SEN05276-06

Shop Manual

HYDRAULIC
EXCAVATOR

PC800 -8E0
PC800LC -8E0
PC800SE -8E0
PC850 -8E0
PC850SE -8E0

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PC800LC- 65001
PC800SE- 65001
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and up

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KOMATSU

Notice of revision

6th revision 2017/07

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SHOP MANUAL

HYDRAULIC EXCAVATOR
PC800-8E0 PC850SE-8E0
PC800LC-8E0
PC800SE-8E0
PC850-8E0

Machine model	Serial number	Machine model	Serial number
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PC800SE-8E0	65001 and up		
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00 Index and foreword

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Foreword and general information
Safety notice

Important safety notice

Appropriate servicing and repair are extremely important to ensure safe operation of the machine. The shop manuals describe the effective and safe servicing and repair methods recommended by Komatsu. Some of the servicing and repair methods require use of special tools designed by Komatsu for special purposes.
The symbol mark "⚠" is indicated for such matters that require special precautions. The work indicated with the warning mark should be performed according to the instructions with special attention to the precautions. Should a hazardous situation occur or be anticipated during such work, be sure to keep safe first and take every necessary measure.

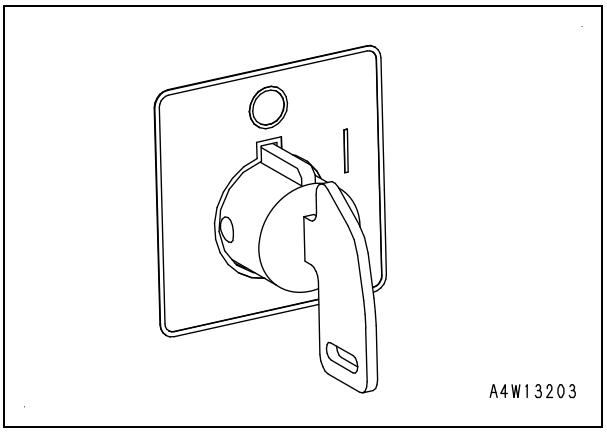
1. **General precautions**
   - ⚠ **Inappropriate handling creates an extreme danger. Read and understand what is described in the Operation and Maintenance Manual before operating the machine. Read and understand what is described in this manual before starting work.**
   1) Before performing any greasing or repairs, read all the safety labels stuck to the machine. For the locations of the safety labels and detailed explanation of precautions, see the Operation and Maintenance Manual.
   2) Locate 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 performing any operation, always wear safety shoes and helmet. Do not wear loose work clothes, or clothes with buttons missing.
      - Always wear the safety glasses when hitting parts with a hammer.
      - Always wear the safety glasses when grinding parts with a grinder, etc.
   4) When performing any operation with two 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 tag in the operator's compartment.
   5) Only qualified workers must perform the 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. Before starting work, thoroughly check the tools, machine, forklift truck, service car, etc.
   7) If welding repairs are needed, always have a trained and experienced welder perform the work. When performing 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.
   9) Avoid continuing work for long hours and take rests at proper intervals to keep your body in good condition and at the provided place.

Safety points

1	Good arrangement
2	Correct work clothes
3	Following work standard
4	Making and checking signals
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. **Preparation work**
   1) Before adding oil or making any repairs, park the machine on a hard and level ground, and apply the parking brake and chock 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 tag on them.
   3) When disassembling or assembling, support the machine with blocks, jacks, or stands before starting the 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.

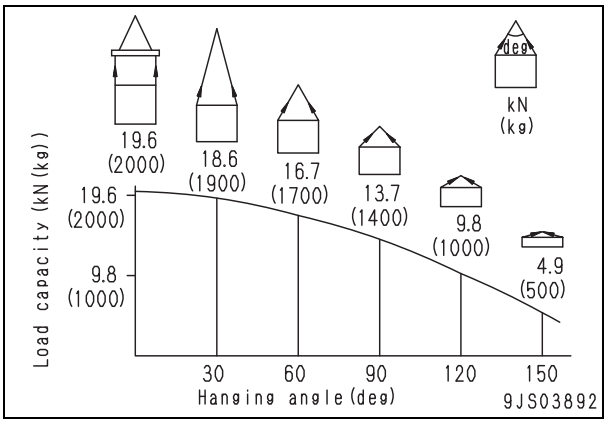
3. **Precautions during work**
   1) Before disconnecting or removing components for the oil, water, or air circuits, first release the pressure completely from the circuit. When removing the oil filler cap, a drain plug, or an oil pressure pickup plug, loosen it slowly to prevent the oil from spurting out.
   2) The coolant and oil in the circuits are hot when the engine is shut down, so be careful not to get scalded. Wait for the oil and coolant to cool before performing any work on the oil or water circuits.
   3) Before starting work, shut down the engine. When working on or around a rotating part, in particular, shut down the engine. When checking the machine without shutting down the engine (measuring oil pressure, revolving speed, temperature, etc.), take extreme care not to get caught in rotating parts or moving parts.
   4) **For the machine equipped with a battery disconnct switch, turn the battery disconnect switch to the OFF (O) position and pull the switch key out, before starting the work.** For machines without a battery disconnct switch, remove the cable from the battery , before starting the work. Always remove the cable from the negative (-) terminal first.



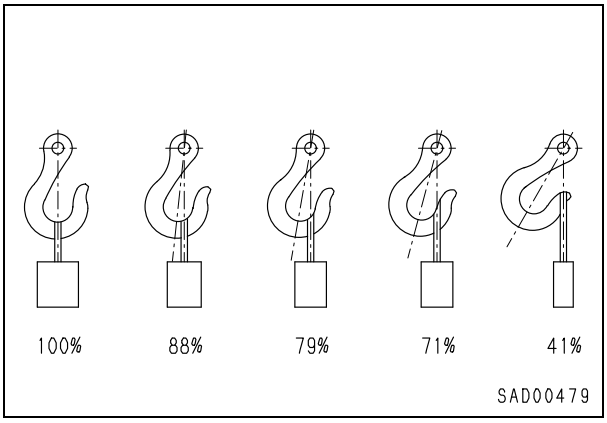
   5) When raising a heavy component (heavier than 25 kg), use a hoist or crane. Before starting work, check that the slings (wire ropes, chains, and hooks) are free from damage. Always use slings which have ample capacity and install them to proper places. Operate the hoist or crane slowly to prevent the 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 by a spring, always leave two 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 off immediately. Fuel or oil on the floor can cause you to slip and can even cause 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 and tubes, make sure that they are not twisted. Damaged hoses and tubes are dangerous, so be extremely careful when installing hoses and tubes for high pressure circuits. In addition, check that connections of them are correct.

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 speeds, be particularly careful to check that they are installed correctly.
13) When aligning two 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 installed.
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 slinging work and making signals**
   1) Only one appointed worker must make signals and co-workers must communicate with each other frequently. The appointed signaler must make specified signals clearly at a place where he is well seen from the operator's seat and where he can see the working condition easily. The signaler 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 one wire rope alone. If it is slung so, It may rotate and may slip out of the rope. Install two or more wire ropes symmetrically.
      ⚠ **Slinging with one 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 degree, as a rule.
      Do not sling a heavy load (25 kg or more) with ropes forming a wide hanging angle from the hook.
      When hoisting a load with two 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 two ropes, each of which is allowed to sling up to 9.8 kN {1,000 kg} vertically, at various hanging angles. When the two 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 two ropes make a hanging angle of 120 degree. If the two ropes sling a 19.6 kN {2,000 kg} load at a lifting angle of 150 degree, 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 at an angle.

13) When lowering 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 traveling crane**
⚠ A hoist crane or similar device must be used for lifting a heavy load (25 kg or more). The weight of a part that is 25 kg or more is indicated with the symbol "⌓" in "Disassembly and assembly".
1) Before starting work, inspect the wire ropes, brake, clutch, controller, rails, over wind stop device, ground fault circuit interrupter, crane collision prevention device, and power application warning lamp, and check safety.
2) Observe the signals 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 at an angle. 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 in 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 ground fault circuit interrupter, check that the devices related to that switch are not in operating condition.
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

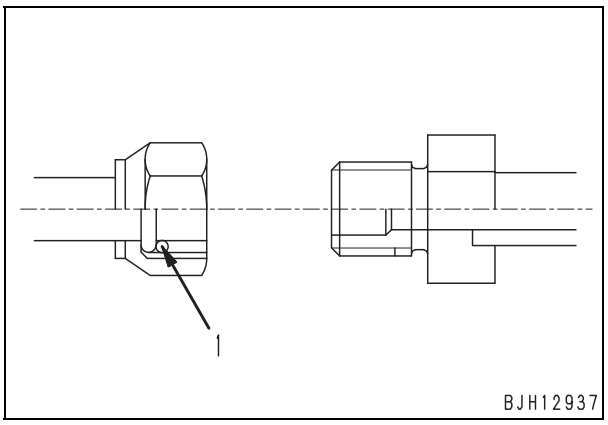
Wire ropes
(Standard "Z" twist ropes without galvanizing)
(JIS G3525, No. 6, Type 6X37-A)

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 to be used (Safety coefficient: 6).

