Engine control system

Precautions

Use of circuit testing tools

In the case of diagnosis according to the diagnostics program, do not use the test lamp for the power train electrical system diagnosis unless otherwise specified. In case the probe terminal will be used for the diagnostic program, please use the terminal testing adapter kit 5-8840-2835-0.

Market available electrical component

The market available electrical components mean the electrical components purchased from the market to install to the vehicle. Since these components are not taken into account during the vehicle design stage, pay attention to them when using these components.

Caution:

The market available electrical component power and ground must be connected to the circuit unconcerned to the electrical control system circuit.

Though the market available electrical components can be used, these may cause the functional fault of the electrical control system in some cases. It includes the devices not connected to the electrical system, for example, the mobile telephone, radio. Therefore, in the power train diagnosis, first check whether such market available electrical components are installed. If so, remove them from the vehicle. If the fault still exists after the componment removal, follow the general flow for diagnosis.

Damage due to ESD

Since the electronic parts in the electrical control system can work under the extremely low voltage, these are easy to be damaged due to ESD. Some electronic parts will be damaged by the static electricity below 100V that not appreciable to the human. The human appreciable ESD requires 4000V voltage. In many cases, the human will carry the static electricity, in which the friction and induction electrification is the most common.

● When the human moves side to side on the seat, it will generate the frictional electrification.

● When the human wearing the insulated shoes is near the highly electrified object, the electrostatic induction will occur at the moment of human touching the ground. The human will be electrified when the charges of the same polarity meet the charges of opposite polarity. Since the static electricity will cause damage, carefully handle the electronic parts and test them.

Caution:

Observe the following rules to prevent the damage due to ESD:

● Do not touch the ECM terminal contact pins and electronic parts soldered to ECM circuit back plate.

● Do not unpack the parks unless the preparation of part installation is finished.

● Connect the package and vehicle normal ground before taking the parts out of the package.

● If moving side to side on the seat, or sitting from standing posture or operating the part while moving in a certain distance, ensure to touch the normal ground before installing the part.

Function and working principle

Engine control (common rail) system

System overview and details

The engine control system means the electrical control system to control the engine to the optimal combustion state according to the driving condition. It consists of the following parts:

● Electronically controlled fuel injection system (common rail type)

Output/input list

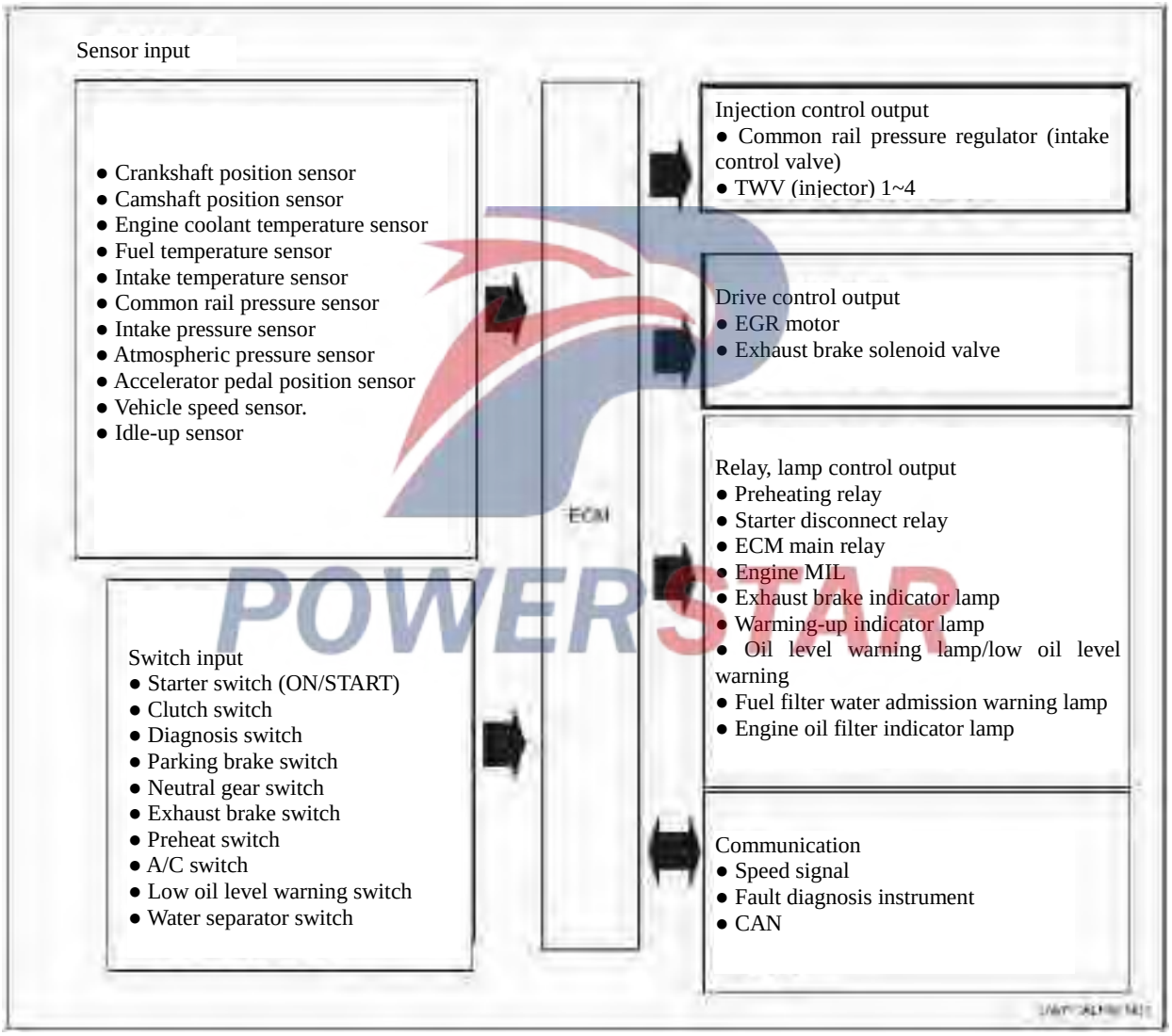
● EGR

Besides, the engine control system includes the following system control functions.

● Warming-up control system

● Engine rotary output

● Communication and self-diagnosis function



Electronically controlled fuel injection system (common rail type)

The common rail system is provided with the pressure chamber and injector. The pressure chamber is designed to store the pressurized fuel and called the common rail; the injector is provided with the electronic control solenoid valve to inject the pressurized fuel to the combustion chamber. Since the injection control (the injection pressure, injection rate and injection time) is controlled by ECM, the common rail system allows the independent control of the engine speed and load. Even if the engine speed is low, the stable injection pressure can be maintained, which will greatly reduce the specific black smoke upon the diesel engine start and acceleration. Through this control, the exhaust gas will become clean, the exhaust volume will be less and the output will be higher.

Injection volume control

It controls the injector winding according to the signal obtained from the engine speed and accelerator pedal opening and consequently controls the fuel injection volume to achieve the best volume.

Injection pressure control

To allow the high pressure injection even if the engine speed is low, the common rail inside fuel pressure should be controlled. Work out the appropriate pressure in the common rail according to the engine speed and fuel injection volume, discharge the proper amount of fuel through the control injection pump and feed it to the common rail under pressure.

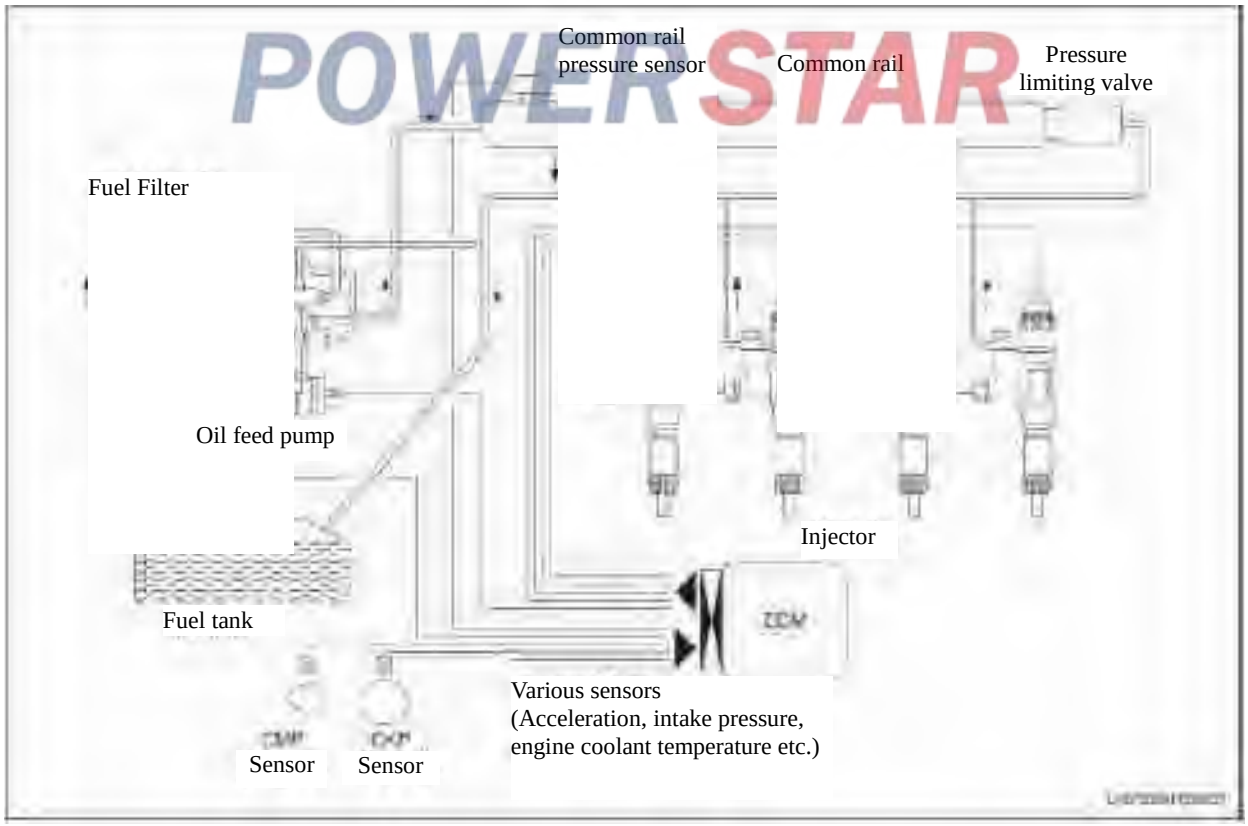
Injection time control

It substitutes the timing function and works out the appropriate fuel injection time according to the engine speed and injection volume and then controls the injector.

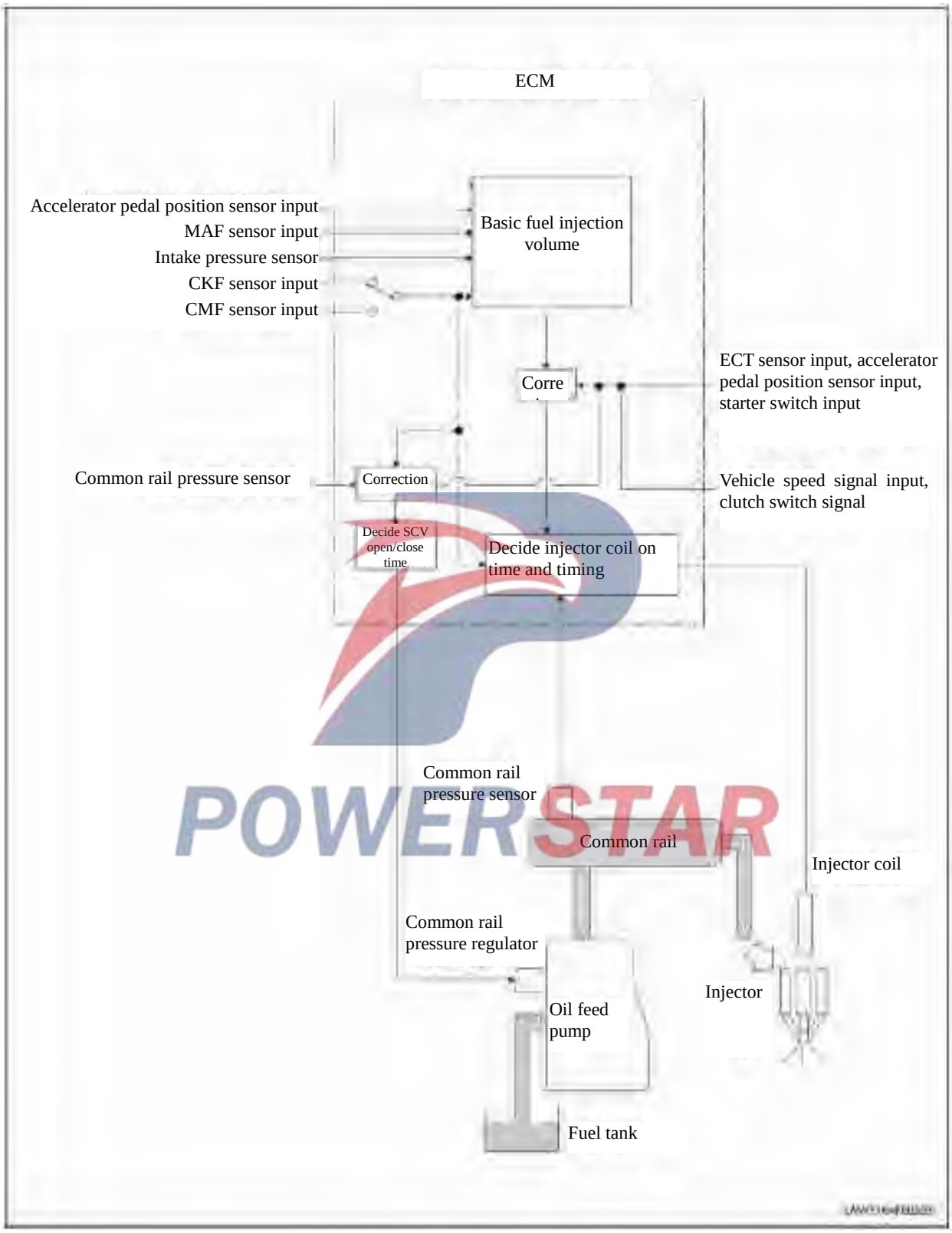
Injection rate control

To enhance the cylinder combustion efficiency, inject (pre-injection) a little fuel for ignition. After the ignition, carry out the second time injection (main injection). Control the injection time and injection volume through the injector (the injector coil).

System overview



System control diagram



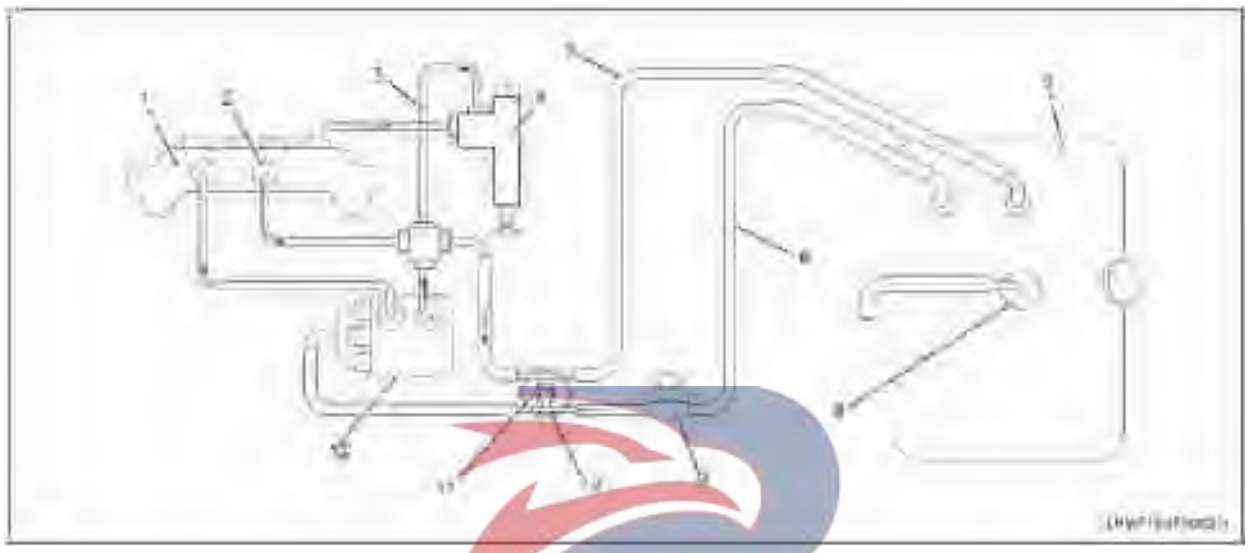
Fuel System

The common rail system consists of 2 fuel pressure systems.

- Low pressure inlet line: between the fuel tank and injection pump
- High pressure line: between the injection pump and injector

The fuel is sucked into injection pump from the fuel tank and boosted in the pump to supply to the common rail. At this point, the signal from ECM controls the suction control valve (the common rail pressure regulator) to control the fuel volume supplied to the common rail.

Fuel system diagram



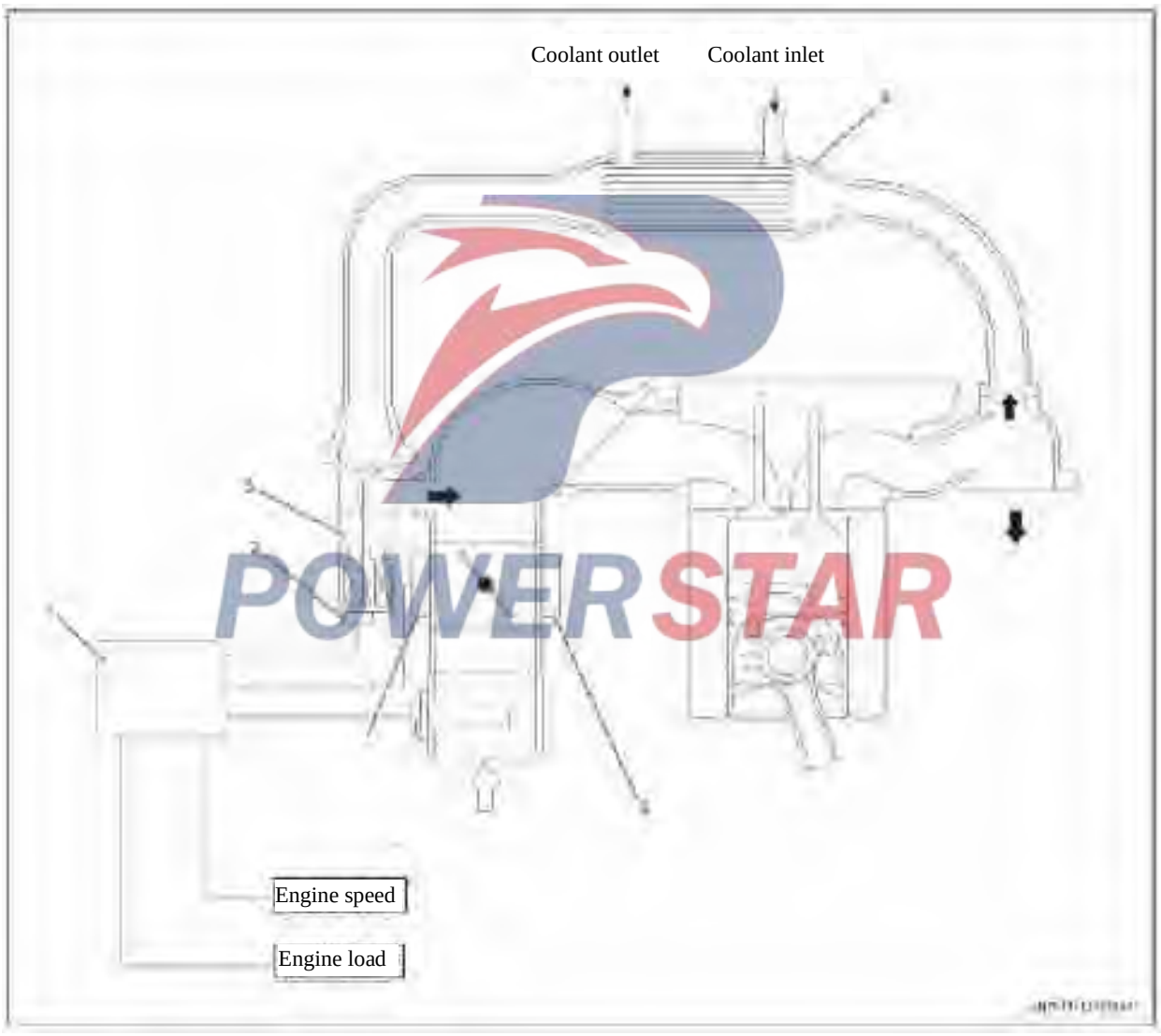
Key

1. Common Rail
2. Pressure limiting valve
3. Injector return pipe
4. Injector
5. Fuel return pipe
6. Fuel supply pipe
7. Fuel tank
8. Breather valve
9. Starter pump
10. Fuel filter (with oil-water separator)
11. Return valve
12. Fuel injection pump

EGR (Exhaust gas recirculation)

Egr system recycles a part of exhaust gas to the intake manifold and consequently reduces the nitrogen oxides (NOx) emission. Through the EGR system, the driving operability and exhaust gas emission reduction can be achieved. The control current from the EGR controls the solenoid valve to work and consequently control the EGR valve lift. In addition, this system detects the actual valve lift with the EGR position sensor to realize the fine control over the EGR.

EGR will start working when the engine speed, engine coolant temperature, intake temperature and barometric pressure conditions are met. Then it will work out the valve opening according to the engine speed and target fuel injection volume. Basing on the calculated valve opening, it decides the solenoid valve drive load and then drives the valve. The air intake throttle will be shut down during EGR operation to enable the intake manifold inside pressure to reach the target value.



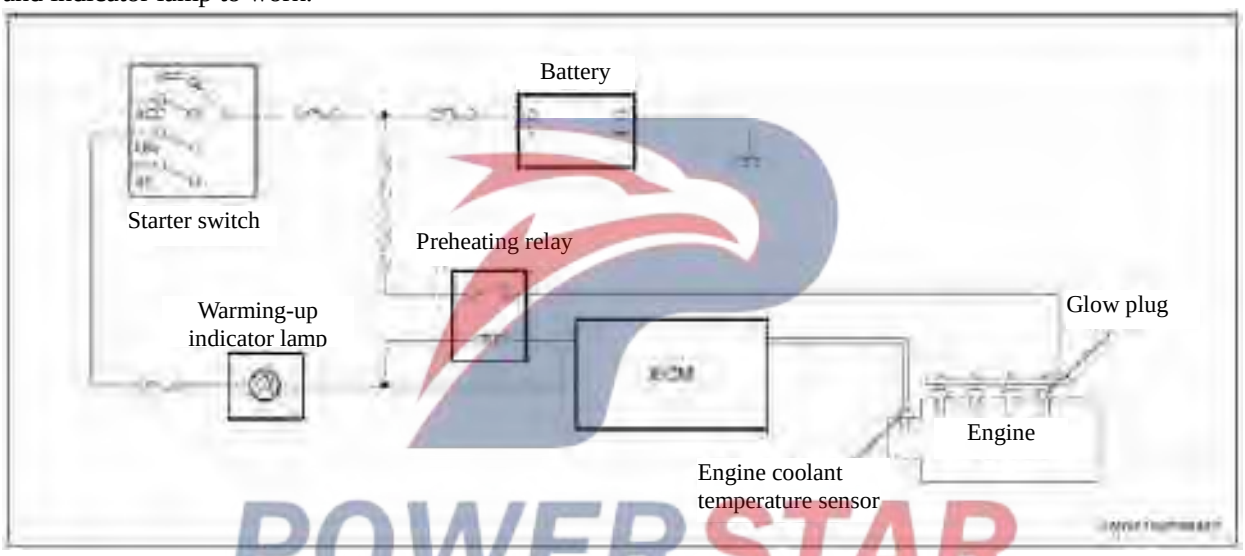
Key

1. ECM
2. EGR position sensor
3. EGR valve
4. EGR cooler
5. Intake throttle valve

Warming-up control

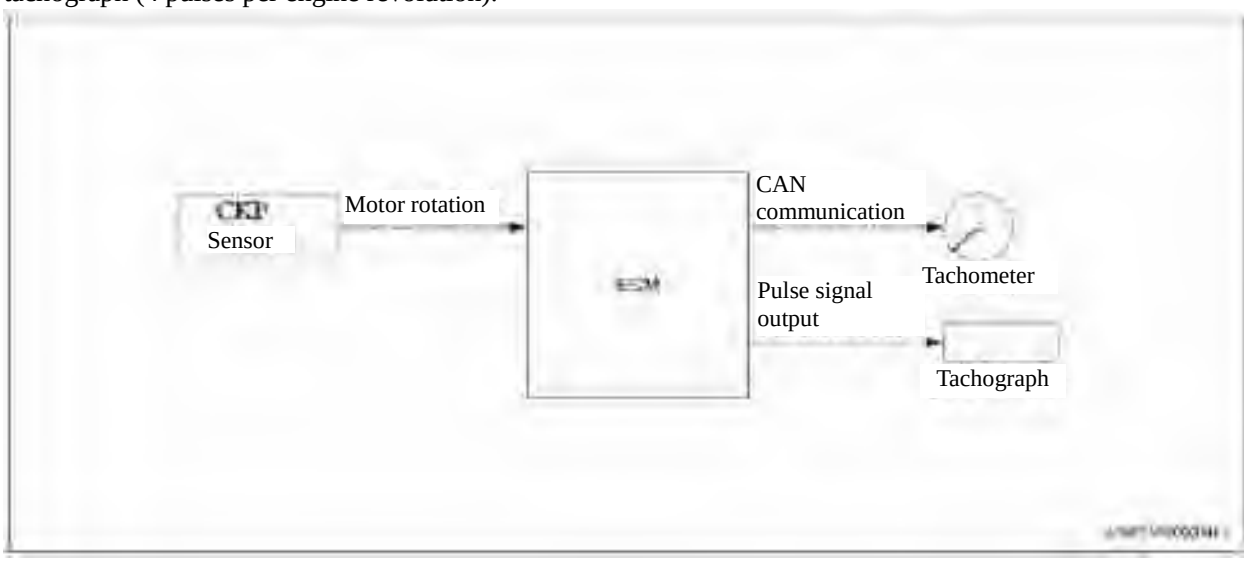
Warming-up control system

The warming-up control system is designed to ease the engine start at low temperature and reduce the white smoke and noise. With the starter switch active, ECM detects the engine coolant temperature according to the signal from the engine coolant temperature (ECT) sensor to adjust the warming-up time and achieve the appropriate starting conditions for the engine. In addition, the residual heat of warming-up can maintain the idling stable. ECM decides the warming-up time according to the engine coolant temperature to drive the warming-up relay and indicator lamp to work.



Engine speed output

ECM transmits the engine speed to the tachometer through the CAN communication. Besides, it transmits the engine speed pulse to the digital tachograph (4 pulses per engine revolution).

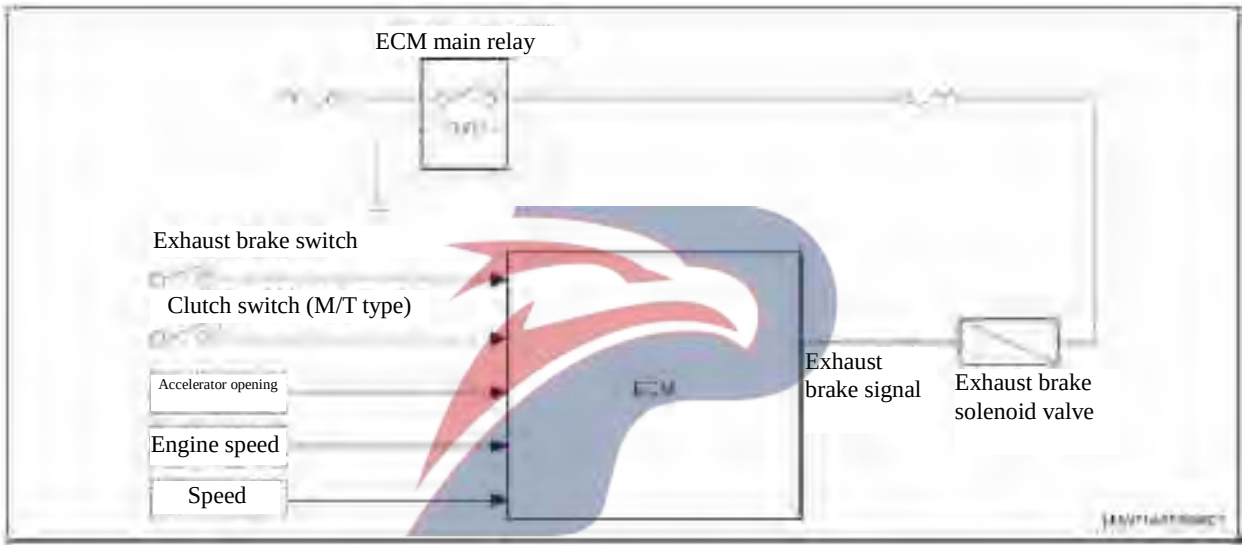


Overview of exhaust brake control

The exhaust brake exhaust pipe is provided with valve inside. Closing the valve can increase the exhaust stroke resistance and enhance the engine brake effect. The exhaust brake valve works according to the vacuum pressure. The exhaust brake vacuum pressure is controlled by the open and close of solenoid valve. ECM will enable the solenoid valve if the engine speed is above 575rpm and all the exhaust brake operating conditions are met.

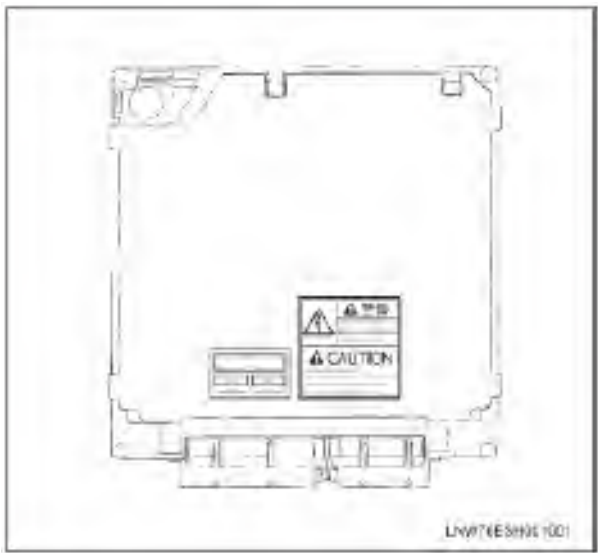
Exhaust brake operating conditions

- Exhaust brake switch on
- Accelerator pedal not depressed
- Not detecting accelerator pedal position (APP) sensor abnormal, exhaust brake circuit abnormal, clutch switch abnormal, APP sensor switch abnormal, A/D switch abnormal etc.
- Clutch pedal not depressed
- System voltage above 24V
- Vehicle speed exceeding specified range



ECM

Overview of ECM



ECM monitors the information from every sensor all the time to control the power train. ECM performs system diagnostic function to detect the system operation problem, remind the driver through the engine MIL and record DTC at the same time. DTC identifies the trouble zone to help the maintenance man.

ECM functions

ECM exports 5V voltage to power various sensors and switches. However, since the power is supplied by the ECM resistance, the test lamp connected to the circuit will not be on even if the resistance is very high. In some case, the common voltmeter cannot display the correct reading since its resistance is too low. To display the correct reading, ensure to use the digital multimeter of 10MΩ input impedance at least (5-8840-2691-0). ECM controls the ground circuit or power circuit through the transistor or other unit and consequently controls the output circuit.

ECM and composition parts

ECM can achieve the high steerability and fuel efficiency while maintaining the specified waste gas exhaust. ECM monitors the engine and vehicle performance through the crankshaft position (CKP) sensor and vehicle speed sensor (VSS) etc.

ECM voltage description

ECM applies the standard voltage to each switch and sensor. This is because the ECM resistance is very high while the voltage applied to the circuit is low. The test lamp will not illuminate even if connected in the circuit. Since the input impedance of voltmeter generally used by the maintenance man is very low, sometimes the voltmeter cannot display the correct reading. In such a case, use digital multimeter of 10MΩ input impedance (5- 8840 -2691-0) to get the correct voltage reading.

The ECM input/output unit is equipped with analog-digital converter, signal damping, counter and special actuator. ECM can control most composition parts through the electronic switch.

EEPROM

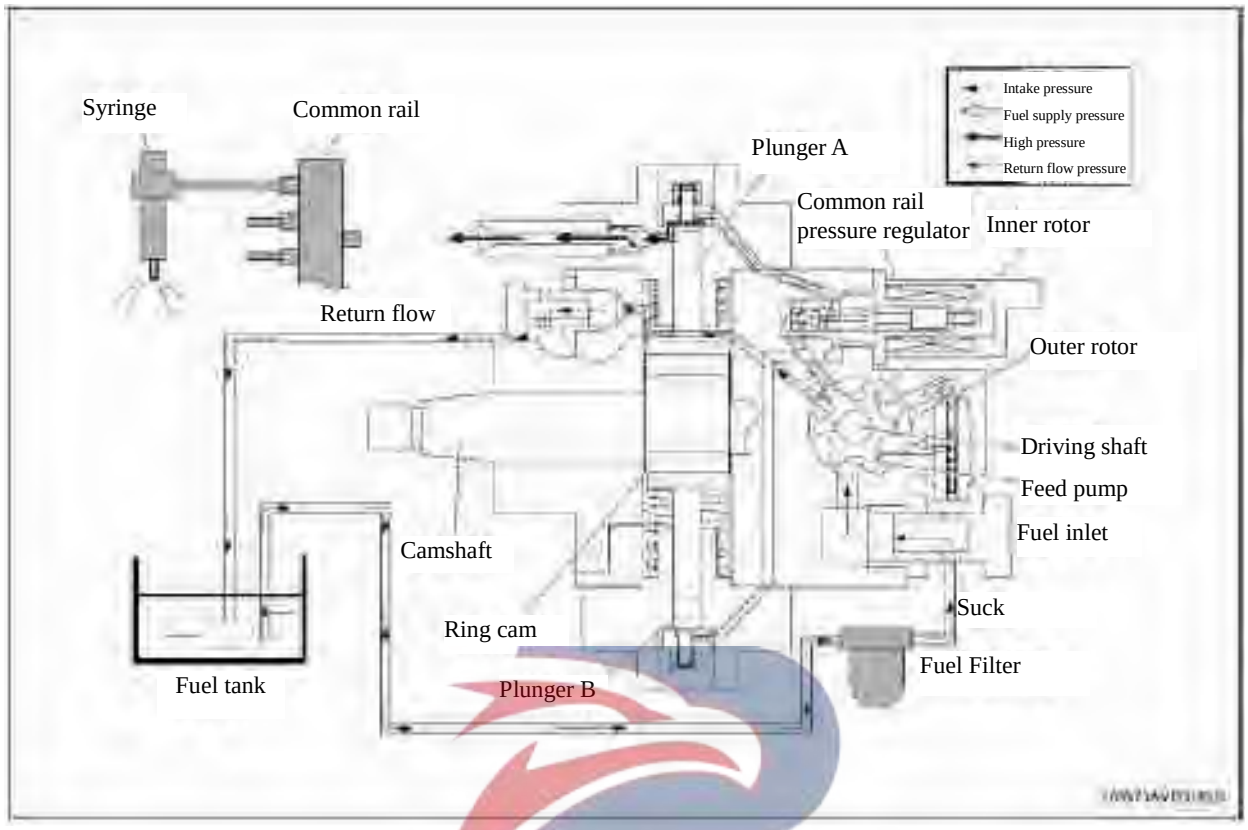
EEPROM is permanent storage chip soldered to the ECM back plate. To control the power train, ECM transmits the necessary program and calibration message to EEPROM.

Different from ROM, EEPROM cannot be replaced. If EEPROM is detected abnormal, replace the ECM directly.

Considerations for ECM repair

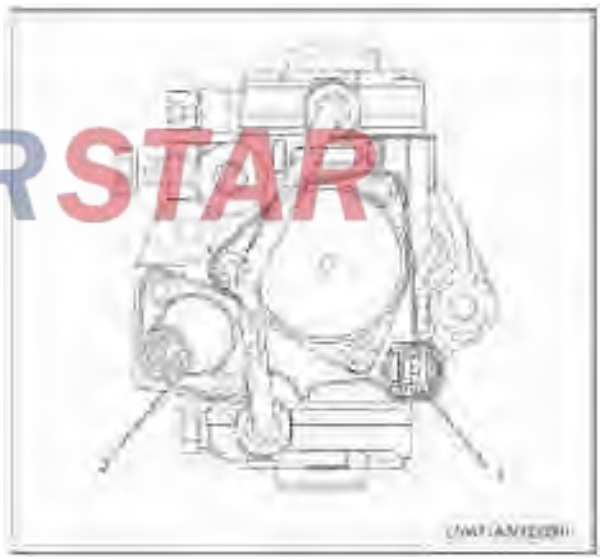
ECM can withstand the general current relevant to vehicle driving. Do not allow the circuit overload. During the open circuit and short circuit test, do not connect the ECM circuit to the ground wire or apply the voltage unless otherwise specified. For such circuit tests, ensure to use the digital multimeter (5-8840-2691-0).

Fuel injection pump



The injection pump is the core part of common rail electronic fuel injection system. The injection pump is installed to the engine front. The common rail pressure regulator and fuel temperature (FT) sensor are the composition parts of the injection pump.

The fuel is fed to the injection pump from the fuel tank through the inside supply pump (rotor type). The supply pump feeds the fuel into 2 plunger compartments in the injection pump. The fuel fed to the plunger compartment is regulated by the common rail pressure regulator. The common rail pressure regulator is only controlled by the ECM supply current. The fuel flow will reach the maximum if no current is fed to the solenoid valve. Contrarily, the fuel will stop flowing when the solenoid valve current reaches the maximum. As the engine rotates, the two plungers build high pressure in the common rail. It controls the common rail pressure regulator according to the ECM signal and consequently controls the fuel volume and pressure to the common rail. In this way, the optimal operating state can be realized to enhance the fuel economical efficiency and reduce the NOx emission.



Key

1. Fuel temperature (FT) sensor
2. Suction control valve (common rail pressure regulator)

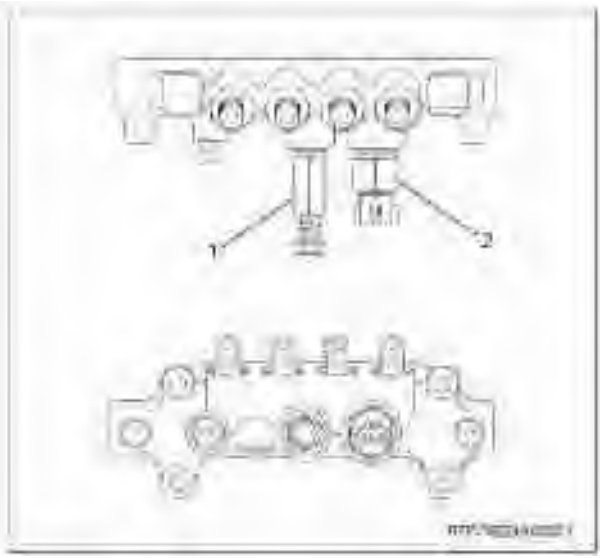
Suction control valve (common rail pressure regulator)

ECM controls the load factor of common rail pressure regulator (the power-on time of common rail pressure regulator) to regulate the fuel volume fed to the high pressure plunger. To achieve the desired rail pressure, feed the proper amount of fuel to reduce the drive load of the injection pump. When the current is fed to the common rail pressure regulator, the variable electromotive force corresponding to the load factor will be generated to vary the fuel line opening and consequently adjust the fuel volume. When the common rail pressure regulator is switched off, the retracting spring will retract, the fuel line will completely open and the fuel will flow to the plunger (the maximum intake and maximum discharge). With the common rail pressure regulator open, the fuel line will close (normally open) under the function of the retracting spring. Through the open and close of common rail pressure regulator, the fuel corresponding to the working load rate will be supplied and then discharged from the plunger.

Fuel temperature (FT) sensor

FT sensor is installed to the injection pump and the thermistor changes the resistance along with the temperature variation. The resistance will be low if the fuel temperature is high and high if the fuel temperature is low. ECM applies 5V voltage to FT sensor through the load resistor and works out the fuel temperature according to the voltage variation to control the injection pump. The voltage will be low if the resistance is low (the temperature is high) and high if the resistance is high (the temperature is low).

Common rail



Key

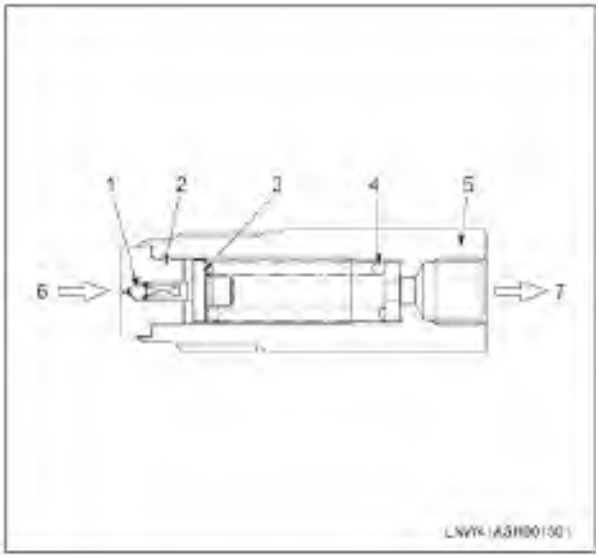
1. Pressure limiting valve
2. Common rail pressure sensor

Due to the common rail type electrical control fuel injection system, the common rail is provided between the injection pump and injector to store the high pressure fuel. The pressure sensor and pressure limiting valve are installed on the common rail. The pressure sensor detects the fuel pressure in the common rail and transmits the signal to ECM. Basing on this signal, ECM controls the fuel pressure in the common rail with the injection pump common rail pressure regulator. If the common rail inside fuel pressure is too high, the pressure limiting valve will open to release the pressure.

Common rail pressure sensor

The common rail pressure sensor is installed to the common rail to detect the fuel pressure in the rail and convert the pressure into voltage signal. The higher the pressure, the higher the voltage; the lower the pressure, the lower the voltage. ECM works out the actual common rail pressure (the fuel pressure) according to the voltage signal from the sensor to control the fuel injection.

Pressure limiting valve

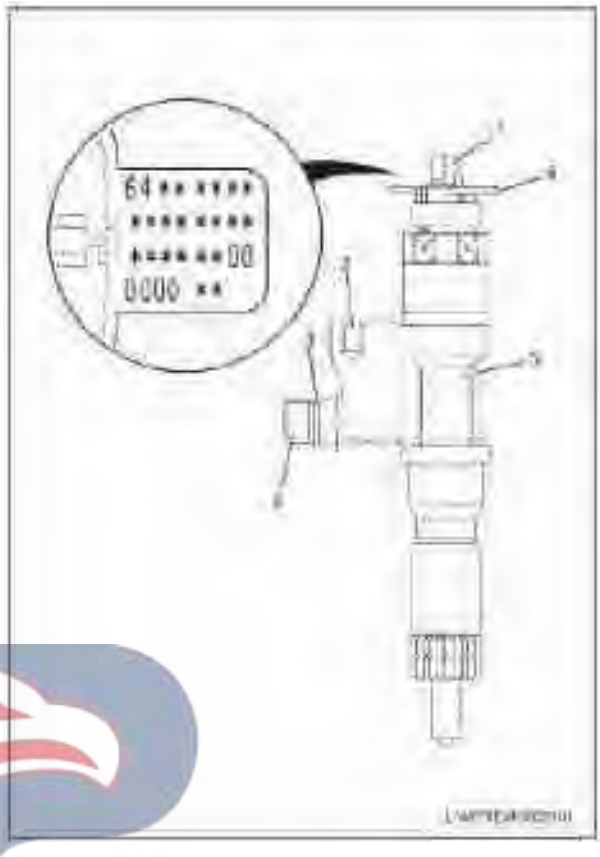


Key

1. Valve
2. Valve body
3. Valve guide
4. Spring
5. Housing
6. Fuel inlet
7. Fuel outlet

In the case of abnormal high pressure, the pressure limiting valve will open to release the pressure. The valve will open when the common rail inside pressure exceeds 220MPa and close when the pressure is below 50MPa. The fuel discharged from the pressure limiting valve will flow to the fuel tank.

