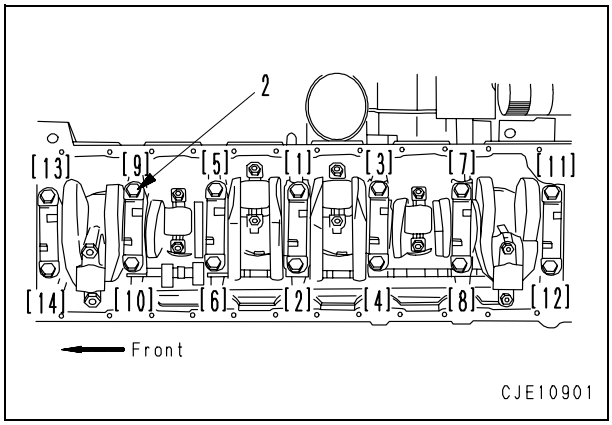
4) Install each lower bearing (3), setting its projection to the cut of the main cap (1).
   - Check the mounting position No. at part (**A**).



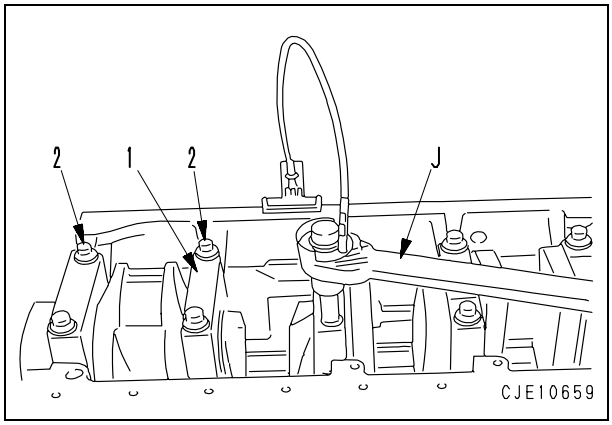
5) Apply engine oil (EO15W-40) to the journal surfaces of the crankshaft.
6) When installing main cap (1), check the mounting position mark on it and direct the embossed letters of “BACK” at part (**A**) toward the rear of the cylinder block.
   - Push in each main cap by hitting it lightly with a plastic hammer or rubber hammer.



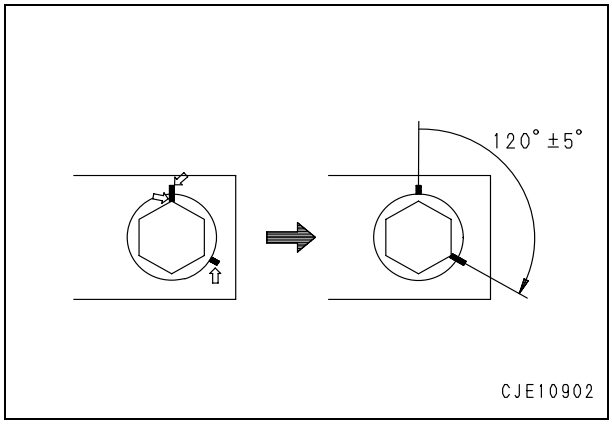
7) Tighten main cap mounting bolts (2).
   ★ Apply engine oil (EO15W-40) to the bolts.
   ★ Tighten the mounting bolts in the order shown below: [1] → [14]



Main cap mounting bolt:
1] **167 ± 8 Nm {17.0 ± 0.8 kgm}**
2] Loosen by **360°**
3] **30.4 ± 3.0 Nm {3.1 ± 0.3 kgm}**
4] **50 ± 4.9 Nm {5.1 ± 0.5 kgm}**
5] **120° ± 5°** (Use angle tightening tool **J**)

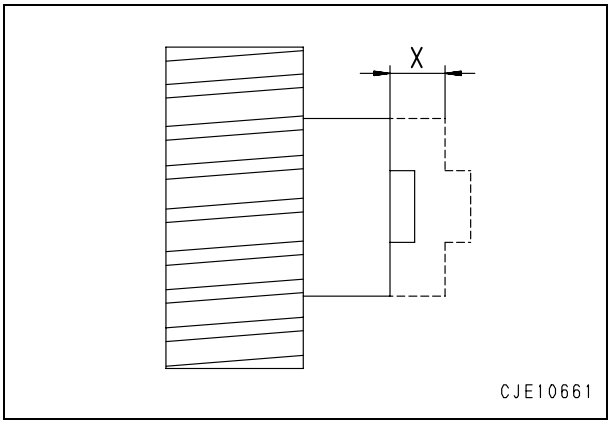


- When not using tool **J**
  Make marks on the main cap and bolt with paint, then tighten the bolt by **120° ± 5°**.



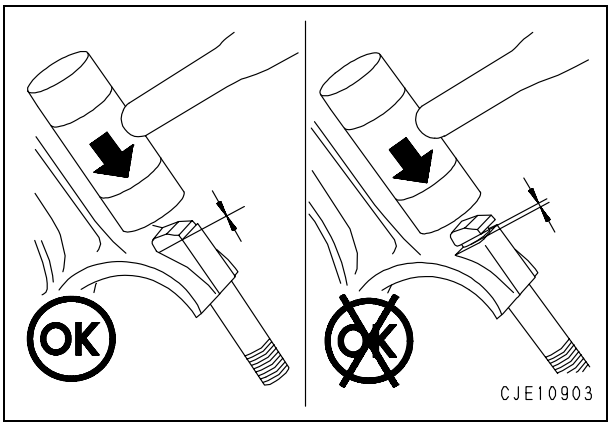
8) After tightening the bolts, make sure that the crankshaft turns smoothly.

9) Measure the end play of the crankshaft with tool **L**.
★ End play: **0.235 ± 0.15 mm**

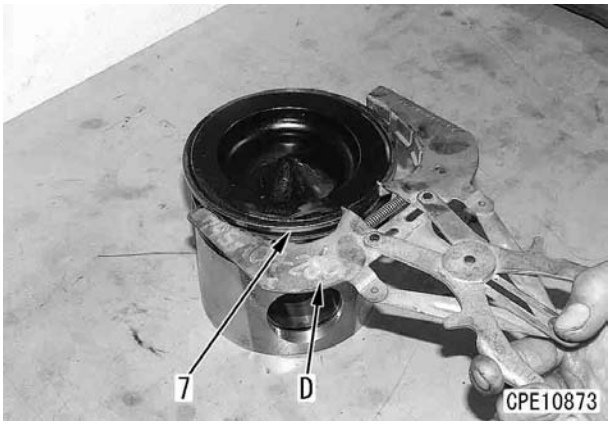


6. Piston and connecting rod assembly

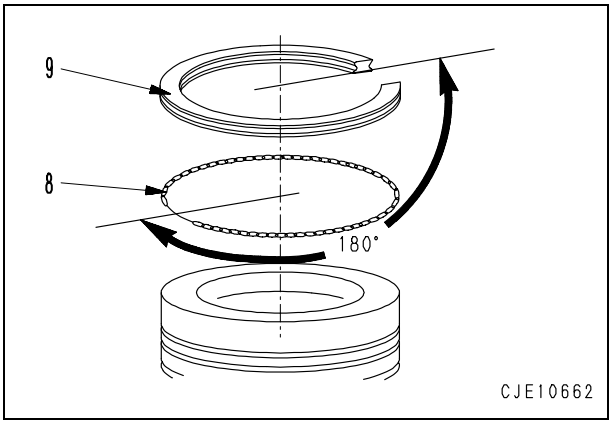
1) Lightly hit the connecting rod bolt with a plastic hammer until its head is aligned with the flat machined surface of the connecting rod and set in position.



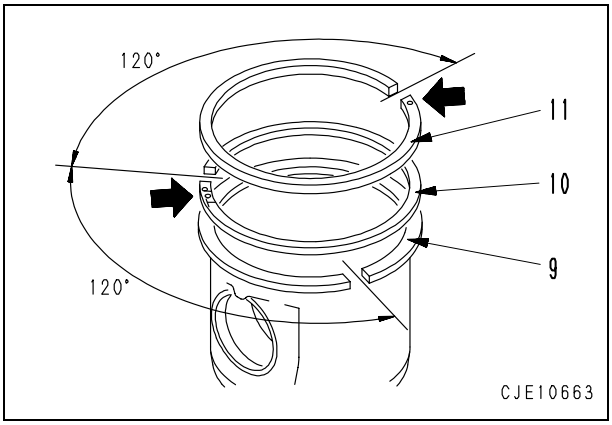
2) Using tool **D**, fit piston rings (7) to the piston.



3) Fitting oil ring
Fit oil ring (9) so that its abutment joint will be at **180°** from the end of expander (8).

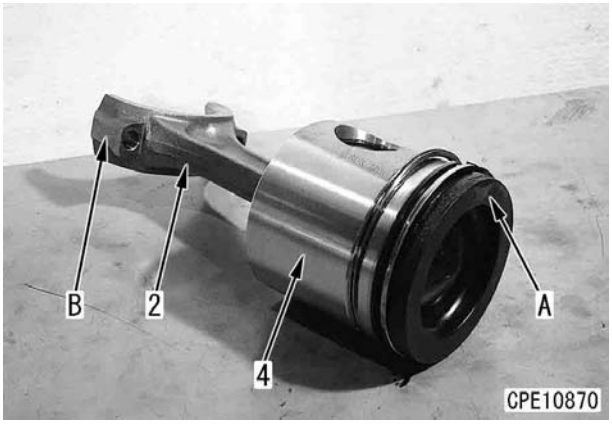


4) Fit second ring (10) with the stamp of "TOP" near the abutment joint up.
5) Fit top ring (11) with the "dot" mark near the abutment joint up.
6) When fitting each ring, set the abutment joint off the thrust, anti-thrust, and piston axis directions.

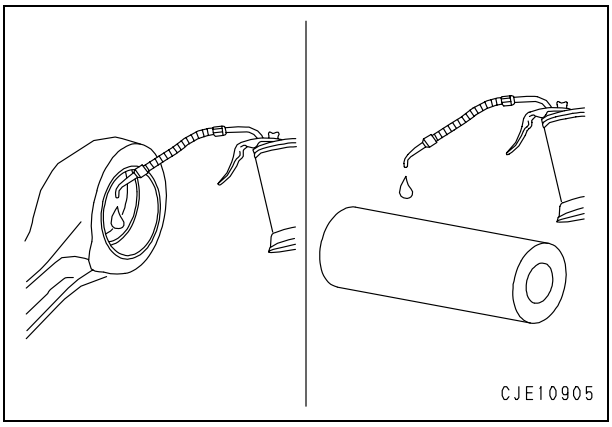


- Apply engine oil (EO15W-40) to the piston rings and piston skirt.

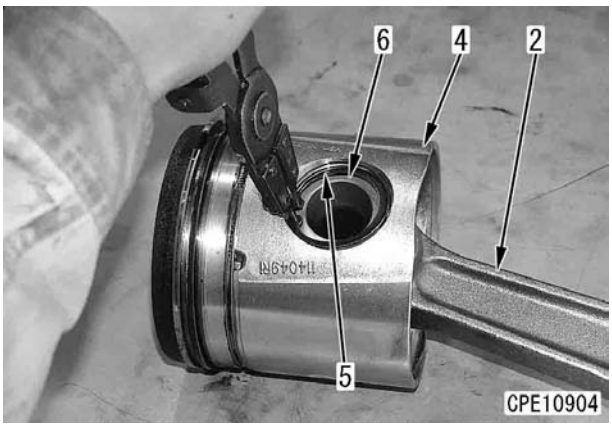
7) Set the piston and connecting rod.
   - Set the “FRONT” mark at part (**A**) of piston (4) up and check that the counter mark of the connecting rod cap is at part (**B**) of connecting rod (2) at this time.



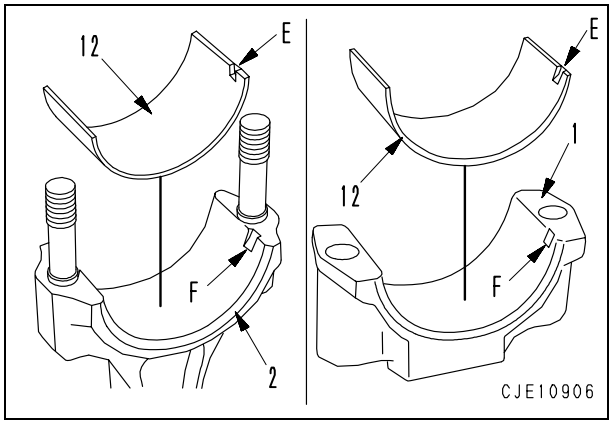
1] Apply engine oil (EO15W-40) to the piston pin hole and piston pin.



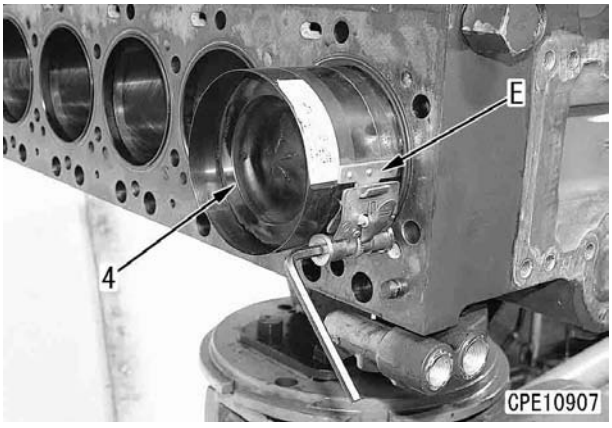
2] Insert piston pin (6) and install piston (4) to connecting rod (2).
3] Install snap rings (5) to both sides.



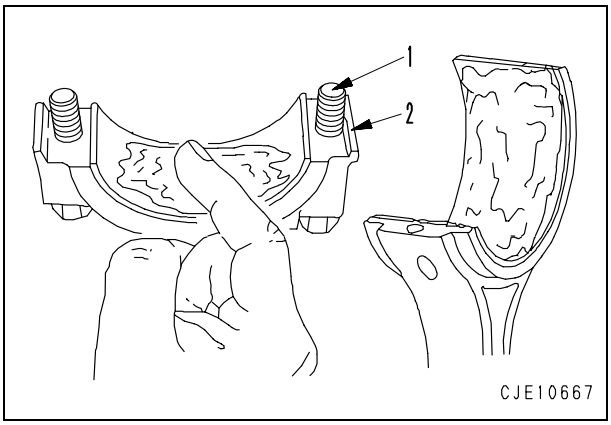
8) Install bearings (12) to connecting rod (2) and connecting rod cap (1).
   - Check that the back side of the bearing is free from foreign matter.
   - Set projection (**E**) of the bearing to cuts (**F**) of the connecting rod and cap.



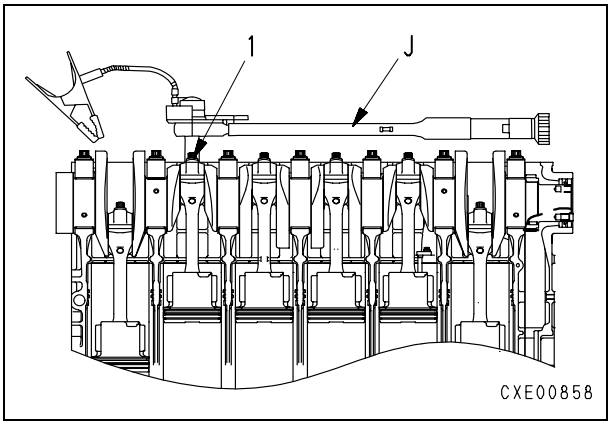
9) Set the crankshaft to the bottom dead center of the cylinder to install the piston and apply engine oil (EO15W-40) to the inside of the cylinder.
10) Set the “FRONT” mark of piston (4) on the front side of the cylinder block and insert the piston and connecting rod assembly.
   - ★ Check the directions of the abutment joints of the piston rings again.
   - ★ When inserting the connecting rod, take care not to damage the wall of the cylinder.
   - ★ When inserting the connecting rod, take care not to hit the cooling nozzle with it.
   - Using tool **E**, reduce the piston rings and push in the piston head with a wood bar, etc.



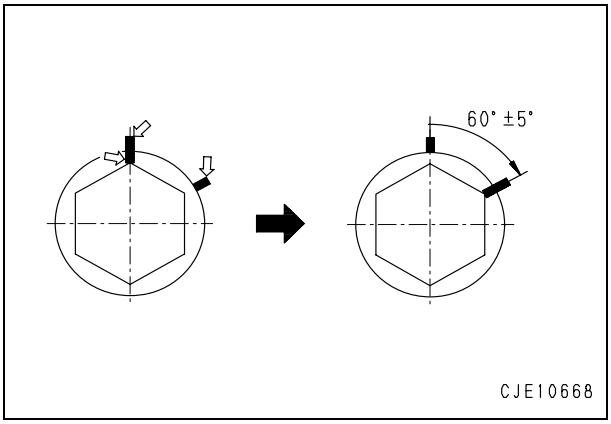
11) Tighten bolts (1) in the following order to install connecting rod caps (2).
★ Apply engine oil (EO15W-40) to the threaded portions of the bolts and inside of the connecting rod bearings.