8. **Precautions for disconnecting and connecting hoses and tubes in an air conditioner circuit**
   1) Disconnection
      ⚠ **Although the refrigerant (refrigerant gas: R134a) used on the machine's air conditioner is less destructive to the ozone layer for environmentally friendliness, it is not allowed to be released into the atmosphere as is. Whenever disconnecting the air conditioner gas circuit, be sure to recover the refrigerant gas to reuse it.**
      ★ Ask a qualified person for collection and charge of the refrigerant (R134a).
      ★ Never release the refrigerant (R134a) to the atmosphere.
      ⚠ **If the refrigerant gas gets in your eyes or contacts your skin, you may lose your sight or your skin may be frozen. Whenever recovering or adding refrigerant gas, you must put on safety glasses, safety gloves and long sleeved clothes.**
      The refrigerant gas must be recovered and added by a qualified person.

   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 O-ring (1) is free from flaw and deterioration.
      4] When connecting the refrigerant piping, apply compressor oil for refrigerant (R134a) **(DENSO: ND-OIL8, VALEO THERMAL SYSTEMS: 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

(Rev. 2010/03)

- 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 contains the index, foreword, safety and basic information. If any revision is made, the LIST OF REVISED PAGES will be added.

01. Specification

This section explains the specifications of the machine.

10. Structure and function

This section explains the structure and function of each component. It serves not only to give an understanding for the structure of each component, but also serves as reference material for troubleshooting.

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 tools and measuring methods for testing and adjusting, as well as the adjusting method of each part. The standard values and judgment criteria for "Testing and adjusting" are explained in "Standard value table".

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.

60. Maintenance standard

This section gives maintenance standard values of each component. The maintenance standard sub-section explains the criteria and remedies for disassembly and service.

80. Appendix

This section explains the structure, function, testing, adjusting, and troubleshooting for the equipment not classifiable in other sections.

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 remanufacturing and repairing engine 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 the revised or added pages in the correct order of the page numbers printed in the LIST OF REVISED PAGES.

- **Revision number**
  When a manual is revised, revision number of each page is increased by 1.
  (Example: (01), (02), (03)...)

- **Revisions**
  The revised pages are shown in the LIST OF REVISED PAGES.

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

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

5. Unit
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

(Rev. 2010/03)

The maintenance standard chapter explains the criteria for replacing or reusing products and parts in the machine maintenance work. The following terms are used to explain the criteria.

1. **Standard dimension and tolerance**
   - To be accurate, the finished dimension of parts is slightly different from one to another.
   - To specify the finished dimension of a part, a certain dimension is set for the part and an allowable difference from that dimension is indicated.
   - The above dimension set is called the "standard dimension" and the range of difference from the standard dimension is called the "tolerance".
   - The tolerance with the symbols of + or – is indicated on the right side of the standard dimension.

Example:

Standard dimension	Tolerance
120	-0.022 -0.126

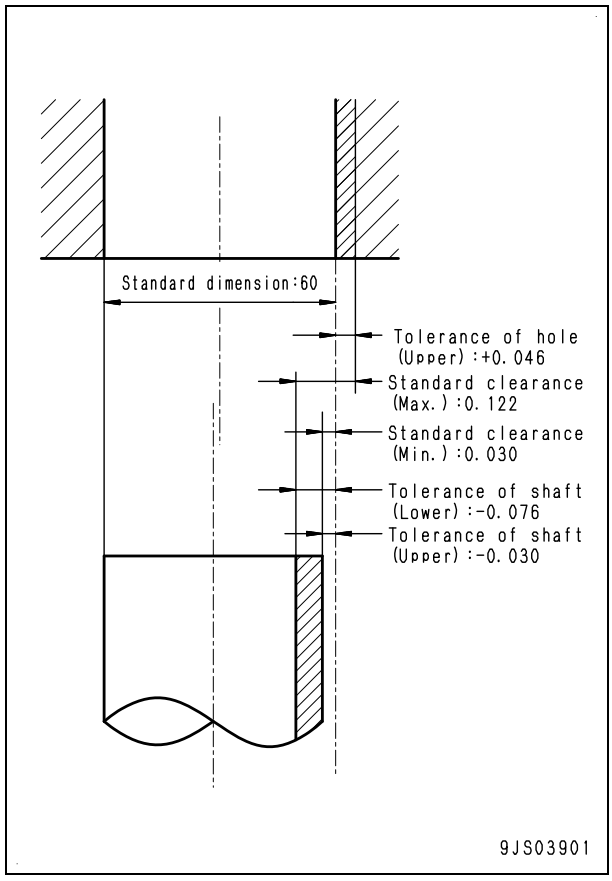
★ The tolerance may be indicated in the text and a table as [standard dimension (upper limit of tolerance/lower limit of tolerance)].
Example) 120 (–0.022/–0.126)

   - Usually, the dimension of a hole and the dimension of the shaft to be inserted into that hole are indicated by the same standard dimension and different tolerances of the hole and shaft. The tightness of fit is decided by the tolerance.
   - Indication of dimension of rotating shaft and hole and their related drawing.

Example:

Standard dimension	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.
   - The values indicating performance and function of new products or equivalent are 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 dimension and tolerance table is smaller than that of the shaft to be inserted, the difference between those diameters is called the "interference".
   - The range (between A and B) from the difference (A) between the minimum dimension of the shaft and the maximum dimension of the hole to the difference (B) between the maximum dimension of the shaft and the minimum dimension of the hole is the “standard interference”.
   - After repairing or replacing some parts, measure the dimension of their hole and shaft and check that the interference is in the standard range.

4. **Repair limit and allowable value or allowable dimension**
   - The dimension of a part changes because of wear and deformation while it is used. The limit of changed dimension is called the "repair limit".
   - If a part is worn to the repair limit, it must be replaced or repaired.
   - The performance and function of a product lowers while it is used. A value with which the product can be used without causing a problem is called the "allowable value" or "allowable dimension".
   - If a product deviates from the allowable value, it must be checked or repaired. However, since most of the allowable values are estimated from various tests or experiences in most cases, it must be judged after considering the operating condition and customer's requirement.

5. **Allowable clearance**
   - 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 "allowable clearance".
   - If the clearance between the parts exceeds the allowable clearance, they must be replaced or repaired.

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

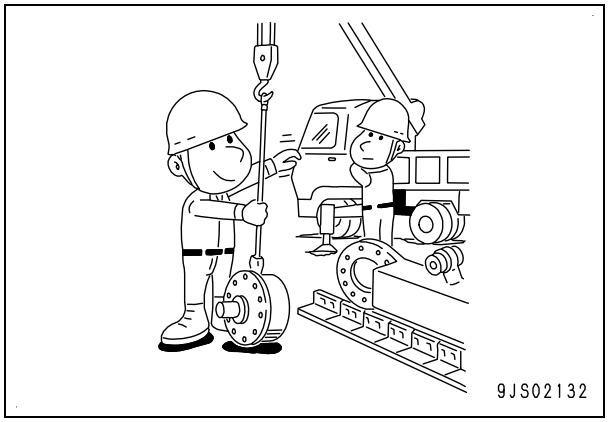
Handling of hydraulic components

(Rev. 2010/03)

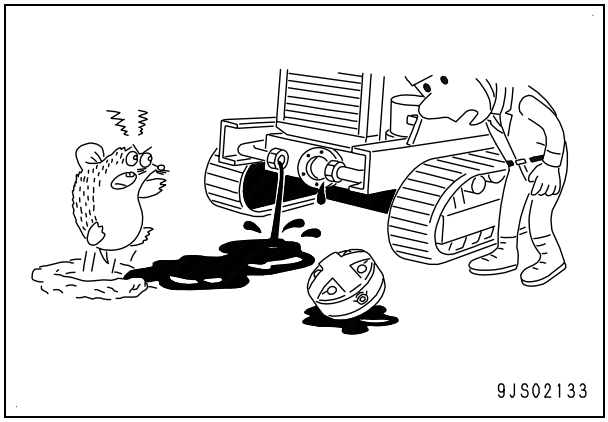
With the increase in pressure and precision of hydraulic equipment, the most common cause of failure is dirt (foreign material) in the hydraulic circuit. Therefore, special precaution is required when adding hydraulic oil, or when disassembling or assembling hydraulic components.

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

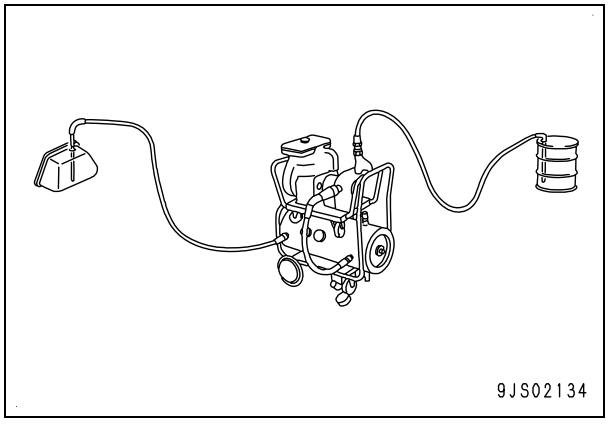
2. **Disassembly and maintenance work in the field**
   If disassembly or maintenance work is performed on hydraulic components in the field, there is danger of dust entering the components. It is also difficult to check the performance after repairs, so it is desirable to use unit exchange. Disassembly and maintenance of hydraulic components should be performed 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.