Injector



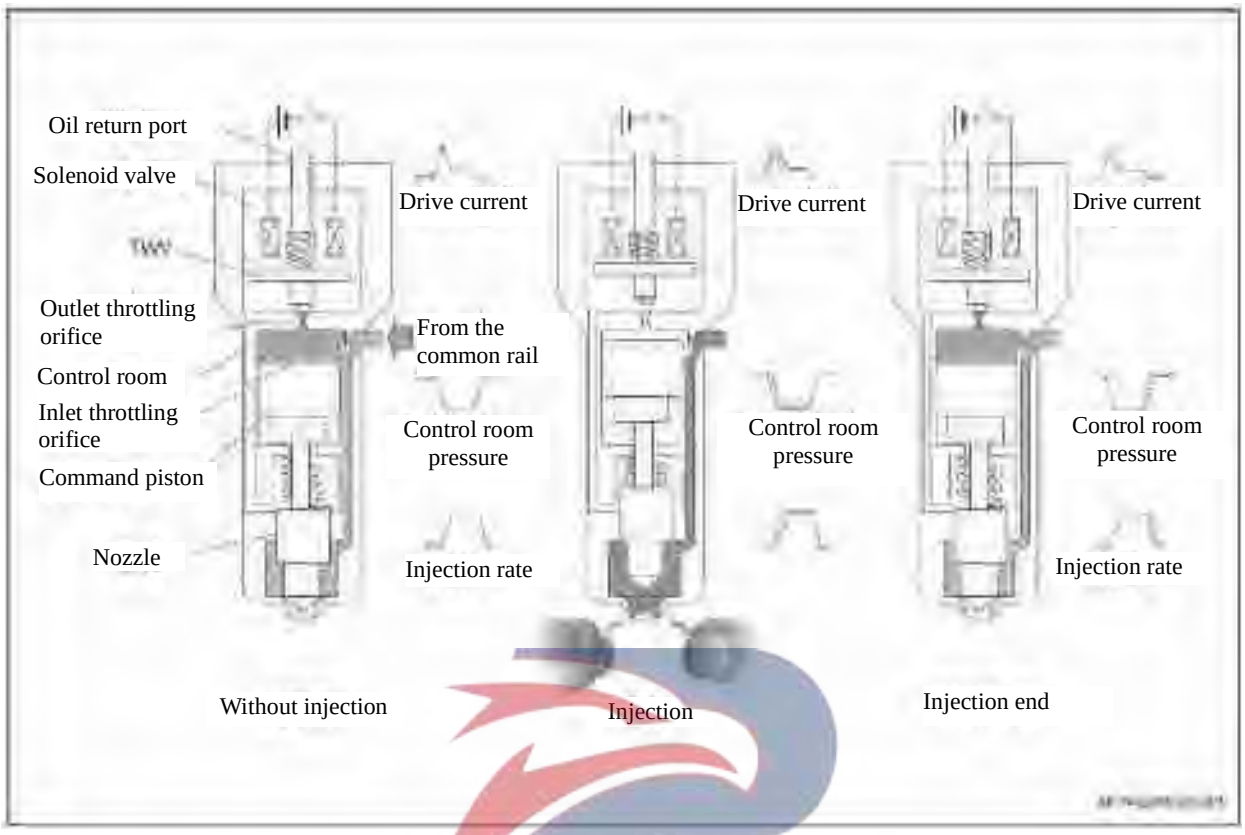
Key

1. Wiring bolt
2. Return to the pipeline installation department
3. O-ring
4. Injection pipe installation part
5. Identification marking
6. Injector ID code

Compared to the earlier injection nozzle, the electrical control injector controlled by ECM is provided with command piston and solenoid valve. This information is recorded in the ID code (24 English numbers) to display the injector characteristics. This system controls the injection volume to achieve the optimal effect with the injector flow information (ID code). When a new injector is installed to the vehicle, ensure to enter ID code in ECM.

To enhance the injection volume accuracy, use the 2D bar code or ID code on the injector. With the code, the decentralized control injection volume can be achieved on each pressure zone to enhance the combustion rate, reduce the exhaust and provide the stable output .

Injector operation



● Without injection

If ECM does not power the solenoid valve through the two-way valve (TWV), it will close the outlet throttling orifice with the piston force. At this point, the fuel pressure applied to the nozzle front end will be balance with the fuel pressure applied to control room through the inlet. In this pressure balance state, the sum of pressure applied to command piston and nozzle piston gravity will be higher than the pressure applied to the nozzle front end. Therefore, the nozzle will be pushed down to close the injection hole.

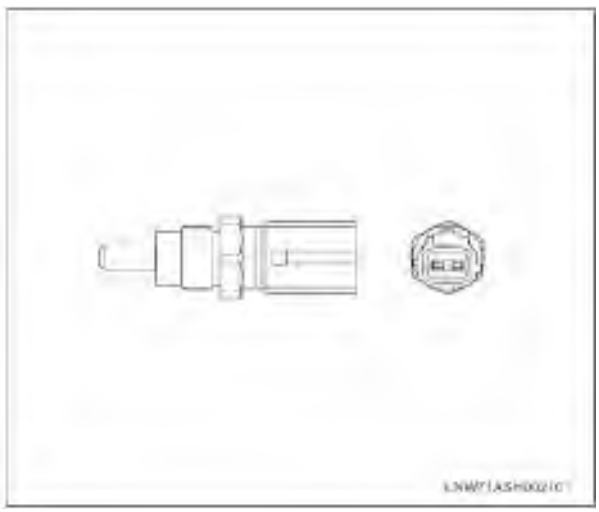
● Injection

If ECM powers the solenoid valve, TWV will be pulled to open the outlet throttling orifice and the fuel will flow to the oil return port. At this point, the nozzle and command piston are lifted together with the pressure applied to the nozzle front end. Then the nozzle injection hole will open to inject the fuel.

● Injection end

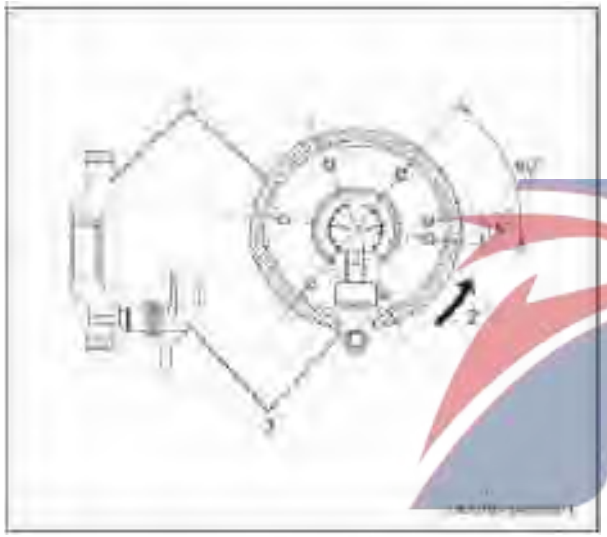
When the ECM stops powering the solenoid valve, TWV will fall and the outlet opening part will close. At this point, the fuel cannot flow to the return port from the control room and the fuel pressure inside will rise quickly. Then the nozzle will be depressed by the command piston to close the injection port and then the fuel injection will stop.

Engine coolant temperature (ECT) sensor



ECT sensor is installed near the thermostat shell and the thermistor changes the resistance along with the temperature variation. The resistance will be lower if the engine coolant temperature is high and high if the engine coolant temperature is low. ECM applies 5V voltage to ECT sensor through the load resistor and works out the engine coolant temperature according to the voltage variation to control the fuel injection. The voltage will be low if the resistance is low (the temperature is high) and high if the resistance is high (the temperature is low).

Camshaft position (CMP) sensor

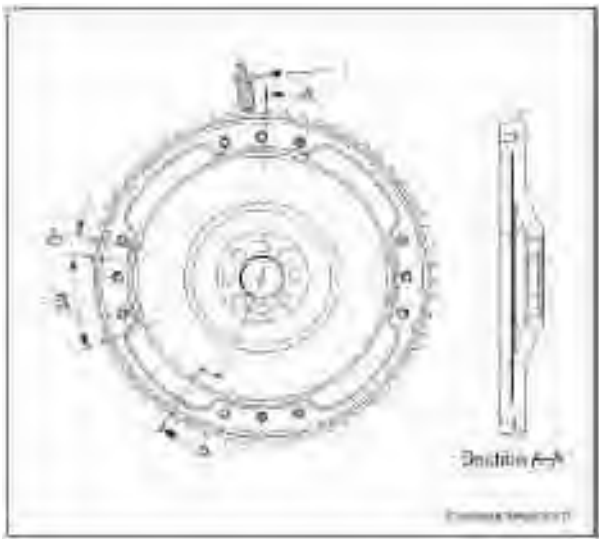


Key

1. Camshaft gear
2. Rotation direction
3. Camshaft position (CMP) sensor

The camshaft position (CMP) sensor is installed to the cylinder head rear section. The cam section of the camshaft generates the CMP signal when passing through the sensor. ECM determines the cylinder conditions and crankshaft angle according to the CMP signal and CKP sensor input CKP signal to control the fuel injection and calculate the engine speed. Though these controls base on CKP signal in general, they will work according to the CMP signal in the case of CKP sensor abnormal.

Crankshaft position (CKP) sensor



Key

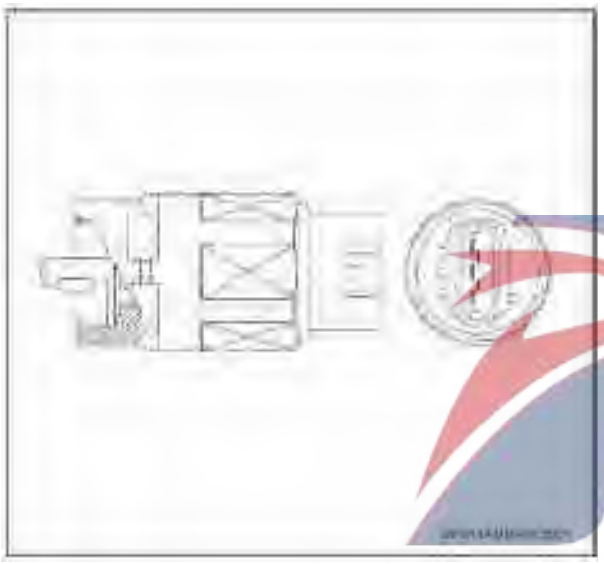
1. Crankshaft position (CKP) sensor

The CKP sensor is installed to the flywheel housing. When the flywheel hole passes through the sensor, it will generate CKP signal. ECM determines the cylinder conditions and camshaft angle according to the CKP signal and CMP sensor input CMP signal to control the fuel injection and calculate the engine speed. Though these controls base on CKP signal in general, they will work according to the CMP signal in the case of CKP sensor abnormal.

Accelerator pedal position (APP) sensor 1

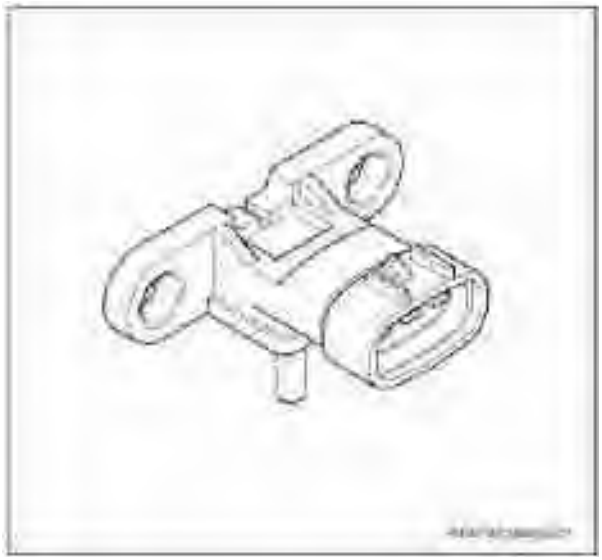
APP sensor is installed to the accelerator pedal control bracket. This sensor consists 2 sensors in one shell. ECM determines the acceleration and deceleration target value with the APP sensor. APP sensor is pin hole 1C type sensor. The signal voltage changes along with the accelerator pedal angle variation proportionably. APP sensor 1 signal voltage is low at in the early stage and increases as the pedal depressed. APP sensor 2 signal voltage is high at in the early stage and decreases as the pedal depressed.

Vehicle speed sensor



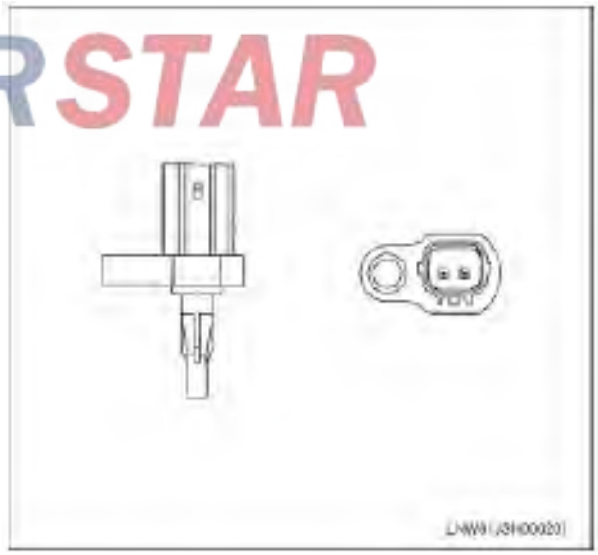
The vehicle speed sensor (VSS) is installed to the transmission. The vehicle speed sensor is equipped with HALL effect circuit. The magnet and output shaft generate the magnetic field when rotating together and then generate the pulse signal through the interaction with the magnetic field.

Atmospheric pressure sensor



The barometric pressure sensor is installed to the dashboard and changes the signal voltage along with the pressure. ECM detects the low signal voltage when the pressure is low in the high elevation area; contrarily, it detects the high signal voltage when the pressure is high. With these voltage signals, ECM can regulate the fuel injection volume and injection time to correct the elevation.

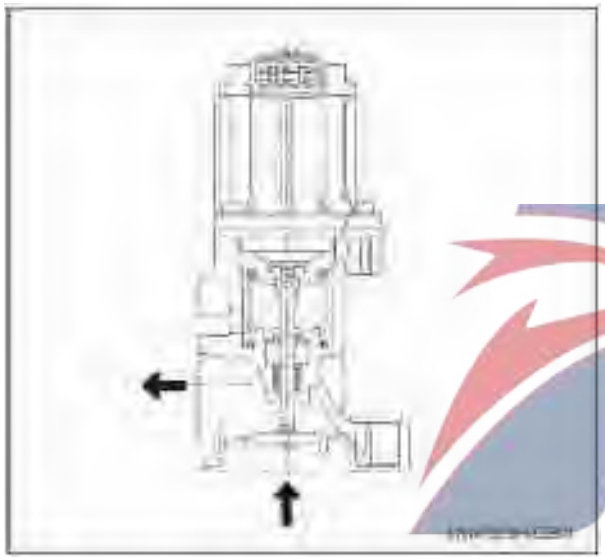
Intake air temperature (IAT) sensor



Intake air temperature (IAT) sensor

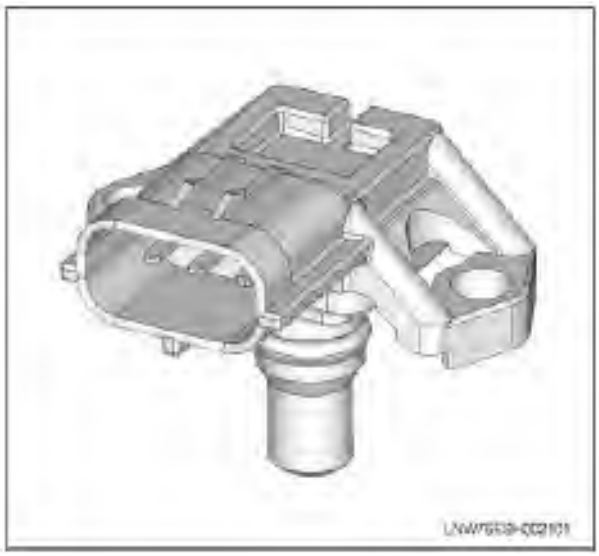
IAT sensor is installed to the guide tube between the air filter and turbocharger. When the IAT sensor temperature is low, the sensor resistance will be high. When the air temperature increases, the sensor resistance will be lower. When the sensor resistance is high, ECM will detect the high voltage on the signal circuit. When the sensor resistance is low, ECM will detect the low voltage on the signal circuit.

EGR valve



EGR valve is installed to the intake manifold. ECM controls the opening of EGR valve according to the engine operating state. According to the duty ratio signal from ECM, it controls the magnetic coil in EGR valve. Through the position sensor, it can detect the EGR valve opening. The position sensor is provided with 3 sensors in EGR valve to detect 3 locations respectively. Position sensors 1, 2, 3 are pin hole 1C type. The position sensor exports the valve open/close state in form of signal, which is in proportion with the variation of EGR valve opening.

Intake pressure sensor

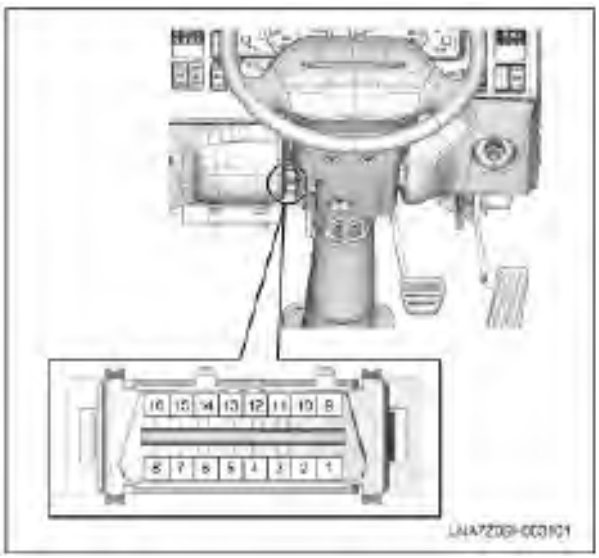


The intake air pressure sensor is installed to the air inlet duct to detect the intake air pressure and convert the pressure into voltage signal. ECM detects high voltage when the pressure is high. It detects low voltage when the pressure is low. ECM works out the intake air pressure according to the voltage signal from the sensor to control the fuel injection and turbocharger.

Engine malfunction warning lamp

The engine malfunction warning lamp is installed inside the instrument to remind the driver of the engine or related system abnormal. When ECM detects abnormal through the self-diagnosis function, the engine malfunction warning lamp will be on. Short the data link connector (DLC) terminals to make the engine malfunction warning lamp blink. Then the DTC detecting state can be confirmed.

Data Link Connector (DLC)

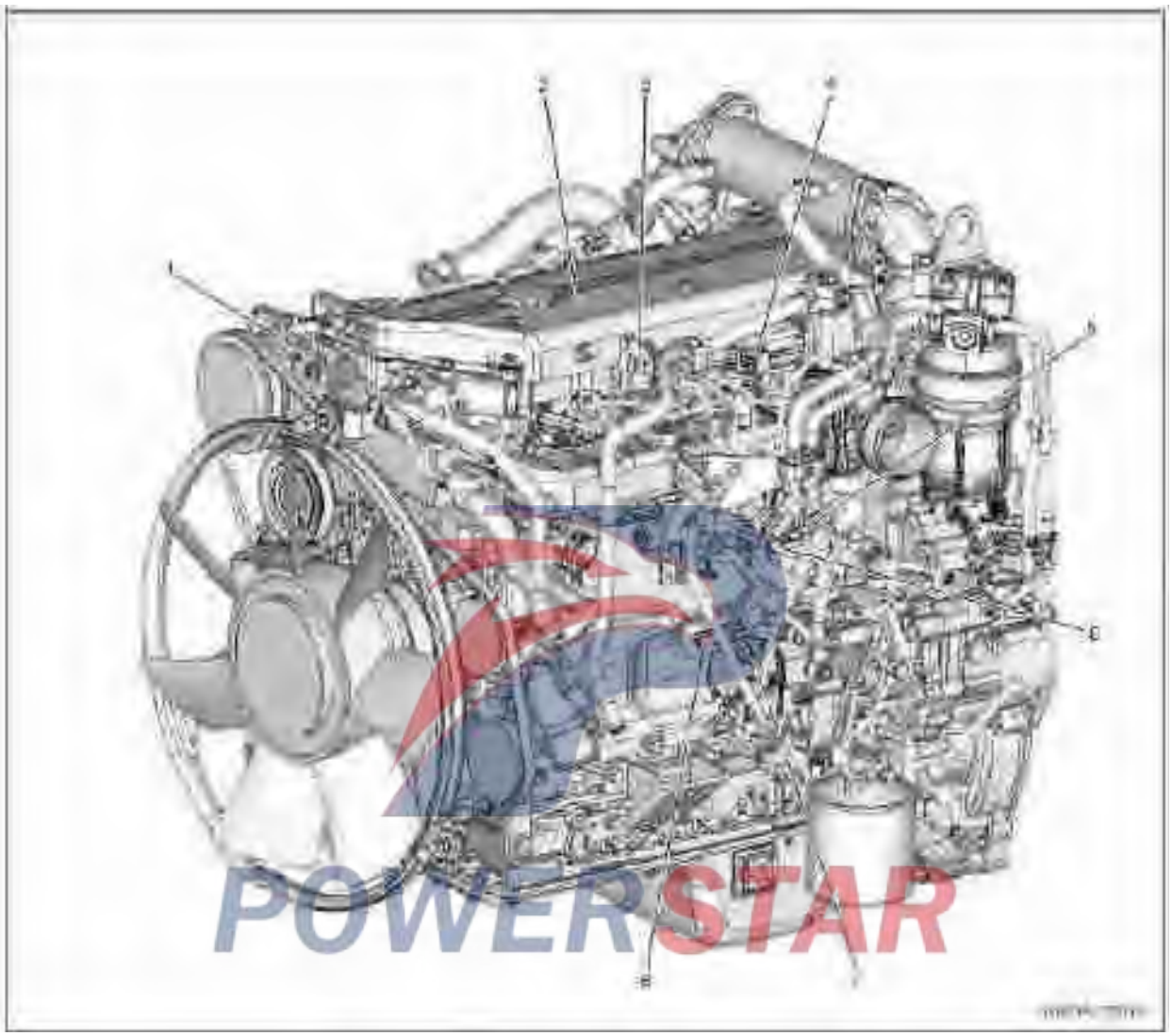


DLC is installed to the lower left of the driver and it is the communication connector for the fault diagnostic meter and each control unit. It is provided with the diagnosis switch function. Through the short-circuit of DLC, it can enable the diagnosis switch.

Parts configuration diagram

Engine composition parts layout

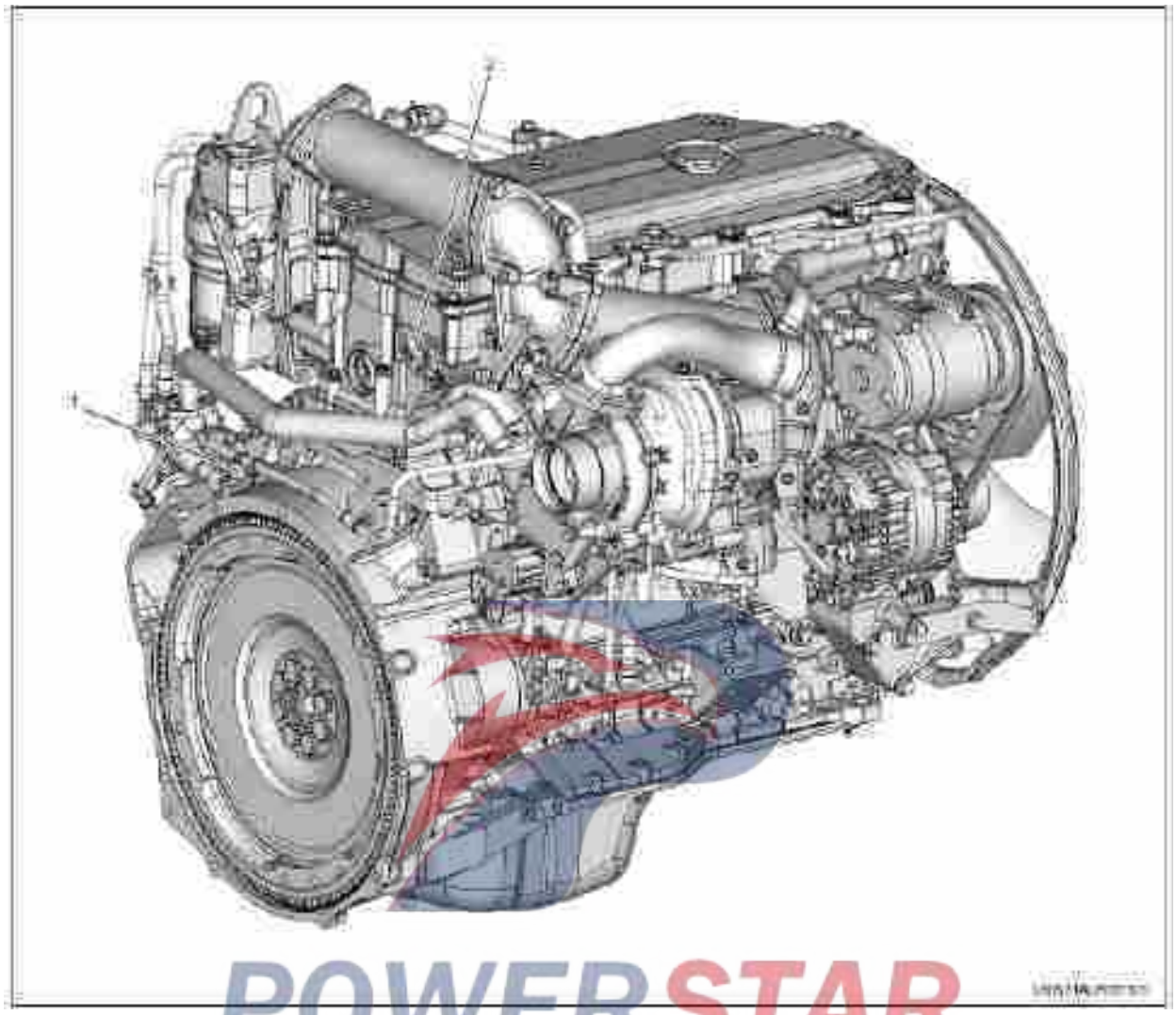
(1/2)



Key

1. Engine coolant temperature (ECT) sensor
2. Injector (in cylinder head cover)
3. Injector harness middle joint
4. EGR valve
5. Common rail pressure sensor
6. Pressure limiting valve
7. Suction control valve (common rail pressure regulator)
8. Fuel temperature (FT) sensor

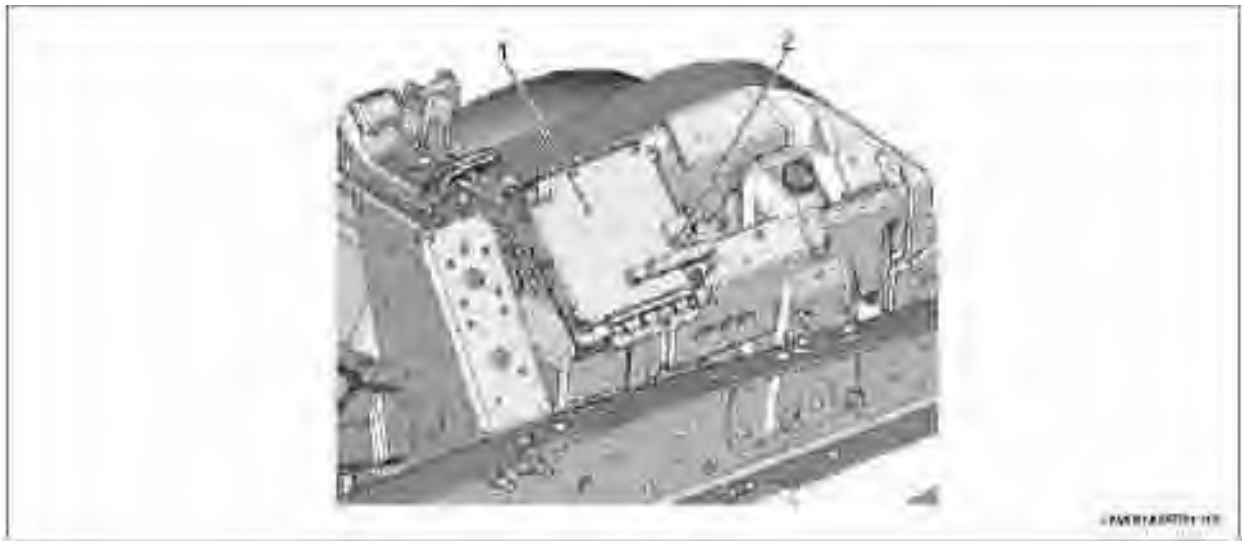
(2/2)



Key

1. Crankshaft position (CKP) sensor
2. Cam position (CMP) sensor

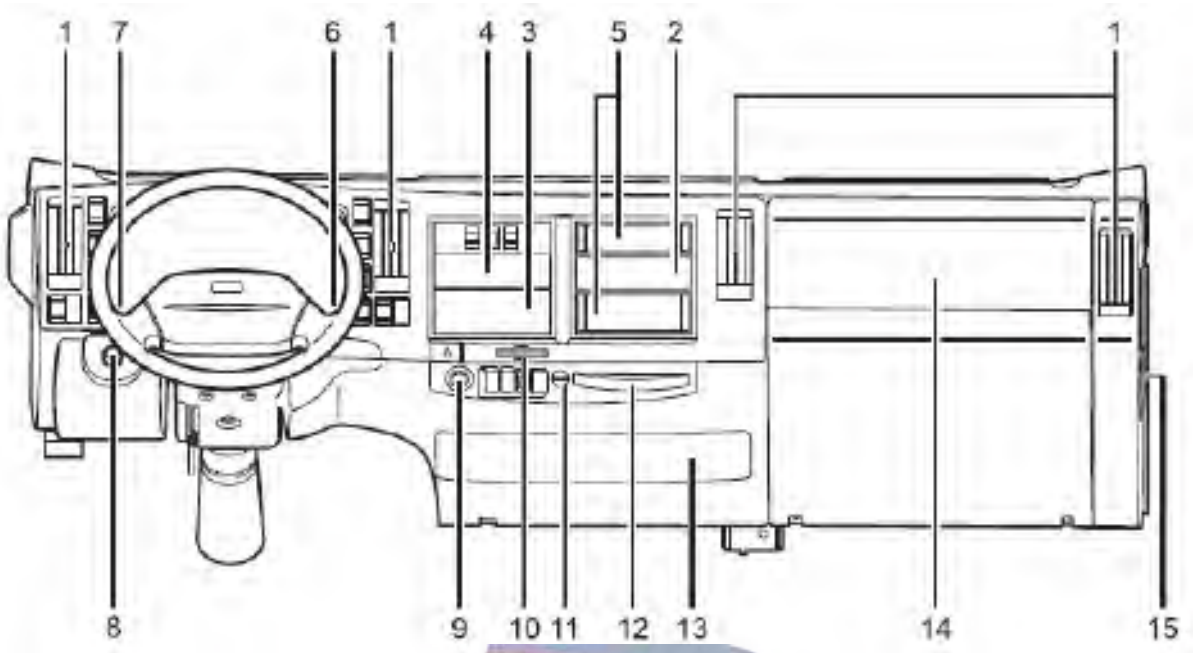
Engine composition parts layout 1



Key

1. ECM
2. Terminal resistor

Engine composition parts layout 3

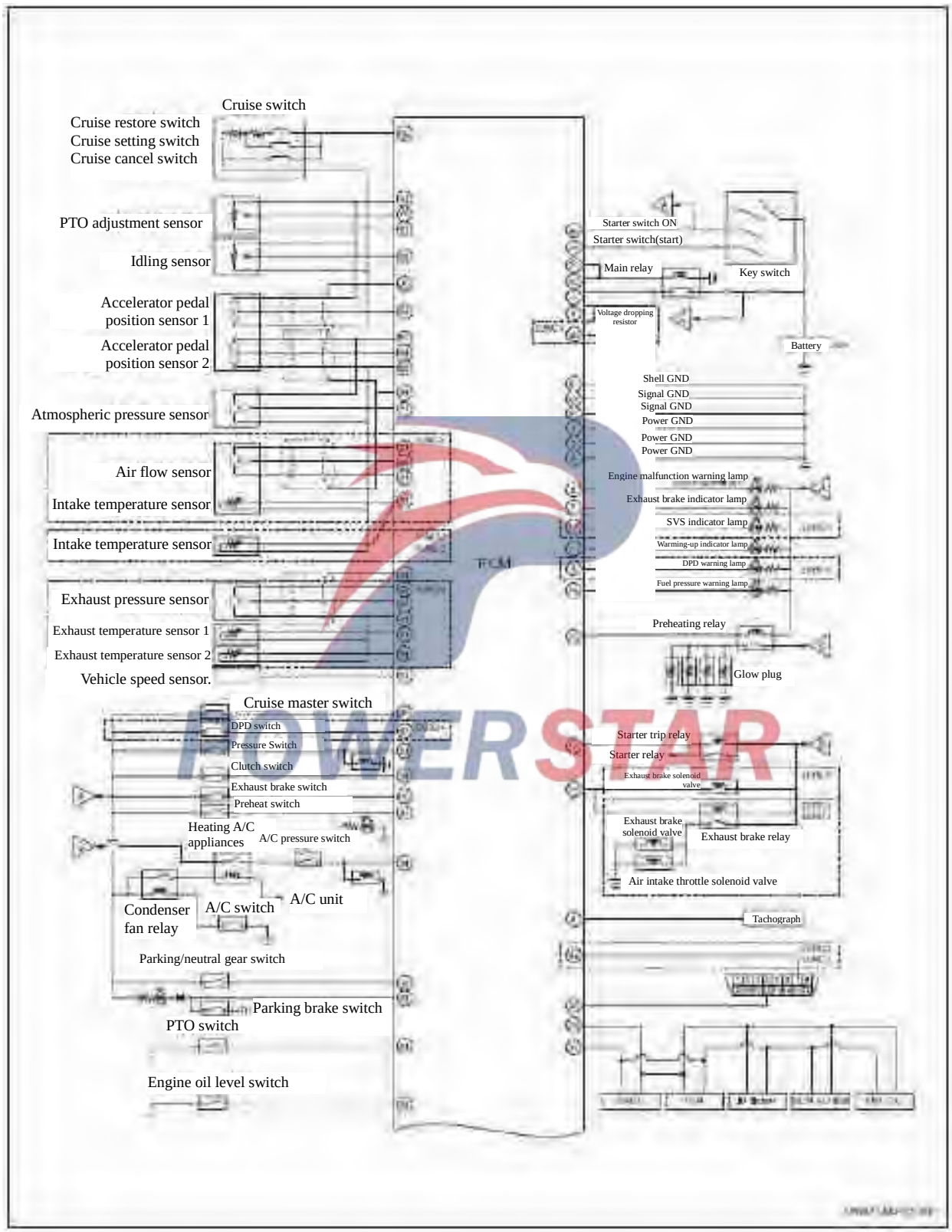


Key

1. Ventilation bar rack
2. Glove box (small)
3. Heating unit, defroster control panel, A/C panel
4. Radio cassette or CD player
5. Glove box (large)
6. Windshield wiper, washer switch lever, exhaust auxiliary brake switch lever
7. Cluster switch lever
8. Steering wheel adjustment locking lever
9. Hazard warning flash lamp switch
10. Cigarette lighter
11. Card case
12. Hook
13. Concealed type cup holder
14. Fuse box cover plate
15. Toolbox

Circuit diagram

Circuit diagram sketch (1/2)



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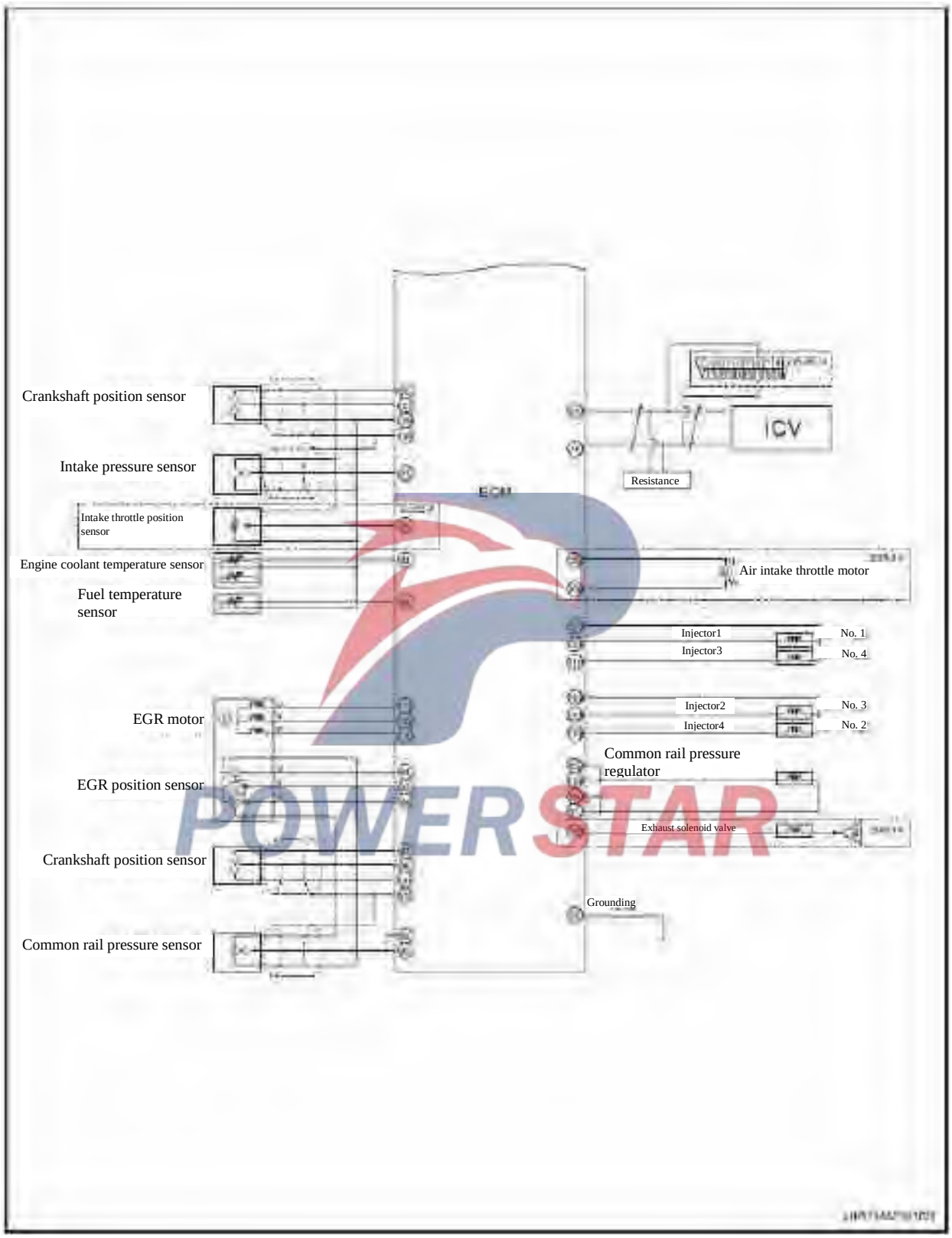
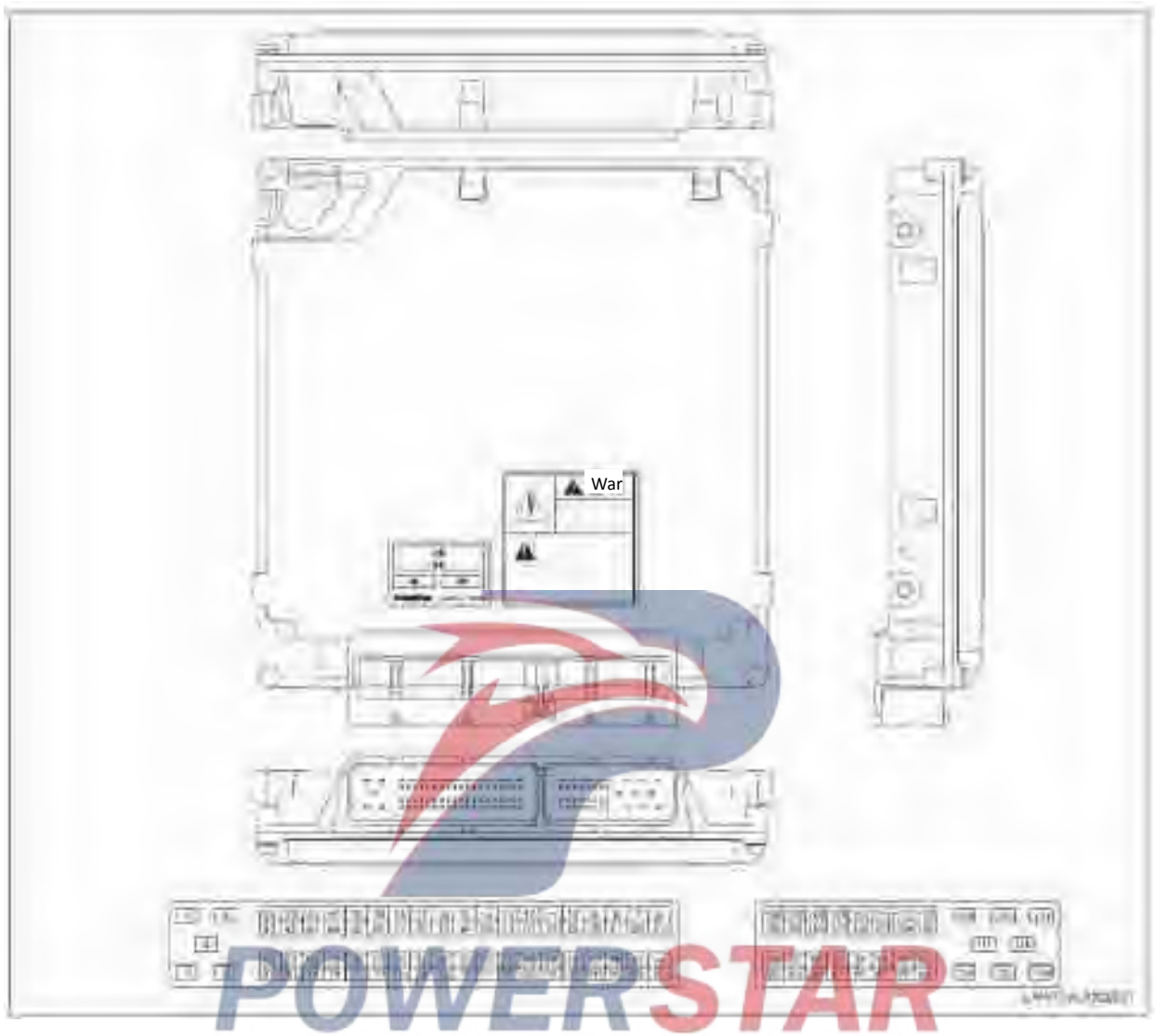