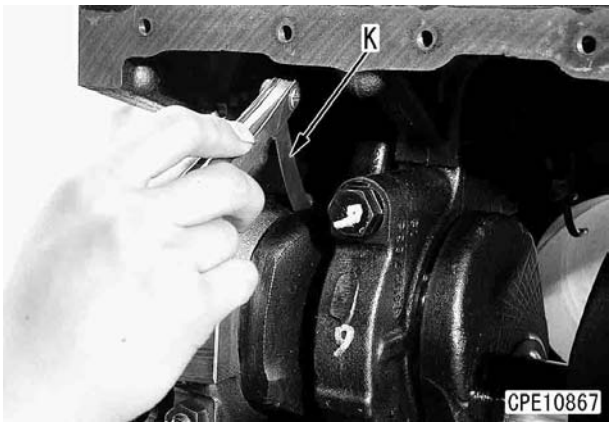
Mounting bolt (Tighten both bolts alternately):
1] **60 ± 4 Nm {6.1 ± 0.4 kgm}**
2] Loosen both bolts by **360°**
3] **70 ± 4.9 Nm {7.1 ± 0.5 kgm}**
4] **60° ± 5°**
(Use angle tightening tool **J**)



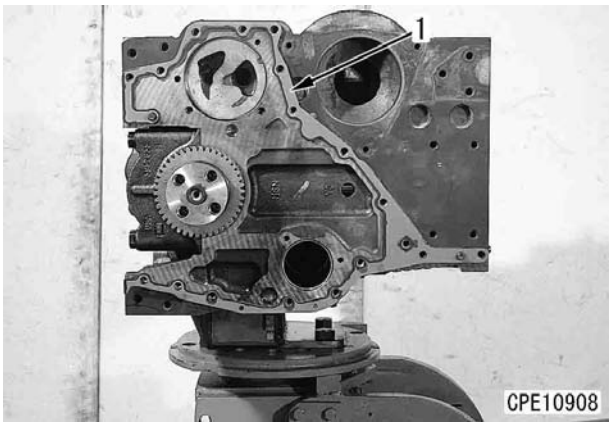
- When not using tool **J**
Make marks on the connecting rod cap and bolt with paint and then tighten the bolt by **60° ± 5°**.



12) After installing the piston and connecting rod assembly, turn the crankshaft to check that it rotates normally.
13) Measure the side clearance between the connecting rod and crankshaft with tool **K**.
★ Side clearance: **0.10 – 0.30 mm**

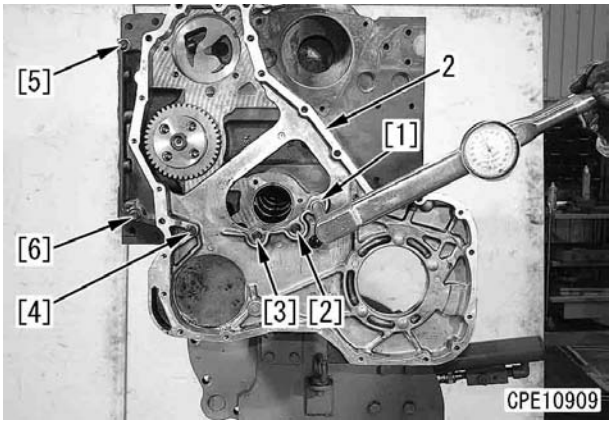


7. Front gear housing
1) Install gasket (1).



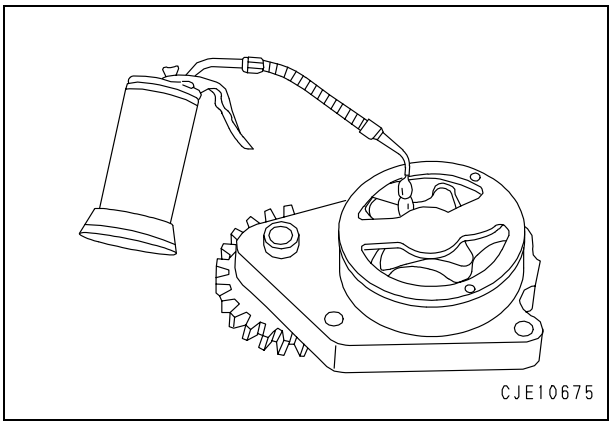
2) Install gear housing (2).
- Tighten the mounting bolts in the numerical order shown below: [1] → [6]

Mounting bolt:
39.2 ± 2.0 Nm {4.0 ± 0.2 kgm}

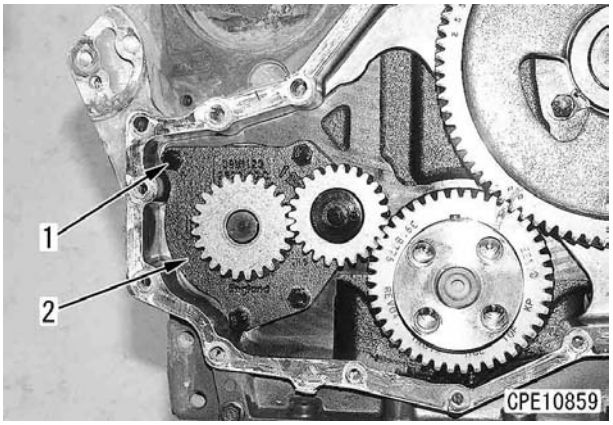


8. Oil pump

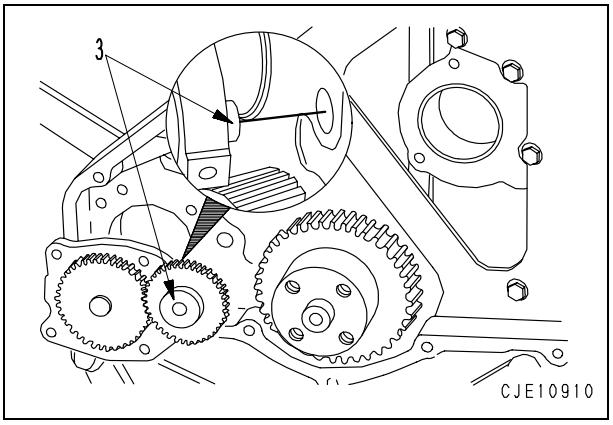
★ Fill the space in the pump rotor and idler shaft bore with engine oil (EO15W-40) and rotate the rotor by 2 turns.



1) Install oil pump assembly (2) with bolts (1).

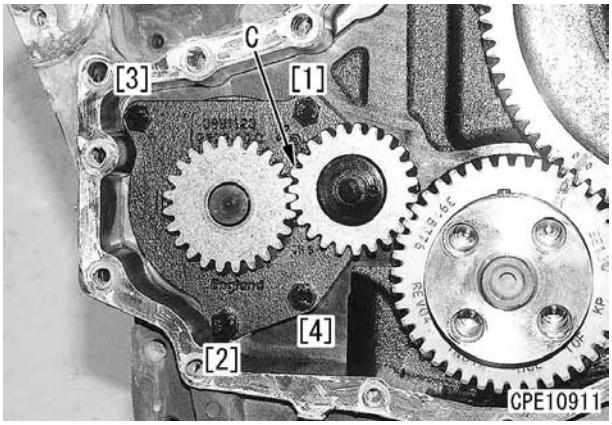


★ Set oil pump idler shaft (3) in the positioning hole of the cylinder block securely.



2) Tightening order of bolts
Tighten the mounting bolts in the numerical order shown below: [1] → [4]
Mounting bolt:
1st time: **5 ± 1 Nm {0.5 ± 0.1 kgm}**
2nd time:
24 ± 4 Nm {2.4 ± 0.4 kgm}

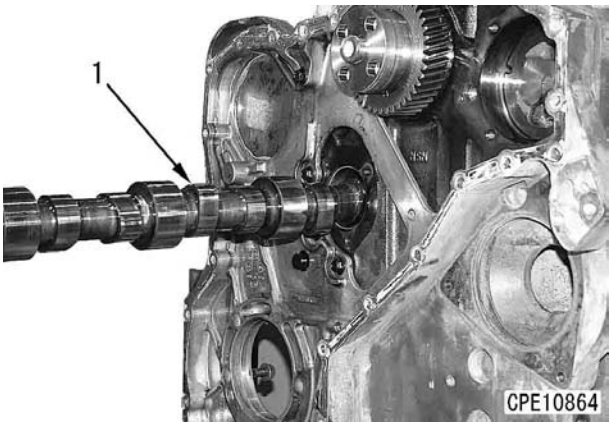
3) Measuring backlash
Rotate the crankshaft by 1 turn and measure backlash (**C**) between the pump and idler gear.
★ Backlash (**C**): **0.205 ± 0.125 mm**



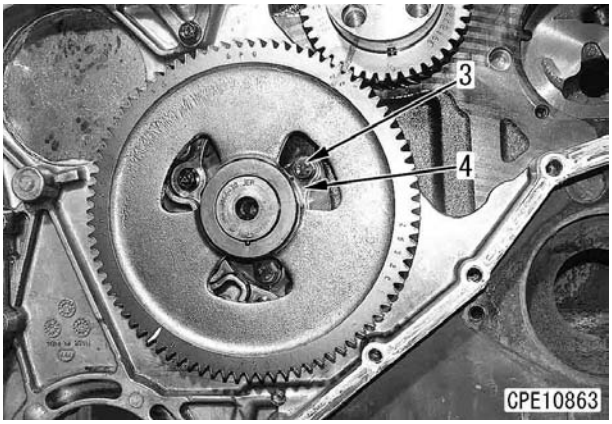
9. Camshaft

★ Rotate the crankshaft to set the No. 1 cylinder to the top dead center.

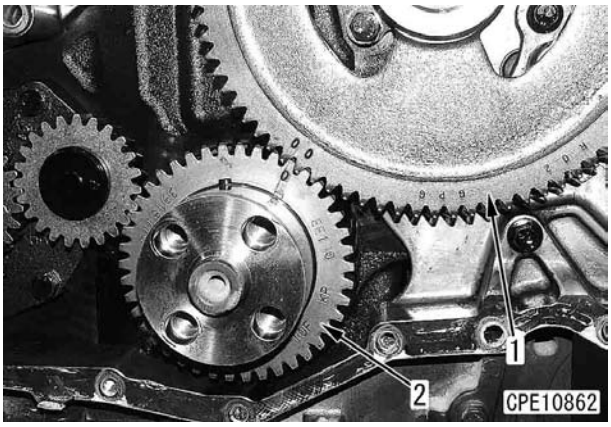
1) Apply engine oil (EO15W-40) to the camshaft bore, camshaft journal, and lobe, and then install camshaft gear assembly (1) while lightly pushing and rotating it.



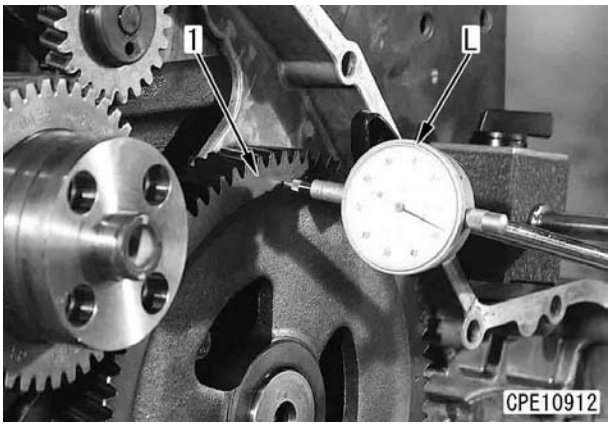
2) Install thrust plate (4) with bolts (3).
Mounting bolt:
24 ± 4 Nm {2.4 ± 0.4 kgm}



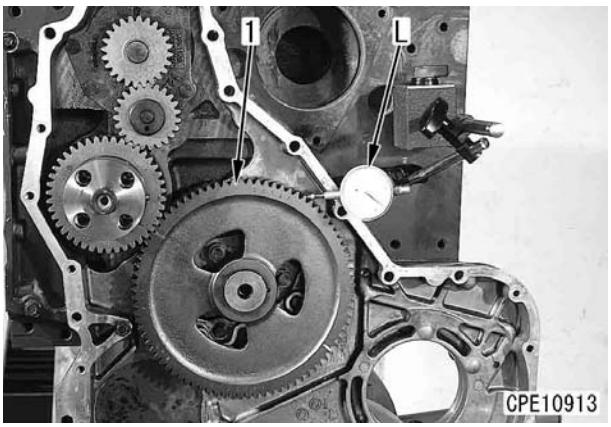
3) Set the timing mark of camshaft gear assembly (1) to that of crankshaft gear (2).



4) Measure the end play of camshaft gear assembly (1) with tool **L**.
   ★ The end play depends on the thickness of the thrust plate and the groove of the camshaft.
   - End play: **Max. 0.5 mm**



5) Measure the backlash of camshaft gear assembly (1) with tool **L**.
   - Backlash: **0.2 ± 0.125 mm**

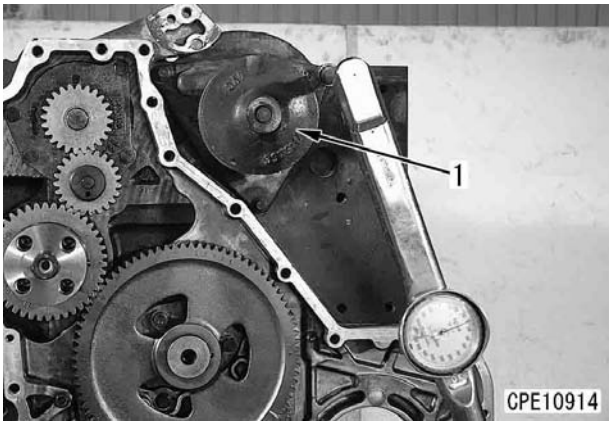


10. Water pump

Install water pump (1).

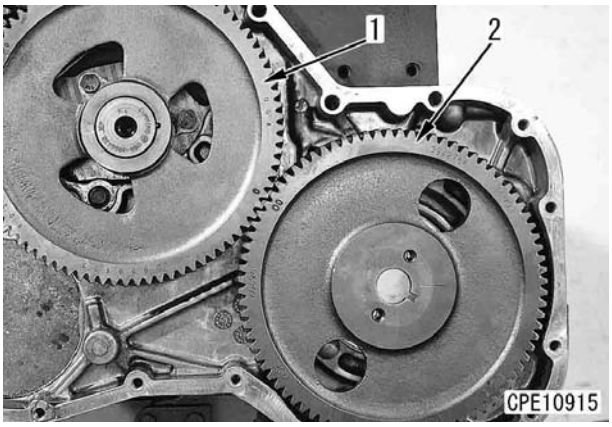
Mounting bolt:

24 ± 4 Nm {2.4 ± 0.4 kgm}



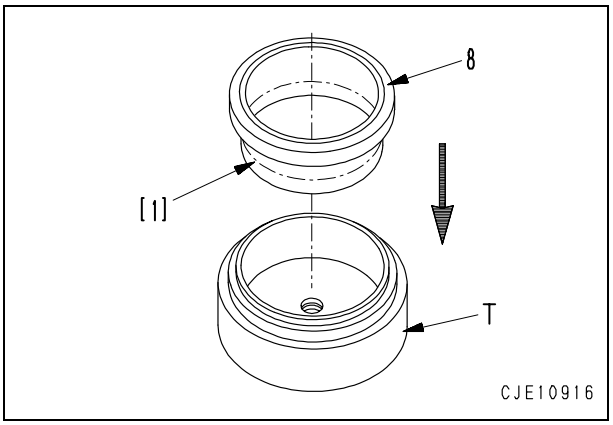
11. Supply pump gear

Set timing mark “00” of supply pump drive gear (2) to timing mark “0” of camshaft gear assembly (1).

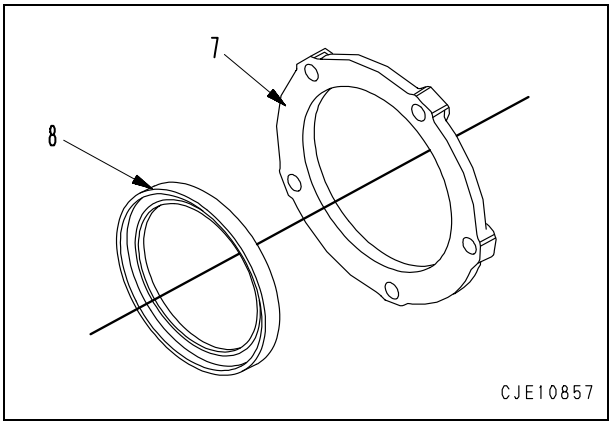


12. Front oil seal

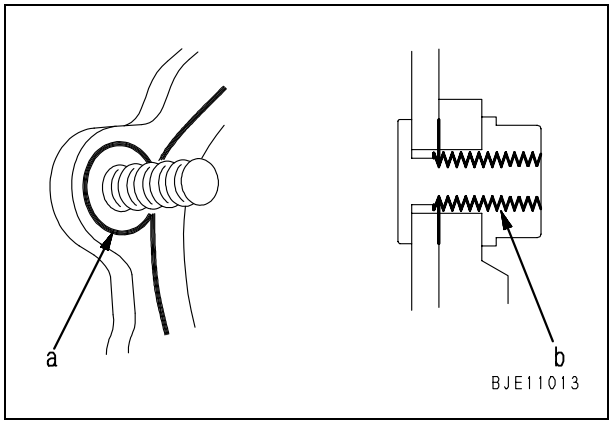
1) Set front oil seal (8) to tool **T** with the oil seal lip side up.
   ★ Since pilot tool [1] on the inside of the front oil seal is used to guide the front cover to the crankshaft, do not remove it from the front oil seal.
   ● Pilot tool [1] is contained in the spare front oil seal.



