Engine
Cooling
(6WG1)
Table of contents

Coolant 1D-2
Inspection 1D-2
Replacement 1D-4
Cooling fan belt 1D-6
Removal 1D-6
Inspection 1D-7
Installation 1D-8
Water pump 1D-10
Removal 1D-10
Removal 1D-13
Inspection 1D-15
Reassembly 1D-16
Installation 1D-20
Thermostat 1D-23
Removal 1D-23
Inspection 1D-26
Installation 1D-27
Cooling fan clutch 1D-30
Removal 1D-30
Inspection 1D-32
Installation 1D-33
Radiator 1D-35
Removal 1D-35
Inspection 1D-38
Installation 1D-39
Screens 1D-42
Removal 1D-42
Inspection 1D-43
Installation 1D-44
Supplementary Information 1D-45

Coolant

Inspection

1. Coolant inspection

Warning:

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

1) Inspect the concentration of the coolant.

Note:

● Dilute the specified coolant with tap water to the specified concentration in order to use.

● However, if it is at a low temperature of -30℃ {-22℉} For vehicles or engines, use 55% coolant.

Caution:

● Rustproof ability declines with a coolant concentration of 30% or less.

● Overheat possibility arises with a coolant concentration of 60% or more.

● If coolant with a concentration other than that specified is used, anti-freezing performance may decrease, causing freezing to occur.

Applied area		Coolant concentration	
		Isuzu original coolant (BESCO)	Isuzu factory coolant except
Basic specifications	The minimum temperature is -12 ℃ {10 ℉} or above.	: 30 %	50 %
Cold area specifications	The lowest temperature is -30 ℃ {-30.00℃} or above.	: 50 %	50 %

Coolant concentration		Mixing ratio	
		Isuzu original coolant (BESCO)	Tap water
30 %	Except for fire engines	: 13.32 L { 2.930 Imp.gal }	: 31.08 L { 6.837 Imp.gal }
	For fire engines	: 14.22 L { 3.128 Imp.gal }	: 33.18 L { 7.299 Imp.gal }
50 %	Except for fire engines	: 22.20 L { 4.883 Imp.gal }	: 22.20 L { 4.883 Imp.gal }
	For fire engines	: 23.70 L { 5.213 Imp.gal }	: 23.70 L { 5.213 Imp.gal }
55 %	Except for fire engines	: 24.42 L { 5.372 Imp.gal }	: 19.98 L { 4.395 Imp.gal }
	For fire engines	: 26.07 L { 5.735 Imp.gal }	: 21.33 L { 4.692 Imp.gal }

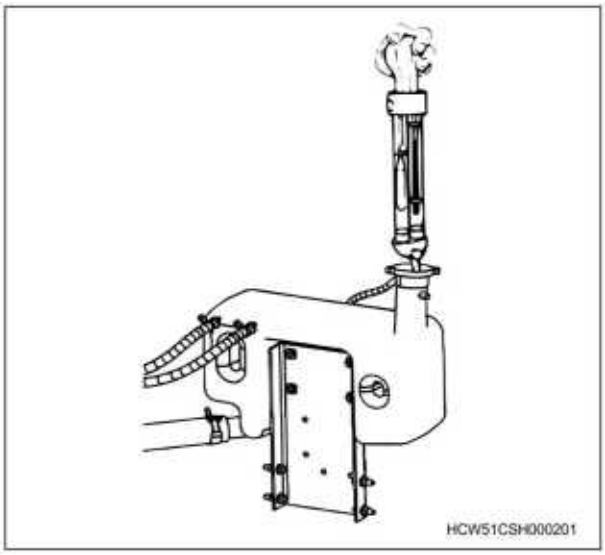
1. Determination of liquid specific gravity

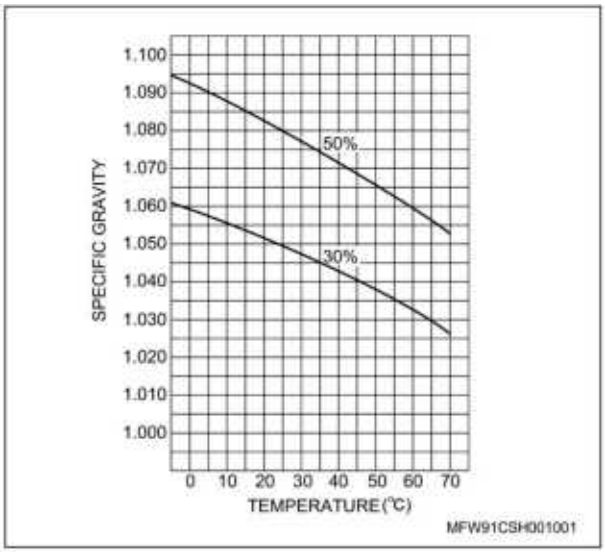
1) Use a hydrometer to measure the specific gravity and coolant temperature.

● After the temperature and specific gravity measurements have been completed, find the concentration from the table.

Caution:

● Measurement is performed when the coolant temperature is in the range of 0 to 50 ℃.





2. Coolant range method

1) Measure the concentration using the coolant instrument.

2. Sub-tank cap inspection

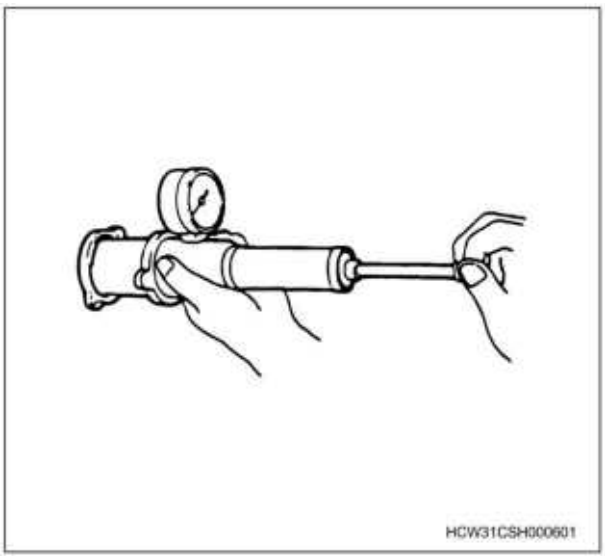
Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Check the condition of the vacuum valve in the center of the seat cover of the secondary tank cap.

2) Use the radiator cap tester to check the opening pressure of the auxiliary tank cap.

Standard: 61.7 to 71.5 kPa {0.63 to 0.73kgf / cm2 /8.9 to 10.4 psi} Positive pressure

Standard: 1.96 to 4.90 kPa {0.02 to 0.05 kgf / cm2 / 0.3 to 0.7 psi} vacuum



3. Coolant on-vehicle inspection

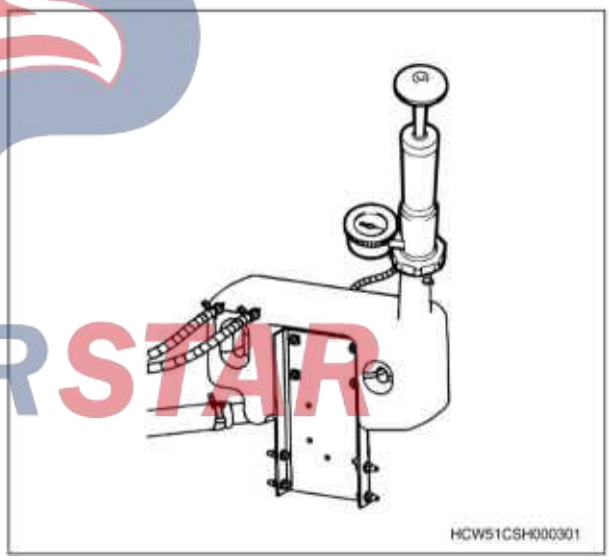
1. Engine coolant leakage inspection

Parts found to be defective as a result of inspection must be adjusted, repaired, or replaced.

1) Use the radiator cap tester to check the following parts for coolant leakage.

- Radiator
- Water pump
- Radiator upper hose
- Radiator lower hose
- Heater hose
- Water pipe
- Water rubber hose
- Secondary tank

Test pressure: 108 kPa { 1.1 kgf/cm2 / 16 psi }



Replacement

1. Coolant drain

1. Replacement

Replacement

Every 400,000 km {248,548 miles} or every 2 years

Caution:

● When replacing the engine coolant, clean the radiator, tank cover, and coolant passages.

● If the coolant is changed irregularly, it will cause corrosion and cause further blockage of water leakage or radiator or blockage of the heater core.

2. Coolant drain

Warning:

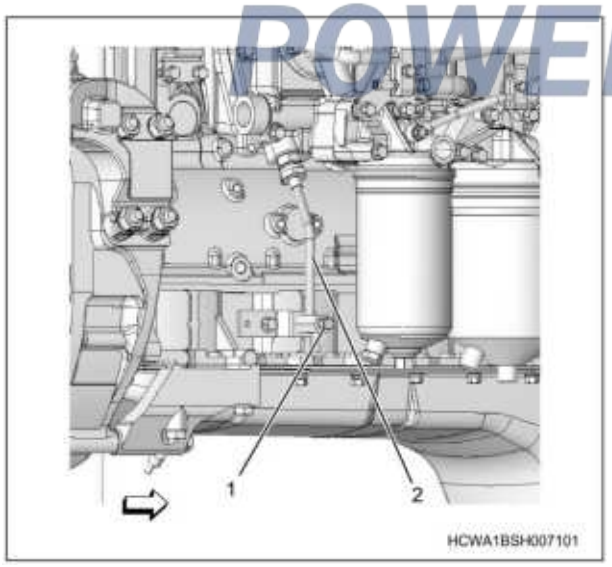
● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is may of burns caused by the release of steam or hot water.

1) Press the sub-tank cap button to release internal pressure.

2) Remove sub-tank cap from radiator.

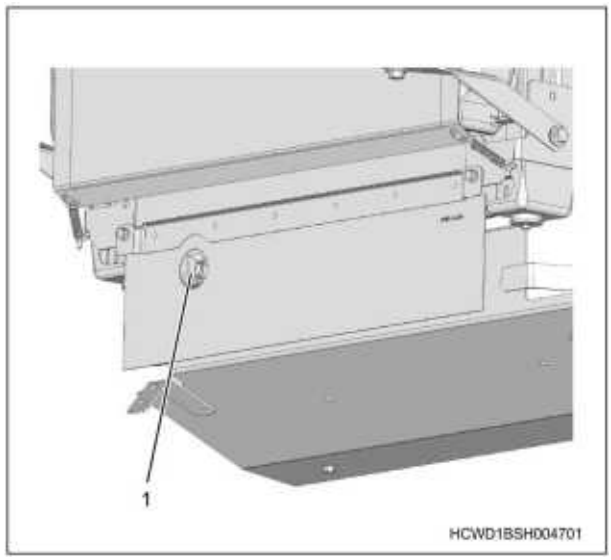
3) Loosen the drain plug on the cylinder block side, and drain the coolant to a pan.



1. Drain plug

2. Drain pipe

4) Loosen the radiator side drain plug, and drain the coolant to a pan.



1. Drain plug

5) Tighten the radiator side drain plug.

6) Tighten the drain plug on the cylinder block side.

7) Install sub-tank cap to radiator.

3. Coolant route cleaning

1) Add tap water up to the maximum level of the radiator sub-tank.

2) Press the radiator upper hose manually several times to remove the air from the hose.

3) Add tap water up to the maximum level of the radiator sub-tank.

Caution:

● Repeat the operation until the water level no longer drops.

4) Install sub-tank cap to radiator.

5) Start and idle the engine.

Note:

● Idle the engine for 20 minutes.

Caution:

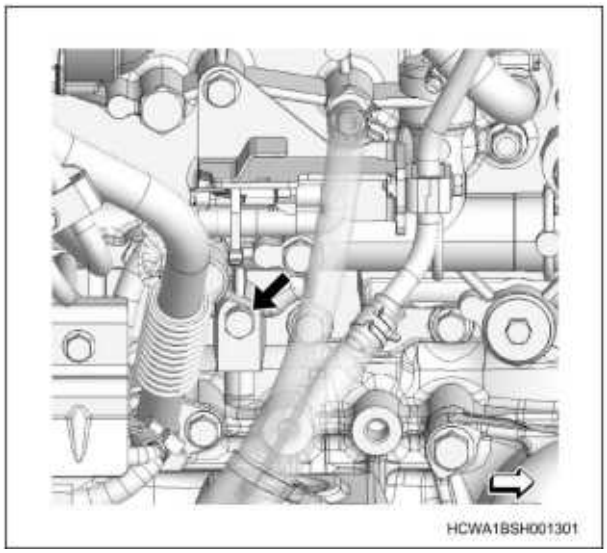
● Circulate the coolant in the heater water passage system as well.

6) Stop the engine.

7) Press the sub-tank cap button to release internal pressure.

8) Remove sub-tank cap from radiator.

9) Loosen the drain plug on the cylinder block side and drain the tap water into a pan.



10) Loosen the radiator side drain plug, and drain the tap water to a pan.

1. Drain plug
2. Radiator

11) Tighten the radiator side drain plug.

12) Tighten the drain plug on the cylinder block side.

2. Coolant filling

1) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Slowly fill with water to avoid air intrusion.

2) Press the radiator upper hose manually several times to remove the air from the hose.

3) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Repeat the operation until the water level no longer drops.

4) Install sub-tank cap to radiator.

5) Start and idle the engine.

Caution:

● Idle the engine for 5 minutes or more.

6)Stop the engine.

7) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

8) Add coolant up to the MAX level of the radiator sub-tank.

9) Install sub-tank cap to radiator.

10) Turn OFF the heater fan switch.

11) Start the engine.

12) Raise the engine speed.

Note:

● Increase the engine speed to around 2000 rpm and run the engine for 5 minutes once the needle of the engine coolant temperature gauge reaches the center.

13) With the engine running, check that the thermostat valve is open.

Note:

● Touch the radiator upper hose, and verify that it has become warm.

Caution:

● If the radiator upper hose has not become warm, raise engine speed to warm it up.

● Do not diagnose only by the engine coolant temperature gauge and the hot air coming out from the heater.

14) Idle the engine for 5 minutes.

15) Stop the engine.

16) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

17) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● If the water level of the sub-tank lowered the next morning, add water up to the MAX line.

Cooling fan belt

Removal

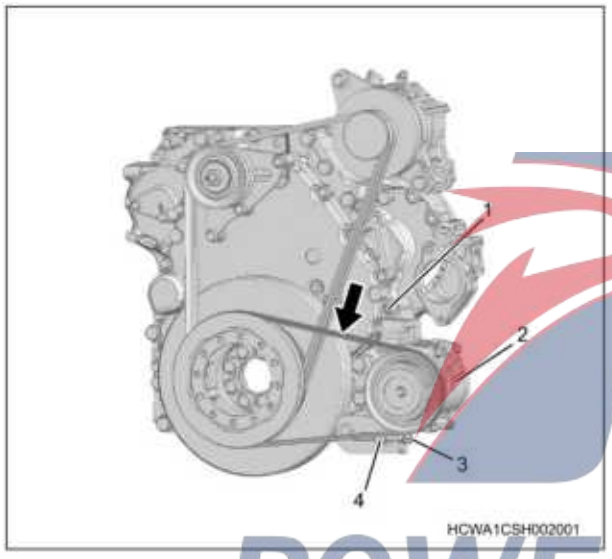
1. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

2. A / C compressor drive belt removal

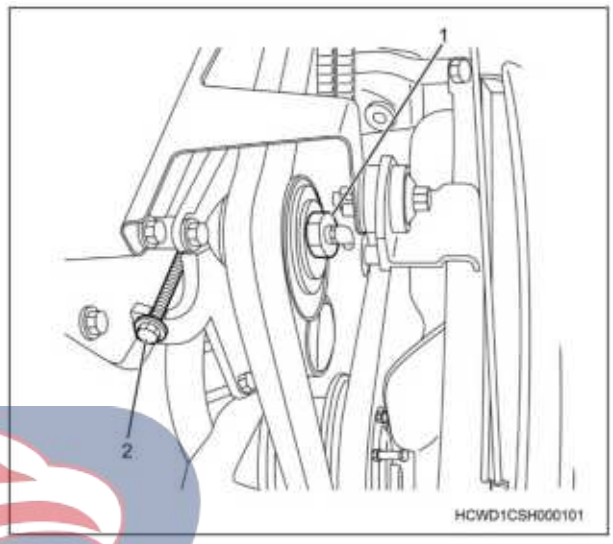
1) Loosen the nuts and the auxiliary bolts and then remove the A / C compressor drive belt of the A / C compressor and crankshaft pulley.



1. Bolt
2. A / C compressor
3. Adjust bolt
4. Nut (back end)

3. Cooling fan belt removal

1) Loosen the lock nut and adjustment screw to remove the cooling fan drive belt from the generator and crankshaft pulley.



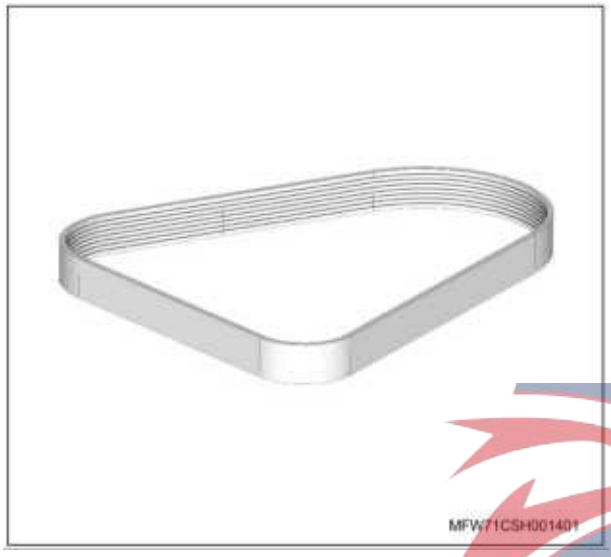
1. Lock nut
2. Adjust bolt

Inspection

1. Cooling fan belt inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Inspect the cooling fan belt for wear and damage.



Installation

1. Cooling fan belt installation

1) Install the cooling fan belt to the generator and the crankshaft pulley.

Caution:

● Verify that the cooling fan belt securely fits into the groove of each pulley.

2. A/C compressor drive belt installation

1) Install the A / C compressor drive belt to the A / C compressor and crankshaft pulley.

3. Cooling fan belt adjustment

Because a V-ribbed belt is used for the cooling fan belt, accurate adjustment of the tension is more necessary compared to a conventional V-belt.

When installing a new belt, initial stretching of the belt occurs.

In addition, when reusing the belt, the belt needs to adapt to the pulley groove.

1) Rotate the adjust bolt and adjust the tension of the cooling fan belt to the specified value.

Caution:

● Accurately adjust the tension because if the tension is not appropriate, there is a possibility the service life will be shortened, or belt squeal may be generated.

● Use a sonic tension meter to verify accurate tension adjustment.

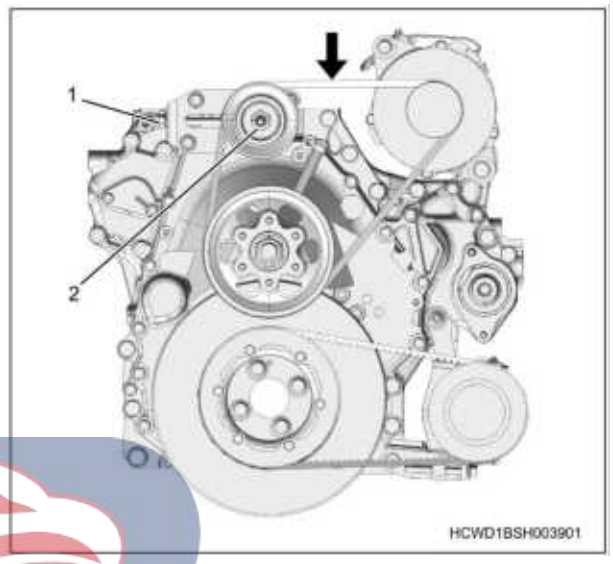
Cooling fan belt tension specified value

	Adjustment conditions	Deflection	Vibration frequency
60 A	When new	: 10 to 13mm { 0.394 to 0.512 in }	: 90 to 106Hz
	When adjusting tension	: 14 to 16mm { 0.551 to 0.630 in }	: 75 to 85Hz
90 A	When new	: 10 to 12mm { 0.394 to 0.472 in }	: 94 to 110Hz
	When adjusting tension	: 13 to 15mm { 0.512 to 0.591 in }	: 79 to 89Hz

Note:

● The specified amount of deflection is shown when pushing the midpoint between the water pump pulley and the generator pulley at the specified value.

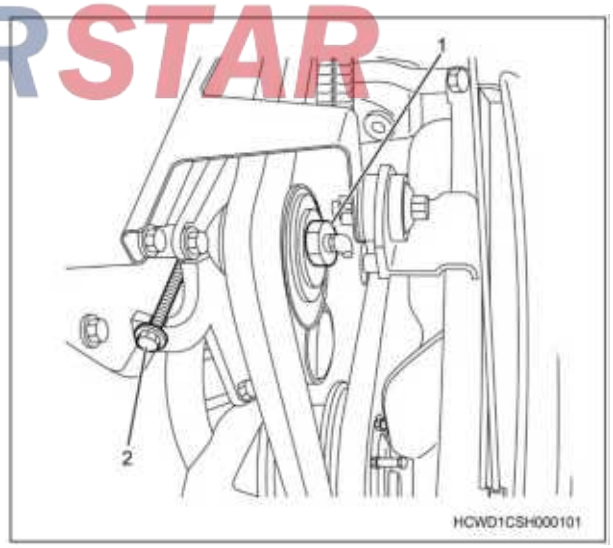
Standard: 98 N { 10.0 kg / 22 lb }



1. Adjust bolt
2. Lock nut

2) Tighten the idler bolt.

Tightening torque: 147 N • m {15.0 kgf • m / 108 lb • ft}



1. Lock nut
2. Adjust bolt

4. A / C compressor drive belt adjustment

If inspecting using a sonic tension meter, adjust the frequency of vibrations at the center point between the A / C compressor pulley and crankshaft pulley to the specified value.

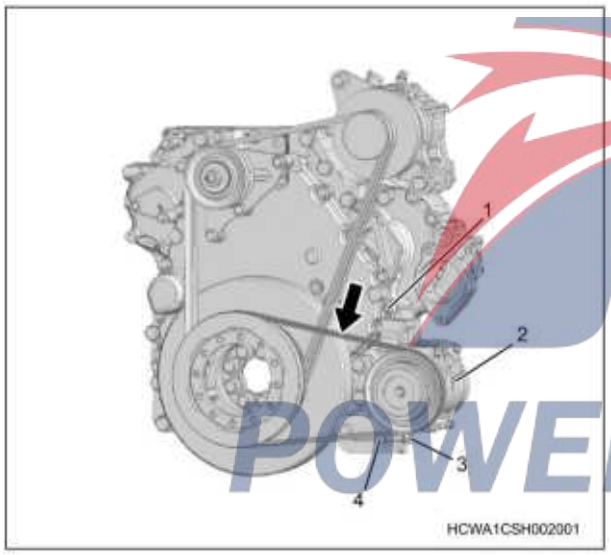
If inspecting the amount of deflection, adjust the amount of deflection to the specified value when a pressure of 98 N {10 kg} is applied the center point between the A / C compressor pulley and the crankshaft pulley.

Air Conditioner Compressor Belt Tension Prescribed value

Adjustment conditions	When new	When adjusting tension
Tension	: 392 to 588N { 40.0 to 60.0kg }	: 294 to 392N { 30.0 to 40.0kg }
Deflection	: 11 to 14mm { 0.4 to 0.6 in }	: 15 to 17mm { 0.6 to 0.7 in }
Vibration frequency	: 102 to 126Hz	: 90 to 102Hz

1) Turn the tension pulley adjust bolt to adjust the A/C compressor drive belt.

2) Tighten the lock nut.



1. Bolt
2. A/C compressor
3. Adjust bolt
4. Nut (back end)

3) Confirm that the air conditioner compressor belt is fixed in each pulley groove.

4) Crank the engine 5 times, and readjust the tension of the A/C compressor belt.

5. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

Water pump

Removal

1. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

2. Coolant drain

Warning:

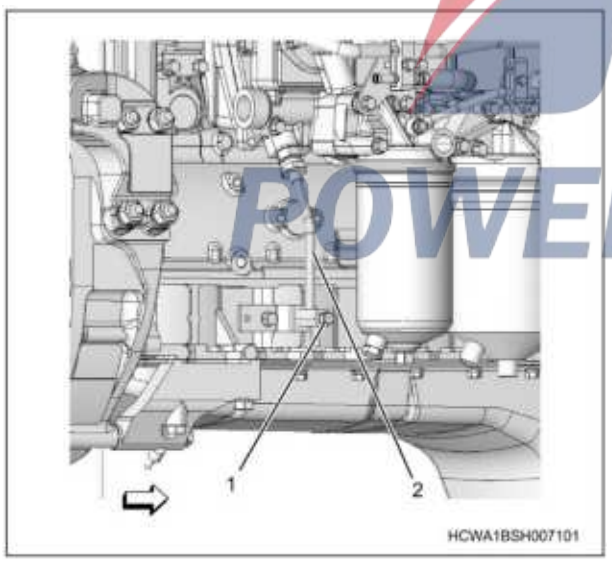
● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

1) Press the sub-tank cap button to release internal pressure.

2) Remove sub-tank cap from radiator.

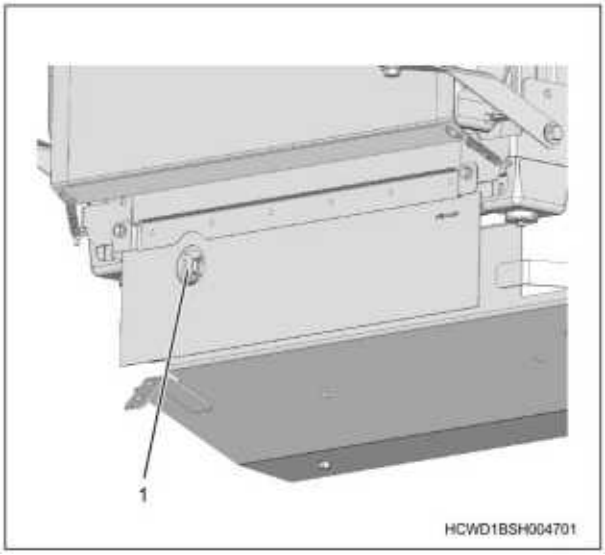
3) Loosen the drain plug on the cylinder block side, and drain the coolant to a pan.



1. Drain plug

2. Drain pipe

4) Loosen the radiator side drain plug, and drain the coolant to a pan.



1. Drain plug

5) Tighten the radiator side drain plug.

6) Tighten the drain plug on the cylinder block side.

7) Install sub-tank cap to radiator.

3. Water charge pipe removal

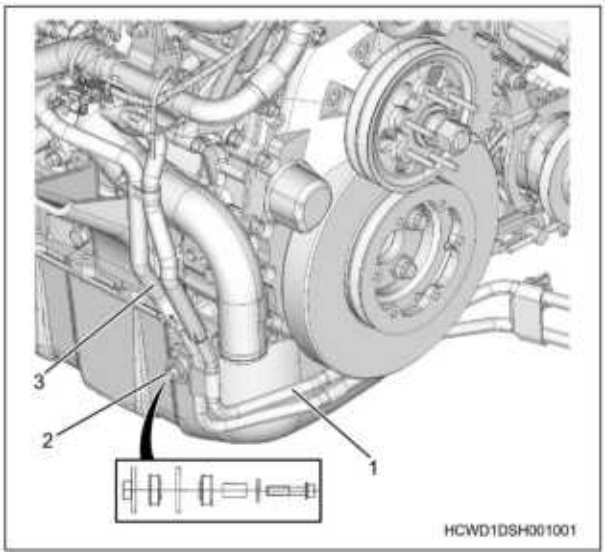
1) Remove the filling pipe from the filling pipe holder.

2) Remove the water-filled bracket from the inlet pipe.

3) Remove the water-filled bracket from exhaust gas recirculation valve line A.

4. Heater hose removal

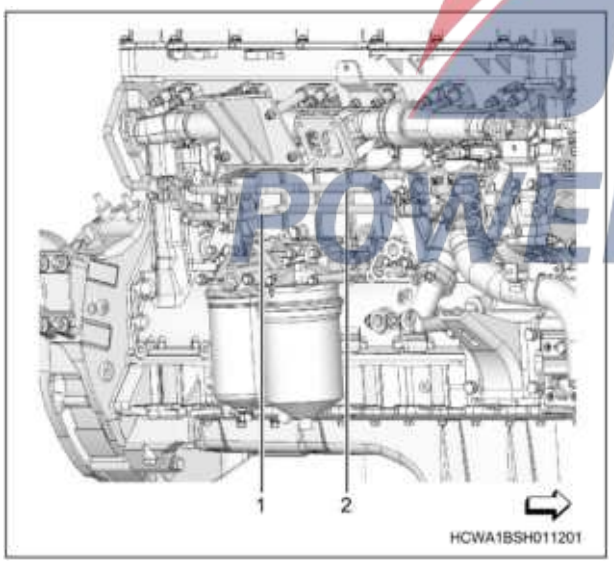
1) Remove the clip and then remove the heater hose from the thermostat housing.



1. Heater hose
2. Heater pipe bracket part
3. Heater pipe

5. EGR cooler water pipe removed

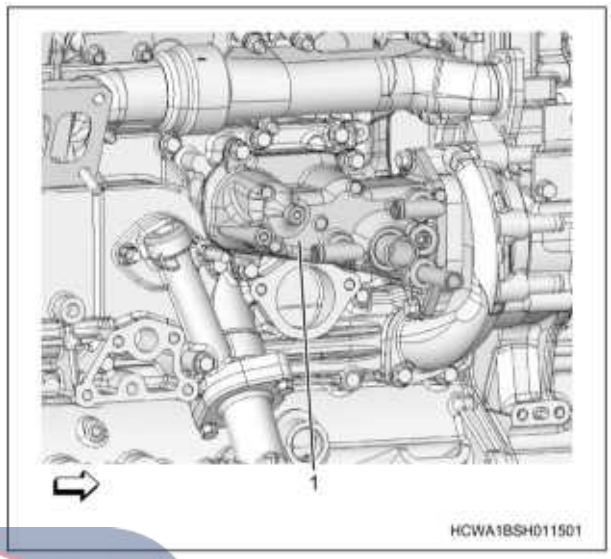
1) Remove the front and rear return lines from the thermostat housing.



1. Back-end return pipe
2. Front return pipe

6. Thermostat housing removal

1) Remove the thermostat housing from the oil cooler.



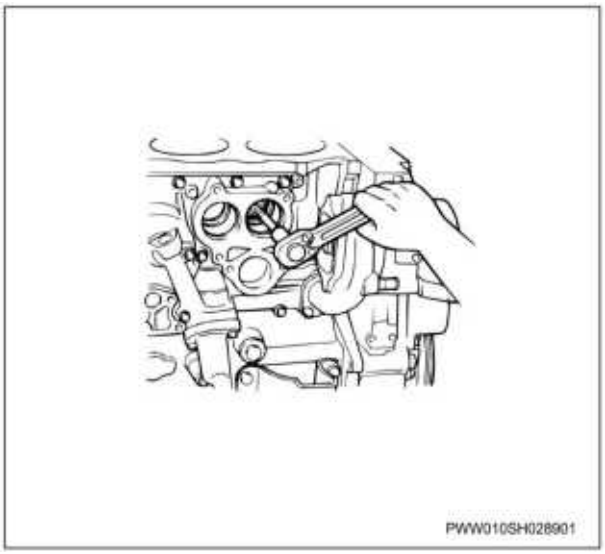
1. Thermostat housing

7. Thermostat removal

1) Remove the thermostat from the oil cooler.

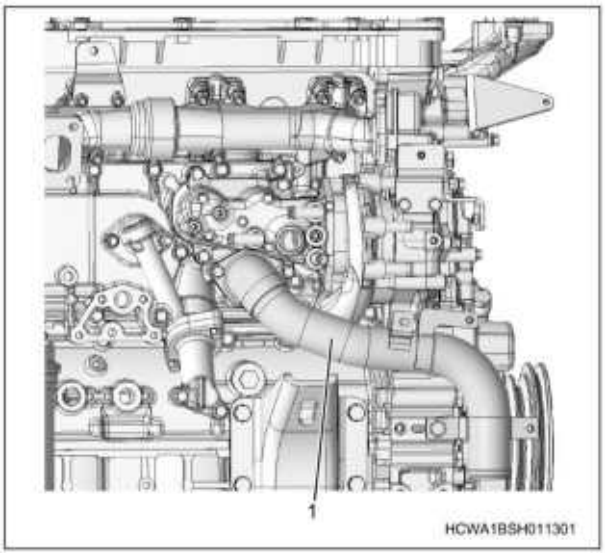
2) Using a special tool, remove the thermostat seal ring from the oil cooler.

SST: 1-8521-0067-0 - thermostat seal remover



8 inlet pipe removed

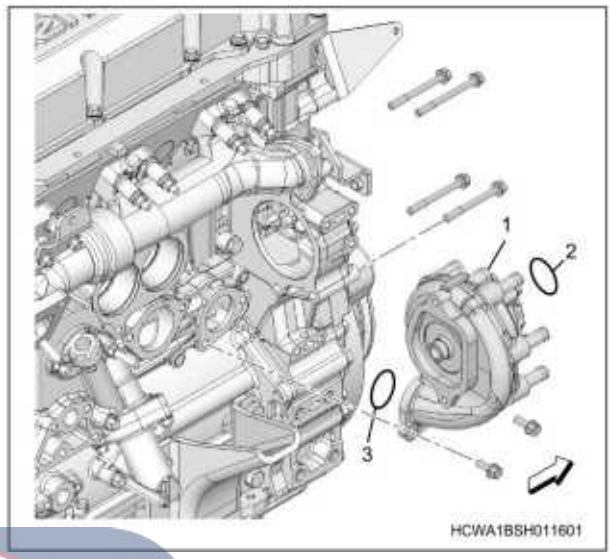
1) Remove the inlet pipe from the oil cooler.



1. Water inlet

9. Water pump removal

1) Remove the pump from the oil cooler and gearbox.

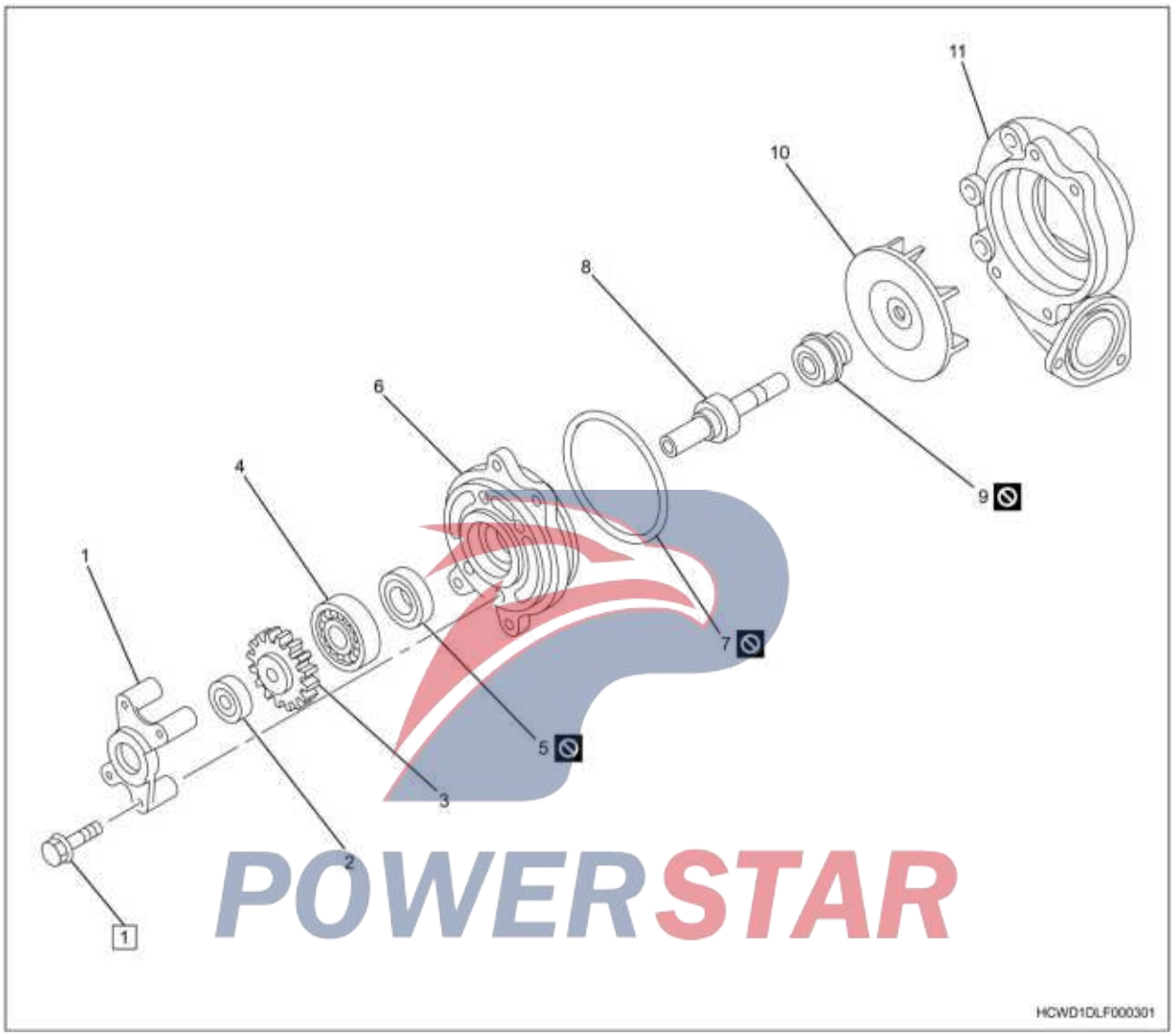


1. Water pump
2. O-ring
3. O-ring

Removal

1. Component Views

Water pump



Part name

1. Back cover
2. Shaft
3. Gear
4. Shaft
5. Oil seal
6. Water pump body
7. O-ring
8. Axis
9. Seal unit
10. Impeller
11. Front cover

Tightening torque

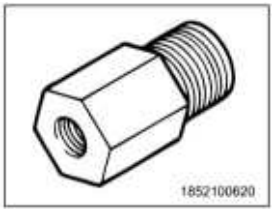
1: 27 N • m {2.8 kgf • m / 20 lb • ft}

2. Water pump removal

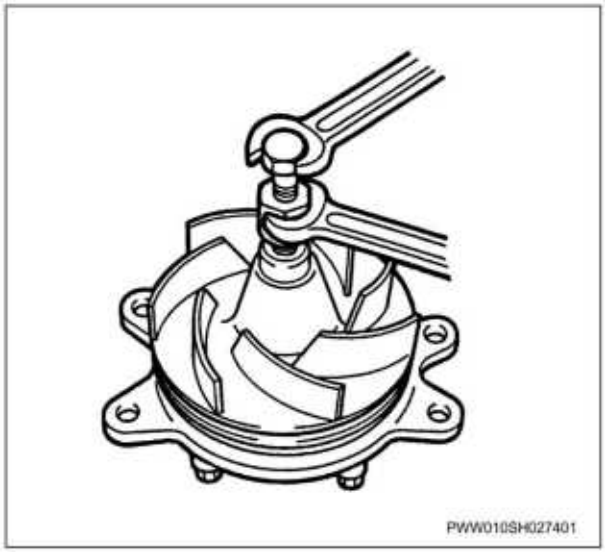
1) Remove the front cover from the pump body.

2) Remove the O-ring of the pump body.

3) Use special tools to remove the impeller from the shaft.



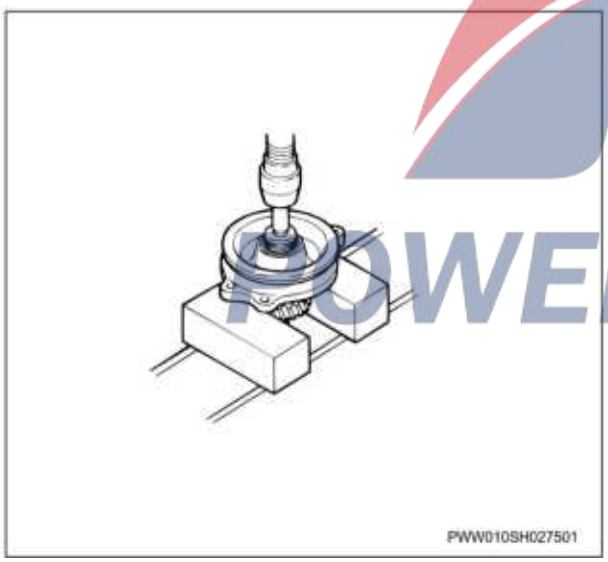
SST: 1-8521-0062-0 - impeller remover



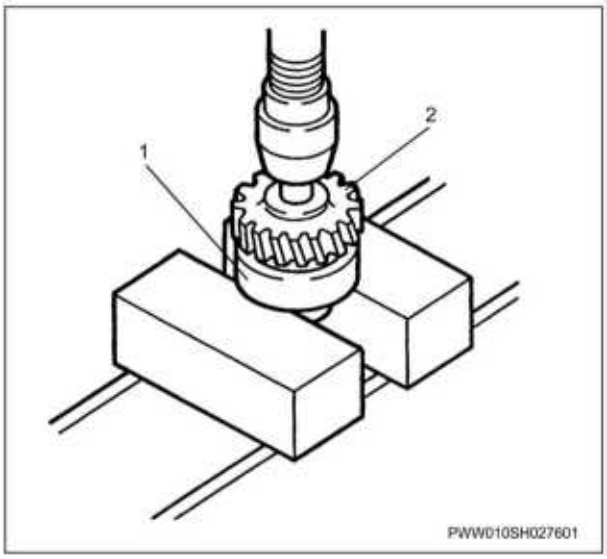
4) Remove the back cover from the pump body.

5) Remove the bearing on the back cover.

6) Push the shaft from the impeller side by extrusion, and remove the shaft and bearing from the side of the pump body gear.



7) Use the press to push the shaft from the gear side and remove it from the gear and bearing.

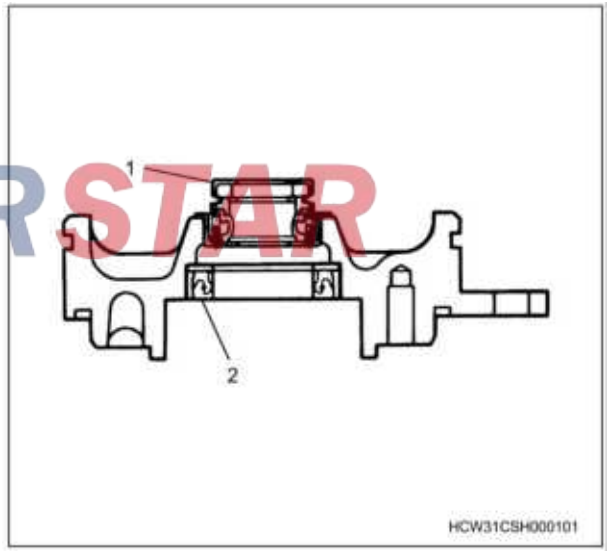


1. Shaft
2. Gear

8) Remove the oil seal from the pump body.

Caution:

● Do not damage the main body of the oil seal press the assembly area.



1. Seal unit
2. Oil seal

9) Remove the seal from the body of the pump.

Caution:

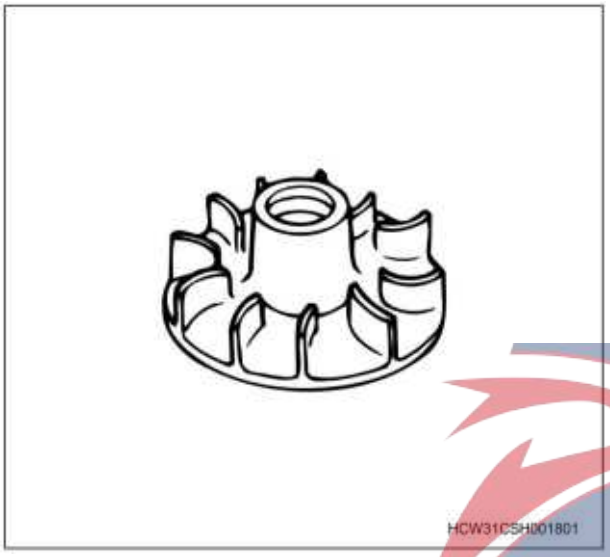
● Do not damage the pump unit's seal unit against the mounting area.

Inspection

1. Impeller inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

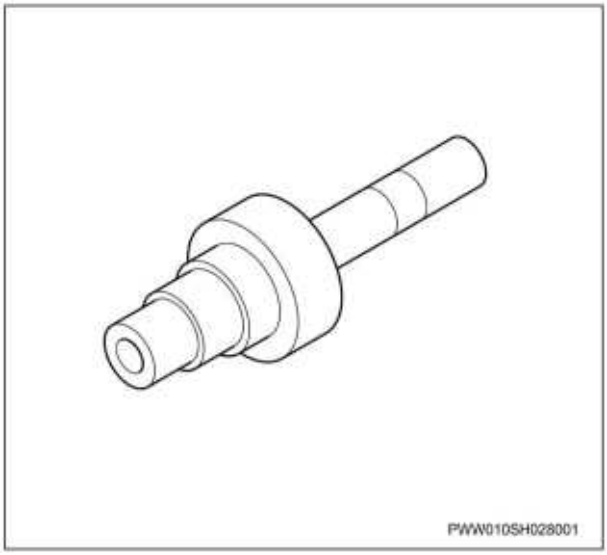
1) Check whether the impeller is corroded, the sealing unit contact surface is worn and damaged.



2. Axis check

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Check shaft seal contact surface for wear and damage.



3. Water pump pulley inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Check the gap between the ball, while checking the entire outer race bearing there are scars and flaking.

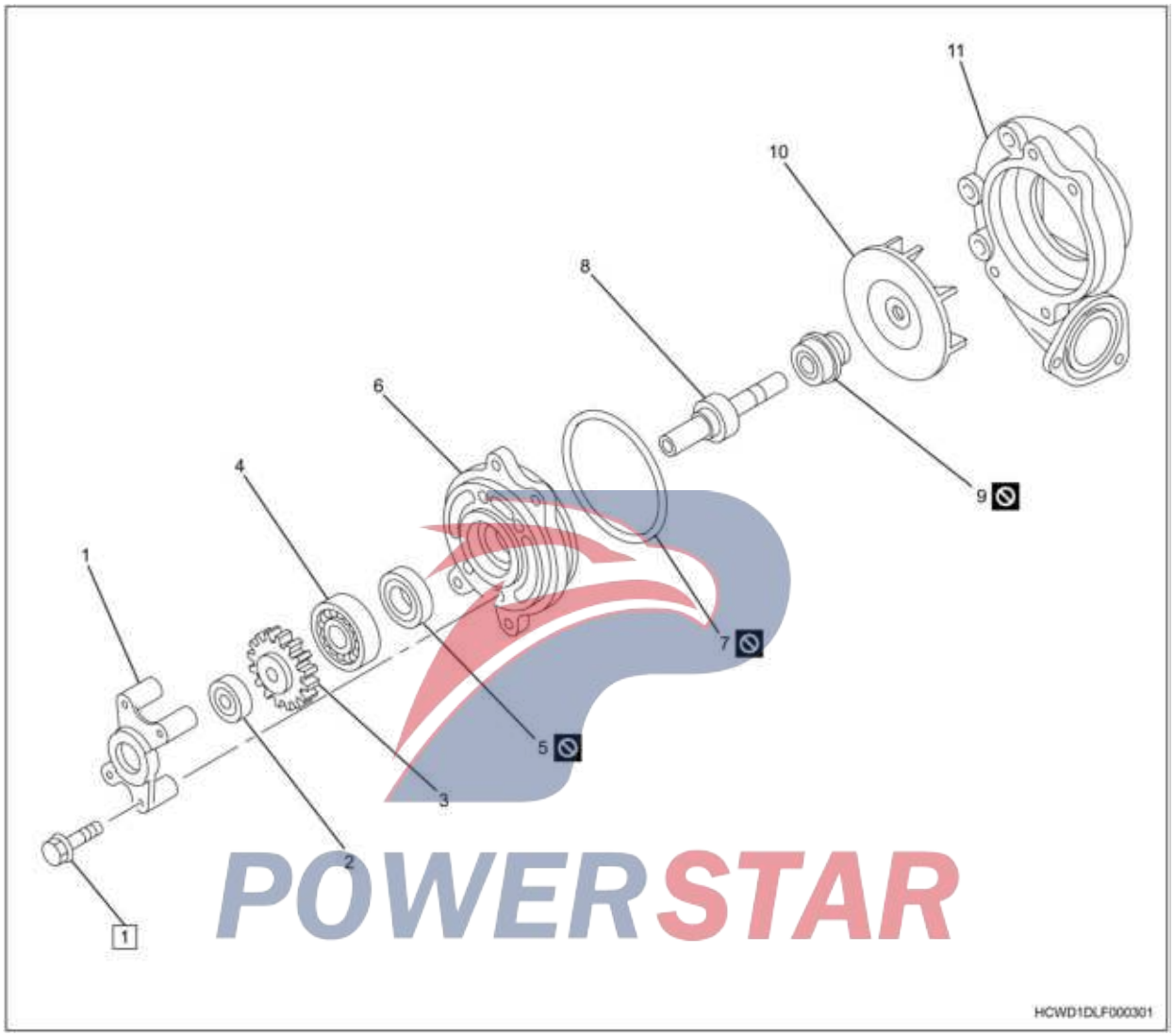
2) Check that the balls and races are excessively loose.

3) Rotate the bearings and manually check for any unusual conditions.

Reassembly

1. Component Views

Water pump



Part name

1. Back cover
2. Shaft
3. Gear
4. Shaft
5. Oil seal
6. Water pump body
7. O-ring
8. Axis
9. seal unit
10. Impeller
11. Front cover

Tightening torque

1: 27 N • m {2.8 kgf • m / 20 lb • ft}

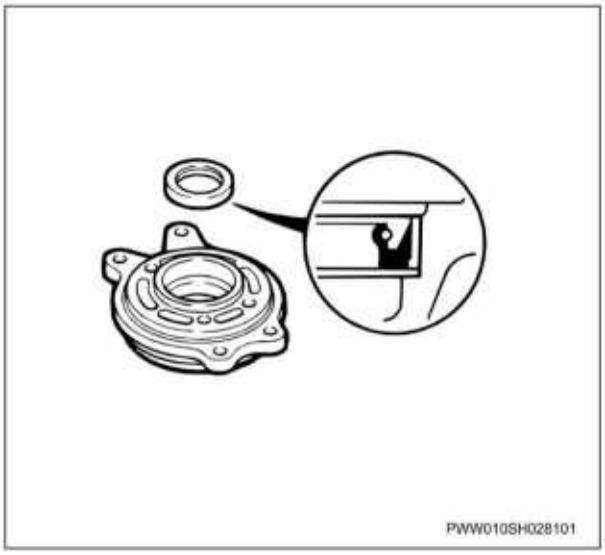
2. Water pump reassembly

1) Lubricate the lip part and outer circumference of the seal with engine oil.

2) Press fit the oil seal to the pump body with the lip area facing up.

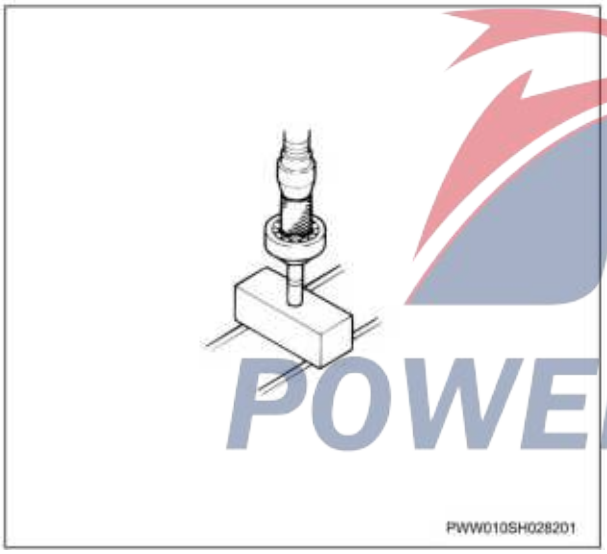
Caution:

● Please pay attention to avoid deformation of oil seal.



3) Apply the engine oil to the shaft.

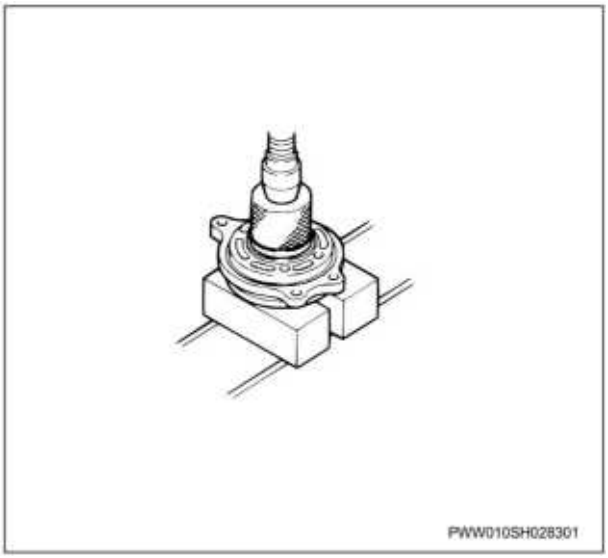
4) Press the bearing assembly to the shaft.



5) Press fit the shaft to the pump body.

Caution:

● Please exercise caution to avoid damaging the oil seal.



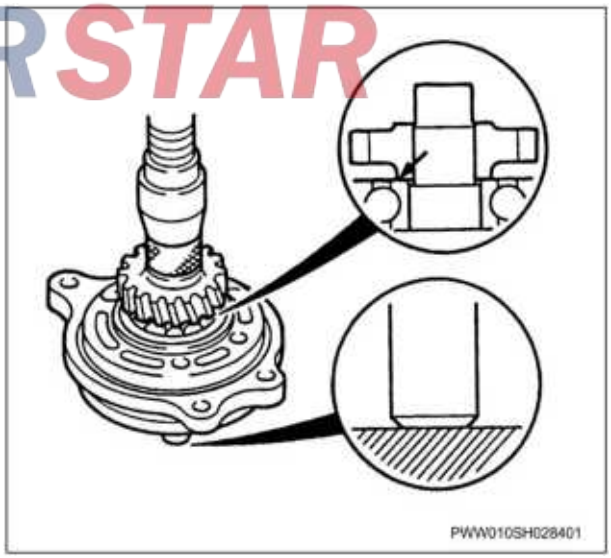
6) Rotate the raised face of the center boss area slightly to the side of the body of the water pump and attach the gear to the shaft.

Note:

● Press the gear assembly until the gear center boss area contacts the bearing.

Caution:

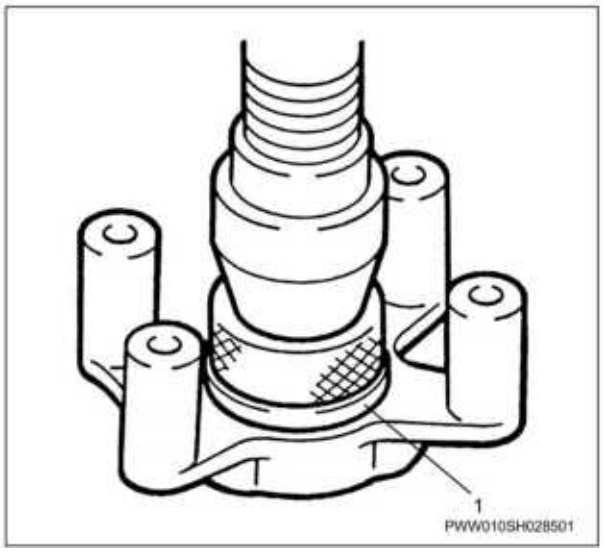
● To prevent damage to the bearings, please press fit to make full contact with the impeller mounting side shaft end face.



7) The pipe and other components placed on the bearing outer race, and then press the bearing assembly to the back cover.

Caution:

● Do not damage the back cover.



1. Outer seat

8) The pipe and other components placed on the bearing inner race, and then press the rear cover fitted to the pump body.

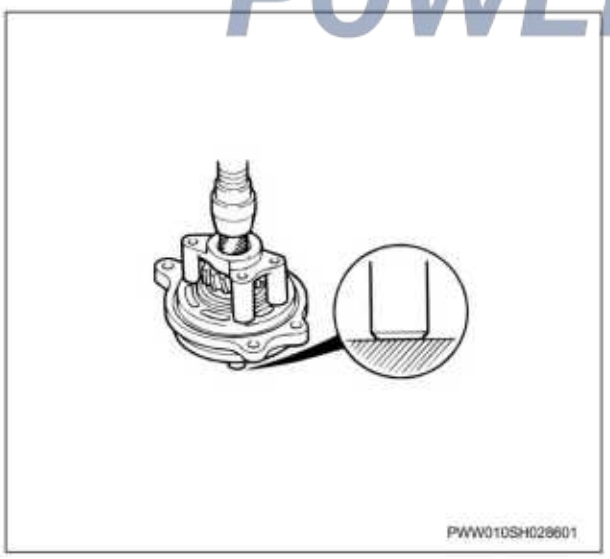
Note:

● Align and install the rear cover bolts.

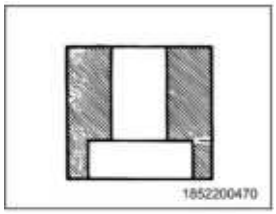
Caution:

● To prevent damage to the bearing and the rear end cover, press fit to make full contact with the impeller mounting side bearing end face.

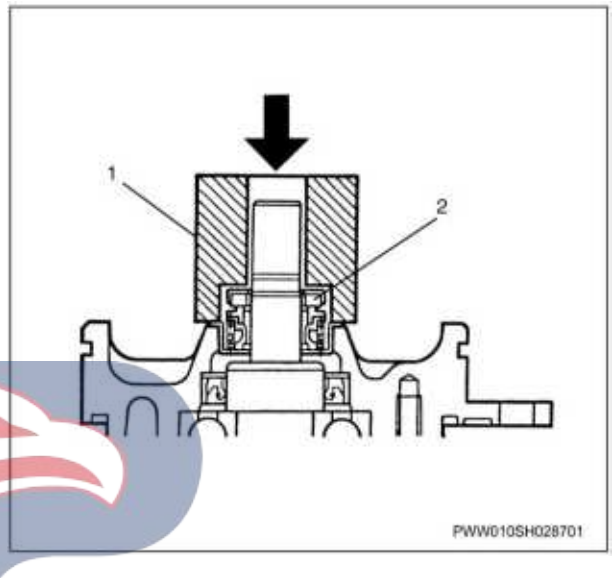
Tightening torque: 27 N • m {2.8 kgf • m / 20 lb • ft}



9) Use a special tool to install the seal to the pump body.



SST: 1-8522-0047-0 - seal unit setting tool



1. Seal unit setting tool
2. Seal unit

Caution:

● Do not damage the sealed unit.

10) Press the impeller onto the shaft.

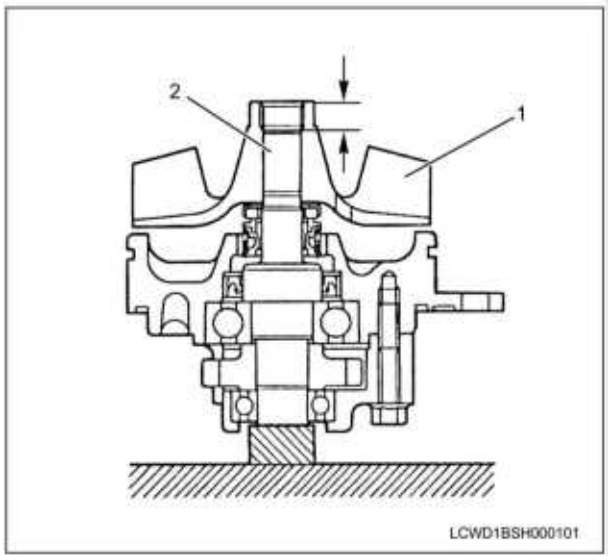
Note:

● Press fit until the clearance between the end of the body and the impeller reaches Prescribed value.

Caution:

● To prevent damage to the bearing, press fit to make full contact with the gear shaft end face.

: 11.9 to 12.1 mm {0.469 to 0.476 in}



1. Impeller
2. Axis

11) Install the O-ring onto the pump body.

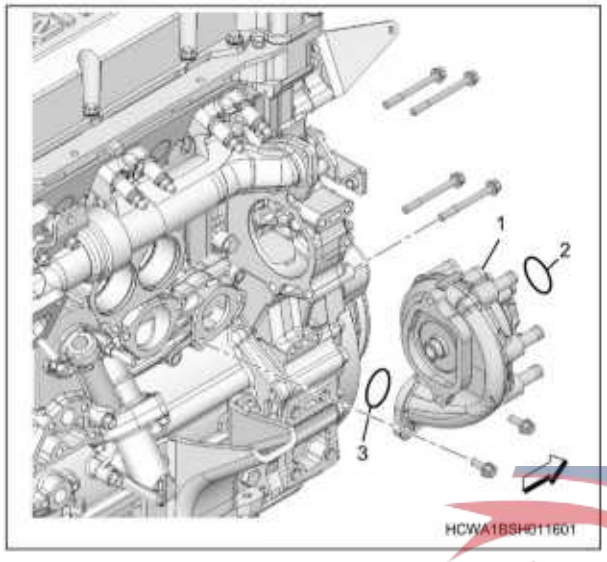
12) Install the front cover onto the pump body.

Installation

1. Water pump installation

1) Install the O-ring and pump to the oil cooler.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}



1. Water pump
2. O-ring
3. O-ring

2. Intake pipe installation

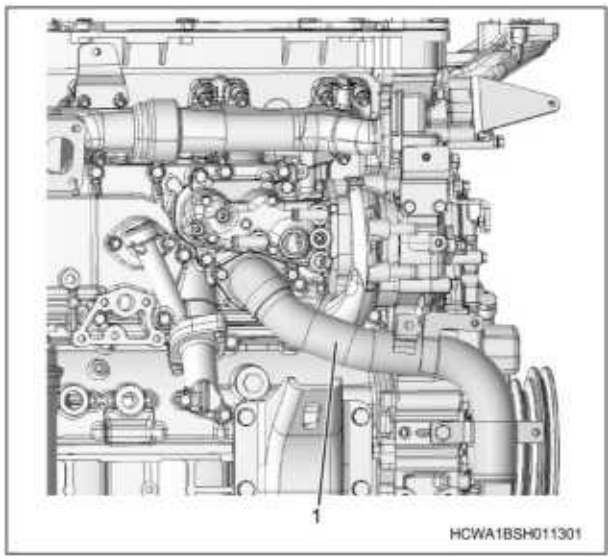
1) Install the water inlet pipe to the oil cooler.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

Oil cooler side

Tightening torque: 88 N • m {9.0 kgf • m / 65 lb • ft}

Gearbox side



1. Water inlet

3. Thermostat installation

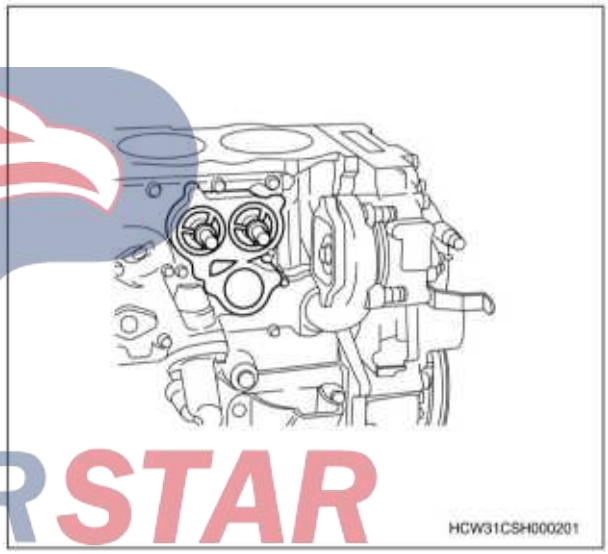
1) Install the thermostat seal ring on the oil cooler using a special tool.

SST: 1-8522-1034-0 - thermostat seal ring Installer

2) Mount the thermostat to the oil cooler.

Caution:

● Care should be taken when installing the seal ring to avoid damaging the seal ring.



4. Thermostat housing installation

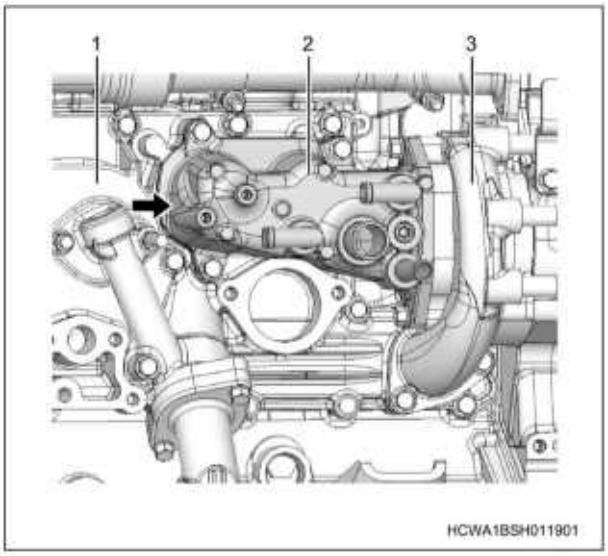
1) Install the o-rings and washers, and then install the thermostat housing on the oil cooler.

Note:

● While tightening the thermostat housing against the oil cooler, tighten the pump end bolts.

● Tighten the oil cooling bolt.

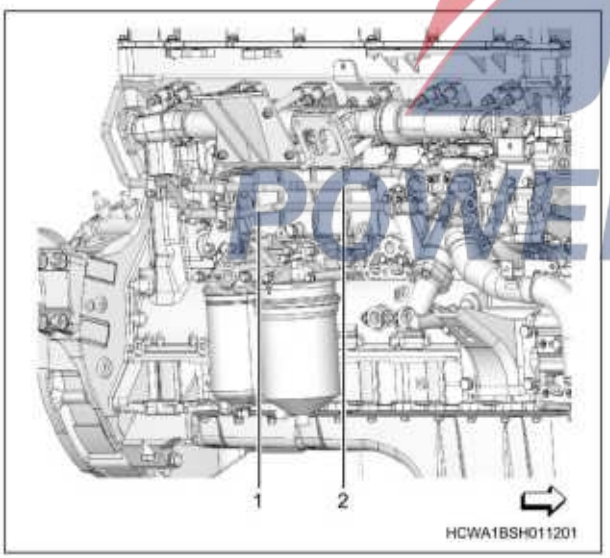
Tightening torque: 39 N • m { 4.0 kgf • m / 29 lb • ft }



1. Oil cooler
2. Thermostat housing
3. Water pump

5. EGR cooler water pipe installation

1) Install the front and rear EGR cooler pipes on the thermostat housing.

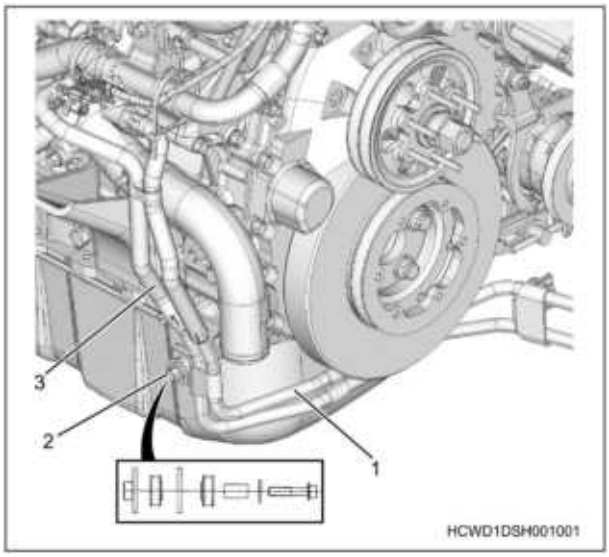


1. Back-end EGR cooler hose
2. EGR cooler hose

Heater hose installation

1) Mount the heater hose to the thermostat housing.

2) Install the clip on the heater hose.



1. Heater hose
2. Heater pipe bracket part
3. Heater pipe

7. Water charge pipe installation

1) Install the water filling pipe bracket on the water inlet pipe.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

2) Install the water fill line bracket on the exhaust gas recirculation valve conduit A.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

3) Install the water filling pipe on the filling pipe bracket.

Tightening torque: 39 N • m { 4.0 kgf • m / 29 lb • ft }

8. Coolant filling

1) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Slowly fill with water to avoid air intrusion.

2) Press the radiator upper hose manually several times to remove the air from the hose.

3) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Repeat the operation until the water level no longer drops.

4) Install sub-tank cap to radiator.

5) Start and idle the engine.

Caution:

● Idle the engine for 5 minutes or more.

6) Stop the engine.

7) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

8) Add coolant up to the MAX level of the radiator sub-tank.

9) Install sub-tank cap to radiator.

10) Turn OFF the heater fan switch.

11) Start the engine.

12) Raise the engine speed.

Note:

● Increase the engine speed to around 2000 rpm and run the engine for 5 minutes once the needle of the engine coolant temperature gauge reaches the center.

13) With the engine running, check that the thermostat valve is open.

Note:

● Touch the radiator upper hose, and verify that it has become warm.

Caution:

● If the radiator upper hose has not become warm, raise engine speed to warm it up.

● Do not diagnose only by the engine coolant temperature gauge and the hot air coming out from the heater.

14) Idle the engine for 5 minutes.

15) Stop the engine.

16) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

17) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● If the water level of the sub-tank lowered the next morning, add water up to the MAX line.

9. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

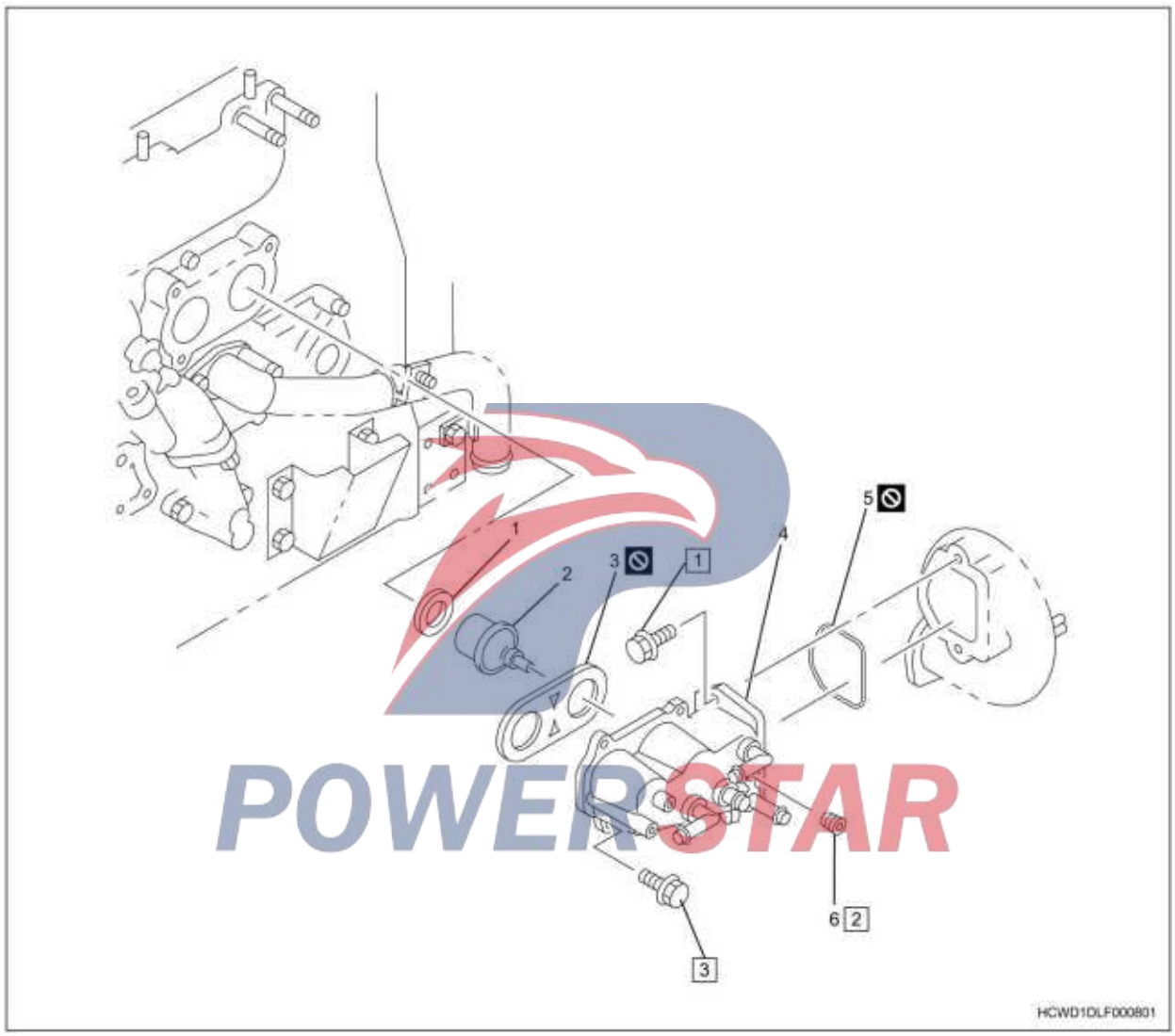
2) Lower the cab, and close the front lid.

Thermostat

Removal

1. Component Views

Thermostat



Part name

1. Thermostat seal ring
2. Thermostat
3. Gasket
4. Thermostat housing
5. O-ring
6. Plug

Tightening torque

1: 39 N • m { 4.0 kgf • m / 29 lb • ft }

2: 34 N • m { 3.5 kgf • m / 25 lb • ft }

3: 39 N • m { 4.0 kgf • m / 29 lb • ft }

2. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

3. Coolant drain

Warning:

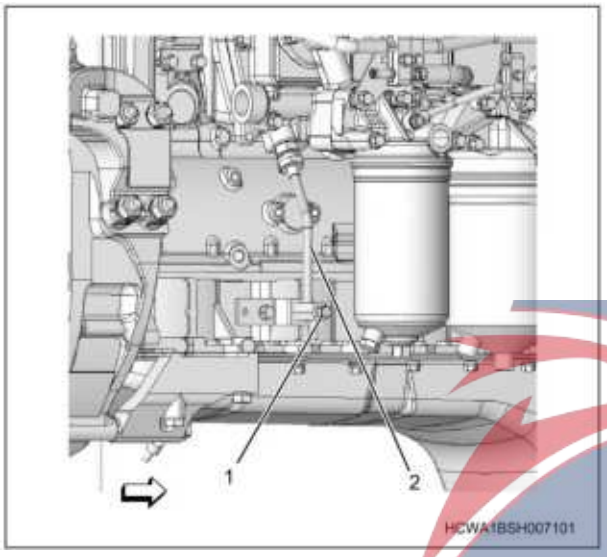
● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

1) Press the sub-tank cap button to release internal pressure.

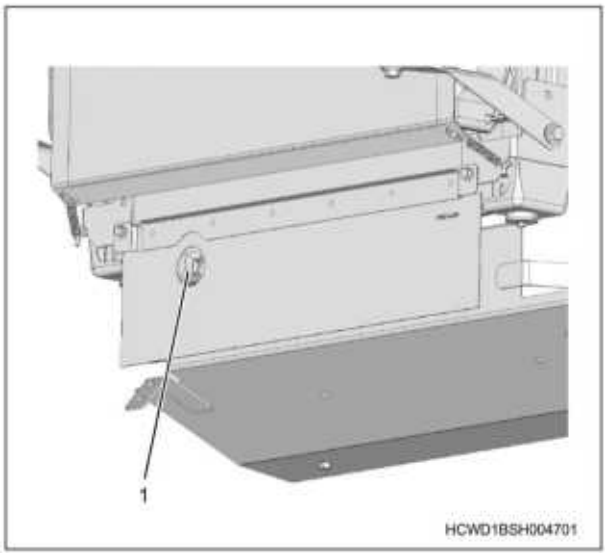
2) Remove sub-tank cap from radiator.

3) Loosen the drain plug on the cylinder block side, and drain the coolant to a pan.



1. Drain plug
2. Drain pipe

4) Loosen the radiator side drain plug, and drain the coolant to a pan.



1. Drain plug

5) Tighten the radiator side drain plug.

6) Tighten the drain plug on the cylinder block side.

7) Install sub-tank cap to radiator.

4. Water charge pipe removal

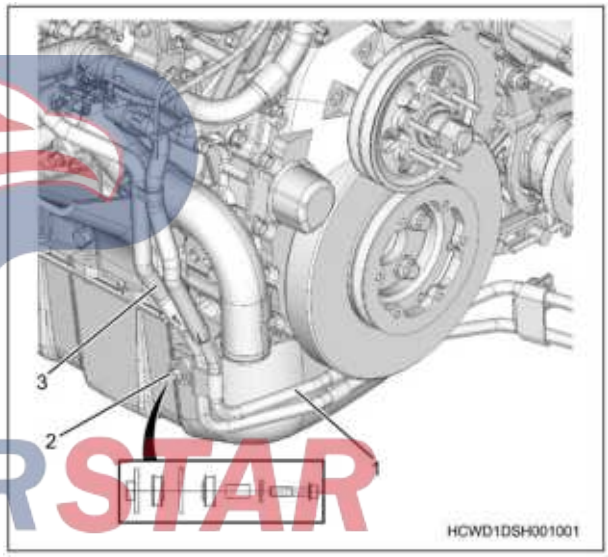
1) Remove the filling pipe from the filling pipe holder.

2) Remove the water-filled bracket from the inlet pipe.

3) Remove the water-filled bracket from exhaust gas recirculation valve line A.

5. Heater hose removal

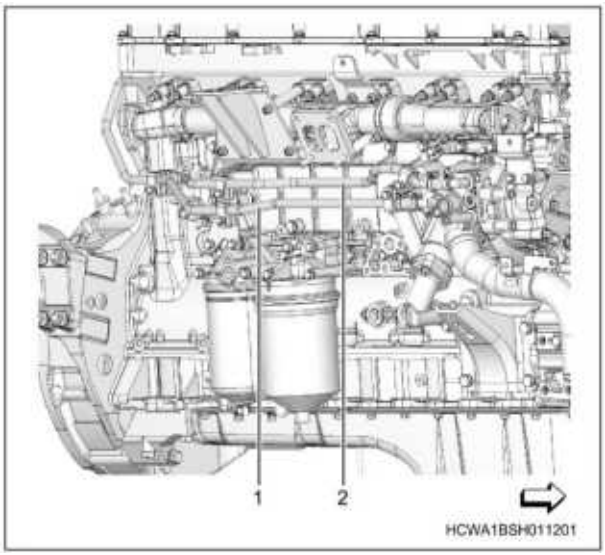
1) Remove the clip and then remove the heater hose from the thermostat housing.



1. Heater hose
2. Heater pipe bracket part
3. Heater pipe

6. EGR cooler water pipe removed

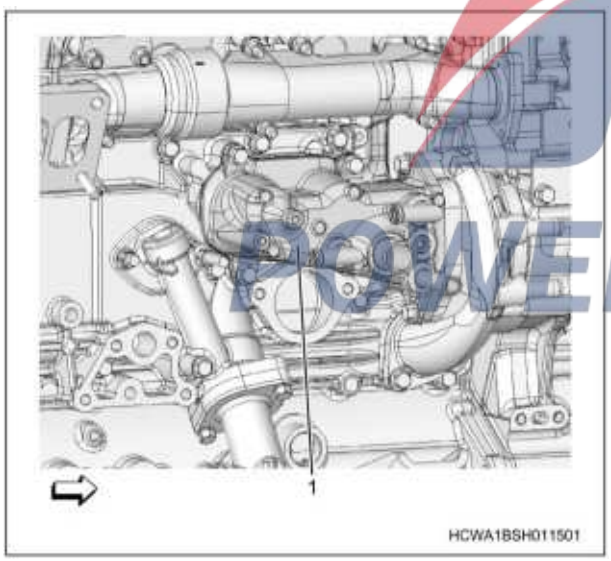
1) Remove the front and rear return lines from the thermostat housing.



1. Back-end return pipe
2. Front return pipe

7. Thermostat housing removal

1) Remove the thermostat housing from the oil cooler.

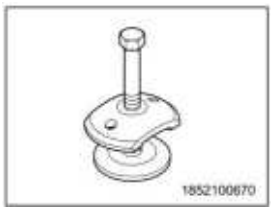


1. Thermostat housing

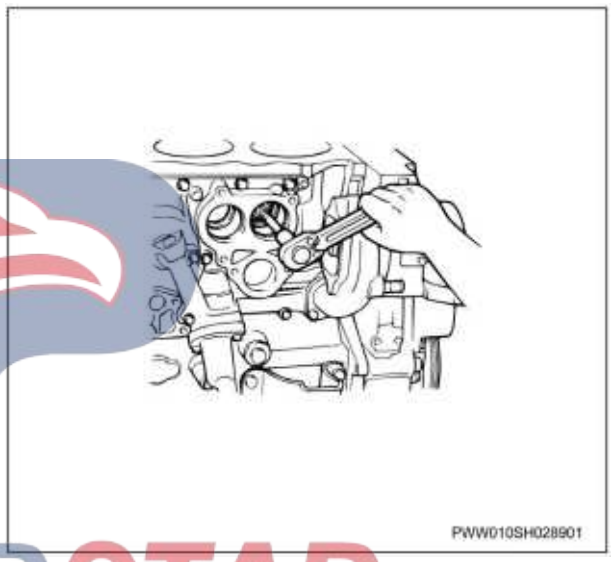
8. Thermostat removal

1) Remove the thermostat from the oil cooler.

2) Using a special tool, attach the thermostat seal ring to the oil cooler Removal.



SST: 1-8521-0067-0 - thermostat seal remover

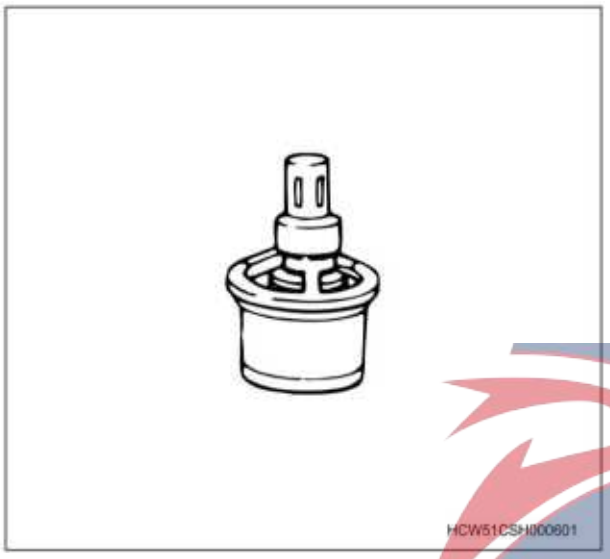


Inspection

1. Thermostat inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Shake the pellet section of the thermostat and inspect the staked section for looseness and damage.



2) Place the thermostat in water, and gradually raise the water temperature to inspect the starting temperature, the temperature when fully open, and the lift amount.

Note:

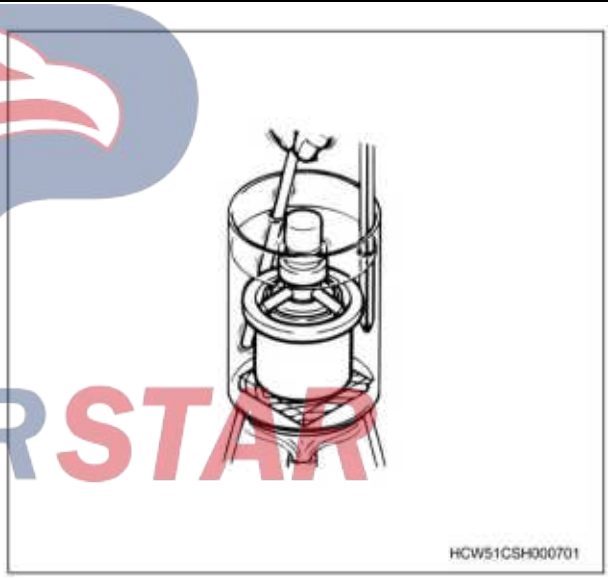
● Since the heat capacity is high for wax type thermostats, there is a slight difference in valve operations for the fluctuations of water temperature.

Caution:

● Place a board at the bottom of the container or hang the thermostat so as not to heat the thermostat directly.

● Keep stirring the warm water to prevent a temperature differential.

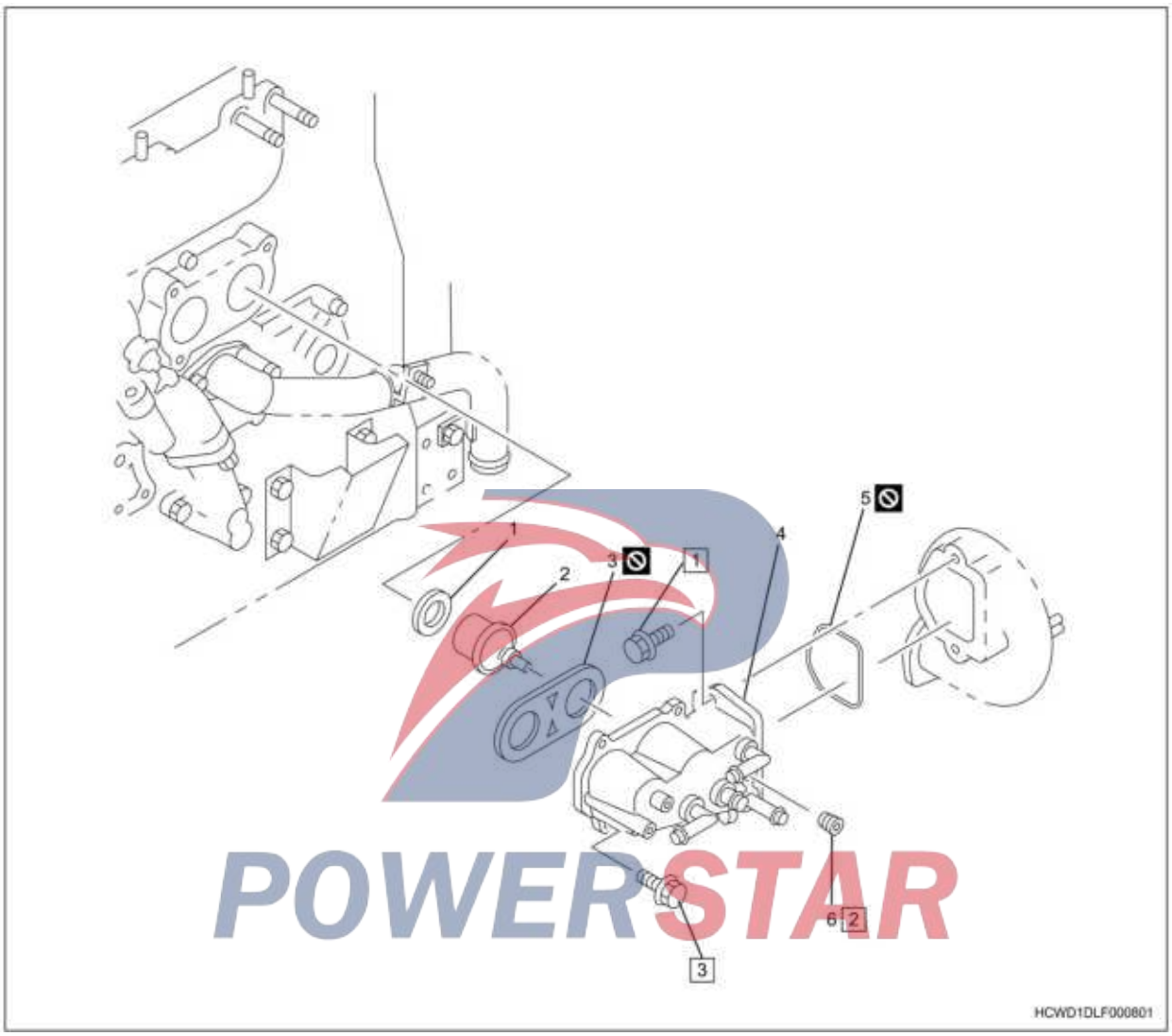
Temperature when beginning to open	: 82 ℃ { 180℉ }
Temperature when fully open	: 95 ℃ { 203℉ }
Lift amount	: 11 mm { 0.433 in }



Installation

1. Component Views

Thermostat



Part name

1. Thermostat seal ring
2. Thermostat
3. Gasket
4. Thermostat housing
5. O-ring
6. Plug

Tightening torque

1: 39 N • m { 4.0 kgf • m / 29 lb • ft }

2: 34 N • m { 3.5 kgf • m / 29 lb • ft }

3: 39 N • m { 4.0 kgf • m / 29 lb • ft }

2. Thermostat installation

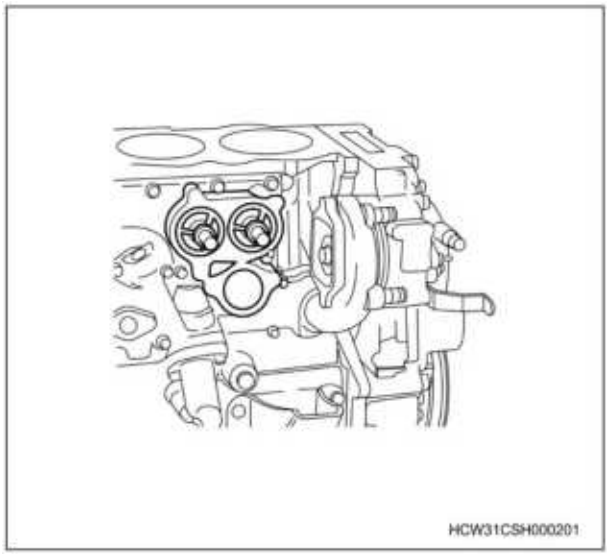
1) Install the thermostat seal ring on the oil cooler using a special tool.

SST: 1-8522-1034-0 - thermostat seal ring Installer

2) Mount the thermostat to the oil cooler.

Caution:

● Care should be taken when installing the seal ring to avoid damaging the seal ring.



3. Thermostat housing installation

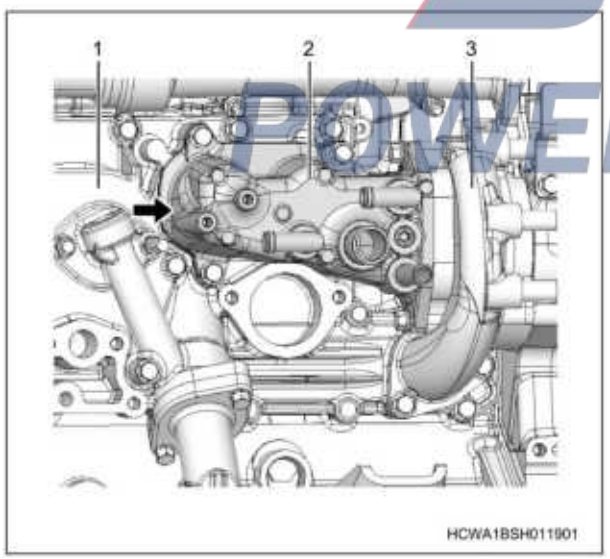
1) Install the o-rings and washers, and then install the thermostat housing on the oil cooler.

Note:

● While tightening the thermostat housing against the oil cooler, tighten the pump end bolts.

● Tighten the oil cooling bolt.

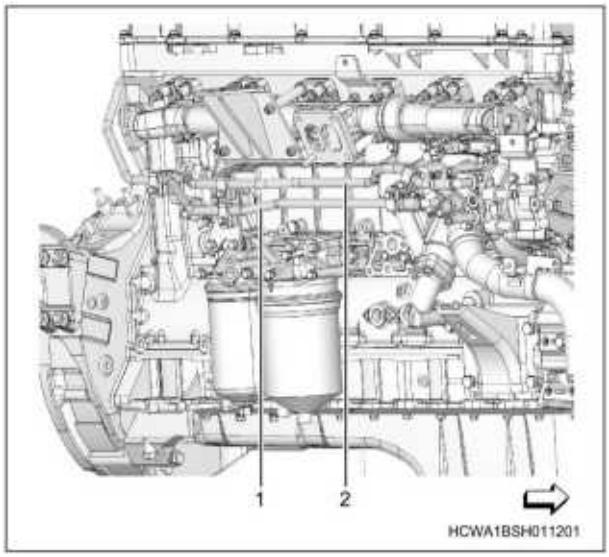
Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}



1. Oil cooler
2. Thermostat housing
3. Water pump

4. EGR cooler water pipe installation

1) Install the front and rear EGR cooler pipes on the thermostat housing.

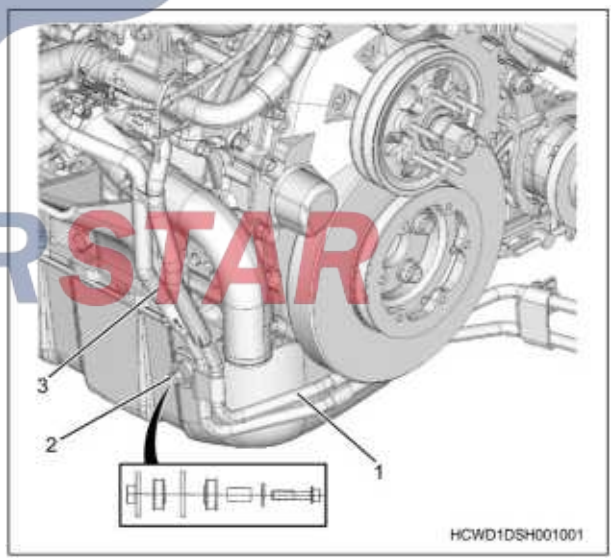


1. Back-end EGR cooler hose
2. EGR cooler hose

5. Heater hose installation

1) Mount the heater hose to the thermostat housing.

2) Install the clip on the heater hose.



1. Heater hose
2. Heater pipe bracket part
3. Heater pipe

6. Water charge pipe installation

1) Install the water filling pipe bracket on the water inlet pipe.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

2) Install the water fill line bracket on the exhaust gas recirculation valve conduit A.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

3) Install the water filling pipe on the filling pipe bracket.

Tightening torque: 39 N • m { 4.0 kgf • m / 29 lb • ft }

7. Coolant filling

1) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Slowly fill with water to avoid air intrusion.

2) Press the radiator upper hose manually several times to remove the air from the hose.

3) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Repeat the operation until the water level no longer drops.

4) Install sub-tank cap to radiator.

5) Start and idle the engine.

Caution:

● Idle the engine for 5 minutes or more.

6)Stop the engine.

7) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

8) Add coolant up to the MAX level of the radiator sub-tank.

9) Install sub-tank cap to radiator.

10) Turn OFF the heater fan switch.

11) Start the engine.

12) Raise the engine speed.

Note:

● Increase the engine speed to around 2000 rpm and run the engine for 5 minutes once the needle of the engine coolant temperature gauge reaches the center.

13) With the engine running, check that the thermostat valve is open.

Note:

● Touch the radiator upper hose, and verify that it has become warm.

Caution:

● If the radiator upper hose has not become warm, raise engine speed to warm it up.

● Do not diagnose only by the engine coolant temperature gauge and the hot air coming out from the heater.

14) Idle the engine for 5 minutes.

15) Stop the engine.

16) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

17) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● If the water level of the sub-tank lowered the next morning, add water up to the MAX line.

8. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

Cooling fan clutch

Removal

1. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

2. Coolant drain

Warning:

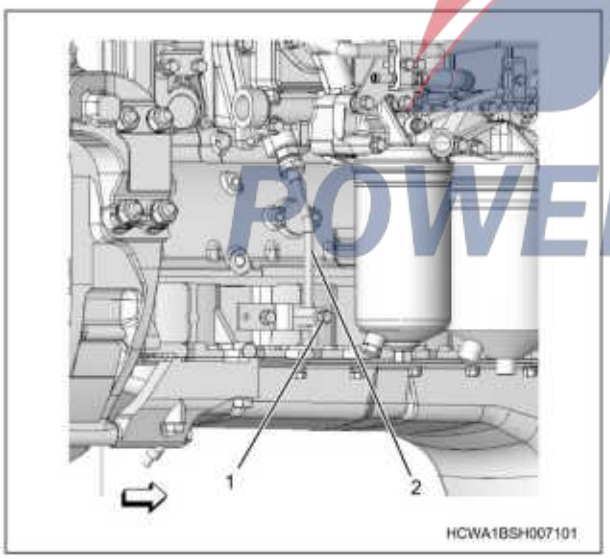
● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

1) Press the sub-tank cap button to release internal pressure.

2) Remove sub-tank cap from radiator.

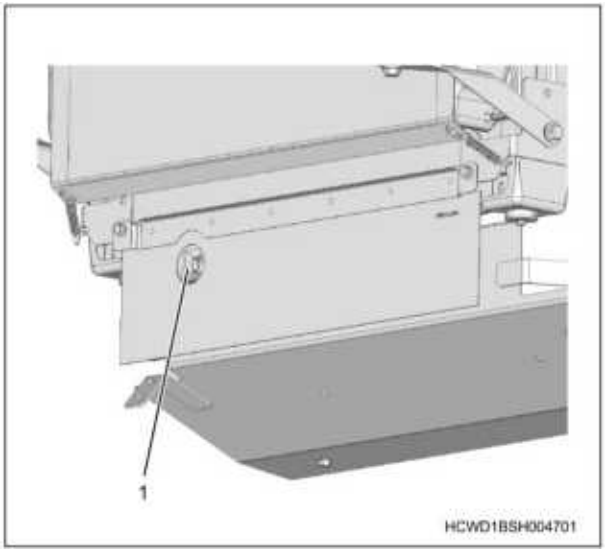
3) Loosen the drain plug on the cylinder block side, and drain the coolant to a pan.



1. Drain plug

2. Drain pipe

4) Loosen the radiator side drain plug, and drain the coolant to a pan.



1. Drain plug

5) Tighten the radiator side drain plug.

6) Tighten the drain plug on the cylinder block side.

7) Install sub-tank cap to radiator.

Radiator lower hose removal

1) Remove the radiator lower hose from the water intake pipe and the radiator.

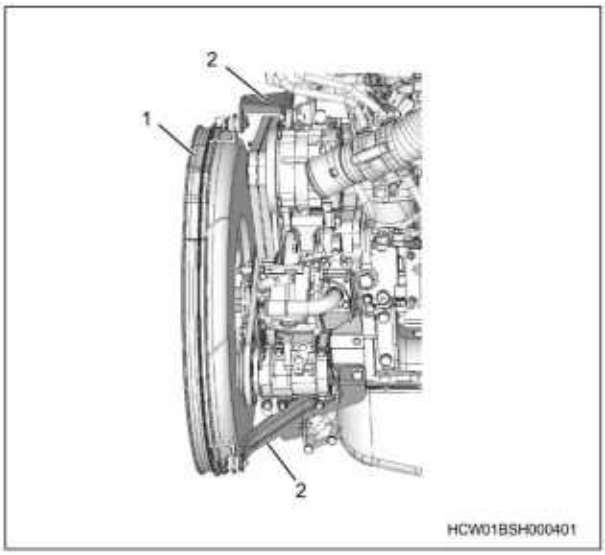
2) Remove the radiator lower hose from the radiator.

4. radiator fan cover disconnect

1) Disconnect the fan guide bracket from the engine.

Caution:

● Do not remove the fan duct connected to the air duct bracket.



1. Fan guide

2. Fan guide bracket

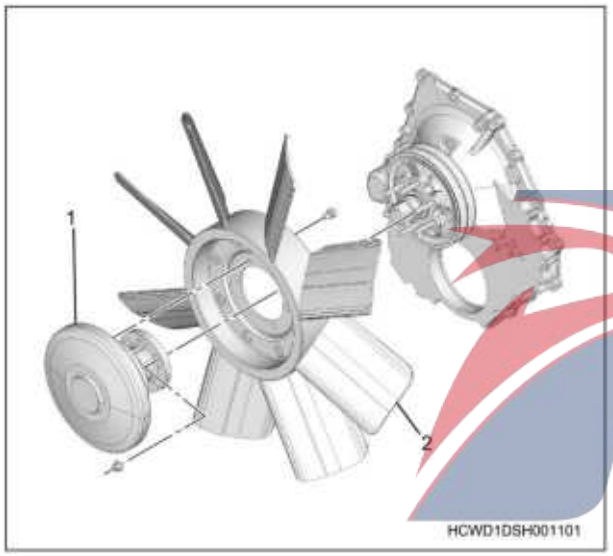
2) Disconnect the radiator fan cover from the fan guide cover.

Cooling fan removal

1) Remove the fan duct and cooling fan from the fan pulley.

6. Cooling fan clutch removal

1) Remove the cooling fan clutch from the cooling fan



1. Cooling fan clutch

2. Cooling fan

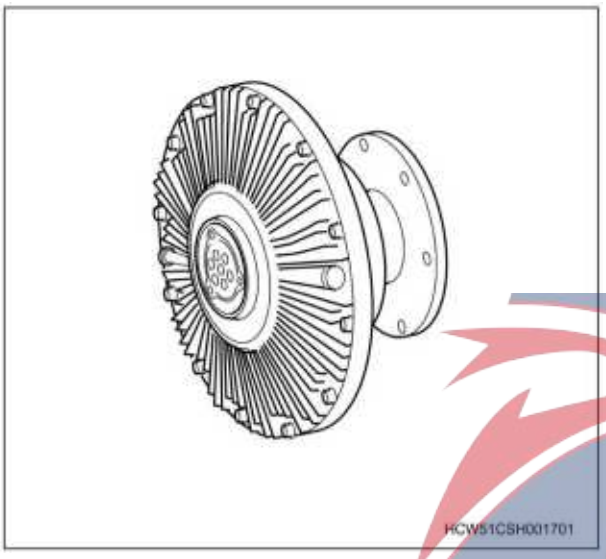
Inspection

1. Cooling fan clutch inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Rotate the cooling fan clutch and inspect the cooling fan clutch for abnormal noise.

2) Inspect the cooling fan clutch for oil leakage.

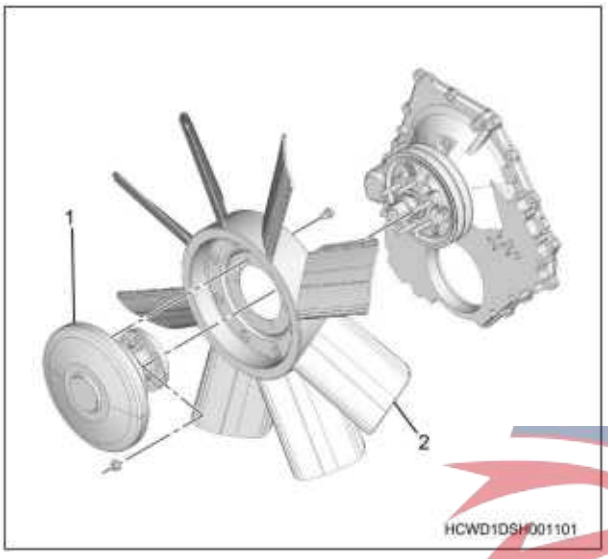


Installation

1. Cooling fan clutch installation

1) Install the cooling fan clutch to the cooling fan

Tightening torque: 58 N • m { 5.9 kgf • m / 43 lb • ft }



1. Cooling fan clutch

2. Cooling fan

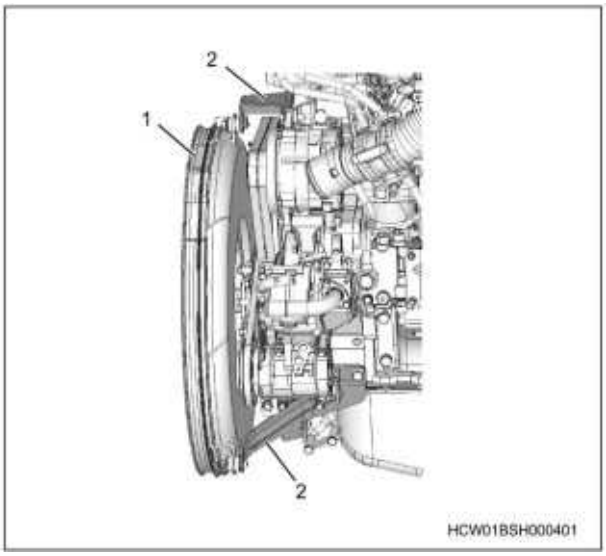
2. Cooling fan installation

1) Install the fan duct and cooling fan on the fan pulley.

Tightening torque: 67.5 N • m {6.9 kgf • m / 50 lb • ft}

3. Radiator fan cover connection

1) Install the fan guide bracket to the engine.



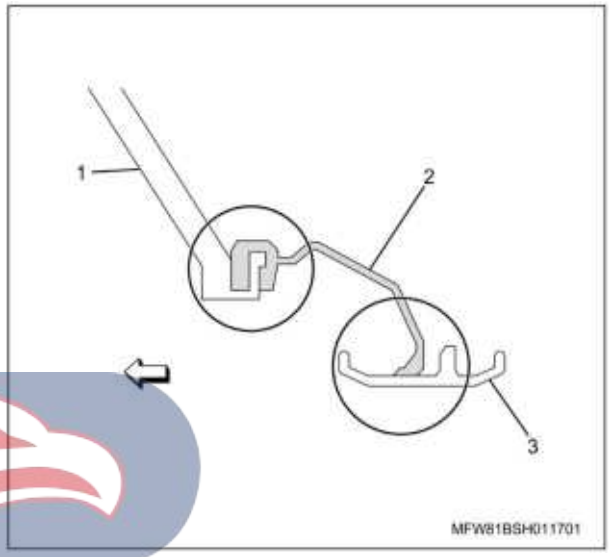
1. Fan guide

2. Fan guide bracket

2) Connect the fan guide to the radiator fan cover.

Caution:

● Verify that the entire circumference of the radiator fan cover is in contact with the fan guide.



1. Fan guide

2. Fan cover

3. Fan guide

4. Radiator lower hose installation

1) Install the radiator lower hose to the radiator and the water intake pipe.

Tightening torque: 5 N • m { 0.5 kgf • m / 44 lb • in }

5. Coolant filling

1) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Slowly fill with water to avoid air intrusion.

2) Press the radiator upper hose manually several times to remove the air from the hose.

3) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Repeat the operation until the water level no longer drops.

4) Install sub-tank cap to radiator.

5) Start and idle the engine.

Caution:

● Idle the engine for 5 minutes or more.

6)Stop the engine.

7) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

8) Add coolant up to the MAX level of the radiator sub-tank.

9) Install sub-tank cap to radiator.

10) Turn OFF the heater fan switch.

11) Start the engine.

12) Raise the engine speed.

Note:

● Increase the engine speed to around 2000 rpm and run the engine for 5 minutes once the needle of the engine coolant temperature gauge reaches the center.

13) With the engine running, check that the thermostat valve is open.

Note:

● Touch the radiator upper hose, and verify that it has become warm.

Caution:

● If the radiator upper hose has not become warm, raise engine speed to warm it up.

● Do not diagnose only by the engine coolant temperature gauge and the hot air coming out from the heater.

14) Idle the engine for 5 minutes.

15) Stop the engine.

16) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

17) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● If the water level of the sub-tank lowered the next morning, add water up to the MAX line.

6. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

Radiator

Removal

1. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

2. Coolant drain

Warning:

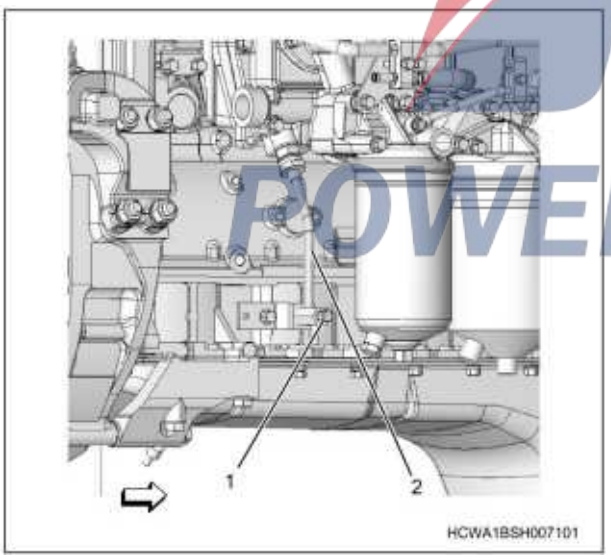
● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

1) Press the sub-tank cap button to release internal pressure.

2) Remove sub-tank cap from radiator.

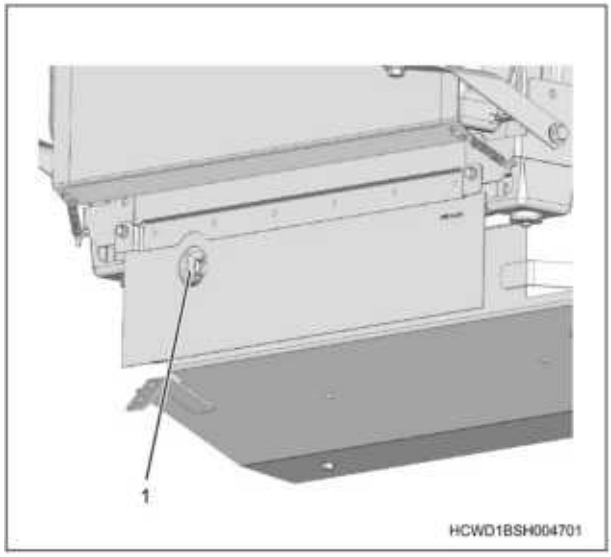
3) Loosen the drain plug on the cylinder block side, and drain the coolant to a pan.



1. Drain plug

2. Drain pipe

4) Loosen the radiator side drain plug, and drain the coolant to a pan.



1. Drain plug

5) Tighten the radiator side drain plug.

6) Tighten the drain plug on the cylinder block side.

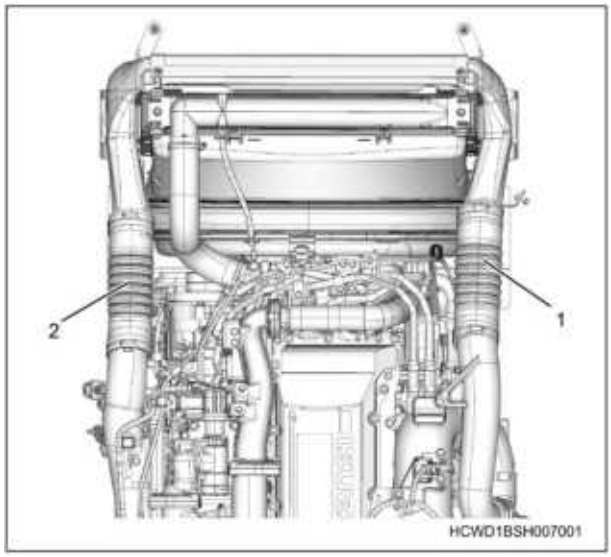
7) Install sub-tank cap to radiator.

3. Intercooler hose removal

1) Disconnect the intercooler hose on the intercooler outlet side from the intercooler.

2) Remove the intercooler hose outlet on the intake line.

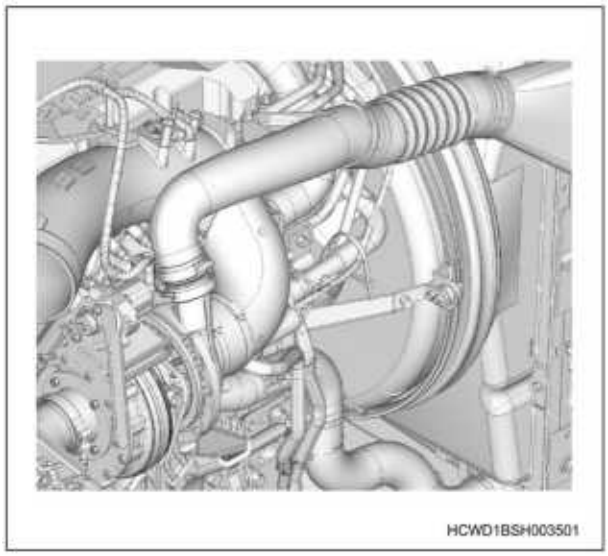
3) disconnect the intercooler hose on the intercooler inlet side from the intercooler.



1. Intercooler hose on the intercooler inlet side

2. Intercooler hose on the intercooler outlet side

4) Remove the intake duct from the turbocharger and the intake end of the intercooler hose.



4. Radiator upper hose removal

1) Remove the radiator upper hose from the water

2) Remove the radiator upper hose from the radiator.

3) Disconnect the radiator air leak hose from the radiator.

5. Radiator lower hose removal

1) Remove the radiator lower hose from the water intake pipe and the radiator.

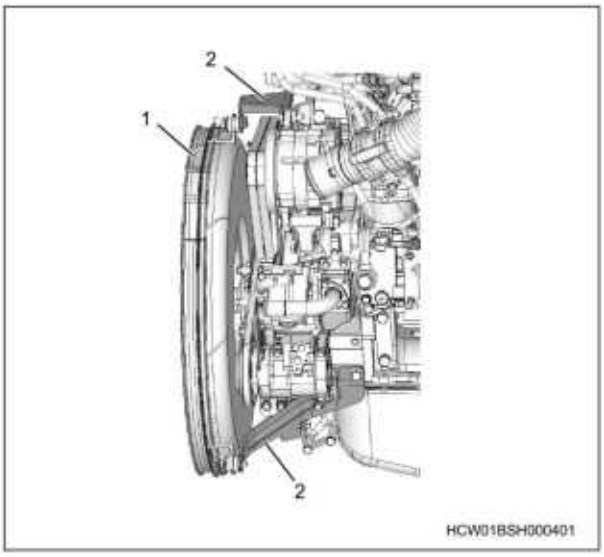
2) Remove the radiator lower hose from the radiator.

6. radiator fan cover disconnect

1) Disconnect the fan guide bracket from the engine.

Caution:

● Do not remove the fan duct connected to the air duct bracket.



1. Fan guide

2. Fan guide bracket

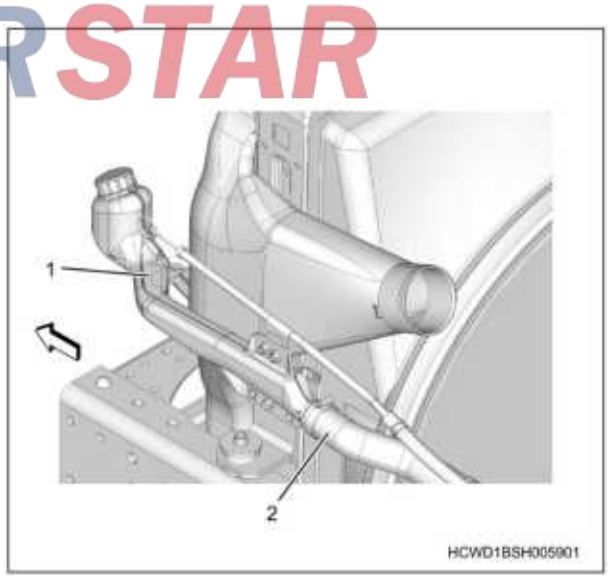
2) Disconnect the radiator fan cover from the fan guide cover.

7. Cooling fan removal

1) Remove the fan duct and cooling fan from the fan pulley.

8. refueling pipe removal

1) Remove the fuel line and rubber hose from the timing gearbox.



1. Fuel pipeline

2. Rubber hose

9. Intercooler removal

1) Remove the intercooler from the radiator.

Caution:

● Remove the fin without damaging it.

10. Radiator removal

1) Remove the radiator stay from the radiator.

2) Remove the radiator from the frame.

Caution:

● Remove the fin without damaging it.

Inspection

1. Radiator inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.

Parts deemed to be fouled or rusted must be cleaned.

1) Inspect the radiator fins for collapsing.

Note:

● If the radiator fin is deformed, heat dissipation declines and it can cause overheating. Therefore, correct the fin.

Caution:

● When repairing the fins, be careful not to damage the base portion.

2) Remove filth or other foreign material.

Caution:

● Clean the inside of the radiator and the coolant passage with tap water, and remove all scales and rust.

● Do not apply high-pressure washing to the radiator, intercooler, and peripheral parts while they are installed in the vehicle.

2. Radiator cleaning

Caution:

● Before cleaning, seal the hose connecting sections using caps, cloth tapes, etc.

1) Thoroughly wash off fouling that can be removed by washing with tap water.

Caution:

● At this time, do not use a high pressure washer or brush.

2) Apply a mild detergent that contains 8% surface acting agent to the radiator, and leave for 10 minutes.

Caution:

● Do not use material other than mild detergent because it may cause corrosion.

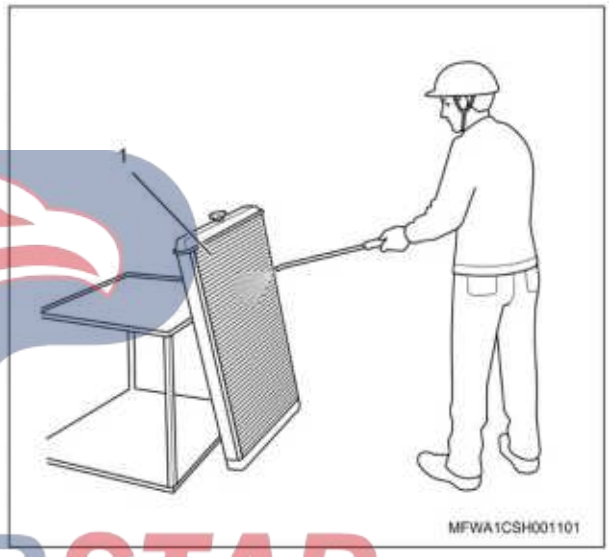
3) Clean the radiator using a high-pressure washer.

Note:

● When dirt is not washed off sufficiently, repeat the cleaning.

Caution:

● High pressure water should be applied perpendicular to the fins from the engine side of the radiator.



1. Radiator

4) Wash the radiator with tap water.

Caution:

● Sufficiently rinse off the detergent ingredient to prevent it from remaining on the core and the resin portions.

5) Remove the seal, and clean the hose connection with tap water.

Installation

1. Radiator installation

1) Install the cushion rubber to the top and bottom of the radiator bracket.

2) Install the radiator to the frame.

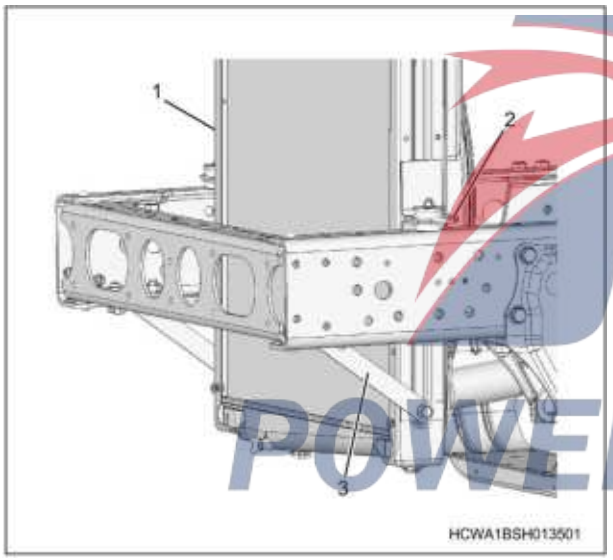
3) Install the washer to the topside of the cushion rubber.

4) Install the nut to the radiator.

Tightening torque: 41 N • m { 4.2 kgf • m / 30 lb • ft }

5) Install the radiator stay to the radiator and the frame.

Tightening torque: 20 N • m { 2.0 kgf • m / 15 lb • ft }



1. Radiator
2. Bracket
3. Bracket

2. Intercooler installation

1) Install the intercooler to the radiator.

Caution:

● Remove dirt and other foreign objects.

● Do not damage the fins during installation or removal.

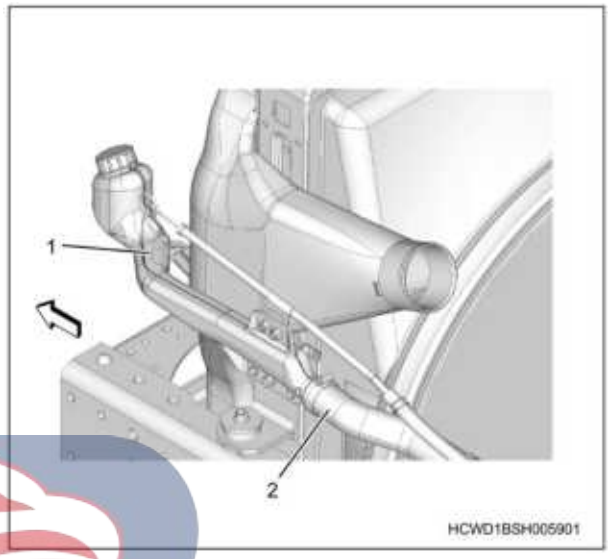
● When the intercooler fin deforms due to heat dissipation slow down, performance degradation, please carry out maintenance.

● Do not damage the fin base when repairing the fin.

● Do not use a high-pressure water jet on the radiator, intercooler, or the surrounding parts.

3. Refueling pipe installation

1) Install the refueling line and rubber hose to the timing gearbox.



1. Fuel pipeline
2. Rubber hose

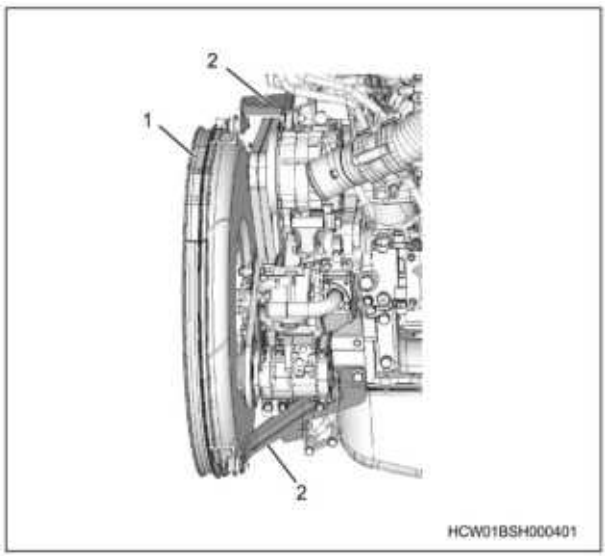
Cooling fan installation

1) Install the fan duct and cooling fan on the fan pulley.

Tightening torque: 67.5 N • m {6.9 kgf • m / 50 lb • ft}

5. Radiator fan cover connection

1) Install the fan guide bracket to the engine.



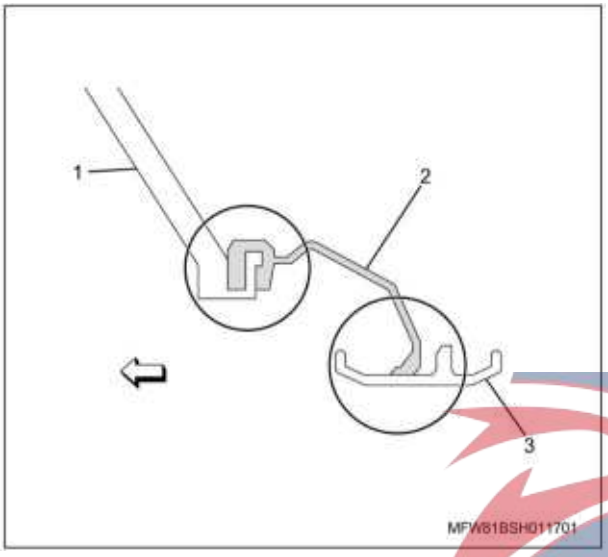
1. Fan guide

2. Fan guide bracket

2) Connect the fan guide to the radiator fan cover.

Caution:

● Verify that the entire circumference of the radiator fan cover is in contact with the fan guide.



1. Fan guide

2. Fan cover

3. Fan guide

6. Radiator lower hose installation

1) Install the radiator lower hose to the radiator and the water intake pipe.

Tightening torque: 5 N • m { 0.5 kgf • m / 44 lb • in }

7. Radiator upper hose installation

1) Connect the radiator air leak hose to the radiator.

2) Install the radiator upper hose to the water outlet duct and the radiator.

Tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}

8. Intercooler hose installation

1) Install the intercooler hose on the intercooler inlet side to the intercooler.

2) Connect the intercooler hose outlet to the intercooler.

3) Install the intake duct to the turbocharger and to the intake side of the intercooler hose.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

M10

Tightening torque: 8 N • m {0.8 kgf • m / 71 lb • in}

Turbocharger side clamp

9. Coolant filling

1) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Slowly fill with water to avoid air intrusion.

2) Press the radiator upper hose manually several times to remove the air from the hose.

3) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Repeat the operation until the water level no longer drops.

4) Install sub-tank cap to radiator.

5) Start and idle the engine.

Caution:

● Idle the engine for 5 minutes or more.

6) Stop the engine.

7) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

8) Add coolant up to the MAX level of the radiator sub-tank.

9) Install sub-tank cap to radiator.

10) Turn OFF the heater fan switch.

11) Start the engine.

12) Raise the engine speed.

Note:

● Increase the engine speed to around 2000 rpm and run the engine for 5 minutes once the needle of the engine coolant temperature gauge reaches the center.

13) With the engine running, check that the thermostat valve is open.

Note:

● Touch the radiator upper hose, and verify that it has become warm.

Caution:

● If the radiator upper hose has not become warm, raise engine speed to warm it up.

● Do not diagnose only by the engine coolant temperature gauge and the hot air coming out from the heater.

14) Idle the engine for 5 minutes.

15) Stop the engine.

16) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

17) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● If the water level of the sub-tank lowered the next morning, add water up to the MAX line.

10. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

Screens

Removal

1. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

2. Screen removed

1) Remove the spring from the spring hook on the low side of the radiator.

2) Remove the screen from the intercooler.

Caution:

● Care should be taken not to pinch your fingers while disassembling.

● If there is any damage, replace the screen.

Inspection

1. Screen inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Check if the screen is damaged.

1. Clean

1) Spray tap water on the screen to clean it, or clean it with a brush clean.

Caution:

● Use a soft brush.

2) Place the screen in a well-ventilated place to allow it to air dry naturally.

Caution:

● If you can not completely remove the dirt, please replace the screen.

Installation

1. Screen installation

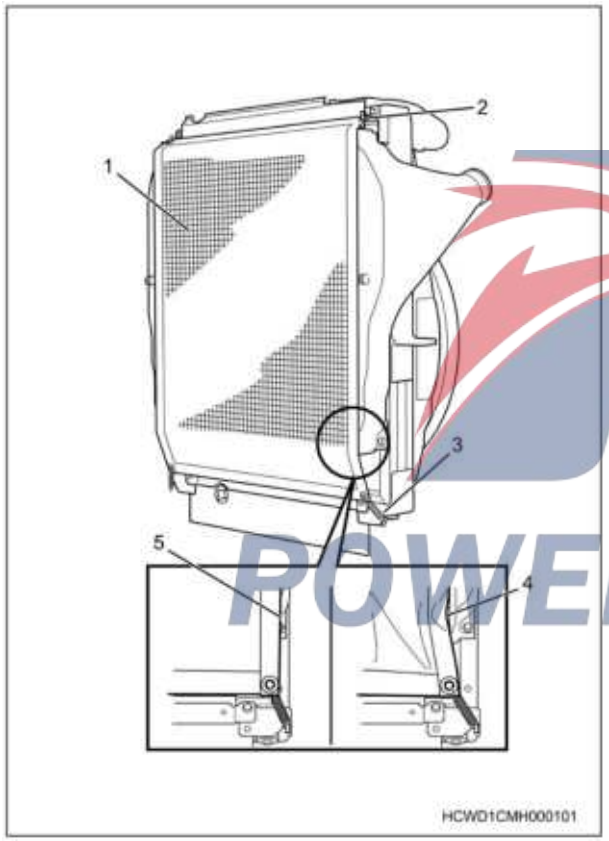
1) Mount the insect net onto the hook on the top of the radiator.

2) Mount the spring to the hooks on the bottom of the radiator and to the insect net.

Caution:

● Care should be taken not to pinch your fingers during installation.

● Do not damage the radiator core or intercooler core.



1. Screen

2. Hook

3. Hook, spring

4. Incorrect

5. Correct

2. Battery cable connect

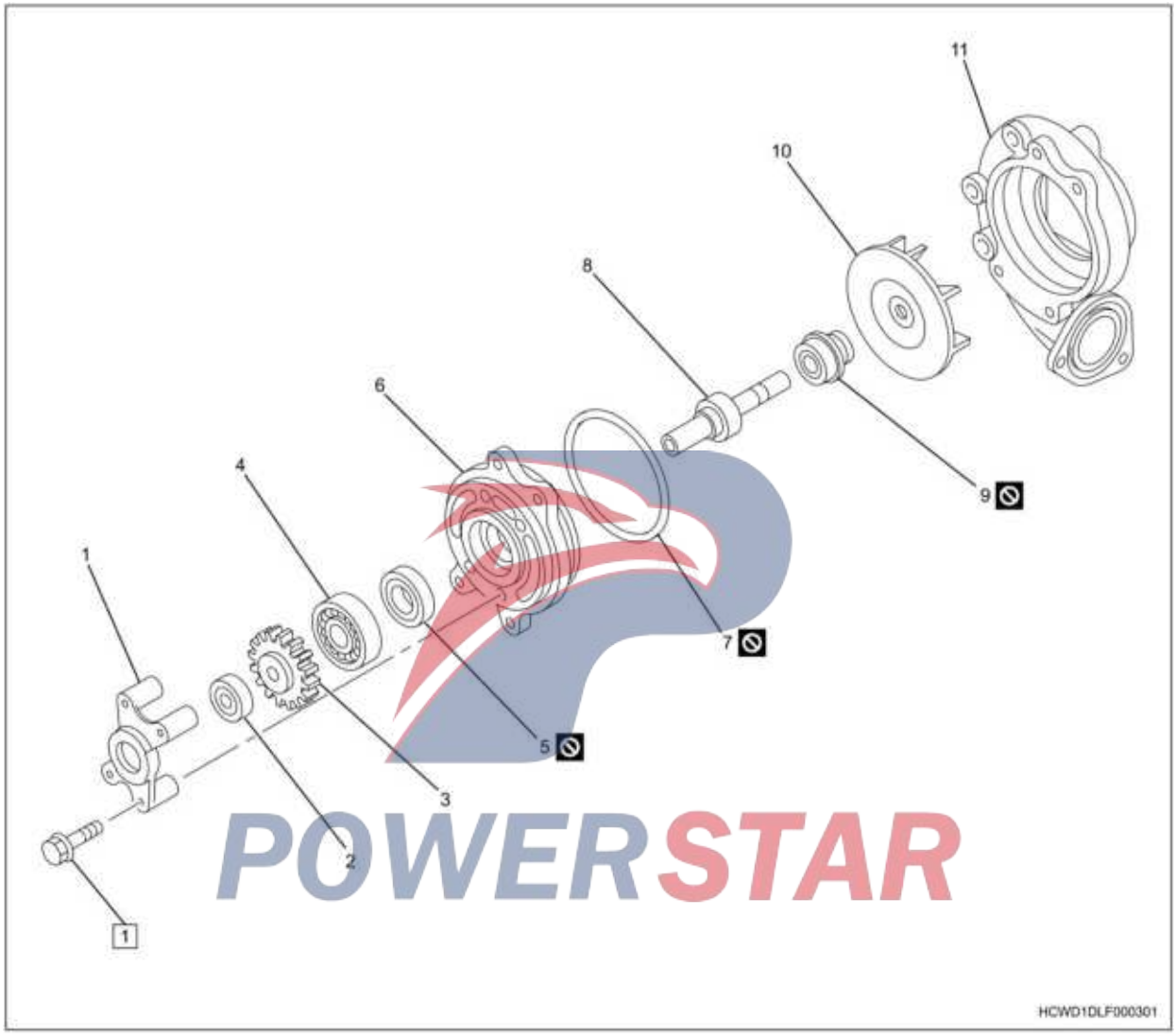
1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

Supplementary Information

1. Component Views

Water pump



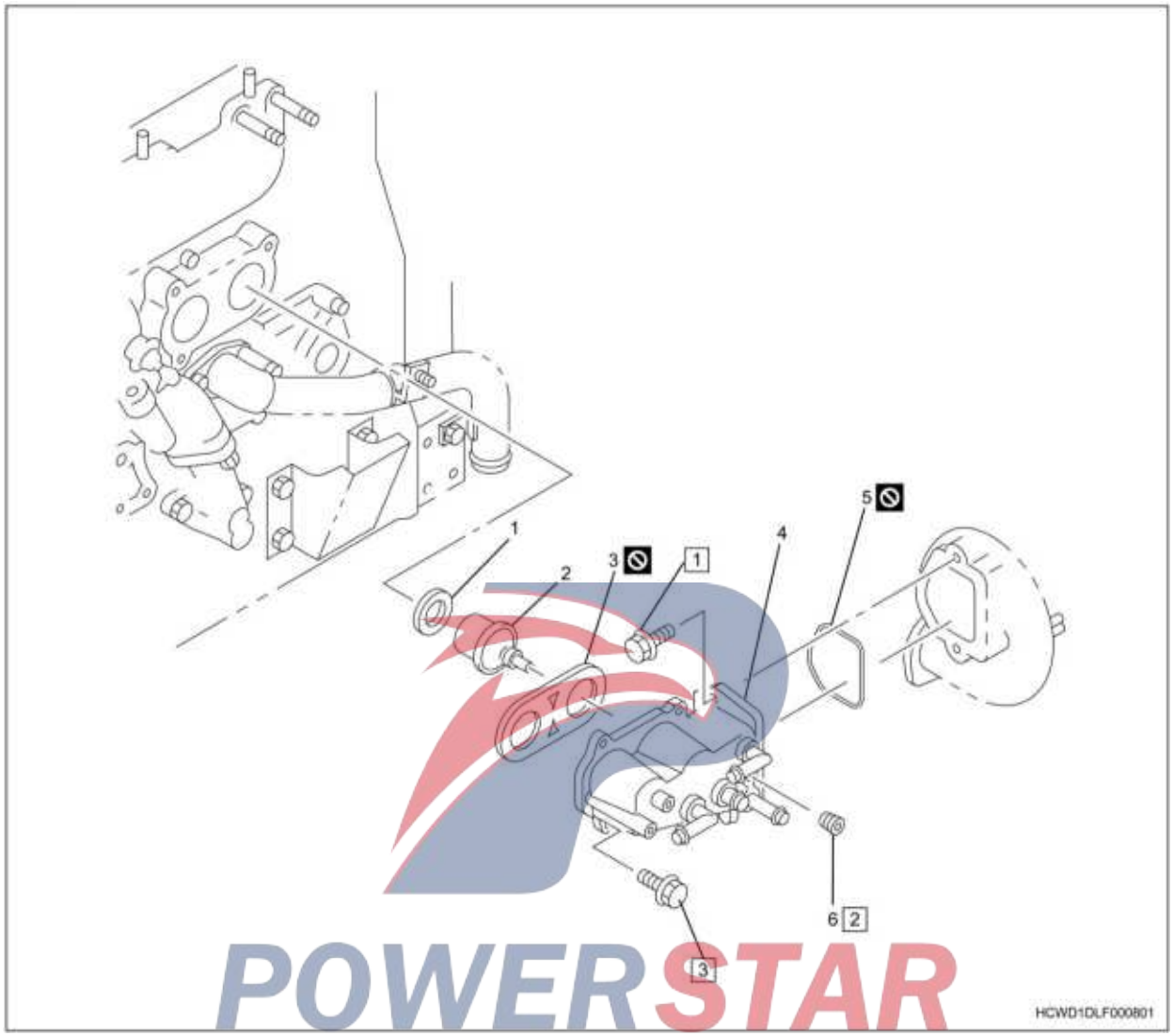
Part name

1. Back cover
2. Shaft
3. Gear
4. Shaft
5. Oil seal
6. Water pump body
7. O-ring
8. Axis
9. Seal unit
10. Impeller
11. Front cover

Tightening torque

1: 27 N • m { 2.8 kgf • m / 20 lb • ft }

Thermostat



Part name

1. Thermostat seal ring
2. Thermostat
3. Gasket
4. Thermostat housing
5. O-ring
6. Plug

Tightening torque

1: 39 N • m { 4.0 kgf • m / 29 lb • ft }

2: 34 N • m { 3.5 kgf • m / 25 lb • ft }

3: 39 N • m { 4.0 kgf • m / 29 lb • ft }

MEMO


POWERSTAR

Engine
Lubrication
(6WG1)
Table of contents

Engine oil 1E-2
Inspection 1E-2
Replacement 1E-3
Oil filter 1E-4
Removal 1E-4
Installation 1E-5
Oil filter element 1E-6
Removal 1E-6
Installation 1E-8
Partial oil filter 1E-10
Removal 1E-10
Installation 1E-11
Partial oil filter element 1E-12
Removal 1E-12
Installation 1E-13
Oil cooler 1E-14
Removal 1E-14
Removal 1E-22
Inspection 1E-24
Reassembly 1E-25
Installation 1E-27
Oil Pan 1E-36
Removal 1E-36
Installation 1E-38
Oil pump 1E-40
Removal 1E-40
Removal 1E-45
Inspection 1E-47
Reassemble 1E-48
Installation 1E-50
Supplementary Information 1E-58

Engine oil

Inspection

1. Engine oil inspection

Caution:

● Engine oil level inspection should be performed with the vehicle parked on a level area before starting the engine or approximately 30 minutes after stopping the engine.

1) Remove the oil level gauge from the oil level gauge guide tube.

2) Wipe off the engine oil attached to the oil level gauge.

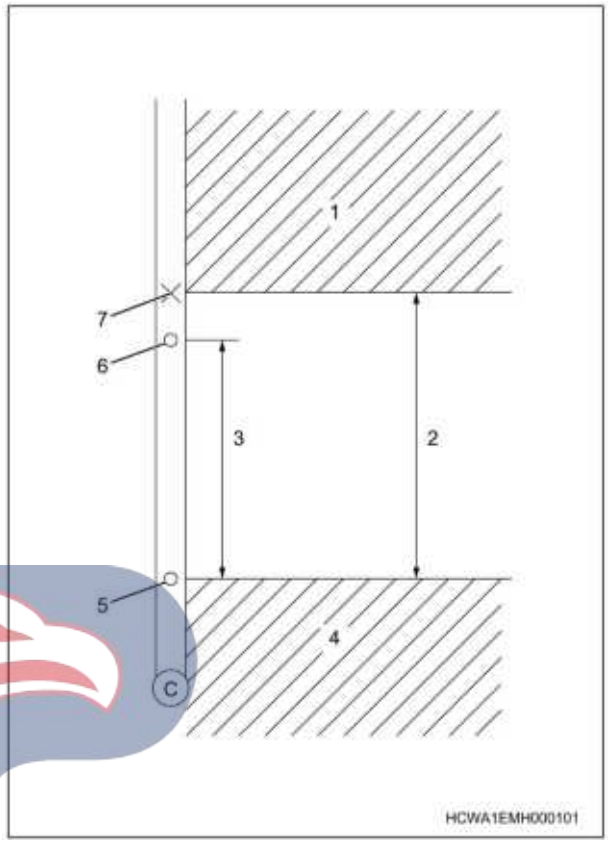
3) Install the oil level gauge to the oil level gauge guide tube.

Note:

● Check the engine oil attached to the oil level gauge.

Engine oil level inspection

Oil amount	Treatment	supply
Check if it is between the minimum and maximum value	-	Good
Check the maximum value or more	Engine oil replacement	-
MIN or less	Fill the engine oil	Supplement to between MIN and MAX levels.



1. Need to change the oil
2. Purification of oil level
3. Can be refilled to maximum
4. Request for supplements
5. Min
6. Replenish the maximum value
7. Check the maximum value

Caution:

● Replace or refill engine oil as needed.

Replacement

1. Engine oil replacement

Engine oil change cycle

Every 20,000 km (12,427 miles), a new car needs to operate when it reaches 1,000 km {621.4 miles}.

Caution:

● Always use the specified engine oil to prevent engine malfunction or excessive fuel consumption.

1) Remove the drain plug from the oil pan, and drain the engine oil to a pan.

2) Install the drain plug to the oil pan.

Tightening torque: 78 N • m { 8.0 kgf • m / 58 lb • ft }

Caution:

● Do not forget to tighten the drain plug.

3) Replenish the engine with the engine oil.

Oil filter

Removal

1. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

2. oil filter warning switch removal

1) Disconnect the oil filter warning switch.

2) Remove the oil filter warning switch and valve from the oil filter body.

3. Oil filter removal

1) Remove the drain plug from the oil filter case and drain the engine oil to a pan.

2) Install the drain plug to the oil filter case.

Caution:

● Do not reuse O-rings.

● Do not forget to tighten the drain plug.

Tightening torque: 45 N • m {4.6 kgf • m / 33 lb • ft}

3) Disconnect the oil filter tubing.

4) Remove the hose clamp bracket from the oil filter.

5) Remove the oil filter from the oil cooler.

Installation

1. Oil filter installation

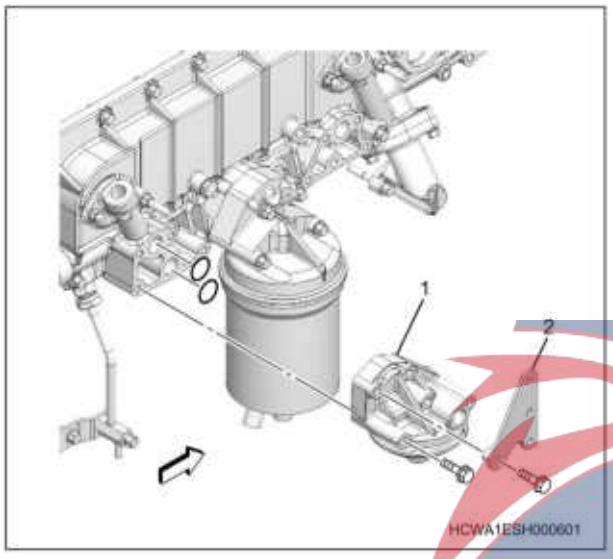
1) Install the O-ring to the oil filter case.

2) Install the oil filter to the oil cooler.

Tightening torque: 50 N • m {5.1 kgf • m / 37 lb • ft}

3) Install the pipe clamp bracket on the oil filter.

Tightening torque: 50 N • m {5.1 kgf • m / 37 lb • ft}



1. Oil filter case.
2. Hose clamp bracket

2. oil filter warning switch installation

1) Install the oil filter warning switch and valve to the oil filter body.

Tightening torque: 78 N • m {8 kgf • m / 58 lb • ft}

2) Connect the harness connector to the oil filter warning switch.

3. Engine oil filling

1) Check the tightening of the oil drain plug.

Tightening torque: 78 N • m { 8.0 kgf • m / 58 lb • ft }

2) Replenish the engine with the engine oil.

4. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

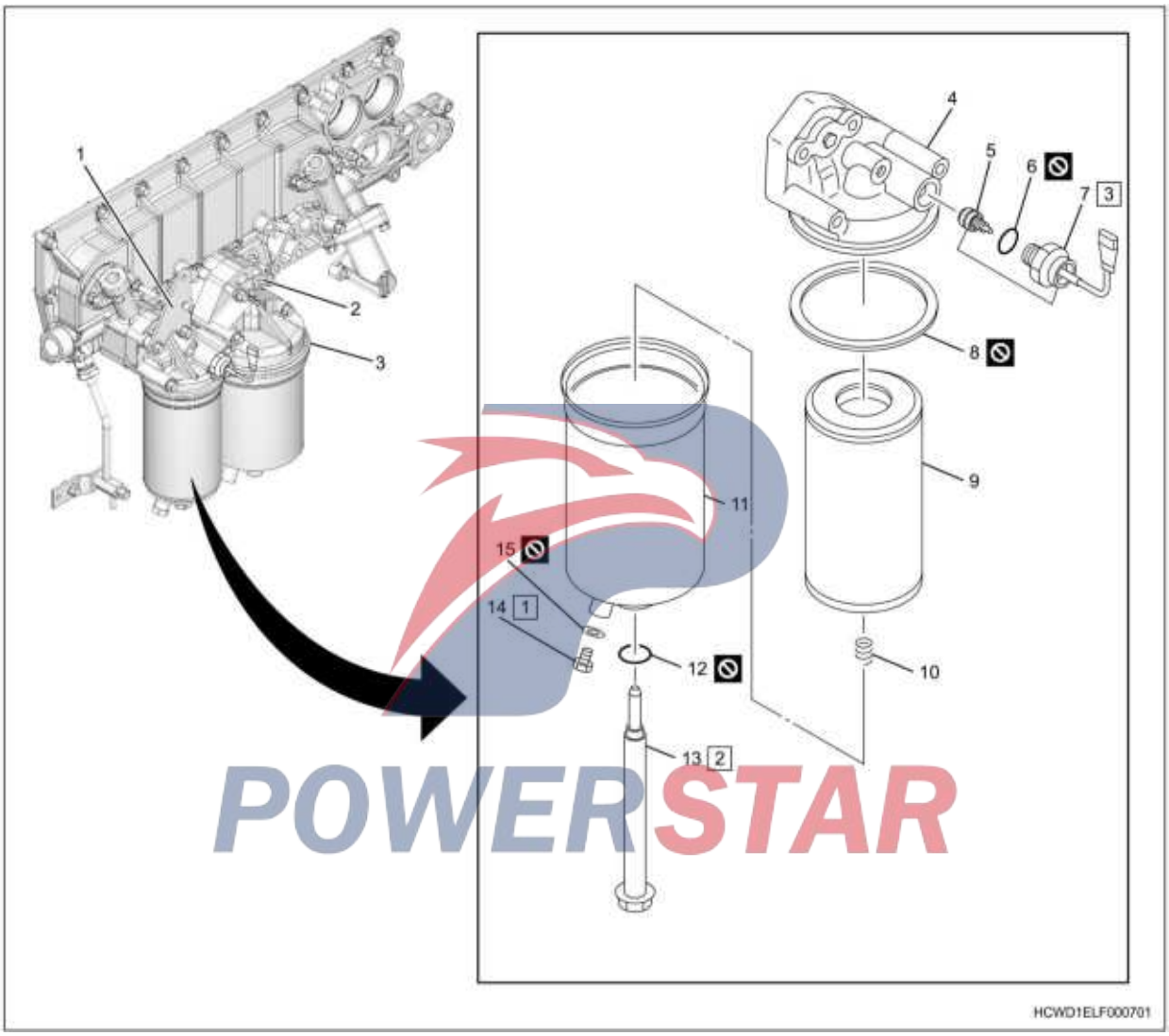
2) Lower the cab, and close the front lid.

Oil filter element

Removal

1. Component Views

Oil filter element



Part name

1. Water pipe
2. Oil pipe clamp bracket
3. Partial oil filter
4. oil filter case.
5. Valve
6. O-ring
7. oil filter warning switch
8. O-ring
9. Oil filter element
10. Spring
11. Oil filter case
12. O-ring
13. Center bolt
14.Gasket
15. Drain plug

Tightening torque

1: 45 N • m { 4.6 kgf • m / 33 lb • ft }

2: 50 N • m { 5.1 kgf • m / 37 lb • ft }

3: 78 N • m { 8.0 kgf • m / 58 lb • ft }

2. Oil filter element removal

1) Remove the drain plug from the oil filter case and drain the engine oil to a pan.

2) Install the drain plug to the oil filter case.

Tightening torque: 45 N • m { 4.6 kgf • m / 33 lb • ft }

Caution:

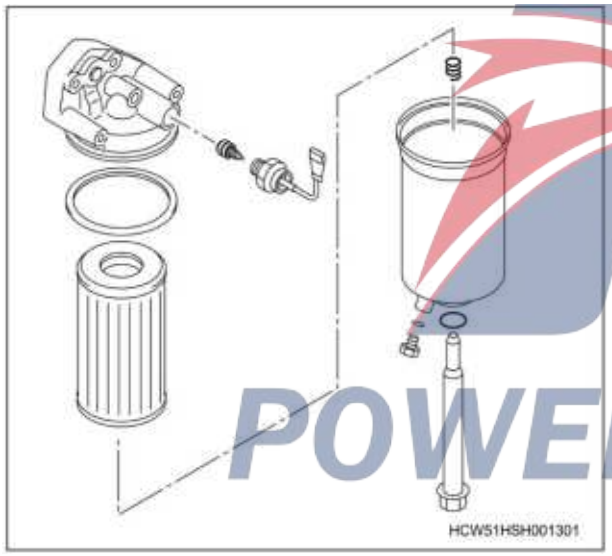
● Do not reuse O-rings.

● Do not forget to tighten the drain plug.

3) Remove the center bolt, and remove the oil filter case from the oil filter body.

4) Remove the oil filter element from the oil filter case.

5) Remove the spring from the oil filter case.

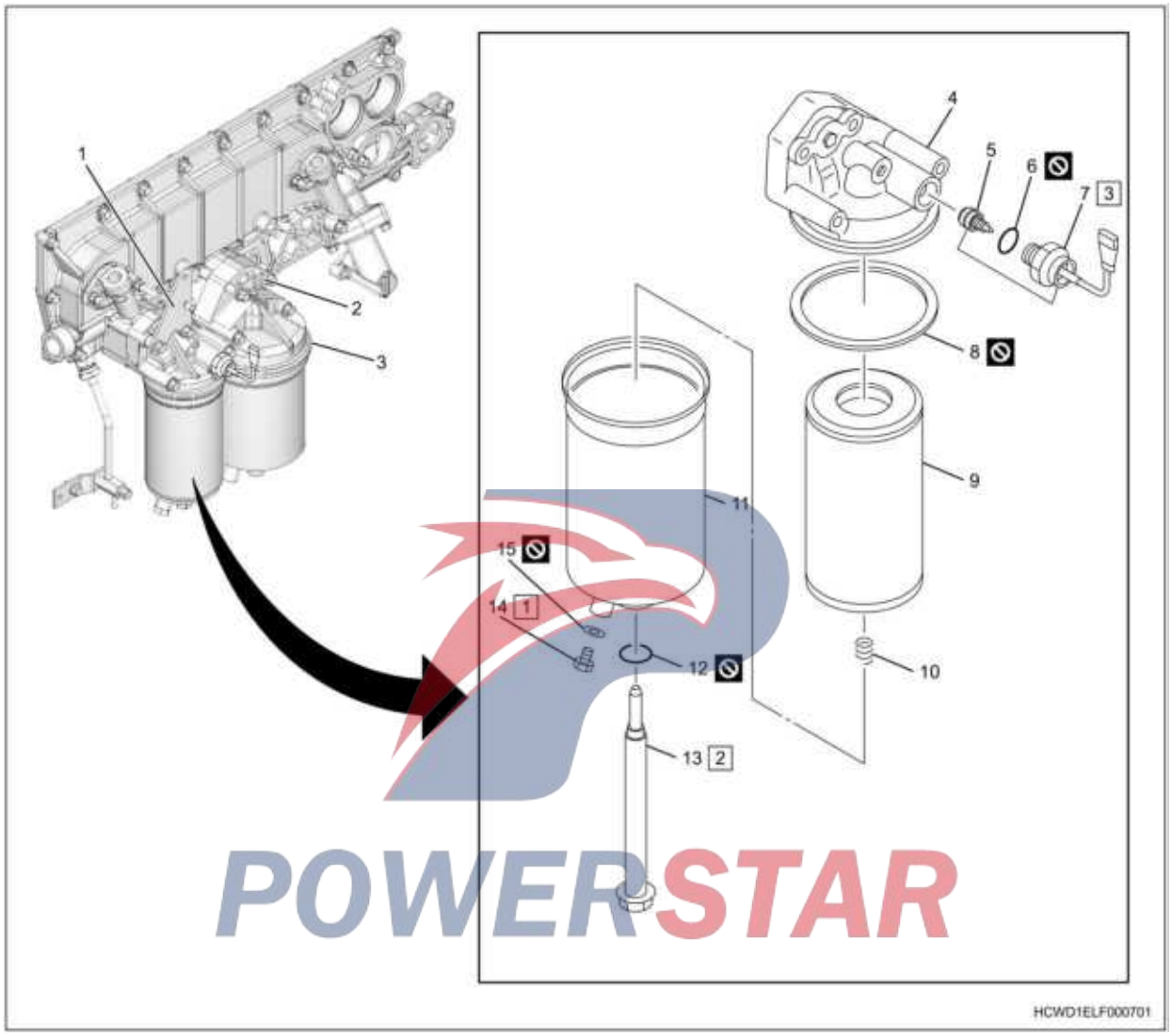


6) Clean the oil filter case.

Installation

1. Component Views

Oil filter element



Part name

1. Water pipe
2. Oil pipe clamp bracket
3. Partial oil filter
4. oil filter case.
5. Valve
6. O-ring
7. oil filter warning switch
8. O-ring
9. Oil filter element
10. Spring
11. Oil filter case
12. O-ring
13. Center bolt
14. Gasket
15. Drain plug

Tightening torque

1: 45 N • m { 4.6 kgf • m / 33 lb • ft }

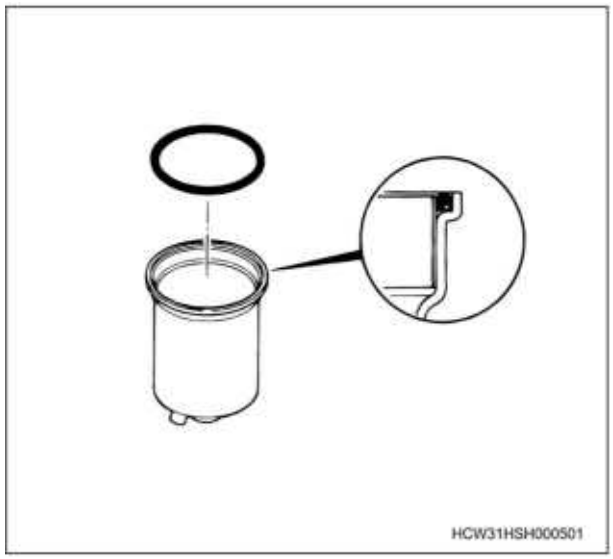
2: 50 N • m { 5.1 kgf • m / 37 lb • ft }

3: 78 N • m { 8.0 kgf • m / 58 lb • ft }

2. Oil filter element installation

1) Apply engine oil to the O-ring.

2) Fit the O-ring into the groove of the oil filter case to install it to the oil filter case.



3) Apply engine oil to the O-ring.

4) Install the O-ring to the center bolt.