Terminal arrangement



ECM terminal end view

ECM

Joint SN		J-14
Joint color		Black
Test adapter SN		J-35616-64A
Port No.	Wire color	Port function
1	Black	ECM signal ground
2	Red	Battery voltage
3	Black	ECM signal ground
4	Black	ECM signal ground
5	Red	Power voltage
6	Blue/Red	Malfunction Indicator Lamp (MIL) Control
7	Blue/Pink	Exhaust brake lamp control
8	Light green	Engine speed signal output to tachometer
9	Light green/Black	DPD indicator lamp control (Euro IV)
10	Black/Red	Glow plug relay control
11	Orange/Blue	Warming-up lamp control
12	-	Not used
13	-	Not used
14	White/blue	Starter on/off relay control
15	Light green/white	Exhaust brake solenoid valve control
16	Blue/yellow	Check oil residual volume warning lamp control

Joint SN		J-14
Joint color		Black
Test adapter SN		J-35616-64A
Port No.	Wire color	Port function
17	Blue/Black	SVS indicator lamp control (Euro IV)
18	Blue/white	CAN high signal input
19	Yellow/green	Vehicle speed sensor signal or electronic hydraulic control unit
20	Black	Accelerator pedal position sensor 1 shield ground
21	Blue/Black	ECM main relay control
22	Green	Air flow sensor signal low input (Euro IV)
23	Yellow	Air flow sensor 12V reference value (Euro IV)
24	Yellow/Black	Ignition voltage
25	Red/white	Cruise master switch signal
26	Brown/yellow	Clutch pedal switch signal
27	-	Not used
28	-	Not used
29	-	Not used
30	-	Not used
31	-	Not used
32	-	Not used
33	Pink	Refrigerating machine switch signal
34	Green/Orange	A/C switch signal
35	Green/white	Voltage dropping resistor
36	-	Not used
37	Blue	CAN lower signal input
38	Light blue	Keyword 2000 line data (non-Euro IV)
39	Black	Accelerator pedal position sensor 2 & air flow sensor (Euro IV) shield ground
40	Blue/Black	ECM main relay control
41	Pink/black	Accelerator pedal position sensor 1, idling sensor, PTO position sensor low input

Joint SN		J-14
Joint color		Black
Test adapter SN		J-35616-64A
Port No.	Wire color	Port function
42	Red	Accelerator pedal position sensor 1, idling sensor, PTO position sensor 5V power
43	Black	ECM signal ground
44	Blue/Orange	PTO Switch signal
45	Light green/red	Exhaust brake switch signal
46	Red/white	Ignition switch signal
47	White /Red	DPD switch signal (Euro IV)
48	White/black	Parking brake switch signal
49	-	Not used
50	Black /blue	Neutral switch signal
51	Light green/blue	Engine Preheat Switch signal
52	Yellow	Diagnosis switch
53	Colorless/yellow	Engine oil volume switch signal
54	-	Not used
55	-	Not used
56	-	Not used
57	-	Not used
58	Blue/white	CAN high signal input (Euro IV)
59	Black	Exhaust differential pressure sensor shield ground
60	Black	Accelerator pedal position sensor 2, barometric pressure sensor & intake air temperature sensor low input
61	Red	Accelerator pedal position sensor 2, barometric pressure sensor & air intake 5 V power
62	Black	ECM signal ground
63	Blue/white	Accelerator pedal position sensor 1 signal
64	White	Accelerator pedal position sensor signal
65		Cruise control switch signal
66	Blue/yellow	Idling sensor signal
67	Light green	Exhaust differential pressure sensor signal (Euro IV)

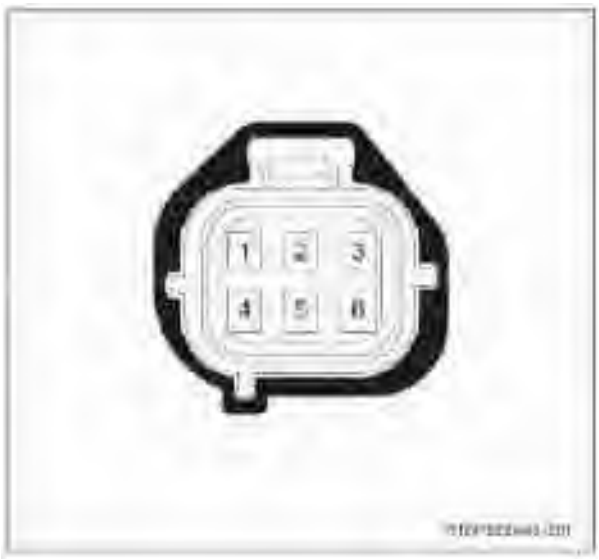
Joint SN		J-14
Joint color		Black
Test adapter SN		J-35616-64A
Port No.	Wire color	Port function
68	Black	Optional (GND)
69	Blue	Air flow sensor signal (Euro IV)
70	Brown	PTO position sensor:
71	Brown/green	Barometric pressure sensor signal
72	Red/Green	Intake temperature sensor signal
73	Yellow/Red	Exhaust temperature sensor 1 signal (Euro IV)
74	Red	Exhaust temperature sensor 2 signal (Euro IV)
75	-	Not used
76	-	Not used
77	-	Not used
78	Blue	CAN low signal input (Euro IV or using boundary member)
79	Black	Exhaust differential pressure sensor, exhaust temperature sensor 1 & exhaust temperature sensor 2 low input (Euro IV)
80	Blue/white	Exhaust differential pressure sensor 5V power (Euro IV)
81	Black	ECM shell GND

Joint SN		E-12
Joint color		Black
Test adapter SN		J-35616-64A
Port No.	Wire color	Port function
82	White	Common rail pressure sensor signal
83	Light green/white	Fuel temperature sensor signal
84	Yellow/Red	Engine coolant temperature sensor signal
85	Colorless/white	Air intake throttle position sensor signal (Euro IV)
86	-	Not used
87	Light green	Camshaft position sensor, fuel rail pressure sensor & EGR 5V power
88	-	Not used
89	Yellow/Red	Common rail pressure regulator control low voltage end
90	Blue/white	Common rail pressure sensor signal
91	Red	Intake air pressure sensor signal
92	-	Not used
93	Light blue	EGR position sensor signal 2
94	White/Orange	EGR position sensor signal 1
95	Yellow	Crankshaft position sensor, air intake throttle position sensor & intake air pressure sensor 5V power
96	-	Not used
97	Yellow/Red	Common rail pressure regulator control lowvoltage end
98	Blue/white	Camshaft position sensor signal
99	Light green/Black	EGR position sensor signal 3
100	Black	Camshaft position sensor & common rail pressure sensor shield ground

Joint SN		E-12
Joint color		Black
Test adapter SN		J-35616-64A
Port No.	Wire color	Port function
101	Yellow/Black	Camshaft position sensor, common rail sensor & EGR system position sensor low input
102	Green/Orange	Exhaust throttle solenoid valve control (Euro IV)
103	Orange	EGR system motor control 2
104	Green	Air intake throttle solenoid valve low voltage end
105	White /Red	Common rail pressure regulator high voltage end
106	-	Not used
107	Red/blue	Crankshaft position sensor signal
108	Black	Crankshaft position sensor & intake air pressure sensor shield ground
109	Black	Crankshaft position sensor, air intake throttle position sensor, fuel temperature sensor, engine coolant temperature sensor, intake air pressure sensor low input
110	White	EGR system motor control 3
111	Black/Orange	EGR system motor control 1
112	Black/green	Air intake throttle solenoid valve high voltage end
113	White /Red	Common rail pressure regulator control high voltage end
114	-	Not used
115	-	Not used
116	Red	Injector power 2 (No.2 and No.3 cylinder)
117	White/yellow	No.2 cylinder injector control
118	Black	No.4 cylinder injector control
119	Green/white	No.1 cylinder injector control
120	Black /blue	No.3 cylinder injector control
121	White	Injector power 1 (No.2 and No.3 cylinder)

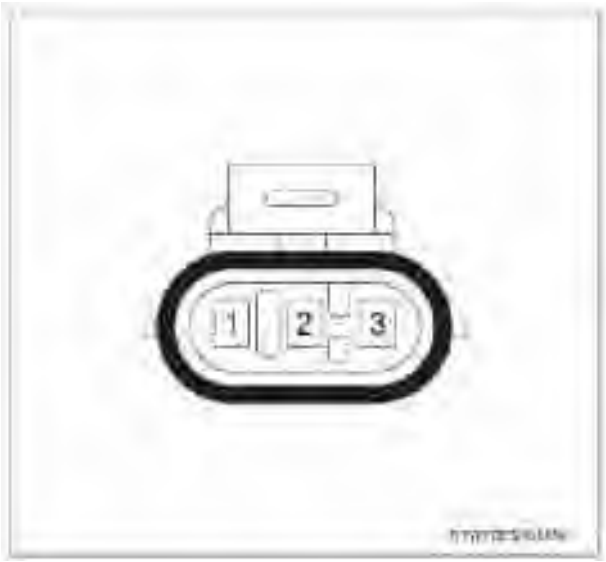
Engine control terminal end view

Accelerator pedal position (APP) sensor



Joint SN		B-5
Joint color		Gray
Test adapter SN		J-35616-33
Port No.	Wire color	Port function
1	Red	APP2 5V power
2	White	APP2 signal
3	Black	APP2 low input
4	Blue	APP1 5V power
5	Blue/white	APP1 signal
6	Blue/Red	APP1 low input

Atmospheric pressure (BARO) sensor.

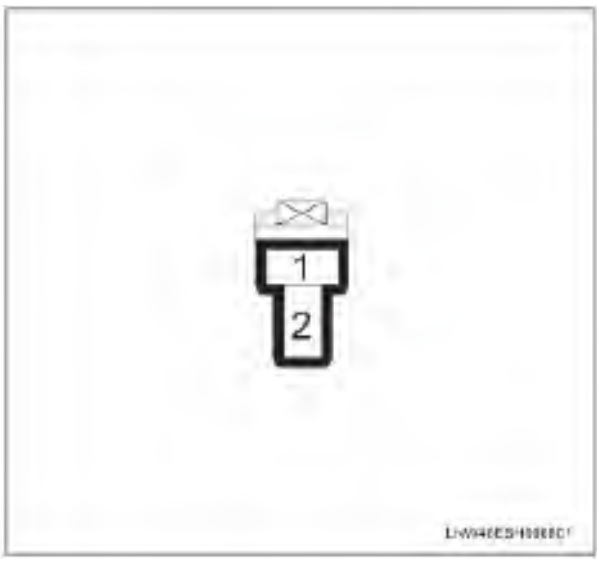


Joint SN		B-121
Joint color		Gray
Test adapter SN		J-35616-33
Port No.	Wire color	Port function
1	Orange	Sensor low input
2	Pink/green	Sensor signal
3	Blue/green	Sensor 5V power

Intake pressure sensor

Joint SN		E-24
Joint color		Black
Test adapter SN		J-35616-33
Port No.	Wire color	Port function
1	Yellow	Sensor signal
2	Blue	Sensor low input
3	Green	Sensor 5V power

Clutch switch

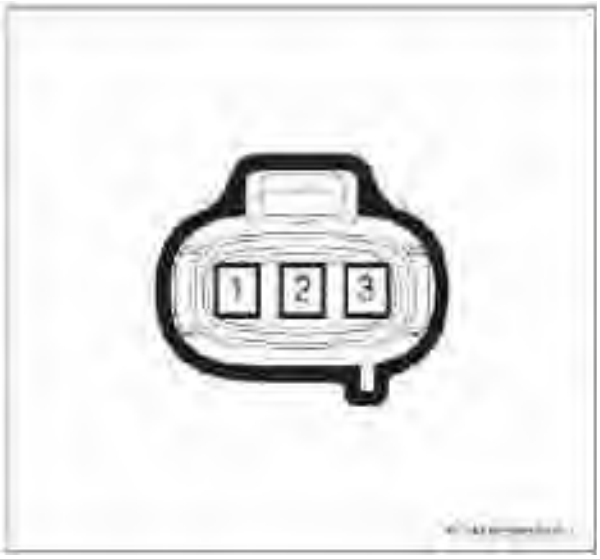


Joint SN		B-161
Joint color		White
Test adapter SN		J-35616-42
Port No.	Wire color	Port function
1	White /green	Ignition voltage supply
2	Yellow	Switch signal

Camshaft position (CMP) sensor

Joint SN		E-18
Joint color		Black
Test adapter SN		J-35616-33
Port No.	Wire color	Port function
1	White	Sensor signal
2	Black	Sensor low input
3	Red	Sensor 5V power

Crankshaft position (CKP) sensor



Joint SN		E-20
Joint color		Black
Test adapter SN		J-35616-33
Port No.	Wire color	Port function
1	Yellow	Sensor signal
2	Blue	Sensor low input
3	Green	Sensor 5V power

Cruise master switch

Joint SN		B-224
Joint color		Brown
Test adapter SN		J-35616-33
Port No.	Wire color	Port function
1	-	Not used
2	-	Not used
3	Black/Orange	Cruise master switch ignition voltage supply
4	Red/white	Cruise master switch ground
5	-	Not used
6	-	Not used
7	Black	Lighting lamp ground
8	Light green/red	Lighting lamp voltage supply
9	-	Not used
10	-	Not used

Data link connector (DLC)

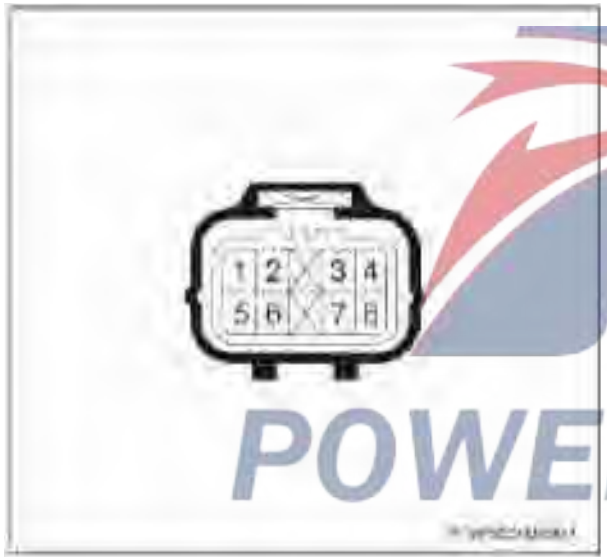
Joint SN		B-31
Joint color		Light blue
Test adapter SN		J-35616-2A
Port No.	Wire color	Port function
1	-	Not used
2	White/black	Secondary serial port data (electronic hydraulic control unit [ABS mode])
3	-	Not used
4	Black	Grounding
5	Black	Grounding
6	Blue/white	CAN high signal input (Euro IV)

Joint SN		B-31
Joint color		Light blue
Test adapter SN		J-35616-2A
Port No.	Wire color	Port function
7	Light blue	Keyword serial port data (ECM [non- Euro IV], SRS, TCM, HSA control unit)
8	-	Not used
9	-	Not used
10	-	Not used
11	-	Not used
12	Yellow	Diagnosis switch SRS, TCM, HSA control unit
13	White /green	Diagnosis switch (electronic hydraulic control unit [ABS mode])
14	Blue	CAN high signal input (Euro IV)
15	-	Not used
16	Red/yellow	Battery voltage

DPD switch

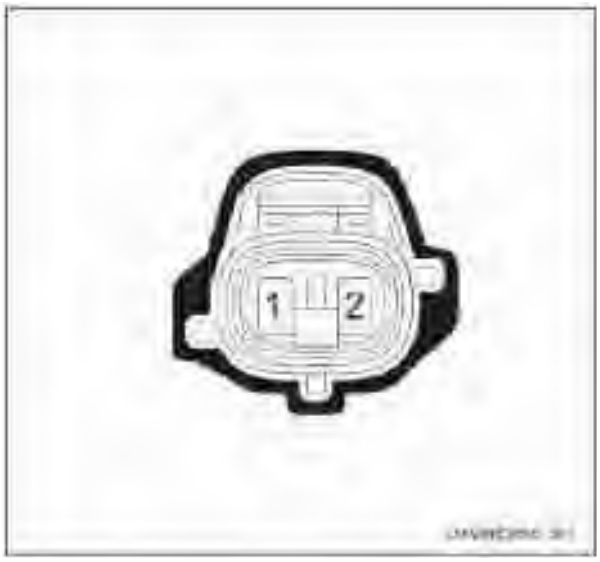
Joint SN		B-165
Joint color		Blue
Test adapter SN		J-35616-33
Port No.	Wire color	Port function
1	Black/Orange	DPD switch voltage supply
2	Blue/white	DPD Switch signal
3	-	Not used
4	-	Not used
5	-	Not used
6	-	Not used
7	Black	Lighting lamp ground
8	Light green/red	Lighting lamp voltage supply
9	-	Not used
10	-	Not used

EGR valve



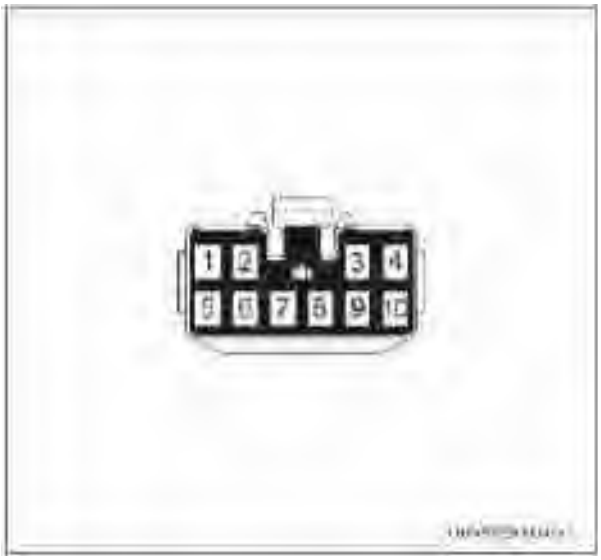
Joint SN		E-15
Joint color		Black
Test adapter SN		J-35616-64A
Port No.	Wire color	Port function
1	Light green	Position sensor 5V power
2	Light green/Black	Position sensor signal 3
3	Light blue	Position sensor signal 2
4	White/Orange	Position sensor signal 1
5	Yellow/Black	Position sensor low input
6	White	Motor control 3
7	Orange	Motor control 2
8	Black/Orange	Motor control 1

Engine coolant temperature (ECT) sensor



Joint SN		E-25
Joint color		Gray
Test adapter SN		J-35616-33
Port No.	Wire color	Port function
1	Yellow/Red	Sensor signal
2	Black	Sensor low input

Engine preheating switch



Joint SN		B-168
Joint color		Gray
Test adapter SN		J-35616-33
Port No.	Wire color	Port function
1	Black/Orange	Engine preheat switch voltage supply
2	Brown/Red	Engine warm-up switch signal
3	-	Not used
4	-	Not used
5	-	Not used
6	-	Not used
7	Black	Lighting lamp ground
8	Light green/red	Lighting lamp voltage supply
9	-	Not used
10	-	Not used

Exhaust brake solenoid valve

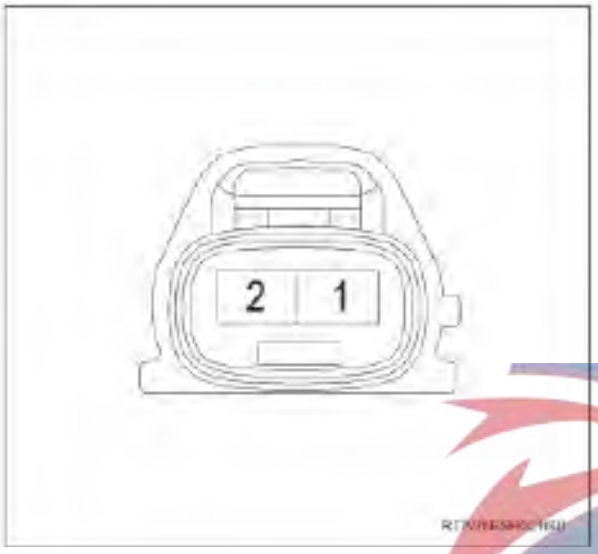
Joint SN		J-26
Joint color		Black
Test adapter SN		J-35616-33
Port No.	Wire color	Port function
1	Yellow/Red	Battery voltage supply
2	Black	Solenoid valve control

Differential pressure sensor

Joint SN		J-33
Joint color		Black
Test adapter SN		J-35616-33
Port No.	Wire color	Port function
1	Yellow/Black	Sensor low input

Joint SN		J-33
Joint color		Black
Test adapter SN		J-35616-33
Port No.	Wire color	Port function
2	Light green	Sensor signal
3	Blue/white	Sensor 5V power

Exhaust temperature sensor 1



Joint SN		J-34
Joint color		Light grey
Test adapter SN		J-35616-33
Port No.	Wire color	Port function
1	Black	Sensor low input
2	Yellow/Red	Sensor signal

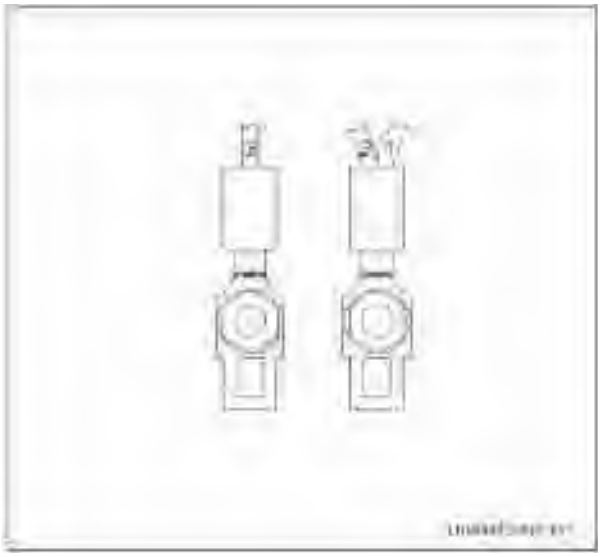
Exhaust temperature sensor 2

Joint SN		J-35
Joint color		Dark grey
Test adapter SN		J-35616-33
Port No.	Wire color	Port function
1	Black	Sensor low input
2	Red	Sensor signal

Exhaust control solenoid valve

Joint SN		J-59
Joint color		Black
Test adapter SN		J-35616-33
Port No.	Wire color	Port function
1	Yellow/Red	Battery voltage supply
2	Black	Solenoid valve ground

Injector No.1 cylinder

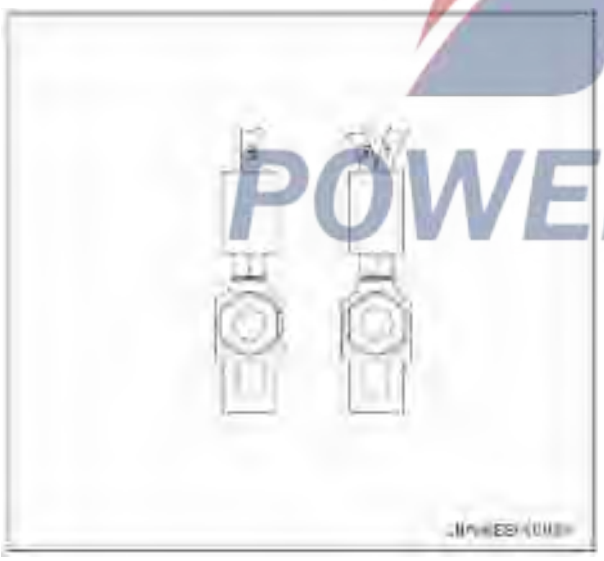


Joint SN		E-35
Port No.	Wire color	Port function
1	White	Injector power 1
2	White	Injector power 1
3	Green	Solenoid valve control

Injector No.3 cylinder

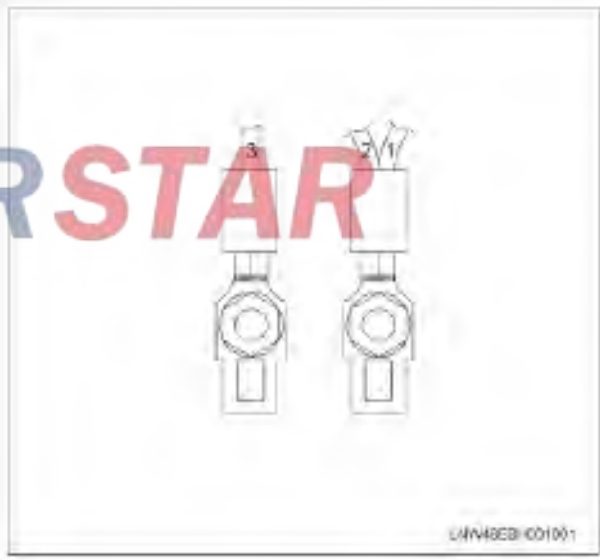
Joint SN		E-39
Port No.	Wire color	Port function
1	Red	Injector power 2
2	Red	Injector power 2
3	Yellow	Solenoid valve control

Injector No.2 cylinder



Joint SN		E-37
Port No.	Wire color	Port function
1	Red	Injector power 2
2	Red	Injector power 2
3	Blue	Solenoid valve control

Injector No.4 cylinder



Joint SN		E-41
Port No.	Wire color	Port function
1	White	Injector power 1
2	White	Injector power 1
3	Black	Solenoid valve control

Common rail pressure (FRP) sensor

Joint SN		E-17
Joint color		Gray
Test adapter SN		J-35616-33
Port No.	Wire color	Port function
1	White /Red	Control high voltage end (PWM)
2	Yellow/Red	Low voltage end

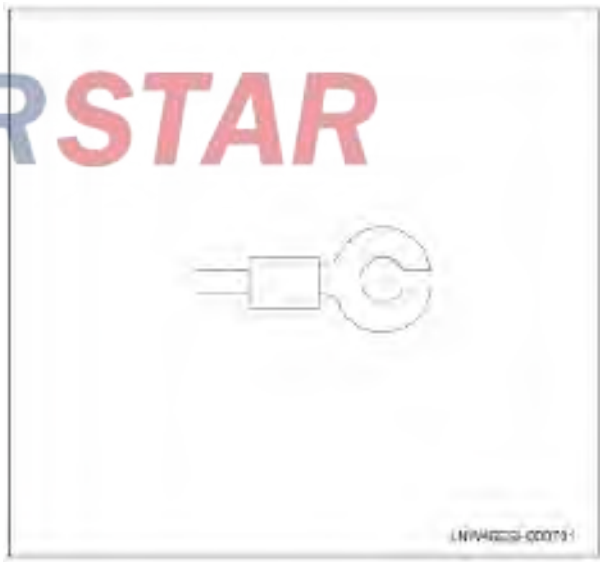
Fuel temperature (FT) sensor

Joint SN		E-22
Joint color		Gray
Test adapter SN		J-35616-33
Port No.	Wire color	Port function
1	Black	Sensor low input
2	Light green/white	Sensor signal

Common rail pressure (FRP) sensor

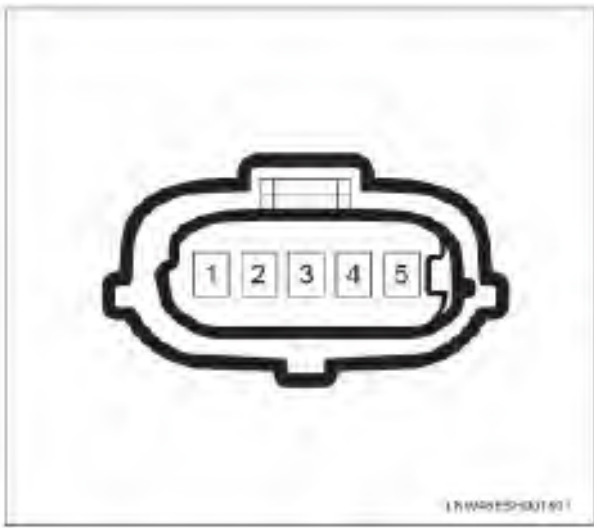
Joint SN		E-19
Joint color		Black
Test adapter SN		J-35616-33
Port No.	Wire color	Port function
1	Yellow/Black	Sensor low input
2	Blue/white	Sensor signal
3	Light green	Sensor 5V power

Glow plug



Joint SN		E-14
Joint color		Silvery
Port No.	Wire color	Port function
1	Black/Red	Power supply

Air flow (MAF)/ intake air temperature (IAT) sensor (Euro IV)

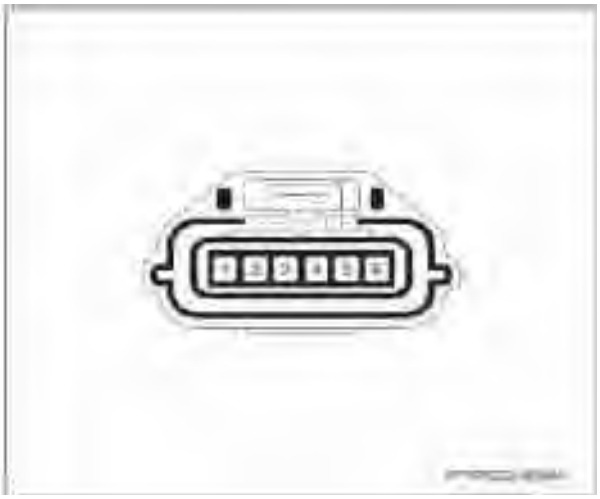


Joint SN		J-38
Joint color		Black
Test adapter SN		J-35616-64A
Port No.	Wire color	Port function
1	Yellow	Air flow sensor 12V power
2	Green	Air flow sensor low input
3	Blue	Air flow sensor signal
4	Red/Green	Intake temperature sensor signal
5	Black	Intake air temperature sensor low input

Intake air temperature (IAT) sensor (non- Euro IV)

Joint SN		J-217
Joint color		Gray
Test adapter SN		J-35616-33
Port No.	Wire color	Port function
1	Red/Green	Sensor signal
2	Black	Sensor low input

Intake throttle valve

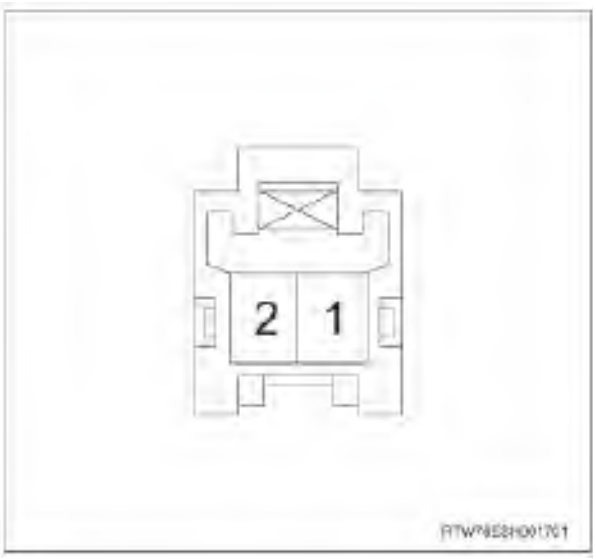


Joint SN		E-16
Joint color		Black
Test adapter SN		J-35616-64A
Port No.	Wire color	Port function
1	Green	Solenoid valve control low voltage end (PWM)
2	Black/green	Solenoid valve drive voltage
3	-	Not used
4	Black	Position sensor low input
5	Colorless/white	Position sensor signal
6	Yellow	Position sensor 5V power

Idling sensor

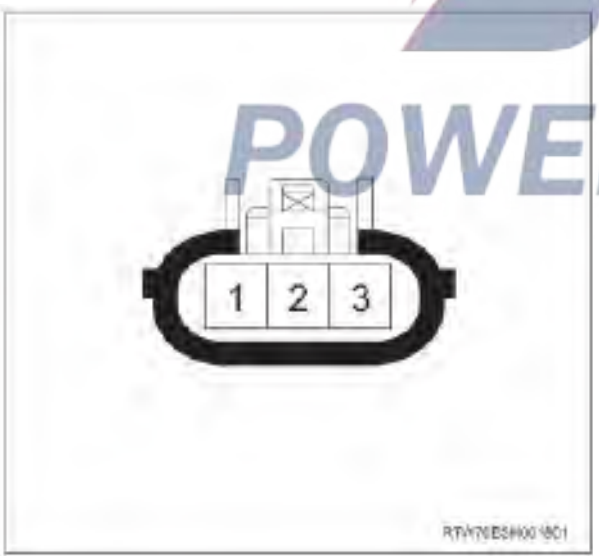
Joint SN		B-87
Joint color		White
Test adapter SN		J-35616-33
Port No.	Wire color	Port function
1	Blue	Sensor low input
2	Blue/yellow	Sensor signal
3	Blue	Sensor 5V power

PTO Switch



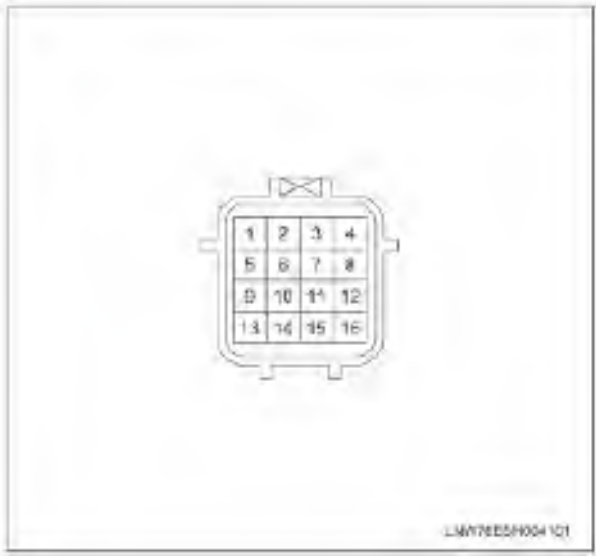
Joint SN		B-166
Joint color		White
Test adapter SN		J-35616-33
Port No.	Wire color	Port function
1	Blue/Orange	PTO Switch signal
2	Black	PTO switch ground

PTO throttle sensor



Joint SN		J-39
Joint color		Gray
Test adapter SN		J-35616-33
Port No.	Wire color	Port function
1	Red	Sensor 5V power
2	Brown	Sensor signal
3	Pink/black	Sensor low input

Variable turbocharger nozzle (VNT) control module

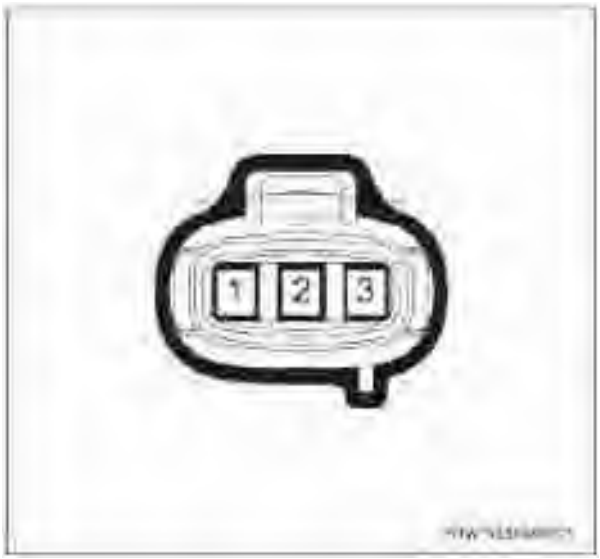


Joint SN		E-4
Joint color		Black
Test adapter SN		J-35616-64A
Port No.	Wire color	Port function
1	Blue/white	Position sensor signal 1
2	Brown	Position sensor signal 2
3	Blue	Position sensor signal 3
4	Black	Position sensor low input
5	Black	Position sensor shield ground
6	-	Not used
I	-	Not used
8	Red	Position sensor voltage
9	-	Not used
10	Yellow/Red	Variable turbocharger nozzle control motor 1
11	Yellow/Red	Variable turbocharger nozzle control motor 2
12	Blue/Red	Variable turbocharger nozzle control motor 3
13	Light green	Ignition voltage supply
14	Black	Grounding
15	Blue/white	CAN high signal input
16	Blue	CAN low signal input

Variable turbocharger nozzle (VNT) drive & sensor

Joint SN		E-2
Joint color		Brown
Test adapter SN		J-35616-33
Port No.	Wire color	Port function
1	Red	Position sensor
2	Blue	Position sensor signal 3
3	Brown	Position sensor signal 2
4	Blue/white	Position sensor signal 1
5	Black	Position sensor low input
6	Blue/Red	Motor control 2
7	Yellow/Red	Motor control 3
8	Yellow/Red	Motor control 1

Vehicle speed sensor



Joint SN		J-48
Joint color		Gray
Test adapter SN		J-35616-33
Port No.	Wire color	Port function
1	Black/yellow	Ignition voltage supply
2	Black	Sensor low input
3	Yellow/green	Sensor signal

How to diagnose the fault

System diagnostics method

The system diagnostics method is the unified approach for the repair of all electrical/electronic (E/E) systems. Different from the common vehicle faults, E/E system faults mostly occur in the following stages.

1. Fault early stage;

● The fault only appears once and the duration is very short. In most cases, the customer does not detect. In the early stage, the customer's question is uncertain and it is difficult to simulate the fault. However, EMC may have stored the fault.

=Old fault

2. Fault middle stage;

● The fault occurs intermittently and the duration is short. It can appear under certain conditions.

The customer's question (the fault contents) is definite while the causes are uncertain.

The vehicle maintenance man can simulat the fault through the fault occurrence conditions.

= intermittent fault (intermittent)

3. Fault current stage;

● The fault continuously occcurs and the customer's question is practical and definite.

The maintenance man can simulat the fault. However, the causes for the fault can be 2 or more.

= current fault

To solve the E/E system problems, the Diagnostic Flow Chart (DFC) is frequently used, which is the start of repair. The diagnostics program is as follows:

1. Confirm the question raised by the customer.

● To confirm the problem, the maintenance man should learn about the normal operating conditions of the system.

2. Carry out the preliminary check.

● Comprehensive visual check

● View the repair history again

● Check for abnormal noise and strange taste etc.

● Collect DTC and data with the fault diagnostic meter

3. Confirm the service bulletin.

4. Refer to "various symptom diagnosis" in the manual.

● In "various symptom diagonosis", the information related to the system not displayed in DTC is included. Ensure the system is in normal to supply the correct diagnosis method for the maintenance man.

5. Refer to the engine mechanical system related records.

DTC memorized

Refer to the specified DTC chart to repair.

No DTC

Select the symptom from the symptom diagnosis. Complete the repair according to the diagnosis procedures. The inspection can be made by referring to the functional diagnosis.

No relevant symptom

1. Analyze the question raised by the customer.

2. Establish the diagnosis plan.

3. Use the wiring diagram and operating principle.

Request the technical support if there is similar case in the repair history. Combine the tcchnical knowledge and available repair information.

Intermittent failure

The fault status not frequently occur is called the intermittent status. To solve the intermittent problems, take the following procedures.

1. Confirm DTC information and engine data.

2. Analyze the customer's problem symptom and conditions.

3. Confirm the circuits and electrical system composition parts with the check list or in other way.

When no fault detected

This state is the vehicle normal running state. Sometimes the state raised by the customer is the normal state. Compare the customer's problem and vehicle in normal operation and confirm. However, some faults are intermittent. Before returning the vehicle to the customer, check the problems again.

1. Investigate the problem again.

If the problem raised by the customer cannot be fully detected or confirmed, carry out the diagnosis again to confirm. The customer's problem can be the "intermittent fault" as above mentioned, or it can be the normal state.

2. Repair and confirm.

Locate the causes and then repair. Check whether the operation is normal and the symptom disappears. This program includes the road test or other checks and proving the fault is fixed in the following conditions.

● Check according to the conditions described by the customer and confirm.

● If DTC is detected, confirm the fault diagnostic meter data and reproduce the state when DTC occurs and check whether the fault is fixed.

Confirm the repair effect

After repairing the electrical control system, confirm the repair effect. If this operation is not well done, the engine malfunction warning lamp may illuminate on the way returning the vehicle to the customer in some cases. In particular, for the intermittent fault, simulate the fault conditions according to the customer's description to confirm.

Clause	Item	Purpose	Method
1	Check DTC	Confirm DTC indication after repair	Clear last DTC. Warm up in idling state and then increase the engine speed above 2000rpm for fast idling to ensure the test conditions.
2	Confirm the idling speed after engine warming-up	Check whether the idling control is normal	Check whether the engine idling speed ia about 530 ~ 550rpm after the engine warming-up with the A/C off. If detecting any fault, refer to the unsteady idling in Symptom diagonosis.
3	Confirm fault diagnostic meter data list	Compare the engine control and communication state with the standard state.	Check the fault diagnostic meter data list and use the representative value check list for inspection. Confirm the representative value of fault diagnostic meter data list.
4	Confirm the restart performance	Check whether the start control is normal.	After the engine warming-up, ensure the engine running is stable after the crankshaft operation for 5s.
5	Check the high electric wave transceiver	When installing the transceiver and other electric wave transport assembly, check whether there is electric wave interference released.	Check whether the engine idling speed changes by turning on and off the transceiver etc. If detecting fault, inform the customer of changing the electric wave transport assembly installation position and output.

Auxiliary confirmation of high electric wave transceiver: in this item, if detecting fault, inform the customer of confirming the following items.

● Install the antenna to the point far from the control unit, sensor and other electronic system as much as possible.

● Install the antenna connecting wire to the point at least 20cm from the control unit, sensor and other electronic system.

● Do not route the antenna connecting wire together with out circuits. In addition, the antenna connecting wire should be kept away from other circuits as far as possible.

● For the additional products, install them according to the respective installation instructions.

● Do not install the high power movable communication equipment.

Caution:

Confirm the maintenance program according to the following steps. If not, the unnecessary repair will be required.

● Study the fault diagnostic meter data related to DTC after the diagnosis and record.

● Clear DTC.

● Drive the vehicle and confirm the relevant fault diagnostic meter data.

Non - OEM parts

When check the OBD system, ensure to use the genuine components. If the market available sensors and switches are installed, it may result in the wrong diagnosis and illuminate the engine MIL.

The market available electrical units such as the radio equipment, stereo equipment and thief-proofer can generate EMI to the control system if not correctly installed. This will cause the sensor to send the wrong message and require more time for diagnosis. Please shut down or remove the market-purchased electrical power during the fault diagnosis.

Vehicle maintenance failure

The MIL will be on if the vehicle maintenance is not done in time. OBD will present the vehicle fault not detected before if the oil is not changed in time, the improper oil is used or the brake shoe wears.

Though the vehicle maintenance failure does not belong to the "fault independent of vehicle", the vehicle maintenance schedule should be strictly observed since OBD sensitivity is very high.

Engine compartment visual check

During the diagnosis, check the engine compartment carefully. This can solve some faults and skip the unnecessary procedures. Observe the following rules for the visual check.

● Check the air hoses for hole, scuffing, disconnection and wrong installation.

● Check the hoses hidden in other component parts and difficult to see.

● Check the harness connected to the engine for wrong connection, buring or abrasion, loose connection or contact with the sharp edge.

It is important to learn about the basic knowledge on tools:

If executing the diagnosis procedures without the basic knowledge, it will cause the wrong diagnosis or damage the component parts. Do not carry out the diagnosis unless possessing the basic knowledge. Learning about the fault diagnostic meter and other manual tools is helpful to the use of this maintenance instruction.

On-board diagnostic test

Confirm the fault diagnostic results according to the following content.

● The diagnostic test in last ignition cycle ends.

● The diagnostic test in current ignition cycle is acceptable.

● There is no fault identified in the diagnostic test. When arriving at the fault results through the diagnostic test, confirm according to the following contents and record the data.