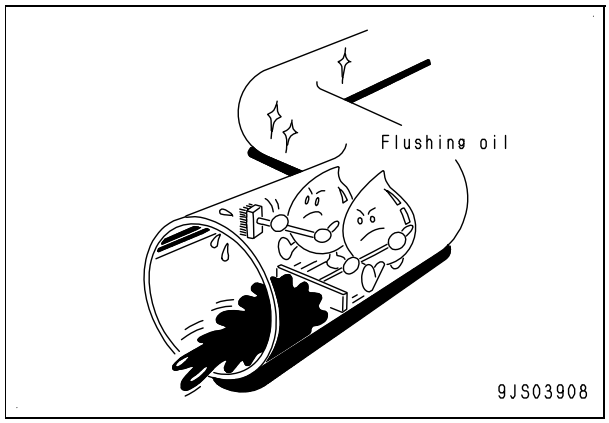


4. **Preventing intrusion of foreign materials during refilling operations.**
   Be careful not to let any dirt or dust get in when refilling with hydraulic oil. Always keep the oil filler and the area around it clean, and also use clean pumps and oil containers. If an oil cleaning device is used, it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

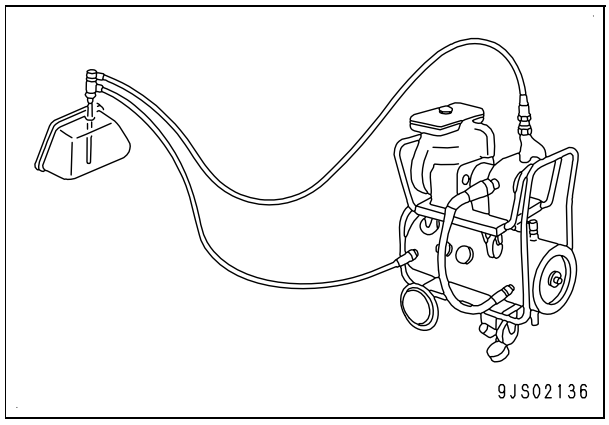


5. **Replacing hydraulic oil while its temperature is high**
   When hydraulic oil or other oil is warm, it flows easily. In addition, the sludge can also be drained out easily from the circuit together with the oil, so it is best to change the oil when it is still warm. When changing the oil, as much 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 hole 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 performed twice. Primary flushing is performed by use of flushing oil and secondary flushing is performed by use of the specified hydraulic oil.



7. **Cleaning operations**
   After repairing the hydraulic equipment (pump, control valve, etc.) or when running the machine, perform oil cleaning to remove the sludge or contaminants in the hydraulic oil circuit. The oil cleaning equipment can 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.



Method of disconnecting and connecting push-pull type coupler

(Rev. 2010/03)

⚠ **Before performing the following work, loosen the oil filler cap of the hydraulic tank gradually to release the remaining pressure in the hydraulic tank.**

⚠ **Even if the remaining pressure is released from the hydraulic tank, some hydraulic oil flows out when the hose is disconnected. Accordingly, prepare an oil 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) With hose joint (2) 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 container.

Fig. 1

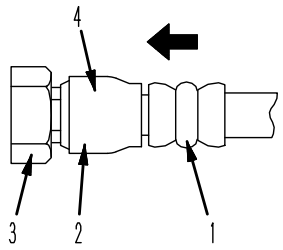


Fig. 2

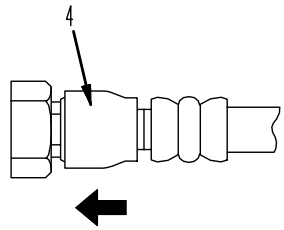
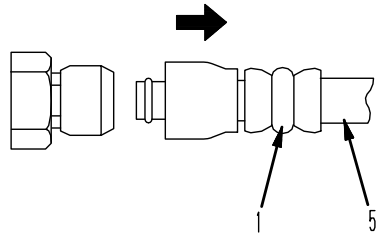


Fig. 3



9JS02109

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 fitting in the adapter on the other side perfectly, pull it back to check the 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

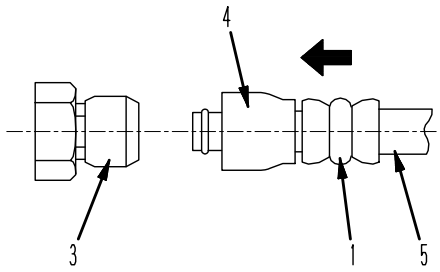
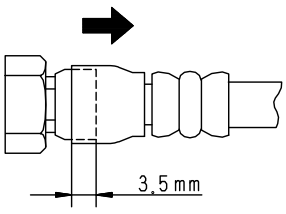


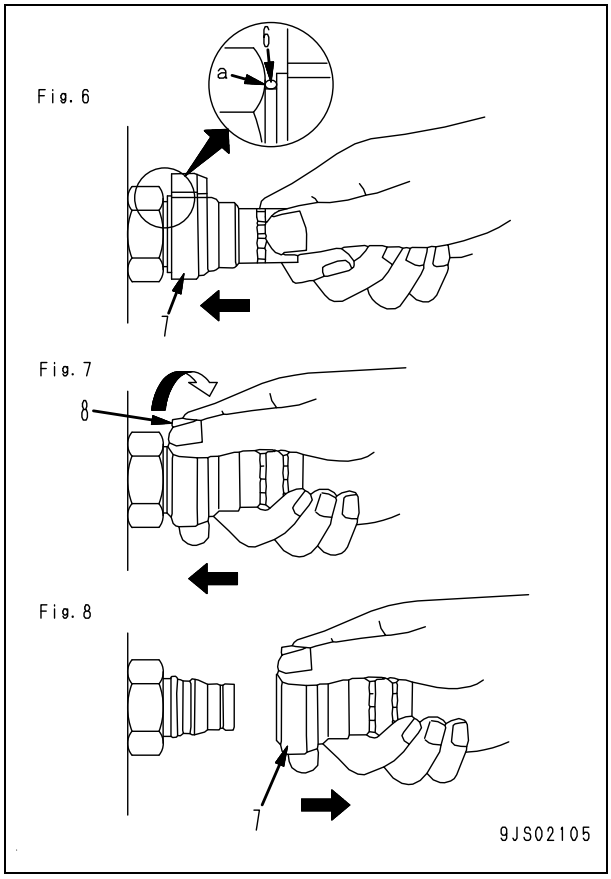
Fig. 5



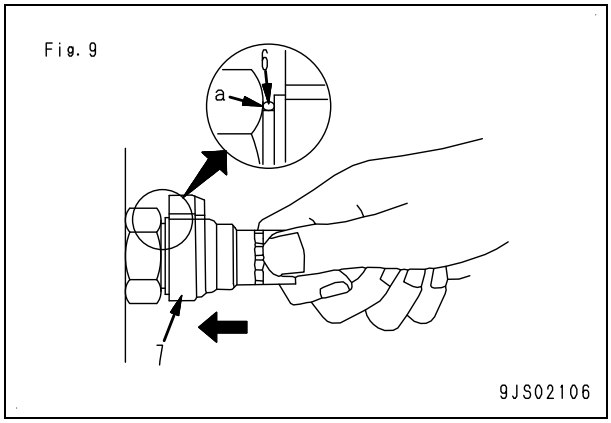
9JS02110

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)

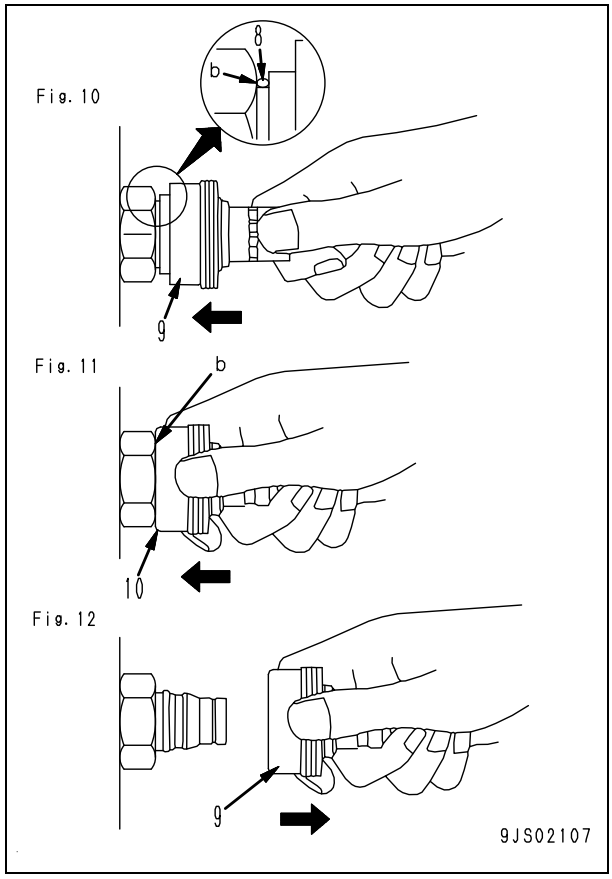


2. **Connection**
   - Hold the tightening portion and push body (7) straight until sliding prevention ring (6) contacts contact surface (a) of the hexagonal portion at the male end. (Fig. 9)