2) Insert oil seal (8) from the front cover mounting side of carrier (7).
   ● Set the seal flush with the face on the inserting side of the carrier.



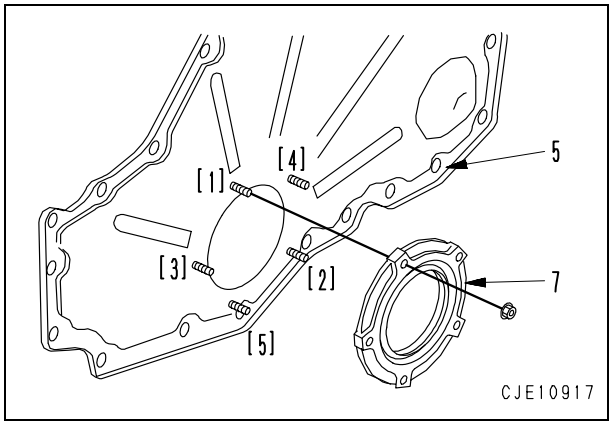
3) Install carrier assembly (7) to front cover (5).
   ★ Apply the gasket sealant not only to the flange surface but also around each of the 5 bolts (a) and to the threaded parts (b) of the nuts.



Surface of flange:
Gasket sealant (LG-7)

● Tighten the mounting bolts in the numerical order shown below: [1] → [5]

Mounting nut:
9.8 ± 2.0 Nm {1.0 ± 0.2 kgm}



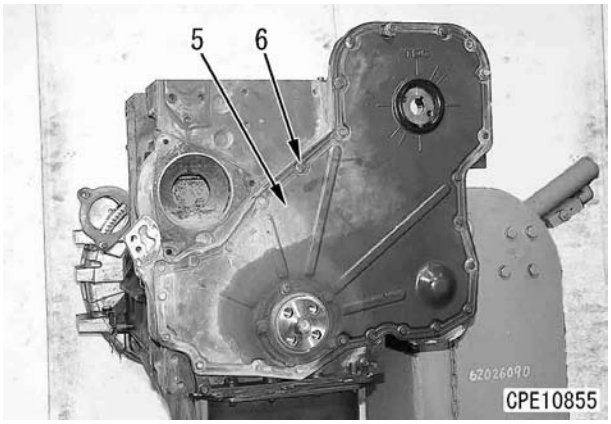
13. Front cover assembly

★ Check that the end corner and lip sliding surface of the crankshaft are free from flaw, burr, sharp fin, rust, etc.

★ Do not apply oil, grease, etc. to the crankshaft and seal lip. Wipe off oil and grease from the shaft.

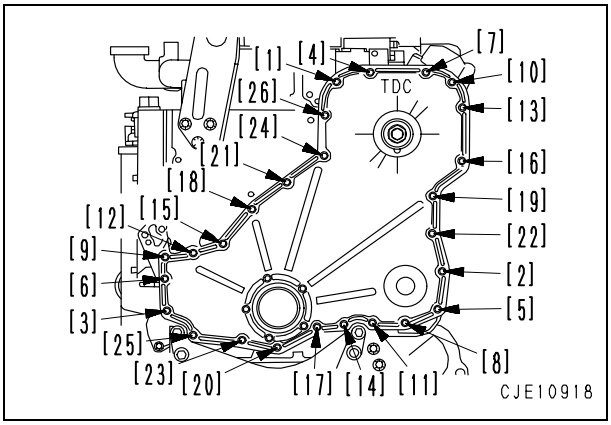
1) Install cover (5) with mounting bolts (6).

Cover mounting face:
Gasket sealant (LG-7)



2) Tightening order of bolts
Tighten the bolts in the numerical order shown below: [1] → [26]
Mounting bolt:

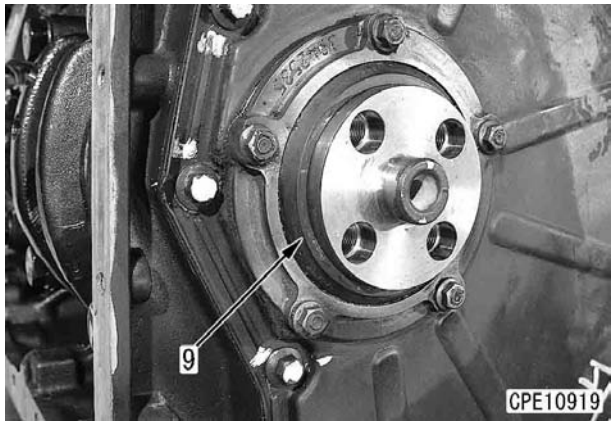
Position of bolt	Size of bolt	Tightening torque
[1] [2] [4] [5] [7] [8] [10] [11] [13] [16] [17] [19] [20] [22] [23]	M8 (Stem length 50 mm)	30 ± 2 Nm {2.9 ± 0.2 kgm}
[3] [6] [9] [12] [14] [15] [18] [21] [24] [25] [26]	M10 (Stem length 16 mm)	40 ± 2 Nm {3.9 ± 0.2 kgm}



3) Remove pilot tool [1] from the front oil seal.

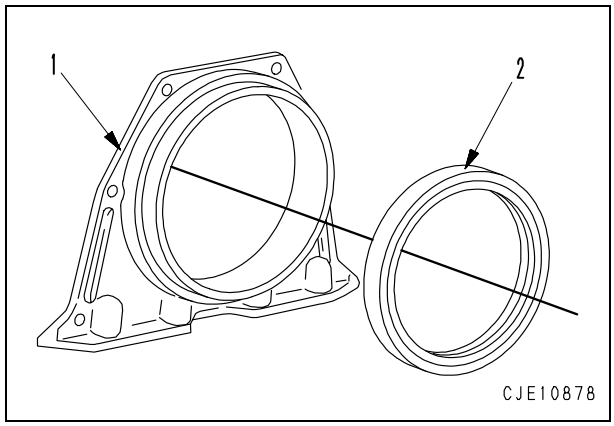
4) Install dust seal (9).

- Push in the dust seal until it touches the oil seal.

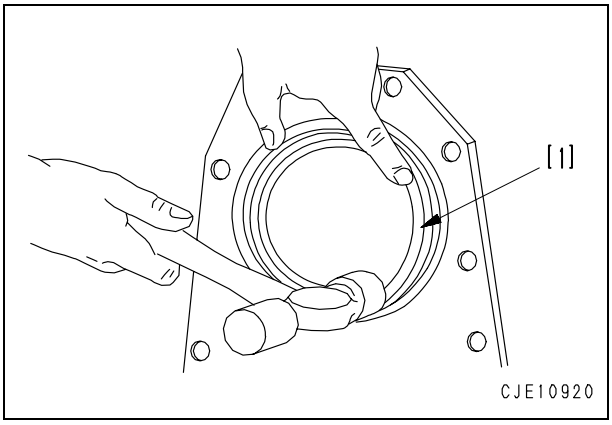


14. Rear oil seal

1) Press fit oil seal (2) to seal housing (1).

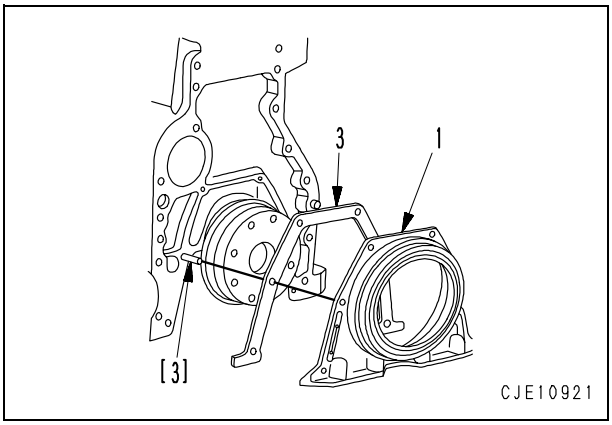


2) Using alignment tool [1], insert the oil seal until it is flush with the mounting flange surface of seal housing (1).
   ★ While lightly hitting the top, bottom, right, and left of alignment tool [1] with a hammer to check that the seal carrier is not bent, push in the oil seal until the outside of alignment tool [1] touches the housing.
   ★ Do not remove the seal mounting pilot tool.

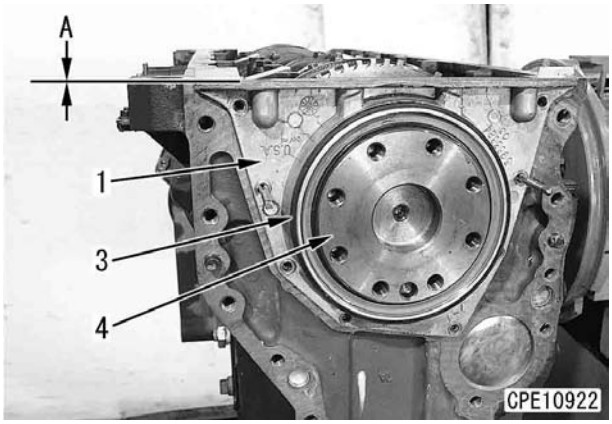


15. Seal housing

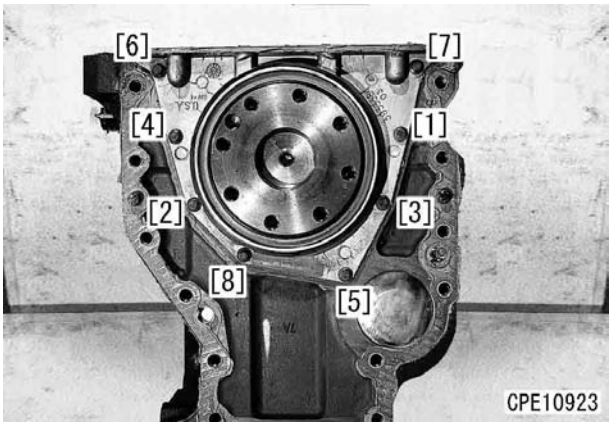
1) Install seal housing (1) and gasket (3) to guide pin [3].



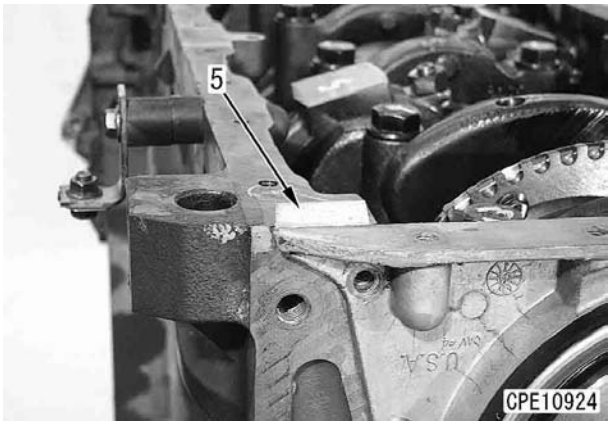
2) Insert seal housing (1), aligning it with crankshaft (4).
   ★ Check that the end corner and lip sliding surface of the crankshaft are free from flaw, burr, sharp fin, rust, etc.
   ★ Do not apply oil, grease, etc. to the crankshaft and seal lip. Wipe off oil and grease from the shaft.
   Housing mounting face:
   Gasket sealant (LG-7)
3) Evenly set the heights of seal housing (1) and both sides (A) of the oil pan rail.
4) Install seal (3).



5) Remove the guide pin and tighten the mounting bolts in the numerical order shown below: [1] → [8]
   Mounting bolt:
   12.7 ± 2.0 Nm {1.3 ± 0.2 kgm}

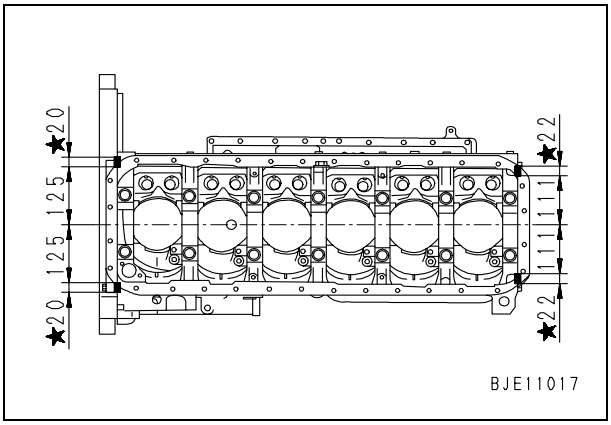


6) Remove the seal mounting pilot tool.
7) Cut off gasket (5). (Right and left)
★ Take care that the cut gasket will not fall in the engine.

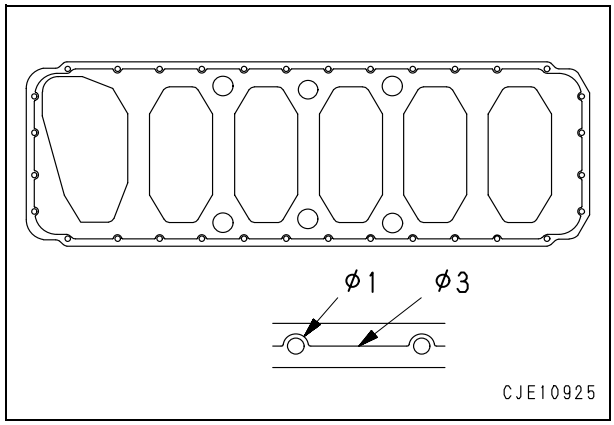


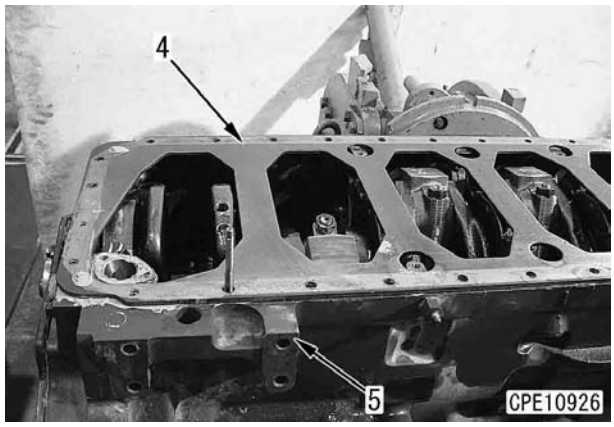
16. Oil pan

1) Fill the spaces ★ between the cylinder block and gear housing and between the cylinder block and rear seal housing with gasket sealant.

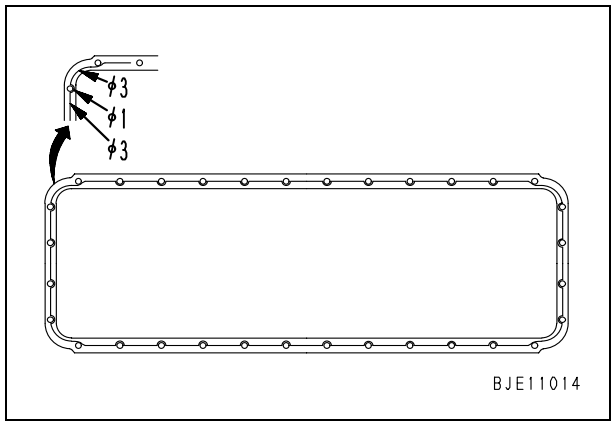


2) Install bed plate (4) to block (5).
Bed plate (Mating surface with cylinder block):
Gasket sealant (LG-7)
- Application drawing of gasket sealant
Diameter of gasket sealant string:
Apply strings of gasket sealant 1 mm in diameter to the range from the bolt hole center to the area of R7. Change the diameter of the gasket sealant smoothly from 1 mm to 3 mm for the other parts unless otherwise specified.

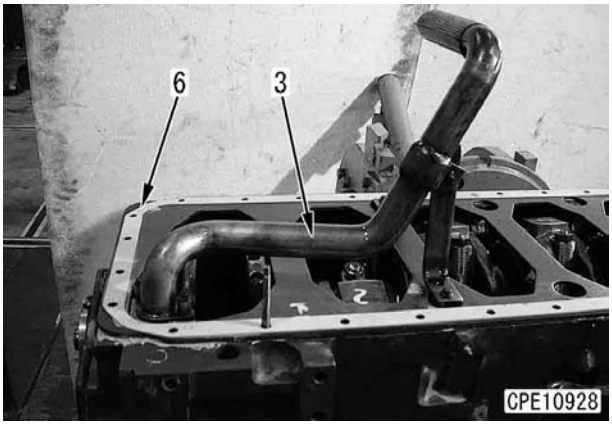




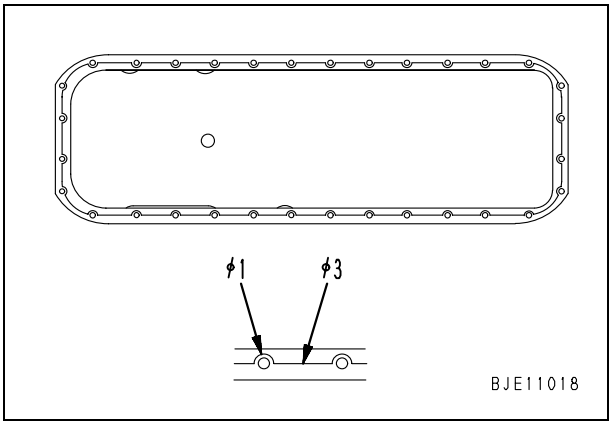
3) Apply gasket sealant to the bed plate mating face shown in the figure and install gasket (6).
Gasket (Mating face of bed plate):
Gasket sealant (LG-7)
★ Apply gasket sealant (strings) similarly to step 2).