● The diagnostic test in last ignition cycle ends.

● There is fault identified in the diagnostic test.

● There is fault in this ignition cycle.

● Operating state upon fault occurrence.

Ignition cycle

The ignition cycle is the cycle from the starter switch on to ECM off.

Running cycle

The running cycle is the cycle from the engine start to ECM off.

ECMOFF(OFF)

Shut down the starter switch, wait for 15s approximately and the ECM power will completely fall back and become inactive.

Comprehensive diagnosis of component parts through monitor

To ensure the normal operation of engine, the comprehensive diagnosis over the component parts is required.

Input parts:

To check the circuit for wire disconnection and numerical value exceeding range, check the input parts first. This includes the reasonableness check. The reasonableness check means the fault is indicated when the sensor signal is determined incorrect.

For the input parts, through it does not restrict to the following component, it includes the following sensors:

● Crankshaft position (CKP) sensor

● Camshaft position (CMP) sensor

● Engine coolant temperature (ECT) sensor

Output parts:

Check whether the output part response to the control unit command is correct. With the functional monitoring unavailable, if considering the composition part applicable, check the circuit for wire disconnection and numerical value exceeding the range. For the output parts, through it does not restrict to the following items, it includes the following:

● Suction control valve (common rail pressure regulator)

● Lamp and relay control

● Solenoid valve

General terms for self-diagnosis

As a noun, diagnosis means any vehicle test made according to the vehicle diagnosis method. Diagnosis is the test made on the system or composition part to check whether the system or composition part is normal. This includes the following:

● Engine speed

● Engine coolant temperature (ECT)

● Idling control

Executing diagnosis

Executing diagnosis not only means adjusting the diagnosis procedures and designating the preferred items, but also means recording and displaying the results. The main items include the following:

● Engine MIL on/off command

● DTC recording and clearing

● Fault diagnostic meter data record

● Current information in relation to diagnostic

Diagnostic information

Diagnostic information means the fault information of circuit or composition part detected according to the diagnostics program. If the vehicle assembly can exert the normal function and there are no several fault currently, plot the information into chart. In the specific control function, the durative self-diagnosis function is available. The diagnostic function is replenished by the diagnosis procedures recorded in the maintenance instruction. DTC system is the language to communicate the fault causes. When detecting fault, the control unit will generate DTC and the engine MIL will be on.

Malfunction Indicator Lamp (MIL)

MIL means the engine MIL and other warning lamps. In principle, if ECM and other electronic controls present fault and DTC is detected, MIL will be on.

Data Link Connector (DLC)

The equipment communicating with the control unit is data link connector (DLC). DLC is designed to connect the fault diagnostic meter. Below is the general use of fault diagnostic meter:

● Identify the memorized DTC

● Read the serial data

Confirm the vehicle repair effect

Through the OBD system diagnostics, the vehicle repair conditions can be effectively confirmed. After the repair, the maintenance man should implement the following procedures.

1. Analyze the diagnostic DTC or fault diagnostic meter data or both and then record.

2. Clear DTC.

3. Run the vehicle according to the fault diagnostic meter data.

4. Before the diagnostic test relevant to the specific DTC through the control unit, check the DTC condition information.

The above procedures are very important for confirming the repair effects through the OBD system diagnostics. Ignoring these procedures will result in the unnecessary repair.

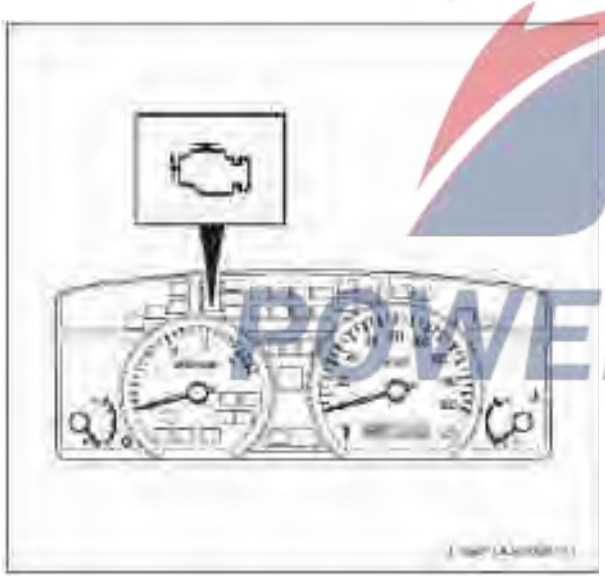
DTC

Each time when this starter switch is turned on, ECM will check all the lines and composition parts. If detecting system fault, ECM will store the fault in the memory and carry out the back-up control through the DTC. In addition, if the system fault impairing the driving occurs, the engine MIL in the dashboard will be on to remind the driver.

Read the DTC

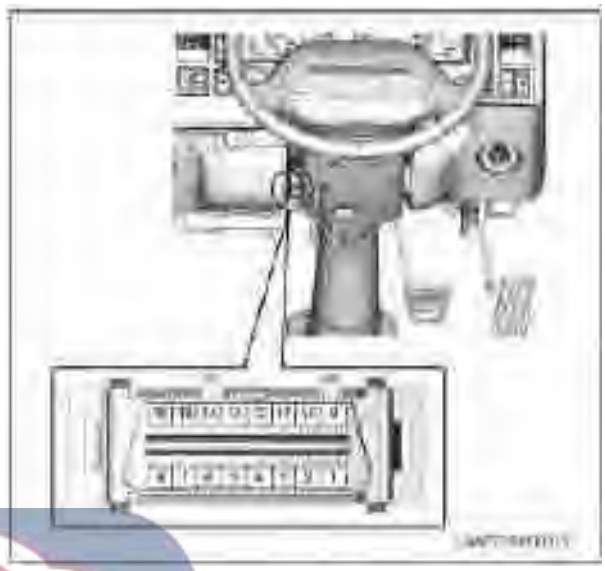
The new and old DTCs memorized in ECM can be displayed when DLC terminals are shorted and engine MIL blinks.

● Turn on the starter switch and ensure the engine MIL is on. (illuminating check).



● Turn on the starter switch and stop the engine.

● Short DLC No.4 pin and No.12 pin. DLC is the blue 16-pin terminal, located at the dashboard lower left to the driver.



● Read the blinking number of the engine MIL.

● Judge DTC contents according to the DTC list.

Read through operating the fault diagnostic meter if connected.

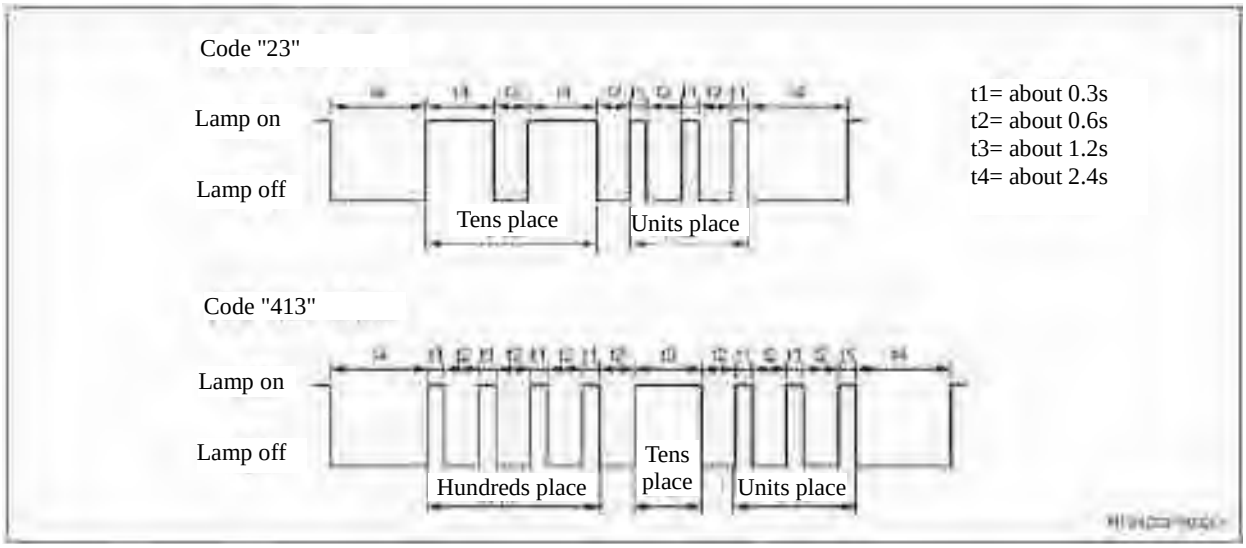
When DTC not memorized

Repeat the display of code "1" indicating the start.

DTC memorized

Display the memorized DTC 3 times. If more than 2 DTCs are memorized, these will be displayed 3 times in turn from the lower number one respectively.

After the codes are displayed once, repeat the display from code "23" again. This display will last as long as DLC terminals are shorted.



Display DTC according to the engine MIL blinking.

With the engine stopped, the current DTC and past DTC can be displayed.

With the engine running, only the current DTC can be displayed.

Clear DTC

In the case of system abnormal, ECM will record DTC. After the fault is fixed, DTC will not disappear. It should be cleared in a compulsory way according to the following requirements.

Clear it through the accelerator pedal

● Turn on the starter switch and maintain the engine stopped.

● Short DLC No.4 terminal and No.12 terminal.

When the above conditions are met, operate as follows to clear DTC.

1. Completely depress the accelerator pedal for 1s to 3s. (WOT)

2. Release the accelerator pedal for 1s to 3s.

3. Completely depress the accelerator pedal for 1s to 3s. (WOT)

4. Release the accelerator pedal for 1s to 3s.

5. Completely depress the accelerator pedal for 1s to 3s. (WOT)

6. Release the accelerator pedal for 1s to 3s.

Clear DTC through the fault diagnostic meter

DTC can be cleared through the clearing operation when the fault diagnostic meter is connected.

Fault diagnosis operation procedures through fault diagnostic meter

In the main menu, select "diagnosis" > "vehicle model year" > "N series wagon" > "engine" > " 4HK1-TC (C/rail)."

Menu overview

Below table shows the functions displayed in fault diagnostic meter software

F0: DTC
F0: Display DTC
F1: Clear DTC.
F1: Data display
F2: Quick check
F3: Actuator test
F0: Engine control system
F0: Fuel common rail pressure
F1: Stop injection
F2: Main injection time
F3: Stop pre - injection
F4: Drive compulsory injection
F1: Equipment control
F0: Preheating relay
F1: Exhaust brake
F2: Intake throttle valve
F3: Exhaust throttle valve
F4: EGR valve
F4: Turbocharger
F6: DPD forced retrieval
F7: DPD forced slow retrieval
F4: Programming
F0: Injector ID code
F0: Injector ID code
F1: ID code upload (Tech2)
F2: ID code upload (Tech2)
F3: Download of ID code (ECM)
F1: DPD recovery data resetting
F5: Special function
F0: Fuel pump adjustment resetting

Menu item

Through the selection menu, the DTC and data can be confirmed and the various tests and learning can be done.

DTC

Read, confirm and clear DTC.

● In this menu, access DTC chart when detecting DTC.

DTC is he language for the maintenance man to communicate with vehicle ECM.

In general, DTC falls into old DTC and new DTC.

● New DTC: means the failure (fault) occurs in this ignition cycle.

● Old DTC: means the failure (fault) occurs in last time or past ignition cycle.

● Multiple DTC: simultaneous display of several DTCs. This is called multiple DTC. Generally, it occurs when several failures (faults) occur. In addition, if several sensors or switches use the common power or ground and the power or ground presents wire disconnection or short circuit, the relevant sensor and switch DTC will display in multiple mode. In the case of multiple display, refer to the common power or ground wire disconnection and short circuit DTC chart to clear DTC information.

Data display

ECM displays the item's identification and control state. The value of displayed item is recorded in the reference value of fault diagnostic meter data list.

The current data can be displayed with this menu.

The displayed data is synchronous with the vehicle and equipment state.

● If the data display menu cannot be selected: there is fault between the ECM and DLC wiring.

● When the abnormal fixed value is displayed:

Example: the engine speed and sensor data display values are fixed value, different from the practical situation. At this point, shake the joint or harness. If the displayed value changes, it indicates the terminal contact is loose or the pins are out of order. Repair the harness disconnection and short circuit.

● When the value is displayed as symbol *:

This is the problem of fault diagnostic meter software.

Even if the symbol * is found in one place only, PCMCIA version should be updated.

Quick check

To locate the fault cause, carry out the quick check and analyze the data again.

● Quickly check the menu recording the data list and plot the chart.

● In this mode, reproduce and record the customer complaint conditions and find out the data abnormal.

● Decide the trigger type and record the data at the moment when DTC appears.

● Reproduce and record the data with the household power for programming

Programming

When replacing ECM, confirm the data for the replacement. Then upload the data to the fault diagnostic meter. After replacing ECM, download data to ECM from the fault diagnostic meter.

Actuator test

Check whether the testing object action and function are normal. Caution:、

Caution

Do not carry out any test if the vehicle and engine running state, engine coolant temperature, vehicle speed, switch and gear conditions are not met or any DTC is detected.

Plot chart

Plot the data obtained from the quick check.

Analyze the chart and locate the fault cause.

Chart plotting based on data

1. After the "data presentation" in the application menu is displayed, select "quick check" in the screen lower.

2. After a period of time, press " EXIT".

3. After the screen switches and "CONTINUE" appears at the screen lower, press "CONTINUE".

4. After the screen displays "PLOTTING", press "PLOTTING".

5. When the item selection screen appears, press the ENTER key conforming to item up to 3 times and select OK.

6. The chart displays on the screen.

Chart plotting based on trigging type

1. Select "data display" in the application menu.

2. After the screen shows the expression item, select it.

3. After the quick check option is displayed, decide the trigging type and select "record quick check" in the screen lower.

4. After the picture lower right corner (standby) is blinking, select the screen lower "trigging".

5. Confirm the trigging type.

6. After the screen switches and "CONTINUE" appears at the screen lower, press "CONTINUE".

7. After the screen displays "PLOTTING", press "PLOTTING".

8. When the item selection screen appears, press the ENTER key conforming to item up to 3 times and select OK.

9. The chart displays on the screen.

Method to reproduce recorded data chart

1. After powering on the fault diagnostic meter, select "quick check data" in the screen.

2. Confirm the title displaying the quick check data.

3. Select the quick check data title.

4. The screen displays the data. To view the chart, select "plotting" in the screen lower.

5. When the item selection screen appears, press the ENTER key conforming to item up to 3 times and select OK.

6. The chart displays on the screen.

Functional check overview

Inquiry	**Depending on the question raised by the customer, master the fault symptom and define the diagnosis points and sequence.**
Engine control system check	Check to locate the engine control system failure part (check sequence)
Fault diagnostic meter data list	Compare the normal vehicle data with the ongoing vehicle engine fault diagnostic meter data.
Fault diagnostic meter output	Check through the actuator test according to the command from the fault diagnostic meter.
Fault diagnostic meter start failure	Check the power circuit system without powering on the fault diagnostic meter (check sequence)
Fault diagnostic meter communication failure	Check the communication circuit system if the fault diagnostic meter communication fails (check sequence)
Communication with ECM abnormal	Check when the fault diagnostic meter cannot communicate with ECM (check sequence)
Starting system confirmation	Check if the engine cannot start while the starter runs (check sequence)
Engine MIL illuminating electrical circuit system confirmation	Check about the engine MIL failure after the starter switch turned on
Engine MIL off electrical circuit system confirmation	Check about the engine MIL on (maintaining lighting) after starter switch turned on
EGR control system inspection	Check upon the EGR relevant parts abnormal (check sequence)
Warming-up control system inspection	Check upon the warming-up control relevant parts abnormal (check sequence)
Inspection of QWS control system	Check upon QWS (warming-up system) relevant parts abnormal (check sequence)
Exhaust brake control system inspection	Check upon the exhaust brake control system relevant parts abnormal (check sequence)
DPD functional check	Check to locate the DPD system failure part (check sequence)

Inquiry

Inquiry

1. Learn about the customer's complaint with the engine control system inquiry form.

(Reference)

This is not the inquiry at discretion. It is to conjecture according to the fault phenomenon (the facts) and determine the fault category.

2. Judge the fault information correctly.

Basing on 5W1H, master the specific conditions.

Example: low air temperature, upon starting, normal time, near the engine, metal clash.

Key points for inquiry

● What: fault phenomenon

● When: which month which day and which hour; occurrence frequency

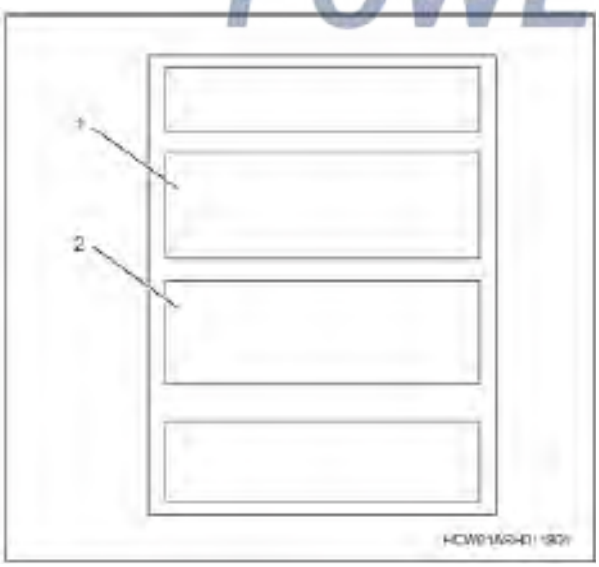
● Where: road conditions

● What driving state, running state and climate

● What results: feeling for phenomena

Engine control system inquiry form

In the repair shop, when receiving the vehicle, it is necessary to confirm the "fault symptom" and "data upon fault occurrence" with the customer according to the engine control system inquiry form.



Key

1. Fault symptom

2. Fault occurrence frequency and conditions

Causes:

1. Sometimes the fault symptom cannot be reproduced in the repair shop.

2. The customer's complaint is not always the vehicle fault condition.

3. It will waste the repair time if no fault condition communication with the person in charge of repair.

● The inquiry form can help the maintenance man for the vehicle diagnosis, repair and repair effect confirmation.

Engine control system inquiry form

Name of inspector_____

Name of customer		Model and model year	
Name of driver		Chassis number	
Vehicle warehousing date		Engine model	
		Engine number	
Registration number		Engine form	
		Odometer reading	

Fault symptom	□ Engine unable to start	□ Engine not start □ no start ignition □ no complete combustion
	□ Difficult starting	□ Engine start slow (over 6s) □ other_____
	□ Unsteady idling	□ Idle speed incorrect (specified speed after complete warming-up)□ idling abnormal □ high (rpm)□ low (rpm) □ idling unsteady (running disorder after complete warming-up) □ other____
	□ Driving performance poor	□ Surge □ knocking combustion □ black smoke, white smoke □ engine vibration □ Abnormal sound □ other_____
	□ Engine stalling	□ Engine stalling immediately after starting □ engine stalling when accelerator pedal released □ Engine stalling after A/C on □ engine stalling immediately after oil change □ Engine stalling upon drive gear engagement □ other_____
	□ Vibration upon idling	□ Engine transverse vibration, body longitudinal vibration (in principle, the engine is in longitudinal vibration while the body vibration is tiny)

Data upon fault occurrence		
Fault frequency		□ Frequently □ occasionally (several times; day/month) □ once only □ Others_____
Fault conditions	Weather	□ Fine day □ cloudy □ rainy day □ snow day □ other_____
	Air temperature	□30℃ above □20-30℃ □10-15℃ □ Below 0℃ (℃)
	Site	□ Express way □ suburban area □ urban area □ uphill □ downhill □ Pothole road □ other_____
	Engine temperature	□ Cold □ warming-up □ after warming-up □ coolant temperature ℃ □ oil temperature ℃
	Running conditions	□ Upon starting □ immediately after starting (min) □ idling □ high speed running □ During driving □ during constant velocity running □ upon acceleration □ upon deceleration □ A/C switch ON/OFF □ other_____

Engine MIL	□ On □ occasionally on □ off			
DTC	Old fault	□ □	New fault	□ □
Past fault history	□ (YY/MM/DD)_____			
	□ (YY/MM/DD)_____			

Engine control system check

Summary

The inspection of engine control system is to confirm the problem due to the malfunction of the engine control system. The system inspection is the origin of driving performance diagnostic. The system inspection enables the maintenance man to find the next reasonable procedure. The learning and correct use of diagnostic list can shorten the diagnosis time and avoid the replacement of normal component.

Test instruction

1. The communication failure to the fault diagnostic meter is because of the fault in the communication circuit between ECU and fault diagnostic meter.

2. When the DTC starting with U is detected, it means there is no communication to other ECU.

3. When detecting DTC, refer to DTC list to carry out diagnosis. If more than one DTC is detected, start diagnosis from the one with the minimum number unless otherwise specified.

● The diagnosis sequence should follow sensor DTC, solenoid valve DTC, actuator DTC, relay DTC. Start diagnosis from the minimum DTC unless otherwise specified in the diagnosis chart.

Considerations for engine control system inspection

Important:

● The diagnosis is not required if there is no driving performance problem and no requirement in other items.

● Do not clear DTC unless the diagnostics program requires.

● If the engine starting system is abnormal, refer to starting system in Chapter 4HK1 in IE electrical system.

● The battery should be fully charged.

● Ensure the battery cables are normal and correctly connected.

● Ensure ECM ground is firm and fixed to the correct position.

● Ensure ECM harness terminals are clean and connected correctly. Do not start the engine without connecting ECM harness terminals.

● Ensure ECM terminals are clean and connected correctly.

● Ensure the injector ID code is correctly written in.

● If there are fuel system DTC (P0087, P0088, P0089, P1093 or P1094) and other DTC, start from sensor DTC, solenoid valve DTC, actuator DTC and relay DTC.

Engine control system check

Step	Operating	Standard value	Yes	No
1	Connect the fault diagnostic meter. Can the fault diagnostic meter start?	—	Go to Step 2	Access "fault diagnostic meter starting failure"
2	Turn on the starter switch. Communicate with the following ECUs with the fault diagnostic meter. ● ECM Is the communication with any ECU normal?	—	Go to Step 3	Access "fault diagnostic meter communication failure"
3	1. Bring the starter switch to START position. Whether the engine start?	—	Go to Step 4	Go to Step 7

Step	Operating	Standard value	Yes	No
4	Bring the starter switch to START position. Whether the engine start?	—	Go to Step 5	Access to "starting system confirmation"
5	Turn on the starter switch. Check the engine MIL. Is the engine MIL on?	—	Go to Step 6	Access to "engine MIL illuminating electrical circuit system confirmation"
6	Short DLC No.4 terminal and No.12 terminal. Check the engine MIL. Is the engine MIL blinking?	—	Go to Step 8	Access to "engine MIL blinking electrical circuit system confirmation"
7	Is DTC P0633, P161B, or U0167 detected?	—	Enter the DTC diagnosis	Access to starting system in Chapter IE electrical system.
8	1. Check whether t the following ECU DTCs are detected with the fault diagnostic meter. ● ECM Is DTC detected?	—	Go to Step 9	Go to Step 13
9	Is the DTC starting with U or the DTC relevant to communication with other ECU detected?	—	Enter the DTC diagnosis	Go to Step 10
10	Is DTC P0601, DTC P0601, P0602, P0604, P0606, P060B, or P1621 detected by the ECM?	—	Enter the DTC diagnosis	Go to Step 11
11	Can DTC P0563 be detected through the ECM?	—	Enter the DTC diagnosis	Go to Step 12
12	Is DTC not included in step 9 to 11 detected?	—	Enter the DTC diagnosis	Go to Step 13

Step	Operating	Standard value	Yes	No
13	1. Check whether the following faults exist. Refer to symptom diagnosis in this chapter. ● Difficult starting ● Surge, unsteady idling or engine stalling ● High idling ● Emergency stop ● Abrupt change ● Underpower, insufficient injection or slow injection ● Detention, soft pedal feel ● Combustion noise ● Combustion economical efficiency low ● Black smoke from exhaust gas ● White exhaust gas Can the above faults be detected?	—	Normal system	Access to intermittent fault in the Symptom diagonosis

Fault diagnostic meter data list

The engine fault diagnostic meter data form lists the data relevant to the engine that can be detected by the fault diagnostic meter. Though the specific parameters are summarized in one data sheet, to group the related data after many times of recording, one data can be recorded in different sheets. Confirm the following items before using the engine fault diagnostic meter data sheet.

- "engine control system inspection" is done.
- OBD systems operation is normal.

The values of engine fault diagnostic meter under normal running can be compared with those of engine under diagnosis. The fault diagnostic meter data sheet indicates the normal running engine values.

- Do not use the fault diagnostic meter displaying the wrong data. Using the faulty fault diagnostic meter may result in the diagnosis error and unnecessary component replacement.

Ensure to use the following data described in this maintenance instruction only for the diagnosis.

Engine data

Fault diagnostic meter data display item	Unit	Reference value upon idling	Reference value upon 1700rpm
Operating conditions: engine idling or 1700rpm speed, engine coolant temperature 75 ~ 85℃, accelerator pedal stable, neutral gear or parking gear engaged, electrical system off, elevation 0m.			
Ignition voltage	V	22~30	22~30
Battery voltage	V	22~30	22~30
Target idle speed	RPM	575	575
Engine speed	RPM	About 600	About 1700
Accelerator pedal sensor 1	V	0.3~0.7	0.7~1.2
Accelerator pedal sensor 2	V	4.1~4.5	3.6~4.1
Accelerator pedal opening	%	0	12~20
Fuel common rail pressure	MPa	-5~5	-5~5
Rail pressure sensor	V	1.4	2.1
Rail pressure feedback mode		Feedback	Feedback
Rail pressure regulator drive load	%	30~45	30~40
Rail pressure regulator feedback current	mA	800~1000	800~1000
Engine coolant temperature sensor	V	0.4~0.6	0.4~0.6
Engine coolant temperature	℃	75~85	75~85
Intake temperature sensor	V	1.4~2.3	1.4~2.3
Intake temperature	℃	20~40	20~40
Fuel temperature sensor	V	0.8~2.3	0.8~2.3
Fuel temperature	℃	20~60	20~60
Atmospheric pressure sensor	V	2.3	2.3

Fault diagnostic meter data display item	Unit	Reference value upon idling	Reference value upon 1700rpm
Atmospheric pressure	kPa	About 100	<115
Intake pressure sensor	V	0.9~1.1	0.9~1.1
Intake pressure	kPa	101	106
Exhaust temperature sensor 1(before filter)	V	Variation	Variation
Exhaust temperature sensor 2(before oxidative catalyst)	V	Variation	Variation
Exhaust temperature 1 (before filter)	℃	60~200	60~200
Exhaust temperature 2(before oxidative catalyst)	℃	60~200	60~200
EGR position	%	-5~5	-5~5
EGR solenoid valve drive load 1	%	0	0
EGR position 1	On/Off	On or Off	On or Off
EGR position 2	On/Off	On or Off	On or Off
EGR position 3	On/Off	On or Off	On or Off
MAF (mass air flow) sensor (air flow)	V	>1.2	>1.2
MAF(Air flow)	g/cyl	>0.2	>0.2
MAF correction value		1	1
MAF average	g/sec	10.1	24.6
Air intake throttle sensor	V	>3.9	>3.9
Air intake throttle opening	%	-5~5	-5~5
Air intake throttle solenoid valve drive load	%	0	0
ASR control accelerator pedal opening	%	100	100
Speed	km/h	0	0
No.1 cylinder fuel correction volume	mm^3/st	-5.0~5.0	0
No.2 cylinder fuel correction volume	mm^3/st	-5.0~5.0	0
No.3 cylinder fuel correction volume	mm^3/st	-5.0~5.0	0
No.4 cylinder fuel correction volume	mm^3/st	-5.0~5.0	0
Engine running state	1/2/3	3	3
Engine preheating switch	On/Off	OFF	OFF
Ignition switch ON	On/Off	ON	ON
Ignition switch START	On/Off	OFF	OFF
Clutch pedal switch	On/Off	ON	ON
Neutral gear switch	On/Off	ON	ON

Fault diagnostic meter data display item	Unit	Reference value upon idling	Reference value upon 1700rpm
Parking brake switch	On/Off	ON	ON
Exhaust brake switch	On/Off	OFF	OFF
Exhaust brake vacuum drive command	On/Off	OFF	OFF
PTO Switch	On/Off	OFF	OFF
PTO remote control throttle	%	0	0
PTO remote control throttle sensor	V	0	0
Idle-up sensor	V	0.3~0.6	0.3~0.6
A/C signal	On/Off	OFF	OFF
Exhaust brake stop demand (ABS module)	Yes/No	No	No
Exhaust brake stop command (TCM)	Yes/No	No	No
Refrigerator switch	On/Off	OFF	OFF
Glow plug relay drive command	On/Off	OFF	OFF
Glow plug indicator lamp drive command	On/Off	OFF	OFF
Turbocharging control solenoid valve abnormal	No/bonding/short circuit	No	No
Turbocharging control postion abnormal	No/all low/all high	No	No
Differential pressure	kPa	Variation	Variation
DPD retrieval switch	On/Off	OFF	OFF
DPD mode		30	30
DPD distance state	0/1/2/3/4	0	0
DPD retrieval defective mode	Calculation	0	0
DPD retrieval incomplete state	Calculation	0	0
DPD cumulation state	0/1/2/3/4/5	0	0
Exhaust throttle valve status	On/Off	OFF	OFF

Immobilizer data sheet

Fault diagnostic meter data display item	Unit	Reference value
Immobilizer signal	Receive/not receive	Receive
Wrong immobilizer signal	Receive/not receive	Receive
Completed immobilizer function programming	Yes/No	Yes
Safety waiting time	OFF/(00:00:00)	OFF

Fault diagnostic meter data list contents

The display data is helpful to solving the exhaust and running problems. This display can be seen with the vehicle running. Carry out "engine control system inspection" first. Check whether the engine operation is normal through "system inspection".

Engine data

Ignition voltage

This data means the ignition voltage is detected in ECM ignition voltage circuit. When the starter switch is turned on, it will apply voltage to ECM.

Battery voltage

This data means the battery voltage is detected in ECM main relay voltage circuit. When the ECM main relay is powered on, it will apply voltage to ECM.

Target idle speed

This data display means the idle speed requied by ECM. ECM modifies the target idle speed according to the engine coolant temperature and other input.

Engine revolution

This data display means the ECM works out the crankshaft rotation speed according to the crankshaft position sensor or camshaft position sensor input.

Accelerator pedal sensor 1

This data display means the APP sensor assembly accelerator pedal position sensor 1 transmits voltage signal to ECM. APP sensor 1 will display the low voltage if the accelerator pedal is not depressed and high voltage if the accelerator pedal is depressed to the end.

Accelerator pedal sensor 2

This data display means the APP sensor assembly accelerator pedal position sensor 2 transmits voltage signal to ECM. APP sensor 2 will display the high voltage if the accelerator pedal is not depressed and low voltage if the accelerator pedal is depressed to the end.

Accelerator pedal opening

This data display means the ECM works out the accelerator pedal opening according to the accelerator pedal position sensor signal. As the accelerator pedal operated, the fault diagnostic meter will display the accelerator pedal opening as 0 ~ 100%.

Fuel common rail pressure

This data display means ECM obtains the ratio of actual fuel common rail pressure according to the common rail pressure sensor signal to the target fuel common rail pressure. The display will be 0% if there is no difference between the actual pressure and target pressure. This data can be used to judge the sensor accuracy and fuel pressure control problem.

Fuel Common Rail Pressure Sensor

This data display means the common rail pressure sensor transmits voltage signal to ECM. The common rail pressure sensor will display low voltage when the common rail pressure is low and high voltage when the common rail pressure is high.

Rail pressure feedback mode

This data display means the common rail pressure feedback mode towards ECM. Wait mode means the starter switch is in START position. Feedback mode means the engine is starting or running. Shutoff mode means the starter switch is in OFF position.

Rail pressure regulator drive load

This data display means the common rail pressure regulator controls the duty ratio signal basing on the sensor input to the ECM. When the common rail pressure regulator is on (increasing the common rail fuel feed), the fault diagnostic meter will display the low ratio. Contrarily, when the common rail pressure regulator is off (reducing common rail fuel feed), the fault diagnostic meter will display the high ratio.

Rail pressure regulator feedback current

This data display means the ECM detects the common rail pressure regulator control feedback current. When the common rail pressure regulator is on (increasing the common rail fuel feed), the fault diagnostic meter will display the low current. Contrarily, when the common rail pressure regulator is off (reducing common rail fuel feed), the fault diagnostic meter will display the high current .

Engine coolant temperature sensor

This data display means the engine coolant temperature (ECT) sensor transmits voltage signal to ECM. ECT sensor will display low voltage at high temperature and high voltage at low temperature.

Engine coolant temperature

This data display means the ECM works out the engine coolant temperature according to the engine coolant temperature (ECT) sensor signal. The fault diagnostic meter will display low temperature when ECT sensor signal voltage is high and high temperature when ECT sensor signal voltage is low.

Intake temperature sensor

This data display means the intake air temperature (IAT) sensor transmits voltage signal to ECM. IAT sensor will display low voltage at high temperature and high voltage at low temperature.

Intake temperature

This data display means ECM works out the intake air temperature according to the intake air temperature (IAT) sensor signal. The fault diagnostic meter will display low temperature when IAT sensor signal voltage is high and high temperature when FT sensor signal voltage is low.

Fuel temperature sensor

This data display means the fuel temperature (FT) sensor transmits voltage signal to ECM. TF sensor will display low voltage at high temperature and high voltage at low temperature.

Fuel temperature

This data display means ECM works out the fuel temperature according to the fuel temperature (FT) sensor signal. The fault diagnostic meter will display low temperature when FT sensor signal voltage is high and high temperature when FT sensor signal voltage is low.

Atmospheric pressure sensor

This data display means the barometric pressure sensor transmits voltage signal to ECM. The barometric pressure sensor will display low voltage at higher elevation and high voltage at low elevation.

Atmospheric pressure

This data display means ECM works out the barometric pressure according to the barometric pressure sensor signal. The fault diagnostic meter will display low voltage when the elevation is high.

Intake pressure sensor

This data display means the intake air pressure sensor transmits voltage signal to ECM. The intake air pressure sensor will display low voltage when the intake air pressure is low (the engine is idling or the load is low) and high voltage when the intake air pressure is high (the engine load is high).

Intake pressure

This data display means ECM works out the intake air pressure in the air inlet duct according to the intake air inlet sensor signal. The fault diagnostic meter will display the low intake air pressure when the engine load is low and high intake air pressure when the engine load is high. The actual intake air pressure is the measured value minus the barometric pressure.

Exhaust temperature sensor 1(before filter)

This data display means the exhaust temperature sensor 1 transmits voltage signal to ECM. The exhaust temperature sensor will display low voltage at high temperature and high voltage at low temperature.

Exhaust temperature sensor 2(before oxidative catalyst)

This data display means the exhaust temperature sensor 2 transmits voltage signal to ECM. The exhaust temperature sensor 2 will display low voltage at high temperature and high voltage at low temperature.

Exhaust temperature 1 (before filter)

This data display means ECM works out the exhaust temperature before the filter according to the exhaust temperature sensor 1 signal. The fault diagnostic meter will display low temperature when the exhaust temperature sensor 1 signal voltage is high and high temperature when the sensor 1 signal voltage is low.

Exhaust temperature 2(before oxidative catalyst)

This data display means ECM works out the exhaust temperature before the oxidative catalyst according to the exhaust temperature sensor 2 signal. The fault diagnostic meter will display low temperature when the exhaust temperature sensor 2 signal voltage is high and high temperature when the sensor 2 signal voltage is low.

EGR position

This data display means ECM obtains the ratio of actual EGR opening to the target EGR opening according to the EGR position sensor signal. It will display 0% if the actual opening and target opening difference is 1. This data can be used to judge the sensor accuracy and EGR control problem.

EGR solenoid valve drive load 1

This data display means the EGR controls the duty ratio signal basing on the sensor input to the ECM. The fault diagnostic meter will display low ratio when EGR is shut down. Contrarily, the fault diagnostic meter will display height ratio when EGR is turned on.

EGR position 1

This data display means the EGR position sensor 1 transmits signal to ECM. The fault diagnostic meter will display OFF when the position sensor is on and display ON when the position sensor is off.

EGR position 2

This data display means the EGR position sensor 2 transmits signal to ECM. The fault diagnostic meter will display OFF when the position sensor is on and display ON when the position sensor is off.

EGR position 3

This data display means the EGR position sensor 3 transmits signal to ECM. The fault diagnostic meter will display OFF when the position sensor is on and display ON when the position sensor is off.

MAF sensor (air flow)

This data display means the mass air flow (MAF) sensor transmits voltage signal to ECM. The MAF sensor will display low voltage when the engine speed is low and high voltage when the engine speed is high.

MAF (Air flow)

This data display means the ECM works out the air flow inside the engine according to the mass air flow (MAF) sensor signal. The fault diagnostic meter will display high value when the engine speed is high and low value when the engine speed is low.

MAF correction value

This data display means the correction value of current input MAF.

MAF average

This data display means the ECM works out the average air flow per second according to the mass air flow (MAF) sensor signal. The fault diagnostic meter will display high value when the engine speed is high and low value when the engine speed is low.

Air intake throttle sensor

This data display means the air intake throttle position sensor transmits voltage signal to ECM. The air intake throttle position sensor will display the low voltage when the air intake throttle is shut down. It will display high voltage when the air intake throttle opens.

Air intake throttle opening

This data display means the data in the form of ratio of actual air intake throttle opening to target air intake throttle opening calculated by ECM according to the signal from the air intake throttle position sensor. It will display 0% if the actual opening and target opening are the same. This is used to judge the sensor accuracy and air intake throttle control problem.

Air intake throttle solenoid valve drive load

This data display means the air intake throttle solenoid valve control duty ratio according to the sensor input signal to ECM. The fault diagnostic meter will display low ratio when the air intake throttle solenoid valve opens. The fault diagnostic meter will display high ratio when the air intake throttle solenoid valve close.

ASR control accelerator pedal opening

This data display means the EHCU works out the accelerator pedal control opening when ASR system is working. The fault diagnostic meter will display 100% when ECM does not require to reduce the fuel injection. To reduce the driving wheel revolution, it will display low ratio when ECM reduces the fuel injection.

Speed

This data display means ECM works out the vehicle speed according to the vehicle speed sensor signal. The fault diagnostic meter will display low value when the vehicle speed is low and high value when the vehicle speed is high.

No.1 to No.4 cylinder fuel correction volume

This data display means the ECM works out the fuel correction volume of every cylinder when the engine speed is low. The fault diagnostic meter will display negative value when the fuel volume reduces. The fault diagnostic meter will display positive value when the fuel volume increases. The cylinder fuel correction will be too high or too low if the injector is abnormal, the cylinder sizes change or the injector ID code program is wrong.

Engine running state

This data display means the engine running state. 0 means the stop state. 1 means the standby state. 2 means the start rotating state. 3 means in running.

Engine preheating switch

This data display means the ECM receives warming-up switch input state. ON means the warming-up switch is pressed and allow the exhaust brake solenoid valve and air intake throttle to be powered on depending on the engine state.

Ignition switch START

This data display means the ECM receives starter switch input state. The fault diagnostic meter will display ON when the starter switch is in START position.

Ignition switch ON

This data display means the ECM receives starter switch input state. The fault diagnostic meter will display ON when the unlocker switch is in ON position.

Clutch pedal switch

This data display means the ECM receives the clutch pedal switch input state. The fault diagnostic meter will display ON when the clutch pedal is depressed.

Neutral gear switch

This data display means the ECM receives the neutral gear switch input state. The fault diagnostic meter will display ON when the gear is in parking or neutral position.

Parking brake switch

This data display means the ECM receives the parking brake switch input state. The fault diagnostic meter will display ON when the parking brake lever is applied.

Exhaust brake switch

This data display means the ECM receives the exhaust brake switch input state. ON means the exhaust brake switch is pressed and allow the exhaust brake solenoid valve and air intake throttle to be powered on depending on the driving conditions. OFF means the exhaust brake switch is not pressed and the exhaust brake does not work.

Exhaust brake valve drive command

This data display means the current setting state of exhaust brake solenoid valve control circuit. ON means the exhaust brake solenoid valve is working according to the ECM command to supply the negative pressure to the exhaust brake valve.

PTO Switch

This data display means the ECM receives the PTO switch input state. The fault diagnostic meter will display ON when the PTO switch is operated through the joystick or button.

PTO remote control throttle

This data display means ECM works out the PTO throttle sensor angle according to the PTO throttle sensor signal. PTO throttle sensor angle is displayed as low ratio when the throttle sensor does not work. It will be displayed as high ratio when the throttle sensor is working.

PTO remote control throttle sensor

This data display means the PTO throttle sensor transmits voltage signal transmit to ECM. PTO throttle sensor is displayed as low voltage when the throttle sensor does not work. It will be displayed as high voltage when the throttle sensor is working.

Idle-up sensor

This data display means the idling lift sensor transmits voltage signal transmit to ECM. The idling lift sensor will display low voltage when the idling control knob is counterclockwise rotated. It will display high voltage when the idling control knob is clockwise rotated.

A/C signal

This data display means the A/C compressor connection state. ON means ECM receives the signal to turn on A/C compressor. OFF means ECM does not receive the signal to turn on A/C compressor.

Exhaust brake stop demand (ABS module)

This data display means the ECM receives the exhaust brake switch cut off demand from Aehcu. YES means EHCU commands exhaust brake to stop.

Exhaust brake stop demand (TCM)

This data display means the ECM receives the exhaust brake switch cut off demand from TCM. YES means TCM commands exhaust brake to stop.

Refrigerator switch

This data display means the cooling unit compressor connection state. ON means ECM receives the signal to turn on cooling unit compressor. OFF means ECM does not receive the signal to turn on cooling unit compressor.

Glow plug relay drive command

This data display means the warming-up relay controls the circuit command. The fault diagnostic meter displays ON or OFF. ON means the warming-up relay supplies voltage to the glow plug and ECM drives the warming-up relay to control the circuit.

Glow plug indicator lamp drive command

This data display means the warming-up indicator lamp control circuit command. The warming-up indicator lamp is ON when the warming-up command is ON. The warming-up indicator lamp is OFF when the warming-up command is OFF.

Differential pressure

This data display means ECM works out the exhaust differential pressure according to the DPD differential pressure sensor signal. The fault diagnostic meter will display low exhaust differential pressure when PM cumulant is low. The fault diagnostic meter will display high exhaust differential pressure when PM cumulant is high.

Turbocharging control solenoid valve abnormal

This data display means the VGS actuator operation is abnormal and the circuit is abnormal. The fault diagnostic meter will display bonding or short circuit if the VGS actuator is abnormal. It will display NO if nothing abnormal.

Turbocharging control postion abnormal

This data display means the VGS actuator position signal is abnormal and the circuit is abnormal. The fault diagnostic meter will display all low or all high if the VGS actuator postion is abnormal. It will display NO if nothing abnormal.

DPD retrieval switch

This data display means the ECM receives the DPD retrieval switch input state. ON means the DPD switch is pressed and allo the engine status to access to retrieval program.

DPD mode

This data display means the retrieval state or operating requirements. 1 and 50 mean DTC is set and DPD retrieval is disabled. It will display 30 if the engine manipulate is normal.

DPD distance state

This data display means the driving distance from DPD retrieval, falling into 0~4 stages. 0 and 1 mean the calculated driving distance is short.

DPD retrieval defective mode

This data display means the DPD retrieval purification failure number.

DPD retrieval incomplete state

This data display means the number of DPD retrieval not completed within certain time.

DPD cumulation state

This data display means the exhaust differential pressure 0 ~ 5 stages. 0, 1 and 2 mean the exhaust differential pressure is low.