5) Install the center bolt to the oil filter case.

6) Install the spring to the oil filter case.

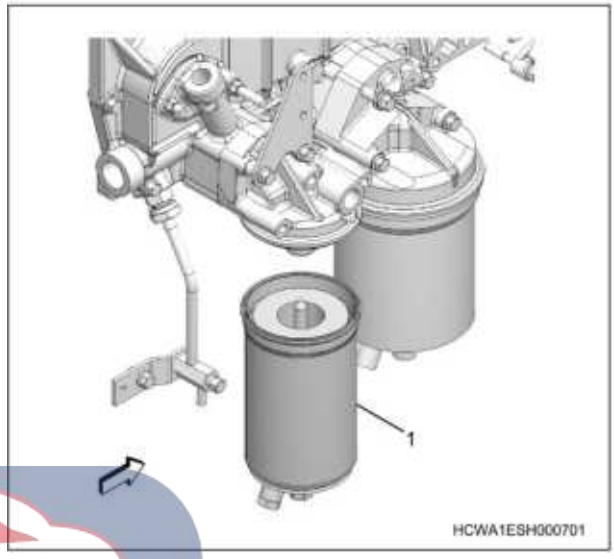
7) Install the oil filter element to the oil filter case.

8) Install the center bolt, and install the oil filter case to the oil filter body.

Tightening torque: 50 N • m { 5.1 kgf • m / 37 lb • ft }

Caution:

- Do not reuse O-rings.
- Do not damage the O-ring.
- Do not tighten the center bolt excessively.



1. Oil filter

3. Engine oil filling

1) Check the tightening of the oil drain plug.

Tightening torque: 78 N • m { 8.0 kgf • m / 58 lb • ft }

2) Replenish the engine with the engine oil.

Partial oil filter

Removal

1. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

2. Partial oil filter removal

1) Remove the drain plug from the partial oil filter case and drain the engine oil to a pan.

2) Install the drain plug to the partial oil filter.

Tightening torque: 45 N • m { 4.6 kgf • m / 33 lb • ft }

3) Remove the clip from the oil pipe.

4) Remove the tubing holder from the splitter oil filter body.

5) Remove the partial oil filter from the oil cooler.

Installation

1. Partial oil filter installation

1) Install the O-ring to the partial oil filter.

2) Install the partial oil filter to the oil cooler as a set with the bracket.

Tightening torque: 50 N • m { 5.1 kgf • m / 37 lb • ft }

3) Install the clip to the oil pipe.

2. Engine oil filling

1) Check the tightening of the oil drain plug.

Tightening torque: 78 N • m { 8.0 kgf • m / 58 lb • ft }

2) Replenish the engine with the engine oil.

3. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

Partial oil filter element

Removal

1. Partial oil filter element

1) Remove the drain plug from the partial oil filter case and drain the engine oil to a pan.

2) Install the drain plug to the partial oil filter.

Tightening torque: 45 N • m { 4.6 kgf • m / 33 lb • ft }

3) Remove the center bolt, and remove the partial oil filter case from the partial oil filter body.

4) Remove the spring from the partial oil filter case.

5) Clean the oil filter case.

6) Clean the main filter oil pipe and the center bolt.

Installation

1. Partial oil filter element installation

1) Apply engine oil to the O-ring.

Caution:

● Do not damage the O-ring.

2) Fit the O-ring into the groove of the partial oil filter case to install it to the partial oil filter case.

3) Apply engine oil to the O-ring.

Caution:

● Do not damage the O-ring.

4) Install the O-ring to the center bolt.

5) Install the center bolt to the partial oil filter case.

6) Install the spring to the partial oil filter case.

7) Install the partial oil filter element to the partial oil filter case.

8) Install the center bolt, and install the partial oil filter case to the partial oil filter body.

Tightening torque: 100 N • m { 10.2 kgf • m / 74 lb • ft }

2. Engine oil filling

1) Check the tightening of the oil drain plug.

Tightening torque: 78 N • m { 8.0 kgf • m / 58 lb • ft }

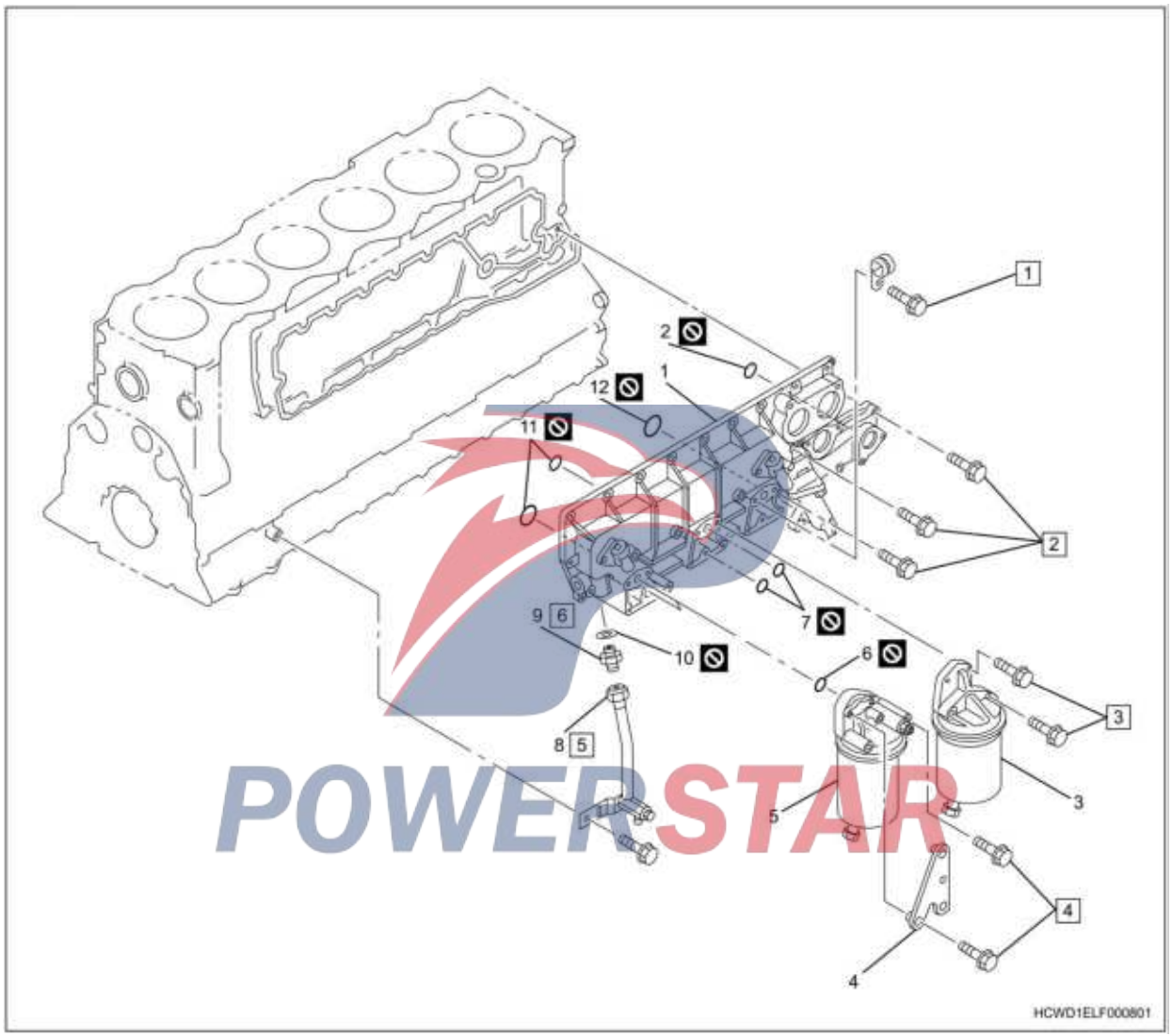
2) Replenish the engine with the engine oil.

Oil cooler

Removal

1. Component Views

Oil cooler



Part name	
1. Oil cooler	10.Gasket
2. O-ring	11. O-ring
3. Partial oil filter	12. O-ring
4. Oil filter bracket	Tightening torque
5. Oil filter	1: 50 N • m { 5.1 kgf • m / 37 lb • ft }
6. O-ring	2: 50 N • m { 5.1 kgf • m / 37 lb • ft }
7. O-ring	3: 50 N • m { 5.1 kgf • m / 37 lb • ft }
8. Drainage line	4: 50 N • m { 5.1 kgf • m / 37 lb • ft }
9. Connector	5: 69 N • m { 7.0 kgf • m / 51 lb • ft }
	6: 78 N • m { 8.0 kgf • m / 58 lb • ft }

2. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

3. Coolant drain

Warning:

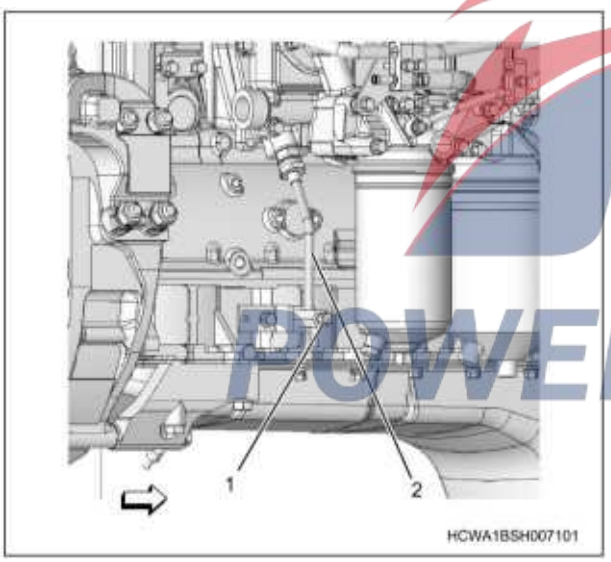
● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

1) Press the sub-tank cap button to release internal pressure.

2) Remove sub-tank cap from radiator.

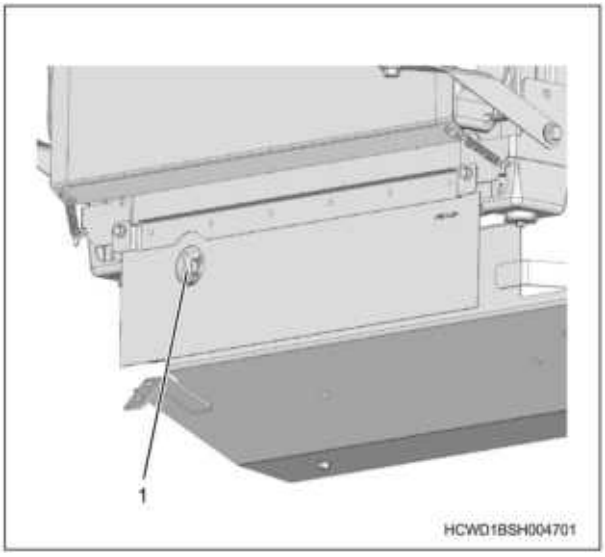
3) Loosen the drain plug on the cylinder block side, and drain the coolant to a pan.



1. Drain plug

2. Drain pipe

4) Loosen the radiator side drain plug, and drain the coolant to a pan.



1. Drain plug

5) Tighten the radiator side drain plug.

6) Tighten the drain plug on the cylinder block side.

7) Install sub-tank cap to radiator.

4. Engine oil drain

1) Remove the drain plug from the oil pan, and drain the engine oil to a pan.

2) Install the drain plug to the oil pan.

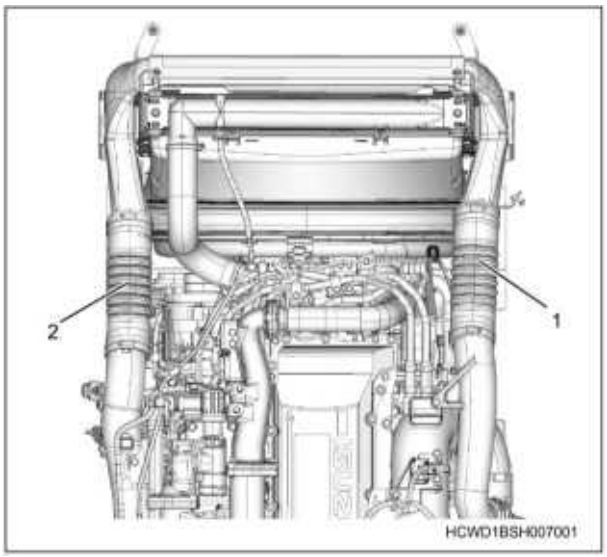
Caution:

● Do not forget to tighten the drain plug.

Tightening torque: 78 N • m {8.0 kgf • m / 58 lb • ft}

5. Intercooler hose removal

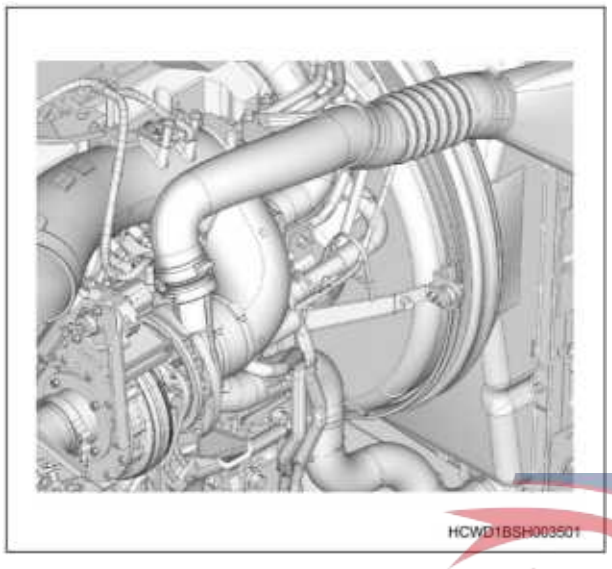
1) Disconnect the intercooler hose on the intercooler inlet side from the intercooler.



1. Intercooler hose on the intercooler inlet side

2. Intercooler hose on the intercooler outlet side

2) Remove the intake duct from the turbocharger and the intake side of the intercooler hose.

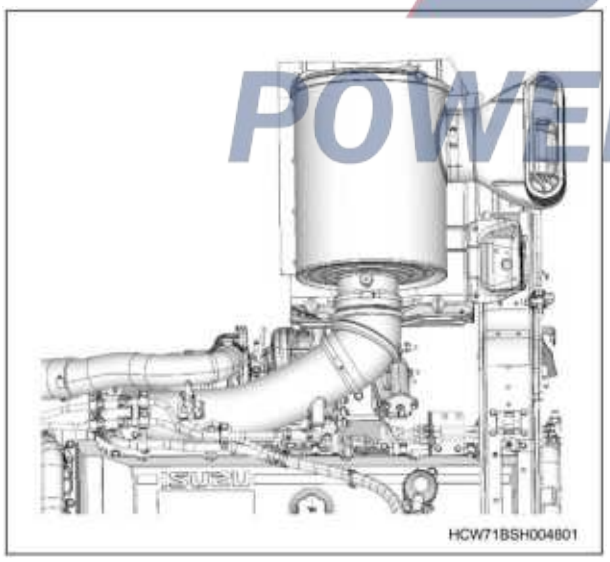


6. Air cleaner removal

1) Remove the air cleaner duct from the air cleaner.

2) Remove the air cleaner from the bracket.

3) Remove the bracket from the frame.



7. Radiator upper hose removal

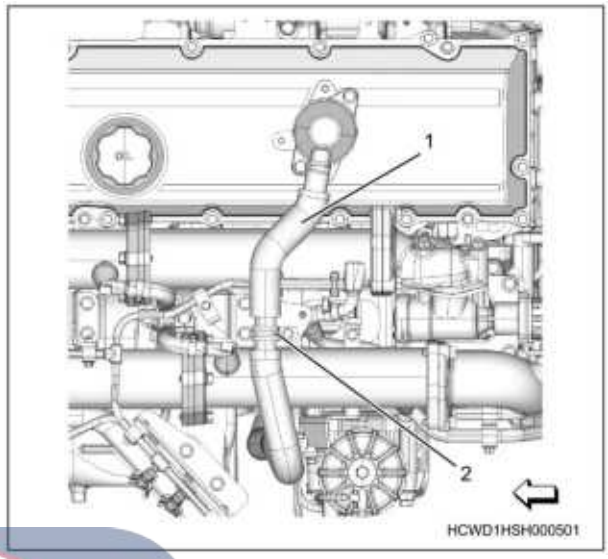
1) Remove the radiator upper hose from the water

2) Remove the radiator upper hose from the radiator.

3) Disconnect the radiator air leak hose from the radiator.

8. Ventilation hose disconnect

1) Disconnect the ventilation hose to the cylinder front cover.

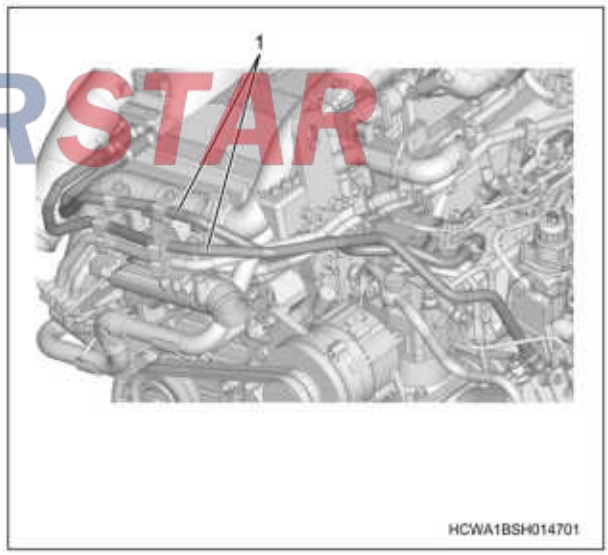


1. Ventilation hose

2. Ventilation hose clip

9. Air duct removal

1) Disconnect the air compressor suction pipe from the air duct.



1. Air compressor suction pipe

2) Remove the heat shield from the air line.

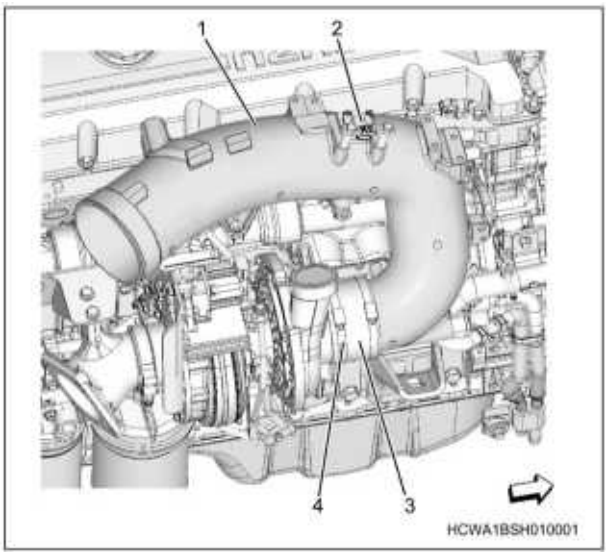
3) Disconnect the harness connector from the mass air flow sensor and intake air temperature sensor.

Note:

● If not necessary, do not disassemble the mass air flow sensor.

4) Remove the air cleaner duct from the air line.

5) Remove the air line from the turbocharger.



1. Air duct
2. Mass air flow and intake air temperature sensor
3. Rubber hose
4. Hose clip

10. Mud guard removal

1) Remove the mudguard on the right of the vehicle from the bracket.

2) Remove the mudguard on the left side of the vehicle from the bracket.

11. Noise shutter panel removal

1) Remove the noise shutter panel on the right side of the vehicle from the frame.

2) Remove the noise shutter panel on the left side of the vehicle from the frame.

Exhaust cover removal

1) Remove the exhaust cover from the frame.

13. Exhaust brake valve removal

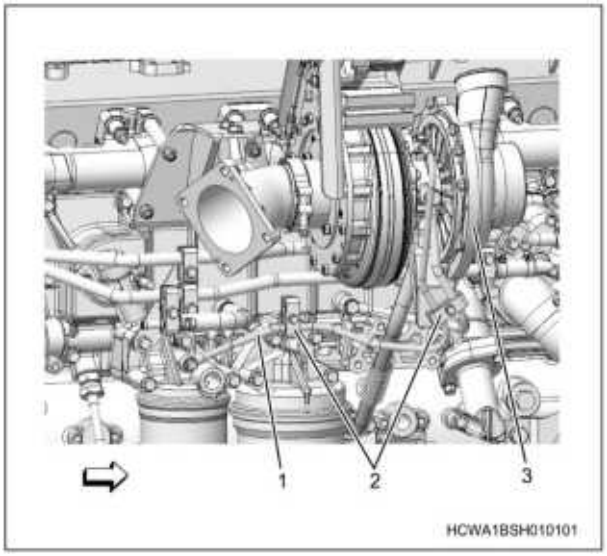
1) Disconnect the air pipe from the exhaust brake valve.

2) Remove the front exhaust pipe A and exhaust brake valve as a set from the exhaust pipe B adapter and exhaust silencer.

14. turbocharger removal

1) Disconnect the oil return pipe from the turbocharger.

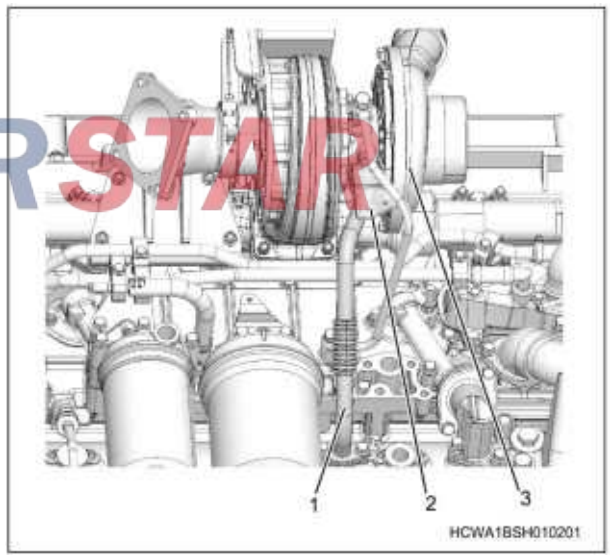
2) Remove the turbocharger fuel supply pipe from the filter body.



1. Turbocharger oil feed pipe
2. Pipe clamp
3. Turbocharger

3) Disconnect turbocharger oil return line.

4) Remove the return pipe from the cylinder block.



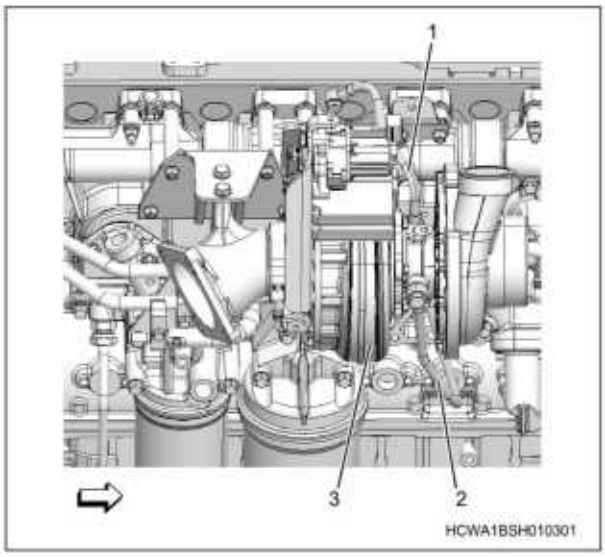
1. Turbocharger return pipe
2. Bracket
3. Turbocharger

5) Disconnect the turbocharger water supply pipe.

6) Remove the water supply pipe from the oil cooler.

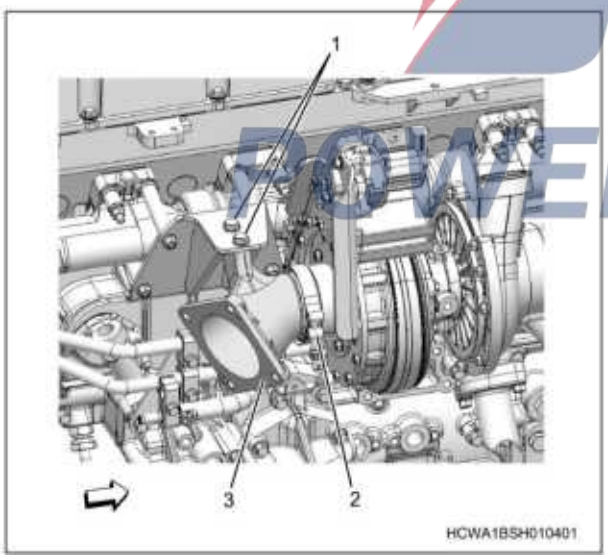
7) Disconnect turbocharger water return pipe.

8) Remove the water return pipe from the cylinder head.



1. Water return pipe
2. Water feed pipe
3. Turbocharger

9) Remove the turbocharger exhaust from the turbocharger.



1. Bolt
2. V-belt
3. Turbocharger exhaust pipe

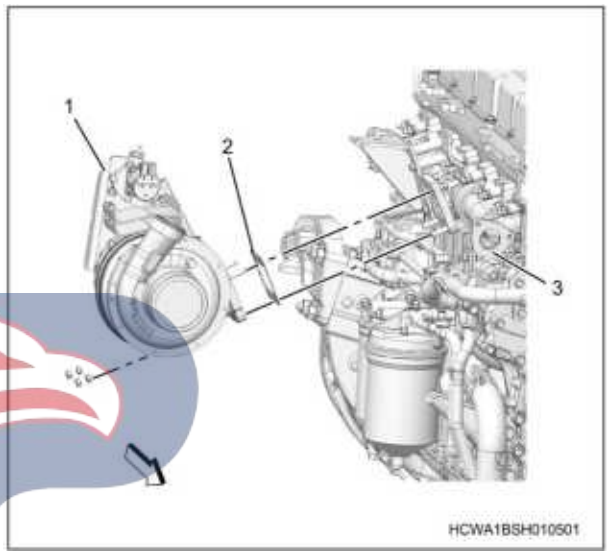
10) Disconnect the harness connector of the variable ratio steering actuator.

11) Remove the turbocharger from the exhaust manifold.

12) Remove the gasket from the exhaust manifold.

Caution:

● Seal each part to prevent the intrusion of foreign material into the turbocharger.



1. Turbocharger
2. Gasket
3. Exhaust manifold

15. Water charge pipe removal

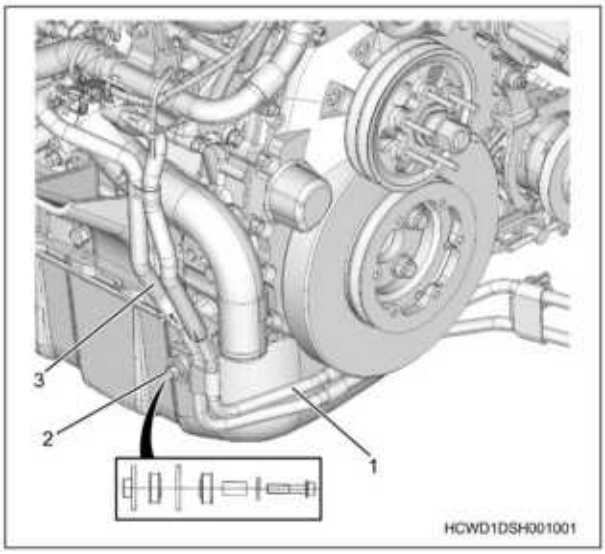
1) Remove the filling pipe from the filling pipe holder.

2) Remove the water-filled bracket from the inlet pipe.

3) Remove the water-filled bracket from exhaust gas recirculation valve line A.

16. Heater hose removal

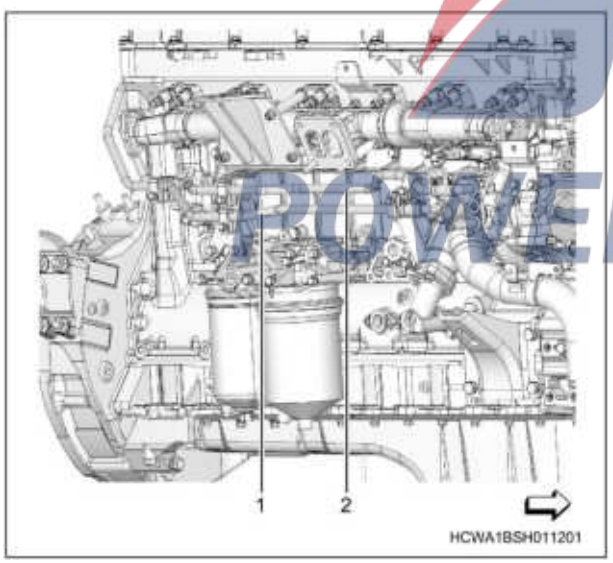
1) Remove the clip and then remove the heater hose from the thermostat housing.



1. Heater hose
2. Heater pipe bracket part
3. Heater pipe

17. EGR cooler water pipe removed

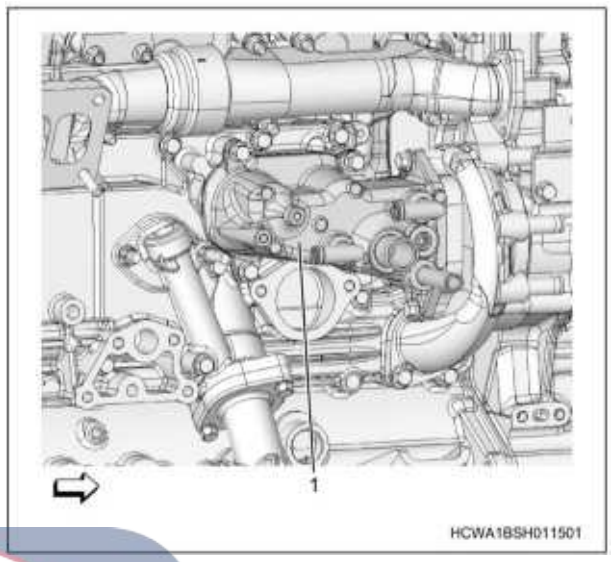
1) Remove the front and rear return lines from the thermostat housing.



1. Back-end return pipe
2. Front return pipe

18. Thermostat housing removal

1) Remove the thermostat housing from the oil cooler.



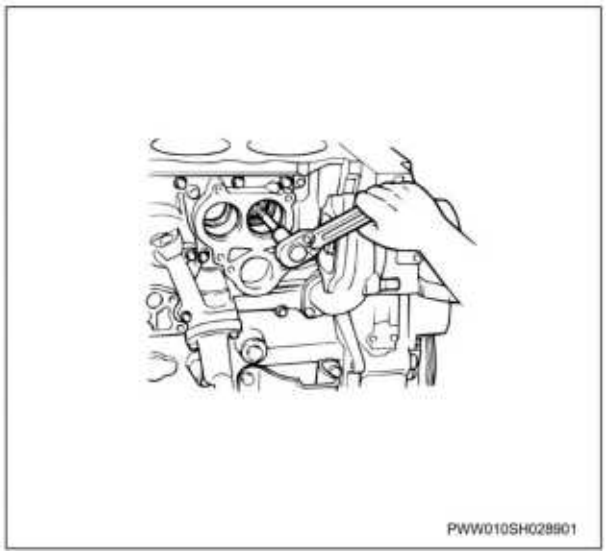
1. Thermostat housing

19. Thermostat removal

1) Remove the thermostat from the oil cooler.

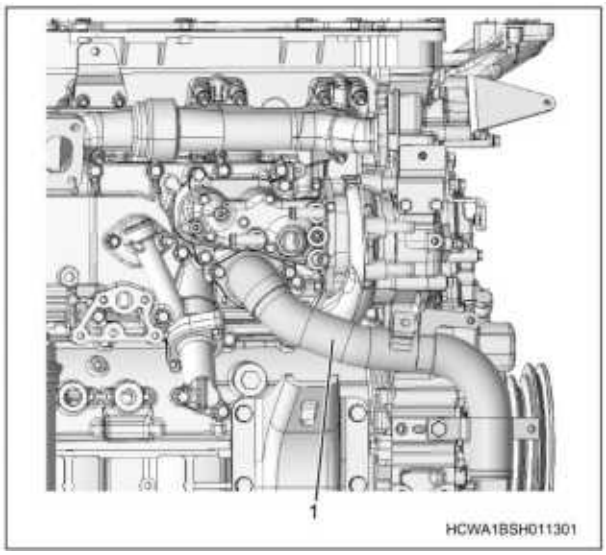
2) Using a special tool, remove the thermostat seal ring from the oil cooler.

SST: 1-8521-0067-0 - thermostat seal remover



20. Intake pipe removed

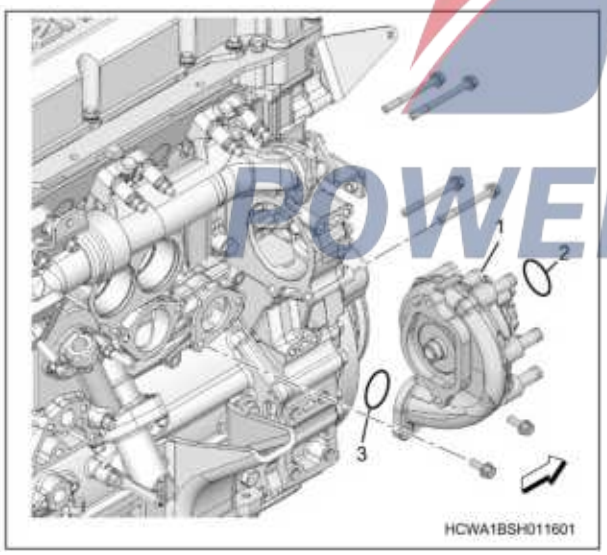
1) Remove the inlet pipe from the oil cooler.



1. Water inlet

21. Water pump removal

1) Remove the pump from the oil cooler and gearbox.



1. Water pump
2. O-ring
3. O-ring

22. oil filter warning switch removal

1) Disconnect the oil filter warning switch.

2) Remove the oil filter warning switch and valve from the oil filter body.

23. Oil filter removal

1) Remove the drain plug from the oil filter case and drain the engine oil to a pan.

2) Install the drain plug to the oil filter case.

Caution:

● Do not reuse O-rings.

● Do not forget to tighten the drain plug.

Tightening torque: 45 N • m {4.6 kgf • m / 33 lb • ft}

3) Disconnect the oil filter tubing.

4) Remove the hose clamp bracket from the oil filter.

5) Remove the oil filter from the oil cooler.

24. Partial oil filter removal

1) Remove the drain plug from the partial oil filter case and drain the engine oil to a pan.

2) Install the drain plug to the partial oil filter.

Tightening torque: 45 N • m {4.6 kgf • m / 33 lb • ft}

3) Remove the clip from the oil pipe.

4) Remove the tubing holder from the splitter oil filter body.

5) Remove the partial oil filter from the oil cooler.

25. Oil cooler removal

1) Remove the drain pipe from the oil cooler.

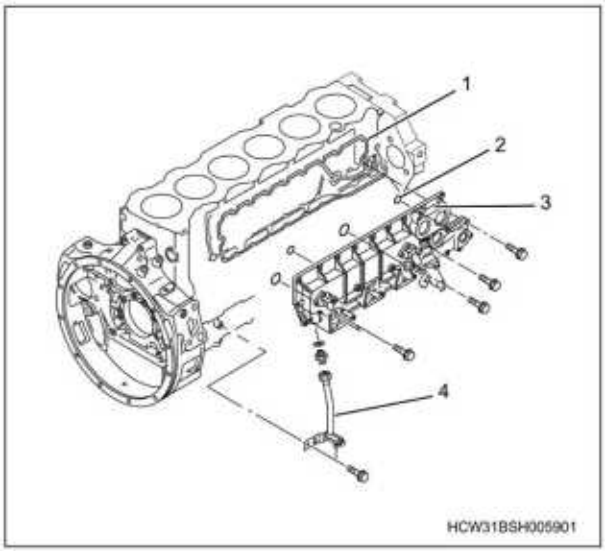
2) Remove the connector from the oil cooler.

3) Disconnect the water pipe from the oil cooler.

Note:

● Disconnect all hoses connected to the oil cooler.

4) Remove the oil cooler from the cylinder block.

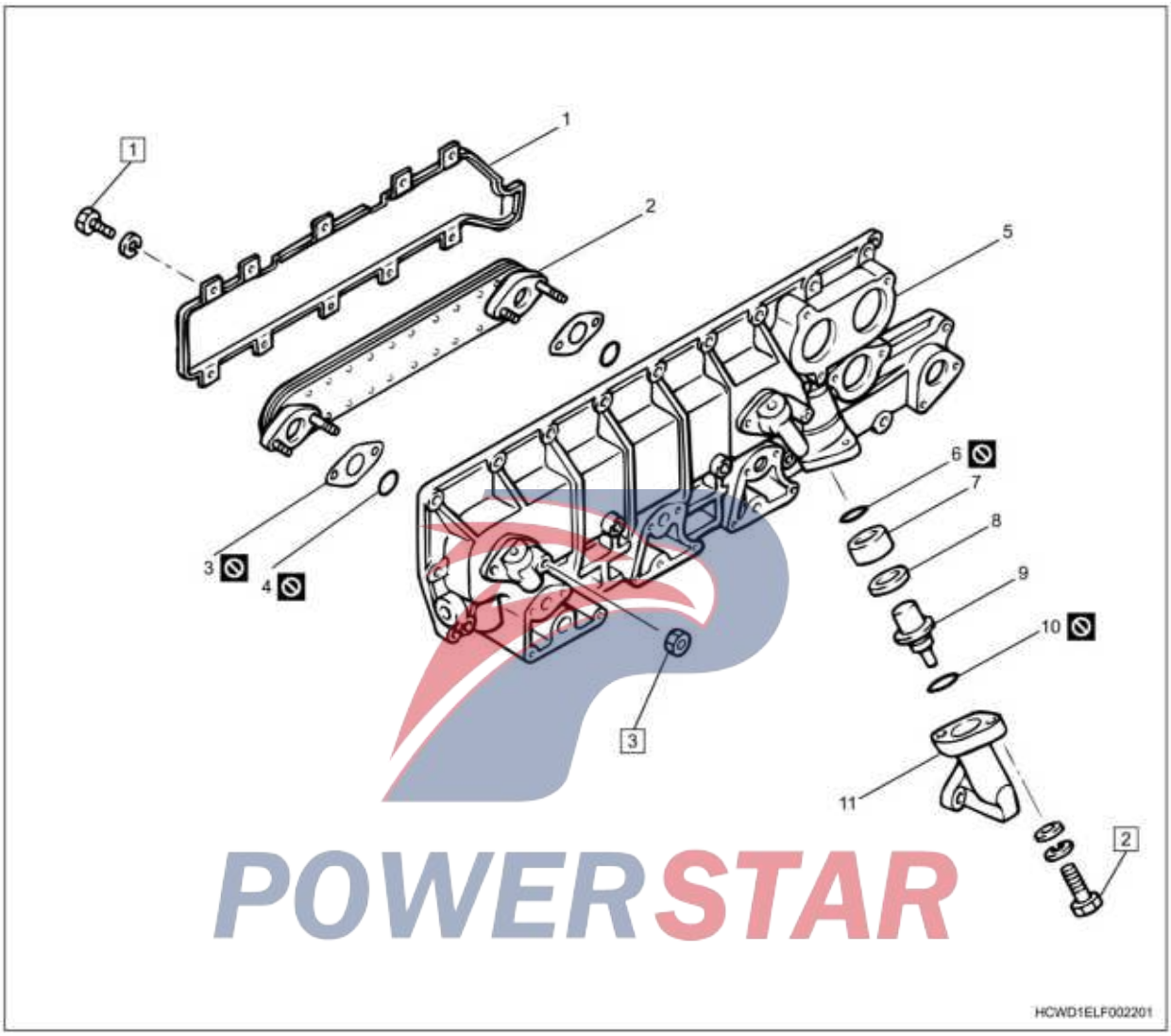


1. Gasket
2. O-ring
3. Oil cooler
4. Drainage line

Removal

1. Component Views

Oil cooler



Part name

1. Water guide
2. Oil cooler element
3. Gasket
4. O-ring
5. Body shell
6. Seal ring
7. Oil thermo valve support
8. Gasket
9. Oil thermo valve
10. O-ring
11. Oil pipe

Tightening torque

1: 4 N • m {0.4 kgf • m / 35 lb • in}

2: 37 N • m {3.8 kgf • m / 27 lb • ft}

3: 25 N • m {2.5 kgf • m / 18 lb • ft}

2. Oil cooler disassembly

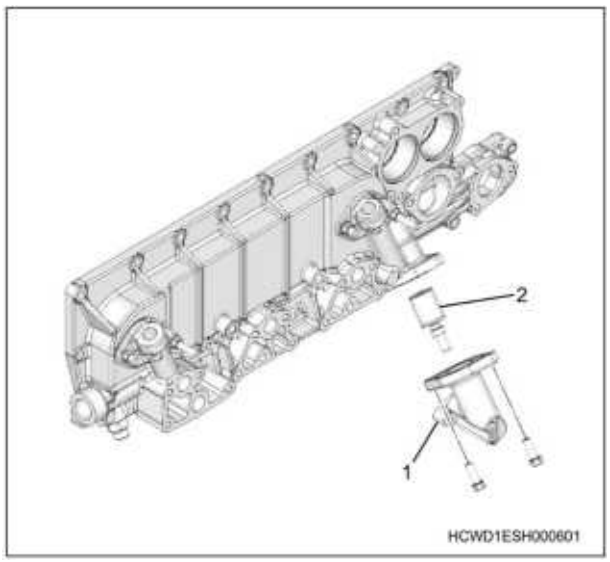
1) Remove the water guide from the oil cooler.

2) Loosen the nut on the oil cooler front side, and remove the oil cooler element from the oil cooler.

Caution:

● Seal the oil path system to prevent entry of foreign substances.

3) Remove the oil pipe and O-ring and then remove the oil temperature control valve from the oil cooler.



1. Oil pipe
2. Oil thermo valve

4) Remove the following parts from the oil cooler.

- Gasket
- Oil thermo valve support
- Seal ring

1. Oil cooler element cleaning

Note:

- If the oil cooler element is extremely dirty, repeat the procedure several times.

Caution:

- Keep the cleaning fluid away from open flames or other sources of ignition, wear glasses and a mask, and provide adequate air ventilation.

1) Put the cleaning fluid shown in the table into the element, and soak for approximately 10 hours.

High aromatics 2S (Nippon oil)	Used in undiluted state
Swasol 310 (Maruzen, Japan)	
Hisol (Showa Shell)	
Mobil Cable A (car)	Dilute solvent kerosene

2) Drain about one third of the cleaning fluid.

3) Blow in compressed air from the oil port, and remove the cleaning fluid.

Air pressure: 196 kPa { 2.0 kgf/cm2 / 28 psi }

Inspection

1. Oil cooler element inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

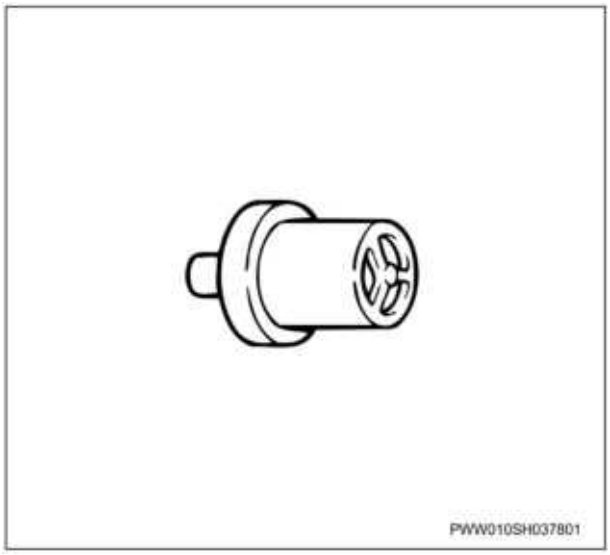
Caution:

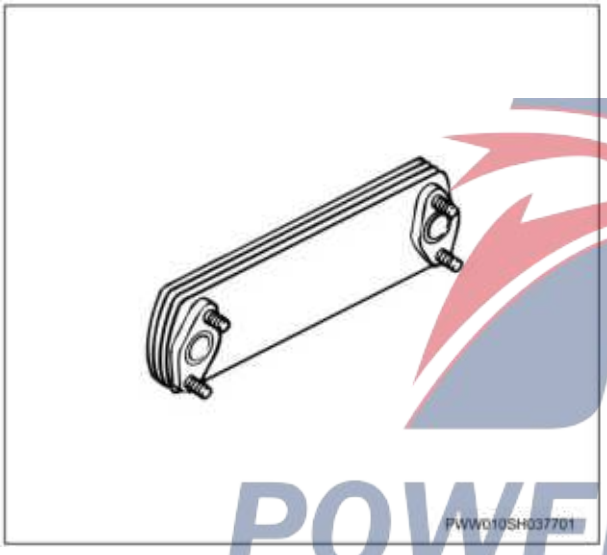
● If oil mixes into the coolant, perform an inspection.

1) Inspect the oil cooler element for cracks.

Note:

● Perform an inspection by dye penetrant check if required.





2. Oil thermo valve inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Inspect the piston and the valve seat surface for wear and damage.

2) Inspect the spring for damage and deterioration.

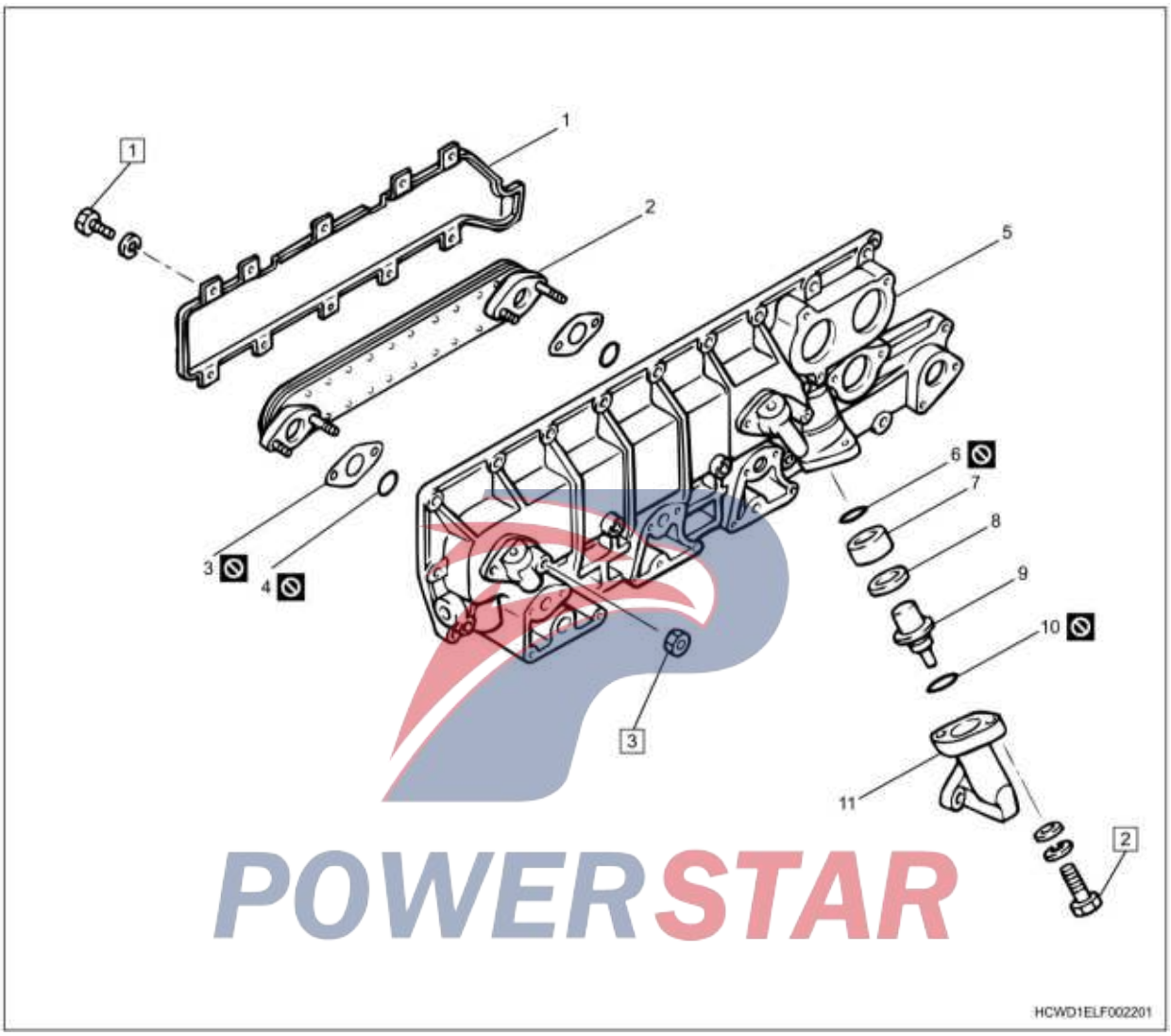
3) Inspect the opening condition of the oil thermo valve.

Valve opening temperature: 103 ℃ { 217℉ }

Reassembly

1. Component Views

Oil cooler



Part name

1. Water guide
2. Oil cooler element
3. Gasket
4. O-ring
5. Body shell
6. Seal ring
7. Oil thermo valve support
8. Gasket
9. Oil thermo valve
10. O-ring
11. Oil pipe

Tightening torque

1: 4 N • m {0.4 kgf • m / 35 lb • in}

2: 37 N • m {3.8 kgf • m / 27 lb • ft}

3: 25 N • m {2.5 kgf • m / 18 lb • ft}

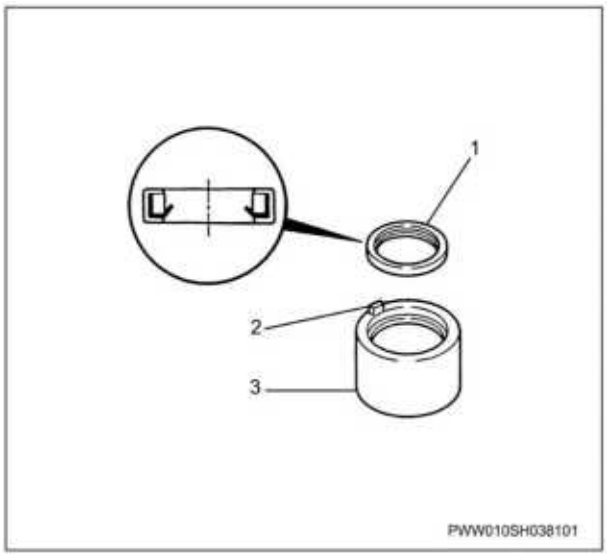
2. Oil cooler reassembly

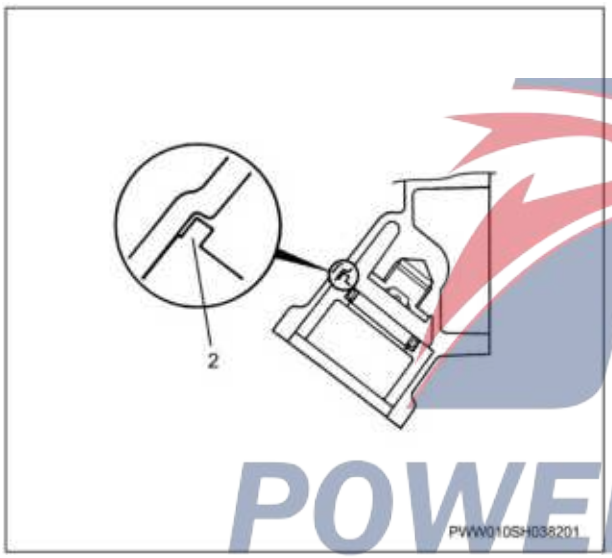
1) Install the seal ring on the oil cooler.

2) Align the stop boss to attach the oil thermostatic valve to the oil cooler.

Caution:

● Please pay attention to the direction of the seal ring during installation.





1. Seal ring
2. Stop the raised part
3. Oil thermo valve support

3) Install the gasket and the oil cooler.

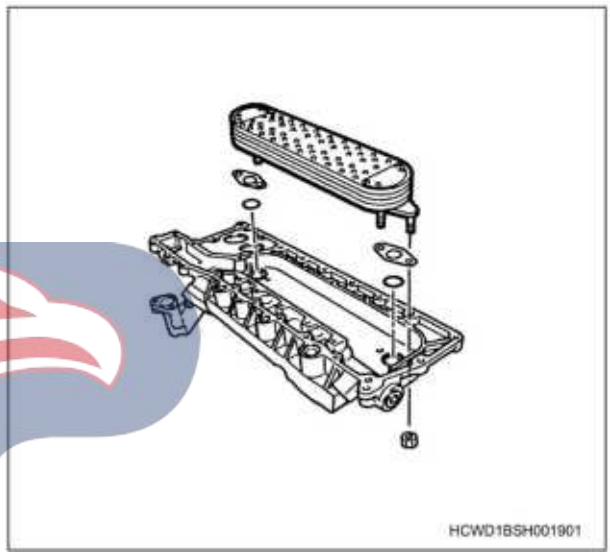
4) Install the oil temperature control valve and install the oil pipe and O-ring onto the oil cooler.

Tightening torque: 37 N • m {3.8 kgf • m / 27 lb • ft}

5) Apply three keys 1208 to the two O-ring groove locations and install the O-ring onto the oil cooler.

6) Install the gasket on the oil cooler element and install the oil cooler element in the oil cooler.

Tightening torque: 25 N • m {2.5 kgf • m / 18 lb • ft}



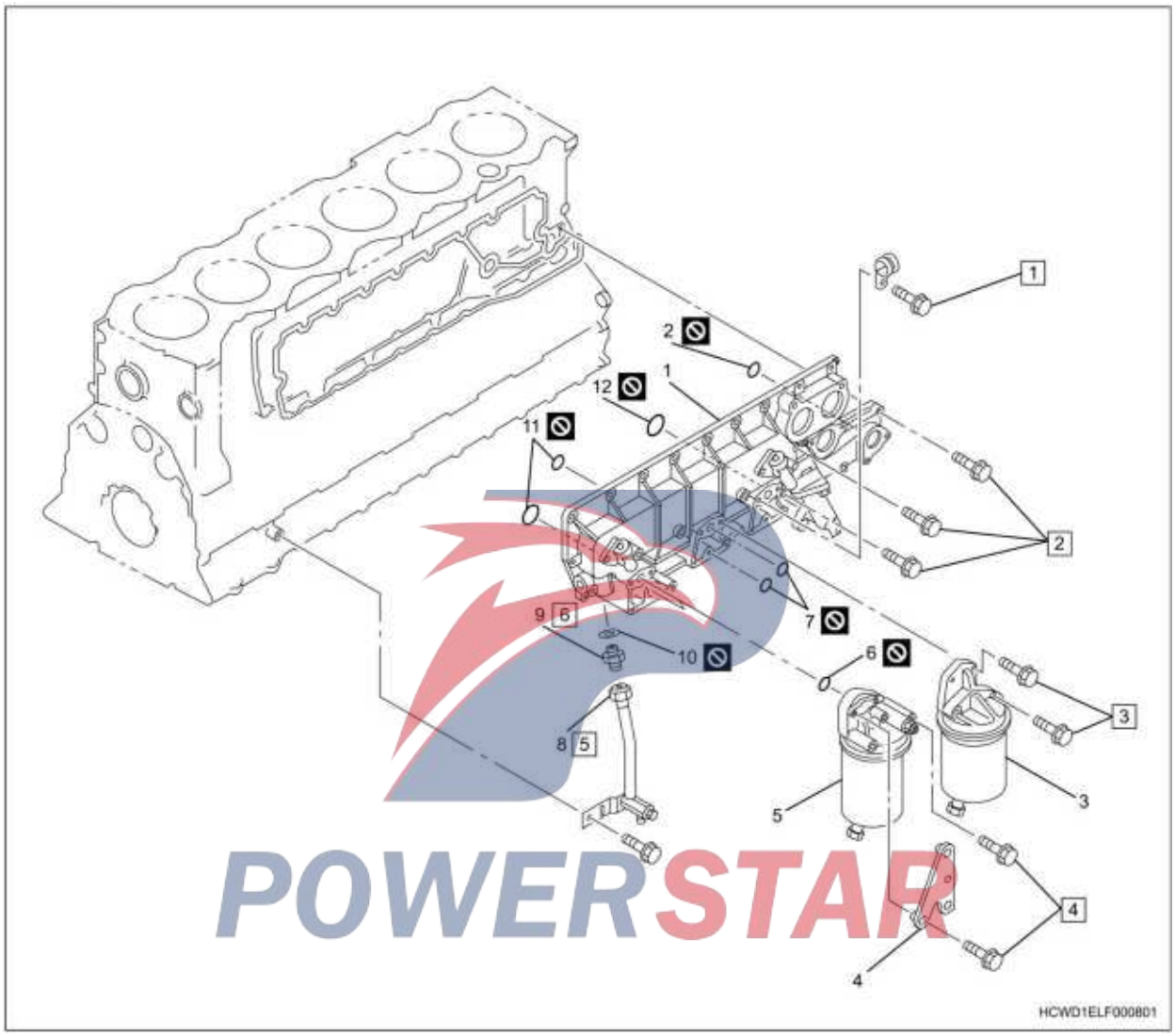
7) The water guide to the oil cooler.

Tightening torque: 4 N • m { 0.4 kgf • m / 35 lb • in }

Installation

1. Component Views

Oil cooler



Part name

1. Oil cooler
2. O-ring
3. Partial oil filter
4. Oil filter bracket
5. Oil filter
6. O-ring
7. O-ring
8. Drainage line
9. Connector
10. Gasket
11. O-ring
12. O-ring

Tightening torque

1: 50 N • m { 5.1 kgf • m / 37 lb • ft }

2: 50 N • m { 5.1 kgf • m / 37 lb • ft }

3: 50 N • m { 5.1 kgf • m / 37 lb • ft }

4: 50 N • m { 5.1 kgf • m / 37 lb • ft }

5: 69 N • m { 7.0 kgf • m / 51 lb • ft }

6: 78 N • m { 8.0 kgf • m / 58 lb • ft }

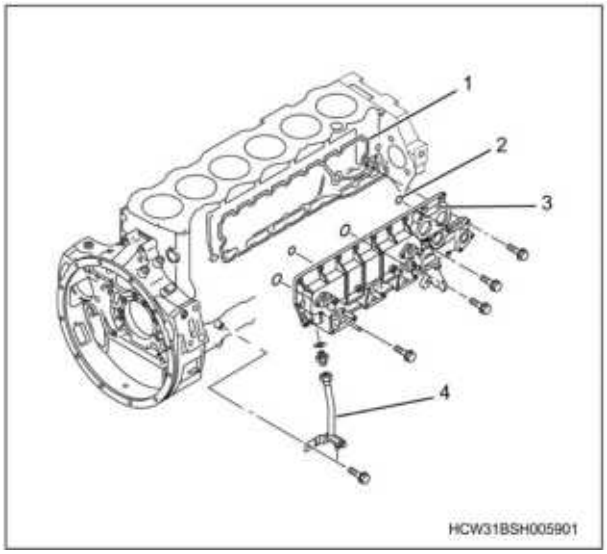
2. Oil cooler installation

1) Install the gasket to the oil cooler.

2) Install the O-ring to the oil cooler.

3) Install the oil cooler to the cylinder block.

Tightening torque: 50 N • m { 5.1 kgf • m / 37 lb • ft }



1. Gasket
2. O-ring
3. Oil cooler
4. Drainage line

4) Install the fitting on the oil cooler.

Tightening torque: 78 N • m {8.0 kgf • m / 58 lb • ft}

5) Install the drain pipe to the connector.

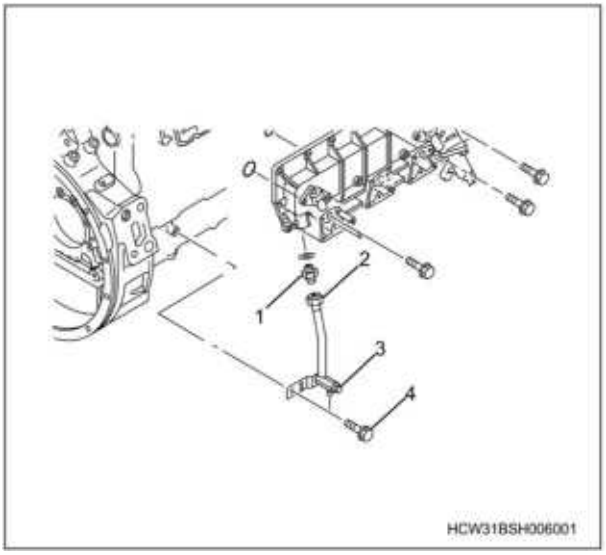
Tightening torque: 69 N • m {7.0 kgf • m / 58 lb • ft}

6) Install the bolt to the cylinder.

Tightening torque: 43 N • m {4.4 kgf • m / 32 lb • ft}

7) Install the drain plug on the pipe.

Tightening torque: 4 N • m {0.4 kgf • m / 35 lb • in}



1. Connector
2. Drainage line
3. Drain plug
4. Bolt

3. Partial oil filter installation

1) Install the O-ring to the partial oil filter.

2) Install the partial oil filter to the oil cooler as a set with the bracket.

Tightening torque: 50 N • m {5.1 kgf • m / 37 lb • ft}

3) Install the clip to the oil pipe.

Oil filter installation

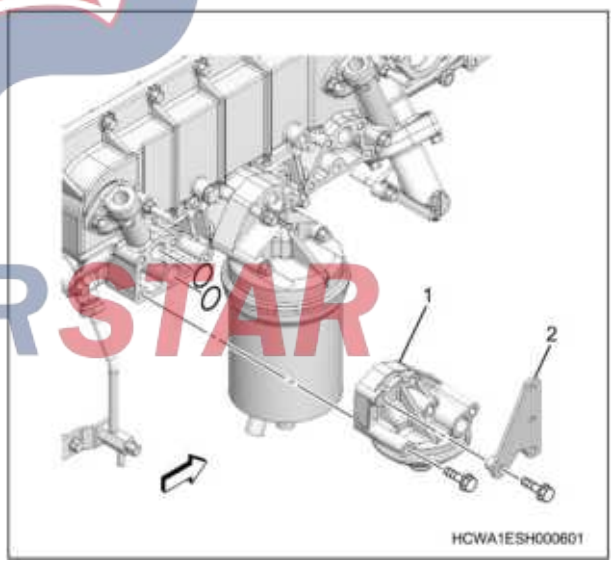
1) Install the O-ring to the oil filter case.

2) Install the oil filter to the oil cooler.

Tightening torque: 50 N • m {5.1 kgf • m / 37 lb • ft}

3) Install the pipe clamp bracket on the oil filter.

Tightening torque: 50 N • m {5.1 kgf • m / 37 lb • ft}



1. Oil filter case.
2. Hose clamp bracket

5. Oil filter warning switch installation

1) Install the oil filter warning switch and valve to the oil filter body.

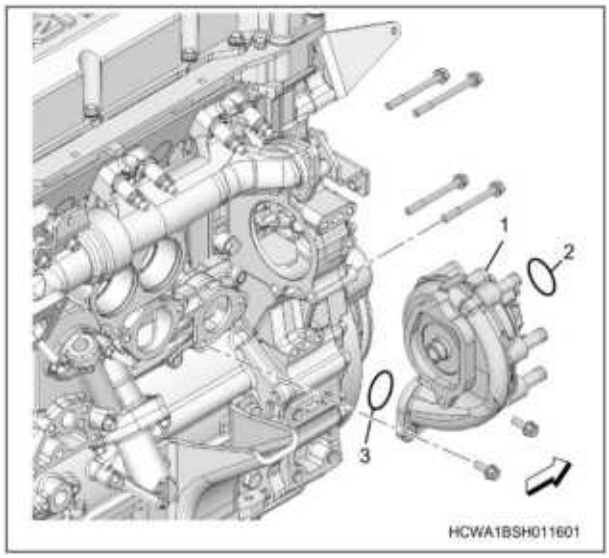
Tightening torque: 78 N • m { 8 kgf • m / 58 lb • ft }

2) Connect the harness connector to the oil filter warning switch.

6. Water pump installation

1) Install the O-ring and pump to the oil cooler.

Tightening torque: 39 N • m { 4.0 kgf • m / 29 lb • ft }



1. Water pump
2. O-ring
3. O-ring

7. Intake pipe installation

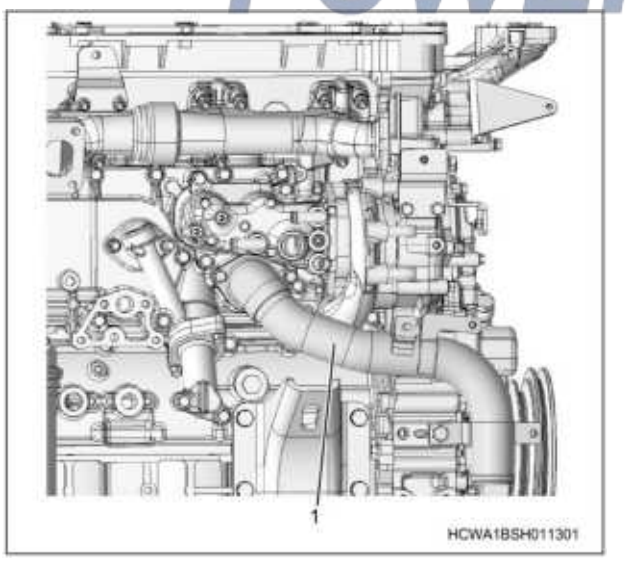
1) Install the water inlet pipe to the oil cooler.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

Oil cooler side

Tightening torque: 88 N • m {9.0 kgf • m / 65 lb • ft}

Gearbox side



1. Water inlet

8. Thermostat installation

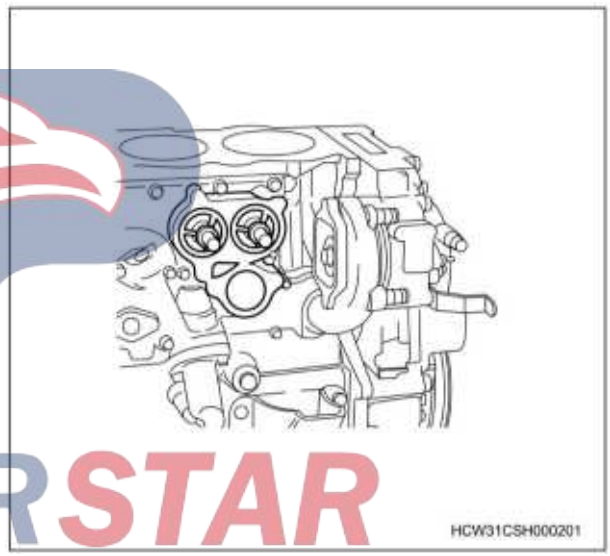
1) Install the thermostat seal ring on the oil cooler using a special tool.

SST: 1-8522-1034-0 - thermostat seal ring Installer

2) Mount the thermostat to the oil cooler.

Caution:

● Care should be taken when installing the seal ring to avoid damaging the seal ring.



9. Thermostat housing installation

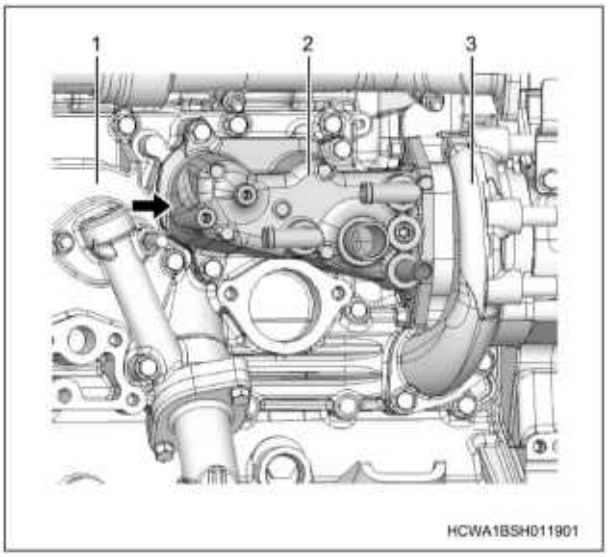
1) Install the o-rings and washers, and then install the thermostat housing on the oil cooler.

Note:

● While tightening the thermostat housing against the oil cooler, tighten the pump end bolts.

● Tighten the oil cooling bolt.

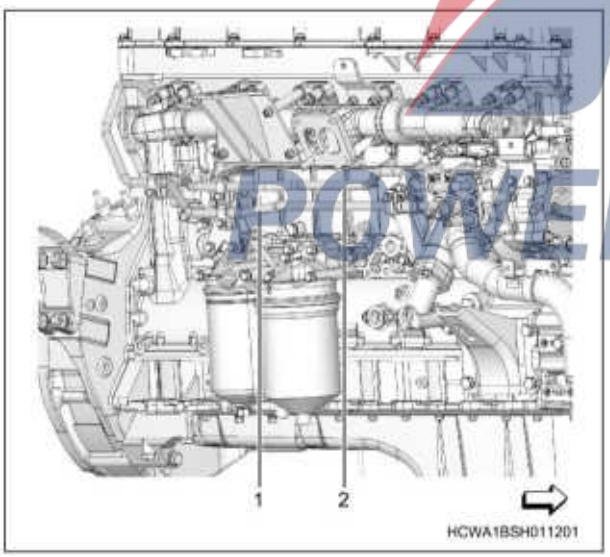
Tightening torque: 39 N • m { 4.0 kgf • m / 29 lb • ft }



1. Oil cooler
2. Thermostat housing
3. Water pump

10. EGR cooler water pipe installation

1) Install the front and rear EGR cooler pipes on the thermostat housing.

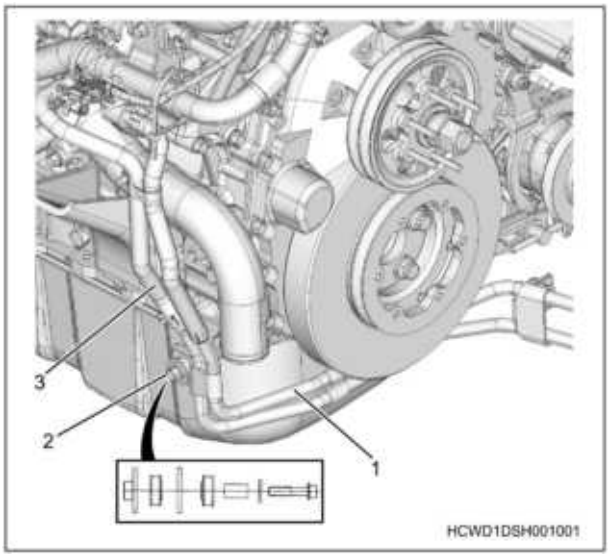


1. Back-end EGR cooler hose
2. EGR cooler hose

11. Heater hose installation

1) Mount the heater hose to the thermostat housing.

2) Install the clip on the heater hose.



1. Heater hose
2. Heater pipe bracket part
3. Heater pipe

12. Water charge pipe installation

1) Install the water filling pipe bracket on the water inlet pipe.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

2) Install the water fill line bracket on the exhaust gas recirculation valve conduit A.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

3) Install the water filling pipe on the filling pipe bracket.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

13. Turbocharger installation

1) Pour approximately 1 cc of the engine oil into the oil passage of the turbocharger.

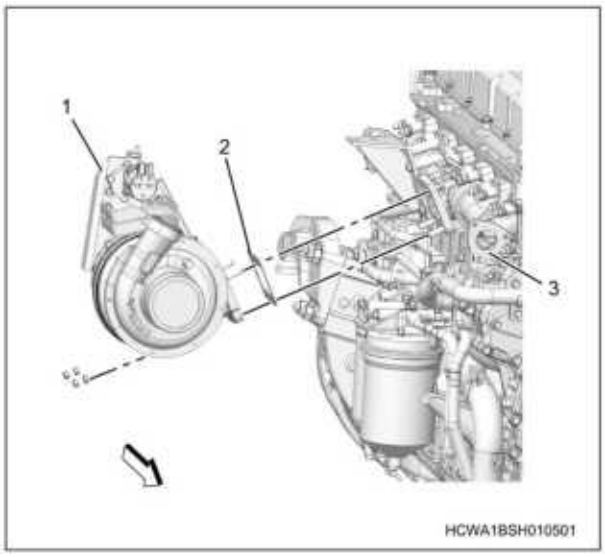
2) Install the gasket to the exhaust manifold.

3) Install the turbocharger to the exhaust manifold.

Note:

● Final tightening, then double nut tightening.

Tightening torque: 45 N • m { 4.6 kgf • m / 33 lb • ft }



1. Turbocharger
2. Gasket
3. Exhaust manifold

4) Connect the harness connector to the variable gear ratio steering actuator.

5) Install the water return pipe to the cylinder head.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

6) Connect the water return pipe to the turbocharger.

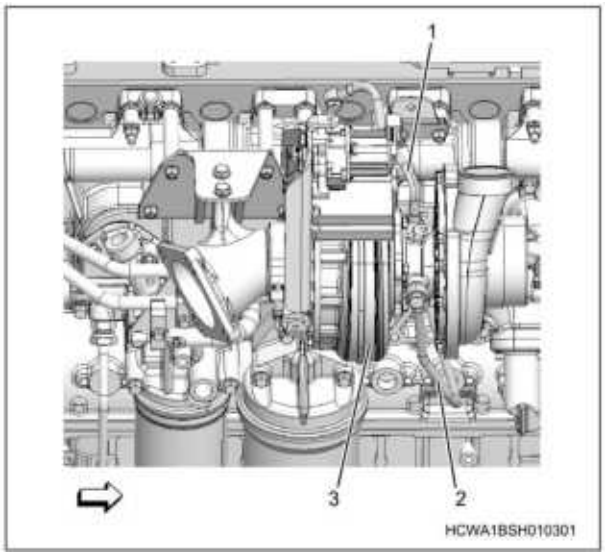
Tightening torque: 50 N • m {5.1 kgf • m / 37 lb • ft}

7) Install the water feed pipe to the cylinder block.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

8) Connect the water feed pipe to the turbocharger.

Tightening torque: 50 N • m {5.1 kgf • m / 37 lb • ft}



1. Water return pipe
2. Water feed pipe
3. Turbocharger

9) Install the O-rings to both ends of the oil return pipe.

10) Temporarily tighten the turbocharger's return line and bracket.

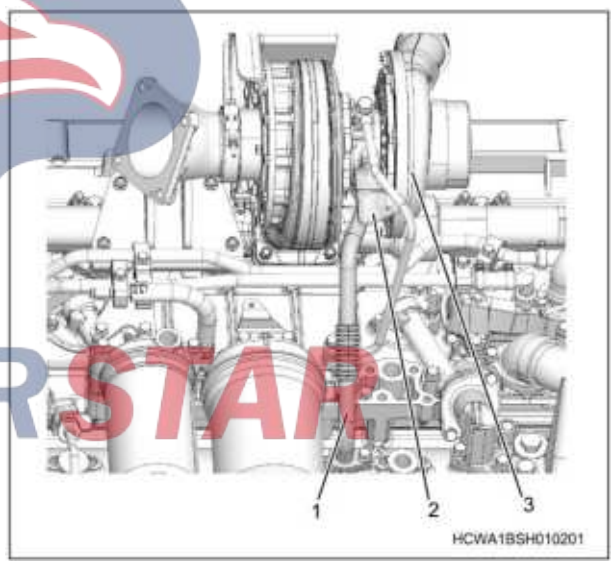
11) Temporarily tighten the oil return pipe to the cylinder block.

12) Final tighten the turbocharger's return line and bracket.

Tightening torque: 22 N • m {2.2 kgf • m / 16 lb • ft}

13) Securely tighten the oil return pipe to the cylinder block.

Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft}



1. Oil return pipe
2. Bracket
3. Turbocharger

14) Temporarily fasten the turbocharger fuel supply pipe to the turbocharger.

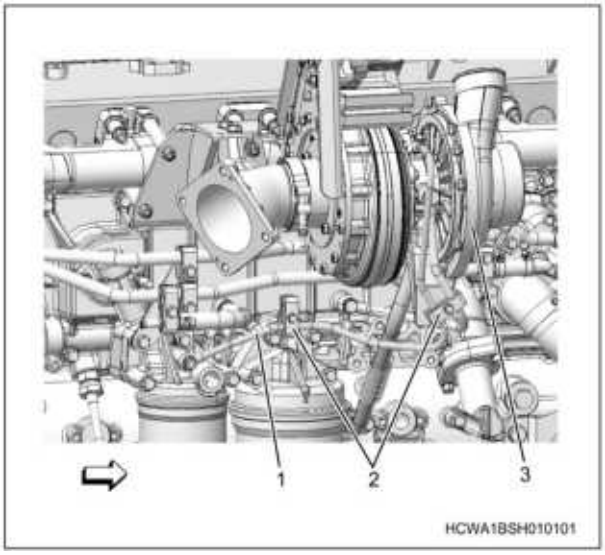
15) Temporarily fasten the turbocharger fuel supply pipe and 2 clips to the oil filter body.

16) Tighten the turbocharger fuel supply pipe to the turbocharger.

Tightening torque: 34 N • m {3.5 kgf • m / 25 lb • ft}

17) Tighten the turbocharger fuel supply tube to the oil filter body finally.

Tightening torque: 34 N • m { 3.5 kgf • m / 25 lb • ft }



1. Turbocharger oil feed pipe
2. Clip
3. Turbocharger

18) Install the turbocharger exhaust pipe on the turbocharger.

19) Install the V-belt on the turbocharger exhaust pipe and turbocharger.

Tightening torque: 10 N • m {1.0 kgf • m / 86 lb • in}

14. Exhaust cover installation

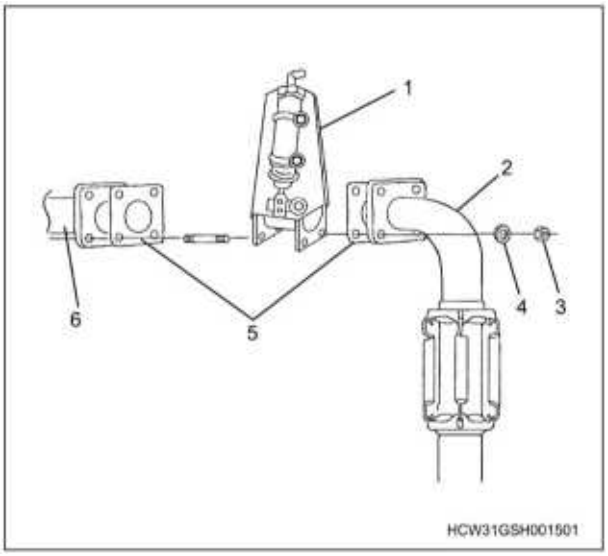
1) Install the gaskets, exhaust brake valves, and front exhaust pipe to the exhaust pipe A adapter.

Caution:

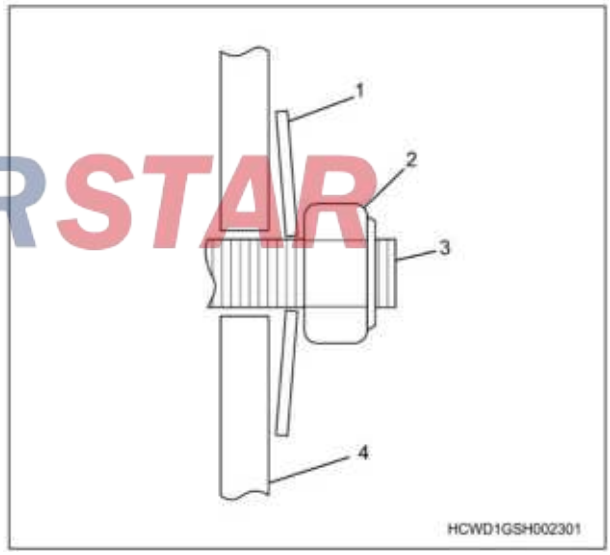
● Uniformly tighten the mounting nuts and bolts of the front exhaust pipe A, and make sure that there are no gas leaks.

● Install the washer with the convex section facing the nut side.

Tightening torque: 59 N • m {6.0 kgf • m / 44 lb • ft}



1. Exhaust brake valve
2. Front exhaust pipe A
3. Nut
4. Washer
5. Gasket
6. Turbocharger exhaust pipe



1. Washer
2. Nut
3. Stud
4. Flange

2) Connect the air hose to the exhaust brake valve.

15. Exhaust cover installation

1) Install the exhaust cover to the frame.

16. Noise shutter panel installation

1) Install the noise shutter panel on the right side of the vehicle to the frame.

2) Install the noise shutter panel on the left side of the vehicle to frame.

17. Mud guard installation

1) Install the mudguard on the right side of the vehicle to the bracket.

2) Install the mudguard on the left side of the vehicle to the bracket.

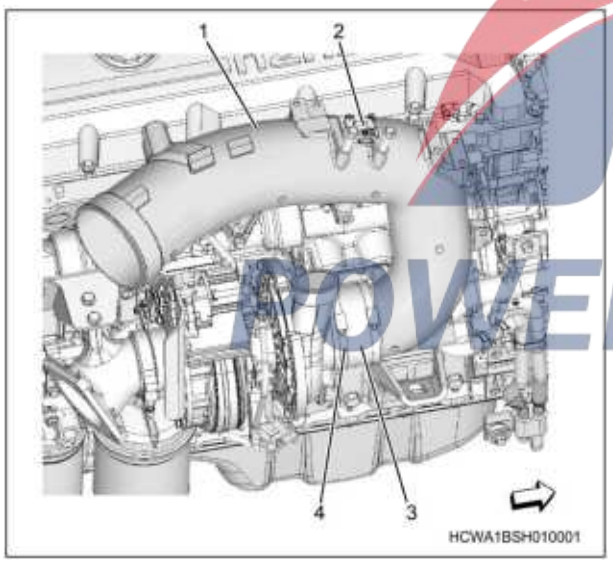
18. Air duct installation

1) Temporarily install the rubber hose and clips on the turbocharger.

2) Install the air line to the rubber hose.

Tightening torque: 39 N • m { 4.0 kgf • m / 29 lb • ft }

M10



1. Air duct

2. Mass air flow and intake air temperature sensor

3. Rubber hose

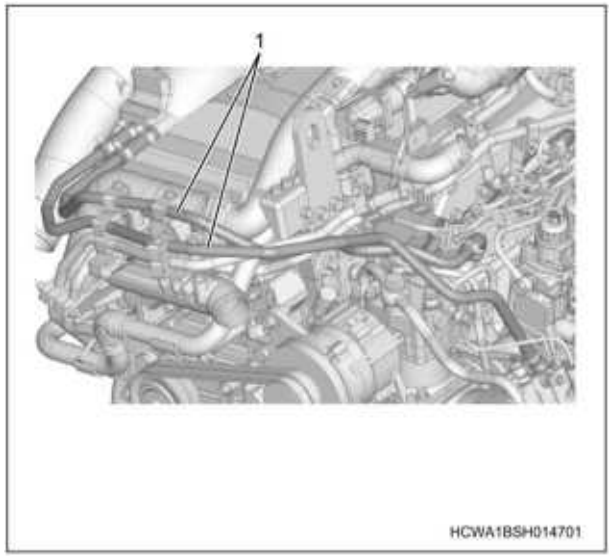
4. Hose clip

3) Connect the air cleaner duct to the air cleaner and turbocharger.

4) Connect the harness connector to the mass air flow sensor and intake air temperature sensor.

5) Install the thermal protection on the air duct.

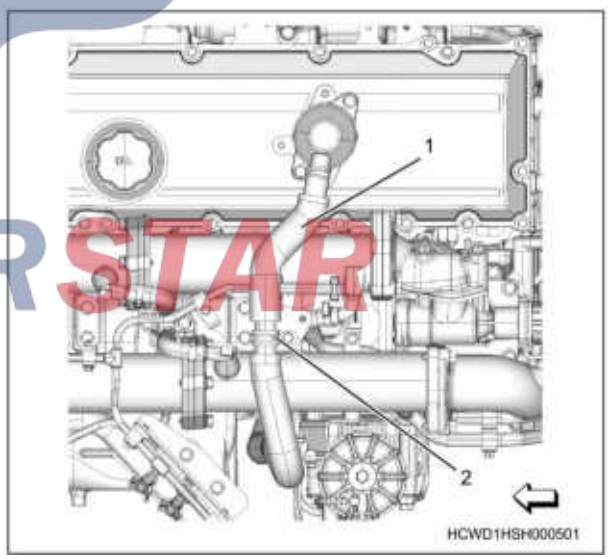
6) Connect the air compressor suction tube to the air duct.



1. Air compressor suction pipe

19. Ventilation hose connect

1) Connect the ventilation hose to the cylinder head cover.



1. Ventilation hose

2. Ventilation hose clip

20. Radiator upper hose installation

1) Connect the radiator air leak hose to the radiator.

2) Install the radiator upper hose to the water outlet duct and the radiator.

Tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}

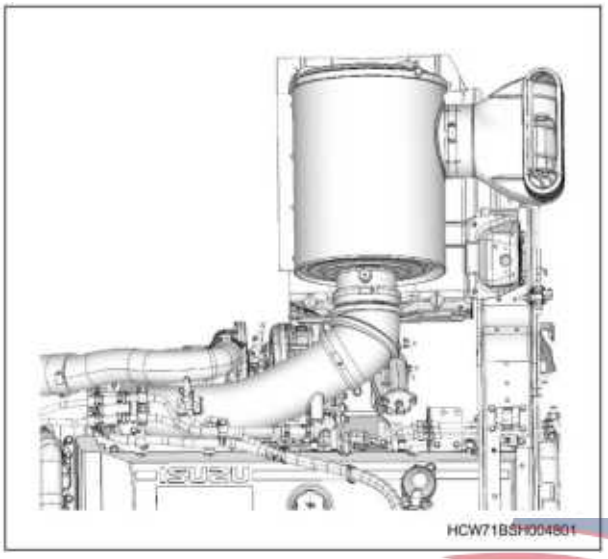
21. Air cleaner installation

1) Mount the bracket to the frame.

2) Install the air cleaner cover to the frame.

3) Install the air cleaner to the air cleaner cover.

4) Connect the air cleaner duct to the air cleaner.



22. Intercooler hose installation

1) Install the air intake duct to the turbocharger and to the intake side of the intercooler hose.

Tightening torque: 39 N • m { 4.0 kgf • m / 29 lb • ft }

M10

Tightening torque: 8 N • m { 0.8 kgf • m / 71 lb • in }

Turbocharger side clamp

23. Engine oil filling

1) Check the tightening of the oil drain plug.

Tightening torque: 78 N • m { 8.0 kgf • m / 58 lb • ft }

2) Replenish the engine with the engine oil.

24. Coolant filling

1) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Slowly fill with water to avoid air intrusion.

2) Press the radiator upper hose manually several times to remove the air from the hose.

3) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Repeat the operation until the water level no longer drops.

4) Install sub-tank cap to radiator.

5) Start and idle the engine.

Caution:

● Idle the engine for 5 minutes or more.

6) Stop the engine.

7) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

8) Add coolant up to the MAX level of the radiator sub-tank.

9) Install sub-tank cap to radiator.

10) Turn OFF the heater fan switch.

11) Start the engine.

12) Raise the engine speed.

Note:

● Increase the engine speed to around 2000 rpm and run the engine for 5 minutes once the needle of the engine coolant temperature gauge reaches the center.

13) With the engine running, check that the thermostat valve is open.

Note:

● Touch the radiator upper hose, and verify that it has become warm.

Caution:

● If the radiator upper hose has not become warm, raise engine speed to warm it up.

● Do not diagnose only by the engine coolant temperature gauge and the hot air coming out from the heater.

14) Idle the engine for 5 minutes.

15) Stop the engine.

16) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

17) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● If the water level of the sub-tank lowered the next morning, add water up to the MAX line.

25. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

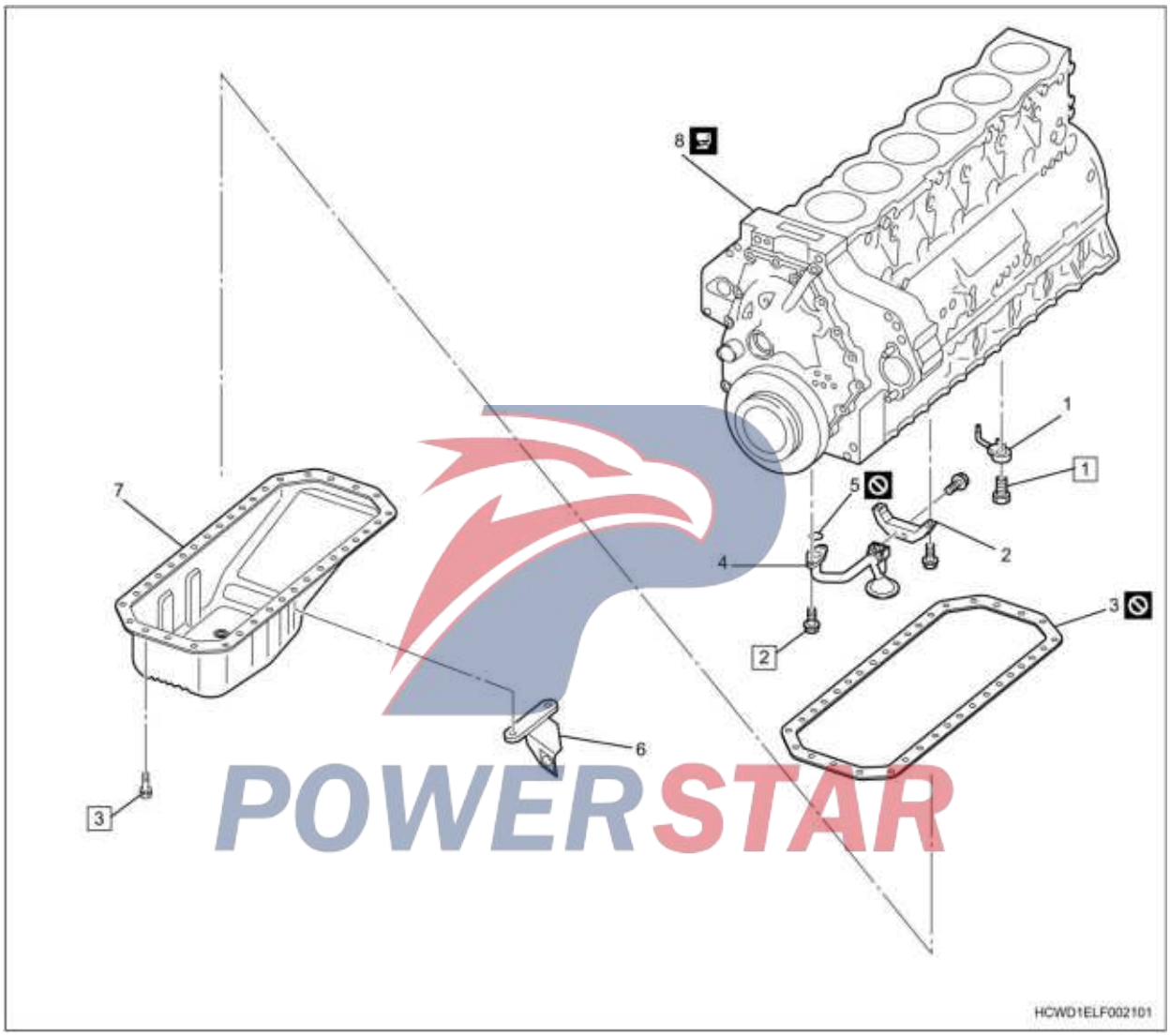
2) Lower the cab, and close the front lid.

Oil Pan

Removal

1. Component Views

Oil Pan



Part name

1. Piston oil nozzle
2. Oil strainer bracket
3. Oil pan gasket
4. Oil strainer filter
5. O-ring
6. Power steering oil pipe bracket
7. Oil pan
8. Cylinder block

Tightening torque

1: 69 N • m {7.0 kgf • m / 51 lb • ft}

2: 49 N • m {5.0 kgf • m / 36 lb • ft}

3: 38 N • m {3.9 kgf • m / 28 lb • ft}

2. Engine oil drain

1) Remove the drain plug from the oil pan, and drain the engine oil to a pan.

2) Install the drain plug to the oil pan.

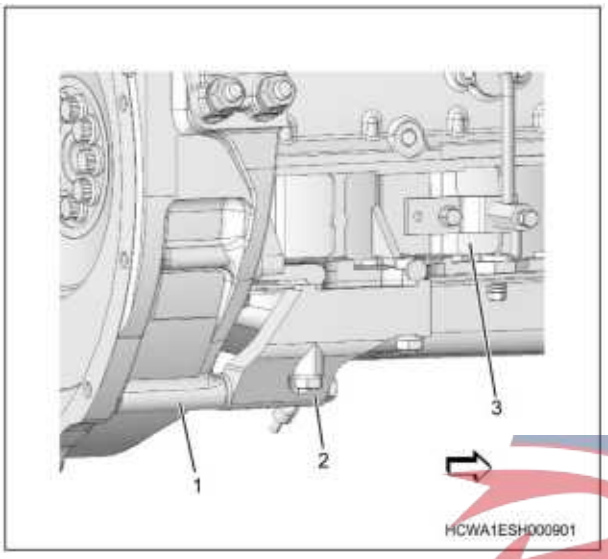
Caution:

● Do not forget to tighten the drain plug.

Tightening torque: 78 N • m {8.0 kgf • m / 58 lb • ft}

3. Oil pan removal

1) Remove the left and right flywheel housing brackets from the cylinder block and flywheel housing.



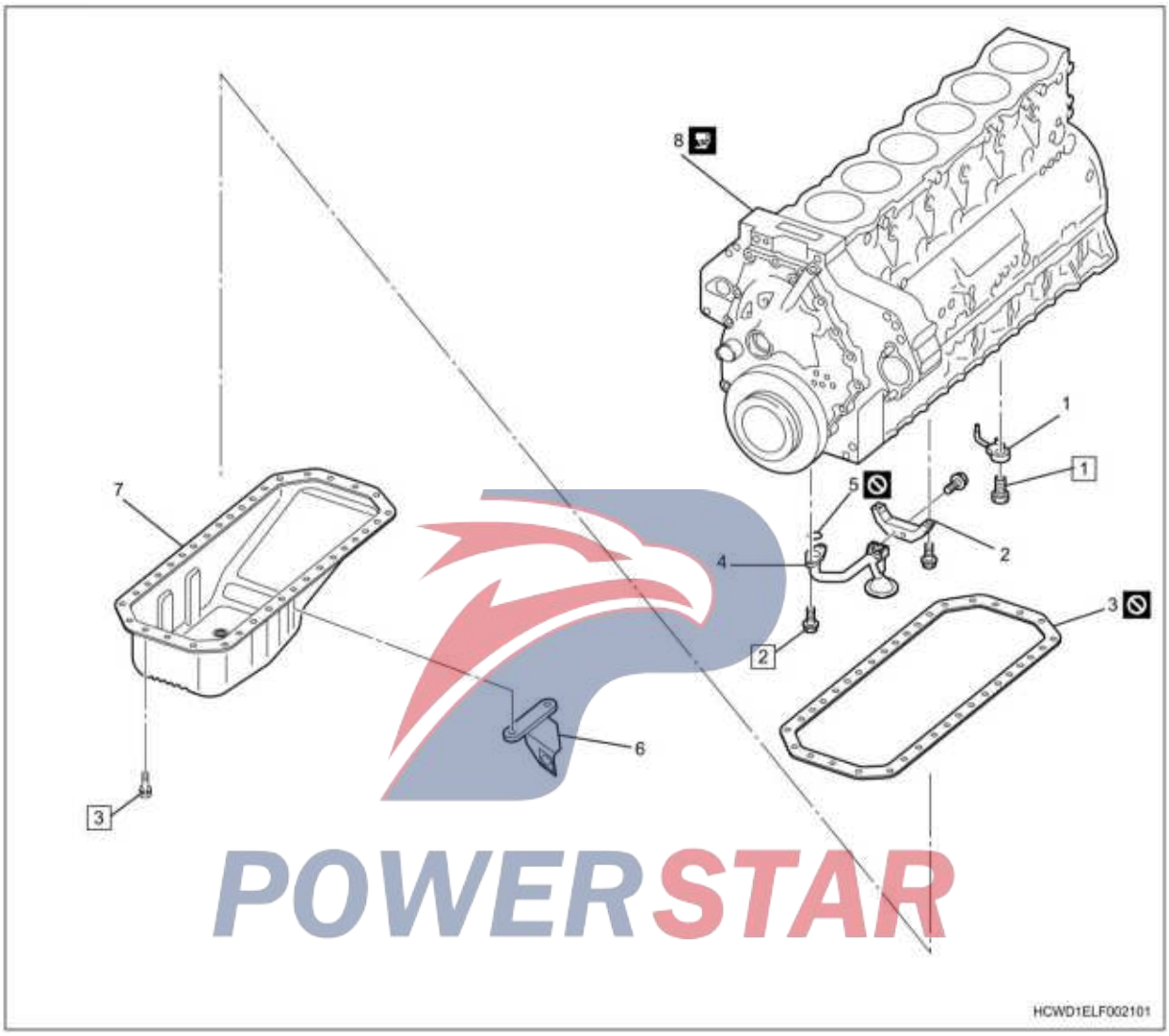
1. Flywheel housing
2. Flywheel housing bracket
3. Cylinder block

2) Remove the oil pan from the cylinder block.

Installation

1. Component Views

Oil Pan



Part name

1. Piston oil nozzle
2. Oil strainer bracket
3. Oil pan gasket
4. Oil strainer filter
5. O-ring
6. Power steering oil pipe bracket
7. Oil pan
8. Cylinder block

Tightening torque

1: 69 N • m {7.0 kgf • m / 51 lb • ft}

2: 49 N • m {5.0 kgf • m / 36 lb • ft}

3: 38 N • m {3.9 kgf • m / 28 lb • ft}

2. Oil pan installation

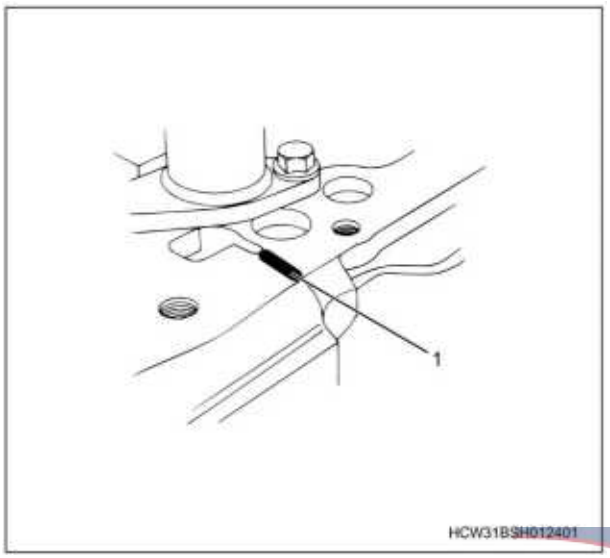
1) apply the liquid gasket to the cylinder block.

Note:

● Three key 1207B with a coating thickness of 3 - 4 mm {0.118 - 0.157 in} and a width of 3-4 mm {0.118 - 0.157 in} on the locating surface of the flywheel housing, gearbox and cylinder block.

Caution:

● Clean the application surface of the gasket before applying the gasket.



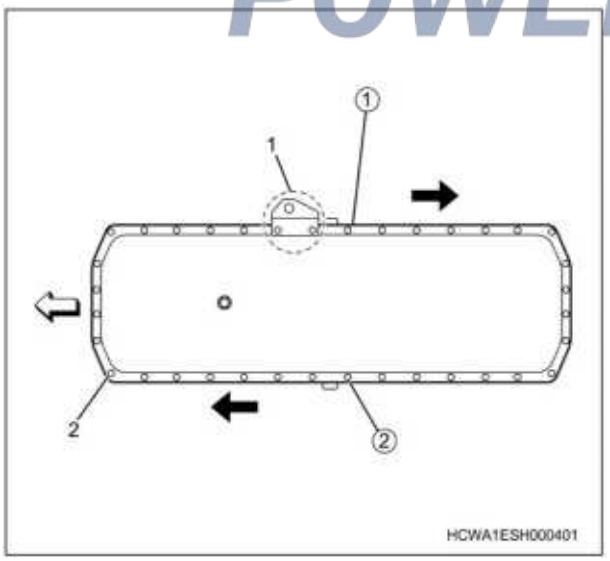
1. Liquid gasket

2) Install the oil pan to the cylinder block in the order of numbers and arrows shown in the diagram.

Caution:

● After tightening all the bolts, tighten all the bolts again with the specified torque from the first tightened bolt.

Tightening torque: 38 N • m {3.9 kgf • m / 28 lb • ft}

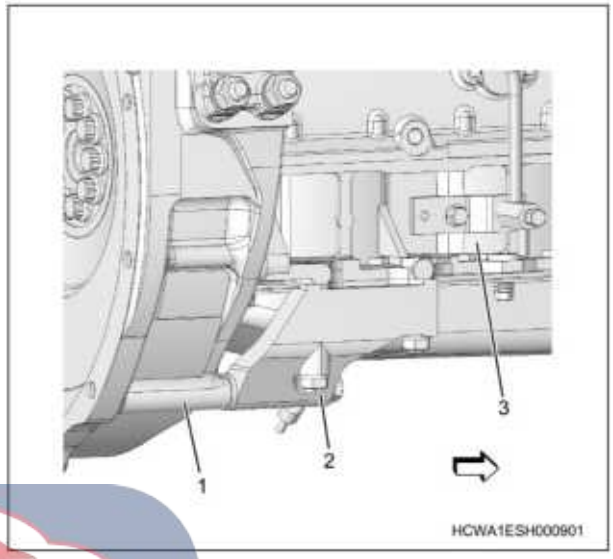


1. M10×35

2. M10×20

3) Install the left and right flywheel housing brackets onto the cylinder block and flywheel housing.

Tightening torque: 113 N • m {11.5 kgf • m / 83 lb • ft}



1. Flywheel housing

2. Flywheel housing bracket

3. Cylinder block

3. Engine oil filling

1) Check the tightening of the oil drain plug.

Tightening torque: 78 N • m { 8.0 kgf • m / 58 lb • ft }

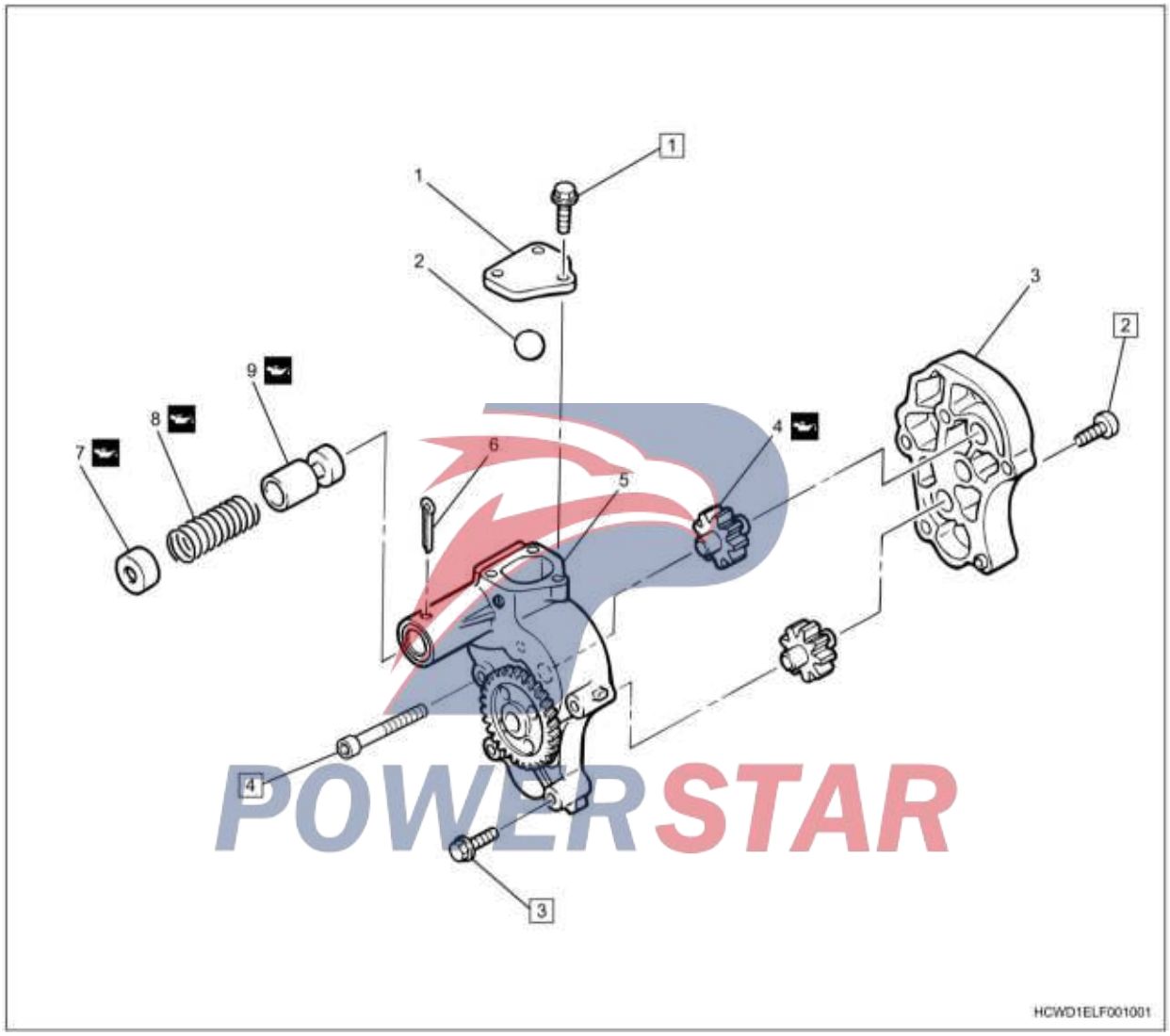
2) Replenish the engine with the engine oil.

Oil pump

Removal

1. Component Views

Oil pump



Part name	Tightening torque
1. Cover	1: 18 N • m { 1.8 kgf • m / 13 lb • ft }
2. Ball	2: 18 N • m { 1.8 kgf • m / 13 lb • ft }
3. Oil pump cover	3: 49 N • m { 5.0 kgf • m / 36 lb • ft }
4. Driven gear	4: 39 N • m { 4.0 kgf • m / 29 lb • ft }
5. Oil pump body	2. Battery cable disconnect
6. Cotter pin	1) Open the front lid, and tilt the cab.
7. Spring seat	2) Disconnect the battery cable from the negative terminal of the battery.
8. Spring	3. Coolant drain
9. Drain valve	

Warning:

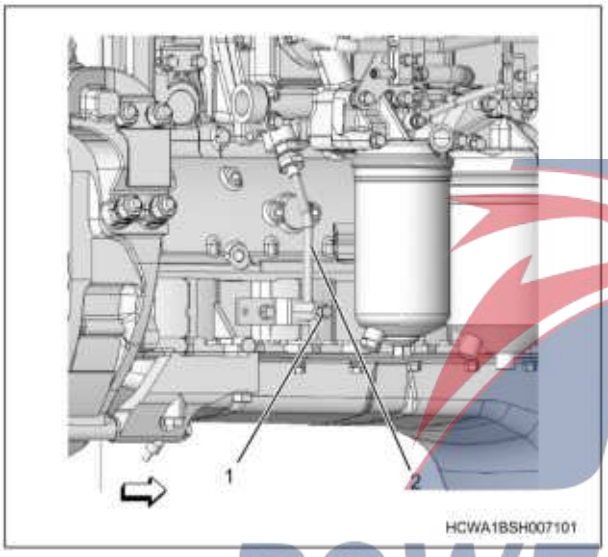
● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

1) Press the sub-tank cap button to release internal pressure.

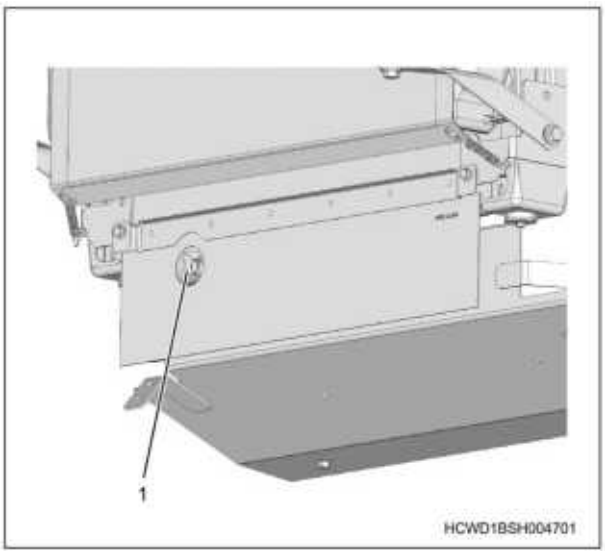
2) Remove sub-tank cap from radiator.

3) Loosen the drain plug on the cylinder block side, and drain the coolant to a pan.



1. Drain plug
2. Drain pipe

4) Loosen the radiator side drain plug, and drain the coolant to a pan.



1. Drain plug

5) Tighten the radiator side drain plug.

6) Tighten the drain plug on the cylinder block side.

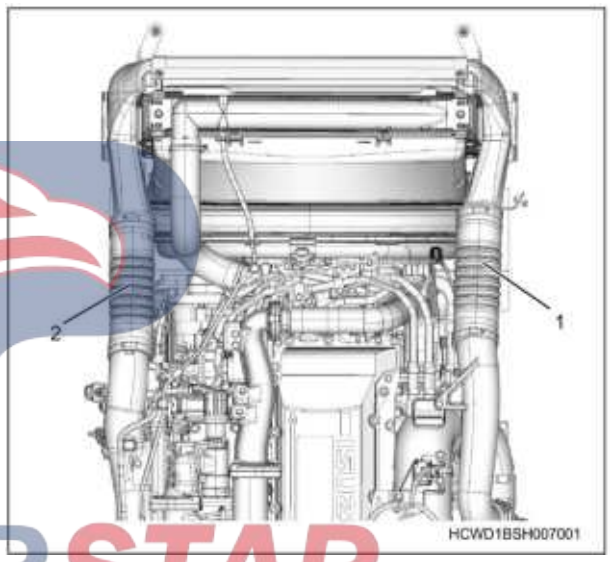
7) Install sub-tank cap to radiator.

4. Intercooler hose removal

1) Disconnect the intercooler hose on the intercooler outlet side from the intercooler.

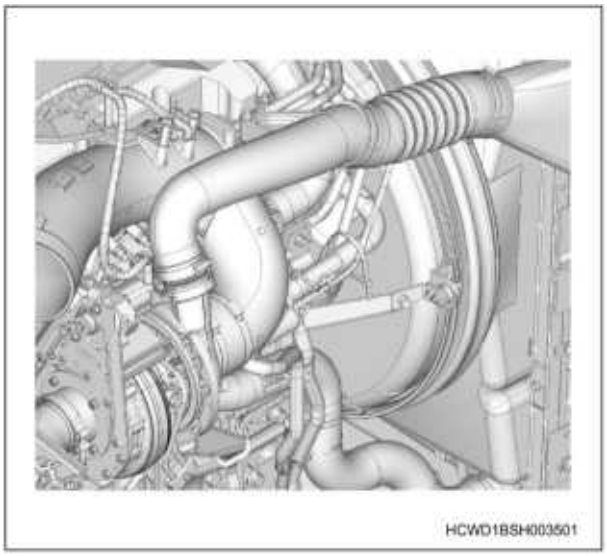
2) Remove the intercooler hose outlet on the intake line.

3) disconnect the intercooler hose on the intercooler inlet side from the intercooler.



1. Intercooler hose on the intercooler inlet side
2. Intercooler hose on the intercooler outlet side

4) Remove the intake duct from the turbocharger and the intake end of the intercooler hose.



5. Radiator upper hose removal

1) Remove the radiator upper hose from the water

2) Remove the radiator upper hose from the radiator.

3) Disconnect the radiator air leak hose from the radiator.

6. Radiator lower hose removal

1) Remove the radiator lower hose from the water intake pipe and the radiator.

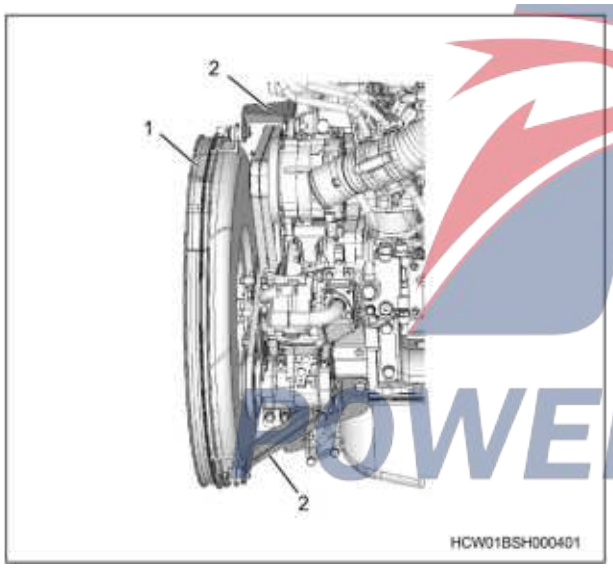
2) Remove the radiator lower hose from the radiator.

7. Radiator fan cover disconnection

1) Disconnect the fan guide bracket from the engine.

Caution:

● Do not remove the fan duct connected to the air duct bracket.



1. Fan guide

2. Fan guide bracket

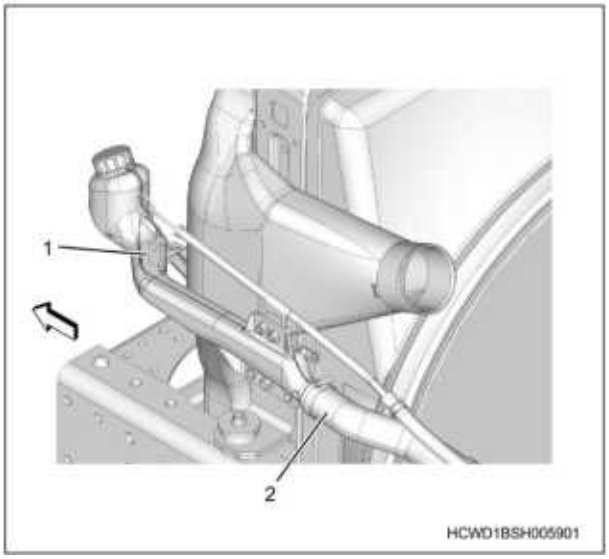
2) Disconnect the radiator fan cover from the fan guide cover.

8. Cooling fan removal

1) Remove the fan duct and cooling fan from the fan pulley.

9. Refueling pipe removal

1) Remove the fuel line and rubber hose from the timing gearbox.



1. Fuel pipeline

2. Rubber hose

10. Intercooler removal

1) Remove the intercooler from the radiator.

Caution:

● Remove the fin without damaging it.

11. Radiator removal

1) Remove the radiator stay from the radiator.

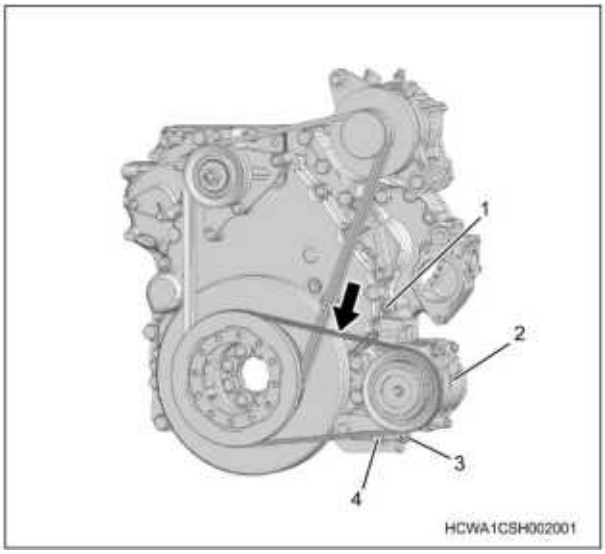
2) Remove the radiator from the frame.

Caution:

● Remove the fin without damaging it.

12. A / C compressor drive belt removal

1) Loosen the nuts and the auxiliary bolts and then remove the A / C compressor drive belt of the A / C compressor and crankshaft pulley.



1. Bolt

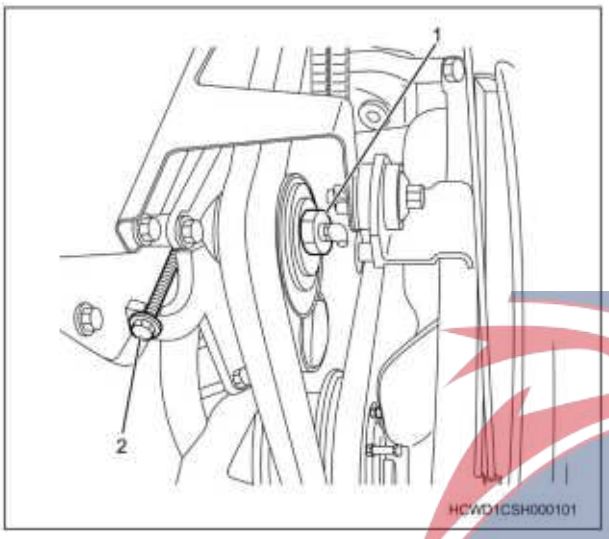
2. A / C compressor

3. Adjust bolt

4. Nut (back end)

13. Cooling fan belt removal

1) Loosen the lock nut and adjustment screw to remove the cooling fan drive belt from the generator and crankshaft pulley.



1. Lock nut

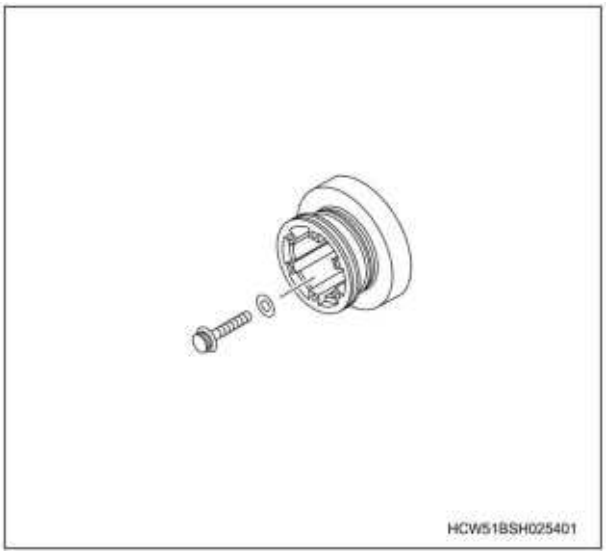
2. Adjust bolt

14. Crankshaft pulley removal

1) Remove the crankshaft pulley from the crankshaft.

Caution:

● Do not damage the sealing surface or excessive force on the pump body.



15. Idle gear removal

1) Remove the idler gear from the gearbox cover.

16. A / C compressor bracket removal

1) Remove the air conditioner compressor bracket and idler gear from the timing gearbox.

17. Gearbox cover removed

1) Remove the gearbox cover from the timing gearbox.

2) Remove the gasket from the gearbox cover.

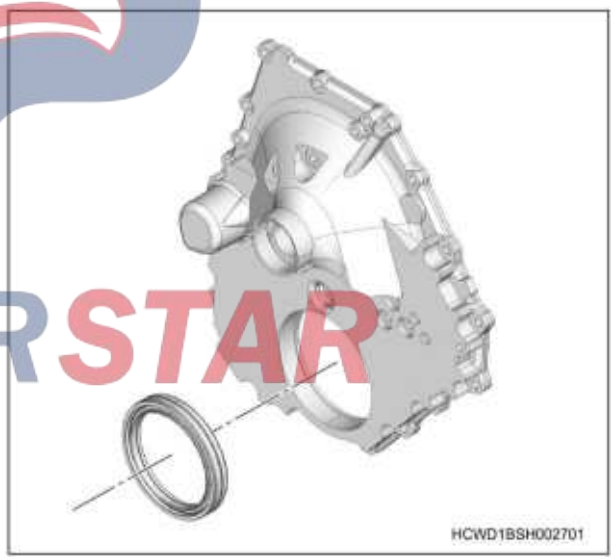
18. Crankshaft oil seal removed

1) Remove the crankshaft front oil seal from the gearbox cover.

Caution:

● Do not damage the oil seal pressure mounting surface.

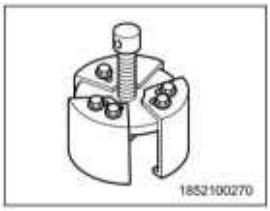
● Do not reuse the slinger or oil seal.



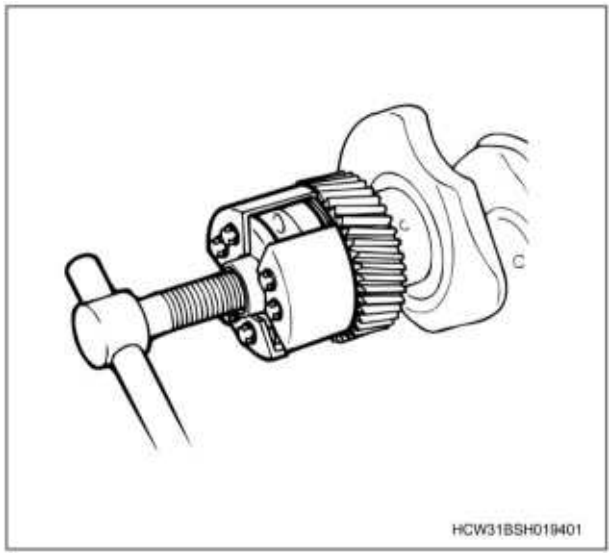
2) Use a special tool to remove the oil deflector from the crankshaft.

Note:

● If removing the oil deflector can be easily removed, use the fastening tape to fasten the outer circumference of the clamp to improve its operational reliability.



SST: 1-8521-0027-0 - Sleeve Removal Unit



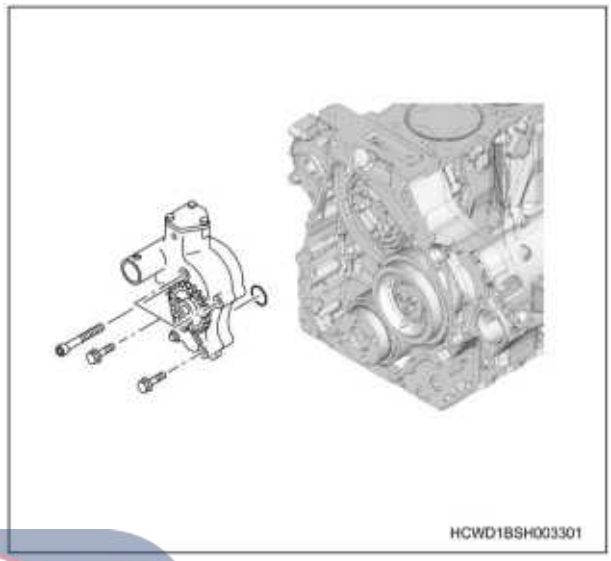
19. Oil pump removal

1) Remove the oil pump from the cylinder block.

Caution:

● Do not remove the bolt with the yellow mark on the top.

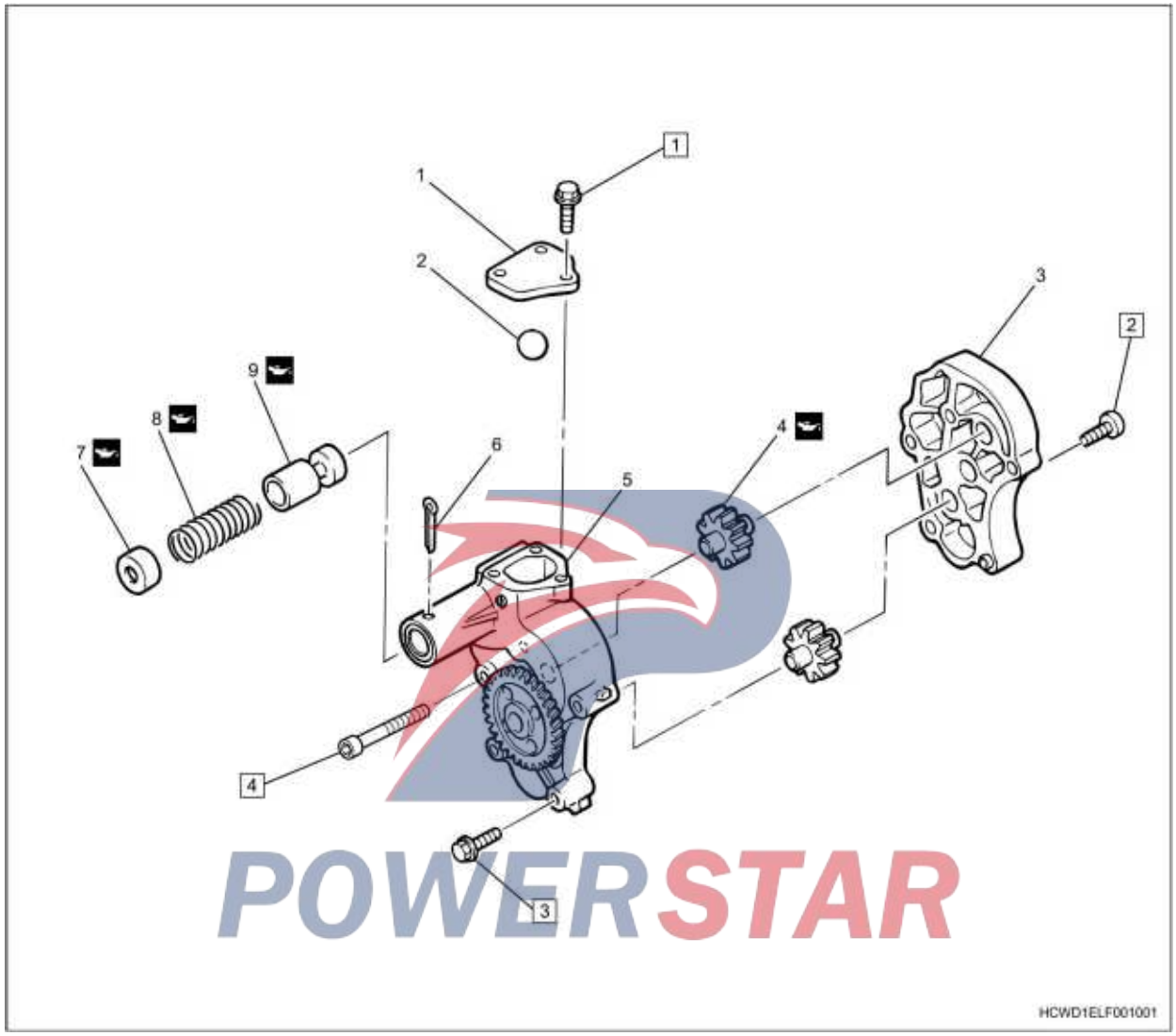
2) Remove the O-ring from the oil pump.



Removal

1. Component Views

Oil pump



Part name

1. Cover
2. Ball
3. Oil pump cover
4. Driven gear
5. Oil pump body
6. Cotter pin
7. Spring seat
8. Spring
9. Drain valve

Tightening torque

1: 18 N • m {1.8 kgf • m / 13 lb • ft}

2: 18 N • m {1.8 kgf • m / 13 lb • ft}

3: 49 N • m {5.0 kgf • m / 36 lb • ft}

4: 39 N • m {4.0 kgf • m / 29 lb • ft}

2. Oil pump removal

1) Remove the cover from the oil pump body.

2) Remove the oil pump body roller.

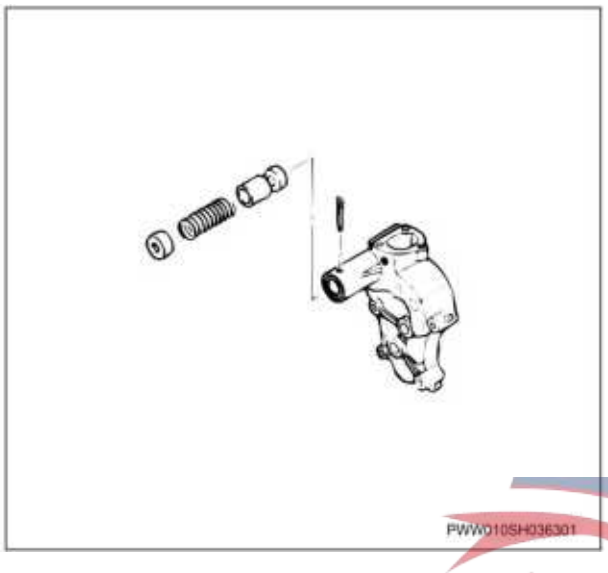
3) Remove the cotter and then remove the following parts from the pump body.

- Spring seat
- Spring

● Oil drain valve

Caution:

● Removing the cotter pin may cause the spring to pop up, taking care to avoid losing it.



4) Remove the oil pump cover from the pump body.

5) Remove the driven gear from the pump body.

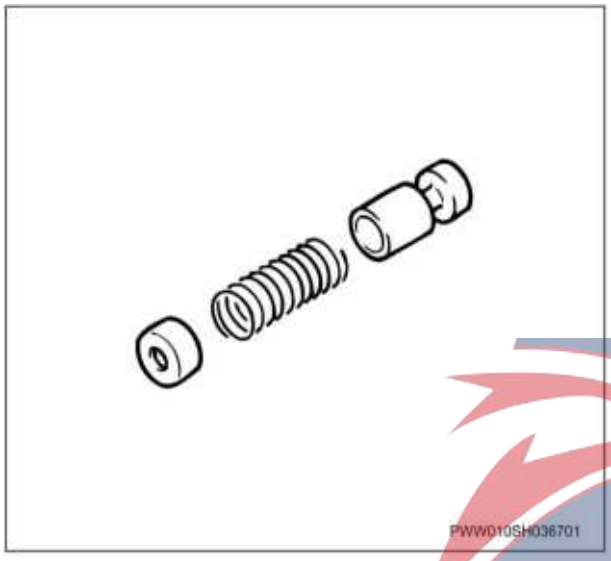
Inspection

1. Oil pump inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

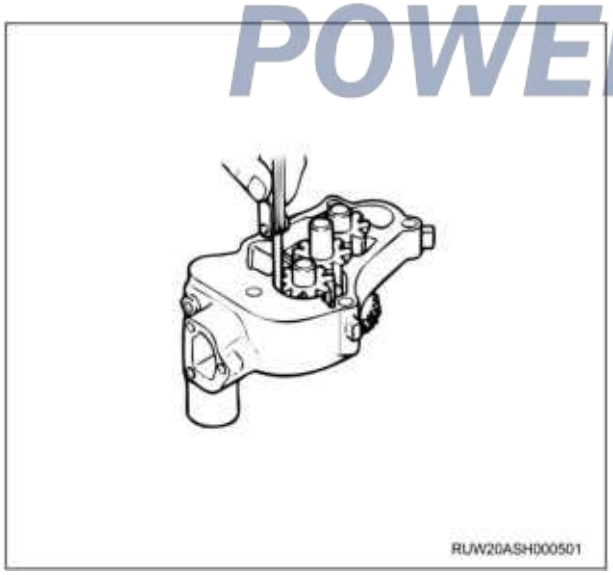
1) Check the drain valve is damaged.

2) Check if the spring is damaged.



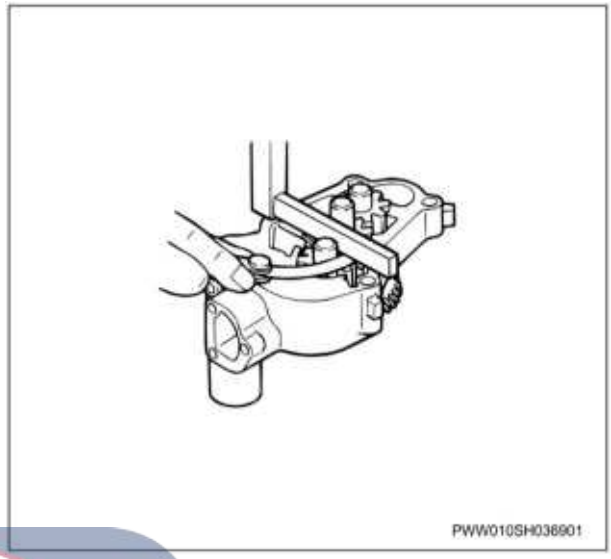
3) Measure the clearance between oil pump body wall and gear.

Standard: 0.050 to 0.098mm {0.0020 to 0.0039in}



4) Measure the clearance between oil pump cover and gear.

Standard: 0.040 to 0.094mm {0.0016 to 0.0037 in}



5) Measure the outer diameter of driven gear shaft.

Standard: 20 mm {0.8 in}

Limit: 19.9 mm {0.78 in}

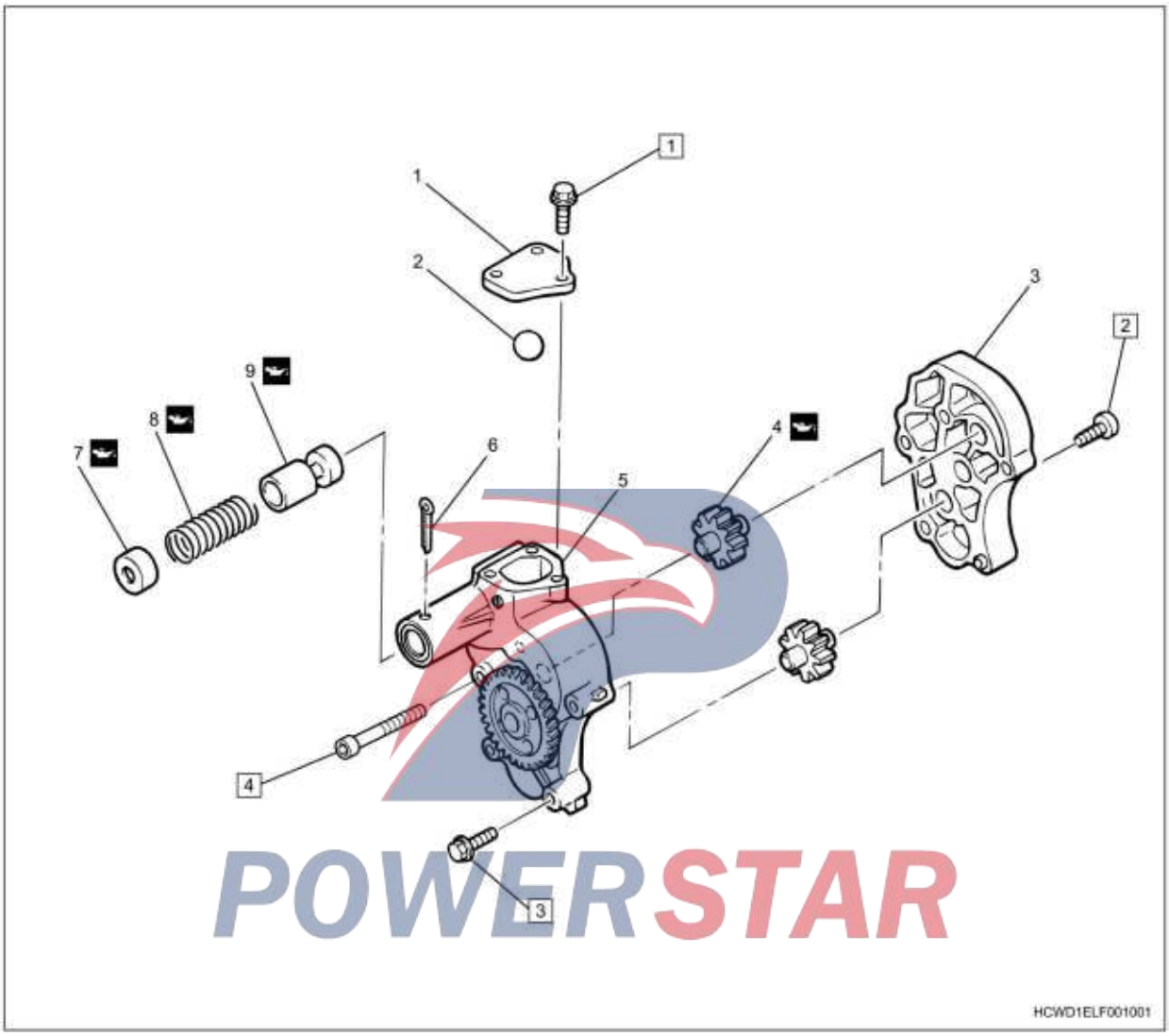
6) Measure the inner diameter of the driven gear shaft mounting boss on one side of the oil pump body and calculate the clearance.

Gap: 0.040 to 0.074 mm {0.0016 to 0.0029 in}

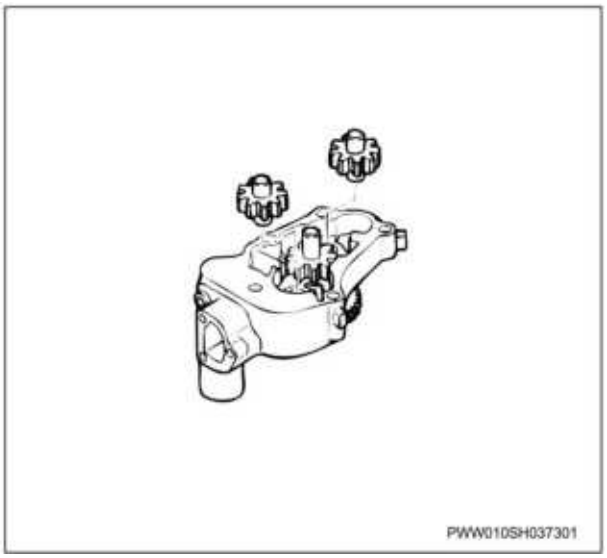
Reassembly

1. Component Views

Oil pump



Part name	Tightening torque
1. Cover	1: 18 N • m {1.8 kgf • m / 13 lb • ft}
2. Ball	2: 18 N • m {1.8 kgf • m / 13 lb • ft}
3. Oil pump cover	3: 49 N • m {5.0 kgf • m / 36 lb • ft}
4. Driven gear	4: 39 N • m {4.0 kgf • m / 29 lb • ft}
5. Oil pump body	2. The oil pump is reassembled
6. Cotter pin	1) Apply the engine oil to the driven gear.
7. Spring seat	2) Mount the driven gear to the oil pump body.
8. Spring	
9. Drain valve	



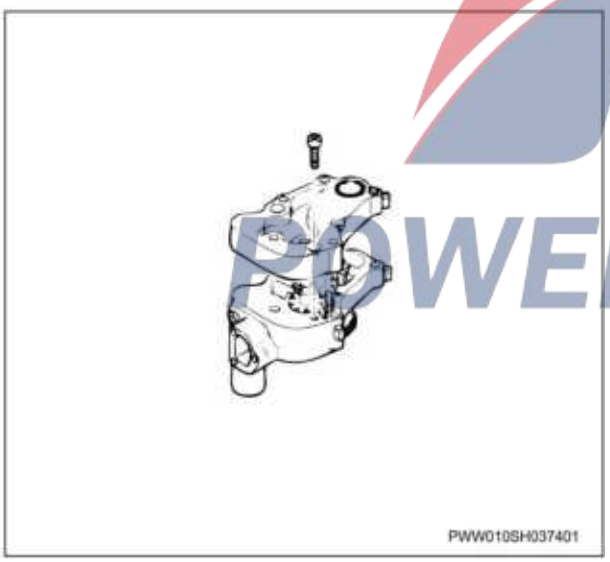
3) Install the pump cover onto the pump body.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

M10

Tightening torque: 18 N • m {1.8 kgf • m / 13 lb • ft}

M8

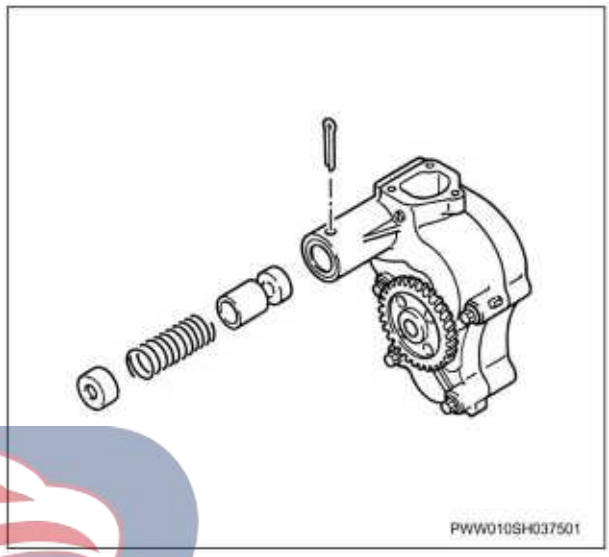


4) Apply the following areas with engine oil.

- Oil drain valve
- Spring
- Spring seat

5) Install the following parts and install the split pin to the oil pump body.

- Oil drain valve
- Spring
- Spring seat



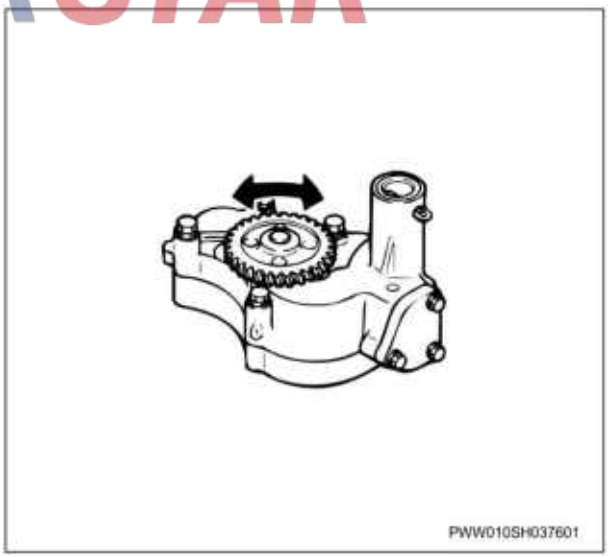
6) Install the ball onto the pump body.

7) Install the cover on the pump body.

Tightening torque: 18 N • m {1.8 kgf • m / 13 lb • ft}

Caution:

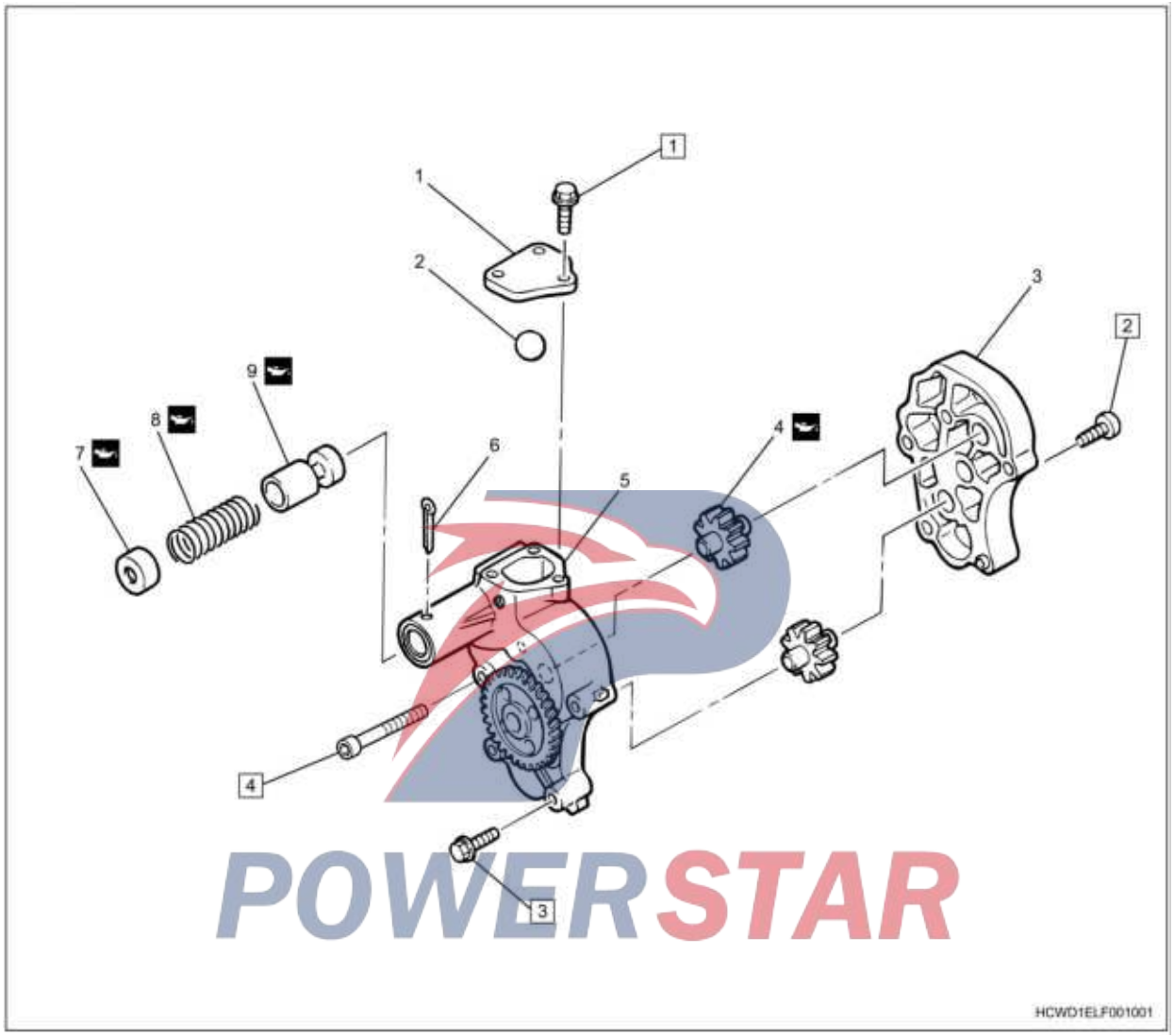
- After assembling the oil pump, manually rotate the transmission gear to ensure smooth rotation.



Installation

1. Component Views

Oil pump



Part name

1. Cover
2. Ball
3. Oil pump cover
4. Driven gear
5. Oil pump body
6. Cotter pin
7. Spring seat
8. Spring
9. Drain valve

Tightening torque

1: 18 N • m {1.8 kgf • m / 13 lb • ft}

2: 18 N • m {1.8 kgf • m / 13 lb • ft}

3: 49 N • m {5.0 kgf • m / 36 lb • ft}

4: 39 N • m {4.0 kgf • m / 29 lb • ft}

2. Oil pump installation

1) Install the O-ring onto the pump.

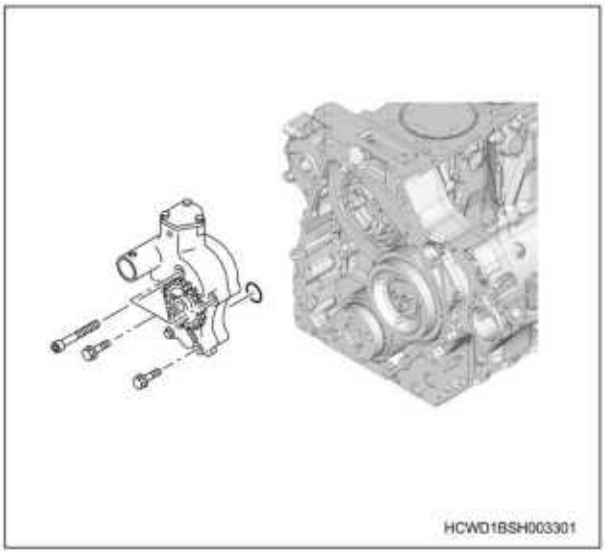
2) Install the pump to the cylinder block.

Caution:

● Do not tighten the screws marked with yellow on the top.

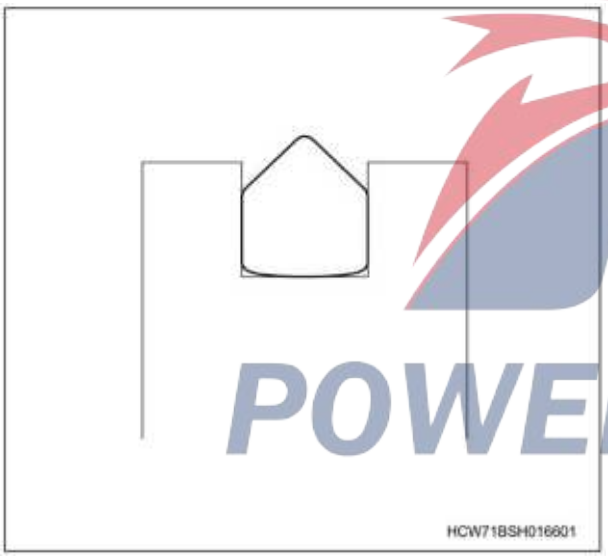
Tightening torque: 49 N • m {5 kgf • m / 36 lb • ft} hex bolts

Tightening torque: 39 N • m {4 kgf • m / 29 lb • ft} Socket head cap screws



3. Gear box cover installed

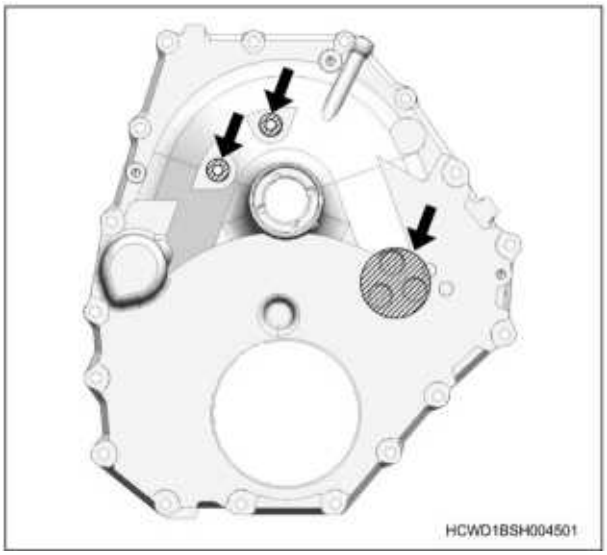
1) Install the gasket on the gear box cover.



2) Use a liquid seal on the gearbox cover.

Note:

● Apply FMD127 to the back of the diagonally marked gearbox cover in the chart.



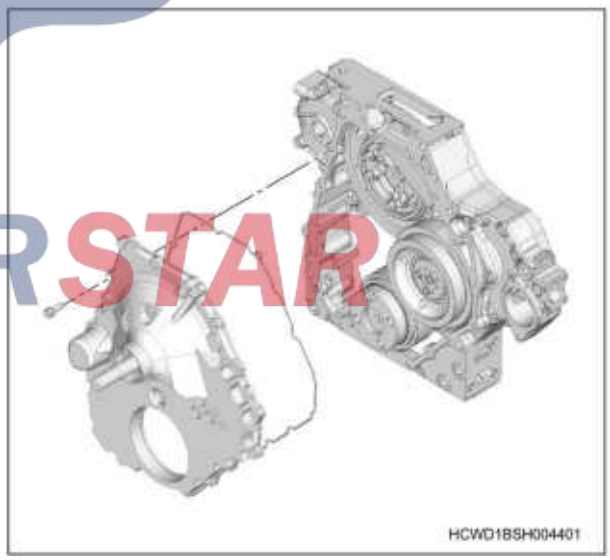
3) Install the gearbox cover onto the timing gearbox.

Tightening torque: 43 N • m {4.4 kgf • m / 32 lb • ft}

M10

Tightening torque: 26 N • m {2.7 kgf • m / 19 lb • ft}

M8



4. Crankshaft front oil seal installation

1) Thinly apply engine oil to the outer circumference of the crankshaft front oil seal.

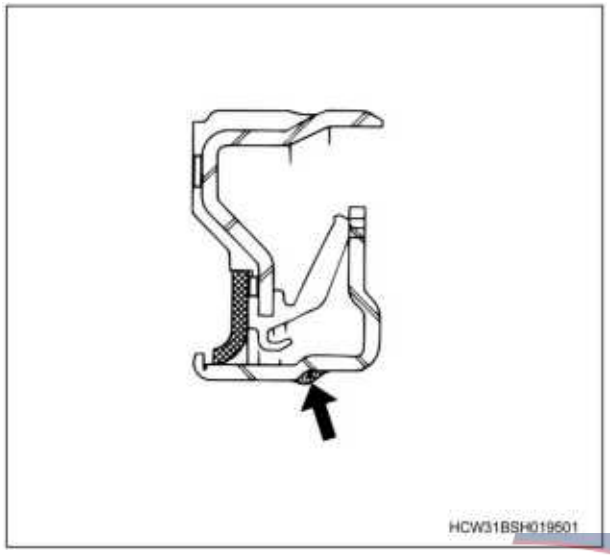
2) Install the crankshaft front oil seal to the front cover with the slinger as a set using the special tool.

Caution:

● Do not disassemble the oil seal and the slinger, and install them at the same time.

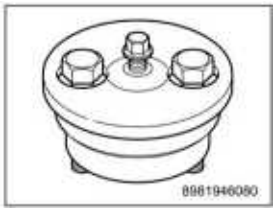
● Do not damage the oil seal.

● If there is scarring on the crankshaft, apply ThreeBond 1207C to the area as shown in the diagram.



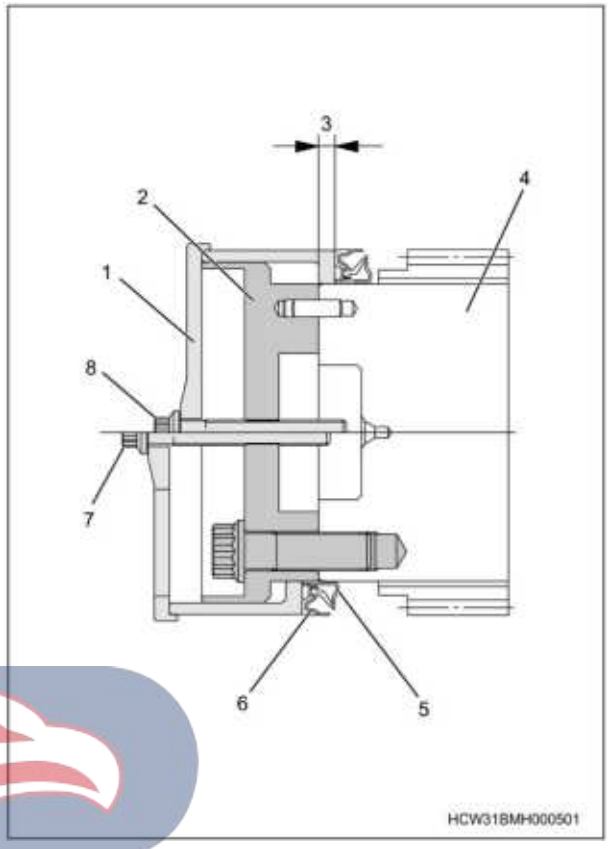
Caution:

● Wipe off the leaked oil after pressing the oil seal.