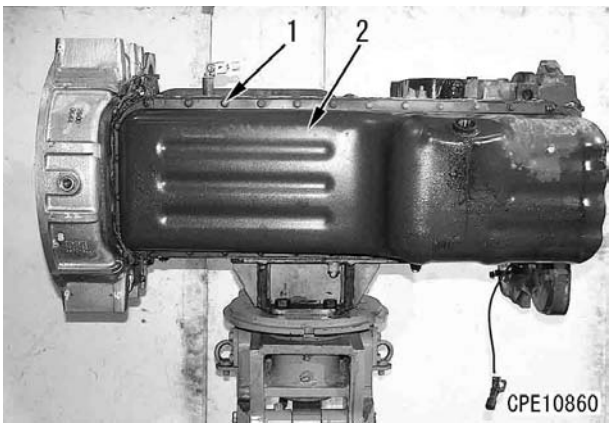
4) Install suction tube (3).
- Set the gasket to the end flange.
  Flange: **Gasket sealant (LG-7)**
  Flange mounting bolt:
  7.8 ± 2 Nm {0.8 ± 0.2 kgm}



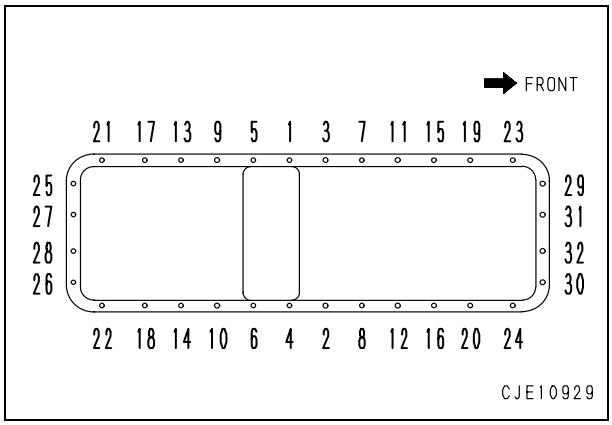
5) Apply gasket sealant to the basket mating face (A) of the oil pan.
   Oil pan: **Liquid gasket (LG-7)**
   ★ Apply gasket sealant (strings) similarly to step 2).



6) Install oil pan (2) with mounting bolts (1).

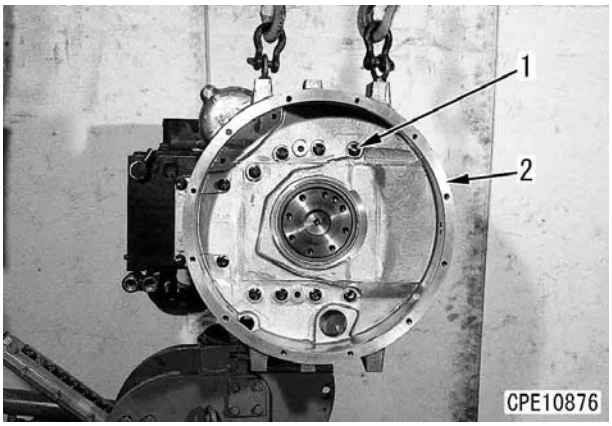


7) Tightening order of bolts
Tighten the bolts in the numerical order shown below: [1] → [32]
Mounting bolt:
24 ± 4 Nm {2.4 ± 0.4 kgm}

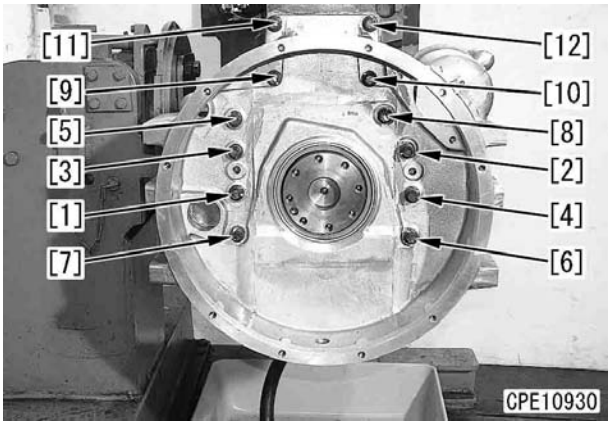


17. Flywheel housing

1) Install flywheel housing (2) with bolts (1).
   ★ Apply a string of gasket sealant **(LG-7)** 1 – 3 mm in diameter to the housing mounting flange face and around each mounting bolt hole.

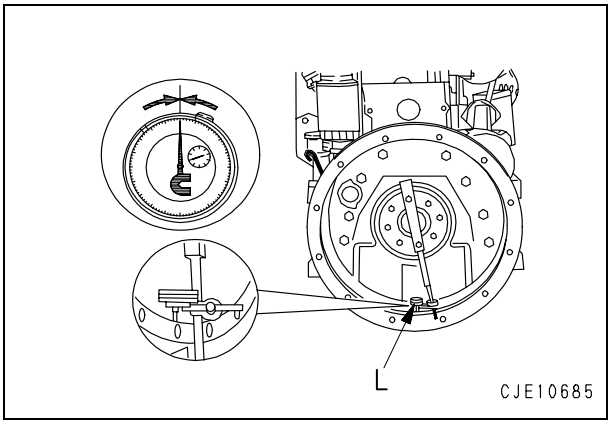


2) Tightening order of bolts
Tighten the bolts in the numerical order shown below: [1] → [12]
Mounting bolt:
77 ± 12 Nm {7.9 ± 1.2 kgm}

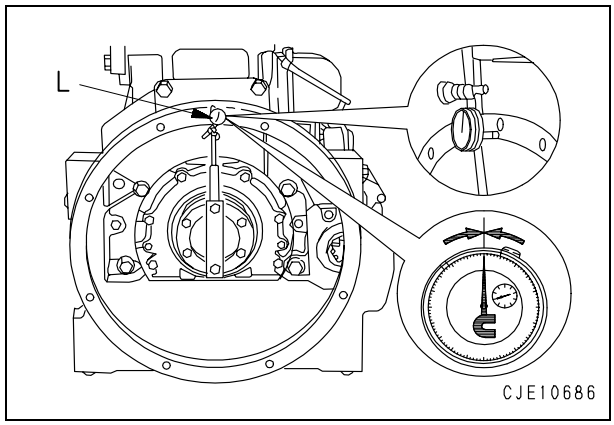


3) After installing the flywheel housing, measure the radial runout and facial runout with tool **L**.
- Radial runout: Max. **0.20 mm**
- Facial runout: Max. **0.20 mm**

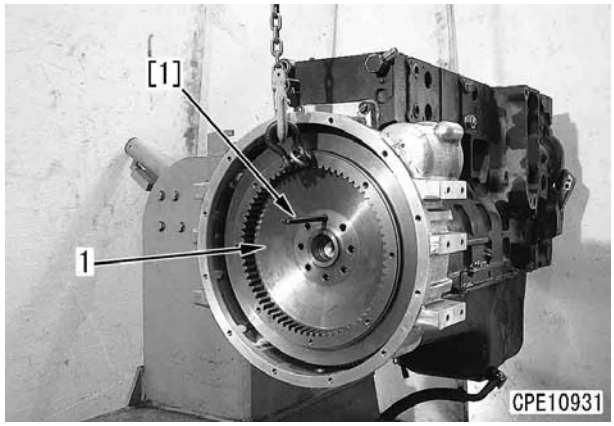
- Measuring radial runout
  1) Install tool **L** to the crankshaft end.
  2) Set the probe of the dial gauge perpendicular to the spigot joint portion of the flywheel housing.
  3) Set the dial gauge reading to “0”, rotate the crankshaft by 1 turn, and measure the difference between the indicated lowest and highest values.
  ★ After the crankshaft is rotated by 1 turn, check that the dial gauge indicates the value at the start of rotation.



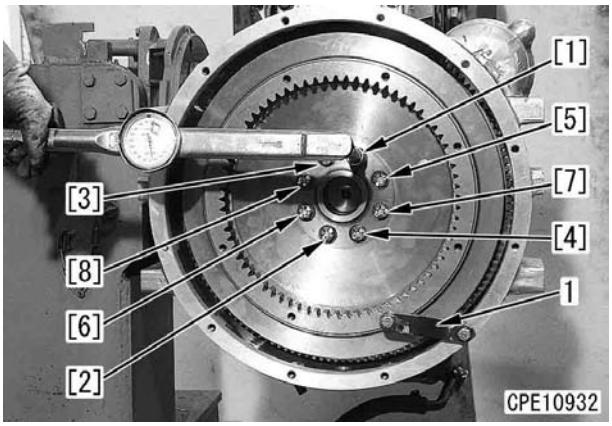
- Measuring facial runout
  1) Similarly to measurement of the radial runout, set the probe of the dial gauge perpendicular to the end face of the flywheel housing.
  ★ When measuring, bring the crankshaft to the front or rear side so that an error will not be caused by the end play.
  2) Set the dial gauge reading to “0”, rotate the crankshaft by 1 turn, and measure the difference between the indicated lowest and highest values.



18. Flywheel
1) Install guide bolt [1] and flywheel (1).
- Apply a string of gasket sealant 1 – 3 mm in diameter around the bolt holes on the crankshaft mounting face (8 places).
  Flywheel mounting face:
  Gasket sealant (LG-7)
  Flywheel assembly: **40 kg**



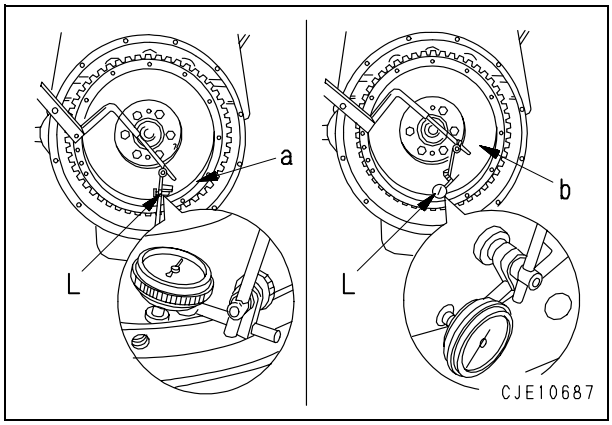
2) Tightening order of bolts
   1] Install lock plate (1).
   2] Tighten the bolts in the numerical order shown below: [1] → [8]
   Mounting bolt:
   137 ± 7 Nm {14.0 ± 0.7 kgm}



3) After installing the flywheel, measure the radial runout and facial runout with tool **L**.
   ★ Radial runout: Max. **0.13 mm**
   ★ Facial runout: Max. **0.20 mm**

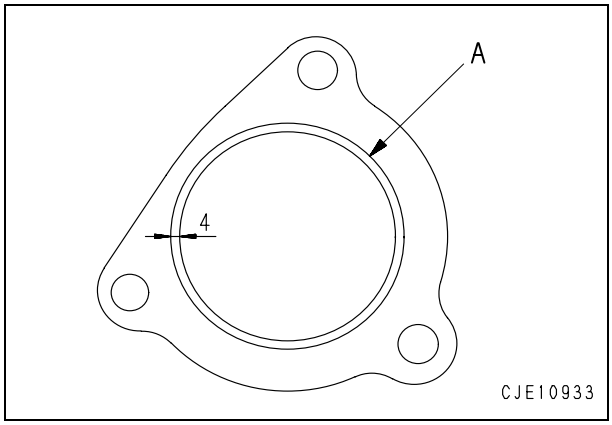
- Measuring radial runout
  1) Install tool **L** to the flywheel housing.
  2) Set the probe of the dial gauge perpendicular to spigot joint portion (**a**) or periphery of the flywheel.
  3) Rotate the flywheel by 1 turn and measure the difference between the indicated lowest and highest values.
  ★ After the flywheel is rotated by 1 turn, check that the dial gauge indicates the value at the start of rotation.

- Measuring facial runout
  1) Similarly to measurement of the radial runout, set the probe of the dial gauge perpendicular to end face (**b**) of the flywheel near the periphery.
     ★ When measuring, bring the crankshaft to the front or rear side so that an error will not be caused by the end play.
  2) Rotate the flywheel by 1 turn, and measure the difference between the indicated lowest and highest values.

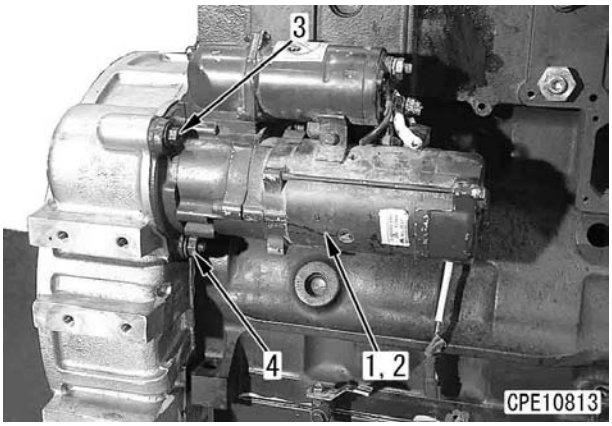


19. Starting motor assembly

1) Apply string (**A**) of gasket sealant 1 mm in diameter.
   Both sides of gasket:
   Gasket sealant (LG-7)

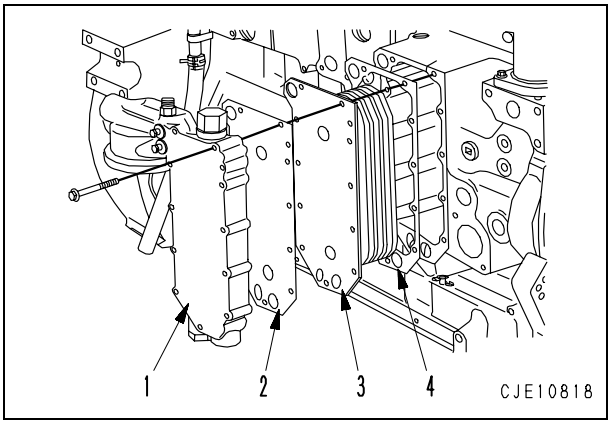


2) Fit the gasket and install starting motor assembly (1) and spacer (2) with bolt (3) and nut (4).



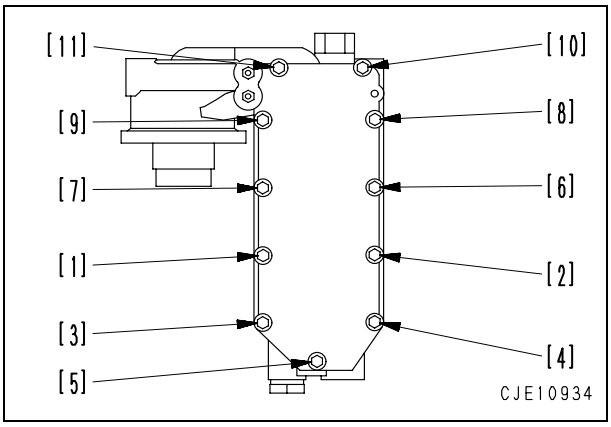
20. Oil cooler

1) Install cooler gasket (4) and oil cooler (3).
2) Install cover gasket (2) and cover (1).



3) Tightening order of bolts
   - Tighten the bolts in the numerical order shown below: [1] → [11]

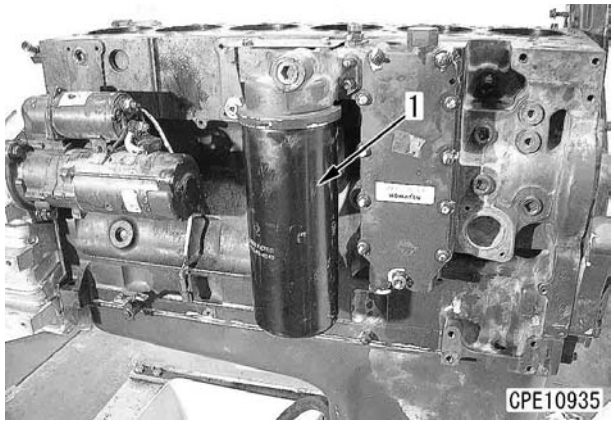
   Mounting bolt:
   24 ± 4 Nm {2.4 ± 0.4 kgm}



21. Oil filter

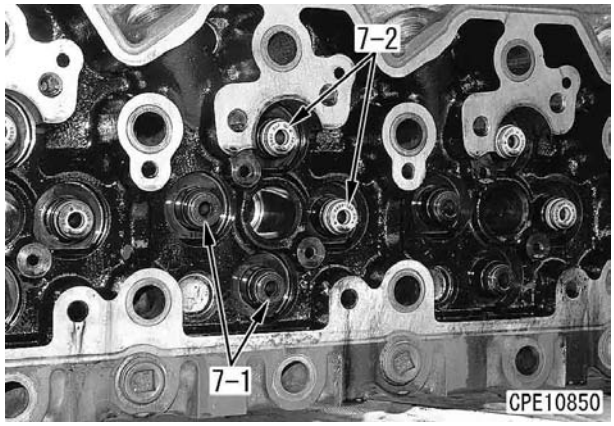
1) Apply engine oil (EO15W-40) to the oil filter seal.
2) Supply clean engine oil (EO15W-40) into the oil filter.
3) Install oil filter (1).