Exhaust throttle valve status

This data display means the exhaust throttle solenoid valve control circuit command state. ON means the ECM commands the exhaust throttle solenoid valve to work and supply the negative pressure to the toexhaust throttle valve.

Immobilizer data sheet

Immobilizer signal

This data display means the communication state to ICU. "receive" means communication to ICU in process. "not receive" means no communication to ICU in process.

Wrong immobilizer signal

This data display means the ICU communication signal succeeding or not. "receive " means receiving the correct safety information from ICU. "no receive" means the information from ICU invalid.

Completed immobilizer function programming

This data display means the ICU programming condition. Yes means the correct safety information is programmed into ICU. NO means the correct safety information is not programmed into ICU.

Safety waiting time

This data display means the length of ICU safe waiting time. OFF means not in safe waiting time state. The display time means in safe waiting time state. In the safe waiting time state, no safety code input will be received until the waiting time ends. The input of incorrect safety code will increase the waiting time. This data display does not count down. The fixed time will be displayed until the waiting time ends. Maintain the starter switch in ON position while waiting.

Fault diagnostic meter output

Actuator test	Explanation
Fuel common rail pressure	This trst is to confirm the common rail pressure variation when the common rail pressure indication is 30MPa to 80MPa. If the common rail pressure difference is high, it means the injection pump, common rail pressure regulator, pressure limiting valve or other fuel tubing is abnormal.
Injector stop injection	This test is to confirm whether the pre-injection is done when the indication is on or off. With the indication off, if the engine speed and vibration do not change, it means the injector is abnormal.
Main injection time	This test is to check whether the injection time changes when the main injection time is "delay angle" or "advance angle".
Pre-injection stop	This test is to check whether the "pre-injection" is about 0mm3/st with the indication on or off. With the indication off, if the engine sound does not change, it means the injector is abnormal.
Compulsory drive injector	This test is to check whether the injector operation is normal with the indication on. With the indication on, if no click is heard (the solenoid valve working sound), while the abnormal sound is heard, it means the injector is abnormal.
Preheating relay	This test is to check whether the warming-up relay operation is normal with the indication on. With the indication on, if not powered on, it means the circuit or warming-up relay is abnormal.
Exhaust brake	This test is to check whether the exhaust brake solenoid valve operation is normal with the indication on. With the indication on, if not powered on, it means the circuit or solenoid valve is abnormal.
Intake throttle valve	This test is to check whether the air intake throttle works according to the command. If the opening difference is high, it means the foreign matter or excessive deposit prevents the valve motion and causes the valve abnormal.
Exhaust throttle valve	This test is to check whether the exhaust throttle solenoid valve operation is normal with the indication on. With the indication on, if not powered on, it means the circuit or solenoid valve is abnormal.
EGR	This test is to check whether the EGR valve opens and closes according to the command. If the position difference is high, it means the foreign matter or excessive deposit prevents the valve motion and causes the valve abnormal.
Turbocharger	This test is to check whether the turbocharger nozzle blade control actuator works with the indication on. With the indication on, if the actuator does not work, it means there is foreign matter, excessive dirt, CAN communication circuit, VGS control unit circuit, VGS actuator circuit abnormal, configuration failure or the solenoid valve and actuator failure prevents the actuator working.
DPD compulsory retrieval	When checking the filter clogging, the fault diagnostic meter will command the compulsory retrieval of DPD. Refer to spot check of DPD functions.
DPD compulsory slow retrieval	If the DPD retrieval is unavailable with the DPD switch, enable the DPD compulsory reactivation with the fault diagnostic meter command.

Special functions	Explanation
Resetting of fuel pump adjustment	This function is to reset the injection pump adjusting value. **Important:** **Ensure to operate according to the "injection pump relearning flow" when replacing the injection pump or engine and install other vehicle ECM. Refer to the injection pump learning in this chapter.**

Fault diagnostic meter start failure

Circuit instructions

The data link connector (DLC) is a 16-terminal connector. The terminal shape and arrangement should conform to the standard and meet the following conditions.

● Terminal 16 fault diagnostic meter power battery is positive voltage.

● Terminal 4 is the fault diagnostic meter power ground.

● Terminal 5 is the common signal ground.

The fault diagnostic meter power is turned on when the starter switch is shut down. However, the communication is active only when the starter switch is on.

Circuit diagram: refer to engine in 9D wiring diagram.

Connector pin arrangement: Refer to the connector list in chapter 9D Wiring Diagrams.

Circuit/system test (fault diagnostic meter start failure)

Step	Operating	Standard value	Yes	No
1	Important: before using this flow chart, check whether the fault diagnostic meter and 24V adapter can normally work in other vehicles. 1. Starter switch is shut down. 2. Check the dashboard central F3 dome lamp and radio (15A) fuse (F3). Is F3 dome lamp and radio (15A) fuse blown?	—	Go to step 2	Go to step 3
2	Replace the dome lamp and radio (15A) fuse (F3). If the fuse blown, repair the circuit short to the ground in the circuit powered by F3 dome lamp and radio (15A) fuse or replace the short circuited auxiliary parts. Is the repair finished?	—	Go to step 7	–
3	1. Check DLC for deformation, loose contact or terminal falling off. 2. Repair the terminal as required. Is the repair finished after the failure detected?	—	Go to step 7	Go to step 4
4	Connect the test lamp between the DLC +B circuit (B31 16 pin) and ground. Is the test lamp on?	—	Go to step 6	Go to step 5
5	Repair the open circuit of battery power circuit to DLC. Is the repair finished?	—	Go to step 7	—

Step	Operating	Standard value	Yes	No
6	1. Test the ground circuit of DLC (B31 pin 4 and pin 5) for open circuit or high resistance. 2. Repair the circuit, clean and tighten the ground point as needed. Is the repair finished after the failure detected?	—	Go to step 7	Go to intermittent fault in symptom diagonosis
7	1. Connect the fault diagnostic meter to DLC. 2. Turn on the fault diagnostic meter power. Is the fault diagnostic meter power ON5?	—	Normal system	Go to step 1

Fault diagnostic meter communication failure (reference)

Circuit instructions

ECM, TCM " Smoother-Ex", immobilizer control unit (ICU), BCM, HSA control unit and SRS control unit use Keyword2000 serial data communication protocol to communicate with the fault diagnostic meter. HSA control module uses Keyword 82 serial data for communication. Corresponding to this, ECM, TCM, electronic hydraulic control unit (EHCU) and BCM communicate mutually through CAN communication. CAN communicate is not used between the fault diagnostic meters and it is common for the modules.

Helper diagnosis

If any of the following conditions occur, the Keyword serial data communication failure will occur between the ECM or fault diagnostic meter and any ECU.

- Keyword serial data circuit open circuit
- Keyword serial data circuit ground short circuit
- Keyword serial data circuit power short circuit
- Keyword serial data circuit ECU or terminal inside power or ground short circuit

Circuit diagram: refer to engine in 9D wiring diagram.

Connector pin arrangement: Refer to the connector list in chapter 9D Wiring Diagrams.

Circuit/system test (fault diagnostic meter communication failure)

Step	Operating	Standard value	Yes	No
1	● Go to "engine control system inspection".	—	Go to step 2	Go to "engine control system inspection".
2	1. Connect the fault diagnostic meter. 2. Set the starter switch to ON without starting the engine. 3. Communicate with the following system ECUs with the fault diagnostic meter. ● ECM ● Transmission control module (TCM) ● Immobilizer control unit (ICU) ● Body control module (BCM) ● HSA control unit ● SRS control unit. Does the fault diagnostic meter communicate with one ECU?	—	Go to step 3	Go to step 6
3	Does the fault diagnostic meter communicate with ECM?	—	Go to step 4	Go to "communication with ECM failure"

Step	Operating	Standard value	Yes	No
4	1. Check whether it communicates with the following system ECU. ● TCM ● ICU ● BCM ● HSA control unit ● SRS control unit. Is there ECU failing to communicate with fault diagnostic meter?	—	Go to the maintenance instruction of this system	Go to step 5
5	If there is intermittent short circuit to the ground or power, check the Keyword serial data circuit. Alternatively, if there is intermittent open circuit inside the circuit (no ECU communication), test the Keyword serial data circuit. Is the repair finished after the failure detected?	—	Go to step 20	Normal system
6	1. Check DLC (B13 pin 7) for intermittent fault, loose contact and corrosion. 2. Repair the connection parts as required. Is the repair finished after the failure detected?	—	Go to step 20	Go to step 7
7	1. Starter switch is shut down. 2. Remove the ECM harness connector. 3. Set the starter switch to ON without starting the engine. 4. Communicate with other ECU except ECM. Can fault diagnostic meter communicate with ECU except ECM?	—	Go to step 14	Go to step 8
8	Note: go to Step 9 if Smoother-Ex transmission unavailable. 1. Starter switch is shut down. 2. Connect all the removed ECM harness joints again. 3. Remove the TCM harness connector. 4. Set the starter switch to ON without starting the engine. 5. Communicate with other ECM except TCM. Can fault diagnostic meter communicate with ECU except TCM?	—	Go to step 15	Go to step 9

Step	Operating	Standard value	Yes	No
9	1. Starter switch is shut down. 2. Connect ECM and TCM harness terminals again if removed. 3. Remove the ICU harness connector. 4. Set the starter switch to ON without starting the engine. 5. Communicate with ECU except ICU. Can fault diagnostic meter communicate with ECU except ICU?	—	Go to step 16	Go to step 10
10	1. Starter switch is shut down. 2. Connect all the removed ICU harness joints again. 3. Remove the BCM harness connector. 4. Set the starter switch to ON without starting the engine. 5. Communicate with other ECU except BCM. Can fault diagnostic meter communicate with ECU except BCM?	—	Go to step 17	Go to step 11
11	Note: go to Step 12 if HSA system unavailable. 1. Starter switch is shut down. 2. Connect BCM harness terminals again if removed. 3. Take down the harness terminal of HSA control unit. 4. Set the starter switch to ON without starting the engine. 5. Communicate with other ECU except HSA control unit. Can fault diagnostic meter communicate with ECU except HSA ECU?	—	Go to step 18	Go to step 12

Step	Operating	Standard value	Yes	No
12	Go to Step 13 if airbag system unavailable. 1. Starter switch is shut down. 2. Connect BCM, HAS ECU harness terminals again if removed. 3. Take down the harness terminal of SRS control unit. 4. Set the starter switch to ON without starting the engine. 5. Communicate with ECU except SRS ECU. Can fault diagnostic meter communicate with ECU except SRS ECU?	—	Go to step 19	Go to step 13
13	Repair the open circuit between DLC and ECM, TCM, HSA, SRS control modules and the ground or voltage short circuit of Keyword serial data circuit. Is the repair finished?	—	Go to step 20	—
14	I. Replace ECM. **Important:** **After replace ECM, ensure to carry out programming and learning.** Is the replacement finished?	—	Go to step 20	—
15	1. Replace the TCM. **Important:** **After replaceTCM, ensure to carry out programming and learning.** Is the replacement finished?	—	Go to step 20	—
16	1. Replace the TCM. **Important:** **Ensure to carry out programming after replacing the ICU.** Is the replacement finished?	—	Go to step 20	—
17	1. Replace BCM. **Important:** **Ensure to carry out programming after replacing the BCM.** Is the replacement finished?	—	Go to step 20	—

Step	Operating	Standard value	Yes	No
18	1. Replace the HSA control unit. **Important:** **After replace HSA control unit, ensure to carry out programming and learning.** Is the replacement finished?	—	Go to step 20	—
19	Replace the SRS control unit. Is the replacement finished?	—	Go to step 20	—
20	Communicate with ECM, TCM, ICU, BCM, HSA and SRS. Does the fault diagnostic meter communicate with all ECUs?	—	Normal system	Go to step 2

Communication failure with ECM (reference)

Circuit instructions

ECM, TCM " Smoother-Ex", immobilizer control unit (ICU), BCM, HSA control unit and SRS control unit use Keyword2000 serial data communication protocol to communicate with the fault diagnostic meter. HSA control module uses Keyword 82 serial data for communication. Corresponding to this, ECM, TCM, electronic hydraulic control unit (EHCU) and BCM communicate mutually through CAN communication. CAN communicate is not used between the fault diagnostic meters and it is common for the modules.

Circuit diagram: refer to engine in 9D wiring diagram.

Connector pin arrangement: Refer to the connector list in chapter 9D Wiring Diagrams.

Circuit/system test (ECM communication failure)

Step	Operating	Standard value	Yes	No
1	Go to "engine control system inspection".	—	Go to step 2	Go to "engine control system inspection".
2	Communicate with ECM. Can the fault diagnostic meter communicate with ECM?	—	Go to "intermittent fault"	Go to step 3
3	1. Check the ECM harness terminal for intermittent fault, loose contact and corrosion. 2. Repair the connection parts as required. Is the repair finished after the abnormal detected?	—	Go to step 15	Go to step 4
4	1. Check the ECM (30A) slow blow fuse, ECM bus (10A) fuse (F33) and ECM, TCM, Smoother (10A) fuse (F20). Replace them if wire disconnection is detected and check again. If the fuse is not blown, repair the ground short circuit of every circuit powered by this fuse. 2. Starter switch is shut down. 3. Remove the ECM harness connector. 4. Set the starter switch to ON without starting the engine. 5. Connect the test lamp to the ground and check the voltage ECM (J14 pin 24) ignition voltage to the circuit. Is the test lamp on?	—	Go to step 6	Go to step 5

Step	Operating	Standard value	Yes	No
5	Repair the wire disconnection of ignition voltage circuit to ECM. Is the repair finished?	—	Go to step 15	_
6	1. Starter switch is shut down. 2. Remove the ECM harness connector. 3. Check the ECM harness terminal (J14 pin 38) for intermittent fault, loose contact and corrosion. 4. Test the Keyword serial data circuit between the ECM (J14 pin 38) and DLC (B31 pin7) to check for wire disconnection or high resistance. 5. Connect or repair the circuit as required. Is the repair finished after the abnormal detected?	—	Go to step 15	Go to step 7
7	1. Check the ECM ground location for corrode and installation failure. **Mark:** **The wire disconnection of ECM ground circuit is not the cause for the communication failure.** 2. Clean the ground location or install again as needed. Is the repair finished after the abnormal detected?	—	Go to step 15	Go to step 8
8	1. Starter switch is shut down. 2. Connect the ECM harness terminal again if not connected. 3. Replace the ECM main relay with warming-up relay or new relay. 4. Set the starter switch to ON without starting the engine. 5. Establish the communication with ECM. Can the fault diagnostic meter communicate with ECM?	—	Go to step 13	Go to step 9
9	1. Starter switch is shut down. 2. Take down the ECM main relay. 3. Set the starter switch to ON without starting the engine. 4. Check the voltage supply circuit to the ECM main relay (X18 pin 1) with the test lamp. 5. Repair the wire disconnection as required. Is the repair finished after the abnormal detected?	—	Go to step 15	Go to step 13

Step	Operating	Standard value	Yes	No
10	1. Install the ECM main relay again. 2. Turn on or off the starter switch and check the ECM main relay for click sound. Wait for 7s before enable or disable the operation. Is a click heard from the ECM main relay when the starter switch is turned on or off?	—	Go to step 12	Go to step 11
11	1. Repair the ECM main relay ground circuit if the ECM main relay (X18 pin 5) and chassis ground terminal (J10) present the following conditions. ● Open circuit ● ECM main relay or ground terminal presents high resistance and loose contact. Is the repair finished?	—	Go to step 15	_
12	1. Check the battery power circuit if the ECM (J14 pin 2 and pin 5) and ECM main relay present the following conditions. ● Open circuit ● ECM or ECM main relay presents high resistance and loose contact. 2. Repair the circuit as required. Is the repair finished after the abnormal detected?	—	Go to step 15	Go to step 14
13	Replace the ECM main relay. Is the replacement finished?	—	Go to step 15	_
14	I. Replace ECM. **Important:** **After replace ECM, ensure to carry out programming and learning.** Is the replacement finished?	—	Go to step 15	_
15	1. Starter switch is shut down. 2. Connect all the previously removed fuses, relays and harness joints again. 3. Set the starter switch to ON without starting the engine. 4. Communicate with ECM. Can the fault diagnostic meter communicate with ECM?	—	Normal system	Go to step 3

Starting system confirmation

Explanation

This diagnostic list is the method for systemic discussion on the engine start failure causes. This diagnostic list can help the maintenance man in carrying out the system diagnostics. In this diagnostic list, the following conditions are supposed.

● The battery is fully charged and the terminals are clean and tight.

● (engine starting) speed is normal.

● The fuel model matches.

● The fuel system is free of leak.

● There is no air entraining in the fuel system.

● The filters (the air filter and fuel filter) are clean.

● The fuses and slow blow fuses are normal.

Helper diagnosis

● Where the intermittent fault is doubtable, refer to "intermittent fault" in this chapter.

Test description

The following numbers indicate the step number in the circuit/system test.

5. In case the common rail pressure regulator Low side circuit and ground are short between ECM and common rail pressure regulator, the "rail pressure regulator feedback current" will be 300mA lower than the standard current or more.

Circuit diagram: refer to engine in 9D wiring diagram.

Connector pin arrangement: Refer to the connector list in chapter 9D Wiring Diagrams.

Step	Operating	Standard value	Yes	No
1	Go to "engine control system inspection".	—	Go to step 2	Go to "engine control system inspection".
2	1. Connect the fault diagnostic meter. 2. Shut down the starter switch and wait for 30s. 3. Start the engine within the specified time. 4. Check the DTC information with the fault diagnostic meter. Does DTC detected?	15 seconds	Go to this DTC	Go to step 3
3	1. Starter switch is shut down. 2. To reduce the common rail fuel pressure, wait for 2min. 3. Set the starter switch to ON without starting the engine. The engine cannot start. 4. Confirm the display of "fuel common rail pressure sensor" with the fault diagnostic meter. Does the fault diagnostic meter display the standard value?	0.9~1.0V	Go to step 4	Go to step 6

Step	Operating	Standard value	Yes	No
4	1. Check whether the fuel volume in the fuel tank is proper and the fuel quality is good (by sampling inspection). **Mark:** **If there is no fuel, the air may enter the fuel system.** 2. In 5s when the engine is running, confirm the display of "fuel common rail pressure sensor" with the fault diagnostic meter. Is the fault diagnostic meter indication higher than the standard value when the engine is starting?	1.4V	Go to step 9	Go to step 5
5	In 5s when the engine is running, confirm the display of "rail pressure regulator feedback current" with the fault diagnostic meter. Is the fault diagnostic meter indication higher than the standard value when the engine is starting?	800 mA	Go to fuel system in Chapter ID fuel system 4HK1	Go to step 8
6	1. Starter switch is shut down. 2. Take down the harness joint of the common rail pressure sensor. 3. Check the common rail pressure sensor harness joint (E19 pin 1, pin 2 and pin 3) for intermittent fault, loose connection and corrosion. 4. Remove the ECM harness connector. 5. Check the ECM harness joint (E12 pin 82, pin 87, pin90 and pin 101) for intermittent fault, loose connection and corrosion. 6. Check every circuit for high resistance. 7. Connect or repair the circuit as required. Is the repair finished after the fault detected?	—	Go to step 11	Go to step 7
7	Replace the common rail pressure sensor. Refer to fuel pressure sensor (common rail) in Chapter 1D fuel system 4HK1. Is the replacement finished?	—	Go to step 11	—
8	Repair the ground short circuit between the ECM (E12 pin89 and pin 97) and common rail pressure regulator (E17 pin 2). Is the repair finished?	—	Go to step 11	—

Step	Operating	Standard value	Yes	No
9	1. Check whether the display of the following sensor input values are normal. Use the fault diagnostic meter data sheet or the measured vehicle values determined as normal. ● Engine coolant temperature (ECT) sensor ● Atmospheric pressure sensor ● Intake pressure sensor ● Air intake throttle position sensor ● EGR position sensor 2. Repair or replace the circuit as required. Is the repair finished after the fault detected?	—	Go to step 11	Go to step 10
10	1. Other probabilities for engine start failure: ● Engine mechanism timing ● Air intake system or exhaust system clogging ● Engine compression failure ● Fuel contamination by water or gasoline 2. Repair as needed. Is the repair finished after the fault detected?	—	Go to step 11	_
11	1. Connect all the previously removed harness joints again. 2. Shut down the starter switch and wait for 30s. 3. Start the engine. Does the engine start?	—	Go to step 12	Go to step 2
12	Check the DTC information with the fault diagnostic meter. Is any DTC not diagnosed?	—	Enter the DTC diagnosis	Normal system

Engine MIL illuminating electrical circuit system confirmation

Circuit instructions

The engine MIL acquires the power voltage through the starter switch and illuminates according to the ECM signal. ECM illuminates the engine MIL when the starter switch is started and the DTC is detected during the lamp testing. Besides, if DLC pin 4 and pin 12 are short circuited, the engine MIL will blink when DTC is detected. ECM is provided with monitoring circuit inside to monitor the operation of warning lamp.

Helper diagnosis

● Where the intermittent fault is doubtable, refer to "intermittent fault" in this chapter.

Test description

The following numbers indicate the step number in the chart.

2. If the signal input to the engine MIL is different from the operation of the engine MIL, DTC P0650 will be detected.

Circuit/system test (confirmation of the engine MIL illuminating electrical circuit system)

Step	Operating	Standard value	Yes	No
I	Go to "engine control system inspection".	—	Go to step 2	Go to "engine control system inspection".
2	1. Turn on the starter switch. 2. Confirm DTC with the fault diagnostic meter. Does DTC P0650 detected?	—	Go to DTC P0650	Go to step 3
3	Confirm the engine MIL illuminating state again. 1. Turn on the starter switch. 2. Check the engine MIL. Is the engine MIL on?	—	Go to Helper diagnosis	Go to step 4
4	I. Replace ECM. **Important:** **After replace ECM, ensure to carry out programming and learning.** Is the replacement finished?	—	Go to step 5	—
5	1. Connect all the previously removed harness joints again. 2. Clear DTC with the fault diagnostic meter. 3. Shut down the starter switch and wait for 30s. 4. Turn on the starter switch. Is the engine MIL on?	—	Go to "engine control system inspection".	Go to step 2

Engine MIL blinking electrical circuit system confirmation

Circuit instructions

The engine MIL acquires the power voltage through the starter switch and illuminates according to the ECM signal. ECM illuminates the engine MIL when the starter switch is started and the DTC is detected during the lamp testing. In addition, if DLC pin 4 and pin 12 are short circuited, the engine MIL will blink the detected DTC. ECM is provided with monitoringing circuit inside to monitor the operation of warning lamp.

Helper diagnosis

● In the case of intermittent fault, refer to "intermittence" in this chapter.

Test instruction

The following numbers are the procedure numbers in the table.

2. If the signal input to the engine MIL is different from the operation of the engine MIL, DTC P0650 will be detected.

Circuit diagram: refer to engine in 9D wiring diagram.

Connector pin arrangement: Refer to the connector list in chapter 9D Wiring Diagrams.

Circuit/system test (confirmation of the engine MIL blinking electrical circuit system)

Step	Operating	Standard value	Yes	No
1	Is the engine control system checked?	—	Go to Step 2	Access "engine control system inspection"
2	1. Turn on the starter switch. 2. Confirm DTC with the fault diagnostic meter. Is DTC P0650 detected?	—	Go into DTC P0650	Go to Step 3
3	1. Starter switch is shut down. 2. Connect the DMM (digital multimeter) between the DLC (B31 pin 12) and ground. 3. Turn on the starter switch. Is the DMM display higher than the standard value?	18V	Go to Step 6	Go to Step 4
4	Confirm the installation state of ECM terminal and middle joint. 1. Check the interface for shake or looseness. 2. Repair as needed. Is the fault detected?	—	Go to Step 9	Go to Step 5
5	1. Check the circuit between the ECM and DLC for the following state. ● Open circuit ● High resistance ● Short to the ground 2. Repair as needed. Is the fault detected?	—	Go to Step 9	Go to Step 7

Step	Operating	Standard value	Yes	No
6	1. Check the circuit between the DLC (B31 pin 4) and ground for the following state. ● Open circuit ● High resistance 2. Repair as needed. Is the fault detected?	—	Go to Step 9	Go to Step 7
7	Confirm the engine MIL blinking state again. 1. Turn on the starter switch. 2. Short DLC (B31 pin 4 and pin 12). 3. Check the engine MIL. Is the engine MIL blinking?	—	Go to Helper diagnosis	Go to Step 8
8	I. Replace ECM. Important: After replace ECM, ensure to carry out programming and learning. Is the replacement finished?	—	Go to Step 9	—
9	1. Install the removed harness terminals again. 2. Clear DTC with the fault diagnostic meter. 3. Shut down the starter switch and wait for 30s. 4. Turn on the starter switch. 5. Short DLC (B31 pin 4 and pin 12). Is the engine MIL blinking?	—	Access "engine control system inspection"	Go to Step 2

Exhaust gas recirculation (EGR) control system inspection

Explanation

EGR system recycles a part of exhaust gas into the intake manifold and consequently reduces the emission of NOx. The operability and low emission are guaranteed by controlling EGR system. ECM output control current drives the solenoid valve and consequently controls the lift of EGR valve. In addition, the actual valve lift measured by EGR position sensor is used for the fine control of EGR. EGR will start working when the engine speed, engine coolant temperature, intake air temperature and barometric pressure conditions are met. After this, work out the valve opening according to the engine speed and target fuel injection volume. Depending on this valve opening, determine the solenoid valve drive load and then drive the valve. With EGR running, closing the air intake throttle will regulate the intake manifold vacuum to the proper degree.

EGR control conditions

- The engine coolant temperature (ECT) is 70℃~100℃
- The intake air temperature (IAT) is above 30℃
- The barometric pressure is above 90kPa

Circuit diagram: refer to engine in 9D wiring diagram.

Connector pin arrangement: Refer to the connector list in chapter 9D Wiring Diagrams.

Circuit/system test (EGR system check)

Step	Operating	Standard value	Yes	No
1	Is the engine control system checked?	—	Go to Step 2	Access "engine control system inspection"
2	1. Install the fault diagnostic instrument. 2. Shut down the starter switch and wait for 30s. 3. Set the starter switch to ON without starting the engine. 4. Confirm DTC with the fault diagnostic meter. If DTC is set, check whether "EGR stopping EGR control" is recorded in "handling of DTC setting".	—	Access to the detected DTC diagnosis	Go to Step 3

Step	Operating	Standard value	Yes	No
3	1. Check for the following conditions. ● EGR valve gasket falling off or damage. ● EGR valve bonding ● Air leak in EGR line between the exhaust manifold and intake manifold ● Breakage of EGR line between the exhaust manifold and EGR valve or air flow resistance ● Exhaust system air flow resistance ● Air filter element clogging, guide tube breakage between the air filter and intake manifold or air flow resistance ● Leak of air intake system ● Moisture admission of air intake system ● Engine coolant temperature (ECT) sensor abnormal. Refer to "sensor resistor temperature characteristic" and test the ECT sensor at various temperature to judge whether the sensor is abnormal. ● Barometric pressure sensor abnormal. Refer to "sensor pressure at differnt elevation differential" and confirm the barometric pressure at the local elevation. ● Air intake throttle bonding 2. Repair as needed. Is the repair finished?	—	Go to Step 13	Go to Step 4
4	1. Move the gear lever to the neutral position and apply the parking brake. 2. Start the engine for warming-up (until the engine coolant temperature reaches 75℃ or higher). 3. Depress the accelerator pedal repeatedly between the idling state and accelerator pedal depressed to increase the engine speed while confirming the "EGR position" data with the fault diagnostic meter. Is the "EGR position" data in the standard range?	±5%	Go to Step 5	Go to Step 7
5	1. Carry out "EGR" test for several times with the fault diagnostic meter. 2. Execute the target EGR position increase/decrease command while confirming "EGR position" value. Is the "EGR position" display in the standard range?	±5%	Normal system	Go to Step 6

Step	Operating	Standard value	Yes	No
6	1. Remove the EGR valve. 2. Check the EGR valve for the following conditions: ● The foreign matters cause the EGR valve inside air flow resistance ● Excessive deposit at the valve ● Valve shaft bending deformation 3. Repair or replace as needed. Is the repair finished?	—	Go to Step 12	Go to Step 7
7	1. Starter switch is shut down. 2. Remove the EGR harness joint. 3. Check the EGR valve harness terminal (E15 pin 1, pin 2, pin 3, pin 4, pin 5, pin 6, pin 7 and pin 8) for intermittent fault, loose contact and corrosion. 4. Remove the ECM harness joint. 5. Check the ECM harness terminal (E12 pin87,93,94,99,101,103,110 and 111) for intermittent fault, loose contact and corrosion. 6. Check each circuit for high resistance. 7. Repair the connection or circuit as needed. Is the repair finished?	—	Go to Step 12	Go to Step 10
8	1. Remove the air intake throttle. 2. Check the air intake throttle for the following conditions: ● The foreign matters cause the air intake throttle inside air flow resistance ● Excessive deposit inside throttle ● Butterfly valve bending deformation 3. Repair or replace as needed. **Mark:** **Replace the air intake throttle in the case of valve bonding.** Is the repair finished?	—	Go to Step 12	Go to Step 9

Step	Operating	Standard value	Yes	No
9	1. Starter switch is shut down. 2. Remove the air intake throttle harness joint. 3. Check the air intake throttle harness terminal (E16 pin 1, pin 2, pin 3, pin 5 and pin 6) for intermittent fault, loose contact and corrosion. 4. Remove the ECM harness joint. 5. Check the ECM harness terminal (E12 pin 85, pin 95, pin 104, pin 109 and pin 112) for intermittent fault, loose contact and corrosion. 6. Check each circuit for high resistance. 7. Repair or replace as needed. Is the repair finished?	—	Go to Step 12	Go to Step 11
10	Replace EGR valve. Refer to EGR valve and EGR cooler in Chapter IF emission control system 4HK1. Is the repair finished?	—	Go to Step 12	—
11	Replace the intake throttle valve. Is the operation finished?	—	Go to Step 12	—
12	Install the removed harness terminals and composition parts again. Is the operation finished?	—	Go to Step 4	—

Warming-up control system inspection

Circuit instructions

The warming-up control system consists of ECM, warming-up relay, warming-up indicator lamp and glow plug. This system works when the engine coolant temperature is low to help the engine start. With the starter switch on and engine shut down, ECM will turn on the warming-up relay for a while. In the postheating stage after the warming-up, the glow plug will continue working for a while even if the engine is running.

Warming-up control conditions

● The warming-up indicator lamp will be on for 0.5s to 10s approximately depending on the engine coolant temperature. The illuminating time will be 0.5s approximately if the temperature exceeds 10℃.

● Front heat: The warming-up indicator lamp will be on for 0.5s to 10s approximately depending on the engine coolant temperature. It will be on for 1s if the temperature exceeds 10℃.

● Rear heat: The warming-up indicator lamp will be on for 0.5s to 10s approximately depending on the engine coolant temperature. It will be on for 1s if the temperature exceeds 10℃.

Circuit diagram: refer to engine in 9D wiring diagram.

Connector pin arrangement: Refer to the connector list in chapter 9D Wiring Diagrams.

Circuit/system test (warming-up control system check)

Step	Operating	Standard value	Yes	No
1	Is the engine control system checked?	—	Go to Step 2	Access "engine control system inspection"
2	1. Install the fault diagnostic instrument. 2. Shut down the starter switch and wait for 30s. 3. Set the starter switch to ON without starting the engine. 4. Confirm DTC with the fault diagnostic meter. Is DTC P0117, P0118, P0380 or P0381 detected?	—	Go to this DTC diagnosis	Go to Step 3
3	1. Starter switch is shut down. 2. Check whether all the battery power supply terminals connected to the glow plug joint are firmly installed (E14). 3. Set the starter switch to ON without starting the engine. 4. Install the test lamp between the glow plug joint battery power supply terminal (E14) and the normal ground. 5. Carry out "warming-up relay" test with the fault diagnostic meter. 6. Turn on the warming-up relay while checking the test lamp. Is the test lamp on only when the on command is released?	—	Go to Step 4	Go to Step 5

Step	Operating	Standard value	Yes	No
4	1. Starter switch is shut down. 2. Take down the metal bus from the glow plug. 3. Measure the resistance of every glow plug between the glow plug terminal and normal ground. Ensure to record all measurements. At the same time, complete the measurement as soon as possible to avoid the engine temperature variation during the measurement. Is the resistance in the standard range?	1Ω	Normal system	Go to Step 15
5	1. Starter switch is shut down. 2. Replace the warming-up relay with starter relay or new relay. 3. Set the starter switch to ON without starting the engine. 4. Install the test lamp between the glow plug joint battery power supply terminal (E14) and the normal ground. 5. Carry out "warming-up relay" test with the fault diagnostic meter. 6. Turn on the glow plug relay while checking the test lamp. Is the test lamp on only when the on command is released?	—	Go to Step 13	Go to Step 6
6	Check the warming-up slow blow fuse (60A) in the relay box of the chassis section. Is the warming-up slow blow fuse (60A) blown?	—	Go to Step 7	Go to Step 8
7	Replace the warming-up slow blow fuse (60A). If the slow blow fuse is blown again, repair the ground short circuit of the circuit supplying power this this fuse or replace the short circuited parts. Is the repair finished?	—	Go to Step 16	—
8	1. Starter switch is shut down. 2. Remove the warming-up relay. 3. Use the test lamp connected to the normal ground and check the battery power supply circuit of relay (X19 pin 1) carefully. Is the test lamp on?	—	Go to Step 9	Go to Step 10
9	1. Use the test lamp connected to the normal ground and check the voltage supply circuit of warming-up relay (X19 pin 2) carefully. 2. Set the starter switch to ON without starting the engine. Is the test lamp on?	—	Go to Step 12	Go to Step 11

Step	Operating	Standard value	Yes	No
10	Repair the open circuit or high resistance between the warming-up slow blow fuse (60A) and warming-up relay (X19 pin 1). Is the repair finished?	—	Go to Step 16	—
11	Repair the open circuit or high resistance between the warming-up relay (X19 pin 2) and glow plug connector lug (E14 terminal). Is the repair finished?	—	Go to Step 16	—
12	1. Repair the open circuit or high resistance between the warming-up relay (X19 pin 2) and glow plug connector lug (E14 terminal). **Important:** **The glow plug will be ignited if the short circuit occurs between the battery power supply circuit and power.** Is the repair finished?	—	Go to Step 16	—
13	1. Remove the warming-up relay. 2. Check the warming-up relay terminals for intermittent fault and loose contact. 3. Repair the connection as needed. Is the repair finished?	—	Go to Step 16	Go to Step 14
14	Replace the glow plug. Is the operation finished?	—	Go to Step 16	—
15	Replace the glow plug. Is the operation finished?	—	Go to Step 16	—
16	1. Install the just removed composition parts, relays, fuses and harness joints. 2. Shut down the starter switch and wait for 30s. 3. Set the starter switch to ON without starting the engine. 4. Install the test lamp between the glow plug joint battery power supply terminal (E14) and the normal ground. 5. Carry out "warming-up relay" test with the fault diagnostic meter. 6. Turn on the warming-up relay while checking the test lamp. Is the test lamp on only when the on command is released?	—	Go to Step 4	Go to Step 2

Exhaust brake/ air inlet restriction control system inspection

Explanation

The exhaust brake control system/ air intake throttle consists of the following components:

- ECM
- Exhaust brake switch
- Exhaust brake relay
- Exhaust brake valve
- Exhaust brake solenoid valve
- Exhaust brake switch
- Intake throttle valve
- Air inlet throttle valve VSV

ECM drives the exhaust brake relay to control the air inlet throttle valve VSV and exhaust brake solenoid valve to close according to the vehicle driving state and exhaust brake switch input signal.

Drive exhaust brake relay, control air intake throttling VSV and exhaust brake solenoid closed

Exhaust brake operating conditions

- Exhaust brake switch ON
- Engine running
- Accelerator pedal not depressed
- Clutch pedal not depressed
- Vehicle speed above specified range

Test instruction

The following numbers indicate the step number in the circuit/system table.

16. Check the data display of "accelerator pedal opening" through the scanner.

It is normal if the data display of "accelerator pedal opening" changes within 0~100% linearly as the accelerator pedal moves.

18. When the "exhaust brake valve drive command" data display is "OFF", check the exhaust brake operating conditions of "vehicle speed", "accelerator pedal opening" and "clutch pedal switch" through the scanner.

Circuit diagram: refer to engine in 9D wiring diagram.

Connector pin arrangement: Refer to the connector list in chapter 9D Wiring Diagrams.

Step	Operating	Standard value	Yes	No
1	Is "engine control system check" implemented?	—	Go to Step 2	Access "engine control system inspection"
2	Is the exhaust brake lamp in the instrument is on when the exhaust brake switch is in ON position? Is the exhaust brake lamp on?	—	Go to Step 6	Go to Step 3
3	Check the exhaust brake indicator lamp operating circuit between the ECM (J14 pin 7) and instrument (B106 pin 13). 1. Take down the harness joint from the ECM. 2. Connect the ECM (J14 pin 7) and ground. 3. Turn on the ignition switch. Is the exhaust brake indicator lamp in the instrument on?	—	Go to Step 24	Go to Step 4
4	Check the exhaust brake indicator lamp operating circuit between the ECM (J14 pin 7) and instrument (B106 pin 13). Whether there is phenomenon for open circuit , short circuit to ground and power supply, and high resistance, etc. If it is not normal, it must be repaired Is the operation finished?	—	Go to Step 5	—
5	Check the instrument and instrument power. If it is not normal, it must be repaired or replaced. Is the operation finished?	—	Go to Step 6	—
6	Operate the exhaust brake switch and check the switch signal input state with the scanner. Turn the exhaust brake switch on and off while checking the data display of "exhaust brake switch" on the scanner. Does the scanner data change to ON or OFF as the switch operated?	—	Go to Step 10	Go to Step 7
7	Check the exhaust brake switch. If it is not normal, it must be repaired or replaced. Is the operation finished?	—	Go to Step 8	—

Step	Operating	Standard value	Yes	No
8	Check the exhaust brake switch operating circuit between the ECM (J14 pin 45) and exhaust brake switch (B188 pin 15). Check the harness for open circuit, short circuit to the ground or power supply and high resistance. If it is not normal, it must be repaired Is the operation finished?	—	Go to Step 9	—
9	Check the circuit of exhaust brake switch power side. If it is not normal, it must be repaired or replaced. Is the operation finished?	—	Go to Step 10	—
10	1. Carry out the "exhaust brake" test with the scanner. 2. Issue ON and OFF command to the exhaust brake solenoid valve. Can the exhaust brake solenoid valve and air inlet throttle valve VSV work sound be heard in every command?		Go to Step 15	Go to Step 11
11	Check the exhaust brake relay. Replace the relay if abnormal. Is the operation finished?	—	Go to Step 12	—
12	Check the following harness for open circuit, short circuit to the ground or power supply and high resistance. ● Exhaust brake relay ~ exhaust brake M/V ● Exhaust brake relay ~ air inlet throttle valve VSV ● Exhaust brake relay (4KH1,J14 pin15) Is the operation finished?	—	Go to Step 13	—
13	Check the vacuum system. If it is not normal, it must be repaired or replaced. Is the operation finished?	—	Go to Step 14	—
14	1. Carry out the "exhaust brake" test with the scanner once again. 2. Issue ON and OFF command to the exhaust brake solenoid valve. Can the exhaust brake solenoid valve and air inlet throttle valve VSV work sound be heard in every command?	—	Go to Step 15	Go to Step 22

Step	Operating	Standard value	Yes	No
15	1. Drive the vehicle to make the exhaust brake work fully. 2. Set the exhaust brake switch to ON position. 3. Release the accelerator pedal. Can the exhaust brake work normaly (if the engine valve sound is heard when the exhaust brake acts, it means the air intake throttle is not closed tightly)?	—	Go to Step 16	Go to Step 18
16	1. Start the exhaust brake again. 2. Depress the accelerator pedal with the exhaust brake working. Does the exhaust brake stop?	—	Go to Step 17	Confirm the data display of "accelerator pedal opening". Diagnose the accelerator pedal position sensor
17	1. Start the exhaust brake again. 2. Depress the clutch pedal with the exhaust brake working. Does the exhaust brake stop?	—	Normal system	Go to Step 19
18	1. Start the exhaust brake again. 2. Record the engine data with the exhaust brake working through the quick check function. 3. Check the data display of "exhaust brake valve drive command" through the scanner. Is the data of "exhaust brake valve drive command" on with the exhaust brake working?		Go to Step 20	ECM forbids the exhaust brake control. Refer to the exhaust brake control operation.
19	Check the clutch related components. Repair, adjust or replace as needed. Is the operation finished?	—	Go to Step 21	—
20	Check the clutch switch. Refer to chapter 5E and check the clutch switch function and installation state etc. Repair, adjust or replace as needed. Is the operation finished?	—	Go to Step 21	—
21	Check the clutch switch circuit. Check the harness for open circuit, short circuit to the ground or power supply and high resistance. If it is not normal, it must be repaired. Is the operation finished?	—	Go to Step 22	—

Step	Operating	Standard value	Yes	No
22	Replace the exhaust brake solenoid valve or air inlet throttle valve VSV no sound in the "exhaust brake" test. Is the operation finished?	—	Go to Step 23	—
23	1. Carry out the "exhaust brake" test with the scanner once again. 2. Issue ON and OFF command to the exhaust brake solenoid valve. Can the exhaust brake solenoid valve and air inlet throttle valve VSV work sound be heard in every command?	—	Go to Step 15	Go to Step 24
24	1. Replace ECM. **Important:** **Carry out programming and learning over the replaced ECM.** Is the operation finished?	—	Go to Step 25	—
25	Connect all the removed components, fuses or harness joints. Is the operation finished?	—	Go to Step 1	—

Symptoms - Engine Controls

Important Preliminary Inspections before Starting

Perform Diagnostic System Check - Engine Controls before using the symptom tables, and verify that all of the following are true:

• The ECM and malfunction indicator lamp (MIL)/ service vehicle soon (SVS) lamp are operating correctly.

• The scan tool data is within the normal operating range. Refer to Scan Tool Data List in this section.

• Verify the customer concern and locate the correct symptom in the table of contents. Inspect the items indicated under that symptom.

Visual and Physical Inspection

Several of the symptom procedures ask for careful visual and physical inspection. This step is extremely important. The visual and physical inspection can lead to correcting a problem without further inspections, and can save valuable time. Ensure that:

• The ECM grounds are clean, tight, and in their proper location.

• The air hoses are not split or kinked, and properly connected. Inspect thoroughly for any type of leak or restriction.

• The air intake ducts are not collapsed or damaged.

• The exhaust pipes are not collapsed or damaged.

• The engine harness wiring and terminals are properly connected and are not pinched or cut.

Intermittent

Important:

Inspect for improper installation of electrical components if an intermittent condition exists. Inspect for aftermarket add-on electrical equipment devices, lights, and cellular phones. Verify that no aftermarket equipment is connected to the controller area network (CAN) or other serial data circuit.

Important:

The problem may or may not turn ON the MIL/ SVS lamp or store a DTC. Faulty electrical connections or wiring cause most intermittent problems. Perform a careful visual and physical inspection of the suspect connectors for the following conditions:

• Improperly mated connector halves

• Terminals that are not seated

• Terminals that are damaged or improperly formed

Reform or replace connector terminals in the problem circuit in order to ensure proper contact tension. Remove the terminal from the connector body in order to inspect for poor terminal wire connection.

Road test the vehicle with the DMM connected to the suspected circuit. An abnormal reading that occurs when the malfunction occurs is a good indication that there is a malfunction in the circuit being monitored.