SST: 8-9819-4608-0 - Oil Seal Installer

3) After the oil seal is installed by pressing assembly method, measure the size between the crankshaft end surface and the oil seal surface.

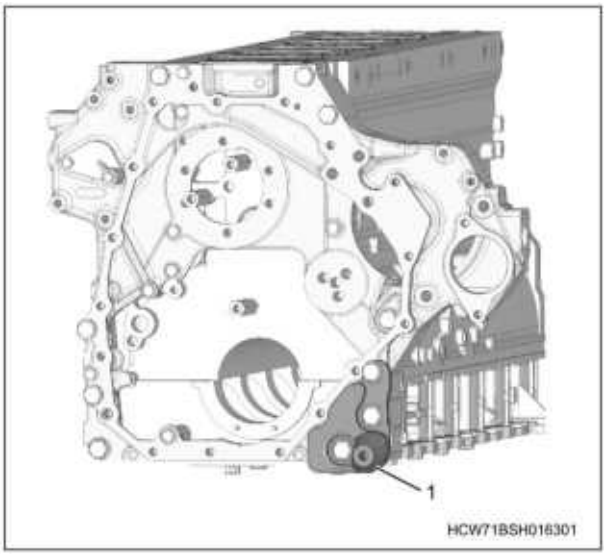


1. 8-9819-4608-0 (Sleeve)
2. 8-9819-4608-0 (Adapter)
3. 6.7 - 7.3 mm {0.264 - 0.287 in}
4. Crankshaft
5. Slinger (silver)
6. Oil seal
7. Oil seal
8. Finish pressing the position of the special tool after assembly

5. A / C compressor bracket installation

1) Install the air conditioner compressor bracket to the timing gearbox.

Tightening torque: 135 N • m { 13.8 kgf • m / 100 lb • ft }



1. Air conditioner compressor bracket

6. Idle gear installation

1) Install the idler gear to the gear cover.

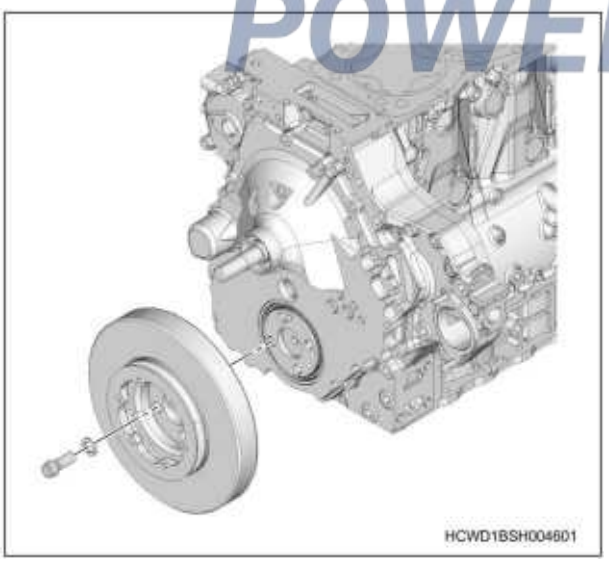
Tightening torque: 39 N • m {4 kgf • m / 29 lb • ft}

7. Crankshaft pulley installation

1) Apply the engine oil to the threaded part of the bolt.

2) Install the crankshaft pulley on the crankshaft.

Tightening torque: 267 N • m {27.2 kgf • m / 197 lb • ft}

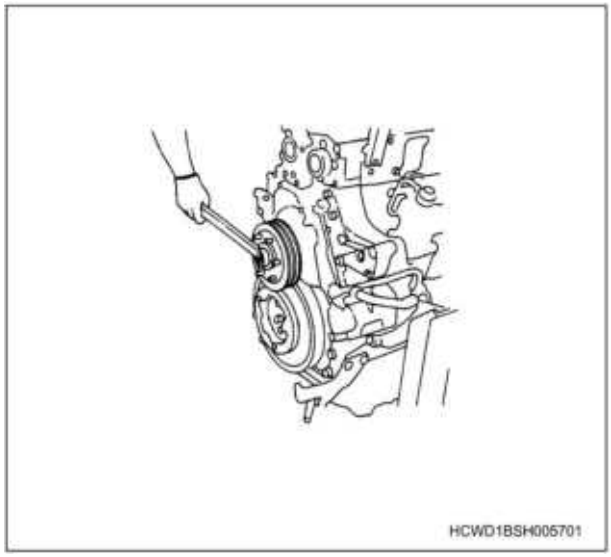


3) Apply molybdenum disulfide grease to the threaded surfaces of fan shaft and fan pulley nuts.

4) Install the fan pulley on the fan shaft.

5) Install the fan pulley nut and tapered bushing onto the fan shaft.

Tightening torque: 539 N • m {55 kgf • m / 398 lb • ft}



8. Cooling fan belt installation

1) Install the cooling fan belt to the generator and the crankshaft pulley.

Caution:

● Verify that the cooling fan belt securely fits into the groove of each pulley.

9. A / C compressor drive belt installation

1) Install the A / C compressor drive belt to the A / C compressor and crankshaft pulley.

10. Cooling fan belt adjustment

Because a V-ribbed belt is used for the cooling fan belt, accurate adjustment of the tension is more necessary compared to a conventional V-belt.

When installing a new belt, initial stretching of the belt occurs.

In addition, when reusing the belt, the belt needs to adapt to the pulley groove.

1) Rotate the adjust bolt and adjust the tension of the cooling fan belt to the specified value.

Caution:

● Accurately adjust the tension because if the tension is not appropriate, there is a possibility the service life will be shortened, or belt squeal may be generated.

● Use a sonic tension meter to verify accurate tension adjustment.

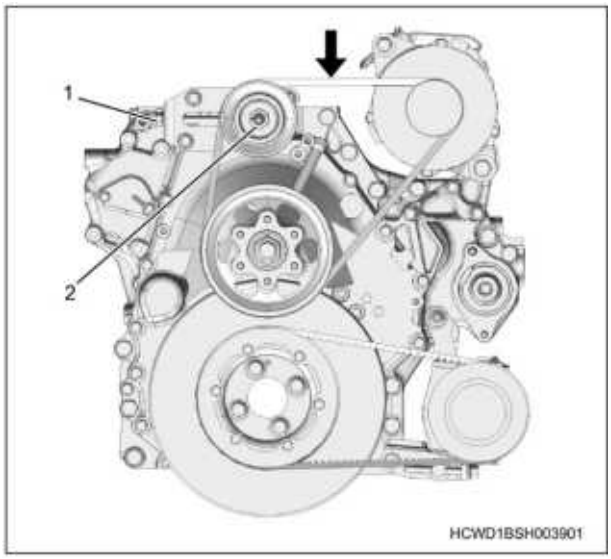
Cooling fan belt tension specified value

	Adjustment conditions	deviation	vibration frequency
60 A	When new	: 10 to 13mm { 0.394 to 0.512 in }	: 90 to 106Hz
	When adjusting tension	: 14 to 16mm { 0.551 to 0.630 in }	: 75 to 85Hz
90 A	When new	: 10 to 12mm { 0.394 to 0.472 in }	: 94 to 110Hz
	When adjusting tension	: 13 to 15mm { 0.512 to 0.591 in }	: 79 to 89Hz

Note:

● The specified amount of deflection is shown when pushing the midpoint between the water pump pulley and the generator pulley at the specified value.

Standard: 98 N { 10.0 kg / 22 lb }



1. Adjust bolt
2. Lock nut

2) Tighten the idler bolt.

Tightening torque: 147 N • m {15.0 kgf • m / 108 lb • ft}

1. Lock nut
2. Adjust bolt

11. A / C compressor drive belt adjustment

If inspecting using a sonic tension meter, adjust the frequency of vibrations at the center point between the A / C compressor pulley and crankshaft pulley to the specified value.

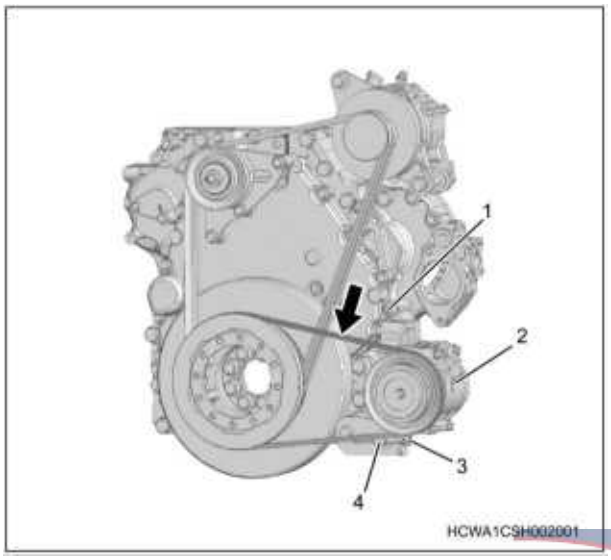
If inspecting the amount of deflection, adjust the amount of deflection to the specified value when a pressure of 98 N {10 kg} is applied the center point between the A / C compressor pulley and the crankshaft pulley.

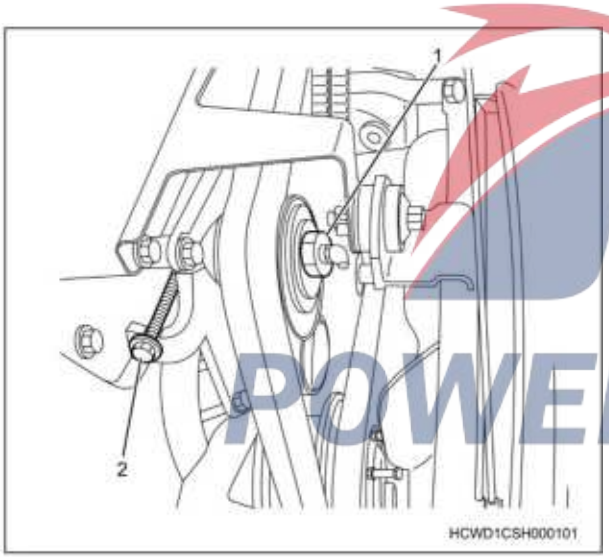
Air Conditioner Compressor Belt Tension Prescribed value

Adjustment conditions	When new	When adjusting tension
Tension	: 392 to 588N { 40.0 to 60.0kg }	: 294 to 392N { 30.0 to 40.0kg }
Deviation	: 11 to 14mm { 0.4 to 0.6 in }	: 15 to 17mm { 0.6 to 0.7 in }
Vibration frequency	: 102 to 126Hz	: 90 to 102Hz

1) Turn the tension pulley adjust bolt to adjust the A/C compressor drive belt.

2) Tighten the lock nut.





1. Bolt
2. A/C compressor
3. Adjust bolt
4. Nut (back end)

3) Confirm that the air conditioner compressor belt is fixed in each pulley groove.

4) Crank the engine 5 times, and readjust the tension of the A/C compressor belt.

12. Radiator installation

1) Install the cushion rubber to the top and bottom of the radiator bracket.

2) Install the radiator to the frame.

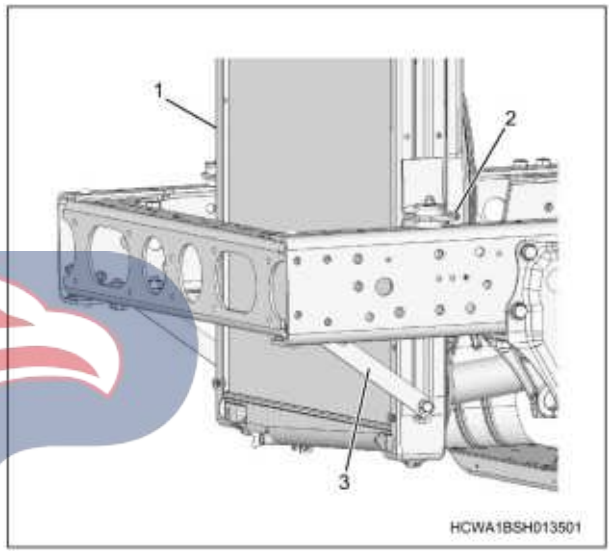
3) Install the washer to the topside of the cushion rubber.

4) Install the nut to the radiator.

Tightening torque: 41 N • m { 4.2 kgf • m / 30 lb • ft }

5) Install the radiator stay to the radiator and the frame.

Tightening torque: 20 N • m { 2.0 kgf • m / 15 lb • ft }



1. Radiator
2. Bracket
3. Bracket

13. Intercooler installation

1) Install the intercooler to the radiator.

Caution:

● Remove dirt and other foreign objects.

● Do not damage the fins during installation or removal.

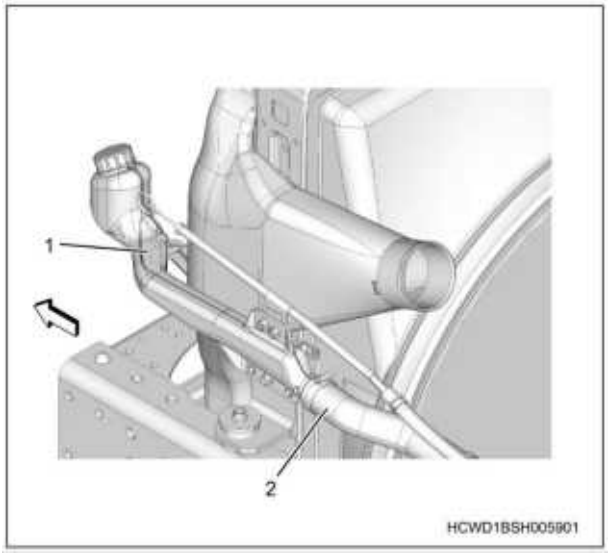
● When the intercooler fin deforms due to heat dissipation slow down, performance degradation, please carry out maintenance.

● Do not damage the fin base when repairing the fin.

● Do not use a high-pressure water jet on the radiator, intercooler, or the surrounding parts.

14. Refueling pipe installation

1) Install the refueling line and rubber hose to the timing gearbox.



1. Fuel pipeline
2. Rubber hose

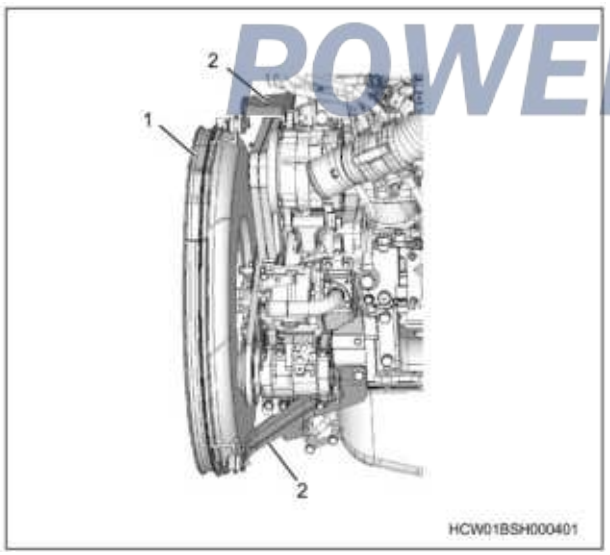
15. Cooling fan installation

1) Install the fan duct and cooling fan on the fan pulley.

Tightening torque: 67.5 N • m {6.9 kgf • m / 50 lb • ft}

16. Radiator fan cover connected

1) Install the fan guide bracket to the engine.

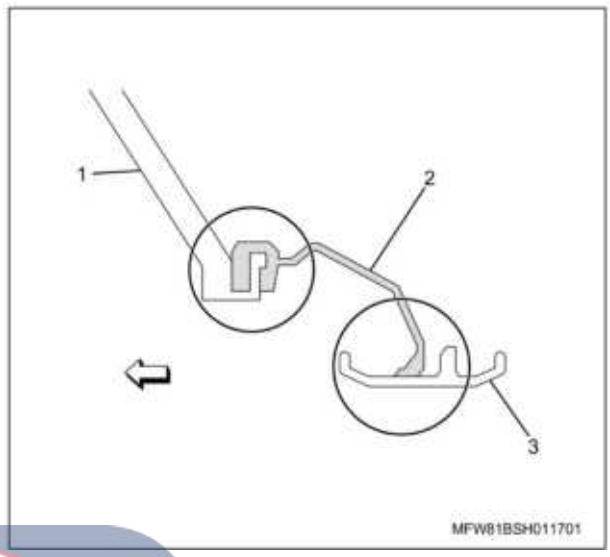


1. Fan guide
2. Fan guide bracket

2) Connect the fan guide to the radiator fan cover.

Caution:

● Verify that the entire circumference of the radiator fan cover is in contact with the fan guide.



1. Fan guide
2. Fan cover
3. Fan guide

17. Radiator lower hose installation

1) Install the radiator lower hose to the radiator and the water intake pipe.

Tightening torque: 5 N • m { 0.5 kgf • m / 44 lb • in }

18. Radiator upper hose installation

1) Connect the radiator air leak hose to the radiator.

2) Install the radiator upper hose to the water outlet duct and the radiator.

Tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}

19. Intercooler hose installation

1) Install the intercooler hose on the intercooler inlet side to the intercooler.

2) Connect the intercooler hose outlet to the intercooler.

3) Install the intake duct to the turbocharger and to the intake side of the intercooler hose.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

M10

Tightening torque: 8 N • m {0.8 kgf • m / 71 lb • in}

Turbocharger side clamp

20. Coolant filling

1) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Slowly fill with water to avoid air intrusion.

2) Press the radiator upper hose manually several times to remove the air from the hose.

3) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Repeat the operation until the water level no longer drops.

4) Install sub-tank cap to radiator.

5) Start and idle the engine.

Caution:

● Idle the engine for 5 minutes or more.

6)Stop the engine.

7) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

8) Add coolant up to the MAX level of the radiator sub-tank.

9) Install sub-tank cap to radiator.

10) Turn OFF the heater fan switch.

11) Start the engine.

12) Raise the engine speed.

Note:

● Increase the engine speed to around 2000 rpm and run the engine for 5 minutes once the needle of the engine coolant temperature gauge reaches the center.

13) With the engine running, check that the thermostat valve is open.

Note:

● Touch the radiator upper hose, and verify that it has become warm.

Caution:

● If the radiator upper hose has not become warm, raise engine speed to warm it up.

● Do not diagnose only by the engine coolant temperature gauge and the hot air coming out from the heater.

14) Idle the engine for 5 minutes.

15) Stop the engine.

16) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

17) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● If the water level of the sub-tank lowered the next morning, add water up to the MAX line.

21. Battery cable connect

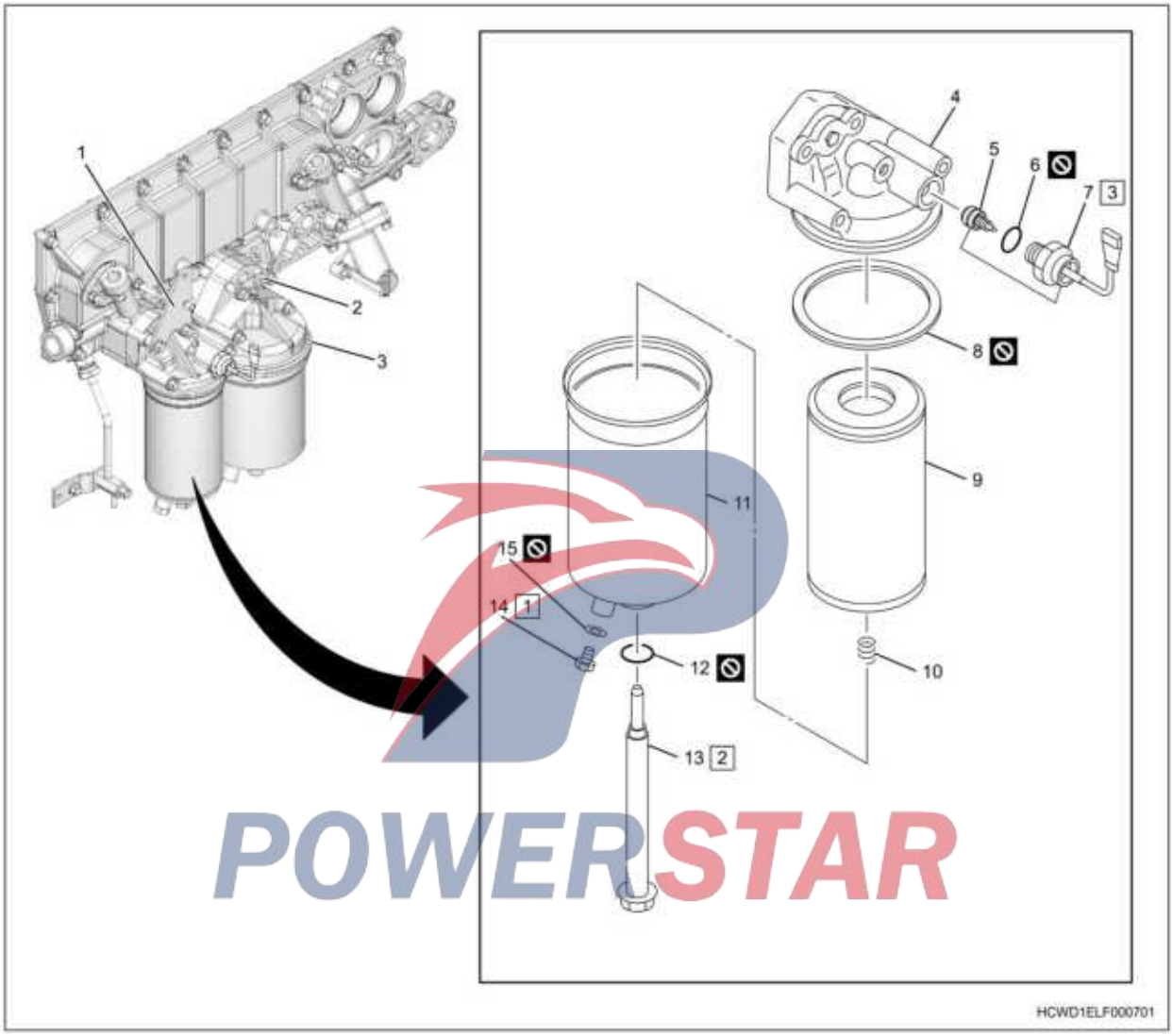
1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

Supplementary Information

1. Component Views

Oil filter element



Part name

1. Water pipe
2. Oil pipe clamp bracket
3. Partial oil filter
4. oil filter case.
5. Valve
6. O-ring
7. oil filter warning switch
8. O-ring
9. Oil filter element
10. Spring
11. Oil filter case
12. O-ring
13. Center bolt
14.Gasket
15. Drain plug

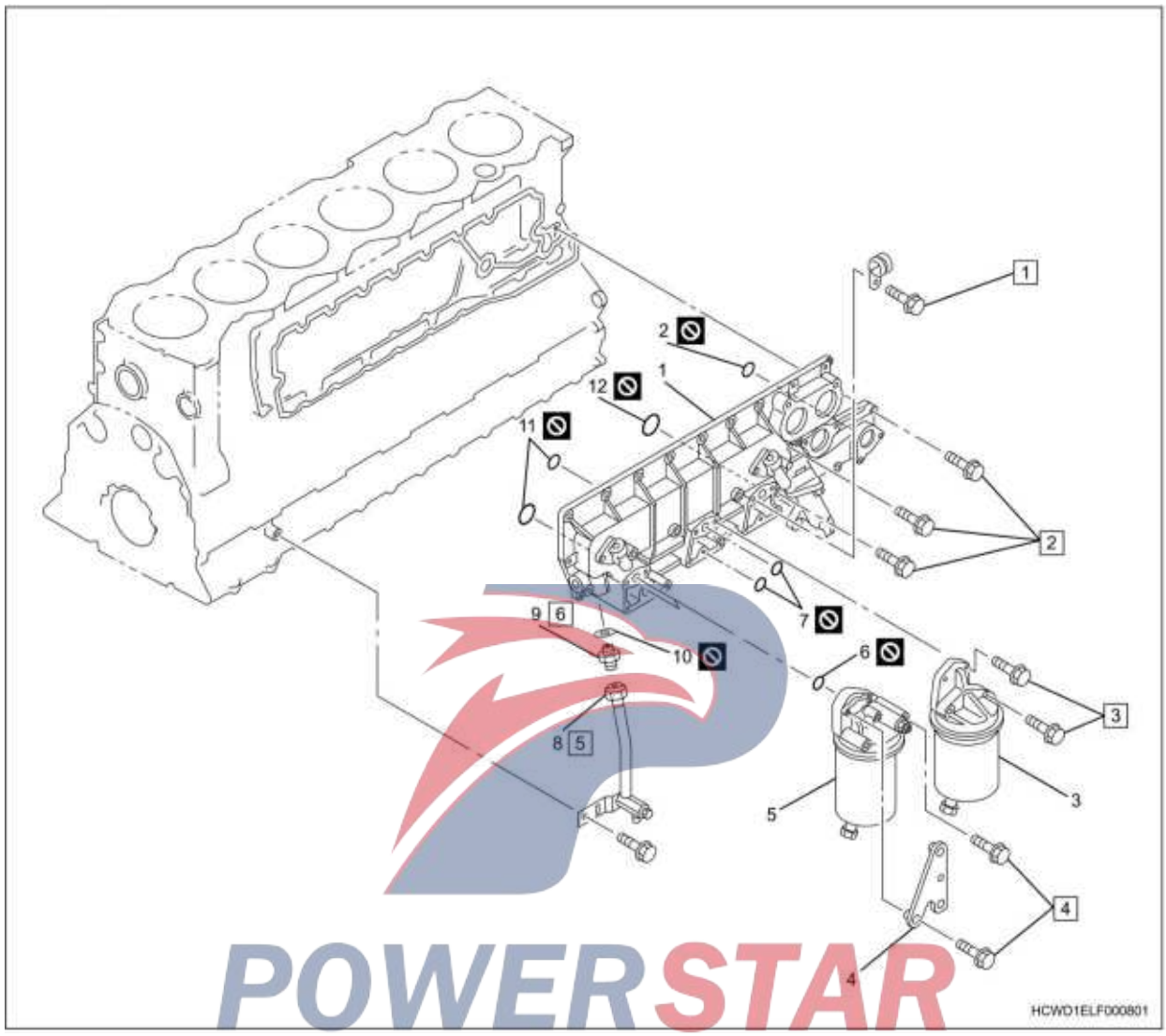
Tightening torque

1: 45 N • m { 4.6 kgf • m / 33 lb • ft }

2: 50 N • m { 5.1 kgf • m / 37 lb • ft }

3: 78 N • m { 8.0 kgf • m / 58 lb • ft }

Oil cooler



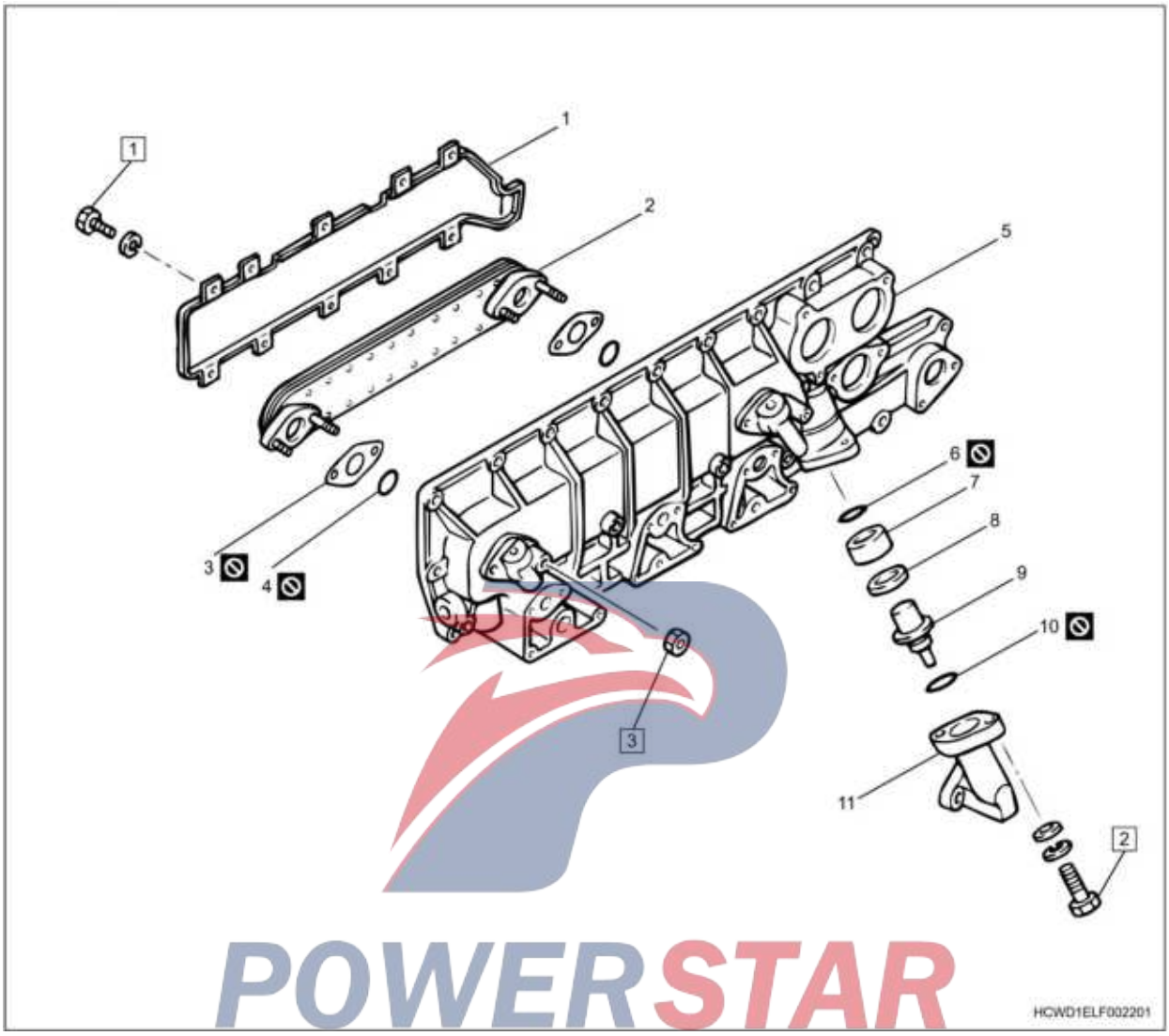
Part name

1. Oil cooler
2. O-ring
3. Partial oil filter element
4. Oil filter bracket
5. Oil filter
6. O-ring
7. O-ring
8. Drainage line
9. Connector
10. Gasket
11. O-ring
12. O-ring

Tightening torque

1: 50 N • m { 5.1 kgf • m / 37 lb • ft }
2: 50 N • m { 5.1 kgf • m / 37 lb • ft }
3: 50 N • m { 5.1 kgf • m / 37 lb • ft }
4: 50 N • m { 5.1 kgf • m / 37 lb • ft }
5: 69 N • m { 7.0 kgf • m / 51 lb • ft }
6: 78 N • m { 8.0 kgf • m / 58 lb • ft }

Oil cooler



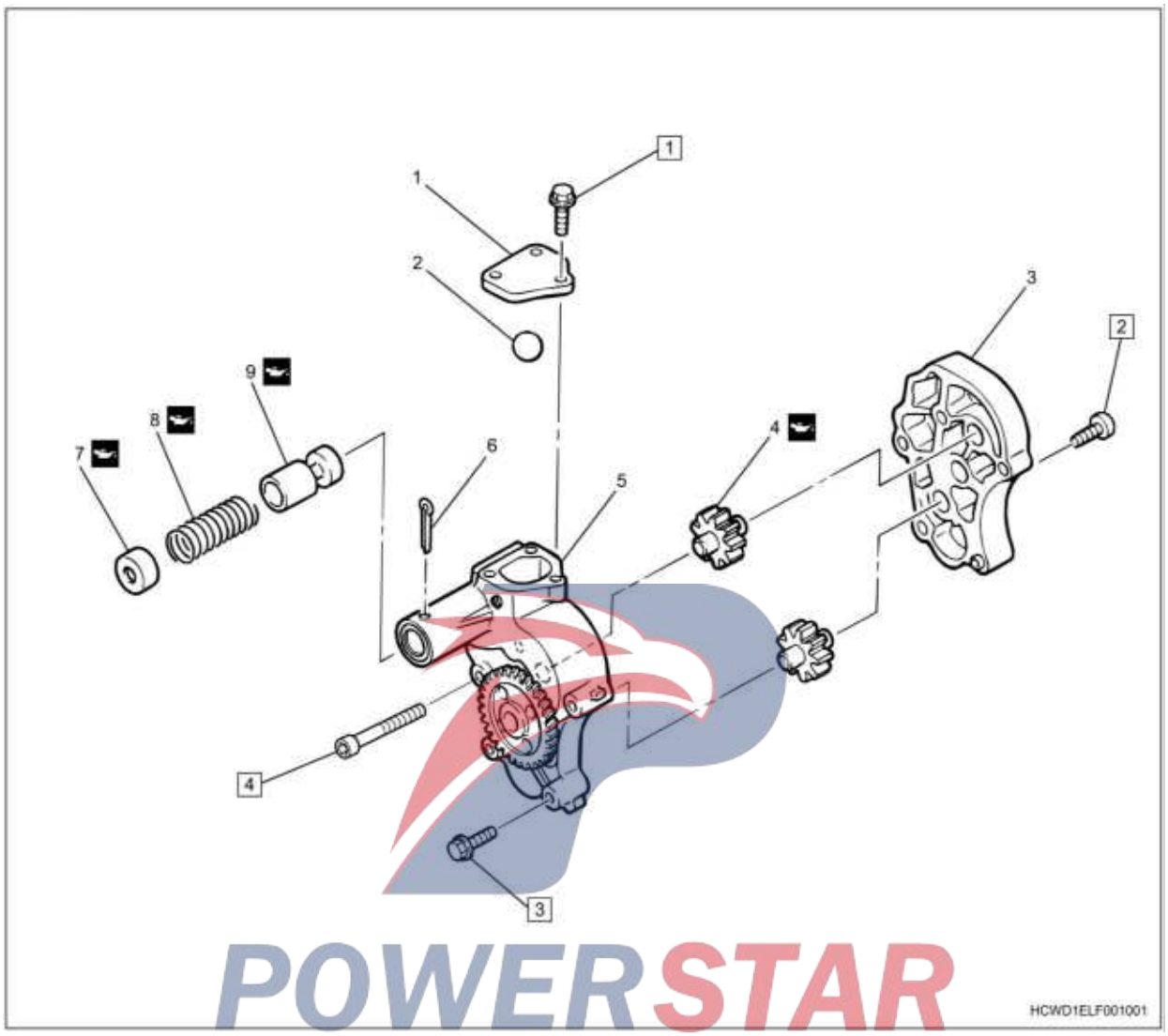
Part name

1. Water guide
2. Oil cooler element
3. Gasket
4. O-ring
5. Body shell
6. Seal ring
7. Oil thermo valve support
8. Gasket
9. Oil thermo valve
10. O-ring
11. Oil pipe

Tightening torque

1: 4 N • m { 0.4 kgf • m / 35 lb • in }
2: 37 N • m { 3.8 kgf • m / 27 lb • ft }
3: 25 N • m { 2.5 kgf • m / 18 lb • ft }

Oil pump



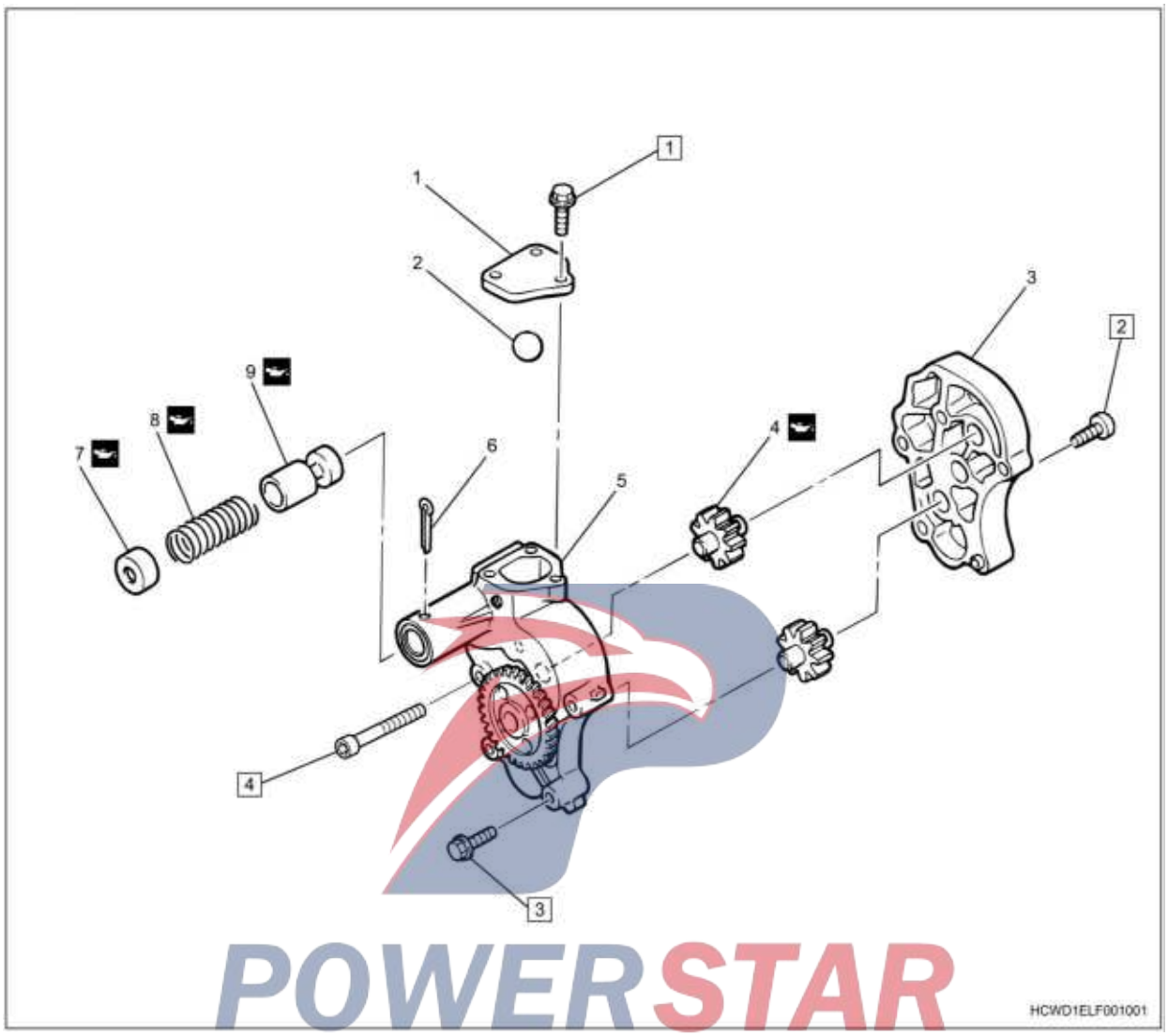
Part name

1. Cover
2. Ball
3. Oil pump cover
4. Driven gear
5. Oil pump body
6. Cotter pin
7. Spring seat
8. Spring
9. Drain valve

Tightening torque

1: 18 N • m { 1.8 kgf • m / 13 lb • ft }
2: 18 N • m { 1.8 kgf • m / 13 lb • ft }
3: 49 N • m { 5.0 kgf • m / 36 lb • ft }
4: 39 N • m { 4.0 kgf • m / 29 lb • ft }

Oil Pan



Part name

1. Piston oil nozzle
2. Oil strainer bracket
3. Oil pan gasket
4. Oil strainer filter
5. O-ring
6. Power steering oil pipe bracket
7. Oil pan
8. Cylinder block

Tightening torque

1: 69 N • m { 7.0 kgf • m / 51 lb • ft }

2: 49 N • m { 5.0 kgf • m / 36 lb • ft }

3: 38 N • m { 3.9 kgf • m / 28 lb • ft }

MEMO


POWERSTAR

Engine

Intake

(6WG1)

Table of contents

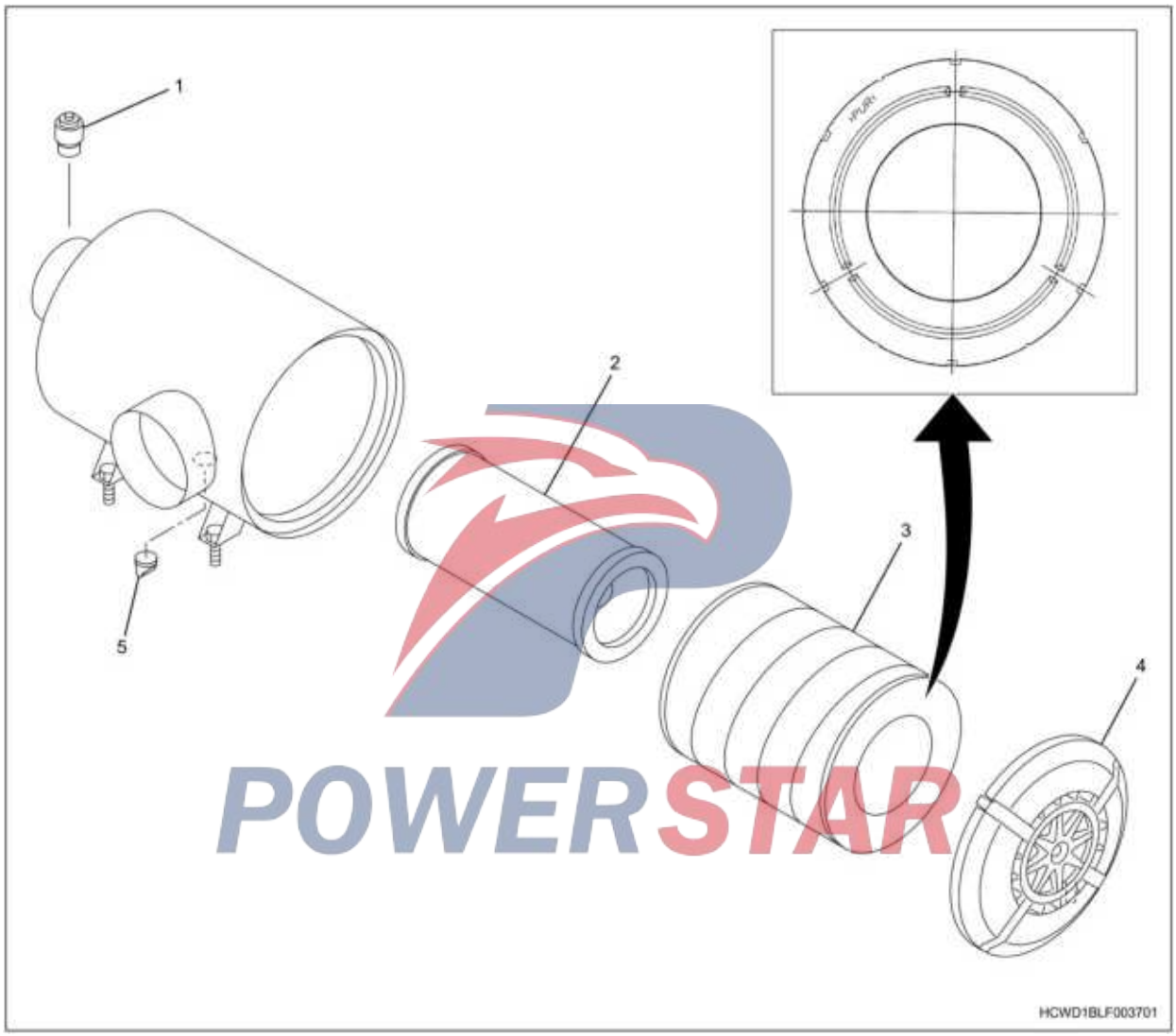
Air filter element 1F-2
Removal 1F-2
Inspection 1F-3
Installation 1F-5
Turbocharger 1F-6
Removal 1F-6
Inspection 1F-10
Installation 1F-11
Intercooler 1F-16
Removal 1F-16
Inspection 1F-18
Installation 1F-19
Supplementary Information 1F-22

Air filter element

Removal

1. Component Views

Air filter element



Part name

1. Dust indicator
2. Inner element
3. Air filter element
4. Air filter cover
5. Water drain valve

2. Air filter element removal

1) Remove the Air filter cover from the Air filter box.

2) Remove the Air filter element from the Air filter box.

3) Remove the internal air filter cartridge from the air filter cartridge.

Caution:

● If the air filter cartridge is contaminated, do not remove the air filter cartridge.

● If the Air filter internal components are contaminated, do not perform cleaning operations, replace them with the filter element.

Inspection

1. Dust indicator inspection

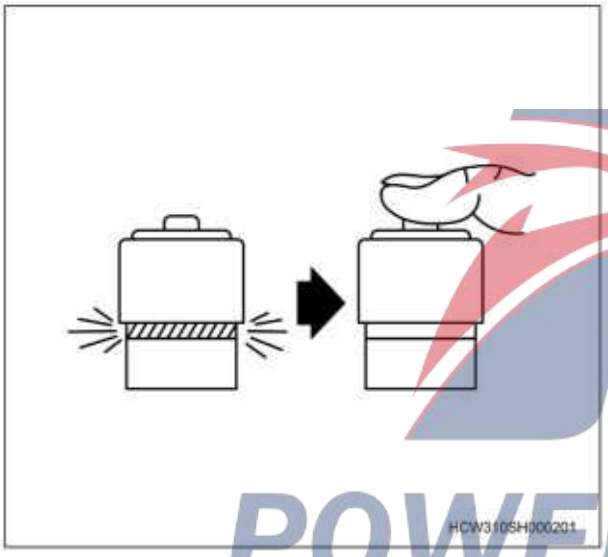
Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Inspect the dust indicator.

Note:

● When the surface of the dust indicator is red, inspect the Air filter element.

● If the Air filter element has been cleaned or replaced, push the button to return the Air filter element to the normal condition.



2. Air filter element cleaning

1) Clean the Air filter element using an air gun.

Note:

● If the Air filter element is dirty with dry dirt such as dust, clean the Air filter element by blowing compressed air into the Air filter element.

Caution:

● When cleaning the Air filter element, do not hit or strike the Air filter element.

● When cleaning the Air filter element, the air pressure should not exceed the specified value.

Standard Value:: 690 kPa { 7.0 kgf/cm2 / 100 psi }

2) Dilute a mild detergent with water, and soak the Air filter element for approximately 20 minutes.

3) Rinse the Air filter element well with running tap water, etc.

Caution:

● When cleaning the Air filter element, the water pressure should not exceed the specified value.

Standard Value: 275 kPa { 2.8 kgf/cm^2 / 40 psi }

4) Let the Air filter element dry naturally for about 2 to 3 days.

Note:

● Naturally dry the air filter cartridge, use a spare air filter cartridge.

Caution:

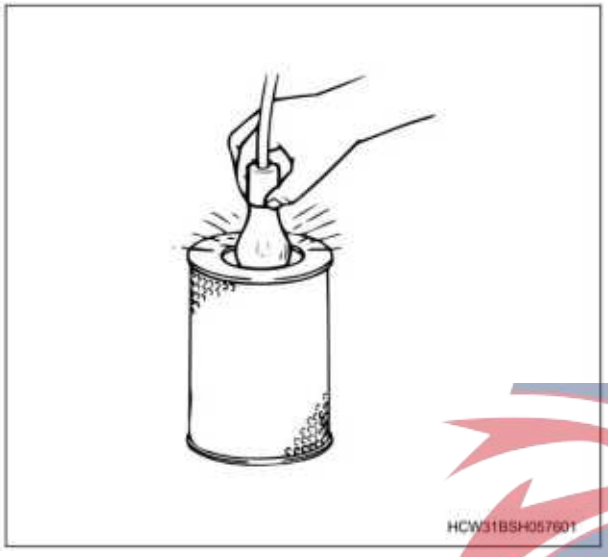
● When drying naturally, do not use heat from a fire.

3. Air filter element inspection

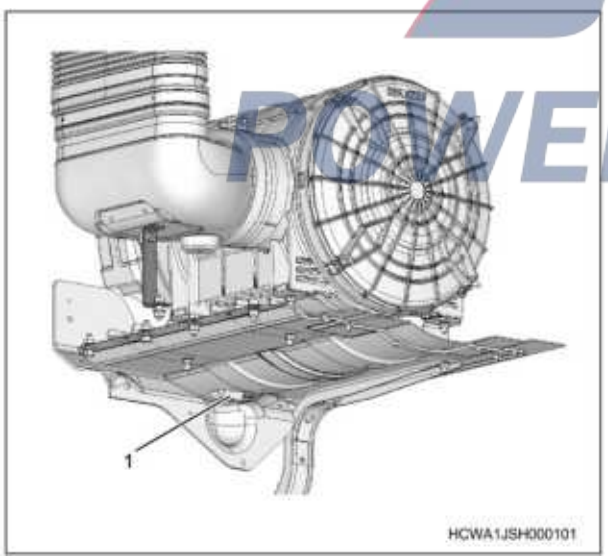
Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.

Parts deemed to be fouled or rusted must be cleaned.

1) Place a light in the Air filter element to inspect the Air filter element for damage and thinned sections.



2) Inspect the water drain valve on the lower side of the Air filter for clogging.

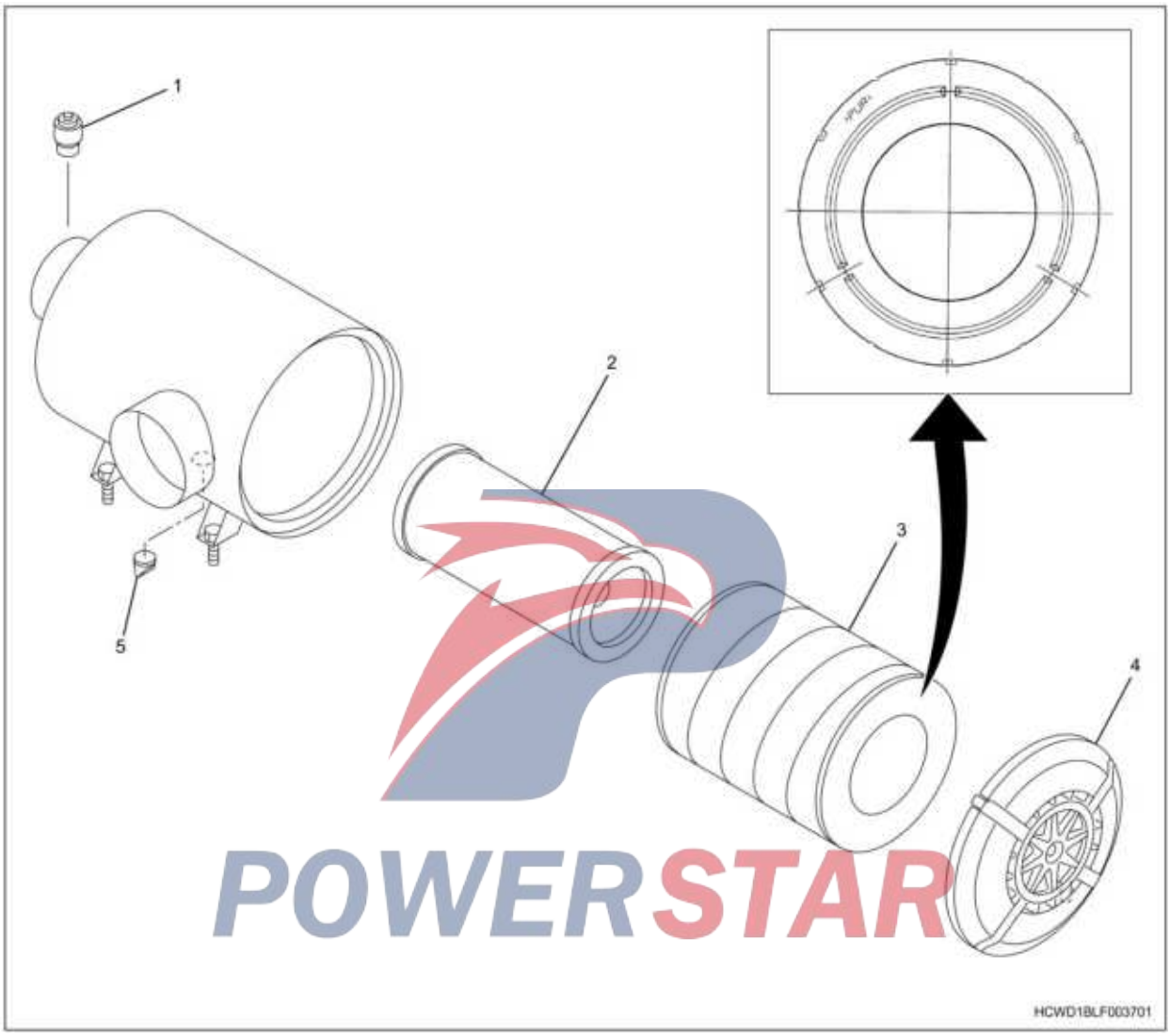


1. Water drain valve

Installation

1. Component Views

Air filter element



Part name

1. Dust indicator
2. Inner element
3. Air filter element
4. Air filter cover
5. Water drain valve

2. Air filter element installation

1) Install the air internal filter element on the Air filter element.

2) Install the Air filter element to the Air filter box.

3) Install the Air filter cover to the Air filter box.

Turbocharger

Removal

1. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

2. Coolant drain

Warning:

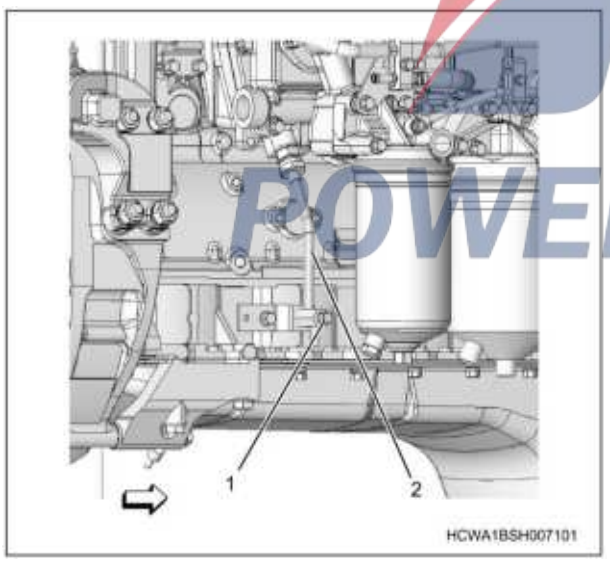
● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

1) Press the sub-tank cap button to release internal pressure.

2) Remove sub-tank cap from radiator.

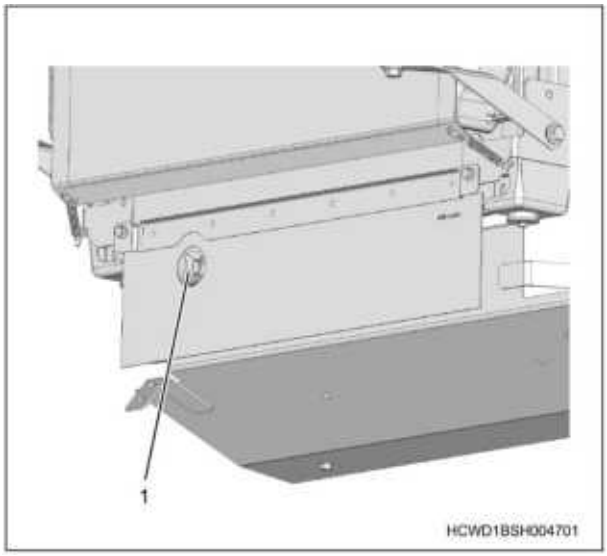
3) Loosen the drain plug on the cylinder block side, and drain the coolant to a pan.



1. Drain plug

2. Drain pipe

4) Loosen the radiator side drain plug, and drain the coolant to a pan.



1. Drain plug

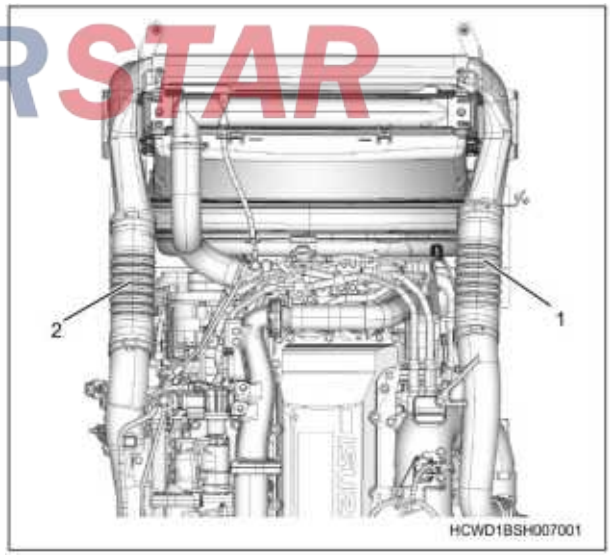
5) Tighten the radiator side drain plug.

6) Tighten the drain plug on the cylinder block side.

7) Install sub-tank cap to radiator.

3. Intercooler hose removal

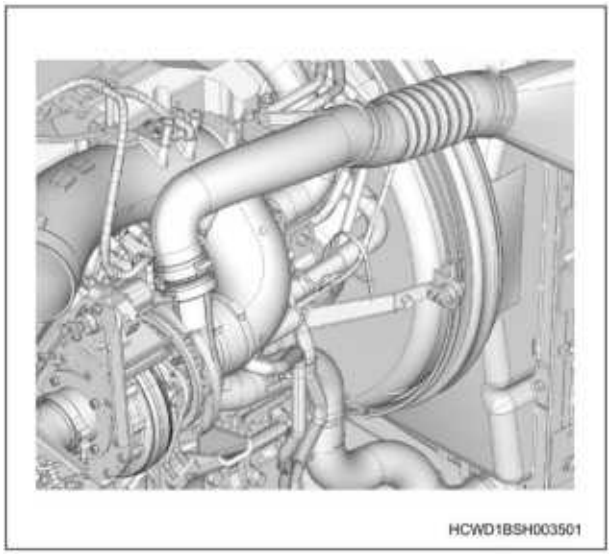
1) Disconnect the intercooler hose on the intercooler inlet side from the intercooler.



1. Intercooler hose on the intercooler inlet side

2. Intercooler hose on the intercooler outlet side

2) Remove the intake duct from the turbocharger and the intake side of the intercooler hose.

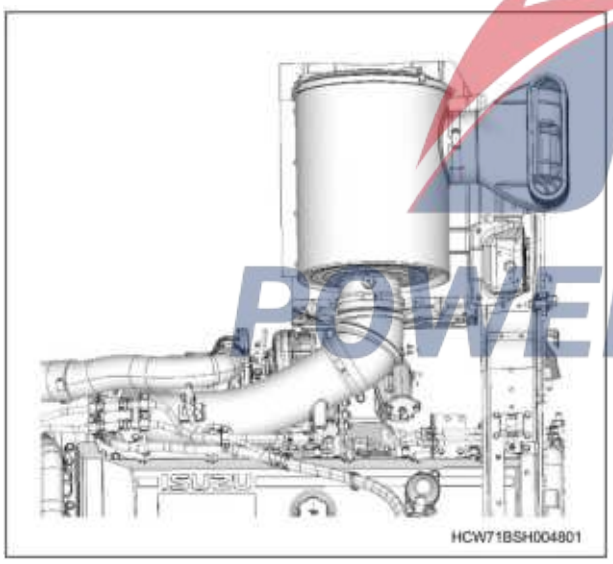


4. Air cleaner removal

1) Remove the air cleaner duct from the air cleaner.

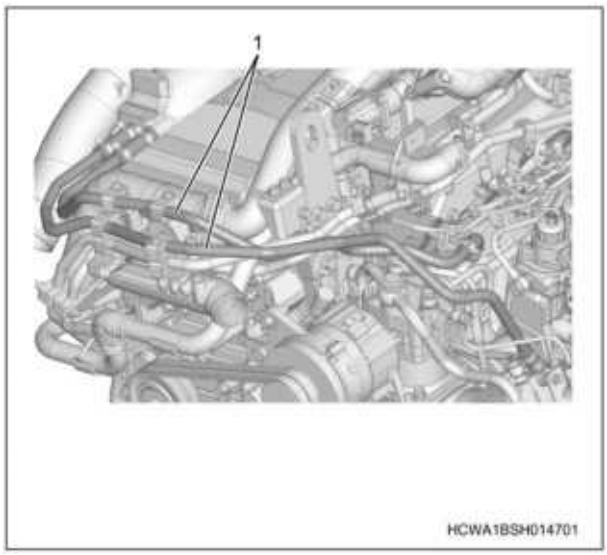
2) Remove the air cleaner from the bracket.

3) Remove the bracket from the frame.



5. Air duct removal

1) Disconnect the air compressor suction pipe from the air duct.



1. Air compressor suction pipe

2) Remove the heat shield from the air line.

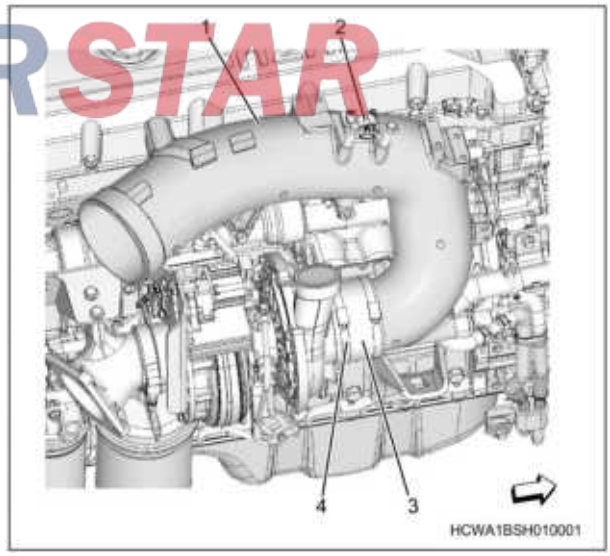
3) Disconnect the harness connector from the mass air flow sensor and intake air temperature sensor.

Note:

● If not necessary, do not disassemble the mass air flow sensor.

4) Remove the air cleaner duct from the air line.

5) Remove the air line from the turbocharger.



1. Air duct

2. Mass air flow and intake air temperature sensor

3. Rubber hose

4. Hose clip

6. Mud guard removal

1) Remove the mudguard on the right of the vehicle from the bracket.

2) Remove the mudguard on the left side of the vehicle from the bracket.

7. Noise shutter panel removal

1) Remove the noise shutter panel on the right side of the vehicle from the frame.

2) Remove the noise shutter panel on the left side of the vehicle from the frame.

8. Exhaust cover removal

1) Remove the exhaust cover from the frame.

9. Exhaust brake valve removal

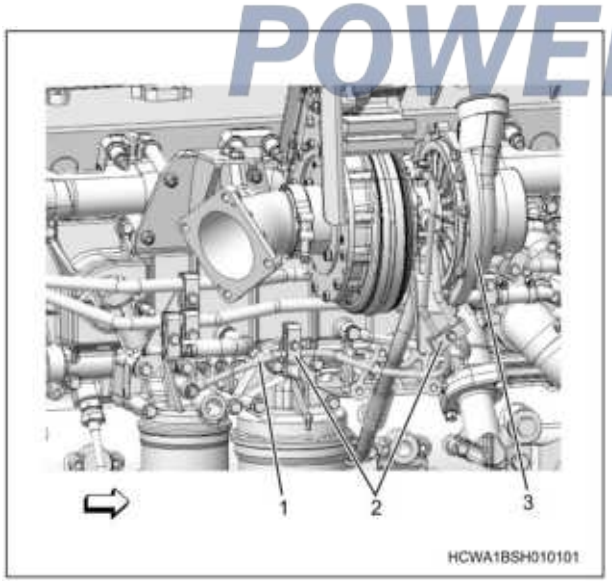
1) Disconnect the air pipe from the exhaust brake valve.

2) Remove the front exhaust pipe A and exhaust brake valve as a set from the exhaust pipe B adapter and exhaust silencer.

10. Turbocharger removal

1) Disconnect the oil return pipe from the turbocharger.

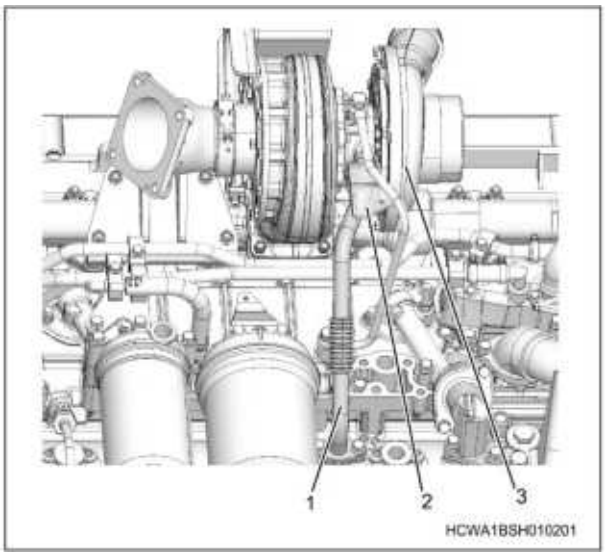
2) Remove the turbocharger fuel supply pipe from the filter body.



1. Turbocharger oil feed pipe
2. Pipe clamp
3. Turbocharger

3) Disconnect turbocharger oil return line.

4) Remove the return pipe from the cylinder block.



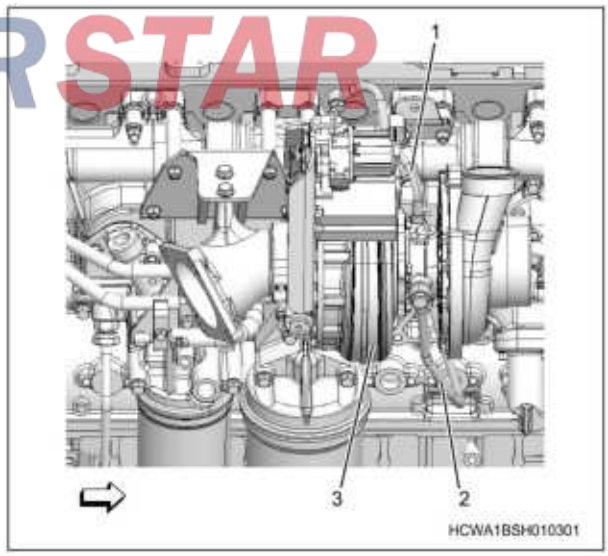
1. Turbocharger return pipe
2. Bracket
3. Turbocharger

5) Disconnect the turbocharger water supply pipe.

6) Remove the water supply pipe from the oil cooler.

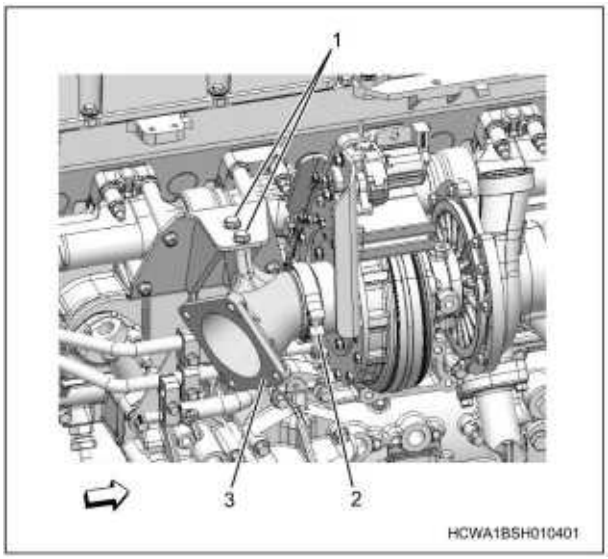
7) Disconnect turbocharger water return pipe.

8) Remove the water return pipe from the cylinder head.

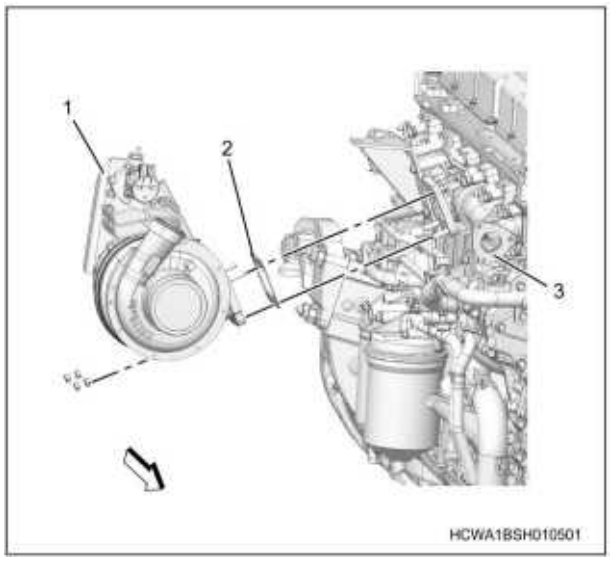


1. Water return pipe
2. Water feed pipe
3. Turbocharger

9) Remove the turbocharger exhaust from the turbocharger.



1. Bolt
2. V-belt
3. Turbocharger exhaust pipe



1. Turbocharger
2. Gasket
3. Exhaust manifold

10) Disconnect the harness connector of the variable ratio steering actuator.

11) Remove the turbocharger from the exhaust manifold.

12) Remove the gasket from the exhaust manifold.

Caution:

● Seal each part to prevent the intrusion of foreign material into the turbocharger.

Inspection

1. Turbocharger inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Check abnormal noise emitted from the turbocharger while driving.

2) Check for scratches and cracks caused by contact of the compressor housing with the fins or with the turbine housing with the fins.

3) Check the sealing part for oil leakage.

Caution:

● Confirm there is no oil leakage on the side of the engine.

● If oil leakage is suspected to exist in the oil separator, inspect it after discharging the leak gas.

4) Rotate the shaft by hand and check its stiffness and interference.

5) Install a micrometer in the axial direction of the turbine shaft and measure the axial clearance of the turbine shaft.

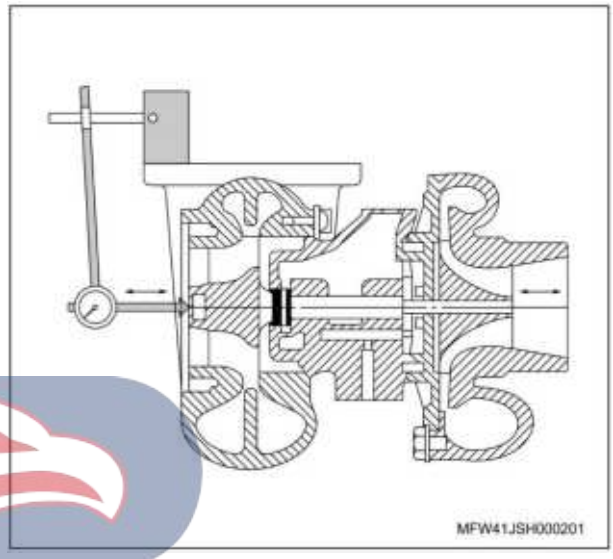
Note:

● Due to oil remaining in the bearing, sufficient thrust force must be applied for the measurement.

Caution:

● Do not disassemble the turbocharger.

Standard: 0.06 to 0.10mm { 0.002 to 0.004 in }



Installation

1. Turbocharger installation

1) Pour approximately 1 cc of the engine oil into the oil passage of the turbocharger.

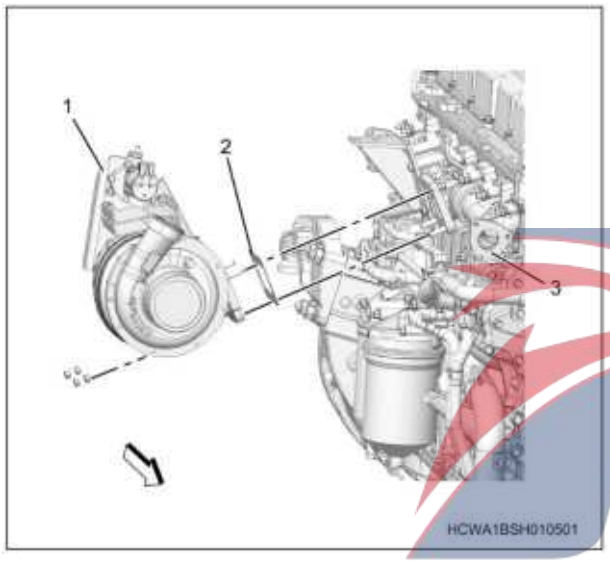
2) Install the gasket to the exhaust manifold.

3) Install the turbocharger to the exhaust manifold.

Note:

● Final tightening, then double nut tightening.

Tightening torque: 45 N • m {4.6 kgf • m / 33 lb • ft}



1. Turbocharger
2. Gasket
3. Exhaust manifold

4) Connect the harness connector to the variable gear ratio steering actuator.

5) Install the water return pipe to the cylinder head.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

6) Connect the water return pipe to the turbocharger.

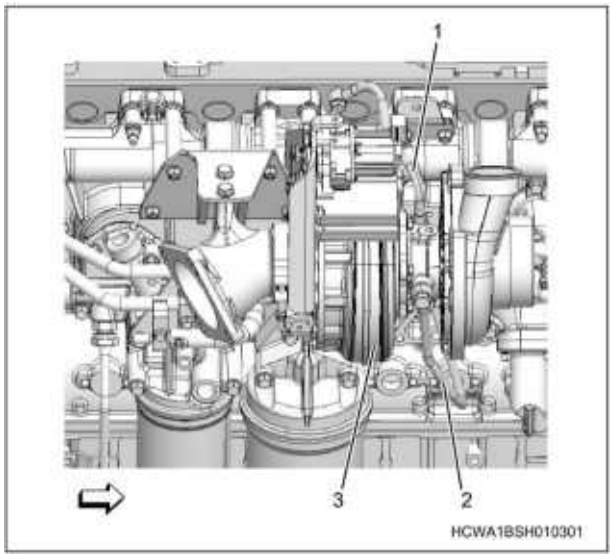
Tightening torque: 50 N • m {5.1 kgf • m / 37 lb • ft}

7) Install the water feed pipe to the cylinder block.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

8) Connect the water feed pipe to the turbocharger.

Tightening torque: 50 N • m {5.1 kgf • m / 37 lb • ft}



1. Water return pipe
2. Water feed pipe
3. Turbocharger

9) Install the O-rings to both ends of the oil return pipe.

10) Temporarily tighten the turbocharger's return line and bracket.

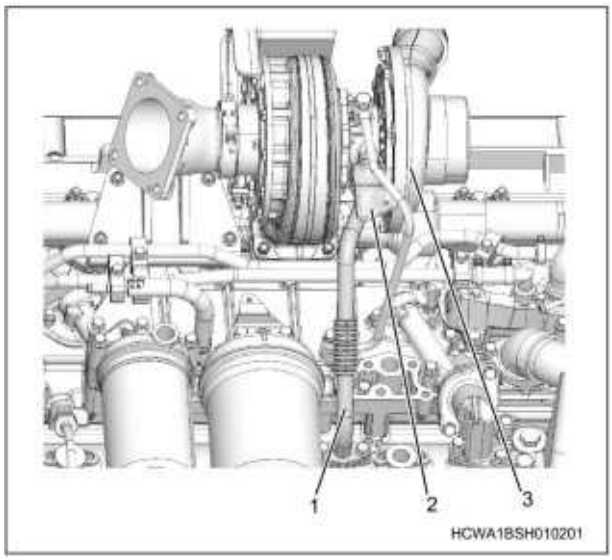
11) Temporarily tighten the oil return pipe to the cylinder block.

12) Final tighten the turbocharger's return line and bracket.

Tightening torque: 22 N • m {2.2 kgf • m / 16 lb • ft}

13) Securely tighten the oil return pipe to the cylinder block.

Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft}



1. Oil return pipe
2. Bracket
3. Turbocharger

14) Temporarily fasten the turbocharger fuel supply pipe to the turbocharger.

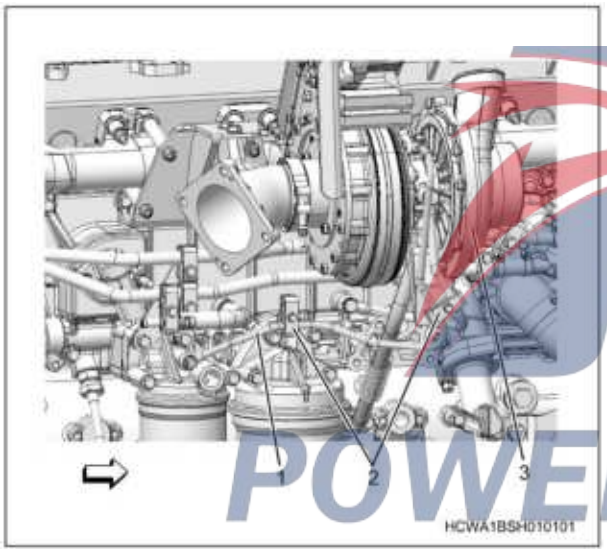
15) Temporarily fasten the turbocharger fuel supply pipe and 2 clips to the oil filter body.

16) Tighten the turbocharger fuel supply pipe to the turbocharger.

Tightening torque: 34 N • m {3.5 kgf • m / 25 lb • ft}

17) Tighten the turbocharger fuel supply tube to the oil filter body finally.

Tightening torque: 34 N • m {3.5 kgf • m / 25 lb • ft}



1. Turbocharger oil feed pipe
2. Clip
3. Turbocharger

18) Install the turbocharger exhaust pipe on the turbocharger.

19) Install the V-belt on the turbocharger exhaust pipe and turbocharger.

Tightening torque: 10 N • m {1.0 kgf • m / 89 lb • in}

2. Exhaust cover installation

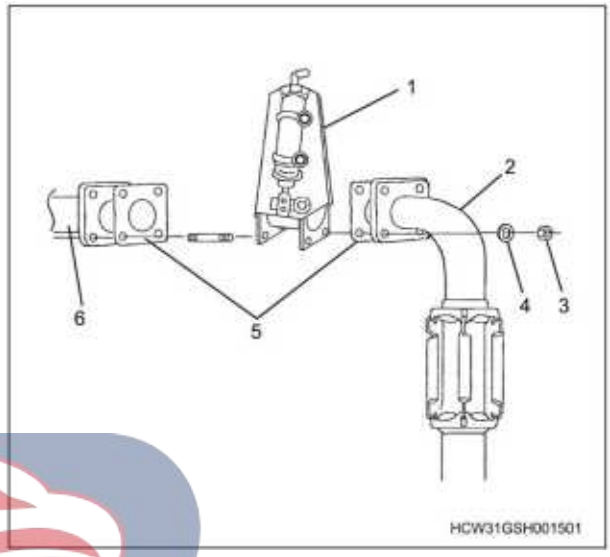
1) Install the gaskets, exhaust brake valves, and front exhaust pipe to the exhaust pipe A adapter.

Caution:

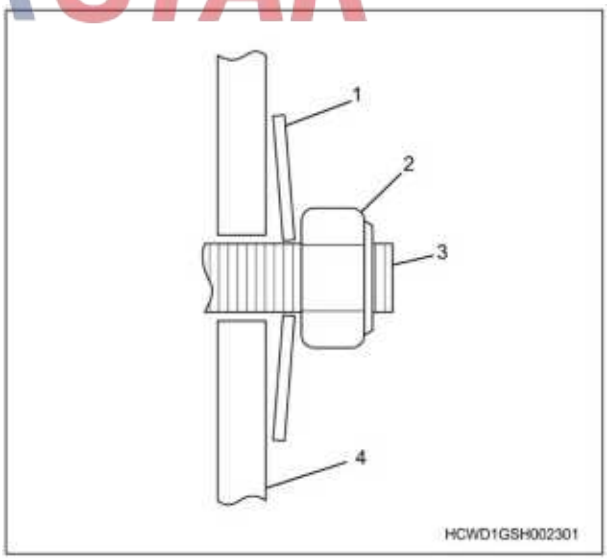
● Uniformly tighten the mounting nuts and bolts of the front exhaust pipe A, and make sure that there are no gas leaks.

● Install the washer with the convex section facing the nut side.

Tightening torque: 59 N • m {6.0 kgf • m / 44 lb • ft}



1. Exhaust brake valve
2. Front exhaust pipe A
3. Nut
4. Washer
5. Gasket
6. Turbocharger exhaust pipe



1. Washer
2. Nut
3. Stud

4. Flange

2) Connect the air hose to the exhaust brake valve.

3. Exhaust cover installation

1) Install the exhaust cover to the frame.

4. Noise shutter panel installation

1) Install the noise shutter panel on the right side of the vehicle to the frame.

2) Install the noise shutter panel on the left side of the vehicle to frame.

5. Mud guard installation

1) Install the mudguard on the right side of the vehicle to the bracket.

2) Install the mudguard on the left side of the vehicle to the bracket.

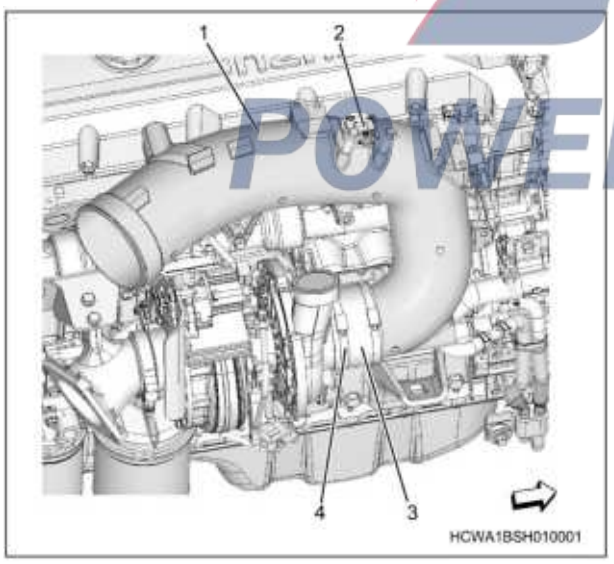
6. Air duct installation

1) Temporarily install the rubber hose and clips on the turbocharger.

2) Install the air line to the rubber hose.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

M10



1. Air duct

2. Mass air flow and intake air temperature sensor

3. Rubber hose

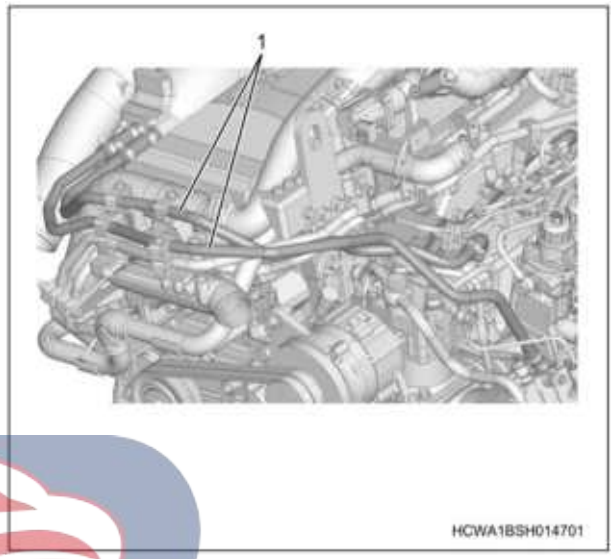
4. Hose clip

3) Connect the air cleaner duct to the air cleaner and turbocharger.

4) Connect the harness connector to the mass air flow sensor and intake air temperature sensor.

5) Install the thermal protection on the air duct.

6) Connect the air compressor suction tube to the air duct.



1. Air compressor suction pipe

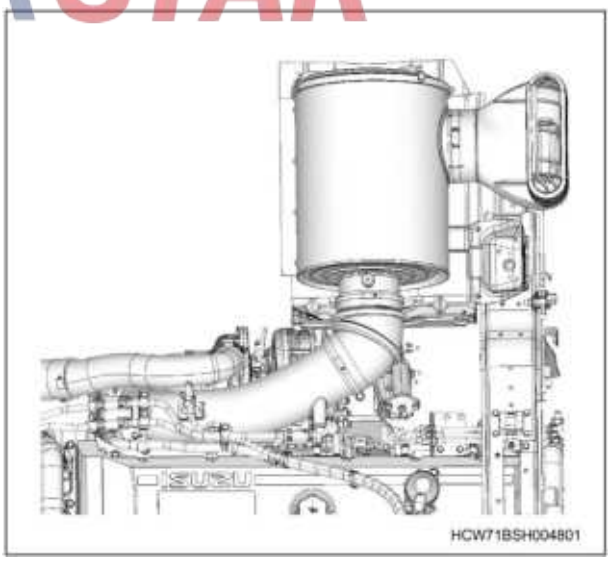
7. Air cleaner installation

1) Mount the bracket to the frame.

2) Install the air cleaner cover to the frame.

3) Install the air cleaner to the air cleaner cover.

4) Connect the air cleaner duct to the air cleaner.



8. Intercooler hose installation

1) Install the air intake duct to the turbocharger and to the intake side of the intercooler hose.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

M10

Tightening torque: 8 N • m {0.8 kgf • m / 71 lb • in}

Turbocharger side clamp

2) Connect the intercooler hose inlet to the intercooler.

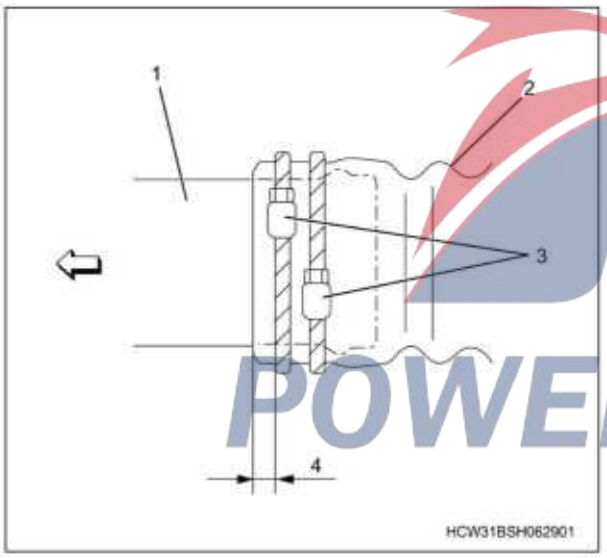
1. Intercooler hose installation precautions

Caution:

● After the intercooler hose has been securely installed until it makes contact with the pipe, refer to the following diagram and secure the intercooler hose with the 2 clips.

● Shift the tightening screw positions of the 2 clips by 27 mm {1.063 in} or 30°or mor e.

Tightening torque: 6.4 N • m { 0.7 kgf • m / 57 lb • in }



1. Intercooler pipe

2. Intercooler hose

3. Clip

4. 5 mm {0.197 in} from the end of the intercooler

9. Coolant filling

1) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Slowly fill with water to avoid air intrusion.

2) Press the radiator upper hose manually several times to remove the air from the hose.

3) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Repeat the operation until the water level no longer drops.

4) Install sub-tank cap to radiator.

5) Start and idle the engine.

Caution:

● Idle the engine for 5 minutes or more.

6) Stop the engine.

7) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

8) Add coolant up to the MAX level of the radiator sub-tank.

9) Install sub-tank cap to radiator.

10) Turn OFF the heater fan switch.

11) Start the engine.

12) Raise the engine speed.

Note:

● Increase the engine speed to around 2000 rpm and run the engine for 5 minutes once the needle of the engine coolant temperature gauge reaches the center.

13) With the engine running, check that the thermostat valve is open.

Note:

● Touch the radiator upper hose, and verify that it has become warm.

Caution:

● If the radiator upper hose has not become warm, raise engine speed to warm it up.

● Do not diagnose only by the engine coolant temperature gauge and the hot air coming out from the heater.

14) Idle the engine for 5 minutes.

15)Stop the engine.

16) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

17) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● If the water level of the sub-tank lowered the next morning, add water up to the MAX line.

10. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

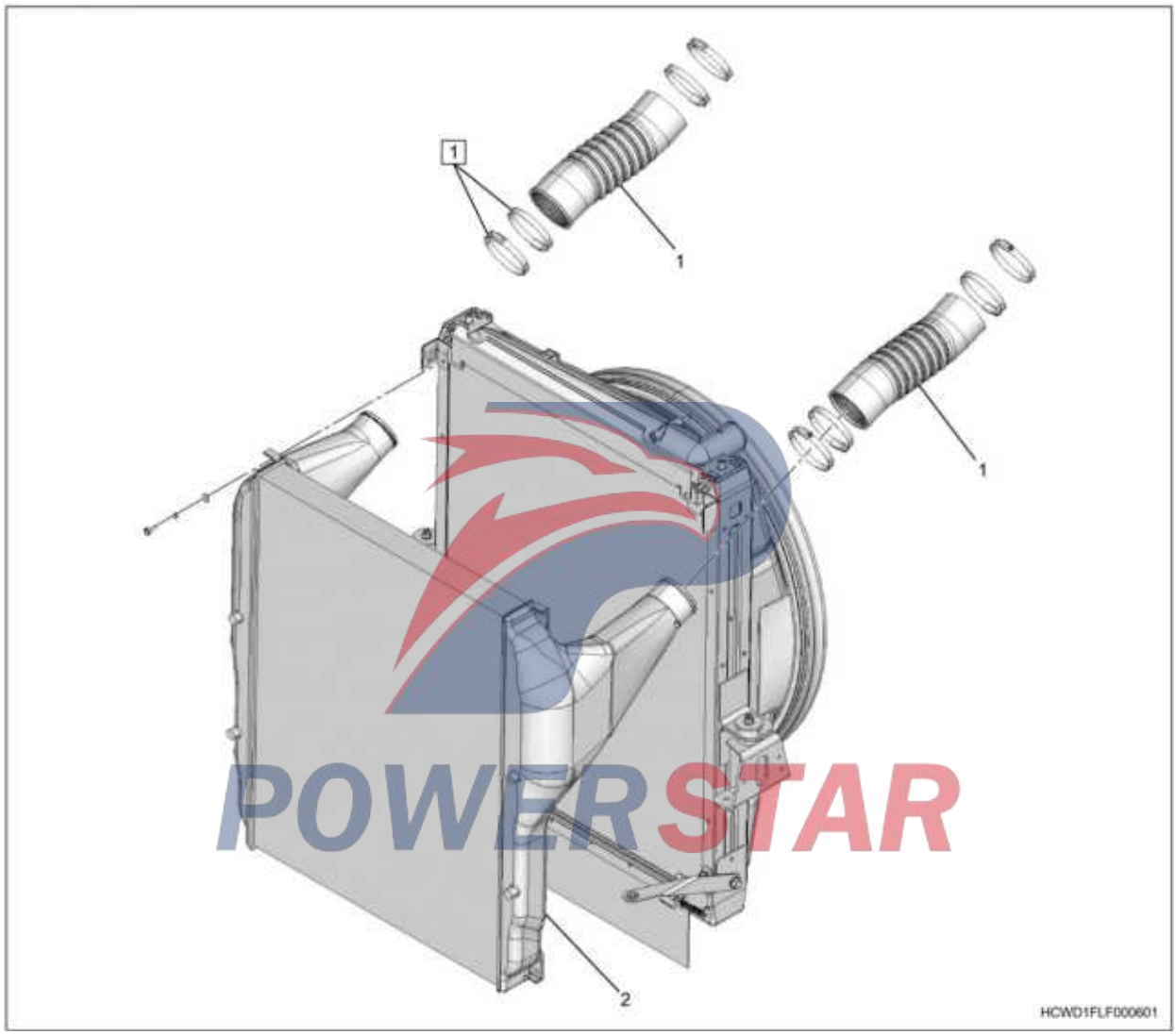
2) Lower the cab, and close the front lid.

Intercooler

Removal

1. Component Views

Intercooler



Part name

1. Intercooler hose

2. Intercooler

Tightening torque

1: 6.4 N • m {0.7 kgf • m / 57 lb • in}

2. Screen removed

1) Remove the spring from the spring hook on the low side of the radiator.

2) Remove the screen from the intercooler.

Caution:

● Care should be taken not to pinch your fingers while disassembling.

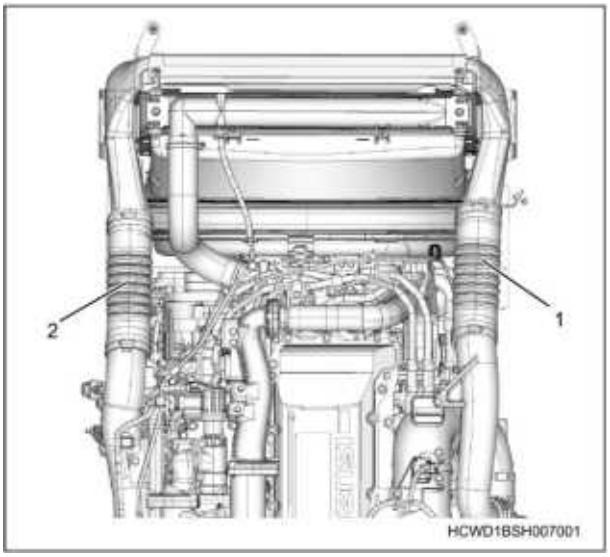
● If there is any damage, replace the screen.

3. Intercooler hose removal

1) Disconnect the intercooler hose on the intercooler outlet side from the intercooler.

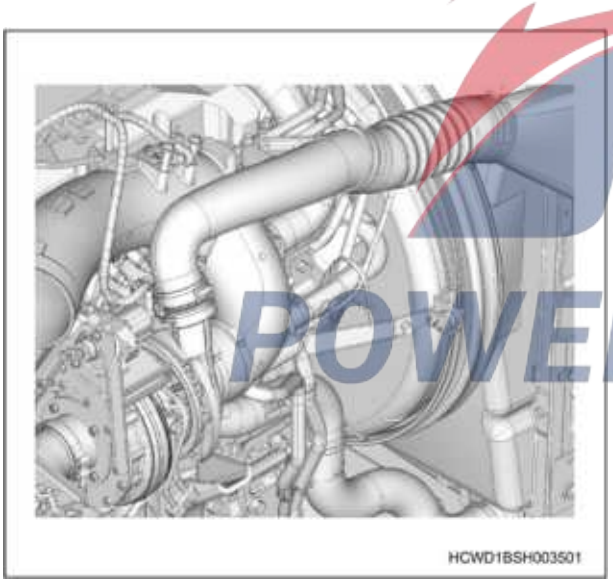
2) Remove the intercooler hose outlet on the intake line.

3) disconnect the intercooler hose on the intercooler inlet side from the intercooler.



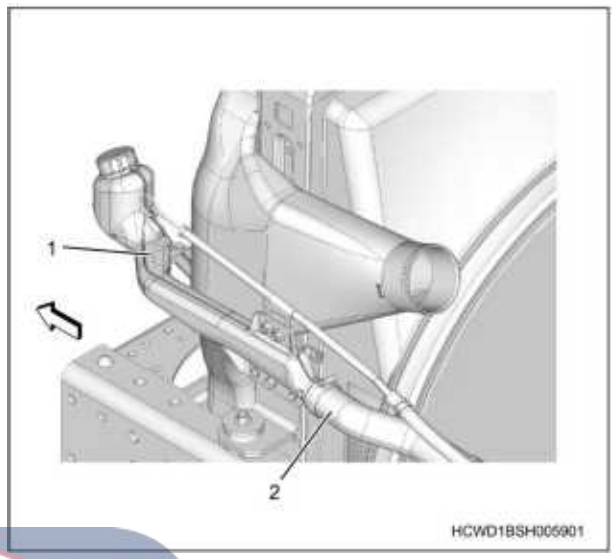
1. Intercooler hose on the intercooler inlet side
2. Intercooler hose on the intercooler outlet side

4) Remove the intake duct from the turbocharger and the intake end of the intercooler hose.



4. Refueling pipe removed

1) Remove the fuel line and rubber hose from the timing gearbox.



1. Fuel pipeline
2. Rubber hose

5. Intercooler removal

1) Remove the intercooler from the radiator.

Caution:

● Remove the fin without damaging it.

Inspection

1. Intercooler inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Inspect the intercooler fin for collapsing.

Caution:

● When repairing the fins, be careful not to damage the base portion.

2) Remove filth or other foreign material.

Caution:

● Inspect the inside of the intercooler for dirt, and clean if it is significantly dirty.

2. Intercooler cleaning

Caution:

● Before cleaning, seal the hose connecting sections using caps, cloth tapes, etc.

1) Thoroughly wash off fouling that can be removed by washing with tap water.

Caution:

● At this time, do not use a high pressure washer or brush.

2) Apply a mild detergent that contains 8% surface acting agent to the intercooler, and leave for 10 minutes.

Caution:

● Do not use material other than mild detergent because it may cause corrosion.

3) Clean the intercooler using the high-pressure washing machine.

Note:

● When dirt is not washed off sufficiently, repeat the cleaning.

Caution:

● High-pressure water should be applied perpendicular to the fins from the engine side of the intercooler.

4) Wash the intercooler with tap water.

Caution:

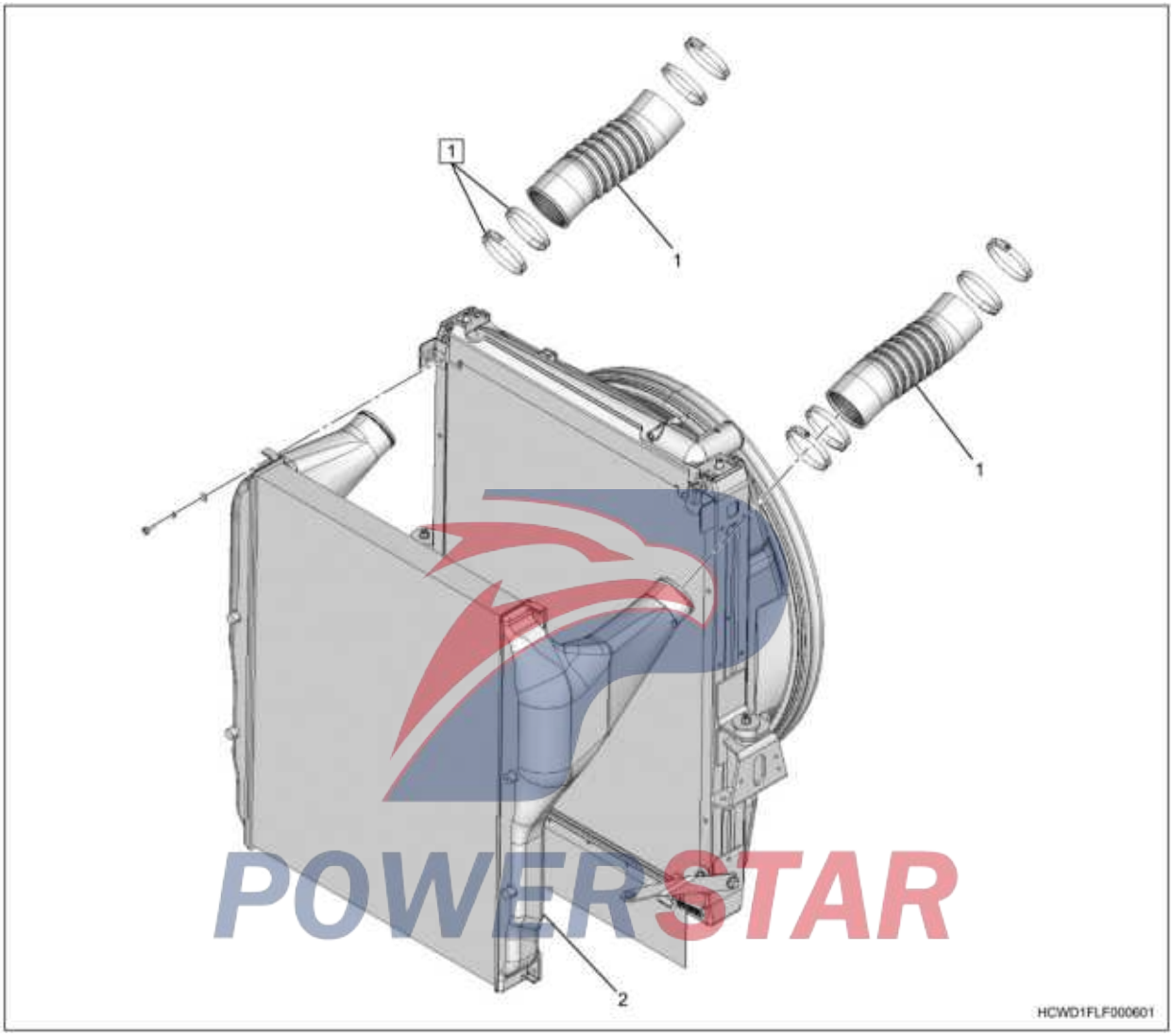
● Sufficiently rinse off the detergent ingredient to prevent it from remaining on the core and the resin portions.

5) Remove the seal, and clean the hose connection with tap water.

Installation

1. Component Views

Intercooler



Part name

1. Intercooler hose

2. Intercooler

Tightening torque

1: 6.4 N • m { 0.7 kgf • m / 57 lb • in }

2. Intercooler installation

1) Install the intercooler to the radiator.

Caution:

● Remove dirt and other foreign objects.

● Do not damage the fins during installation or removal.

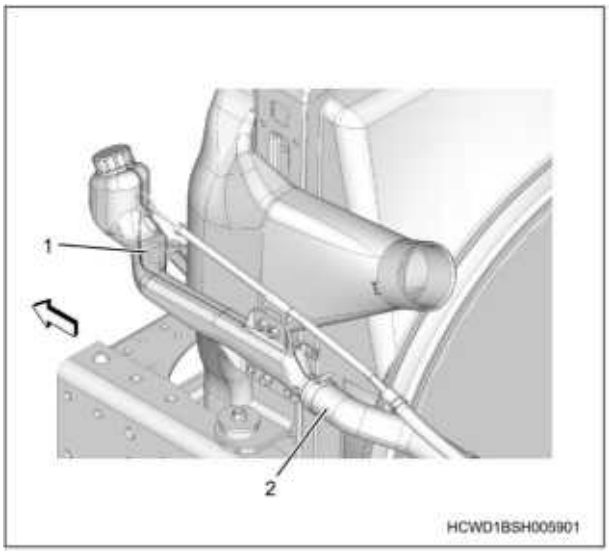
● When the intercooler fin deforms due to heat dissipation slow down, performance degradation, please carry out maintenance.

● Do not damage the fin base when repairing the fin.

● Do not use a high-pressure water jet on the radiator, intercooler, or the surrounding parts.

3. Refueling pipe installation

1) Install the refueling line and rubber hose to the timing gearbox.



1. Fuel pipeline
2. Rubber hose

4. Intercooler hose installation

1) Install the intercooler hose on the intercooler inlet side to the intercooler.

2) Connect the intercooler hose outlet to the intercooler.

3) Install the intake duct to the turbocharger and to the intake side of the intercooler hose.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}
M10
Tightening torque: 8 N • m {0.8 kgf • m / 71 lb • in}
Turbocharger side clamp

4) Connect the intercooler hose inlet to the intercooler.

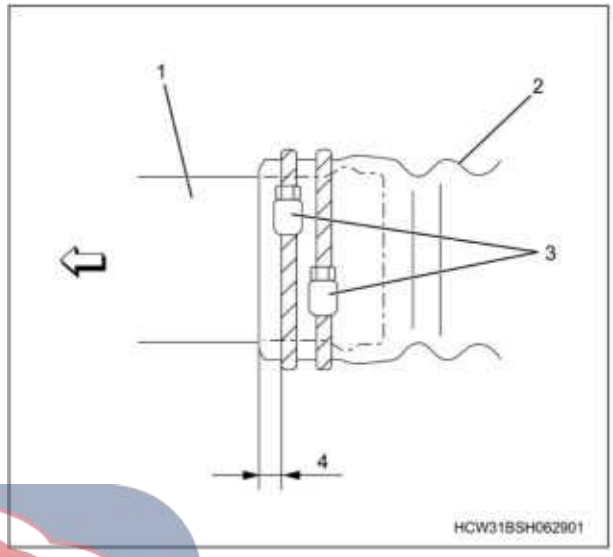
1. Intercooler hose installation precautions

Caution:

● After the intercooler hose has been fixed installed until it makes contact with the pipe, refer to the following diagram and secure the intercooler hose with the 2 clips.

● Shift the tightening screw positions of the 2 clips by 27 mm {1.063 in} or 30 ° or more.

Tightening torque: 6.4 N • m {0.7 kgf • m / 57 lb • in}



1. Intercooler pipe
2. Intercooler hose
3. Clip
4. 5 mm {0.197 in} from the end of the intercooler

5. Screen installation

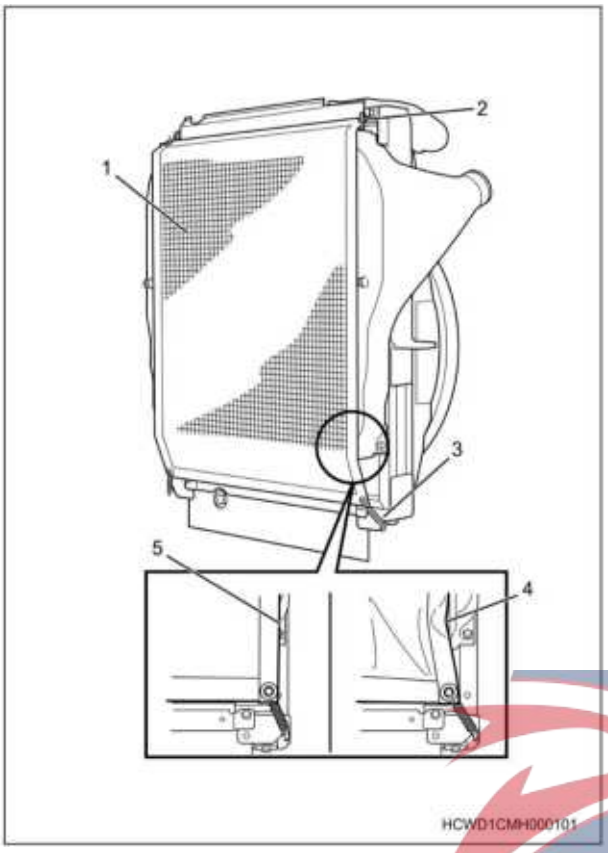
1) Mount the insect net onto the hook on the top of the radiator.

2) Mount the spring to the hooks on the bottom of the radiator and to the insect net.

Caution:

● Care should be taken not to pinch your fingers during installation.

● Do not damage the radiator core or intercooler core.

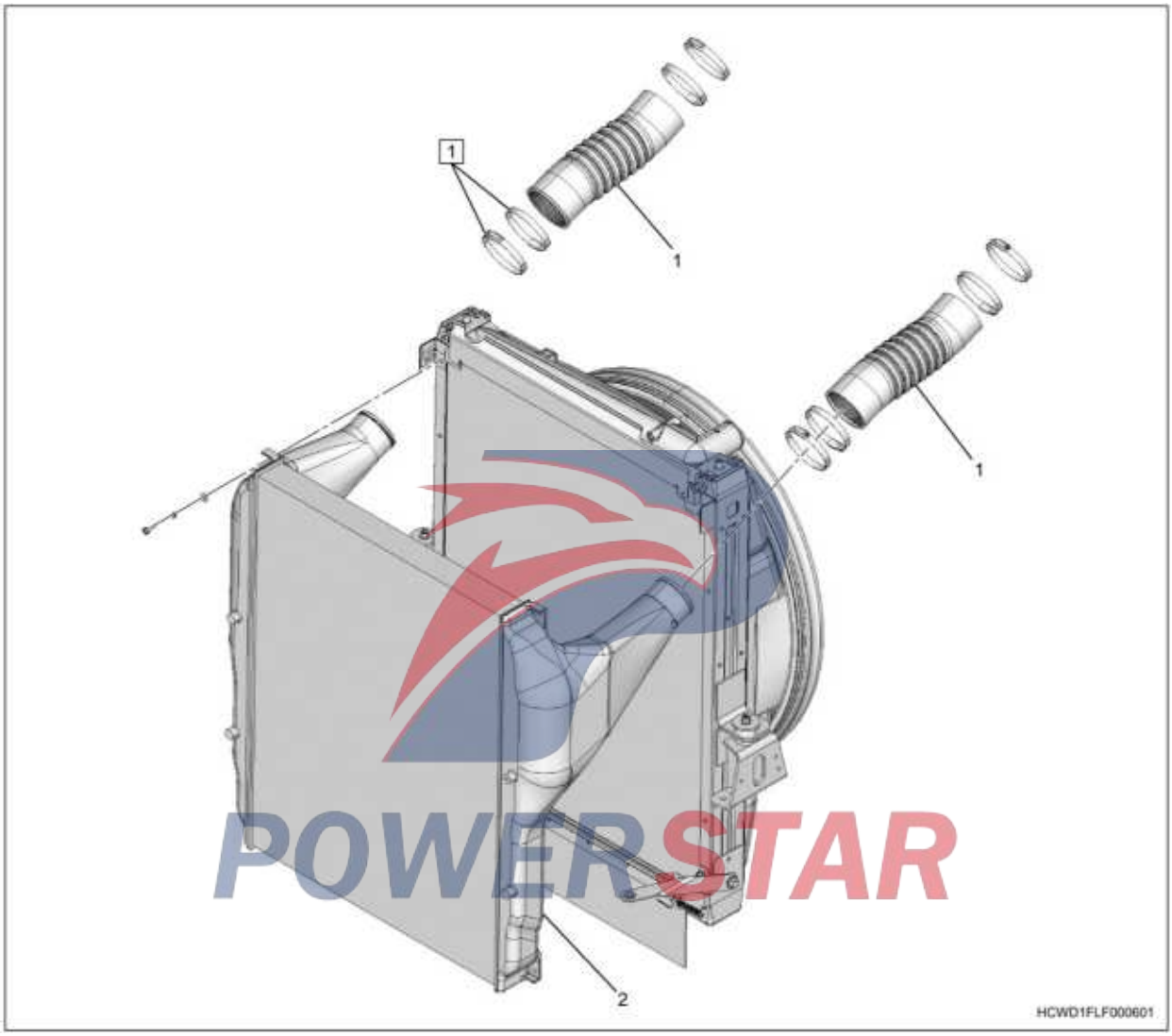


1. Screen
2. Hook
3. Hook, spring
4. Incorrect
5. Correct

Supplementary Information

1. Component Views

Intercooler



Part name

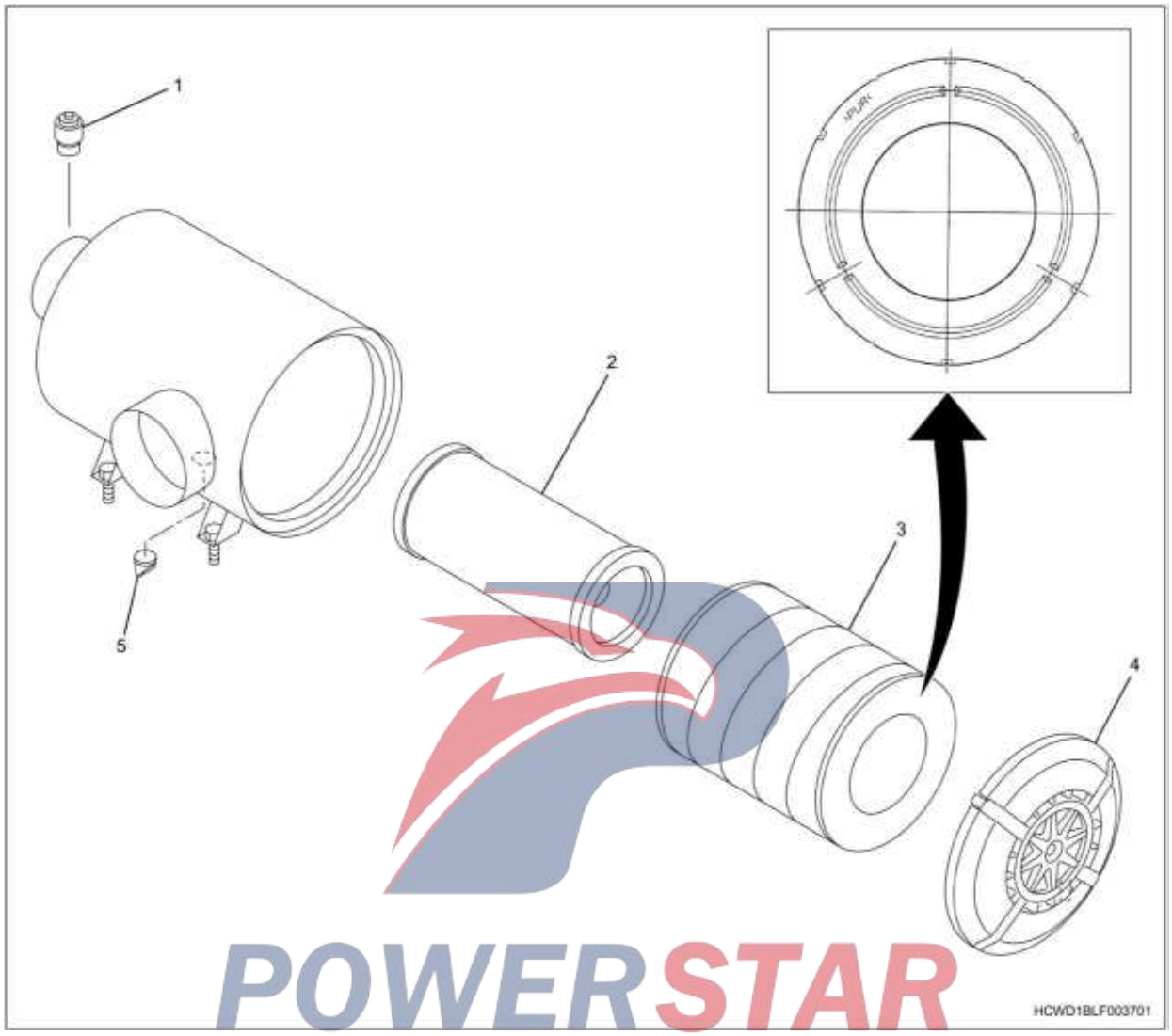
1. Intercooler hose

2. Intercooler

Tightening torque

1: 6.4 N • m { 0.7 kgf • m / 57 lb • in }

Air filter element



Part name

1. Dust indicator
2. Inner element
3. Air filter element
4. Air filter cover
5. Water drain valve


POWERSTAR

Engine

Exhaust

(6WG1)

Table of contents

Exhaust pipe 1G-2
Removal 1G-2
Inspection 1G-3
Installation 1G-4
Differential pressure pipe 1G-7
Removal 1G-7
Inspection 1G-8
Installation 1G-9
Supplementary Information 1G-1

Exhaust pipe

Removal

1. Component Views

2. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

3. Mud guard removal

1) Remove the mudguard on the right of the vehicle from the bracket.

4. Noise shutter panel removal

1) Remove the noise shutter panel on the right side of the vehicle from the frame.

5. Exhaust cover removal

1) Remove the exhaust cover from the frame.

6. Exhaust brake valve removal

1) Disconnect the air pipe from the exhaust brake valve.

2) Remove the front exhaust pipe A and exhaust brake valve as a set from the exhaust pipe B adapter and exhaust silencer.

7. Front exhaust pipe removal

1) Remove the front exhaust pipe B from the silencer.

2) Remove the front exhaust pipe B from the silencer.

3) Remove the front exhaust pipe B from the silencer.

8. Differential pressure pipe removal

1) Disconnect the differential pressure hose from the differential pressure pipe.

2) Loosen the sleeve nut of the differential pressure pipe.

3) Remove the clip from the differential pressure pipe.

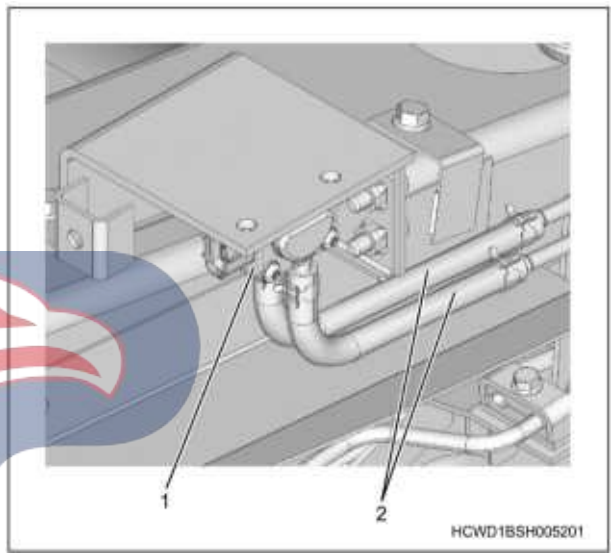
4) Remove the differential pressure pipe from the silencer.

9. Exhaust differential pressure sensor removal

1) Mark the installation location of the differential pressure hose.

2) Disconnect the differential pressure hose from the differential pressure sensor.

3) Disconnect the connector from the differential pressure sensor.



1. Differential pressure sensor

2. Differential pressure hose

Caution:

● Never loosen or tighten the 4 screws on the differential pressure sensor.

● Replace the differential pressure sensor if it is loose.

● If the differential pressure sensor is dropped, do not reuse it.

● When removing the differential pressure sensor, do not use tools that generate vibrations, such as an impact wrench.

10. Exhaust muffler removed

1) Remove the exhaust muffler from the bracket.

Inspection

1. Exhaust pipe on-vehicle inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Inspect the connecting section for looseness, damage, and leaking exhaust gas.

Caution:

● Please note that the body panel may be damaged due to overheating or vibration and exhaust gas may enter the cab.

2) Inspect the clamp and rubber for deterioration, cracking, and damage.

3) Inspect the pipe for cracking due to corrosion and denting.

Installation

1. Component Views

2. Exhaust cover installation

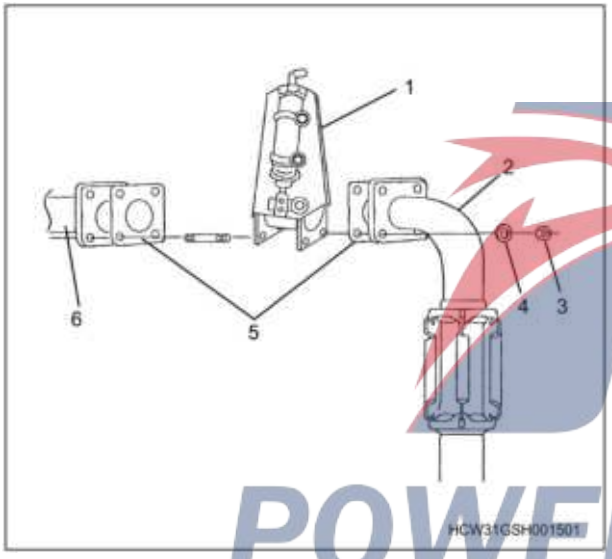
1) Install the gaskets, exhaust brake valves, and front exhaust pipe to the exhaust pipe A adapter.

Caution:

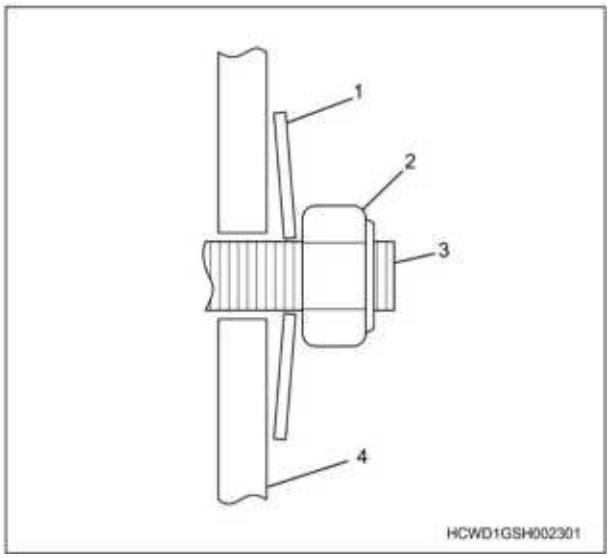
● Uniformly tighten the mounting nuts and bolts of the front exhaust pipe A, and make sure that there are no gas leaks.

● Install the washer with the convex section facing the nut side.

Tightening torque: 59 N • m {6.0 kgf • m / 44 lb • ft}



1. Exhaust brake valve
2. Front exhaust pipe A
3. Nut
4. Washer
5. Gasket
6. Turbocharger exhaust pipe



1. Washer
2. Nut
3. Stud
4. Flange

2) Connect the air hose to the exhaust brake valve.

3. Exhaust cover installation

1) Install the exhaust cover to the frame.

4. Exhaust silencer installation

1) Install the exhaust muffler on the bracket.

Tightening torque: 20 N • m {2.0 kgf • m / 15 lb • ft}

5. Exhaust differential pressure sensor installation

1) Install the differential pressure sensor to the bracket.

Tightening torque: 25 N • m {2.5 kgf • m / 18 lb • ft}

2) Install the connector to the differential pressure sensor.

3) Connect the differential pressure hose to the differential pressure sensor.

Caution:

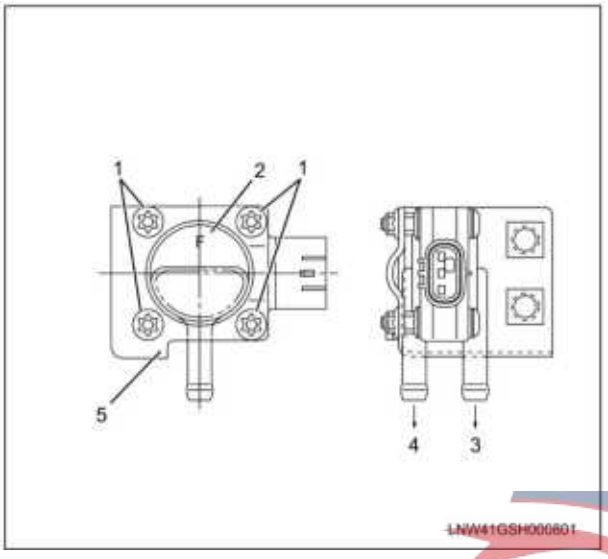
● Install the differential pressure hose with white marking on the differential pressure sensor side with the white "F" mark.

● Firmly install the hose clip.

● Do not use cracked hoses.

● If there is material attached to the gasket seal surface of the flange, wipe it off with a wet cloth.

● Because the differential pressure sensor may malfunction if there is exhaust gas leakage from connections, be sure to check for any leaks after starting the engine.



1. Bolt
2. Front mark
3. Outlet side differential pressure hose port
4. Inlet side differential pressure hose port
5. Bracket

6. Differential pressure pipe installation

1) Clean the old anti-seize lubricant on the sleeve nut, and apply new anti-seize lubricant to the threaded portion of the sleeve nut.

Caution:

● Apply Never-Seez High Pressure Stainless Grade 5-87411-039-0 by Bostik of USA as the anti-seize lubricant.

2) Temporarily tighten the differential pressure pipe to the silencer.

Note:

● Temporarily tighten the sleeve nut by hand.

Caution:

● Make sure to follow the differential pressure pipe installation procedure as not doing so could cause the nuts to loosen.

3) Temporarily tighten the clip and align the differential pressure pipe position.

Caution:

● Install so that the differential pressure pipe marking end and the clip end surface meet.

4) Securely tighten the clip to the silencer.

Tightening torque: 10 N • m { 1.0 kgf • m / 89 lb • in }

5) Securely tighten the differential pressure pipe to the silencer.

Tightening torque: 35 N • m { 3.6 kgf • m / 26 lb • ft }

6) Install the differential pressure hose to the differential pressure pipe.

Caution:

● Install the differential pressure hose with the white marking to both the differential pressure sensor F-marked side port and the inlet side of the differential pressure pipe.

● The differential pressure hose must be inserted to make secure contact with the bulged section of the pipe.

● Firmly install the hose clip.

● Be careful not to overhang the clamp over the bobbin or bulge

● Be careful not to mistake the location of the differential pressure hose.

● Do not use cracked hoses

● If there is material attached to the gasket seal surface of the flange, wipe it off with a wet cloth.

● Since the exhaust gas leakage at the accessory may cause a malfunction of the differential pressure sensor, check whether there is a leak after starting the engine.

7. Front exhaust pipe installation

1) Install the front exhaust pipe B onto the front exhaust pipe A and exhaust muffler.

Tightening torque: 106 N • m {10.8 kgf • m / 78 lb • ft}

2) Install the front exhaust pipe B onto the front exhaust pipe A and exhaust muffler.

Tightening torque: 106 N • m {10.8 kgf • m / 78 lb • ft}

3) Install the front exhaust pipe B onto the front exhaust pipe A and exhaust muffler.

Tightening torque: 106 N • m {10.8 kgf • m / 78 lb • ft}

8. Noise shutter panel installation

1) Install the noise shutter panel on the right side of the vehicle to the frame.

2) Install the noise shutter panel on the left side of the vehicle to frame.

9. Mud guard installation

1) Install the mudguard on the right side of the vehicle to the bracket.

2) Install the mudguard on the left side of the vehicle to the bracket.

10. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

11. Exhaust differential pressure sensor adjustment

1. 0-point correction of the differential pressure sensor

If the differential pressure sensor is replaced, perform a 0-point adjustment of the differential pressure sensor on the vehicle.

1) Turn ON the ignition switch.

Note:

● The engine does not start.

2) Confirm that 40 seconds or more have elapsed.

3) Turn the ignition switch to the OFF position and leave for 15 seconds or more.

Caution:

● The 0-point correction operation is very susceptible to heat, so perform the correction when the differential pressure sensor is at room temperature.

Differential pressure pipe

Removal

1. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

2. Differential pressure pipe removal

1) Disconnect the differential pressure hose from the differential pressure pipe.

2) Loosen the sleeve nut of the differential pressure pipe.

3) Remove the clip from the differential pressure pipe.

4) Remove the differential pressure pipe from the silencer.

Inspection

1. Differential pressure pipe inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

2. Differential pressure pipe cleaning

1. Preparation

1) Prepare the tools listed in the table.

Tools for use	Supplement
Electric drill or electric screwdriver	Adjustable speed, with forward and reverse functions
3 types of wire rope	Ends can be left as is after cutting with a wire cutter.

Diameter	Material	Construction	Strand diameter	Length
: 3 mm { 0.12 in }	Stainless wire	7×7	: 0.25 mm { 0.0098 in }	: 200 mm { 7.87 in }
: 5 mm { 0.20 in }	Steel wire	6×19	: 0.25 mm { 0.0098 in }	: 200 mm { 7.87 in }
: 3 mm { 0.12 in }	Stainless wire	7×7	: 0.25 mm { 0.0098 in }	: 800 mm {31.50 in}

2. Clean.

1) Install 200 mm (7.87 in) of wire with a 3 mm (0.12in) diameter to an electric drill.

2) Insert wire into the differential pressure pipe.

3) Insert wire into the differential pressure pipe from the silencer side by twisting the wire while taking care not to vibrate it.

Caution:

● Adjust the rotating speed and pressing force so that the wire does not catch on the differential pressure pipe.

4) Pull the wire out of the differential pressure pipe, and replace with 5 mm (0.20 in) diameter wire having a length of 200 mm (7.87 in).

5) Insert wire into the differential pressure pipe.

6) Insert wire into the differential pressure pipe from the silencer side by twisting the wire while taking care not to vibrate it.

Caution:

● Adjust the rotating speed and pressing force so that the wire does not catch on the differential pressure pipe.

7) Pull the wire out of the differential pressure pipe, and replace with 3 mm (0.12 in) diameter wire having a length of 800 mm (31.5 in).

8) Run wire through the differential pressure pipe.

9) Insert a wire, and push in until it comes out the opposite side of the differential pressure pipe.

Note:

● Thin down the wire if it is difficult to insert.

Caution:

● Make sure to check that the end of the differential pressure pipe is plugged.

10) Remove any dirt in the pipe with an air blower.

Note:

● If removal is not possible using only an air blower, use cleaning fluid as well.

Installation

1. Differential pressure pipe installation

1) Clean the old anti-seize lubricant on the sleeve nut, and apply new anti-seize lubricant to the threaded portion of the sleeve nut.

Caution:

● Apply Never-Seez High Pressure Stainless Grade 5-87411-039-0 by Bostik of USA as the anti-seize lubricant.

2) Temporarily tighten the differential pressure pipe to the silencer.

Note:

● Temporarily tighten the sleeve nut by hand.

Caution:

● Make sure to follow the differential pressure pipe installation procedure as not doing so could cause the nuts to loosen.

3) Temporarily tighten the clip and align the differential pressure pipe position.

Caution:

● Install so that the differential pressure pipe marking end and the clip end surface meet.

4) Securely tighten the clip to the silencer.

Tightening torque: 10 N • m { 1.0 kgf • m / 89 lb • in }

5) Securely tighten the differential pressure pipe to the silencer.

Tightening torque: 35 N • m { 3.6 kgf • m / 26 lb • ft }

6) Install the differential pressure hose to the differential pressure pipe.

Caution:

● Install the differential pressure hose with the white marking to both the differential pressure sensor F-marked side port and the inlet side of the differential pressure pipe.

● The differential pressure hose must be inserted to make secure contact with the bulged section of the pipe.

● Firmly install the hose clip.

● Be careful not to overhang the bobbin or bulge on the clip.

● Be careful not to mistake the location of the differential pressure hose.

● Do not use cracked hoses

● If there is material attached to the gasket seal surface of the flange, wipe it off with a wet cloth.

● Since the exhaust gas leakage at the accessory may cause a malfunction of the differential pressure sensor, check whether there is a leak after starting the engine.

2. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.


POWERSTAR

Supplementary Information

1. Component Views

Engine

Aux. Emission Control Devices (6WG1)

Table of contents

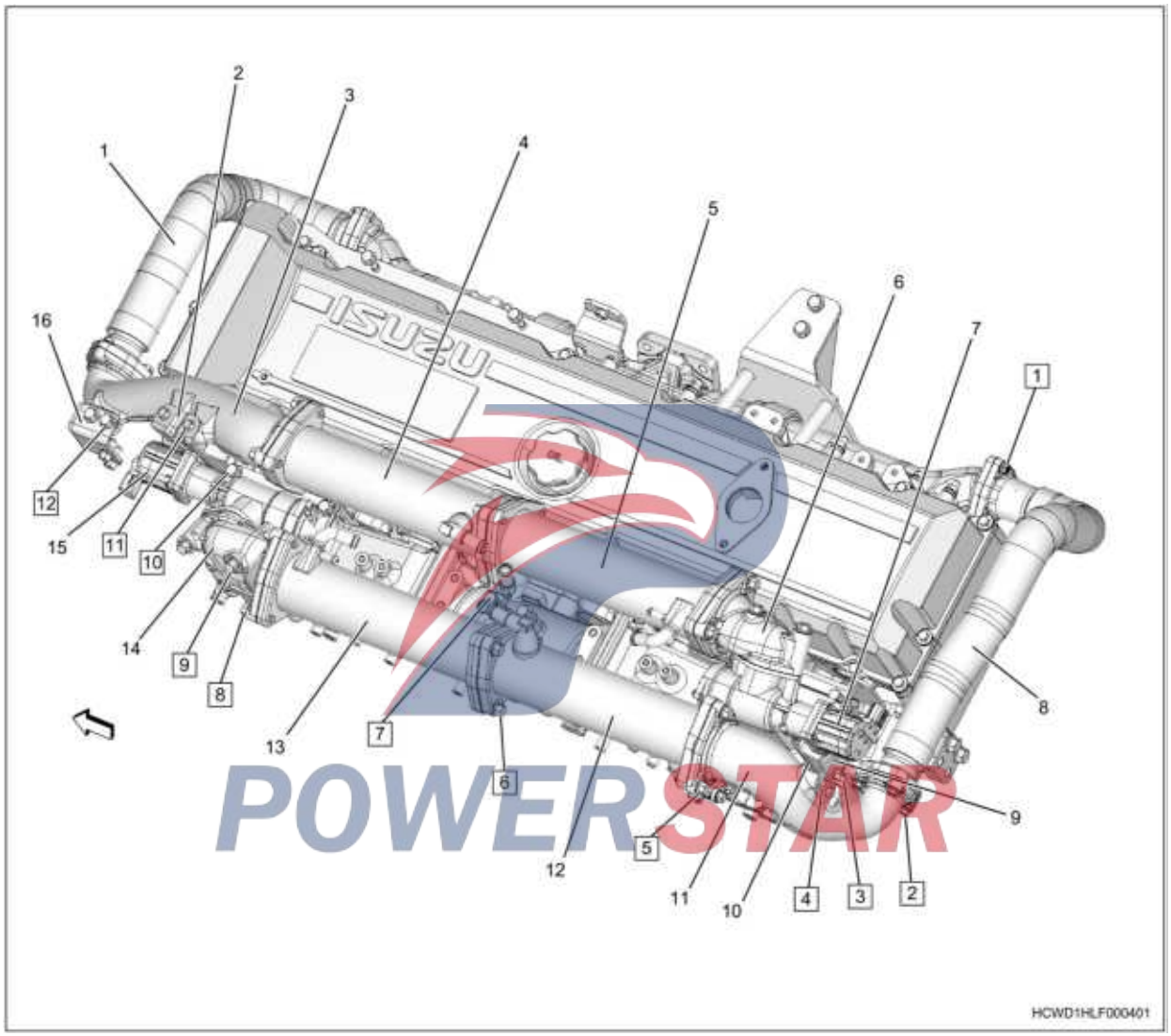
EGR cooler 1H-2
Removal 1H-2
Inspection 1H-10
Installation 1H-11
EGR valve 1H-20
Removal 1H-20
Inspection 1H-27
Installation 1H-28
Additional information 1H-37

EGR cooler

Removal

1. Component Views

EGR cooler



1. Exhaust gas recirculation line A
2. Exhaust gas recirculation valve thermal protection device
3. EGR cooler Duct A.
4. EGR cooler A.
5. EGR cooler duct B.
6. EGR cooler B
7. EGR valve 1
8. Exhaust gas recirculation line B
9. Exhaust gas recirculation duct holder
10. Exhaust gas recirculation valve thermal protection device
11. EGR cooler duct C
12. EGR cooler C.
13. EGR cooler D
14. EGR cooler duct D.
15. EGR valve 2
16. EGR cooler duct bracket

Tightening torque

1: 25 N • m { 2.5 kgf • m / 18 lb • ft }

2: 25 N • m { 2.5 kgf • m / 18 lb • ft }

3: 24.7 N • m { 2.5 kgf • m / 18 lb • ft }

4: 20 N • m { 2.0 kgf • m / 15 lb • ft }

5: 50 N • m { 5.1 kgf • m / 37 lb • ft }

6: 50 N • m { 5.1 kgf • m / 37 lb • ft }

7: 43.8 N • m { 4.5 kgf • m / 32 lb • ft }

8: 50 N • m { 5.1 kgf • m / 37 lb • ft }

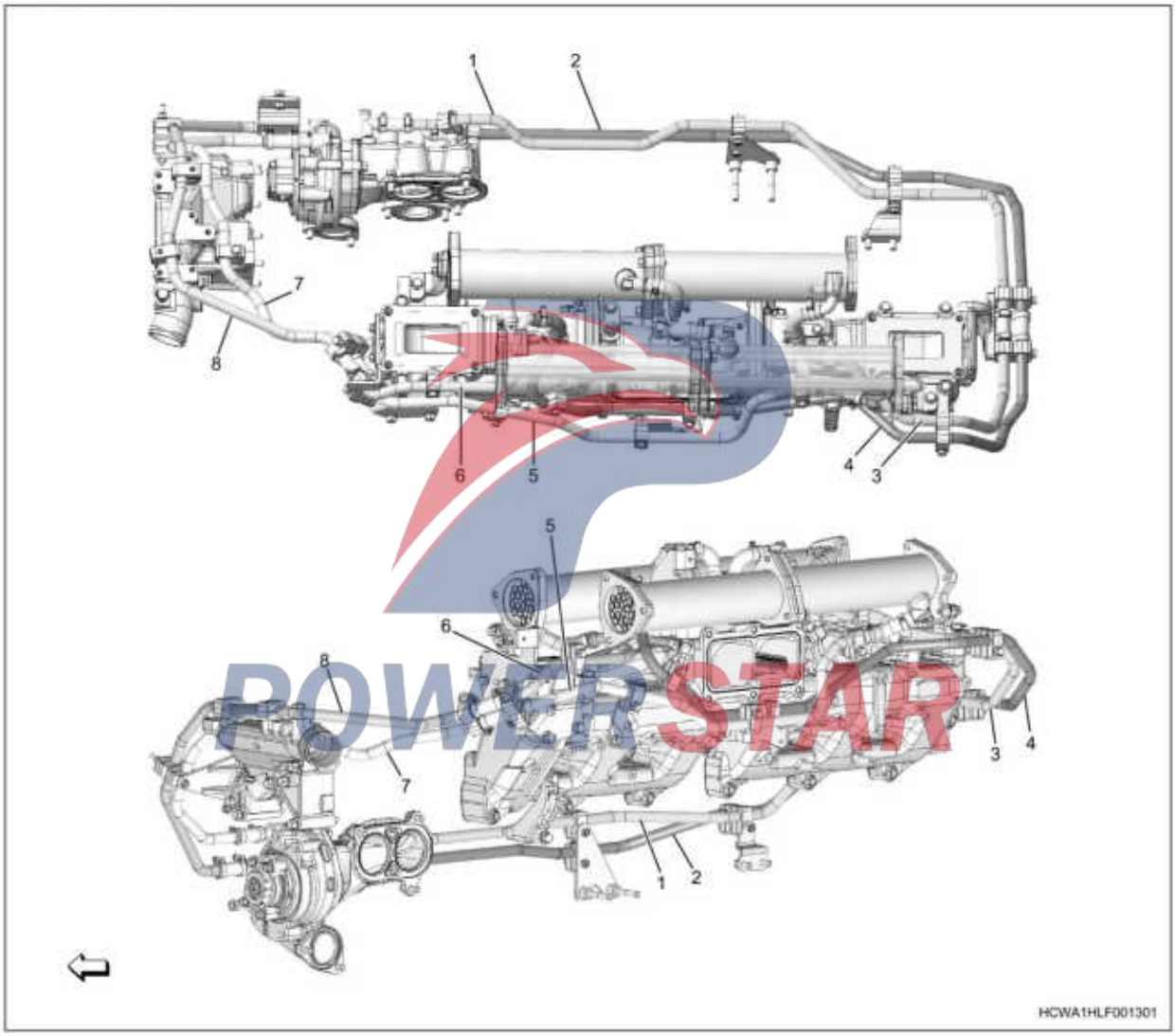
9: 43.8 N • m { 4.5 kgf • m / 32 lb • ft }

10: 43.8 N • m { 4.5 kgf • m / 32 lb • ft }

11: 20 N • m { 2.0 kgf • m / 15 lb • ft }

12: 24.7 N • m { 2.5 kgf • m / 18 lb • ft }

EGR cooler



Part name

1. Exhaust gas recirculation return pipe (front 2)
2. Exhaust gas recirculation return pipe (rear 2)
3. Exhaust gas recirculation return pipe (rear 1)
4. Exhaust gas recirculation return pipe (front 1)
5. EGR cooler hose (rear 2)
6. EGR cooler hose (front 2)
7. EGR cooler hose (rear 1)
8. EGR cooler hose (front 1)

2. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

3. Coolant drain

Warning:

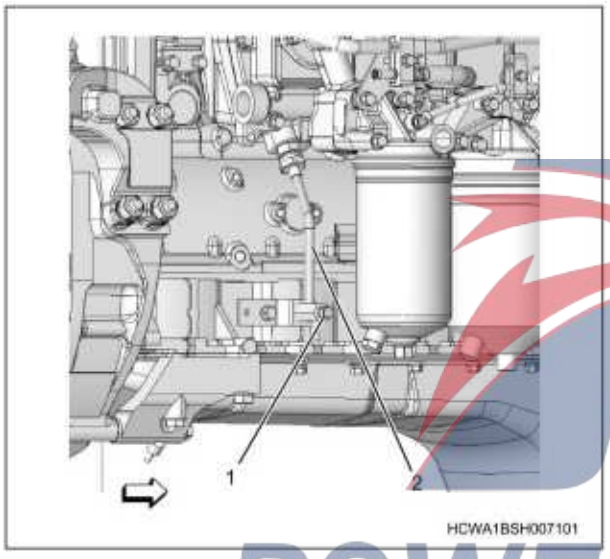
● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

1) Press the sub-tank cap button to release internal pressure.

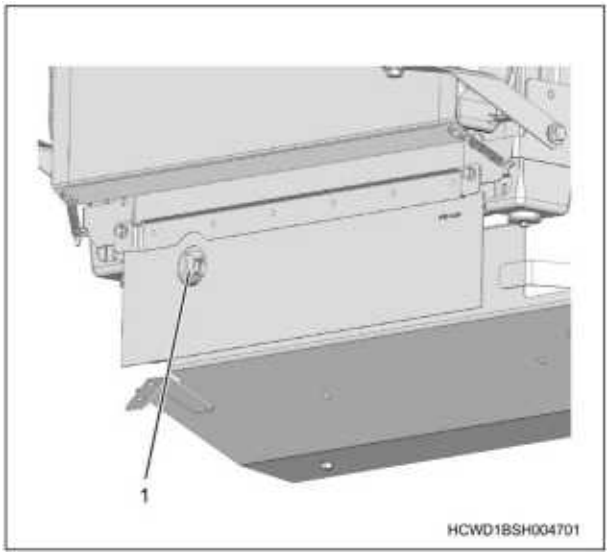
2) Remove sub-tank cap from radiator.

3) Loosen the drain plug on the cylinder block side, and drain the coolant to a pan.



1. Drain plug
2. Drain pipe

4) Loosen the radiator side drain plug, and drain the coolant to a pan.



1. Drain plug

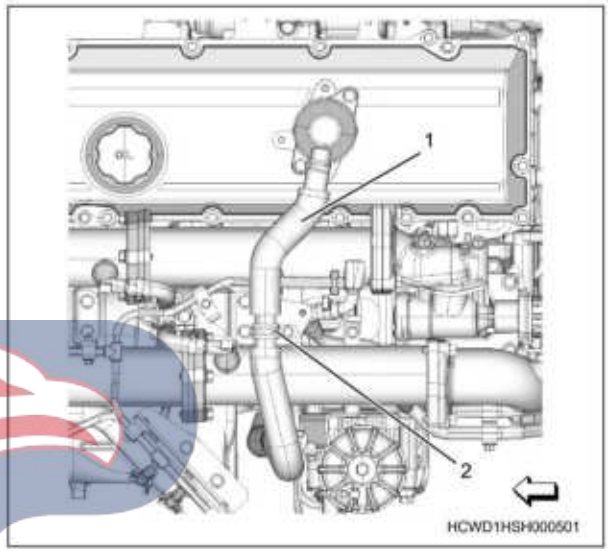
5) Tighten the radiator side drain plug.

6) Tighten the drain plug on the cylinder block side.

7) Install sub-tank cap to radiator.

4. Ventilation hose disconnect

1) Disconnect the ventilation hose to the cylinder front cover.

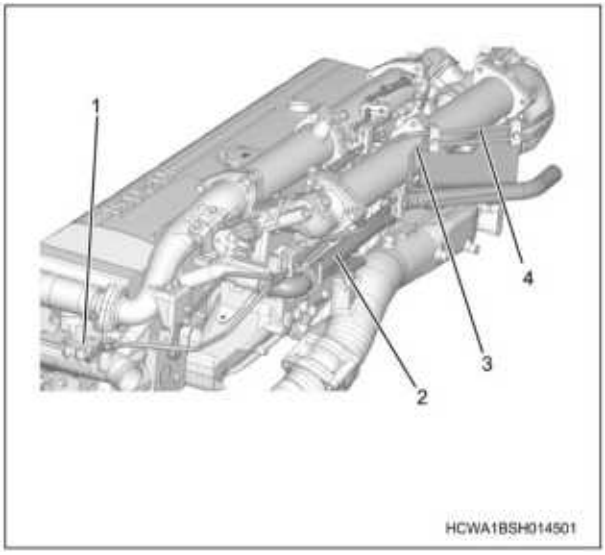


1. Ventilation hose
2. Ventilation hose clip

5. Air leak pipe removal

1) Remove the 4 clips and remove the front air leak on the EGR cooler.

2) Remove the two clips and then remove the rear blow-by tube on the EGR cooler and drain line.



1. Outlet pipe
2. Water charge pipe
3. Back-end leakage pipe
4. Front leakage pipe

6. Water charge pipe removal

1) Remove the filling pipe from the filling pipe holder.

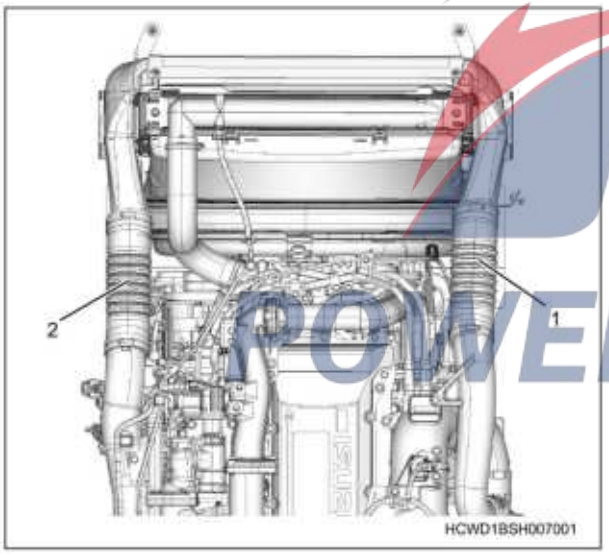
2) Remove the water-filled bracket from the inlet pipe.

3) Remove the water-filled bracket from exhaust gas recirculation valve line A.

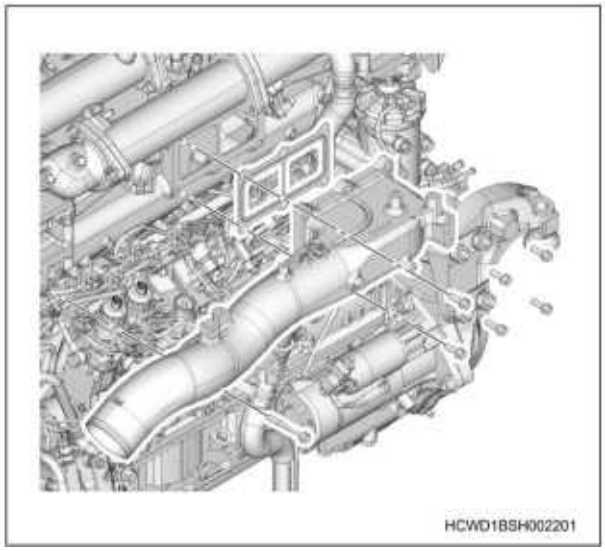
7. Intercooler hose removal

1) Disconnect the intercooler hose on the intercooler outlet side from the intercooler.

2) Remove the intercooler hose outlet on the intake line.



1. Intercooler hose on the intercooler inlet side
2. Intercooler hose on the intercooler outlet side



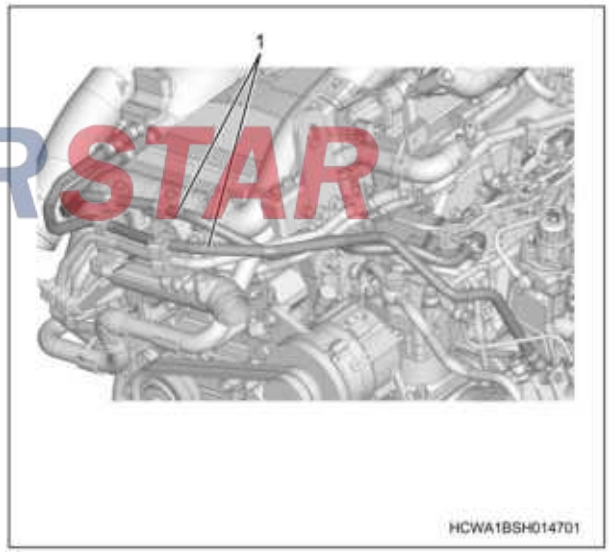
8. Intake duct removal

1) Disconnect the harness connector from the inlet line.

2) Remove the intake line from the intake manifold.

9. Suction pipe removal

1) Remove the 4 clips and then remove the 2 air extraction lines of the air compressor.

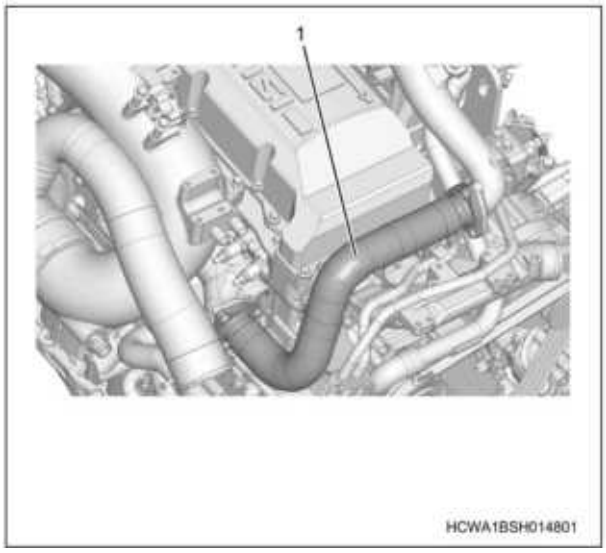


1. Exhaust pipe

10. EGR cooler removal

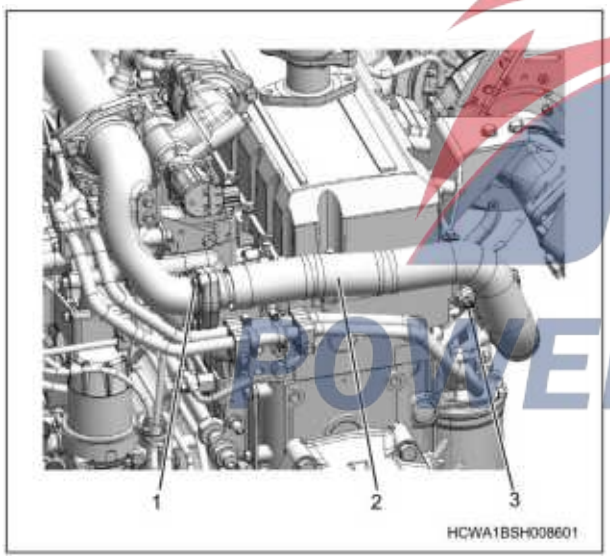
1) Remove the bracket from the drain.

2) Remove the exhaust gas recirculation line A on the EGR cooler line A.



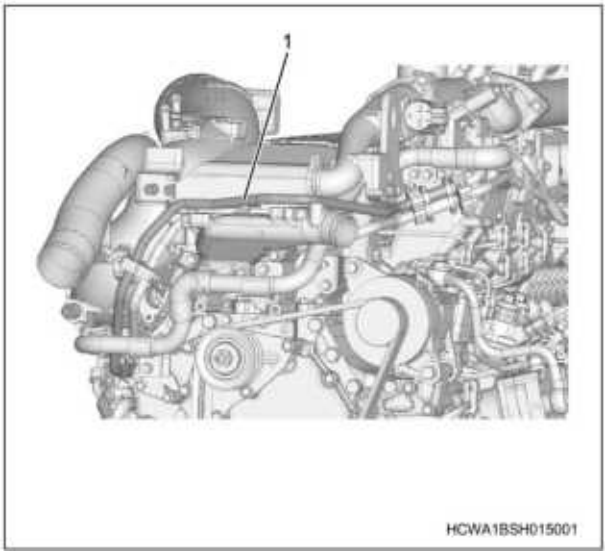
1. Exhaust gas recirculation line A

3) Remove the exhaust gas recirculation line B on the C recirculation cooler line.



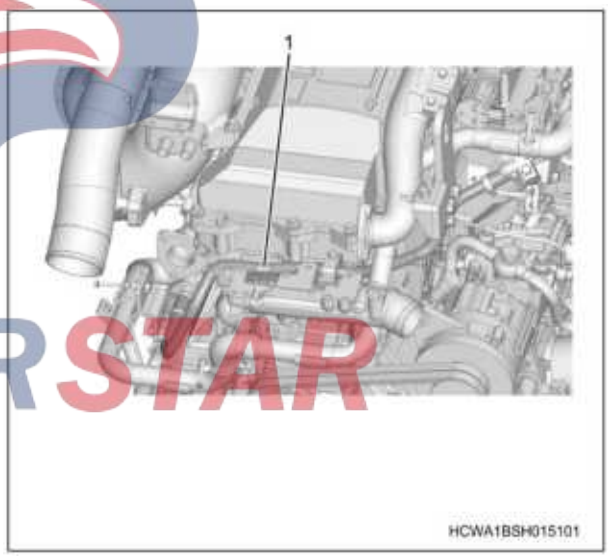
1. Standard bolt
2. Exhaust gas recirculation line B
3. High temperature steel flange bolts

4) Remove the front EGR cooler hose on the pump.



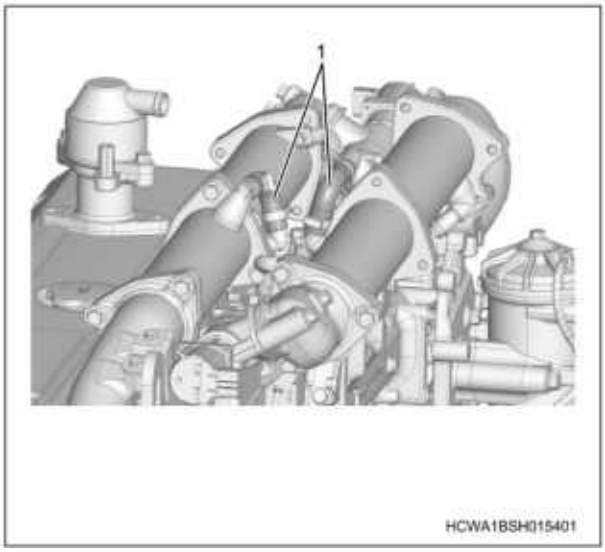
1. Front EGR cooler hose

5) The back-end water supply pipe removed from the pump.



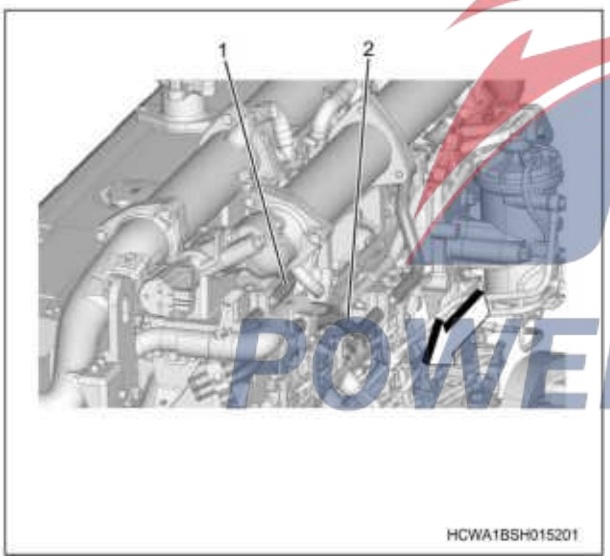
1. Back-end water pipe

6) Remove the water supply hose from the EGR cooler.