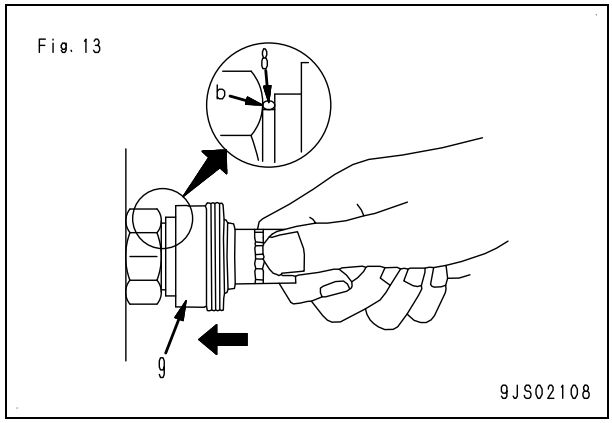


Type 3

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 sliding prevention ring (8) contacts contact surface (b) of the hexagonal portion at the male end. (Fig. 13)



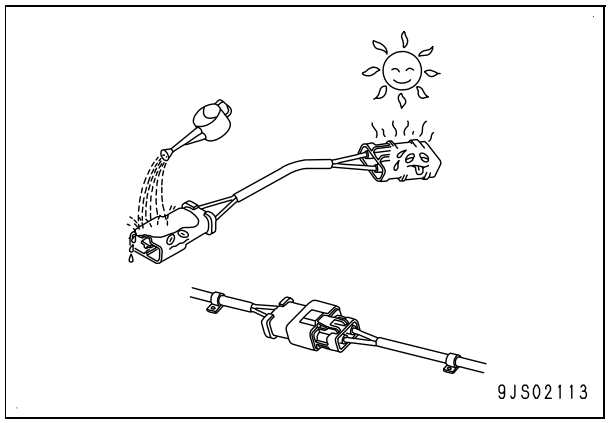
Handling of electric equipment

(Rev. 2010/03)

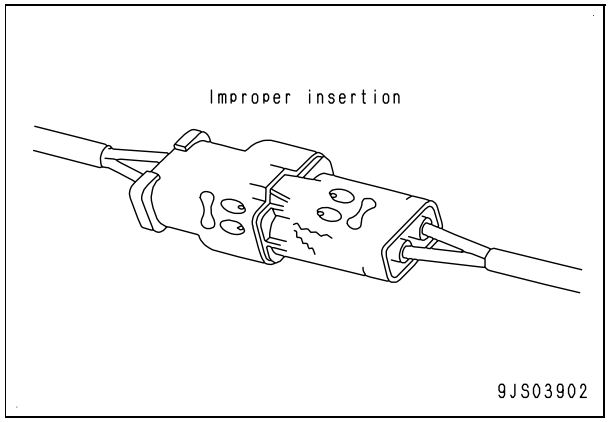
To maintain the performance of the machine over a long period, and to prevent failures or other troubles before they occur, correct "operation", "maintenance and inspection", "troubleshooting", and "repairs" must be performed. This section deals particularly with correct repair procedures for mechatronics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

Points to remember when handling electric equipment

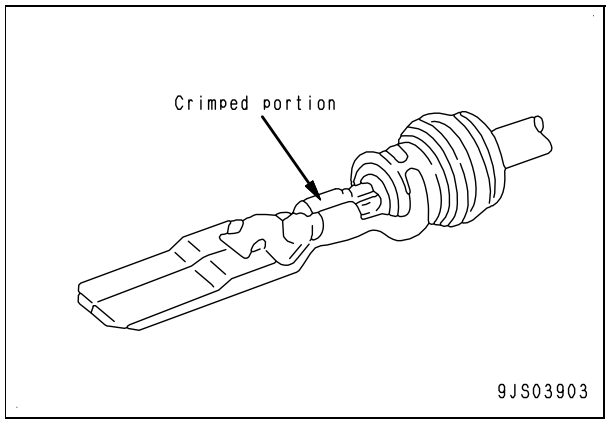
1. **Handling wiring harnesses and connectors**
   Wiring harnesses consist of wires connecting one component to another component, connectors used for connecting and disconnecting one wire from another wire, and protectors or tubes used for protecting the wires.
   Compared with other electrical components 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.



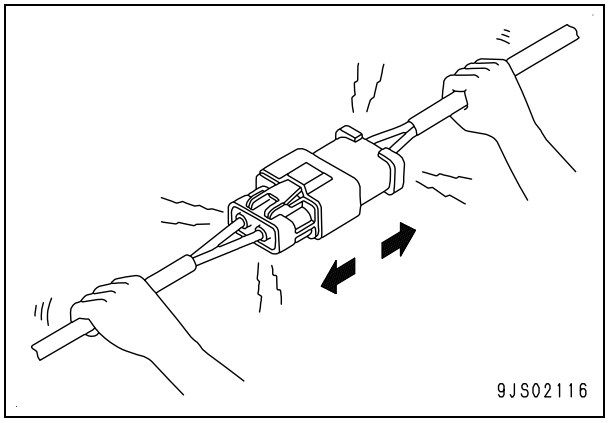
2. **Main failures occurring in wiring harnesses**
   1) Defective contact of connectors (defective contact between male and female connectors)
      Problems with defective contact are likely to occur because the male connector is not properly fitted into the female connector, or because one or both 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 ten times.



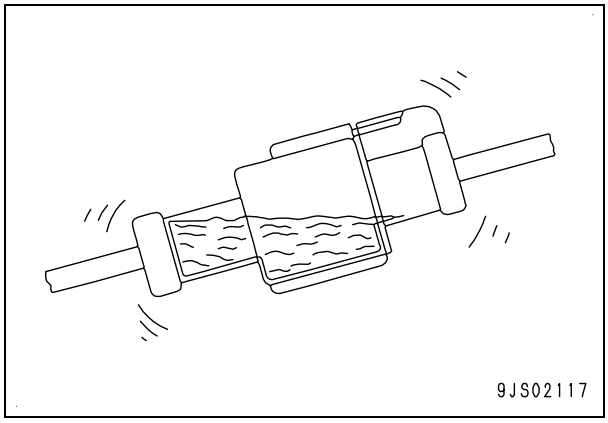
   2) Defective crimping or soldering of connectors
      The pins of the male and female connectors are attached to wires by crimping or soldering. If excessive force is applied to the wire, the joint is separated and causes a defective contact or the wire is broken.



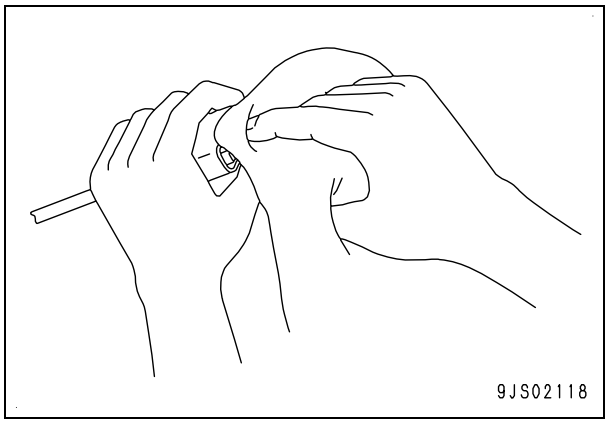
3) Disconnections in wiring
If the harness is pulled to disconnect the connector, or components are lifted with a crane with the harness still connected, or a heavy object hits the harness, the crimping of the connector may separate, or the soldering may be damaged, or the harness may be broken.



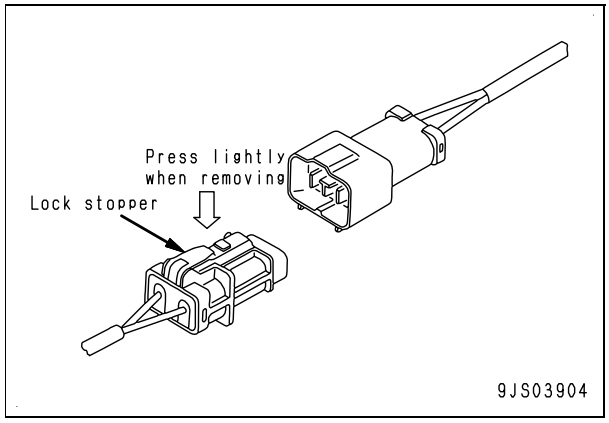
4) High-pressure water entering connector
The connector is designed to make it difficult for water to enter (drip-proof structure), but if high-pressure water is sprayed directly on the connector, water may enter the connector, depending on the direction of the water jet.
Accordingly, take care not to spray 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.