   Oil filter: **13 ± 2 Nm {1.3 ± 0.2 kgm}**
   - You may tighten the oil filter 3/4 turns more after its sealing face touches the seat.

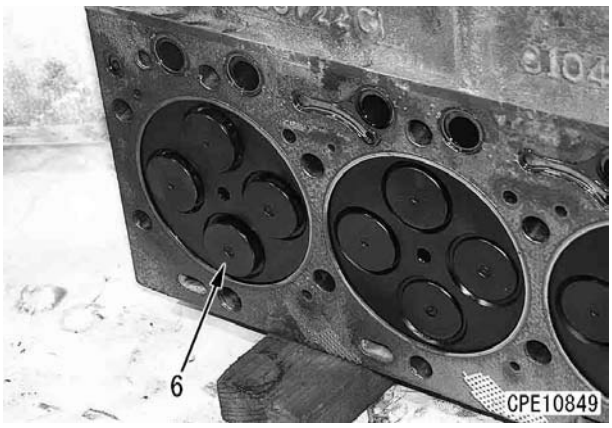


22. Cylinder head assembly

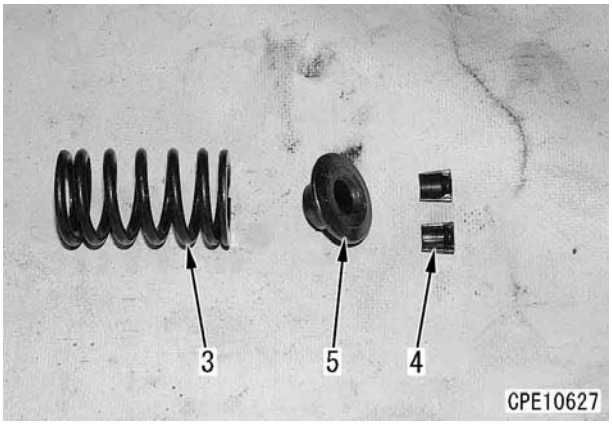
1) Assemble the cylinder head assembly according to the following procedure:
   1] Install valve seals (7-1) and (7-2).
   ★ The valve seals are colored according to their locations.
   - Exhaust valve: Black (7-1)
   - Air intake valve: Blue (7-2)



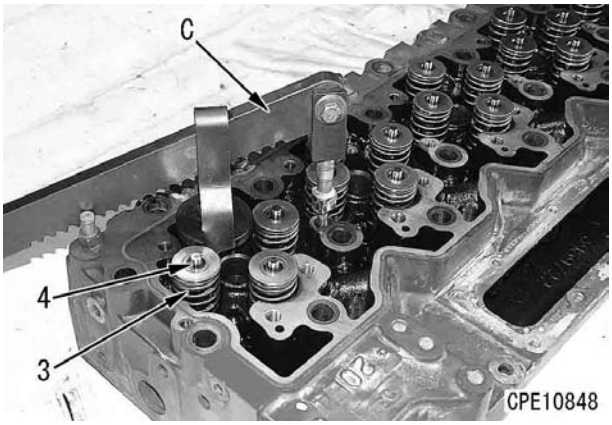
2] Apply engine oil (EO15W-40) to the valve stem and inside of valve guide and install valve (6).



3] Raise the cylinder head and install valve spring (3) and upper seat (5).

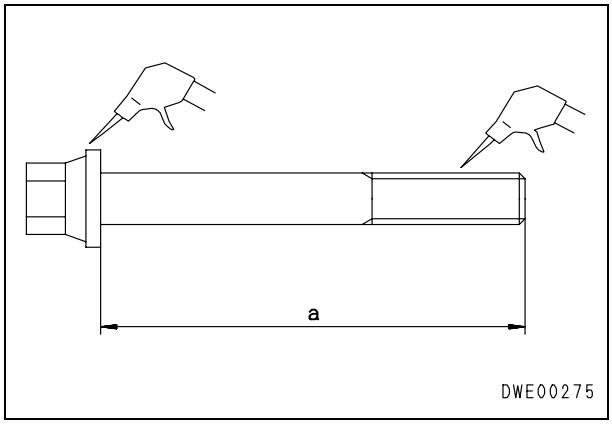


4] Using tool **C**, compress valve spring (3) and install valve collet (4).

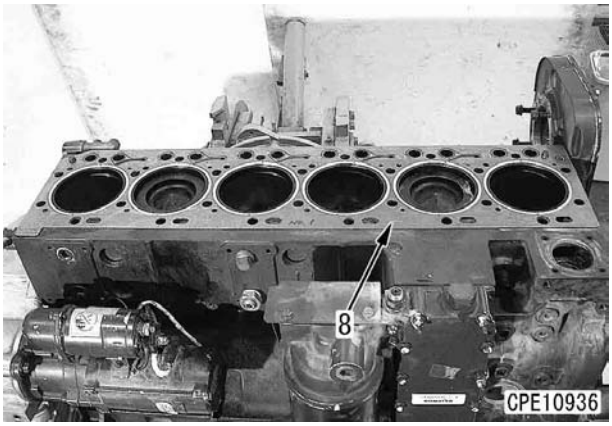


★ Hit the valve stem lightly with a plastic hammer to check that the valve collet is fitted to the groove of the valve stem.

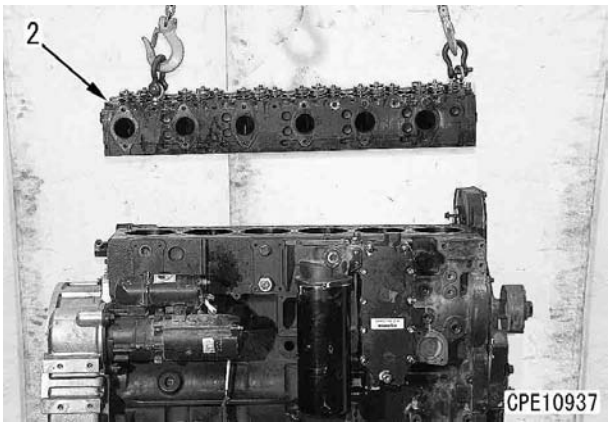
2) Before tightening the cylinder head mounting bolts, check the following:
   1] Measure stem length (**a**) of each mounting bolt and check that it is shorter than the using limit.
   2] Using limit length of bolt: less than 162.6 mm
      ★ If a bolt is longer than the using limit, do not reuse it but replace it.



3) Check that there is no dirt and foreign matter on the cylinder head mounting surface and in the cylinders and then set cylinder head gasket (8).
   ★ Check that the gasket is set to the holes of the cylinder block.



4) Install cylinder head assembly (2) to the cylinder block.

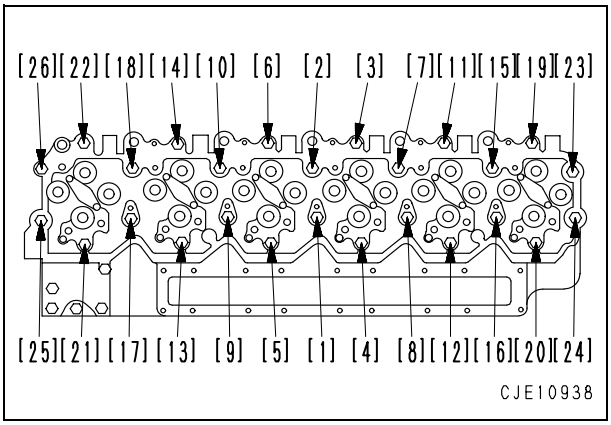


★ First, tighten the mounting bolts by 2 – 3 turns with the hand, and then tighten them according to the following procedure.

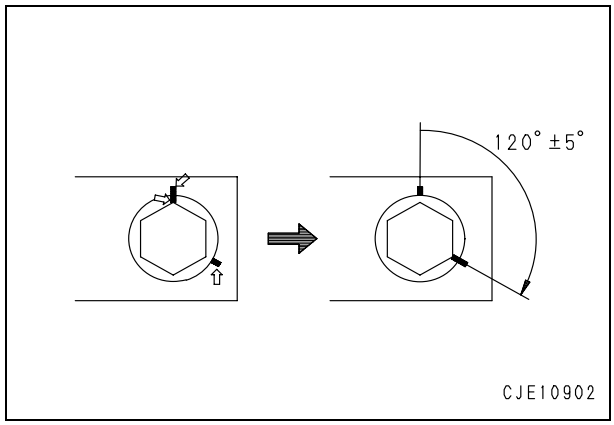
Apply engine oil (EO15W-40) to the threaded portion and head seat of each bolt.

Tighten the bolts in the numerical order shown below.

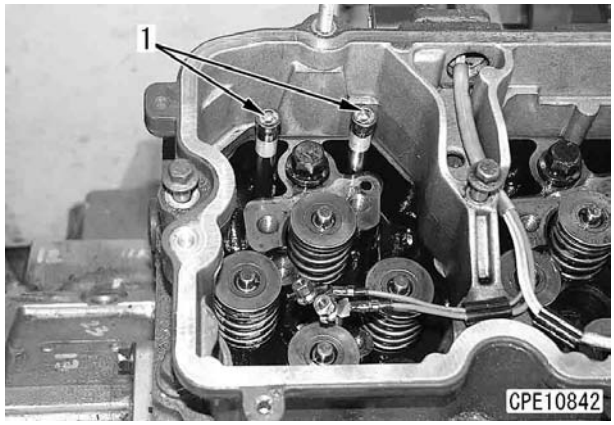
1] **150 ± 9.8 Nm {15.3 ± 1.0 kgm}**
2] Return all bolts **360°**
3] **115 ± 4.9 Nm {11.7 ± 0.5 kgm}**
4] Check tightening torque of **115 ± 4.9 Nm {11.7 ± 0.5 kgm}**
5] **120° ± 5°**
(Tighten with angle tightening tool)



● When not using angle tightening tool
Make a mark on the cylinder head and each bolt with paint and then tighten the bolt by **120° ± 5°**.



23. Push rod
Install push rod (1).
★ Check that the push rod is in the tappet.
★ Fill the push rod socket with engine oil (EO15W-40).



24. Fuel injector assembly

★ Check that the injector sleeve is free from flaw and dirt.

★ When replacing the injector, replace the inlet connector, too.

★ Check the inlet connector for the following items. If it is defective, replace it.

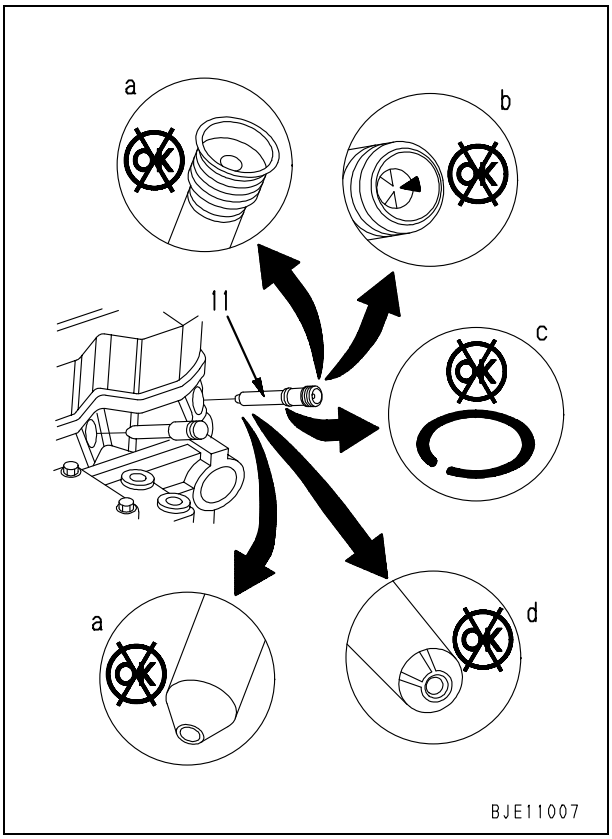
a] If there are burrs or deformation at the inlet or outlet of the connector, do not use the inlet connector.

b] If the edge filter is clogged or dirty or there is sediment in it, do not use the inlet connector.

c] If the O-ring is broken or deteriorated, do not use the inlet connector.

d] If the sealing surface of the outlet side is worn, in contact unevenly or has a trace of leakage, do not use the inlet connector.

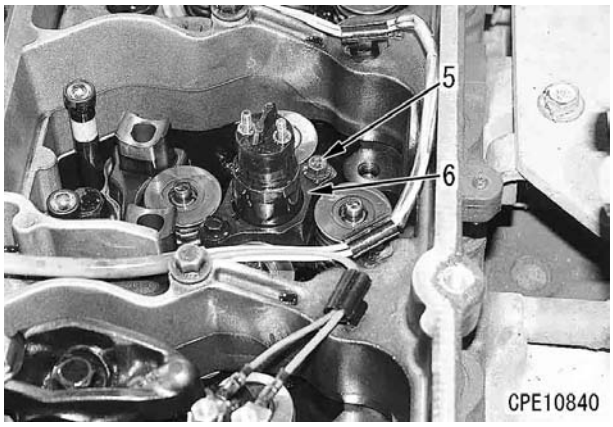
If high-pressure fuel leaks, the seat surface is eroded and has fine streaks or flaws. If there are such streaks or flaws, replace the connector and injector.



1) Fit the gasket and O-ring to injector (7).
2) Apply engine oil (EO15W-40) to the O-ring of injector (7) and head side.
3) Insert injector (7) in the cylinder head, directing its fuel inlet hole toward the air intake manifold.



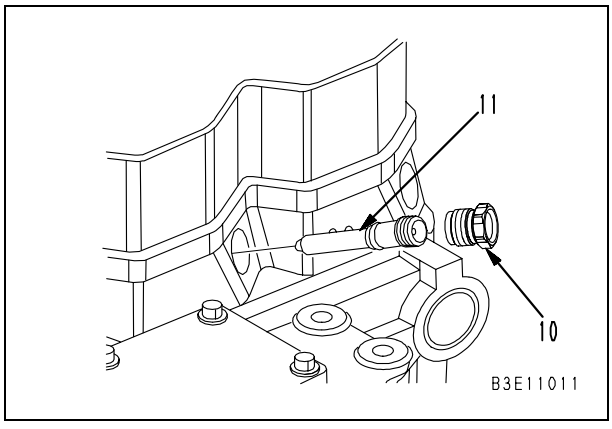
4) Install holder (6) and tighten bolts (5) by 3 – 4 turns by hand.



5) Coat the O-ring of inlet connector (11) and the mounting hole on the head with engine oil (EO15W-40).
6) Install inlet connector (11) temporarily with retainer (10).

Retainer:

15 ± 5.0 Nm {1.5 ± 0.5 kgm}

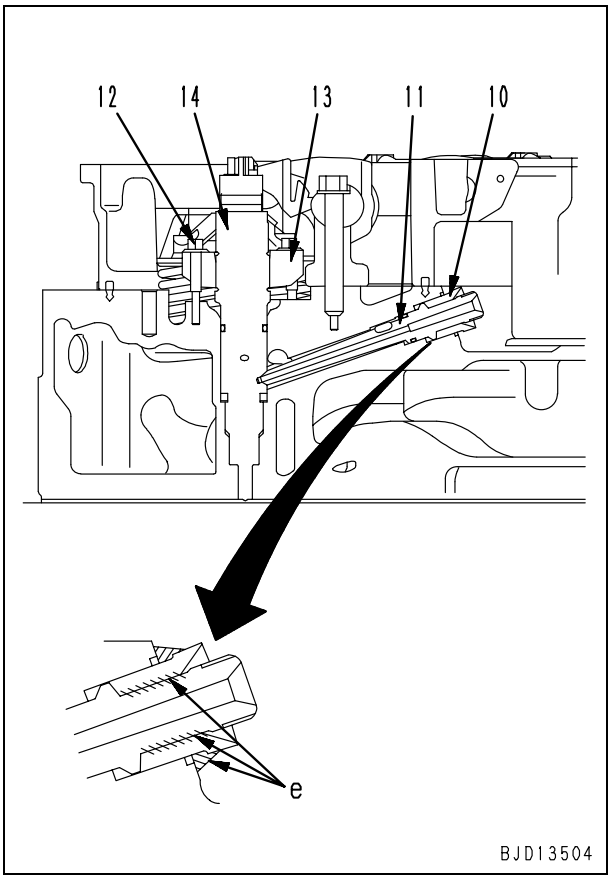


7) Tighten bolts (5) of holder (6) alternately.
   Bolt: **10 ± 2 Nm {1.0 ± 0.2 kgm}**
   - The top of the holder must be in parallel with the top of the cylinder head. Allowable angle: **2.4°**

8) Tighten bolts (12) to the specified torque.
   ★ Tighten bolts diagonally so that the upper surface of holder (13) becomes parallel to the upper surface of the cylinder head.
   - Maximum angle limit: 2.4°

   Bolt: **10 ± 2.0 Nm {1.0 ± 0.2 kgm}**

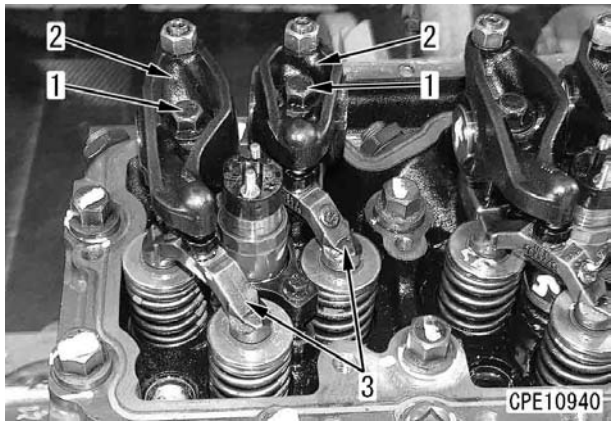
9) Tighten inlet connector (11) to the specified torque.
   Retainer (10):
   41 ± 4 Nm {4.1 ± 0.4 kgm}
   Apply the caulking compound (**e**) (hatched section) to retainer (10) and the cylinder head.
   Caulking compound:
   GE TOSHIBA SILICON TOSSEAL 381



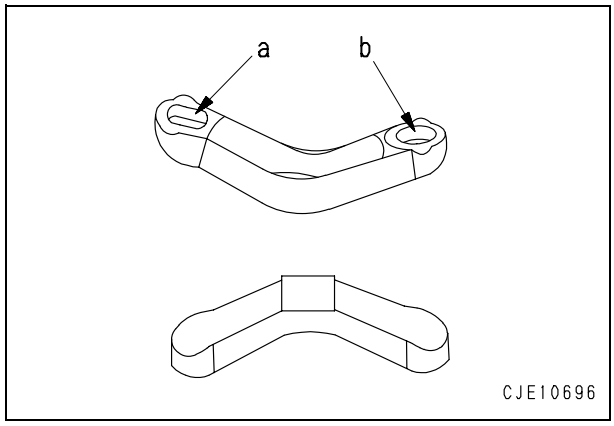
25. Rocker arm assembly

1) Install crosshead (3).
2) Install rocker arm assembly (2) and tighten bolts (1).
   ★ Before tightening the bolts, check that the ball of the adjustment screw is set in the push rod socket securely.