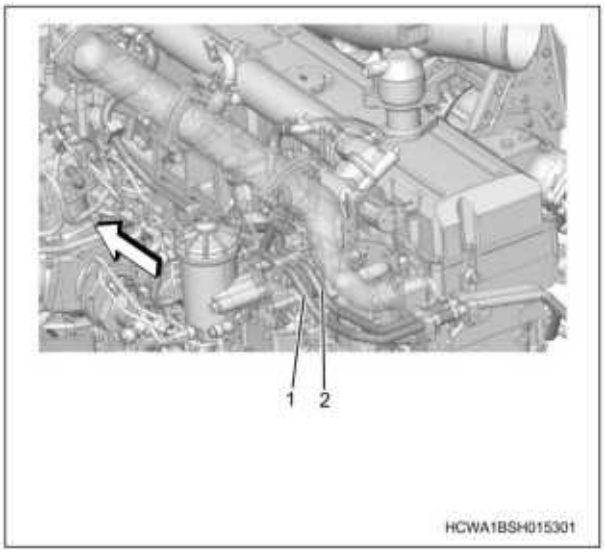
1. Water feed hose

7) Remove the front and rear EGR cooler pipes from the EGR cooler.



1. Front-end water supply pipe
2. Back-end water pipe

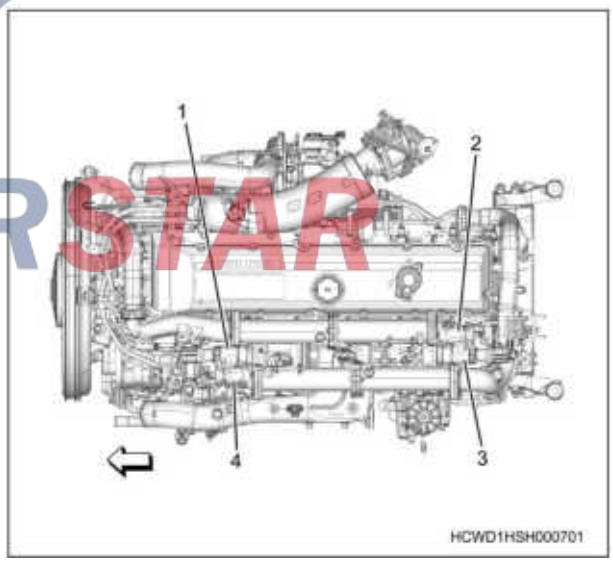
8) Remove the front and rear EGR cooler pipes from the EGR cooler.



1. Front return pipe
2. Back-end return pipe

9) Remove the EGR cooler duct D from the exhaust gas recirculation valve 2 and the EGR cooler D.

10) Remove the EGR cooler duct B from the exhaust gas recirculation valve 1 and the EGR cooler B.

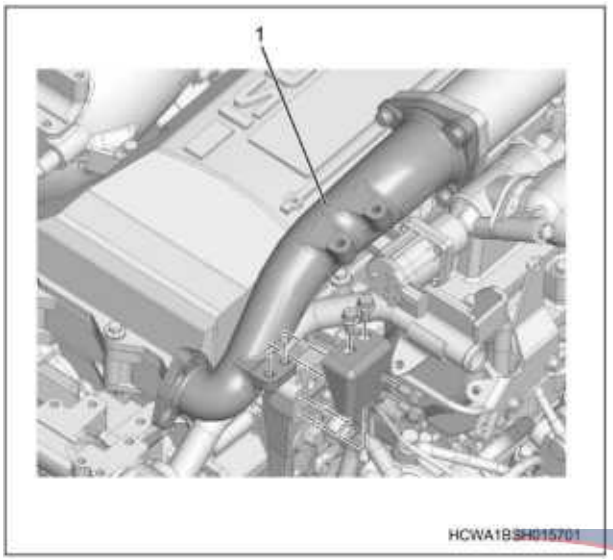


1. EGR valve 2
2. EGR cooler duct B
3. EGR valve 1
4. EGR cooler duct D

11) Remove front exhaust gas recirculation line bracket of EGR cooler line A.

12) Remove the exhaust gas recirculation valve heat shield on the EGR cooler line A.

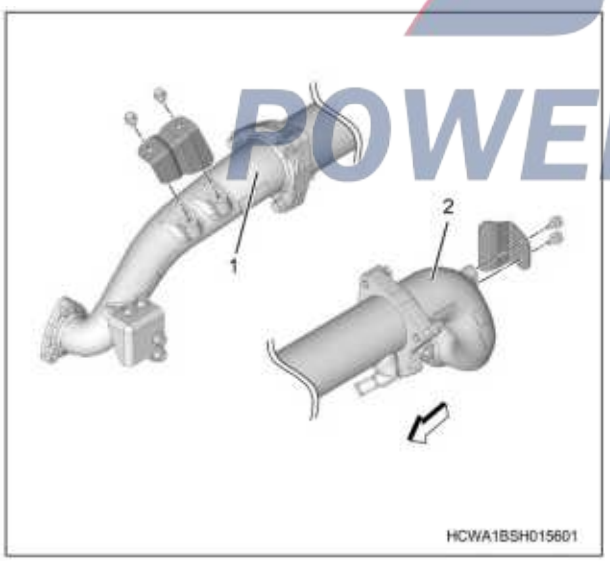
13) Remove EGR cooler Line A from EGR cooler A.



1. EGR cooler duct A

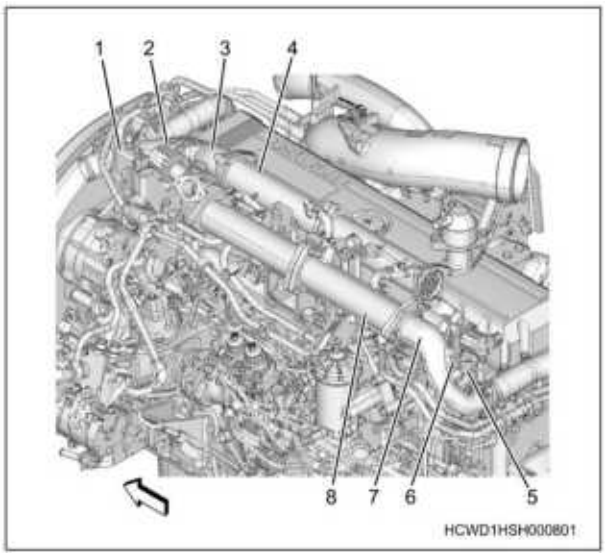
14) Remove the back-end exhaust gas recirculation line bracket of EGR cooler line C.

15) Remove exhaust gas recirculation valve heating protection device on EGR cooler C.



1. EGR cooler duct A
2. EGR cooler duct C

16) Remove EGR cooler Line C on EGR cooler C.

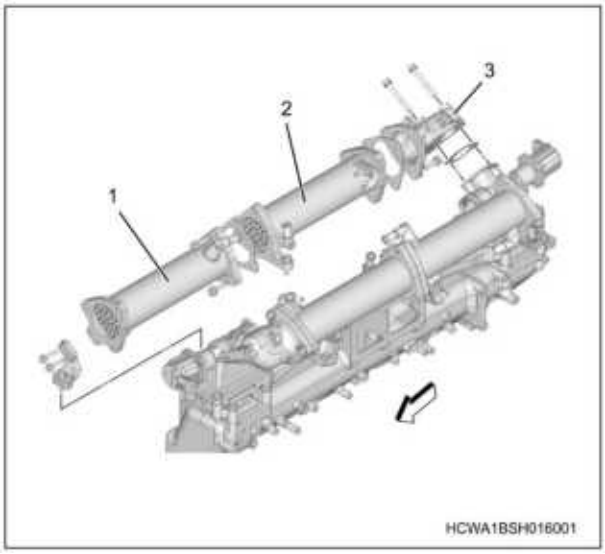


1. Front-end exhaust gas recirculation duct bracket
2. Exhaust gas recirculation valve thermal protection device
3. EGR cooler duct A
4. EGR cooler A
5. Back-end exhaust gas recirculation duct bracket
6. Exhaust gas recirculation valve thermal protection device
7. EGR cooler duct C
8. EGR cooler C

17) Remove the EGR cooler holder on the EGR cooler.

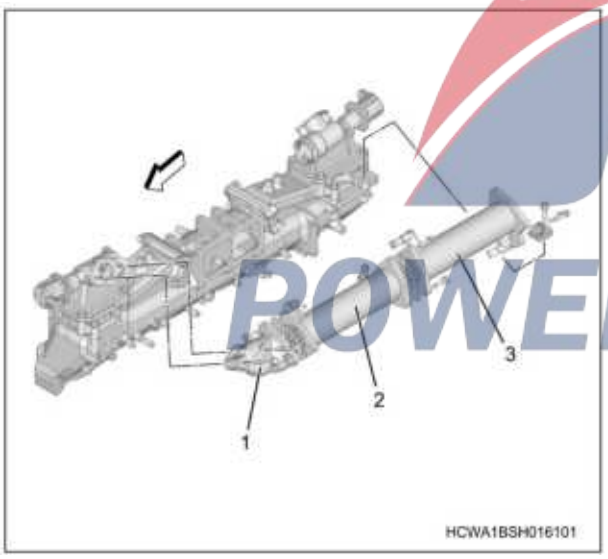
18) Remove the EGR cooler support on EGR cooler C.

19) Remove the EGR cooler A on the EGR cooler B.



1. EGR cooler A.
2. EGR cooler B
3. EGR cooler duct B

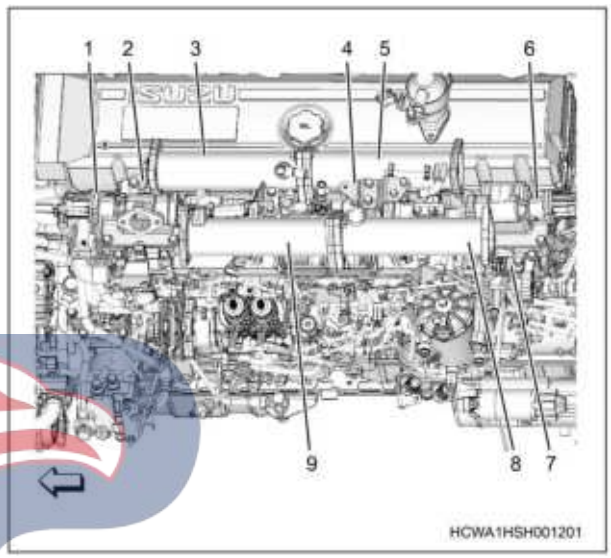
20) Remove the EGR cooler C on the EGR cooler D.



1. EGR cooler duct D
2. EGR cooler D
3. EGR cooler C

21) Remove the EGR cooler B on the intake manifold.

22) Remove the EGR cooler D on the intake manifold.



1. EGR valve 2
2. EGR cooler bracket
3. EGR cooler A.
4. Leakage pipe bracket
5. EGR cooler B.
6. EGR valve 1
7. EGR cooler bracket
8. EGR cooler C
9. EGR cooler D

Inspection

1. EGR cooler inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.

Parts deemed to be fouled or rusted must be cleaned.

1) Inspect the EGR cooler.

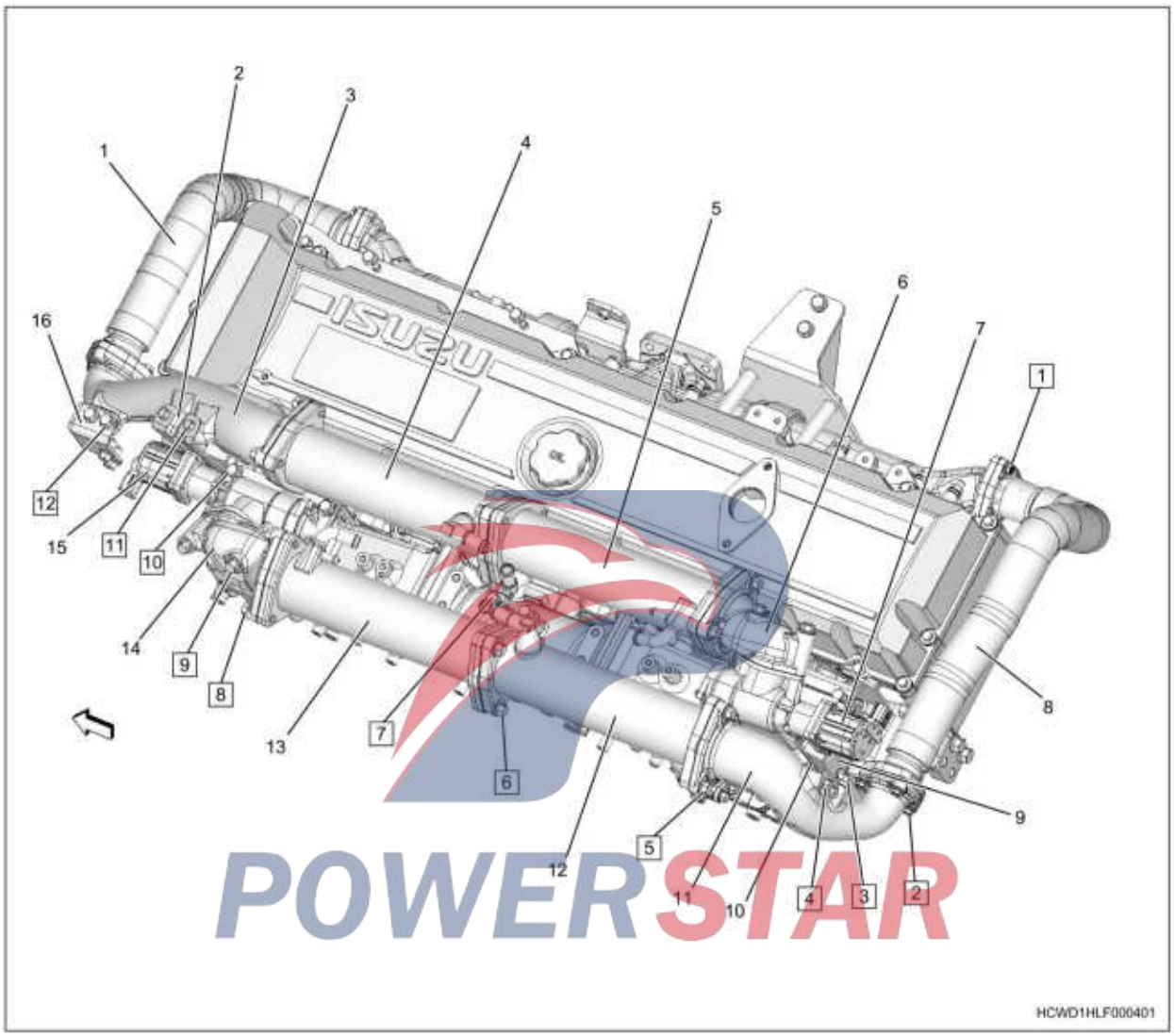
Note:

● Clean the EGR cooler if there is carbon buildup.

Installation

1. Component Views

EGR cooler



1. Exhaust gas recirculation line A
2. Exhaust gas recirculation valve thermal protection device
3. EGR cooler duct A
4. EGR cooler A
5. EGR cooler B
6. EGR cooler duct B
7. EGR valve 1
8. Exhaust gas recirculation line B
9. Exhaust gas recirculation duct bracket
10. Exhaust gas recirculation valve thermal protection device
11. EGR cooler duct C
12. EGR cooler C
13. EGR cooler D
14. EGR cooler duct D
15. EGR valve 2
16. EGR cooler duct bracket

Tightening torque

1: 25 N • m { 2.5 kgf • m / 18 lb • ft }

2: 25 N • m { 2.5 kgf • m / 18 lb • ft }

3: 24.7 N • m { 2.5 kgf • m / 18 lb • ft }

4: 20 N • m { 2.0 kgf • m / 15 lb • ft }

5: 50 N • m { 5.1 kgf • m / 37 lb • ft }

6: 50 N • m { 5.1 kgf • m / 37 lb • ft }

7: 43.8 N • m { 4.5 kgf • m / 32 lb • ft }

8: 50 N • m { 5.1 kgf • m / 37 lb • ft }

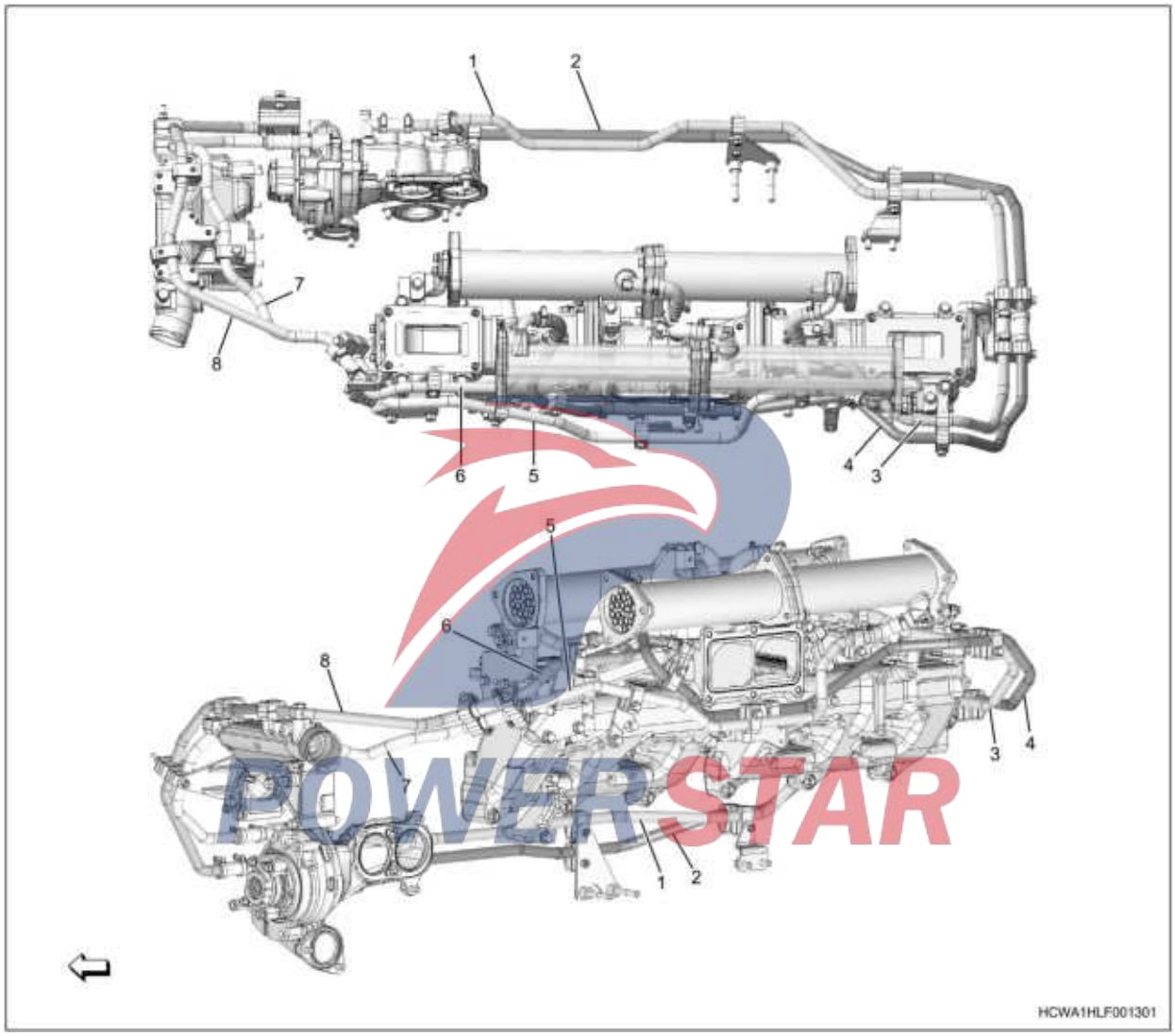
9: 43.8 N • m { 4.5 kgf • m / 32 lb • ft }

10: 43.8 N • m { 4.5 kgf • m / 32 lb • ft }

11: 20 N • m { 2.0 kgf • m / 15 lb • ft }

12: 24.7 N • m { 2.5 kgf • m / 18 lb • ft }

EGR cooler



Part name

1. Exhaust gas recirculation return pipe (front 2)
2. Exhaust gas recirculation return pipe (rear 2)
3. Exhaust gas recirculation return pipe (rear 1)
4. Exhaust gas recirculation return pipe (front 1)
5. EGR cooler hose (rear 2)
6. EGR cooler hose (front 2)
7. EGR cooler hose (rear 1)
8. EGR cooler hose (front 1)

2. EGR cooler installation

Caution:

● If the procedures or methods for assembling the EGR device are mistaken, it can lead to cracks in the pipe or gas leaks. Always follow the procedures.

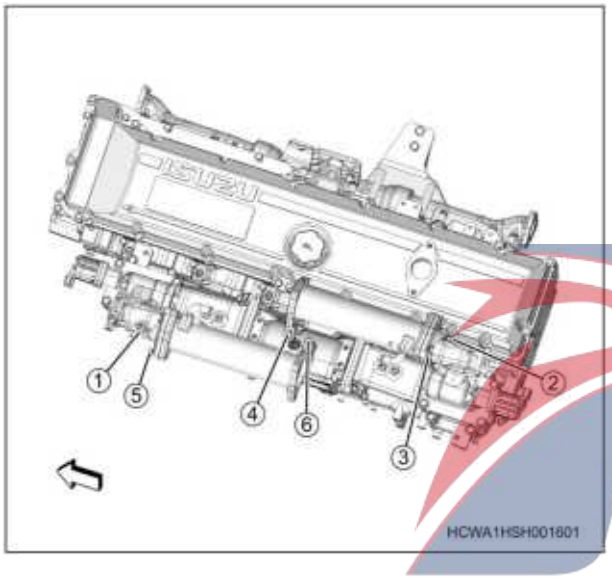
● Do not reuse the gasket.

● When removing only a part of an EGR-related part, loosen the entire EGR-related part once, replace the gaskets with new ones, and then temporarily and securely tighten in the following order.

1) Temporarily tighten the following exhaust gas recirculation valve components in the numerical order shown.

- EGR cooler duct D
- EGR cooler duct B
- EGR cooler B
- EGR cooler D

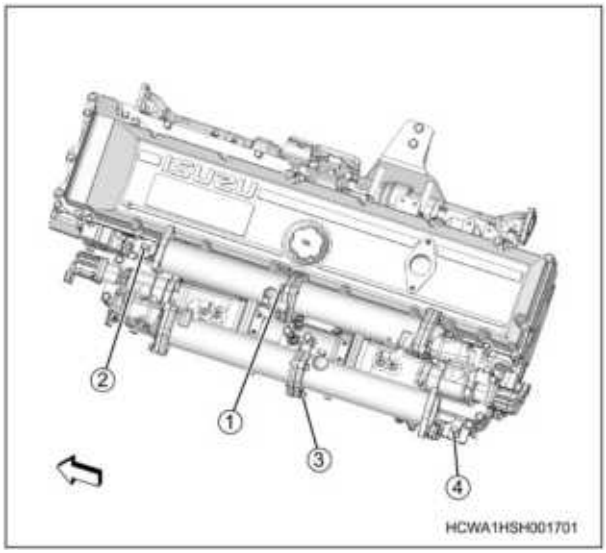
Temporary tightening torque: 5 N • m { 0.5 kgf • m / 44 lb • in }



2) Temporarily tighten the following EGR cooler components according to the figure in numerical order.

- EGR cooler A.
- EGR cooler bracket
- EGR cooler C
- EGR cooler bracket

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}



3) Finally tighten the EGR valve components and the EGR cooler in the order shown in the diagram.

- EGR cooler duct D.
- EGR cooler duct B
- EGR cooler B
- EGR cooler D
- EGR cooler A.
- EGR cooler bracket
- EGR cooler C
- EGR cooler bracket

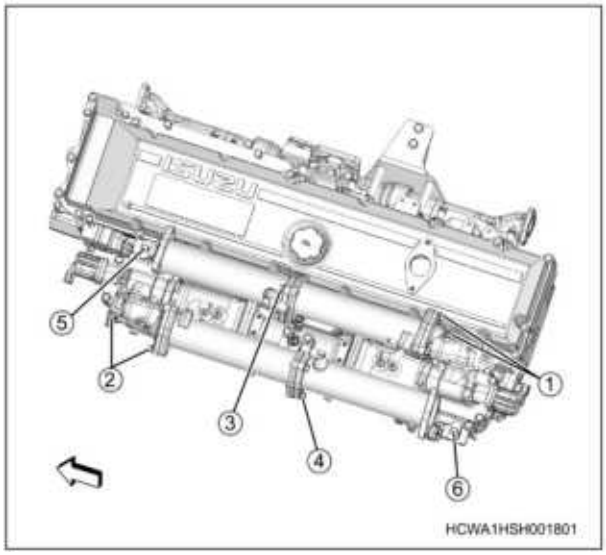
Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft} 1,2

Tightening torque: 50 N • m {5.1 kgf • m / 37 lb • ft} 3,4,5 (M10), 6 (M10)

Tightening torque: 25 N • m {3 kgf • m / 18 lb • ft} 5 (M8), 6 (M8)

Note:

- The number behind the tightening torque indicates the diagram number.



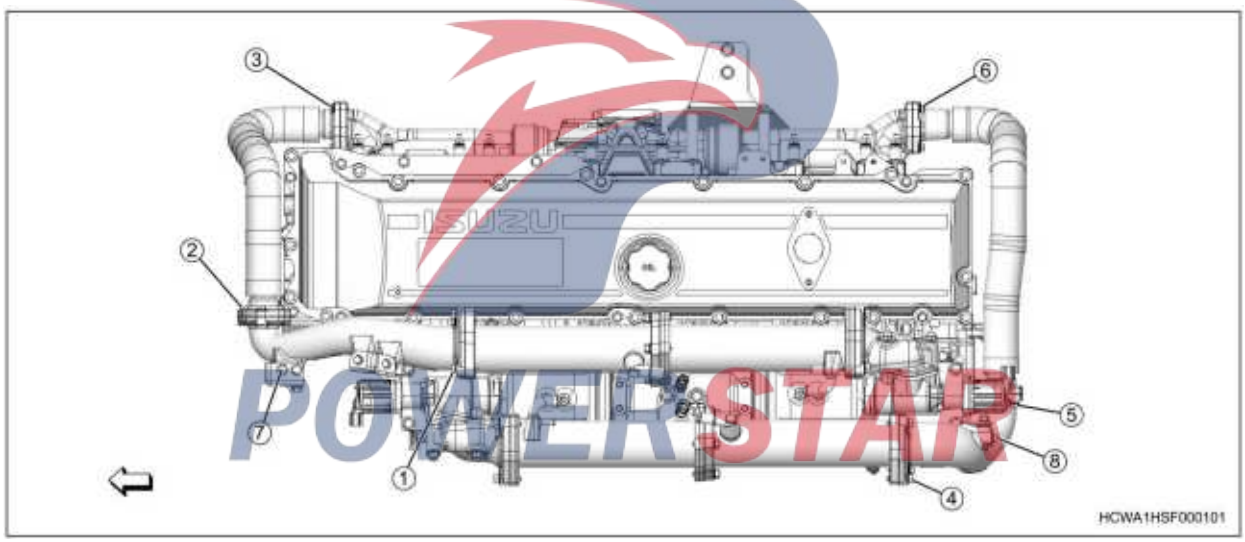
4) Temporarily tighten the following EGR cooler components and finally tighten the exhaust manifold in numerical order shown.

- EGR cooler duct A.
- EGR duct A
- EGR cooler duct C.
- EGR duct B.
- Bracket

Caution:

- Use high temperature resistant steel flange bolts for exhaust manifold mounting bolts and exhaust gas recirculation line A and exhaust gas recirculation line B.

Temporary tightening torque: 5 N • m { 0.5 kgf • m / 44 lb • in }



5) Final tightening of the following EGR cooler components and final tightening of the exhaust manifold in the numerical order shown.

- EGR cooler duct A.
- EGR duct A
- EGR cooler duct C.
- EGR duct B.
- Bracket

Tightening torque: 50 N • m {5.1 kgf • m / 37 lb • ft} 1 (M10), 2,3,9 (M10), 10 (M10)

Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft} 4

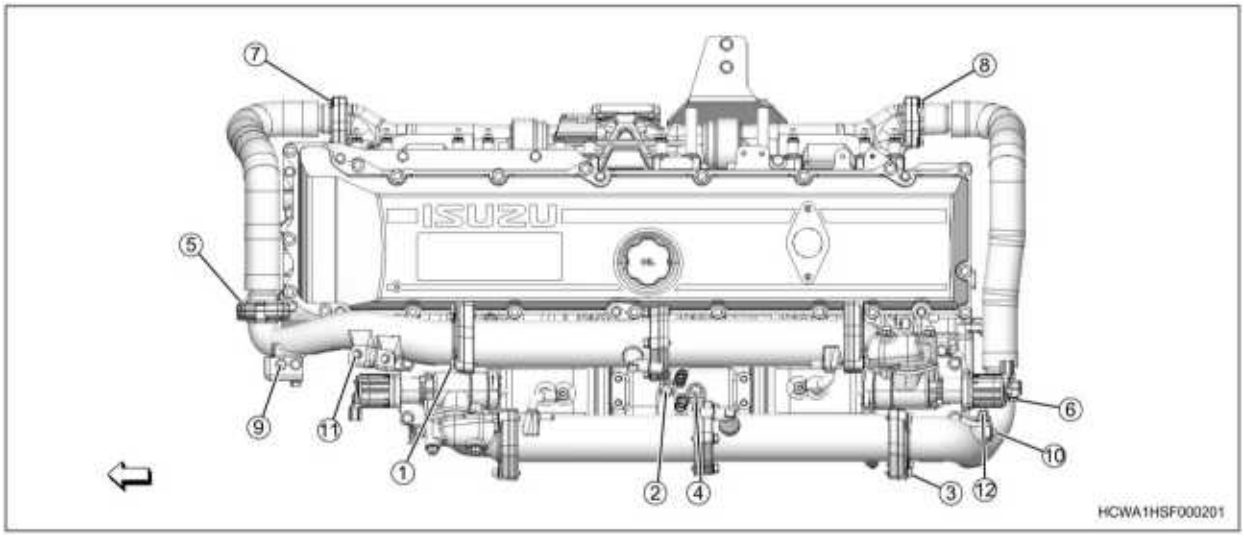
Tightening torque: 25 N • m {2.5 kgf • m / 18 lb • ft} 5,6 (M8), 7,8 (M8), 9 (M8)

Tightening torque: 24.7 N • m {2.5 kgf • m / 18 lb • ft} 10 (M8)

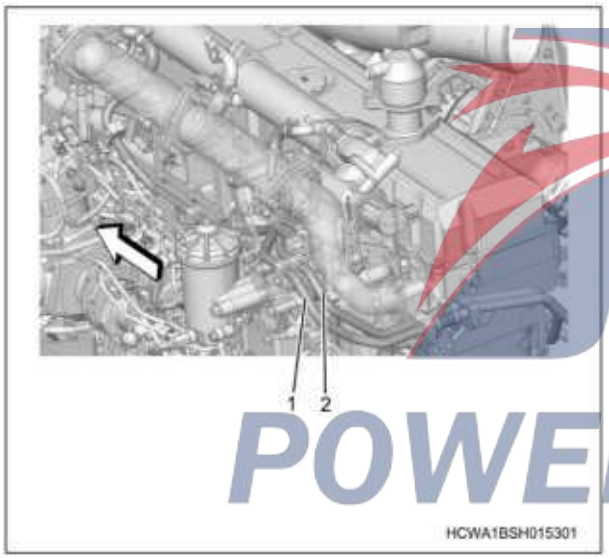
Tightening torque: 20 N • m {2.0 kgf • m / 15 lb • ft} 11,12 (M8)

Note:

- The number behind the tightening torque indicates the diagram number.



6) Install the front and rear return lines to the EGR cooler.



1. Front return pipe
2. Back-end return pipe

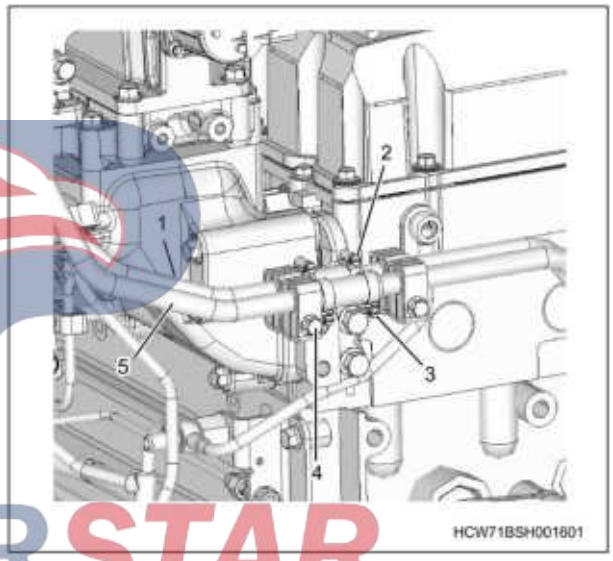
7) Install the clip on the return pipe.

Caution:

● During installation, care should also be taken to prevent the clamp from rotating.

● Install the water supply hose clamp to keep it horizontal.

● Install the water supply hose clamp and adjust the orientation to secure it to the rear of the engine.

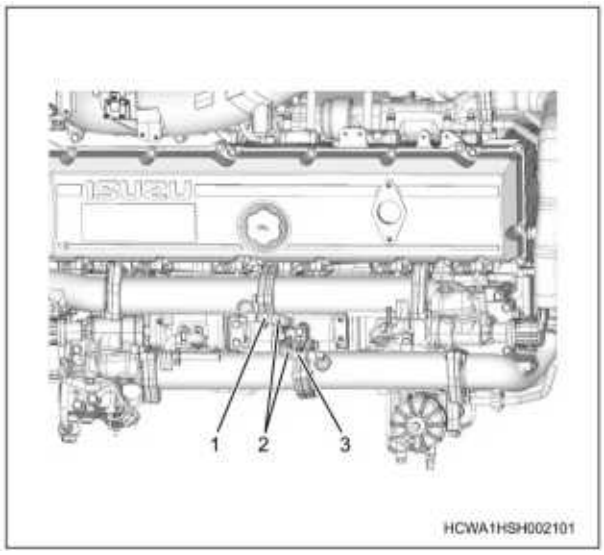


1. Front return pipe
2. Water supply hose clamp
3. Water supply hose clamp
4. Clamp bolt
5. Back-end return pipe

8) Install the water supply hose to the EGR cooler.

Caution:

● Hose clamps should be toward the top of the engine.

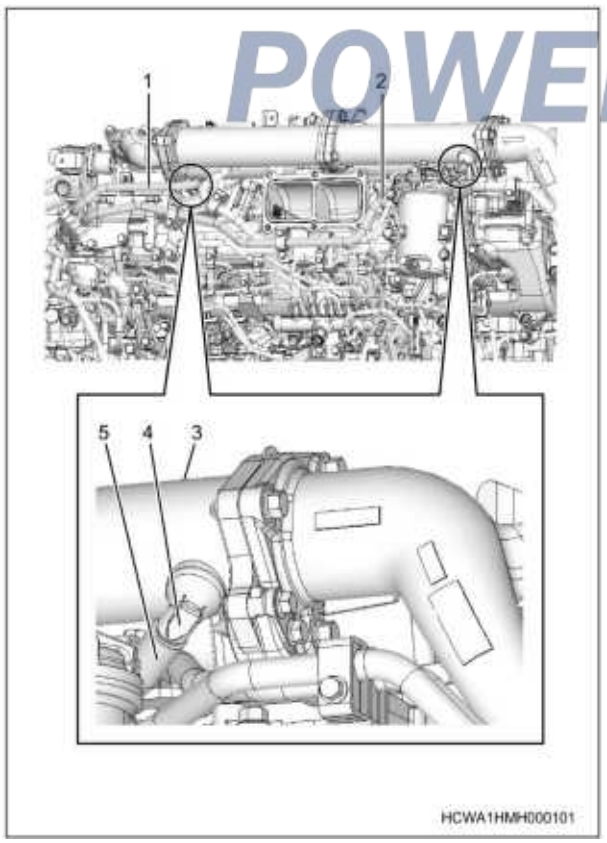


1. Hose clip
2. Water feed hose
3. Hose clip

9) Align the raised tips on the EGR cooler with the markings on the water supply hose and install the front and rear water lines on the EGR cooler.

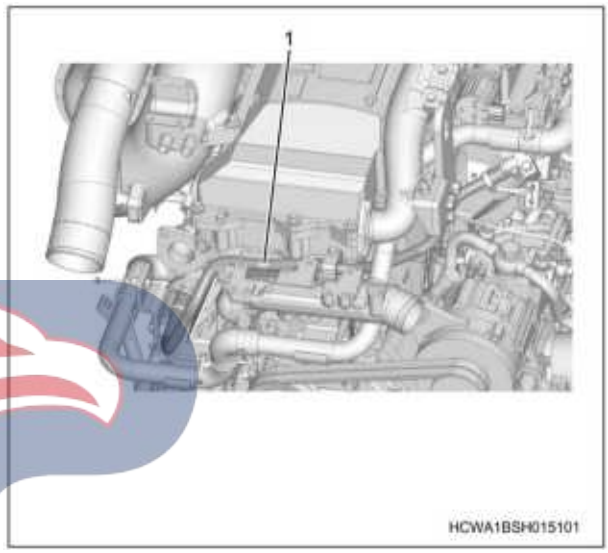
Caution:

● During installation, care should also be taken to prevent the clamp from rotating.



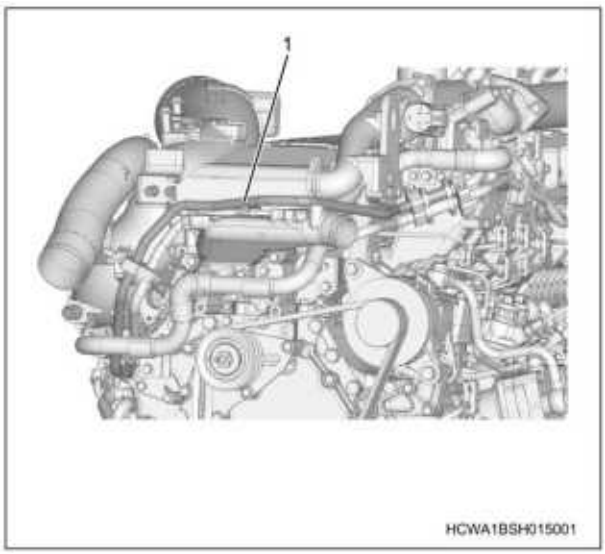
1. Front-end water supply pipe
2. Back-end water pipe
3. EGR cooler.
4. Raised part of the tip
5. Marking

10) Install the rear water supply pipe to the rubber hose between the rear water supply pipe and the water pump.



1. Back-end water pipe

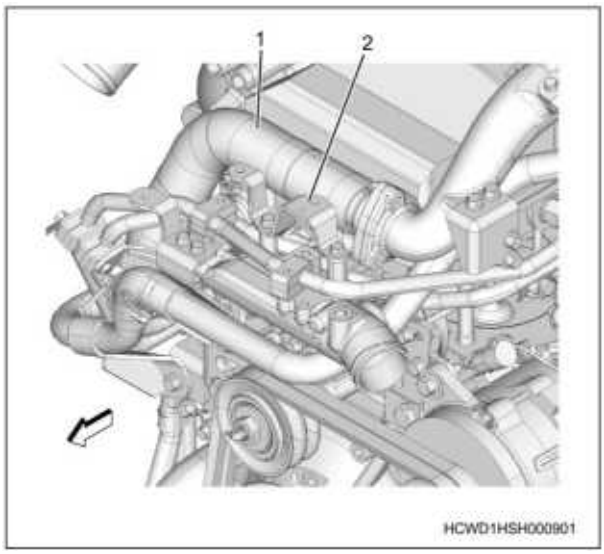
11) Install the front water supply pipe to the rubber hose between the front water supply pipe and the water pump.



1. Front-end water supply pipe

3. Suction pipe installation

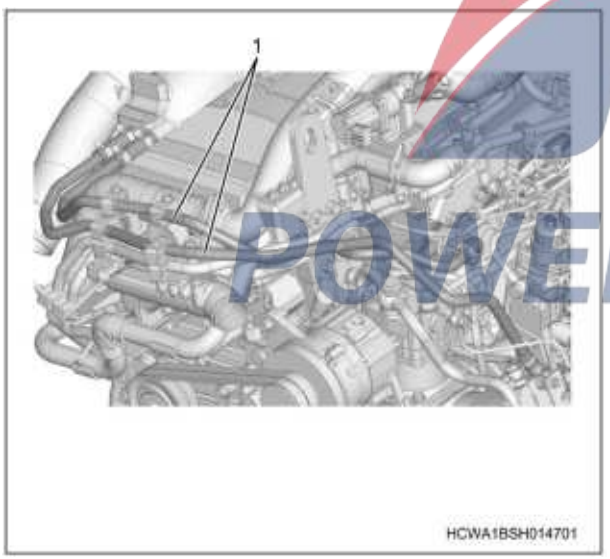
1) Install the bracket on the drain.



1. Front exhaust gas recirculation line

2. Bracket

2) Install 2 air suction tubes to the air compressor.

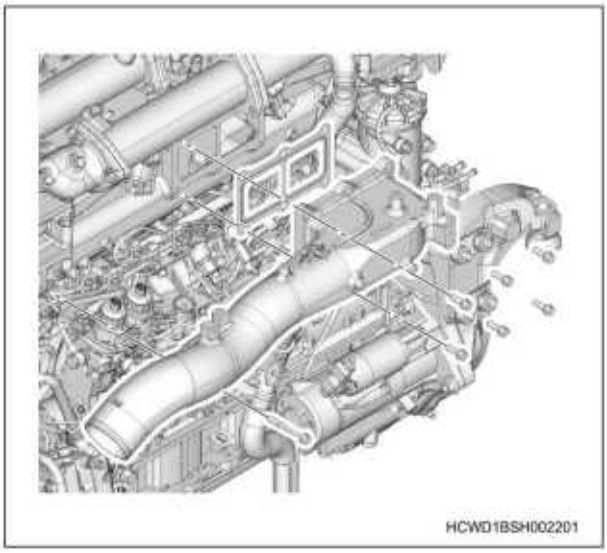


1. Exhaust pipe

Intake duct installation

1) Install the intake line to the intake manifold.

Tightening torque: 43.8 N • m { 4.5 kgf • m / 32 lb • ft }



5. Intercooler hose installation

1) Install the intercooler hose on the intercooler inlet side to the intercooler.

2) Connect the intercooler hose outlet to the intercooler.

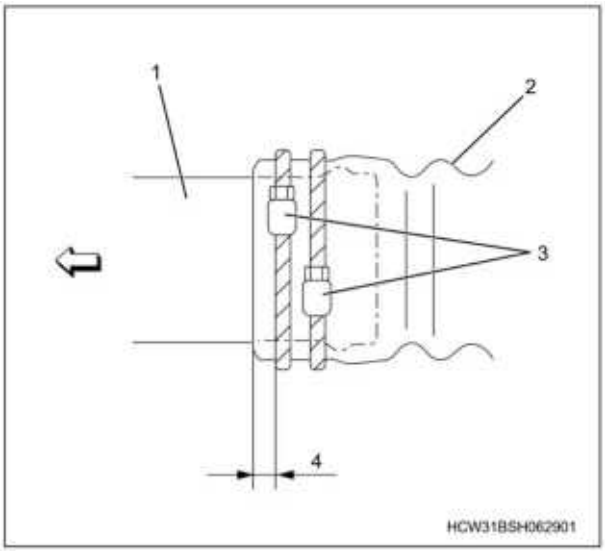
1. Intercooler hose installation precautions

Caution:

● After the intercooler hose has been fixed installed until it makes contact with the pipe, refer to the following diagram and secure the intercooler hose with the 2 clips.

● Shift the tightening screw positions of the 2 clips by 27 mm {1.063 in} or 30 °o r more.

Tightening torque: 6.4 N • m {0.7 kgf • m / 57 lb • in}



1. Intercooler pipe

2. Intercooler hose

3. Clip

4. 5 mm {0.197 in} from the end of the intercooler

6. Water charge pipe installation

1) Install the water filling pipe bracket on the water inlet pipe.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

2) Install the water fill line bracket on the exhaust gas recirculation valve conduit A.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

3) Install the water filling pipe on the filling pipe bracket.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

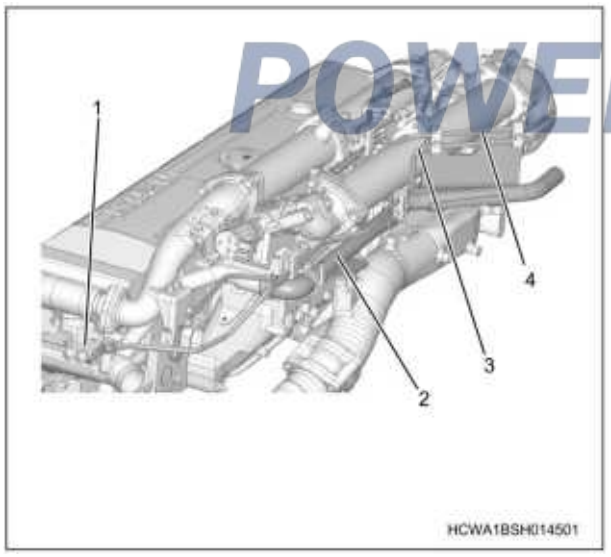
7 leakage pipe installation

1) Install the rear blow-by tube to the EGR cooler and drain line and install 2 clips.

2) Install the blowholes to the EGR cooler and install 4 clips.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

Rings bolts



1. Outlet pipe

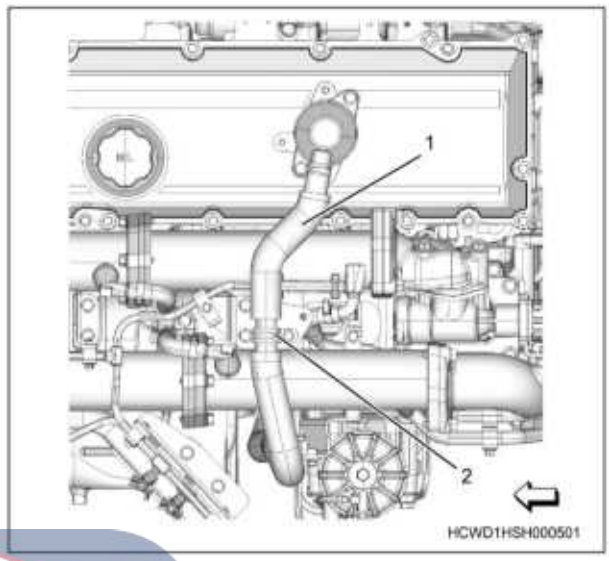
2. Water charge pipe

3. Back-end leakage pipe

4. Front leakage pipe

8. Ventilation hose connect

1) Connect the ventilation hose to the cylinder head cover.



1. Ventilation hose

2. Ventilation hose clip

9. Coolant filling

1) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Slowly fill with water to avoid air intrusion.

2) Press the radiator upper hose manually several times to remove the air from the hose.

3) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Repeat the operation until the water level no longer drops.

4) Install sub-tank cap to radiator.

5) Start and idle the engine.

Caution:

● Idle the engine for 5 minutes or more.

6) Stop the engine.

7) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

8) Add coolant up to the MAX level of the radiator sub-tank.

9) Install sub-tank cap to radiator.

10) Turn OFF the heater fan switch.

11) Start the engine.

12) Raise the engine speed.

Note:

● Increase the engine speed to around 2000 rpm and run the engine for 5 minutes once the needle of the engine coolant temperature gauge reaches the center.

13) With the engine running, check that the thermostat valve is open.

Note:

● Touch the radiator upper hose, and verify that it has become warm.

Caution:

● If the radiator upper hose has not become warm, raise engine speed to warm it up.

● Do not diagnose only by the engine coolant temperature gauge and the hot air coming out from the heater.

14) Idle the engine for 5 minutes.

15) Stop the engine.

16) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

17) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● If the water level of the sub-tank lowered the next morning, add water up to the MAX line.

10. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

EGR valve

Removal

1. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

2. Coolant drain

Warning:

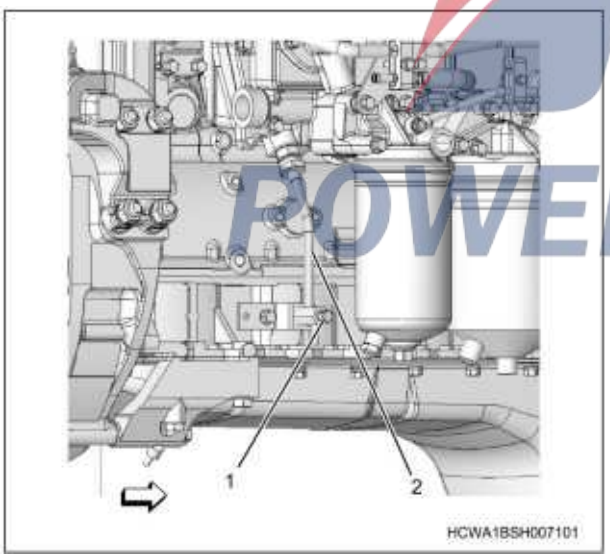
● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

1) Press the sub-tank cap button to release internal pressure.

2) Remove sub-tank cap from radiator.

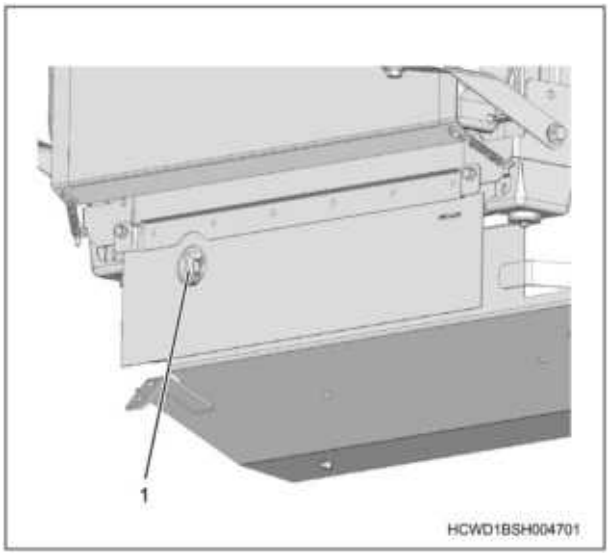
3) Loosen the drain plug on the cylinder block side, and drain the coolant to a pan.



1. Drain plug

2. Drain pipe

4) Loosen the radiator side drain plug, and drain the coolant to a pan.



1. Drain plug

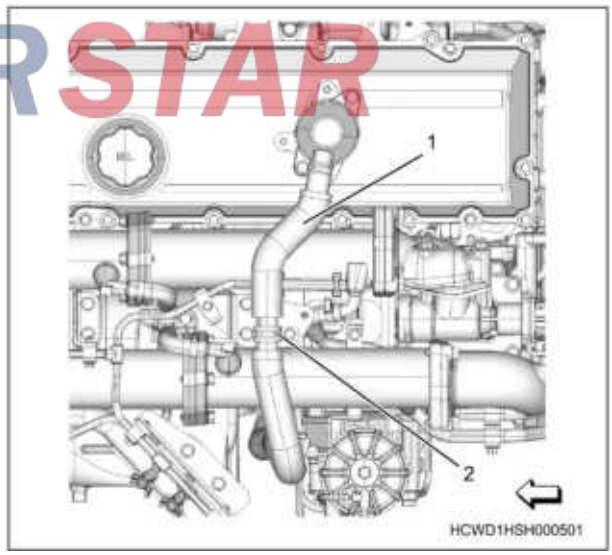
5) Tighten the radiator side drain plug.

6) Tighten the drain plug on the cylinder block side.

7) Install sub-tank cap to radiator.

3. Ventilation hose disconnect

1) Disconnect the ventilation hose to the cylinder front cover.



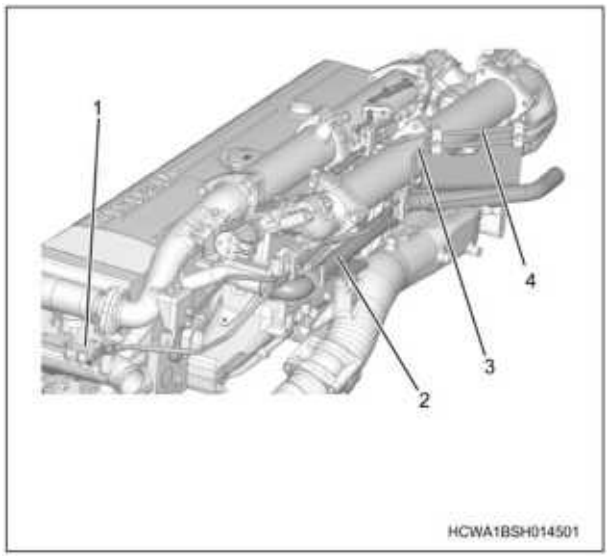
1. Ventilation hose

2. Ventilation hose clip

4. Air leak pipe removal

1) Remove the 4 clips and remove the front air leak on the EGR cooler.

2) Remove the two clips and then remove the rear blow-by tube on the EGR cooler and drain line.



1. Outlet pipe
2. Water charge pipe
3. Back-end leakage pipe
4. Front leakage pipe

5. Water charge pipe removal

1) Remove the filling pipe from the filling pipe holder.

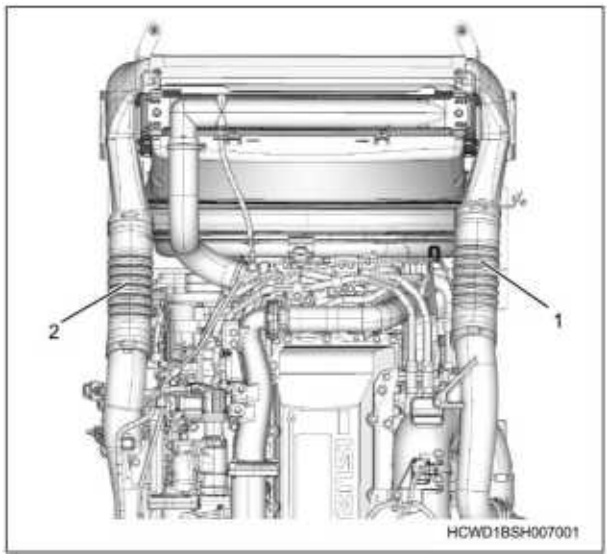
2) Remove the water-filled bracket from the inlet pipe.

3) Remove the water-filled bracket from exhaust gas recirculation valve line A.

6. Intercooler hose removal

1) Disconnect the intercooler hose on the intercooler outlet side from the intercooler.

2) Remove the intercooler hose outlet on the intake line.

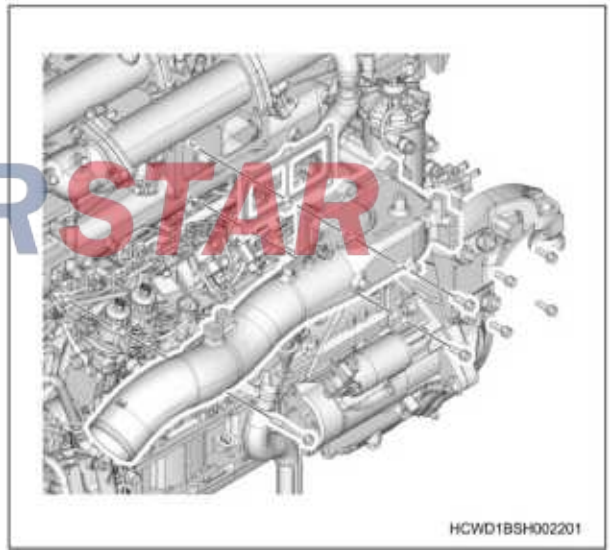


1. Intercooler hose on the intercooler inlet side
2. Intercooler hose on the intercooler outlet side

7. Intake duct removal

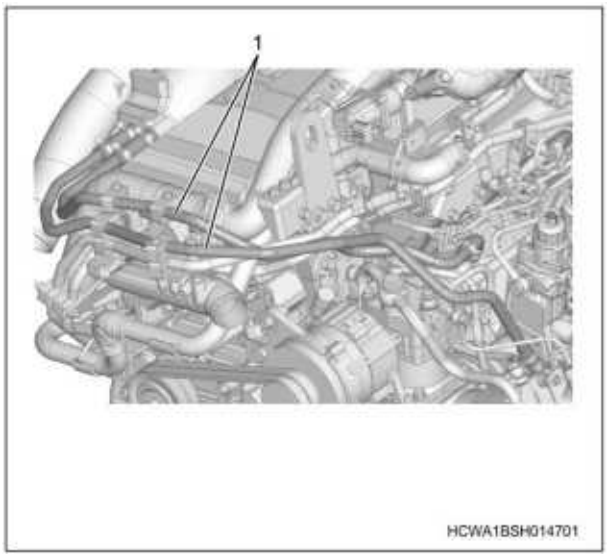
1) Disconnect the harness connector from the inlet line.

2) Remove the intake line from the intake manifold.



8. Suction pipe removal

1) Remove the 4 clips and then remove the 2 air extraction lines of the air compressor.

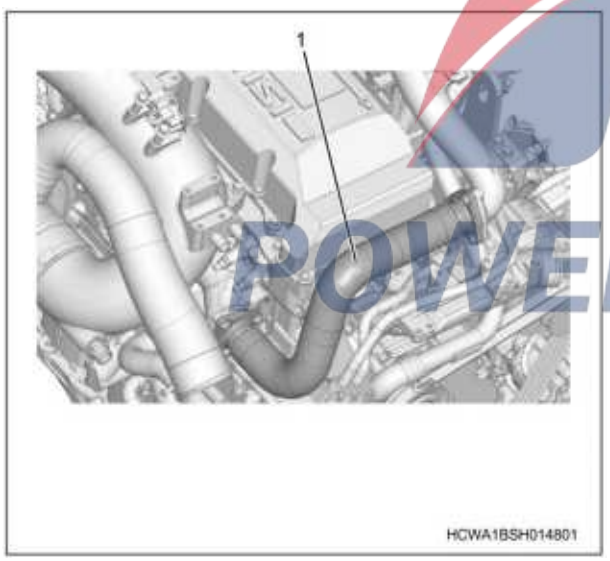


1. Exhaust pipe

9. EGR cooler removal

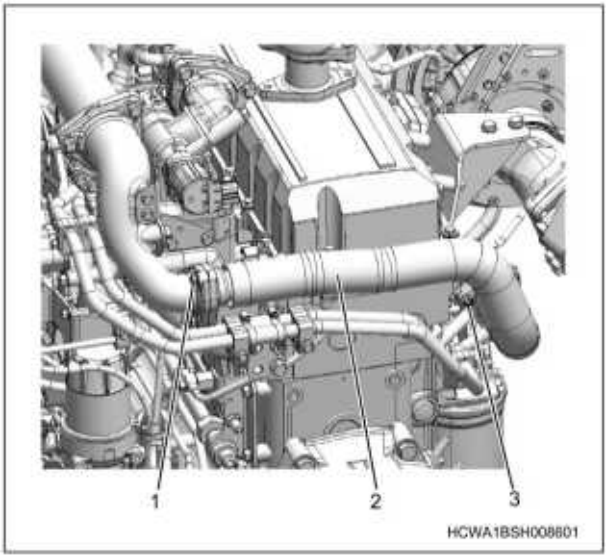
1) Remove the bracket from the drain.

2) Remove the exhaust gas recirculation line A on the EGR cooler line A.



1. Exhaust gas recirculation line A

3) Remove the exhaust gas recirculation line B on the C recirculation cooler line.

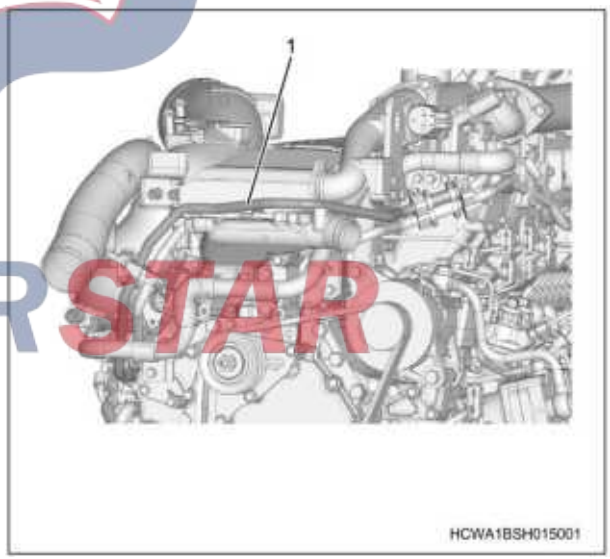


1. Standard bolt

2. Exhaust gas recirculation line B

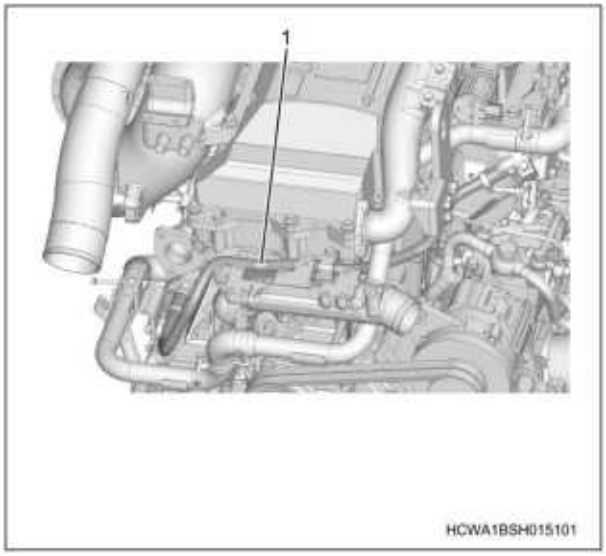
3. High temperature steel flange bolts

4) Remove the front EGR cooler hose on the pump.



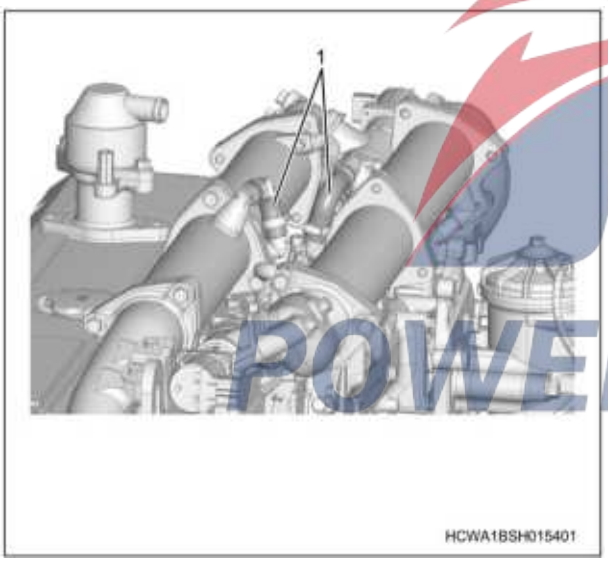
1. Front EGR cooler hose

5) The back-end water supply pipe removed from the pump.



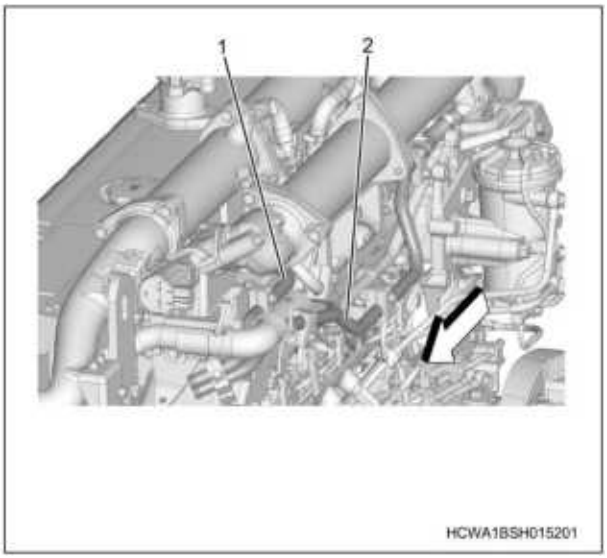
1. Back-end water pipe

6) Remove the water supply hose from the EGR cooler.



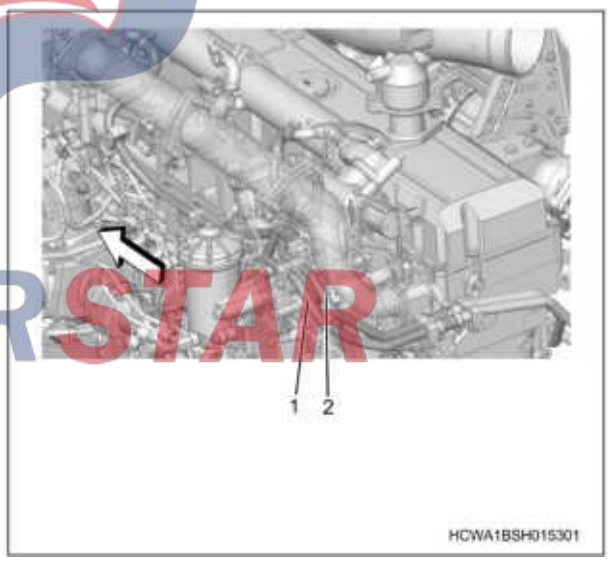
1. Water feed hose

7) Remove the front and rear EGR cooler pipes from the EGR cooler.



1. Front-end water supply pipe
2. Back-end water pipe

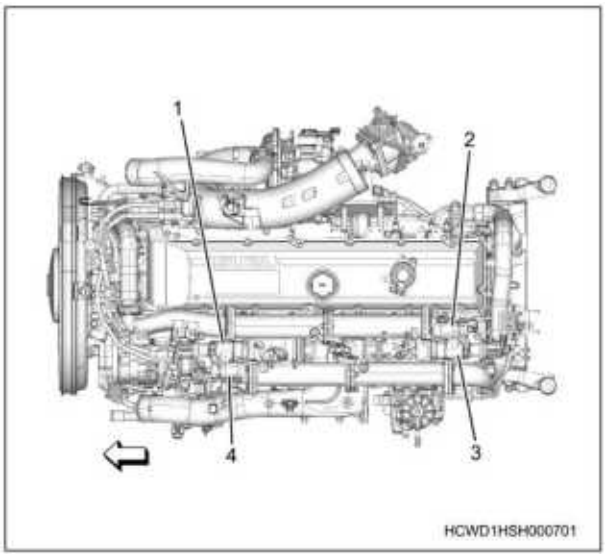
8) Remove the front and rear EGR cooler pipes from the EGR cooler.



1. Front return pipe
2. Back-end return pipe

9) Remove the EGR cooler duct D from the exhaust gas recirculation valve 2 and the EGR cooler D.

10) Remove the EGR cooler duct B from the exhaust gas recirculation valve 1 and the EGR cooler B.

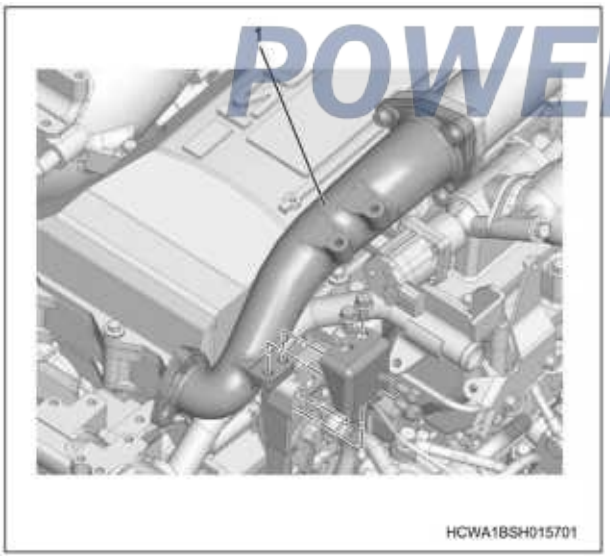


1. EGR valve 2
2. EGR cooler duct B
3. EGR valve 1
4. EGR cooler duct D

11) Remove front exhaust gas recirculation line bracket of EGR cooler line A.

12) Remove the exhaust gas recirculation valve heat shield on the EGR cooler line A.

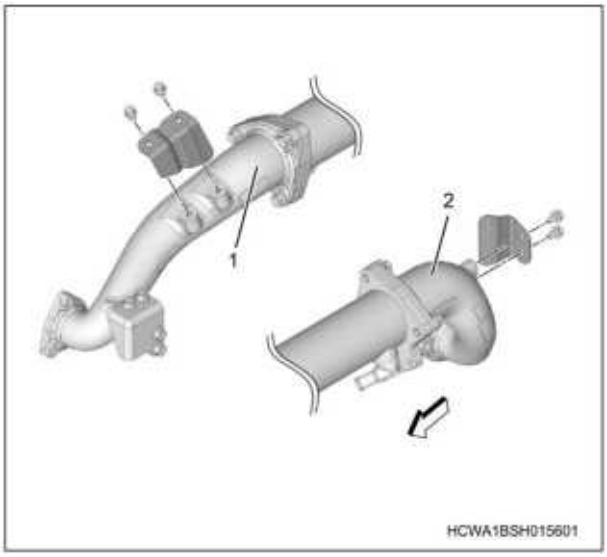
13) Remove EGR cooler Line A from EGR cooler A.



1. EGR cooler duct

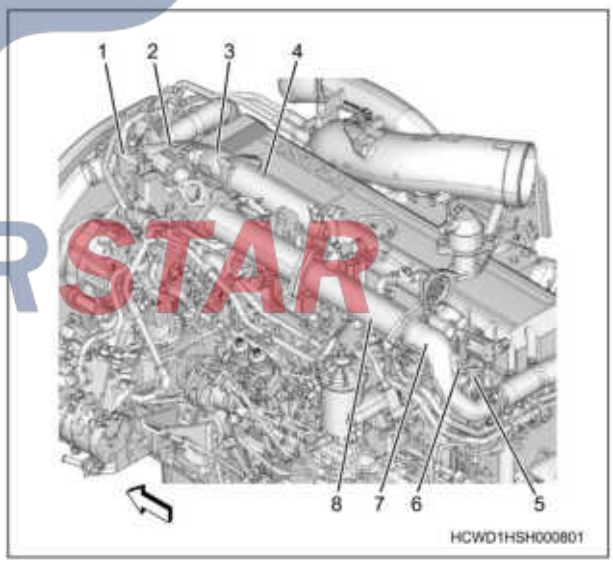
14) Remove the back-end exhaust gas recirculation line bracket of EGR cooler line C.

15) Remove exhaust gas recirculation valve heating protection device on EGR cooler C.



1. EGR cooler duct A
2. EGR cooler duct C

16) Remove EGR cooler Line C on EGR cooler C.



1. Front-end exhaust gas recirculation duct bracket
2. Exhaust gas recirculation valve thermal protection device
3. EGR cooler duct A.
4. EGR cooler A.
5. Back-end exhaust gas recirculation duct bracket

6. Exhaust gas recirculation valve thermal protection device

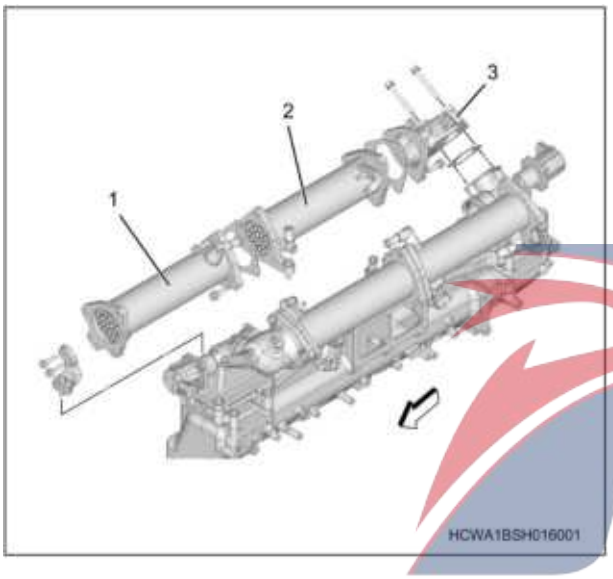
7. EGR cooler duct C

8. EGR cooler C

17) Remove the EGR cooler holder on the EGR cooler.

18) Remove the EGR cooler support on EGR cooler C.

19) Remove the EGR cooler A on the EGR cooler B.

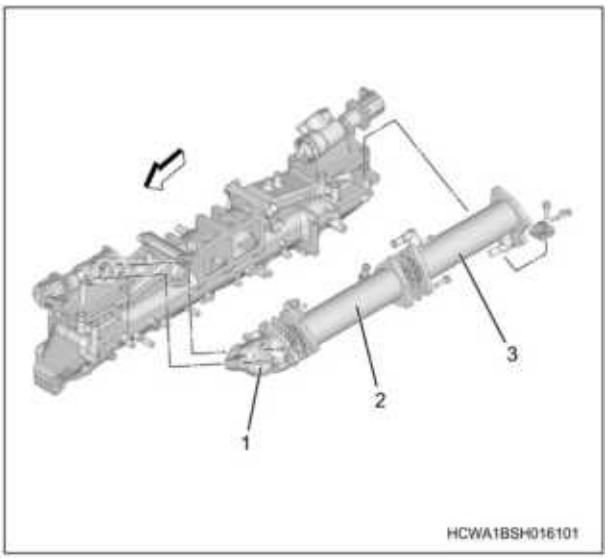


1. EGR cooler A

2. EGR cooler B

3. EGR cooler duct B

20) Remove the EGR cooler C on the EGR cooler D.



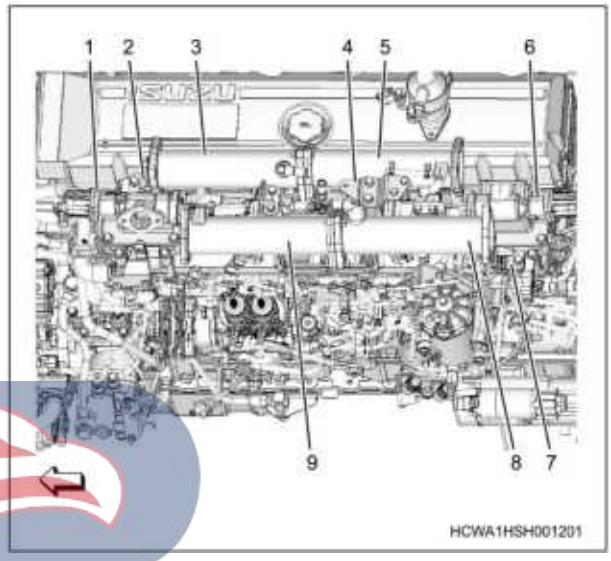
1. EGR cooler duct D

2. EGR cooler D

3. EGR cooler C

21) Remove the EGR cooler B on the intake manifold.

22) Remove the EGR cooler D on the intake manifold.



1. EGR valve 2

2. EGR cooler bracket

3. EGR cooler A

4. Leakage pipe bracket

5. EGR cooler B

6. EGR valve 1

7. EGR cooler bracket

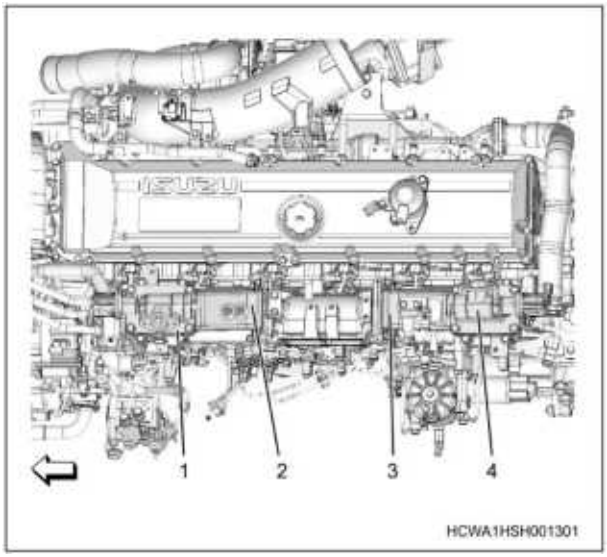
8. EGR cooler C

9. EGR cooler D

10. Exhaust gas recirculation valve removal

1) Remove exhaust gas recirculation valve 2 from exhaust gas recirculation valve conduit A.

2) Remove exhaust gas recirculation valve 1 from exhaust gas recirculation valve conduit A.



1. EGR valve 2
2. EGR valve duct A
3. EGR valve duct B
4. EGR valve 1

3) Remove exhaust gas recirculation valve line A on intake manifold.

4) Remove exhaust gas recirculation valve line B on intake manifold.

11. Guide the valve to remove

1) Remove pilot valve from EGR valve duct A.

2) Remove pilot valve from EGR valve duct B.

Inspection

1. EGR valve inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Inspect the EGR valve.

Note:

● Clean the EGR valve if carbon is piled up.

Installation

1. Guide the valve installation

1) Install poppet valve to exhaust gas recirculation valve guide A.

Tightening torque: 10 N • m {1.0 kgf • m / 89 lb • in}

2) Install poppet valve to exhaust gas recirculation valve guide B.

Tightening torque: 10 N • m {1.0 kgf • m / 89 lb • in}

2. EGR valve installation

1) Temporarily tighten the EGR valve duct A on the pilot valve side and the manifold bracket of the intake manifold.

Caution:

● Prevent the parts from overlapping or interfering with the top of the surrounding parts.

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}

2) Temporarily tighten the exhaust gas recirculation valve tube B on the EGR valve and the water manifold of the intake manifold.

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}

3) Temporarily tighten the EGR valve duct A on the pilot valve side and the water manifold of the intake manifold.

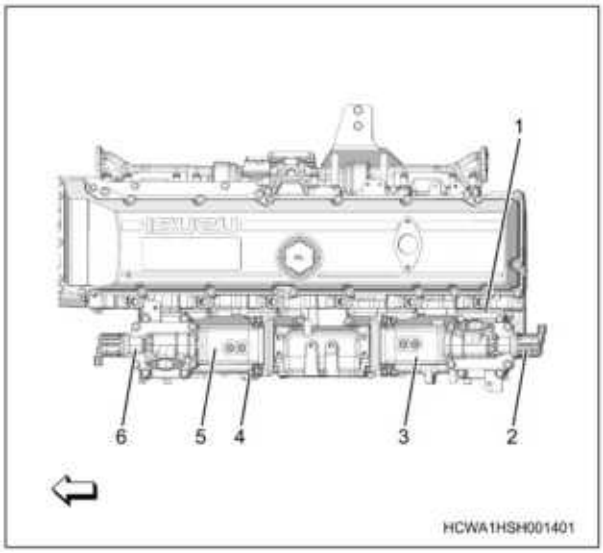
Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}

Caution:

● Prevent the parts from overlapping or interfering with the top of the surrounding parts.

4) Temporarily tighten the exhaust gas recirculation valve tube B on the EGR valve and the water manifold of the intake manifold.

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}



1. Harness bracket
2. EGR valve 1
3. EGR valve duct B
4. Pipe bracket
5. EGR valve duct A
6. EGR valve 1

5) Final Tighten the EGR valve conduit A on the pilot valve side and the water manifold of the intake manifold.

Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}

6) Tighten the exhaust gas recirculation valve tube B on the EGR valve and the manifold bracket of the intake manifold.

Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}

7) Final tighten the EGR valve conduit A on the pilot valve side and the manifold bracket of the intake manifold.

Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}

8) Tighten the exhaust gas recirculation valve tube B on the EGR valve and the water manifold of the intake manifold.

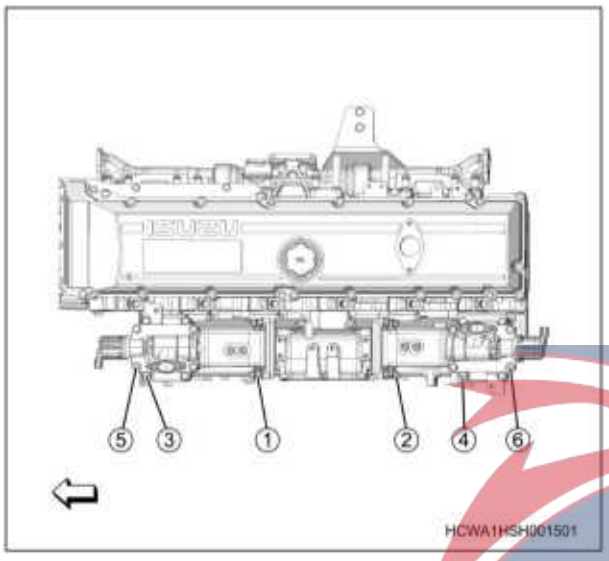
Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}

Caution:

● After the installation is completed, check the surrounding parts for interference.

9) Install the EGR valve in the figure on the exhaust gas recirculation valve in numerical order.

Tightening torque: 43.8 N・m { 4.5 kgf • m / 32 lb • ft }



3. EGR cooler installation

Caution:

● If the procedures or methods for assembling the EGR device are mistaken, it can lead to cracks in the pipe or gas leaks. Always follow the procedures.

● Do not reuse the gasket.

● When removing only a part of an EGR-related part, loosen the entire EGR-related part once, replace the gaskets with new ones, and then temporarily and securely tighten in the following order.

1) Temporarily tighten the following exhaust gas recirculation valve components in the numerical order shown.

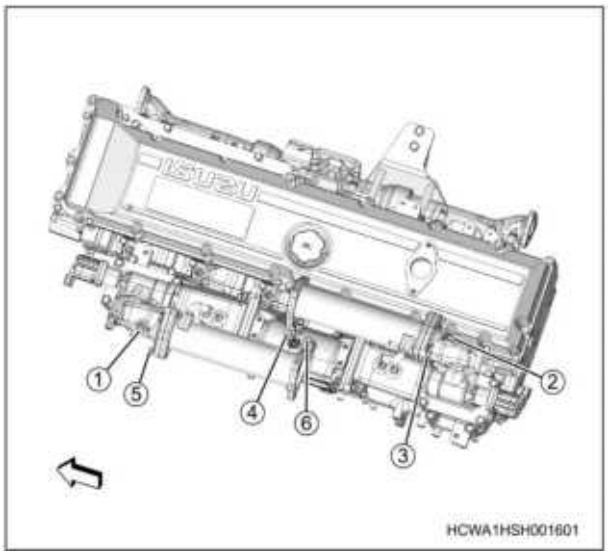
● EGR cooler duct D

● EGR cooler duct B

● EGR cooler B

● EGR cooler D

Temporary tightening torque: 5 N • m { 0.5 kgf • m / 44 lb • in }



2) Temporarily tighten the following EGR cooler components according to the figure in numerical order.

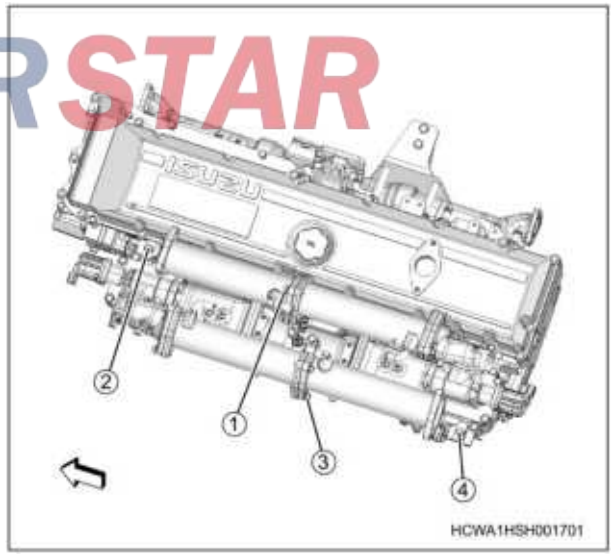
● EGR cooler A

● EGR cooler bracket

● EGR cooler C

● EGR cooler bracket

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}



3) Finally tighten the EGR valve components and the EGR cooler in the order shown in the diagram.

● EGR cooler duct D

● EGR cooler duct B

● EGR cooler B

● EGR cooler D

● EGR cooler A

● EGR cooler bracket

● EGR cooler C

● EGR cooler bracket

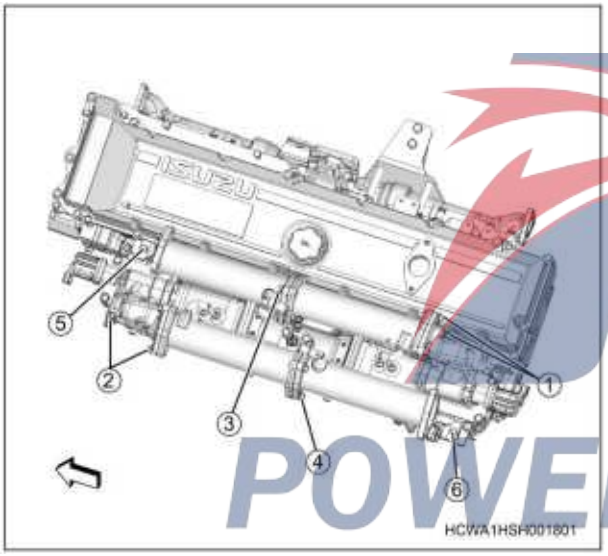
Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft} 1,2

Tightening torque: 50 N • m {5.1 kgf • m / 37 lb • ft} 3,4,5 (M10), 6 (M10)

Tightening torque: 25 N • m {3 kgf • m / 18 lb • ft} 5 (M8), 6 (M8)

Note:

● The number behind the tightening torque indicates the diagram number.



4) Temporarily tighten the following EGR cooler components and finally tighten the exhaust manifold in numerical order shown.

● EGR cooler duct A

● EGR duct A

● EGR cooler duct C

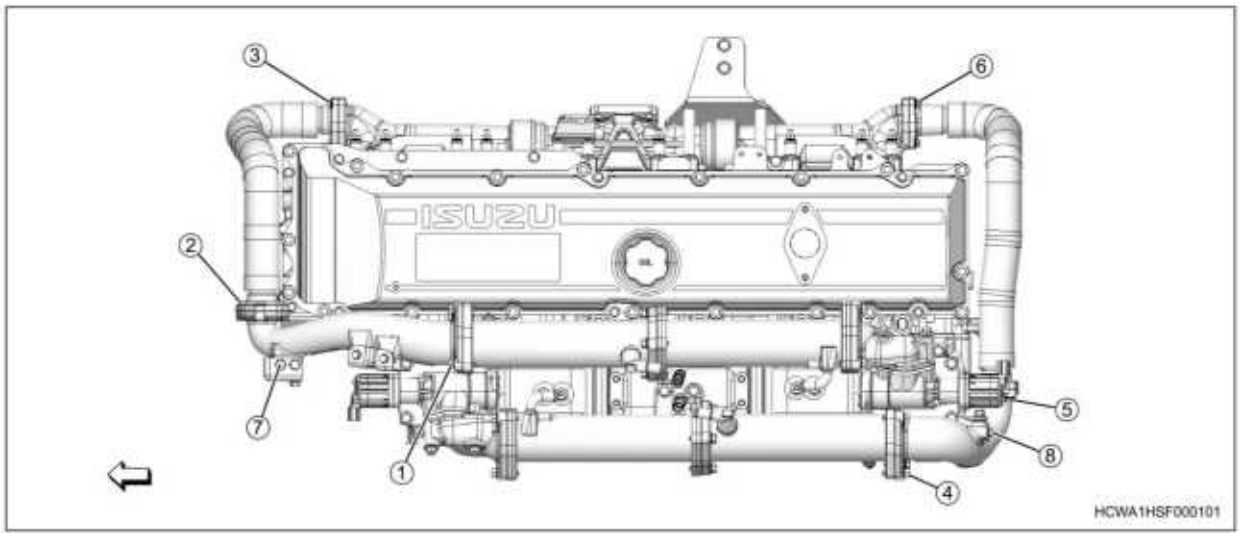
● EGR duct B

● Bracket

Caution:

● Use high temperature resistant steel flange bolts for exhaust manifold mounting bolts and exhaust gas recirculation line A and exhaust gas recirculation line B.

Temporary tightening torque: 5 N • m { 0.5 kgf • m / 44 lb • in }



5) Final tightening of the following EGR cooler components and final tightening of the exhaust manifold in the numerical order shown.

- EGR cooler duct A
- EGR duct A
- EGR cooler duct C
- EGR duct B
- Bracket

Tightening torque: 50 N • m {5.1 kgf • m / 37 lb • ft} 1 (M10), 2,3,9 (M10), 10 (M10)

Tightening torque: 44 N • m {4.5 kgf • m / 32 lb • ft} 4

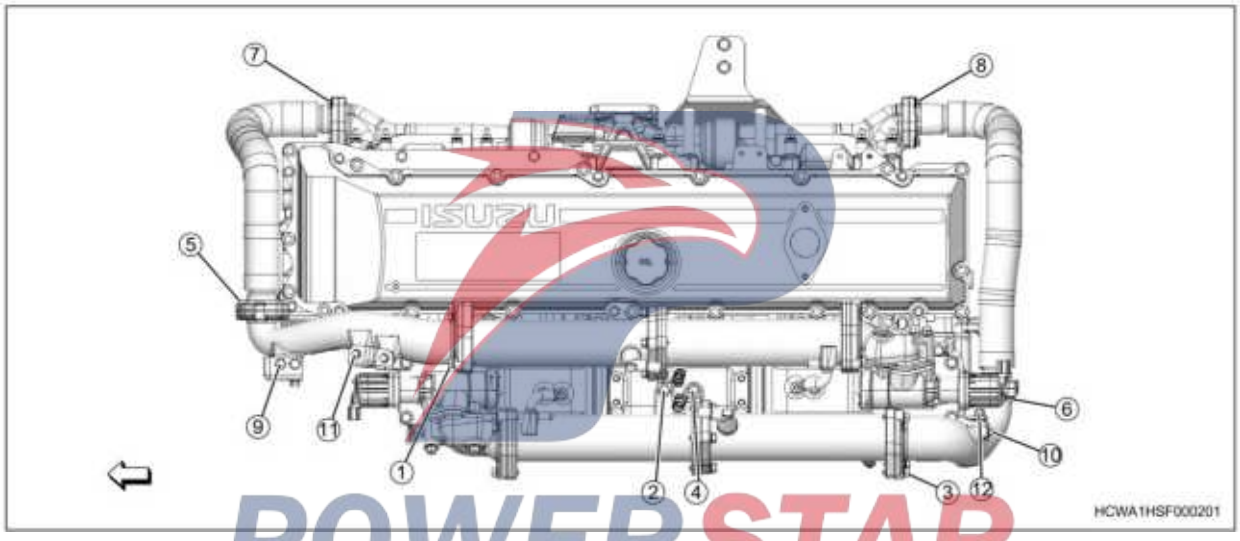
Tightening torque: 25 N • m {2.5 kgf • m / 18 lb • ft} 5,6 (M8), 7,8 (M8), 9 (M8)

Tightening torque: 24.7 N • m {2.5 kgf • m / 18 lb • ft} 10 (M8)

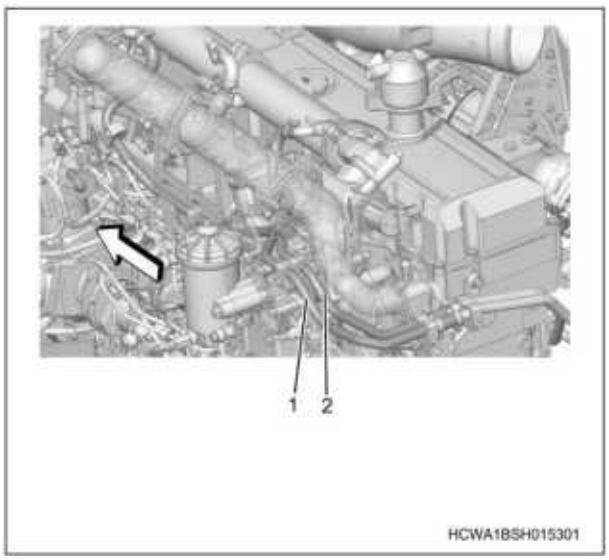
Tightening torque: 20 N • m {2.0 kgf • m / 15 lb • ft} 11,12 (M8)

Note:

- The number behind the tightening torque indicates the diagram number.



6) Install the front and rear return lines to the EGR cooler.

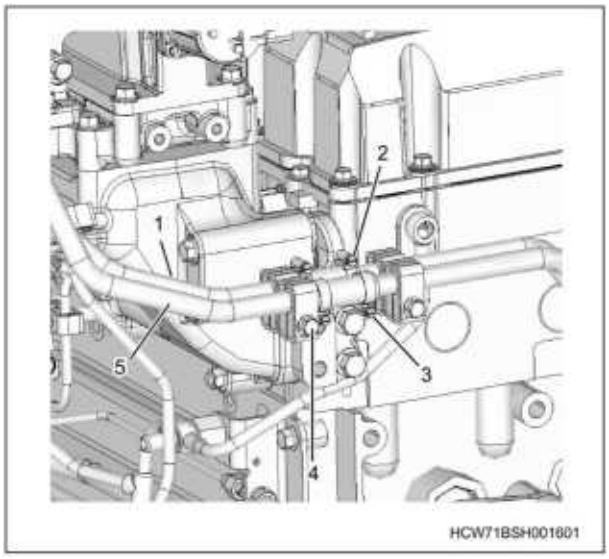


1. Front return pipe
2. Back-end return pipe

7) Install the clip on the return pipe.

Caution:

- During installation, care should also be taken to prevent the clamp from rotating.
- Install the water supply hose clamp to keep it horizontal.
- Install the water supply hose clamp and adjust the orientation to secure it to the rear of the engine.

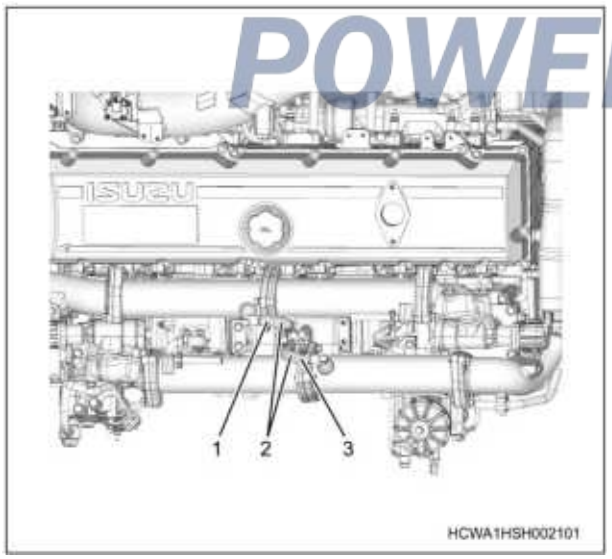


1. Front return pipe
2. Water supply hose clamp
3. Water supply hose clamp
4. Clamp bolt
5. Back-end return pipe

8) Install the water supply hose to the EGR cooler.

Caution:

● Hose clamps should be toward the top of the engine.

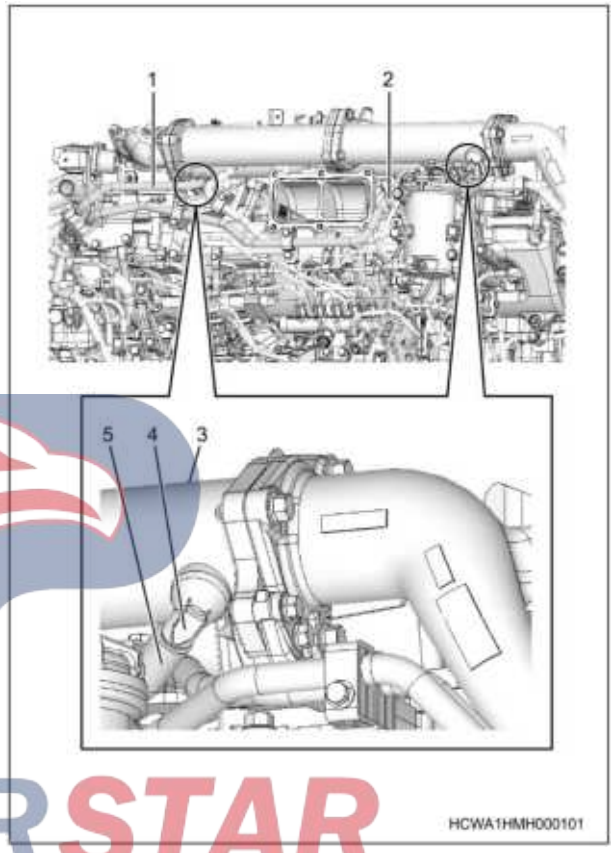


1. Hose clip
2. Water feed hose
3. Hose clip

9) Align the raised tips on the EGR cooler with the markings on the water supply hose and install the front and rear water lines on the EGR cooler.

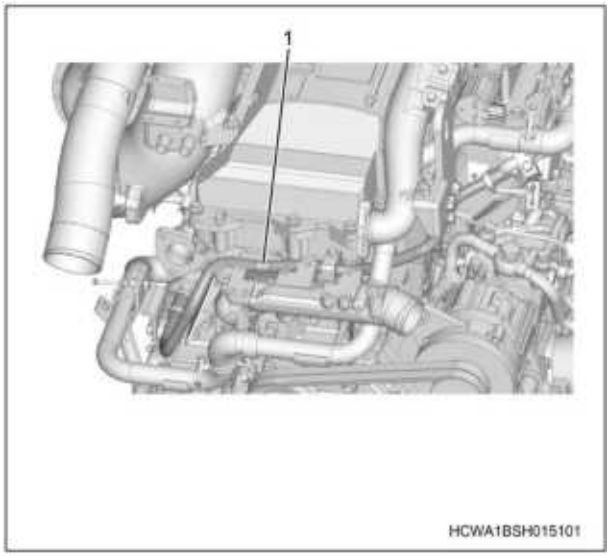
Caution:

● During installation, care should also be taken to prevent the clamp from rotating.



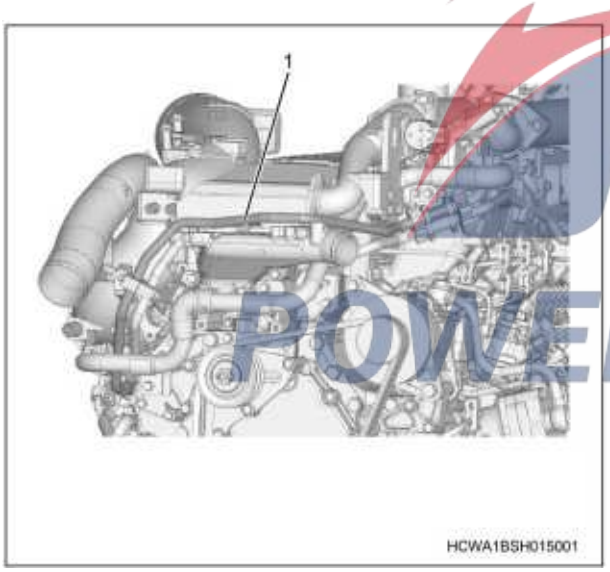
1. Front-end water supply pipe
2. Back-end water pipe
3. EGR cooler
4. Raised part of the tip
5. Marking

10) Install the rear water supply pipe to the rubber hose between the rear water supply pipe and the water pump.



1. Back-end water pipe

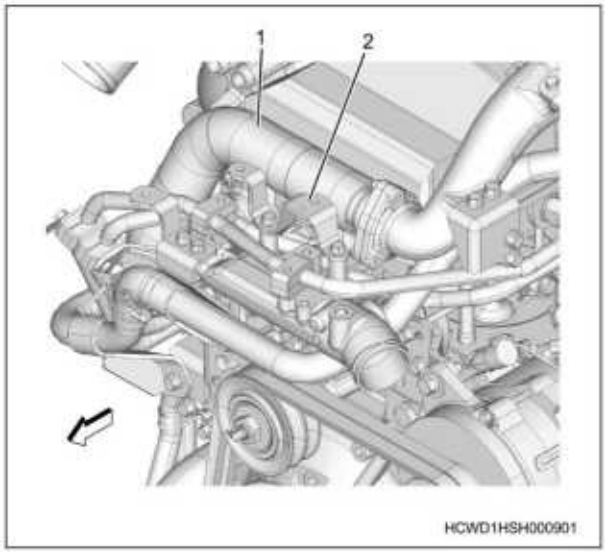
11) Install the front water supply pipe to the rubber hose between the front water supply pipe and the water pump.



1. Front-end water supply pipe

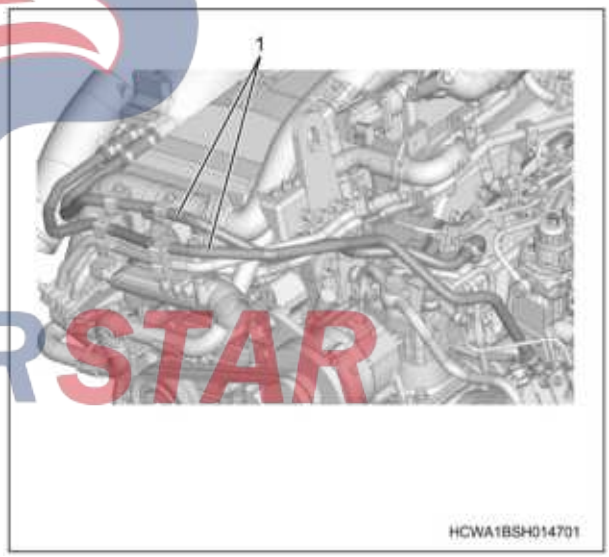
4. Suction pipe installation

1) Install the bracket on the drain.



1. Front exhaust gas recirculation line
2. Bracket

2) Install 2 air suction tubes to the air compressor.

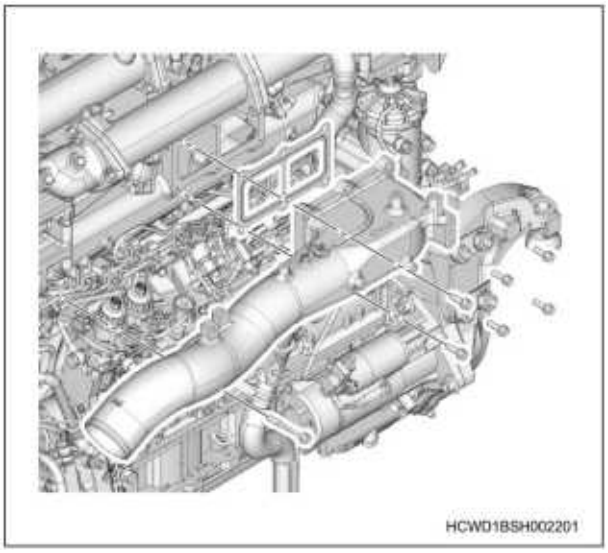


1. Exhaust pipe

Intake duct installation

1) Install the intake line to the intake manifold.

Tightening torque: 43.8 N • m { 4.5 kgf • m / 32 lb • ft }



6. Intercooler hose installation

1) Install the intercooler hose on the intercooler inlet side to the intercooler.

2) Connect the intercooler hose outlet to the intercooler.

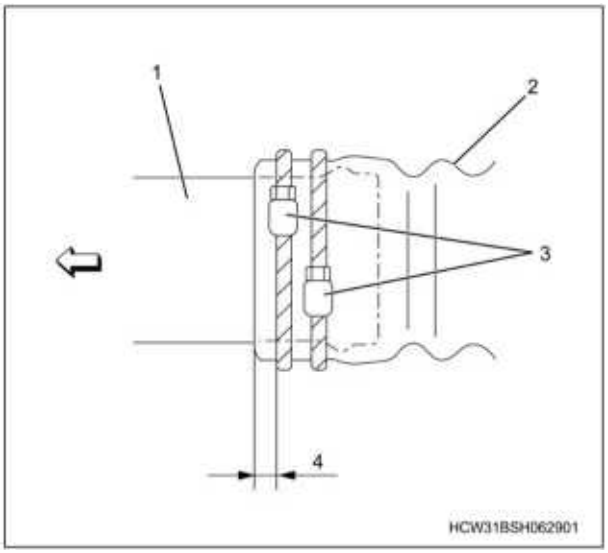
1. Intercooler hose installation precautions

Caution:

● After the intercooler hose has been fixed installed until it makes contact with the pipe, refer to the following diagram and secure the intercooler hose with the 2 clips.

● Shift the tightening screw positions of the 2 clips by 27 mm {1.063 in} or 30 ° r more.

Tightening torque: 6.4 N • m {0.7 kgf • m / 57 lb • in}



1. Intercooler pipe

2. Intercooler hose

3. Clip

4. 5 mm {0.197 in} from the end of the intercooler

7. Water charge pipe installation

1) Install the water filling pipe bracket on the water inlet pipe.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

2) Install the water fill line bracket on the exhaust gas recirculation valve conduit A.

Tightening torque: 39 N • m {4.0 kgf • m /29 lb • ft}

3) Install the water filling pipe on the filling pipe bracket.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

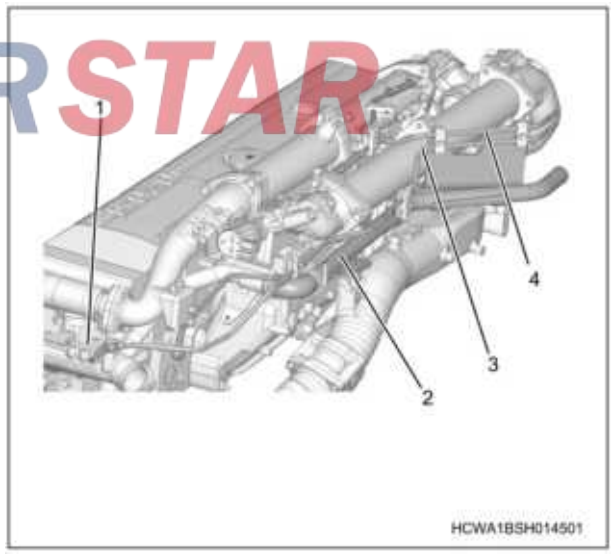
8 leakage pipe installation

1) Install the rear blow-by tube to the EGR cooler and drain line and install 2 clips.

2) Install the blowholes to the EGR cooler and install 4 clips.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

Rings bolts



1. Outlet pipe

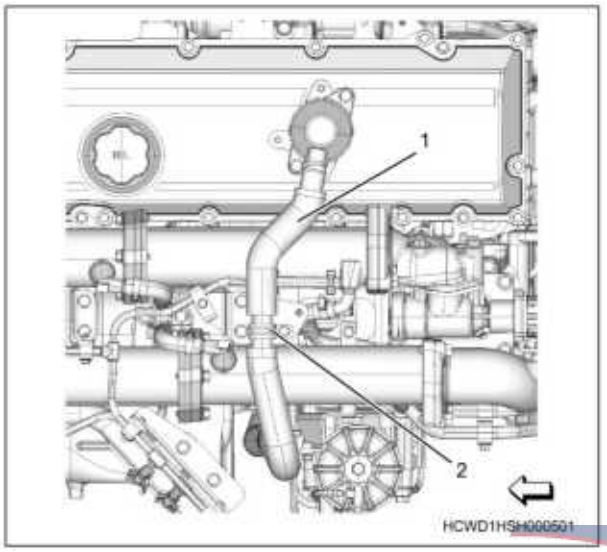
2. Water charge pipe

3. Back-end leakage pipe

4. Front leakage pipe

9. Ventilation hose connect

1) Connect the ventilation hose to the cylinder head cover.



1. Ventilation hose
2. Ventilation hose clip

10. Coolant filling

1) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Slowly fill with water to avoid air intrusion.

2) Press the radiator upper hose manually several times to remove the air from the hose.

3) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Repeat the operation until the water level no longer drops.

4) Install sub-tank cap to radiator.

5) Start and idle the engine.

Caution:

● Idle the engine for 5 minutes or more.

6) Stop the engine.

7) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

8) Add coolant up to the MAX level of the radiator sub-tank.

9) Install sub-tank cap to radiator.

10) Turn OFF the heater fan switch.

11) Start the engine.

12) Raise the engine speed.

Note:

● Increase the engine speed to around 2000 rpm and run the engine for 5 minutes once the needle of the engine coolant temperature gauge reaches the center.

13) With the engine running, check that the thermostat valve is open.

Note:

● Touch the radiator upper hose, and verify that it has become warm.

Caution:

● If the radiator upper hose has not become warm, raise engine speed to warm it up.

● Do not diagnose only by the engine coolant temperature gauge and the hot air coming out from the heater.

14) Idle the engine for 5 minutes.

15) Stop the engine.

16) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

17) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● If the water level of the sub-tank lowered the next morning, add water up to the MAX line.

11. Battery cable connect

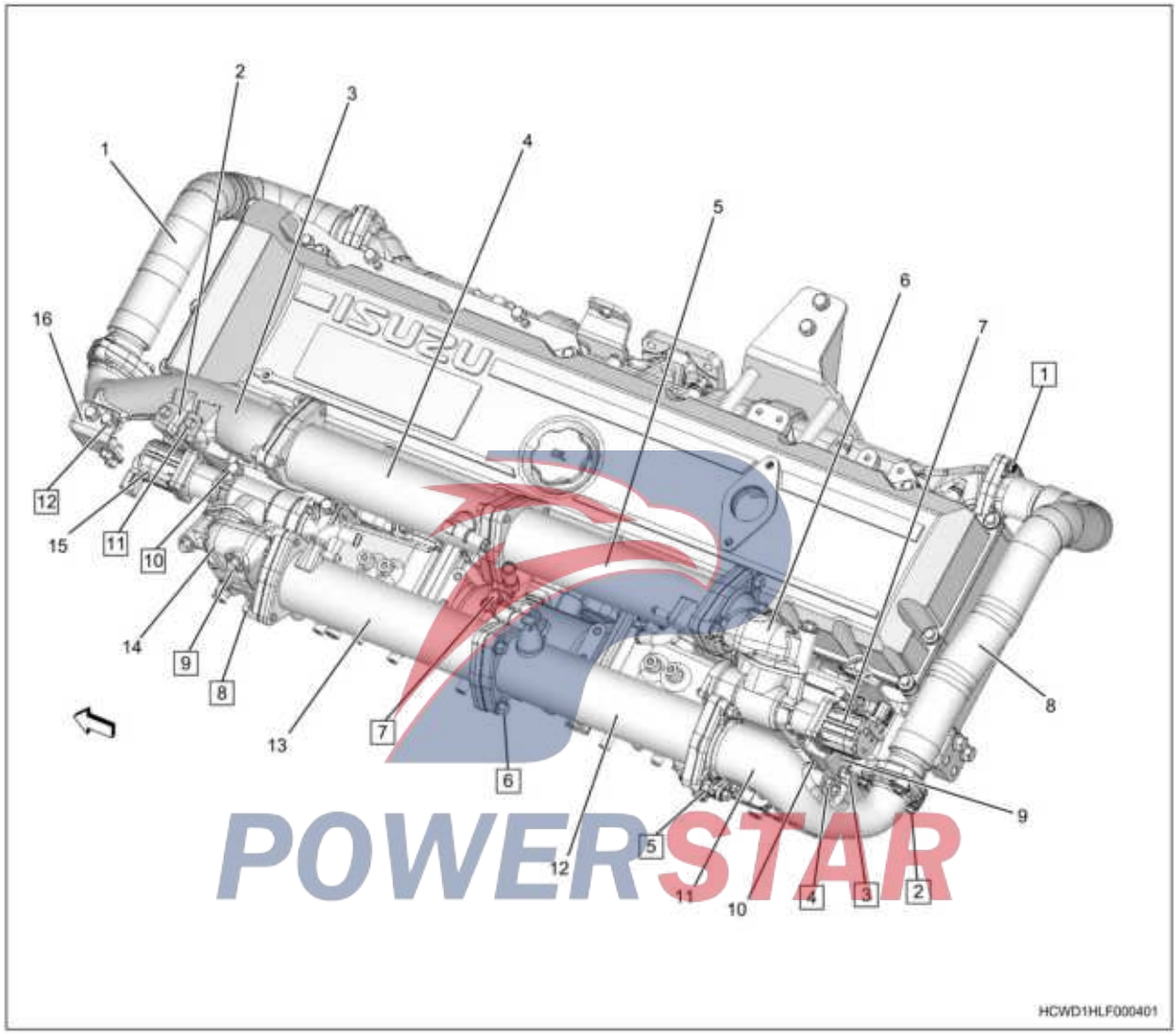
1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

Supplementary information

1. Component Views

EGR cooler



1. EGR line A
2. EGR valve thermal protection device
3. EGR cooler duct A
4. EGR cooler A
5. EGR cooler B
6. EGR cooler duct B
7. EGR valve 1
8. EGR line B
9. EGR duct bracket
10. Exhaust gas recirculation valve thermal protection device
11. EGR cooler duct C
12. EGR cooler C
13. EGR cooler D
14. EGR cooler duct D
15. EGR valve 2
16. EGR cooler duct bracket

Tightening torque

1: 25 N • m { 2.5 kgf • m / 18 lb • ft }

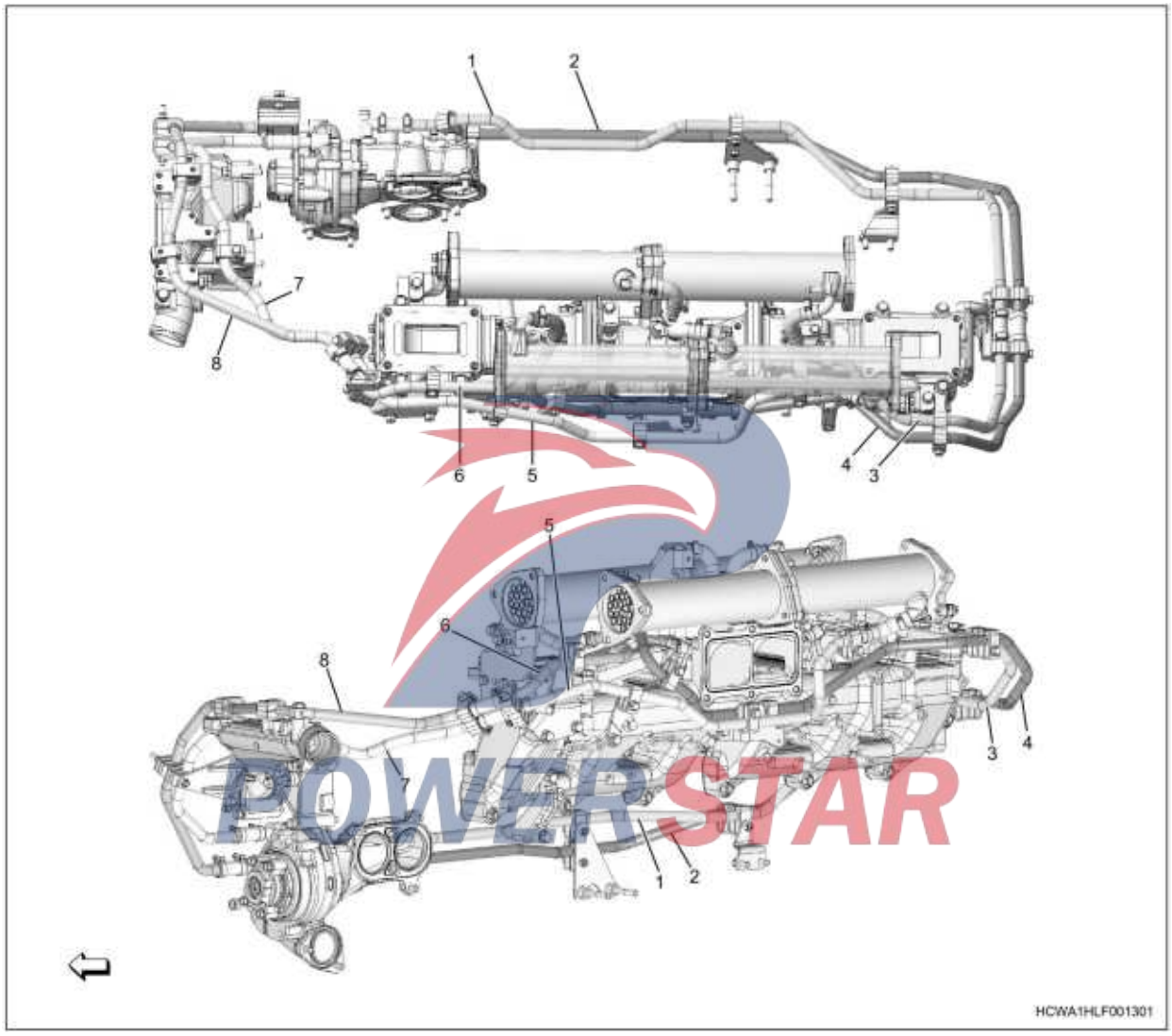
2: 25 N • m { 2.5 kgf • m / 18 lb • ft }

3: 24.7 N • m { 2.5 kgf • m / 18 lb • ft }

4: 20 N • m { 2.0 kgf • m / 15 lb • ft }

5: 50 N • m { 5.1 kgf • m / 37 lb • ft }
6: 50 N • m { 5.1 kgf • m / 37 lb • ft }
7: 43.8 N • m { 4.5 kgf • m / 32 lb • ft }
8: 50 N • m { 5.1 kgf • m / 37 lb • ft }
9: 43.8 N • m { 4.5 kgf • m / 32 lb • ft }
10: 43.8 N • m { 4.5 kgf • m / 32 lb • ft }
11: 20 N • m { 2.0 kgf • m / 15 lb • ft }
12: 24.7 N • m {2.5 kgf • m / 18 lb • ft}

EGR cooler



Part name

1. Exhaust gas recirculation return pipe (front 2)
2. Exhaust gas recirculation return pipe (rear 2)
3. Exhaust gas recirculation return pipe (rear 1)
4. Exhaust gas recirculation return pipe (front 1)
5. EGR cooler hose (rear 2)
6. EGR cooler hose (front 2)
7. EGR cooler hose (rear 1)
8. EGR cooler hose (front 1)

Engine

Speed Control Systems

(6WG1)

Table of contents

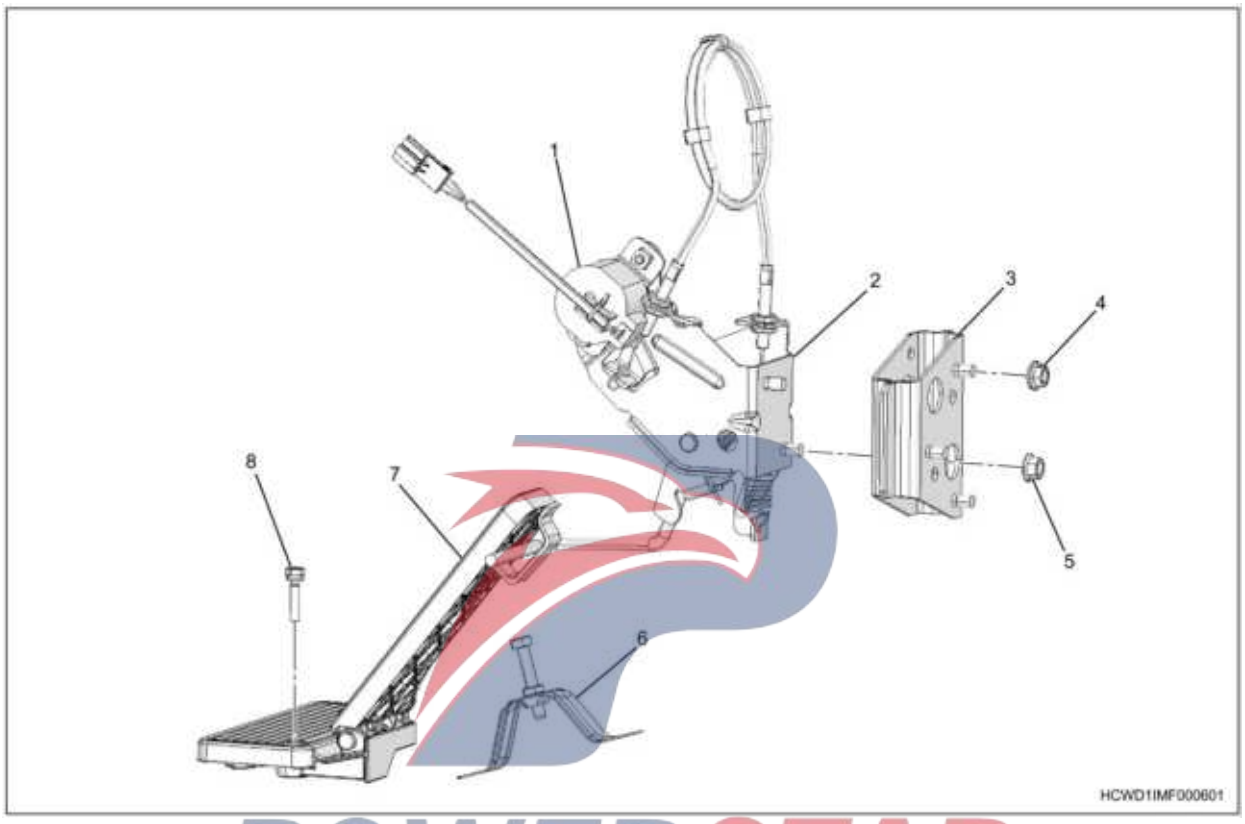
Accelerator pedal..... 1I-2
Removal 1I-2
Installation..... 1I-3
Accelerate pedal lever 1I-4
Removal 1I-4
Installation..... 1I-5
Supplementary Information..... 1I-7

Accelerator pedal

Removal

1. Component Views

Accelerator control link



Part name

1. Accelerator pedal position sensor
2. Control connecting rod
3. Bracket
4. Nut
5. Nut
6. Stopper bracket
7. Accelerator pedal
8. Bolt

2. Battery cable disconnect

1) Disconnect the battery cable from the negative terminal of the battery.

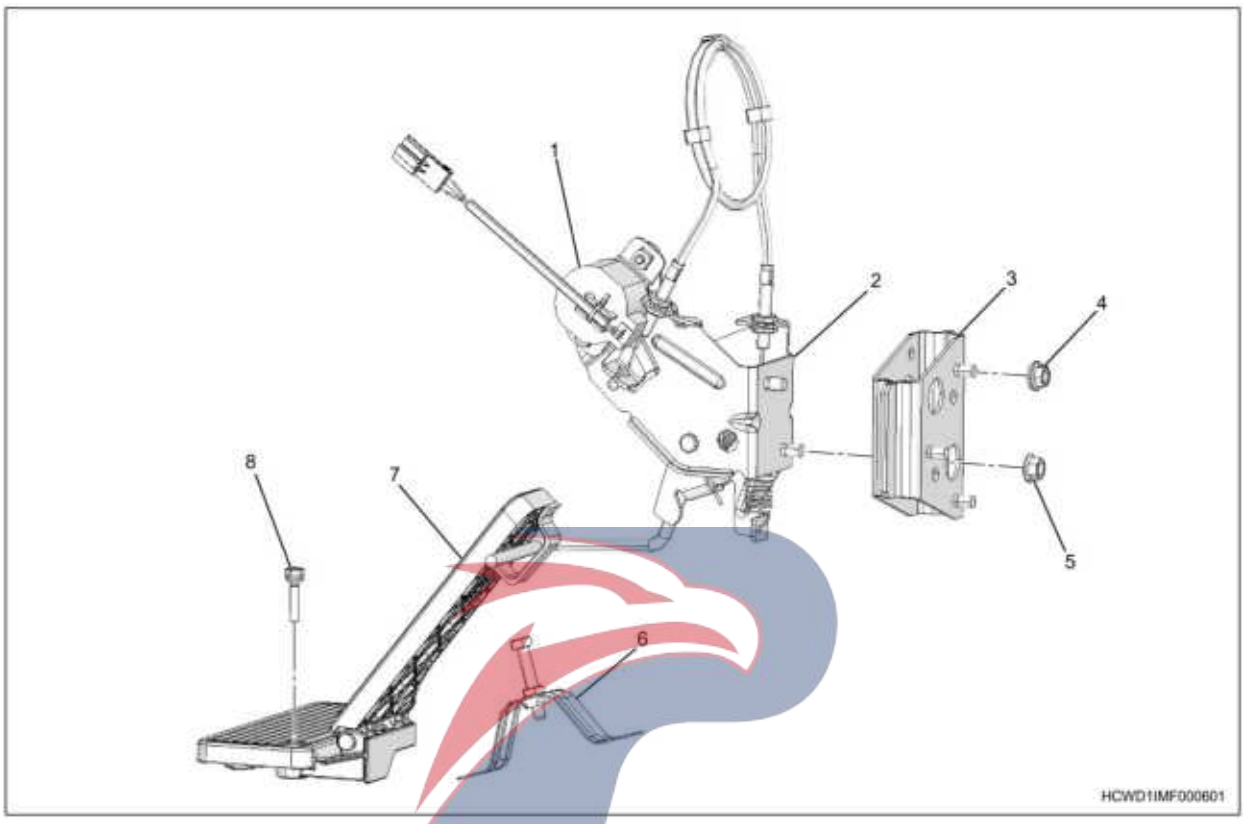
3. Accelerator pedaL removal

1) Remove the accelerator pedal on the vehicle.

Installation

1. Component Views

Accelerator control link



Part name

1. Accelerator pedal position sensor
2. Control link
3. Bracket
4. Nut
5. Nut
6. Stopper bracket
7. Accelerator pedal
8. Bolt

2. Accelerator pedal installation

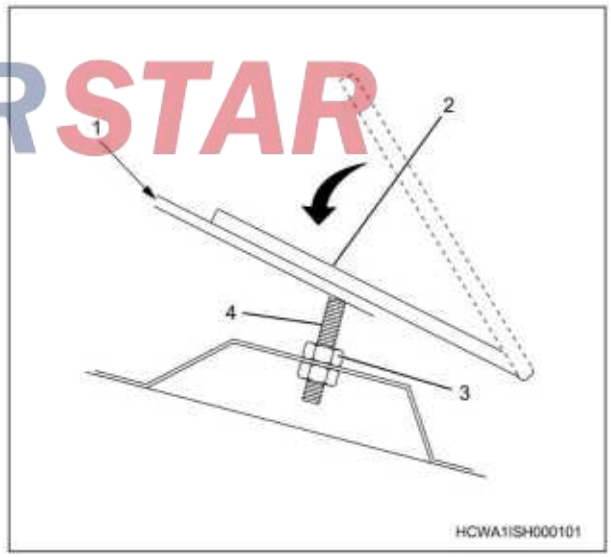
1) Mount the accelerator pedal to the vehicle.

2) Adjust the clearance to the specified value using the stopper bolt.

Note:

● Adjust the clearance of the accelerator pedal and stopper bolt with the accelerator pedal depressed to the full position.

Standard: 1.0 to 2.0mm {0.04 to 0.08in}



1. Accelerator pedal and stop bolt clearance
2. Depress the accelerator pedal
3. Lock nut
4. Stop bolt

3. Battery cable connect

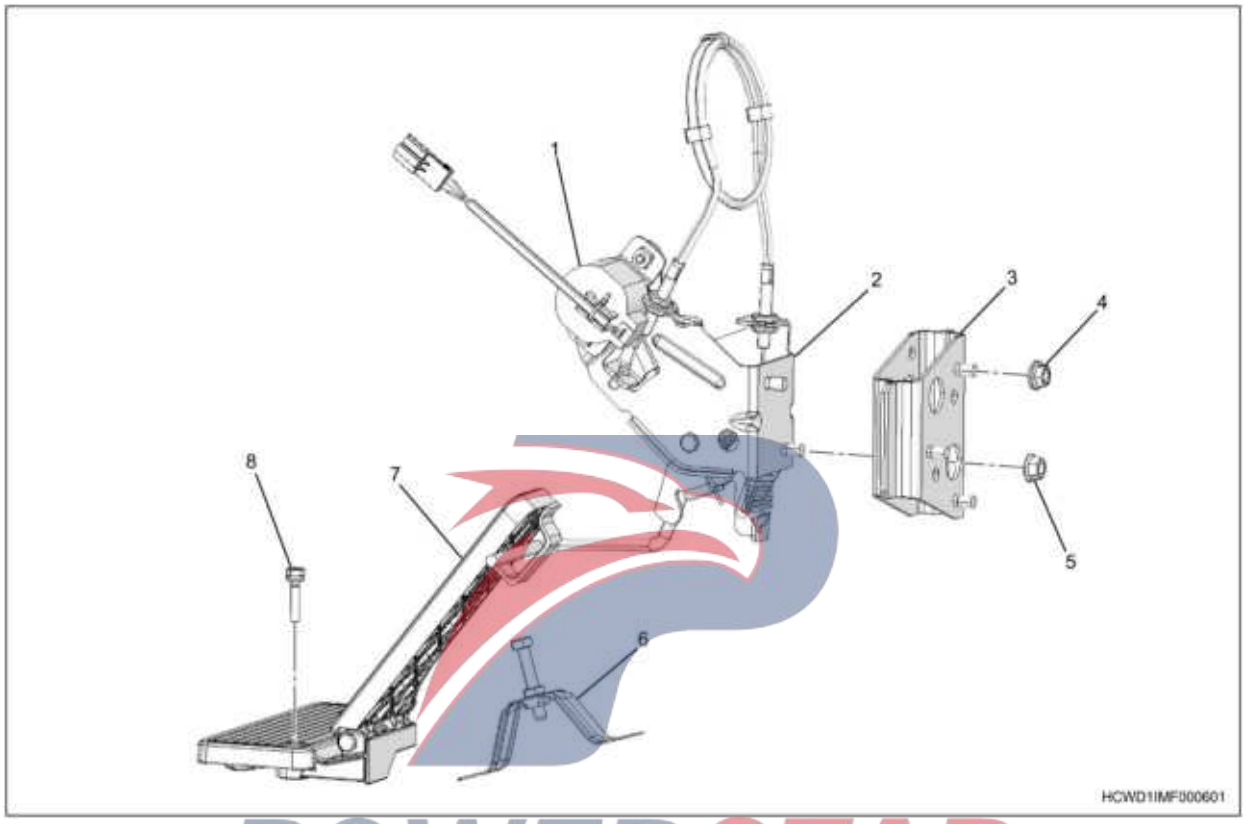
1) Connect the battery cable to the battery negative terminal.

Accelerate pedal lever

Removal

1. Component Views

Accelerator control link



Part name

1. Accelerator pedal position sensor
2. Control link
3. Bracket
4. Nut
5. Nut
6. Stopper bracket
7. Accelerator pedal
8. Bolt

2. Battery cable disconnect

1) Disconnect the battery cable from the negative terminal of the battery.

3. Accelerator pedal lever removed

1) Disconnect the accelerator pedal connected to the accelerator control link.

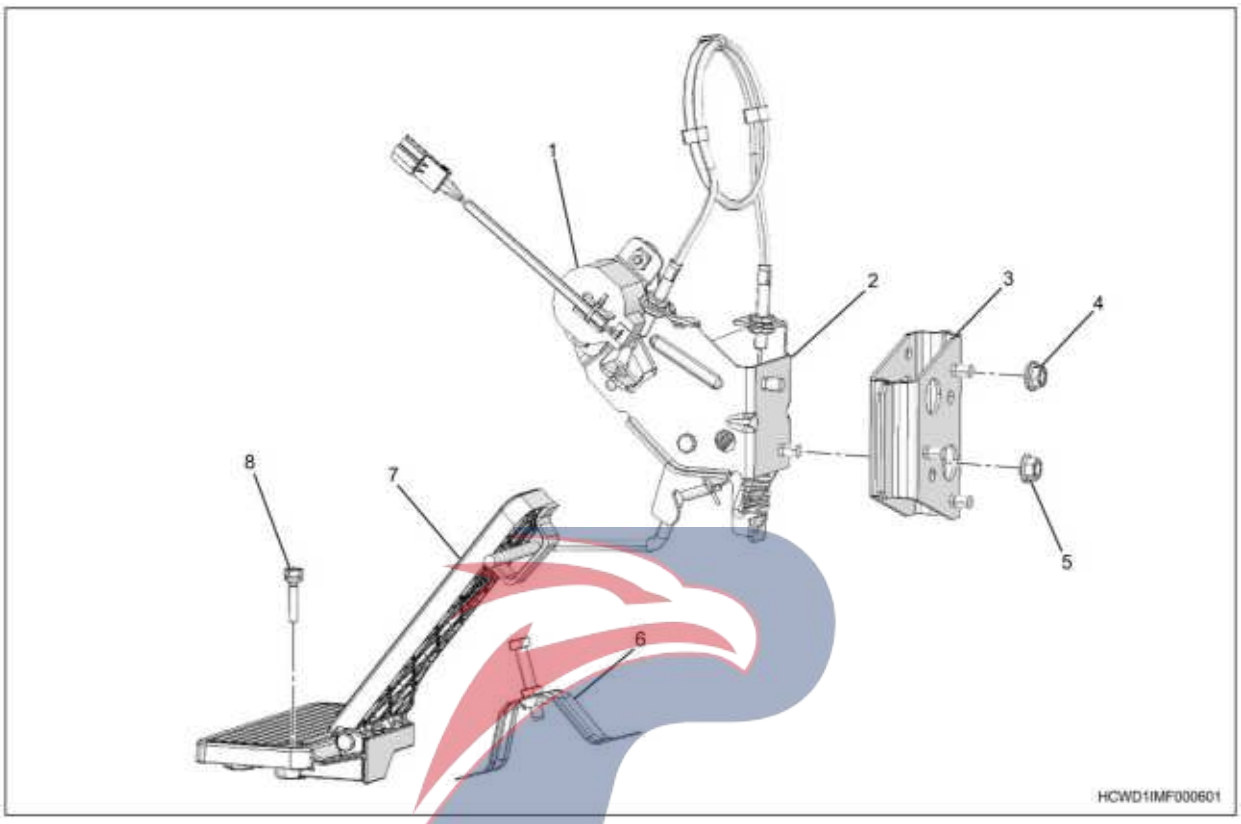
2) Disconnect the accelerator control link rod.

3) Remove the accelerator control link assembly from the front panel.

Installation

1. Component Views

Accelerator control linkage



Part name

1. Accelerator pedal position sensor
2. Control connecting rod
3. Bracket
4. Nut
5. Nut
6. Stopper bracket
7. Accelerator pedal
8. Bolt

2. Accelerate the pedal lever installation

1) Mount the accelerator control link to the front panel.

2) Connect the connector to the accelerator lever.

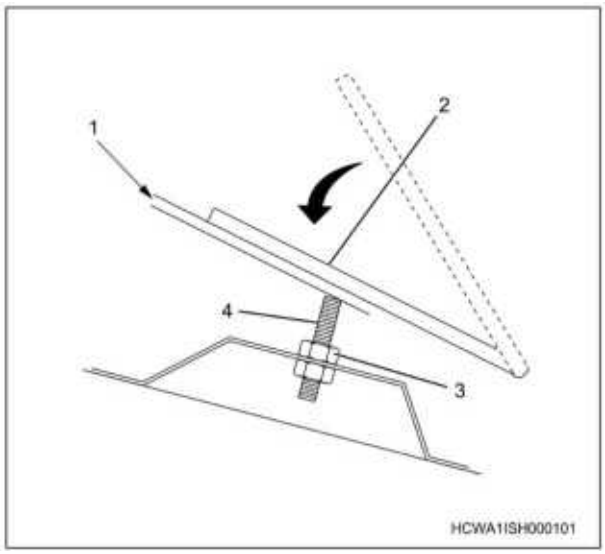
3) Connect the accelerator pedal to the accelerator lever.

4) Adjust the clearance to the specified value using the stopper bolt.

Note:

● Adjust the clearance of the accelerator pedal and stopper bolt with the accelerator pedal depressed to the full position.

Standard: 1.0 to 2.0 mm {0.0394 to 0.0787 in}



1. Accelerate pedal and stop bolt clearance
2. Depress the accelerator pedal
3. Lock nut
4. Stop bolt

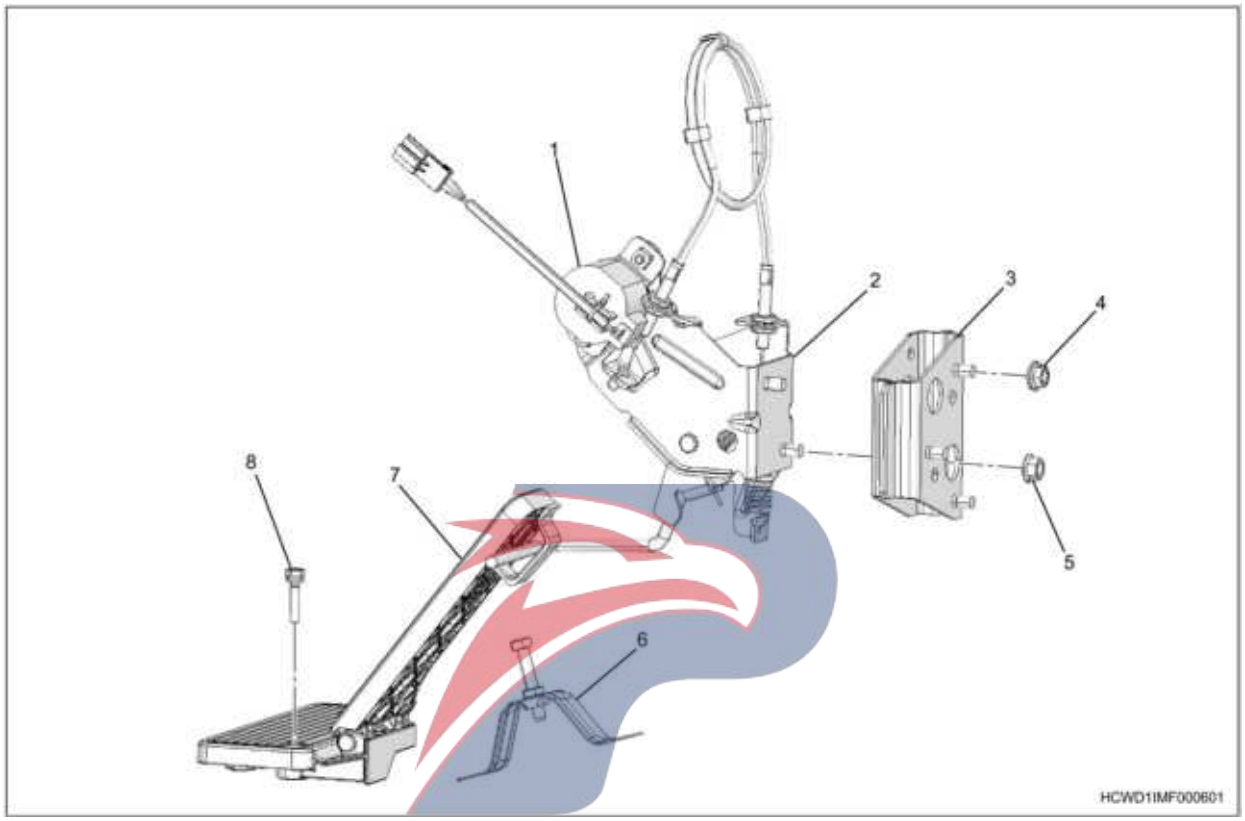
3. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

Supplementary Information

1. Component Views

Accelerator control link



Part name

1. Accelerator pedal position sensor
2. Control link
3. Bracket
4. Nut
5. Nut
6. Stopper bracket
7. Accelerator pedal
8. Bolt


POWERSTAR

Engine
Electrical
(6WG1)
Table of contents

Starter motor....1J-2
Removal....1J-2
Removal....1J-3
Inspection....1J-7
Magnetic switch inspection....1J-10
Installation....1J-15
Alternator....1J-16
Removal....1J-16
Removal....1J-17
Inspection....1J-22
Reassembly....1J-26
Installation....1J-31
Glow plug....1J-33
Removal....1J-33
Inspection....1J-39
Installation....1J-40
Supplementary Information....1J-48

Starter motor

Removal

1. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

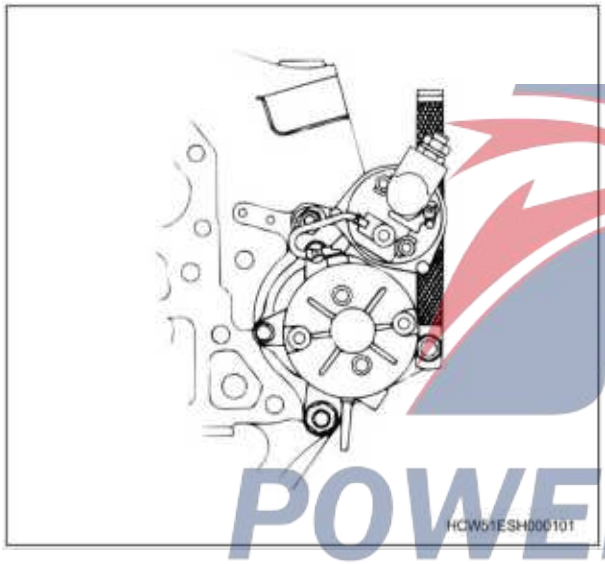
2. Starter motor removal

1) Disconnect the starter ground cable.

2) Disconnect starter B terminal.

3) Disconnect starter S-terminal.

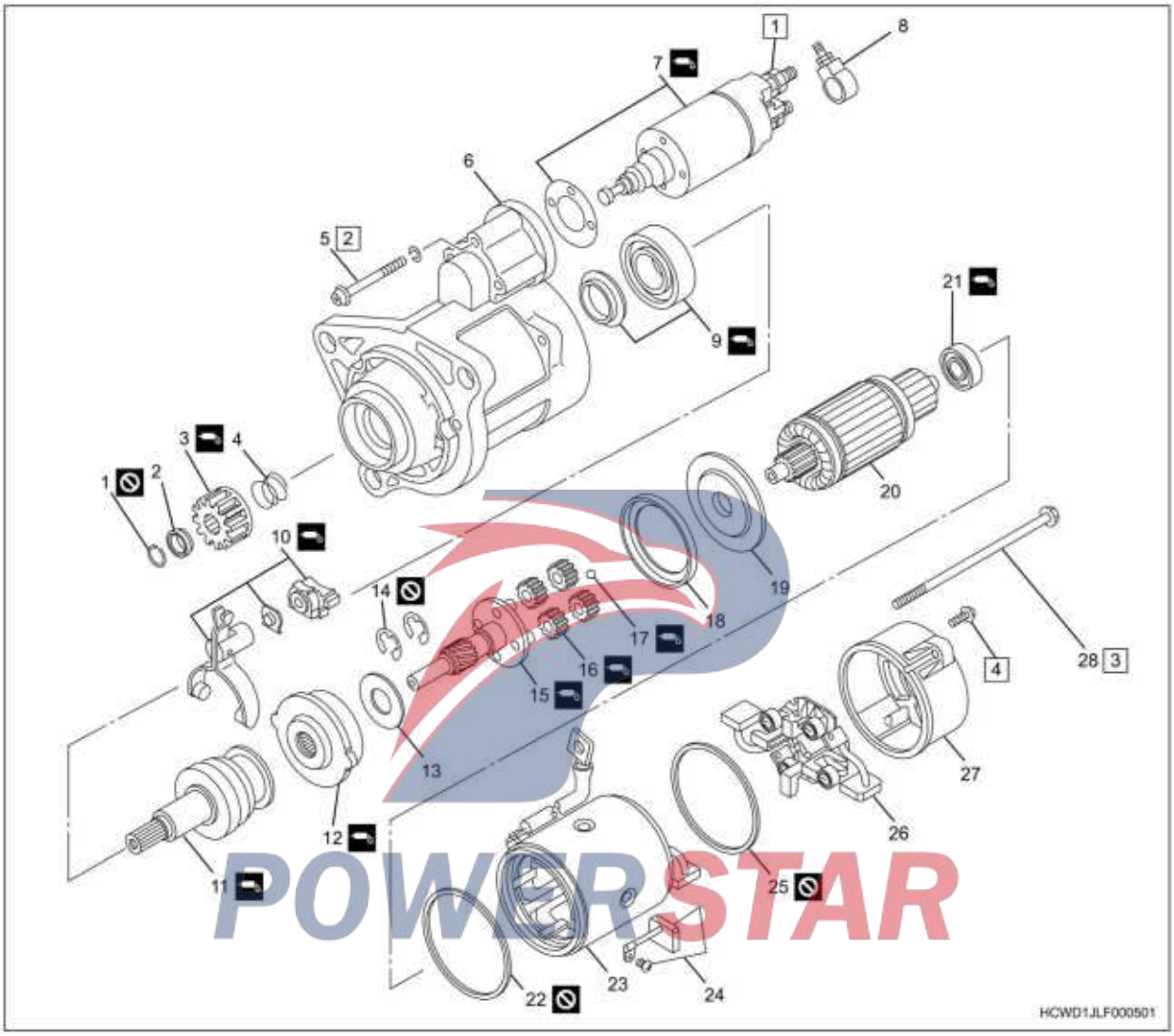
4) Remove the starter from the flywheel housing.



Removal

1. Component Views

Starter motor



Part name

1. Snap ring
2. Stop ring
3. Pinion
4. Pinion spring
5. Screw
6. Front bracket
7. Magnetic switch
8. Bracket
9. Shaft
10. Lever
11. Overrunning clutch
12. Internal gear
13. Washer
14. E-ring
15. Gear shaft
16. Planetary gear
17. Ball
18. Gasket
19. Plate
20. Armature
21. Shaft
22. O-ring
23. Yoke

24. Brush

25. O-ring

26. Brush holder

27. Rear bracket

28. Penetration bolt

Tightening torque

1: 23 N • m { 2.3 kgf • m / 17 lb • ft }

2: 6 N • m { 0.6 kgf • m / 53 lb • in }

3: 10 N • m { 1.0 kgf • m / 89 lb • in }

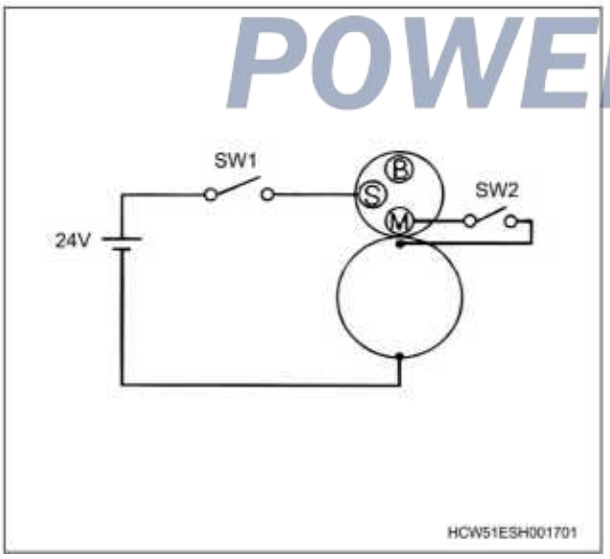
4: 3 N • m { 0.3 kgf • m / 27 lb • in }

2. Starter motor disassembly

Before disassembling the starter, place alignment marks on the magnetic switch, the yoke, the front bracket and the rear bracket to make it easy to reassemble later.

Remove the pinion first. If disassembly is continued without removing the pinion, there will be no way to remove the pinion and disassembly will not be possible. However, it is possible to remove the motor or magnetic switch without removing the pinion.

1) Referring to the diagram, connect the starter motor to the battery.



2) Close switches SW1 and SW2.

Note:

● When switches SW1 and SW2 are closed, the pinion advances to the cranking position, and the armature rotates.

Caution:

● Because leaving the pinion energized generates heat, remove the pinion within 10 seconds.

3) Open switch SW2 to stop the rotation of the armature.

4) Slide the snap ring.

Note:

● Place a pipe the exact size onto the stop ring, and tap the pipe with a hammer to temporarily displace the stop ring to the pinion side.

5) Remove the stop ring from the overrunning clutch.

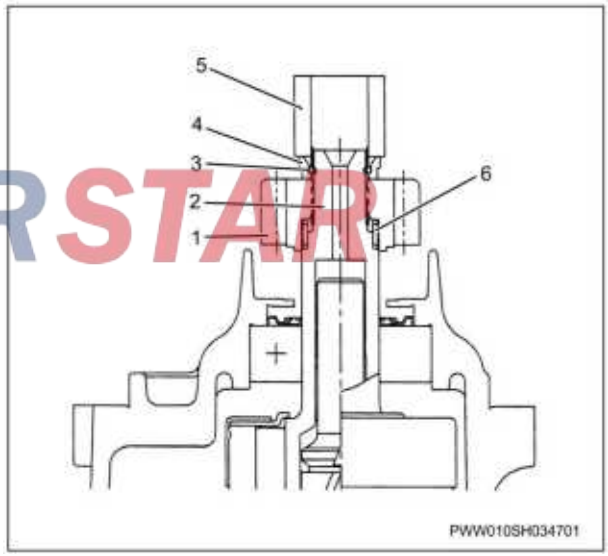
6) Remove the snap ring from the overrunning clutch.

Caution:

● Do not reuse the locking ring that has been removed.

7) Remove the pinion from the overrunning clutch.

8) Remove the pinion spring from the overrunning clutch.



1. Pinion

2. Overrunning clutch

3. Snap ring

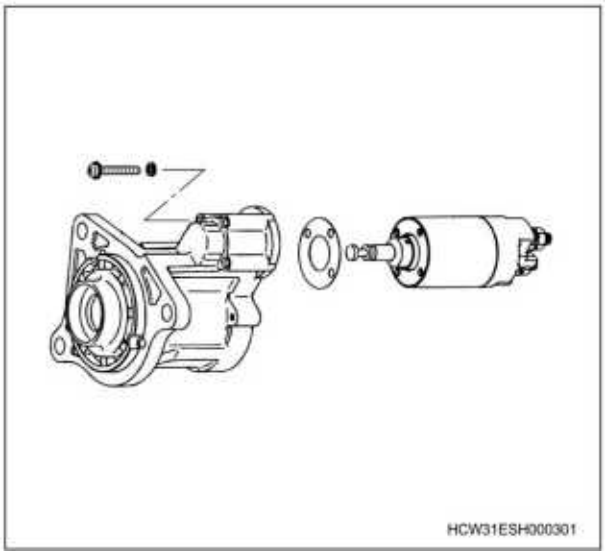
4. Stop ring

5. Pipe

6. Pinion spring

9) Remove the magnetic switch M-terminal nut, and disconnect the lead wire with the terminals.

10) Remove the magnetic switch from the front bracket using a hammer driver.



11) Remove the screw and the penetration bolt, and remove the rear bracket from the yoke.

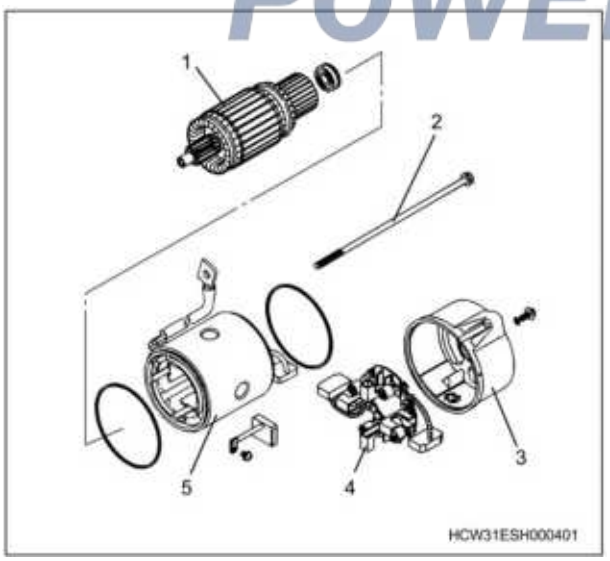
12) Remove the O-ring from the yoke.

13) Remove the yoke from the front bracket.

Note:

● Place a 38 mm OD receptacle on the armature rectifier, slide the brush on the receptacle, install the brush on the receptacle, and remove the yoke.

14) Remove the O-ring from the yoke.



1. Armature
2. Penetration bolt
3. Rear bracket
4. Brush holder

5. Yoke

15) Lift up the brush spring, remove the brush from the brush holder, and remove the brush holder from the yoke.

16) Remove the armature from the gear shaft.

Note:

● Although the ball comes out when the armature is removed, it may stick to the grease and not come out.

17) Remove the bearing from the armature.

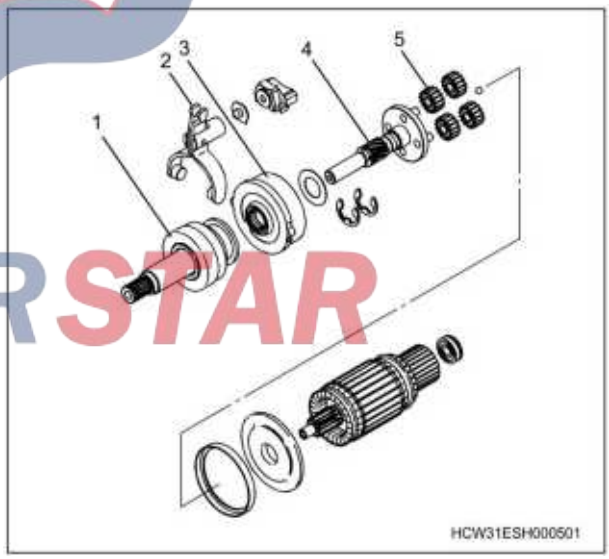
Note:

● The bearing can be removed with a general purpose puller.

18) Remove the plate and the gasket from the gear shaft.

19) Remove the lever support gasket and plate from the lever.

20) Remove the planetary gear from the gear shaft.



1. Overrunning clutch
2. Lever
3. Internal gear
4. Gear shaft
5. Planetary gear

21) Remove the following parts as a set from the front bracket.

● Internal gear

● Gear shaft

● Overrunning clutch

● Lever

22) Remove the lever from the overrunning clutch.

Caution:

● Make sure to remember the direction of the lever.

23) Remove the E-ring from the gear shaft.

Caution:

● Once removed, do not reuse the E-rings.

24) Rotate the overrunning clutch by 1 spline tooth and remove the overrunning clutch from the gear shaft.

25) Remove the internal gear from the gear shaft.

26) Remove the washer from the gear shaft.

27) Remove the bearing from the front bracket.