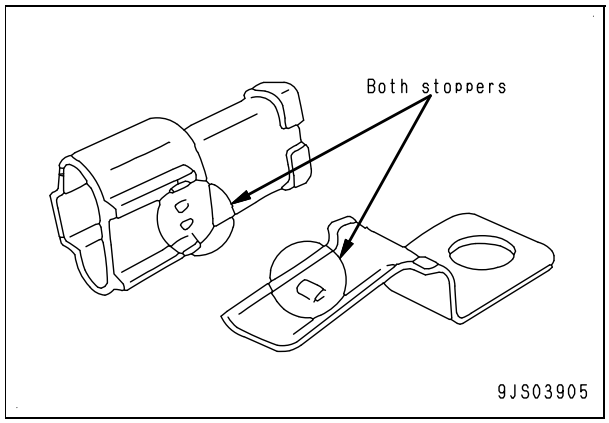
5) Oil or dirt stuck to connector
If oil or grease are stuck to the connector and an oil film is formed on the mating surface of the male and female pins, the oil will not let the electricity pass, so there will be defective contact. If there is oil or grease stuck to the connector, wipe it off with a dry cloth or blow it to dry with compressed air and spray it with electric contact cleaner.
   - ★ When wiping the joint portion of the connector, be careful not to apply 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.



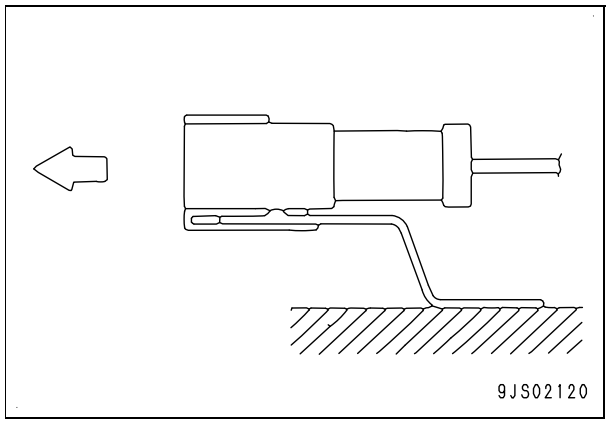
3. **Removing, installing, and drying connectors and wiring harnesses**
   1) Disconnecting connectors
      1] Hold the connectors when disconnecting. When disconnecting the connectors, hold the connectors. For connectors held by a screw, loosen the screw fully, then hold the male and female connectors 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.



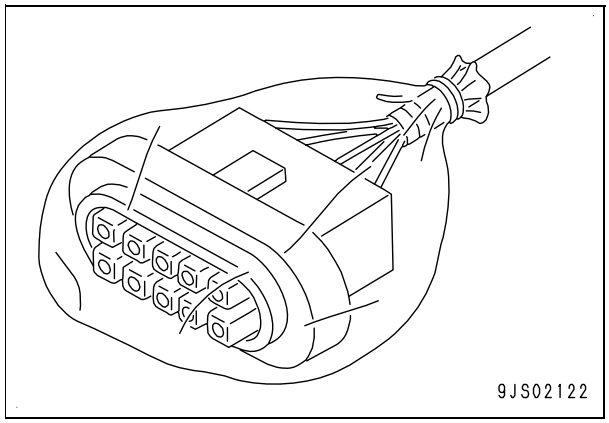
      2] When removing from clips
         - Both of the connector and clip have stoppers, which are engaged with each other when the connector is installed.



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

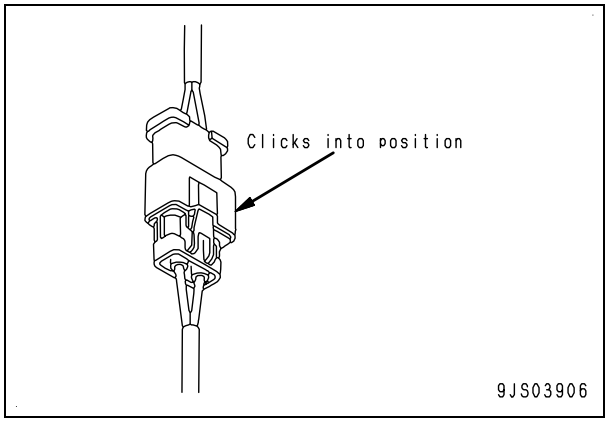


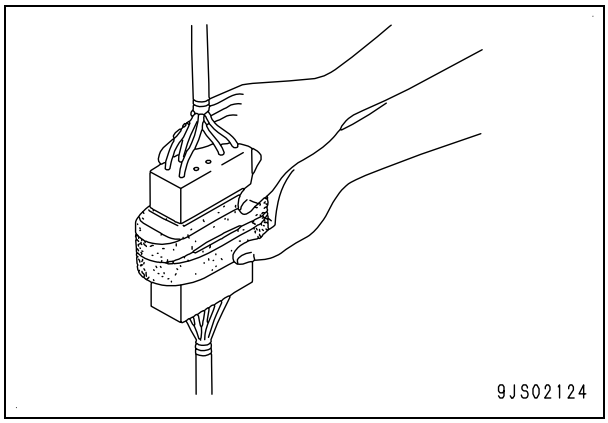
      3] Action to take after removing connectors
         After removing a connector, cover it with a vinyl bag to prevent the entry of dust, dirt, oil, or water to the contact portion.
         ★ If the machine is left disassembled for a long time, it is particularly easy for improper contact to occur, so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

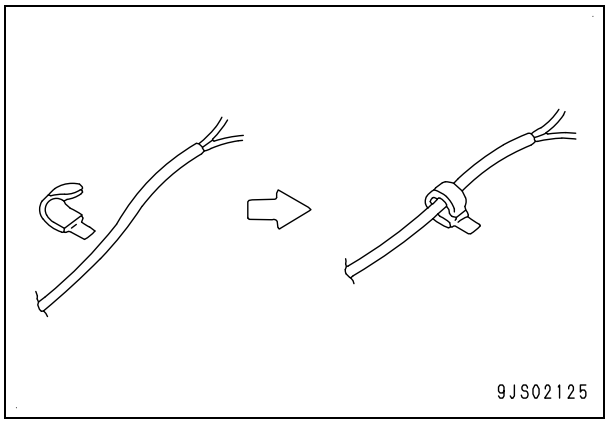


2) Connecting connectors
   1] Check the connector visually.
   Check that no oil, dirt, or water is stuck to connector pins (joint portion).
   Check that connector pins are free from deformation, defective contact, corrosion, or damage.
   Check that external surfaces of the connectors are free from damage or breakage.
   ★ 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 connector and harness with a dryer, but be careful not to make them too hot as this will cause short circuits.
   2] Fix the connector securely.
   Position the connectors correctly, and then fit them securely. For connectors with the lock stopper, push in the connector until the stopper clicks into position.
   3] Correcting protrusion of the boot and misalignment of the wiring harness
   For connectors fitted with the boot, correct any extrusion of the boot. In addition, if the wiring harness is moved in laying, or the clamp is out of position, correct it to its right position.
   ★ If the connector cannot be corrected easily, remove the clamp and adjust the position.
   ● If the connector clamp is removed, be sure to return it to its original position. Check also that there are no loose clamps.

★ If there is any damage or breakage, replace the connector.

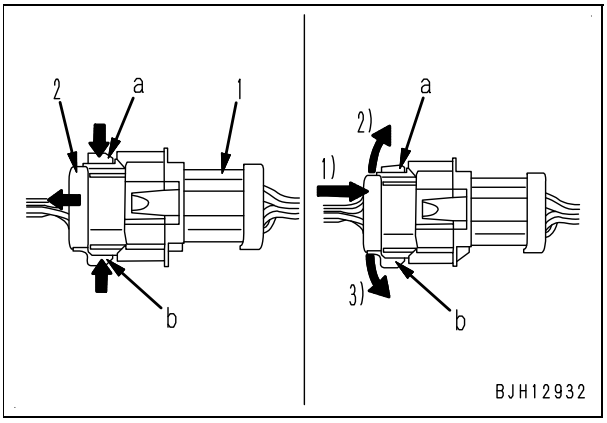






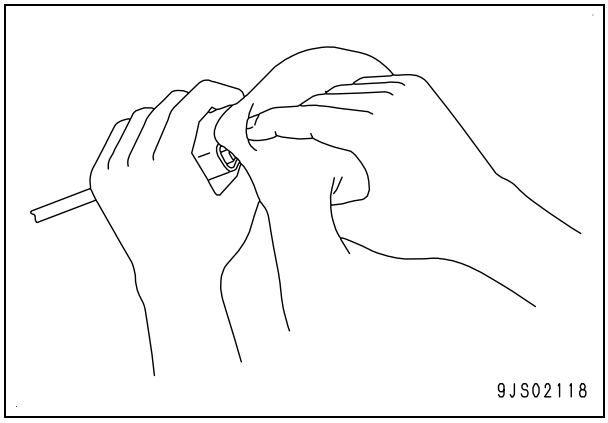
3) Deutsch connector (DT 8-pin, 12-pin)
   Disconnection (Left of figure)
   While pressing locks (a) and (b), pull out the female connector (2).
   Connection (Right of figure)
   1] Push in female connector (2) horizontally until the lock clicks.
      Arrow: 1)
   2] Since locks (a) and (b) may not 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))

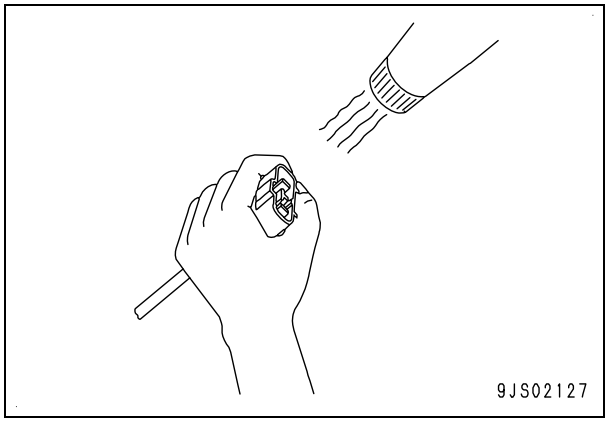


4) Drying wiring harness
If there is any oil or dirt on the wiring harness, wipe it off with a dry cloth. Avoid washing it in water or using steam. If the connector must be washed in water, do not use high-pressure water or steam directly on the wiring harness. If water gets directly on the connector, do as follows.