   Bolt: **64.7 ± 4.9 Nm {6.6 ± 0.5 kgm}**



★ The shapes of holes (**a**) and (**b**) of each crosshead are different. Accordingly, when reusing the crossheads, install each of them to the same intake and exhaust valve in the same direction as it has been installed.
- A new crosshead may be installed in either direction.



26. Adjusting valve clearance

Adjust the valve clearance according to the following procedure.

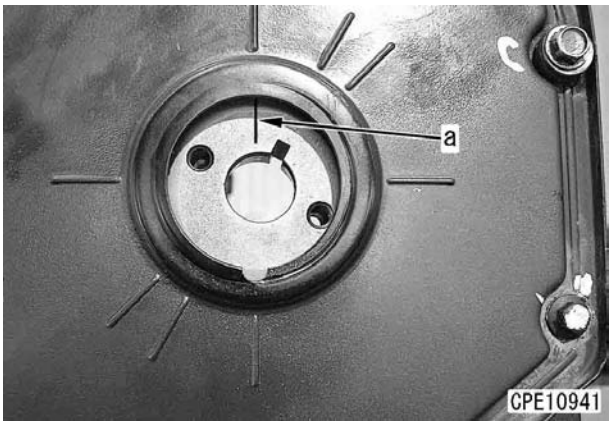
★ As the valve clearance, adjust the clearance between the crosshead and rocker arm to the following value.

★ Valve clearance (when cold)

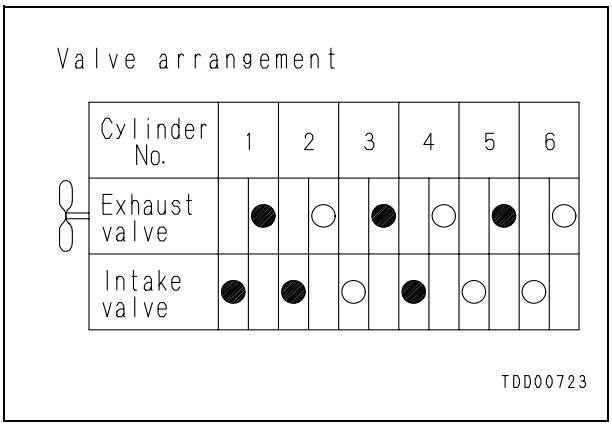
Unit: mm

Intake valve	Exhaust valve
0.30 ± 0.05	0.56 ± 0.05

1) Rotate the crankshaft forward to bring stamped line (**a**) of the supply gear to the top and set the No. 1 cylinder to the compression top dead center (T.D.C).



2) While the No. 1 cylinder is at the compression top dead center, adjust the valve clearances marked with ● in the valve arrangement drawing.



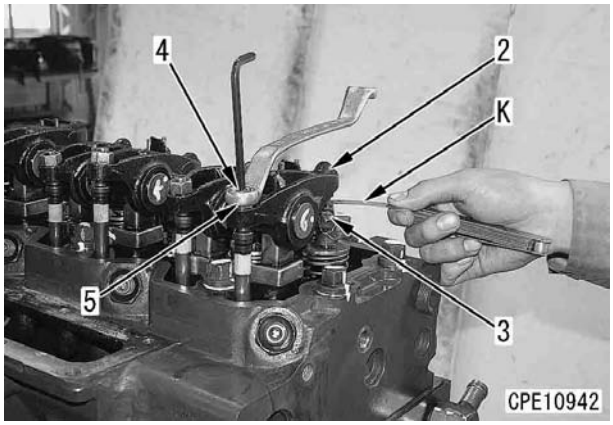
3) Insert clearance gauge **K** between rocker arm (2) and crosshead (3) and set adjustment screw (4) to a degree that you can move the clearance gauge lightly.

4) Tighten locknut (5) under this condition.

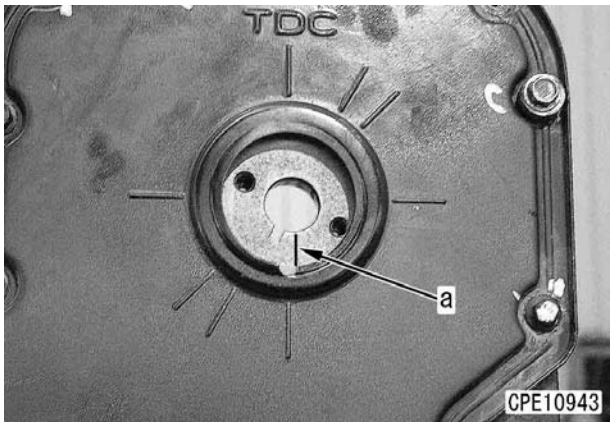
Locknut:

24 ± 4 Nm {2.4 ± 0.4 kgm}

★ After tightening the locknut, check the valve clearance again.



● After adjusting all of the valves marked with ●, rotate the crankshaft forward by 1 turn to bring stamped line (**a**) of the supply pump drive gear to the bottom and set the No. 6 cylinder to the compression top dead center.



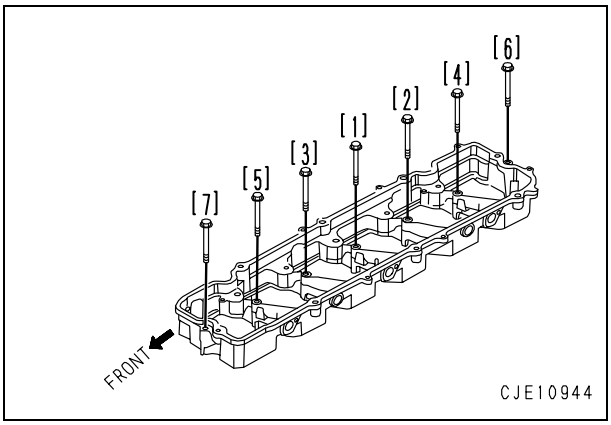
5) While the No. 6 cylinder is at the compression top dead center, adjust the valve clearances marked with ○ in the valve arrangement drawing.

★ Adjust the valve clearance according to steps 3) and 4) above.

27. Rocker housing

1) Fit the gasket and install housing assembly (1).
2) Tightening order of bolts
   - Tighten the bolts in the numerical order shown below: [1] → [7]

   Mounting bolt:
   24 ± 4 Nm {2.4 ± 0.4 kgm}

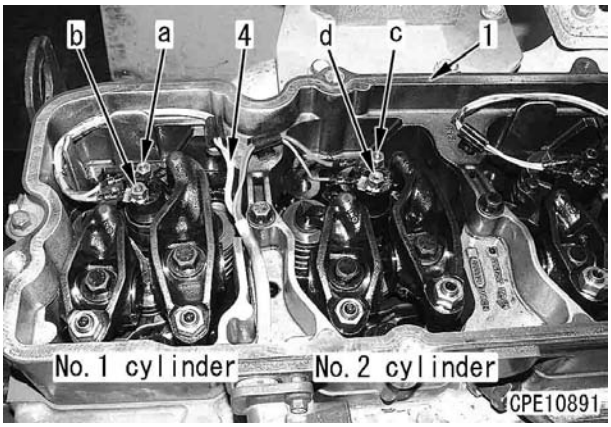


3) Install wiring harness (4).

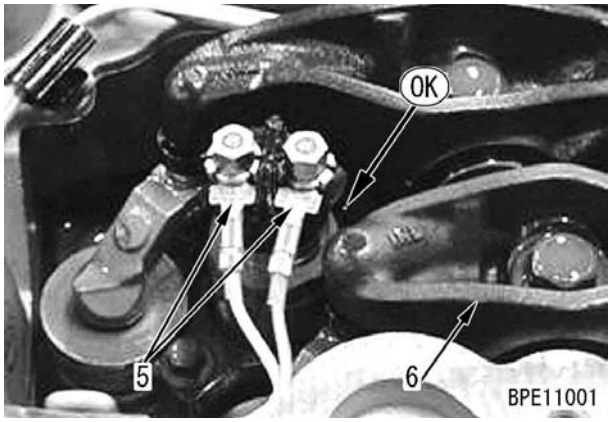
   Mounting nut:
   1.25 ± 0.25 Nm {0.10 ± 0.03 kgm}

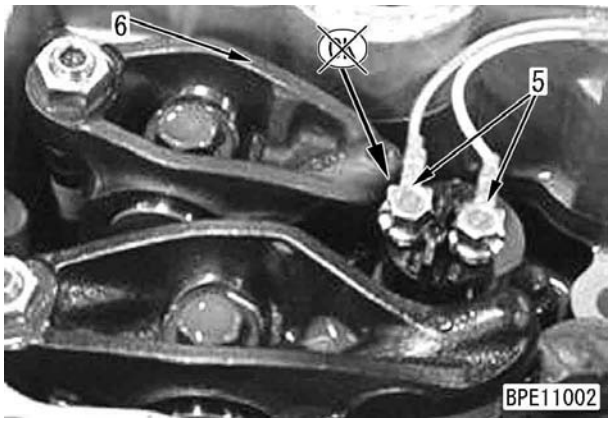
   ★ Locations of wiring harnesses

Color of cable		Cylinder No.	
a	Yellow	1, 3, 5	Right side
b	Orange		Left side
c	Red	2, 4, 6	Right side
d	Brown		Left side

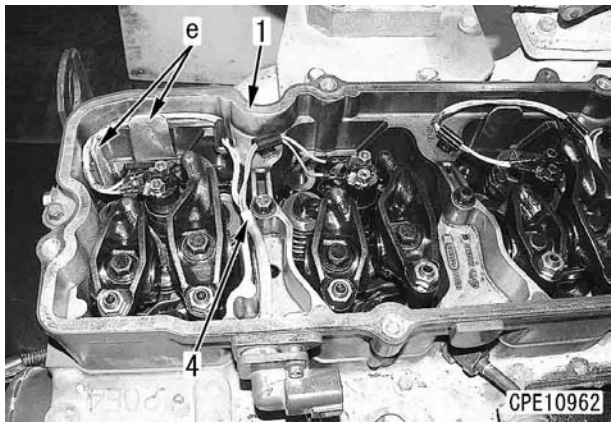


★ Install the injector wiring harness terminal (5) in a direction where it will not interfere with the rocker arm (6) which moves up and down.





★ Take care that wiring harness (4) will not be pressed strongly against the inside wall of housing (1), will not come off guide (**e**), or will not be bent sharply.

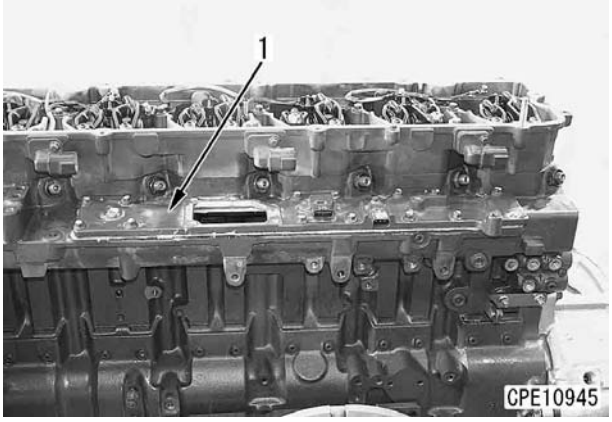


28. Air intake manifold cover

Fit the gasket and install manifold cover (1).

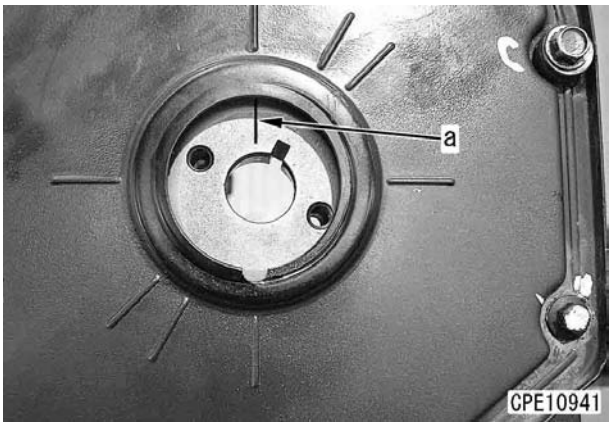
Both sides of gasket: **Gasket sealant (LG-7)**

Tube mounting bolt: **24 ± 4 Nm {2.4 ± 0.4 kgm}**

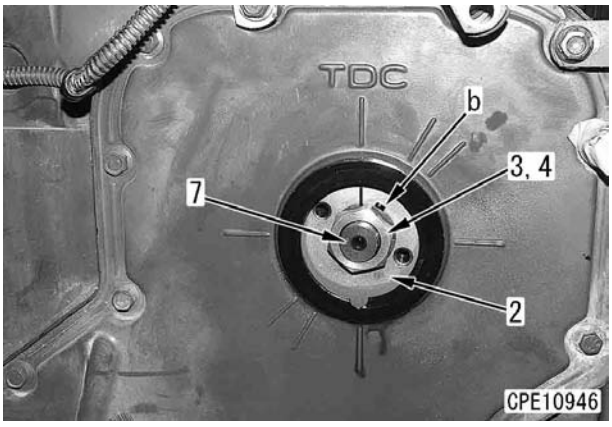


29. Fuel supply pump

1) Rotate the crankshaft forward to bring stamped line (**a**) of the supply pump gear to the top and set the No. 1 cylinder to the compression top dead center (T.D.C).



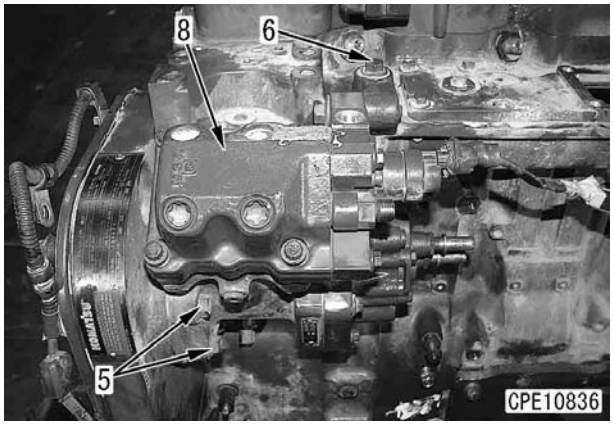
2) Fit the O-ring and push in supply pump drive shaft (7) in supply pump drive gear (2), setting the pin of the former to the key way (**b**) of the latter, and tighten nut (3) and washer (4) temporarily.



3) Install supply pump assembly (8) with mounting nuts (5) and bolt (6).