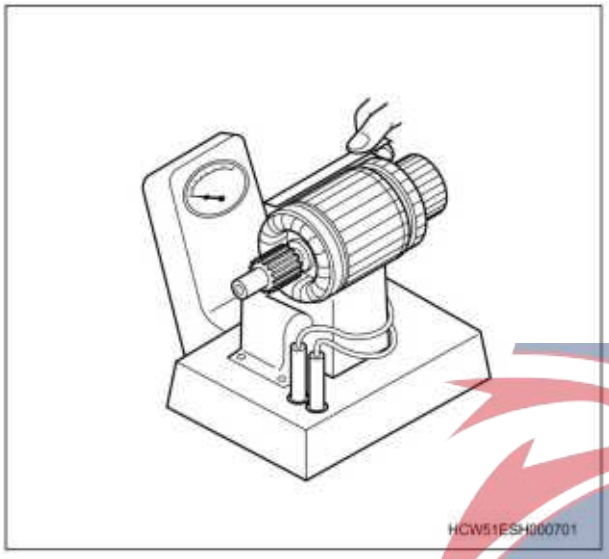
28) Remove the brush from the yoke.

Inspection

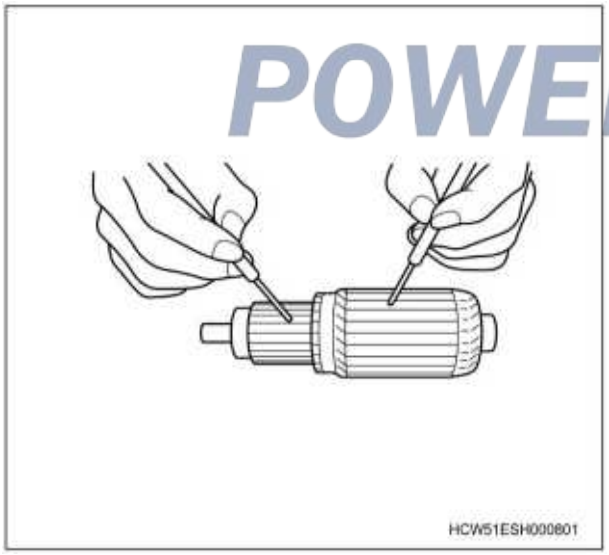
1. Armature inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Inspect for a short circuit inside the armature coil using a growler tester.



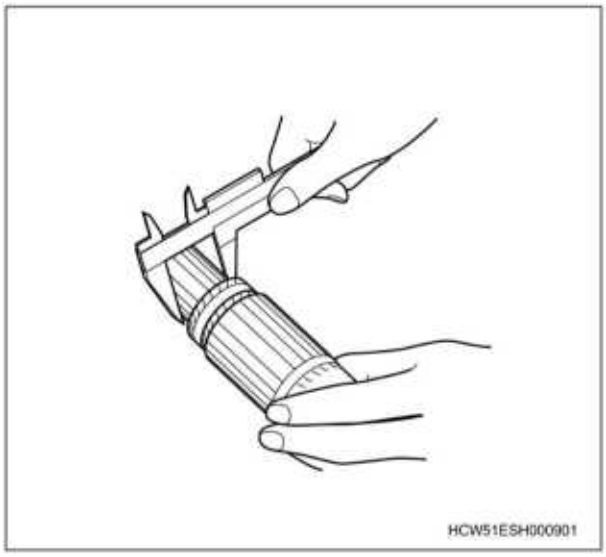
2) Inspect the insulation of the armature coil using a DMM.



3) Measure the outer diameter of the commutator using a vernier caliper.

Standard: 38.7 mm { 1.5236 in }

Limit: 38.1 mm { 1.5000 in}



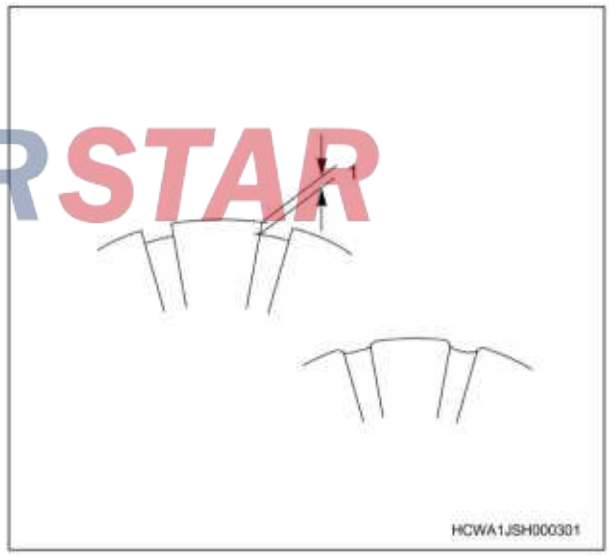
4) Measure the insulated mold dimension of the commutator using a vernier caliper.

Caution:

- Inspect after removing the wear particles, etc., from the brush.

Standard: 0.8 mm { 0.0315 in }

Limit: 0.2 mm { 0.0079 in }

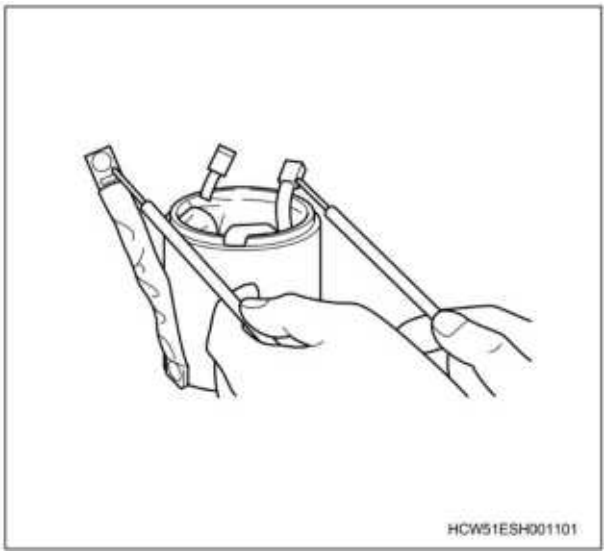


1. Commutator dimension

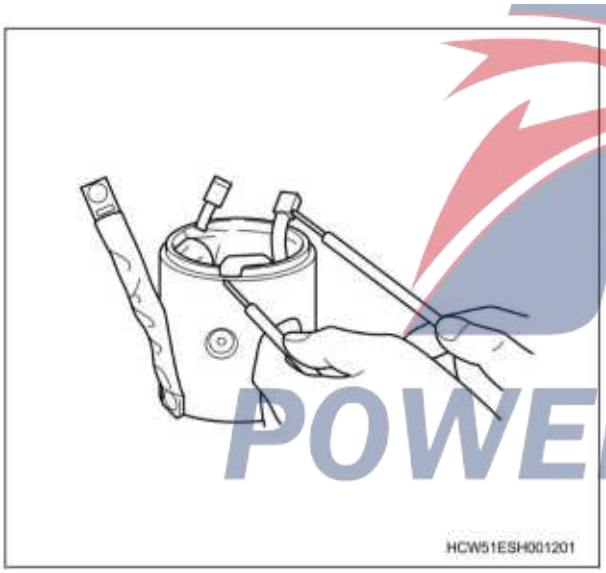
2. Yoke inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Inspect the field coil for an open circuit using a DMM.



2) Inspect for poor insulation of the field coil using a DMM.



3. Brush holder inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Measure the brush length using a vernier caliper.

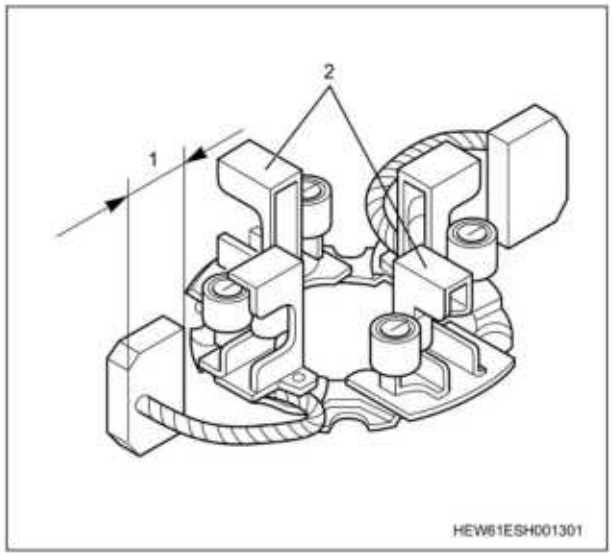
Note:

● If the wear of the brush on the brush holder side is close to the limit, replace the brush holder.

● If the yoke side brush is worn close to the limit, replace the brush only.

Standard: 23 mm { 0.9055 in }

Limit: 12 mm { 0.4724 in }



1. Brush length

2. Brush holder insulation

2) Check the brush holder for smooth movement without interference.

3) Inspect the pressure of the brush spring.

Standard: 33 to 45N { 7.42 to 10.12 lb }

Limit: 20 N { 4.50 lb }

4) Attach one of the probes of the circuit tester to the brush holder plate ,then attach the other probe to the insulated holder, and inspect continuity.

Caution:

● Inspect after cleaning the brush holder.

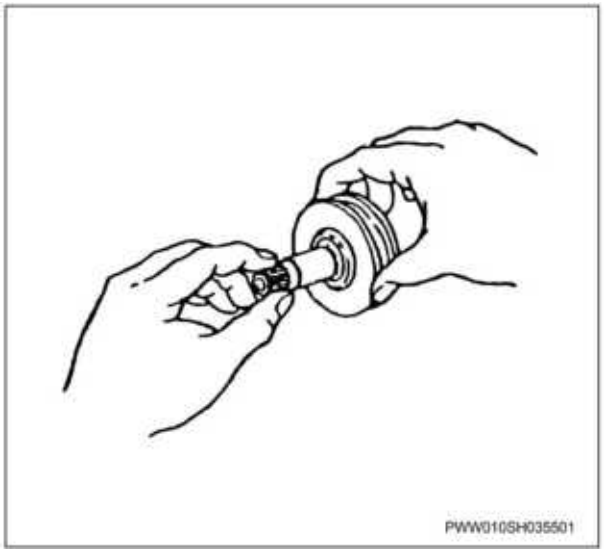
4. Overrunning clutch inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

Caution:

● When cleaning the overrunning clutch, do not use a cleaning agent.

1) When rotating the pinion by hand, verify that the pinion slightly rotates in one direction with some resistance, but does not rotate in the opposite direction.



5. Front bracket inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Inspect the front bracket for dirt and damage.

2) Rotate the bearing by hand, and inspect for abnormal conditions such as abnormal noise or looseness.

6. Internal gear inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Inspect the internal gear for abnormal wear and damage.

7. Planetary gear inspection

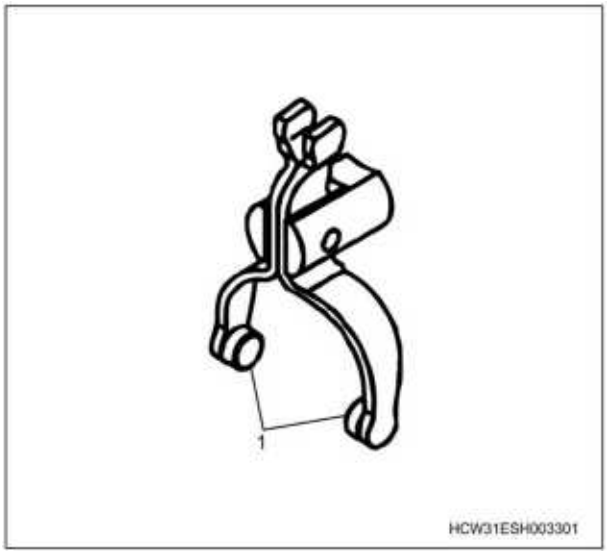
Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Inspect abnormal wear and damage of the planetary gear.

8. Lever inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Inspect the sliding section of the lever and the overrunning clutch for wear.



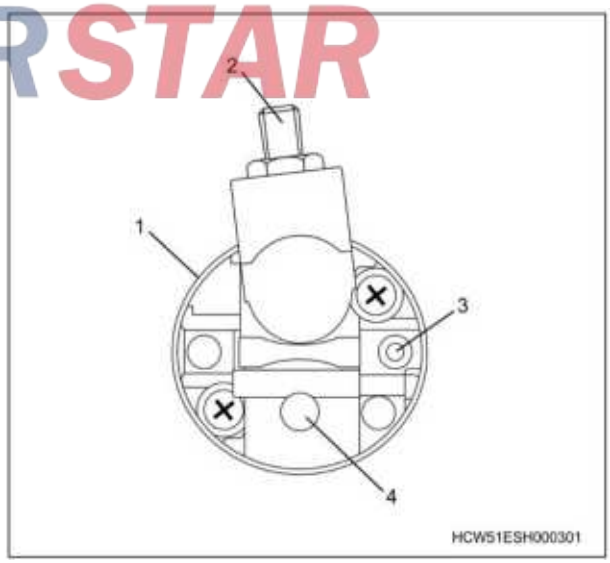
1. Sliding section of the lever and the overrunning clutch

9. Magnetic switch inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Inspect for continuity between the M-terminal and the body using a DMM.

2) Inspect for continuity between the B-terminal and the M-terminal using a DMM.



1. Magnetic switch

2. B-terminal

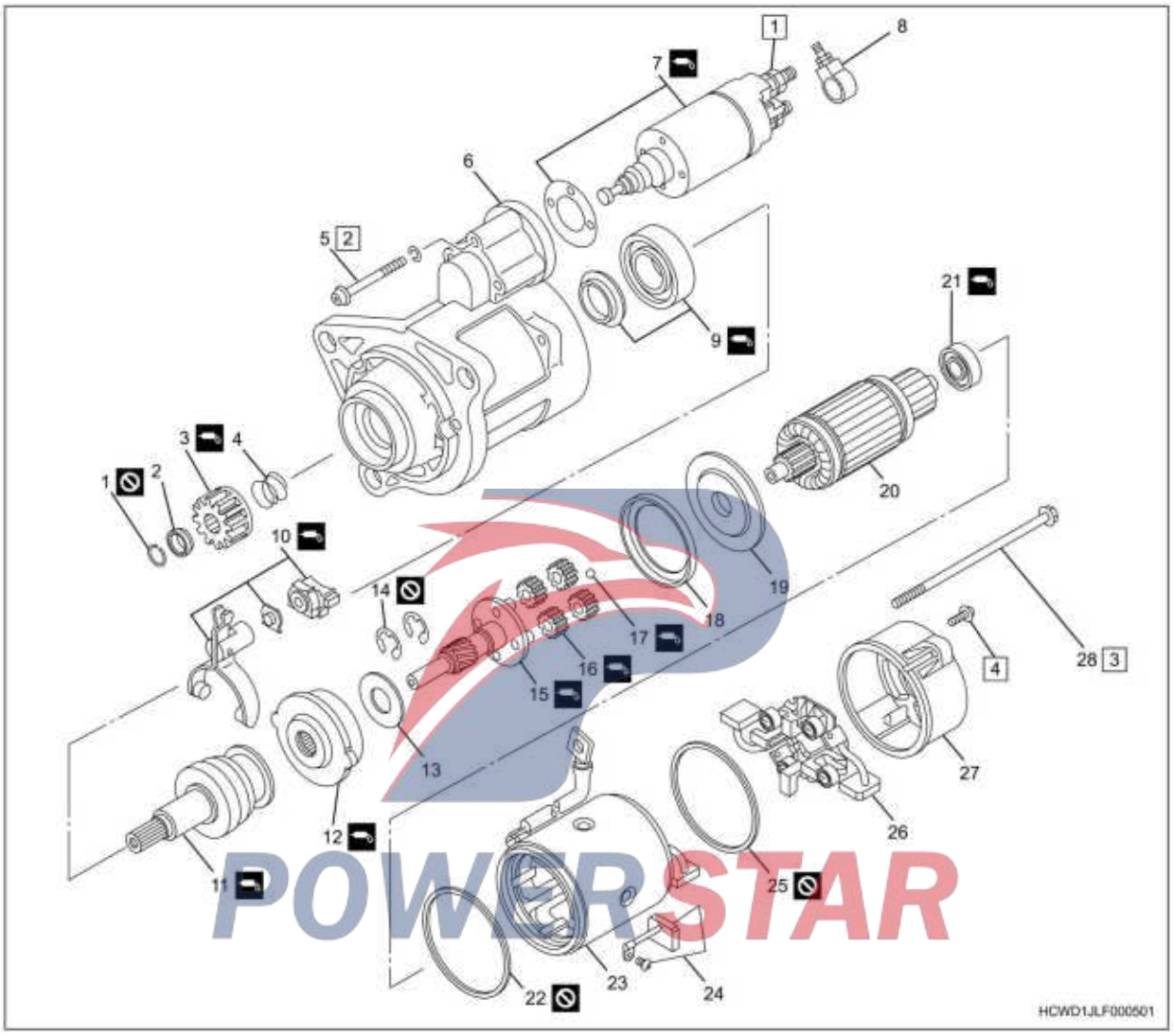
3. S-terminal

4. M-terminal

Reassembly

1. Component Views

Starter motor



Part name

1. Snap ring
2. Stop ring
3. Pinion
4. Pinion spring
5. Screw
6. Front bracket
7. Magnetic switch
8. Bracket
9. Shaft
10. Lever
11. Overrunning clutch
12. Internal gear
13. washer
14. E-ring
15. Gear shaft
16. Planetary gear
17. Ball
18. Gasket
19. Plate
20. Armature
21. Shaft
22. O-ring
23. Yoke

24. Brush
25. O-ring
26. Brush holder
27. Rear bracket
28. Penetration bolt

Tightening torque

1: 23 N • m { 2.3 kgf • m / 17 lb • ft }

2: 6 N • m { 0.6 kgf • m / 53 lb • in }

3: 10 N • m { 1.0 kgf • m / 89 lb • in }

4: 3 N • m { 0.3 kgf • m / 27 lb • in }

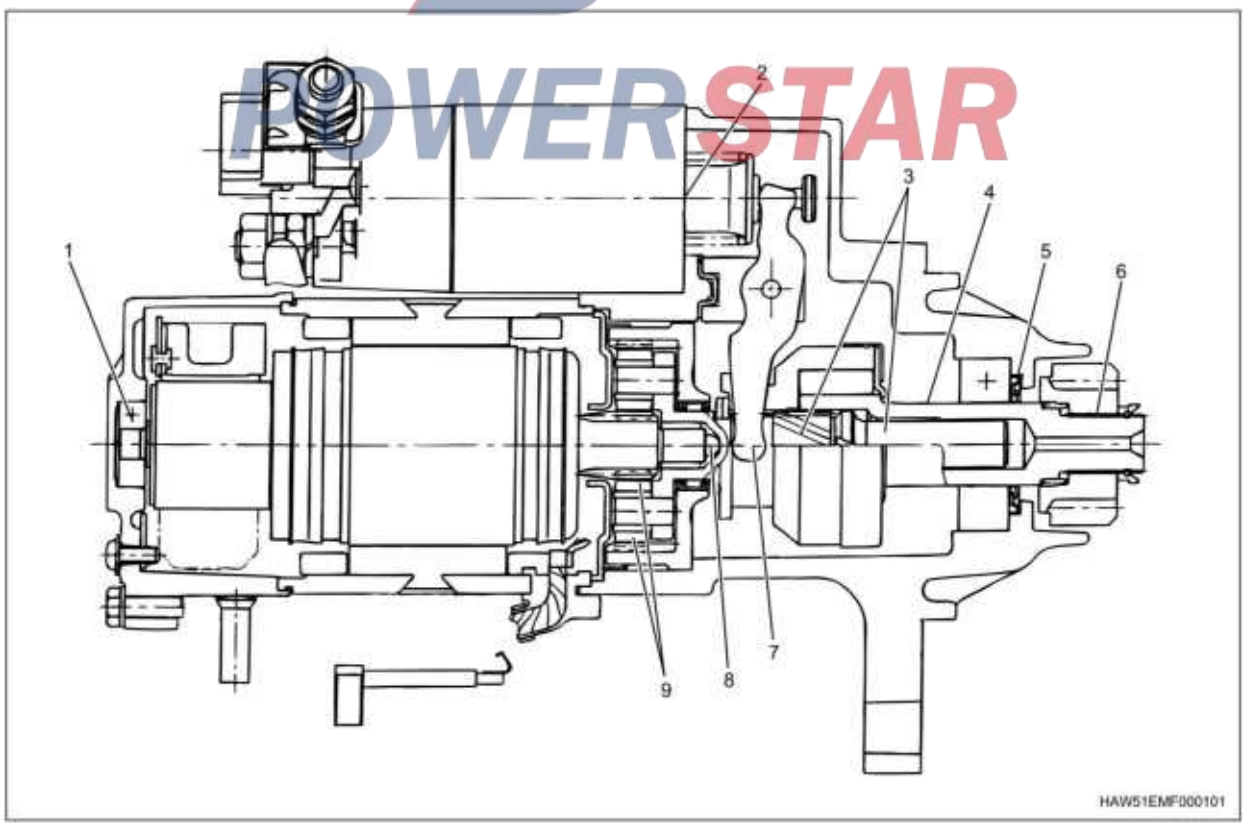
2. Starter motor reassembly

Caution:

● Replace the snap ring, the E-ring and the O-ring with the new ones.

● Regarding the areas that require grease when assembling the starter motor, refer to the table and the diagram.

Lubrication areas		Recommended grease	
		Manufacturer	Product name
1	Surface of the armature bearing outer circumference	Co-fats	MULTEMP 0A-171
2	Plunger surface		
3	Spline section and sliding section of the gear shaft		
4	Clutch shaft sliding section		
5	Oil seal		
6	Pinion bottom		
7	Sliding section of the lever and the overrunning clutch	Dow Corning	MOLYCOAT R-AG650
8	Sleeve bearing and ball		
9	Armature shaft gear, planetary gear, internal gear		



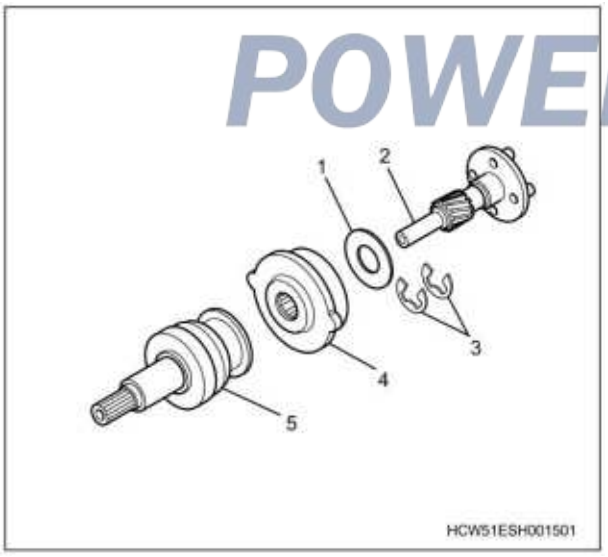
1. Surface of the armature bearing outer circumference
2. Plunger surface
3. Spline section and sliding section of the gear shaft
4. Clutch shaft sliding section
5. Oil seal
6. Pinion bottom
7. Sliding section of the lever and the overrunning clutch
8. Sleeve bearing and ball
9. Armature shaft gear, planetary gear, internal gear

1) Install the brush to the yoke.
2) Install the bearing to the front bracket.
3) Install the washer to the gear shaft.
4) Install the internal gear to the gear shaft.
5) Install the overrunning clutch to the gear shaft.

Caution:

● Make sure that the overrunning clutch does not come off after shifting aside the overrunning clutch by 1 spline tooth.

6) Install the E-ring to the gear shaft.



1. Washer
2. Gear shaft
3. E-ring
4. Internal gear
5. Overrunning clutch

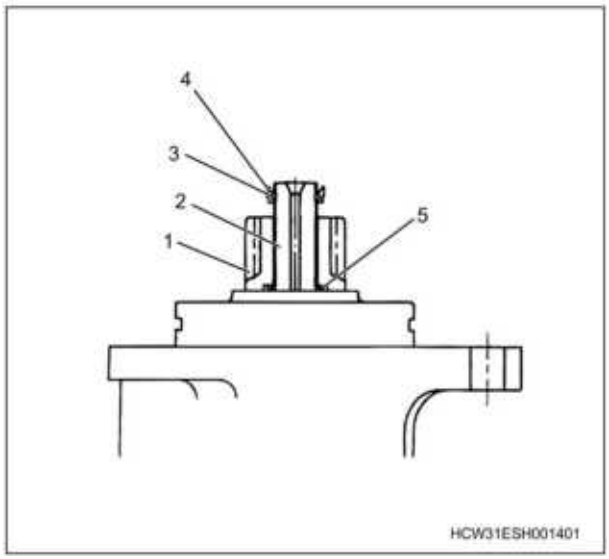
7) Install the lever to the overrunning clutch.
8) Install the following parts as a set to the front bracket.

● Internal gear
● Gear shaft
● Overrunning clutch
● Lever

9) Install the planetary gear to the gear shaft.
10) Install the lever support gasket and plate to the lever.
11) Install the plate and the gasket to the gear shaft.
12) Install the bearing to the armature.
13) Check the installation status of the ball, and install the armature to the gear shaft.
14) Install the O-ring to the yoke.
15) Install the yoke to the front bracket.
16) After checking the installation status of the brush, install the brush holder to the armature.
17) Install the O-ring to the yoke.
18) Install the screw and core bolt, and then mount the rear bracket to the yoke.
19) Mount the pinion spring to the one-way clutch.
20) Install the pinion on the one-way clutch.
21) Install the stop ring onto the overrunning clutch.
22) Install snap ring onto overrunning clutch.

Note:

● Press the retaining ring firmly into the groove in the shaft section of the high-load clutch. Using a gear puller, pull the retaining ring toward the retaining ring and secure the retaining ring and retaining ring.



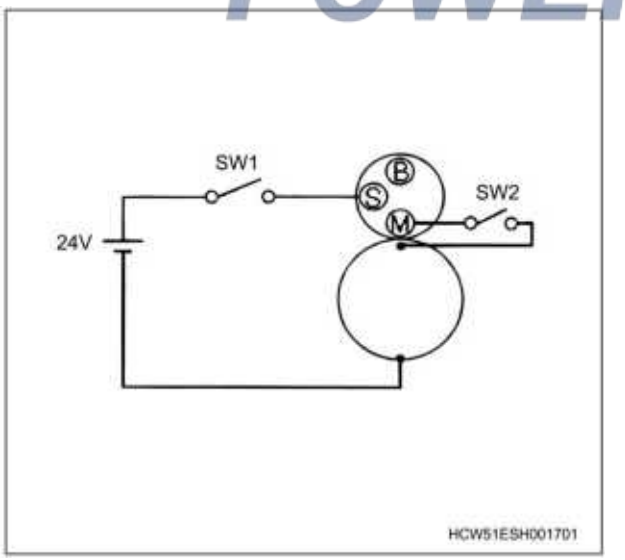
1. Pinion
2. Overrunning clutch shaft
3. Snap ring
4. Stop ring
5. Pinion spring

23) Install the magnetic switch to the front bracket.

24)Install the magnetic switch M-terminal nut, and connect the lead wire with the terminals.

1. Pinion protrusion position inspection

1) Referring to the diagram, connect the starter motor to the battery.



2) Close switches SW1 and SW2.

Note:

● When switches SW1 and SW2 are closed, the pinion advances to the cranking position, and the armature rotates.

3) Open switch SW2 to stop the rotation of the armature.

4) Slightly push back the head of the overrunning clutch shaft by hand and measure the movement of the overrunning clutch shaft.

Note:

● If the measured value is outside the specified value, adjust through the number of gaskets between the magnetic switch and the front bracket, or replace the lever.

Standard: 0.5 to 2.0mm { 0.0197 to 0.0787 in }

Gasket thickness: 0.5 mm {0.0197 in}

Caution:

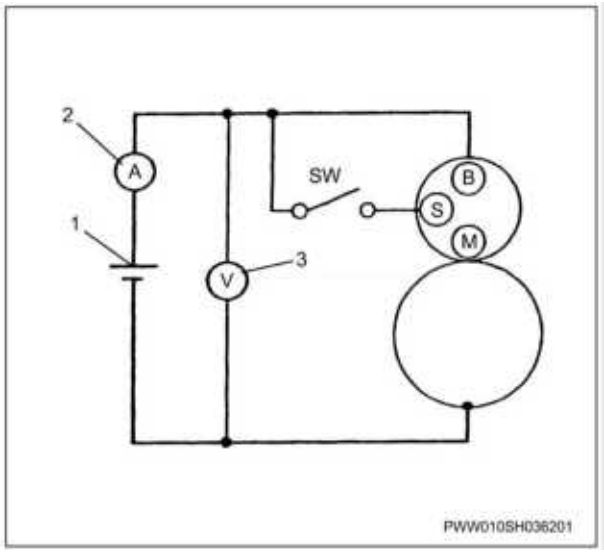
● If an adjustment is made by the number of the gaskets, use 2 or less gaskets.

2. Load test

1) Referring to the diagram, connect the starter motor to the battery.

Caution:

● Use a sufficiently thick electric wire, and securely tighten the connection.



1. Battery
2. Ammeter
3. Voltmeter

2) Close the switch, and check the current and the voltage.

Caution:

● If the reading is outside the specified value, disassemble and inspect once again.

No-load characteristics

Item	Specified value
Voltage	: 23.5 V
Current	: 125 A or less
Number of rotations	3,100 rotations or more per minute

Installation

1. Starter motor installation

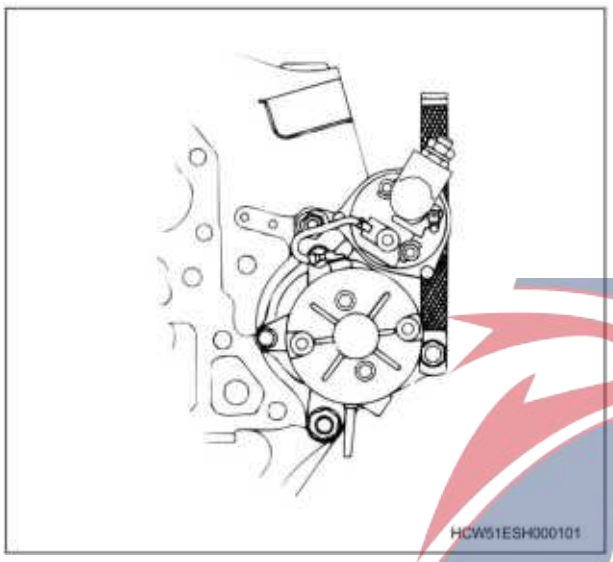
1) Install the starter to the flywheel housing.

Tightening torque: 103 N • m {10.5 kgf • m / 76 lb • ft}

2) Connect the S-terminal to the starter.

3) Connect the B-terminal to the starter.

4) Connect the grounding cable to the starter.



2. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

Generator

Removal

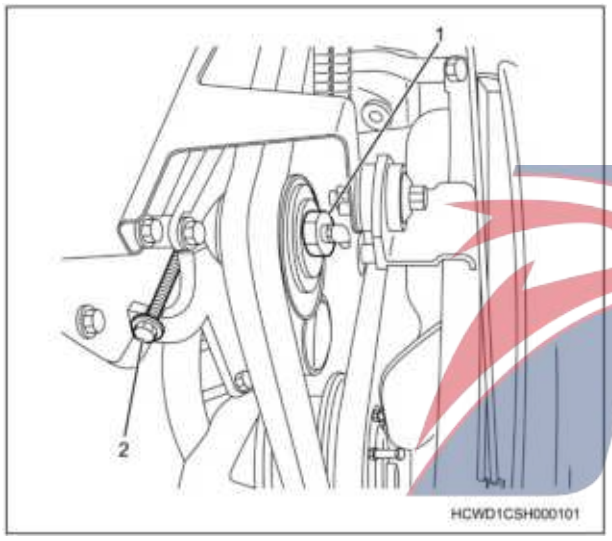
1. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

2. Cooling fan belt removal

1) Loosen the lock nut and adjustment screw to remove the cooling fan drive belt from the generator and crankshaft pulley.



1. Lock nut
2. Adjust bolt

3. Generator removal

1) Disconnect the harness connector from the generator.

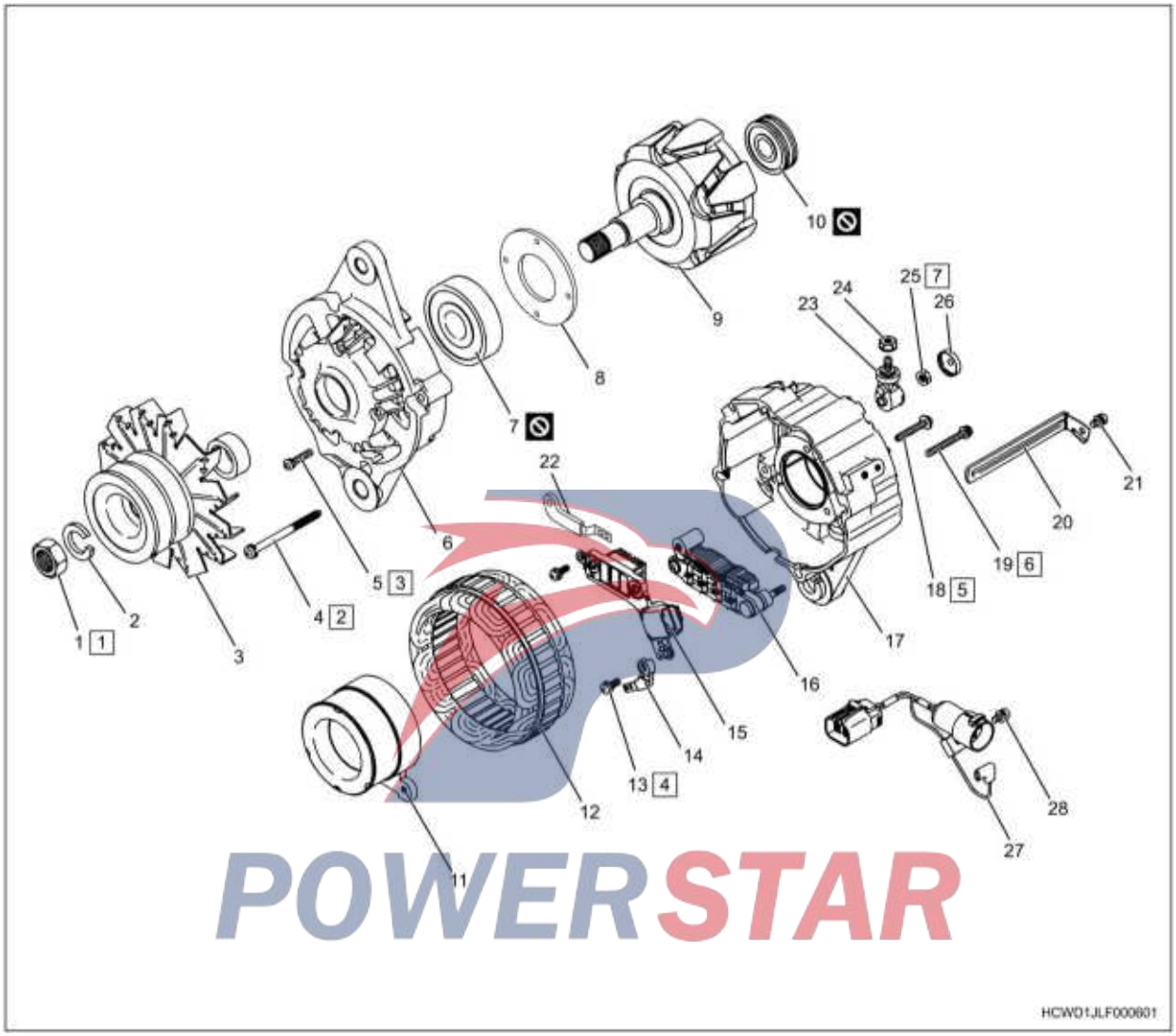
2) Disconnect the generator from the ground and B-terminal harness.

3) Remove the generator from the bracket.

Removal

1. Component Views

Generator (60 A size)



Part name

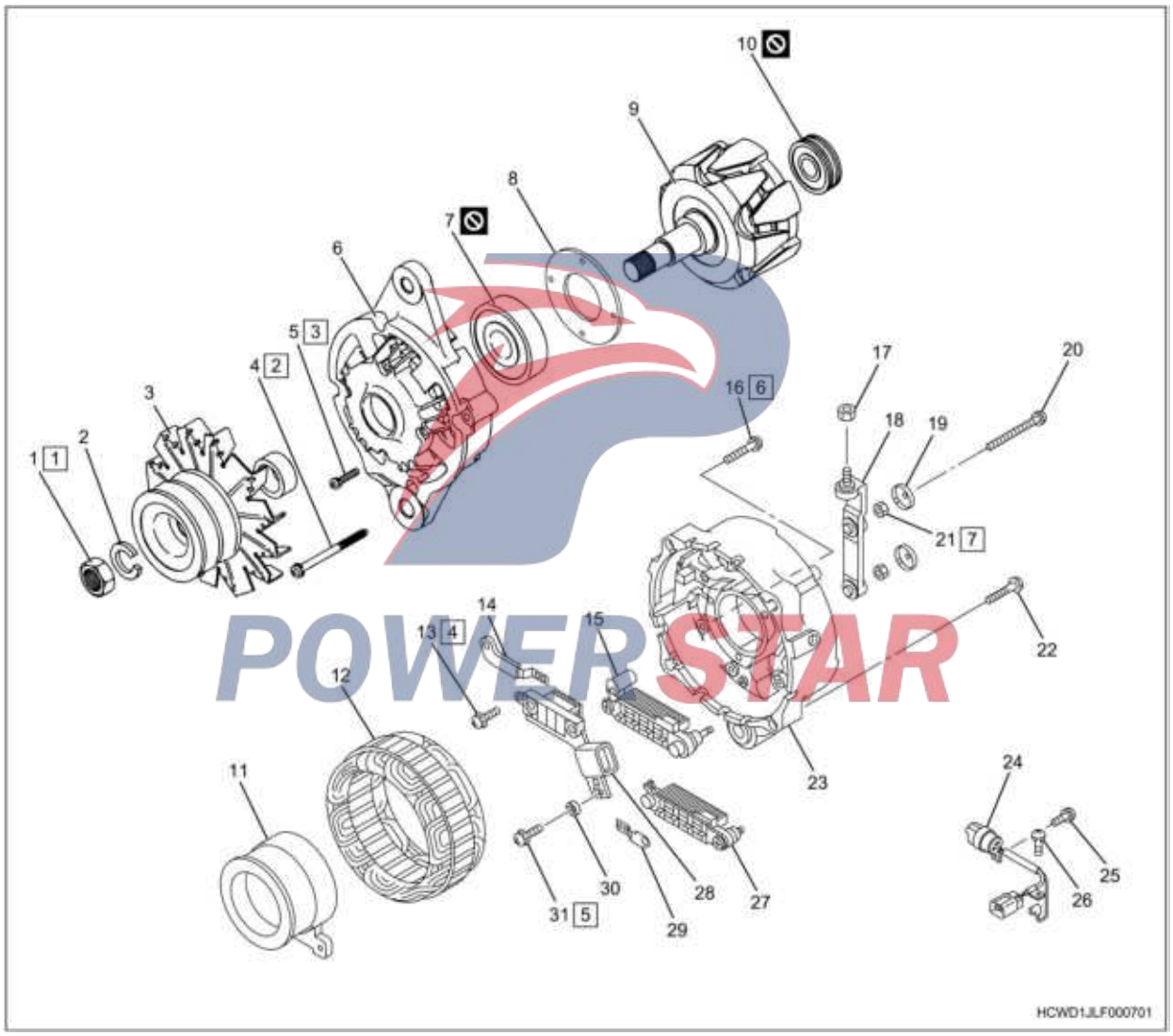
1. Nut
2. Spring washer
3. Pulley
4. Penetration bolt
5. Retaining ring fastening screws
6. Front bracket
7. Shaft
8. Cage
9. Rotor
10. Shaft
11. Excitation coil
12. Stator
13. Regulator fastening screw
14. Plate
15. Regulator
16. Rectifier
17. Rear bracket
18. Regulator fixing screw
19. Excitation coil fastening screw
20. Pipe clamp
21. Pipe clamp mounting screws
22. Terminal B
23. B-terminal bolt

24. B-terminal fastening nut
25. B-Terminal Bolt Nut
26. B-terminal cover
27. connector
28. Connector mounting screw

Tightening torque

1: 147 N • m { 15.0 kgf • m / 108 lb • ft }
2: 5 N • m { 0.5 kgf • m / 44 lb • in }
3: 4 N • m { 0.4 kgf • m / 35 lb • in }
4: 4 N • m { 0.4 kgf • m / 35 lb • in }
5: 4 N • m { 0.4 kgf • m / 35 lb • in }
6: 4 N • m { 0.4 kgf • m / 35 lb • in }
7: 9 N • m { 0.9 kgf • m / 80 lb • in }

Generator (90 A Specifications)



Part name

1. Nut
2. Spring washer
3. Pulley
4. Penetration bolt
5. Retaining ring fastening screws
6. Front bracket
7. Shaft
8. Cage
9. Rotor
10. Shaft
11. Excitation coil
12. Stator
13. Regulator fastening screw

14. Terminal B
15. Rectifier
16. Regulator fixing screw
17. B-terminal clamp nut
18. B-terminal bolt
19. B-terminal cover
20. B-terminal mounting screws
21. B-terminal bolt nut
22. E-terminal bolt
23. Rear bracket
24. connector
25. Connector mounting screw
26. Connector mounting screw
27. Rectifier
28. Regulator
29. Plate
30. Mold
31. Regulator fixing screw

Tightening torque

1: 147 N • m {15.0 kgf • m / 108 lb • ft}
2: 15 N • m {1.5 kgf • m / 11 lb • ft}
3: 4 N • m {0.4 kgf • m / 35 lb • in}
4: 4 N • m {0.4 kgf • m / 35 lb • in}
5: 4 N • m {0.4 kgf • m / 35 lb • in}
6: 4 N • m {0.4 kgf • m / 35 lb • in}
7: 9 N • m {0.9 kgf • m / 80 lb • in}

2. Generator removal

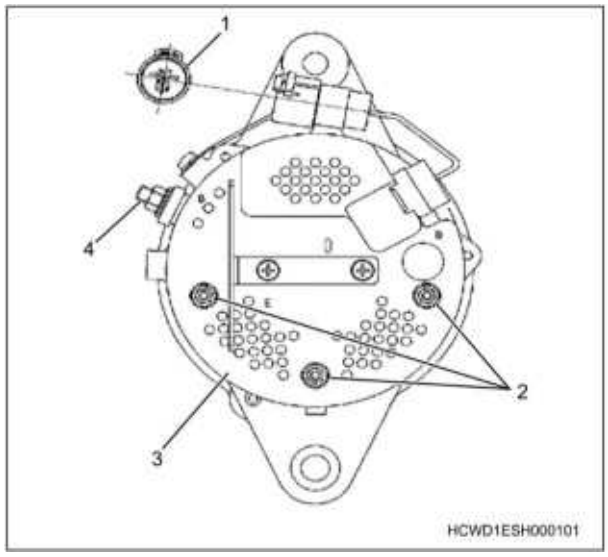
1. 50 A and 60 A specifications

Caution:

● Before disassembly, set the alignment marks on the front and rear brackets respectively.

1) Remove the core bolt from the generator.

2) Remove the back cover from the generator.



1. Connector
2. Nut
3. Cover
4. B-terminal

3) Remove the collar from the terminal B-terminal.

4) Use an impact wrench to remove the nut on the generator.

5) Remove the following parts from the generator.

● Pulley
● Fan
● Collar

6) Use the press to remove the rotor and collar from the front bracket.

Caution:

● Do not tighten the pliers.

7) Remove the cage from the front bracket.

8) Remove the front bearing from the front bracket.

Note:

● Push the bearing out using the appropriate sleeve.

Caution:

● If not necessary, do not disassemble the bearings.
● Do not reuse the bearings that have been removed.

9) Remove the four stator coil wires and remove the stator from the rectifier.

Caution:

● Use 180-270W iron and remove in about 5 seconds.

● Do not damage the diode.

10) Remove the excitation coil lead from the rectifier.

Caution:

● Use 180-270W iron and remove in about 5 seconds.

11) Remove the lead wire from the clip.

12) Remove the regulator from the generator.

13) Remove the rectifier from the generator.

14) Remove the feeding coil from the generator.

2. 90 A specifications

Caution:

● Before disassembly, set the alignment marks on the front and rear brackets respectively.

1) Remove the core bolt from the generator.

2) Disconnect the front bracket from the rear bracket.

Note:

● Use a flathead screwdriver to pry open the stator and front bracket and carefully separate the front and rear brackets.

Caution:

● Avoid damaging the stator coil.

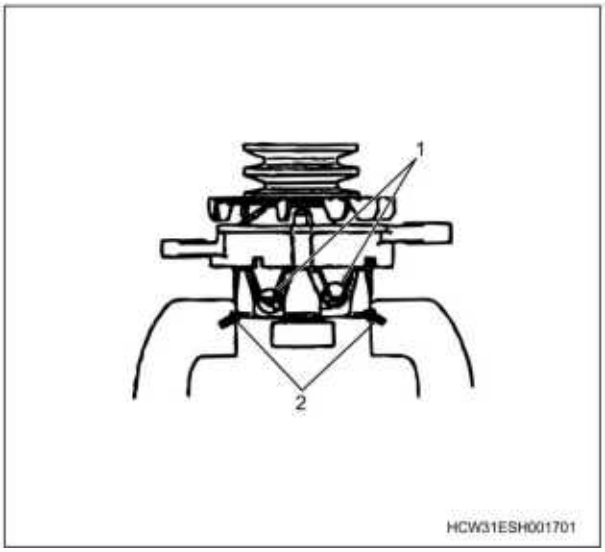
3) Fix the rotor on the vise.

Caution:

● Be careful not to deform the rotor ball.

● Clamp the place between the fixed positions when tightening the rotor with a vise.

● Due to the low strength of the area, do not squeeze the area if it is not fixed.



1. Not fastened position

2. Fastened position

4) Remove the pulley fastening nut and remove the following parts from the rotor.

● Pulley

● Gasket

● Front bracket

5) Remove the retainer on the rotor.

6) Remove the bearing from the front bracket.

Note:

● Push the bearing out using the appropriate sleeve.

Caution:

● If not necessary, do not disassemble the bearings.

● Do not reuse the bearings that have been removed.

7) Remove the bearing from the stator with puller.

Caution:

● If not necessary, do not disassemble the bearings.

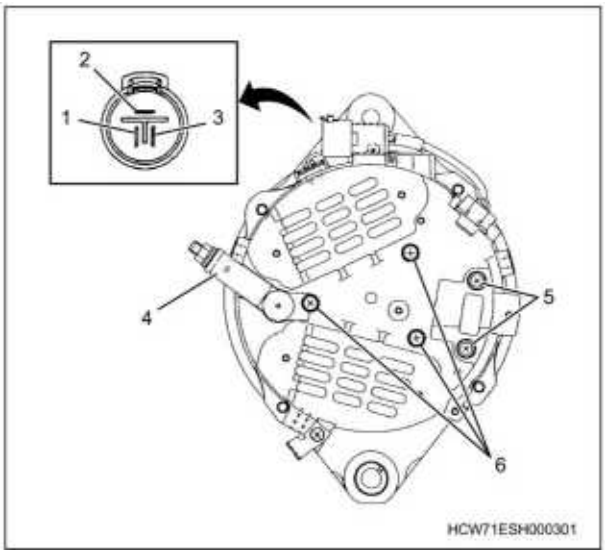
● Do not reuse the bearings that have been removed.

8) Remove the regulator mounting screw from the generator.

9) Remove the excitation coil retaining screw from the generator.

Caution:

● If the regulator mounting screws are already installed, do not remove the magnetic field coil mounting screws.



1. L-terminal
2. N-terminal
3. IG-terminal
4. Terminal B
5. Regulator fixing screw
6. Excitation coil mounting screw

10) Remove the connector from the generator.

11) Remove the fixture from the generator.

12) Remove the cap and nut from the rectifier terminal bolt.

13) Screw the B-terminal assembly and remove it from the rear bracket.

Note:

● Leave the pipe on the rear bracket.

Caution:

● Do not lose pipe fittings.

14) Remove the rectifier captive screw and adjuster captive screw from the rear bracket.

15) Remove the terminal block B on the rear cover.

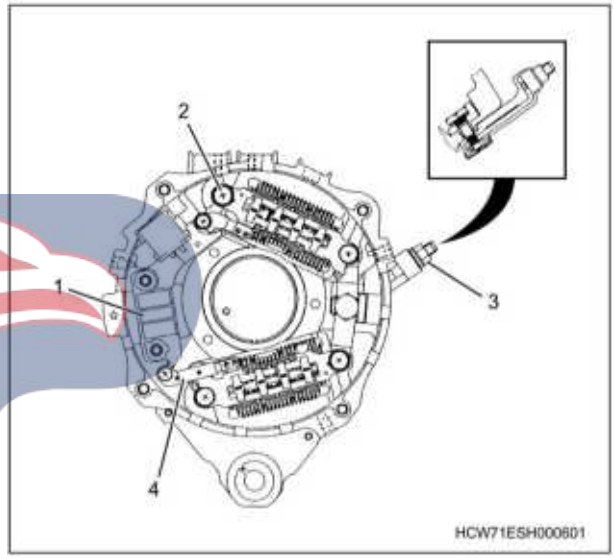
16) Completely remove the rectifier and stator from the rear bracket.

17) Remove the adjuster from the rear bracket.

18) Remove the four stator coil wires and remove the stator from the rectifier.

Caution:

● Use 180-270W iron and remove in about 5 seconds.



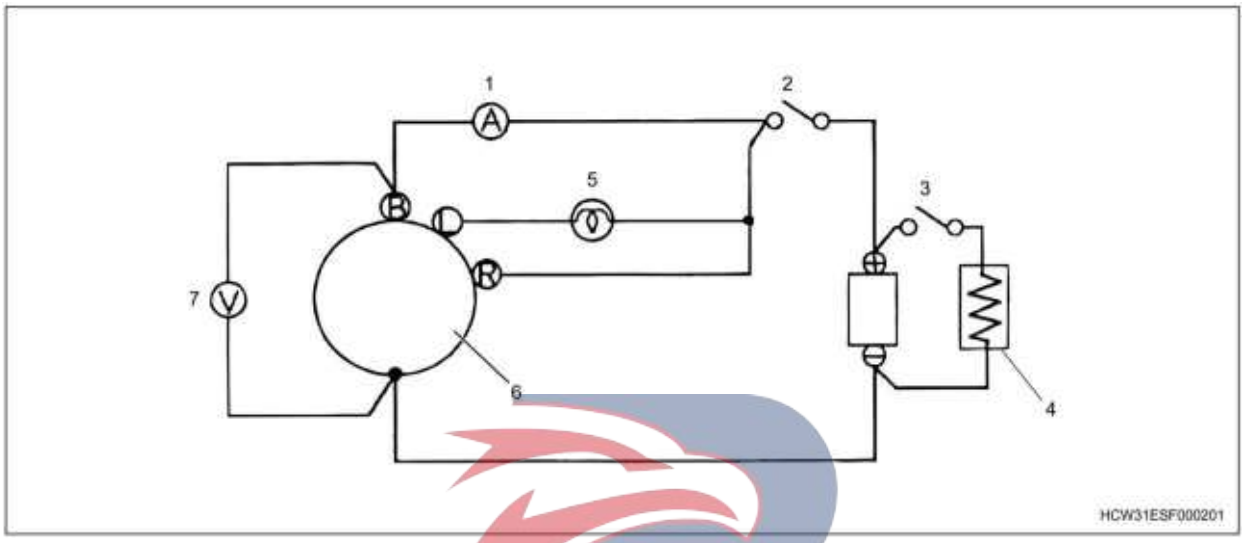
1. Regulator
2. Rectifier terminal bolt
3. B-terminal assembly
4. Terminal B

Inspection

1. Generator functional inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Prepare tester.



1. Ammeter
2. Switch 2
3. Switch 3
4. Load resistance
5. Lights of 24 V - 3 W or less
6. Generator
7. Voltmeter

3) Close switch 2 and verify that the test lamp illuminates.

Caution:

● Turn off the No. 3 switch.

4) If the test lamp does not illuminate when closing switch 2, measure the voltage of the L-terminal.

Note:

● If the voltage is close to the battery voltage, inspect the generator.

● If the voltage is low, check the lamp or the lamp circuit for an open circuit.

5) Slowly raise the rotation speed of the generator.

Note:

● Check that the lamp is off at approximately 1300 rpm.

Note:

● Use an ammeter rated at 150 A.

● Use a voltmeter rated at 30 V.

● Use a variable type rated 150A or higher for the load resistance.

2) Install the generator on the tester.

6) Observe the voltmeter.

Note:

● There is possibility of IC regulator malfunction if the voltage exceeds 30 V.

● If the voltage does not reach battery voltage or more, electric power is not generated.

7) Slowly raise the generator rotation speed to approximately 5000 rpm.

Note:

● If the current meter reading is more than 5 A, continue charging until it is 5 A or less, or replace the battery with a fully charged one.

8) If the current is 5 A or less when the generator rotation speed is approximately 5000 rpm, measure the regulator adjustment voltage.

Caution:

● If the regulator adjusting voltage is not the specified value, replace the regulator.

Standard: 28 to 29 V

9) Make the load resistance value maximum, and close switch 3.

Note:

● The current will become the minimum.

10) Adjust the load resistance so that the output current will be maximized while retaining the generator rotation speed at approximately 5000 rpm.

11) Maintain the rotational speed and the output current of the generator for 15 minutes, and raise the generator temperature.

12) Refer to the table, and adjust the load resistance so that the output current is maximized at 2500 rpm and 5000 rpm.

Generator maintenance standards（60 A）

	Rotational speed	: 2,500 rpm	: 5,000 rpm
Output characteristics,when hot	voltage	: 27 V	
	Current	: 59 A or more	:65 A or above
Feed coil resistance, at 20℃	: 5.9 to 6.8 Ω		
IC regulator adjustment voltage	: 28 to 29 V		
Rotational direction	Right direction		

Generator Repair Standard (90 A)

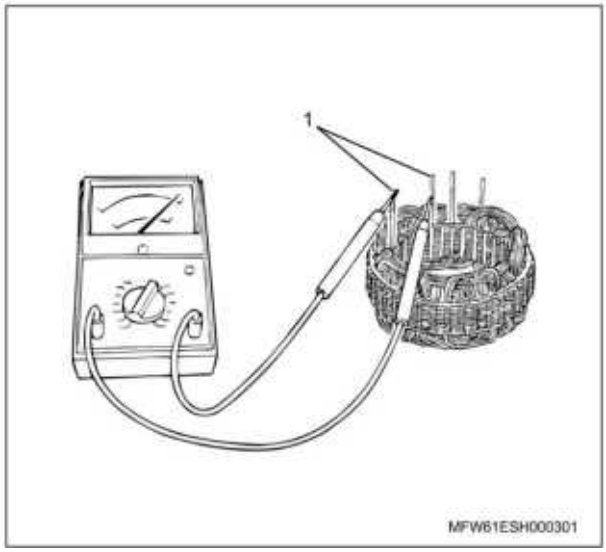
	Rotational direction	: 2,500 rpm	: 5,000 rpm
Output characteristics,when hot	voltage	: 27 V	
	Current	: 77 A or more	: 85 A or more
Feed coil resistance, at 20℃	: 6.3 to 7.3 Ω		
IC regulator adjustment voltage	: 28 to 29 V		
Rotational direction	Right direction		

2. Stator inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

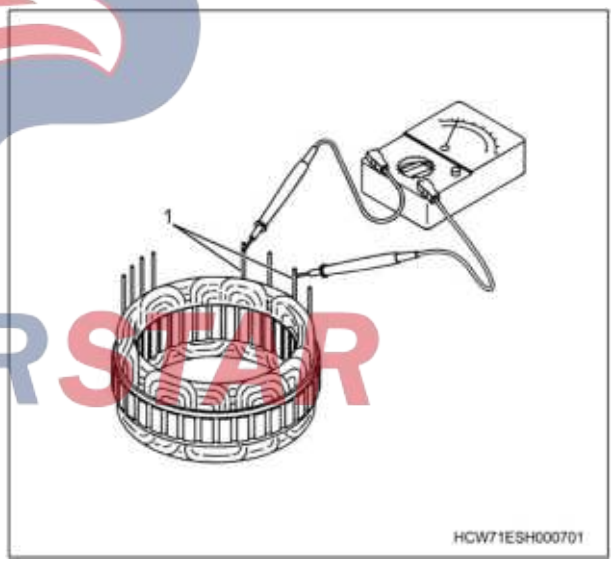
1) Inspect the continuity between the 2 stator coil lead wires using a DMM.

50 A and 60 A specifications



1. Stator coil lead wire

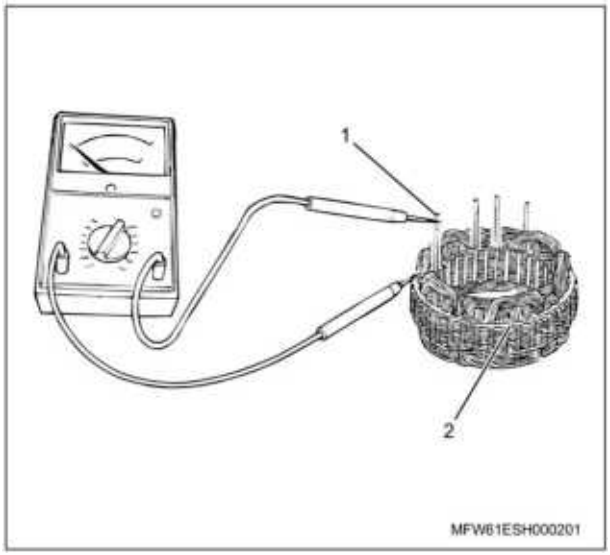
90 A specifications



1. Stator coil lead wire

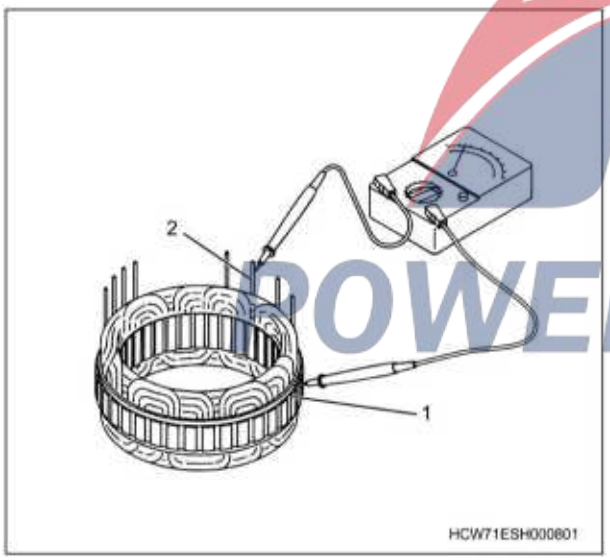
2) Use a digital multimeter to check the continuity between the stator coil leads and the core.

50 A and 60 A specifications



1. Core
2. Stator coil lead wire

90 A specifications



1. Core
2. Stator coil lead wire

3. Rotor inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Inspect for damage or scarring.

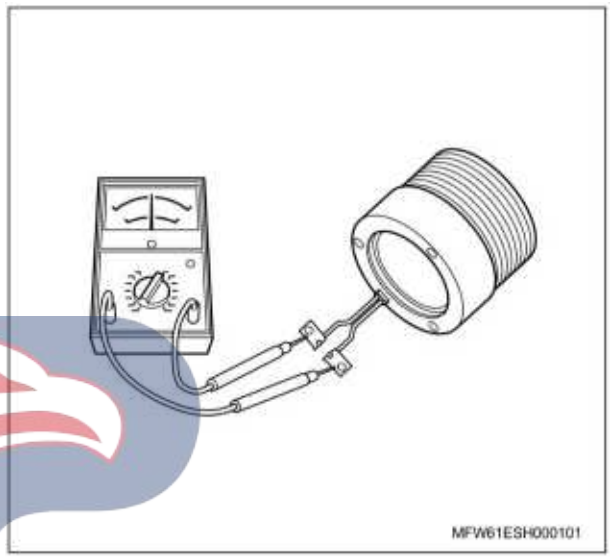
4. Field coil inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

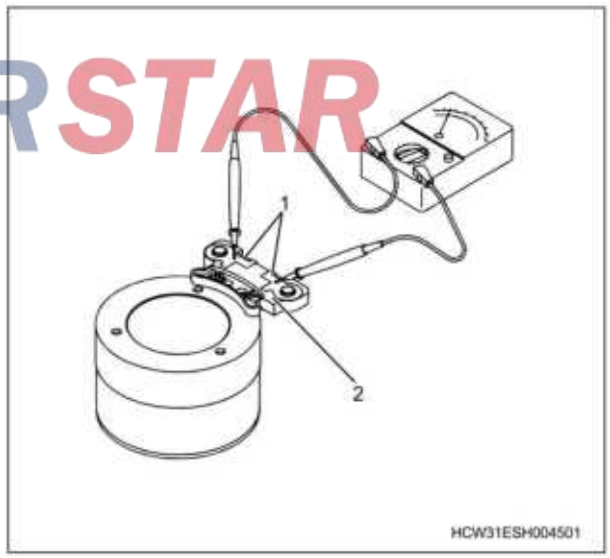
1) Measure the resistance between both terminals of the field coil terminal using a DMM.

The resistance of the feed coil at 20 ℃ {68 ℉}50 A, 60 A Specifications	: 8.3 to 9.1 Ω
90 A specifications	: 6.3 to 7.3 Ω

50 A and 60 A specifications



90 A specifications



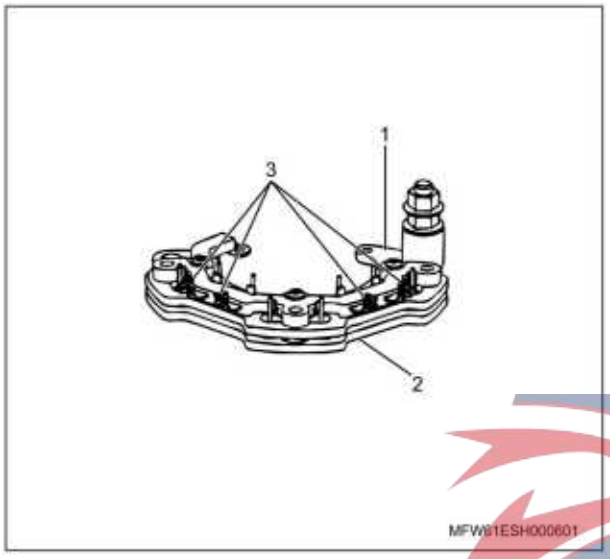
1. Terminal
2. Excitation coil

5. Rectifier check

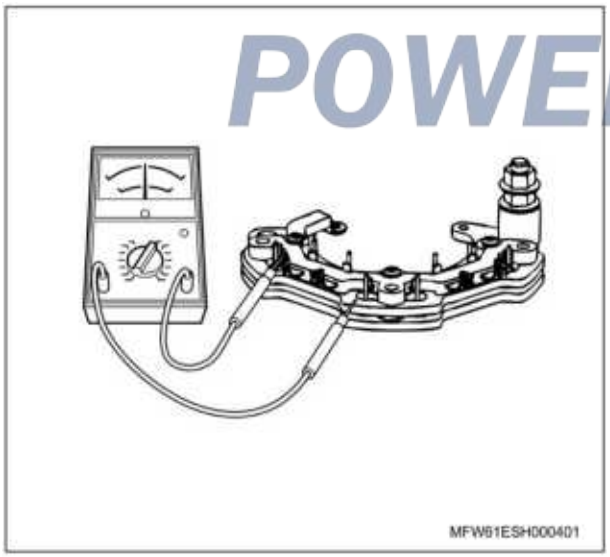
1. 50 A and 60 A specifications

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Check the continuity of the 4 diodes of the rectifier using a digital multimeter.



1. Positive radiator
2. Negative radiator section
3. Diode terminals

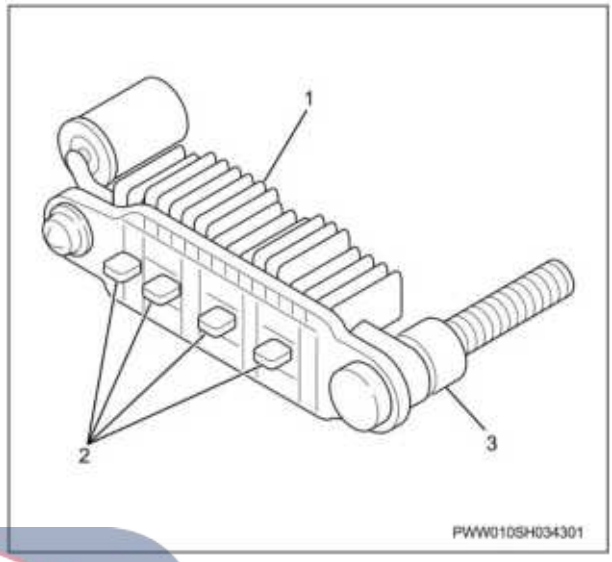


2. 90 A specifications

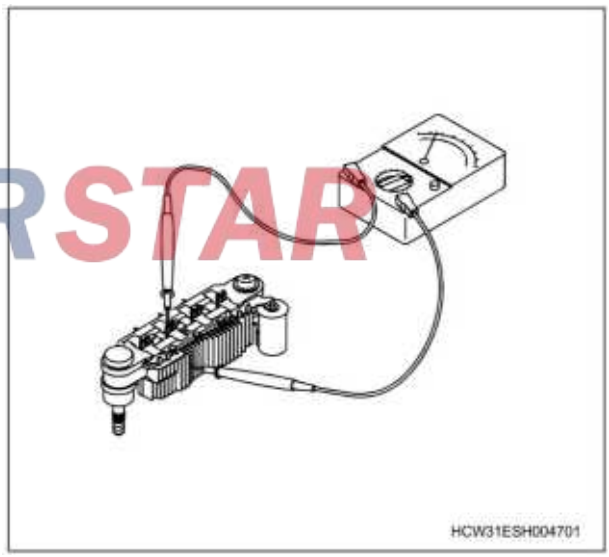
Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Check the continuity between the positive diode and the 4 diode terminals using a digital multimeter.

2) Check the continuity between the negative diode and the 4 diode terminals using a digital multimeter.



1. Positive diode
2. Diode terminals
3. Negative diode



6. Bearing inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

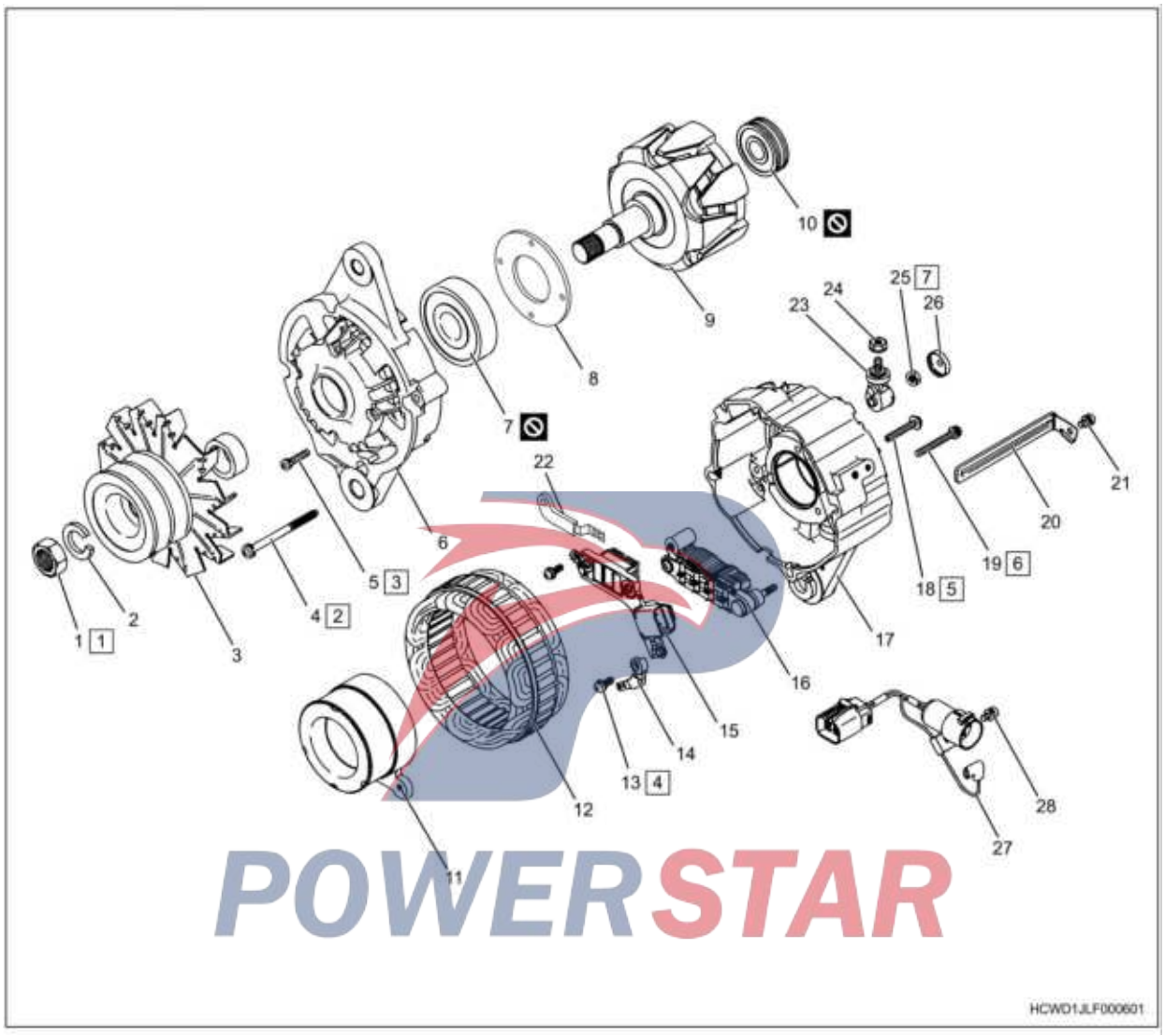
1) Check whether the grease leaks.

2) Rotate the bearing by hand, and inspect for abnormal conditions such as abnormal noise or looseness.

Reassembly

1. Component Views

Generator (60 A size)



Part name

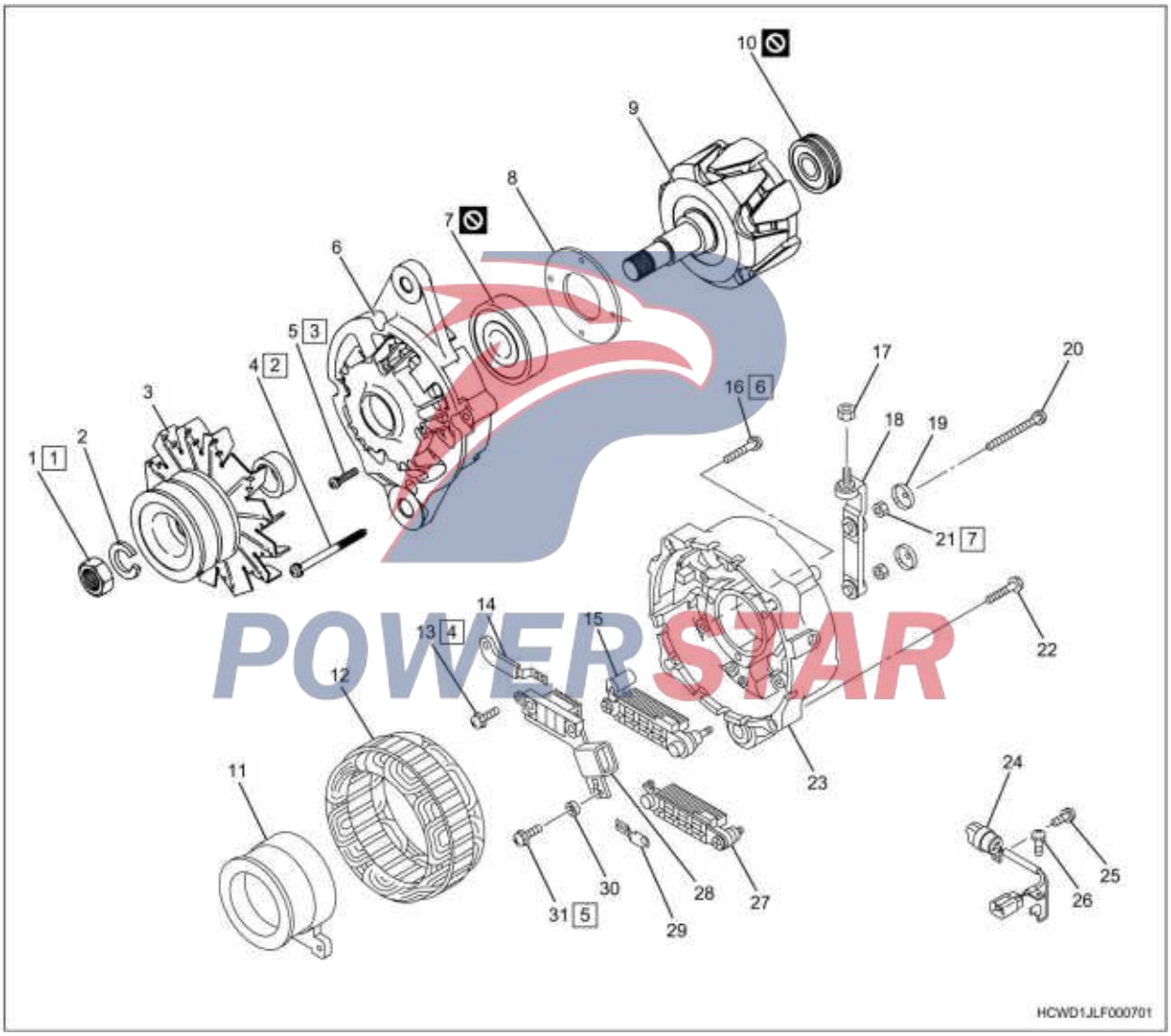
1. Nut
2. Spring washer
3. Pulley
4. Penetration bolt
5. Retaining ring fastening screws
6. Front bracket
7. Shaft
8. Cage
9. Rotor
10. Shaft
11. Excitation coil
12. Stator
13. Regulator fastening screw
14. Plate
15. Regulator
16. Rectifier
17. Rear bracket
18. Regulator fixing screw
19. Excitation coil fastening screw
20. Pipe clamp
21. Pipe clamp mounting screws
22. Terminal B
23. B-terminal bolt

24. B-terminal fastening nut
25. B-Terminal Bolt Nut
26. B-terminal cover
27. connector
28. Connector mounting screw

Tightening torque

1: 147 N • m { 15.0 kgf • m / 108 lb • ft }
2: 5 N • m { 0.5 kgf • m / 44 lb • in }
3: 4 N • m { 0.4 kgf • m / 35 lb • in }
4: 4 N • m { 0.4 kgf • m / 35 lb • in }
5: 4 N • m { 0.4 kgf • m / 35 lb • in }
6: 4 N • m { 0.4 kgf • m / 35 lb • in }
7: 9 N • m { 0.9 kgf • m / 80 lb • in }

Generator (90 A Specifications)



Part name

1. Nut
2. Spring washer
3. Pulley
4. Penetration bolt
5. Retaining ring fastening screws
6. Front bracket
7. Shaft
8. Cage
9. Rotor
10. Shaft
11. Excitation coil
12. Stator
13. Regulator fastening screw

14. Terminal B
15. Rectifier
16. Regulator fixing screw
17. B-terminal clamp nut
18. B-terminal bolt
19. B-terminal cover
20. B-terminal mounting screws
21. B-terminal bolt nut
22. E-terminal bolt
23. Rear bracket
24. connector
25. Connector mounting screw
26. Connector mounting screw
27. Rectifier
28. Regulator
29. Plate
30 mold
31. Regulator fixing screw

Tightening torque

1: 147 N • m {15.0 kgf • m / 108 lb • ft}
2: 15 N • m {1.5 kgf • m / 11 lb • ft}
3: 4 N • m {0.4 kgf • m / 35 lb • in}
4: 4 N • m {0.4 kgf • m / 35 lb • in}
5: 4 N • m {0.4 kgf • m / 35 lb • in}
6: 4 N • m {0.4 kgf • m / 35 lb • in}
7: 9 N • m {0.9 kgf • m / 80 lb • in}

2. Generator reassembled

1. 50 A and 60 A specifications

1) Install the feed coil to the generator.

Tightening torque: 3 N • m {0.3 kgf • m / 27 lb • in}

2) Install the rectifier on the generator.

Tightening torque: 3 N • m {0.3 kgf • m / 27 lb • in}

3) Install the regulator on the generator.

Tightening torque: 3 N • m {0.3 kgf • m / 27 lb • in}

4) Lead the excitation coil to the rectifier.

Caution:

● Use 180-270W iron and install in about 5 seconds.

5) Lead the 4 starter coils to the rectifier.

Caution:

● Use 180-270W iron and install in about 5 seconds.

● Do not damage the diode.

6) Mount the lead to the clamp.

7) Assemble the stator.

8) Install the front bearing on the front bracket.

Note:

● Since the bearings are oil filled and sealed, there is no need to apply grease.

Caution:

● After removing it, do not remove the bearing.

● Wipe clean all oil on the front bearing housing.

9) Press the rotor onto the front bracket.

Caution:

● Do not tighten the pliers.

10) Install the following parts on the generator.

● Collar

● Fan

● Pulley

● Nut

Tightening torque: 137 N • m { 14.0 kgf • m / 101 lb • ft }

11) Install the back cover on the generator.

Tightening torque: 3 N • m {0.3 kgf • m / 27 lb • in}

12) Install the core bolt on the generator.

Tightening torque: 6 N • m {0.6 kgf • m / 53 lb • in}

Caution:

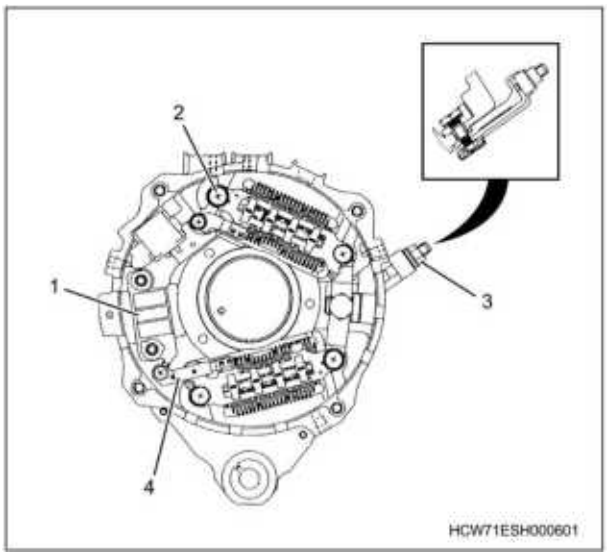
● After the assembly is completed, check whether the pulley is rotating smoothly.

2. 90 A specifications

1) Install 4 stator coil leads and install the stator to the rectifier.

Caution:

● Use 180-270W iron and install in about 5 seconds.



1. Regulator
2. Rectifier terminal bolt
3. B-terminal assembly
4. Terminal B

2) Mount the adjuster to the rear bracket.

3) Install the rectifier and stator in the rear bracket.

4) Install terminal B on the rear cover.

5) Install the rectifier captive screw and adjuster captive screw on the rear bracket.

Tightening torque: 4 N • m {0.4 kgf • m / 35 lb • in}

6) Mount the B-terminal assembly to the rear bracket.

7) Install the cap and nut to the rectifier terminal screw.

Tightening torque: 9 N • m {0.9 kgf • m / 80 lb • in}

8) Install the pipe clamp on the generator.

9) Install the connector on the generator.

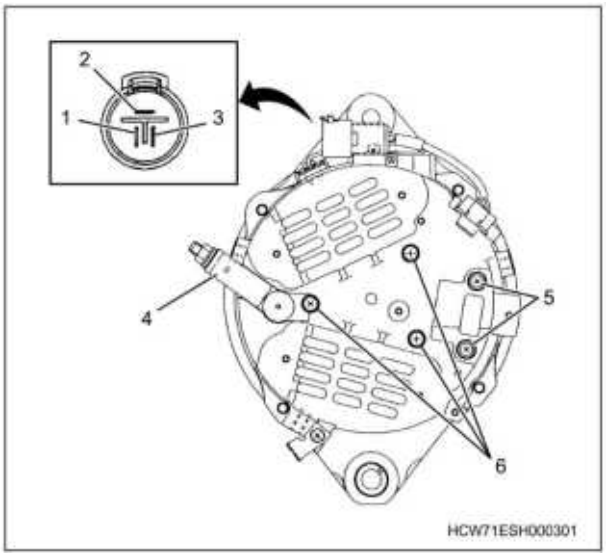
10) Install the excitation coil to the back cover, then tighten the excitation coil mounting screw.

Tightening torque: 4 N • m {0.4 kgf • m / 35 lb • in}

50 A and 60 A specifications

Tightening torque: 9 N • m {0.9 kgf • m / 80 lb • in}

90 A specifications



1. L-terminal
2. N-terminal
3. IG-terminal
4. Terminal B
5. Regulator fixing screw
6. Excitation coil mounting screw

11) Install the regulator mounting screw on the back cover.

Tightening torque: 4 N • m {0.4 kgf • m / 35 lb • in}

12) Install the bearing on the rotor.

Note:

● Since the bearings are oil filled and sealed, there is no need to apply grease.

Caution:

● After removing it, do not remove the bearing.

● Oil on bracket bearing housing after erasing.

13) Install the bearing to the front bracket.

Caution:

● After removing it, do not remove the bearing.

● Do not apply oil to the rotor shaft bearing with resin tape.

14) Install the stopper to the rotor.

Tightening torque: 4 N • m {0.4 kgf • m / 35 lb • in}

15) Install the rotor on the front bracket.

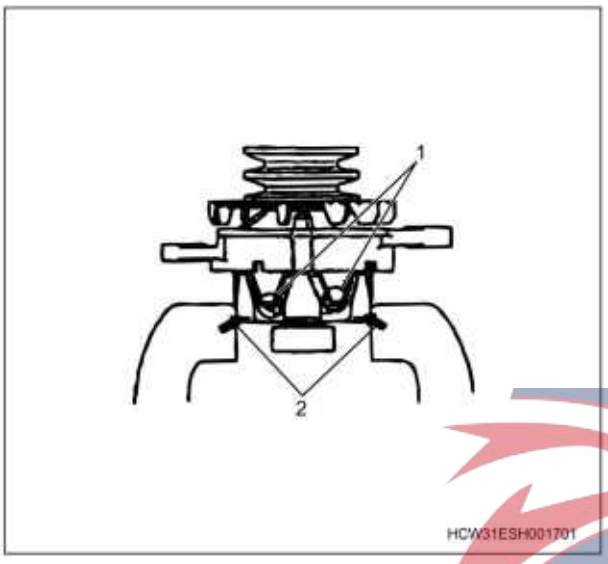
16) Fix the rotor on the vise.

Caution:

● Be careful not to deform the rotor ball.

● Clamp the place between the fixed positions when tightening the rotor with a vise.

● Due to the lower strength of the area, do not squeeze the area if it is not fixed.



1. Not fastened position

2. Fasten the position

17) Install the septum and pulley sequentially to the rotor shaft section and tighten the pulley with the tension nut.

Tightening torque: 147 N • m {15 kgf • m / 108 lb • ft}

18) Install the front bracket to the rear bracket.

Caution:

● Before assembly, heat the cross-section of the bearing housing of the rear bracket to 50-60 ℃

Through bolt Tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in} 50 A, 60 A Specifications

Through bolt tightening torque: 15 N • m {1.5 kgf • m / 11 lb • ft} 90 A specification

Caution:

● After the assembly is completed, check whether the pulley is rotating smoothly.

Installation

1. Starter motor installation

1. 50 A and 60 A specifications

1) Temporarily fasten the generator to the adjustment plate and bracket.

Note:

● Adjust the cooling fan belt and tighten.

2) Connect the ground wire and the B-terminal harness to the generator.

3) Connect the harness connector to the generator.

2. 90 A specifications

1) Install the generator on the bracket.

Tightening torque: 83 N • m {8.5 kgf • m / 61 lb • ft}

Upper bolt

Tightening torque: 127 N • m {13.0 kgf • m / 94 lb • ft}

Lower bolt

2) Connect the ground wire and the B-terminal harness to the generator.

3) Connect the harness connector to the generator.

2. Cooling fan belt installation

1) Install the cooling fan belt to the generator and the crankshaft pulley.

Caution:

● Verify that the cooling fan belt securely fits into the groove of each pulley.

3. Cooling fan belt adjustment

Because a V-ribbed belt is used for the cooling fan belt, accurate adjustment of the tension is more necessary compared to a conventional V-belt.

When installing a new belt, initial stretching of the belt occurs.

In addition, when reusing the belt, the belt needs to adapt to the pulley groove.

1) Rotate the adjust bolt and adjust the tension of the cooling fan belt to the specified value.

Caution:

● Accurately adjust the tension because if the tension is not appropriate, there is a possibility the service life will be shortened, or belt squeal may be generated.

● Use a sonic tension meter to verify accurate tension adjustment.

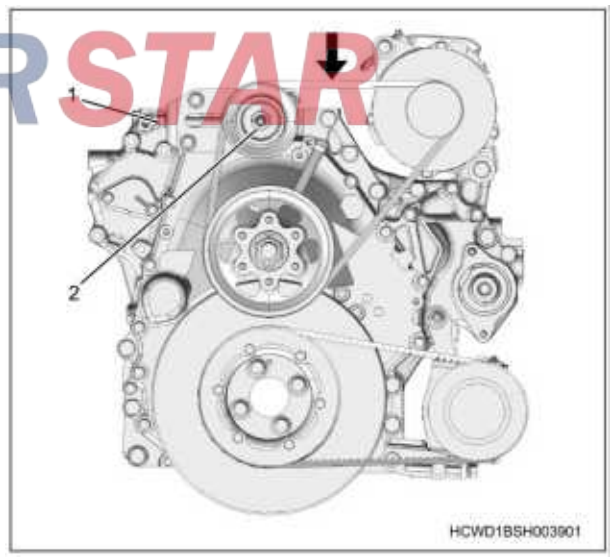
Cooling fan belt tension specified value

	Adjustment conditions	deviation	Vibration frequency
60 A	When new	: 10 to 13mm { 0.394 to 0.512 in }	: 90 to 106Hz
	When adjusting tension	: 14 to 16mm { 0.551 to 0.630 in }	: 75 to 85Hz
90 A	When new	: 10 to 12mm { 0.394 to 0.472 in }	: 94 to 110Hz
	When adjusting tension	: 13 to 15mm { 0.512 to 0.591 in }	: 79 to 89Hz

Note:

● The specified amount of deflection is shown when pushing the midpoint between the water pump pulley and the generator pulley at the specified value.

Standard: 98 N { 10.0 kg / 22 lb }

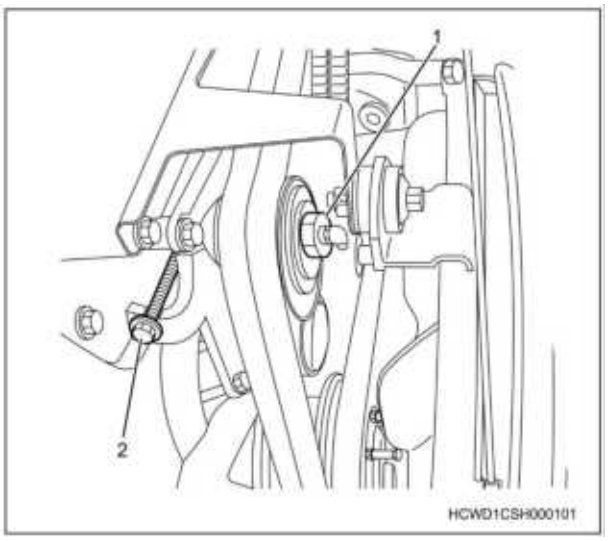


1. Adjust bolt

2. Lock nut

2) Tighten the idler bolt.

Tightening torque: 147 N • m { 15.0 kgf • m / 108 lb • ft }



1. Lock nut

2. Adjust bolt

4. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

Glow plug

Removal

1. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

2. Coolant drain

Warning:

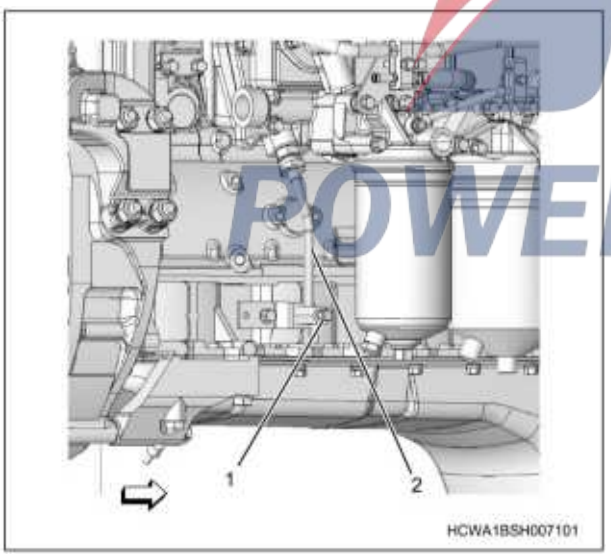
● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

1) Press the sub-tank cap button to release internal pressure.

2) Remove sub-tank cap from radiator.

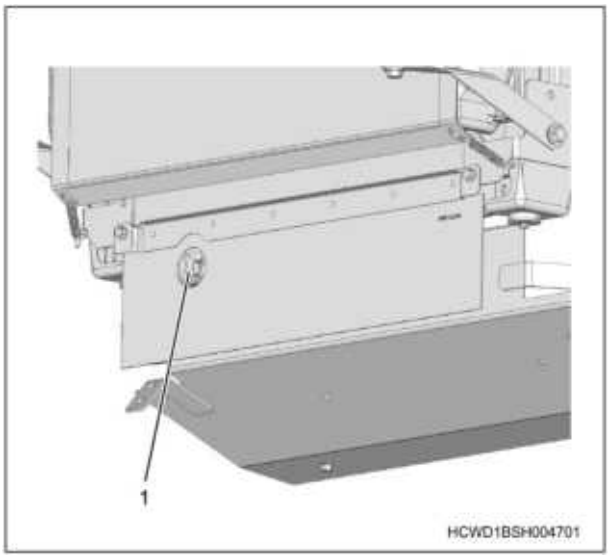
3) Loosen the drain plug on the cylinder block side, and drain the coolant to a pan.



1. Drain plug

2. Drain pipe

4) Loosen the radiator side drain plug, and drain the coolant to a pan.



1. Drain plug

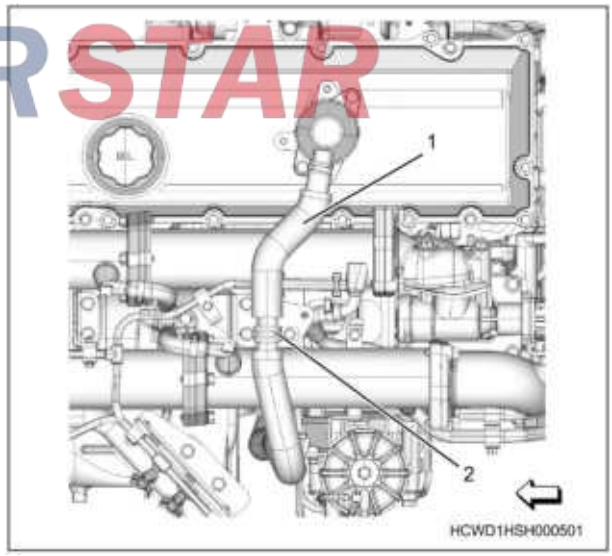
5) Tighten the radiator side drain plug.

6) Tighten the drain plug on the cylinder block side.

7) Install sub-tank cap to radiator.

3. Ventilation hose disconnect

1) Disconnect the ventilation hose to the cylinder front cover.



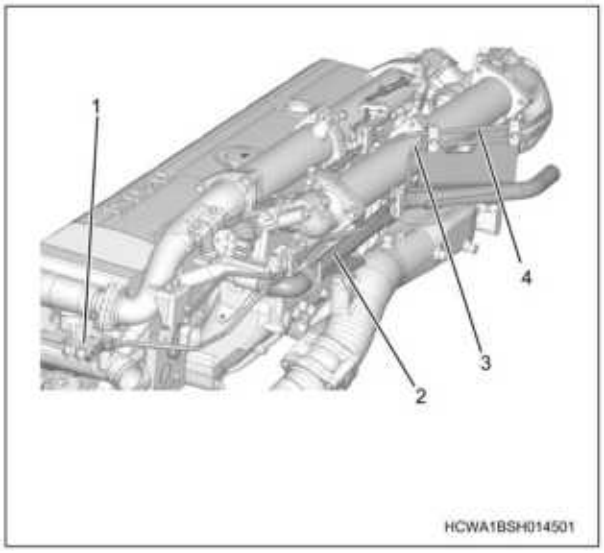
1. Ventilation hose

2. Ventilation hose clip

4. Air leak pipe removal

1) Remove the 4 clips and remove the front air leak on the EGR cooler.

2) Remove the two clips and then remove the rear blow-by tube on the EGR cooler and drain line.



1. Outlet pipe
2. Water charge pipe
3. Back-end leakage pipe
4. Front leakage pipe

5. Water charge pipe removal

1) Remove the filling pipe from the filling pipe holder.

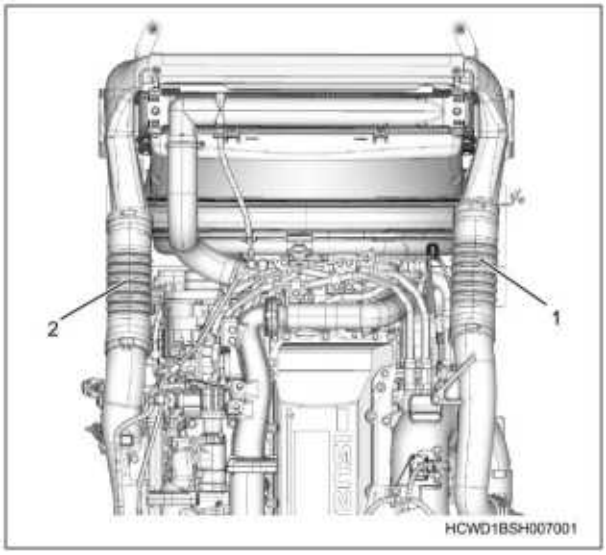
2) Remove the water-filled bracket from the inlet pipe.

3) Remove the water-filled bracket from exhaust gas recirculation valve line A.

6. Intercooler hose removal

1) Disconnect the intercooler hose on the intercooler outlet side from the intercooler.

2) Remove the intercooler hose outlet on the intake line.

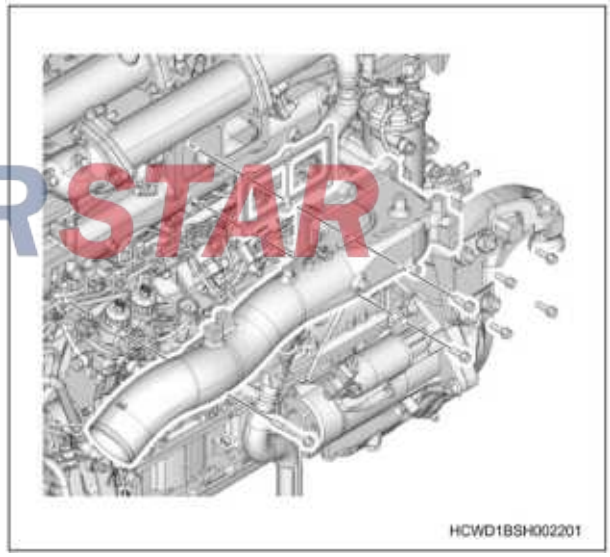


1. Intercooler hose on the intercooler inlet side
2. Intercooler hose on the intercooler outlet side

7. Intake duct removal

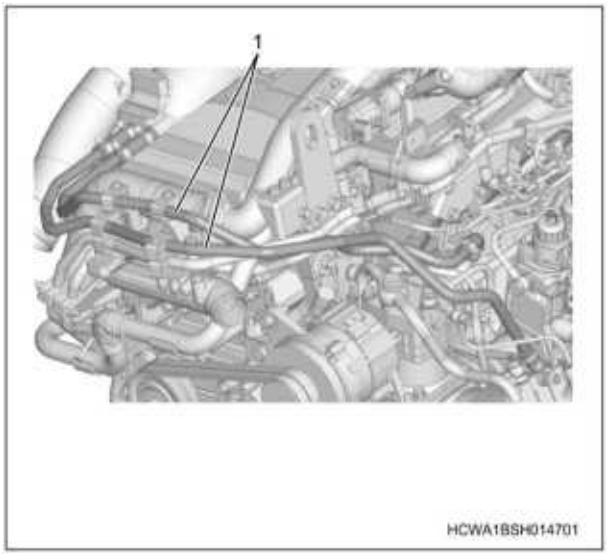
1) Disconnect the harness connector from the inlet line.

2) Remove the intake line from the intake manifold.



8. Suction pipe removal

1) Remove the 4 clips and then remove the 2 air extraction lines of the air compressor.

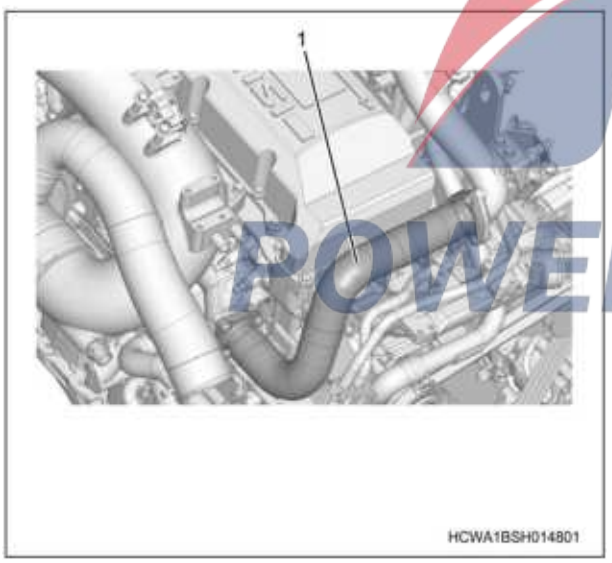


1. Exhaust pipe

9. EGR cooler removal

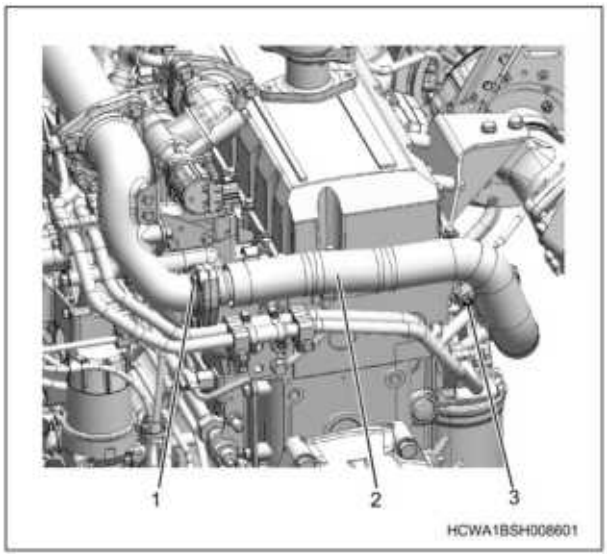
1) Remove the bracket from the drain.

2) Remove the exhaust gas recirculation line A on the EGR cooler line A.



1. Exhaust gas recirculation line A

3) Remove the exhaust gas recirculation line B on the C recirculation cooler line.

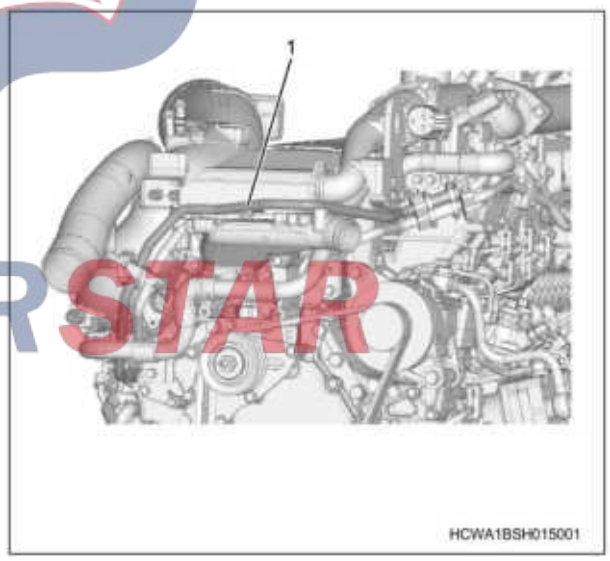


1. Standard bolt

2. Exhaust gas recirculation line B

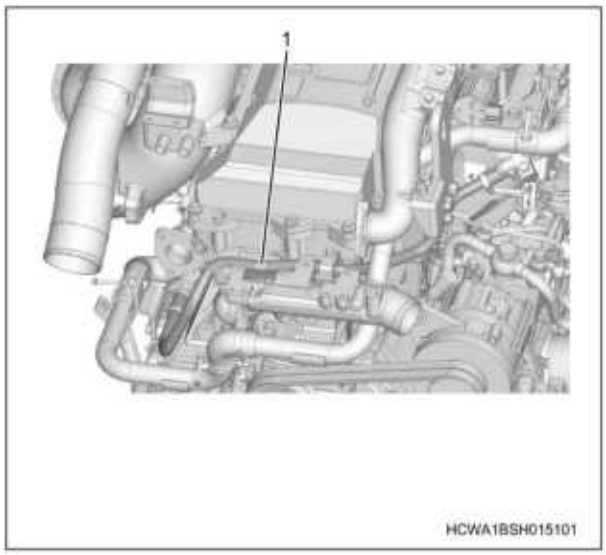
3. High temperature steel flange bolts

4) Remove the front EGR cooler hose on the pump.



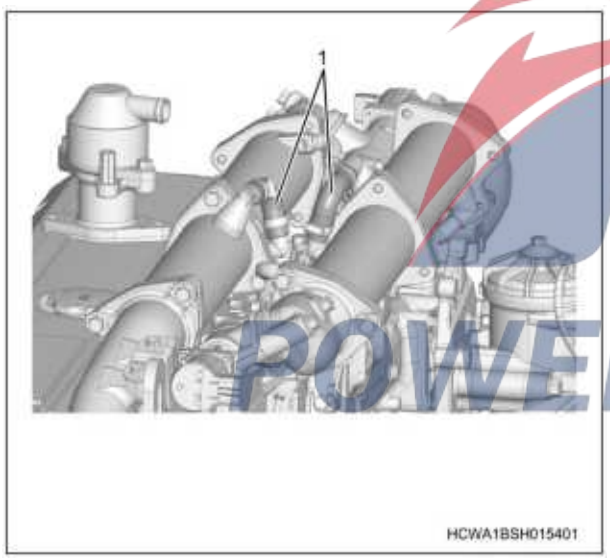
1. Front EGR cooler hose

5) The back-end water supply pipe removed from the pump.



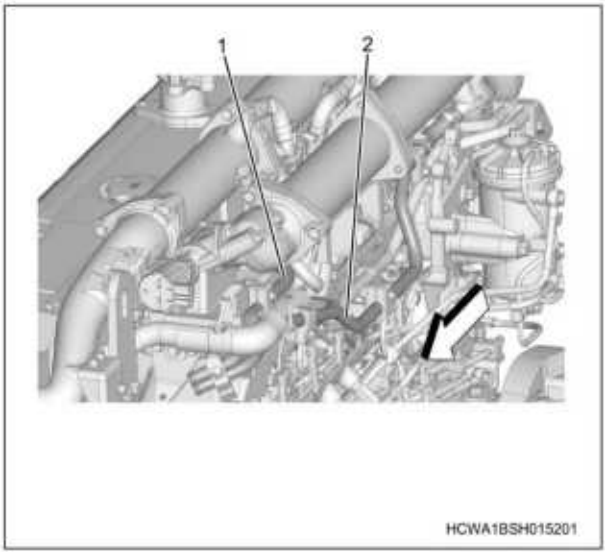
1. Back-end water pipe

6) Remove the water supply hose from the EGR cooler.



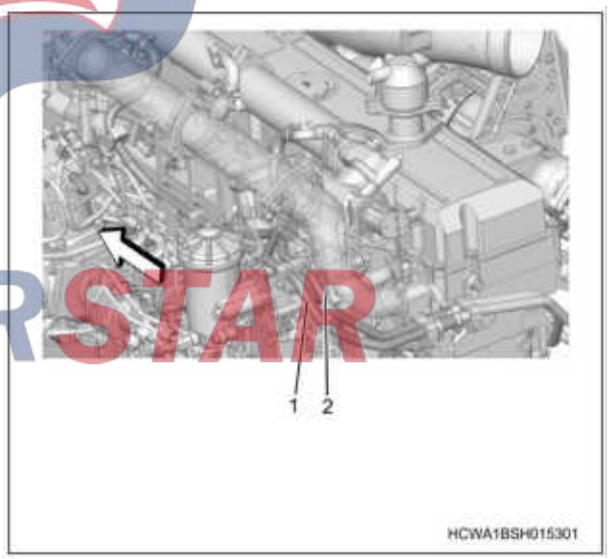
1. Water feed hose

7) Remove the front and rear EGR cooler pipes from the EGR cooler.



1. Front-end water supply pipe
2. Back-end water pipe

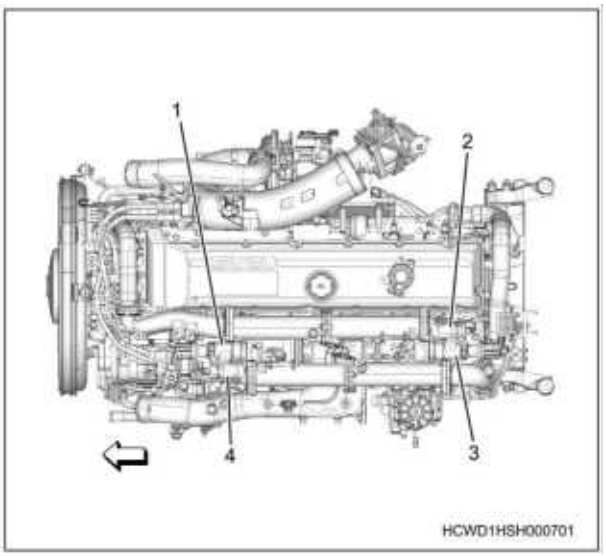
8) Remove the front and rear EGR cooler pipes from the EGR cooler.



1. Front return pipe
2. Back-end return pipe

9) Remove the EGR cooler duct D from the exhaust gas recirculation valve 2 and the EGR cooler D.

10) Remove the EGR cooler duct B from the exhaust gas recirculation valve 1 and the EGR cooler B.



1. EGR valve 2
2. EGR cooler duct B
3. EGR valve 1
4. EGR cooler duct D

11) Remove front exhaust gas recirculation line bracket of EGR cooler line A.

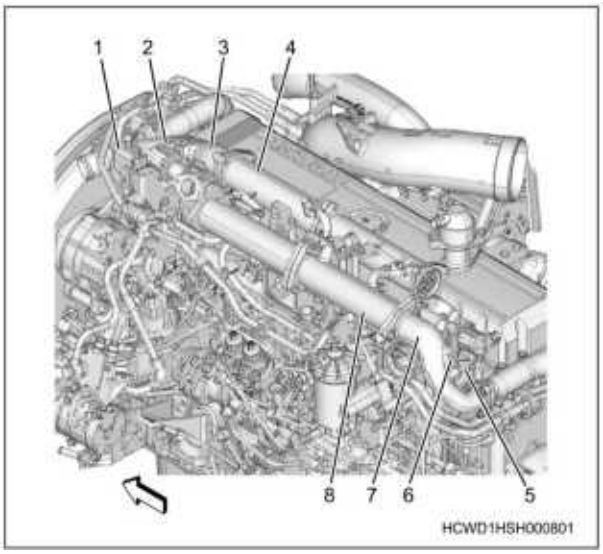
12) Remove the exhaust gas recirculation valve heat shield on the EGR cooler line A.

13) Remove EGR cooler Line A from EGR cooler A.

14) Remove the back-end exhaust gas recirculation line bracket of EGR cooler line C.

15) Remove exhaust gas recirculation valve heating protection device on EGR cooler C.

16) Remove EGR cooler Line C on EGR cooler C.



1. Front-end exhaust gas recirculation duct bracket
2. Exhaust gas recirculation valve thermal protection device
3. EGR cooler Duct A.
4. EGR cooler A.
5. Back-end exhaust gas recirculation duct bracket
6. Exhaust gas recirculation valve thermal protection device
7. EGR cooler duct C
8. EGR cooler C

17) Remove the EGR cooler holder on the EGR cooler.

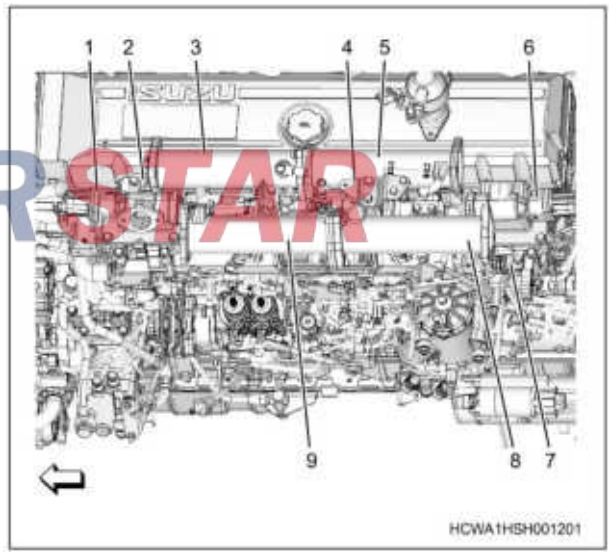
18) Remove the EGR cooler support on EGR cooler C.

19) Remove the EGR cooler A on the EGR cooler B.

20) Remove the EGR cooler C on the EGR cooler D.

21) Remove the EGR cooler B on the intake manifold.

22) Remove the EGR cooler D on the intake manifold.



1. EGR valve 2
2. EGR cooler bracket
3. EGR cooler A.
4. Leakage pipe bracket
5. EGR cooler B.
6. EGR valve 1
7. EGR cooler bracket
8. EGR cooler C

9. EGR cooler D

10. Glow plug removal

1) Disconnect the glow plug connector from the glow plug.

Note:

● Leave the disconnected glow plug connector in a position that does not affect operation.

2) Remove the glow plug from the cylinder head.

Inspection

1. Glow plug Inspection

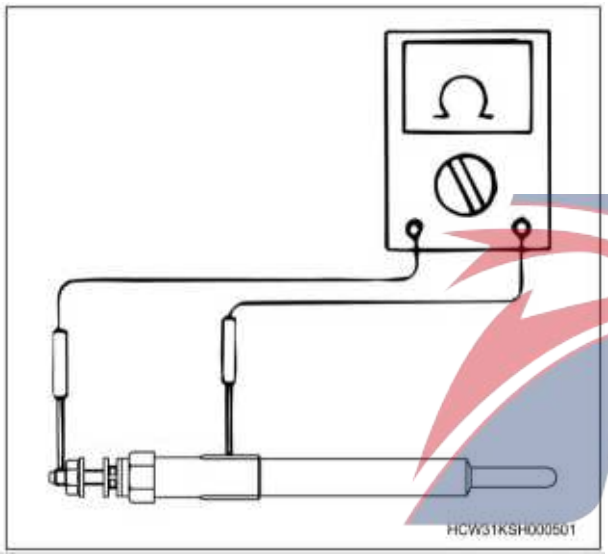
Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Measure a resistance using a DMM.

Caution:

● Use 6 glow plugs from the same manufacturer as a set.

Standard: about 4.3 Ω (At room temperature)



Installation

1. Glow plug installation

1) Install the glow plug to the cylinder head.

Tightening torque: 25 N • m { 2.5 kgf • m / 18 lb • ft }

2) Install the glow plug connector to the glow plug.

Tightening torque: 1.5 N • m { 0.15 kgf • m / 13 lb • in }

2. EGR cooler installation

Caution:

● If the procedures or methods for assembling the EGR device are mistaken, it can lead to cracks in the pipe or gas leaks. Always follow the procedures.

● Do not reuse the gasket.

● When removing only a part of an EGR-related part, loosen the entire EGR-related part once, replace the gaskets with new ones, and then temporarily and securely tighten in the following order.

1) Temporarily tighten the following exhaust gas recirculation valve components in the numerical order shown.

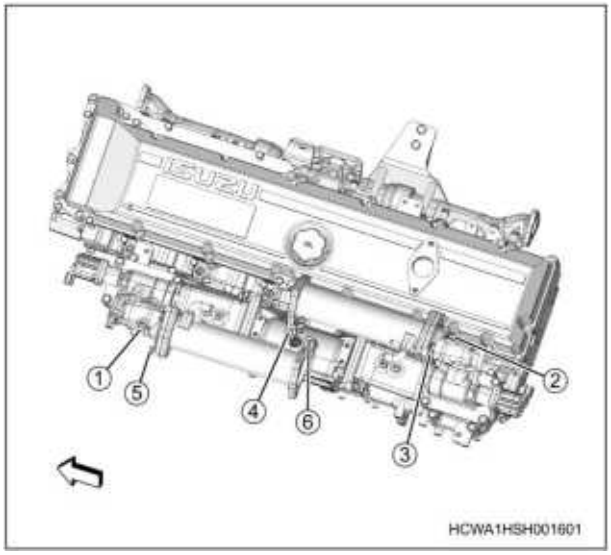
● EGR cooler duct D.

● EGR cooler duct B

● EGR cooler B

● EGR cooler D

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}



2) Temporarily tighten the following EGR cooler components according to the figure in numerical order.

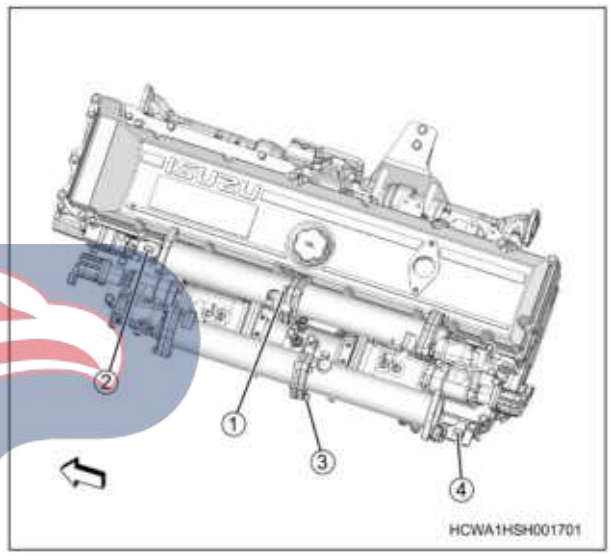
● EGR cooler A

● EGR cooler bracket

● EGR cooler C

● EGR cooler bracket

Temporary tightening torque: 5 N • m { 0.5 kgf • m / 44 lb • in }



3) Finally tighten the EGR valve components and the EGR cooler in the order shown in the diagram.

● EGR cooler duct D

● EGR cooler duct B

● EGR cooler B

● EGR cooler D

● EGR cooler A

● EGR cooler bracket

● EGR cooler C

● EGR cooler bracket

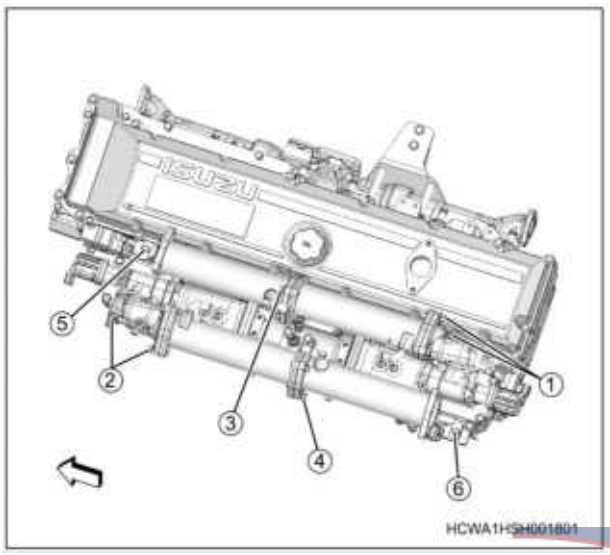
Tightening torque: 44 N • m { 4.5 kgf • m / 32 lb • ft } 1, 2

Tightening torque: 50 N • m { 5.1 kgf • m / 37 lb • ft } 3, 4, 5（M10）, 6（M10）

Tightening torque: 25 N • m { 3 kgf • m / 18 lb • ft } 5（M8）, 6（M8）

Note:

● The number behind the tightening torque indicates the diagram number.



4) Temporarily tighten the following EGR cooler components and finally tighten the exhaust manifold in numerical order shown.

● EGR cooler duct A.

● EGR duct A

● EGR cooler duct C.

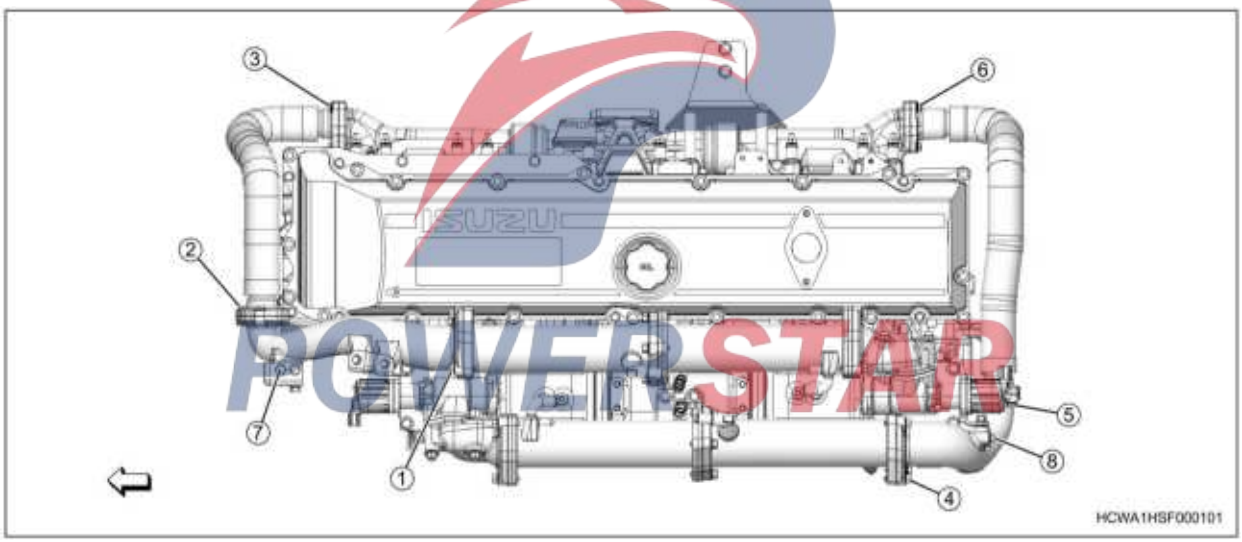
● EGR duct B.

● Bracket

Caution:

● Use high temperature resistant steel flange bolts for exhaust manifold mounting bolts and exhaust gas recirculation line A and exhaust gas recirculation line B.

Temporary tightening torque: 5 N • m {0.5 kgf • m / 44 lb • in}



5) Final tightening of the following EGR cooler components and final tightening of the exhaust manifold in the numerical order shown.

● EGR cooler duct A.

● EGR duct A

● EGR cooler duct C

● EGR duct B

● Bracket

Tightening torque: 50 N • m { 5.1 kgf • m / 37 lb • ft } 1（M10）, 2, 3, 9（M10）, 10（M10）

Tightening torque: 44 N • m { 4.5 kgf • m / 32 lb • ft } 4

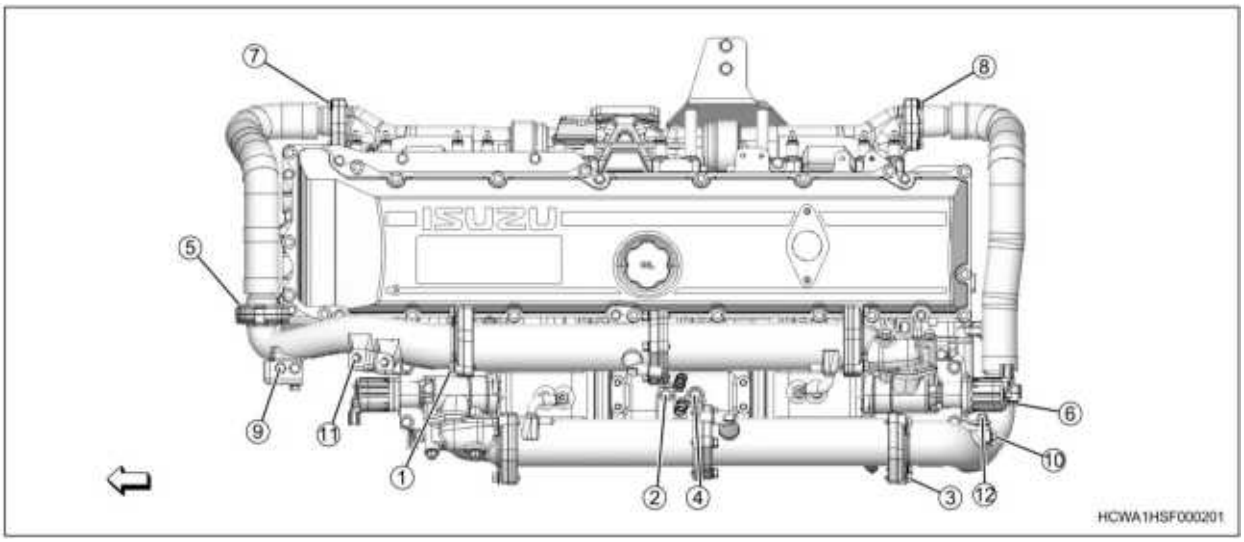
Tightening torque: 25 N • m { 2.5 kgf • m / 18 lb • ft } 5, 6（M8）, 7, 8（M8）, 9（M8）

Tightening torque: 24.7 N • m { 2.5 kgf • m / 18 lb • ft } 10（M8）

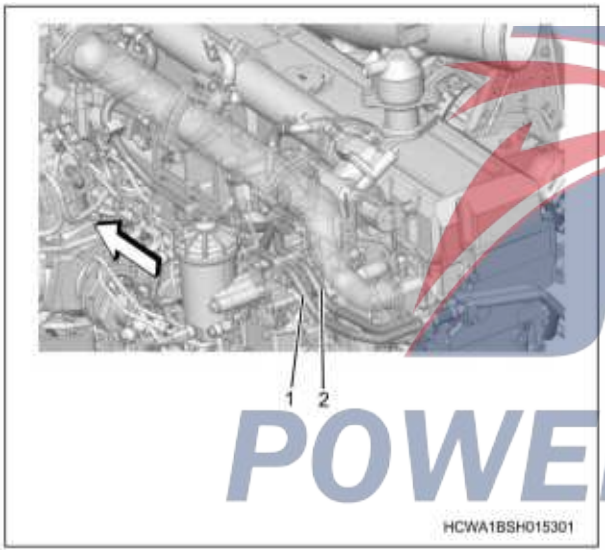
Tightening torque: 20 N • m { 2.0 kgf • m / 15 lb • ft } 11, 12（M8）

Note:

● The number behind the tightening torque indicates the diagram number.



6) Install the front and rear return lines to the EGR cooler.

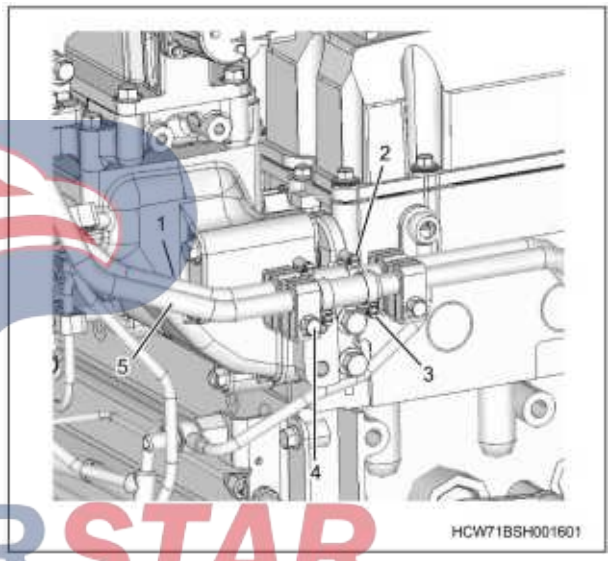


1. Front return pipe
2. Back-end return pipe

7) Install the clip on the return pipe.

Caution:

- During installation, care should also be taken to prevent the clamp from rotating.
- Install the water supply hose clamp to keep it horizontal.
- Install the water supply hose clamp and adjust the orientation to secure it to the rear of the engine.

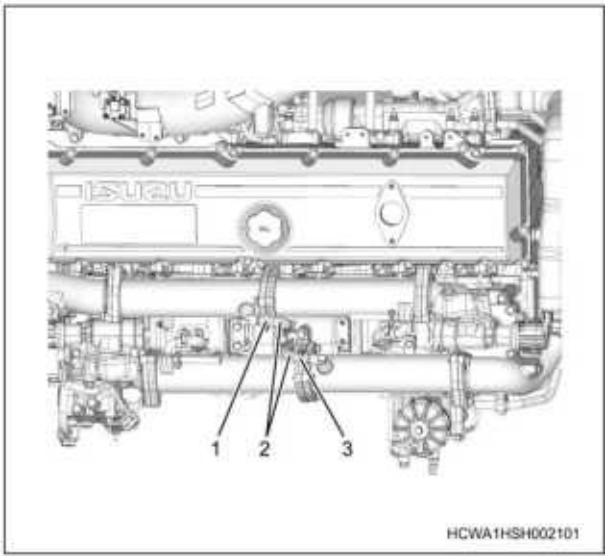


1. Front return pipe
2. Water supply hose clamp
3. Water supply hose clamp
4. Clamp bolt
5. Back-end return pipe

8) Install the water supply hose to the EGR cooler.

Caution:

- Hose clamps should be toward the top of the engine.

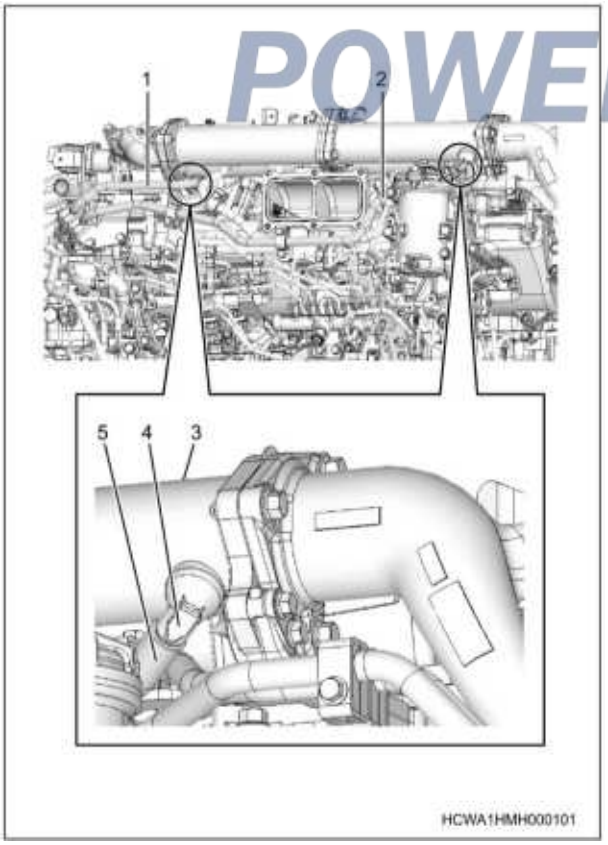


1. Hose clip
2. Water feed hose
3. Hose clip

9) Align the raised tips on the EGR cooler with the markings on the water supply hose and install the front and rear water lines on the EGR cooler.

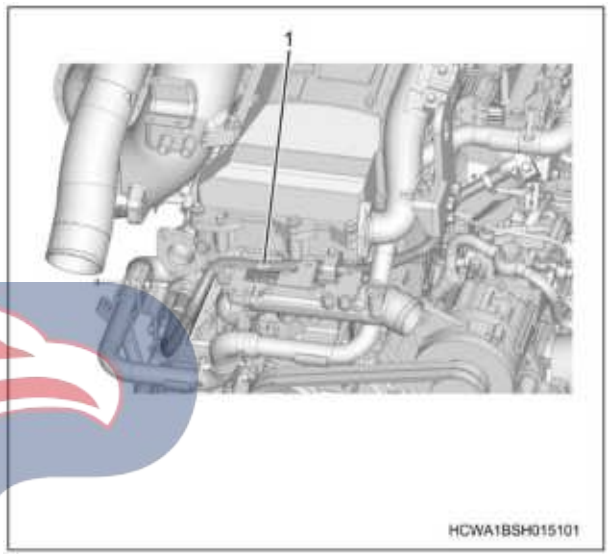
Caution:

● During installation, care should also be taken to prevent the clamp from rotating.



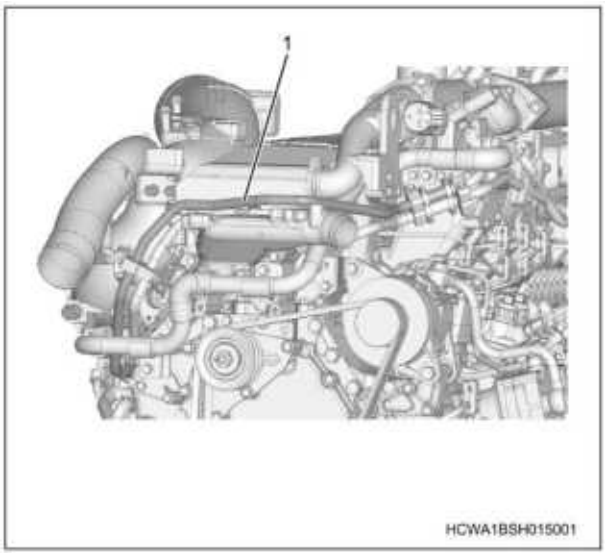
1. Front-end water supply pipe
2. Back-end water pipe
3. EGR cooler.
4. Raised part of the tip
5. Marking

10) Install the rear water supply pipe to the rubber hose between the rear water supply pipe and the water pump.



1. Back-end water pipe

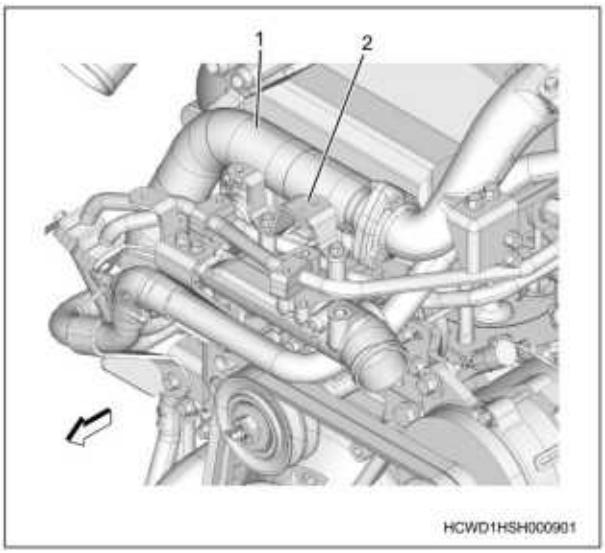
11) Install the front water supply pipe to the rubber hose between the front water supply pipe and the water pump.



1. Front-end water supply pipe

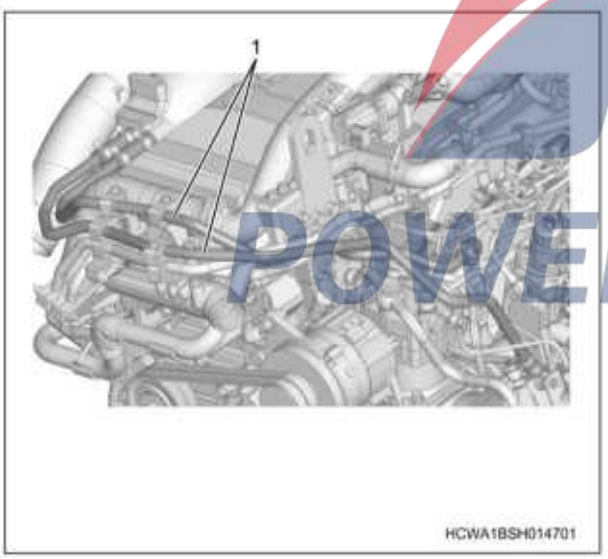
3. Suction pipe installation

1) Install the bracket on the drain.



1. Front exhaust gas recirculation line
2. Bracket

2) Install 2 air suction tubes to the air compressor.

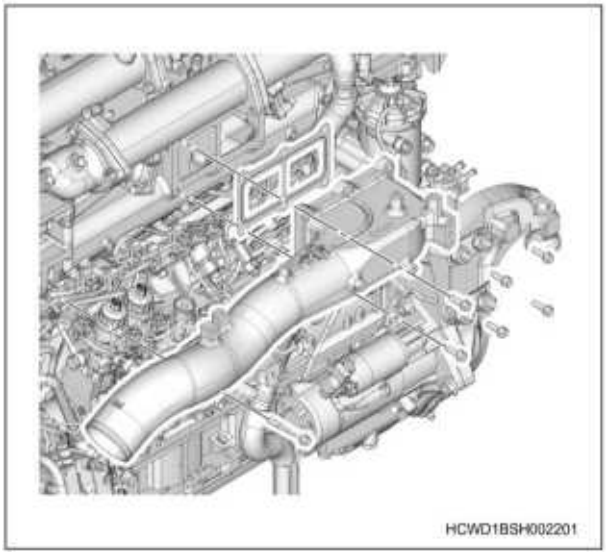


1. Exhaust pipe

4. Intake duct installation

1) Install the intake line to the intake manifold.

Tightening torque: 43.8 N • m {4.5 kgf • m / 32 lb • ft}



5. Intercooler hose installation

1) Install the intercooler hose on the intercooler inlet side to the intercooler.

2) Connect the intercooler hose outlet to the intercooler.

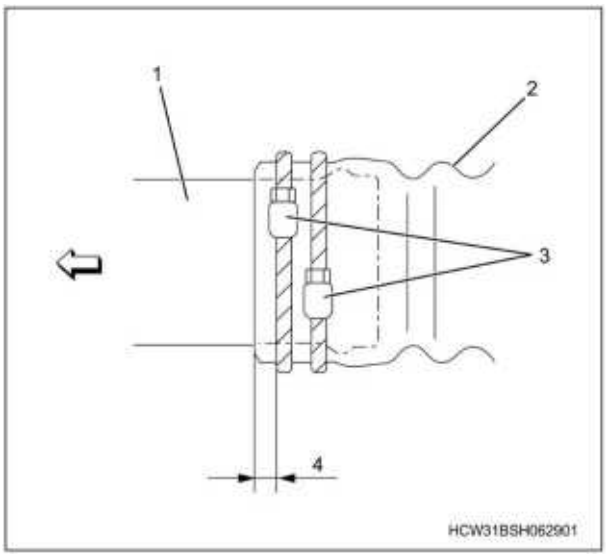
1. Intercooler hose installation precautions

Caution:

● After the intercooler hose has been securely installed until it makes contact with the pipe, refer to the following diagram and secure the intercooler hose with the 2 clips.

● Shift the tightening screw positions of the 2 clips by 27 mm {1.063 in} or 30°or more.

Tightening torque: 6.4 N • m { 0.7 kgf • m / 57 lb • in }



1. Intercooler pipe

2. Intercooler hose

3. Clip

4. 5 mm {0.197 in} from the end of the intercooler

6. Water charge pipe installation

1) Install the water filling pipe bracket on the water inlet pipe.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

2) Install the water fill line bracket on the exhaust gas recirculation valve conduit A.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

3) Install the water filling pipe on the filling pipe bracket.

Tightening torque: 39 N • m {4.0 kgf • m / 29 lb • ft}

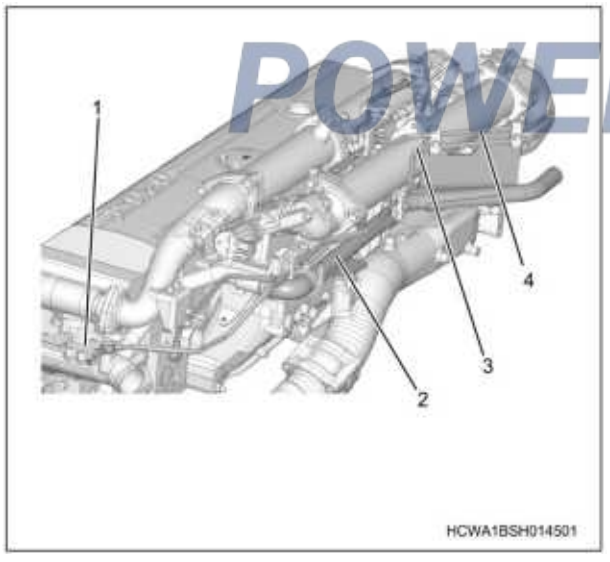
7 leakage pipe installation

1) Install the rear blow-by tube to the EGR cooler and drain line and install 2 clips.

2) Install the blowholes to the EGR cooler and install 4 clips.

Tightening torque: 41 N • m {4.2 kgf • m / 30 lb • ft}

Rings bolts



1. Outlet pipe

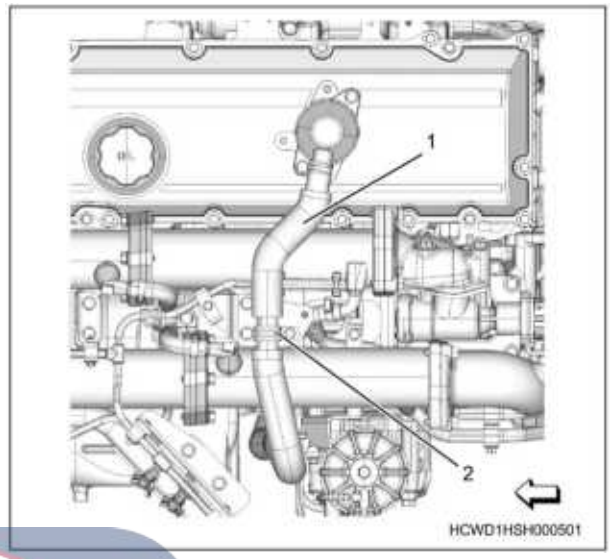
2. Water charge pipe

3. Back-end leakage pipe

4. Front leakage pipe

8. Ventilation hose connect

1) Connect the ventilation hose to the cylinder head cover.



1. Ventilation hose

2. Ventilation hose clip

9. Coolant filling

1) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Slowly fill with water to avoid air intrusion.

2) Press the radiator upper hose manually several times to remove the air from the hose.

3) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Repeat the operation until the water level no longer drops.

4) Install sub-tank cap to radiator.

5) Start and idle the engine.

Caution:

● Idle the engine for 5 minutes or more.

6) Stop the engine.

7) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

8) Add coolant up to the MAX level of the radiator sub-tank.

9) Install sub-tank cap to radiator.

10) Turn OFF the heater fan switch.

11) Start the engine.

12) Raise the engine speed.

Note:

● Increase the engine speed to around 2000 rpm and run the engine for 5 minutes once the needle of the engine coolant temperature gauge reaches the center.

13) With the engine running, check that the thermostat valve is open.

Note:

● Touch the radiator upper hose, and verify that it has become warm.

Caution:

● If the radiator upper hose has not become warm, raise engine speed to warm it up.

● Do not diagnose only by the engine coolant temperature gauge and the hot air coming out from the heater.

14) Idle the engine for 5 minutes.

15) Stop the engine.

16) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

17) Add coolant up to the MAX level of the radiator sub-tank.

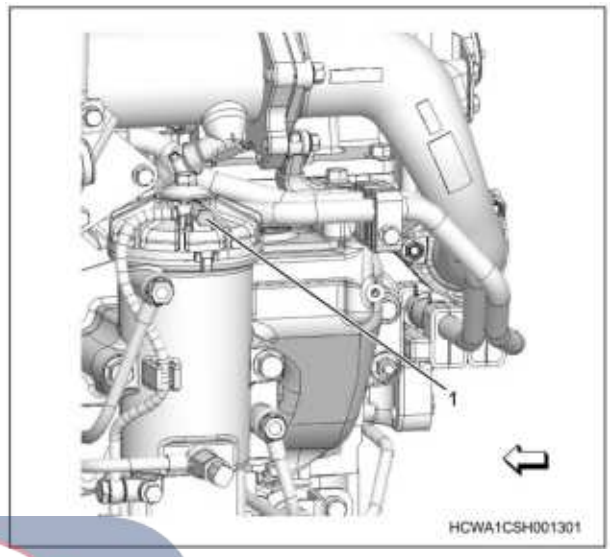
Caution:

● If the water level of the sub-tank lowered the next morning, add water up to the MAX line.

10. Fuel air bleed

1) Turn the priming pump cap until it pops up.

2) Loosen the plug of the fuel filter section.



1. Plug

3) Operate the priming pump until large bubbles are no longer formed.

4) Tighten the plug of the fuel filter section.

Tightening torque: 7 N • m { 0.7 kgf • m / 62 lb • in }

Caution:

● Do not excessively tighten the plug.

5) Loosen the bleeder screw of the fuel supply pump.

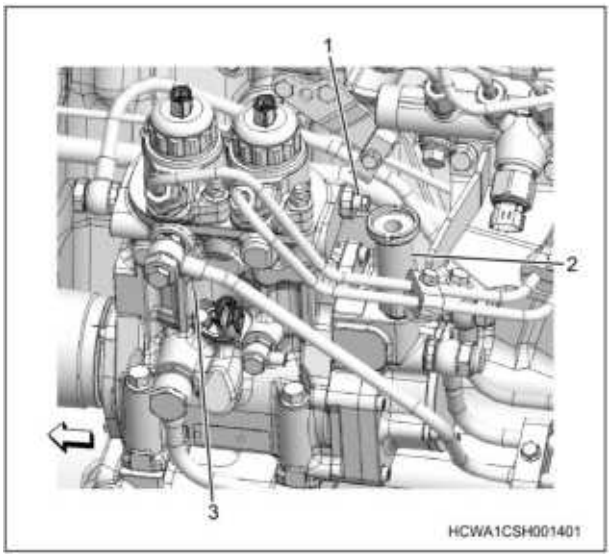
6) Operate the priming pump until large bubbles are no longer formed.

7) Tighten the bleeder screw of the fuel supply pump.

Tightening torque: 6 N • m { 0.6 kgf • m / 53 lb • in }

Caution:

● Do not excessively tighten the bleeder screw.



1. Bleeder screw
2. Priming pump
3. Fuel pump

8) Start the pump 150 times.

9) Turn the starter pump cover back to its original position.

Caution:

● Tighten the cover.

● Carefully clean the spilled fuel.

11. Battery cable connect

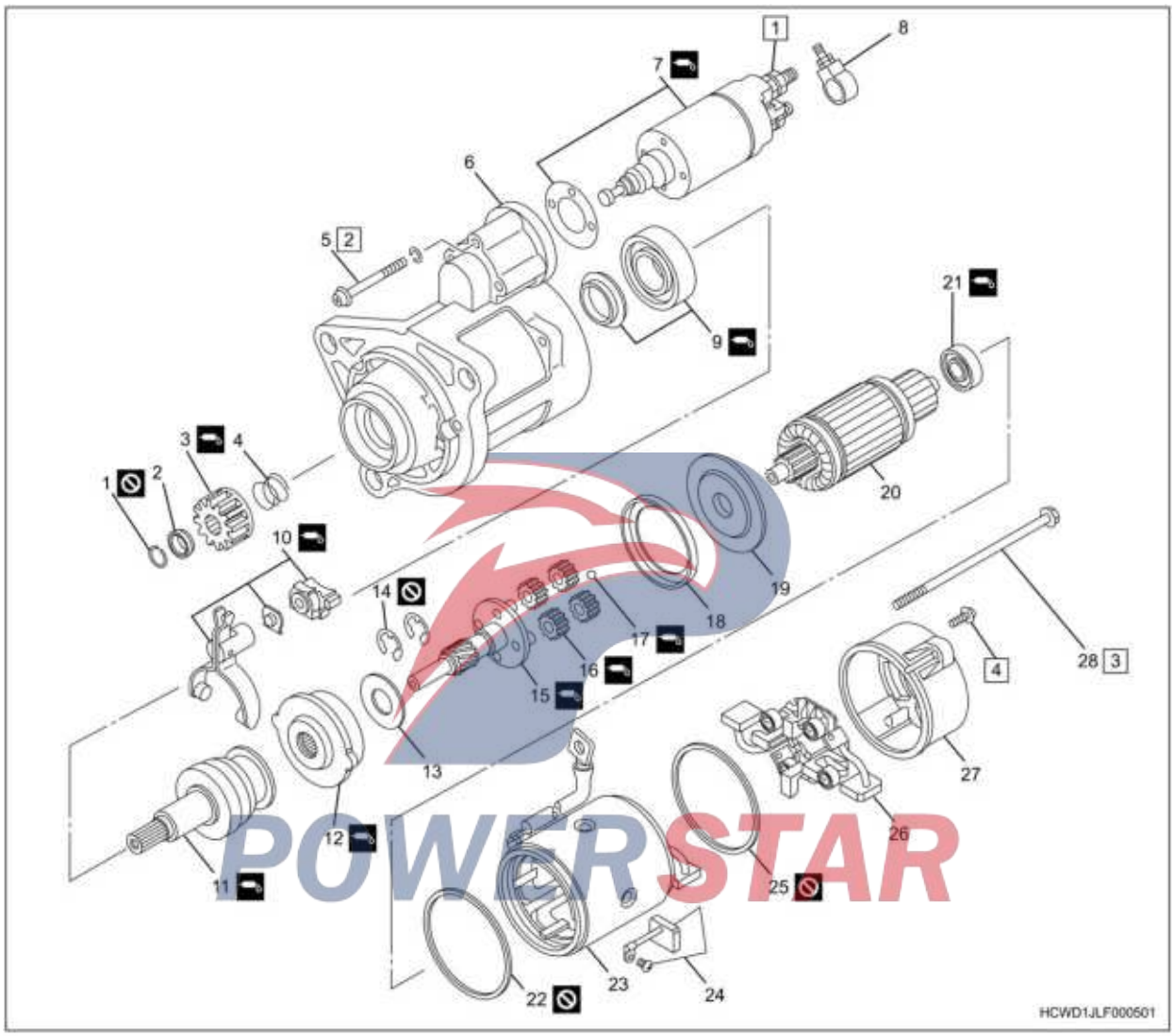
1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

Supplementary Information

1. Component Views

Starter motor



Part name

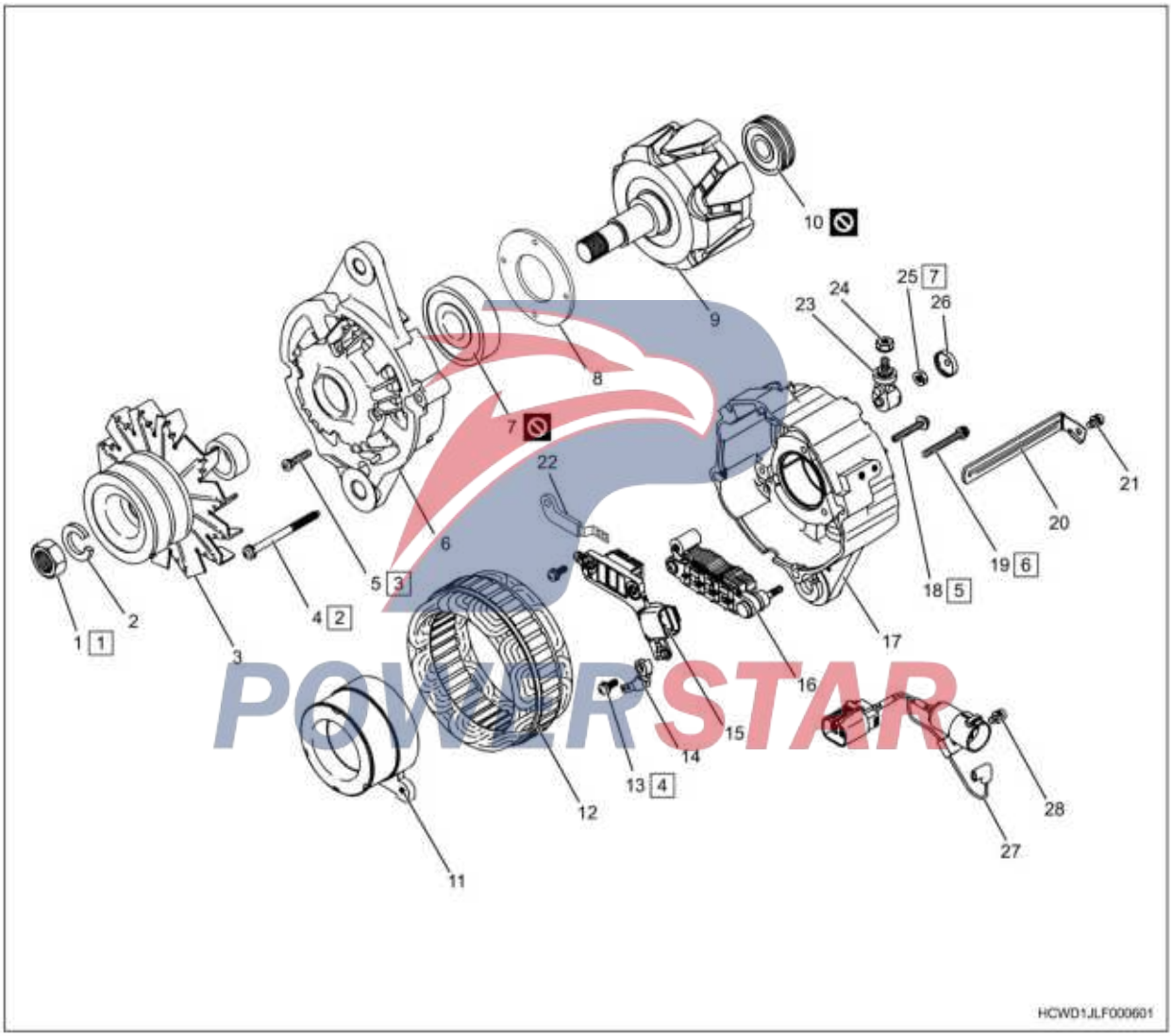
1. Snap ring
2. Stop ring
3. Pinion
4. Pinion spring
5. Screw
6. Front bracket
7. Magnetic switch
8. Bracket
9. Shaft
10. Lever
11. Overrunning clutch
12. Internal gear
13. Washer
14. E-ring
15. Gear shaft
16. Planetary gear
17. Ball
18. Gasket
19. Plate
20. Armature
21. Shaft

22. O-ring
23. yoke.
24. Brush
25. O-ring
26. Brush holder
27. Rear bracket
28. Penetration bolt

Tightening torque

1: 23 N • m { 2.3 kgf • m / 17 lb • ft }
2: 6 N • m { 0.6 kgf • m / 53 lb • in }
3: 10 N • m { 1.0 kgf • m / 89 lb • in }
4: 3 N • m { 0.3 kgf • m / 27 lb • in }

Generator (60 A size)



Part name

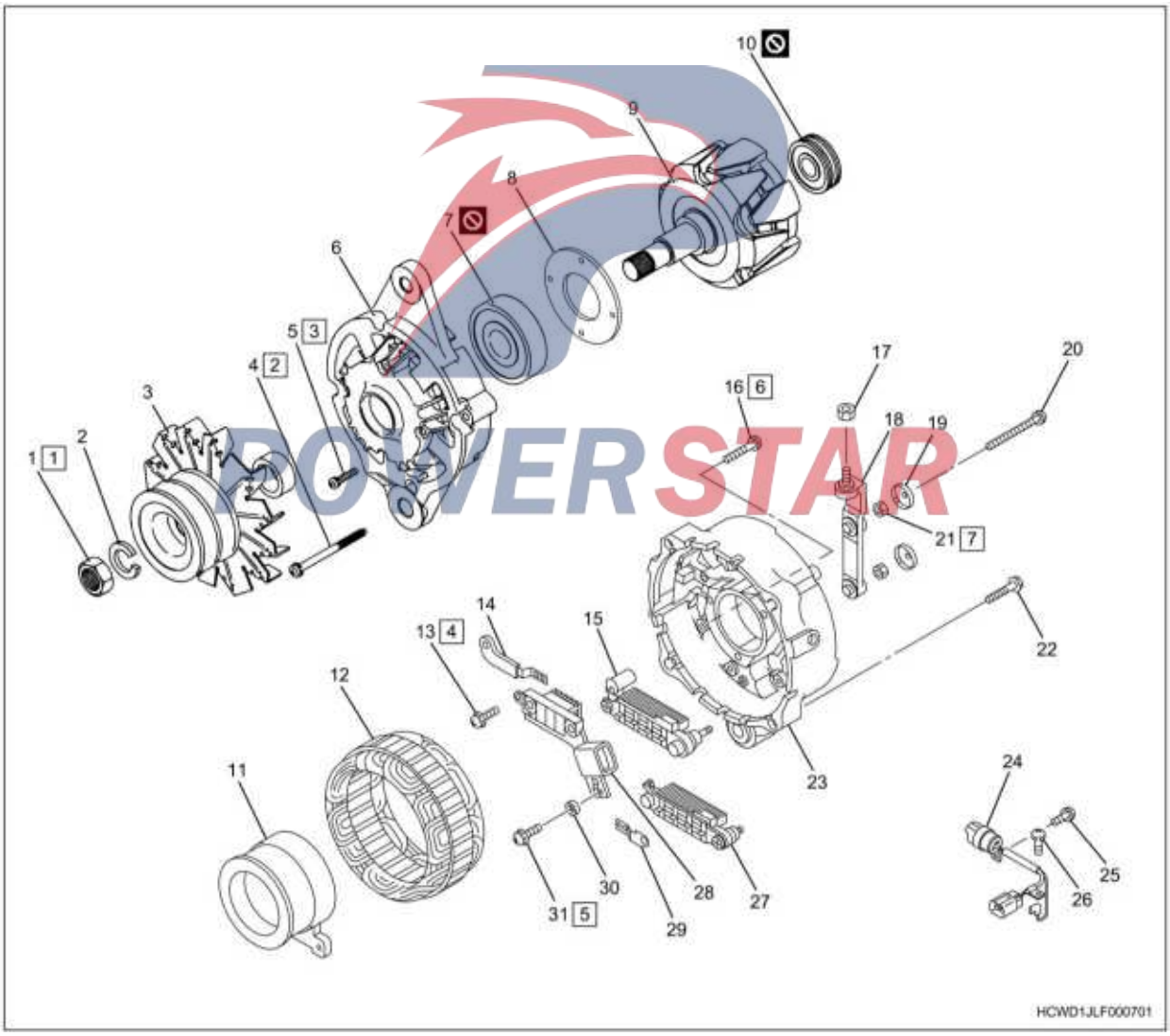
1. Nut
2. Spring washer
3. Pulley
4. Penetration bolt
5. Retaining ring fastening screws
6. Front bracket
7. Shaft
8. Cage
9. Rotor
10. Shaft
11. Excitation coil
12. Stator
13. Regulator fastening screw
14. Plate
15. Regulator

16. Rectifier
17. Rear bracket
18. Regulator fixing screw
19. Excitation coil fastening screw
20. Pipe clamp
21. Pipe clamp mounting screws
22. Terminal B
23. B-terminal bolt
24. B-terminal fastening nut
25. B-Terminal Bolt Nut
26. B-terminal cover
27. connector
28. Connector mounting screw

Tightening torque

1: 147 N • m {15.0 kgf • m / 108 lb • ft}
2: 5 N • m {0.5 kgf • m / 44 lb • in}
3: 4 N • m {0.4 kgf • m / 35 lb • in}
4: 4 N • m {0.4 kgf • m / 35 lb • in}
5: 4 N • m {0.4 kgf • m / 35 lb • in}
6: 4 N • m {0.4 kgf • m / 35 lb • in}
7: 9 N • m {0.9 kgf • m / 80 lb • in}

Generator (90 A Specifications)



Part name

1. Nut
2. Spring washer
3. Pulley
4. Penetration bolt
5. Retaining ring fastening screws
6. Front bracket
7. Shaft
8. Cage
9. Rotor
10. Shaft
11. Excitation coil
12. Stator
13. Regulator fastening screw
14. Terminal B
15. Rectifier
16. Regulator fixing screw
17. B-terminal clamp nut
18. B-terminal bolt
19. B-terminal cover
20. B-terminal mounting screws
21. B-terminal bolt nut
22. E-terminal bolt
23. Rear bracket
24. connector
25. Connector mounting screw
26. Connector mounting screw
27. Rectifier
28. Regulator
29. Plate
30 mold
31. Regulator fixing screw

Tightening torque

1: 147 N • m { 15.0 kgf • m / 108 lb • ft }
2: 15 N • m { 1.5 kgf • m / 11 lb • ft }
3: 4 N • m { 0.4 kgf • m / 35 lb • in }
4: 4 N • m { 0.4 kgf • m / 35 lb • in }
5: 4 N • m { 0.4 kgf • m / 35 lb • in }
6: 4 N • m { 0.4 kgf • m / 35 lb • in }
7: 9 N • m { 0.9 kgf • m / 80 lb • in }

MEMO

Engine

Engine Electrical Control (6WG1)

Table of contents

CMP sensor 1Z-2
Removal 1Z-2
Inspection 1Z-3
Installation 1Z-4
Crankshaft position sensor 1Z-5
Removal 1Z-5
Inspection 1Z-6
Installation 1Z-7
Fuel temperature sensor 1Z-8
Removal 1Z-8
Inspection 1Z-9
Installation 1Z-10
FRP sensor 1Z-12
Removal 1Z-12
Inspection 1Z-13
Installation 1Z-14
Engine coolant temperature sensor 1Z-15
Removal 1Z-15
Inspection 1Z-16
Installation 1Z-17
Air mass flow and intake air temperature sensor 1Z-19
Removal 1Z-19
Inspection 1Z-20
Installation 1Z-21
Boost pressure sensor 1Z-22
Removal 1Z-22
Inspection 1Z-23
Installation 1Z-24
VNT control module 1Z-25
Removal 1Z-25
Installation 1Z-26
Exhaust differential pressure sensor 1Z-27
Removal 1Z-27
Inspection 1Z-28
Installation 1Z-29
Barometric pressure sensor 1Z-30
Removal 1Z-30
Inspection 1Z-31
Installation 1Z-32
ECM 1Z-33
Removal 1Z-33
Installation 1Z-35
Setting 1Z-36
Supplemantary information 1Z-38

CMP sensor

Removal

1. Battery cable disconnect

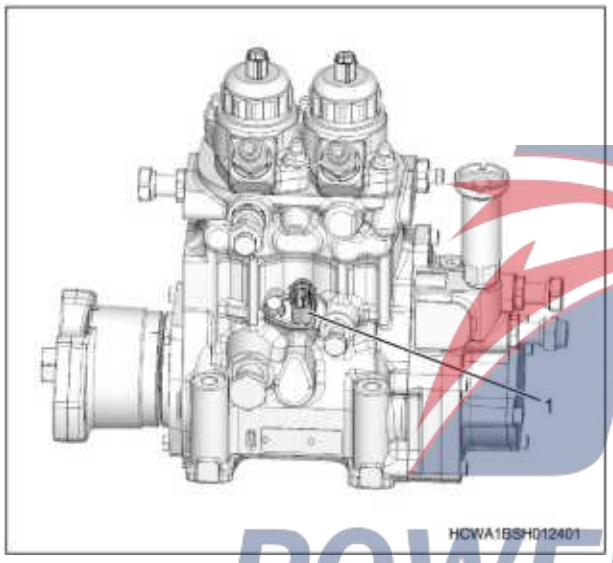
1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

2. CMP sensor removal

1) Disconnect the connector from the CMP sensor.