Use the scan tool in order to help detect intermittent conditions. Useful features of the Tech 2 scan tool include the following:

• Trigger the Snapshot feature in order to capture and store engine parameters when the malfunction occurs. Review this stored information in order to see the specific running conditions that caused the malfunction.

• Use the Plot Function on the scan tool in order to plot selected data parameters. Review this stored information to aid in locating an intermittent problem. Refer to scan tool Users Guide for more information.

Important:

If the intermittent condition exists as a start and then stall, test for DTCs relating to the vehicle theft deterrent system. Test for improper installation of electrical options such as lights, cellular phones, etc.

Any of the following may cause an intermittent MIL/ SVS lamp with no stored DTC:

• The ECM grounds are loose or dirty. Refer to engine control wirings.

• The MIL/ SVS lamp circuit intermittently shorted to ground

• Electrical system interference caused by a malfunctioning relay, ECM driven solenoid, or switch. The electrical component can cause a sharp electrical surge. Normally, the problem will occur when the malfunctioning component is operating.

• There are any open diodes.

Important:

The following symptom tables contain groups of possible causes for each symptom. The order of these procedures is not important.

If the scan tool readings do not indicate the problems, then proceed in a logical order, easiest to check or most likely to cause first.

In order to determine if a specific vehicle is using a particular system or component, refer to 9D engine control wirings for an application.

Use the following tables when diagnosing a symptom complaint:

• Intermittent Conditions
• Hard Start
• Rough, Unstable, or Incorrect Idle and Stalling
• High Idle Speed
• Cuts Out
• Surges
• Lack of Power, Sluggishness or Sponginess
• Hesitation, Sag or Stumble
• Abnormal Combustion Noise
• Poor Fuel Economy
• Excessive Smoke (Black Smoke)
• Excessive Smoke (White Smoke)

Intermittent Conditions

Checks	Action
Definition: The problem is not currently present but is indicated in DTC History. OR There is a customer complaint, but the symptom cannot currently be duplicated, if the problem is not DTC related.	
Preliminary Checks	• Refer to Symptoms - Engine Controls before starting.
Harness/ Connector	Many intermittent open or shorted circuits are affected by harness/ connector movement that is caused by vibration, engine torque, bumps/ rough pavement, etc. Test for this type of condition by performing the applicable procedure from the following list: • Move related connectors and wiring while monitoring the appropriate scan tool data. • Move related connectors and wiring with the component commanded ON, and OFF, with the scan tool. Observe the component operation. • With the engine running, move related connectors and wiring while monitoring engine operation. If harness or connector movement affects the data displayed, component/ system operation, or engine operation, inspect and repair the harness/ connections as necessary.
Electrical Connections or Wiring	Poor electrical connections, terminal tension or wiring problems cause most intermittent. To perform the following inspections: • Poor mating of the connector halves, or terminals improperly seated in the connector body. • Improperly formed or damaged terminals. Test for poor terminal tension. • Poor terminal to wire connections including terminals crimped over insulation. This requires removing the terminal from the connector body. • Corrosion/ water intrusion. Pierced or damaged insulation can allow moisture to enter the wiring. The conductor can corrode inside the insulation, with little visible evidence. Look for swollen and stiff sections of wire in the suspect circuits. • Wires that are broken inside the insulation. • Harness for pinched, cut or rubbed through wiring. • Ensure that the wiring does not come in contact with hot exhaust components.
Control Module Power and Grounds Component Power and Grounds	Poor power or ground connections can cause widely varying symptoms. • Test all control module power supply circuits. Many vehicles have multiple circuits supplying power to the control module. Other components in the system may have separate power supply circuits that may also need to be tested. Inspect connections at the module/ component connectors, fuses, and any intermediate connections between the power source and the module/ component. A test lamp or a DMM may indicate that voltage is present, but neither tests the ability of the circuit to carry sufficient current. Ensure that the circuit can carry the current necessary to operate the component. • Test all control module ground and system ground circuits. The control module may have multiple ground circuits. Other components in the system may have separate grounds that may also need to be tested. Inspect grounds for clean and tight connections at the grounding point. Inspect the connections at the component and in splice packs, where applicable. Ensure that the circuit can carry the current necessary to operate the component.

Checks	Action
Temperature Sensitivity	• An intermittent condition may occur when a component/ connection reaches normal operating temperature. The condition may occur only when the component/ connection is cold, or only when the component/ connection is hot. • Freeze Frame, Failure Records or Snapshot Data may help with this type of intermittent conditions, where applicable. • If the intermittent is related to heat, review the data for a relationship with the following: - High ambient temperatures. - Underhood/ engine generated heat. - Circuit generated heat due to a poor connection, or high electrical load. - Higher than normal load conditions, towing, etc. • If the intermittent is related to cold, review the data for the following: - Low ambient temperatures-In extremely low temperatures, ice may form in a connection or component. Test for water intrusion. - The condition only occurs on a cold start. - The condition goes away when the vehicle warms up. • Information from the customer may help to determine if the trouble follows a pattern that is temperature related.
Electromagnetic Interference (EMI) and Electrical Noise	Some electrical components/ circuits are sensitive to EMI or other types of electrical noise. Inspect the following conditions: • A misrouted harness that is too close to high voltage/ high current devices such as injection components, motors, generator etc. These components may induce electrical noise on a circuit that could interfere with normal circuit operation. • Electrical system interference caused by a malfunctioning relay, or the ECM driven solenoid or switch. These conditions can cause a sharp electrical surge. Normally, the problem will occur when the malfunctioning component is operating. • Improper installation of non-factory or aftermarket add on accessories such as lights, 2-way radios, amplifiers, electric motors, remote starters, alarm systems, cell phones, etc. These accessories may lead to an emission related failure while in use, but do not fail when the accessories are not in use. • Test for any open diodes. Some relays may contain a clamping diode. • Test the generator for a bad rectifier bridge that may be allowing AC noise into the electrical system.
Duplicating Failure Conditions	• If none of the previous tests are successful, attempt to duplicate and/ or capture the failure conditions. • An alternate method is to drive the vehicle with the DMM connected to a suspected circuit. An abnormal reading on the DMM when the problem occurs, may help you locate the problem.
Scan Tool Snapshot	The scan tool can be set up to take a Snapshot of the parameters available via serial data. The Snapshot function records live data over a period of time. The recorded data can be played back and analyzed. The scan tool can also graph parameters singly or in combinations of parameters for comparison. The Snapshot can be triggered manually at the time the symptom is noticed, or set up in advance to trigger when a DTC sets. An abnormal value captured in the recorded data may point to a system or component that needs to be investigated further. Refer to scan tool Users Guide for more information.

Hard Start

Checks	Action
Definition: The engine cranks OK, but does not start for a long time. The engine does eventually run, or may start but immediately dies.	
Preliminary Checks	• Diagnostic System Check - Engine Controls. • Ensure the driver is using the correct starting procedure. • Inspect the ECM grounds for being clean, tight, and in their proper locations. • Inspect that the harness connectors are correctly connected. • Inspect the fuel type and quality. • Inspect the programmed fuel injector ID code for each cylinder. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to Scan Tool Data List in this section. • Compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) parameters on a cold engine condition. If the difference among temperature reading is more than 5°C on a cold engine, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure Sensor parameter with the engine OFF. The FRP Sensor should read 0.9 to 1.0 volt with the ignition switch ON and engine OFF after the engine has stopped running for a minimum of 1 minute. If not, check for high resistance in each circuit or for a skewed sensor. • Crankshaft position (CKP) sensor is tight and the sensor rotor is not damaged. • Camshaft position (CMP) sensor is tight and the camshaft gear is not damaged.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to Fuel System Check chart and appropriate procedure in Section 1D 4HK1 Engine Fuel. • Air in the fuel system. • Water contamination in the fuel. • External fuel leaks or high engine oil level. • Fuel leak off from the fuel pressure limiter valve and fuel injectors. • Fuel lines between the fuel tank and fuel supply pump for being crushed, kinked, tightness, cracks and plugged. • A plugged fuel tank vent hose. • Inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. • Fuel supply pump operation. Notice: The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. • Perform the Cylinder Balance Test with a scan tool. • Perform the Injector Forced Drive with a scan tool. • Observe the FRP Regulator Feedback current on the scan tool.

Checks	Action
Air Intake System Checks	Inspect the air intake system for the following conditions. • Air cleaner, air intake ducts and charge air cooler for a restriction, holes, or leaks. • A restriction in the turbocharger inlet duct. • Intake throttle valve for a stuck condition. • A restriction or leak in the intake manifold.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to Exhaust System in Section 1G 4HK1 Engine Exhaust.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to Section 1B 4HK1 Engine Mechanical. • Poor cylinder compression. • Improper mechanical timing (timing gear). • Improper valve gap. • Broken or weak valve springs. • Worn camshaft lobes.
Electrical System Checks	Inspect the engine electrical for the following conditions. Refer to Section 1E 4HK1 Engine Electrical. • Glow plug control system operation. Refer to QOS Control System Check in this section. • Slow cranking speed. • Weakened batteries.

Rough, Unstable, or Incorrect Idle and Stalling

Checks	Action
Definition: Engine runs unevenly at idle. If severe, the engine or vehicle may shake. Engine idle speed may vary in RPM. Either condition may be severe enough to stall the engine.	
Preliminary Checks	• Diagnostic System Check - Engine Controls. • Remove the air cleaner and check for dirt, or for air ducts being plugged or restricted. Replace as necessary. • Inspect the ECM grounds for being clean, tight, and in their proper locations. • Inspect that the harness connectors are correctly connected. • Inspect the fuel type and quality. • Inspect the programmed fuel injector ID code for each cylinder. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to Scan Tool Data List in this section. • Compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) parameters on a cold engine condition. If the difference among temperature reading is more than 5°C on a cold engine, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure Sensor parameter with the engine OFF. The FRP Sensor should read 0.9 to 1.0 volt with the ignition switch ON and engine OFF after the engine has stopped running for a minimum of 1 minute. If not, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure and Desired Fuel Rail Pressure parameter between idle and W.O.T. (accelerator pedal full travel) in Neutral. Fuel Rail Pressure parameter should follow within ± 5 Mpa quick enough. • Crankshaft position (CKP) sensor is tight and the sensor rotor is not damaged. • Camshaft position (CMP) sensor is tight and the camshaft gear is not damaged.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to Fuel System Check chart and appropriate procedure in Section 1D 4HK1 Engine Fuel. • Air in the fuel system. • Water contamination in the fuel. • External fuel leaks or high engine oil level. • Fuel leak off from the fuel pressure limiter valve and fuel injectors. • Fuel lines between the fuel tank and fuel supply pump for being crushed, kinked, tightness, cracks and plugged. • A plugged fuel tank vent hose. • Inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. • Fuel supply pump operation. **Notice:** **The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM.** • Perform the Cylinder Balance Test with a scan tool. • Perform the Injector Forced Drive with a scan tool. • Observe the Fuel Compensation for each cylinder at idle on the scan tool. • Observe the FRP Regulator Feedback current on the scan tool.

Checks	Action
Air Intake System Checks	Inspect the air intake system for the following conditions. • Air cleaner, air intake ducts and charge air cooler for a restriction, holes, or leaks. • A restriction in the turbocharger inlet duct. • Intake throttle valve for a stuck condition. • A restriction or leak in the intake manifold.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to Exhaust System in Section 1G 4HK1 Engine Exhaust.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to Section 1B 4HK1 Engine Mechanical. • Poor cylinder compression. • Improper mechanical timing (timing gear). • Improper valve gap. • Broken or weak valve springs. • Worn camshaft lobes. • Incorrect basic engine parts such as camshaft, cylinder head, pistons, etc.
Additional Checks	• Electromagnetic interference (EMI) on the reference circuit can cause an engine miss condition. The scan tool can usually detect EMI by monitoring the engine speed. A sudden increase in speed with little change in actual engine speed change indicates that EMI is present. If a problem exists, check routing of high voltage components, such as fuel injector solenoid valve wiring, near the sensor circuits. • Faulty engine mounts. • Faulty crank pulley. • Faulty generator & A/C compressor. • Generator output voltage. • EGR system operating correctly. Refer to EGR Control System Check in this section. • A/C operation.

High Idle Speed

Checks	Action
Definition: Engine idle speed is higher than normal in regardless of engine coolant temperature or DPD system regeneration.	
Preliminary Checks	• Diagnostic System Check - Engine Controls. • Inspect that the harness connectors are correctly connected. • Use the scan tool to compare the engine speed and tachometer on the instrument panel (IP) cluster. • Inspect the A/C operation. • Inspect the fuel type and quality. • Inspect the engine oil level. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to Scan Tool Data List in this section. • Compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) parameters on a cold engine condition. If the difference among temperature reading is more than 5°C on a cold engine, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure Sensor parameter with the engine OFF. The FRP Sensor should read 0.9 to 1.0 volt with the ignition switch ON and engine OFF after the engine has stopped running for a minimum of 1 minute. If not, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure and Desired Fuel Rail Pressure parameter between idle and W.O.T. (accelerator pedal full travel) in Neutral. Fuel Rail Pressure parameter should follow within ± 5 Mpa quick enough. • Observe the Accelerator Pedal Position (APP). APP parameter should change linearly from 0 to 100% according to the accelerator pedal operation.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to Fuel System in Section 1D 4HK1 Engine Fuel. • Fuel injectors. Remove the injectors and visually inspect. (Injector tip(s) may be damaged)

Cuts Out

Checks	Action
Definition: A constant jerking that follows the engine speed, usually more pronounced as the engine load increase. The exhaust has a steady spitting sound at idle, low speed, or hard acceleration for the fuel starvation that can cause the engine to cut-out.	
Preliminary Check	• Diagnostic System Check - Engine Controls. • Inspect that the harness connectors are correctly connected. • Inspect the ECM grounds for being clean, tight, and in their proper locations. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to Scan Tool Data List in this section. • Observe the Fuel Rail Pressure Sensor parameter with the engine OFF. The FRP Sensor should read 0.9 to 1.0 volt with the ignition switch ON and engine OFF after the engine has stopped running for a minimum of 1 minute. If not, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure and Desired Fuel Rail Pressure parameter between idle and W.O.T. (accelerator pedal full travel) in Neutral. Fuel Rail Pressure parameter should follow within ± 5 Mpa quick enough. • Observe the Accelerator Pedal Position (APP). APP parameter should change linearly from 0 to 100% according to the accelerator pedal operation. • Crankshaft position (CKP) sensor is tight and the sensor rotor is not damaged. • Camkshaft position (CMP) sensor is tight and the sensor rotor is not damaged.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to Fuel System Check chart and appropriate procedure in Section 1D 4HK1 Engine Fuel. • Air in the fuel system. • Water contamination in the fuel. • Fuel leak off from the fuel pressure limiter valve and fuel injectors. • Fuel lines between the fuel tank and fuel supply pump for being crushed, kinked, tightness, cracks and plugged. • Inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. • Perform the Cylinder Balance Test with a scan tool. • Perform the Injector Forced Drive with a scan tool. • Observe the Fuel Compensation for each cylinder at idle on the scan tool.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Air cleaner, air intake ducts and charge air cooler for a restriction, holes, or leaks. • A restriction in the turbocharger inlet duct. • Intake throttle valve for a stuck condition. • A restriction or leak in the intake manifold.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to Exhaust System in Section 1G 4HK1 Engine Exhaust.
Additional Checks	• Electromagnetic interference (EMI) on the reference circuit can cause an engine miss condition. The scan tool can usually detect EMI by monitoring the engine speed. A sudden increase in speed with little change in actual engine speed change indicates that EMI is present. If a problem exists, check routing of high voltage components, such as fuel injector solenoid valve wiring, near the sensor circuits.

Surges

Checks	Action
Definition: The engine has a power variation under a steady throttle or cruise. The vehicle seems to speed up and slow down with no change in the accelerator pedal.	
Preliminary Checks	• Diagnostic System Check - Engine Controls. • Ensure the driver understands the A/C compressor operation. • Use the scan tool in order to make sure the Vehicle Speed parameter reading matches the vehicle speedometer. • Inspect the ECM grounds for being clean, tight, and in their proper locations. • Inspect that the harness connectors are correctly connected. • Inspect the fuel type and quality. • Inspect the programmed fuel injector ID code for each cylinder. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to Scan Tool Data List in this section. • Observe the Fuel Rail Pressure Sensor parameter with the engine OFF. The FRP Sensor should read 0.9 to 1.0 volt with the ignition switch ON and engine OFF after the engine has stopped running for a minimum of 1 minute. If not, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure and Desired Fuel Rail Pressure parameter between idle and W.O.T. (accelerator pedal full travel) in Neutral. Fuel Rail Pressure parameter should follow within ± 5 MPa quick enough. • Observe the Accelerator Pedal Position (APP). APP parameter should change linearly from 0 to 100% according to the accelerator pedal operation.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to Fuel System Check chart and appropriate procedure in Section 1D Engine Fuel. • Air in the fuel system. • Water contamination in the fuel. • Fuel leak off from the fuel pressure limiter valve and fuel injectors. • Fuel lines between the fuel tank and fuel supply pump for being crushed, kinked, tightness, cracks and plugged. • A plugged fuel tank vent hose. • Inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. • Fuel supply pump operation. **Notice: The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM.** • Perform the Cylinder Balance Test with a scan tool. • Perform the Injector Forced Drive with a scan tool.

Checks	Action
Air Intake System Checks	Inspect the air intake system for the following conditions. • Air cleaner, air intake ducts and charge air cooler for a restriction, holes, or leaks. • A restriction in the turbocharger inlet duct. • Intake throttle valve for a stuck condition. • A restriction or leak in the intake manifold. • Turbocharger nozzle control solenoid for a stuck condition. Refer to Turbocharger Assembly in Section 1J Induction.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to Exhaust System in Section 1G 4HK1 Engine Exhaust.
Additional Checks	• Check the alternator output voltage. • Inspect the EGR system operating correctly. Refer to EGR Control System Check in this section. • Inspect the A/C operation.

Lack of Power, Sluggishness or Sponginess

Checks	Action
Definition: The engine delivers less than expected power. There is little or no increase in speed when partially applying the accelerator pedal.	
Preliminary Checks	• Diagnostic System Check - Engine Controls. • Compare the vehicle with a similar unit. Ensure the vehicle has an actual problem. • Remove the air cleaner and check for dirt, or for air ducts being plugged or restricted. Replace as necessary. • Have the tire sizes changed? • Are excessively heavy loads being carried? • Inspect for clutch slip. • Inspect brake drag. • Inspect for a proper transmission shift pattern and down shift operation. • Inspect the fuel quality (cetane index). • Inspect the engine oil level and quality. • Use the scan tool in order to make sure the Vehicle Speed parameter reading matches the vehicle speedometer. • Inspect the ECM grounds for being clean, tight, and in their proper locations. • Inspect the programmed fuel injector ID code for each cylinder. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to Scan Tool Data List in this section. • Compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) parameters on a cold engine condition. If the difference among temperature reading is more than 5°C on a cold engine, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure Sensor parameter with the engine OFF. The FRP Sensor should read 0.9 to 1.0 volt with the ignition switch ON and engine OFF after the engine has stopped running for a minimum of 1 minute. If not, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure and Desired Fuel Rail Pressure parameter between idle and W.O.T. (accelerator pedal full travel) in Neutral. Fuel Rail Pressure parameter should follow within ± 5 MPa quick enough. • Observe the Accelerator Pedal Position (APP). APP parameter should change linearly from 0 to 100% according to the accelerator pedal operation. • Observe the Boost Pressure and Barometric Pressure (BARO) with ignition ON and engine OFF. Both parameters should be within the 7.0 kPa each other.

Checks	Action
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to Fuel System Check chart and appropriate procedure in Section 1D Engine Fuel. • Air in the fuel system. • Water contamination in the fuel. • External fuel leaks or high engine oil level. • Fuel leak off from the fuel pressure limiter valve and fuel injectors. • Fuel lines between the fuel tank and fuel supply pump for being crushed, kinked, tightness, cracks and plugged. • A plugged fuel tank vent hose. • Inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. • Fuel supply pump operation. **Notice:** **The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM.** • Perform the Cylinder Balance Test with a scan tool. • Perform the Injector Forced Drive with a scan tool. • Observe the Fuel Compensation for each cylinder at idle on the scan tool.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Air cleaner, air intake ducts and charge air cooler for a restriction, holes, or leaks. • A restriction in the turbocharger inlet duct. • Intake throttle valve for a stuck condition. • A restriction or leak in the intake manifold. • Carry out the eddy currnt control test with the fault diagnostic meter. Check the membrane valve working conditions when on/off command is implemented. • A worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Refer to Turbocharger Assembly in Section 1J Induction. • Turbocharger nozzle control solenoid for a stuck condition. Refer to Turbocharger Assembly in Section 1J 4HK1 Induction.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to Exhaust System in Section 1G 4HK1 Engine Exhaust.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to Section 1B 4HK1 Engine Mechanical. • Poor cylinder compression. • Improper valve gap. • Broken or weak valve springs. • Worn camshaft lobes.
Additional Checks	• Inspect the EGR system operating correctly. Refer to EGR Control System Check in this section. • Inspect for an engine overheat condition. Refer to Cooling System in Section 1C 4HK1 Engine Cooling. • Inspect the A/C operation.

Hesitation, Sag or Stumble

Checks	Action
Definition: The vehicle has a momentary lack of response when pushing down on the accelerator. The condition can occur at any vehicle speed. The condition is usually most severe when trying to make the vehicle move from a stop. If severe enough, the condition may cause the engine to stall.	
Preliminary Checks	• Diagnostic System Check - Engine Controls. • Compare the vehicle with a similar unit. Ensure the vehicle has an actual problem. • Remove the air cleaner and check for dirt, or for air ducts being plugged orrestricted. Replace as necessary. • Inspect for a proper transmission shift pattern and down shift operation. • Inspect the fuel quality (cetane index). • Inspect the engine oil level and quality. • Inspect the ECM grounds for being clean, tight, and in their proper locations. • Inspect the programmed fuel injector ID code for each cylinder. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to Scan Tool Data List in this section. • Compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) parameters on a cold engine condition. If the difference among temperature reading is more than 5℃ on a cold engine, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure Sensor parameter with the engine OFF. The FRP Sensor should read 0.9 to 1.0 volt with the ignition switch ON and engine OFF after the engine has stopped running for a minimum of 1 minute. If not, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure and Desired Fuel Rail Pressure parameter between idle and W.O.T. (accelerator pedal full travel) in Neutral. Fuel Rail Pressure parameter should follow within ± 5 MPa quick enough. • Observe the Accelerator Pedal Position (APP). APP parameter should change linearly from 0 to 100% according to the accelerator pedal operation. • Observe the Boost Pressure and Barometric Pressure (BARO) with ignition ON and engine OFF. Both parameters should be within the 7.0 kPa each other. • Crankshaft position (CKP) sensor is tight and the sensor rotor is not damaged.

Checks	Action
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to Fuel System Check chart and appropriate procedure in Section 1D 4HK1 Engine Fuel. • Air in the fuel system. • Water contamination in the fuel. • External fuel leaks or high engine oil level. • Fuel leak off from the fuel pressure limiter valve and fuel injectors. • Fuel lines between the fuel tank and fuel supply pump for being crushed, kinked, tightness, cracks and plugged. • A plugged fuel tank vent hose. • Inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. • Fuel supply pump operation. **Notice:** **The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM.** • Perform the Cylinder Balance Test with a scan tool. • Perform the Injector Forced Drive with a scan tool. • Observe the Fuel Compensation for each cylinder at idle on the scan tool.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Air cleaner, air intake ducts and charge air cooler for a restriction, holes, or leaks. • A restriction in the turbocharger inlet duct. • Intake throttle valve for a stuck condition. • A restriction or leak in the intake manifold. • A worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Refer to Turbocharger Assembly in Section 1J 4HK1 Induction.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to Exhaust System in Section 1G 4HK1 Engine Exhaust.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to Section 1B 4HK1 Engine Mechanical. • Poor cylinder compression. • Improper valve gap. • Broken or weak valve springs. • Worn camshaft lobes.
Additional Checks	• Inspect the EGR system operating correctly. Refer to EGR Control System Check in this section. • Inspect for an engine overheat condition. Refer to Cooling System in Section 1C 4HK1 Engine Cooling. • Inspect the A/C operation.

Abnormal Combustion Noise

Checks	Action
Definition: A mild to severe ping, usually worse under acceleration. The engine makes sharp metallic knocks that change with the throttle opening.	
Preliminary Checks	• Diagnostic System Check - Engine Controls. • Ensure the vehicle has an actual problem. • Inspect for smoke associated with the combustion noise. • Inspect the fuel quality (cetane index). • Inspect the programmed fuel injector ID code for each cylinder. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to Scan Tool Data List in this section. • Compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) parameters on a cold engine condition. If the difference among temperature reading is more than 5°C on a cold engine, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure Sensor parameter with the engine OFF. The FRP Sensor should read 0.9 to 1.0 volt with the ignition switch ON and engine OFF after the engine has stopped running for a minimum of 1 minute. If not, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure and Desired Fuel Rail Pressure parameter between idle and W.O.T. (accelerator pedal full travel) in Neutral. Fuel Rail Pressure parameter should follow within ± 5 MPa quick enough. • Crankshaft position (CKP) sensor is tight and the sensor rotor is not damaged.
Fuel System Checks	• If excessive smoke is present, check for a stuck open fuel injector. Inspect for fuel leakage into the combustion chamber. • Inspect the fuel injectors. Remove the injectors and visually inspect. • Perform the Cylinder Balance Test with a scan tool. • Perform the Injector Forced Drive with a scan tool. • Observe the Fuel Compensation for each cylinder at idle on the scan tool.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to Section 1B 4HK1 Engine Mechanical. • Poor cylinder compression. • Incorrect basic engine parts such as camshaft, cylinder head, pistons, etc. • Inspect for any excessive oil entering combustion chamber.
Additional Checks	• Inspect other possible causes that can make similar noise such as loose component parts, bracket, mount and weak clutch damper spring.

Poor Fuel Economy

Checks	Action
Definition: Fuel economy, as measured by actual road tests and several tanks of fuel, is noticeably lower than expected. Also, the economy is noticeably lower than it was on this vehicle at one time, as previously shown by actual road tests.	
Preliminary Checks	• Remove the air cleaner and check for dirt, or for air ducts being plugged or restricted. Replace as necessary. • Inspect the driving habits of the owner. • Is the A/C ON full time, defroster mode ON? • Are the tires at the correct pressure? • Are the tire sizes changed? • Are excessively heavy loads being carried? • Is the acceleration too much, too often? • Inspect for clutch slip. • Inspect brake drag. • Inspect dive belt tension. • Inspect for a proper transmission shift pattern and down shift operation (Smoother only). • Inspect the fuel quality (cetane index). • Inspect the engine oil level and quality. • Suggest to the owner to fill the fuel tank and recheck the fuel economy. • Inspect the odometer is correctly operated. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to Scan Tool Data List in this section. Compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) parameters on a cold engine condition. If the difference among temperature reading is more than 5°C on a cold engine, check for high resistance in each circuit or for a skewed sensor.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to Fuel System in Section 1D 4HK1 Engine Fuel. • Fuel type and quality. • Check fuel leak.
Cooling System Checks	Inspect the cooling system for the following conditions. • Engine coolant level. • Engine thermostat for always being open or for the wrong heat range. • Engine cooling fan for always being ON.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Air cleaner, air intake ducts and charge air cooler for a restriction, holes, or leaks. • A restriction in the turbocharger inlet duct. • Intake throttle valve for a stuck condition. • A restriction or leak in the intake manifold. • A worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Refer to Turbocharger Assembly in Section 1J 4HK1 Induction.

Checks	Action
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to Exhaust System in Section 1G 4HK1 Engine Exhaust.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to Section 1B 4HK1 Engine Mechanical. • Poor cylinder compression. • Improper valve gap. • Broken or weak valve springs. • Worn camshaft lobes.

Excessive Smoke (Black Smoke)

Checks	Action
Definition: Black smoke under load, idle or start up hot or cold.	
Preliminary Check	• Ensure the vehicle has an actual problem. • Inspect the ECM grounds for being clean, tight, and in their proper locations. • Remove the air cleaner and check for dirt, or for air ducts being plugged or restricted. Replace as necessary. • Inspect the fuel quality (cetane index). • Inspect the engine oil level and quality. • Inspect the programmed fuel injector ID code for each cylinder. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to Scan Tool Data List in this section. • Compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) parameters on a cold engine condition. If the difference among temperature reading is more than 5°C on a cold engine, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure Sensor parameter with the engine OFF. The FRP Sensor should read 0.9 to 1.0 volt with the ignition switch ON and engine OFF after the engine has stopped running for a minimum of 1 minute. If not, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure and Desired Fuel Rail Pressure parameter between idle and W.O.T. (accelerator pedal full travel) in Neutral. Fuel Rail Pressure parameter should follow within ± 5 MPa quick enough. • Observe the Accelerator Pedal Position (APP). APP parameter should change linearly from 0 to 100% according to the accelerator pedal operation. • Observe the Boost Pressure and Barometric Pressure (BARO) with ignition ON and engine OFF. Both parameters should be within the 7.0 kPa each other.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to Fuel System in Section 1D 4HK1 Engine Fuel. • Fuel injectors. Remove the injectors and visually inspect. • Perform the Cylinder Balance Test with a scan tool. • Perform the Pre Injection Control with a scan tool. • Observe the Fuel Compensation for each cylinder at idle on the scan tool.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Air cleaner, air intake ducts and charge air cooler for a restriction, holes, or leaks. • A restriction in the turbocharger inlet duct. • Intake throttle valve for a stuck condition. • A restriction or leak in the intake manifold.• A worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Refer to Turbocharger Assembly in Section 1J Induction.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to Exhaust System in Section 1G 4HK1 Engine Exhaust.

Checks	Action
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to Section 1B 4HK1 Engine Mechanical. • Inspect for poor cylinder compression. • Improper mechanical timing (timing gear). • Improper valve gap. • Broken or weak valve springs. • Worn camshaft lobes. • Any excessive oil entering combustion chamber.
Additional Checks	• EGR system operating correctly. Refer to EGR Control System Check in this section. • Excessive blow-by gasses.

Excessive Smoke (White Smoke)

Checks	Action
Definition: White smoke under load, idle or start up hot or cold.	
Preliminary Check	• Ensure the vehicle has an actual problem. • Inspect the ECM grounds for being clean, tight, and in their proper locations. • Inspect the fuel quality (cetane index). • Inspect the programmed fuel injector ID code for each cylinder. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to Scan Tool Data List in this section. • Compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) parameters on a cold engine condition. If the difference among temperature reading is more than 5°C on a cold engine, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure Sensor parameter with the engine OFF. The FRP Sensor should read 0.9 to 1.0 volt with the ignition switch ON and engine OFF after the engine has stopped running for a minimum of 1 minute. If not, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure and Desired Fuel Rail Pressure parameter between idle and W.O.T. (accelerator pedal full travel) in Neutral. Fuel Rail Pressure parameter should follow within ± 5 MPa quick enough. • Observe the Accelerator Pedal Position (APP). APP parameter should change linearly from 0 to 100% according to the accelerator pedal operation. • Observe the Boost Pressure and Barometric Pressure (BARO) with ignition ON and engine OFF. Both parameters should be within the 7.0 kPa each other. • Crankshaft position (CKP) sensor is tight and the sensor rotor is not damaged.
Fuel System Checks	Check the fuel system for the following conditions. Refer to fuel system in Chapter ID fuel system 4HK1. • Fuel injectors. Remove the injectors and visually inspect. • Perform the Cylinder Balance Test with a scan tool. • Perform the Pre Injection Control with a scan tool. • Observe the Fuel Compensation for each cylinder at idle on the scan tool.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Air cleaner, air intake ducts and charge air cooler for a restriction, holes, or leaks. • A restriction in the turbocharger inlet duct. • Intake throttle valve for a stuck condition. • A restriction or leak in the intake manifold. • A worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Oil leak from turbocharger. Refer to Turbocharger Assembly in Section 1J 4HK1 Induction.

Checks	Action
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to Section 1B 4HK1 Engine Mechanical. • Poor cylinder compression. • Improper mechanical timing (timing gear). • Improper valve gap. • Broken or weak valve springs. • Worn camshaft lobes. • Any excessive oil entering combustion chamber.
Electrical System Checks	• Glow plug control (preheating) system operation. Refer to Glow Control System Check in this section.

Main sensor parameters

Sensor resistor temperature characteristics

Engine coolant temperature

Temperature (℃)	Resistance value (Ω)
110	160
100	200
90	260
80	350
70	470
60	640
50	880
40	1250
30	1800
20	2650
10	4000
0	6180
-10	9810
-20	16000
-30	27000

Intake air temperature

Temperature (℃)	Resistance value (Ω)
90	240
80	320
70	430
60	590
50	810
40	1150
30	1650
20	2430
10	3660
0	5650
-10	8970
-20	147000

The fuel temperature

Temperature (℃)	Resistance value (Ω)
110	140
100	180
90	240
80	310
70	420
60	580
50	810
40	1150
30	1660
20	2450
10	3700
0	5740
-10	9160
-20	15000
-30	25400

Exhaust temperature

Temperature (℃)	Resistance value (Ω)
1000	115-127
950	130-143
900	147-163
850	167-187
800	192-219
750	226-258
700	267-309
650	333-360
600	406-442
550	504-552
500	640-709
450	835-937
400	1130-1280
350	1590-1850
300	2360-2830
200	6230-7830
150	11900-16300
100	27600-41200
50	82000-137000

Altitude and sensor pressure

Altitude (m)	Atmospheric pressure（kPa）
4267	56-64
3962	58-66
3658	61-69
3353	64-72
3048	66-74
2743	69-77
2438	71-79
2134	74-82
1829	77-85
1524	80-88
1219	83-91
914	87-95
610	90-98
305	94-102
0	96-104
-305	101-105

Special Tools and Equipment

Illustration	Tool Number/ Description
	5-8840-2691-0 Digital Multimeter
	Tech2 Diagnostic instrument
	Tech2 Volt Adapter 2
	5-8840-2835-0 Connector Test Adapter Kit
	5-8840-0632-0 Terminal puller
	5-8840-0388-0 Water package terminal puller

Programming

Programming rule

Ensure to write the data in ECM (programming) after replacing ECM, injector and DPD.

Items to be confirmed before programming

Conform the following items upon programming as needed.

• Engine model

• Injector ID code

Situation requiring programming

Carry out programming after replacing the following components.

•ECM

• Engine (model, output partition modification)

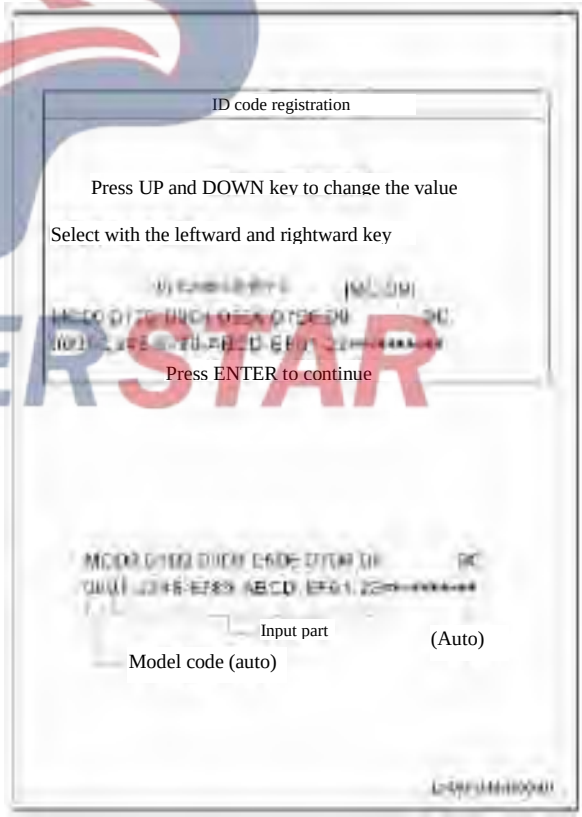
• Injector

Item		How to use
F0: Injector ID code	F0: Injector ID code	Ensure the injector ID code is programmed to each cylinder.
	F1: register ID code	Use it when registering injector ID code after ECM is replaced, when the data cannot be uploaded from the old ECM or after the injector is replaced.
	F2: upload ID code (Tech2)	Use it when read data from the old ECM to the fault diagnostic meter upon ECM replacement.
	F3: Download ID code (ECM)	Use it when register (write) the data to the new ECM from the fault diagnostic meter after replacing ECM.

Programming

Registration of injector ID code

1. Connect the fault diagnostic meter.
2. Turn on the starter switch.
3. Select "diagnose" > vehicle identification > "engine" > "4HK1-TC (C/Rail)" > "programming "> "injector ID code" > "ID code registration".
4. After the next screen displays, ensure the engine stops and then press [ENTER].
5. Select the cylinder of which the ID code will be registered (No. 1 to No. 4) and press [ENTER]. (Here is the example of No.1 cylinder.)
6. If the previously registered ID code is displayed, press [MOD].
7. If the input data bytes of ID code [MC-D9] are all entered, press [ENTER]. (The model code (MC) and BCC code (BC) are automatically registered by the fault diagnostic meter and do not require entering.)



8. After the next screen displays, ensure the input ID code is correct and press [PROG].

To terminate programming (registration), press [INT] or [EXIT] to return step 2.

9. If the entered value is incorrect, the screen will display "data invalid - enter again". Then press [ENTER] to enter again.

10. If the entered ID code is consistent with that registered to ECM, the screen will display "programming finished!”

To continue ID code registration, press [YES].

11. If the entered ID code is not consistent with that registered to ECM, the screen will display "programming failed!” Press [END] and start ID code registration again.

Upload injector ID code (Tech2)

1. Connect the fault diagnostic meter.
2. Turn on the starter switch.
3. Select "diagnose" > vehicle identification > "engine" > " 4HK1-TC (C/Rail)" >4 'Programming'>"injector ID code" "upload ID code (Tech2)".
4. Press [YES] to upload.
5. After upload completes, the screen will display "Upload finished!". Press the [ENTER] button.
6. After upload fails, the screen will display "Upload failed!". Press [ENTER] to upload again.

Download ID code (ECM)

1. Connect the fault diagnostic meter.
2. Turn on the starter switch.
3. Select "diagnose" > vehicle identification > "engine" > "4HK1-TC (C/Rail)" > "programming "> "injector ID code" > “Download ID code (ECM)”.
4. After the next screen displays, ensure the engine is stopped and then press [ENTER].
5. Press [YES] and then the uploaded ID code (No.1 to No.4 cylinder) will be downloaded (registered) to ECM.
6. If the download is normal, switch to the next screen when the No.4 cylinder registration screen is displayed. If the download is abnormal, switch to the next screen after repeating the registration of No. 1 to No.4 cylinder for 3 times.
7. If the download is normal, the screen will display "Programming finished!". Press on the [ENTER] button.
8. If the download fails, the screen will display "Programming failed!". Press [ENTER] to download again.

4HK1 engine

Precautions

To avoid engine damage and engine operation, pay attention to the following points when servicing the engine. Also, see an overview of the appropriate safety actions.

• When lifting the engine or supporting the engine, the jack cannot directly support the jack.

When the engine is placed on the ground, instead of directly on the oil sump on the ground, open, etc., to use the engine block and the lower part of the flywheel housing. (The gap between the oil sump and the oil pump filter is small, so it does not damage the oil sump and the oil pump filter).

• When removing intake system components such as the intake manifold or air filter, cover the air intake to prevent foreign matter from entering the cylinder.

• The battery ground terminal must be removed when servicing the main unit. If you work without removing the battery ground terminal, the harness or electrical components may be damaged. When checking the power supply during the inspection, special care must be taken to avoid short circuits.

• To protect and lubricate the slider surface during initial operation, apply sufficient oil to the sliding surface.

• Disassemble valve related parts, fuel injectors, pistons, piston rings, connecting rods and ordinary crankshaft bearings for organization and storage.

• When installing, put the same part to its original position before disassembling.

• After removing gaskets, oil seals, O-rings, etc., new parts must be used when reinstalling.

• Where liquid sealants are used, remove the old liquid sealant first, do not allow oil, moisture, dirt, etc. To adhere to it, and then apply the specified liquid sealant.

• After using the liquid sealant, install it within the specified time. If the specified installation time is exceeded, remove the sealant and reuse it.

• When assembling and installing, tighten to the specified torque.

The engine operation precautions

Inside the ejector, the holes and clearances of the fuel passage of the fuel system are precisely machined. If foreign matters are mixed, it is likely to cause malfunction. Therefore, after the parts are disassembled, be sure to cover the dust cover to prevent foreign matter from entering the room. .

Service announcement

Method of using a plastic line gap gauge

Type	Measurable range (mm)
PG-1(Green)	0.025∽0.076
PR-1(Red)	0.051∽0.152
PB-1(Blue)	0.102∽0.229

<Example> Measuring Method of Rod Bearing Clearance and Crank Pin

• Clean the connecting rod and bearing and assemble it to the connecting rod.

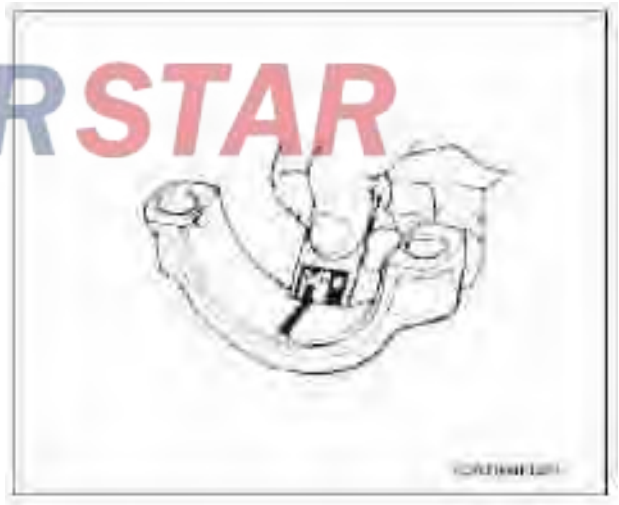
• Place the air gap gauge parallel to the crankpin width to avoid crankshaft pin holes.

• Assemble the fingerprint of the bearing cap alignment mark on the contact surface of the mop coated with molybdenum disulfide and the threaded part of the fixing bolt, and alternately tighten the stopper to reach the predetermined torque.

Mark:

When measuring with a plastic gap gauge, the connecting rod must not be moved.

• Slowly loosen the bearing cap and connecting rod and measure the width (gap) of the plastic gauge according to the scale printed on the plastic gauge.



<Example> Crankshaft bearing clearance measurement and crankshaft journal

• Clean the cylinder block, crankcase mounting surfaces and bearings and assemble them to the cylinder block and crankcase.

• Gently attach the crankshaft to the cylinder block and turn it approximately 30° to fix it.

• Place the air gap meter parallel to the width of the crankshaft journal to avoid oil holes in the trunnion.