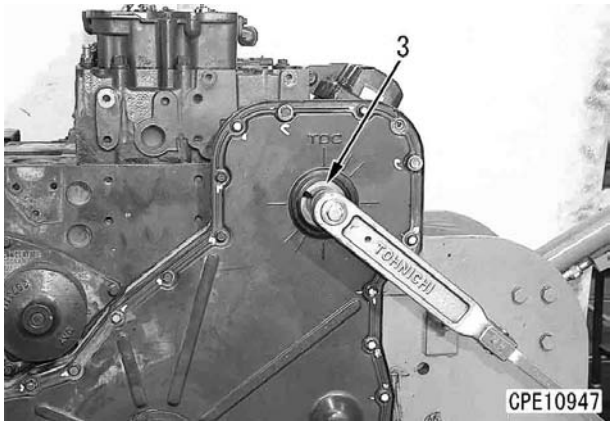
Mounting nut: **Adhesive (LT-2)**

Mounting nut and bolt: **43 ± 6 Nm {4.4 ± 0.6 kgm}**

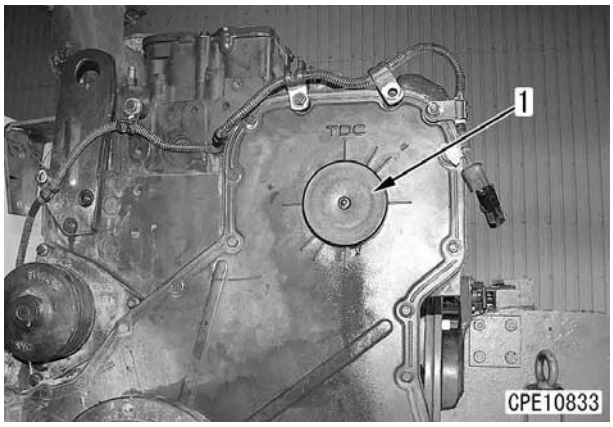


4) Tighten nut (3).

Mounting nut: **180 ± 12.7 Nm {18.4 ± 1.3 kgm}**

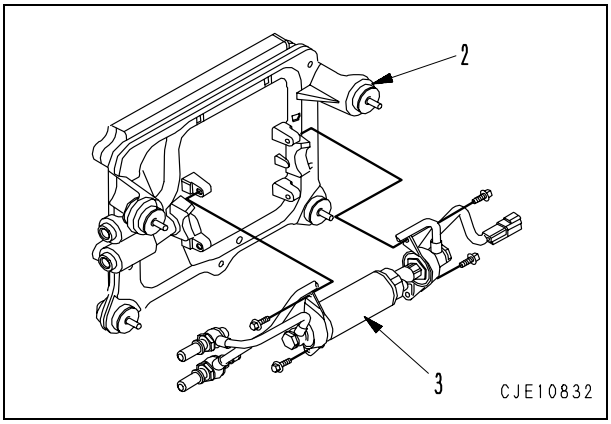


5) Install cap (1).

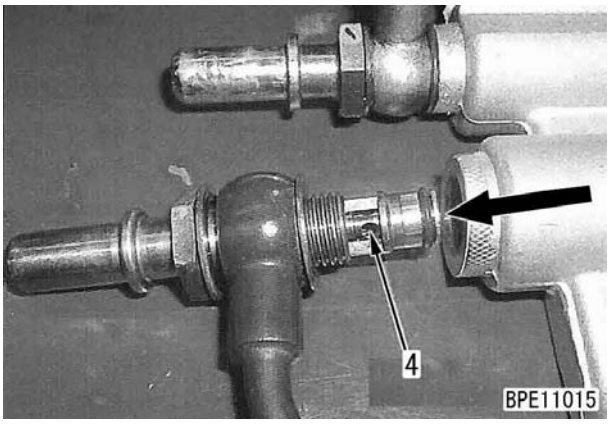


30. Fuel lift pump and main controller cooling plate

1) Install fuel lift pump (3) to main controller cooling plate (2).
   Mounting bolt:
   10 ± 2 Nm {1.0 ± 0.2 kgm}

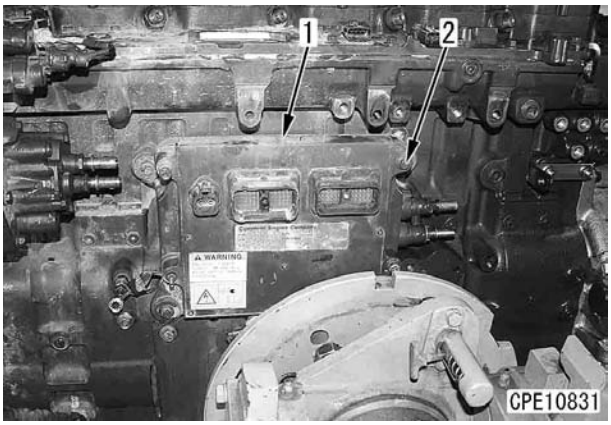


2) Lightly press the valve of the check valve (4) of main controller cooling plate (2) from the arrow side and check that it moves smoothly and the sealing face is closed perfectly.
3) Install the main controller cooling plate (2).



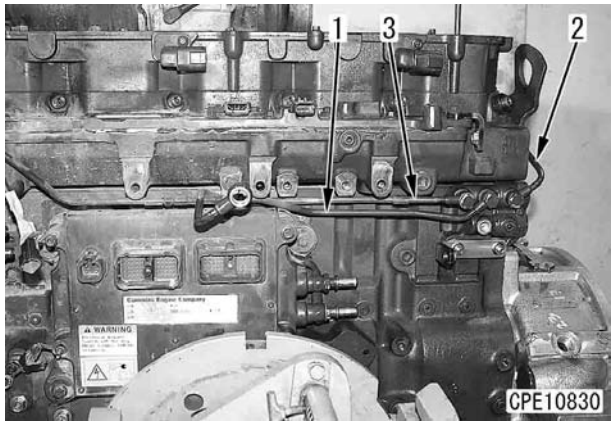
31. Main controller assembly

Install main controller assembly (1) to the cylinder block with mounting bolts (2).



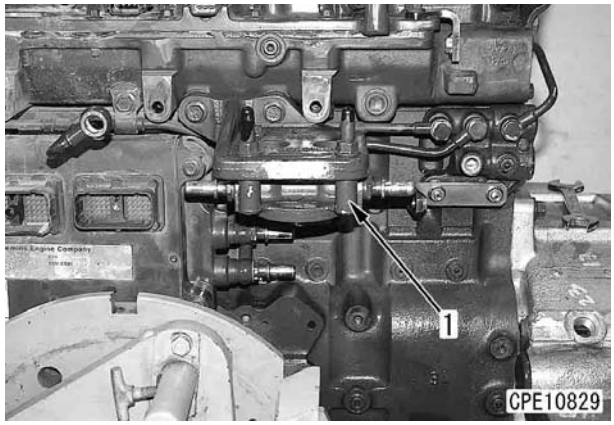
32. Fuel drain tube

1) Install tube (1) between the supply pump and drain and tube (2) between the cylinder head and drain.
   Joint bolt:
   24 ± 4 Nm {2.4 ± 0.4 kgm}
2) Clamp tube (3) between the common rail and drain temporarily.



33. Fuel filter bracket

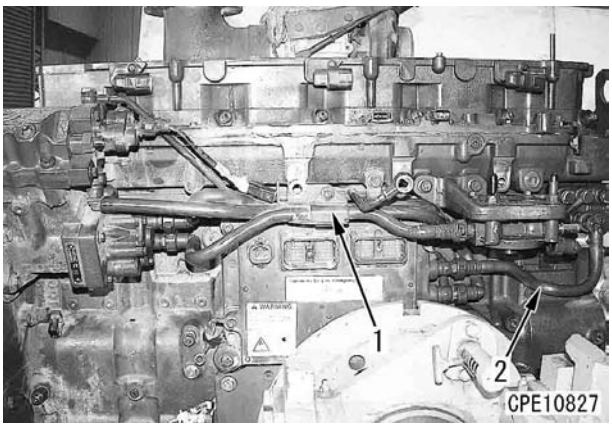
Install fuel filter bracket (1).



34. Fuel low-pressure hose

⚠ **The internal parts of the adapter may be damaged when the hose is removed. Accordingly, do not reuse the adapter but use new one when installing the hose again, as a rule.**

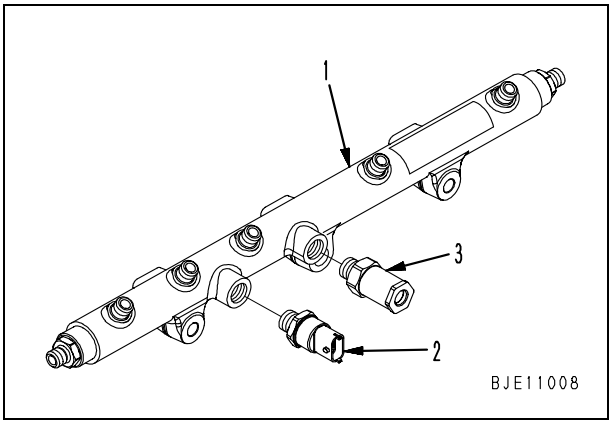
1) Install supply hose (2).
2) Install low-pressure hose assembly (1).
   - After connecting the hose, tighten the clamp bolt at the center.



35. Fuel pressure sensor and relief valve

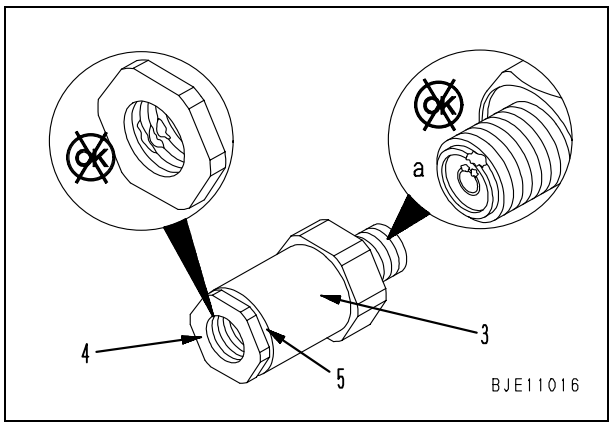
1) Replace fuel pressure sensor (2), if necessary, according to the following procedure.
   - ★ Do not remove fuel pressure sensor (2) from common rail (1) for a purpose other than replacement.
   - ★ Once the fuel pressure sensor is removed from the common rail, be sure to replace it.

   1] Before removing the fuel pressure sensor, remove mud etc. from around it thoroughly and clean it.
   2] Remove the fuel pressure sensor.
   3] Check the fuel pressure sensor connector for crack, breakage, damage of the seal, foreign matter on the pin and corrosion, bend and breakage of the pin.
   4] Install a new fuel pressure sensor.
   Threaded part of fuel pressure sensor:
   Gear oil (#90)
   Fuel pressure sensor:
   70 ± 5 Nm {7.1 ± 0.5 kgm}



   5] Connect the engine wiring harness. At this time, take care not to connect the wiring harness in reverse.
   6] Start the engine and check that fuel does not leak.
   For the testing procedure, see Testing and adjusting, “Testing fuel system for leakage”.

2) Replace relief valve (3), if necessary, according to the following procedure.
   1] Before removing the relief valve, remove mud etc. from around it thoroughly and clean it.
   2] Remove the relief valve.
   3] If the leakage from the relief valve exceeds the specified value, do not reuse it.
   4] Check that high-pressure seal surfaces (a) of the relief valve and rail are free from damage.
   5] Check that the adapter is free from flaw.
   6] Install the relief valve.
   Threaded part of relief valve:
   Gear oil (#90)
   Relief valve:
   100 ± 4 Nm {10.2 ± 0.4 kgm}
   Excessive tightening can cause leakage. Take care not to tighten too strongly.



   7] If adapter (4) was removed, use a new copper washer (5) and coat the adapter with gear oil #90 and tighten it.
   Threaded part of adapter:
   Gear oil (#90)
   Adapter:
   37 ± 4 Nm {3.8 ± 0.4 kgm}
   8] Start the engine and check that there is no leakage.
   For the testing procedure, see Testing and adjusting, “Testing fuel system for leakage”.

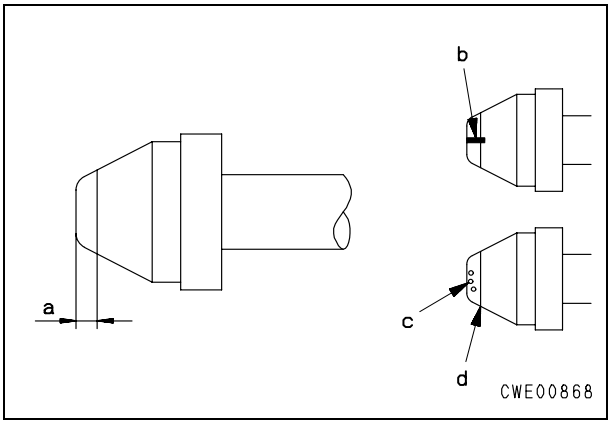
36. Common rail and piping

⚠ Do not bend the high-pressure pipe to collect before installing.

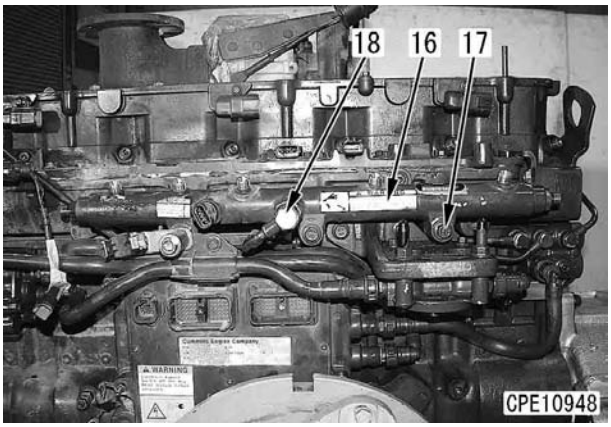
⚠ Be sure to use the genuine high-pressure pipe clamps and observe the tightening torque.

⚠ Install each high-pressure pipe and wiring harness at least 10 mm apart from each other.

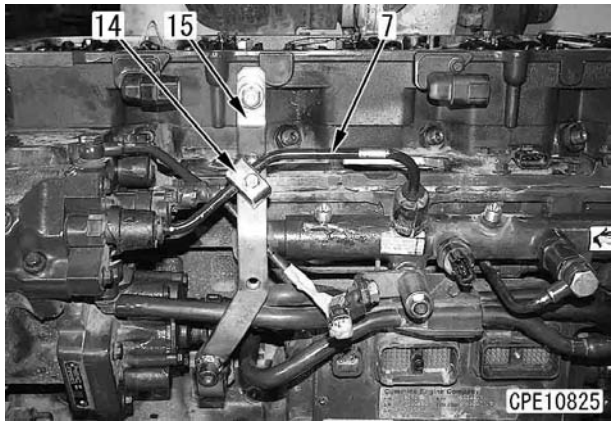
★ When installing each high-pressure pipe, check the taper seal of its joint (Part (**a**): Part of 2 mm from the end) for visible lengthwise slit (**b**) and spot (**c**) and check part (**d**) (End of taper seal: Part at 2 mm from the end) for stepped-type wear caused by fatigue which your nail can feel. If there is any of those defects, it can cause fuel leakage. In this case, replace the high-pressure pipe.



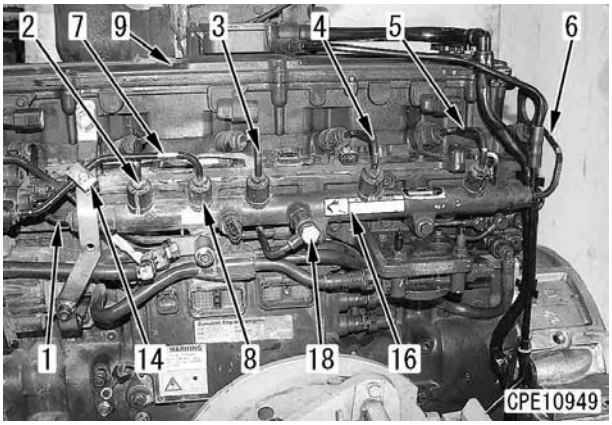
1) Install common rail (16) temporarily with mounting bolts (17) (Tighten the bolts by hand).
2) Tighten drain tube (18) temporarily.



3) Install tube (7) between the supply pump and common rail.
   Nut: **37.3 ± 4 Nm {3.8 ± 0.4 kgm}**
4) Install stay (15) and tighten clamp (14) temporarily.