2) Remove the CMP sensor from the fuel supply pump.



1. CMP sensor

Inspection

1. CMP sensor inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Check the following items.

● Inspect the sensor for damage.

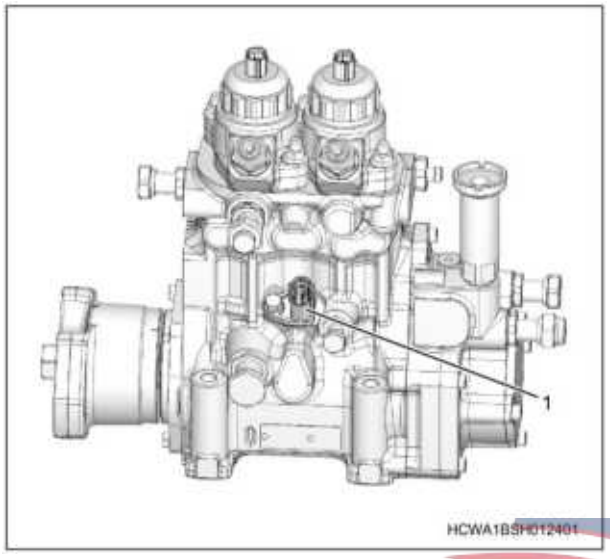
● Inspect the sensor for looseness and poor installation.

● Inspect for foreign material passing between the sensor and the sensor rotor.

Installation

1. CMP sensor installation

1) Install the CMP sensor to the fuel supply pump.



1. CMP sensor

2) Connect the connector to the CMP sensor.

2. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

Crankshaft position sensor

Removal

1. Battery cable disconnect

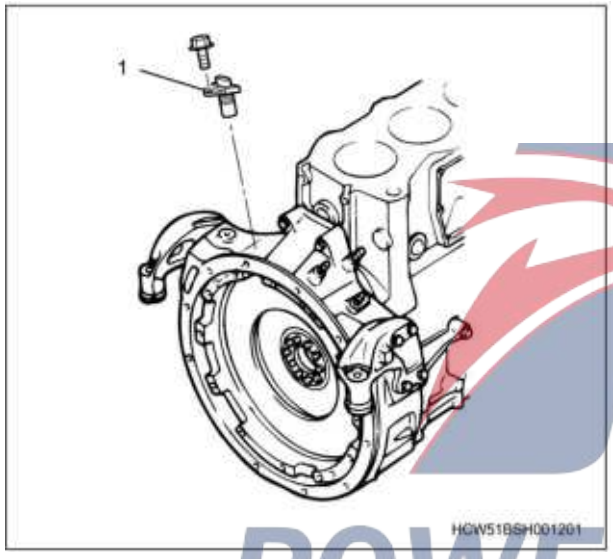
1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

2. CMP sensor removal

1) Disconnect the connector from the CMP sensor.

2) Remove the crankshaft position sensor from the flywheel housing.



1. CMP sensor

Inspection

1. CKP sensor inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

2) Remove the crankshaft position sensor from the flywheel housing.2) Remove the crankshaft position sensor from the flywheel housing.

● Inspect the sensor for damage.

● Inspect the sensor for looseness and poor installation.

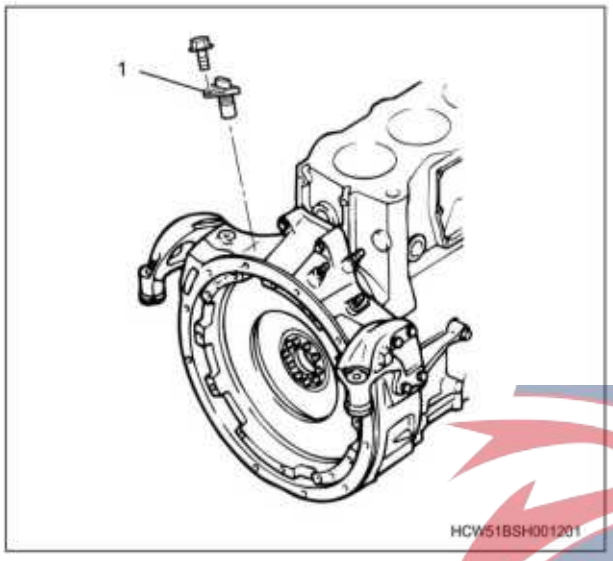
● Inspect for foreign material passing between the sensor and the sensor rotor.

Installation

1. CMP sensor installation

1) Install the crankshaft position sensor to the flywheel housing.

Tightening torque: 8 N • m { 0.8 kgf • m / 71 lb • in }



1. CMP sensor

2) Connect the connector to the CMP sensor.

2. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

Fuel temperature sensor

Removal

1. Fuel safety information

Caution:

● Add cleaning agent to the steam cleaner and thoroughly clean the sensor and common rail areas.

● Completely remove moisture with an air blower.

● Verify that foreign material has been completely removed, and start the work.

● After replacing the various sensors, clear the trouble code, and verify the replaced sensors operate normally.

● Because fuel leakage may lead to fire, wipe off the leaked fuel after completing the work and after the inspection, and be sure to check for fuel leaks after starting the engine.

2. Battery cable disconnect

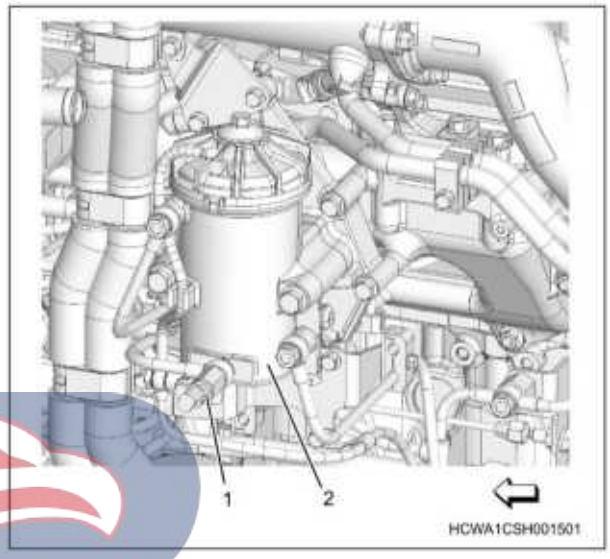
1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

3. Fuel temperature sensor removal

1) Disconnect the connector to the fuel temperature sensor.

2) Remove the fuel temperature sensor from the fuel filter body.



1. Fuel temperature sensor
2. Fuel filter

Inspection

1. Fuel temperature sensor inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Check the following items.

● Inspect for dirt and other foreign material attached to the sensor.

● Inspect for causes of poor connections such as collapsing or bending of the terminals.

2) Measure a resistance using a DMM.

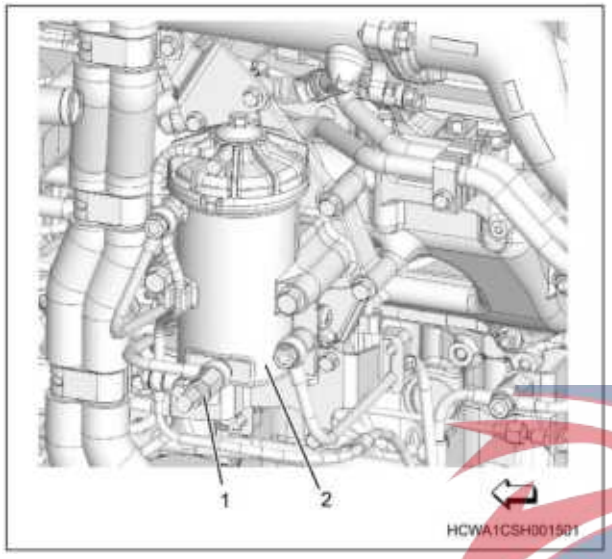
Fuel temperature	Electric resistance: 0 Ω
: 120 ℃ { 248 ℉ }	: 110.8 Ω
: 110 ℃ { 230 ℉ }	: 141.7 Ω
: 100 ℃ { 212 ℉ }	: 183.6 Ω
: 90.0 ℃ { 194 ℉ }	: 240 Ω
: 80.0 ℃ { 176 ℉ }	: 318 Ω
: 70.0 ℃ { 158 ℉ }	: 428 Ω
: 60.0 ℃ { 140 ℉ }	: 584 Ω
: 50.0 ℃ { 122 ℉ }	: 811 Ω
: 40.0 ℃ { 104 ℉ }	: 1,150 Ω
: 30.0 ℃ { 86 ℉ }	: 1,660 Ω
: 20.0 ℃ { 68 ℉ }	: 2,450 Ω
: 10.0 ℃ { 50 ℉ }	: 3,700 Ω
: 0.0 ℃ { 32 ℉ }	: 5,740 Ω
: -10.0 ℃ { 14 ℉ }	: 9,160 Ω
: -20.0 ℃ { -4 ℉ }	: 15,000 Ω
: -30.0 ℃ { -22 ℉ }	: 25,400 Ω

Installation

1. Fuel temperature sensor installation

1) Install the fuel temperature sensor to the fuel filter body.

Tightening torque: 22 N • m { 2.2 kgf • m / 16 lb • ft }



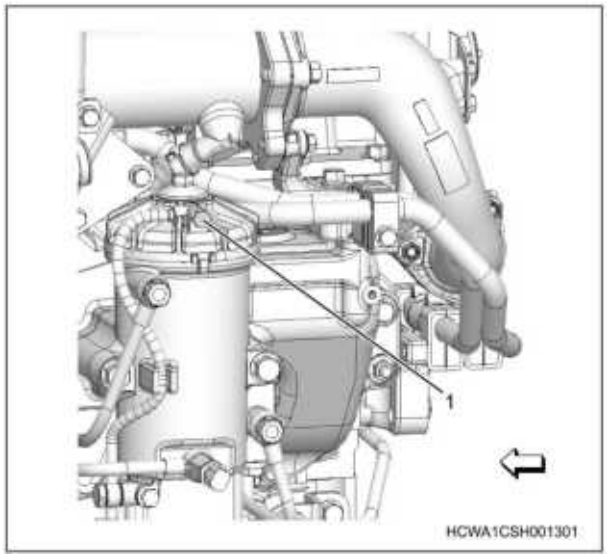
1. Fuel temperature sensor
2. Fuel filter

2) Connect the connector to the fuel temperature sensor.

2. Fuel air bleed

1) Turn the priming pump cap until it pops up.

2) Loosen the plug of the fuel filter section.



1. Plug

3) Operate the priming pump until large bubbles are no longer formed.

4) Tighten the plug of the fuel filter section.

Tightening torque: 7 N • m { 0.7 kgf • m / 62 lb • in }

Caution:

● Do not excessively tighten the plug.

5) Loosen the bleeder screw of the fuel supply pump.

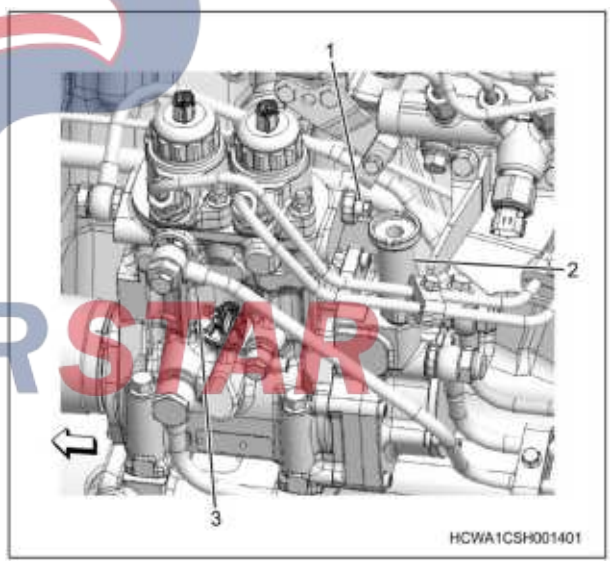
6) Operate the priming pump until large bubbles are no longer formed.

7) Tighten the bleeder screw of the fuel supply pump.

Tightening torque: 6 N • m { 0.6 kgf • m / 53 lb • in }

Caution:

● Do not excessively tighten the bleeder screw.



1. Bleeder screw
2. Priming pump
3. Fuel pump

8) Start the pump 150 times.

9) Turn the starter pump cover back to its original position.

Caution:

● Tighten the cover.

● Carefully clean the spilled fuel.

3. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

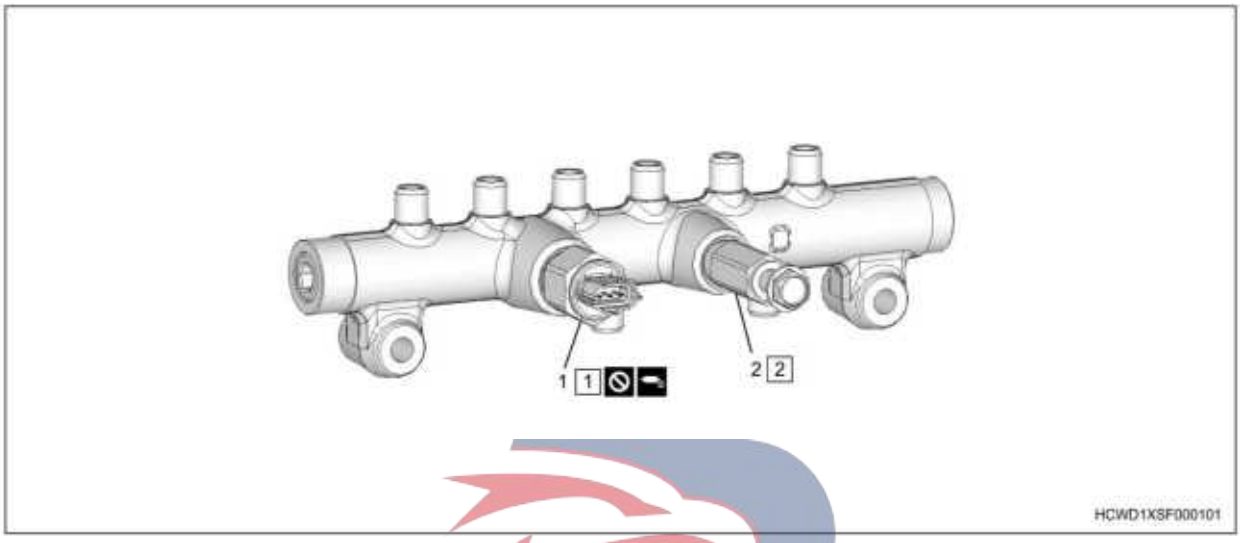
2) Lower the cab, and close the front lid.

FRP sensor

Removal

1. Component Views

Fuel pressure sensor



Part name

1. FRP sensor

2. Pressure limiter

Tightening torque

1: 98 N・m { 10.0 kgf • m / 72 lb • ft }

2: 172 N • m { 17.5 kgf • m / 127 lb • ft }

2. Fuel safety information

Caution:

● Add cleaning agent to the steam cleaner and thoroughly clean the sensor and common rail areas.

● Completely remove moisture with an air blower.

● Verify that foreign material has been completely removed, and start the work.

● After replacing the various sensors, clear the trouble code, and verify the replaced sensors operate normally.

● Because fuel leakage may lead to fire, wipe off the leaked fuel after completing the work and after the inspection, and be sure to check for fuel leaks after starting the engine.

3. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

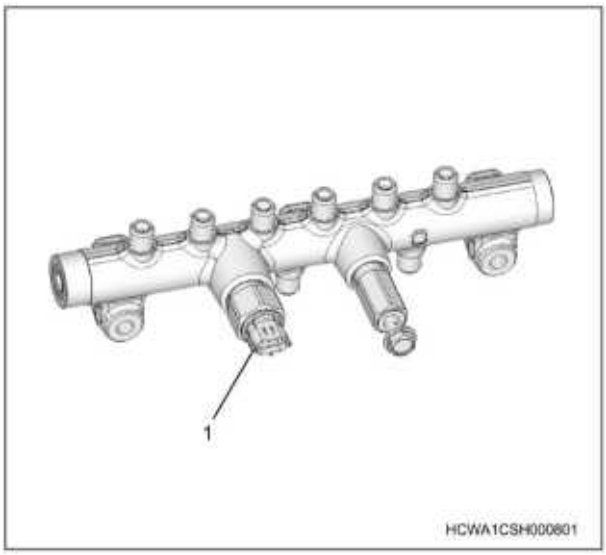
4. FRP sensor removal

1) Disconnect the harness connector from the FRP sensor.

2) Use a socket wrench with a 27 mm {1.06 in} width across flats, and remove the FRP sensor from the common rail (fuel rail).

Caution:

● Do not reuse the removed fuel pressure sensor.



1. FRP sensor

Inspection

1. FRP sensor inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Check the following items.

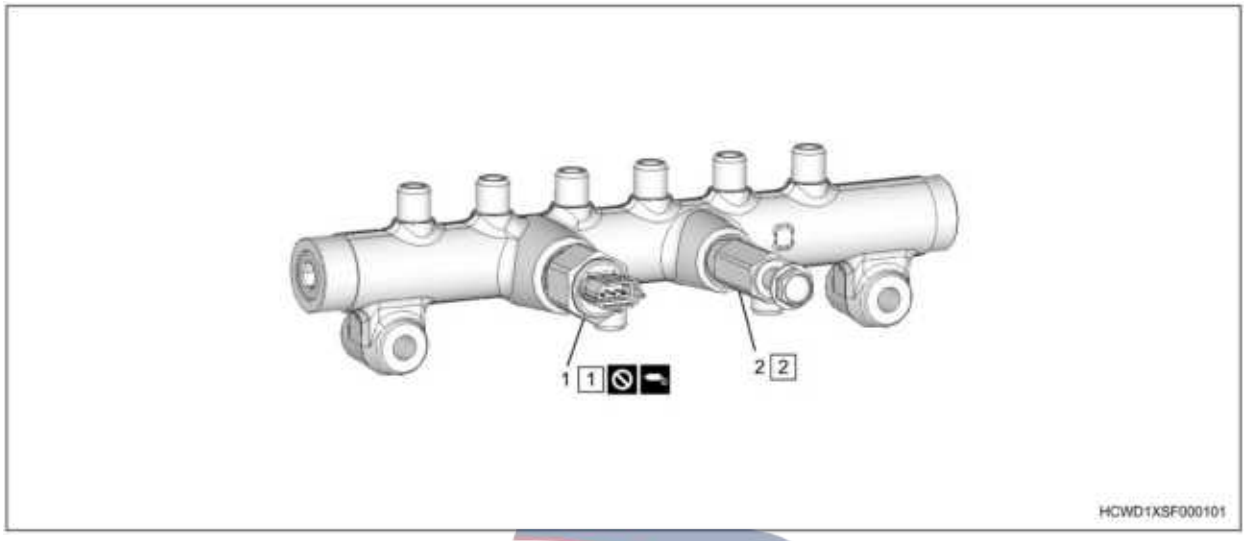
● Inspect for dirt and other foreign material attached to the sensor.

● Inspect for causes of poor connections such as collapsing or bending of the terminals.

Installation

1. Component Views

Fuel pressure sensor



Part name

1. FRP sensor

2. Pressure limiter

Tightening torque

1: 98 N • m {10.0 kgf • m / 72 lb • ft}

2: 172 N • m {17.5 kgf • m / 127 lb • ft}

2. Fuel rail pressure sensor installed

1) Apply DENSO 5 grease or silicone grease to the fuel rail position sensor thread.

2) Install the fuel rail pressure sensor on the common rail (fuel rail).

Caution:

● Install so that this does not interfere with the connector terminals.

● Do not allow foreign material to adhere to the threaded portion.

● Before installation, thoroughly check that there is no foreign material in the installation section.

Tightening torque: 98 N • m { 10.0 kgf • m / 72 lb • ft }

3) Connect the harness connector to the FRP sensor.

3. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

Engine coolant temperature sensor

Removal

1. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

2. Coolant drain

Warning:

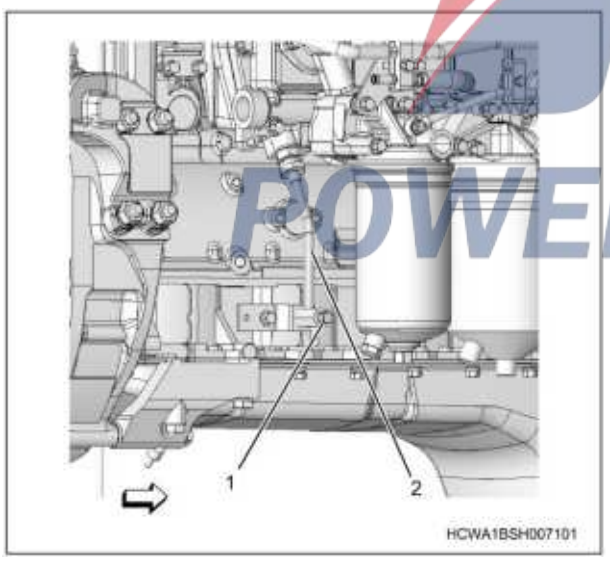
● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

1) Press the sub-tank cap button to release internal pressure.

2) Remove sub-tank cap from radiator.

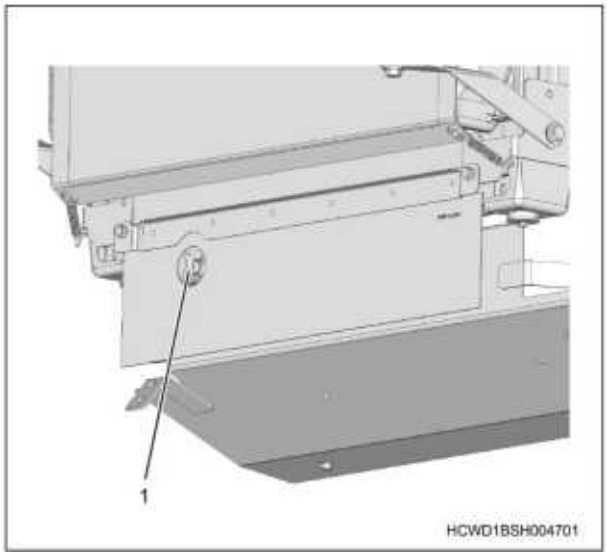
3) Loosen the drain plug on the cylinder block side, and drain the coolant to a pan.



1. Drain plug

2. Drain pipe

4) Loosen the radiator side drain plug, and drain the coolant to a pan.



1. Drain plug

5) Tighten the radiator side drain plug.

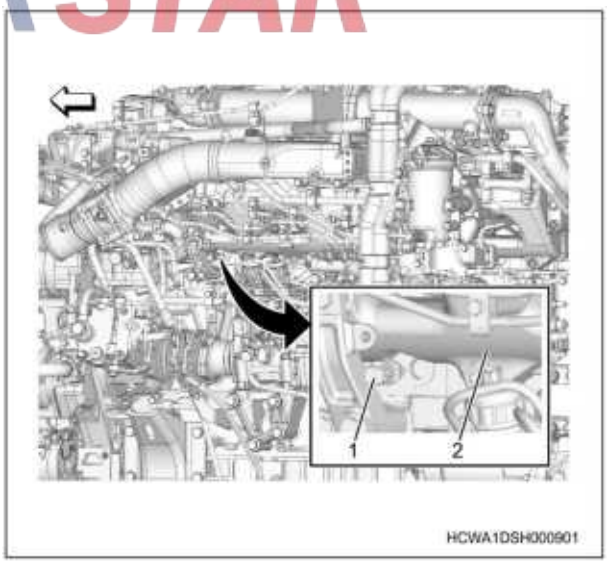
6) Tighten the drain plug on the cylinder block side.

7) Install sub-tank cap to radiator.

3. Engine coolant temperature sensor removal

1) Disconnect the engine coolant temperature sensor connector.

2) Remove the engine coolant temperature sensor from the cylinder head.



1. Engine coolant temperature sensor

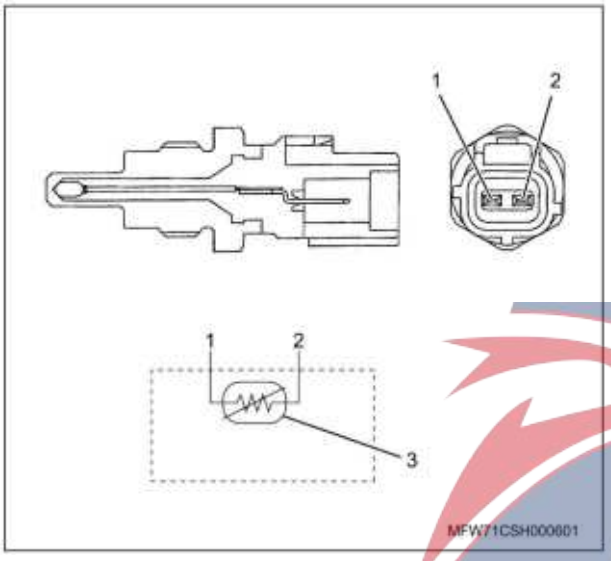
2. Intake manifold

Inspection

1. Engine coolant temperature sensor inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

The engine coolant temperature sensor for the engine control module is a thermistor-type sensor whose resistance decreases with increasing temperature.



1. Wiring method indication
2. Wiring method indication
3. Engine control module thermistor

1) Measure a resistance using a DMM.

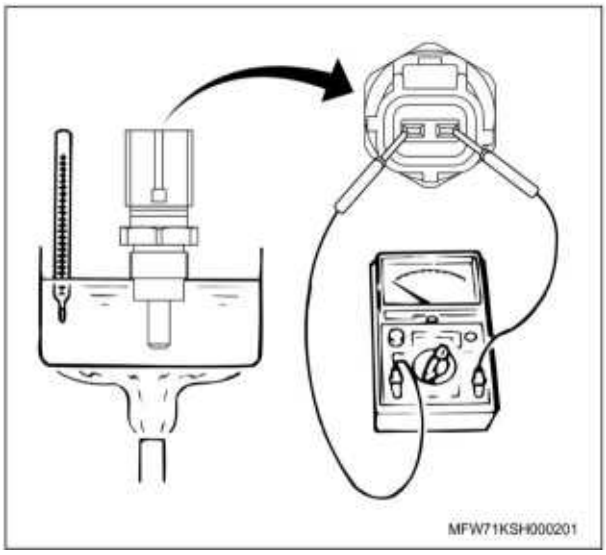
Note:

● Put the thermosensitive part of the sensor into water, and verify that the resistance matches the values in the graph indicating the thermistor characteristics while changing the water temperature.

Caution:

● Do not allow water to enter the terminal section.

● After inspection, wipe off the water droplets on the sensor.



Coolant temperature	Electric resistance: 0 Ω
: 130 ℃ { 266 ℉ }	: 0.093 kΩ
: 120 ℃ { 248 ℉ }	: 0.116 kΩ
: 110 ℃ { 230 ℉ }	: 0.147 kΩ
: 100 ℃ { 212 ℉ }	: 0.188 kΩ
: 90 ℃ { 194 ℉ }	: 0.245 kΩ
: 80 ℃ { 176 ℉ }	: 0.322 kΩ
: 70 ℃ { 158 ℉ }	: 0.431 kΩ
: 60 ℃ { 140 ℉ }	: 0.587 kΩ
: 50 ℃ { 122 ℉ }	: 0.813 kΩ
: 40 ℃ { 104 ℉ }	: 1.148 kΩ
: 30 ℃ { 86 ℉ }	: 1.658 kΩ
: 20 ℃ { 68 ℉ }	: 2.450 kΩ
: 10 ℃ { 50 ℉ }	: 3.714 kΩ
: 0 ℃ { 32 ℉ }	: 5.790 kΩ
: -10 ℃ { 14 ℉ }	: 9.308 kΩ
: -20 ℃ { -4 ℉ }	: 15.480 kΩ
: -30 ℃ { -22 ℉ }	: 26.740 kΩ
: -40 ℃ { -40 ℉ }	: 48.140 kΩ

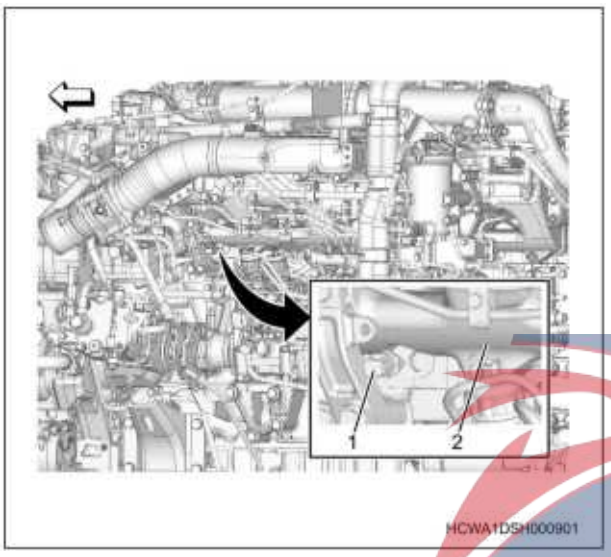
Installation

1. Engine coolant temperature sensor installation

1) Apply Loctite 262 or 962 to the threads of the engine coolant temperature sensor.

2) Install the engine coolant temperature sensor on the cylinder head.

Tightening torque: 25 N • m {2.5 kgf • m / 18 lb • ft}



1. Engine coolant temperature sensor
2. Intake manifold

2. Coolant filling

1) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Slowly fill with water to avoid air intrusion.

2) Press the radiator upper hose manually several times to remove the air from the hose.

3) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● Repeat the operation until the water level no longer drops.

4) Install sub-tank cap to radiator.

5) Start and idle the engine.

Caution:

● Idle the engine for 5 minutes or more.

6) Stop the engine.

7) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

8) Add coolant up to the MAX level of the radiator sub-tank.

9) Install sub-tank cap to radiator.

10) Turn OFF the heater fan switch.

11) Start the engine.

12) Raise the engine speed.

Note:

● Increase the engine speed to around 2000 rpm and run the engine for 5 minutes once the needle of the engine coolant temperature gauge reaches the center.

13) With the engine running, check that the thermostat valve is open.

Note:

● Touch the radiator upper hose, and verify that it has become warm.

Caution:

● If the radiator upper hose has not become warm, raise engine speed to warm it up.

● Do not diagnose only by the engine coolant temperature gauge and the hot air coming out from the heater.

14) Idle the engine for 5 minutes.

15) Stop the engine.

16) Remove sub-tank cap from radiator.

Warning:

● Do not loosen the radiator sub-tank cap when the coolant temperature is high.

● Verify that the engine is cool because there is possibility of burns caused by the release of steam or hot water.

17) Add coolant up to the MAX level of the radiator sub-tank.

Caution:

● If the water level of the sub-tank lowered the next morning, add water up to the MAX line.

3. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

Air mass flow and intake air temperature sensor

Removal

1. Battery cable disconnect

1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

2. Air mass flow and intake air temperature sensor removed

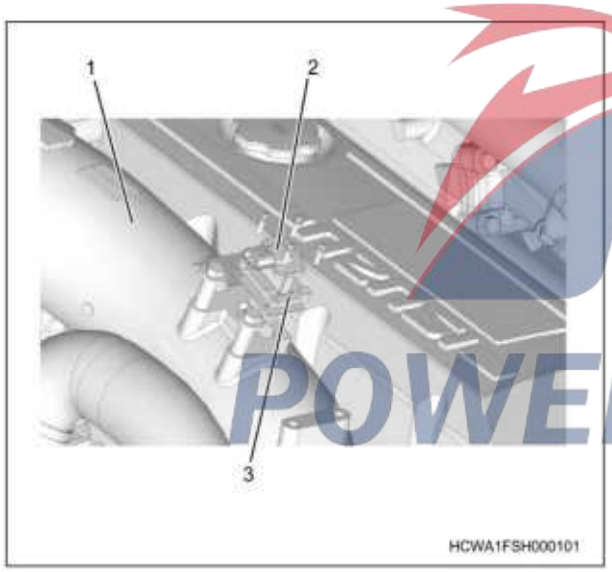
1) Disconnect mass air flow sensor and intake air temperature sensor connector.

2) Remove the following parts from the air line.

● Mass air flow and intake air temperature sensor

● Adapter

● Gasket



1. Air duct

2. Mass air flow and intake air temperature sensor

3. Adapter

Inspection

1. Air quality flow sensor check

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Check the mass air flow sensor for dirt or damage.

Caution:

● Do not allow solvents, lubricants, etc., to come in contact with the detecting part of the sensor.

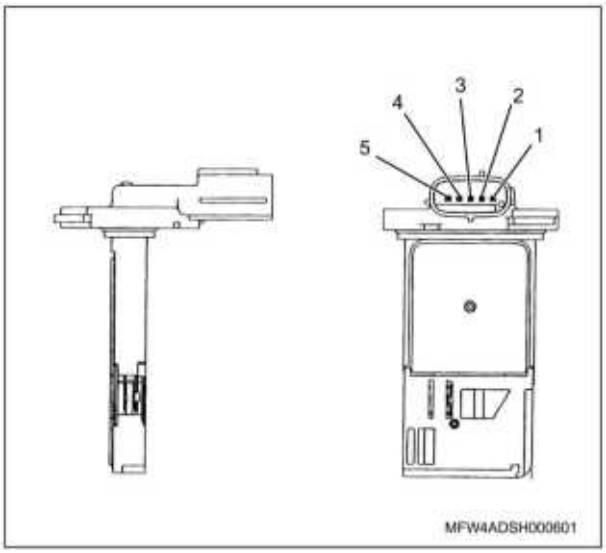
2. Intake air temperature sensor check

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Check intake air temperature sensor for dirt or damage.

2) Do not allow solvents, lubricants, etc., to come in contact with the detecting part of the sensor.

3) Use a digital multimeter to measure the resistance between inlet temperature sensor terminal 4 and terminal 5.



1. Mass air flow sensor power supply
2. Mass air flow sensor is grounded
3. Mass air flow sensor signal
4. Intake air temperature sensor signal
5. Intake air temperature sensor is grounded

Ambient temperature	Resistance characteristics
: -20 ℃ { -4 ℉ }	: 12.5 to 16.9 kΩ
: 25 ℃ { 77 ℉ }	: 1.8 to 2.2kΩ
: 60 ℃ { 140 ℉ }	: 500 to 600kΩ

Installation

1. Air mass flow and intake air temperature sensor installed

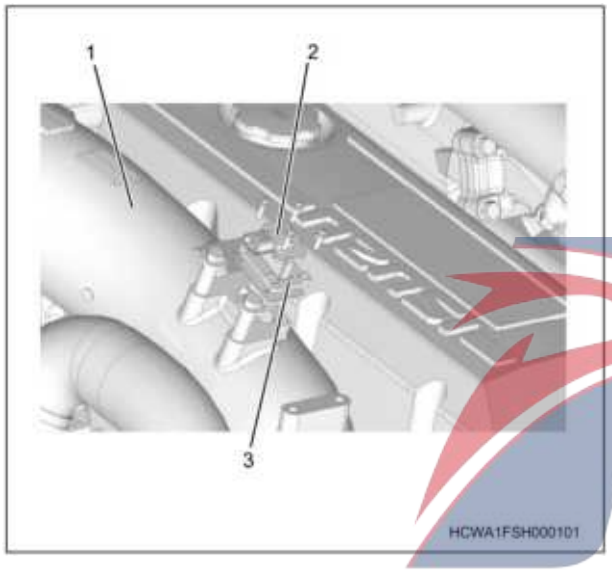
1) Install the following parts on the air duct.

● Mass air flow and intake air temperature sensor

● Adapter

● Gasket

Tightening torque: 1.5 N • m {0.2 kgf • m / 13 lb • in}



1. air duct

2. Mass air flow and intake air temperature sensor

3. Adapter

2) Connect the connector to the mass air flow sensor and intake air temperature sensor.

2. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

Boost pressure sensor

Removal

1. Battery cable disconnect

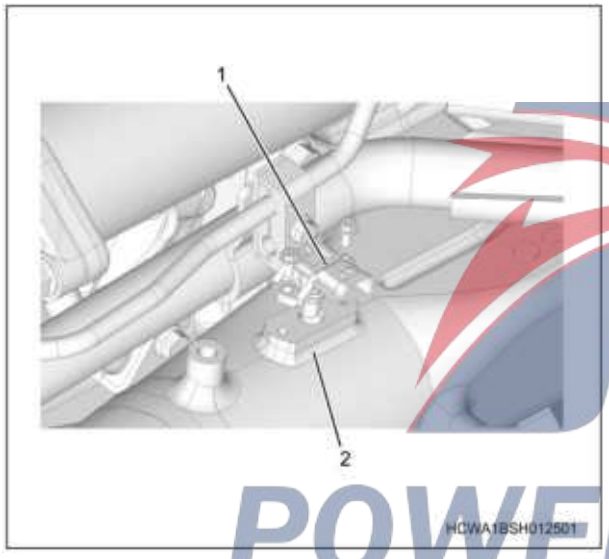
1) Open the front lid, and tilt the cab.

2) Disconnect the battery cable from the negative terminal of the battery.

2. Boost pressure sensor removal

1) Disconnect the boost pressure sensor harness connector.

2) Remove the boost pressure sensor on the intake line.



1. Boost pressure sensor

2. Intake line

Inspection

1. Boost pressure sensor check

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Check booster pressure sensor for dirt or damage.

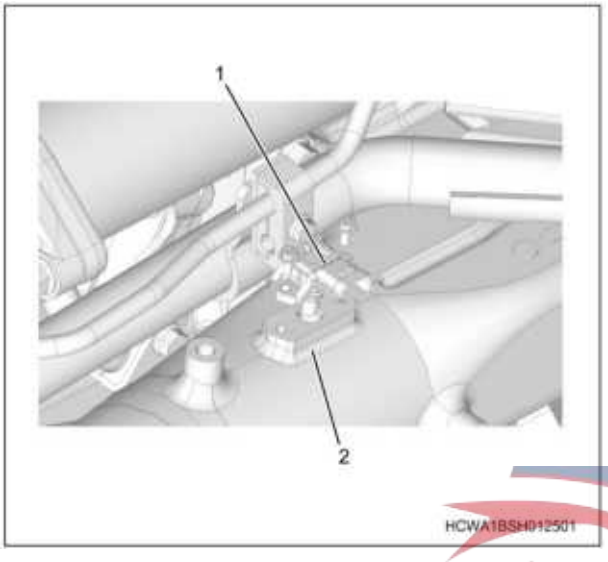
2) Check the connector terminal for any fault.

Installation

1. Boost pressure sensor installed

1) Install the boost pressure sensor to the intake duct.

Tightening torque: 2 N • m {0.2 kgf • m / 18 lb • in}



1. Boost pressure sensor

2. Intake line

2) Connect the connector to the boost pressure sensor.

2. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

VNT control module

Removal

1. Battery cable disconnect

1) Disconnect the battery cable from the negative terminal of the battery.

2. VNT control module removed

1) Disconnect variable transmission ratio steering control unit connector.

2) Remove the variable gear ratio steering control unit from the bracket.

Installation

1. VNT control module installed

1) Mount the variable speed ratio steering control unit to the bracket.

2) Connect the connector to the variable ratio steering control unit.

2. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

Exhaust differential pressure sensor

Removal

1. Battery cable disconnect

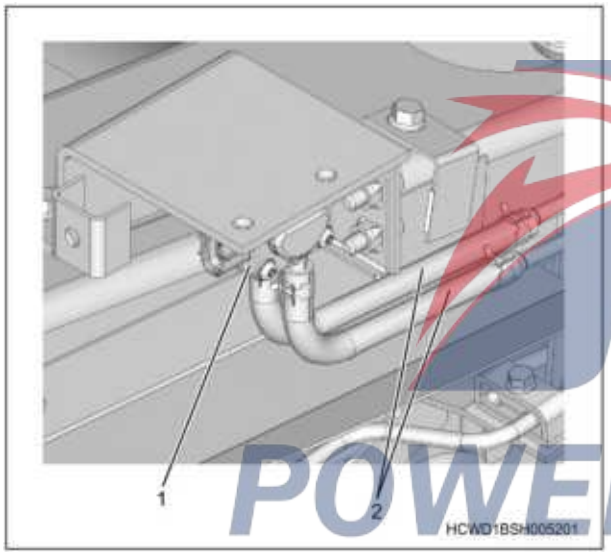
1) Disconnect the battery cable from the negative terminal of the battery.

2. Exhaust differential pressure sensor removal

1) Mark the installation location of the differential pressure hose.

2) Disconnect the differential pressure hose from the differential pressure sensor.

3) Disconnect the connector from the differential pressure sensor.



1. Differential pressure sensor

2. Differential pressure hose

Caution:

● Never loosen or tighten the 4 screws on the differential pressure sensor.

● Replace the differential pressure sensor if it is loose.

● If the differential pressure sensor is dropped, do not reuse it.

● When removing the differential pressure sensor, do not use tools that generate vibrations, such as an impact wrench.

Inspection

1. Exhaust differential pressure sensor inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Inspect the differential pressure sensor for dirt or damage.

2) Inspect the connector terminal of the differential pressure sensor for abnormal conditions.

Installation

1. Exhaust differential pressure sensor installation

1) Install the differential pressure sensor to the bracket.

Tightening torque: 25 N • m { 2.5 kgf • m / 18 lb • ft }

2) Install the connector to the differential pressure sensor.

3) Connect the differential pressure hose to the differential pressure sensor.

Caution:

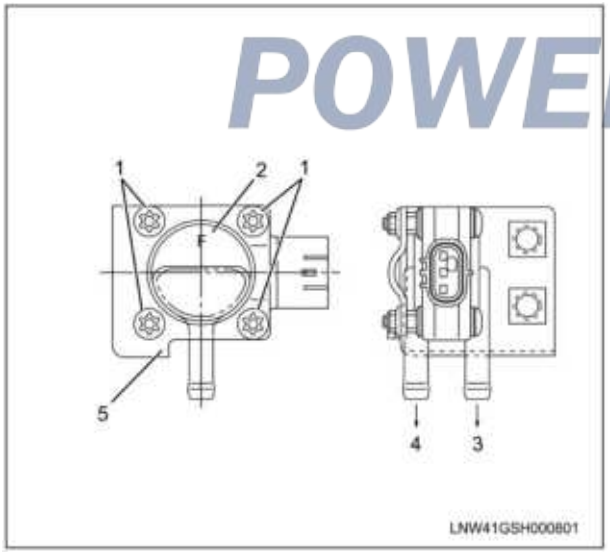
● Install the differential pressure hose with the white marking to the side of the differential pressure sensor with the white F mark.

● Firmly install the hose clip.

● Do not use cracked hoses.

● If there is material attached to the gasket seal surface of the flange, wipe it off with a wet cloth.

● Because the differential pressure sensor may malfunction if there is exhaust gas leakage from connections, be sure to check for any leaks after starting the engine.



1. Bolt

2. Front mark

3. Outlet side differential pressure hose port

4. Inlet side differential pressure hose port

5. Bracket

2. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

3. Exhaust differential pressure sensor adjustment

1. 0-point correction of the differential pressure sensor

If the differential pressure sensor is replaced, perform a 0-point adjustment of the differential pressure sensor on the vehicle.

1) Turn ON the ignition switch.

Note:

● The engine does not start.

2) Confirm that 40 seconds or more have elapsed.

3) Turn the ignition switch to the OFF position and leave for 15 seconds or more.

Caution:

● The 0-point correction operation is very susceptible to heat, so perform the correction when the differential pressure sensor is at room temperature.

Barometric pressure sensor

Removal

1. Battery cable disconnect

1) Open the front lid, and tilt the cab.

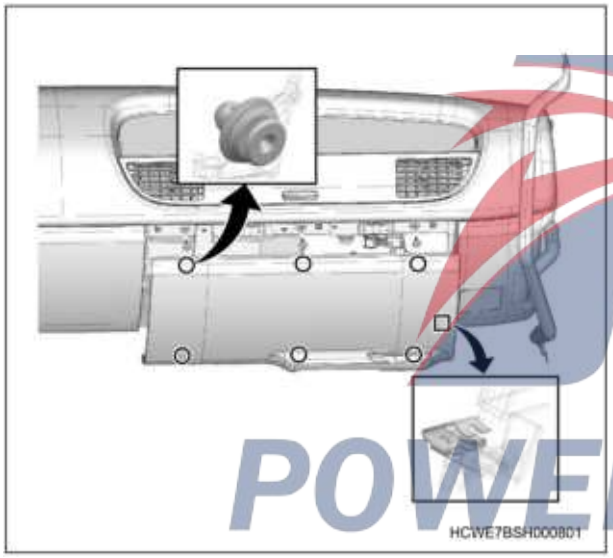
2) Disconnect the battery cable from the negative terminal of the battery.

2. Auxiliary end cap removed

1) Remove the auxiliary cover on the meter reinforcement.

Note:

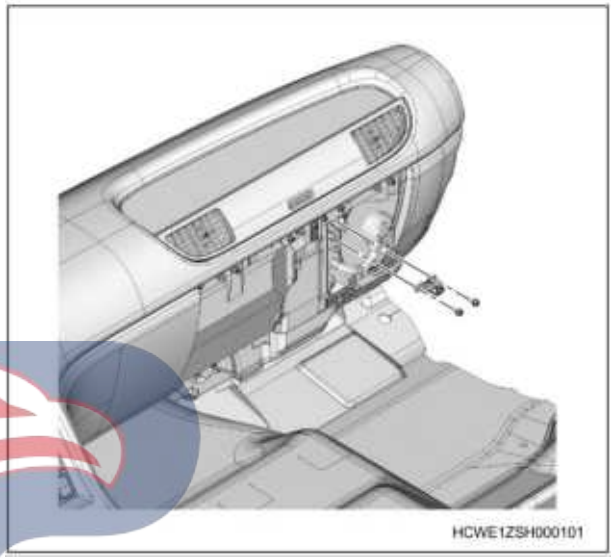
● Remove the retaining clip and pull the cover toward the operator side.



3. Barometric pressure sensor removal

1) Disconnect the harness connector from the barometric pressure sensor.

2) Remove the barometric pressure sensor from the bracket.



Inspection

1. Barometric pressure sensor inspection

Parts deemed to be defective as a result of inspection must be adjusted, repaired, or replaced.Parts deemed to be fouled or rusted must be cleaned.

1) Check the air pressure sensor for dirt or damage.

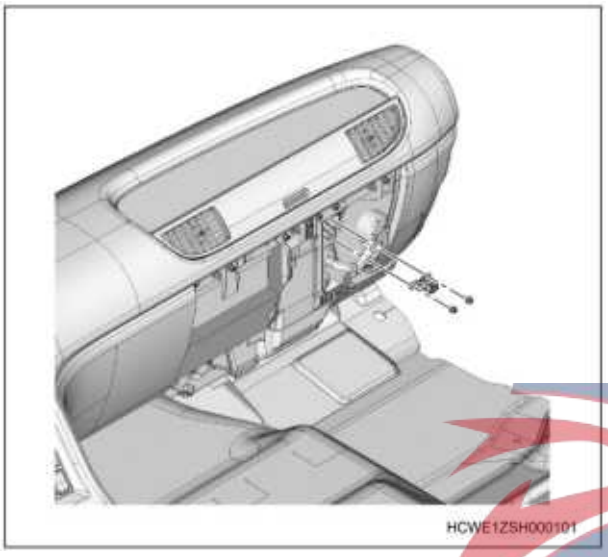
2) Check the connector terminal for any fault.

Installation

1. Barometric pressure sensor installation

1) Install the barometric pressure sensor to the bracket.

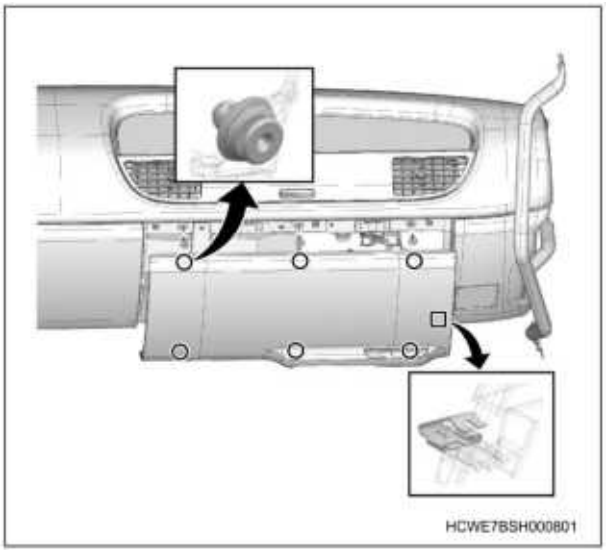
Tightening torque: 5 N • m { 0.5 kgf • m / 44 lb • in }



2) Connect the harness connector to the barometric pressure sensor.

2. Auxiliary end cap installation

1) Install the auxiliary cover onto the meter reinforcement.



3. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

2) Lower the cab, and close the front lid.

ECM

Removal

1. ECM safety information

When replacing the ECM, make sure to write the vehicle information to a new ECM.

The scan tool used for the replacement procedure must be use from start to finish. If the scan tool is changed midway, information cannot be written correctly.

Perform the ECM replacement and programming according to the following procedure.

	If communication with the ECM was possible before replacement	If communication with the ECM was not possible before replacement
1	ECM data upload	-
2	ECM replacement	ECM replacement
3	ECM data download	Write the injector identification number
4	DPD forced recovery	DPD forced recovery

2. ECM upload

1. Precautions

If communication cannot be established with the ECM from before replacement, do not perform the ECM data upload.

2. ECM data upload

1) Download to the scan tool the following data in the ECM before replacement.

● Fuel delivery rate

● Injector ID Code

● Mass air flow learning value

3. Upload fuel delivery rate data

1) Connect the scan tool to the DLC.

2) Turn ON the ignition switch.

3) Select the scan tool item.

● Diagnosis

● Engine

● Engine model

● Programming

● Fuel delivery rate

● Upload fuel delivery rate data

4) Upload the fuel delivery rate to the scan tool by following the instructions on the screen.

5) After completing the upload, go to Injector ID Code upload.

4. Injector ID code upload

1) Turn ON the ignition switch.

2) Select the scan tool item.

● Diagnosis

● Engine

● Engine model

● Programming

● Injector ID Code

● Injector ID code upload

3) Upload the Injector ID Code to the scan tool by following the instructions on the screen.

4) After completing the upload, upload the quality air flow learned value.

5. Upload quality air flow learning value

1) Turn ON the ignition switch.

2) Select the scan tool item.

● Diagnosis

● Engine

● Engine model

● Programming

● Mass air flow learning value

● Upload quality air flow learning value

3) Follow the instructions on the screen to upload the mass air flow learned value to the scanning tool.

4) After the upload is completed, turn off the scanning tool.

5) Turn OFF the ignition switch.

3. Battery cable disconnect

1) Disconnect the battery cable from the negative terminal of the battery.

4. ECM removal

1) Remove the control unit cover from the seat frame.

2) Remove the engine control module with the bracket from the base bracket.

3) Remove the engine control module from the bracket.

Installation

1. ECM installation

1) Install the ECM to the ECM bracket.

2) Install the ECM to the vehicle together with the ECM bracket.

3) Install the control unit cover on the seat frame.

2. Battery cable connect

1) Connect the battery cable to the battery negative terminal.

Setting

1. ECM setting

1. ECM precautions

When replacing the ECM, make sure to write the vehicle information to a new ECM.

The scan tool used for the replacement procedure must be use from start to finish. If the scan tool is changed midway, information cannot be written correctly.

2. ECM data download

If communication cannot be established with the ECM from before replacement, do not perform the ECM data

download.

Verify the vehicle specifications before performing the ECM data download.

1) Download the following data in the ECM before replacement to the ECM for after replacement.

- Fuel delivery rate
- Injector ID Code
- Mass air flow learning value

3. Download fuel delivery rate data

1) Connect the scan tool to the DLC.

2) Turn ON the ignition switch.

3) Select the scan tool item.

- Diagnosis
- Engine
- Engine model
- Programming
- Fuel delivery rate
- Download fuel delivery rate data

4) Download the fuel delivery rate to the ECM by following the instructions on the screen.

5) After completing the download, go to Injector ID Code download.

4. Injector ID code download

1) Turn ON the ignition switch.

2) Select the scan tool item.

- Diagnosis
- Engine
- Engine model
- Programming
- Injector ID Code
- Injector ID code download

3) Download the Injector ID Code to the ECM by following the instructions on the screen.

4) After completing the download, turn OFF the ignition switch.

5. Download quality air flow learning value

1) Turn ON the ignition switch.

2) Select the scan tool item.

- Diagnosis
- Engine
- Engine model
- Programming
- Mass air flow learning value

Download quality air flow learning value

3) Download the mass air flow learned value to the engine control module as illustrated on the screen.

4) After the download is completed, The ignition switch is OFF.

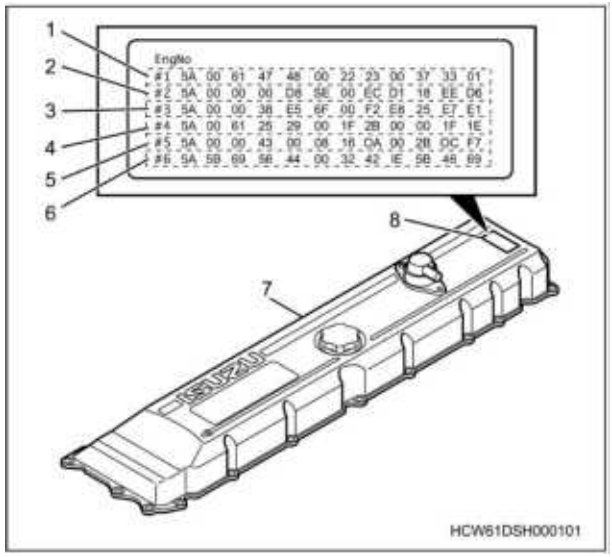
6. Write the injector identification number

If you download the injector identification code, this procedure is not implemented.

At the factory, check the label on the engine cover or the housing of each injector for an injector identification number.

If you need to verify the label, you can only choose to have not been replaced before the injector.

Injector cap on the label



1. Cylinder No.1 Injector ID Code
2. Cylinder No.2 Injector ID Code
3. Cylinder No.3 Injector ID Code
4. Cylinder No.4 Injector ID Code
5. Cylinder No.5 Injector ID Code
6. Cylinder No.6 Injector ID Code
7. Engine cover
8. Injector ID Code label

The correct order of the ID codes shown in the following injector illustration are as follows.

5A 52 70 1E 35 DD 21 57 00 1F 5A BD

1. Injector ID Code
2. Injector

1) Connect the scan tool to the DLC.

2) Turn ON the ignition switch.

3) Select the scan tool item.

- Diagnosis
- Engine
- Engine model
- Programming
- Injector ID Code
- Write the injector identification code

4) Program the Injector ID Code into the ECM by following the instructions on the screen.

5) After the programming is completed, turn OFF the ignition switch.

7. DPD forced recovery

If you replaced the engine control module, implement DPD forced recovery.

1) Turn ON the ignition switch.

2) Select the scan tool item.

- Diagnosis
- Engine
- Engine model
- Actuator test
- Equipment control
- DPD recovery
- DPD forced recovery

3) Follow the instructions on the screen to implement DPD recovery.

Note:

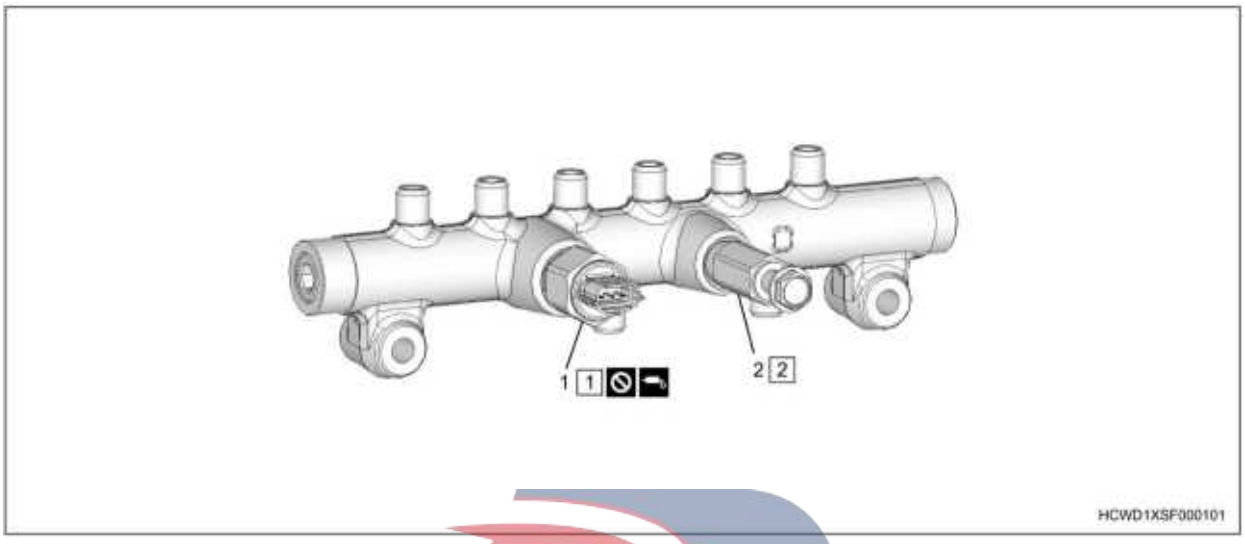
- Allow engine to idle until full recovery.

4) The ignition switch is OFF after the DPD has been restored.

Supplemantary information

1. Component Views

Fuel pressure sensor



Part name

1. FRP sensor

2. Pressure limiter

Tightening torque

1: 98 N • m { 10.0 kgf • m / 72 lb • ft }

2: 172 N • m { 17.5 kgf • m / 127 lb • ft }

Release date: April 2014

The first edition

ISUZU
C-SERIES

Workshop Manual

Engine (6WG1 model)

Issued by Isuzu Car Company

Life Cycle Business Promotion Dept.

Tokyo Shinagawa District 140-8722

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Pages

Gearbox overview 5
Introguide pipeion 6
Safety prompt 7
Maintenance instructions 8
Tightening torque 10
Supplies 11
Setting parameters 12
ZF-Ecosplit Tightening torque 14
Spring table 17
Professional tools 19
1. Polyamide pipes used for the high - low gears and valves 1-11
(Overlap) single H 1-2
Double H 1-3
2. Gearshift suspension arm / suspension 2-1
(Overlap) single H gearshift housing 2-4
Double H gearshift housing 2-21
3. High -low gear groups 3-1
4. Planetary gear transmission with synchronizers 4-1
5. GV-piston and two -position five-way valve 5-1
6. Release bearings, connecting plates and pumps 6-1
7. Clutch housing 7-1
8. Shaft and gearshift slide lever 8-1
9. Gearbox housing 9-1
10. Input shaft 10-1
Structure with axial / thrust roller bearings 10-2
Structure with tapered roller bearings 10-4
8 Gear structure, TO (K1) 10-6
8 Gear structure, TO (K1) 10-8
11.Intermediate shaft 11-1
Standard structure 11-2
8 Gear structure, TD (K2) 11-4

Pages

12. Spindle 12-1
Structure with axial / thrust roller bearings 12-3
Structure with tapered roller bearings 12-13
13. Bearing setting of main shaft, input shaft and intermediate shaft 13-1
Structure with axial / thrust roller bearings 13-2
Structure with tapered roller bearings 13-5
14. Synchronizer 14-1

The following gearboxes and transmission types are included in the maintenance instructions:

• Gearbox models:

(Included in the prototypes 1355, 1356 and 1367) 16 S 1630 TD * / 8 S 1630 TD *

16 S 1830 TO*/ 8 S 1830 TO*

16 S 1930 TD

16 S 2230 TO / 8 S 2230 TO

16 S 2230 TD

16 S 2530 TO

16 S 2330 TD

16 S 2730 TO**

* Short structure

** Strengthening structure

• **Variable type gearshift suspension arm/suspension:**

(Overlap) single H

– Standard type

–Double H determined by gears

High-low gear group:

Standard Type

Strengthen the structure (16 S 2730 TO)

Planet carrier

Standard Type

Strengthen the structure (16 S 2730 TO)

GV- piston and two - position five - way valves:

Standard Type

8-gear structure

Input shaft:

Used for axial /thrust roller bearings as well as tapered roller bearings

Used for 8-gear

–Structure TO, K1

(8 S 1830 TO, 8 S 2230 TO)

–Structure TD, K2 (8 S 1630 TD)

Intermediate shaft:

Standard Type

8-gear

–Structure TD, K2 - Structure TD, K2

Main shaft:

Bearings with axial / thrust rollers and bearings with tapered rollers

Synchronizer:

Synchronizer with molybdenum layers (all gears)

Synchronizer with carbon layers (only 1-gear / 2-gear and 3-gear / 4-gear)

Preface

This manual is intended for the professional personnel who have received the training related to the ZF proguide pipe maintenance and repair of ZF Friedrichshafen AG. It is only allowed that the work covered shall be completed by the personnel who has been authorized, trained and instructed. The user or maintenance unit is responsible for providing the training that can meet the professional requirements.

The ZF series of proguide pipes covered in this manual conform to the proguide pipe design status when this manual is issued.

Due to the continuous development of technology, the maintenance of the equipment you use may require different workflows as well as different adjustment and test data. Therefore, we recommend that the ZF proguide pipes you use can be handed over to the mechanics and assemblers who regularly receive the theoretical and practical operation training at our Service Training Center.

ZF Friedrichshafen AG's global service centers will provide you with:

1. Professional personnel who have been continuously trained.

2. Necessary facilities, such as special tools, etc..

3. Original ZF spare parts matching the latest batch proguide pipeion technology conditions.

The ZF service centers ensure to implement all kinds of service work highly, strictly and meticulously.

Guarantee

The repair work carried out by the ZF service centers are stipulated within the corresponding effective contractual condition frameworks.

The direct and / or indirect costs arising from the following situations are not in the scope of contractual liabilities:

• The repair work not conforming to the regulations and / or unprofessional repair work implemented by non ZF employees without authorization,

• Use 〝non" ZF original components.

When a fault occurs, measures must be immediately taken to ensure the functions of ZF equipment assembly can be completely restored to normal, and to minimize the loss.

We will retain implementing the partial claims or even reject the claim requirement if delaying the repair work without any reason is found and confirmed.

The following safety hints are used in this maintenance manual:

Hint

Hints used for special processes, methods, information, auxiliary tools, etc.

Caution

Use this hint when incorrect and unprofessional operations may cause the damage of proguide pipes.

⚠Danger!

Use this hint when a person is injured or a person's life is in danger due to negligence.

Safety warning

In principle, the maintenance personnel of ZF equipment should be responsible for their own work safety.

Complying with all the valid safety regulations and law restraints is a prerequisite to avoid the personal injury and proguide pipe damage during the maintenance and repair work.

The maintenance personnel must be familiar with these regulations before beginning to work.

The correct maintenance of ZF proguide pipes should be completed by the professional personnel who have received the corresponding training. The maintenance personnel have an obligation to receive the training.

⚠Harmful to health!

Please safely use fuels and auxiliary materials. Please comply with the manufacturer's regulations.

⚠Harmful to the environment!

Do not allow lubricants, fuels and cleaning agents to enter the soil, groundwater or sewers.

• Obtain the safety data sheets of related proguide pipes from the relevant environmental protection agency and act accordingly.

• Collect the waste oil in sufficiently large containers.

• Dispose the waste oil, contaminated filters, lubricants, and cleaning agents in accordance with the environmental protection regulations.

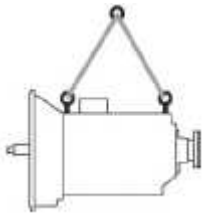
• Use and dispose the lubricants and cleaning agents in accordance with the manufacturer's regulations.

Caution

Gearboxes must not be hung on the input shaft, output flange or additional components.

Error

Correct



⚠Danger!

Do not stand under the suspended object when a lifting device is being used to transport.

General hints

Please read this manual carefully before the testing and maintenance work is started.

Be sure to follow the ZF service information. This information is available at all the ZF service centers or through the ZF service hotline.

Please be sure to consult the professional departments relevant to ZF service if there is any question.

As to all the work implemented for the gearboxes, it should be noted to keep the working environment clean, which shall be carried out by specially-assigned persons. The disassembly and assembly of gearboxes shall be carried out by using the designated special tools.

Caution

The pictures, drawings, components and parts provided in the manual may not be consistent with the real ones, and they are only used to demonstrate the workflow.

Pictures, drawings, components and parts are not drawn according to proportions, so the actual dimensions and weights must not be deduced from them (it is also not allowed even if within the same figure).

The work must be done in accordance with the text instructions.

After the repair work and testing are completed, it must be confirmed by a specially-assigned person whether the function of proguide pipes has been restored to normal.

Modifications and changes will affect the operation safety of gearboxes. Therefore, the special specifications requested by the customer must be negotiated in writing with ZF Corporation. Before the gearbox is opened, the suitable cleaning agent shall be used to thoroughly clean the disassembled transmission. The corners of housings and cover plates shall be especially cleaned.

Clean the parts

Clean up the old seal residue on all the sealing surfaces. Burrs or similar uneven parts need to be carefully removed with oil stones.

There shall be no anti-rust oil and foreign bodies in the lubrication holes and oil grooves, and it must be checked whether the passages are unblocked.

The opened gearbox should be carefully covered with coverings to prevent foreign objects from falling in.

Reuse the parts

The professional personnel must check and judge if bearings, blades, gaskets and other components can be reinstalled.

Damaged and severely worn parts must be replaced with new ones.

Seal gaskets and locking plates

•The parts which are damaged during disassembly, like seal gaskets and locking plates, must be replaced.

Do not use the sealants or grease when installing seal gaskets. When measuring the seal ring/gasket with coating layers, carry out it accurately according to the specified methods.

Shaft seal ring

• If the sealing lip of shaft seal becomes rough, cracked or hardened, it must be replaced. The sealing surface must be absolutely kept clean and intact.

Reprocessing of parts

If the gaskets or compensation gaskets and similar gaskets, etc. need to be reprocessed due to clearance adjustment, it should be noted that there is no quality problems on the reprocessed surface and there is the same surface smoothness as the original surface.

Assemble gearboxes

The assembly should be carried out on a clean workbench.

The adjustment data and tightening torque required in the maintenance manual must be observed.

• Bearing

If the bearing is assembled under hot conditions, it must be subject to uniform heating (such as with heating cabinet).

The heating temperature should be around 85 °C and not exceed 120 °C. After the assembly, each bearing must be lubricated with lubricants.

•Sealant

If it is recommended to use the sealant *, the manufacturer's operation instructions must be followed. The sealant should be thinly smeared on the surface and evenly covered. The sealant shall be prevented from entering the oil pipes and oil holes.

When the sealant is smeared within the sealing ranges of oil pipes and oil holes, it should be noted that the sealant must not enter the oil pipes and oil holes when the parts are being pressed.

•Fixatives

Fixatives * are only used in the places required by the list of materials. When using the fixatives (eg Loctite), be sure to follow the manufacturer's operation instructions.

All the regulation values, test data and tightening torques should be followed during assembly.

• Shaft seal ring

Flatly press the sleeve or plane disk used for shaft seal rings into the corresponding installation depth.

a) Thinly smear a layer of sealant * to the peripheral edge of the shaft seals with *Steel Sleeves*.

b) The sealant must not be used to smear the shaft seals with *Rubber Sleeves*, but the vaseline oil **8420**, alcohol or lubricant should be used, for example, the water-soluble liquid washing concentrate is thinly smeared a layer at the peripheral edge.

c) The shaft seals with steel sleeves and rubber sleeves should be treated at the peripheral edge of the rubber sleeves as the shaft seals **(b)**.

d) The double-lip shaft seal ring has two seal lips. The dust-proof seal lip **(X)** must face outward.

Lubricating grease shall be added in 60% the space between the seal lips *.

• Transmission oil

After the repair work is completed, the transmission oil shall be added to the transmission. For the oiling methods and permissible oiling types, the ZF Operation Manual and the List TE-ML of Lubricants (see Nameplate X) can be referred to.

The relevant information can be acquired from all the ZF service centers or via the website **www.zf.com**. After oiling, the plug screws at the oiling port and the oil overflow port must be tightened in accordance with the specified tightening torque.

* Please refer to the chapter of consumptive materials

The tightening torque of screws and nuts uses ZF Standards 148.

These standards are applicable to the screws involved in **DIN 912, DIN 931, DIN 933, DIN 960, DIN 961 as well as ISO 4762, ISO 4014, ISO 4017, ISO 8765, ISO 8676** and the nuts involved in **DIN 934, ISO 4032, ISO 8673**.

These standards include the screws and nuts with **8.8, 10.9** and **12.9** in intensity levels and the tightening torque data of the nuts with **8, 10** and **12** in intensity levels.

Surface treatment status of screws / nuts:

Blacken when heated and smear the oil on the surface, or implement the galvanized treatment and oiled.

It is needed to use the calibrated torque wrench to fix the screws.

Hint

Deviation of the tightening torque will be separately listed in the maintenance manual.

Coarse thread

Specification	Tightening torque, unit Nm		
Screw	8.8	10.9	12.9
Nut	8	10	12
M4	2.8	4.1	4.8
M5	5.5	8.1	9.5
M6	9.5	14	16.5
M7	15	23	28
M8	23	34	40
M10	46	68	79
M12	79	115	135
M14	125	185	215
M16	195	280	330
M18	280	390	460
M20	390	560	650
M22	530	750	880
M24	670	960	1100
M27	1000	1400	1650
M30	1350	1900	2250

Fine thread

Specification	Tightening torque, unit Nm		
Screw	8.8	10.9	12.9
Nut	8	10	12
M8x1	24	36	43
M9x1	36	53	62
M10x1	52	76	89
M10x1.25	49	72	84
M12x1.25	87	125	150
M12x1.5	83	120	145
M14x1.5	135	200	235
M16x1.5	205	300	360
M18x1.5	310	440	520
M18x2	290	420	490
M20x1.5	430	620	720
M22x1.5	580	820	960
M24x1.5	760	1100	1250
M24x2	730	1050	1200
M27x1.5	1100	1600	1850
M27x2	1050	1500	1800
M30x1.5	1550	2200	2550
M30x2	1500	2100	2500

Proguide pipe name ZF item number	Name		Qty. Approximately	Application	Comments
Grease 0750 199 001	For example Spectron FO 20			Ordinary installation aids	
Grease 0671 190 016	Industrial vaseline 8420			Ordinary installation aids	
Grease 0750 199 019	For example Renolit CX-EP2		5g 3g 1g 2g 1g 3g 2g 1g 1g	**GV**- leather bowl Double grooved ring Lockpin limiter Shaft seal rings / pipes **GP**- leather bowl **GP**- seal ring Shaft seal ring Tappet Pin	Chapter 10 Chapter 10 Chapter 10 Chapter 7 Chapter 3 Chapter 3 Chapter 3 Chapter 2 Chapter 2
Adhesive agent 0666 690 017	Loctite Nr. 241		300 mm3	Eye bolt	Chapter 3
Surface sealant 0666 790 033	Loctite Nr. 574		1 cm3	Hexagonal bolt	Chapter 2
Corrosion protection oil 0750 199 008	For example Renolin MR 40 Z		0.50 cm3 0.20 cm3	Oil pump rotor Axial / thrust needle roller bearings	Chapter 7 Chapter 4
Grease 0671 190 050	Olista longtime 3EP		3g	Clutch fork ball bowl	Chapter 6
0634 316 057	O-ring		1 piece	Stopper	Chapter 2.3

Hint: Please ask for the size of packages supplied before ordering!

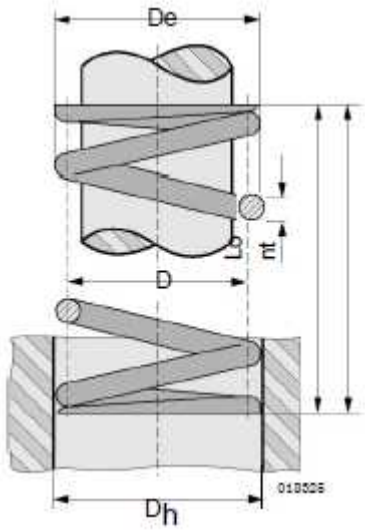
Name	**Dimensions**	**Measuring instrument**	**Remarks**
01. Axial clearances of intermediate shaft	0.01 to 0.10 mm	Depth vernier caliper	Turn the intermediate shaft, align the bearing rollers, set it to the zero clearance and then use the correspondingly thick adjusting washer to adjust the clearance.
02. Axial clearances of main shaft and input shaft	0.01 to 0.10 mm	Depth vernier caliper	Turn the input shaft and main shaft, align the bearing rollers, set it to the zero clearance, and then use the correspondingly thick adjusting washer to adjust the clearance.
03. Axial clearances of main shaft's upper separation rings	-0.05 to +0.05 mm	Feeler gauge	Select the corresponding ring.
04. Installation sizes of bearing cover's inner shaft seal rings	9 ±0.1 mm	Special kit 1X56 138 669	Installation dimensions when the kit is used.
05. Installation sizes of oil pump rotors	23 mm –0.5 mm	Depth vernier caliper	Do not separate the gear sets, only used for inspection.
06. Axial clearances of annular gear bracket's inner groove ball bearing snap ring	0 to 0.1 mm	Feeler gauge	Use the correspondingly thick snap ring to adjust.
07. Axial clearances of main shaft and intermediate shaft	0 to 0.1 mm	Feeler gauge	Use the correspondingly thick retaining ring to adjust.

Name	Dimensions	Measuring instrument	Remarks
08. For the wear limit of synchronous ring or clutch body, measure the distances between the axial plane, the ring and the body in the case of aligning and no clearance close to the cone.	Main gearbox and sub-gear group 0.80 mm High-low gear group 1.20 mm	Feeler gauge	If it is lower than the specified size, the synchronous ring and clutch body shall be replaced.
09. To understand the synchronous clearance (axial)	> 0.60 mm(Molybdenum layer) > 0.70 mm(Carbon layer)	Feeler gauge	The upper limit of synchronous clearances is obtained through the wear limit values of **0.80** or **1.20 mm**..
10. Clearances of GV - gearshift fork upper sliding bar	0.1 + 0.2 mm	Feeler gauge	Measure the distance from the sliding bar's lower end to the sliding gear sleeve (not required for the 8-gear structure)
11. Check sizes used to adjust the GV - gearshift fork	Short pattern: 93.70 mm Long pattern: 107.20 mm	Depth vernier caliper	Refer to the Installation Rules **0000 701 102** (not required for the 8-gear structure)
12. Axial clearances of main shaft's upper thrust washer	+0.07 to -0.08 mm	Depth vernier caliper	Only for the structure with tapered roller bearings. Select the corresponding thrust washers.
13. Permissible axial tolerances for the transmissions of main shaft / planetary gear	±0.05 mm	Measuring socket / plug sleeving 1X56 138,158	Only for the gearbox models 16 S 2730 TO。 Use the corresponding adjusting washer to adjust. Refer to the Installation Rules 1316 700 017

Name	**Dimensions**	**Measuring instrument**	**Remarks**
01. Screw-plugs on the gearbox housing M24x1.5	60 Nm	Torque wrench	Use a new seal ring
02. Breathable caps on the gearbox housing	10 Nm	Torque wrench	The breathable caps must not be blocked.
03. Lock the screw-plugs on the device M26x1.5	70 Nm	Torque wrench	Use a new seal ring
04. Screw-plugs on the clutch housing M18x1.5	35 Nm	Torque wrench	Use a new seal ring
05. Hexagonal bolts on the clutch housing M10x60	50 Nm	Torque wrench	
06. Combination bolts on the guide pipe M8x22	32 Nm	Torque wrench	
07. Hexagonal bolts on the connecting plate M10x60	46 Nm	Torque wrench	
08. Screw-plugs on the gearbox housing M18x1.5	35 Nm	Torque wrench	Use a new seal ring
09. Hexagonal bolts on the gearshift suspension arm / suspension M8x80 M8x25	23 Nm 23 Nm	Torque wrench	
10. Hexagonal bolts used for the pneumatic servo unit M8x80	23 Nm	Torque wrench	Use the sealant at the location of 71.180
11. Hexagonal bolts used for the gearshift suspension arm / suspension M8x20	23 Nm	Torque wrench	

Name	**Dimensions**	**Measuring instrument**	**Remarks**
12. Hexagonal bolts on the valve block M8x70	23 Nm	Torque wrench	
13. Pressure switches on the valve block	23 Nm	Torque wrench	
14. Switches of the valve block	45 Nm	Torque wrench	Use a new seal ring
15. Reverse switches on the valve block	45 Nm	Torque wrench	Use a new seal ring
16. Plum bolts on the pump cover M6x30	10 Nm	Torque wrench	
17. Hexagonal bolts on the high- and low- gear group housings M10x60	50 Nm	Torque wrench	
18. The locking device on the GV - clutch housing	45 Nm	Torque wrench	(8 block structure is not required)
19. Hexagonal bolts on the two-position five-way valve or the connection housing (8-gear structure) M6x40	9.5 Nm	Torque wrench	
20. The lockpin limiter on the gearbox housing M16x15	50 Nm	Torque wrench	Use a new seal ring
21. Self-locking nuts used for the GV - gearshift sliding bar piston M16x1.5	150 Nm	Torque wrench	Use a new seal ring (8 block structure is not required)
22. Pulse sensors on the high- and low- gear group housings	45 Nm	Torque wrench	
23. The screw-plug of the High-low gear group shell M24x1.5	60 Nm	Torque wrench	Use a new seal ring
24. Hexagonal bolts on the output end cover M10x40	46 Nm	Torque wrench	

Name	**Dimensions**	**Measuring instrument**	**Remarks**
25. Hexagonal bolts used for the power take-off cover M12x25	79 Nm	Torque wrench	
26. The screw-plug of the High-low gear group shell M10x1	15 Nm	Torque wrench	
27. Hexagonal bolts on the output flange M12x60	120 Nm	Torque wrench	
28. Eye bolts on the high- and low- gear group housings M24x1.5	250 Nm	Torque wrench	Use the sealant.
29. Self-locking nuts used on the GP-gearshift sliding bar piston M16x1.5	150 Nm	Torque wrench	Use new self-locking nuts.
30. Hexagonal bolts on the **GP** - cylinder M10x90	46 Nm	Torque wrench	
31. Lockpin limiters on the gearbox housing	50 Nm	Torque wrench	Use a new seal ring
32. Switches on the gearbox housing	45 Nm	Torque wrench	Use a new seal ring
33. Hexagonal bolts used for the heat exchanger interface M22x1.5	50 Nm	Torque wrench	Use a new seal ring
34. Hexagonal bolts on the declutch shaft M12x50	115 Nm	Torque wrench	



De Spring diameter + tolerance, mm

Dh Test the casing diameter, mm

L0 length of the spring when it is unstressed, mm

nt The total number of windings

d Core wire diameter

Order number:	**Installation place**	**Qty. wire circle [nt]**	**Core-wire diameter-Ø Unit mm [d]**	**Spring outer diameter -Ø L0 unit mm [De]**	**No stretched Length unit mm [L0]**
0732 041 011	Shift cantilever / suspension (overlapping) single H shift system	4.5	2.0	30.5	50.1
0732 040 985	Shift system Lock pin	6.5	2.0	14.8	23.4
0732 040 984	Shift system Lock pin	9.5	1.4	9.1	23.3
0732 040 385	Synchronization device High-low gear group	18.5	1.25	6.35	34.2
0732 040 386	Synchronization device High-low gear group	35.5	0.7	3.2	34.7
0732 040 409	Synchronization device Main gearbox	12.5	1.4	6.65	23.7
0732 040 736	Shift system (locking device)	13.5	1.6	9.6	36.0
0732 040 983	Shift system Lock pin	12.5	1.1	5.4	18.8
0732 040 986	Shift system Lock pin	5.5	2.25	14.5	21.6

Order number:	**Installation place**	**Qty. wire circle**	**Core wire diameter unit mm-Ø**	**Spring outer diameter unit mm-Ø**	**No stretched Length unit mm**
0732 040 237	Shift cantilever / suspension Double H shift system	7.5	2.5	39.2	76.9
0732 041 612	Shift cantilever / suspension Lock pin	6.5	1.7	13.9	25.8

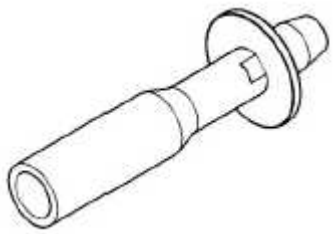
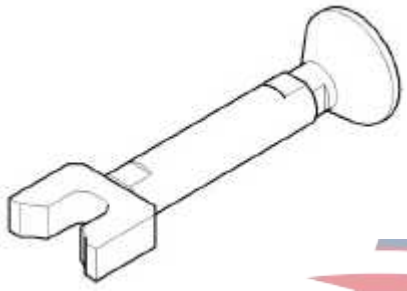
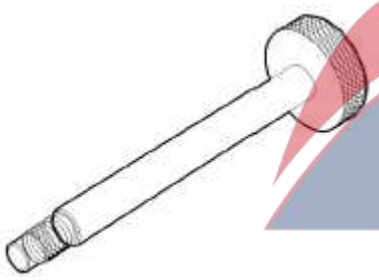
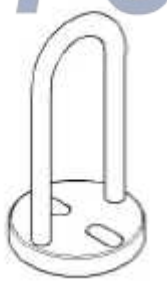
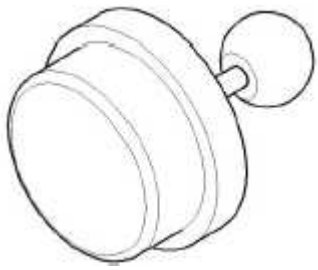
Figure number	Pattern	Order number	Application	Number of pieces	Comments
1		1X25 139 707	Kit Used on the gearshift housing bushings	1	Chapter 2
2		1X25 139,783	Knocking device Used to dismantle the needle roller sleeve on the valve handle	1	Chapter 2.2 Chapter 2.3
3		1X46 183 298	Positioning pin Used to install the gearshift suspension arm / suspension (Need 2 pins)	1	Chapter 2 In addition, it can be processed and made by oneself
4		1X56 136,260	Used for the hoisting device of high- and low- gear groups	1	Chapter 3
5		1X56 138,674	Heating equipment Used for the output bearings On the inner ring	1	Chapter 3

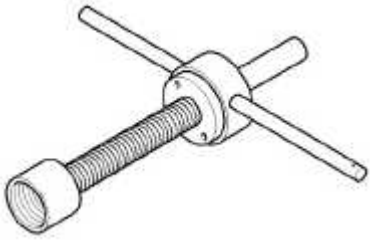
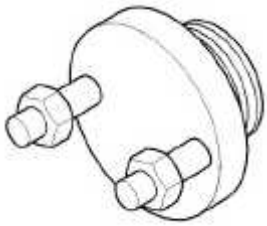
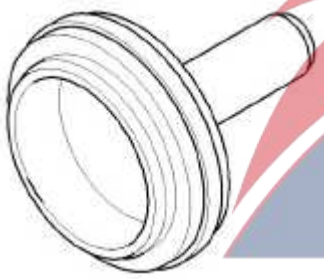
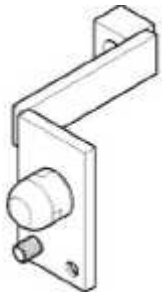
Figure number	Pattern	Order number	Application	Number of pieces	Comments
6		1X56 137,808	Threaded spindle Used to import the output bearings	1	Chapter 3
7		1X56 137,654	Screw pin Used to output the bearings and the threaded spindle Coordinate with 1X56 137 808 to use	1	Chapter 3
8		1X56 138 669	Extruded rod Used for the shaft seal ring in the output cover	1	Chapter 3
9		1X56 138,158	Measuring socket / plug-sleeve Used to adjust or measure the main shaft / planetary transmission	1	Chapter 3 Only used for gearboxes 9 16 S 2730 TO
10		1X56 138,675	Fixing device Used for the oil pipe at output end	1	Chapter 3

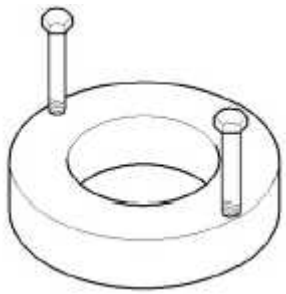
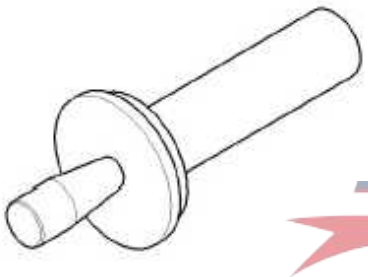
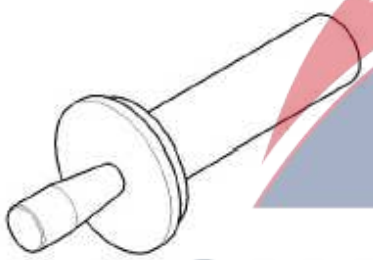
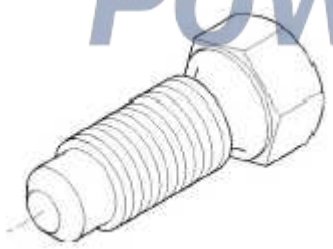
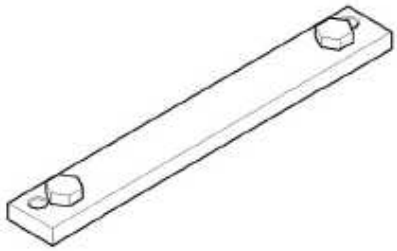
Figure number	Pattern	Order number	Application	Number of pieces	Comments
11		1X56 138,696	Heating device Used for the output bearings / bearing positions of housing outer rings and the threaded spindle 1X56 137 808 With use	1	Chapter 3
12		1X56 138,664	Fixing pin d = 89.9 mm For fixing plate and high-low gear group shell (Without retarders)	1	Chapter 4
13		1X56 138,668	Fixing pin d = 84.9 mm For fixing plate and high-low gear group shell (With retarders)	1	Chapter 4
14		1X56 138,100	Fixing device Used for GV- gearshift sliding bar	1	Chapter 5 (8 block structure not required)
15		1X56 138,673	Fixing device Used for seal check of GV-cylinder and the adjustment of GV-gearshift sliding bar fork	1	Chapter 5 Chapter 8 (8 block structure not required)

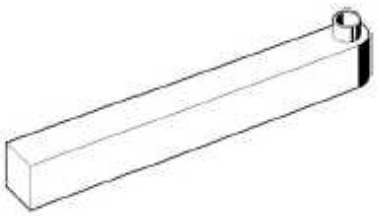
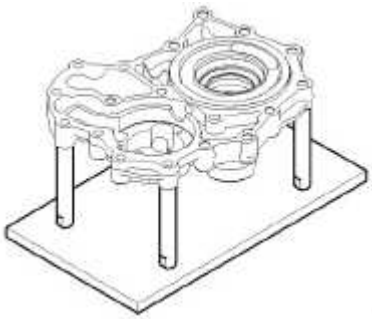
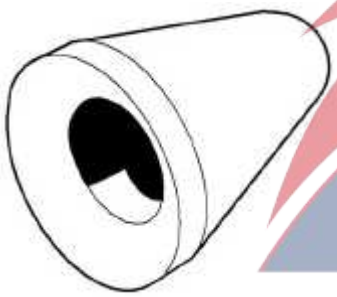
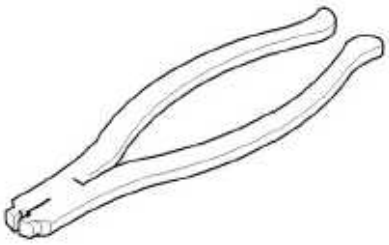
Figure number	Pattern	Order number / Application	Number of pieces	Comments
16		1X56 138,063 Pulling tools Used for the fixed pins of clutch housings / gearbox housings	1	Chapter 5
17		1X56 138,628 Install auxiliary equipment Used for connecting plates	1	Chapter 6
18		1X56 138,064 Jacket Used for shaft seal rings / connecting plates	1	Chapter 6
19		1X56 138,639 Centering device Used to gearshift sliding bar	1	Chapter 7
20		1X56 138,626 Clamp Used for the caulking of oil pipes	1	Chapter 7

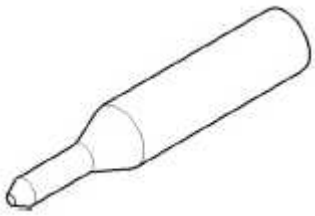
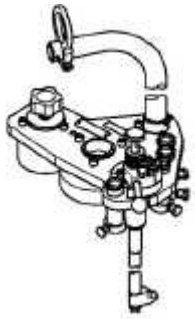
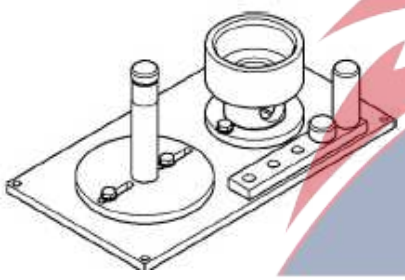
Figure number	Pattern	Order number	Application	Number of pieces	Comments
21		1X56 138,695 Positioning pin Used for clutches and gearbox housings (Need 2 pins)		1	Chapter 7
22		1T66 161 756 The hoisting support device For shafts and shift rails		1	Chapter 8
23		1X56 137,675 Seat For shafts and shift rails		1	Chapter 8
24		1X56 137,953 rivet (12 mm) For shafts and support seat 1X56 137 675 With use		1	Chapter 8 "Long" structure
25		1X56 137,920 rivet (17 mm) For shafts and support seat 1X56 137 675 With use		1	Chapter 8 "Short" structure

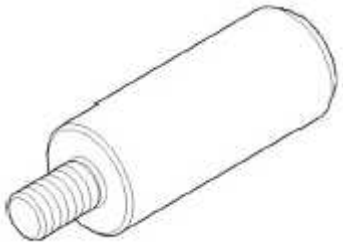
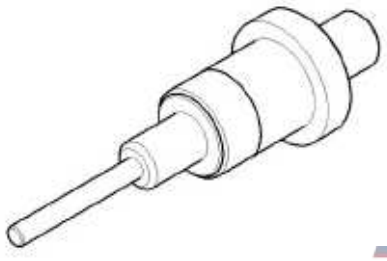
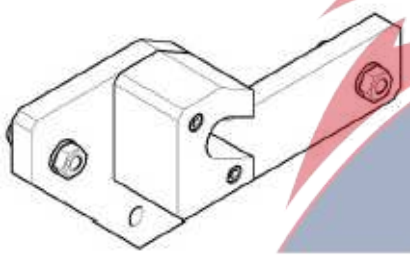
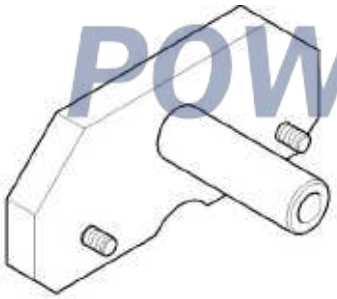
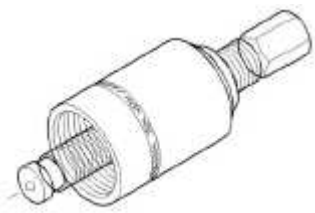
Figure number	Pattern	Order number / Application	Number of pieces	Comments
26		1X56 138,257 rivet (67 mm) For shafts and support seat 1X56 137 675 With use	1	Chapter 8 "Reinforcing" structure
27		1X56 138,627 Install auxiliary equipment Used for interlocking pins	1	Chapter 8
28		1X56 138,632 Install auxiliary equipment Used to support GV-gearshift sliding bars	1	Chapter 8 (8 block structure not required)
29		1X56 138 633(short structure) 1X56 138 634(long structure) Install auxiliary equipment Used to adjust the gearshift fork	1	Chapter 8.3 (8 block structure not required)
30		1X56 122,304 Basic toolings and Fixture / Clamper 1X56 136 722 Fixture / Clamper 1X56 136,756 Fixture / Clamper 1X56 136,743 With use	1	Chapter 10 Chapter 11 Chapter 12

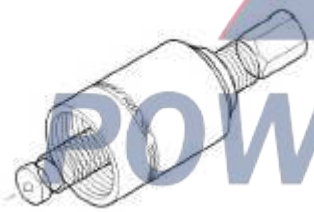
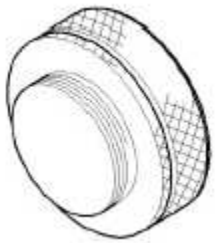
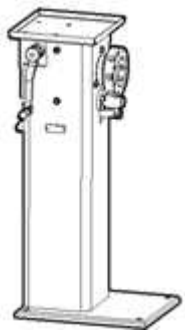
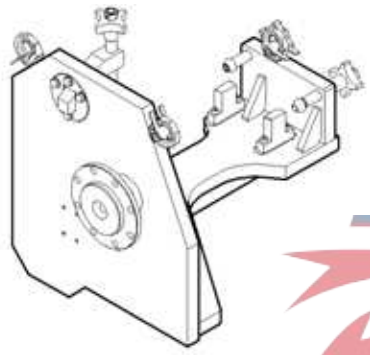
Figure number	Pattern	Order number Application	Number of pieces	Comments
31		1X56 136,722 Clamper Used for the tapered roller bearings on the input shaft	1	Chapter 10
32		1X56 136,756 Clamper Used for the tapered roller bearings on the intermediate shaft	1	Chapter 11
33		1X56 136,743 Clamper Used for the tapered roller bearings on the main shaft / input shaft	1	Chapter 12 (for the tapered roller bearing structure)
34		1X56 122,306 Basic toolings And the clamp / clamp holder 1X56 138 596 With use	1	Chapter 12 (Base on needs)
35		1X56 138,596 Clamper Used for the tapered roller bearings on the main shaft / output shaft	1	Chapter 12 (Base on needs)

Figure number	Pattern	Order number	Application	Number of pieces	Comments
36		1P01 181 850	Assembly support (fixed type) And 1X56 138 630 With use	1	General purpose
37		1X56 138,630	Assembly equipment Used to clamp the gearboxes	1	General purpose

1 Polyamide pipe for high-low gear and valves

1.1 (Overlap) single H 1-2

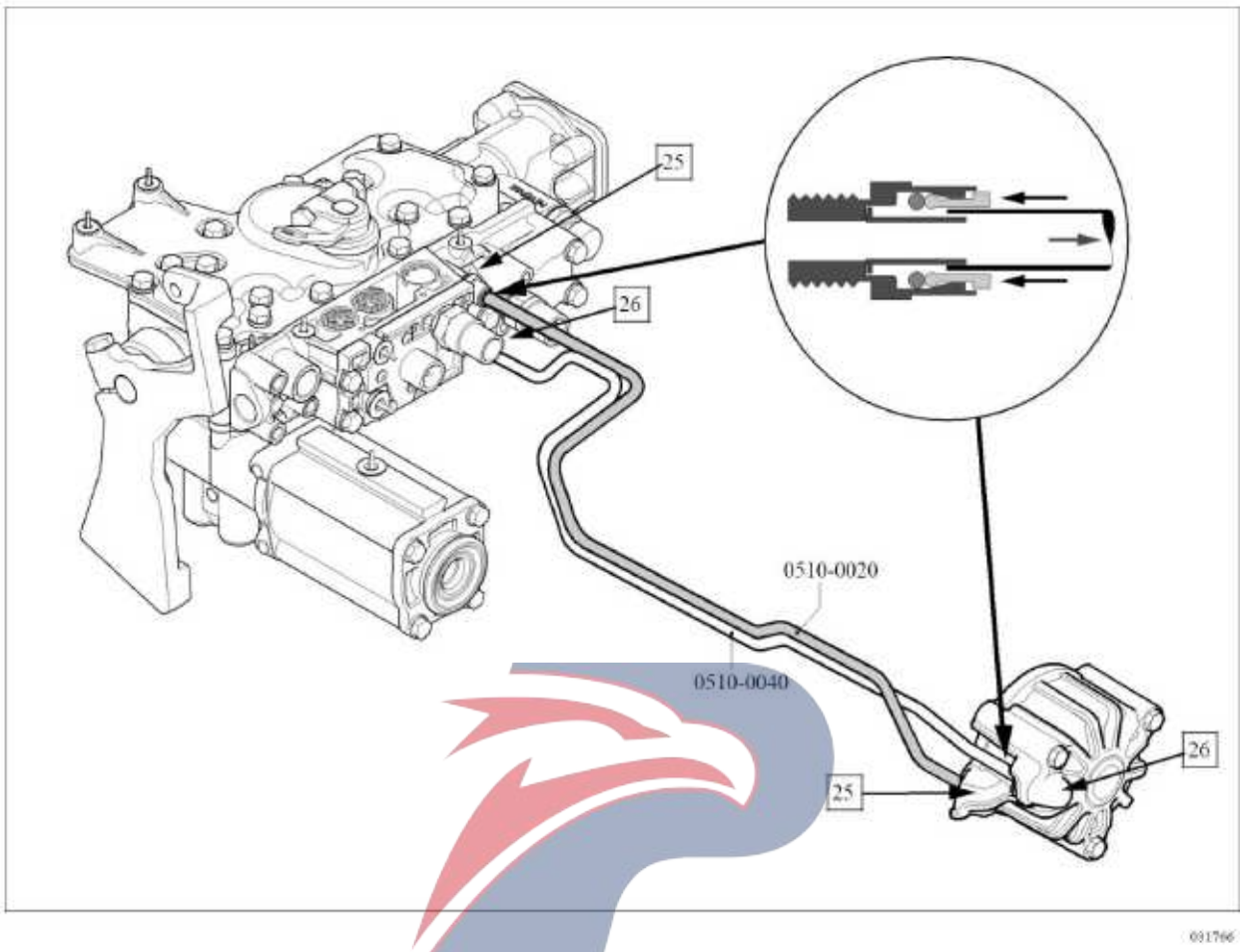
1.1.1 Disassemble the polyamide pipe 1-2

1.1.2 Install polyamide pipe 1-2

1.2 double H 1-3

1.1.1 Disassemble the polyamide pipe 1-3

1.1.2 Install polyamide pipe 1-3



1 Polyamide pipe for high-low gear and valves

1.1 (Overlap) single H

1.1.1 Disassemble the polyamide pipe

Hint

The interface positions are marked. The tubes are mounted with reversion-twist.

• Location 0510-0020 (25),

The valve block is up, and GP is down.

• Location 0510-0040 (26),

The valve block is down, and GP is up.

1 Release the polyamide tubing 0510-0020 and 0510-0040 on the clutch (see simplified illustration) and remove.

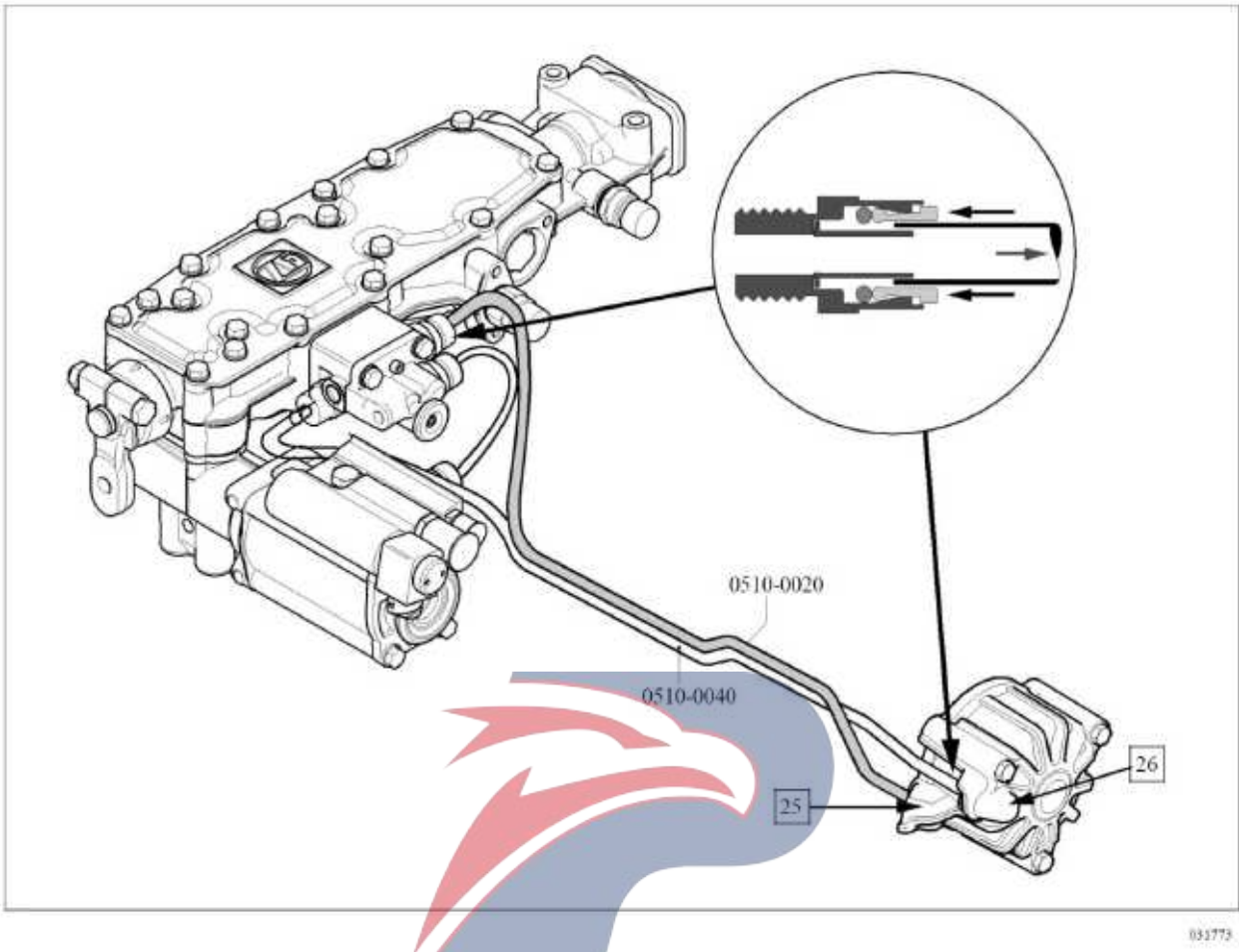
1.1.2 Install polyamide pipe

1 Install polyamide tubes 0510-0020 and 0510-0040 according to the markings made.

Insert the polyamide tube into the plug clutch on the high and low cylinder and shift system and check to see if the tube is secure by pulling it lightly.

Hint

Observe the distance from the polyamide tube to the housing of at least 5 mm.



1.2 Double H

1.2.1 Dismantle the polyamide pipes

Hint

The interface positions are marked. The tubes are mounted with reversion-twist:

• Location 0510-0020 (25),

The valve block is behind, and GP is down.

• Location 0510-0040 (26),

The valve block is in front, and GP is up.

1 Release the polyamide tubing 0510-0020 and 0510-0040 on the clutch (see simplified illustration) and remove.

1.2.2 Install the polyamide pipes

1 Install the polyamide tube according to the markings made 0510-0020 and 0510-0040。

Insert the polyamide tube into the clutches on the high - low gear cylinder and shift system and check to see if the tube is stationary by lightly pulling.

Hint

Observe the distance from the polyamide tube to the housing of at least 5 mm.

2 Shift cantilever / suspension

2.1 Pneumatic servo control unit 2-3

2.1.1 Disassembly the pneumatic servo control unit 2-3

2.1.2 Install pneumatic servo control unit 2-3

2.2 2.2 (Overlap) Single H shift housing 2-4

2.2.1 Standard shift housing 2-4

2.2.1.1 Disassembly and dismantling of shift housing 2-4

2.2.1.2 Assemble the shift housing 2-8

2.2.1.3 Gear selection diagrams of standard (overlap) single **H** gearshift suspension arm / suspension 2-11

2.2.2 Standard shift housing 2-12

2.2.2.1 Disassembly and dismantling of shift housing 2-12

2.2.2.2 Assemble the shift housing 2-16

2.2.2.3 The gear selection diagrams of (overlapped) single **H** gearshift system gearshift suspension arm / suspension are determined by gears 2-20

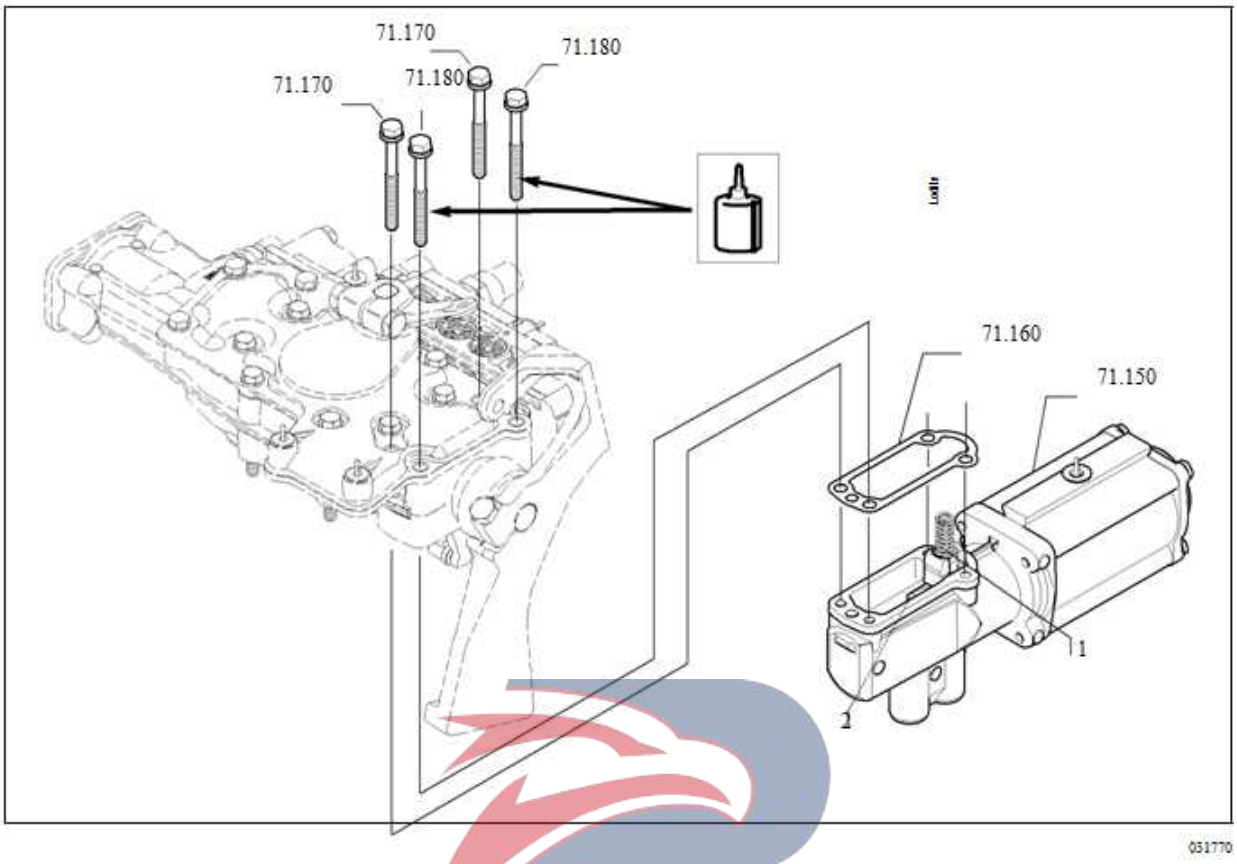
2.3 Double H shift housing 2-21

2.3.1 Disassembly and dismantling of shift housing 2-21

2.3.2 Assemble the shift housing 2-23

2.3.3 Gear selection diagrams of double **H** gearshift system gearshift suspension arm / suspension 2-26

2.4 Integral mounting Shift cantilever / suspension 2-28



2 Shift cantilever / suspension

2.1 Pneumatic servo control unit

2.1.1 Disassembly pneumatic servo control unit

1 Release the hexagonal bolt 71.170 / 71.180.

2 Remove the pneumatic servo control unit 71.150 together with the sealing gasket 71.160 and the compression spring (1).

Hint

• The compression spring (1) is loosely placed in the pneumatic servo control unit.

• Do not continue to disassemble the pneumatic servo control unit, which is a whole unit.

• The servo control unit

0501 216 414* Standard servo control unit

0501 216 322 * Servo unit determined by gears

2.1.2 Install pneumatic servo control unit

1 Place the compression spring (1) in the servo control unit.

2 Install the pneumatic servo control unit 71.150 together with the new gasket 71.160 onto the gearshift suspension arm / suspension.

3 Install and tighten the hexagonal bolt 71.170 / 71.180.

Tightening torque: 23 Nm

Hint

Apply the **Loctite 574** joint agent to the hexagonal bolt **71.180** and install it in.

Order number: Compression spring **(1) 0501 318 490**

Stopper (2) 0501 319 920

* Refer to the general assembly list for the binding instructions.

2.2 (Overlap) Single H shift housing

2.2.1 Standard shift housing

2.2.1.1 Disassembly and dismantling shift housing

1 Loosen hex bolts 11.340 and remove selector handle 11.320 and cover 11.300.

Hint

If the selector rod covers the hexagonal bolt, the gearshift system can not be disassembled before the selector rod is removed.

2 Loosen hex bolts 08.890 and remove remove shift arm / suspension and seal

Take down the roller 8.470 from the valve stem.

Hint

Remove the servo shift mechanism, see section 2.1.

3 Loosen the hexagonal bolt 08.950 and remove the gearshift lever 08.940 and the protective cover 08.930.

Hint

Mark the shift lever position.

4 Loosen hex bolts 09.090 / 09.100 and remove it with valve block 09.010 together.

Hint

The gasket will stick to the housing, remove it from the housing and place it in the valve block. Do not dismantling the valve block, because it is whole.

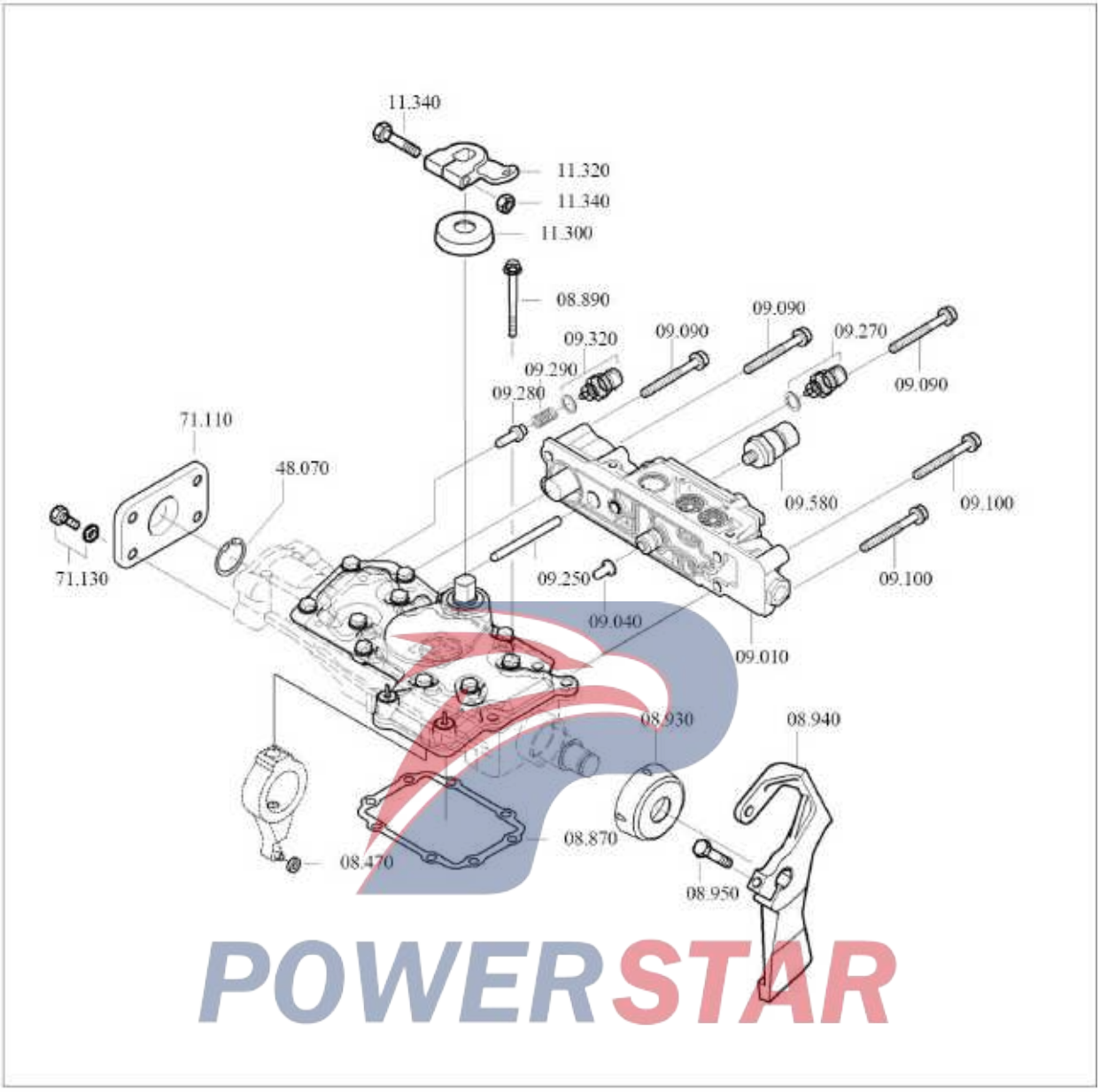
5 When needed, loosen and remove the neutral switch 09.270, gasket and pressure switch 09.580.

6 Remove tappet 09.040 and pin 09.250 from the shift housing.

7 Release the reverse switch 09.320 and the sealing ring together with the compression spring 09.290 and the locking pin 09.280.

8 Loosen the hexagon screw 71.130 and remove the cover 71.110.

9 Remove the V-ring 49.070 from the housing.


11.340
11.320
11.340
11.300
08.890
09.090
09.090
09.270
09.320
09.290
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08.930
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08.870
08.470
08.950
POWERSTAR
031860

10 Loosen hexagon socket head cap screw 08.830, remove cap 08.810 and seal 08.800.

11 Remove pawl 08.540 and pin 08.530.

12 Pass pin 08.560 through the shift housing and remove.

Note

Retaining ring 08.380 must not be distracted - using adjustable clamps.

13 pop-up ring 08.380.

14 Remove the stud 08.370 / 110 and remove the retainer ring 08.370 / 120 if necessary.

15 Push the hollow shaft 08.300 toward the closure cover.16 Make the percussion auxiliary device 1X25 139 783 pass through the needle roller sleeve 08.440, and slightly press / tap the valve stem 8.410 downward.

17 Remove the needle roller sleeve 08.440.

18 Remove the pin 08.430.

19 Remove the gearshift shaft 08.150 from the gearshift housing in the direction of the arrow, and take down the valve stem 08.410 and the handle 08.490.

Hint

heck the holes on the shift shaft and, if necessary, trim the burrs / flanges.

20 Remove the pin 08.450 from the valve stem, do not remove the lower needle roller sleeve. If the needle roller sleeve is damaged, replace the valve stem and the needle roller sleeve together.

21 Place the plastic mandrel over the hollow shaft 08.300 and knock out / eject the bushing 08.100 and the shaft seal 08.130 from the shift housing together with the hollow shaft. Push the hollow shaft out of the shift housing and remove the follower 08.350 and the lock block 08.360.

22 Remove the stud 08.080 if necessary.

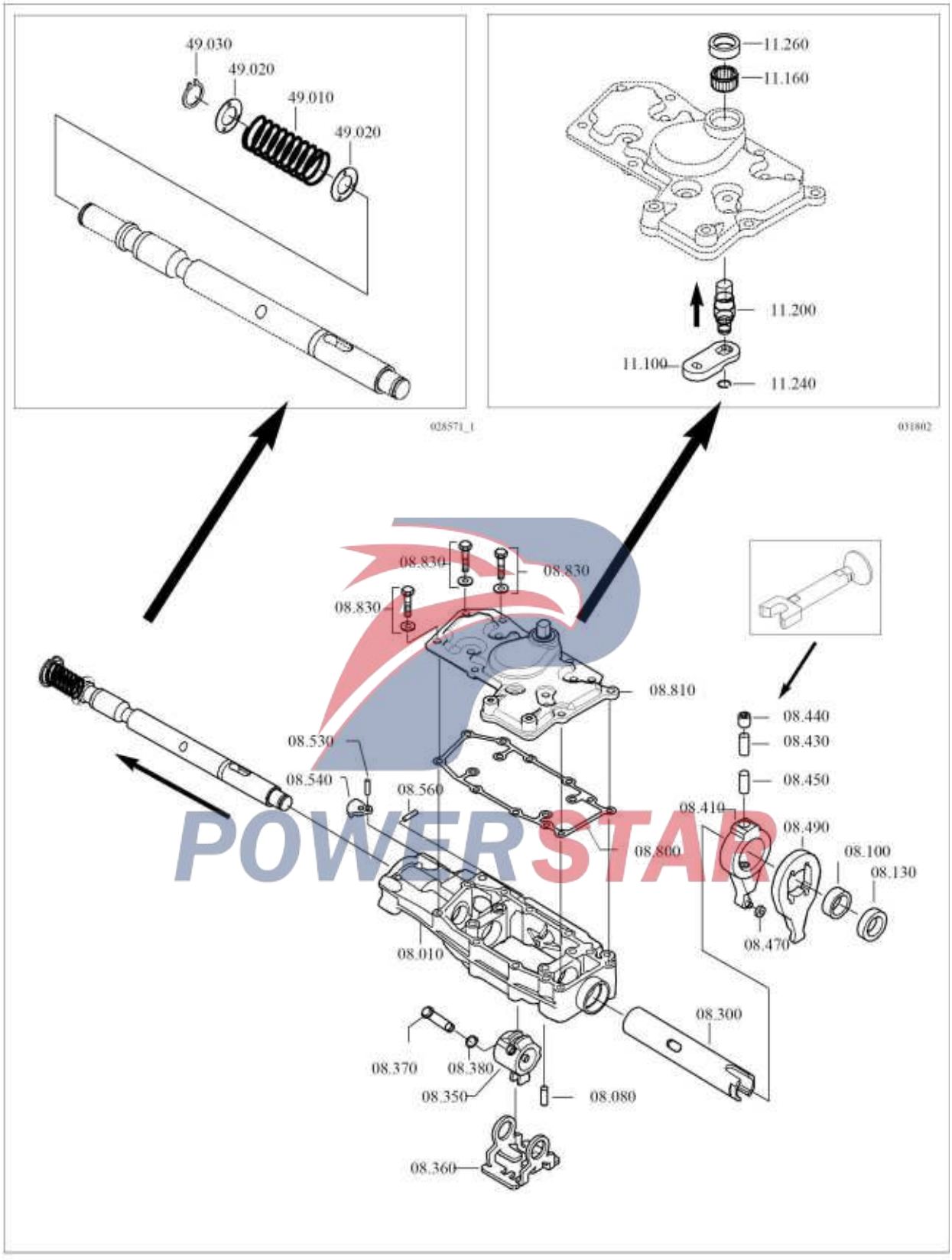
23 Remove the V-ring 49.030 from the shift shaft with the clamp.

24 Remove washer 49.020 and compression spring 49.010 from the shift shaft.25 将 V-ring 11.240 Remove from gear selector shaft 11.200.

26 Slide selector shaft 11.200 out / out of housing cover in the direction of the arrow and remove with shaft seal 11.260 together.

27 Remove the gearshift handle 11.100 from the housing cover.

28 Remove the needle guard 11.160 from the housing cover, if necessary.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2.2.1.2 Assemble the shift case

1 Place the 11.160 needle roller holder flat on the housing cover when required.

2 Insert the selector lever 11.100 into the housing cover.

3 Insert selector shaft 11.200 in the direction of the arrow into housing cover and selector lever.

4 Insert the V-ring 11.240 into the gearbox shaft.

5 Apply grease to shaft seal 11.260 and fit snugly in axial position.

6 Install washer 49.020, compression spring 49.010 and washer 49.020 onto the shift shaft.

7 Apply V-ring 49.030 to the shift shaft with a clamp.

8 Guide the follower 08.350 and the lock block 08.360 into the shift housing. Push the hollow shaft 08.300 into the shift housing, locking block and follower exactly.

9 Press the bushing 08.100 into the housing using the kit 1X25 139 707 and align / level.

10 Grease the shaft seal 08.130 and push it into place.

11 Insert the stud 08.450 into the valve stem 08.410. Press into stud 08.080 if necessary.

12 Fit the valve stem 08.410 and the handle 08.490 in the shift housing to the hollow shaft.

13 Slide shift shaft 08.150 into the hollow shaft in the direction of the arrow.

Hint

The stud pin 08.450 must engage the shift shaft. Position the shift shaft and hollow shaft.

14 Insert the studs 08.430, press in the new needle cap 08.440 and align / level. Check the shift shaft activity freely.

Note

Retaining rings 08.370 / 120 and 08.380 must not be distracted - use adjustable clamps.

15 Fit the retainer ring 08.370/120 onto pin 08.370 / 110 and fit into the follower and shift shaft. Insert the retaining ring 08.380.

16 Install the pin 08.520 in the hollow shaft and the gearshift shaft.

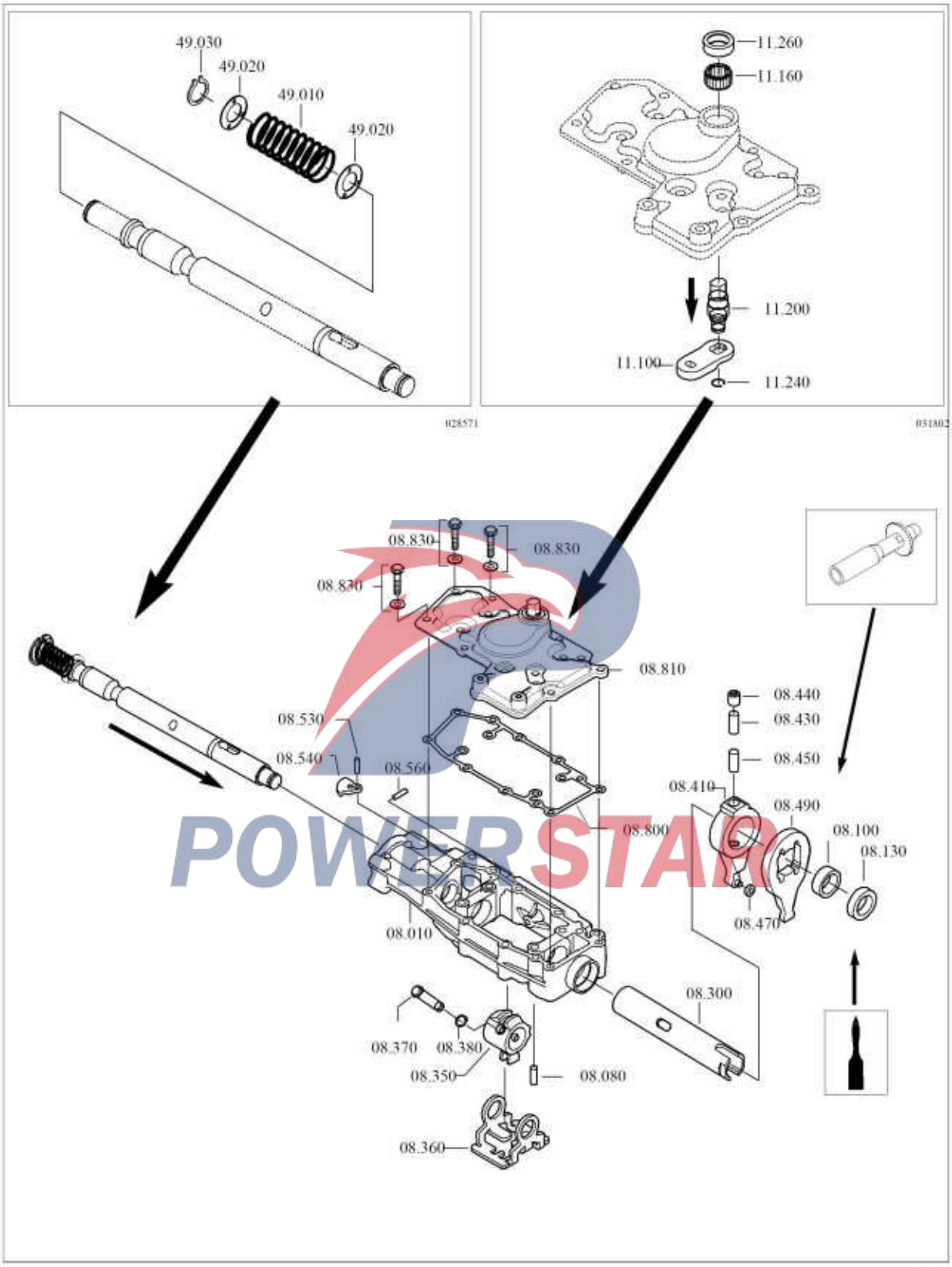
17 Install the pin 08.560 in the housing until it stops, and use the pin **08.530** to fix.

Insert pawl 08.540.

18 Place the new gasket 08.800 and the lid 08.810.

19 Insert the hexagon socket head cap screw 08.830 and tighten.

Tightening torque: 23 Nm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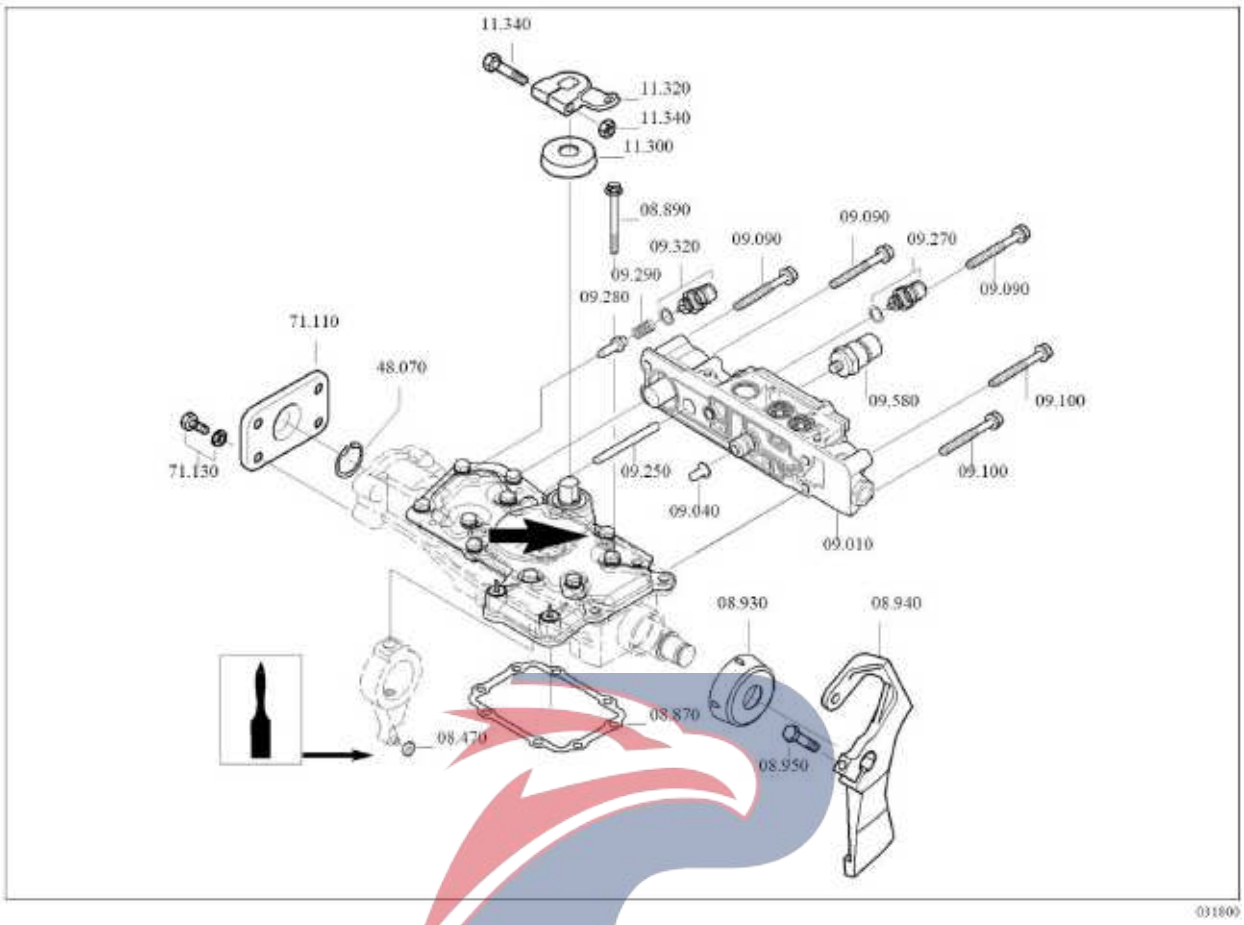


19 Fit lock pin 09.280, spring 09.290, and reverse switch 09.320 to the shift housing together with the seal and tighten.

Tightening torque: 45 Nm

20 Insert tappet 09.040 and pin 09.250 into the shift housing.

21 Fasten the valve block 09.010 with the hexagonal bolt 09.090 / 09.100 to the shift housing.

Tightening torque: 23 Nm

22 Screw neutral switch 09.270 and new seal ring onto the valve block and tighten.

Tightening torque: 45 Nm

23 Screw pressure switch 09.580 onto the valve block and tighten.

Tightening torque: 23 Nm

24 Insert the V-ring 49.070 into the shift housing.

25 Fasten the cover 71.110 to the housing with the hexagon bolt 71.130 and tighten the bolt.

Tightening torque: 23 Nm

26 Apply grease to roller 08.470 and attach to valve stem.

Hint

• Install the servo shift mechanism, see section 2.1.

• Install the entire gear shift system on the gearbox, see section 2.4.

27 Fit cover 11.300 and selector lever 11.320 to the selector shaft and secure with hex nuts 11.340.

Tightening torque: 23 Nm

Hint

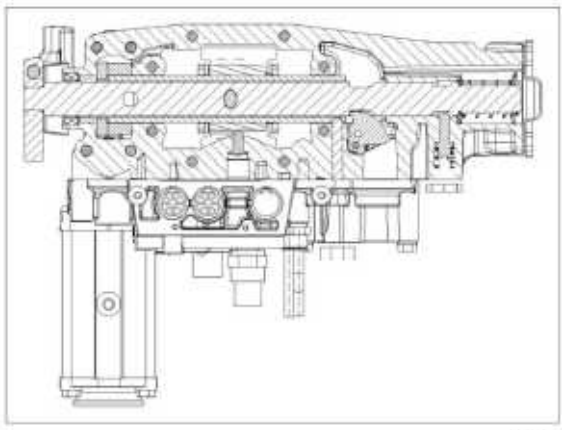
If the shift system is to be mounted rearward on the gearbox, the bolts (see arrow) must be installed in the shift system before the gear selector lever is installed.

2.2.1.3 Gear selection diagrams

For standard (overlapped) single **H** gearshift system gearshift suspension arm / suspension, see Sectional View 1341 173 027

Selecte gear figure I

Spring group Q1 arrangement



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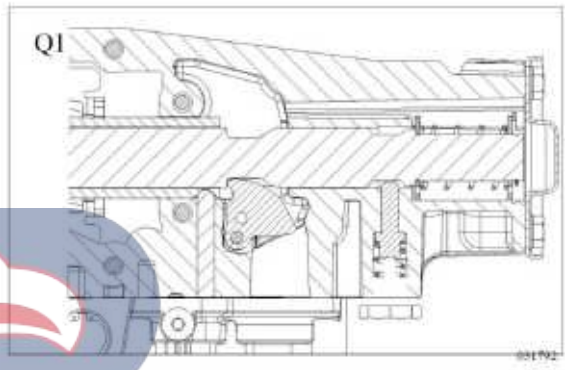


2.2.2 Gear shift housing

2.2.2.1 Remove and disassemble the shift housing

1 Loosen the hexagon bolt 11.340 and remove the selector lever 11.320 and cover 11.300.

Hint

The gearshift handle blocks the hexagonal bolt. The gearshift system can not be disassembled before the gearshift handle is removed.

2 Loosen the hex head bolt 08.890 and remove the shift arm / suspension and seal gasket 08.870.

Remove the roller 08.470 from the valve stem.

Hint

Remove the servo shift mechanism, see chapter 2.1

13 Loosen the hexagonal bolt 08.950, and remove the gearshift handle 08.940 and the protective cover 08.930.

Hint

Mark the position of gearshift handle.

4 Loosen hex bolts 09.090 / 09.100 and remove with valve block 09.010.

Hint

The gasket will stick to the housing, remove it from the housing and place it in the valve block. Do not continue to disassemble the valve block, for the whole.

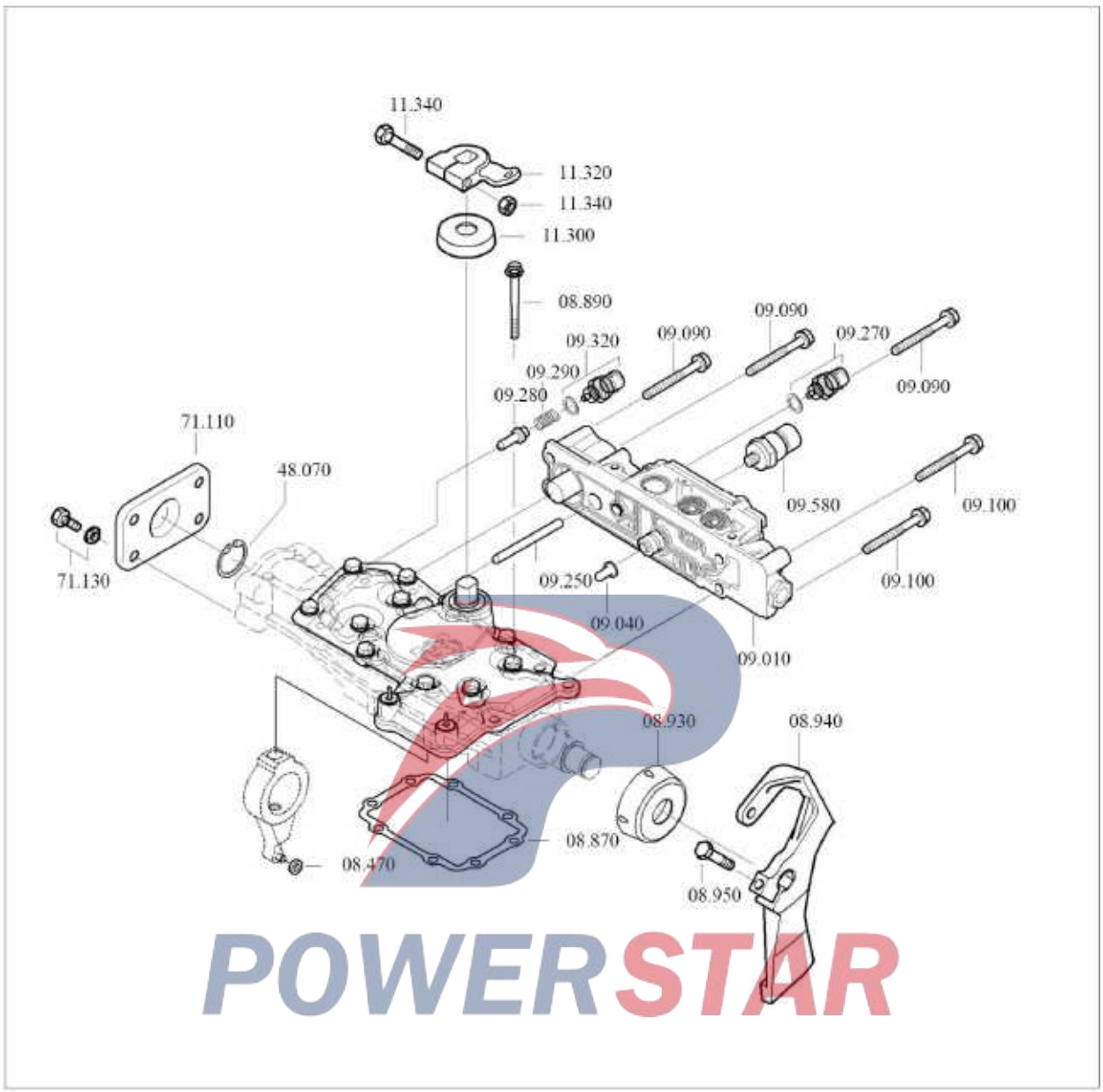
5 When needed, loosen and remove the neutral switch 09.270, gasket and pressure switch 09.580.

6 Remove tappet 09.040 and pin 09.250 from the shift housing.

7 Release the reverse switch 09.320 and the sealing ring together with the compression spring 09.290 and the locking pin 09.280.

8 Loosen the hexagon screw 71.130 and remove the cover 71.110.

9 Remove the V-ring 49.070 from the housing.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G01800

10 Loosen hexagon socket head cap screw 08.830, remove cap 08.810 and seal 08.800.

11 Remove pawl 08.540 and pin 08.530.

12 Pass pin 08.560 through the shift housing and remove.

note

Retaining ring 08.380 must not be distracted - using adjustable clamps.

13 pop-up ring 08.380.

14 Remove the stud 08.370 / 110 and remove the retainer ring 08.370 / 120 if necessary.

15 Remove the pin 08.520.

16 Push the hollow shaft 08.300 toward the closure cover.

17 Pass the percussion aid 1X25 139 783 through the needle guard 08.440 and slightly lower the valve handle 08.410.

18 Remove the needle roller sleeve 08.440.

19 Remove the dowel 08.430.

20 Remove the gearshift shaft 08.150 from the gearshift housing in the direction of the arrow, and meantime take down the valve handle 08.410 and the handle 08.490.

Hint

Check the holes on the shift shaft and, if necessary, trim the burrs / flanges.

21 Remove the pin 08.450 from the valve stem without removing the lower needle guard. If the needle guard is damaged, replace the valve stem together with the needle guard.

22 Place the plastic mandrel over the hollow shaft 08.300 and knock out / eject the bushing 08.100 and the shaft seal 08.130 from the shift housing together with the hollow shaft. Push the hollow shaft out of the shift housing and remove the follower 08.350 and the lock block 08.360.

23 Remove the stud 08.080 if necessary.

24 Use a clamp to remove the V-ring 49.030 from the shift shaft.

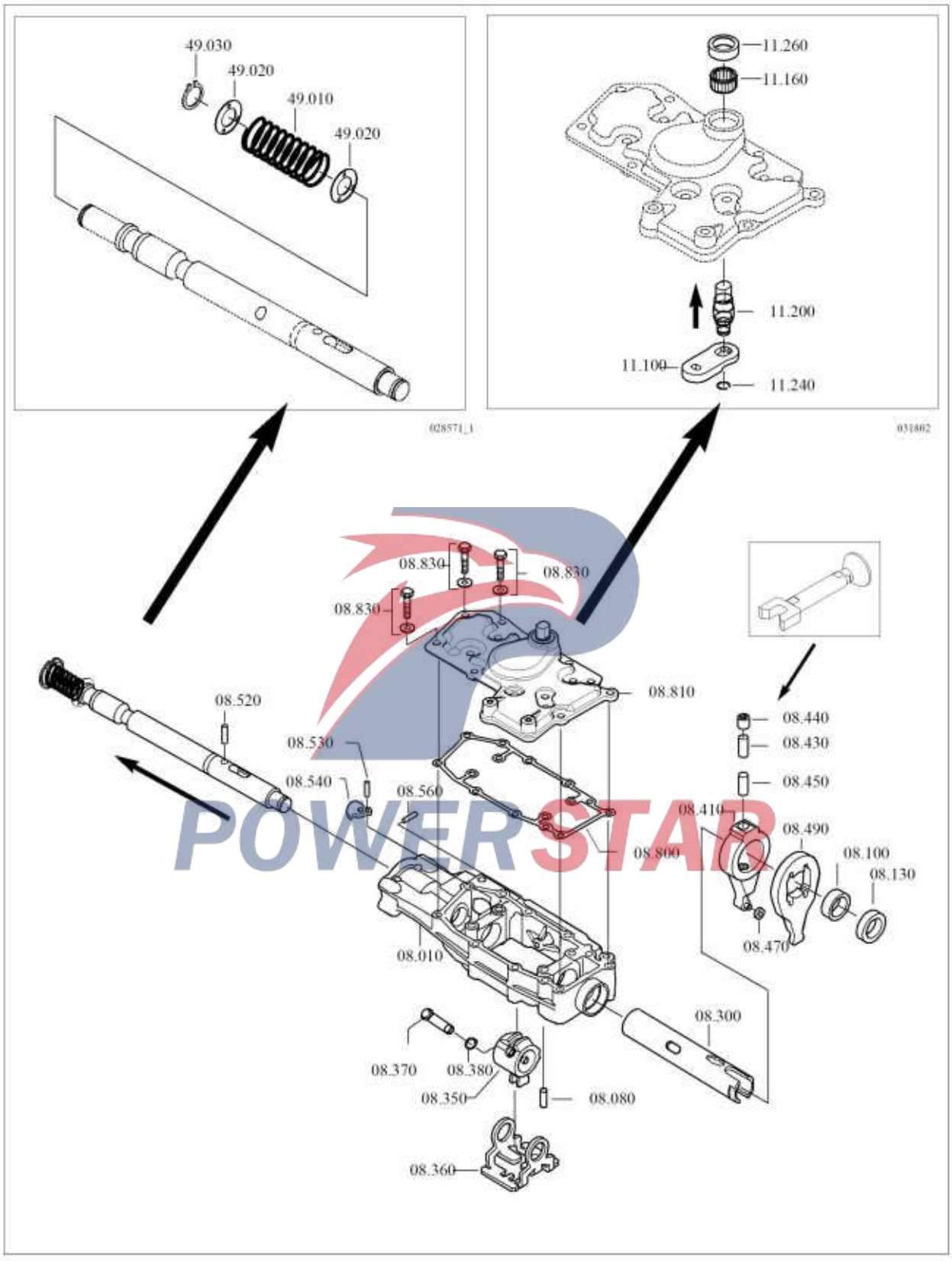
25 Remove washer 49.020 and compression spring 49.010 from the shift shaft.

26 Remove the V-ring 11.240 from the gear selector shaft 11.200.

27 Slide selector shaft 11.200 out of the housing cover in the direction of the arrow and remove with shaft seal 11.260.

28 Remove the gearshift handle 11.100 from the housing cover.

29 Remove the needle guard 11.160 from the housing cove if necessary.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08.010
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031801_1

2.2.2.2 Assemble the shift housing case

1 Place the 11.160 needle roller holder flat on the housing cover when required.

2 Insert the selector lever 11.100 into the housing cover.

3 Insert selector shaft 11.200 in the direction of the arrow into housing cover and selector lever.

4 Insert the V-ring 11.240 into the gearbox shaft.

5 Apply grease to shaft seal 11.260 and fit snugly in axial position.

6 Install washer 49.020, compression spring 49.010 and washer 49.020 onto the shift shaft.

7 Apply V-ring 49.030 to the shift shaft with a clamp.

8 Guide the follower 08.350 and the lock block 08.360 into the shift housing. Push the hollow shaft 08.300 into the shift housing, locking block and follower exactly.

9 Press the bushing 08.100 into the housing using the kit 1X25 139 707 and align / level.

10 Grease the shaft seal 08.130 and push it into place.

11 Insert the stud 08.450 into the valve stem 08.410. Press into stud 08.080 if necessary.

12 Fit the valve stem 08.410 and the handle 08.490 in the shift housing to the hollow shaft.

13 Slide shift shaft 08.150 into the hollow shaft in the direction of the arrow.

Hint

The stud pin 08.450 must engage the shift shaft. Position the shift shaft and hollow shaft.

14 Insert the studs 08.430, press in the new needle cap 08.440 and align / level. Check the shift shaft activity freely.

Note

Retaining rings 08.370 / 120 and 08.380 must not be distracted - use adjustable clamps.

15 Fit the retainer ring 08.370/120 onto pin 08.370 / 110 and fit into the follower and shift shaft. Insert the retaining ring 08.380.

16 Install the pin 08.520 in the hollow shaft and the gearshift shaft.

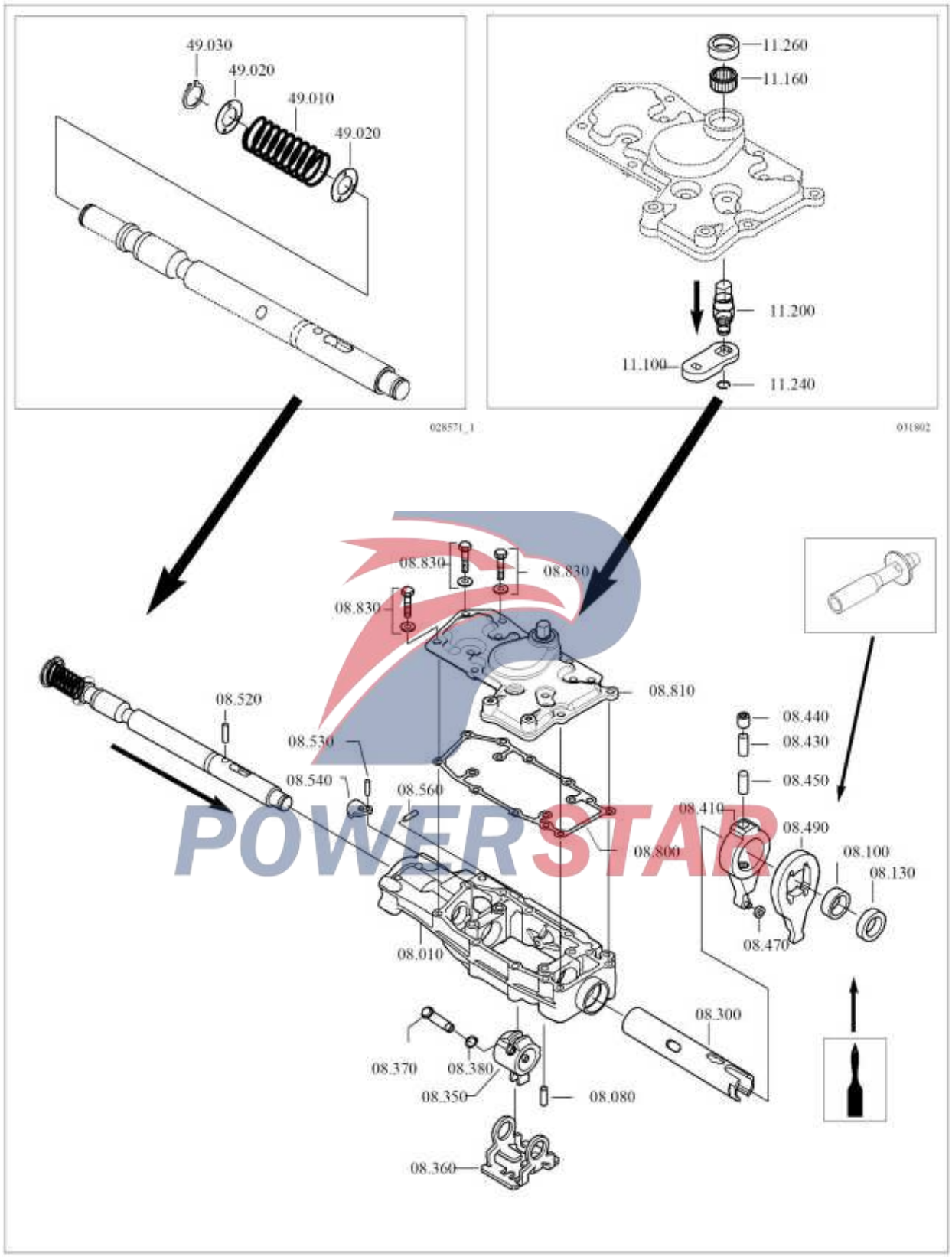
17 Install the pin **08.560** in the housing until it stops and use the pin 08.530 to fix.

Insert pawl 08.540.

18 Place the new gasket 08.800 and the lid 08.810.

19 Insert the hexagon socket head cap screw 08.830 and tighten.

Tightening torque: 23 Nm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08.490
08.100
08.130
08.470
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08.080
08.360
031801_1

20 Fit lock pin 09.280, spring 09.290 and reverse gear switch 09.320 together with the sealing ring onto the shift housing and tighten.

Tightening torque: 45 Nm

21 Load tappet 09.040 and pin 09.250 into the shift housing.

22 Fasten the valve block 09.010 to the shift housing with the hexagon socket head cap screw 09.090 / 09.100.

Tightening torque: 23 Nm

23 Screw neutral switch 09.270 and new seal ring onto the valve block and tighten.

Tightening torque: 45 Nm

24 Screw pressure switch 09.580 onto the valve block and tighten.

Tightening torque: 23 Nm

25 Insert the V-ring 49.070 into the shift housing.

26 Fasten the cover 71.110 to the housing with the hexagon bolt 71.130 and tighten the bolt.

Tightening torque: 23 Nm

27 Apply grease to roller 08.470 and attach to valve stem.

Hint

• Install the servo shift mechanism, see section 2.1.