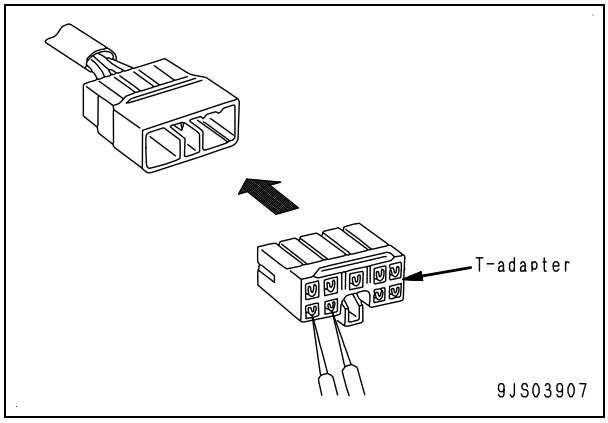
1] Disconnect the connector and wipe off the water with a dry cloth.
★ If the connector is to be blown with dry compressed air, there is the risk that oil in the air may cause defective contact, remove oil and water in the air before starting air blow.



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.



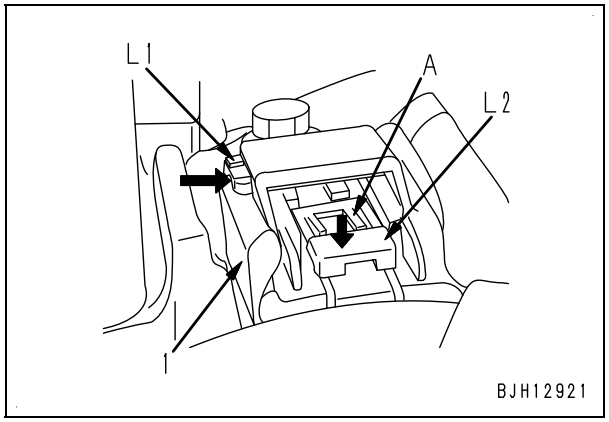
3] Perform a continuity test on the connector.
After drying, leave the wiring harness disconnected and perform a continuity test to check for any short circuits between pins caused by water.
★ After completely drying the connector, blow it with electric contact cleaner and reassemble.



4. **Handling of connectors used on engine**
   ★ Mainly, following engines are object for following connectors.
   - 95E-5
   - 107E-1
   - 114E-3
   - 125E-5
   - 140E-5
   - 170E-5
   - 12V140E-3

1) **Slide, lock type (FRAMATOME-3, FRAMATOME-2)**
   - 95/107/114/125/140/170/12V140 Series
     - Various pressure sensors and NE speed sensor
       Examples)
       Intake air pressure sensor in intake manifold: PIM (125/170/12V140 series)
       Oil pressure sensor: POIL (125/170/12V140 series)
       Oil pressure switch (95/107/114 series)
       Ne speed sensor on flywheel housing: NE (95/107/114/125/140/170/12V140 series)
       Ambient pressure sensor: PAMB (125/170/12V140 series)

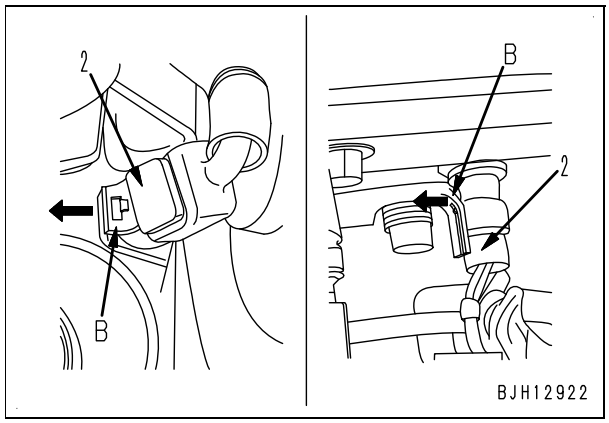
Disconnection
1] Slide lock L1 to the right.
2] While pressing lock L2, pull out connector (1) toward you.
   ★ Even if lock L2 is pressed, connector (1) cannot be pulled out toward you, if part (A) does not float. In this case, float part (A) with a small screwdriver while pressing lock L2, and then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



Connection
Insert the connector straight until it "clicks".

2) **Pull lock type (PACKARD-2)**
   - 95/107/114/125/140/170/12V140 Series
     - Various temperature sensors
       Examples)
       Intake air temperature sensor in intake manifold: TIM
       Fuel temperature sensor: TFUEL
       Oil temperature sensor: TOIL
       Coolant temperature sensor: TWTR, etc.

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

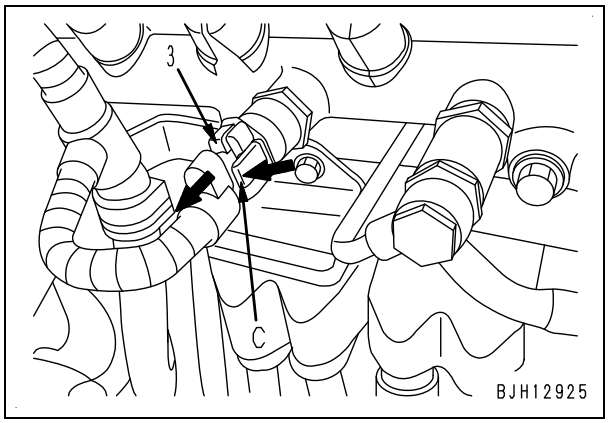


Connection
Insert the connector straight until it "clicks".

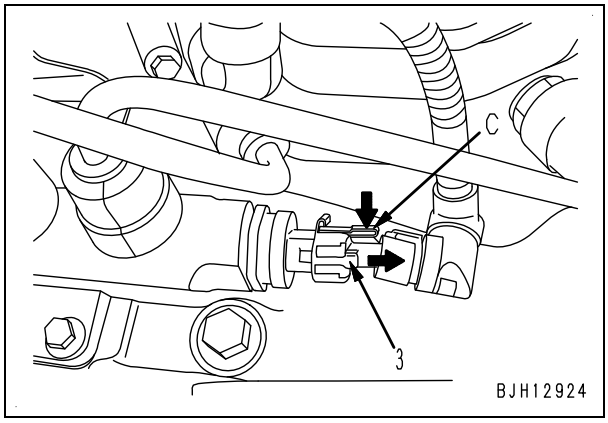
3) **Push lock type (1)**
   - 95/107/114 series
     Example) Fuel pressure sensor in common rail **(BOSCH-03)**

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

- 114 series

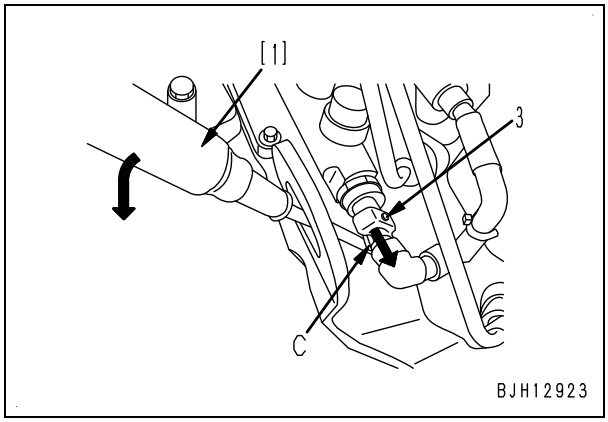


- 107 series



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

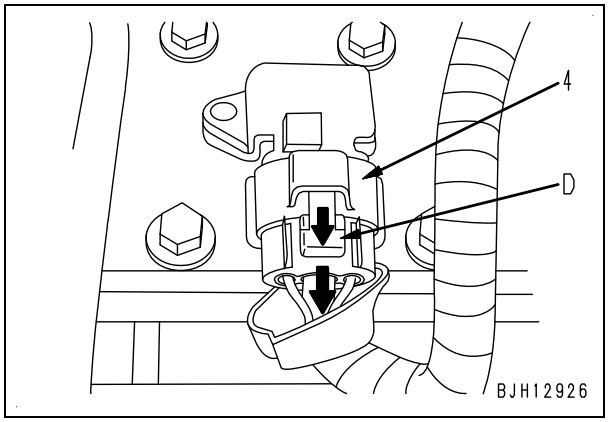
While pressing up lock (C) of the connector with flat-head screwdriver [1], pull out connector (3) in the direction of the arrow.



Connection
Insert the connector straight until it "clicks".