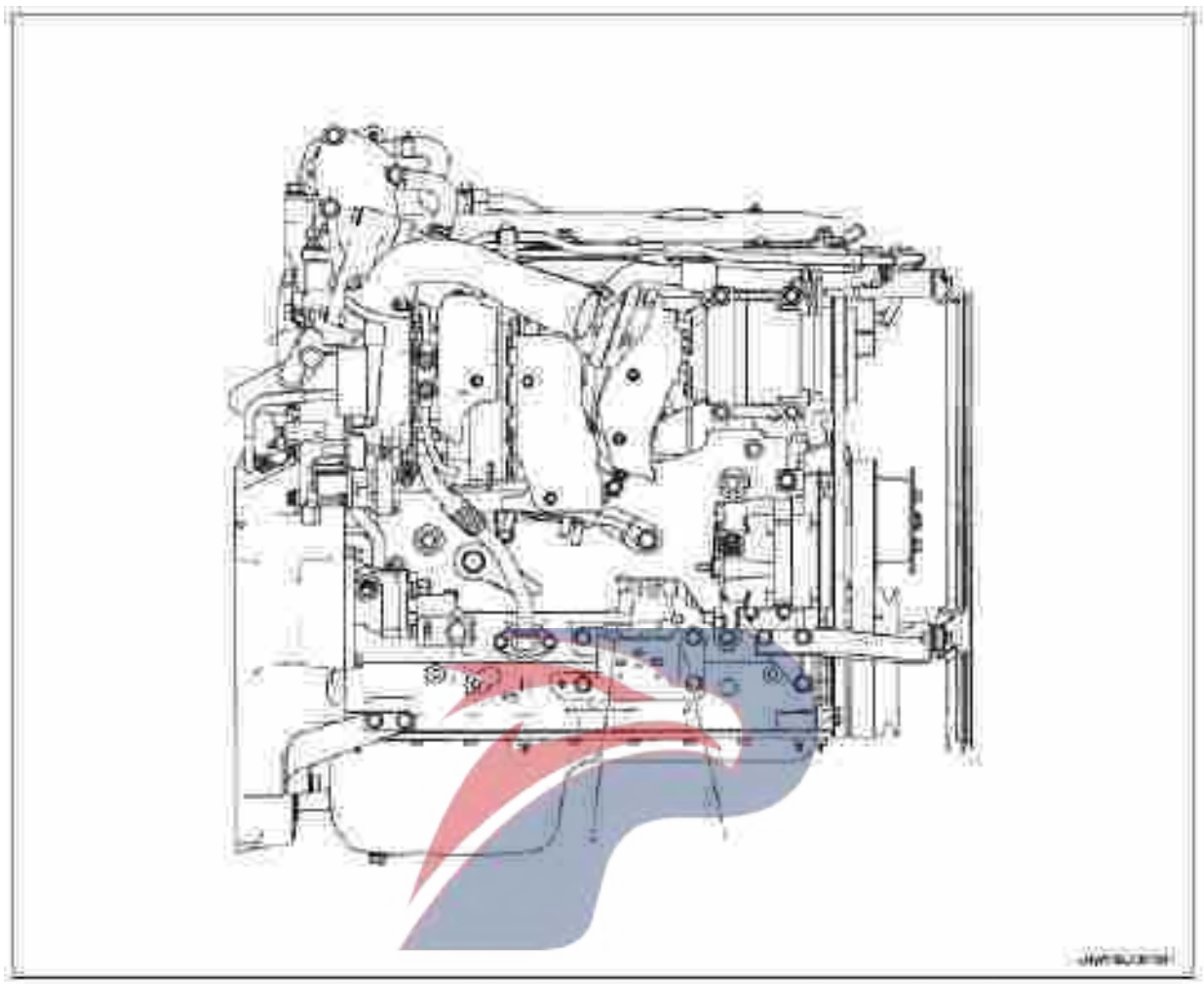
• Slightly adhere to the housing on the cylinder block, apply the contact surface of molybdenum disulfide and the threaded part of the fixing bolts, and then clamp the required clamping torque sequence.

Mark:

The crankshaft must not rotate during the use of plastic gauges.

• Carefully remove the housing and measure the width (gap) of the plastic gauge according to the scale printed on the plastic gauge.

Model reading method

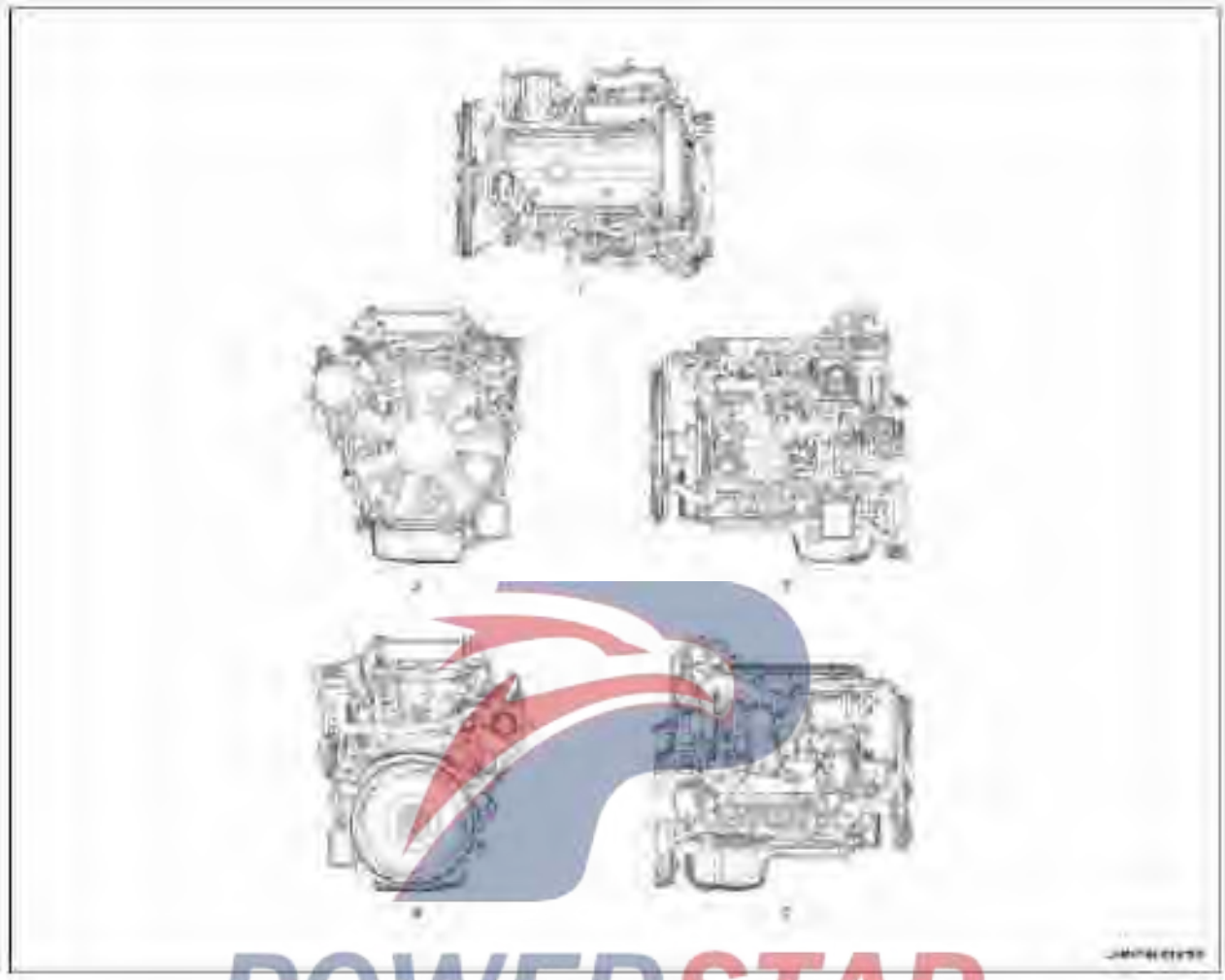


Key

1. Engine model(4HK1)
2. Marked with engine number (******)

Function and working principle

Engine appearance



Key

1. Above
2. Positive
3. Left side
4. Behind
5. Right side

Function and working principle

Electronically controlled engine control system

The intake air, the intake throttle of the exhaust gas, the fuel injection amount of the idle speed, etc., injection timing, and EGR are used to control the injection engine control module (ECM).

Cylinder block

The cylinder block is cast iron, each cylinder has the same spacing and is symmetrical with respect to the center of the crankshaft, and the rigidity is very high. The bearing cap is a trapezoidal frame structure and is fixed by an angle fixing method.

Cylinder

In order to select the cylinder liner corresponding to the inner diameter of the cylinder block body for assembly, the cylinder is hatched on the left side.

Piston

The piston is an aluminum alloy product and is a controlled thermal expansion piston with a cast iron support. The combustion chamber is a circular chamber.

Cylinder head

The cylinder head is made of cast iron parts with 4 valves per cylinder. Bolt bolts are fixed by angle.

Crankshaft

The crankshaft is diffusion nitrided and the height of each trunnion diameter is printed on the first counterweight.

Connecting rod cover bolt

The fixing bolts of the connecting rod bearing cover are fixed by the bracket.

Common Rail Electronic Control Injection System

The rail type common fuel injection system controlled by the preset set point pressure and the high pressure fuel supply pump oil is maintained in the high pressure common rail fuel injection and after the pressure of the refinery high pressure fuel injector assembly. The ECM controls the injection time and injection amount under all driving conditions based on various signals.

Injector

The injector is a multi-hole nozzle and the injection amount and injection time are adjusted by controlling the opening and closing of the solenoid valve at the injector head.

Fuel filter with oil-water separator

In the fuel filter, there is a separator that uses the difference in fuel and water density to remove moisture and provides an indicator of water deposition.

EGR device

The ECM controls EGR based on information such as water temperature, engine speed, engine load, etc. So that it recirculates a portion of the exhaust gas to purify the gas. Exhaust.

The main components of the EGR device are the EGR valve, EGR cooler, exhaust brake valve and various sensors.

Lubrication system

In the full-path bypass oil filter, the oil passes through the oil cooler and flows from the oil circuit to each lubrication point.

Warming-up control system

The temperature increase control system is a system that can make it easier to start the engine at a low temperature and reduce white smoke and noise generated after starting. After the start switch is activated, the ECM detects the coolant temperature of the engine based on the signal transmitted by the sensor engine coolant temperature (ECT) to adjust the warm-up time to obtain proper start conditions. In addition, the idle speed after startup can be stabilized by using the post-heating function. The ECM determines the warm-up time based on the engine coolant temperature so that the warm-up relay and the warm-up lamp light up.

Functional check:

Check and adjust valve clearance

1. Check the valve clearance

Mark:

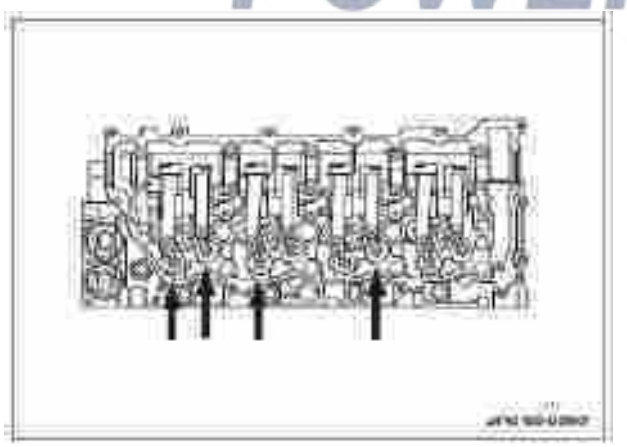
This must be done in the cold state of the engine.

Valve clearance	
Intake valve	0.4 mm
Exhaust valve	0.4 mm

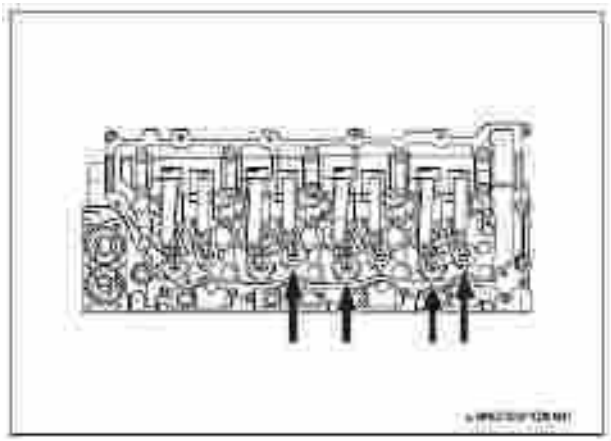
• When the first cylinder is compressed at top dead center, the square table lashes and when the fourth cylinder is compressed at the top of the neutral position, the label of the eyelashes X in the table is checked.

Number of cylinders	1		2		3		4	
Valve	Inside	Row	Inside	Row	Inside	Row	Inside	Row
The 1st cylinder is located at the compression top dead center	○	○	○			○		
The 4th cylinder is located at the compression top dead center				X	X		X	X

The first cylinder is in the check position of compression top dead center

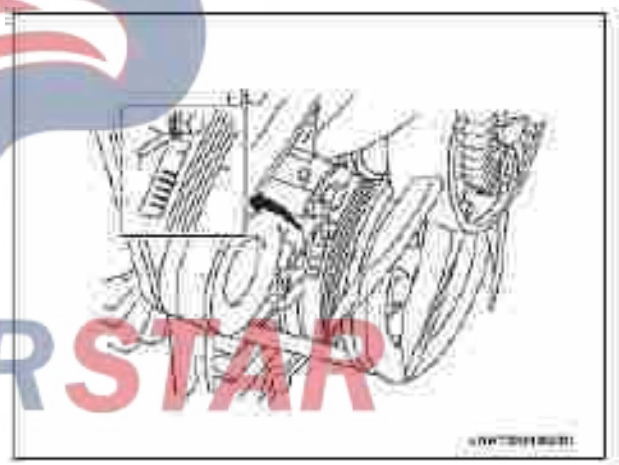


The 4th cylinder is in the check position of compression top dead center



a. Place the first cylinder of the engine on the compression stop point.

• Turn the crankshaft so that the mark on the crankshaft pulley is aligned with the BTDC 0° front mark.



b. Insert the feeler gauge into the gap between the rocker arm and the deck cover and measure the gap.

c. Place the 4th cylinder of the engine on the compression stop point.

• Rotate the crankshaft crank by 360° and align the crankshaft pulley mark with the 0°BTDC mark on the front cover.

d. Insert the feeler gauge into the gap between the rocker arm and the deck cover and measure the gap.

e. Adjust the valve clearance when the measured value is out of the specified range.

2. Adjust the valve clearance

Valve clearance	
Intake valve	0.4 mm
Exhaust valve	0.4 mm

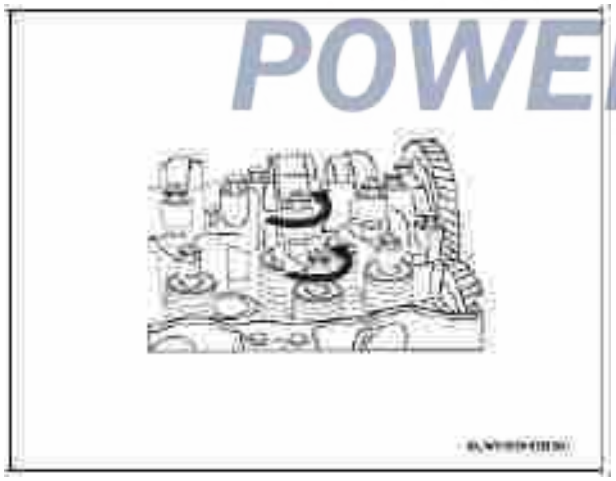
• When the first cylinder is in the top dead center compression, adjust the eyelash label O in the table. If the fourth cylinder is at the top of the dead point compression, adjust the label of the eyelash X in the table.

Number of cylinders	1		2		3		4	
Valve	Inside	Row	Inside	Row	Inside	Row	Inside	Row
The first cylinder is located at the compression top dead center	O	O	O			O		
The 4th cylinder is located at the compression top dead center				X	X		X	X

Mark:

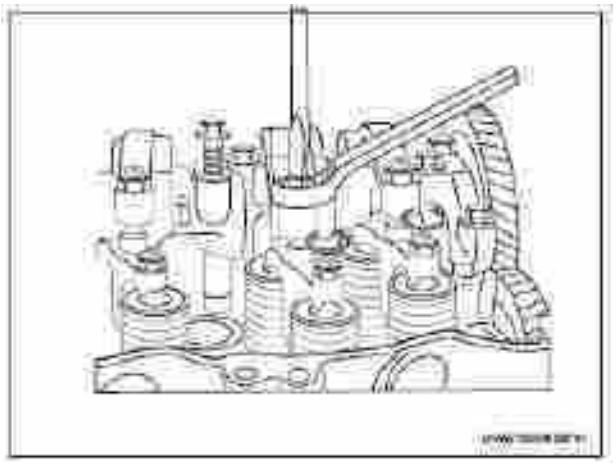
Adjust the bridge to horizontal (contact the two valve shaft ends)

a. Fully release the bridge and rocker arm adjustment screws.

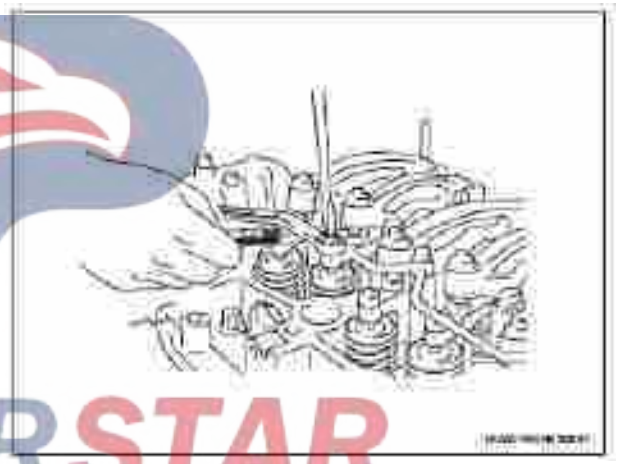


b. Inserts the front end of the 0.4 mm probe into the rocker arm (valve side), and between the cover (assembled on the bridge), the set screw is screwed into the rocker arm, and the swing arm is used to adjust the retaining nut when the probe is not easily moved.

Tightening torque : 22 N•m {2.2kgf•m}



c. With the feeler gauge inserted, gently tighten the bridge adjustment screw and check that the front end of the adjustment screw is in contact with the valve shaft end and the feeler is not easily moved.

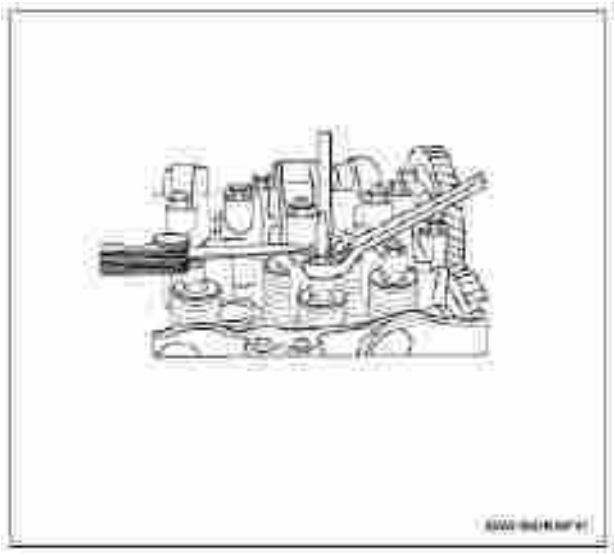


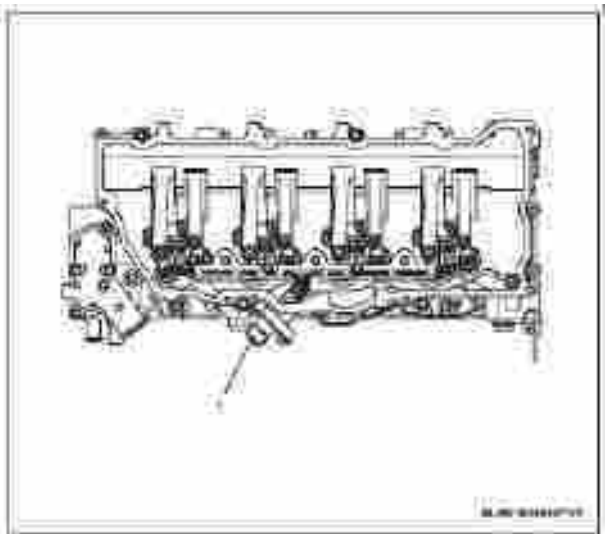
d. Then check if the end of the valve shaft on the other side is lifted and tilted. If the end of the stem is raised or tilted, loosen the adjustment screws slightly and readjust the stem ends on both sides for accurate contact.

Valve bridge clearance: less than 0.1 mm

e. When adjusting the valve shaft ends on both sides for accurate contact, in order not to make the bridge adjustment screw turn, use a flathead screwdriver to fix and tighten the fixing nut on the adjustment screw of the bridge.

Tightening torque : 22 N•m {2.2kgf•m}





Key

1. Harness connector

Mark:

If the bridge adjustment screw is not properly adjusted, the bridge will be pressed down, causing the bridging tube to jam and bridge and other malfunctions, so precise adjustments must be made.

Check compression force

1. Pre-warm engine.
2. Remove the battery's negative terminal and remove all glow plugs.
3. Remove the sprayer harness connector installed on the lower head of the cylinder head. (do not inject fuel)

Mark:

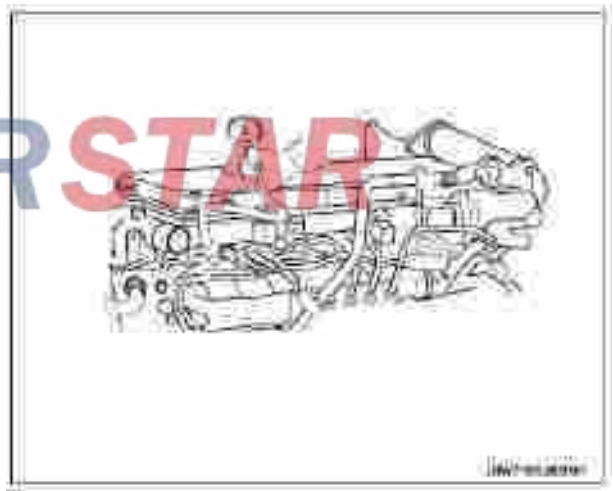
After removing the harness connector, the ECM will judge it as a fault and save the DTC. Remove the DTC after the measurement is completed. For the DTC disassembly method, see Engine Control System in Chapter IA Motor Control System (4HK1).

4. Install the battery's negative terminal.
5. Rotate the starter and remove the debris from the cylinder.
6. Install a special tool - cylinder pressure gauge adapter and pressure gauge.

Special tools

Cylinder pressure gauge adapter: 5-8840-2815-0

Cylinder pressure gauge: 5-8840-2675-0



7. Rotate the starter and check the compression pressure.

Compression pressure	kPa (kg/cm2)/ rpm
Standard value	2.75±0.15 {28±1.5}/220 2.65±0.15 {27±1.5}/185 2.55±0.15 {26±1.5}/150
Standard value	2.16 {22}
Differences per cylinder	294kPa{3.0}

• Measure each cylinder in turn.

Mark:

To keep the engine speed above 200 rpm, use a fully charged battery.

8. Remove the pressure gauge from the cylinder.

9. Remove the battery's negative terminal.

10. Assemble the injector harness connector installed on the cylinder head bottom cover.

11. Install all glow plugs.

Tightening torque : 20 N•m {2.0kgf•m}

12. Install the battery's negative terminal.

Overhaul time

Increased consumption of oil

If you calculate the fuel consumption of the new car (the distance traveled by the IL oil) to be 100%, you must perform the revision when the consumption is less than 50%.

Increased fuel consumption rate

If the fuel consumption (km / L) at the time of the new vehicle is calculated at 100%, the modification must be made when the consumption rate drops below 60%.

Engine internal noise

When abnormal noise occurs inside the engine, major repairs should be carried out as soon as possible.

※ Abnormal noise can be explained by different reasons: If the engine parts are worn, it is mainly due to heat accumulation or foreign matter.

Tightening torque - Overview

• Engine is not running

• The engine is running but does not start

• Emission of black smoke

• White smoke is emitted from the exhaust pipe.

• Engine explosion

• Engine rotation error

• Poor load

Phenomenon: The engine does not run.

Phenomenon	Probable causes	Treatment measures
Starter does not turn	Battery discharged completely	Charge or replace battery
	Battery relay failure	Replace
	Harness bad contact	Connection or repair
	Start host failure	Check the starter and replace if it fails
Starter rotates but steering wheel does not rotate	Ring wear	Repair or replace
	Incorrect starter's magnetic switch adjustment	Adjustment or repair
Although the starter drive sprocket meshes with the crown, the engine does not rotate	Battery discharged completely	Charge or replace battery
	Idle terminal of wiring circuit	Repair
	Start host failure	Check the starter and replace if it fails
	The engine is hot inside	Decomposition and maintenance

Phenomenon: Engine rotation but does not start

Phenomenon	Probable causes	Treatment measures
Fuel is not supplied at the pump	Mixed air in the fuel system	Exhaust
	Fuel line air mixing	Exhaust or replace
	No fuel	Supplement
	Filter cover at fuel inlet	Clean or replace
	Fuel line blockage	Clean or replace
	Fuel pump failure	Replace
	Cold period = Fuel cannot be used in cold areas	Replace with the appropriate fuel
	Fuel filter blockage	Replace
	Engine control system failure	For diagnosis of the engine control system, see Section IA Engine Control System (4HK1) - Engine Control System
Fuel reaches the pump	Relax fuel hose connection	Tighten the connection
	Bad safety valve seal	Replace
	Internal pump failure	Replace
	Bad connection or disconnection	Repair or replace
	Engine control system failure	For diagnosis of the engine control system, see Section IA Engine Control System (4HK1) - Engine Control System
Insufficient fuel injection and instability	Mixed air in the fuel system	Exhaust
	Fuel line blockage	Clean or replace
	Feed pump performance is poor	Replace
	Injector connection nozzle	Replace
	Bad connection or disconnection	Repair or replace
	Fuel filter blockage	Replace
	Engine control system failure	For diagnosis of the engine control system, see Section IA Engine Control System (4HK1) - Engine Control System

Phenomenon: Black smoke is emitted from the exhaust pipe.

Phenomenon	Probable causes	Treatment measures
Inaccurate injection time	Motor control system is abnormal	For diagnosis of the engine control system, see Section IA Engine Control System (4HK1) - Engine Control System
Abnormal injector	Nozzle bonding	Replace
	Motor control system is abnormal	For diagnosis of the engine control system, see Section IA Engine Control System (4HK1) - Engine Control System
Abnormal compression pressure	Valve clearance is too large	Adjustment
	Valve stem sticking (valve open)	Decomposition and maintenance
	Valve spring abnormalities	Replace
	Valve seat wear	Decomposition and maintenance
	Due to piston ring abnormal compression leakage	Decomposition and maintenance
	Bad seal pad	Decomposition and maintenance
	Piston heating	Decomposition and maintenance
Abnormal fuel	Water and fuel mixing	Replace
	Poor fuel used	Replace
Admission is abnormal	Block the intake pipe	Repair or replace
	Air filter element is blocked	Clean or replace
	Adhesion of gas	Decomposition and maintenance
Discovered engine control system failure	Abnormalities such as sensors	Repair or replace
	Motor control system is abnormal	For diagnosis of the engine control system, see Section IA Engine Control System (4HK1) - Engine Control System
EGR, abnormal intake	Intake gas manifold	Repair or replace
	EGR valve combination	Repair or replace
	Exhaust brake valve combination	Repair or replace
	Motor control system is abnormal	For diagnosis of the engine control system, see Section IA Engine Control System (4HK1) - Engine Control System

Phenomenon: White smoke is emitted from the exhaust pipe.

Phenomenon	Probable causes	Treatment measures
Inaccurate injection time	Motor control system is abnormal	For diagnosis of the engine control system, see Section IA Engine Control System (4HK1) - Engine Control System
Discovered engine control system failure	Abnormalities such as sensors	Replace
	ECM abnormality	Replace
	Motor control system is abnormal	For diagnosis of the engine control system, see Section IA Engine Control System (4HK1) - Engine Control System
Abnormal compression pressure	Valve clearance is too large or too small	Adjustment
	Valve stem sticking (valve open)	Decomposition and maintenance
	Valve spring abnormalities	Replace
	Valve seat wear	Decomposition and maintenance
	Due to piston ring abnormal compression leakage	Decomposition and maintenance
	Bad seal pad	Decomposition and maintenance
	Piston heating	Decomposition and maintenance
Abnormal fuel	Water and fuel mixing	Replace
High fuel consumption	Piston ring wear	Decomposition and maintenance
	Valve seal is not good	Decomposition and maintenance

Phenomenon: Engine explosion

Phenomenon	Probable causes	Treatment measures
Inaccurate injection time	Motor control system is abnormal	For diagnosis of the engine control system, see Section IA Engine Control System (4HK1) - Engine Control System
Discovered engine control system failure	Abnormalities such as sensors	Replace
	ECM abnormality	Replace
	Motor control system is abnormal	For diagnosis of the engine control system, see Section IA Engine Control System (4HK1) - Engine Control System
Abnormal fuel	Poor fuel used	Replace
Admission is abnormal	Into the inlet hose	Repair or replace
	Motor control system is abnormal	For diagnosis of the engine control system, see Section IA Engine Control System (4HK1) - Engine Control System
Engine failure	Gas cylinders have foreign bodies	Repair or replace
	Pistons, bearings, etc.	Repair or replace

Phenomenon: Engine rotation error

Phenomenon	Probable causes	Treatment measures
No increase in speed	ECM abnormality	Replace
	Motor control system is abnormal	For diagnosis of the engine control system, see Section IA Engine Control System (4HK1) - Engine Control System
Rotational instability	ECM abnormality	Replace
	Motor control system is abnormal	For diagnosis of the engine control system, see Section IA Engine Control System (4HK1) - Engine Control System
	Fuel filter element blockage	Replace the filter element
	Abnormal injector	Replace
	Water and fuel mixing	Replace
	Mixed air in the fuel system	Exhaust
	Exhaust brake valve combination	Repair or replace
	Intake gas manifold	Repair or replace

Phenomenon: Poor charging

Phenomenon	Probable causes	Treatment measures
Do not load	Broken wires, short circuit or poor contact	Repair or replace
	Poor generator internal efficiency	Decomposition and maintenance
Insufficient charging	Short circuit of wiring, poor contact	Connection or repair
	Poor generator internal efficiency	Decomposition and maintenance
	Generator drive unit	Replace
	Battery abnormality	Replace
Squeeze	Short circuit of wiring	Connection or repair
	Poor generator internal efficiency	Decomposition and maintenance

Main parameters

Item		Engine Type 4HK1
Type		Diesel • 4 stroke • Water cooled online OHC
Type of combustion chamber		Direct injection
Type of cylinder liner		Dry type
The number of stroke cylinders with an inner diameter of X	(mm)	4-115x125
Total displacement	(L)	5.193
Compression ratio		17.5
Compression pressure kPa (kg/cm2)/ rpm		2.75 {28}/220
Idle speed	(rpm)	
Valve play	Intake	0.4 (low temperature)
	Exhaust	0.4 (low temperature)
Ignition method		Compression ignition
Jet sequence		1-3-4-2
Injection time (top dead point)		0º
Lubrication device		
Lubrication method		Delivery
Type of oil pump		Gear type
Lubricant capacity [Reference value]	(L)	13.0
Oil filter type		Filter paper (rake type)
Oil cooler type		Integrated, water cooled
Cooling device		
Cooling method		Water-cooled type
Radiator type		Tube type (pressure supply type)
Pump type		Centrifuge, belt type
Thermostat type		Wax Pill 2
Thermostat open temperature	(℃)	82, 85
Coolant capacity [reference value]	(L)	17.1 (with radiator)
Fuel device		
Jet pump type		Electronically controlled common rail type
Governor type		Electronic type
Timer type		Electronic type
Syringe nozzle type		Porous type
Charging equipment		
Generator type		AC type
Output	(V-A)	24 - 50, 24 - 80
Open the controller type		IC
Starting device		
Initiator type		Reduce speed
Output	(V-kW)	24 - 4.5
Preheater type		Glow plug
Glow plug rated voltage, current	(V-A)	23 - 3.5

Special tools

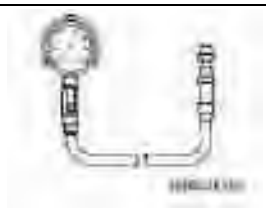
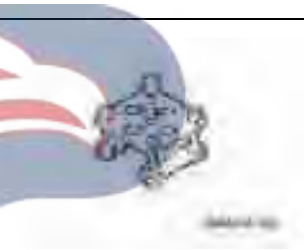
Illustration	Tool number Tool name
	5-8840-2815-0 Cylinder pressure gauge adapter
	5-8840-2675-0 Pressure gauge
	5-8840-2230-0 Crankshaft cover
	5-8840-2621-0 Valve Spring Dresser
	5-8840-2808-0 Support framework
	5-8840-2833-0 Valve seal installation personnel

Illustration	Tool number Tool name
	5-8840-0019-0 Slide hammer
	5-8840-2628-0 Valve guide replacer
	5-8840-2222-0 Seal cup installer
	5-8840-0266-0 Angle meter
	5-8840-2826-0 Ejector removal tool
	5-8840-2623-0 Nozzle sleeve removal tool

Illustration	Tool number Tool name
	5-8840-2627-0 Oil seal installer
	5-8840-2626-0 Bridge catheter installation tool
	5-8840-2624-0 Nozzle sleeve installation tool
	5-8840-2340-0 Connection changer
	5-8840-9018-0 Piston installation tool
	5-8840-2360-0 Accelerator Extractor

Illustration	Tool number Tool name
	5-8840-2703-0 Oil seal mounting kit
	8-9439-6818-0 Crankshaft gear extraction tool
	8-9439-6819-0 Crankshaft gear placement machine

Engine assembly

Disassembly

Caution:

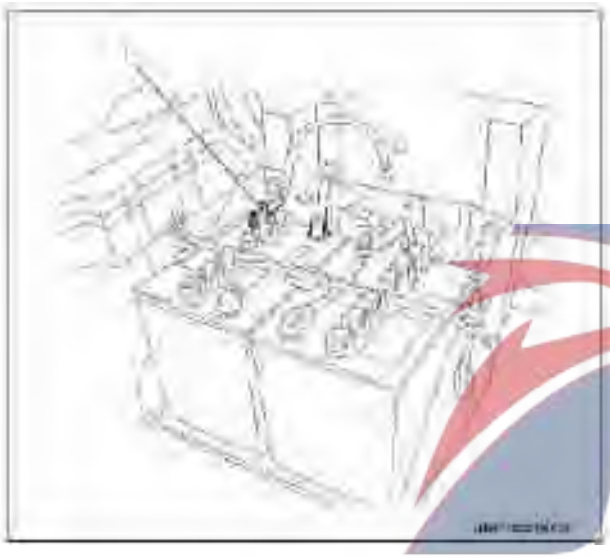
• The wheels must stop.

• The engine hoist must use sturdy tools.

• Do not lift the engine underneath when lifting the engine.

• Do not place your hand where it can be easily caught.

1. Remove the negative terminal (1) from the battery cable.



2. Discharge the coolant.

3. Remove the starter ground wire.

• Loosen the front frame harness connector next to the transmission control box and remove the harness clip.

• Remove the 2 upper and lower starter bolts and remove the starter from the clutch housing.

• Fix the wires etc. In a position that does not affect the disassembly of the transmission.

4. Remove the starter.

5. Remove front exhaust pipe A and exhaust brake assembly.

• Remove front exhaust pipe A and turbocharger mounting nut.

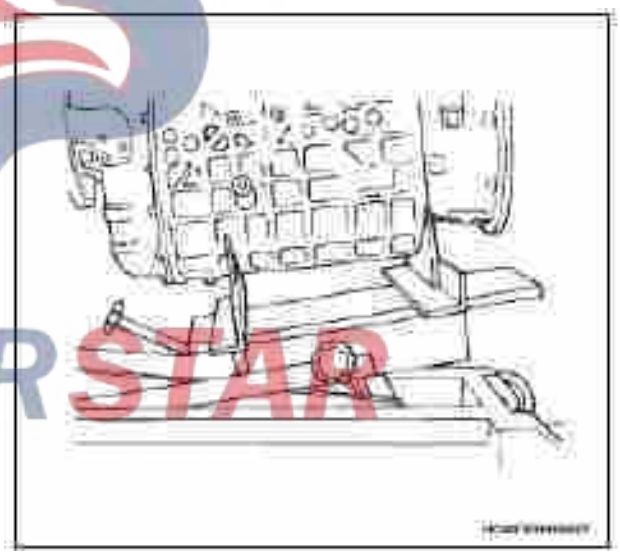
• Remove the nuts that secure the front exhaust pipe A and the exhaust brake.

At the same time, remove the exhaust brake assembly.

• Remove the bolt that secures the exhaust pipe bracket to the right side of the transmission.

6. Remove the transmission.

M/T models, see transmission control cable in MLD section 5C manual transmission.



7. Remove the intake pipe from the turbocharger.

• Remove the PCV hose (1) from the intake hose.

• Loosen the fastening strap (5) of the intake manifold of the turbocharger.

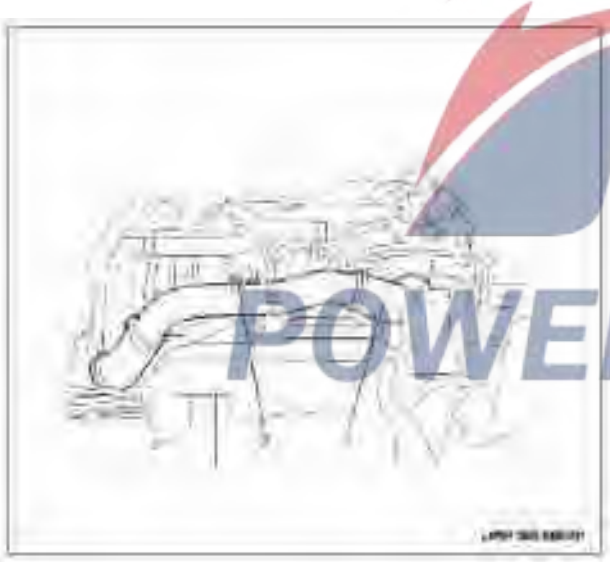
8. Remove the turbocharger inlet tube (2).

• Loosen the hose clamp of the intake hose (3).

• Remove the fixing screws for the intake pipe (4).

9. Remove the connector (6) from the turbocharger actuator.

10. Remove the intake pipe.
• Remove the clamping band.
• Remove the intake pressure sensor connector.

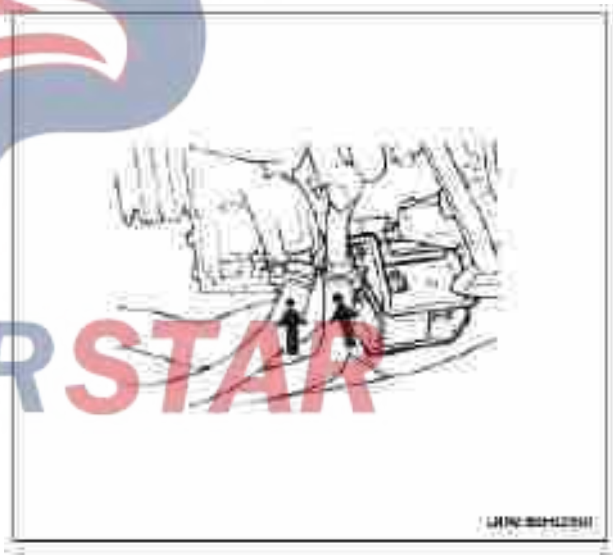


Key

1. Intake pipe
2. Intake pressure sensor

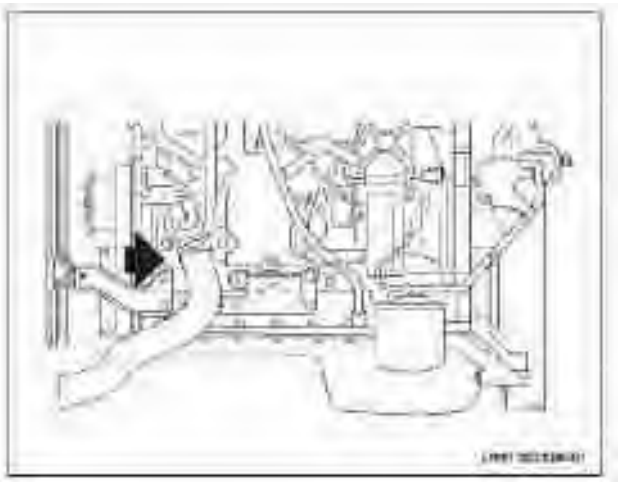
11. Remove the engine harness.
• Remove the ECM.
• Remove 2 connectors from the main ECM harness.
• Disconnect the engine ground wire.
12. Remove the water pipe from the radiator.
• Remove the water pipe on the side of the engine.
13. Remove the hose from the coolant reservoir.
• Remove the hose from the coolant tank on the radiator side.

14. Remove the heated hose.
• Remove the heated hose on the motor side.



15. Remove the oil return hose.
16. Remove the oil supply hose.
• Remove the fuel supply hose from the fuel pump side and close the stopper to prevent the fuel from sinking and adhering.

17. Remove the radiator drain on the side of the engine.



18. Remove the fan guide cover and place it on the fan assembly.

19. Remove the heat sink

• Remove the mounting bolts and nuts on the left and right sides of the heat sink and remove the heat sink.

• Remove the fan cover that covers the fan assembly.

20. Remove the power steering pump.

• Use a bracket to remove the power steering pump from the side of the engine and secure it in place with a hose or the like.

21. Air conditioning compressor

• Remove the compressor drive belt from the air conditioner.

• First remove the compressor from the air-conditioning compressor bracket and secure it in place with a hose or the like.

22. Vacuum hose

• Remove the hose on the side of the vacuum pump.

23. AC generator wiring harness

• Remove the B terminal cable and generator harness connector.

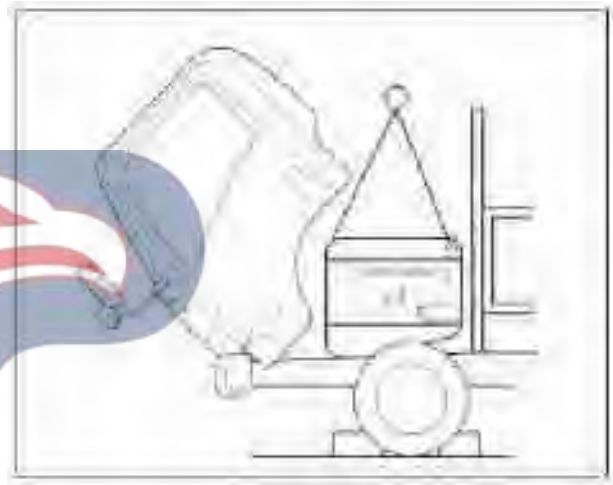
24.Engine support

• Before removing the motor bracket, use a crane to lift the motor.

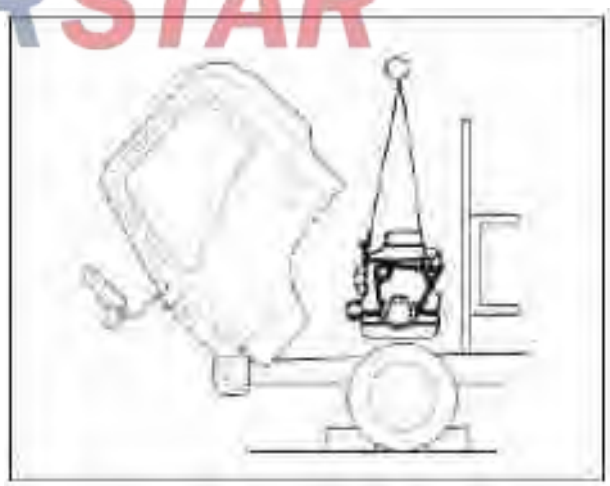
• Remove the mounting bolts on the side of the motor bracket frame.

25. Disassemble the entire engine.

• Slowly operate the crane to raise the engine to a higher position than the chassis.



• Turn the engine 90° to start moving from the chassis and remove the engine components.