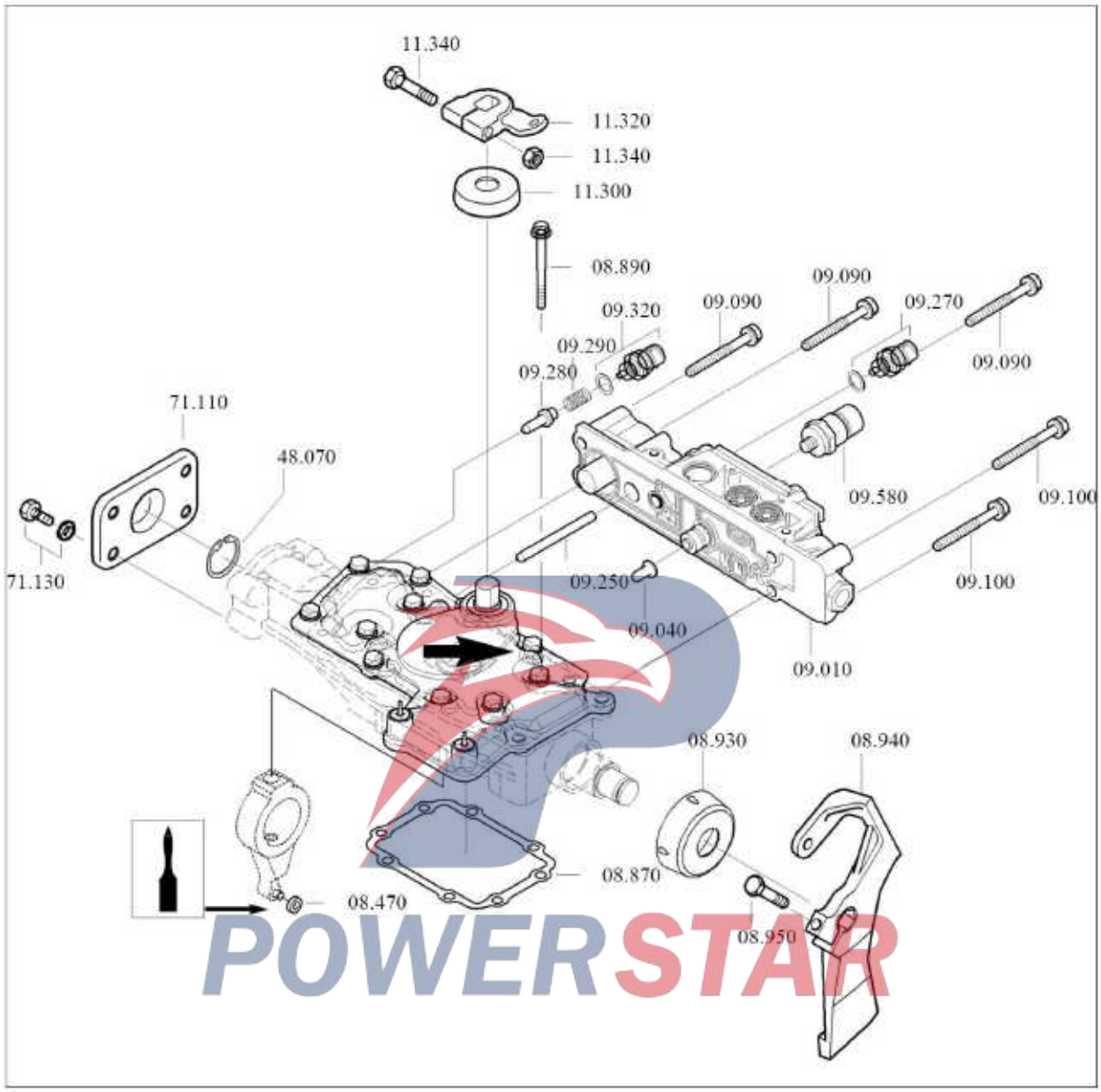
• Install the entire gear shift system on the gearbox, see section 2.4.

28 Fit the cover 11.300 and selector lever 11.320 to the selector shaft and fasten it with the hex nut 11.340.

Tightening torque: 23 Nm

Hint

If the shift system is to be mounted rearward on the gearbox, the bolts (see arrow) must be installed in the shift system before the gear selector lever is installed.


11.340
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09.580
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71.130
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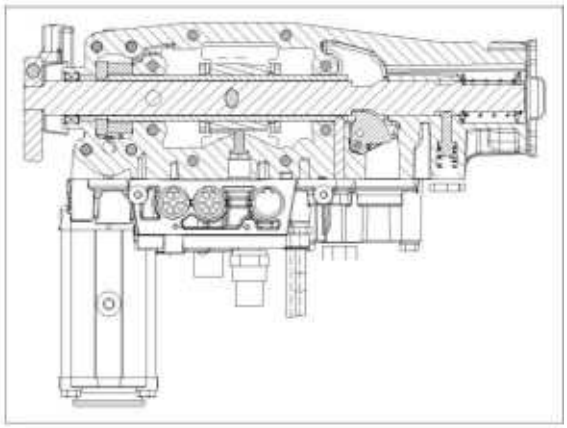
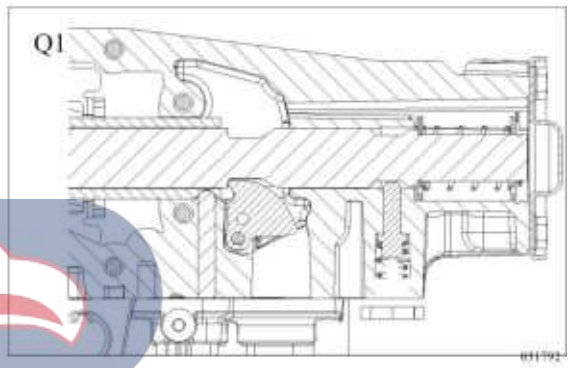
2.2.2.3 Gear selection diagrams

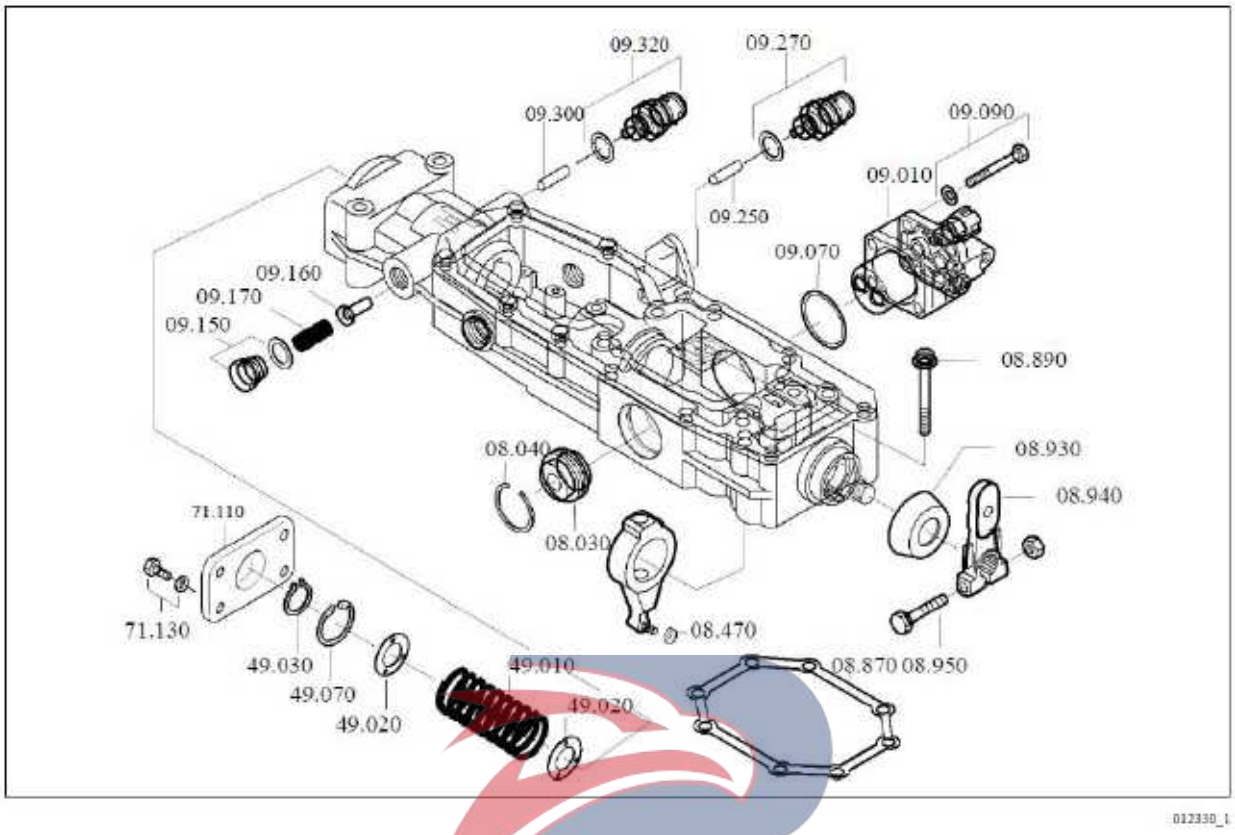
For the gear (overlapped) single H gearshift system gearshift suspension arm /suspension, see Sectional View 1341 173 057

Selecte gear figure I

Spring group Q1 arrangement







2.3 double H shift housing case

2.3.1 Remove and disassemble the shift housing case

1 Loosen the hex bolt 08.890 and remove the shift arm / suspension and gasket 08.870.

Remove the roller 08.470 from the valve stem.

Hint

Remove the servo shift mechanism, see chapter 2.1.

2 Loosen the gearshift handle (**08.940** in accordance with the material genaeral assembly list). and remove it together with the protective cover **08.930**.

Hint

Mark the selector lever position.

3 Disassemble the throttle valve 09.010, and take down it together with the O-ring **09.070**.

Hint

Do not disassemble the throttle valve, which is a whole unit.

4 Loosen the switch **09.320** and **09.270,** and take down them together with the sealing gasket and the pin **09.300** as well as **09.250**. Install the screw-plugs according to different material general assembly lists.

5 Pop-up the V-ring **08.040,** and dismantle the positioning parts **8.030** and the **O**-rings from the gearshift housing.

Hint

Check the **O**-rings and replace them if necessary (see Consumptive Materials).

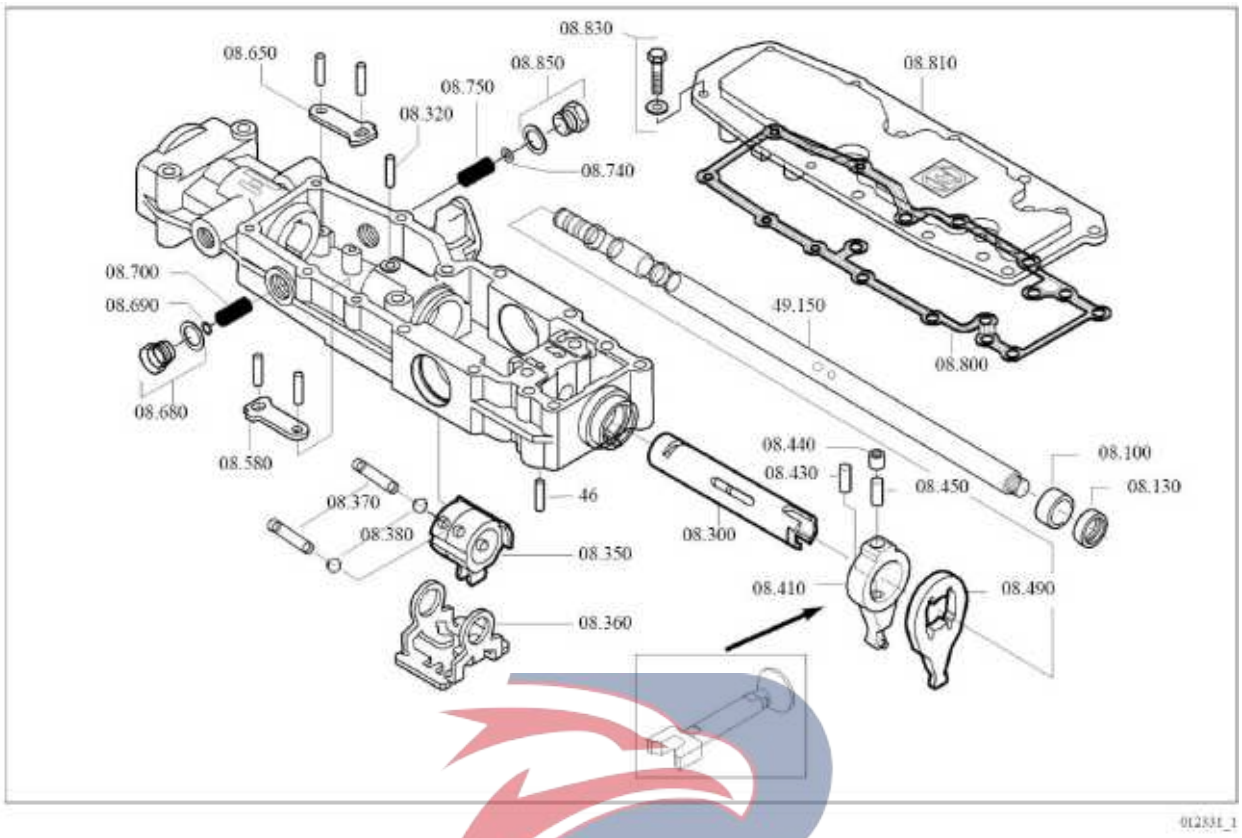
6 Loosen the hexagon screw 71.130 and remove the cover 71.110.

7 Pop the V-ring **49.030** and the retaining ring **49.070**, and dismantle the washer **49.020**, the spring **49.010** and the washer **49.020**.

Hint

The discharge and order of components in operation 7 are based on the material assembly list.

8 Loosen the bolt **09.150**, and dismantle it together with the seal ring, the spring **09.170** and the lock pin **09.160**.



9 Loosen the hexagon socket head cap screw 08.830, remove the cap 08.810 and the gasket 08.800.

10 Loosen the screw plugs **08.680** and **08.730**, and dismantle them together with the sealing ring, the spacing washer **08.690 / 08.740** and the spring **08.700 / 08.750**.

11 Remove the stop handle **08.580** and **08.650** from the gearshift housing. Remove the cylindrical pin if necessary.

Caution

Retaining ring 08.380 must not be open up more - using adjustable clamps.

12 pop-up retainer ring 08.380.

13 Remove the cylinder pin **08.370,** and remove the retaining ring if necessary.

14 Remove the pin **08.320** and push the hollow shaft **08.300** in the direction of the closing cover.

15 Pass the percussion aid 1X25 139 783 through the needle guard 08.440 and slightly lower the valve handle 08.410.

16 Remove the needle roller sleeve 08.440.

17 Remove the pin 08.430.

18 Remove the gearshift shaft **49.150** from the gearshift housing, and meantime remove the valve handle **08.410** and the handle **08.490**.

Hint

Check the holes on the shift shaft and, if necessary, trim the burrs / flanges.

19 Remove the pin 08.450 from the valve stem and do not remove the lower needle roller sleeve. If the needle guard is damaged, replace the valve stem with the needle guard.

20 Place the plastic mandrel over the hollow shaft 08.300 and knock out / eject the bushing 08.100 and the shaft seal 08.130 from the shift housing together with the hollow shaft. Push the hollow shaft out of the shift housing and remove the follower 08.350 and the lock block 08.360.

21 Remove the stud pin 08.080 if necessary.

2.3.2 Assemble the shift housing case

1 Guide the follower 08.350 and the lock block 08.360 into the shift housing. Push the hollow shaft 08.300 into the shift housing, locking block and follower exactly.

2 Press the bushing 08.100 into the housing with the kit 1X25 139 707 and align / level it.

3 Grease the shaft seal 08.130 and press it into place.

4 Install the cylindrical pin **08.430** in the valve handle **08.410**. Press into stud pin 08.080 if necessary.

5 Fit the valve stem 08.410 and the handle 08.490 in the shift housing to the hollow shaft.

6 Insert the gearshift shaft **49.150** into the hollow shaft.

Hint

The cylindrical pin **08.430** must be meshed with the gearshift shaft. Position the shift shaft and hollow shaft.

Caution

The cylindrical pin 08.320 is only used to fix the hollow shaft, and only use a hand to insert until it stops - do not knock/ press it.

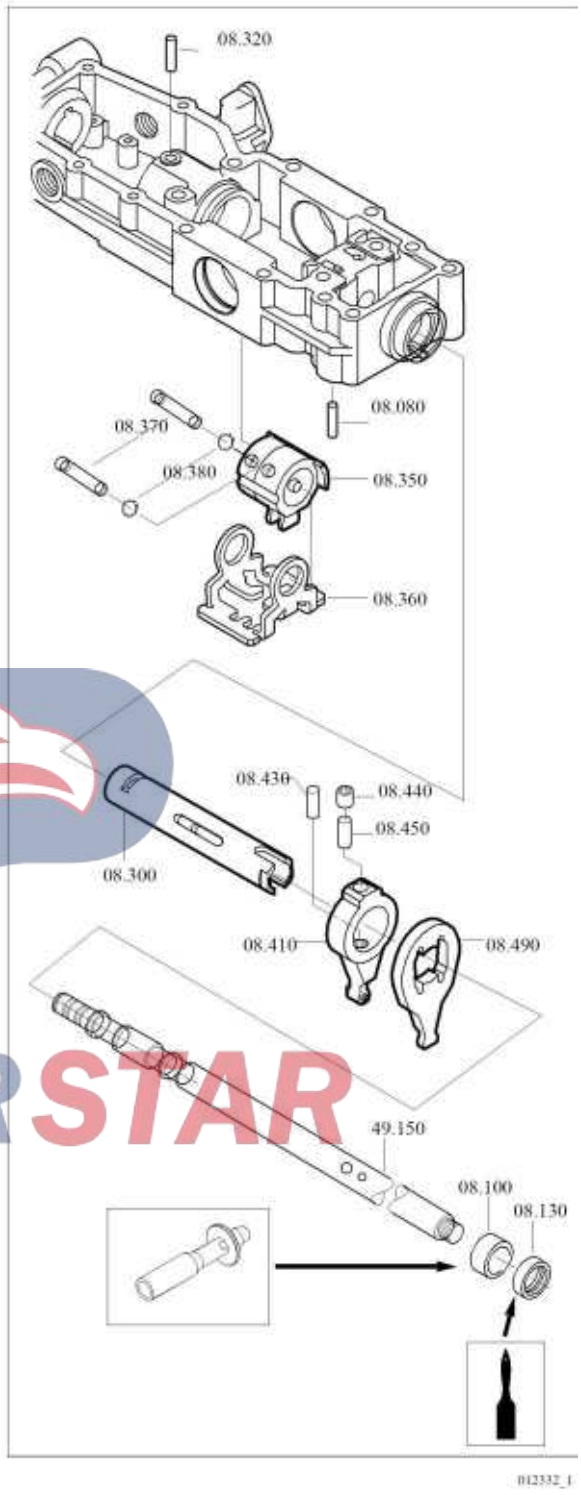
7 Install the cylindrical pin **08.320** in. Check the freedom of movement of the shift shaft.

8 Install the cylindrical pin **08.450**, press the new needle roller sleeve **08.440** in, and align / level it. Check the freedom of movement of the shift shaft.

Caution

Retaining ring 08.380 must not be open up more - using adjustable clamps.

9 Install the pin **08.370** in the follower and the gearshift shaft. Insert the retaining ring **08.380**.



10 Put the stop handles **08.590** and **08.650** into the gearshift housing. Insert the cylindrical pin if necessary.

Hint

The stop handle's discharge position is determined by the material general assembly list.

(See Diagram 012334) 。

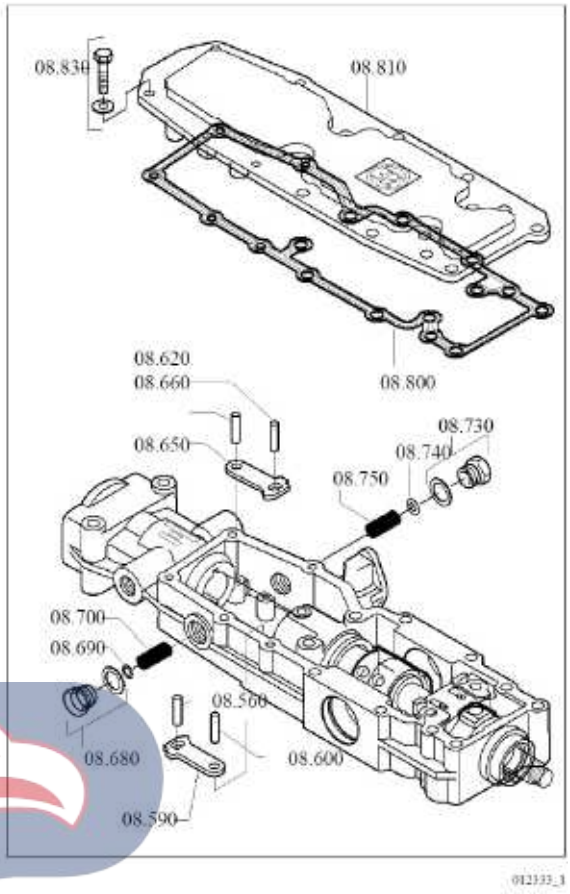
11 Install the screw-plug **08.680** / **08.730** together with the new seal ring, the space washer **08.690** / **08.740**, and the spring **08.700** / **08.750,** and tighten them.

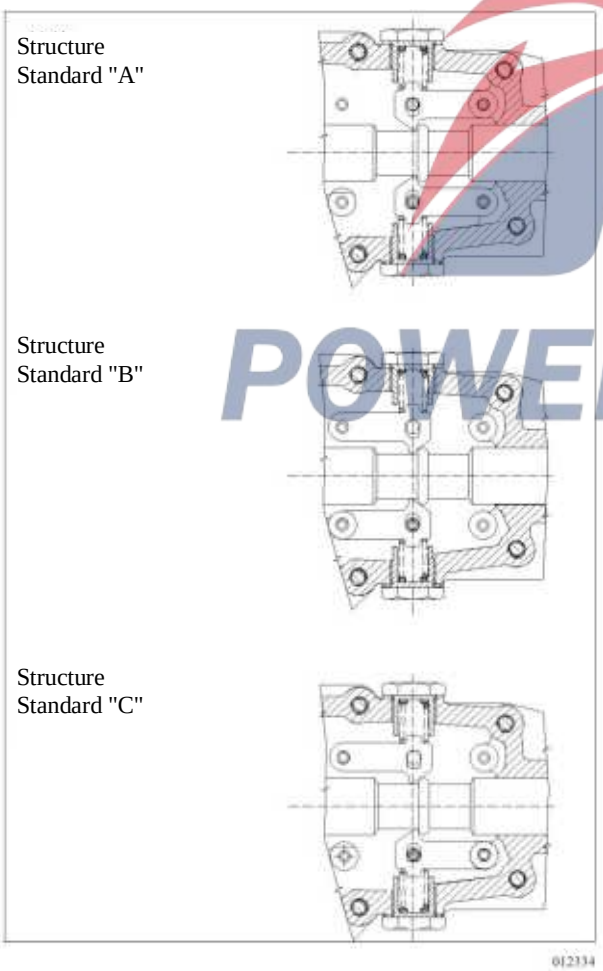
Tightening torque: 60 Nm

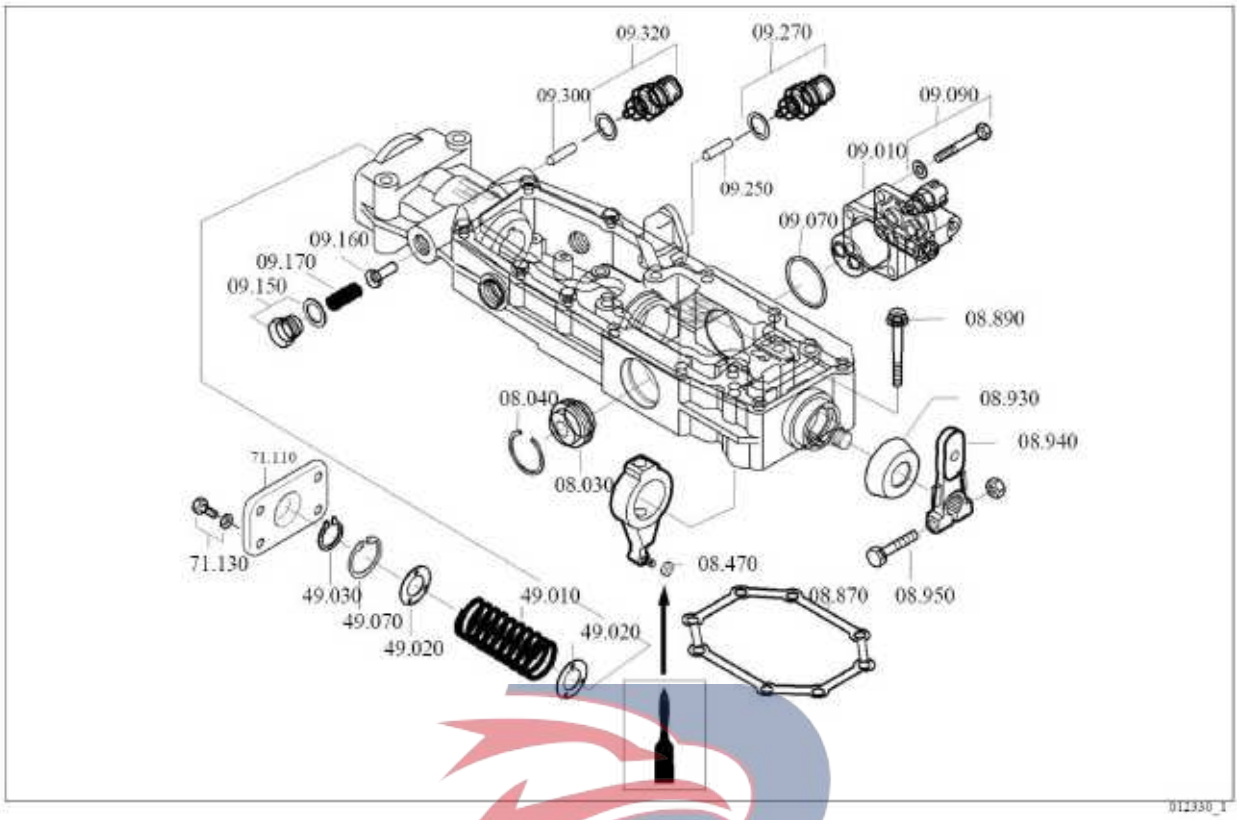
12 Place the new gasket 08.800 and the lid 08.810.

13 Insert the hexagon socket head cap screw 08.830 and tighten.

Tightening torque: 23 Nm







14 Install the washer **49.020**, the spring **49.010** and the washer **49.020,** and insert the retaining ring **49.070** and the V-ring **49.030**.

Hint

The discharge and order of the components in Operation 14 are based on the material assembly.

15 Place the cover **71.110** and use the hexagonal bolt **71.130** to tighten it.

Tightening torque: 23 Nm

16 Install the lock pin **09.160**, the spring **09.170** and the plug screw **09.150** together with the new seal ring and tighten them.

Tightening torque: 60 Nm

17 Install the positioning part **08.030** as well as the grease-coated O-ring and V-ring **08.040** in the gearshift housing.

See Consumptive Materials for the new O-ring.

18 Install the switch **09.320 / 09.270** together with the new seal ring and the pin **09.300 / 09.250** in the gearshift housing, and tighten them.

Tightening torque: 45 Nm

Install the screw plug according to the general material assembly list.

Tightening torque: 35 Nm

19 Use the hexagonal bolt **09.090** to install the throttle valve **09.010** and the grease-coated O-ring **09.070** on the gearshift housing.

Tightening torque: 23 Nm

20 Install the gearshift handle **08.940** and the cover **08.930** on the gearshift shaft, and screw up the hexagon nut **08.950**.

Tightening torque: 49 Nm

21 Apply grease to roller 08.470 and attach to valve stem.

Hint

• See Section 2.1 for installing the servo gearshift mechanism.

• See Section 2.4 for installing the whole gearshift system on the gearbox.

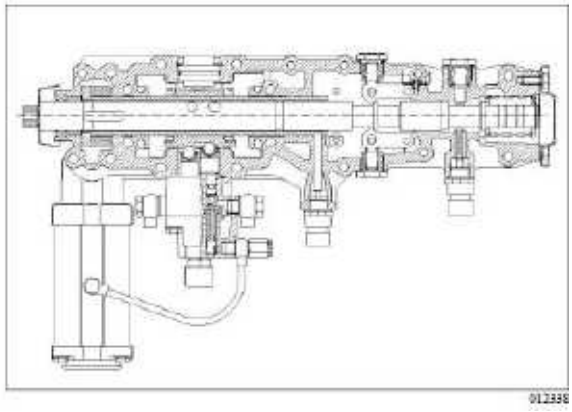
2.3.3 Gear selection diagrams

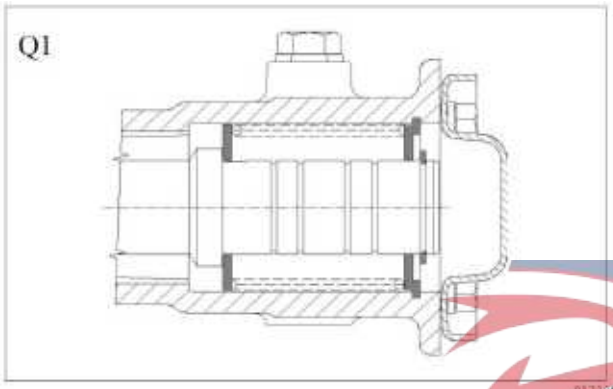
Double H shift system

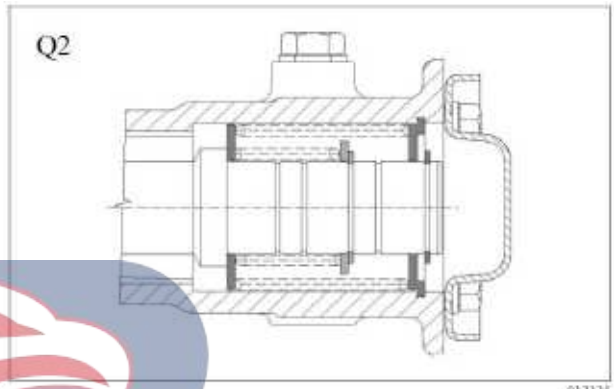
Sectional view 1316 173 010

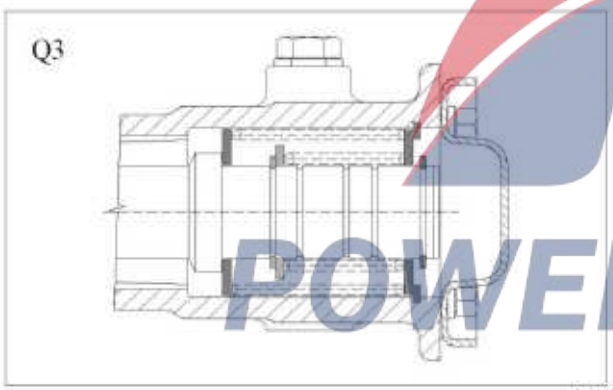
Selecte gear figure I

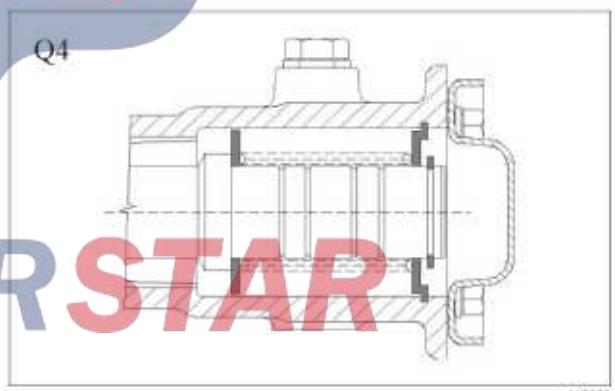
Spring group Q1 arrangement

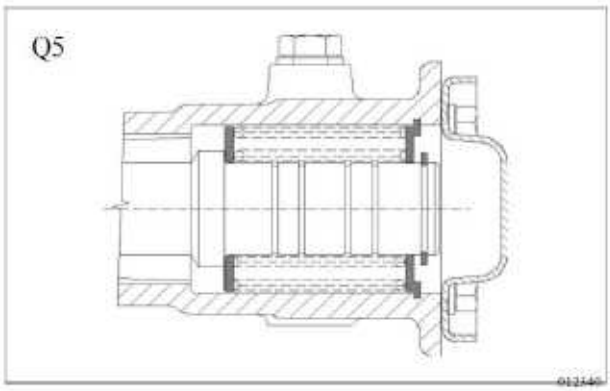


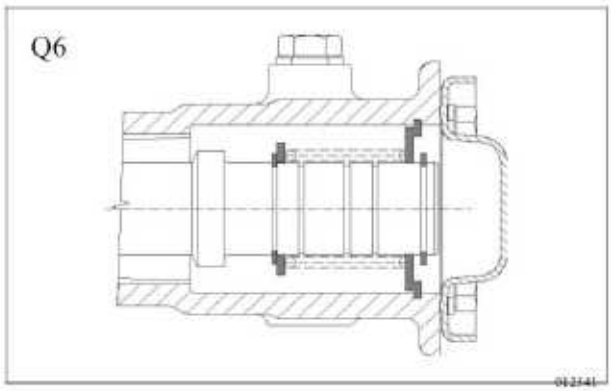






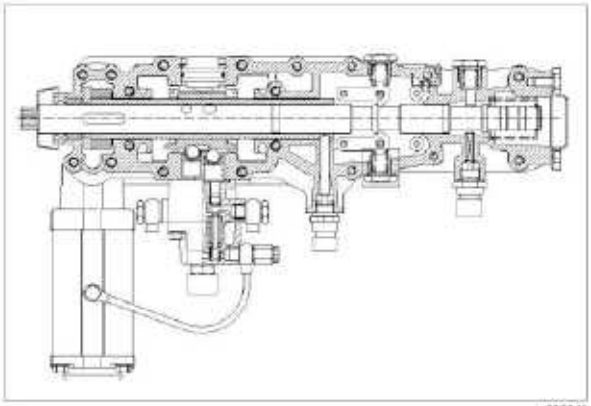


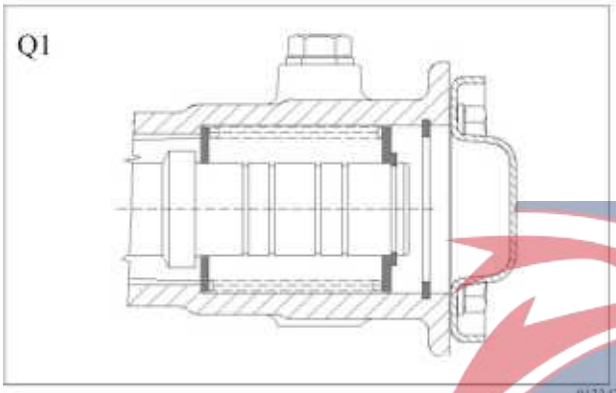


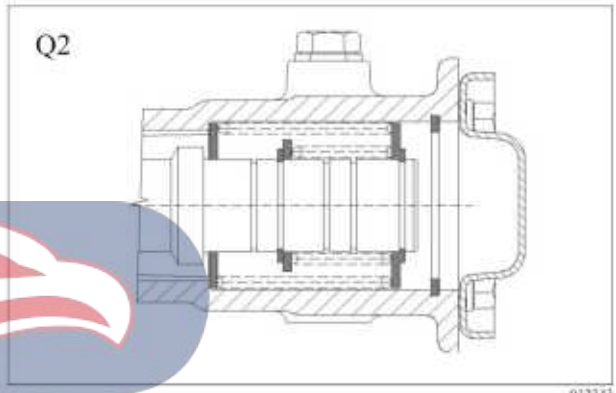


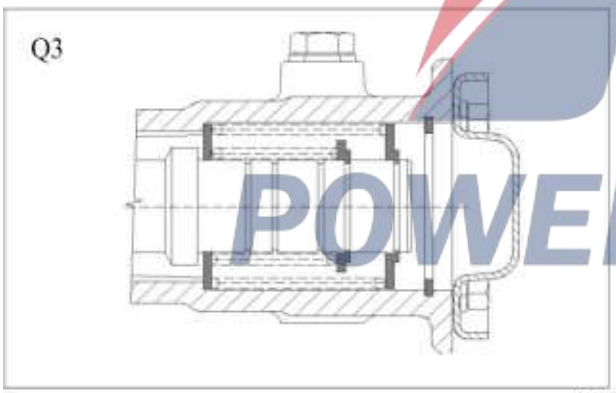
Gear Selection Diagram II

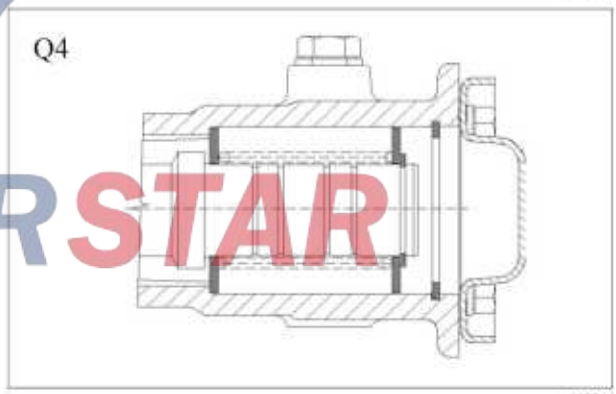
Spring group Q1 – Q6 arrangement

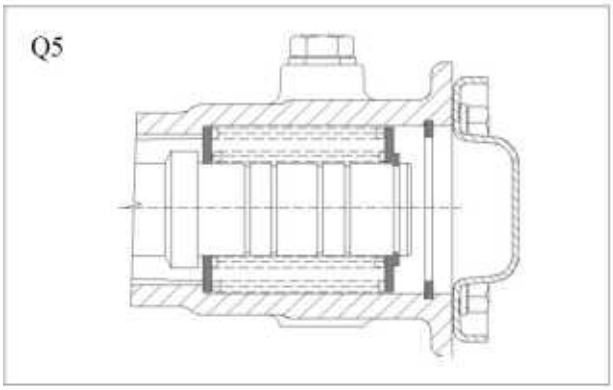


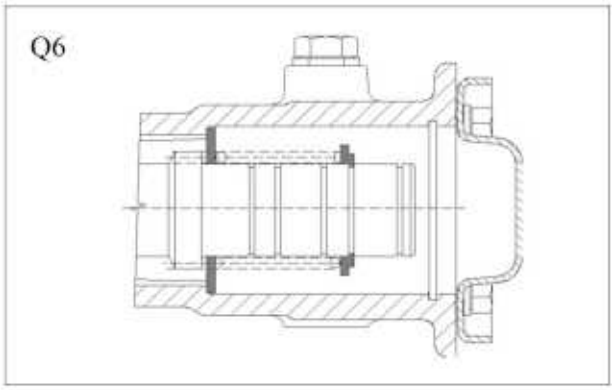












2.4 Overall installation shift cantilever / suspension

1 Install the new sealing gasket **08.870** on the clutch housing or put it onto the sealing surface.

2 Place the whole gearbox housing **08.010** on it.

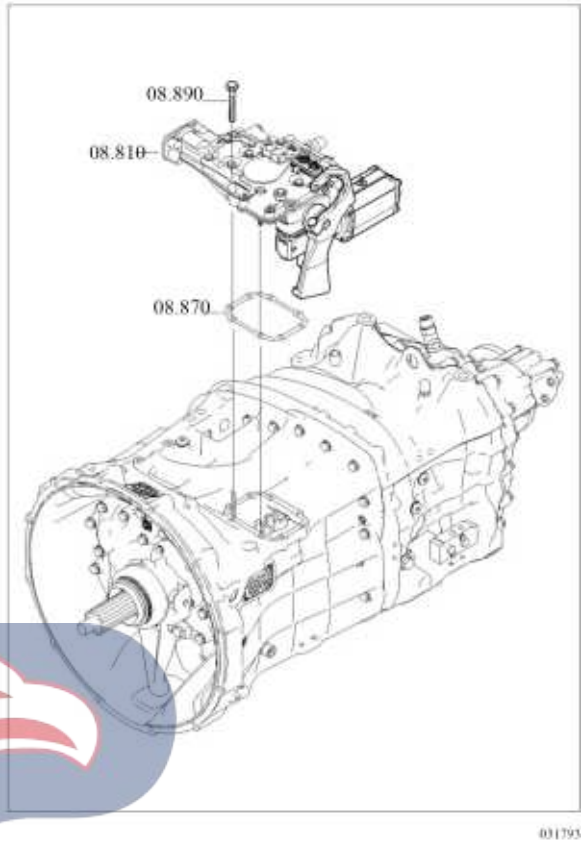
Position the holes in the gearbox housing and the sealing gasket.

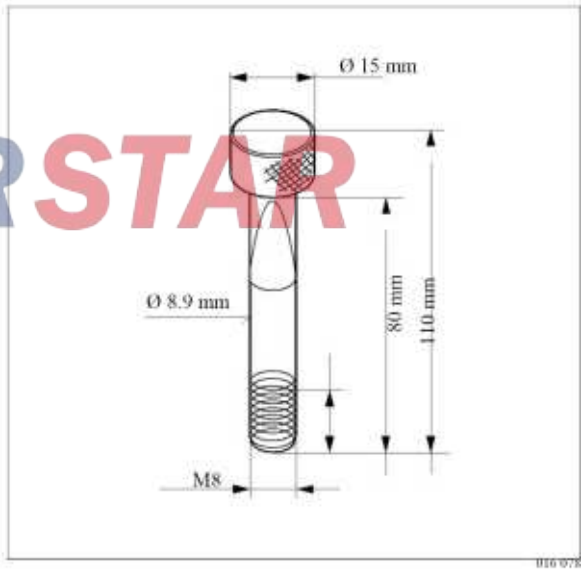
Hint

The positioning between the clutch housing, the sealing gasket and the gearbox housing must be achieved by using **2** positioning pins **1X46 183 298**. In addition, the pins can be self-made, and the diagram 016078 can be referred to.

3 Insert all the hexagonal bolts **08.890** and tighten them.

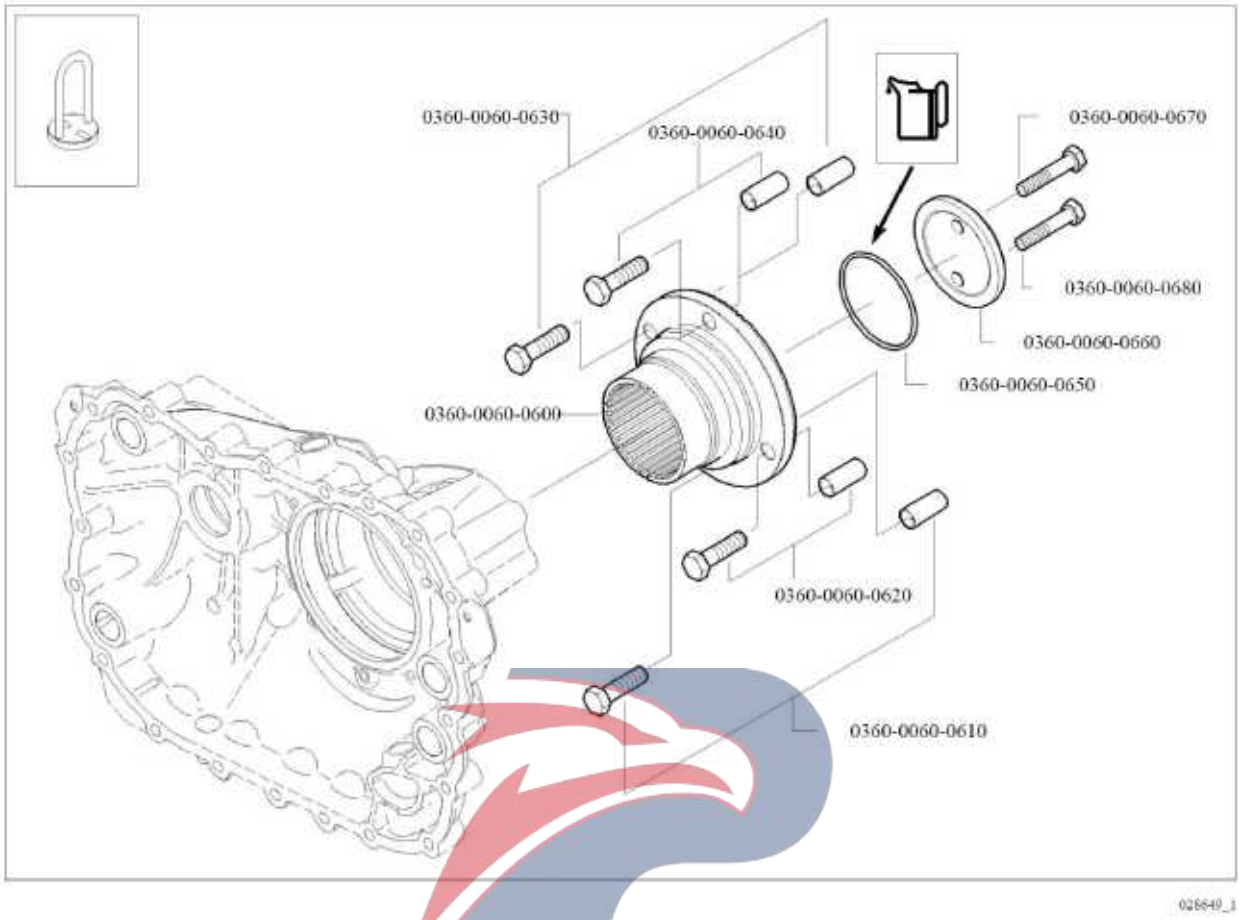
Tightening torque: 23 Nm





3 High-low gear group

3.1 Output flange 3-2
3.1.1 Disassemble the output flange 3-2
3.1.2 Assemble the output flange 3-3
3.2 Cover and output bearings 3-4
3.2.1 Disassemble cover and output bearing 3-4
3.2.2 Assemble the cover and the output bearing 3-5
3.3 High-low gear group 3-6
3.3.1 High-low gear group(standard) 3-6
3.3.1.1 Disassemble high-low gear group 3-6
3.3.1.2 Assemble high-low gear group 3-7
3.3.2 High - low gear group (Reinforcing structure **16 S 2730 TO**) 3-8
3.3.2.1 Disassemble high-low gear group 3-8
3.3.2.2 Assemble high-low gear group 3-9
3.3.2.3 measuring spindle and planetary gear 3-10
3.4 Disassemble and assemble high-low gear group 3-11
3.4.1Disassemble high-low gear group cylinder and piston 3-11
3.4.2 Assemble high-low gear group cylinder and piston 3-12



3 High-low gear group

Hint

When the high - low gear group is repaired, the following steps should followed. If it needs further maintenance and only the high - low gear group should be removed, only the washer **0360-0060-0660** can be removed, and the tooling **1X56 136 260** shall be fixed.

See Section **3.3** for removing the high - low gear group.

3.1 output flange

3.1.1 Disassemble the output flange

1 Remove the hexagonal bolts **0360-0060-0670** and **0360-0060-0680,** and remove the washer **0360-0060-0660**.

2 Use the universal three-jaw puller to unplug the output flange **0360-0060-0600.**

Hint

To protect the shaft, use the gaskets when pulling and unplugging.

3 Remove the hexagonal bolts **0360-0060-0610** to **0360-0060-0640** from the output flange.

4 Remove the O-ring **0360-0060-0650**.

3.1.2 Assemble the output flange

Hint

• Assemble high-low gear group on gearbox, refer to chapter 3.3.

• See Section **3.2** when the output bearing and the cover have been installed.

1 Insert the hexagonal bolts **0360-0060-0610 to 0360-0060-0640** into the output flange.

⚠Danger

Only wear protective gloves to touch the heated output flange.

2 Heat the output flange **0360-0060-0600** to a maximum temperature 100 ℃, and push it onto the meshing teeth of planet carrier until it clings to the axial position.

Hint

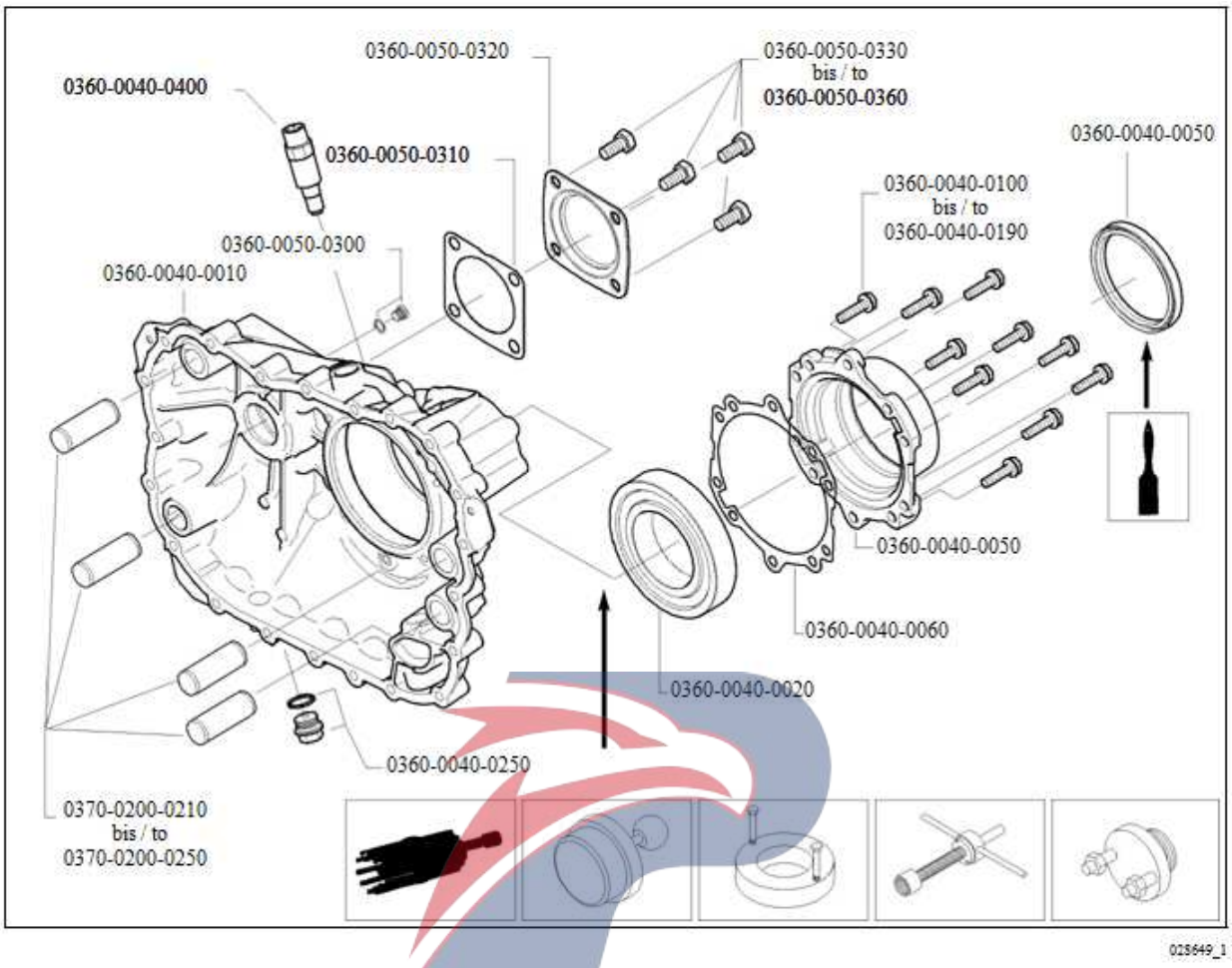
If necessary, install the output flange with the aid of the washers **0360-0060-0660** and two auxiliary mounting bolts until it clings to the axial position. Then remove the washer and the auxiliary mounting bolts.

3 Apply a little oil to the new O-ring **0360-0060-0650,** and place it in the gap between the output flange and the planet carrier shaft.

4 Use the hexagonal bolts **0360-0060-0670** and **0360-0060-0680** to fix the washer **0360-0060-0660**. The flange clamp can also be used to fix the output flange, preventing the reverse twist.

Tightening torque: 120 Nm

5 If necessary, the protective cover can be installed on the hexagonal bolts **0360-0060-0610** to **0360-0060-0640**.



3.2 Cover and output bearings

3.2.1 Disassemble cover and output bearing

1 Dismantle the hexagonal bolts **0360-0050-0330** to **0360-0050-0360**.

Remove the cover **0360-0050-0320** and the sealing gasket **0360-0050-0310**.

2 Remove the screw plug **0360-0050-0300** and the seal ring as needed.

3 Remove the pulse sensor **0360-0040-0400**.

4 Remove the hexagonal bolts **0360-0040-0100** to **0360-0040-0190** on the cover **0360-0040-0050**.

5 Use the plastic hammer to slightly knock for making the cover **0360-0040-0050** loosened, and remove it together with the sealing gasket **0360-0040-0060**.

6 Use a plastic hammer to knock the shaft seal ring **0360-0040-0070** out of the bearing cover.

7 Remove the screw plug **0360-0040-0250** as needed.

8 Use a universal puller to pull the ball bearing **0360-0040-0020** out of the housing.

3.2.2 Assemble cover and output bearing

Hint

• Assemble high-low gear group on gearbox, refer to chapter 3.3.

⚠Danger

Only wear protective gloves to touch the heated output flange.

1 Use the heating device **1X56 138 696** to heat the housing bearing hole range to be approximately **60 ° C**.

Use the heating device **1X56 138 674** to heat the bearing inner ring to be approximately **60 ℃** .

2 Make the ball bearing **0360-0040-0020** together with the heating device **1X56 138 696**, the sleeve **1X56 137 654** and the spindle **1X56 137 808** pass through the planet carrier and pulled into the housing, and they shall cling to the axial position.

3 Insert the screw plug **0360-0040-0250** and the new seal ring.

Tightening torque: 60 Nm

4 Clean the sealing surface on the GP-housing and the cover 0360-0050-0320.

5 Install the new sealing gasket 0360-0050-0310 and the cover 0360-0050-0320.

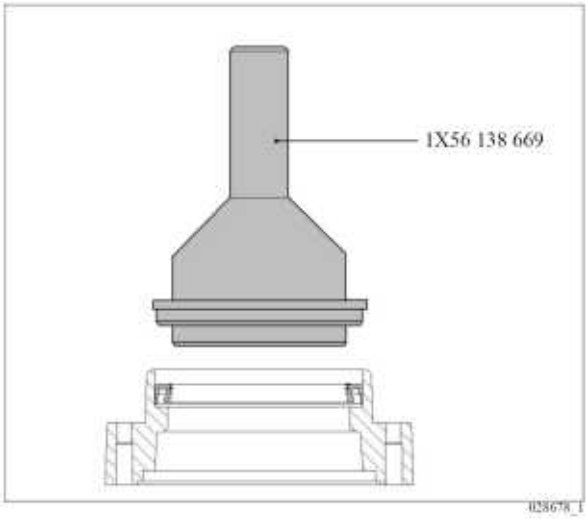
6 Insert the hexagonal bolts 0360-0050-0330 to 0360-0050-0360.

Tightening torque: 79 Nm

7 Insert the screw plug 0360-0050-0300 and the new seal ring.

Tightening torque: 15 Nm

8 Use the alcohol to moisten the outer periphery of the shaft seal ring 0360-0040-0070, and use the assembly mandrel 1X56 138 669 to press it into the bearing cover until it clings to the position.



Hint

The installation size of shaft seal rings is determined by the size of assembly mandrels.

Smear a little grease on the seal lip of shaft seal ring.

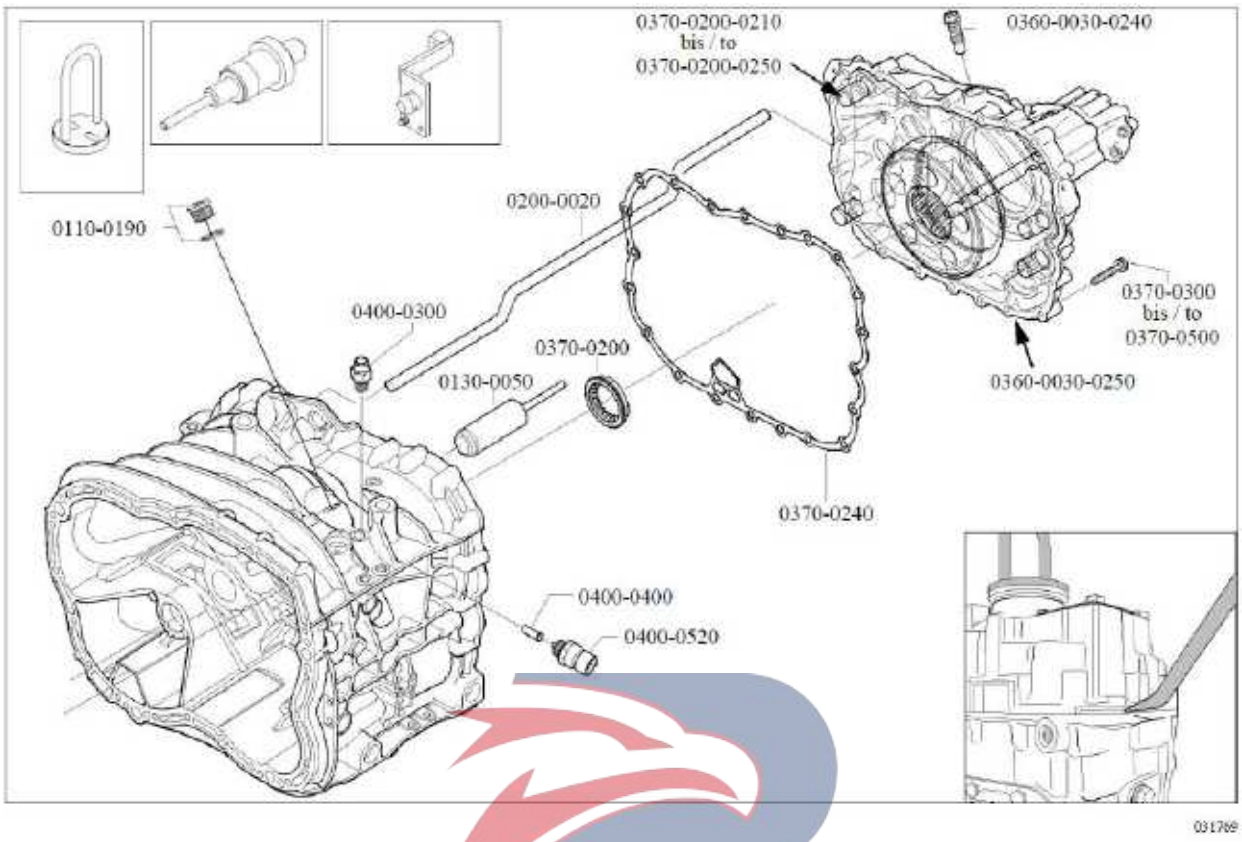
9 Place the new sealing gasket 0360-0040-0060 onto the housing.

10 Place the cover 0360-0040-0050 onto the housing, and use the hexagonal bolts 0360-0040-0100 to 0360-0040-0190 to fix.

Tightening torque: 46 Nm

11 Screw up the pulse sensor 0360-0040-0400.

Tightening torque: 45 Nm



3.3 High-low gear group

3.3.1 High-low gear group(satndard)

3.3.1.1 Disassemble high-low gear group

1 Loosen the two eye bolts 0360-0030-0240 and 0360-0030-0250, do not remove it temporarily.

2 Remove the locking-pin limiter 0400-0300.

3 Loosen the screw plug 0110-0190 and remove it with the sealing ring. Screw in installation aid 1X56 138 627.

4 Loosen and remove the hex bolts 0370-0300 to 0370-0500 on the high and low set.

5 Loosen switch 0400-0520 and remove with dowel 0400-0400.

6 Fix the tool 1X56 136 260 to the planet carrier. With the overhead crane and two mounting crowbars, separate the entire high - low gear group from the transmission and place it.

7 Remove the sealing gasket 0370-0240 and clean the sealing surface.

8 Remove reverse gear pin 0130-0050 from the transmission housing.

9 Pull tubing 0200-0020 from the transmission housing.

10 Remove the compression ring 0370-0200 from the main shaft.

Hint

If necessary, remove the cylinder pins 0370-0200-0210 to 0370-0200-0250 from the housing.

3.3.1.2 Assemble high-low gear group

1 If necessary, assemble the cylinder pins 0370-0200-0210 to 0370-0200-0250 into the housing.

2 Place the sealing gasket 0370-0240 onto the gearbox housing.

3 Push the compression ring 0370-0200 onto the main shaft, with the flange facing the input end.

4 Use the fixed tooling 1X56 138 675 to install the oil pipe 0200-0020 into the position which clings to the gearbox housing, with the three oil holes facing the input end.

5 Push the reverse pin 0130-0050 into the reverse gear.

6 Hook up the group to hang on the traveling crane, carefully cross from above the gearbox case and drop down in the placement place.

Hint

• GV-cylinder must has been installed.

• Guide the shift lever impot into the hole which used for shift plate safety device (interlock) bearing plate.

• Secure the tubing from the outside and into the plate 0360-0020-0020.

• Engage the main shaft with the meshing teeth of the planetary gears by turning.

7 Screw in and tighten hex bolts 0370-0300 to 0370-0500.

Tightening torque: 50 Nm

8 Tighten eye bolts 0360-0030-0240 and 0360-0030-0250 coated with Loctite No. 241.

Tightening torque: 250 Nm

9 Insert and tighten the locking-pin limiter 0400-0300 and the new gasket.

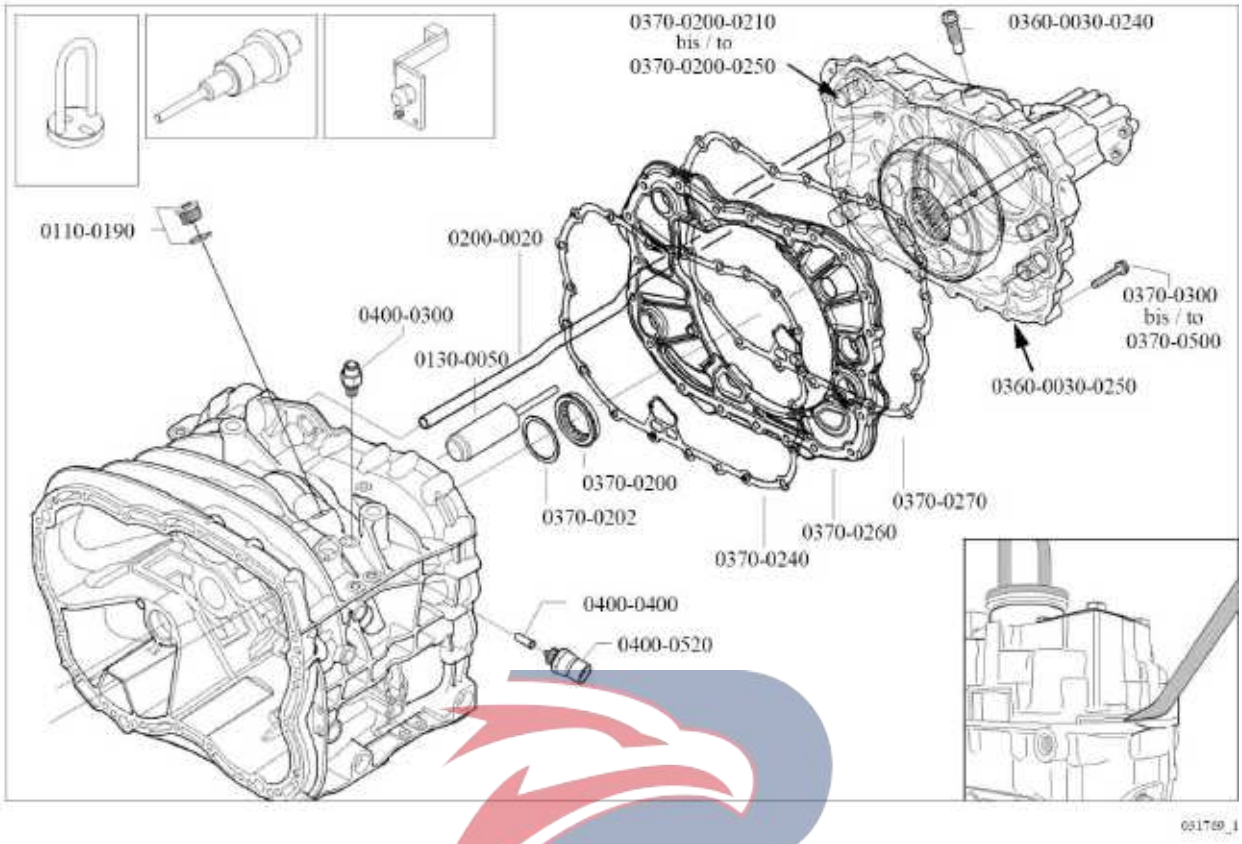
Tightening torque: 50 Nm

10 Remove mounting aid 1X56 138 627 and install screw plug 0110-0190 and new seal.

Tightening torque: 70 Nm

11 Smear the grease to the pin 0400-0400 and install it in, screw in and tighten the switch 0400-0520.

Tightening torque: 45 Nm



3.3.2 High - low gear group

(Strengthen structure 16 S 2730 TO)

3.3.2.1 Disassemble high-low gear geoup

1 Loosen the two eye bolts 0360-0030-0240 and 0360-0030-0250, do not remove temporarily.

2 Remove the locking-pin limiter 0400-0300.

3 Loosen screw plug 0110-0190 and remove together with sealring. Screw in installation aid 1X56 138 627.

4 Loosen and remove the hex bolts 0370-0300 to 0370-0500 on the high - low gear group.

5 Loosen switch 0400-0520 and remove together with dowel 0400-0400.

6 Fix the tool 1X56 136 260 to the planet carrier. With the overhead crane and two mounting crowbars, separate the entire high - low gea group from the transmission and place it.

7 Remove the sealing gaskets 0370-0270, the middle plate 0370-0260 and the sealing gasket 0370-0240, and clean the sealing surfaces.

8 Remove reverse gear pin 0130-0050 from the transmission housing.

9 Pull tubing 0200-0020 from the transmission housing.

10Remove the compression ring 0370-0200 from the main shaft and adjust the washer 0370-0202.

Hint

If necessary, disassemble the cylinder pins 0370-0200-0210 to 0370-0200-0250 from the housing.

3.3.2.2 Assemble high-low gear group

1 If necessary, sassemble the cylinder pins 0370-0200-0210 to 0370-0200-0250 into the housing.

2 Place the sealing gasket 0370-0240, the middle plate 0370-0260 and the sealing gasket 0370-0270 onto the gearbox housing.

3 Push the measured adjusting washer 0370-0202 and the compression ring 0370-0200 onto the main shaft, with the flange facing the input end.

Hint

See Section 3.3.2.3 for measuring the size from the main shaft to the planet transmission,.

4 Use the fixed tooling 1X56 138 675 to install the oil pipe 0200-0020 into the gearbox housing till the cling position, with the three oil holes facing the input end.

5 Push the reverse pin 0130-0050 into the reverse gear.

6 Hook up the group to hang on the line, carefully from the gearbox case and down to the placement.

5 Push the reverse pin 0130-0050 into the reverse gear.

6 Hook up the group to hang on the traveling crane, carefully cross from above the gearbox case and drop down in the placement place.

Hint

• GV-cylinder must has been installed.

• Guide the shift lever impot into the hole which used for shift plate safety device (interlock) bearing plate.

• Secure the tubing from the outside and into the plate 0360-0020-0020.

• Engage the main shaft with the meshing teeth of the planetary gears by turning.

7 Screw in and tighten hex bolts 0370-0300 to 0370-0500.

Tightening torque: 50 Nm

8 Tighten eye bolts 0360-0030-0240 and 0360-0030-0250 coated with Loctite No. 241.

Tightening torque: 250Nm

9 Insert and tighten the lock retainer 0400-0300 and the new gasket.

Tightening torque: 50 Nm

10 Remove mounting aid 1X56 138 627 and install screw plug 0110-0190 and new seal ring.

Tightening torque: 70 Nm

• GV-cylinder must has been installed.

• Guide the shift lever impot into the hole which used for shift plate safety device (interlock) bearing plate.

• Secure the tubing from the outside and into the plate 0360-0020-0020.

• Engage the main shaft with the meshing teeth of the planetary gears by turning.

7 Screw in and tighten hex bolts 0370-0300 to 0370-0500.

Tightening torque: 50 Nm

8 Tighten eye bolts 0360-0030-0240 and 0360-0030-0250 coated with Loctite No. 241.

Tightening torque: 250 Nm

9 Insert and tighten the locking-pin limiter 0400-0300 and the new gasket.

Tightening torque: 50 Nm

10 Remove mounting aid 1X56 138 627 and install screw plug 0110-0190 and new seal.

Tightening torque: 70 Nm

11 Smear the grease to the pin 0400-0400 and install it in, screw in and tighten the switch 0400-0520.

Tightening torque: 45 Nm

3.3.2.3 Measuring spindle and planetary gear

1 Make the compression ring 0370-0200 pass through the meshing teeth and push it onto the main shaft.

2 Install the measuring busing (1) 1X56 138 158 onto the compression ring, and set the dial indicator (2) to zero.

3 Push the measuring busing 1X56 138 158 straight up to the limit, and read the corresponding value on the dial indicator.

Hint

• The contact points of measuring busing must be clean.

• Measure in two opposite positions, and take the middle value.

4 The reading matches the thickness of the adjusting washer 0370-0202.

Please follow the permissible tolerance of ± 0.05 mm here.

Example 1:

Measured value = 1.97 mm

If the permissible tolerance is ± 0.05 mm, a 2.00 mm adjustment washer should be selected.

Example 2:

Measured value = 1.93 mm

If clearance tolerances are ± 0.05 mm, a 1.90 mm adjustment washer should be selected.

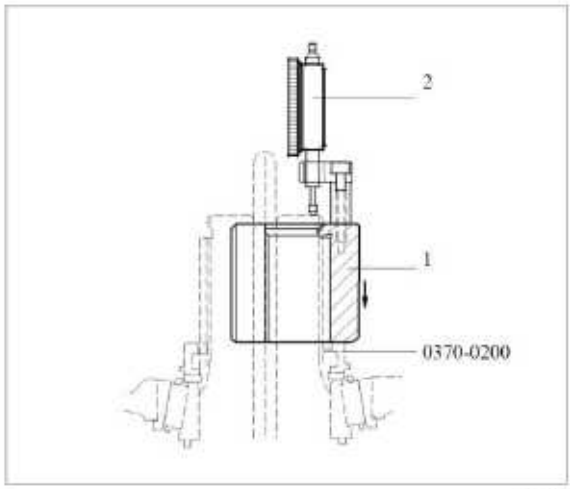
Hint

See Installation Rules 1316 700 017 here.

5 Remove the measuring busing and the compression ring from the main shaft.

Hint

See Section 3.3.2 for installing the adjusting washer 0370-0202 and the compression ring 0370-0200 onto the main shaft.



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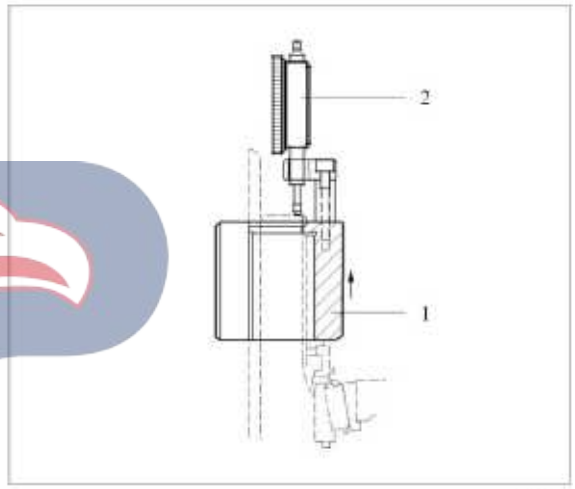

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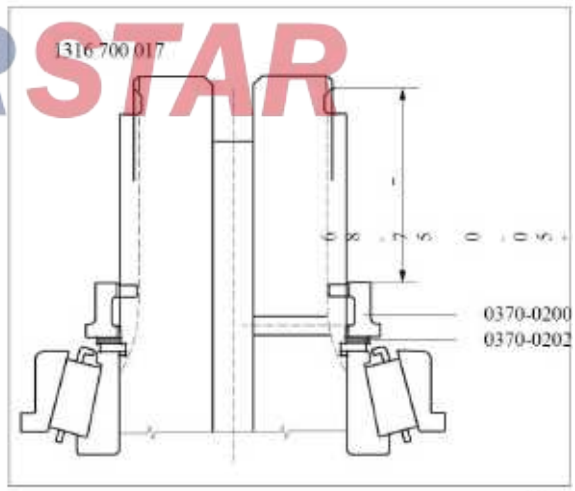

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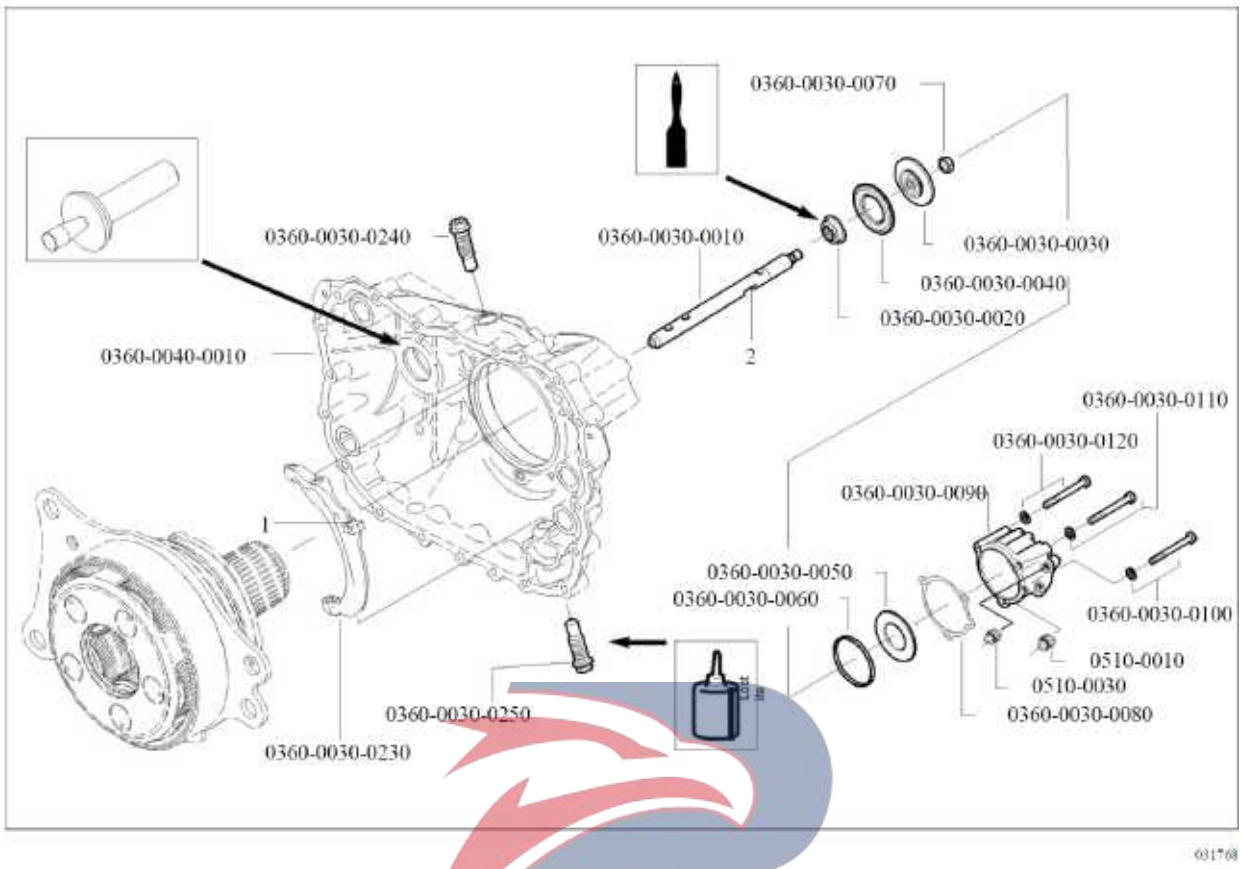


3.4 Disassemble and assemble high-low gear group

3.4.1 Disassemble high-low gear group cylinder and piston

1 Remove the loosened eye bolts 0360-0030-0240 and 0360-0030-0250.

2 Loosen the hexagonal bolts 0360-0030-0100 to 0360-0030-0120, and remove it together with the washer.

3 Take down the cylinder 0360-0030-0090 and the sealing gasket 0360-0030-0080.

4 Remove the gearshift lever 0360-0030-0010 from the gearshift fork 0360-0030-0230, and pull the piston out of the housing hole.

5 Dismantle the self-locking nuts 0360-0030-0070 on the piston 0360-0030-0030, remove the piston and take out the seal ring 0360-0030-0040, 0360-0030-0050 and the guide ring 0360-0030-0060 from the piston.

6 Use the appropriate tools to take the leather bowl 0360-0030-0020 out of the high-low gear group housing.

Caution

The leather bowls may be damaged. Therefore, replace the damaged one with a new one every time.

7 If necessary, loosen and remove the plug clutches 0510-0010 and 0510-0030 on the cylinder 0360-0030-0090.

8 Remove the housing 0360-0040-0010 from the planet transmission.

3.4.2 Assemble high-low gear group cylinder and piston

1 Use the positioning pin 1X56 138 664 to make the housing cling to the power take-off hole and the bearing plate, then put it onto the planet transmission until it stops.

Hint

The gearshift fork must be put in,and Chapter 4 can be referred to.

2 Use the ethanol (alcohol) to moisten the support hole and the outer periphery of the new leather bowl 0360-0030-0020. Install the leather bowl before the ethanol evaporates.

3 Using the appropriate tool to push the leather bowl 0360-0030-0020 into the high - low gear group housing until it clings to the axial position.

Smear grease on the sealing lip of the bowl.

4 Install the seal rings 0360-0030-0040, 0360-0030-0050 and the guide ring 0360-0030-0060 for the piston0360-0030-0030. Install the whole piston on the gearshift lever 0360-0030-0010.

Caution

• Always use a new self-locking nut 0360-0030-0070.

• The thread of self-locking nut (Spiralock locknut) must be made clean before being screwed up.

5 Tighten the self-locking nut 0360-0030-0070.

Tightening torque: 150 Nm

Caution

Do not damage the sealing lip of the bowl.

6 Make the gearshift lever enter the housing hole through the leather bowl, and make the piston cling to the axial position.

7 Smear the grease to the insides of two seal rings 0360-0030-0040, 0360-0030-0050 and the cylinder 0360-0030-0090.

8 Make the positions of the new seal ring 0360-0030-0080 accurately installed on the cylinder 0360-0030-0090.

9 Install the cylinder and the sealing gasket on the high - low gear group, and use the hexagonal bolts 0360-0030-0100 to 0360-0030-0120 to fix them.

Tightening torque: 46 Nm

10 Make the protruding part (1) of the gearshift fork 0360-0030-0230 insert the groove (2) of the gearshift lever 0360-0030-0010.

11 After aligning the gearshift fork with the threaded hole of housing, make the bearing opening of the gearshift fork face the threaded hole of housing

12 Screw up the eye bolts 0360-0030-0240 and 0360-0030-0250, but do not tighten it.

Hint

• Threads must be clean, free of grease and oil.

• Use the Loctite 241 to moisten the thread of eye bolts.

13 If necessary, install the plug clutches 0510-0010 and 0510-0030 into the cylinder 0360-0030-0090 and tighten them.

Tightening torque: 10 Nm

4 The lanetary gears transmission device that with synchronization device

4.1 Synchronization device 4-2
4.1.1 Disassemble synchronization device 4-2
4.1.2 Assemble synchronization device 4-3
4.2 Ring gear 4-5
4.2.1 Ring gear(standard type) 4-5
4.2.1.1 Dismantle the gear ring 4-5
4.2.1.2 Assemble ring gear 4-5
4.2.2 Gear ring (reinforcing structure 16 S 2730 TO) 4-6
4.2.2.1 Disassemble ring gear 4-6
4.2.2.2 Assemble ring gear 4-6
4.3 Planet carrier 4-7
4.3.1 The planetary carrier (standard type) 4-7
4.3.1.1 Disassemble the planetary carrier 4-7
4.3.1.2 Assemble the planetary carrier 4-8
4.3.2 Planet carrier (Reinforcing structure 16 S 2730 TO) 4-10
4.3.2.1 Disassemble the planetary carrier 4-10
4.3.2.2 Assemble the planetary carrier 4-11

4 The lanetary gears transmission device that with synchronization device

4.1 Synchronization device

4.1.1 Disassemble synchronization device

1 Remove the gearshift fork 0360-0030-0230.

2 Remove the slide blocks 0360-0030-0200 and 0360-0030-0210 from the gearshift fork.

3 Place the intermediate spacer on the planet carrier, and use a two-claw or three-claw puller to clamp the sliding gear sleeve 0360-0020-0050-0190.

⚠Danger

Briquetting / pressure pin withstand spring pressure.Prevent popping-up, for example, use a piece of cloth to cover.

4 Remove the sliding gear sleeve 0360-0020-0050-0190, the synchronous ring 0360-0020-0050-0140 and the clutch body 0360-0020-0250. Make the pressure block / pressure pin under the spring pressure 0360-0020-0050-0150 and the compression spring 0360-0020-0050-0160 and 0360-0020-0050-0170 caught by the cloth.

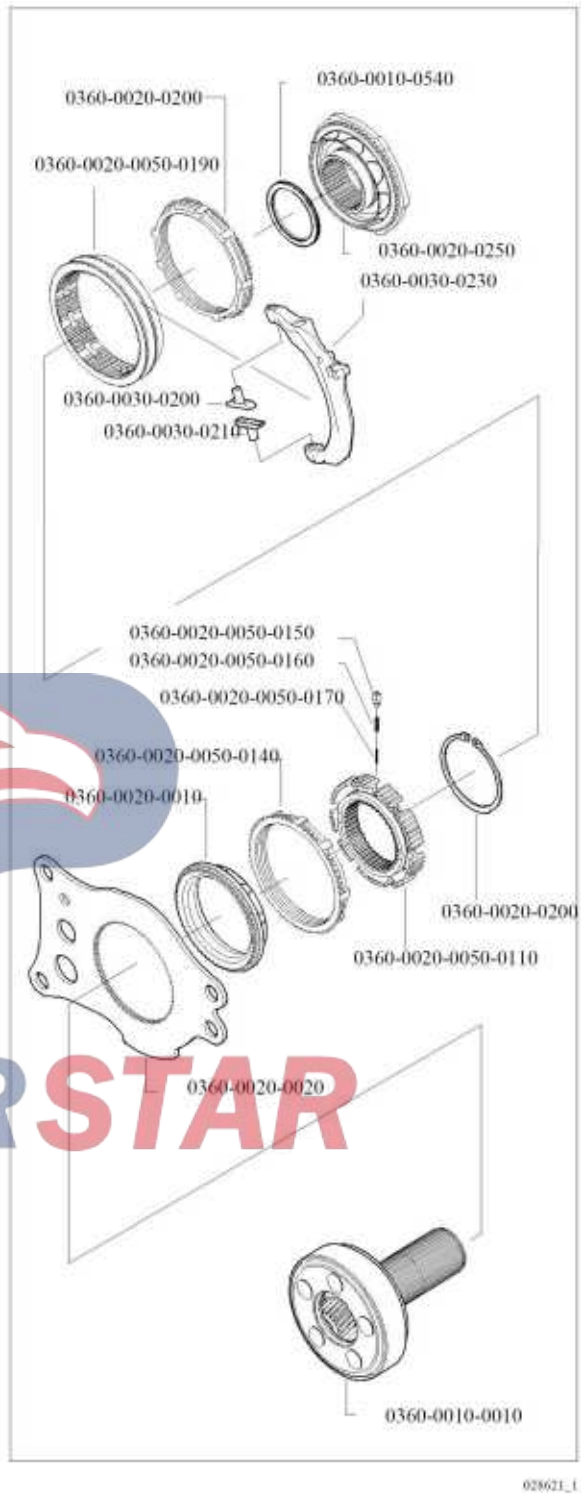
5 Inspect the functions of axial / thrust bearings 0360-0010-0540, and it can not be removed until it is damaged.

6 Remove the retaining ring 0360-0020-0200.

7 Use the two-jaw puller to clamp the clutch body 0360-0020-0010 and unplug it.

8 Remove the synchronizer 0360-0020-0050-0110 and the synchronous ring 0360-0020-0050-0140 from the planet carrier 0360-0010-0010.

9 Remove the backing board 0360-0020-0020 from the planet carrier.



4.1.2 Assemble synchronization device

Hint

See Section 14 for the wear check of synchronizer.

Hint

Smear a little grease on the friction cone of the clutch body and synchronous ring.

1 Make the backing plate 0360-0020-0020 accurately on the planet carrier 0360-0010-0010.

Hint

The hole in the connecting oil pipe must be located in the upper right, as shown by the arrow.

2 Install the clutch body 0360-0020-0010 and the synchronous ring 0360-0020-0050-0140 on the planet carrier.

3 Cover the synchronizer 0360-0020-0050-0110, the long side of the protruding part faces the planet carrier. The convex key of synchronous ring 0360-0020-0050-0140 must be embedded in the groove of synchronizer.

4 Press in the retaining ring 0360-0020-0200.

Hint

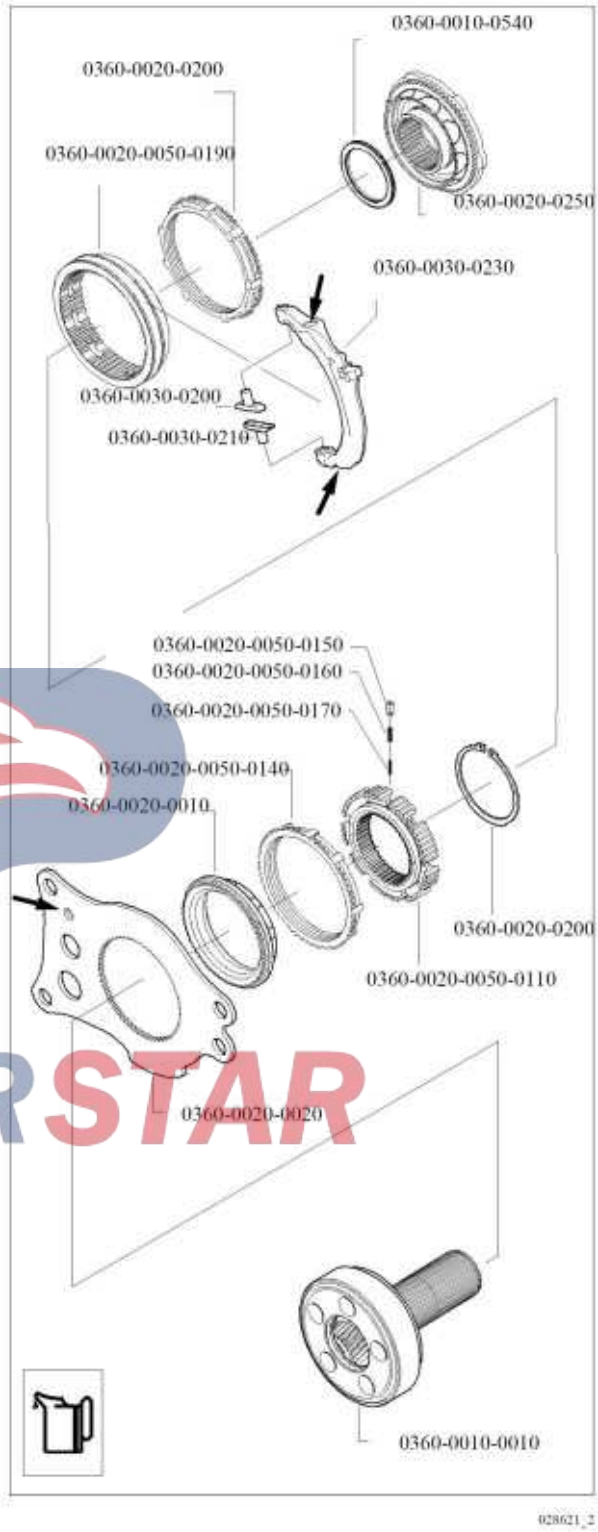
The axial clearance of retaining ring must be between 0 and 0.10 mm.

Try to reach 0.0 mm. Select the corresponding retaining ring according to Parts Catalog.

5 Install the sliding gear sleeve 0360-0020-0050-0190 onto the synchronizer and make it cling to the axial position.

Hint

The groove of sliding gear sleeve must be the same as the groove of synchronizer.



6 Install the new compression springs 0360-0020-0050-0170 and 0360-0020-0050-0160 together with the pressure block / pressure pins 0360-0020-0050-0150 into the synchronizer, and use the appropriate tools to lead in the sliding gear sleeve.

7 Install the synchronous ring 0360-0020-0050-0200 onto the synchronizer. The convex key of synchronous ring must be embedded in the groove of synchronizer.

8 If necessary, place the new axial / thrust bearing 0360-0010-0540 on the annular gear ring bracket.

9 Push the clutch body 0360-0020-0250 onto the planet carrier.

10 Press the clutch body and adjust the sliding gear sleeve to the neutral position. The click sound of pressure block / pressure pin can clearly be heard.

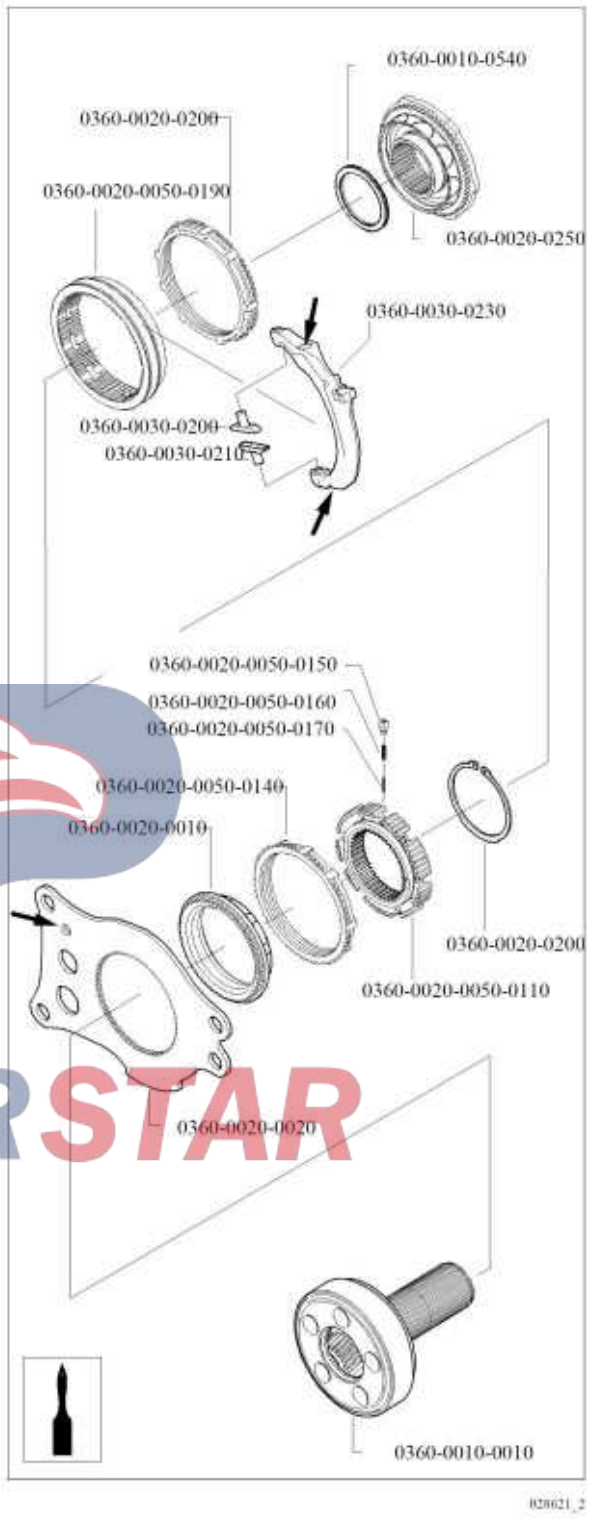
11 Install the sliding blocks 0360-0030-0200 and 0360-0030-0210 into the gearshift fork 0360-0030-230.

12 Install the gearshift fork into the sliding gear sleeve 0360-0020-0050-0190.

13 Apply a little grease to the mounting holes (see the arrow) of gearshift fork.

Hint

See Section 3.2 for installing the high-low gear group housing.



4.2 Ring gear

4.2.1 Ring gear(standard type)

4.2.2.1 Disassmble the ring gear

1 Remove the whole gear ring from the planet carrier 0360-0010-001.

2 Remove the bushing from the planet carrier 0360-0010-0500。

3 Pop the steel wire retaining ring 0360-0010-0530 from the annular groove in the gear ring 0360-0010-0520, and remove it.

Use a plastic hammer annular gear ring bracket 0360-0010-0510 to tap out / push out from the gear ring.

4.2.1.2 Assmble the ring gear

1 Install the bushing 0360-0010-0500 onto the planet carrier.

2 Install the annular gear ring bracket 0360-0010-0510 into the gear ring 0360-0010-0520 until it clings to the axial position.

3 Install the steel wire retaining ring 0360-0010-0530 into the O-groove of gear ring.

Hint

The steel wire retaining ring must be located at the bottom of the groove.

4 Install the gear ring on the planet carrier and meanwhile rotate the gear ring to make the planet gear ring mesh with the gear teeth of gear ring.

4.2.2 Gear ring

(Strengthen structure 16 S 2730 TO)

4.2.2.1 Disassmble the ring gear

1 Pop the steel wire retaining ring 0360-0010-0530 out of the O-groove in the gear ring.

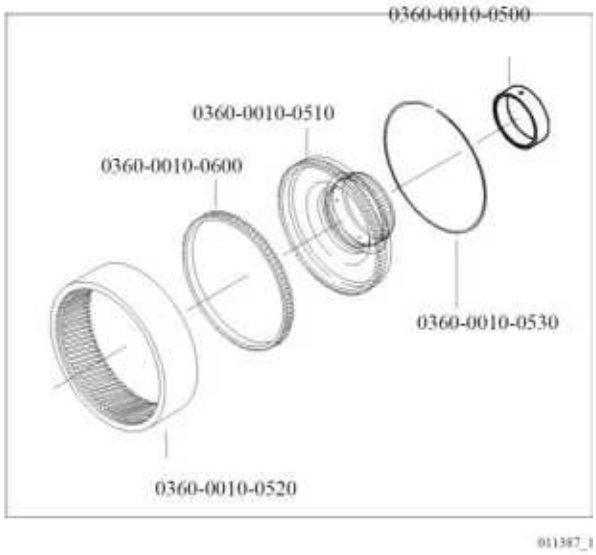
2 Press the retaining ring 0360-0020-0200 in Section 4.1 into the annular gear ring bracket 0360-0010-0510. Install the pressure block/pressure pin on the planet carrier 0360-0010-0010, and use the two- or three- jaw puller to clamp the retaining ring.

Unplug the annular gear ring bracket 0360-0010-0510.

3 Remove the gear ring 0360-0010-0520 and the thrust ring 0360-0010-0600 from the planet carrier.

4 Remove the thrust ring 0360-0010-0600 from the gear ring.

5 Remove the bushing from the planet carrier 0360-0010-0500。



4.2.2.2 Assmble the ring gear

1 Install the thrust ring 0360-0010-0600 in the position which clings to the gear ring 0360-0010-0520.

⚠Danger

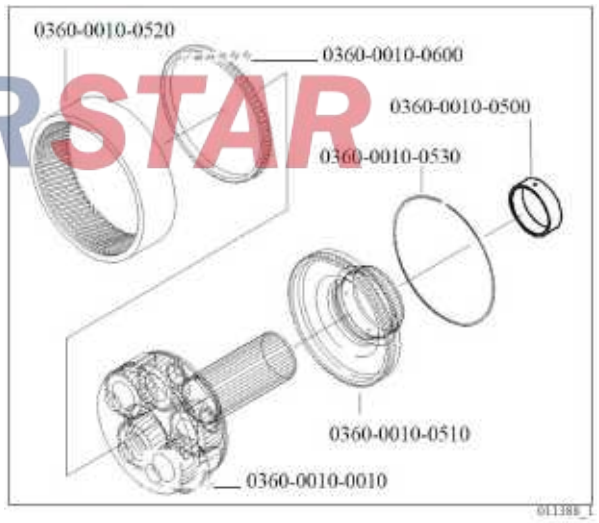
Protective gloves must be worn to touch the heated gear ring.

2 Heat the gear ring to 60 ℃ and install the planet carrier 0360-0010-0010 into the gear ring. When installing, turn the planet carrier and make the gear rings mesh each other.

3 Push bushing 0360-0010-0500 onto the planet carrier.

4 Push the annular gear ring bracket 0360-0010-0510 into the gear ring until it clings to the axial position.

5 Place the steel wire retaining ring 0360-0010-0530 in the O-groove of synchronizer, and compact (cling) around the retaining ring.



4.3 The planetary carrier

Hint

Only one set of gear ring groups is displayed for the sake of simplicity, and the disassembly process of all five planet gears is the same.

4.3.1 Planetary carrier (standard type)

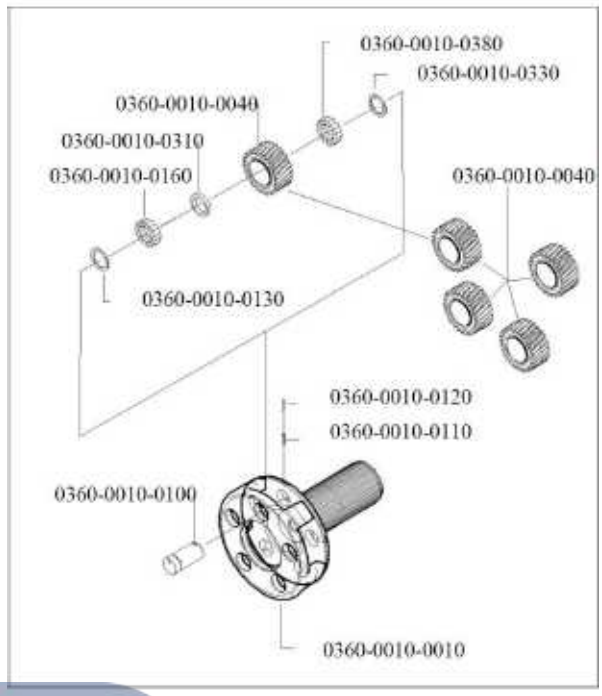
4.3.1.1 Disassmble planetary carrier

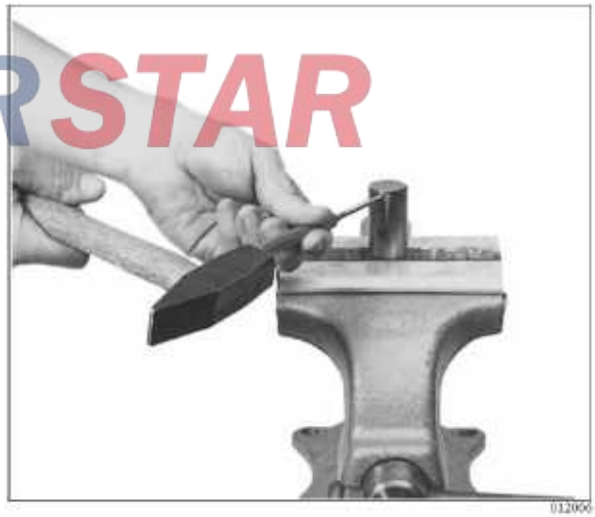
1 Press in/ knock in all the elastic pins 0360-0010-0110, 0360-0010-0120 into the planet mechanism with hole pins 0360-0010-0100 at the full length.

2 Using a hammer and plastic wand, beat all five planetary gear bearing pins 0360-0010-0100 on the planet carrier 0360-0010-0010 towards the input end direction .

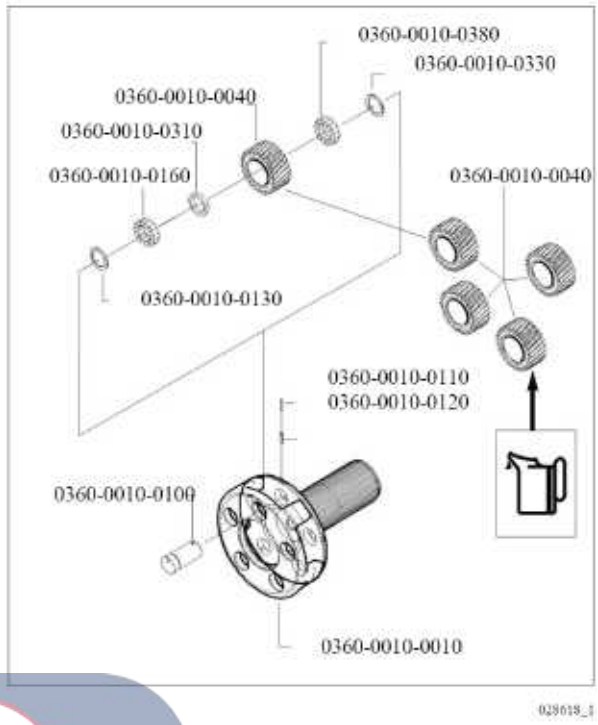
3 Remove the 5 planet gears 0360-0010-0040 from the planet carrier together with the intermediate washers 0360-0010-0130, 0360-0010-0310, 0360-0010-0330 and the rollers 0360-0010-0160, 0360-0010-0380.

4 Knock out / push out the elastic pins 0360-0010-0110, 0360-0010-0120 from the planet mechanism with hole pins 0360-0010-0100.





4.3.1.2 Assmble planetary carrier



Caution

Do not change the planetary gear 0360-0010-0040 alone, must completly replacement.

1 Smear the grease to the planetary gear 0360-0010-0040 front and roller guide slightly.

2 Place the planetary agencies hole-pins 0360-0010-0100 with the flange facing down.

3 Insert the intermediate washer 0360-0010-0130 onto the planetary agencies hole-pins.

4 Install the planetary gear 0360-0010-0040 onto the planetary agencies hole-pins.

5 Place 14 rollers 0360-0010-0160 in the planetary gear and insert the intermediate washer 0360-0010-0310 onto the planetary agencies hole-pins.

Hint

Only use the rollers with the same tolerance.

6 Load the additional 14 rollers 0360-0010-0380, lightly grease and place the intermediate washer 0360-0010-0330.

7 Place the planetary carrier 0360-0010-0010 on the shaft assembly.

8 Carefully remove the entire planet gear and center washer from the planetary agencies hole-pins and fit it into the planetary carrier.

9 Orient the planetary gear 0360-0010-0040 to the bearing hole.

Hint

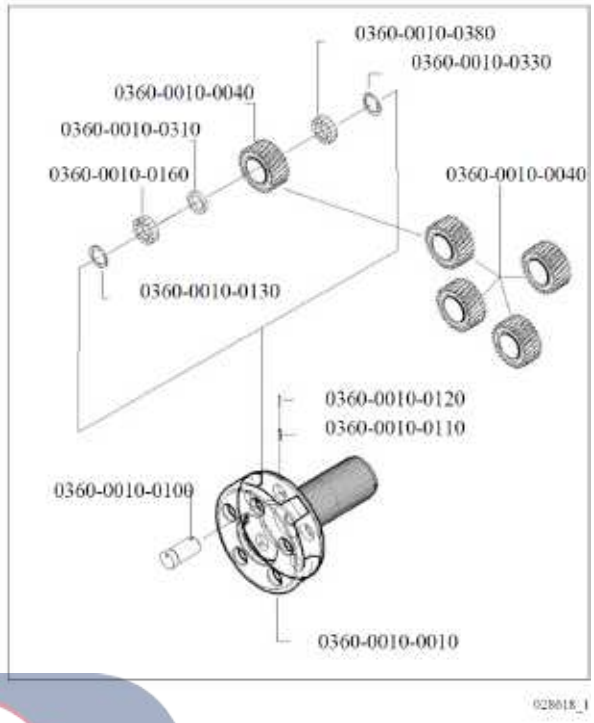
Planetary agencies hole pin positive face "O" mark must face the outer radius of the planet carrier. The hole of the planetary agencies hole-pins which is use to place the spring pin must be aligned with the hole in the planetary carrier.

10 Place the planetary agencies hole- pin 0360-0010-0100 radically into the bearing hole.

11 Use a plastic hammer to knock in the planetary agencies hole- pin and check that the hole in the spring pin is aligned.

12 Push the new spring pin 0360-0010-0110 in half. Turn the second (new) spring pin 0360-0010-0120 up about 180 ℃(the pin's suture) and press it into the first spring pin. The two spring pins sunk into the planetary carrier approximately 0.5 mm.

13 Assemble the other four planetary gears to repeat steps 1 to 12.



4.3.2 Planet carrier

(Strengthen structure 16 S 2730 TO)

4.3.2.1 Disassmble planetary carrier

Hint

Only one set of gear ring groups is displayed for the sake of simplicity

The disassembly process of all five planet gears is the same.

1 Press the full length of all elastic pins 0360-0010-0110 and 0360-0010-0120 into the planet mechanism with hole pins 0360-0010-0100.

2 Using a hammer and plastic wand, beat all five planetary gear bearing pins 0360-0010-0100 on the planet carrier 0360-0010-0010 towards the input end direction .

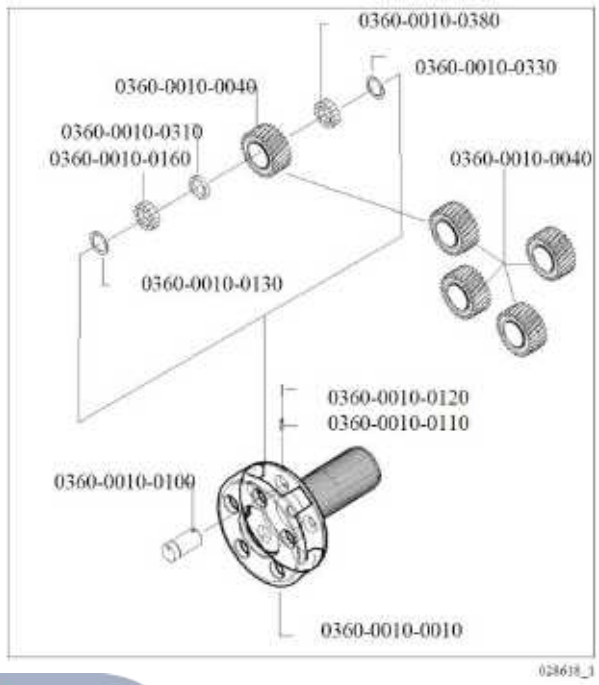
3 Take out the five planet gears 0360-0010-0040 together with the intermediate washers 0360-0010-0130, 0360-0010-0310, 0360-0010-0330 as well as the rollers 0360-0010-0160 and 0360-0010-0380 from the planet carrier.

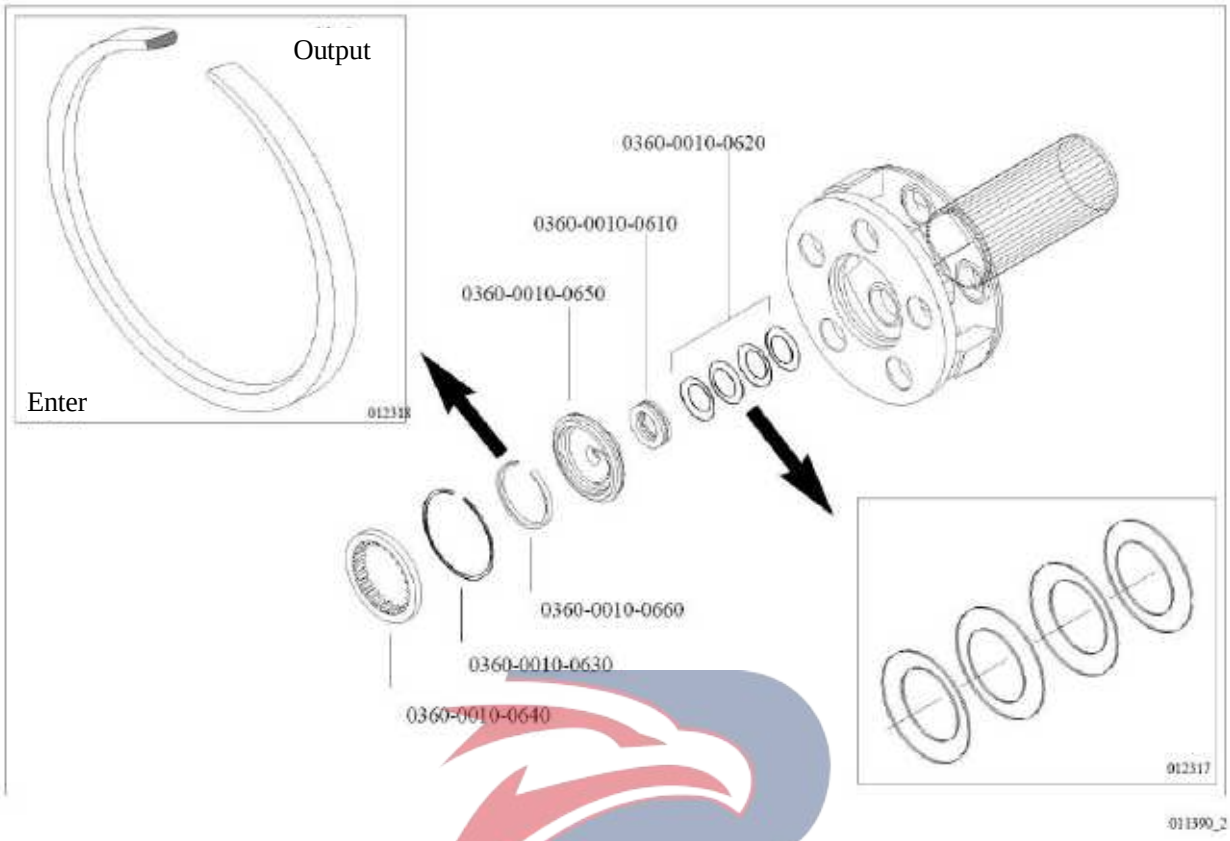
4 Knock out/ push out the elastic pins 0360-0010-0110 and 0360-0010-0120 from the planet mechanism with hole pins 0360-0010-0100.

5 Remove the compression ring 0360-0010-0640 from the planet carrier.

6 Pop the clamping rings 0360-0010-0630 and 0360-0010-0660, and remove them together with the cover 0360-0010-0650.

7 Remove the thrust ball bearing 0360-0010-0610 and the four disc springs 0360-0010-0620.





4.3.2.2 Assmble planetary carrier

1 Place the four disc springs 0360-0010-0620 in the planet carrier.

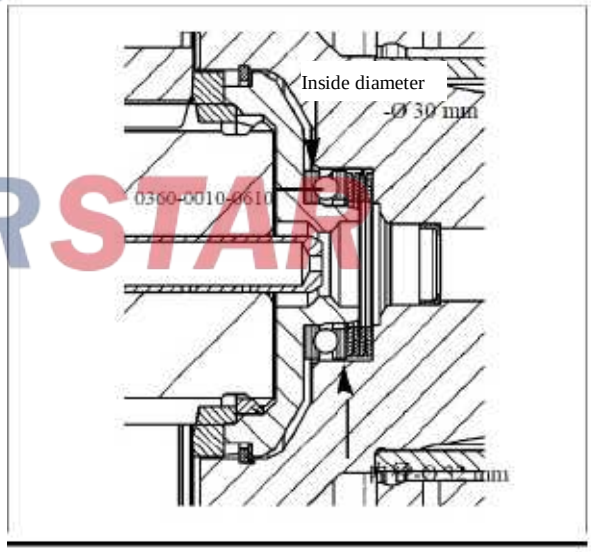
Hint

See Figure 012317 for the layout of four disc springs.

2 Place the thrust ball bearings 0360-0010-0610 into the planet carrier.

Caution

Please note that the thrust ring with inner diameter -Ø 32 mm shall be mounted facing the output end, and the thrust ring with inner diameter -Ø30mm shall be mounted facing the input end. See Figure 032254.



3 Install the cover 0360-0010-0650 and the clamping rings 0360-0010-0630, 0360-0010-0660.

Hint

Refer to Figure 012318 for the correct mounting position of the clamping ring 0360-0010-0660.

4 Put the compression ring 0360-0010-0640 on.

Caution

Do not change the planetary gear 0360-0010-0040 alone, must completly replacement.

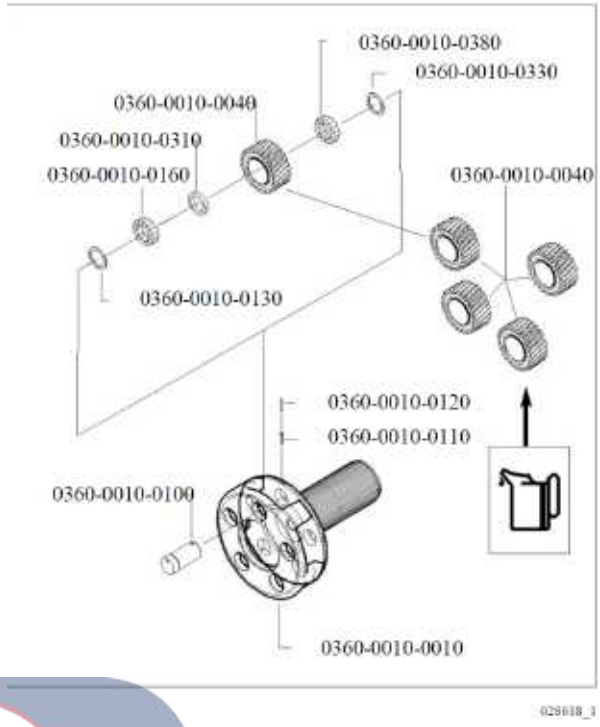
1 Smear the grease to the planetary gear 0360-0010-0040 front and roller guide slightly.

2 Place the planetary agencies hole-pins 0360-0010-0100 with the flange facing down.

3 Insert the intermediate washer 0360-0010-0130 onto the planetary agencies hole-pins.

4 Install the planetary gear 0360-0010-0040 onto the planetary agencies hole-pins.

5 Place 14 rollers 0360-0010-0160 in the planetary gear and insert the intermediate washer 0360-0010-0310 onto the planetary agencies hole-pins.



Hint

Only applicable to the rollers with the same tolerance.

6 Load the additional 14 rollers 0360-0010-0380, lightly grease and place the intermediate washer 0360-0010-0330.

7 Place the planetary carrier 0360-0010-0010 on the shaft assembly.

8 Carefully remove the entire planet gear and center washer from theplanetary agencies hole-pins and fit it into the planetary carrier.

9 Orient the planetary gear 0360-0010-0040 to the bearing hole.

Hint

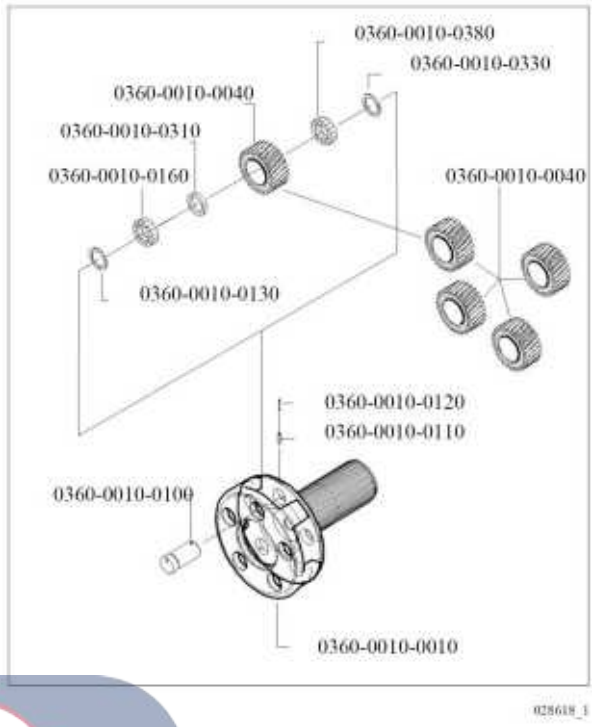
Planetary agencies hole pin positive face "O" mark must face the outer radius of the planet carrier. The hole of the planetary agencies hole-pins which is use to place the spring pin must be aligned with the hole in the planetary carrier.

14 Place the planetary agencies hole- pin 0360-0010-0100 radically into the bearing hole.

15 Use a plastic hammer to knock in the planetary agencies hole- pin and check that the hole in the spring pin is aligned.

16 Push the new spring pin 0360-0010-0110 in half. Turn the second (new) spring pin 0360-0010-0120 up about 180 ℃(the pin's suture) and press it into the first spring pin. The two spring pins sunk into the planetary carrier approximately 0.5 mm.

17 Assemble the other four planetary gears to repeat steps 5 to 16.

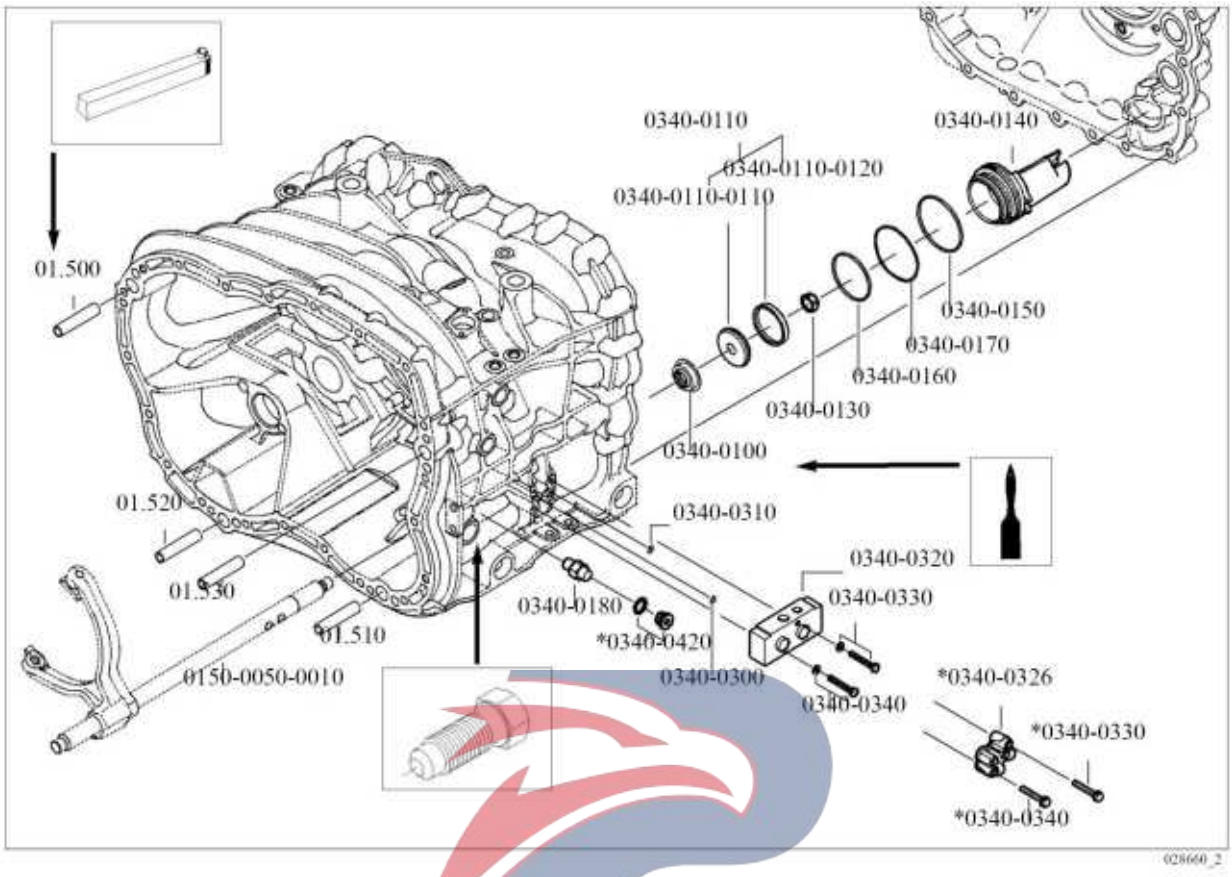


5 GV- Piston and two-position five-way valve

5.1 Disassmble piston and valve 5-2

5.2 Assmble piston and valve 5-3

5.3 Pistons and GV-Cylinder Compressed Air Detection 5-4



5 GV- Piston and two-position five-way valve

5.1 Disassmble piston and valve

Hint

8-gear structure without GV- gearshift track, GV-piston, lockpin limiter and 2-position 5-way valve.

1 Manually remove the cylinder 0340-0140.

2 Loosen the hexagon screw plugs 0340-0330 and 0340-0340, and remove them together with the two-position 5-way valve 0340-0320 or the gearbox housing 0340-0326.

3 Catch the O-rings 0340-0300 and 0340-0310.

Hint

Do not disassemble the two-position 5-way valve, which is a whole unit.

4 Remove lock-pin limiter 0340-0180 and install fixing device 1X56 138 100.

Hint

If it is a 8-gear structure, remove the screw plug 0340-0190 and the seal ring.

5 Remove the self-locking nut 0340-0130.

6 Pop the spring 0340-0170 out from the housing.

7 Remove the whole piston 0340-0110 from the gearshift lever 0150-0050-0010.

8 Remove the double-grooved circlip 0340-0110-0120 from the piston 0340-0110-0110.

9 Remove the O-rings 0340-0160 and 0340-0150 from the cylinder.

Hint

• See Chapter 9 for removing the leather bowl 0340-0100.

• See Chapter 8 for removing the gearshift lever 0150-0050-0010.

10 Use the pulling tool 1X56 138 063 to push the cylindrical pins 0180-0500 to 0180-0530 towards the input end and remove them.

5.2 Install valve and piston

Hint

The gearshift lever 0150-0050-0010 (see Chapter 8) and the leather bowl 0340-0100 (See Chapter 9) must be installed and smeared with the grease.

1 Thread the new O-rings 0340-0160 and 0340-0150 onto the cylinder 0340-0140.

2 Install the double-grooved circlip 0340-0110-0120 onto the piston 0340-0110-0110, and smear a little grease.

3 Push the whole piston 0340-0110 onto the gearshift lever 0150-0050-0010.

4 Remove lock-pin limiter 0340-0180 and install fixing device 1X56 138 100.

5 Screw the new self-locking nut 0340-0130 onto the gearshift track and tighten it.

Tightening torque: 150 Nm

6 Press the spring ring 0340-0170 into the housing.

7 Remove the fixing device 1X56 138 100, and screw up the lock pin limiter 0340-0180.

Tightening torque: 50 Nm

8 Install the cylinder 0340-0140 into the housing.

9 Install the new O-rings 0340-0300 and 0340-0310 into the two-position five-way valve 0340-0320.

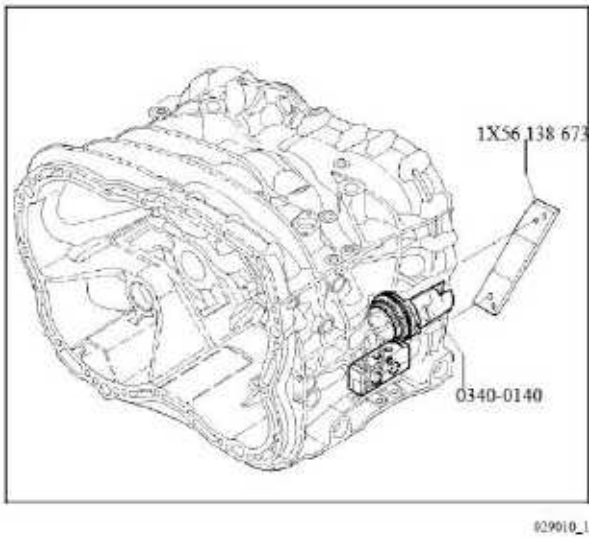
10 Use the hexagonal bolts 0340-0330 and 0340-0340 to tighten the two-position five-way valve 0340-0320 or the connection housing 0340-0326 on the gearbox housing.

Tightening torque: 9.5 Nm

11 If it is a 8-gear structure, screw up the screw plug 0340-0190 and the new seal ring.

Tightening torque: 50 Nm

5.3 Pistons and GV-Cylinder Compressed Air Inspection



Hint

The 8-gear structure does not need the compressed air inspection.

1 Screw the fixing device 1X56 138 673 used for the GV cylinder 0340-0140 onto the gearbox housing.

2 Fill the two-position five-way valve or the piston with the compressed air (Max. 6.8 bar).

3 Smear a suitable liquid to the outside of the GV-cylinder, and take care to prevent the air bubbles from producing.

4 Fill the piston with the compressed air in the opposite direction of gearshift, and take care to prevent the leakage.

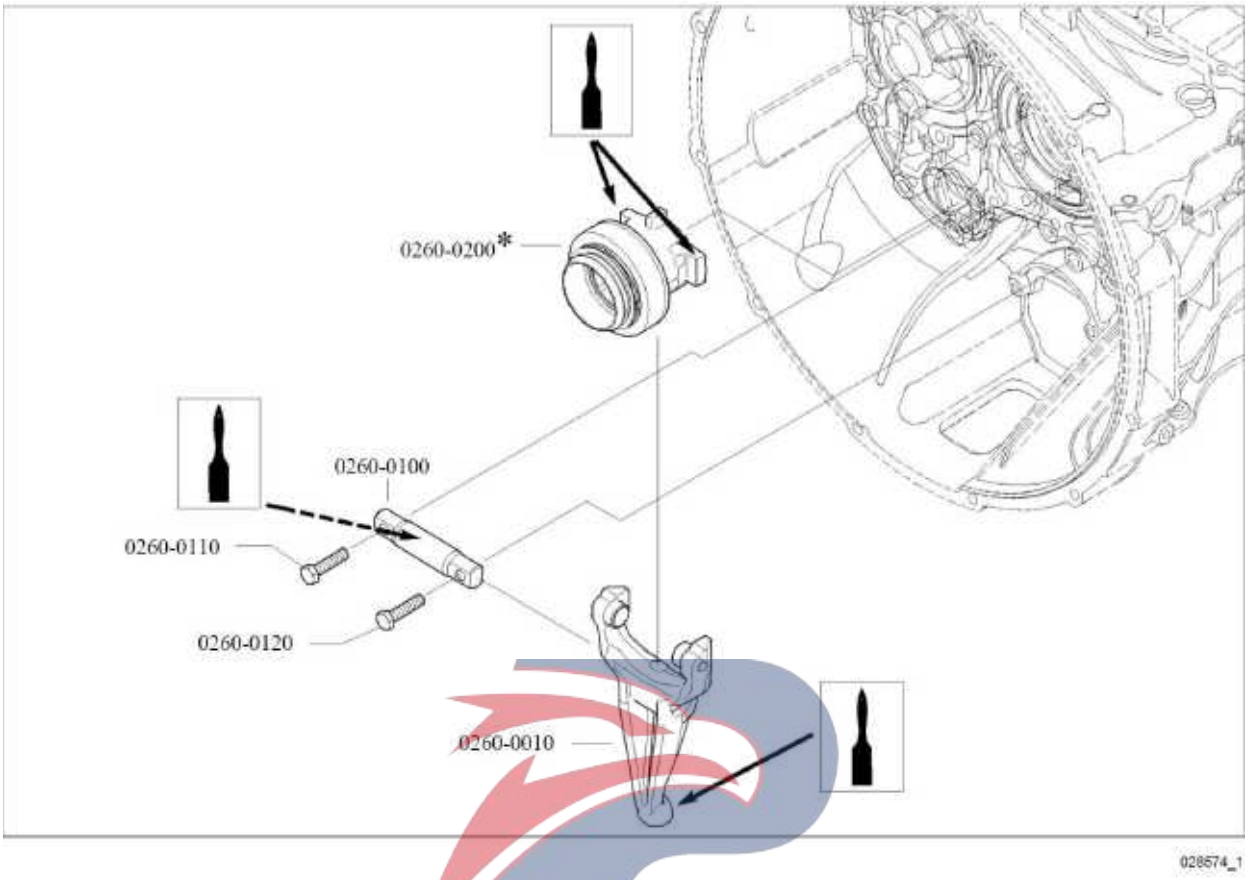
5 If air bubbles are generated, install a new O-ring to the cylinder if necessary, and check whether the mounting position is correct.

6 If there is leakage, replace the double-grooved circlip 0340-0110-0120 on the piston 0340-0110-0110.

7 Remove the fixing device 1X56 138 673.

6 Release bearings, connecting plates and pumps

6.1 Release bearings 6-2
6.1.1 Disassmble release bearings 6-2
6.1.2 Assmble release bearings 6-2
6.2 Connecting plates 6-3
6.2.1 Disassmble connecting plates 6-3
6.2.2 Assmble connecting plates 6-4
6.3 Pumps 6-6
6.3.1 Disassmble pumps 6-6
6.3.2 Assmble pumps 6-6



6 Release bearings, connecting plates and pumps

6.1 Release bearing

6.1.1 Disassmble release bearing

1 Loosen and remove the bolts 0260-0110 and 0260-0120.

2 Remove the separation fork 0260-0010 and the declutch shaft 0260-0100. Remove the declutch shaft.

3 Remove the release bearing 0260-0200 from the guide pipe.

6.1.2 Assmble release bearing

1 Use the release bearing 0260-0200 to cover the guide pipe.

2 Install the declutch shaft 0260-0100 into the separation fork 0260-0010.

3 Install the separation fork into the release bearing, and use the hexagonal bolts 0260-0110 and 0260-0120 to fix it on the connecting plate.

Tightening torque: 115 Nm

Hint

• Smear a little grease (Olista Longtime 3EP) on the specified locations.

• Only smear a little grease to the used declutch shaft 0260-0100.

The new declutch shaft has been smeared with the grease when supplied.

* Depend on the structures

6.2 Connecting plates

6.2.1 Disassmble connecting plates

1 Loosen the combination bolts 0220-0910-0340 to 0220-0910-0370, and remove them together with the guide pipe 0220-0910-0320.

2 Loosen and remove the hexagonal bolts 0240-0500 to 0240-0670.

3Use the installation crow bar to loosen the connecting plate **0220-0910-0300**, and remove it together with the sealing gasket 0220-0910-0440.

Hint

Install the installation crow bar onto the casting socket.

4 Remove the washers 0200-0070, 00-000080 and the spacer ring 0200-0090 from the input shaft.

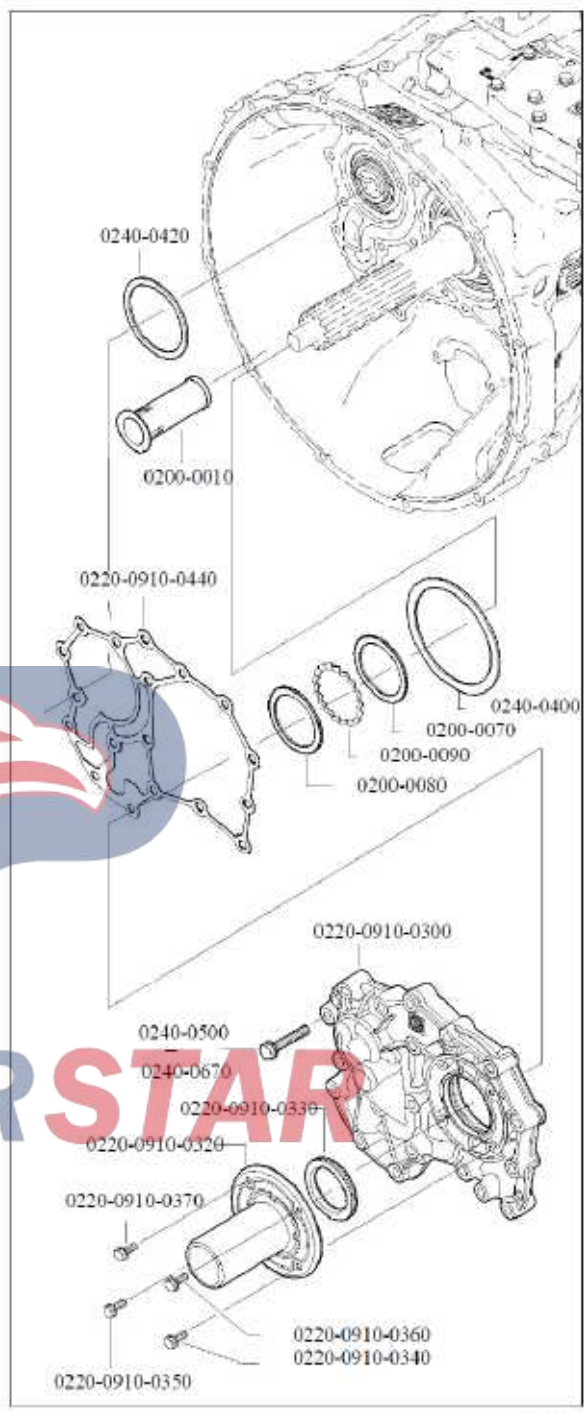
5 Remove the adjusting washer 0240-0420 from the intermediate shaft, and remove the adjusting washer 0240-0400 from the input shaft.

6 Remove the shaft seal ring 0220-0910-0330 from the connecting plate.

Hint

Clean the connecting surface, clean the threaded hole -, and plus the tapping if necessary.

7 Remove and clean the filter 0200-0010.



6.2.2 Assmble connecting plates

1 Install the filter 0200-0010 into the clutch housing.

2 Make the shaft seal ring 0220-0910-0330 over the auxiliary mounting device 1X56 138 628, and flatly press the connecting plate 0220-0910-0300 in.

Hint

• Use the alcohol to moisten the outside of the shaft seal ring.

• The lip of shaft seal ring faces the output end.

• Smear a little grease on the shaft seal ring.

3 Place the measured washer 0240-0400 on the input shaft.

4 Place the washers 0200-0070, 00200-0080 and the spacer ring 0200-0090 exactly on the input shaft.

Hint

Washer 0200-0070 = Ø 88 mm

Washer 0200-0080 = Ø 85 mm

5 Place the measured adjusting washer 0240-0420 on the intermediate shaft.

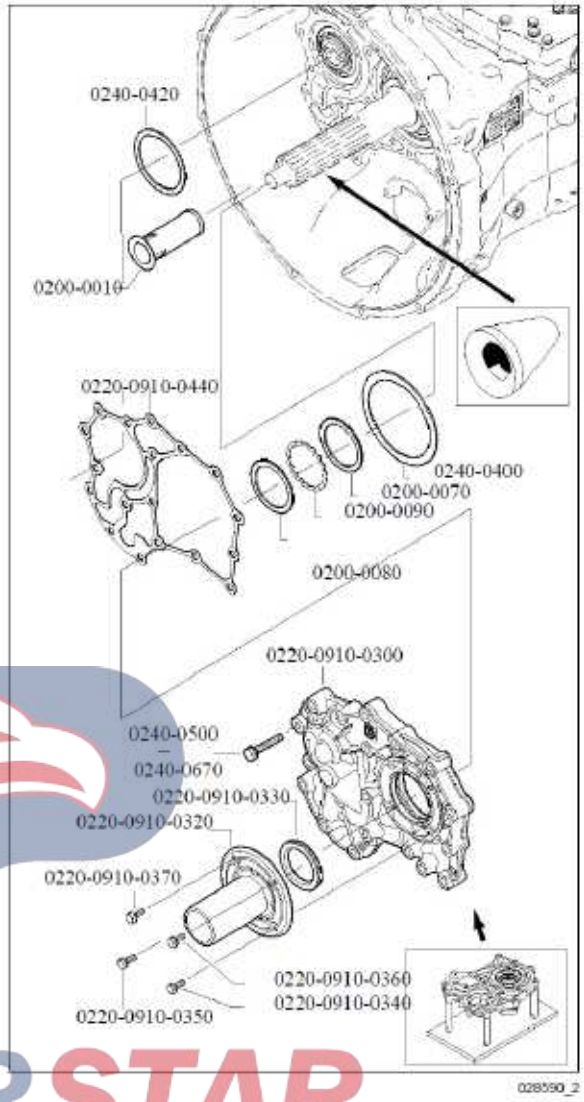
Hint

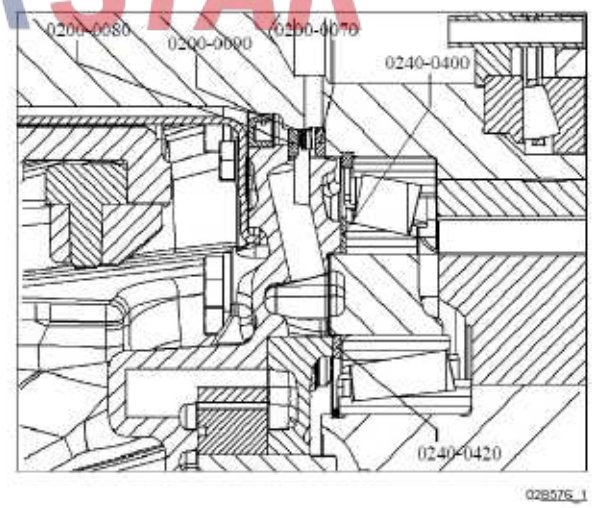
The washers 0240-0400 and 0240-0420 have been tested in Chapter 13.

6 Place the new sealing gasket 0220-0910-0440 on the gearbox

7 Install the guide pipe 0220-0910-0320 on the connecting plate, and use the combination bolts 0220-0910-0340 to 0220-0910-0370 to fix them.

Tightening torque: 32 Nm





8 Align the groove of intermediate shaft to the follower of the pump wheel.

Installation recommendations: Set the notch of the intermediate shaft by turning the input shaft and make the notch face the housing casting point (C). Make the follower of rotary pump wheel face the groove (D) of the pump cover (See Diagram 031856).

9 Thread the protective sleeve 1X56 138 064 used for protecting the shaft seal ring onto the input shaft.

10 Install the connecting plate 0220-0910-0300 into the clutch housing, and use a plastic hammer to tap it until it clings to the position. Remove the protective sleeve.

Hint

Threaded holes and connection surfaces must be clean.

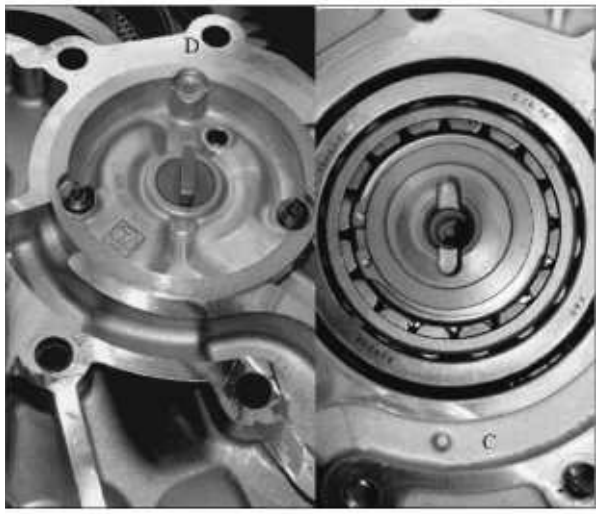
11 Install the new hexagonal bolts 0240-0500 to 0240-0670 and tighten them.

Tightening torque: 46 Nm

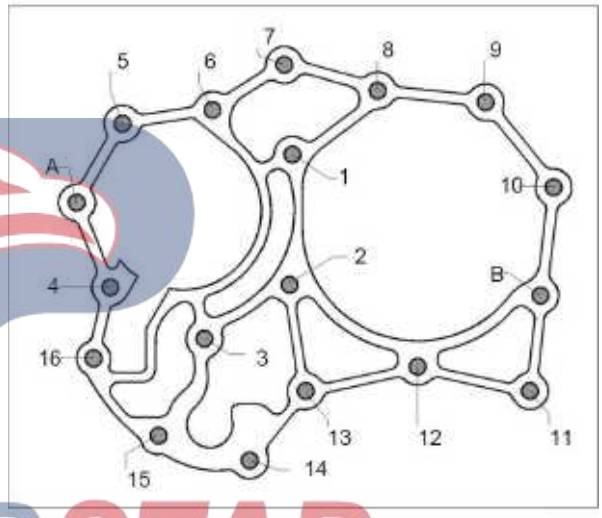
Hint

• To position the connecting plate better, please use the fixing pins (3) in the positions of A and B.

• Screw up the bolts in order (1 - 16).



031856



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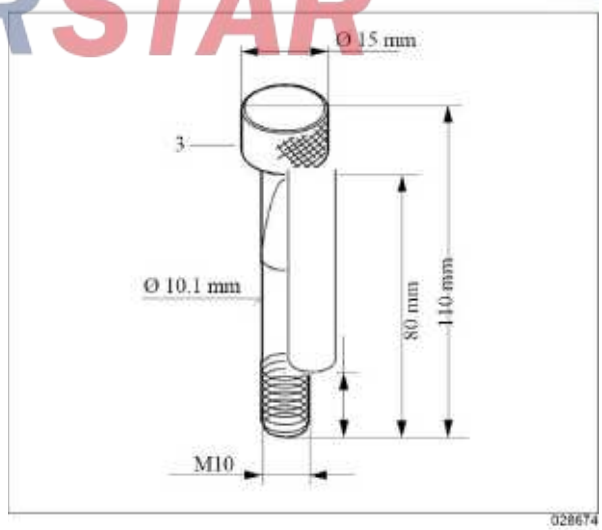


028674

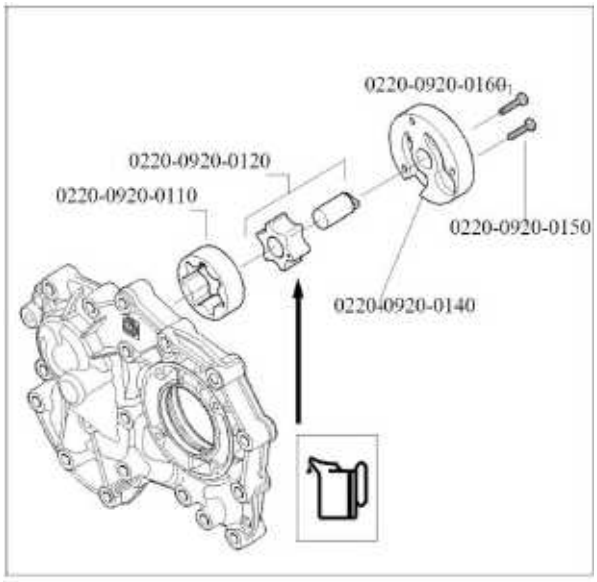
6.3 Pump

6.3.1 Disassemble pump

1 Loosen and remove the plum bolts 0220-0920-0150 and 0220-0920-0160.

2 Remove the pump cover 0220-0920-0140 from the connecting plate.

3 Remove the gear group 0220-0920-0120 and the rotor 0220-0920-0110 from the connecting plate.



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6.3.2 Assemble pump

1 Install the rotor 0220-0920-0110 and the gear group 0220-0920-0120 into the connecting plate.

Hint

Check whether the rotor 0220-0920-0120 is correctly assembled.

Hint

Smear the corrosion protection oil on the rotor 0220-920-0110 and the gear group 0220-0920-0120.

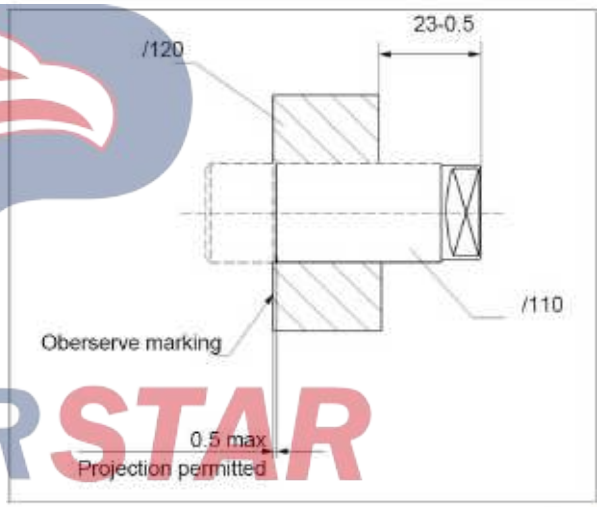
2 Install the pump cover 0220-0920-0140 into the connecting plate.

3 Install the plum bolts 0220-0920-0150 and 0220-0920-0160 into the pump cover and tighten them.

Tightening torque: 10 Nm

Hint

Check the activity of the rotor.



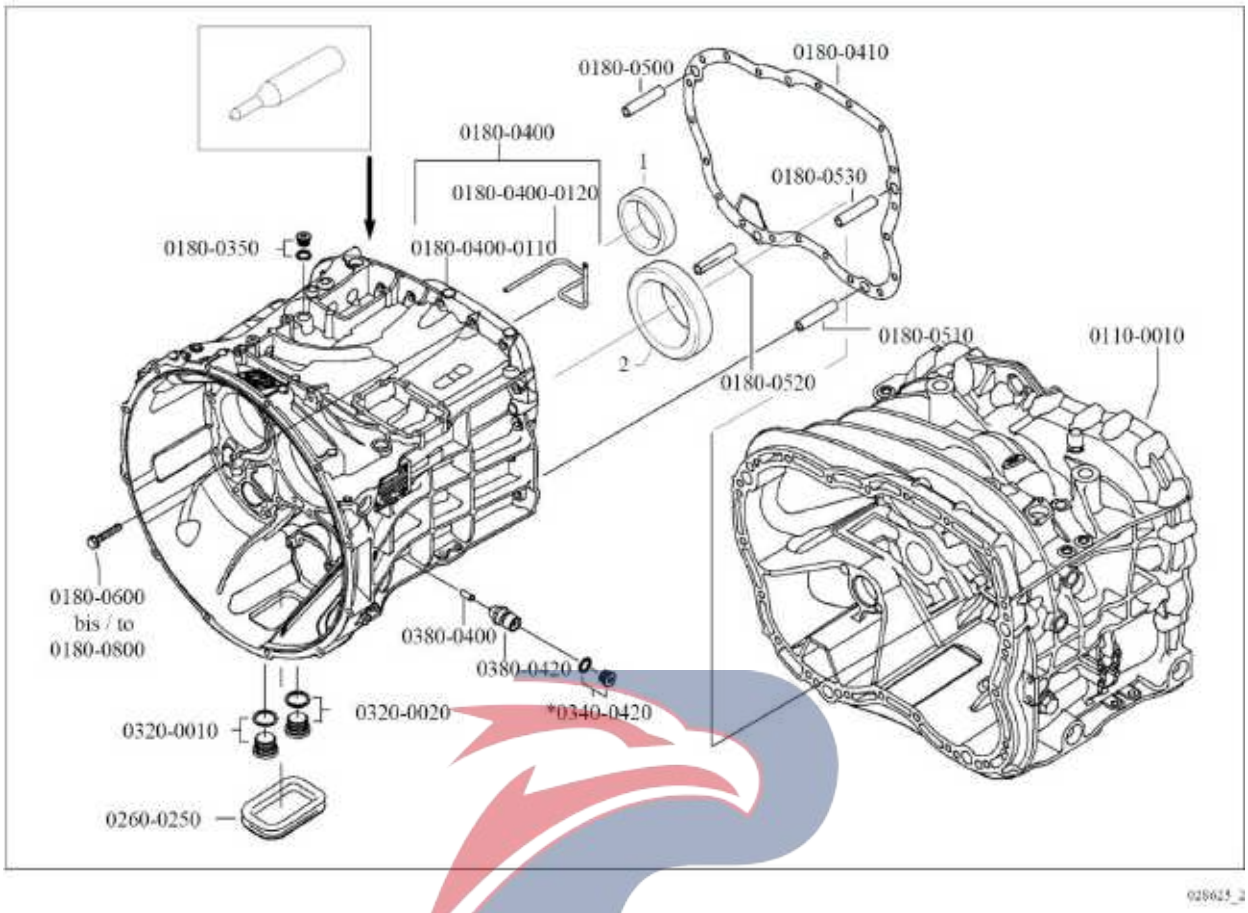
028679

7 Clutch housing

7.1 Disassemble clutch housing 7-2

7.2 Assemble clutch housing 7-3

7.3 Pipe installation 7-4



7 Clutch housing

7.1 Disassemble clutch housing

1 Loosen the switch 0380-0420, and remove it with the pin 0380-0400.

Hint

If it is a 8-gear structure, remove the screw plug 0380-0420 and the seal ring.

2 Remove the hexagonal bolts 0180-0600 to 0180-0800 from the clutch housing. Do not use the impact bolts.

3 Remove the clutch body 0180-0400.

4 Remove the sealing gasket 0180-0410 from the gearbox housing.

5 Remove the pipe 0180-0400-0120 from the clutch housing if necessary.

6 Loosen the screw plug 0180-0350 and remove the seal ring.

7 Remove the bearing outer ring (1) from the tapered roller bearing 0150-0020-0080, and remove the bearing inner ring (2) from the tapered roller bearing 0150-0010-0230 of the clutch housing.

8 If necessary, remove the screw plug 0260-0250.

9 Loosen the screw plugs 0320-0010 and 0320-0020, and remove them together with the seal ring.

7.2 Assemble clutch housing

Hint

8-gear structure without GV-gearshift lever (1).

1 Screw in and tighten the screw plugs 0320-0010 and 0320-0020 together with the new seal ring.

Tightening torque: 50 Nm

2 Install the seal cover 0260-0250.

3 If necessary, install the new pipe 0180-0400-0120 into the clutch housing. See Installation Hint Section 7.3.

4 Remove the bearing outer ring (1) from the tapered roller bearing 0150-0020-0080 and the bearing inner ring (2) from the tapered roller bearing 0150-0010-0230 of the clutch housing.

5 Place the centering device 1X56 138 639 on the gearbox housing 0110-0010, and use this method to position the gearshift lever (see Fig. 031767).

6 Place the sealing gasket 0180-0410, and use the two-claw puller 1X56 138 695 to position.

7 Slowly lower the clutch housing 0180-0400 toward the gearbox housing through the centering locating pin until the gearshift lever is centered in the gearbox housing.

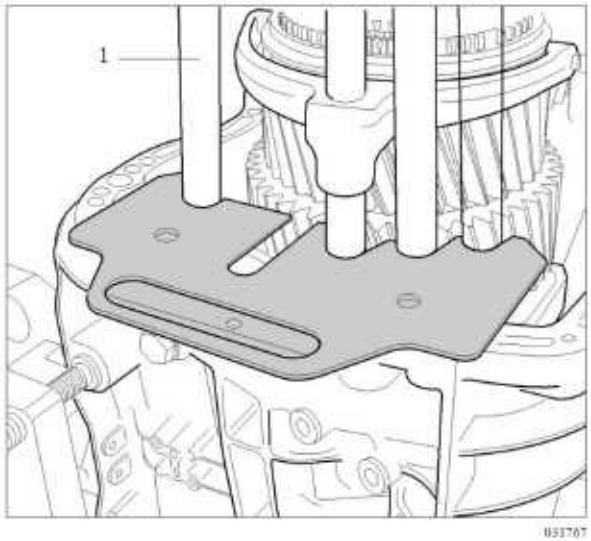
8 Remove the centering device 1X56 138 639 and lower the clutch housing in place.

Hint

• The measurements of spindle axial / thrust roller bearing have been implemented. See Section 13.1.

• The GV-gearshift lever has been adjusted. See Section 5.1.

9 Knock the cylindrical pin 0180-0500 to 0180-0530 into the gearbox housing.



10 Install and tighten the hexagonal bolts 0180-0600 to 0180-0800.

Tightening torque: 50 Nm

11 Screw in the screw plug 0180-0350 and the new seal ring, and tighten them.

Tightening torque: 35 Nm

12 Smear the grease for the pins 0380-0400, screw up the switch 0380-0420 and tighten it.

Tightening torque: 45 Nm

13 If it is a 8-gear structure, screw up the screw plug 0380-0420 and the new seal ring.

Tightening torque: 45 Nm

7.3 Pipe installation

1 Install the new pipe 0180-0400-0120 into the clutch housing, and make the pipe approximately 20 mm higher than the input end.

Hint

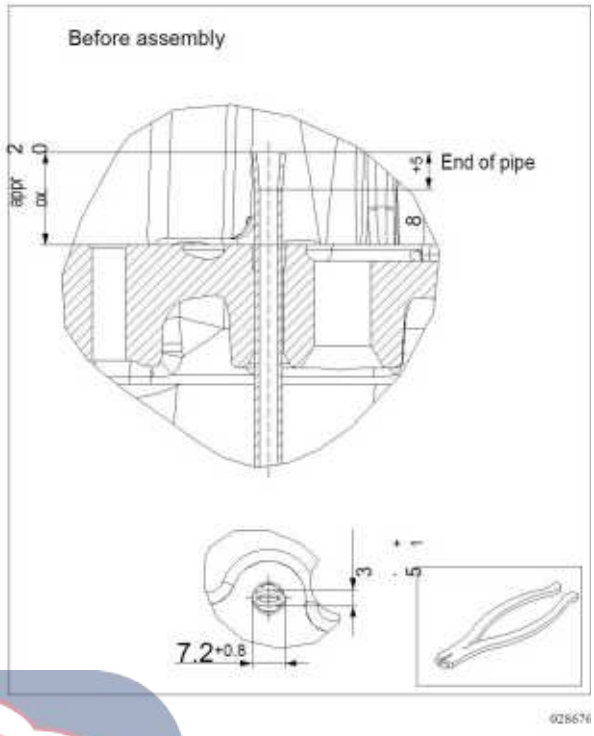
The position above the housing support rib should be accurate.

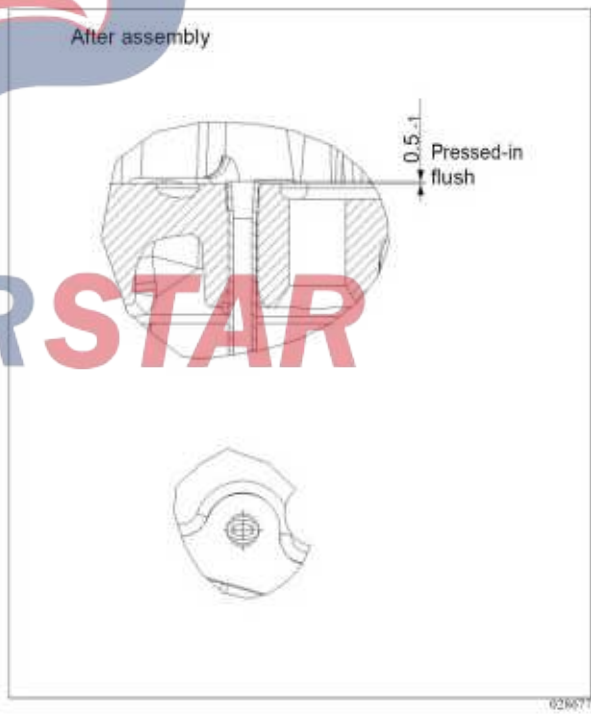
2 Use an assembly clamp 1X56 138 626 to properly clamp the end of the pipe and make it flat.

3 Press the pipe flatly into the clutch housing.

Hint

Housings and pipes can be deformed.