4) **Push lock type (2)**
   - 107/114 series
     Example) Intake air pressure/temperature sensor in intake manifold **(SUMITOMO-04)**

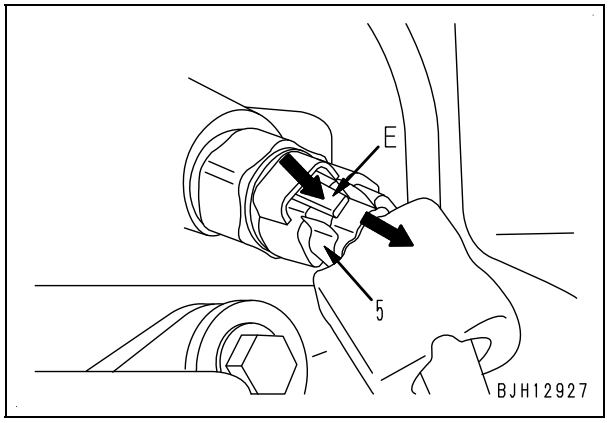
Disconnection
While pressing lock (D), pull out connector (4) in the direction of the arrow.



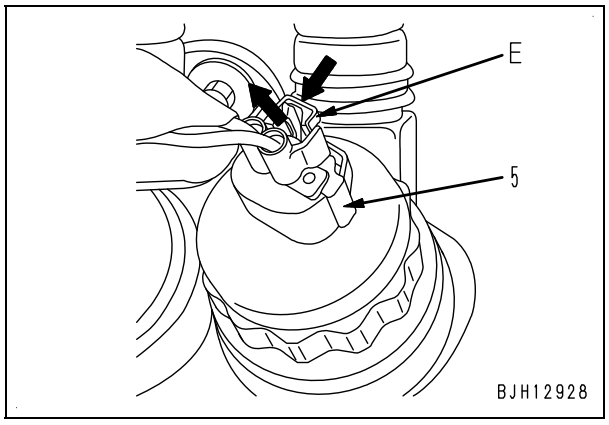
Connection
Insert the connector straight until it "clicks".

5) **Push lock type (3)**
- 95/125/140/170/12V140 series

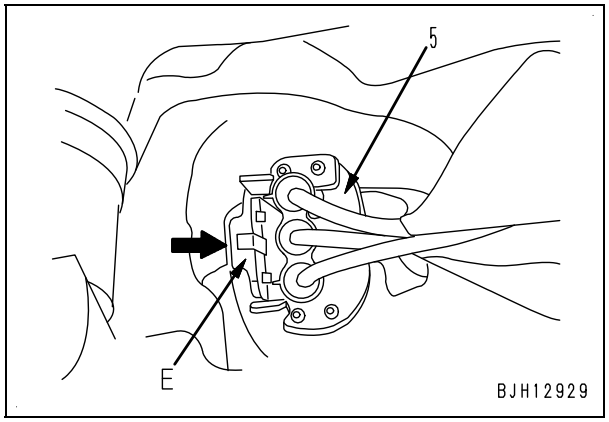
Disconnection
While pressing lock (E) of the connector, pull out connector (5) in the direction of the arrow.
Example) Fuel pressure sensor in common rail: PFUEL etc. **(AMP-3)**



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



Examples) Speed sensor of fuel supply pump: G **(SUMITOMO-3)**
★ Pull the connector straight up.

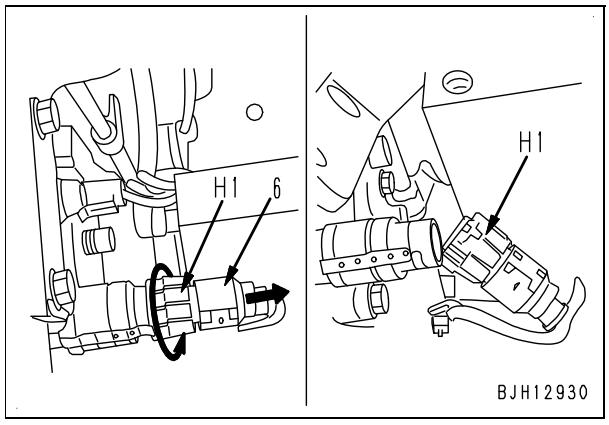


Connection
Insert the connector straight until it "clicks".

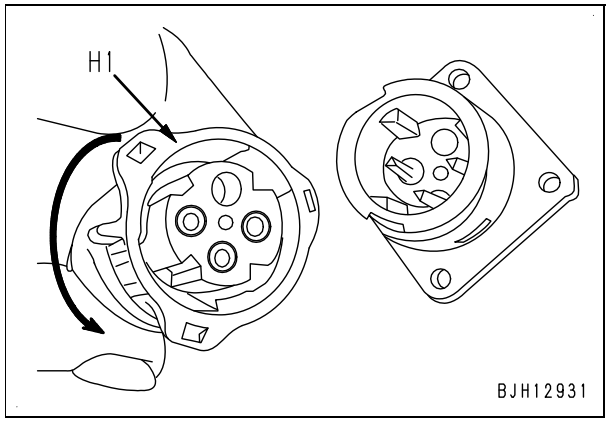
6) **Turn-housing type (Round green connector)**
- 140 series

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

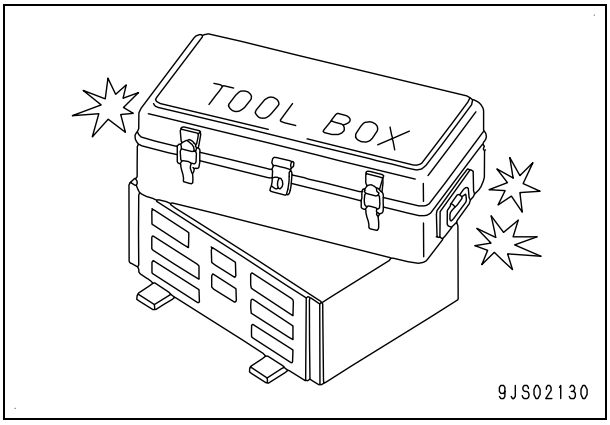
Disconnection
1] Turn housing (H1) in the direction of the arrow.
★ When connector is unlocked, housing (H1) becomes heavy to turn.
2] Pull out housing (H1) in the direction of the arrow.
★ Housing (H1) is left on the wiring harness side.

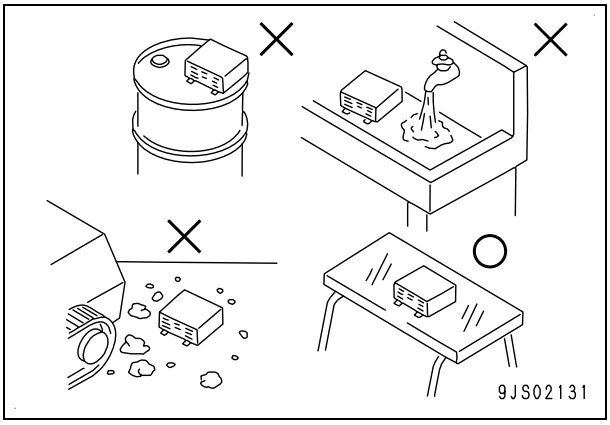


Connection
1] Insert the connector to the end, while setting its groove.
2] Turn housing (H1) in the direction of the arrow until it "clicks".



5. **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 a place that can be heated to a high temperature even for a short time. (Place it on a suitable dry stand.)
   6) Precautions when performing arc welding
      When performing arc welding on the machine body, disconnect all of the wiring harness connectors connected to the controller. Fit an arc welding ground to the place close to the welding point.



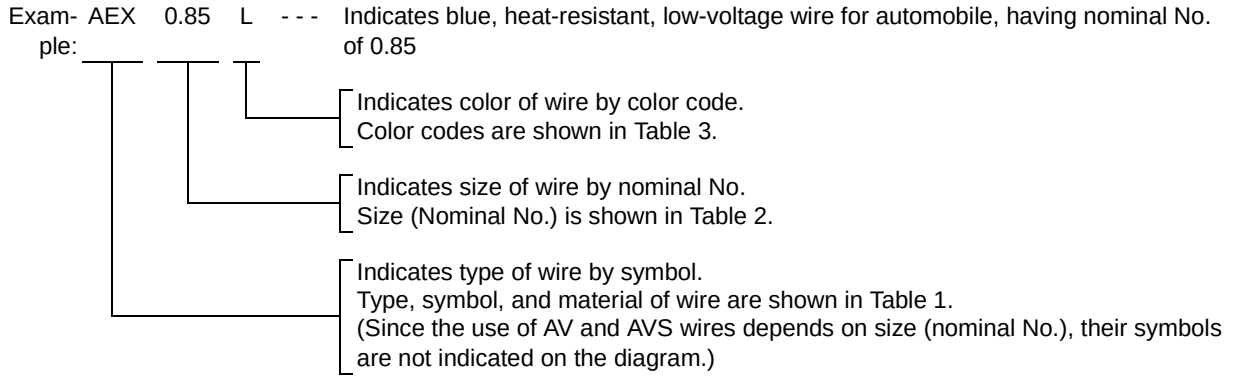


6. **Points to remember when troubleshooting electric circuits**
   1) Be sure to turn the power OFF before disconnecting or connecting connectors.
   2) Before performing troubleshooting, check all the related connectors for loose connection.
      ★ Disconnect and connect the related connectors several times to check.
   3) Be sure to connect any disconnected connectors before going on to the next step.
      ★ If the power is turned ON with the connectors still disconnected, unnecessary warning will be displayed.
   4) When performing troubleshooting of circuits (measuring the voltage, resistance, continuity, or current), wag the related wiring harnesses and connectors several times and check that there is no change in the reading of the tester.
      ★ If there is any change, there may be defective contact in the circuit.