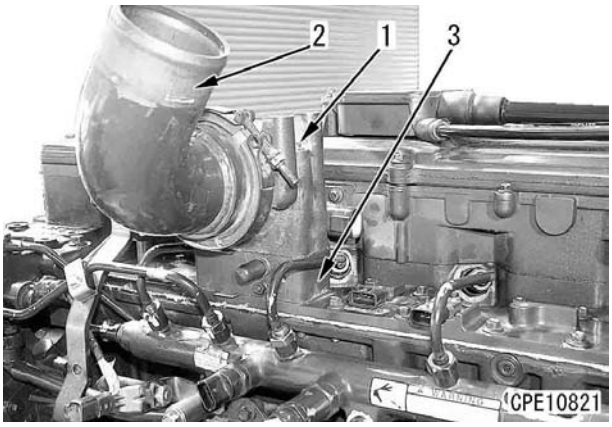


5) Install tubes (1) – (6) between the common rail and injector.
   Nut: **37.3 ± 4 Nm {3.8 ± 0.4 kgm}**
   ★ When installing the tubes to the No. 1, No. 3, and No. 5 cylinders, disconnect the wiring connector of the injector wiring harness.
6) Tighten drain tube (18) permanently.
   Joint bolt:
   24 ± 4 Nm {2.4 ± 0.4 kgm}
7) Tighten common rail (16) permanently.
   Joint bolt:
   43.1 ± 4.0 Nm {4.4 ± 0.4 kgm}
8) Tighten clamp (14) permanently.
9) Install bellows (8).
   ★ Set the slits of each bellows out and down.
   ★ The bellows are installed so that fuel will not spout over the hot parts of the engine and catch fire when it leaks for some reason.
10) Fit the gasket and install head cover assembly (9).
    Head cover assembly mounting bolt:
    11.8 ± 1.96 Nm {1.2 ± 0.2 kgm}



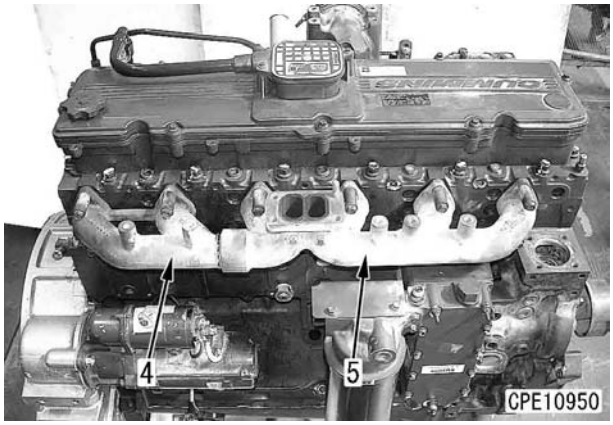
37. Electrical intake air heater and air intake connector

1) Fit the gaskets to the top and bottom of electrical intake air heater (3) and install them.
2) Install air intake connector assembly (2) with bolts (1).



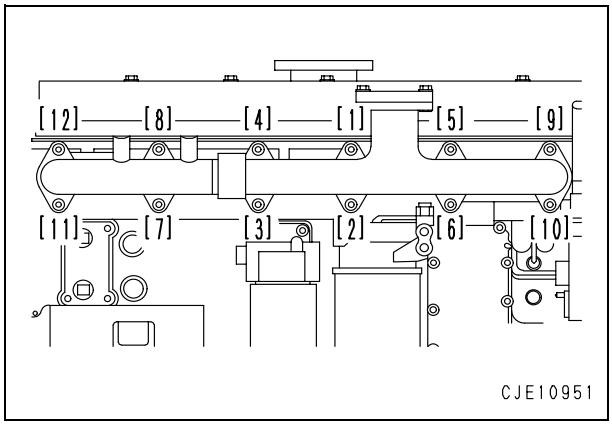
38. Exhaust manifold and turbocharger

1) Fit the gaskets and install exhaust manifolds (4) and (5). Tighten the mounting bolts in the numerical order shown below: [1] → [12]

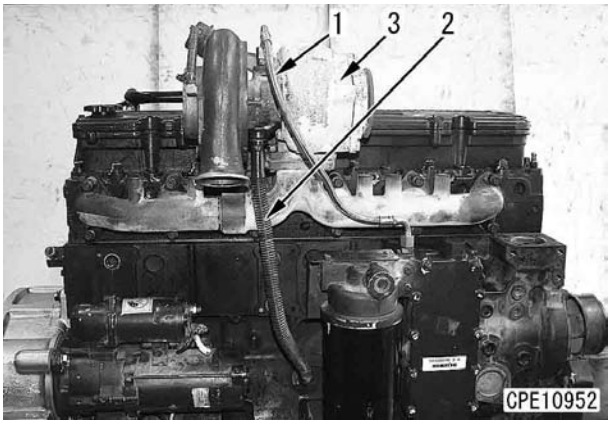


Tightening order of bolts:

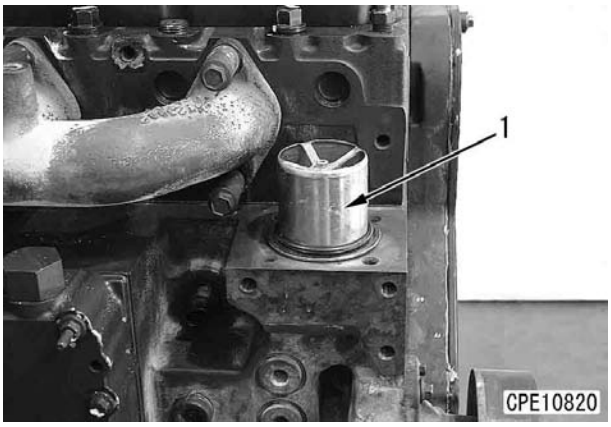
1] Tighten all the bolts to **24 ± 4 Nm {2.4 ± 0.4 kgm}**.
2] Retighten only bolts [1] – [4] in the figure to **24 ± 4 Nm {2.4 ± 0.4 kgm}** in the order of their numbers.
3] Tighten all the bolts to **43 ± 6 Nm {4.4 ± 0.6 kgm}**.
4] Retighten only bolts [1] – [4] in the figure to **43 ± 6 Nm {4.4 ± 0.6 kgm}** in the numerical order.



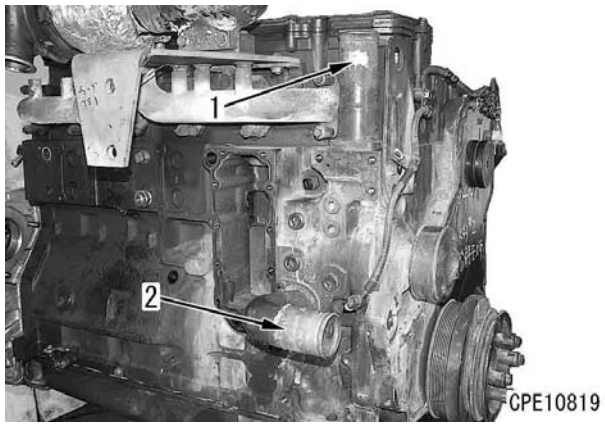
2) Fit the gasket and install turbocharger assembly (3).
   Mounting nut:
   45 ± 7 Nm {4.6 ± 0.7 kgm}
3) Install lubrication hose (1) and drain hose (2).
   Lubrication hose nut:
   35.3 ± 4.9 Nm {3.6 ± 0.5 kgm}
   Drain hose clamping bolt:
   24 ± 4 Nm {2.4 ± 0.4 kgm}



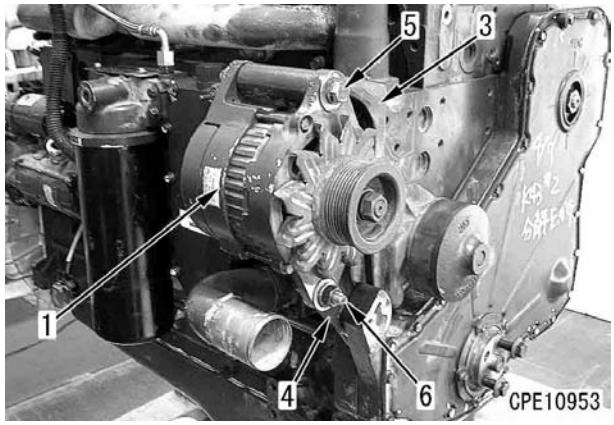
39. Thermostat
Fit the O-ring and install thermostat (1).



40. Coolant connector
1) Install coolant outlet connector (1).
2) Fit the gasket and install coolant inlet connector (2).
   Mounting bolt:
   24 ± 4 Nm {2.4 ± 0.4 kgm}

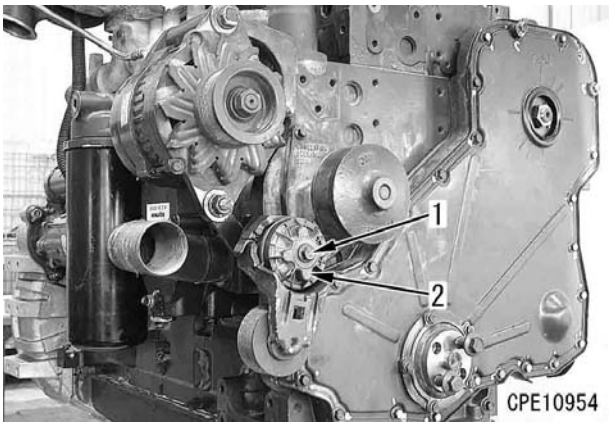


41. Alternator
1) Install brackets (3) and (4).
2) Install alternator (1) with mounting bolts (5) and (6).
   Mounting bolt (5):
   43 ± 6 Nm {4.4 ± 0.6 kgm}
   Mounting bolt (6):
   24 ± 4 Nm {2.4 ± 0.4 kgm}



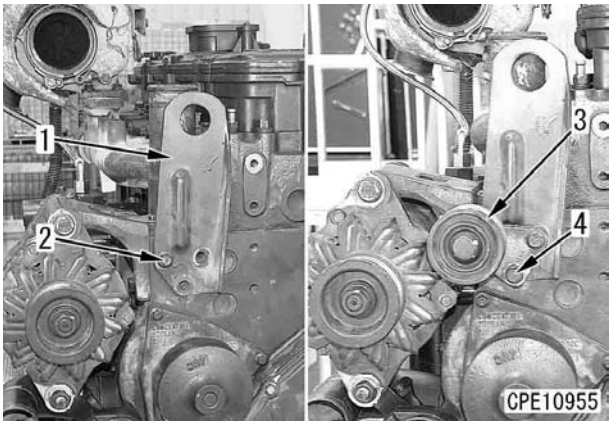
42. Belt tensioner

Install belt tensioner (2) with mounting bolt (1).



43. Idler roller and hanging plate

1) Install hanging plate (1) with bolt (2).
   - Install only 1 bolt.
2) Install idler roller (3) with bolt (4).
   - Clamp the hanging plate, too.

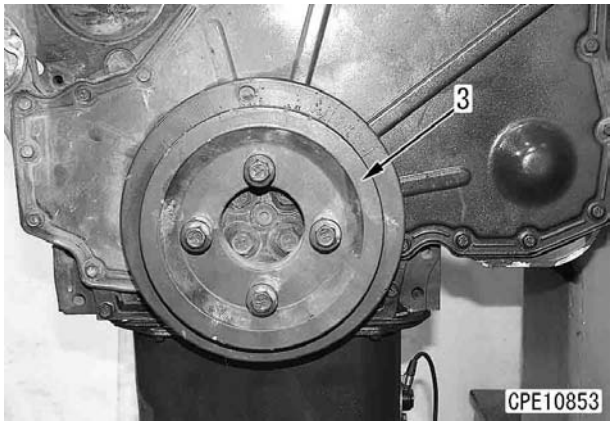


44. Vibration damper

1) Install vibration damper (4).
   Mounting bolt:
   200 ± 10 Nm {20 ± 1.0 kgm}

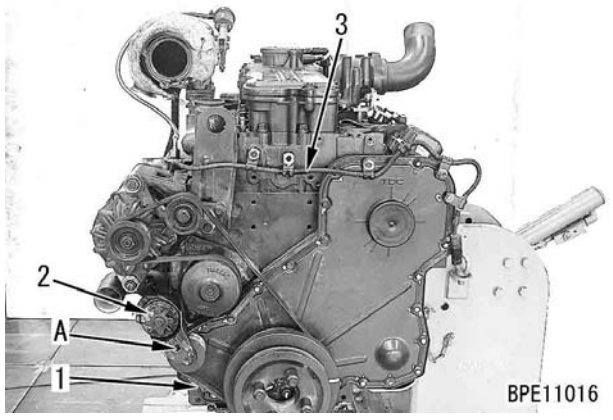


2) Install pulley (3).



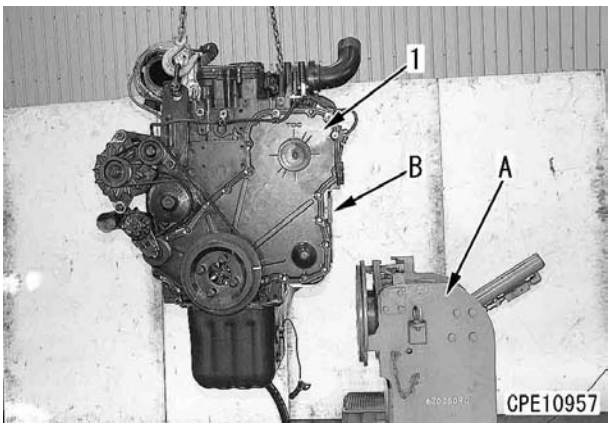
45. Fan belt and wiring harness

1) Install fan belt (1).
   - Insert a wrench to the portion (A) (width across flats □ 12.7 mm) of the tensioner assembly (2), and rotate it to the opposite to the winding-up direction to decrease the fan belt (1) tension.
     - ⚠ **Make sure that the wrench is secured at the portion (A) before rotating it. (The spring of the tensioner assembly (2) is strong. If the wrench is loosely inserted, the wrench may accidentally come off while being rotated and it is extremely dangerous.)**
     - ⚠ **Install the fan belt (1), return the tensioner assembly (2) slowly with care.**
     - ⚠ **Be careful not to get your fingers caught between the pulley and fan belt (1) during work.**
2) Install wiring harness (3).
   - ★ Check that the clearance between wiring harness (3) and fan belt (1) is 15 mm or wider.

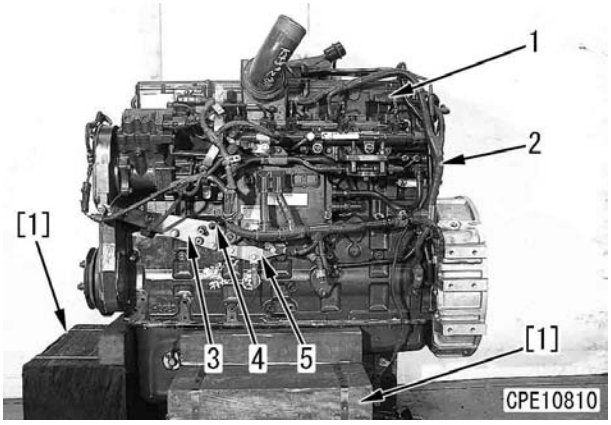


46. Removal from engine repair stand

1) Sling engine assembly (1) temporarily and disconnect it from repair stand **A**.
   Engine assembly: **Approx. 800 kg** (Weight depends on each applicable machine)
2) Remove tool **B**.

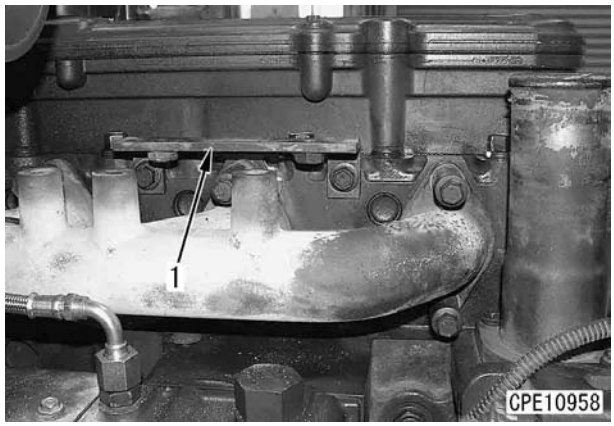


3) Place and fix engine assembly (1) on stable engine stand [1].
4) Install plates (3) and (5).
5) Install ground wire (4) of the main controller to plate (3).

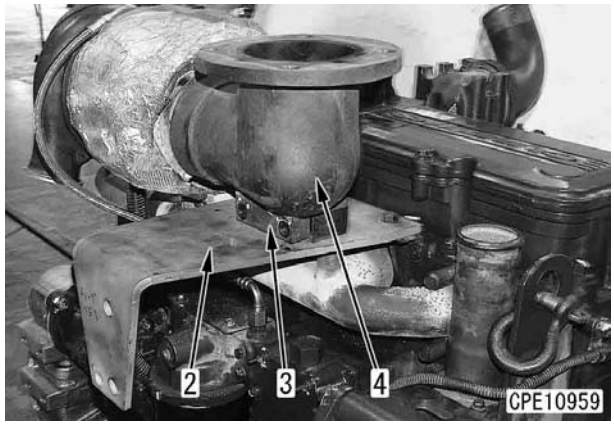


47. Muffler

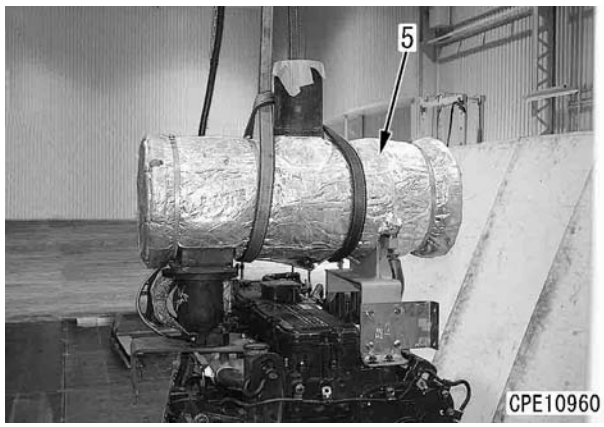
1) Install plate (1).



2) Install plate (2) and block (3).
3) Install tube (4).
   Clamp:
   6.9 – 8.8 Nm {0.7 – 0.9 kgm}



4) Install muffler assembly (5).



48. Refilling with oil

1) Check that the engine oil drain plug is tightened.
2) Add oil through the oil filler to the specified level.
   Engine oil pan: **Approx. 24 ℓ**

KOMATSU 114E-3 Series Diesel engine

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