8 Shaft and gear shift lever

8.1 Disassmeble shaft and gear shift lever 8-2

8.2 Assmeble shaft and gear shift lever 8-5

8.3 AdjustGV- shift slider lever 8-8

8 Shaft and gear shift slider lever

8.1 Disassmeble shaft and gear shift lever

Hint

8-gear structure without GV-gearshift lever.

1 Push the reverse gear 0130-0010 (without shafts and gearshift lever shown in the diagram) towards the housing wall.

2 Remove the screw plug 0110-0190 and the seal ring.

3 Screw in the auxiliary mounting device 1X56 138 627.

Simultaneously press the lock pin 0150-0040-0250 of interlocking device towards the spring pressure.

⚠Danger

• Carefully Secure load-bearing spreader and chain.

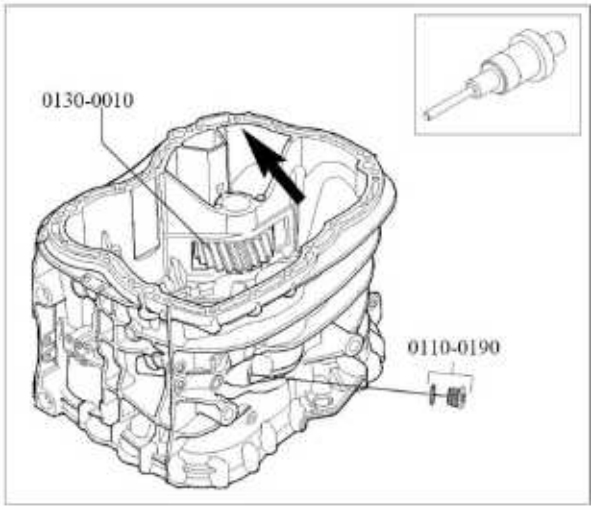
• Do not stay under the hanging objects.

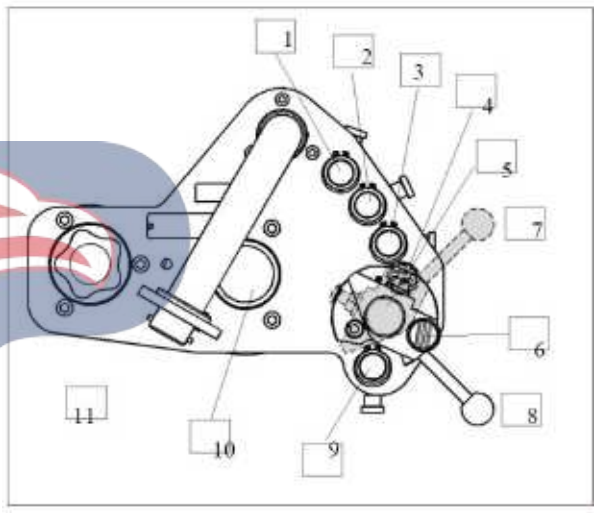
• Do not touch the chain's limit range.

4 Place the load-bearing spreader 1T66 161 756 over the shaft and the shift slider lever with the overhead crane and lower it carefully.

5 Lower the load-bearing spreader until all the shift rails and shafts are properly lifted.

6 Lower the load-bearing unit to the stop position, unload and check that the position is correct.





1 Reverse gear catheter

2 1/2 gear shift slider catheter

3 3 / 4th gear shift slider catheter

4 * "short / long" dowel pin

5 * "short / long" guide rod

6 * "on / off" dowel pin

7 * Reversing lever "OFF"

8 * Reversing lever "ON"

9 ** GV - Shift slider catheter

10 input shaft / spindle catheter

11 Intermediate shaft catheter and fixing device

* Function is only for 12 gear structure

** 8 gear structure is empty

7 Screw the plum handle (11) into the intermediate shaft and tighten it manually.

8 Secure the shift slider (1, 2, 3 and 9) by tightening the knurled bolt.

9 Lift the shaft kit slightly and check if the position of load-bearing device is fixed.

10 Install the replaceable pins / rivets used for the intermediate shaft onto the bracket / seat 1X56 137 675.

1X56 137 953, 12 mm

(16 S 1930, 16/8 S 2230, 16 S 2330,

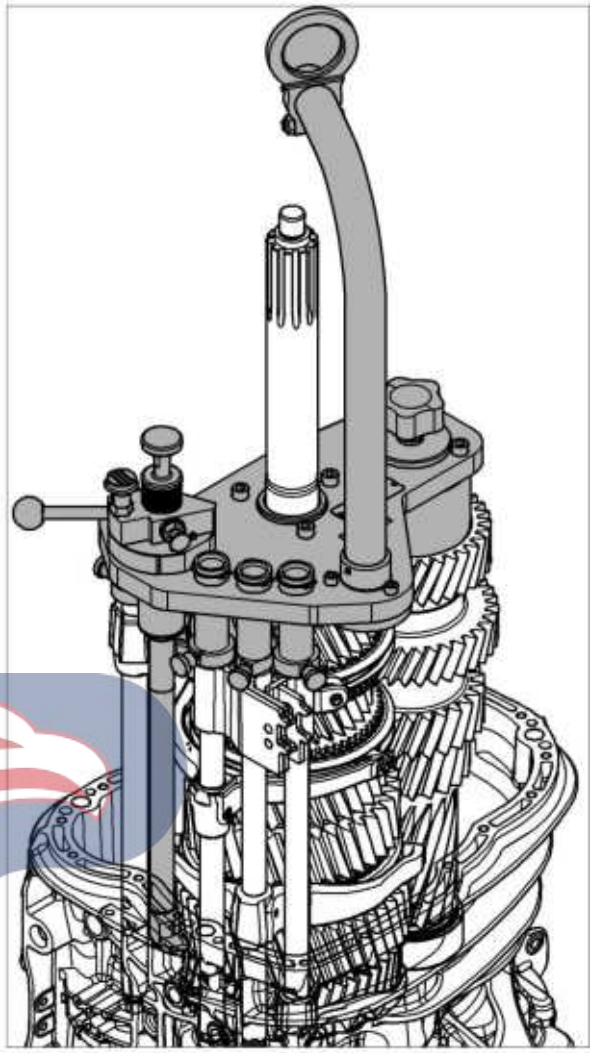
16 S 2530)

1X56 137,920, 17 mm

(16/8 S 1630, 16/8 S 1830)

1X56 138,257, 67 mm

(16 S 2730)



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⚠Danger

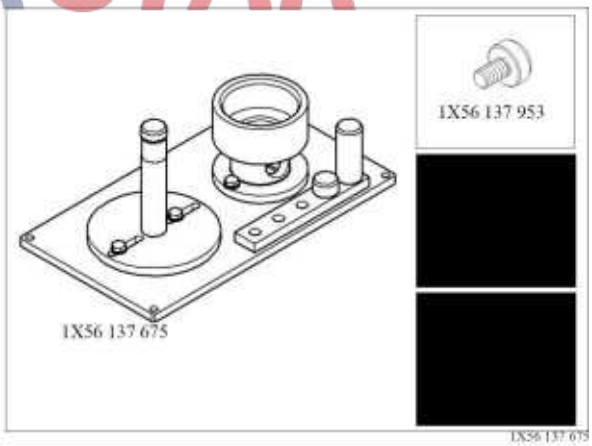
Take care when removing the shaft kit outwards: Do not make the hook catched or get stuck.

11 Pull the shaft kit and gearshift lever out of the gearbox housing without any curls, and place it in the tooling 1X56 137 675.

⚠Danger

When moving to leave the load-bearing spreader, be careful not to hang or catch the hook or conduit of the shift slider.

12 Loosen all safety fixtures and carefully lift the load-bearing spreader away.



1X56 137 675

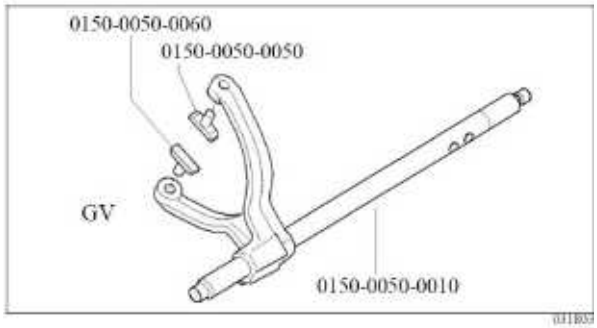
13 Remove the gearshift lever together with the fork and the sliding block.

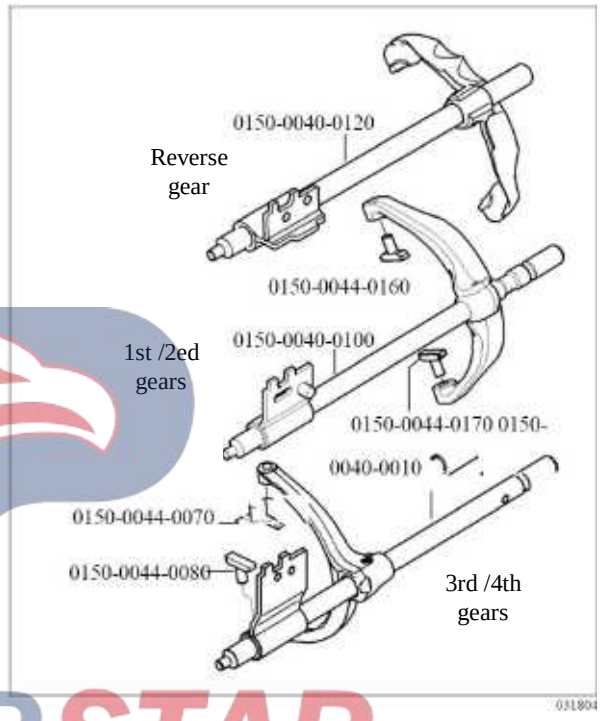
14 Remove the sliding block from the gearshift fork.

Hint

Do not continue to disassemble the gearshift lever, which is a whole structure.

15 At this time, the main shaft can be carefully separated from the intermediate shaft.





8.2 Install the shaft and shift slider

Hint

• The spindle size must be measured. See Chapter 13.

• The reverse gear must be in gear. See Chapter 9.

• The bearing outer ring must be installed. See Chapter 9.

• The leather bowl must be installed. See Chapter 9.

• 8 The gearbox of 8-speed structure has no GV-gearshift lever and the leather bowl.

1 Install the replaceable pins / rivets used for the intermediate shaft onto the bracket / seat 1X56 137 675.

1X56 137 953, 12 mm

(16 S 1930, 16/8 S 2230, 16 S 2330,

16 S 2530)

1X56 137,920, 17 mm

(16/8 S 1630, 16/8 S 1830)

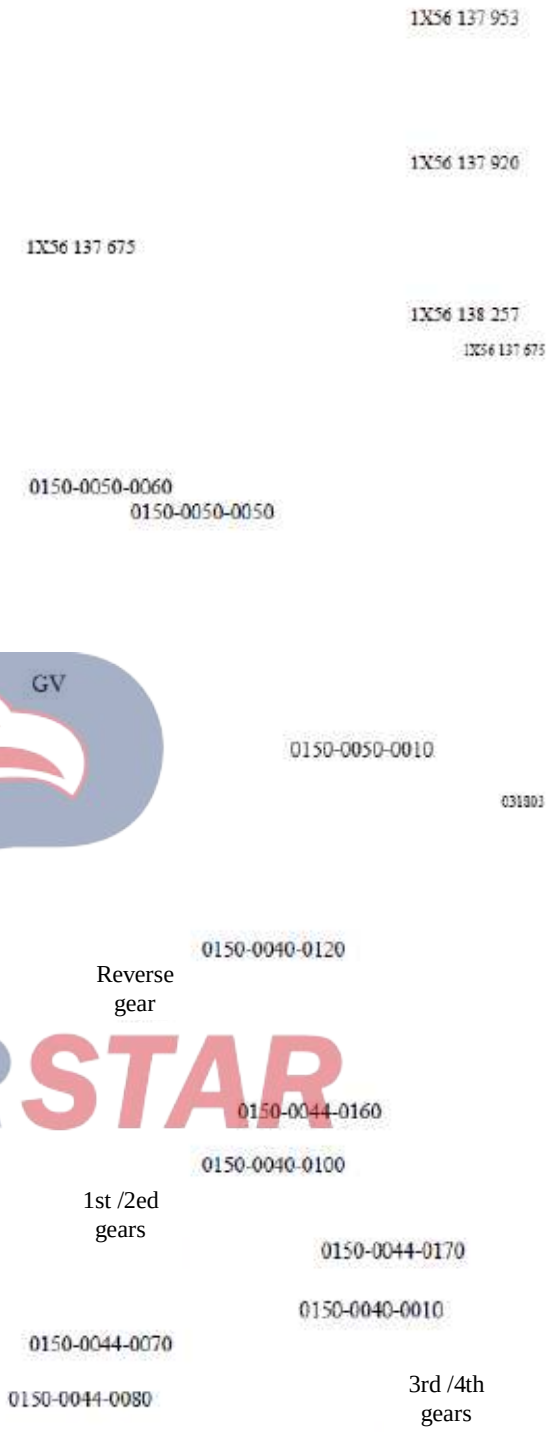
1X56 138,257, 67 mm

(16 S 2730)

2 Install the output end of main shaft 0150-0030-00105 into the bracket 1X56 137 675. Install the whole input shaft 0150-0010-0010 onto the main shaft.

Install the intermediate shaft 0150-0020-0010 and position it to the gear meshing height. Push the intermediate shaft onto the main shaft and mesh the gear.

3Install the gearshift lever and the sliding block into the sliding gear sleeve of main shaft.



⚠Danger

- **Secure load-bearing spreader and chain.**
- **Do not stay under suspension.**
- **Do not touch the chain's limit range.**

4 Place the load-bearing spreader 1T66 161 756 over the shaft and the shift slider lever with the overhead crane and lower it carefully.

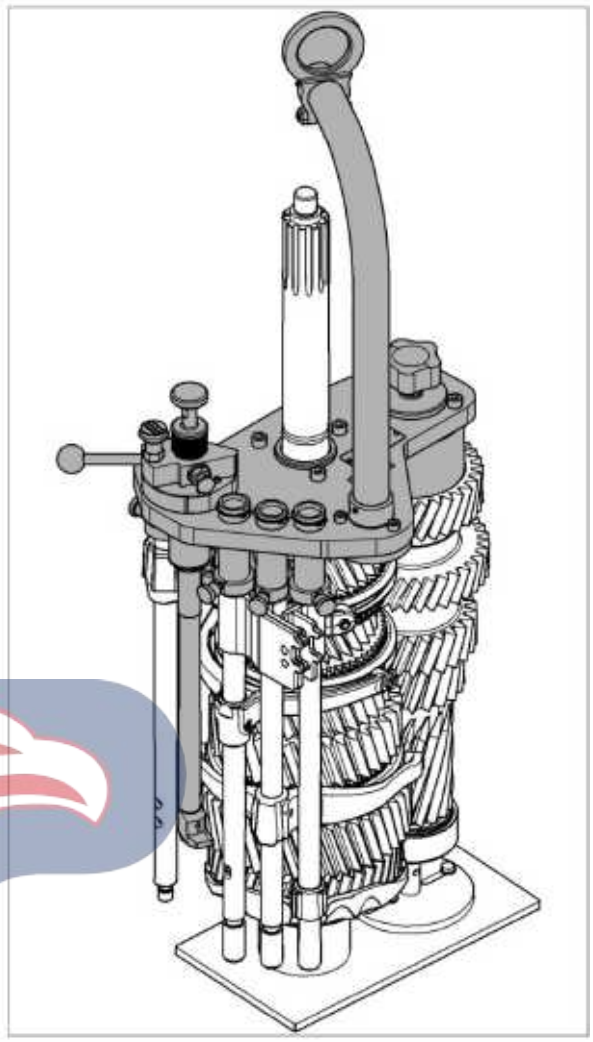
5 Lower the load-bearing spreader until all the shift rails and shafts are properly lifted.

6 Lower the load-bearing unit to the stop position, unload and check that the position is correct.

7 Screw the plum handle (11) into the intermediate shaft and tighten it manually.

8 Secure the shift slider (1, 2, 3 and 9) by tightening the knurled bolt.

9 Gently lift the shaft kit, check the fixed position and install the shaft kit over the gearbox housing.



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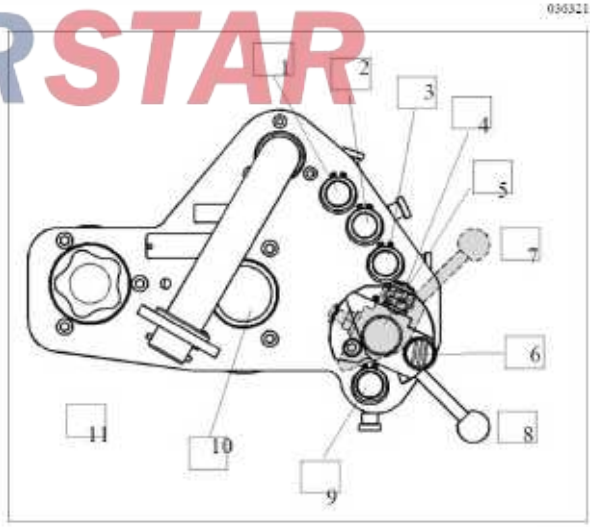


036282

1 Reverse gear catheter

2 1/2 gear shift slider catheter

3 3 / 4th gear shift slider catheter

4 * "short / long" dowel pin

5 * "short / long" guide rod

6 * "on / off" dowel pin

7 * Reversing lever "OFF"

8 * Reversing lever "ON"

9 ** GV - Shift slider catheter

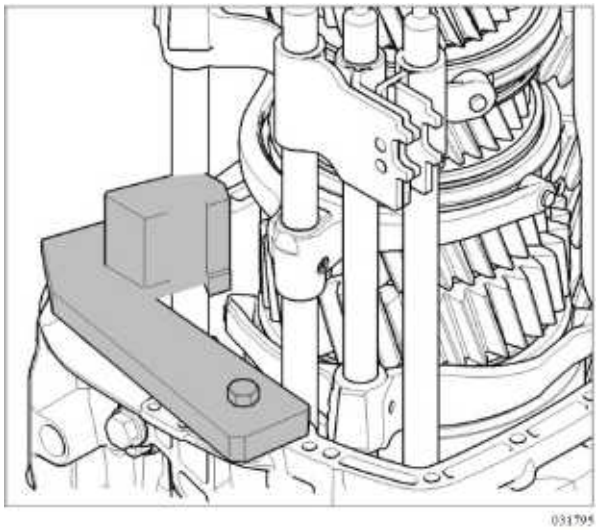
10 input shaft / spindle catheter

11 Intermediate shaft catheter and fixing device

* Function is only for 12 gear structure

** 8 gear structure is empty

10 Install the supporting device 1X56 138 632 of GV-gearshift lever to the gearbox housing (See Diagram 031795).



Caution

Do not damage the sealing lip of the leather bowl.

11 Lower the shaft and the gearshift lever slowly, and guide the GV-gearshift lever through the supporting device until it is centered in the leather bowl.

12 Remove the supporting device 1X56 138 632.

13 Install the main shaft, together with the input shaft and intermediate shaft, into the outer ring of the gearbox housing tapered roller bearing without any curls.

Hint

• The locking device must be kept still (not move) during the operation.

• Carefully make the the GV-gearghift lever 0150-0050-0010 pass through the leather bowl.

• Mesh the meshing teeth of the reverse gear.

• Switch the gearbox to the constant 2.

⚠Danger

When moving to leave the load-bearing spreader, be careful not to hang or catch the hook or conduit of the shift slider.

14 Loosen all safety fixtures and carefully lift the load-bearing spreader away.

15 Remove the tooling 1X56 138 627 of mechanical interlocking device.

16 Turn the input shaft to align the bearing rollers.

8.3 Adjust the GV-shift slider

Hint

• The gearshift lever needs to be measured only when the new parts replace the old ones. Refer to Section 8.2 for installing the gearghift lever.

• The gearbox of **8**-gear structure need not be measured.

1 Screw the adjusting tooling 1X56 138 633 (short structure) or 1X56 138 634 (long structure) onto the sealing surface (1) of gearbox housing.

Switch the sliding gear sleeve 0150-0010-0100 to the output direction. The GV-gearshift lever must be axially fixed in the adjusting tooling, and position it accordingly.

The sliding block (2) must be reserved with the clearance at the lower inside the sliding gear sleeve.

B = **0.1 + 0.2 mm** (Use a thin feeler to check)

Inspection size A:

Short type = **93.70 mm**

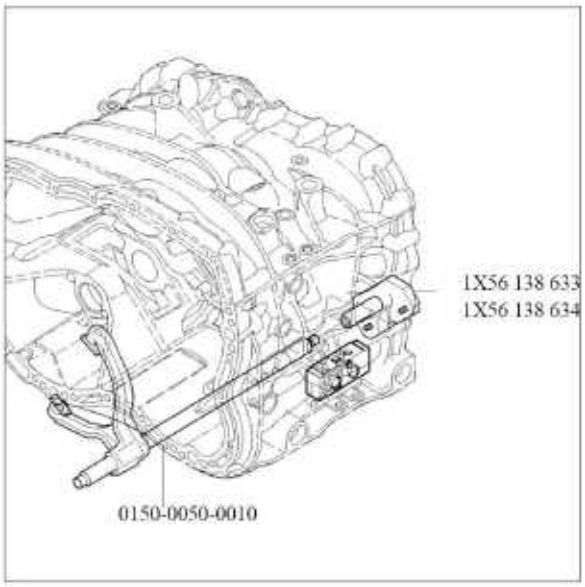
Long type = **107.20 mm**

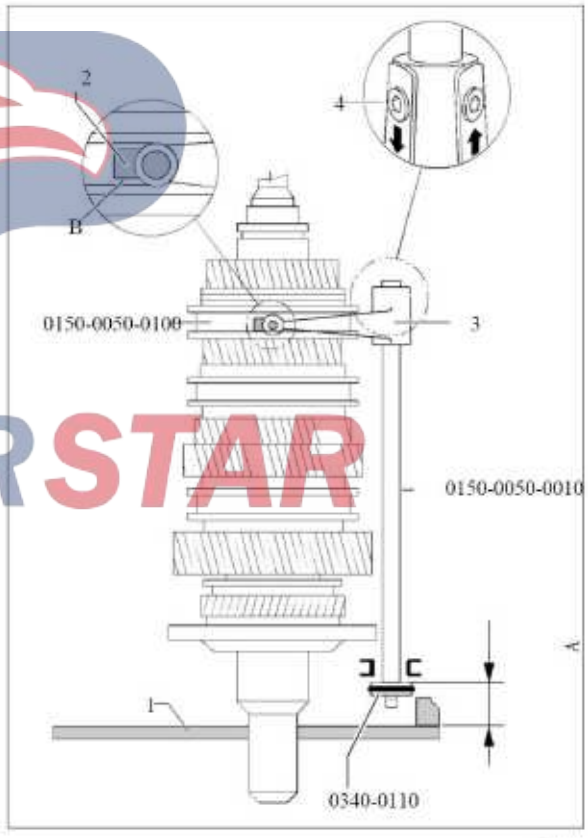
Hint

Refer to Installation Rules 0000 701 102 here.

3 Screw evenly the screw pin (4) onto the gearshift fork(3).

Tightening torque: 60 Nm

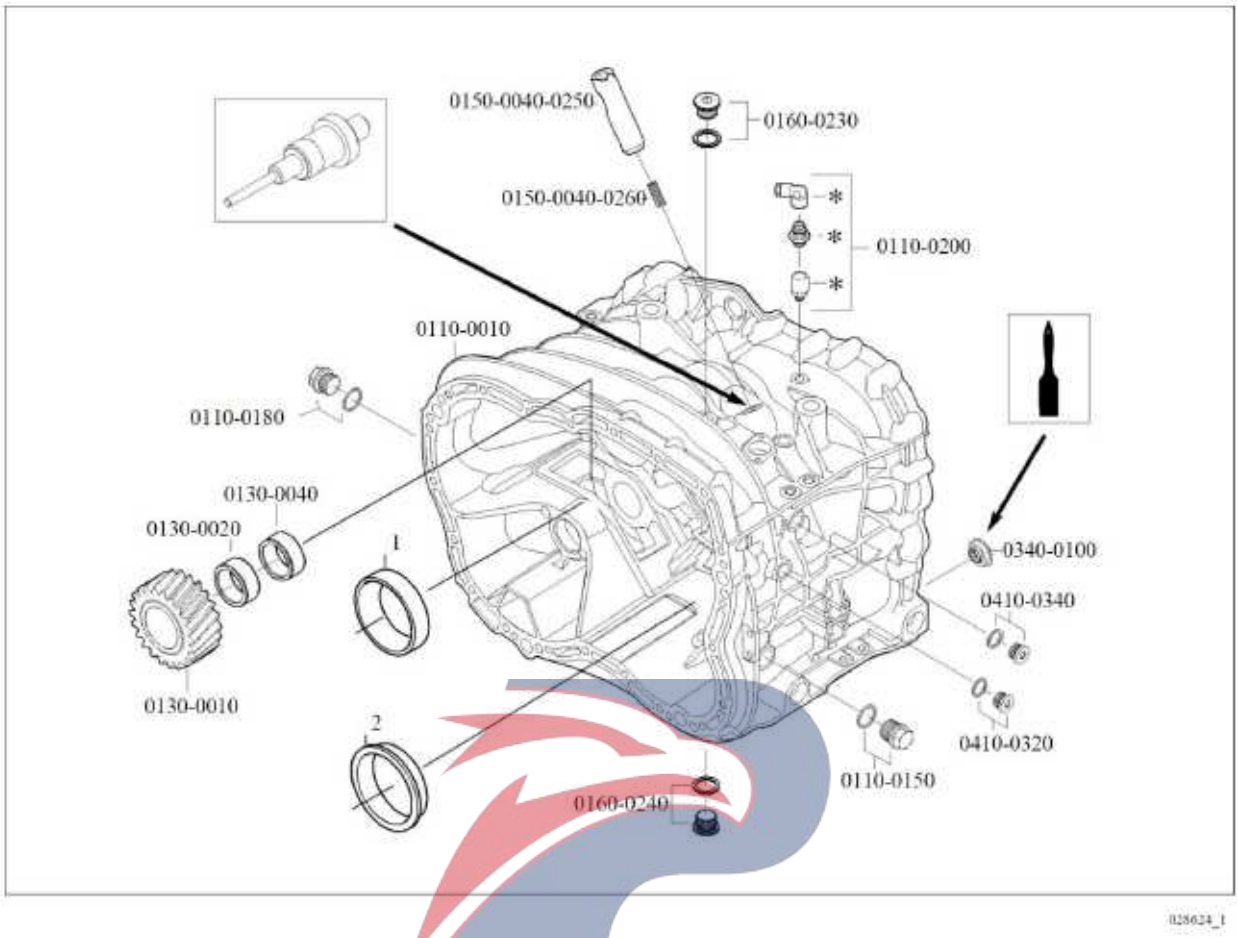




9 Transmission housing

9.1 Disassemble transmission housing 9-2

9.2 Assemble transmission housing 9-3



9 Transmission housing

9.1 Disassemble transmission housing

Hint

The 8-gear structure lacks the leather bowl.

1 Use a soft mandrel to knock out the bearing outer ring (1) of tapered roller bearing **0150-0020-0020** and the bearing outer ring (2) of tapered roller bearing **0150-0030-0230** from the gearbox housing or make it face the input end.

2 Remove the breathable cap 0110-0200 (* The structure is shown in Material General Assembly List).

3 Loosen the screw plugs 0110-0150 and 0110-0180 as needed, and remove them together with the seal ring.

4 Loosen and remove the screw plug 0410-0320 and the switch 0410-0340 as needed.

5 Loosen and remove the screw plugs 0160-0230 and 0160-0240 as needed.

6 Unscrew the tooling 1X56 138 627, and remove the lock pin 0150-0040-0250 as well as the compression spring 0150-0040-0260.

7 Use an appropriate tool to remove the leather bowl 0340-0100 from the housing.

8 Remove the reverse gear 0130-0010 together with the needle holder 0130-0020 and 0130-0040 from the housing, and remove the needle roller holder from the reverse gear.

9.2 Assemble transmission housing

1 Screw up the screw plugs 0160-0230 and 0160-0240 together with the new seal ring.

Tightening torque: 35 Nm

2 Screw up the screw plugs 0410-0320 and 0410-0340 together with the new seal ring.

Tightening torque: 35 Nm

3 Screw up the screw plugs 0110-0150 and 0110-0180 together with the new seal ring.

Tightening torque: 60 Nm

4 Screw up the breather cap 0110-200 into the housing.

Tightening torque: 10 Nm

⚠Danger

The protective gloves must be worn to touch the heating element.

5 Use a hot hair dryer to heat around the bearing hole of the housing to be approximately 80 ℃.

6 Use a plastic mandrel or an appropriate sleeve machine to install the bearing outer ring (1) of the tapered roller bearing 0150-0020-0020 and the bearing outer ring (2) of the tapered roller bearing 0150-0030-0230 into the housing until they cling to the axial position.

7 Use the ethanol (alcohol) to moisten the support holes and the outer periphery of the new leather bowl 0340-0100. Install the leather bowl before the ethanol evaporates.

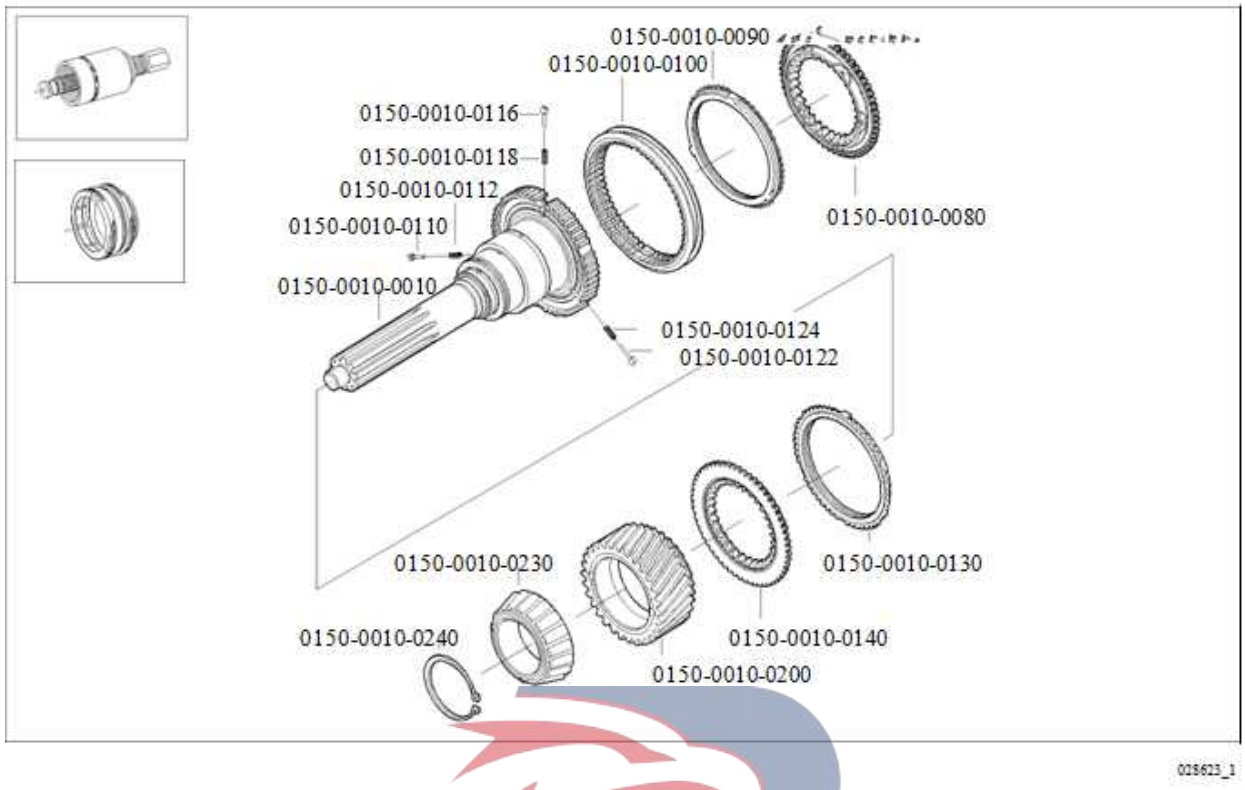
8 Use an appropriate tool to install the leather bowl 0340-0100 to the housing clinging to the axial position. Grease the sealing lip of the leather bowl.

9 Insert the compression spring 0150-0040-0260 together with the lock pin 0150-0040-0250 and adjust their positions. Screw in the auxiliary mounting device 1X56 138 627.

10 Place the reverse gear 0130-0010 together with the needle roller holders 0130-0020 and 0130-0040 into the housing.

10 Input shaft

10.1 Structure with axial / thrust roller bearings 10-2
10.1.1 Disassemble the input shaft 10-2
10.1.2 Assemble the input shaft 10-3
10.2 Structure with tapered roller bearing 10-4
01.02.10 Disassemble the input shaft 10-4
02.02.10 Assemble the input shaft 10-5
10.3 8- Block structure, TO (K1) 10-6
01.03.10 Disassemble the input shaft 10-6
02.03.10 Assemble the input shaft 10-7
10.4 8- Block structure, TD (K2) 10-8
01.04.10 Disassemble the input shaft 10-8
02.04.10 Assemble the input shaft 10-9



10 Input shaft

10.1 With axial / thrust roller bearing structure

10.1.1 Disassemble the input shaft

Hint

The input shaft can only be removed after removing the clutch housing (see section 7) , the output shaft (see section 8).

1 Remove the input shaft 0150-0010-0010 from the main shaft as a whole.

2 Remove clutch body 0150-0010-0080 and synchronizer ring 0150-0010-0090 from the input shaft synchronizer.

⚠ **Danger**

The pressure block / pressure pin withstands the spring pressure to prevent pop-up.

3 Remove the sliding sleeve 0150-0010-0100 from the input shaft. Take over the released briquetting / pressure pins 0150-0010-0110, 0150-0010-0116, 0150-0010-0122 and compression spring 0150-0010-0112, 0150-0010-0118, 0150-0010-0124.

4 Loosen and remove retaining ring 0150-0010-0240.

5 Remove the roller bearing inner ring 0150-0010-0230 from the input shaft using the clamp / holder 1X56 136 722 and the basic tooling 1X56 122 304. During operation, place the clamp 1X56 136 722 on the roller bearing inner ring until it fits securely against the roller and is locked with a jacketed ring.

6 Remove the bevel gear 0150-0010-0200 from the input shaft.

7 Remove clutch body 0150-0010-0140 and synchronizer ring 0150-0010-0130 from the input shaft.

10.1.2 Assemble input shaft

1 Check the wear limit of the synchronizer, see Chapter 14.

2 Install the synchronizer ring 0150-0010-0130 and clutch body 0150-0010-0140 onto the input shaft.

Hint

The protruding part of synchronous ring must be embeded into the groove of the input shaft synchronizer.

3 Place the bevel gear 0150-0010-0200 onto the input shaft.

Hint

The synchromesh tooth of the bevel gear faces the output end and must engage the internal toothing of the clutch body.

⚠Danger

Only be wearing protective gloves can touch the heated roller bearing inner ring.

4 Heat the roller bearing inner ring 0150-0010-0230 to approximately 100 ℃ and apply it to the input shaft. Roller bearings must be axially cooled against the input shaft flange.

5 Press in the retainer ring 0150-0010-0240.

6 Install the sliding sleeve 0150-0010-0100 onto the input shaft and fasten it. Load new compression springs 0150-0010-0112, 0150-0010-0118, 0150-0010-0124 and briquetting / pressure pins 0150-0010-0110, 0150-0010-0116, 0150-0010-0122 into the input shaft and use appropriate tools into the sliding gear sleeve.

7 Install the synchronizer ring 0150-0010-0090 and clutch body 0150-0010-0080 onto the input shaft.

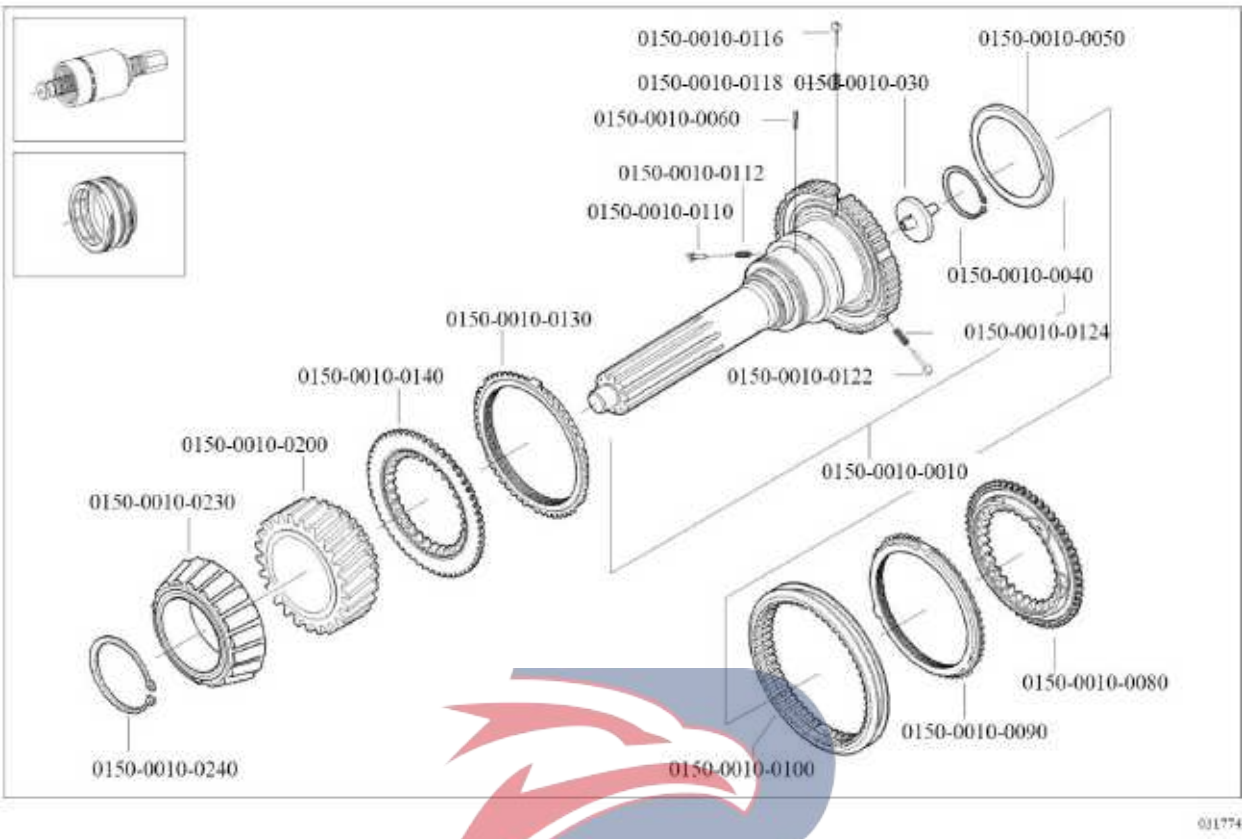
8 Adjust the sliding gear sleeve to the middle position.

Press into the clutch body 0150-0010-0080, you can clearly hear the bite / pressure pin stuck sound.

9 Install the input shaft on the spindle.

Hint

Input shaft installation Refer to chapter 8。



10.2 With tapered roller bearing structure

01.02.10 Disassemble input shaft

Hint

The input shaft can only be removed after removing the clutch housing (see section 7) , the output shaft (see section 8).

1 Remove the input shaft 0150-0010-0010 from the main shaft as a whole.

2 Remove clutch body 0150-0010-0080 and synchronizer ring 0150-0010-0090 from the input shaft synchronizer.

⚠Danger

Briquetting / pressure pin withstand spring pressure.

Prevent pop-up.

3 Remove the sliding sleeve 0150-0010-0100 from the input shaft. Take over the released briquetting / pressure pins 0150-0010-0110, 0150-0010-0116, 0150-0010-0122 and compression spring 0150-0010-0112, 0150-0010-0118, 0150-0010-0124.

4 Loosen and remove retaining ring 0150-0010-0240.

5 Remove the roller bearing inner ring 0150-0010-0230 from the input shaft using the clamp / holder 1X56 136 722 and the basic tooling 1X56 122 304. During operation, place the clamp 1X56 136 722 on the roller bearing inner ring until it fits securely against the roller and is locked with a jacketed ring.

6 Remove the bevel gear 0150-0010-0200 from the input shaft.

7 Remove clutch body 0150-0010-0140 and synchronizer ring 0150-0010-0130 from the input shaft.

8 Loosen and remove retaining ring 0150-0010-0040.

9 Remove the cannula 0150-0010-0030。

10 Remove the oil deflector 0150-0010-0050 on the input shaft.

11 Depending on the structure, remove the pin 0150-0010-0060。

02.02.10 Assemble input shaft

1 Depending on the structure, insert the pin 0150-0010-0060。

2 Fit the oil pan 0150-0010-0050 to the input shaft with the appropriate tool (Fig. 031775).

3 Place cannula 0150-0010-0030 in the input shaft exactly (see Fig. 031775).

4 Press in the retainer ring 0150-0010-0040.

5 Check the synchronization unit wear limit, see section 14.

6 Install the synchronizer ring 0150-0010-0130 and clutch body 0150-0010-0140 onto the input shaft.

Hint

The protruding part of synchronous ring must be embeded into the groove of the input shaft synchronizer.

7 Place the bevel gear 0150-0010-0200 onto the input shaft.

Hint

The synchromesh tooth of the bevel gear faces the output end and must engage the internal toothing of the clutch body.

⚠Danger

Only be wearing protective gloves can touch the heated roller bearing inner ring.

8 Heat the roller bearing inner ring 0150-0010-0230 to approximately 100 ℃ and apply it to the input shaft. Roller bearings must be axially cooled against the input shaft flange.

9 Press in the retainer ring 0150-0010-0240.

10 Install the sliding sleeve 0150-0010-0100 onto the input shaft and fasten it. Load new compression springs 0150-0010-0112, 0150-0010-0118, 0150-0010-0124 and briquetting / pressure pins 0150-0010-0110, 0150-0010-0116, 0150-0010-0122 into the input shaft and use appropriate tools into the sliding gear sleeve.

11 Install the synchronizer ring 0150-0010-0090 and clutch body 0150-0010-0080 onto the input shaft.

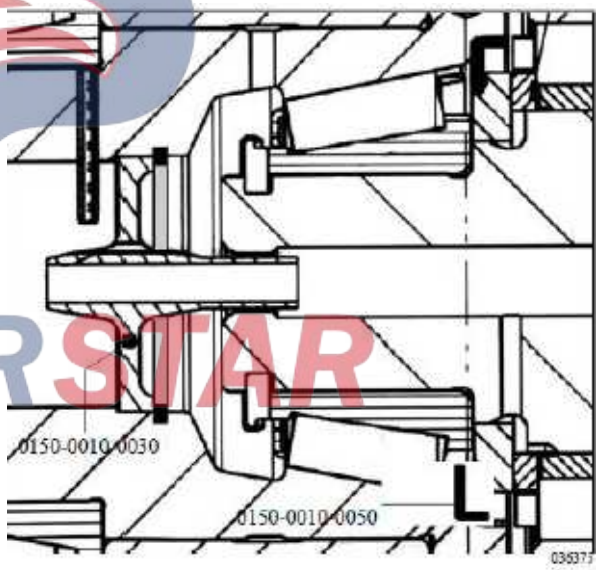
12 Adjust the sliding gear sleeve to the middle position.

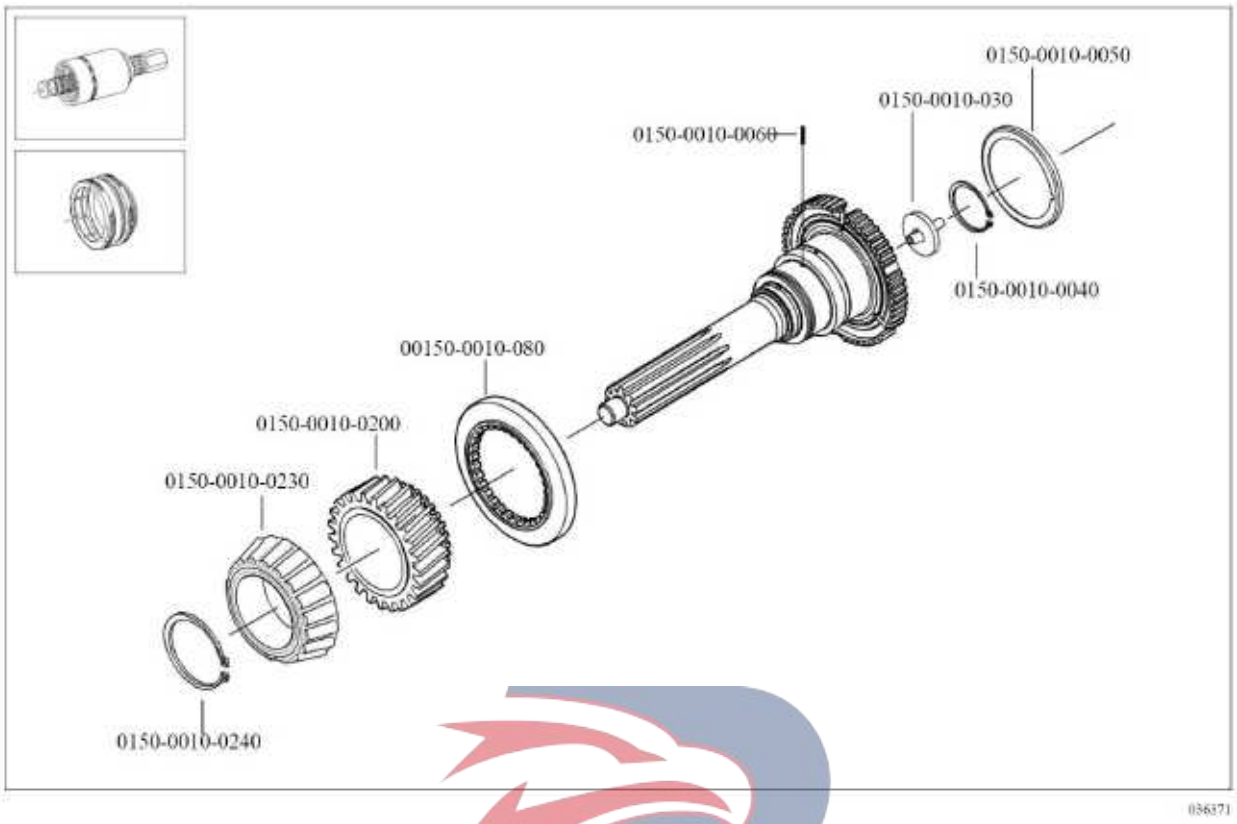
Press into the clutch body 0150-0010-0080, you can clearly hear the bite / pressure pin stuck sound.

13 Install the input shaft on the spindle.

Hint

Input shaft installation Refer to chapter 8.





10.3 8 Block structure, TO (K1)

10.3.1 Disassemble the input shaft

Hint

The input shaft can only be removed after removing the clutch housing (see section 7) , the output shaft (see section 8).

1 Remove the input shaft 0150-0010-0010 from the main shaft as a whole.

2.Loosen and remove retaining ring 0150-0010-0240.

3 Remove the roller bearing inner ring 0150-0010-0230 from the input shaft using the clamp / holder 1X56 136 722 and the basic tool 1X56 122 304. Operation, the fixture 1X56 136 722 to wear the roller bearing inner ring until close to the roller fixed position, and with a rope loop lock.

4 Remove bevel gear 0150-0010-0200 from the input shaft.

5 Remove the clutch disc 0150-0010-0080 from the input shaft.

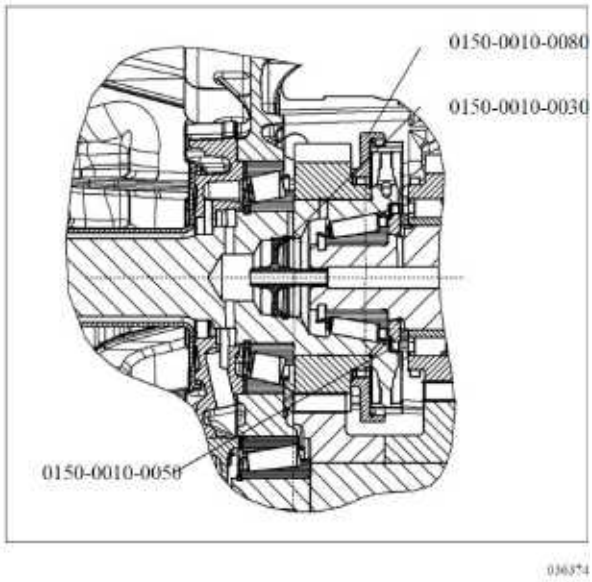
6 Loosen and remove retaining ring 0150-0010-0040。

7 Remove cannula 0150-0010-0030.

8 Remove the drain pan 0150-0010-0050 on the input shaft.

9 Depending on the construction, remove dowel 0150-0010-0060.

10.3.2 Assemble the input shaft



1 Depending on the structure, insert the pin 0150-0010-0060。

2 Fit the oil pan 0150-0010-0050 to the input shaft with the appropriate tool (Fig. 031775).

3 Place cannula 0150-0010-0030 in the input shaft exactly (see Fig. 031775).

4 Press in the retainer ring 0150-0010-0040.

5 Install the clutch disc 0150-0010-0080 onto the input shaft.

Hint

The open side of clutch disc faces the output end.

6 Place the bevel gear 0150-0010-0200 onto the input shaft.

Hint

The helical gear's synchronizing teeth face the output end, and must mesh the internal engaging tooth of clutch disc.

⚠Danger

Only be wearing protective gloves can touch the heated roller bearing inner ring.

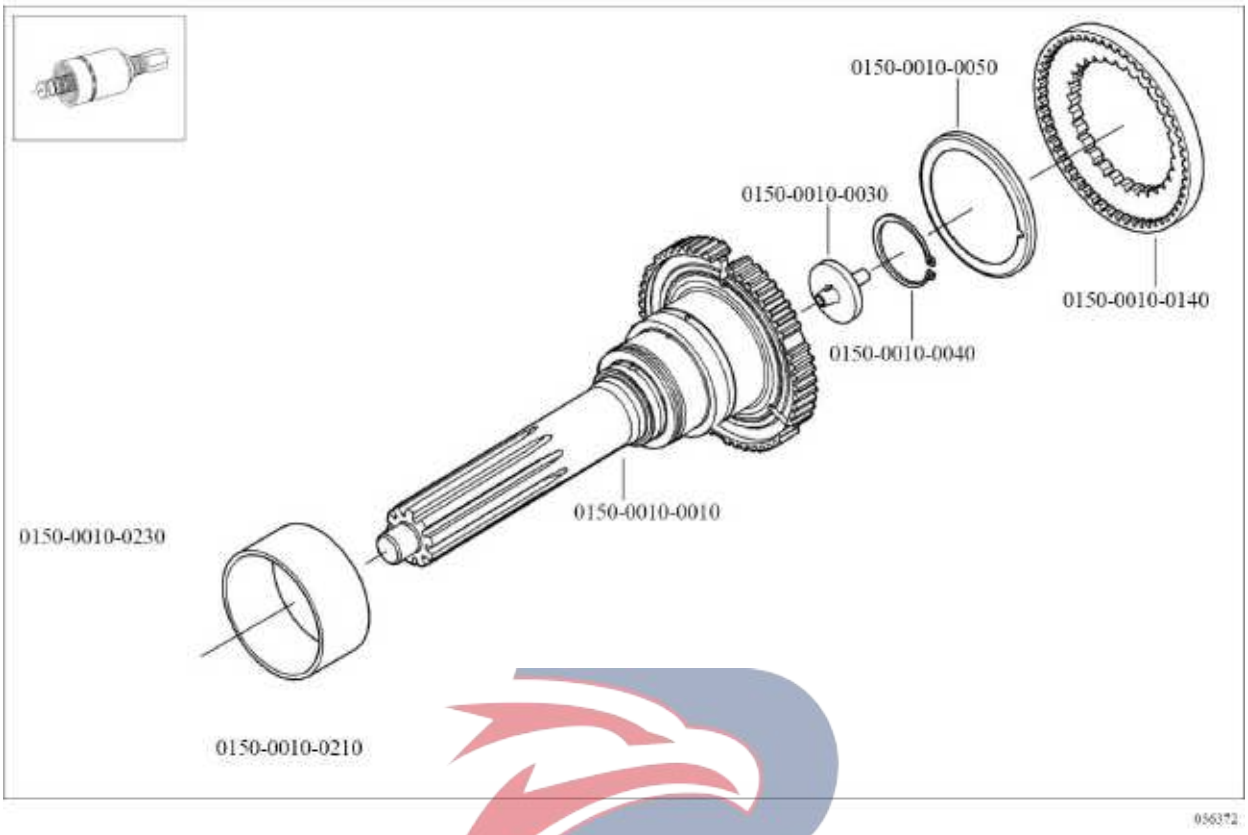
7 Heat roller bearing inner ring 0150-0010-0230 to approx. 100 ℃ and apply it to the input shaft. Roller bearings must be axially cooled against the input shaft flange.

8 Press in the retainer ring 0150-0010-0240.

9 Install the input shaft on the spindle.

Hint

Input shaft installation Refer to chapter 8.



10.4 8 Block structure, TD (K2)

01.04.10 Disassemble the input shaft

Hint

The input shaft can only be removed after removing the clutch housing (see section 7) , the output shaft (see section 8).

1 Remove the input shaft 0150-0010-0010 from the main shaft as a whole.

2 Remove the clutch disc 0150-0010-0140 from the input shaft.

3 3.Loosen and remove retaining ring 0150-0010-0040.

4 Remove the cannula 0150-0010-0030。

5 Remove the oil deflector 0150-0010-0050 on the input shaft.

6 Remove the roller bearing inner ring 0150-0010-0230 from the input shaft with clamp / holder 1X56 136 722 and basic tool 1X56 122 304. Operation, the fixture 1X56 136 722 to wear the roller bearing inner ring until close to the roller fixed position, and with a rope loop lock.

7 Remove the bushing 0150-0010-0210 from the input shaft.

10.4.2 Assemble the input shaft

1 Make the bushing 0150-0010-0210 cover the input shaft.

Danger

Only be wearing protective gloves can touch the heated roller bearing inner ring.

2 Heat roller bearing inner ring 0150-0010-0230 to approx. 100 ℃ and apply it to the input shaft. Roller bearings must be axially cooled against the input shaft flange.

3 Install the oil deflector 0150-0010-0050 against the input shaft with the proper tool (see Fig. 031775).

4 Insert the cannula 0150-0010-0030 into the input shaft accurately (see Fig. 031775).

5 Press in the retainer ring 0150-0010-0040。

6 Install the clutch disc 0150-0010-0140 onto the input shaft.

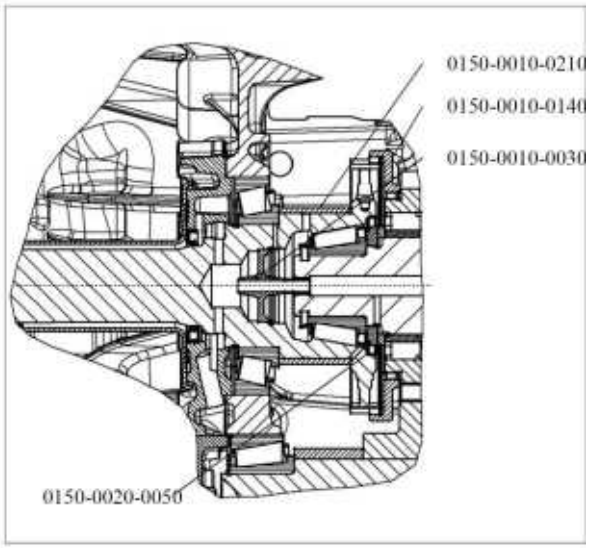
Hint

The open side of clutch disc faces the input end.

7 Install the input shaft to the spindle.

Hint

Input shaft installation Refer to chapter 8.



11 Intermediate shaft

11.1 Standard structure 11-2

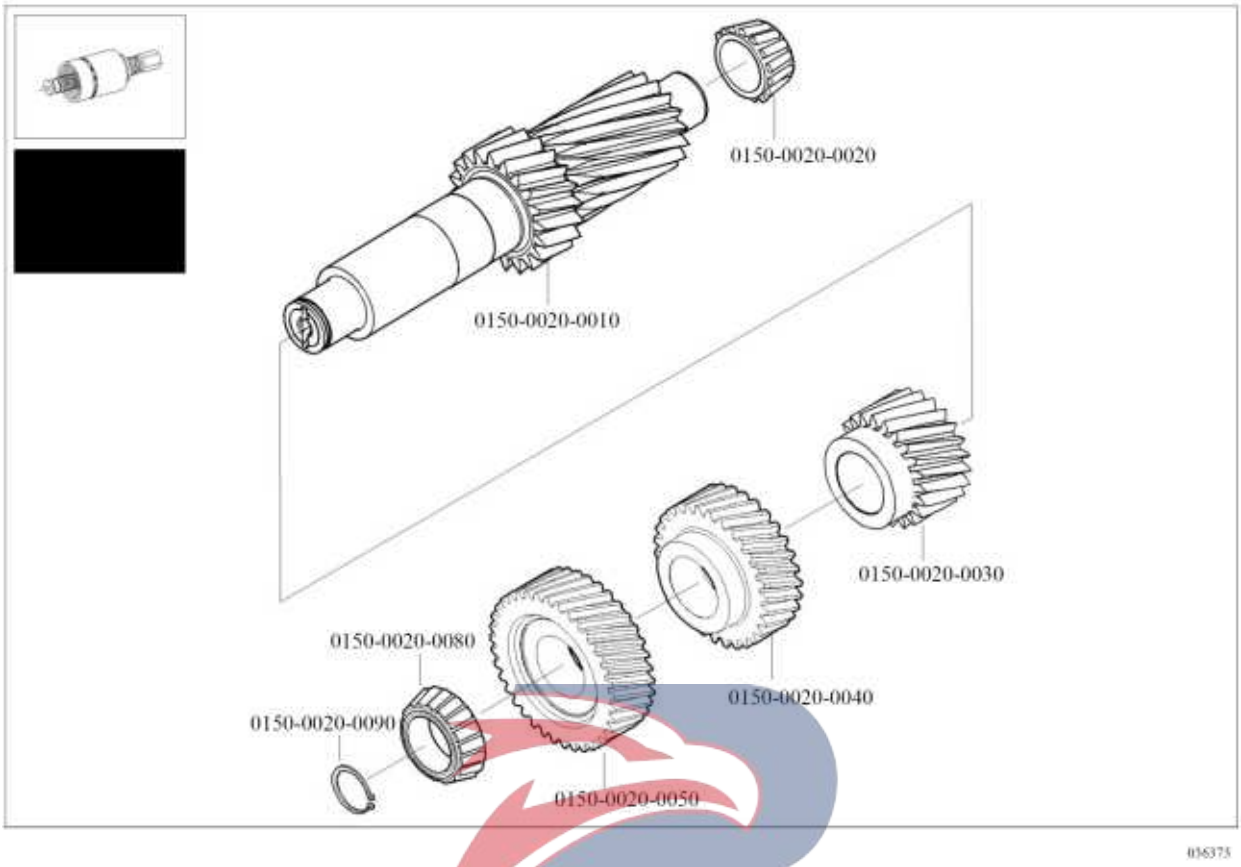
11.1.1 Disassemble the intermediate shaft 11-2

11.1.2 Assemble the intermediate shaft 11-3

11.2 8 Block structure , TD (K2) 11-4

11.2.1 Disassemble the intermediate shaft 11-4

11.2.2 Assemble the intermediate shaft 11-5



11 Intermediate shaft

11.1 Standard structure

Hint

• Disassemble the intermediate shaft, see chapter 8.

• The standard structure is constructed in the same way as the 8-gear structure, **TO (K1)**.

11.1.1 Disassemble the intermediate shaft

Hint

To protect the intermediate shaft, a pressure block must be placed between the puller and the intermediate shaft 0150-0020-0010.

1 Place the clamp / holder 1X56 136 756 on the inner ring of tapered roller bearings 0150-0020-0020. Turn the jacketed rope loop until the clamps are firmly seated.

2 Screw the basic tooling 1X56 122 304 onto the clamp and remove the bearing inner ring from the countershaft.

3 Eject and remove the retaining ring 0150-0020-0090.

4 Mount the clamp / holder 1X56 136 756 onto the inner ring of tapered roller bearings 0150-0020-0080. Turn the jacketed rope loop until the clamps are firmly seated.

5 Screw the basic tooling 1X56 122 304 onto the clamp and remove the bearing inner ring from the countershaft.

Caution

If necessary, replace the tapered roller bearing 0150-0020-0020 / 0150-0020-0080, bearing roller will be damaged due to pulling the dial.

6 Due to the overhigh extrusion pressure, use the appropriate hydraulic jacks to squeeze out the helical gears 0150-0020-0050, 0150-0020-0040 and 0150-0020-0030 one by one. Helical gears can withstand pressures up to 500 kN.

Hint

To avoid gear damage, place the intermediate shaft or bevel gear on a soft cushion.

11.1.2 Assemble intermediate shaft

Danger

Only be wearing protective gloves can touch the heating and cooling components.

1 The positions of the helical gear holes and countershaft must be oil-free, grease-free and dust-free.

2 Heat the helical gears 0150-0020-0030, 0150-0020-0040 and 0150-0020-0050 to 170 °C (maximum).

3 It is sometimes necessary to cool the countershaft 0150-0020-0010, specifying a temperature difference of 150 ℃ between the bevel gear and the countershaft.

4 Place the heated helical gears 0150-0020-0030, 0150-0020-0040 and 0150-0020-0050 by overlapping up and down on the top of hydraulic jacks, and place them correctly.

5 Push the countershaft into the bevel gear hole and immediately squeeze the bevel gear until it is close to the axial position. Cool the assembly.

Hint

Tapered roller bearing inner ring due to pull and damage. Therefore, to be carefully examined or the use of new tapered roller bearings.

6 Heat the tapered roller bearing inner ring 0150-0020-0020 / 0150-0020-0080 to 120 to 130 ° C for a maximum of 15 minutes and attach it to the intermediate shaft.

Pay attention to close to the axial position, if necessary, continue to use soft mandrel pressure.

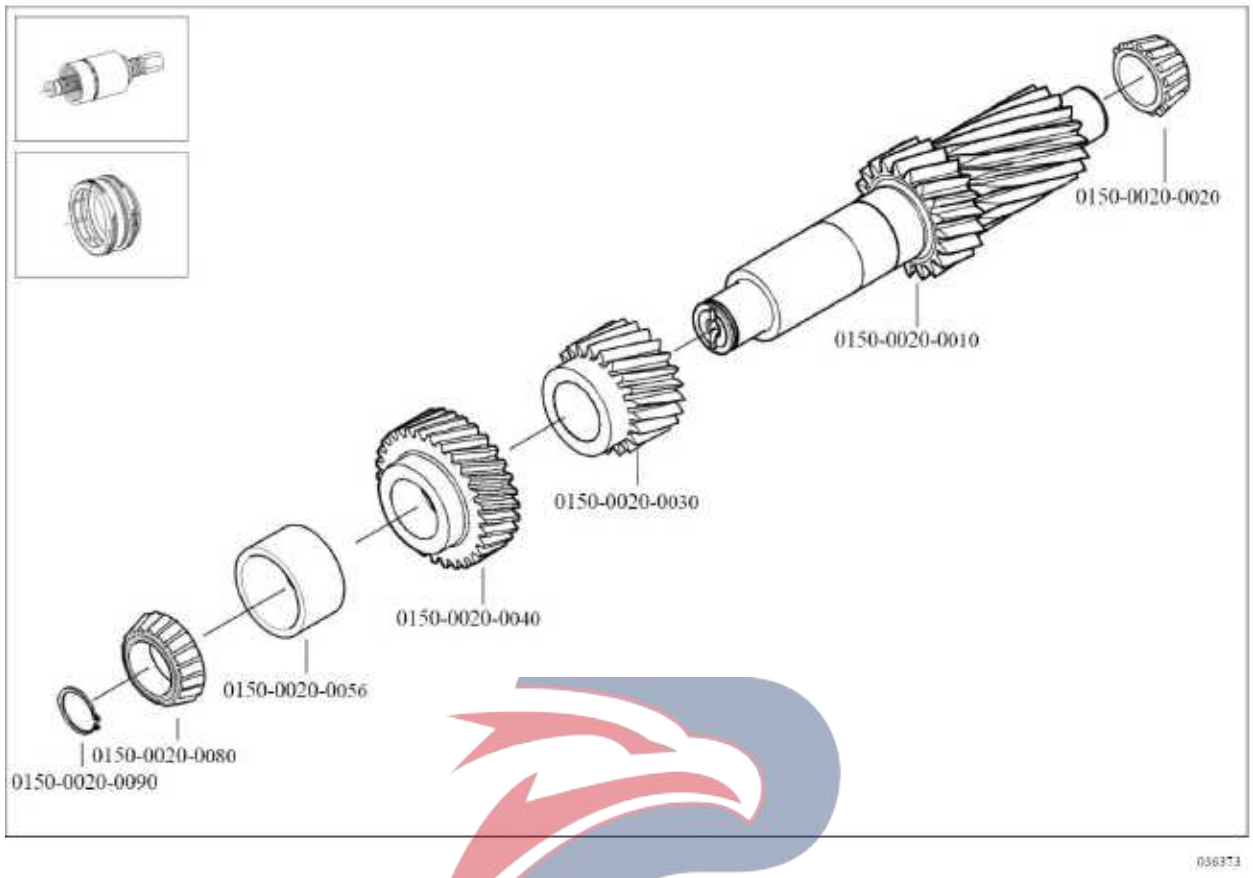
7 Press in the retaining ring 0150-0020-0090. Please note that the retaining ring 0150-0020-0090 should be close to the bottom of the intermediate shaft groove.

Hint

The axial clearance of the retaining ring must be between 0.01 and 0.10 mm, select the retaining ring according to the spare parts catalog.

Hint

Install the intermediate shaft, see Chapter 8.



11.2 8 Block structure, TD (K2)

Hint

• Disassemble the intermediate shaft, see chapter 8.

11.2.1 Disassemble the intermediate shaft

Hint

To protect the countershaft, a pressure block must be placed between the puller and the countershaft 0150-0020-0010.

1 Place the clamp / holder 1X56 136 756 on the inner ring of tapered roller bearings 0150-0020-0020. Turn the jacketed rope loop until the clamps are firmly seated.

2 Screw the basic tooling 1X56 122 304 onto the clamp and remove the bearing inner ring from the countershaft.

3 Eject and remove the retaining ring 0150-0020-0090.

4 Mount the clamp / holder 1X56 136 756 onto the inner ring of tapered roller bearings 0150-0020-0080. Turn the jacketed rope loop until the clamps are firmly seated.

5 Screw the basic tooling 1X56 122 304 onto the clamp and remove the bearing inner ring from the countershaft.

6 Remove the bushing 0150-0020-0056 from the intermediate shaft.

Caution

If necessary, replace the tapered roller bearing 0150-0020-0020 / 0150-0020-0080, bearing roller will be damaged due to pulling the dial.

7 Due to the overhigh extrusion pressure, use the appropriate hydraulic jacks to squeeze out the helical gear 0150-0020-0040 and 0150-0020-0030 one by one. Helical gears can withstand pressures up to 500 kN.

Hint

To avoid gear damage, place the intermediate shaft or bevel gear on a soft cushion.

02.02.11 Assemble the intermediate shaft

⚠ Danger

Only be wearing protective gloves can touch the heating and cooling components.

1 The positions of the helical gear holes and countershaft must be oil-free, grease-free and dust-free.

2 Heat the helical gears 0150-0020-0030 and 0150-0020-0040 to 170 ℃ (maximum).

3 It is sometimes necessary to cool the countershaft 0150-0020-0010, specifying a temperature difference of 150 ℃ between the bevel gear and the countershaft.

4 Place the heated helical gears 0150-0020-0030 and 0150-0020-0040 by overlapping up and down on the top of hydraulic jacks, and place them correctly.

5 Press the countershaft into the bevel gear hole and immediately squeeze the bevel gear until it abuts the axial position. Cool the assembly.

Hint

Tapered roller bearing inner ring due to pull and damage.

Therefore, to be carefully examined or the use of new tapered roller bearings.

6 Make the bushing 0150-0020-0056 cover the position clinging to the intermediate shaft. 7 Heat tapered roller bearing inner ring 0150-0020-0020 / 0150-0020-0080 to 120 to 130 ℃ for a maximum of 15 minutes and attach it to the countershaft. Pay attention to close to the axial position, if necessary, continue to use soft mandrel pressure.

8 Press in the retainer ring 0150-0020-0090. Please note that the retaining ring 0150-0020-0090 should be close to the bottom of the middle shaft groove.

Hint

The axial clearance of the retaining ring must be between 0.01 and 0.10 mm, select the retaining ring according to the spare parts catalog.

Hint

Install the countershaft, see Chapter 8.

12 Main shaft

12.1 Structure with axial / thrust roller bearings 12-3

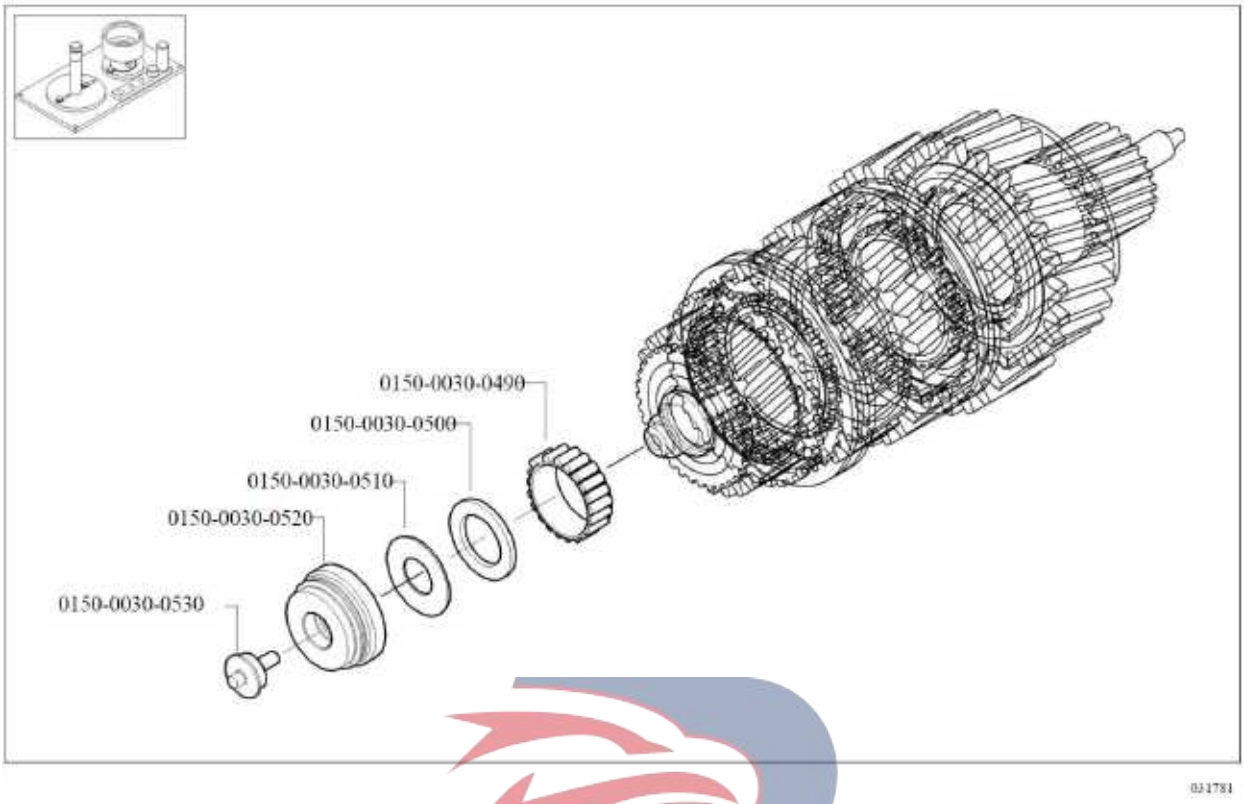
12.1.1 Disassemble the Main shaft 12-3

12.1.2 Assemble the main shaft 12-8

12.2 Structure with tapered roller bearing 12-13

01.02.12 Disassemble the Main shaft 12-13

02.02.12 Assemble the main shaft 12-18



12 Main shaft

12.1 Structure with axial / thrust roller bearings

12.1.1 Disassemblethe Main shaft

Hint

• Disassemblethe Main shaft, see chapter 8。

• The synchronization ring for the 1st gear / 2nd gear and 3rd gear / 4th gear synchronizer (ZF-BK) is coated with a carbon or molybdenum layer, see section 14 here.

Caution

• Clutch body with smooth taper fits carbon-layer synchronizer ring.

• The clutch body with arc groove is matched with the synchronous ring of molybdenum layer, if necessary, the oil hole in the cone surface extends gently.

• The synchronization devices must be installed in pairs as required.

Be careful when installing!

1 Place the maon shaft output in holder 1X56 137 675.

2 Remove the axial/thrust roller bearing 0150-0030-0520 and the oil retaining ring 0150-0030-0530.

3 Remove the cylindrical roller bearing 0150-0030-0490 together with the washer 0150-0030-0500 and the disc spring 0150-0030-0510.

4 Turn the main shaft and place the input into holder 1X56 137 675.

5 Remove the retaining ring 0150-0030-0240.

6 Place the appropriate washer on the main shaft. Put the universal two-jaw puller on the reverse gear 0150-0030-0220 and unplug it together with the tapered roller bearing inner ring 0150-0030-0230.

7 Remove needle roller retainer 0150-0030-0210 and inner ring 0150-0030-0200.

8 Clamp 1st gear helical gear 0150-0030-0160 with universal two-jaw puller and unplug it together with clutch body 0150-0030-0180.

9 Remove needle roller retainer 0150-0030-0150 and inner ring 0150-0030-0140.

10 Use the universal two-claw puller to clamp the 2-gear helical gear 0150-0030-0040, and unplug it together with the synchronizer 0150-0030-0050.

11 Remove the needle roller holder 0150-0030-0030 (2 sections).

12 Remove the clutch body 0150-0030-0050-0080 and synchronizer ring 0150-0030-0050-0030 from the synchronizer body 0150-0030-0050-0010.

⚠Danger

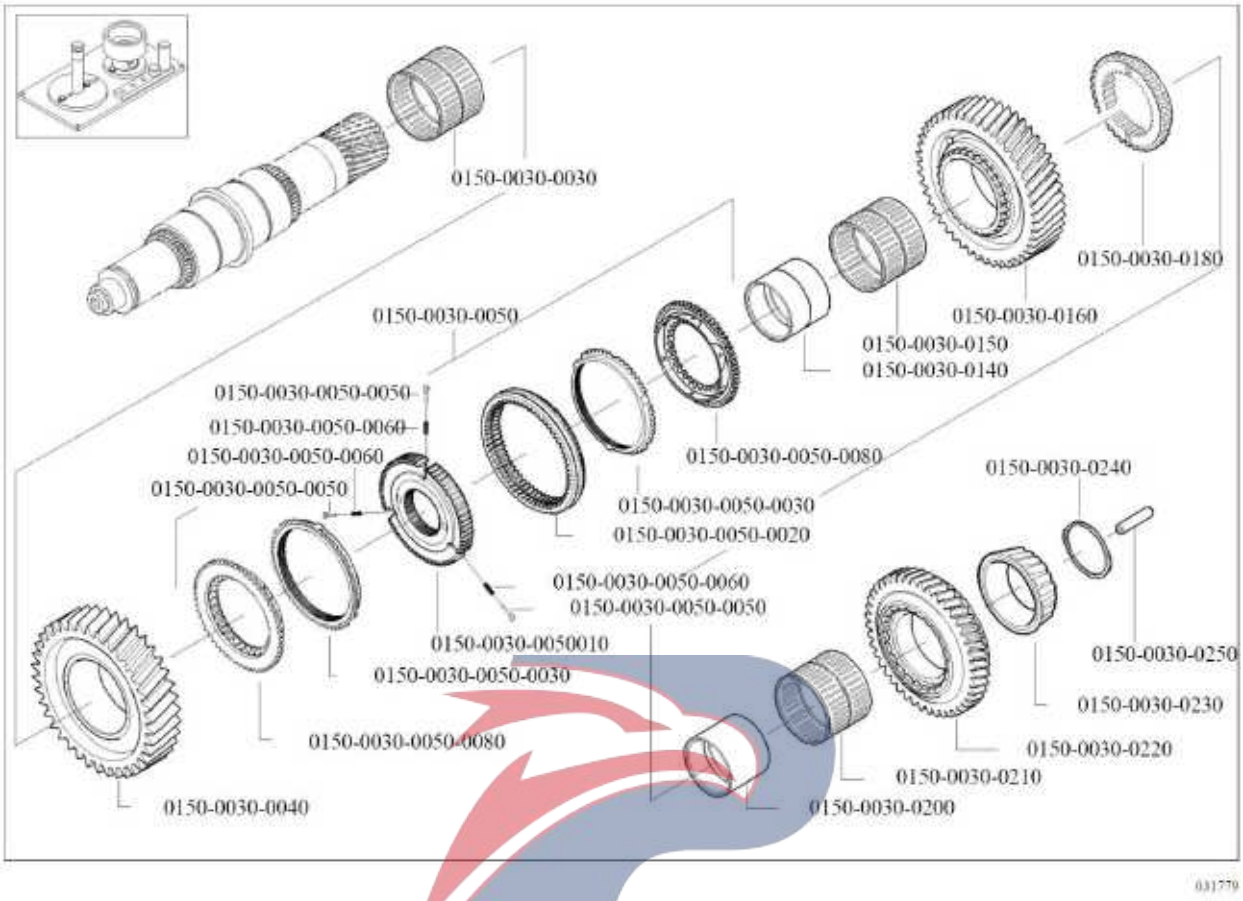
The three briquetting / pressure pins 0150-0030-0050-0050 and the three compression springs 0150-0030-0050-0060 are released when removed. These parts are subject to the pressure of the spring, the protection of the components to prevent pop-up (such as using a piece of cloth).

13 Remove the 1st gear / 2nd gear sliding sleeve 0150-0030-0050-0020 from the synchronous body 0150-0030-0050-0010.

14 The synchronous ring 0150-0030-0050-0030 and the clutch body 0150-0030-0050-0080 will be loosened.

15 If damaged, remove the insertion pipe/ oil pipe 0150-0030-0250.

16 Turn main shft 0150-0030-0010 and place the output into holder 1X56 137 675。


0150-0030-0030
0150-0030-0180
0150-0030-0160
0150-0030-0150
0150-0030-0140
0150-0030-0050
0150-0030-0050-0050
0150-0030-0050-0060
0150-0030-0050-0060
0150-0030-0050-0050
0150-0030-0050-0080
0150-0030-0240
0150-0030-0050-0030
0150-0030-0050-0020
0150-0030-0050-0060
0150-0030-0050-0050
0150-0030-0050010
0150-0030-0050-0030
0150-0030-0250
0150-0030-0230
0150-0030-0050-0080
0150-0030-0220
0150-0030-0210
0150-0030-0040
0150-0030-0200
031779

17 Remove the separation ring 0150-0030-0450.

18 Remove the thrust washers 0150-0030-0390, 0150-0030-0380, 4th gear helical gear 0150-0030-0440, roller cage 0150-0030-0420, 0150-0030-0410 and inner ring 0150-0030-0400

19 Use the universal two-jaw puller to clamp the 3-gear helical gear 0150-0030-0270, and remove it with the synchronizer 0150-0030-0290.

20 Remove the needle roller holder 0150-0030-0260 (2 sections).

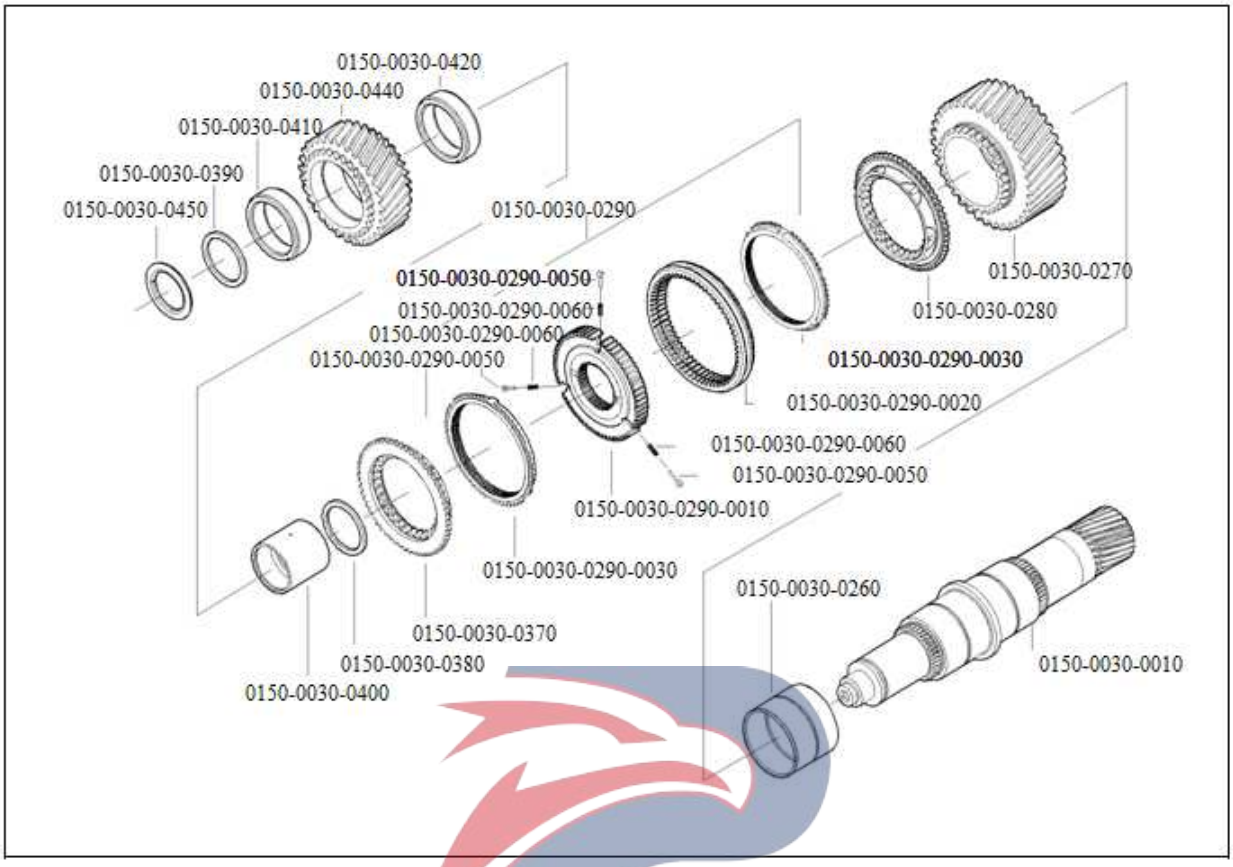
21 Remove the clutch body 0150-0030-0370 and synchronizer ring 0150-0030-0290-0030 from the synchronizer body 0150-0030-0290-0010.

⚠Danger

The three pressure blocks / pressure pins 0150-0030-0290-0050 and the three compression springs 0150-0030-0290-0060 will be loosened when removed. These parts are subject to the pressure of the spring, the protection of the components to prevent pop-up (such as using a piece of cloth).

22 Remove the 3-gear / 4-gear sliding gear sleeve 0150-0030-0290-0020 from the synchronizer 0150-0030-0290-0010.

23 The synchronous ring 0150-0030-0290-0030 and the clutch body 030-0150-0030-0280 will be loosened.


0150-0030-0420
0150-0030-0440
0150-0030-0410
0150-0030-0390
0150-0030-0450
0150-0030-0290
0150-0030-0270
0150-0030-0290-0050
0150-0030-0290-0060
0150-0030-0280
0150-0030-0290-0060
0150-0030-0290-0050
0150-0030-0290-0030
0150-0030-0290-0020
0150-0030-0290-0060
0150-0030-0290-0050
0150-0030-0290-0010
0150-0030-0290-0030
0150-0030-0260
0150-0030-0370
0150-0030-0380
0150-0030-0010
0150-0030-0400
031776_1

12.1.2 Assemnle the main shaft

1 Check the spindle oil hole passage is smooth. Cannula / tubing 0150-0030-0250 Must be secured in the spindle.

2 Place the spindle input in holder 1X56 137 675.

Hint

Give the needle cage and bevel gear thrust surface and the operating surface a little bit of oil.

3 Insert the needle roller cage 0150-0030-0030 (2 parts) onto the spindle 0150-0030-0010.

4 With a slight rotation, place the 2nd gear helical gear 0150-0030-0040 over the needle cage onto the main shaft. The flange faces the output.

Note

As described in Section 14, check the wear limits of all synchronizer rings and clutch bodies.

5 Fit clutch body 0150-0030-0050-0080 and synchronizer ring 0150-0030-0050-0030 onto the driven gear.

⚠ **Danger**

Only be wearing protective gloves can touch the heated synchronization body.

6 Heat synchronizer body 0150-0030-0050-0010 to approx. 120 ℃ and attach it to the spindle gear. The narrow end is toward the output.

Hint

The protruding part of the synchronizing ring must fit into the groove of the synchronizer body.

7 Make the 1/2-gear sliding gear sleeve 0150-0030-0050-0020 pass through the synchronizer, synchronous ring and clutch body, and install it in the position clinging to the 2-gear helical gear. When installing, make sure that the groove on the inner side of the sliding sleeve is overlapped with the mounting position of the synchronizer body (compression spring and briquetting / pressure pin).

8 Fit the three compression springs 0150-0030-0050-0060 and bolster / pressure pin 0150-0030-0050-0050 into the synchronization body hole or into the sliding sleeve with suitable tools.

Hint

Use a new compression spring and move the sliding sleeve to the neutral position (neutral position).

9 Put the synchronization ring 0150-0030-0050-0030. The protruding part of the synchronizing ring must fit into the groove of the synchronizer body.

10 Fit the clutch body 0150-0030-0050-0080 onto the synchronizer ring and set the sliding sleeve to the neutral position (neutral position). At this moment, the synchronizer ring and the clutch body are compressed.

⚠ **Danger**

Only be wearing protective gloves can touch the heated inner ring.

11 Heat inner ring 0150-0030-0140 to 120 °C. Place the inner ring and needle roller bearings 0150-0030-0150 (2 parts) onto the main shaft 0150-0030-0010.

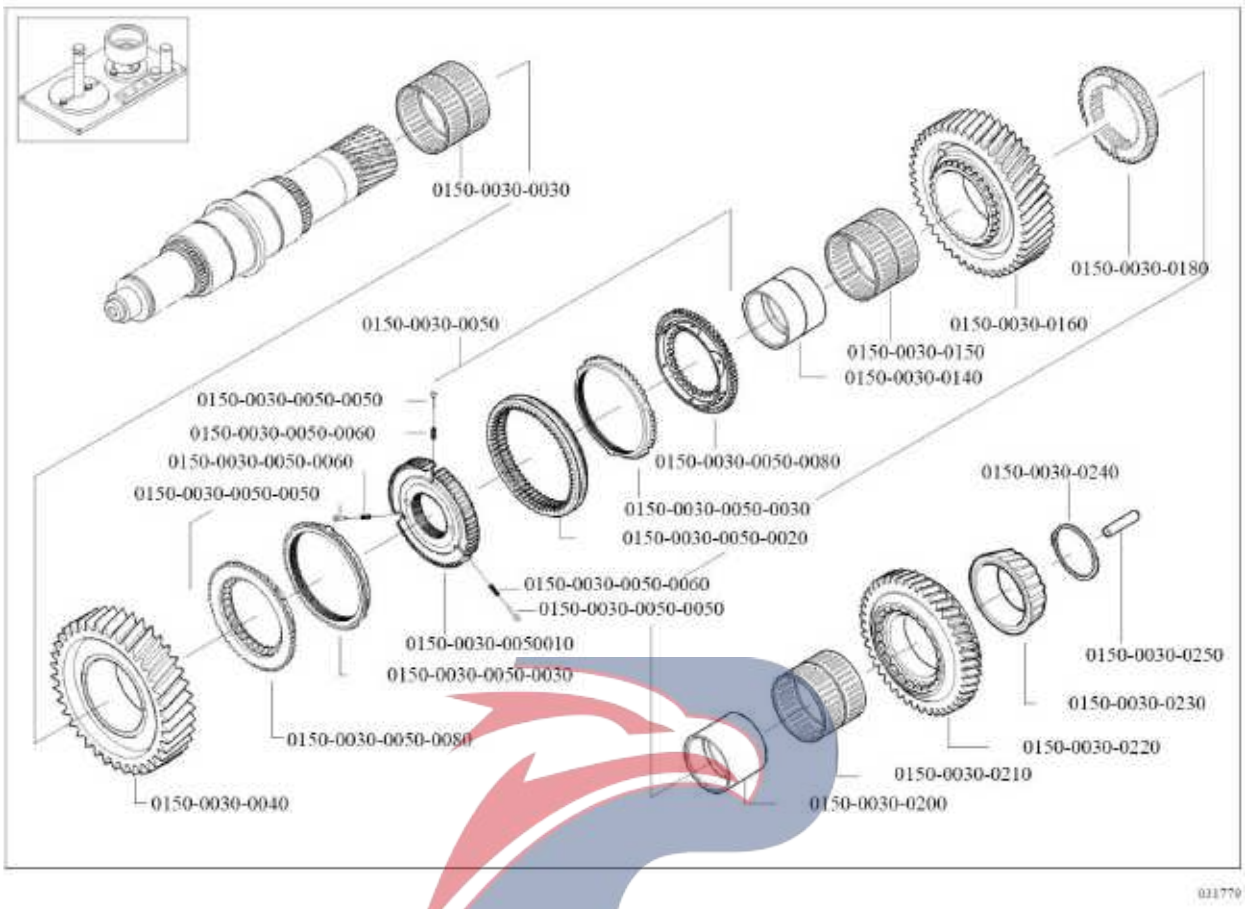
12 With slight rotation, place the 1st gear helical gear 0150-0030-0160 through the needle cage onto the main shaft. The flange faces the output.

⚠ **Danger**

Only be wearing protective gloves can touch the heated clutch body and inner ring.

13 Heat clutch body 0150-0030-0050-0180 to 120 ° C and push onto the main shaft.

Flat end of the output.



14 Heat inner ring 0150-0030-0200 to 120 °C. Make the inner ring and needle roller bearings 0150-0030-0210 cover the position of the main shaft clinging to the synchronizer.

15 With the slight rotation, install the reverse bevel gear 0150-0030-0220 onto the needle roller cage. Follower gear teeth toward the input. It should be noted here that the clutch body is located on the driven gear.

⚠ Danger

Only be wearing protective gloves can touch the heated tapered roller bearing inner ring.

16 Heat the inner ring of the tapered roller bearing 0150-0030-0230 to 120 °C and push it onto the main shaft with follow-up jacking / tapping until it abuts the axial position.

17 Remove the retaining ring 0150-0030-0240.

Hint

The axial clearance of the collar must be between 0.01 and 0.10 mm. According to the spare parts catalog select the appropriate ring.

18 Turn the spindle over and place the output into holder 1X56 137 675.

19 Place the needle roller cage 0150-0030-0260 (2 parts) onto the spindle.

20 With slight rotation, install the 3rd gear helical gear 0150-0030-0270 onto the needle cage.

Follower gear teeth toward the input.

21 Fit clutch body 0150-0030-0280 and synchronizer ring 0150-0030-0290-0030 onto the driven gear.

Caution

As described in Section 14, check the wear limits of all synchronizer rings and clutch bodies.

⚠ **Danger**

Only be wearing protective gloves can touch the heated synchronization body.

22 Heat synchronizer body 0150-0030-0290-0010 to approx. 120 °C and attach it to the spindle gear. Symmetrical symmetrical at both ends, so the installation can not consider the location of both ends. Subsequent top pressure / tapping until close to the axial position.

Hint

The protruding part of the synchronizing ring must fit into the groove of the synchronizer body.

23 Pass the 3rd / 4th gear sliding sleeve 0150-0030-0290-0020 through the synchronizer, synchronizer ring and clutch body, and into the 3rd gear helical gear. When installing, make sure that the groove on the inner side of the sliding sleeve is overlapped with the mounting position of the synchronizer body (compression spring and briquetting / pressure pin).

24 Fit the three compression springs 0150-0030-0290-0060 and briquetting / pressure pins 0150-0030-0290-0050 into the synchronization body hole or into the sliding sleeve with suitable tools.

Hint

Use a new compression spring.

25 Put the synchronization ring 0150-0030-0290-0030. The protruding part of the synchronizing ring must fit into the groove of the synchronizer body.

26 Fit the clutch body 0150-0030-0370 onto the synchronizer ring and set the sliding sleeve to the neutral position (neutral position). At this moment, the synchronizer ring and the clutch body are compressor.

⚠ **Danger**

Only be wearing protective gloves can touch the heated inner ring.

27 Heat inner ring 0150-0030-0400 to 120 ℃.

28 sets of thrust washers 0150-0030-0380 and the inner ring 0150-0030-0400.

29 Place the roller cages 0150-0030-0410 and 0150-0030-0420 in the 4th gear helical gear 0150-0030-0440.

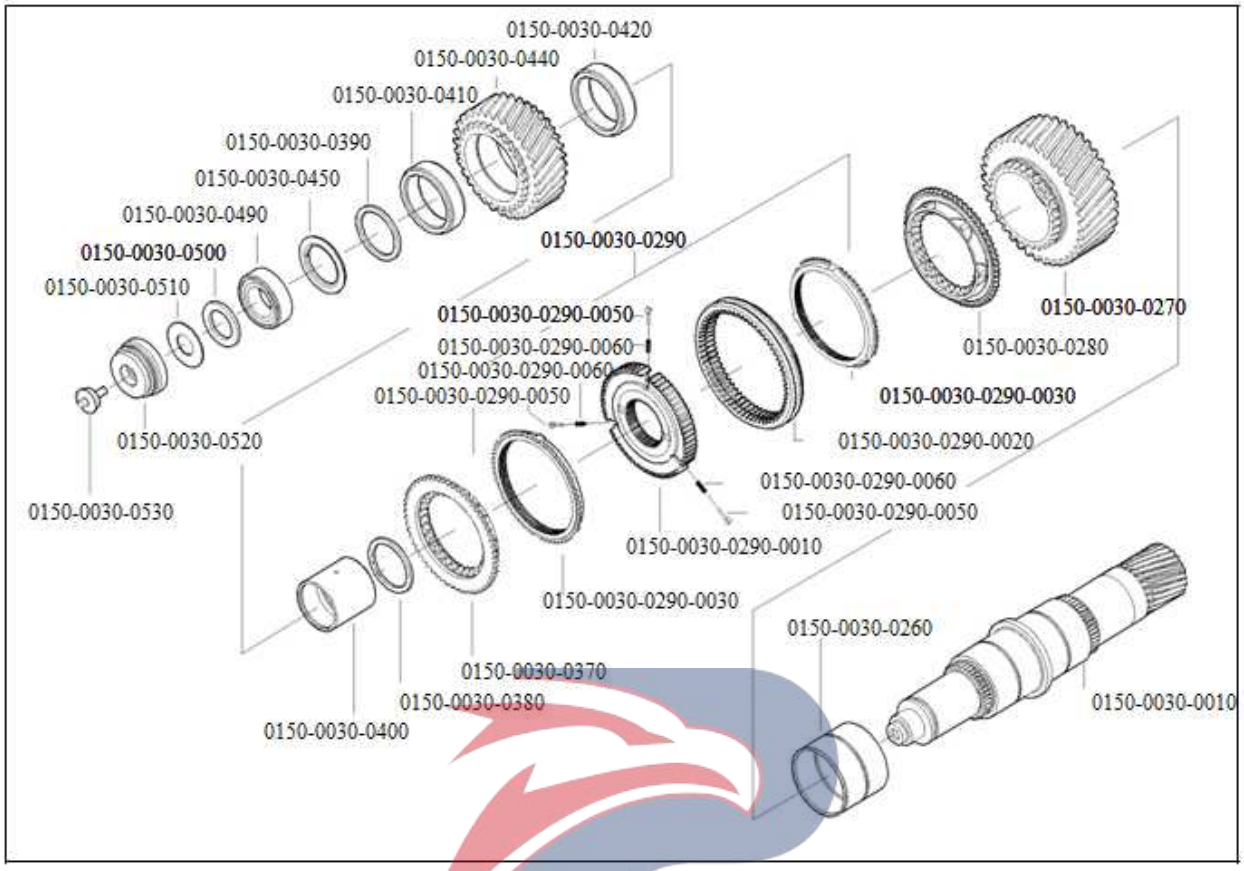
30 Pass the flanged bevel 0150-0030-0440 toward the output, push the clutch body through the inner ring and place the thrust washer 0150-0030-0390.

31 Install the separation ring 0150-0030-0450 into the main shaft groove, and use the retaining ring to fix through the 3 x 120 ℃caulking.

Hint

The axial clearance of the separating ring must be between -0.05 and +0.05 mm.

According to the spare parts catalog select the appropriate retaining ring.



Danger

The protective gloves must be worn to touch the heated cylindrical roller bearings.

32 Heat the cylindrical roller bearings 0150-0030-0490 to be approximately 120 °C, and push it to the position clinging to the main shaft.

33 Place the washer 0150-0030-0500.

Hint

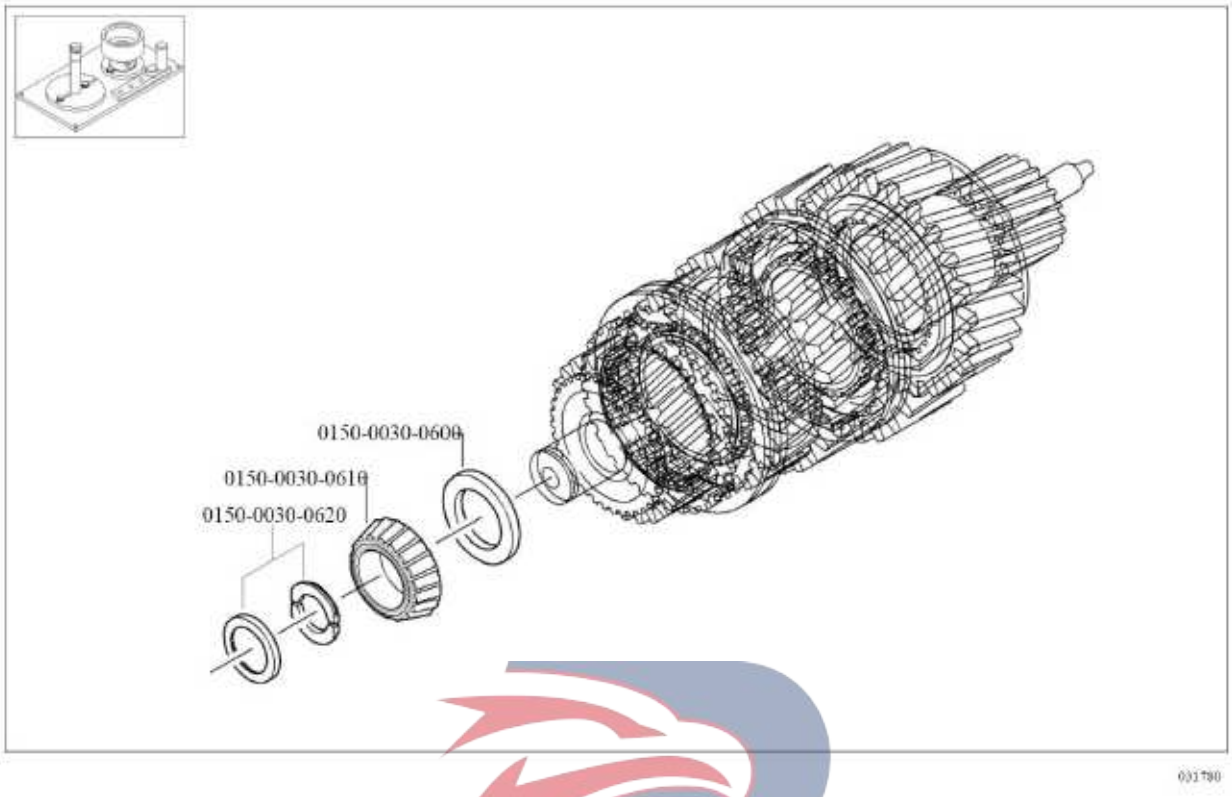
Before installing the disc spring 0150-0030-0510, the dimensions of the input shaft and the main shaft must be measured. See Section 13.1 for the measurement.

34 Place the disc spring 0150-0030-0510 and the axial / thrust roller bearing 0150-0030-0520.

35 Install the oil retaining ring 0150-0030-0530 into the axial / thrust roller bearing and the main shaft.

Hint

See Chapter 8 for installing the main shaft.



12.2 Structure with tapered roller bearings

12.2.1 Disassemble main shaft

Hint

• Remove the spindle, see Chapter 8.

• The synchronization rings for the 1st gear / 2nd gear and 3rd gear / 4th gear synchronizer (ZF-BK) are coated with a carbon or molybdenum layer, see section 14 here.

Note

• **Clutch body with smooth taper fits carbon-layer synchronizer ring.**

• **The clutch body with arc groove is matched with the synchronous ring of molybdenum layer, if necessary, the oil hole in the cone surface extends gently.**

• **The synchronization devices must be installed in pairs as required.**

Be careful when installing!

1 Place the main shaft output in holder 1X56 137 675.

2 Remove the retaining ring and separation ring 0150-0030-0620.

3 Install the clamp / clamp holder 1X56 136 743 on the inner ring of tapered roller bearing 0150-0030-0610. Turn the clamp rope figure ring until the clamp is fixed.

4 Screw the basic tooling 1X56 122 304 onto the clamp / clamp holder, and unplug the bearing inner ring from the main shaft.

5 Remove the axial / thrust washer 0150-0030-0600.

6 Turn the main shaft and place the input into holder 1X56 137 675.

7 Remove the retaining ring 0150-0030-0240.

8 Place the appropriate washer on the spindle. Put the universal two-jaw puller on the reverse gear 0150-0030-0220 and unplug it together with the tapered roller bearing inner ring 0150-0030-0230.

9 Remove needle roller retainer 0150-0030-0210 and inner ring 0150-0030-0200.

10 Clamp 1st gear helical gear 0150-0030-0160 with universal two-jaw puller and unplug it together with clutch body 0150-0030-0180.

11 Remove needle roller retainer 0150-0030-0150 and inner ring 0150-0030-0140.

12 Use the universal two-jaw puller to clamp the 2-gear helical gear 0150-0030-0040, and remove it together with the synchronizer 0150-0030-0050.

13 Remove the needle roller holder 0150-0030-0030 (2 parts).

14 Remove the clutch body 0150-0030-0050-0080 and synchronizer ring 0150-0030-0050-0030 from the synchronizer body 0150-0030-0050-0010.

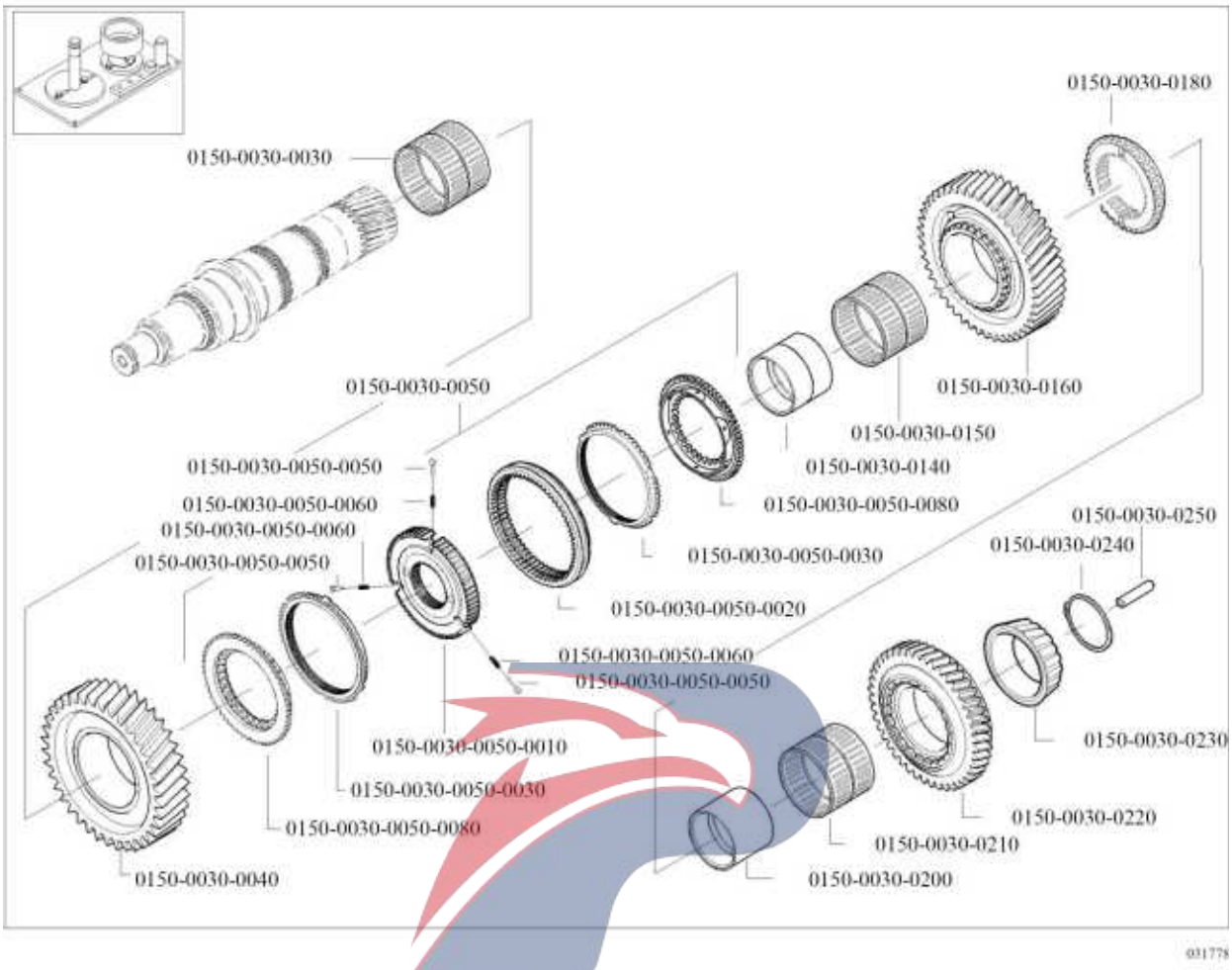
⚠Danger

The three briquetting / pressure pins 0150-0030-0050-0050 and the three compression springs 0150-0030-0050-0060 are released when removed. These parts are subject to the pressure of the spring, to protect the parts from pop-up (such as using a piece of cloth).

15 Remove the 1st gear / 2nd gear sliding sleeve 0150-0030-0050-0020 from the synchronous body 0150-0030-0050-0010.

16 The synchronous ring 0150-0030-0050-0060 and the clutch body 0150-0030-0050-0110 will be loosened.

17 If there is damage, remove the insertion pipe 0150-0030-0250.


0150-0030-0180
0150-0030-0030
0150-0030-0050
0150-0030-0160
0150-0030-0150
0150-0030-0050-0050
0150-0030-0140
0150-0030-0050-0060
0150-0030-0050-0080
0150-0030-0250
0150-0030-0050-0060
0150-0030-0240
0150-0030-0050-0050
0150-0030-0050-0030
0150-0030-0050-0020
0150-0030-0050-0060
0150-0030-0050-0050
0150-0030-0230
0150-0030-0050-0010
0150-0030-0050-0030
0150-0030-0220
0150-0030-0050-0080
0150-0030-0210
0150-0030-0200
0150-0030-0040
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19 Remove the thrust washers 0150-0030-0390, 0150-0030-0380, 4th gear helical gear 0150-0030-0440, roller cage 0150-0030-0420, 0150-0030-0410 and inner ring 0150-0030- 0400.

20 Use the universal two-jaw puller to clamp the 3-gear helical gear 0150-0030-0270, and remove it with the synchronizer 0150-0030-0290.

21 Remove needle roller holder 0150-0030-0260 (2 sections).

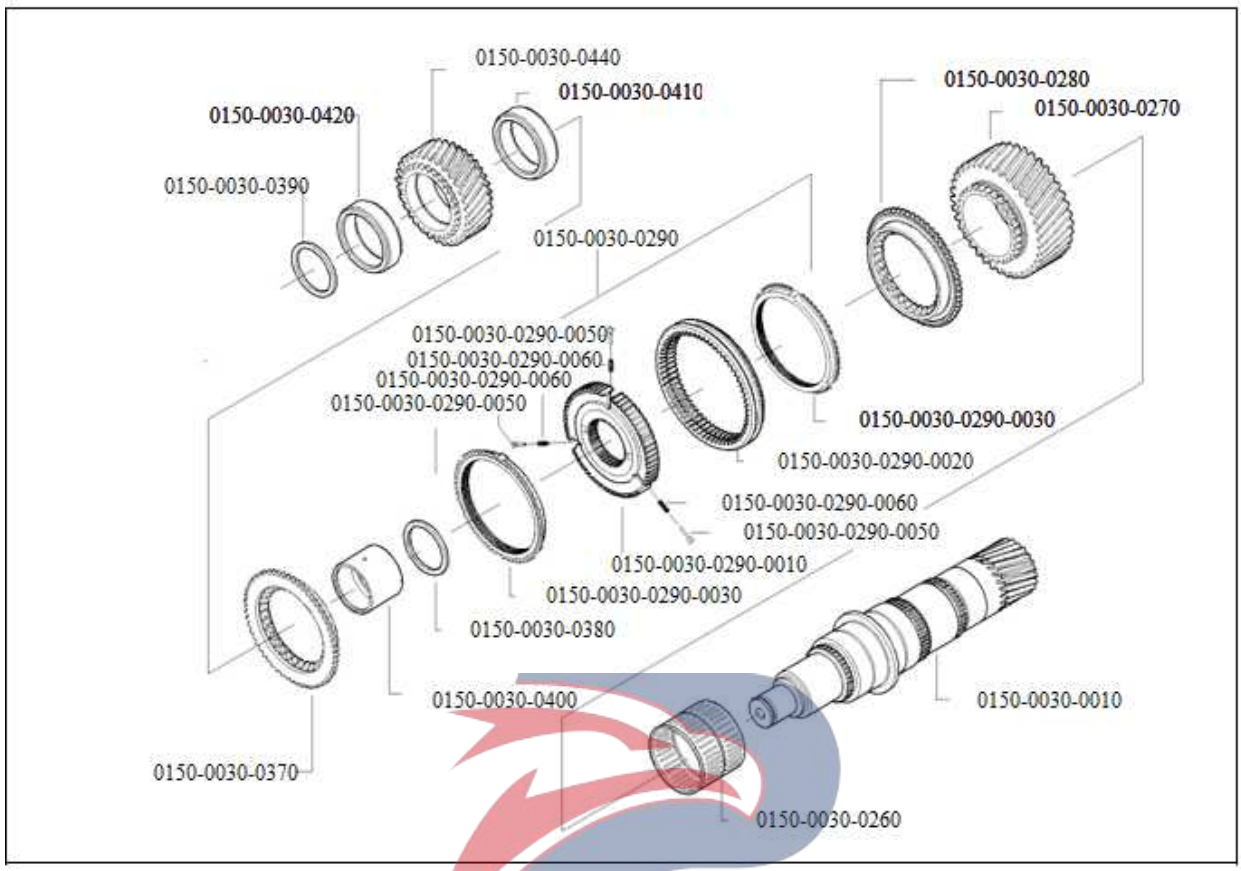
22 Remove the clutch body 0150-0030-0370 and synchronizer ring 0150-0030-0290-0030 from the synchronizer body 0150-0030-0290-0010.

⚠Danger

The three briquetting / pressure pins 0150-0030-0050-0050 and the three compression springs 0150-0030-0050-0060 are released when removed. These parts are subject to the pressure of the spring, the protection of the components to prevent pop-up (such as using a piece of cloth).

23 Remove the 3- / 4-gear sliding gear sleeve 0150-0030-0290-0020 from the synchronizer 0150-0030-0290-0010.

24 The synchronous ring 0150-0030-0290-0030 and the clutch body 0150-0030-0280 will be loosened.


0150-0030-0440
0150-0030-0410
0150-0030-0420
0150-0030-0390
0150-0030-0290
0150-0030-0280
0150-0030-0270
0150-0030-0290-0050
0150-0030-0290-0060
0150-0030-0290-0060
0150-0030-0290-0050
0150-0030-0290-0030
0150-0030-0290-0020
0150-0030-0290-0060
0150-0030-0290-0050
0150-0030-0290-0010
0150-0030-0290-0030
0150-0030-0380
0150-0030-0400
0150-0030-0010
0150-0030-0370
0150-0030-0260
051777_1

12.2.2 Assemble the main shaft

1 Check the spindle oil hole passage is smooth. Cannula / tubing 0150-0030-0250 Must be secured in the spindle.

2 Place the spindle input in holder 1X56 137 675.

Hint

Give the needle cage and bevel gear thrust surface and the operating surface a little bit of oil.

3 Insert the needle roller cage 0150-0030-0030 (2 parts) onto the spindle 0150-0030-0010.

4 With a slight rotation, place the 2nd gear helical gear 0150-0030-0040 over the needle cage onto the main shaft. The flange faces the output.

Note

As described in Section 14, check the wear limits of all synchronizer rings and clutch bodies.

5 Fit clutch body 0150-0030-0050-0080 and synchronizer ring 0150-0030-0050-0030 onto the driven gear.

⚠Danger

Only be wearing protective gloves can touch the heated synchronization body.

6 Heat synchronizer body 0150-0030-0050-0010 to approx. 120 ℃ and attach it to the spindle gear. The narrow end is toward the output.

Hint

The protruding part of the synchronizing ring must fit into the groove of the synchronizer body.

7 Make the 1-gear / 2-gear sliding gear sleeve 0150-0030-0050-0020 pass through the synchronizer, synchronous ring and clutch body, and cling it to the 2-gear helical gear.

When installing, make sure that the groove on the inner side of the sliding sleeve is overlapped with the mounting position of the synchronizer body (compression spring and briquetting / pressure pin).

8 Fit the three compression springs 0150-0030-0050-0060 and bolster / pressure pin 0150-0030-0050-0050 into the synchronization body hole or into the sliding sleeve with suitable tools.

Hint

Use a new compression spring and move the sliding sleeve to the neutral position (neutral position).

9 Put the synchronization ring 0150-0030-0050-0030. The protruding part of the synchronizing ring must fit into the groove of the synchronizer body.

10 Fit the clutch body 0150-0030-0050-0080 onto the synchronizer ring and set the sliding sleeve to the neutral position (neutral position). At this moment, the synchronizer ring and the clutch body are compressed。

⚠ Danger

Only be wearing protective gloves can touch the heated inner ring.

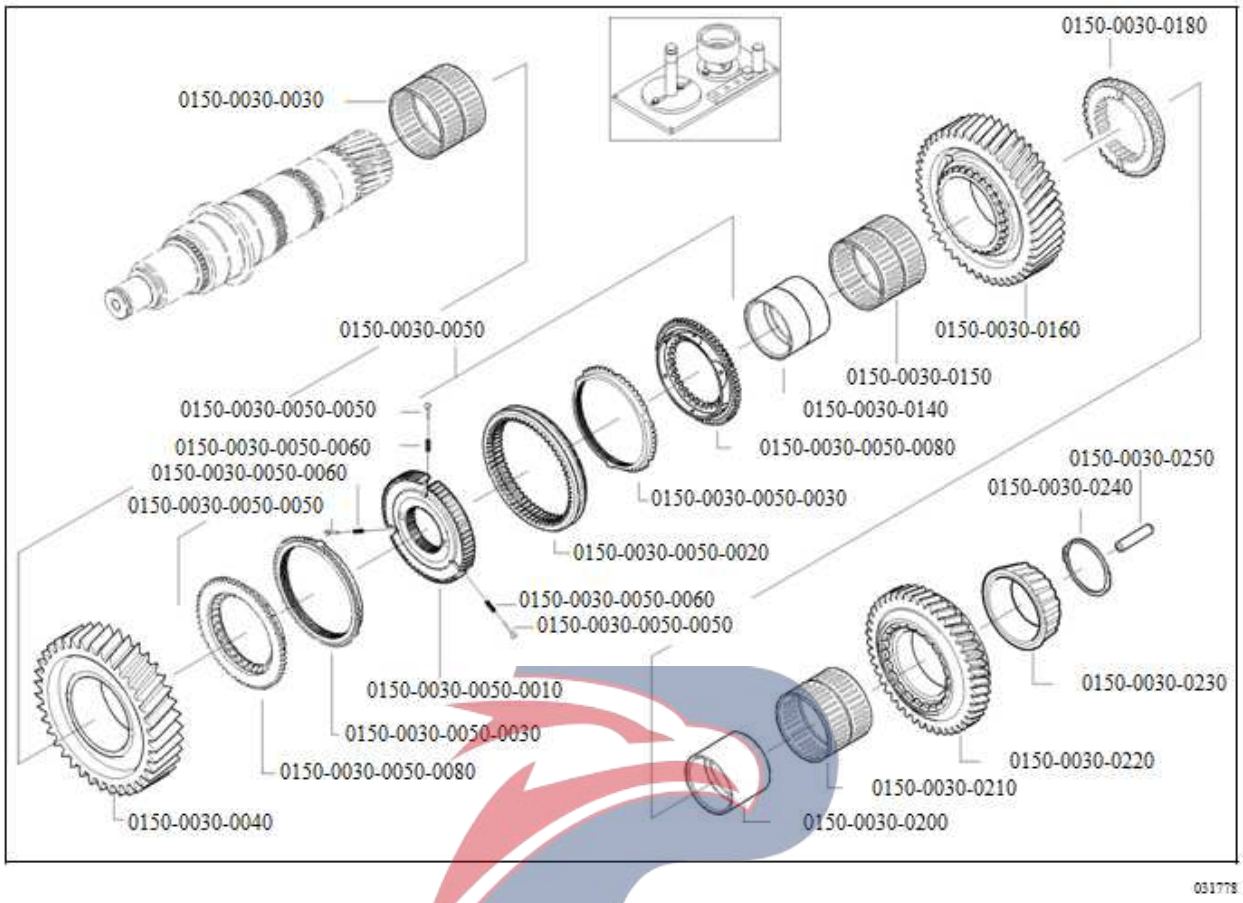
11 Heat inner ring 0150-0030-0140 to 120 °C. Place the inner ring and needle roller bearings 0150-0030-0150 (2 parts) onto the main shaft 0150-0030-0010.

12 With slight rotation, place the 1st gear helical gear 0150-0030-0160 through the needle cage onto the main shaft. The flange faces the output.

⚠ Danger

Only be wearing protective gloves can touch the heated clutch bodies and ring.

13 Heat clutch body 0150-0030-0050-0180 to 120 ° C and push onto the main shaft. Flat end of the output.



14 Heat inner ring 0150-0030-0200 to 120 ℃. Make the inner ring 0150-0030-0200 and the needle roller bearings 0150-0030-0210 cover the position of the main shaft clinging to the synchronizer.

15 With slight rotation, install the reverse bevel gear 0150-0030-0220 onto the needle roller cage. Follower gear teeth toward the input. It should be noted here that the clutch body is located on the driven gear.

⚠Danger

Only be wearing protective gloves can touch the heated inner ring of the tapered roller bearing.

16 Heat the inner ring of the tapered roller bearing 0150-0030-0230 to 120 °C and push it onto the main shaft with follow-up jacking / tapping until it abuts the axial position.

17 Remove the retaining ring 0150-0030-0240.

Hint

The axial clearance of the collar must be between 0.01 and 0.10 mm. According to the spare parts catalog select the appropriate ring.

18 Turn the spindle over and place the output into holder 1X56 137 675.

19 Place the needle roller cage 0150-0030-0260 (2 parts) onto the spindle.

20 With slight rotation, install the 3rd gear helical gear 0150-0030-0270 onto the needle cage.

Follower gear teeth toward the input.

21 Fit clutch body 0150-0030-0280 and synchronizer ring 0150-0030-0290-0030 onto the driven gear.

Note

As described in Section 14, check the wear limits of all synchronizer rings and clutch bodies.

⚠ **Danger**

Only be wearing protective gloves can touch the heated synchronizer body

22 Heat synchronizer body 0150-0030-0290-0010 to approx. 120 °C and attach it to the spindle gear. Symmetrical symmetrical at both ends, so the installation can not consider the location of both ends. Subsequent top pressure / tapping until close to the axial position.

Hint

The protruding part of the synchronizing ring must fit into the groove of the synchronizer body.

23 Pass the 3rd / 4th gear sliding sleeve 0150-0030-0290-0020 through the synchronizer, synchronizer ring and clutch body, and into the 3rd gear helical gear. When installing, make sure that the groove on the inner side of the sliding sleeve is overlapped with the mounting position of the synchronizer body (compression spring and briquetting / pressure pin).

24 Fit the three compression springs 0150-0030-0290-0060 and briquetting / pressure pins 0150-0030-0290-0050 into the synchronization body hole or into the sliding sleeve with suitable tools.

Hint

Use a new compression spring.

25 Put the synchronization ring 0150-0030-0290-0030. The protruding part of the synchronizing ring must fit into the groove of the synchronizer body.

26 Fit the clutch body 0150-0030-0370 onto the synchronizer ring and set the sliding sleeve to the neutral position (neutral position).

At this moment, the synchronizer ring and the clutch body are compressed.

⚠ **Danger**

Only be wearing protective gloves can touch the heated inner ring.

27 Heat inner ring 0150-0030-0400 to 120 ℃.

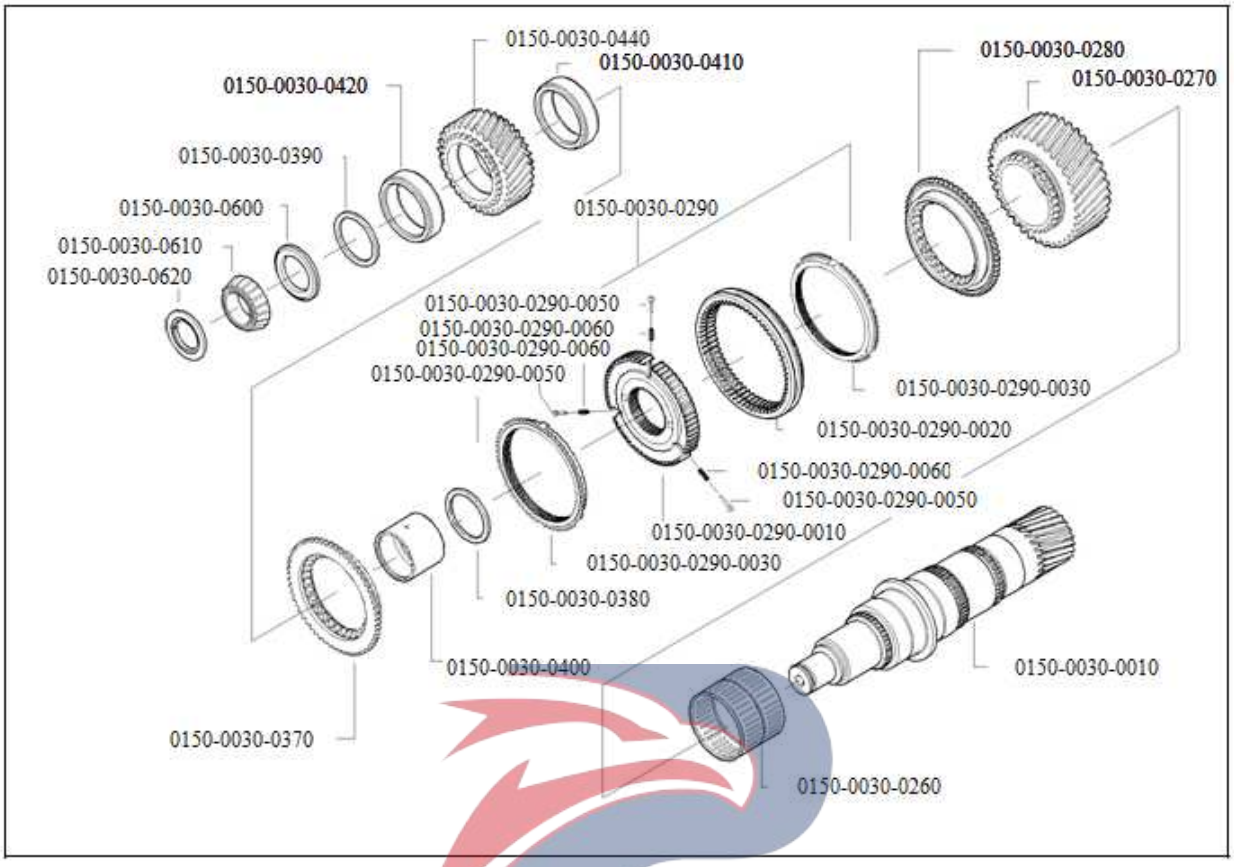
28 sets of thrust washers 0150-0030-0380 and the inner ring 0150-0030-0400.

29 Place the roller cages 0150-0030-0410 and 0150-0030-0420 in the 4th gear helical gear 0150-0030-0440.

30 Pass the flanged bevel 0150-0030-0440 toward the output, push the clutch body through the inner ring and place the thrust washer 0150-0030-0390.

31 Place the axial / thrust washer 0150-0030-0600.

32 Use a depth vernier caliper to measure the dimensions from the tapered roller bearing contact surface to the axial / thrust washer 0150-0030-0600. The measured dimensions must be within the tolerances of +0.07 to -0.08 mm. See Installation Rules 1315 700 037 here. If there is deviation, select the corresponding axial / thrust washer from the parts catalog.



33 Heat the bearing inner ring 0150-0030-0610 to 100 °C, and install it to the main shaft journal until it clings to the axial position. Use a plastic mandrel to subsequently press / knock.

34 Install the separation ring 0150-0030-0620 into the main shaft groove, and use the retaining ring to fix through the 3 x 120 °caulking.

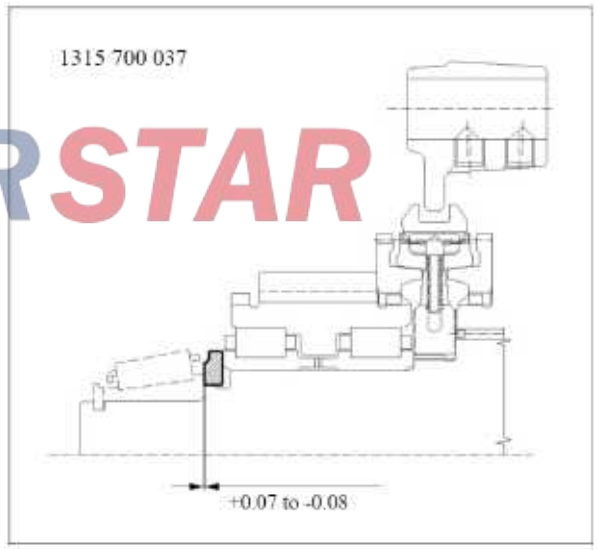
Hint

The axial clearance of the separating ring must be between -0.05 and +0.05 mm. Select the corresponding ring from the parts catalog.

Hint

• See Chapter 8 for installing the main shaft.

• See Section 13.2 for measuring the main shaft.



13 The bearing setup of the main shaft, input shaft and intermediate shaft

13.1 Adjust the main shaft and input shaft .....

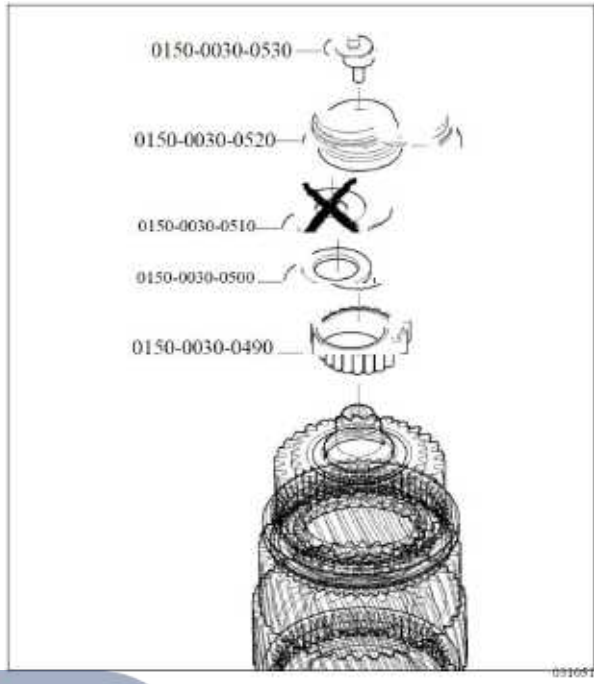
Structure with axial / thrust roller bearings 13-2

13.2 Adjust the main shaft and input shaft .....

Structure with tapered roller bearings 13-5

13.3 Adjust the intermediate shaft 13-7

13 The bearing setup of the main shaft, input shaft and intermediate shaft



13.1 Adjust axial / thrust roller bearings structure of the main shaft and input shaft

Caution

With gap adjust the main shaft and input shaft.

The gap is 0.01 to 0.10 mm.

1 Assemble the main shaft to the disc spring as described in Section 12.2. Do not install the disc spring 0150-0030-0510.

2 Place the axial / thrust roller bearing 0150-0030-0520, and install the oil retaining ring 0150-0030-0530 into the axial / thrust roller bearing and the main shaft.

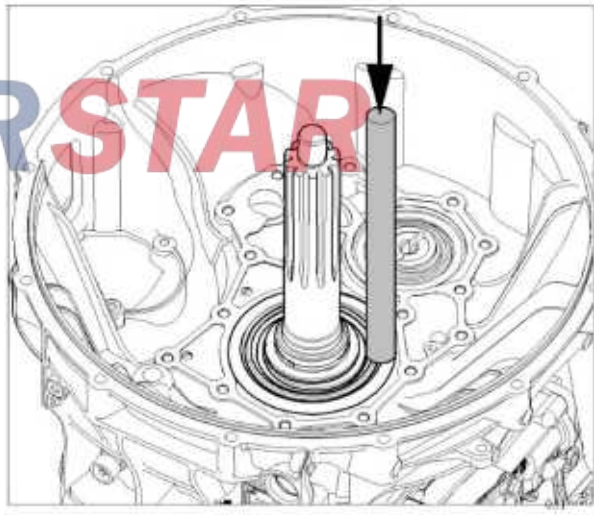
3 Use the lifting tool to install the main shaft into the gearbox housing.

Hint

The bearing outer ring of output end must be installed.

4 Install the input shaft to the main shaft.

5 Use the locating pin / guide pin to install the clutch housing to the gearbox housing.



Hint

The bearing outer ring of input end must be installed.

6 Adjust the input bearing to zero clearance and beat the outer race of the bearing with the mandrel toward the spindle.

Note

Do not press or tap in the oil path range, otherwise it will damage the shell.

7 In order to center the bearing rollers in the bearing position, turn the input shaft and the spindle several times. Use pointed items to check whether the bearing rollers are movable.

Hint

The gearbox must be switched to constant 2.

Hint

If it is zero clearance, the bearing roller must have no clearance, that is, the bearing roller can not be displaced. But there must be no prestress.

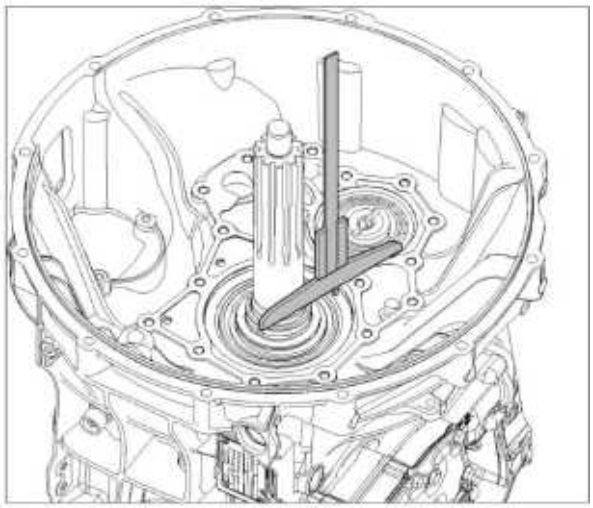
8 Measure the distance from the top edge of the bearing outer ring to the coupling face of the clutch housing by means of a depth vernier caliper. Take the dimensions and add the thickness of the seal 0240-0440 to give the dimension "A".

E.g: A = 6.50 mm

+ 0.40 mm(Sealing gasket)

– 1.00 mm(Thickness of disc spring) + 0.40 mm

A = 5.90 mm



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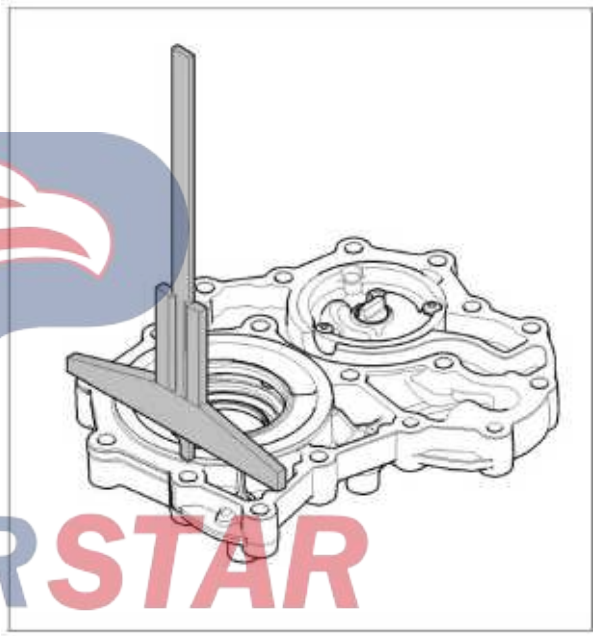
Hint

Measure between two opposite positions and take the middle value.

9 Using the depth vernier caliper, measure the distance from the connecting surface to the adjusting washer contact surface and grasp the dimension "B".

E.g: B = 4.20 mm



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Hint

Measure between two opposite positions and take the middle value.

10 Measure the gap "C" and grasp the dimensions.

E.g: C = A – B = 5.90 mm – 4.20 mm

C = 1.70 mm

11 Calculate the thickness "D" of the adjustment washer 0240-0400.

E.g: D = C – gap

= 1.70 mm – 0.10 mm

D = 1.60 至 1.70 mm

12 Select washer 0240-0400 according to spare parts catalog.

Hint

Mounting adjustment washer 0240-0400 is described in section 6.

13 Remove the clutch housing again.

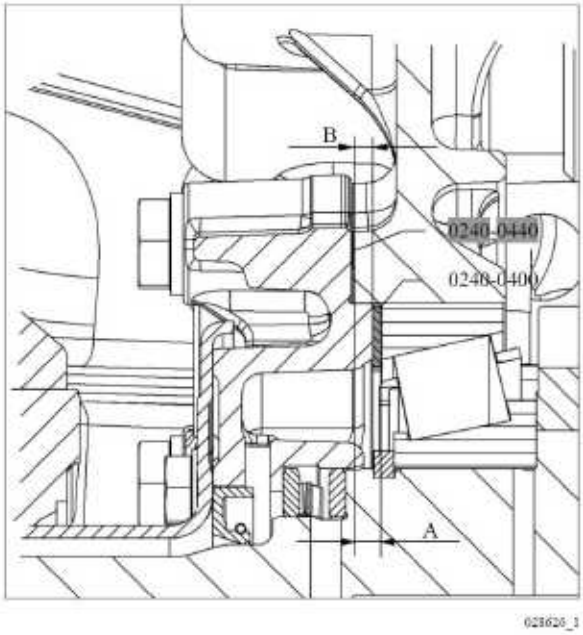
14 Remove the whole input shaft.

15 Use the lifting device to take out the main shaft from the gearbox housing, and place it in the tooling.

16 Remove the oil retaining ring and the axial / thrust bearing.

17 Make the main shaft a complete set, as described in Section 12.2.

18 For the shaft installation, see Chapter 8.



13.2 Adjust tapered roller bearings structure of main shaft and input shaft

Note

With gap adjust the main shaft and input shaft.

The gap is 0.01 to 0.10 mm.

6 Adjust the input bearing to zero clearance and beat the outer race of the bearing with the mandrel toward the spindle.

Note

Do not press or tap in the oil path range, otherwise it will damage the shell.

7 In order to center the bearing rollers in the bearing position, turn the input shaft and the spindle several times. Use pointed items to check whether the bearing rollers are movable.

Hint

The gearbox must be switched to constant 2.

Hint

If it is zero clearance, the bearing roller must have no clearance, that is, the bearing roller shall not be displaced. But there must be no prestress.

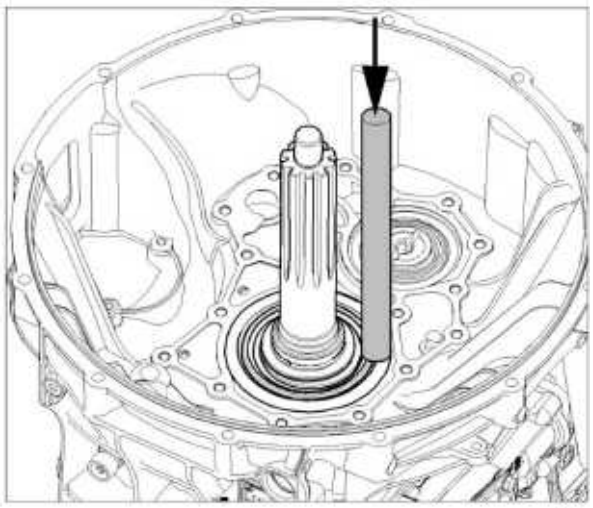
3 Measure the distance from the top edge of the bearing outer ring to the coupling face of the clutch housing by means of a depth vernier caliper. Take the dimensions and add the thickness of the seal 0240-0440 to give the dimension "A".

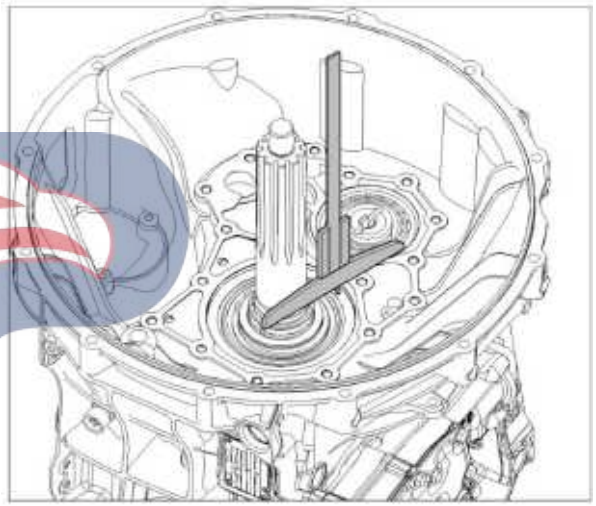
For example: A = 5.50 mm + 0.40 mm (sealing gasket)

A = 5.90 mm

Hint

Measure between two opposite positions and take the middle value.





4 Use a depth vernier caliper to measure the distance from the connecting surface to the adjusting washer contact surface and grasp the dimension "B".

For example: B = 4.20 mm

Hint

Measure between two opposite positions and take the middle value.

5 Measure the difference "C" and grasp the dimensions.

E.g: C = A – B = 5.90 mm – 4.20 mm

C = 1.70 mm

6 Calculate the thickness of the adjustment washer 0240-0400 "D"

E.g: D = C – gap

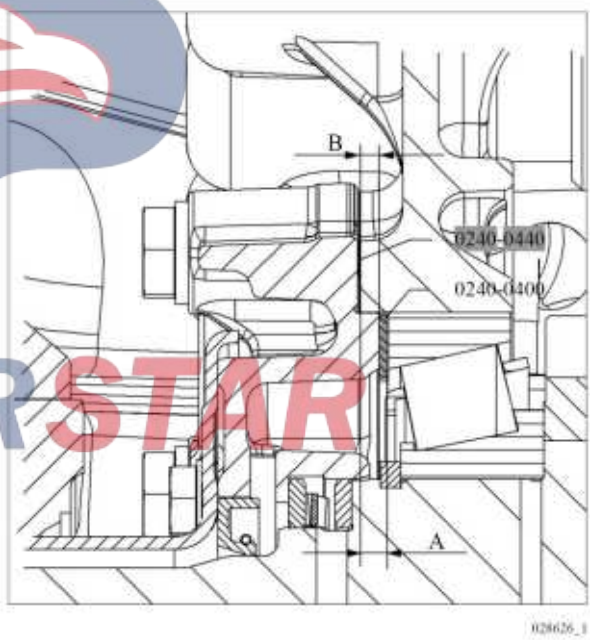
= 1.70 mm – 0.10 mm

D = 1.60 至 1.70 mm

7 Select washer 0240-0400 according to spare parts catalog.

Hint

Mounting adjustment washer 0240-0400 is described in section 6.



13.3 Adjust the internediate shaft

Hint

• Shafts and gearshift levers must be fully installed. See Chapter 8.

• The dimensions of main shaft must be measured. See Section 13.1 or 13.2.

Note

Adjust the intermediate shaft with clearances.

The gap is 0.01 to 0.10 mm。

1 The gearbox is in the vertical position.

2 Set the intermediate shaft roller bearing to zero clearance, and use a mandrel to knock the bearing outer ring towards intermediate shaft.

Note:

Do not press or tap in the oil path range, otherwise it will damage the shell.

3 In order to align the bearing rollers at the bearing position, rotate the input shaft and the spindle a few times. Use pointed items to check whether the bearing rollers are movable.

Hint

If it is zero clearance, the bearing roller must have no clearance, that is, the bearing roller shall not be moved. But there must be no prestress.

4 Use a depth vernier caliper to measure the distance from the coupling face of the clutch housing to the upper edge of the bearing outer ring. Grasp the size and add the thickness of the sealing gasket 0240-0440 to obtain the size 〝a".

E.g: a = 4.00 mm + 0.40 mm(sealing gasket)

a = 4.40 mm

Hint

Measure between two opposite positions and take the middle value.

5 Use a depth vernier caliper to measure the distance from the pump to the connecting plate contact surface, and grasp the size "b".

For example: b = 1.40 mm

6 Measure the difference "c" and grasp it.

For example: c = a – b = 4.40 mm – 1.40 mm

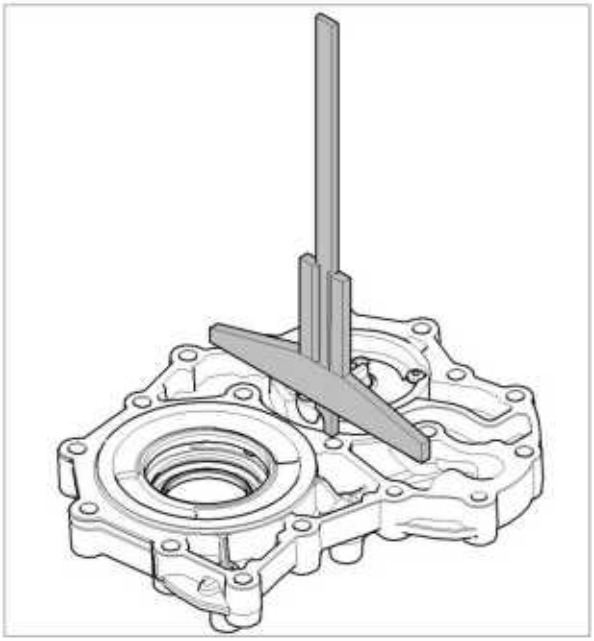
c = 3.00 mm

7 Calculate the thickness "d" of the adjusting washer 0240-0420.

For example: d = c – Clearance = 3.00 mm – 0.10 mm

d = 2.90 to 3.00 mm

8 Select the adjusting washer 0240-0420 according to the parts catalog.



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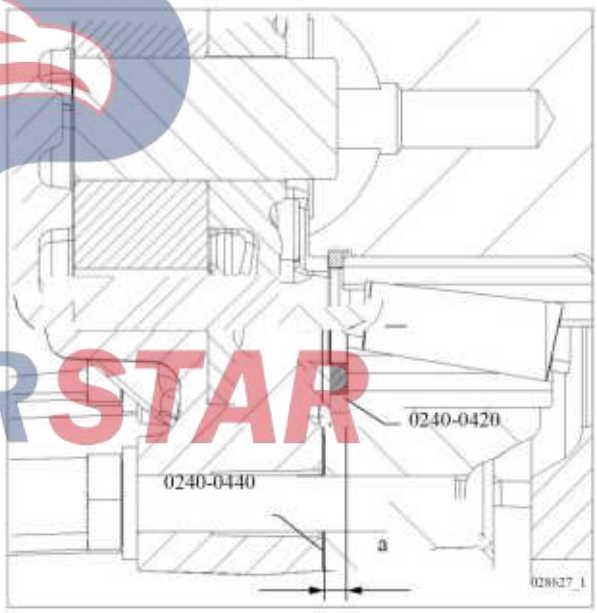
Hint

There are instructions for mounting the adjusting washer 0240-0420 in Chapter 6.



14 Synchronization device

14.1 Important tips for the ZF-BK structure..... 14-3

14.2 ZF-BK, ZF-B structure.....

Measure the wear limit of synchronizer 14-4

14.3 Assemble the synchronizer 14-5

14.4 Synchronization device section /ZF-BK..... 14-5

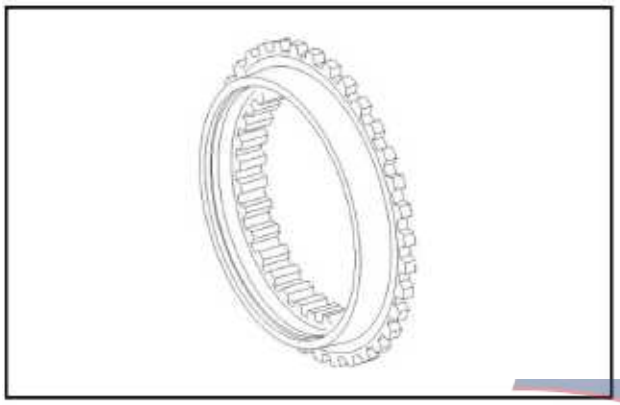
14 Synchronization device

14.1 Important tips for the ZF-BK structure

Depending on the differences in the gearbox structures, 1-gear / 2-gear and 3-gear / 4-gear synchronizers with carbon or molybdenum layers will be mounted on the main shaft.

Carbon layer structure

The carbon layer structure is only used on the gearbox with servo units.



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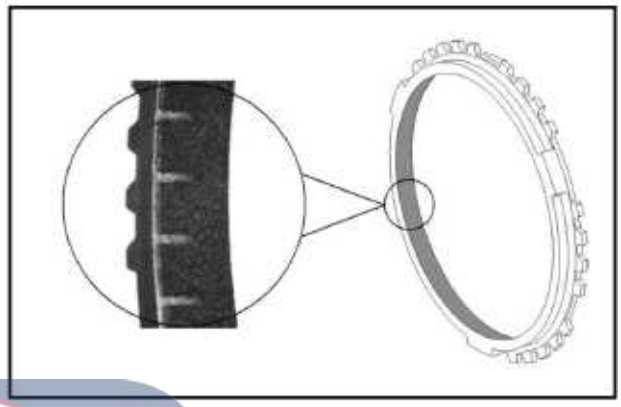

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Clutch body:

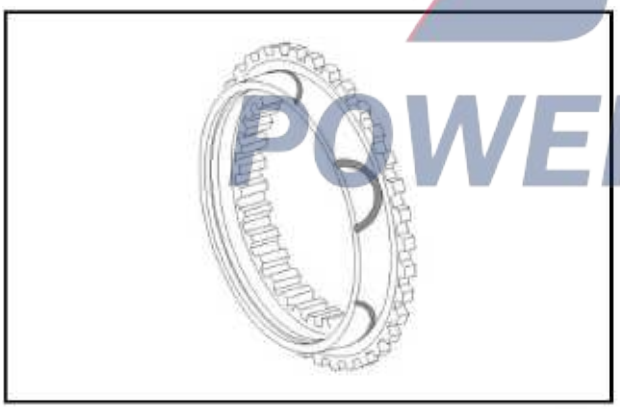
Clutch body without a oil groove.

Synchronous ring:

The carbon layer is flat.

Molybdenum layer structure

The molybdenum layer structure is used on the gearboxes with / without servo units.



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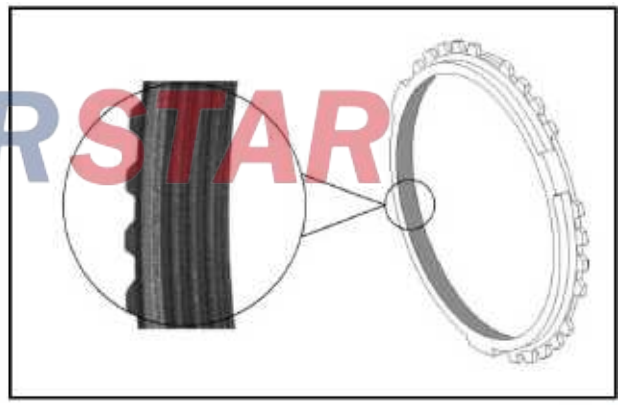

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Clutch body:

Clutch body with oil groove.

Synchronous ring:

The molybdenum layer is of a groove shape.

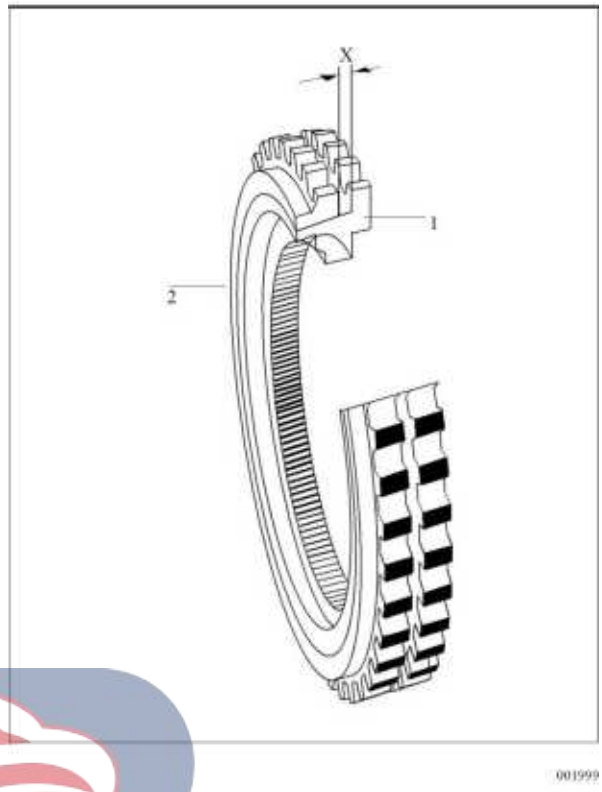
14.2 ZF-BK, ZF-B structure

Measure the wear limit of synchronizer.

Before the synchronizer is assembled, the conditions of the synchronous ring and the clutch body must be checked.

Hint

Be sure not to change the synchronous parts wrongly.



1 Install the synchronous ring (2) to the matching clutch body (1). Rotate the synchronous parts to make the cone evenly and parallelly stressed.

The wear limit of the synchronous ring on the main gearbox and the sub-gear group synchronizer is 0.8 mm, and 1.2 mm for the high-low gear group.

2 Use a sheet feeler to measure in the two opposite positions the distance (X) between the clutch body and the synchronous ring. If the wear limit is less than 0.8 or 1.2 mm, the synchronous ring and the clutch body must be replaced.

3 In addition, check the synchronization parts' status (visual inspection). If the surface is wavy, replace the synchronization parts. The parts checked together shall not be changed wrongly(marks shall be made).

14.3 Assemble the synchronizer

ZF-BK structure

(Displayed molybdenum layer structures)

1 Check the wear limit.

2 The compression spring (5) shall be replaced by the new one.

The super-slip force prescribed in the sliding gear sleeve (6) will be therefore guaranteed.

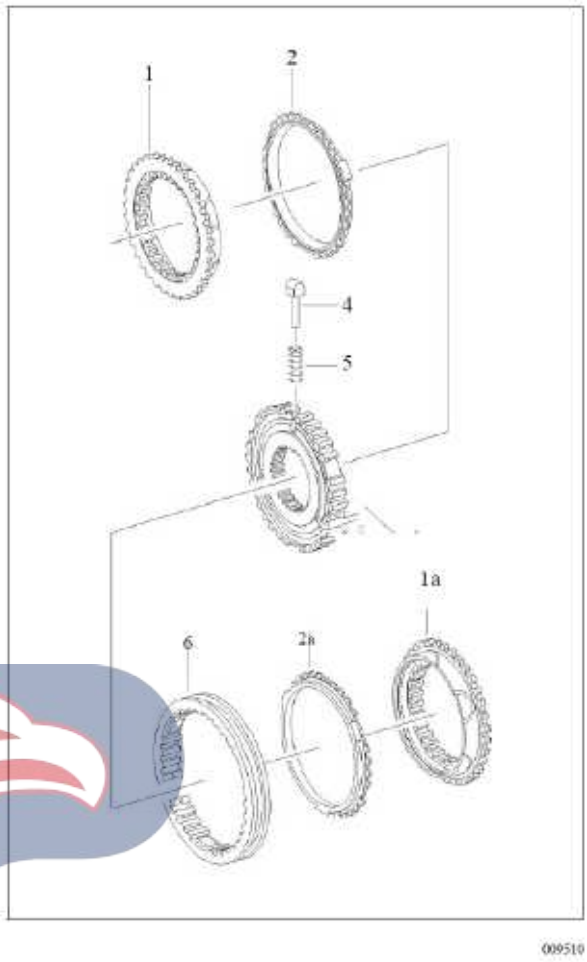
3 The synchronizer can be assembled as a whole or on the main shaft.

4 Push the sliding gear sleeve (6) onto the synchronizer (3).

Install the new compression spring (5) and pressure block / pressure pin (4) into the synchronizer (3).

Place the mandrel in the center part of pressure block / pressure pin, and guide it into the sliding gear sleeve (6).

5 Put the clutch body (1) and synchronous ring (2), and push the sliding gear sleeve (6) into the center position.



Hint

Note the correct position of pressure block / pressure pin.

14.4 Synchronization device section /ZF-BK

1/1a	Clutch body
2/2a	Synchronous ring
3	Synchronizer
4	Pressure block / pressure pin
5	Compression spring
6	Sliding gear sleeve