How to read electric wire code

(Rev. 2010/03)

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 only in thickness and outside diameter of the cover. CAVS has a circular compressed conductor. It differs from AV and AVS in the outside diameter and thickness of the cover. And AEX is similar to AV in thickness and outside diameter of the cover but different from AV and AVS in material of the cover.

(Table 1)

Type	Symbol	Material		Temperature range for use (°C)	Example of use
Low-voltage wire for automobiles	AV	Conductor	Annealed copper for electric appliance	-30 – +60	General wiring (nominal No. 5 and above)
		Insulator	Soft polyvinyl chloride		
Thin low-voltage wire for automobile (type 1)	AVS	Conductor	Annealed copper for electric appliance		General wiring (nominal No. 3 and below)
		Insulator	Soft polyvinyl chloride		
Thin low-voltage wire for automobile (type 2)	CAVS	Conductor	Annealed copper for electric appliance		For mid- to small-size excavators (nominal No. 1.25 and below)
		Insulator	Soft polyvinyl chloride		
Heat resistant low-voltage wire for automobiles	AEX	Conductor	Annealed copper for electric appliance	-50 – +110	General wiring in extremely cold weather district, wiring at high ambient temperature place
		Insulator	Heat-resistant crosslinked polyethylene		

2. **Dimensions**

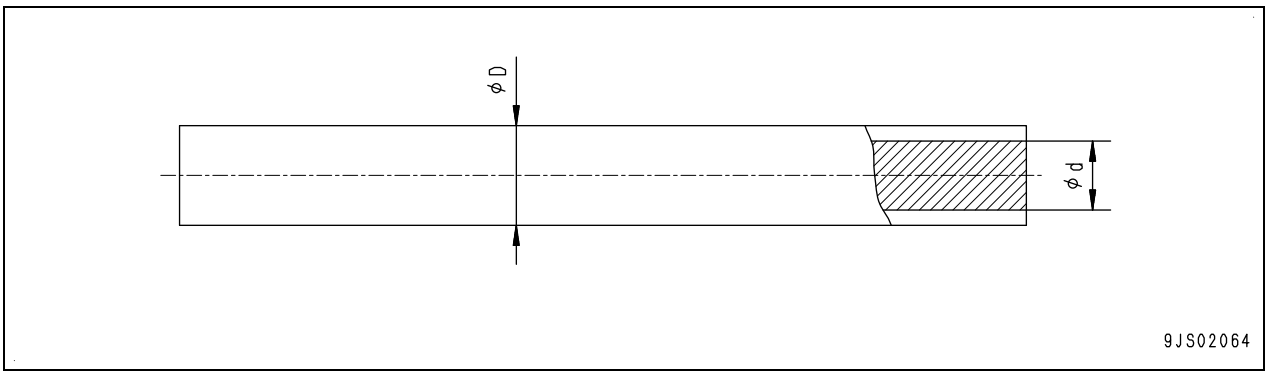
(Table 2)

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

Nominal No.			0.5f	0.5	0.75f	0.85	1.25f	1.25
Conductor		Number of strands/Diameter of strand	–	7/Circular compressed	–	11/Circular compressed	–	16/Circular compressed
		Sectional area (mm^2)	–	0.56	–	0.88	–	1.29
		d (approx.)	–	0.9	–	1.1	–	1.4
Cover D	CAVS	Standard	–	1.6	–	1.8	–	2.1

"f" of nominal No. denotes "flexible".



3. **Color codes table**

(Table 3)

Color Code	Color of wire
B	Black
Br	Brown
BrB	Brown & Black
BrR	Brown & Red
BrW	Brown & White
BrY	Brown & Yellow
Ch	Charcoal
Dg	Dark green
G	Green
GB	Green & Black
GL	Green & Blue
Gr	Gray
GR	Green & Red
GW	Green & White
GY	Green & Yellow
L	Blue
LB	Blue & Black
Lg	Light green
LgB	Light green & Black
LgR	Light green & Red

Color Code	Color of wire
LgW	Light green & White
LgY	Light green & Yellow
LR	Blue & Red
LW	Blue & White
LY	Blue & Yellow
O	Orange
P	Pink
R	Red
RB	Red & Black
RG	Red & Green
RL	Red & Blue
RW	Red & White
RY	Red & Yellow
Sb	Sky Blue
Y	Yellow
YB	Yellow & Black
YG	Yellow & Green
YL	Yellow & Blue
YR	Yellow & 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, AV, CAVS						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 performing work

(Rev. 2010/03)

When removing, installing, disassembling or assembling a unit, be sure to follow the general precautions given below.

1. **Precautions for removal work**
   - If the coolant contains antifreeze, dispose of it correctly as chemicals.
   - 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.
   - Check the match marks showing the installation position, and put 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.
   - Attach the tags to wires and hoses to show their installation position to prevent any mistake when installing.
   - Check the number and thickness of the shims, and keep them in a safe place.
   - When slinging component, be sure to use lifting equipment of ample strength.
   - When using forcing screws to remove any component, tighten the forcing screws uniformly and alternately.
   - 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**
   Put the following plugs into the piping after disconnecting it during disassembly operations.

   1) Face seal type hoses and tubes

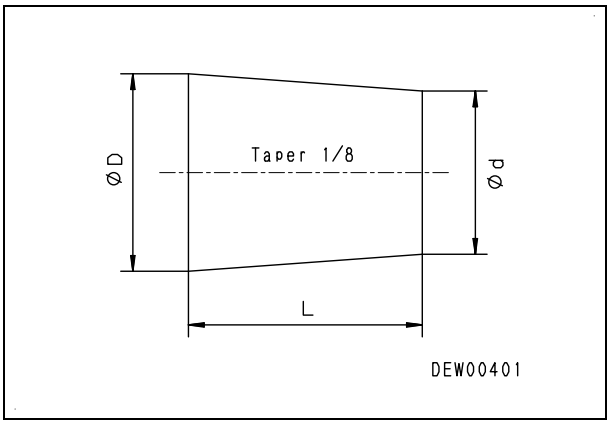
Nominal number	Plug (nut end)	Sleeve nut (elbow end)
02	07376 - 70210	02789 - 20210
03	07376 - 70315	02789 - 20315
04	07376 - 70422	02789 - 20422
05	07376 - 70522	02789 - 20522
06	07376 - 70628	02789 - 20628
10	07376 - 71034	07221 - 21034
12	07376 - 71234	07221 - 21234

   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 No.	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



2. **Precautions for installation work**
   - Tighten all of the bolts and nuts (sleeve nuts) to the specified torque (KES).
   - Install the hoses without twisting or interference and fix them with intermediate clamps, if available.
   - Replace all of the gaskets, O-rings, cotter pins, and lock plates with new parts.
   - Bend the cotter pins and lock plates securely.
   - When coating with adhesive, clean and degrease the part, and coat the threaded portion with two to three drops of adhesive.
   - When coating with liquid gasket, clean and degrease the surface, and apply it uniformly after making sure that the surface is free from dirt or damage.
   - Clean all of the parts, and correct any damage, dents, burrs, or rust found on them.
   - Coat the rotating parts and sliding parts with engine oil.
   - When press-fitting parts, coat the surface with molybdenum disulfide lubricant (LM-P).
   - After installing the snap rings, check that the snap ring is settled in the ring groove completely.
   - When connecting wiring connectors, clean the connector to remove all oil, dirt, or water, then connect them securely.
   - When using eyebolts, check that there is no deformation or deterioration, screw them in fully, and align the direction of the hook.
   - When installing split flanges, fasten them uniformly and alternately to prevent excessive tightening on one side.
   - ★ When operating the hydraulic cylinders for the first time after reassembling the cylinders, hydraulic pumps and other hydraulic component removed for repair, be sure to bleed the air as follows:
     1] Start and run the engine at low idle.
     2] Operate the work equipment control lever to operate the hydraulic cylinder four to five times, stopping the piston at 100 mm off the end of its stroke.
     3] Next, operate the hydraulic cylinder three to four times to the end of its stroke.
   - ★ When using the machine for the first time after repair or long storage, follow the same procedure.

3. **Precautions for completing work**
   1) Refilling of coolant, oil and grease
      - If the coolant is drained, close the drain valve, and add coolant to the specified level. Run the engine to circulate the coolant through the system . Then add the coolant again if necessary.
      - If the hydraulic component is removed and installed again, add engine oil to the specified level. Run the engine to circulate the oil through the system. Then add the oil again if necessary.
      - If the hydraulic piping or hydraulic equipment are removed, be sure to bleed air from the system after reassembling the parts, by referring to "Testing and adjusting".
      - Supply the specified amount of grease (molybdenum disulfide grease) to the work equipment parts.

   2) Check of installed condition of cylinder head and manifolds
      Check the cylinder head and intake and exhaust manifold mountings for looseness.
      If any part is loosened, retighten it.
      - For the tightening torques, see the "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.