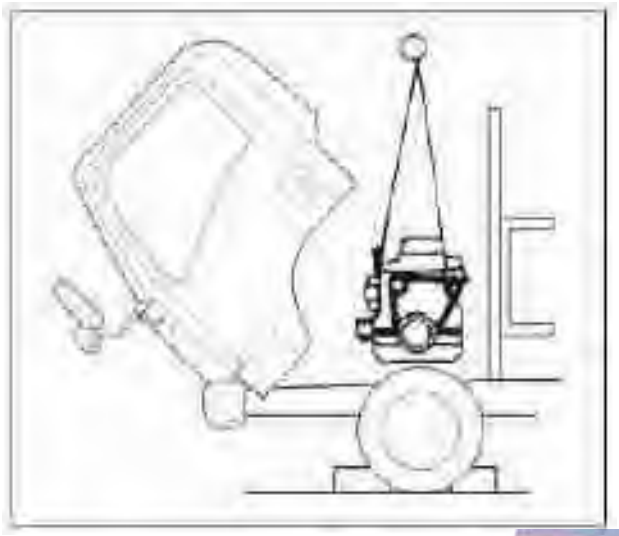


Installation

1. Install the engine assembly.

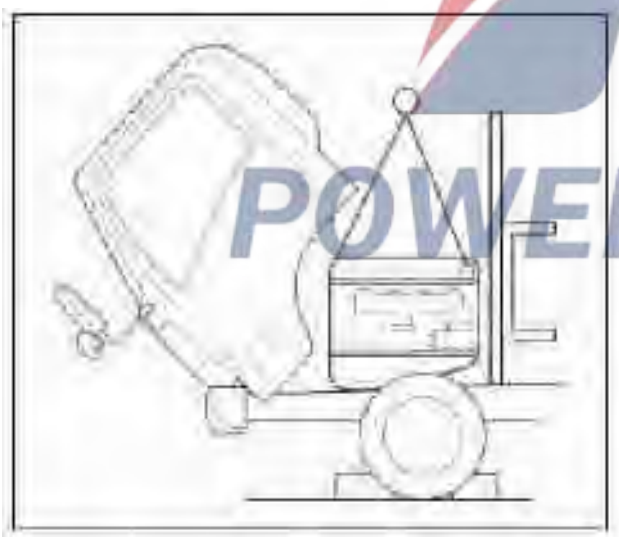
Install hoist ropes on engine rings and cranes and lift the engine.

• Operate the crane and move the engine to the installation position.



• Rotate the engine 90° and slowly lower the motor to the mounting position.

• At this time, lower the side of the transmission and slowly operate the crane to pull it towards the rear of the engine.



2. Install the motor bracket.

• Install the motor bearings in the holes of the motor support beam and tighten them to the specified torque.

Tightening torque : 48 N•m {4.9kgf•m}

3. Install the alternator harness.

• Install the harness connector (1 pole) and terminal cable B on the generator.

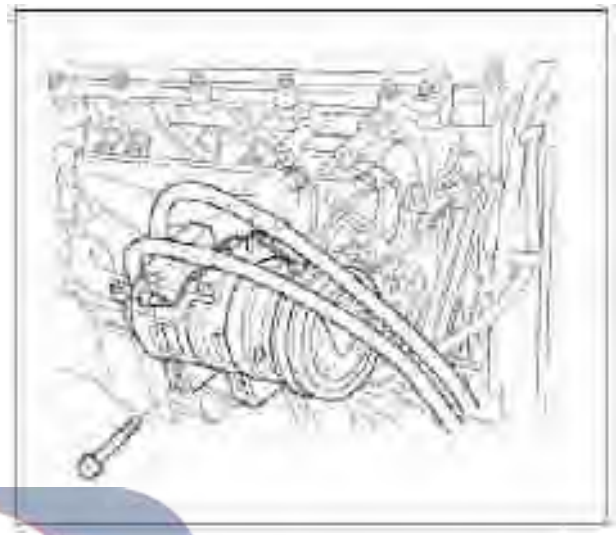
4. Install the suction hose.

• Install the suction hose on the vacuum pump.

5. Install A/C compressor.

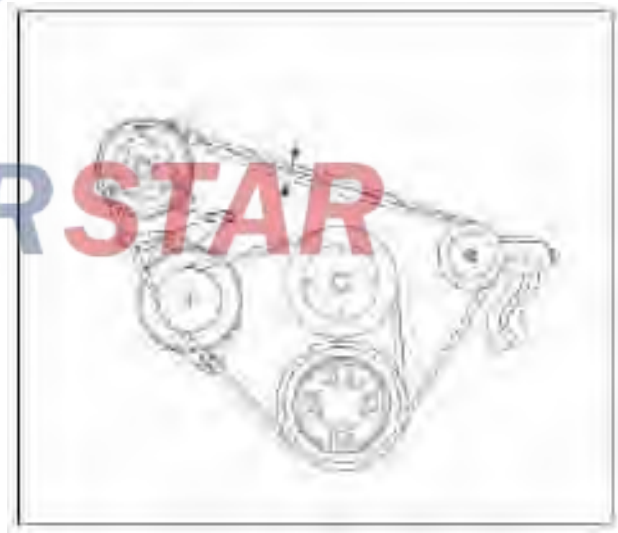
• Install the A/C compressor as shown and tighten it to the specified torque.

Tightening torque : 24 N•m {2.4kgf•m}



• First set the drive belt, then tighten the pulley adjustment screw to adjust the belt tension.

• For details on adjusting the belt tension, refer to the drive belt in Chapter 1C Cooling System (4HK1).



6. Power steering pump

• Tighten the power steering pump to the specified torque.

Flywheel fixing bolts (1)

Tightening torque : 43 N•m {4.4kgf•m}

Cylinder block fixing bolt (2)

Tightening torque : 44 N•m {4.5kgf•m}

Key

1. Flying shell bolt
2. Cylinder bolt

7. Install the radiator.

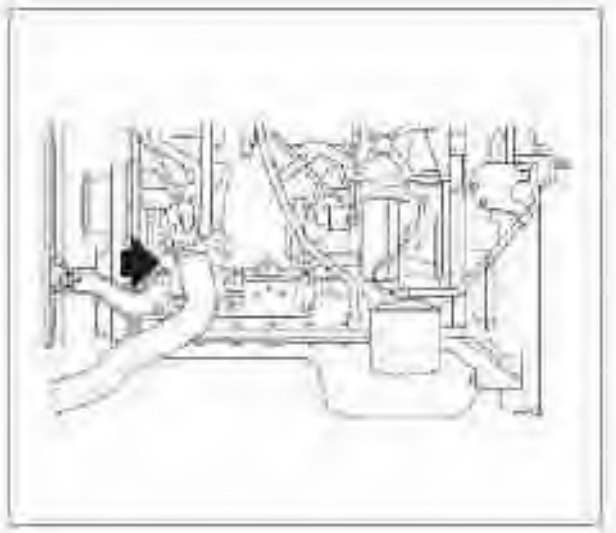
• Install the fan guides to the fan assembly.

• Attach the left and right radiator brackets to the frame bracket as shown.

Tightening torque : 55 N•m {5.6kgf•m}

8. Install the fan cover.

9. Install the radiator hose.



10. Install the coolant tank hose.

11. Install the water pipe from the radiator.

12. Install the oil supply hose.

13. Install the fuel return pipe.

14. Install the heater hoses.

• Mark the pipe upwards during installation.

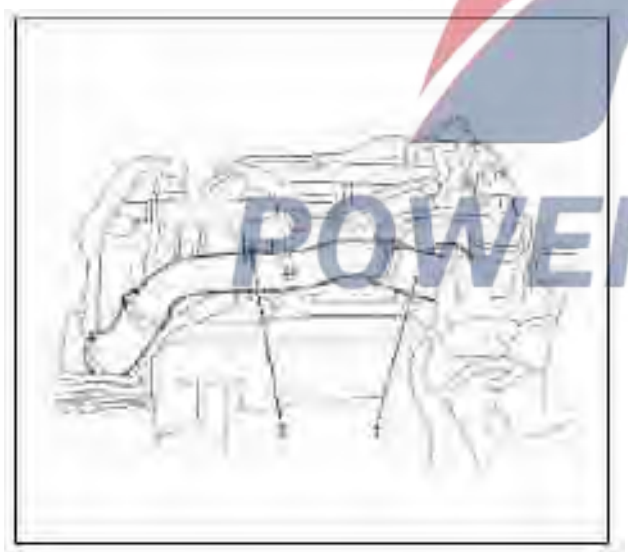
15. Install air inlet hose

• First install the flange and tighten it to the specified torque. Please use the new clip.

• Install the inlet pressure sensor connector.

Clip

Tightening torque : 6 N•m {0.6kgf•m}



Key

1. Intake pipe
2. Intake pressure sensor

16. Install the air hose on the turbocharger inlet and tighten the collar (3) to the specified torque.

Tightening torque : 10 N•m {1.0kgf•m}

Mark:

Use new clip.

17. Install the intake hose on the turbocharger.

• Clamping the intake pipe clamp for the predetermined tightening torque (5) at the inlet of the turbocharger.

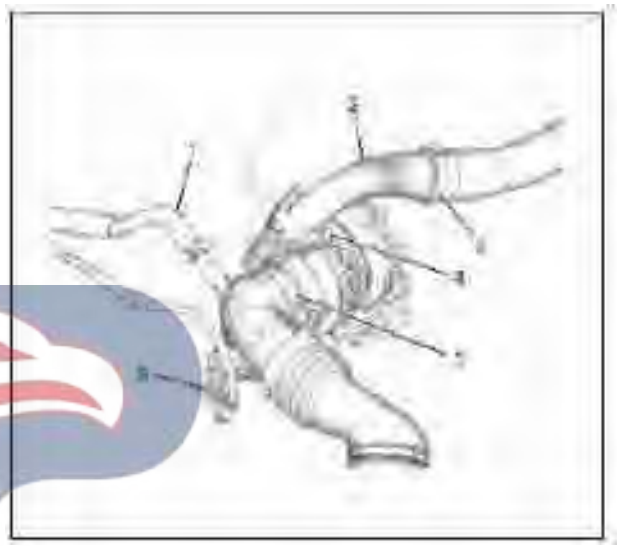
Tightening torque : 6 N•m {0.6kgf•m}

Mark:

Use new clamp.

• Install the PCV hose (1) on the intake hose.

18. Install the connector (6) on the turbocharger actuator.



19. Install the engine wiring harness.

• Install the engine ground wire.

• Connect 2 main harness connectors to ECM.

• Install ECM 0

20. Install the transmission assembly.

M/T models, see transmission control cable in MLD section 5C manual transmission.

21. Install the launcher.

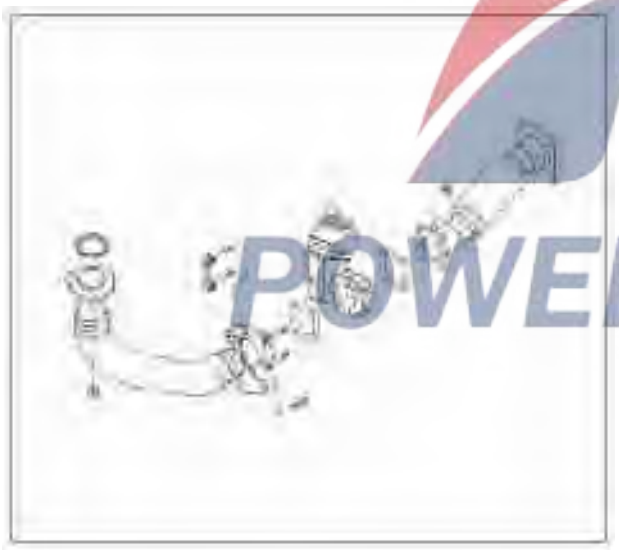
Tightening torque : 76 N•m {7.7kgf•m}

• Tighten the starter to the clutch housing and tighten with the specified torque.

22. Install front exhaust pipe A and exhaust brake and tighten them to the specified torque.

Tightening torque:

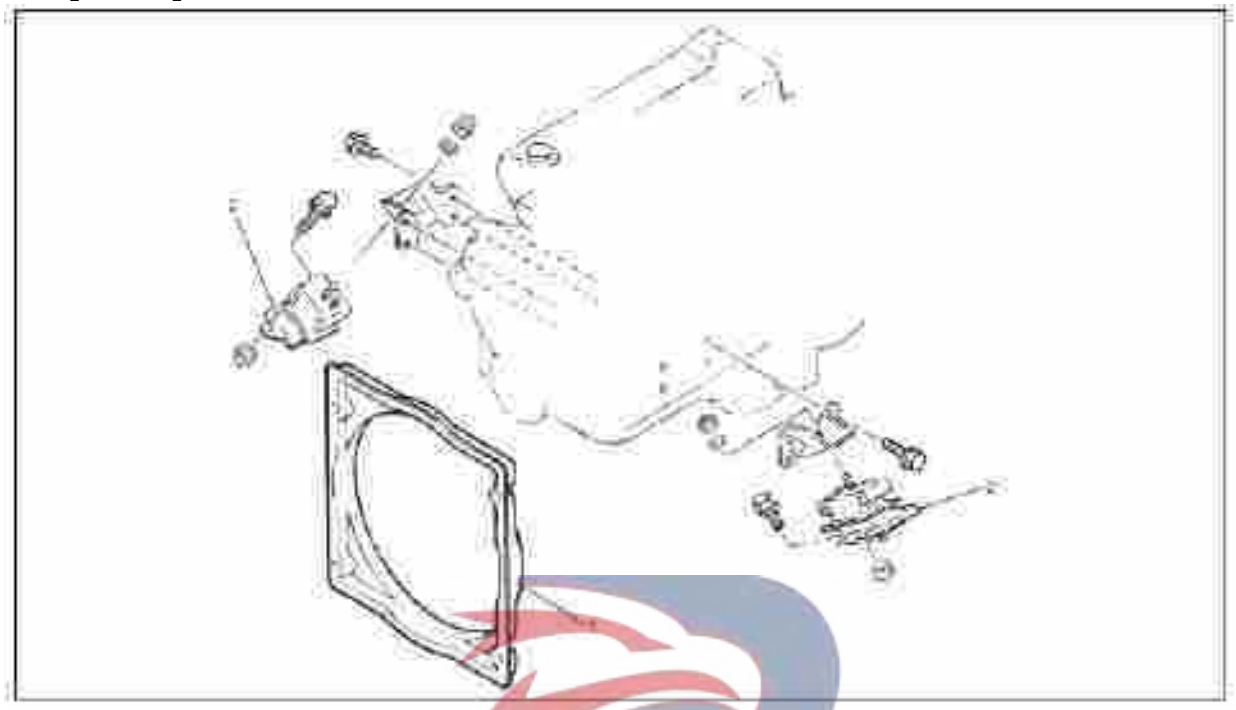
Turbocharger side nut	67 N•m {6.8kgf•m}
Exhaust pipe support bolt	18 N•m {1,8 kgf•m}
Exhaust brake side nut	27 N•m {2.8 kgf•m}



23. Attach the front frame harness connector.
24. Supplement the coolant.
25. Install the negative terminal of the battery cable.

Engine support

Component parts



Key

1. Fan cover
2. Engine support

Disassembly

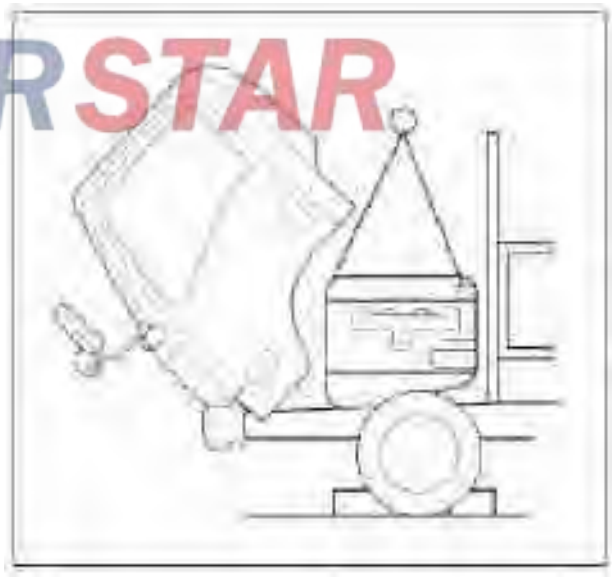
1. Remove the fan guide from the heat sink and connect it to the fan.
2. Remove the motor bracket.

• Before removing the motor bracket, use a crane to lift the motor.

• Remove the fixing nut and motor bracket from the bottom of the motor.

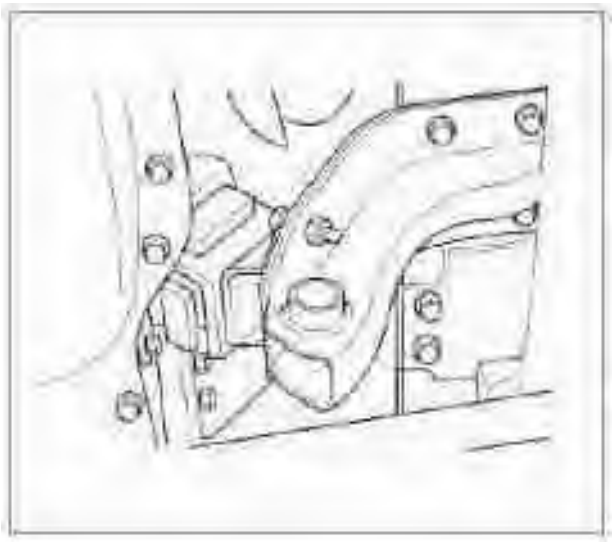
• Remove the side mounting bolts from the engine chassis frame.

• Lift the engine assembly and remove the engine bracket.



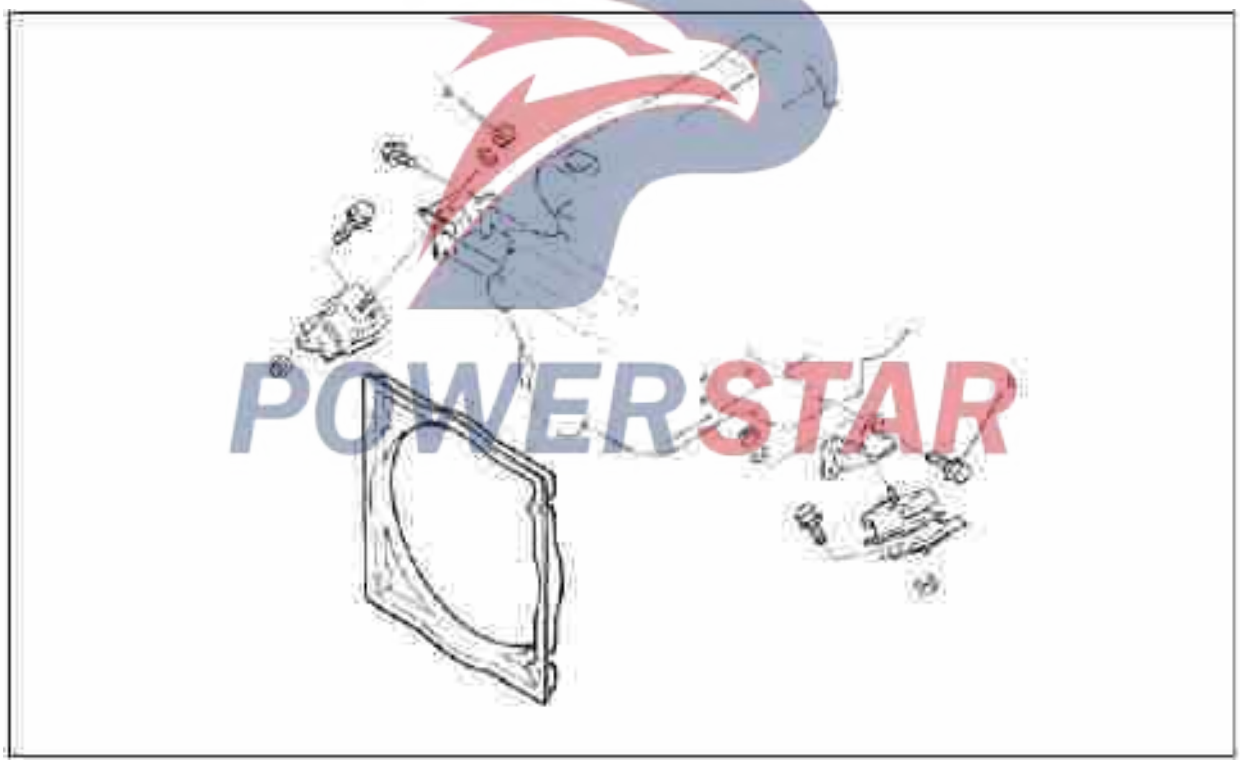
Installation

1. Install the motor bracket and tighten it to the specified torque.
Chassis side frame
Tightening torque : 40 N•m {4.1kgf•m}
Bolt at the bottom
Tightening torque : 51 N•m {5.2kgf•m}



2. Install the fan cover.
• Start the engine and check the motor bracket for any abnormalities.

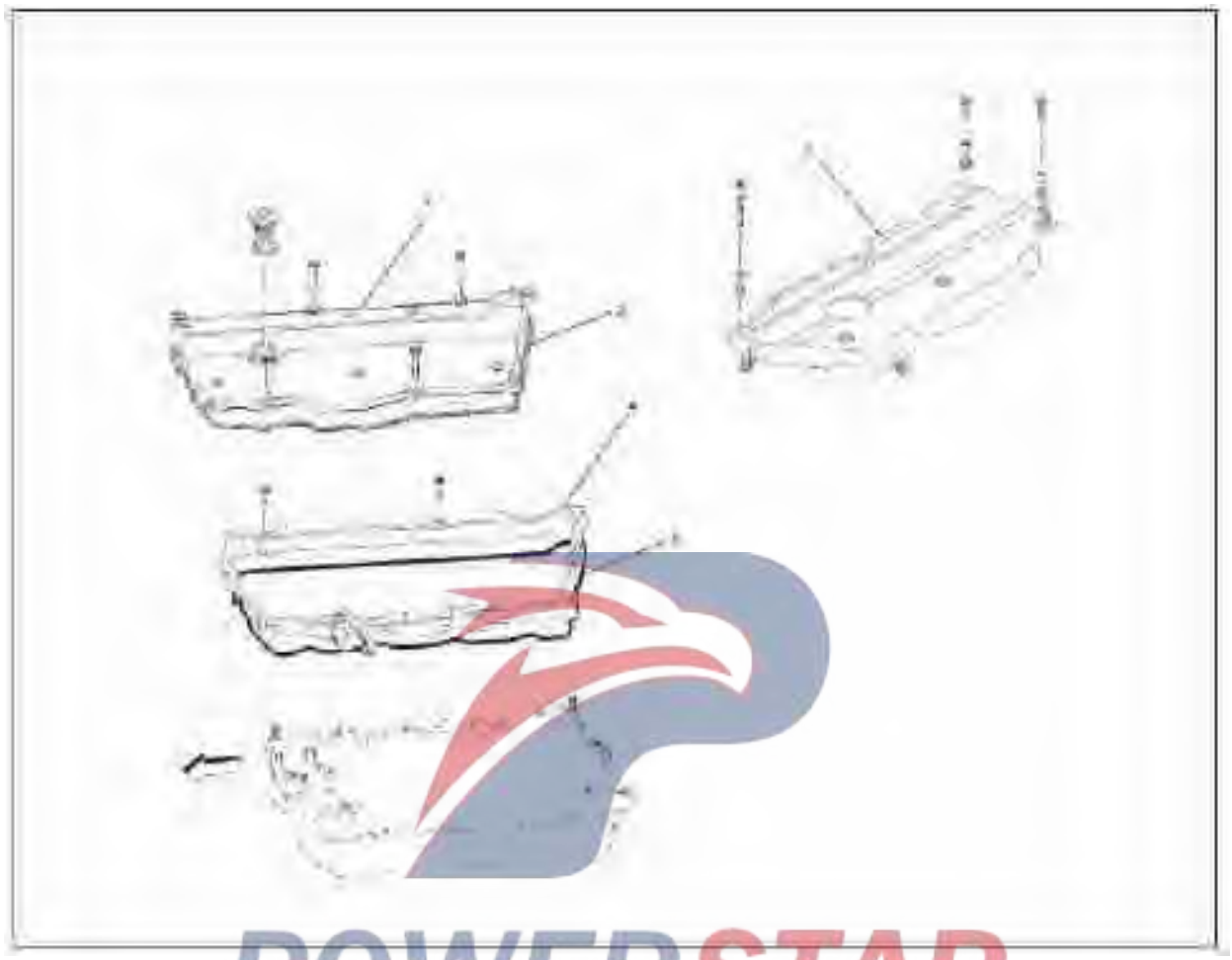
Tightening torque - Overview



(a) 40 N·m { 4.1kgf·m }
(b) 51 N·m { 5.2kgf·m }

Cylinder head cover

Component parts



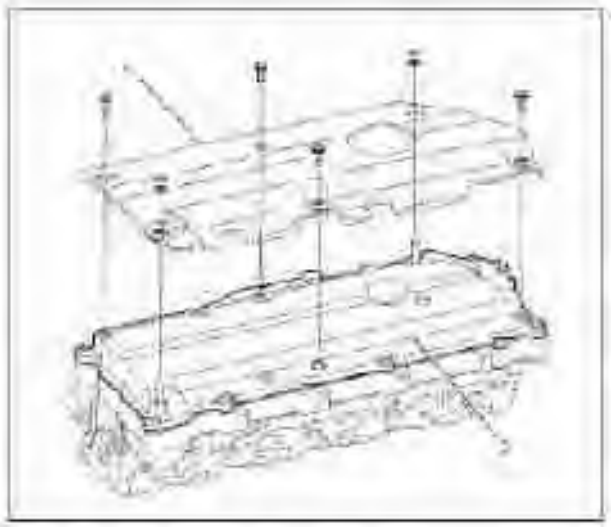
Key

1.Cylinder head cover
2. Seal gaskets
3. Noise cover
4. Bottom cover
5. Seal gaskets

Disassembly

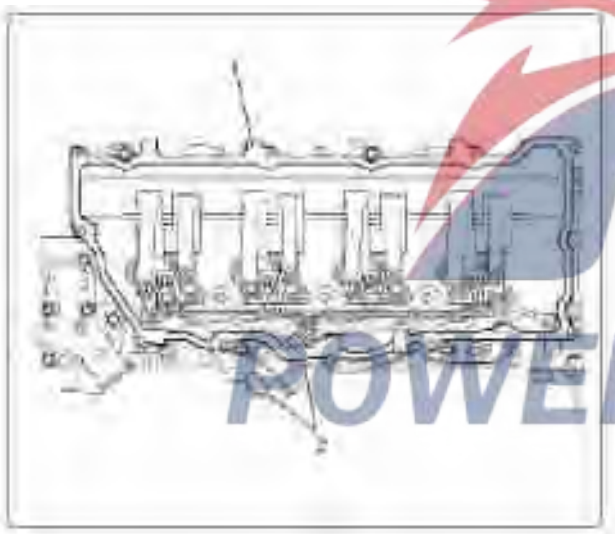
1. Remove the soundproof cover (1).

2. Remove the cylinder head cover (2) and seal it.



3. Remove the connector from the injector harness (2).

4. Remove the bottom cover (1) and the gasket.



Installation

1. Install the gasket on the bottom cover (1).

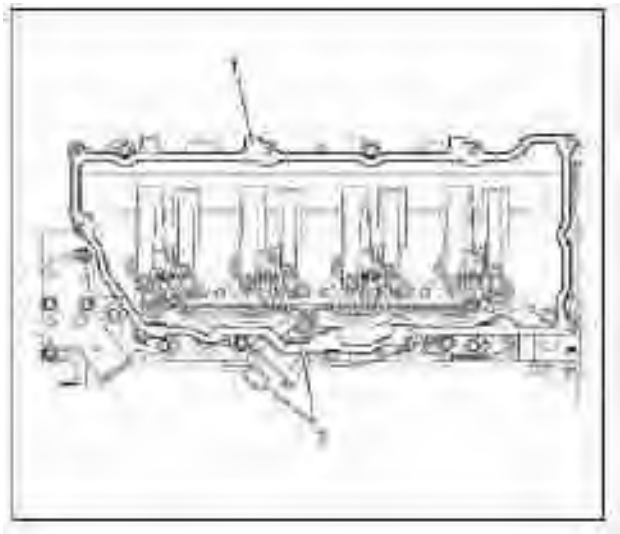
2. Install the lower cover (1).

Tightening torque : 18 N•m {1.8kgf•m}

3. Install the connector from the injector harness (2).

Mark:

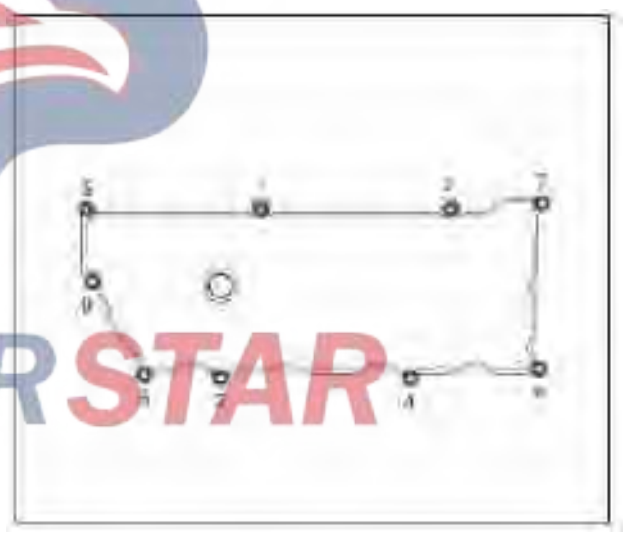
Press fully until the lock card pops up.



4. Install the gasket on the cylinder head cover.

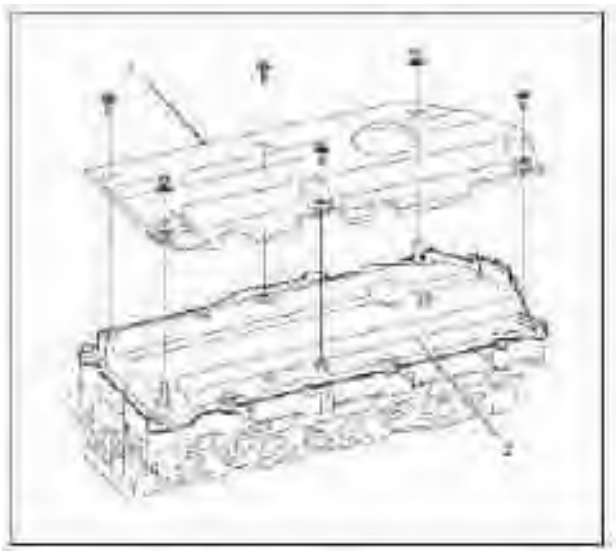
5. Install cylinder head cover (2) and tighten in the order shown.

Tightening torque : 18 N•m {1.8kgf•m}

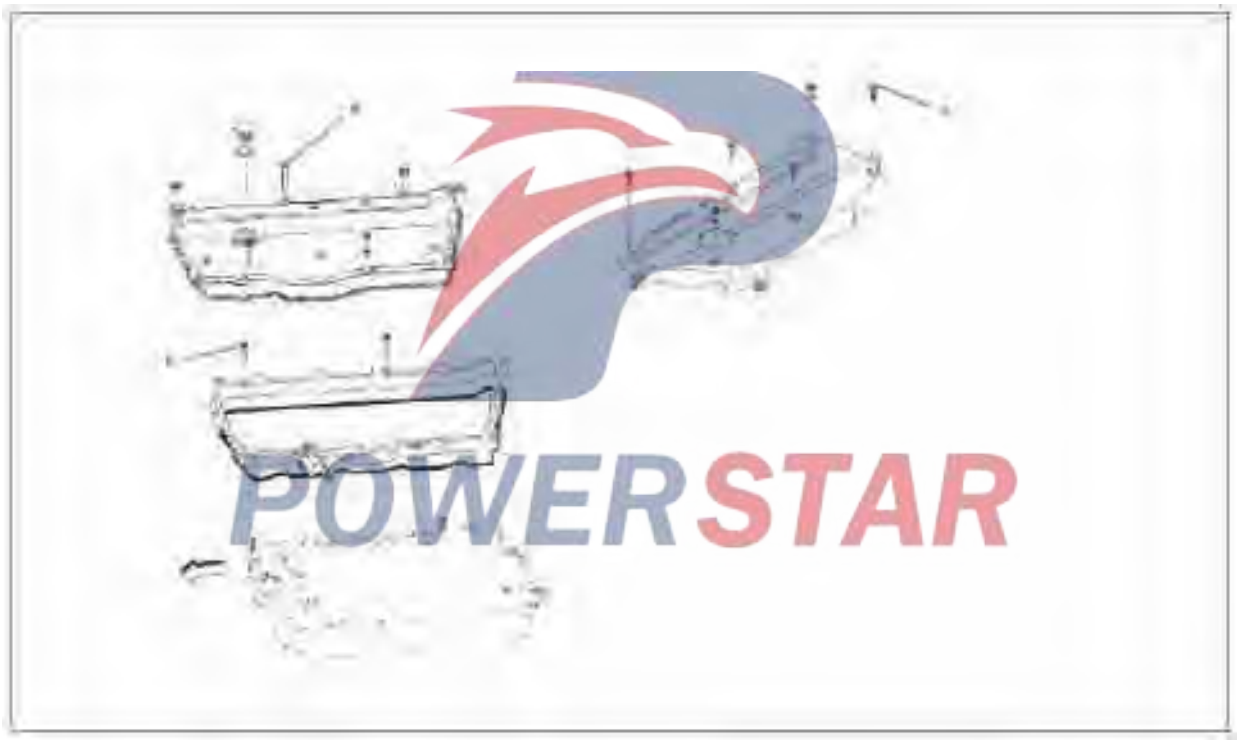


6. Install soundproof cover (1).

Tightening torque : 8 N•m {0.8kgf•m}



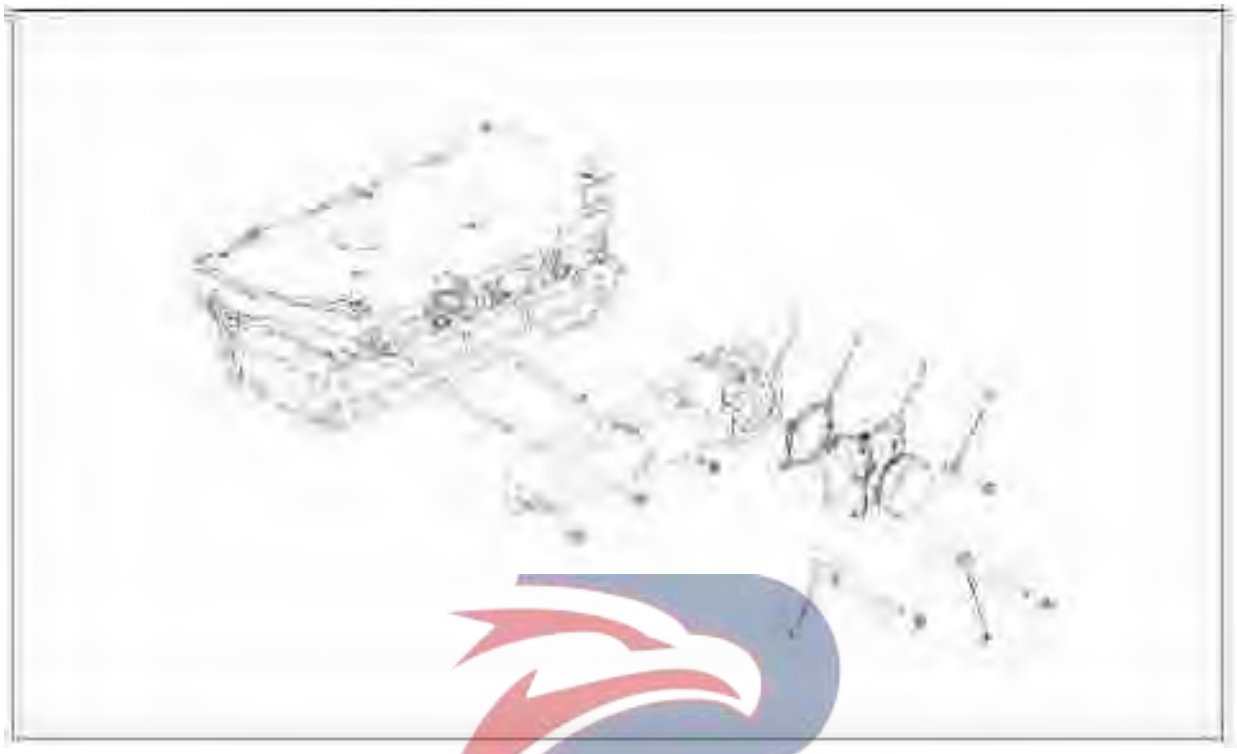
Tightening torque - Overview



(a) 18 N·m { 1.8kgf·m }
(b) 18 N·m { 1.8kgf·m }
(c) 8 N·m { 0.8kgf·m }

Intake manifold

Component parts



Key

1.Intake manifold
2. Throttle seal gasket
3. Throttle valve assembly
4. Rubber support

Disassembly

1. Remove the common rail.

Refer to common rail in section 1D Power Supply (4HK1).

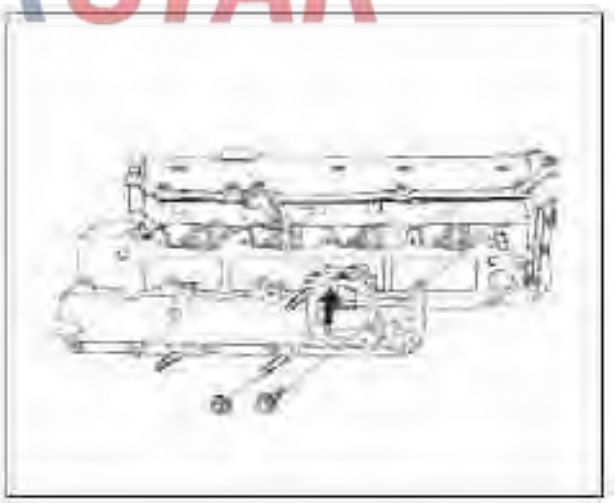
2. Remove the throttle valve assembly.

• The rubber rolls off easily, being careful not to lose it.

3. Remove the intake manifold.

• The throttle bracket mounting parts (arrows) have bolts on the intake manifold, taking care not to remove them.

• Carefully remove the liquid sealant.



Installation

1. Install the intake manifold.

• Alignment manifold slot width 2.5-5.5 mm liquid sealant applicator (TB-1207C).

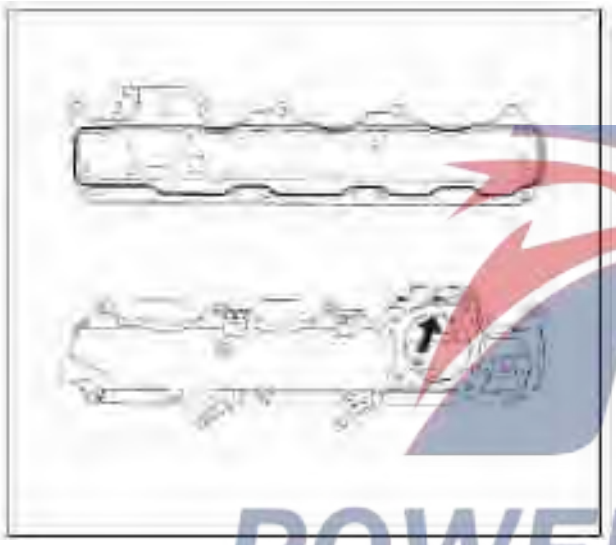
• After using the liquid sealant, install it within 5 minutes.

Tightening torque : 22 N•m {2.2kgf•m}

Mark:

• Be sure to remember to tighten the bolt at the arrow.

• Use common rails to tighten the bolts.



2. Install the throttle valve assembly.

• Accurately install support rubber.

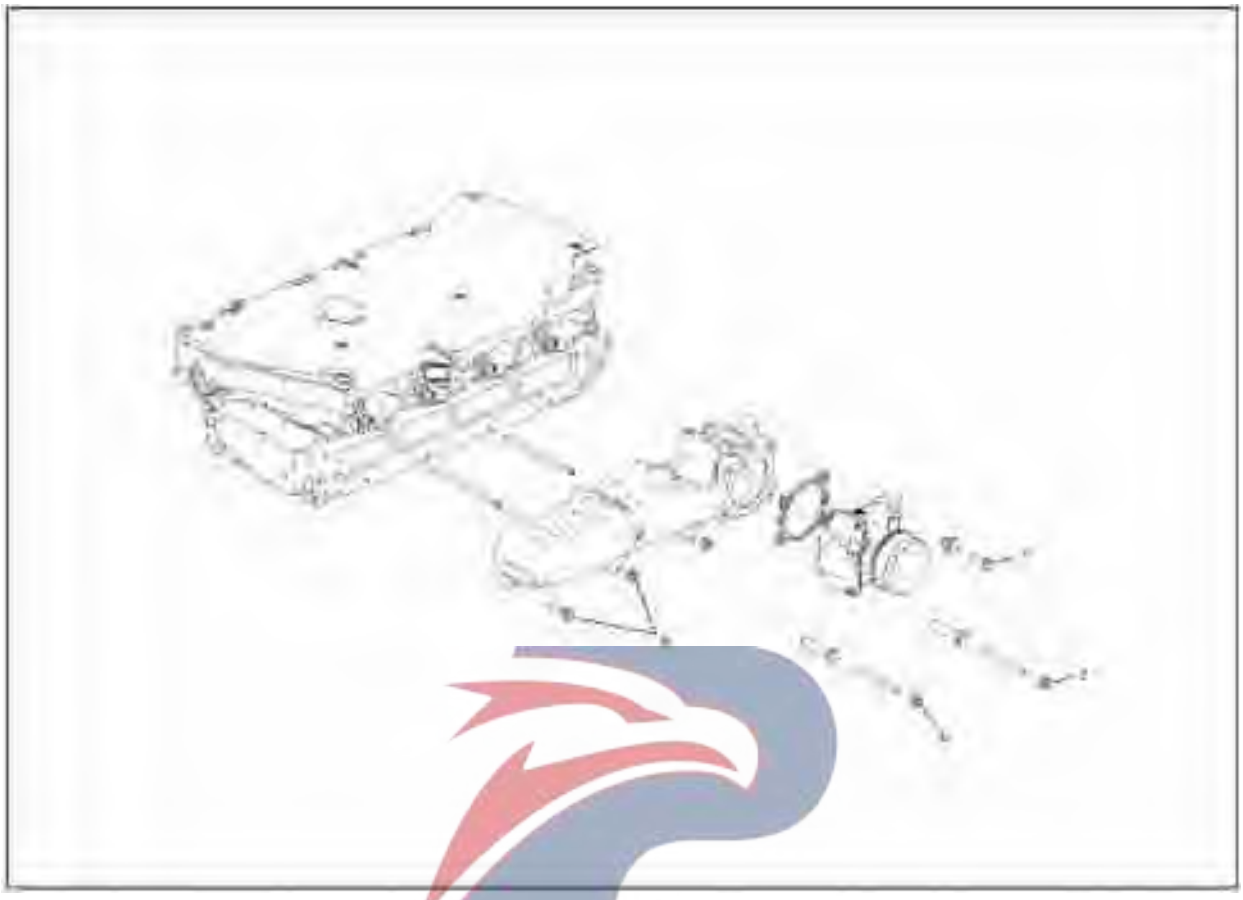
• Install gaskets, throttle valve assembly and tighten with the specified torque.

Tightening torque : 24 N•m {2.4kgf•m}

3. Install the common rail.

Refer to common rail in section 1D Power Supply (4HK1).

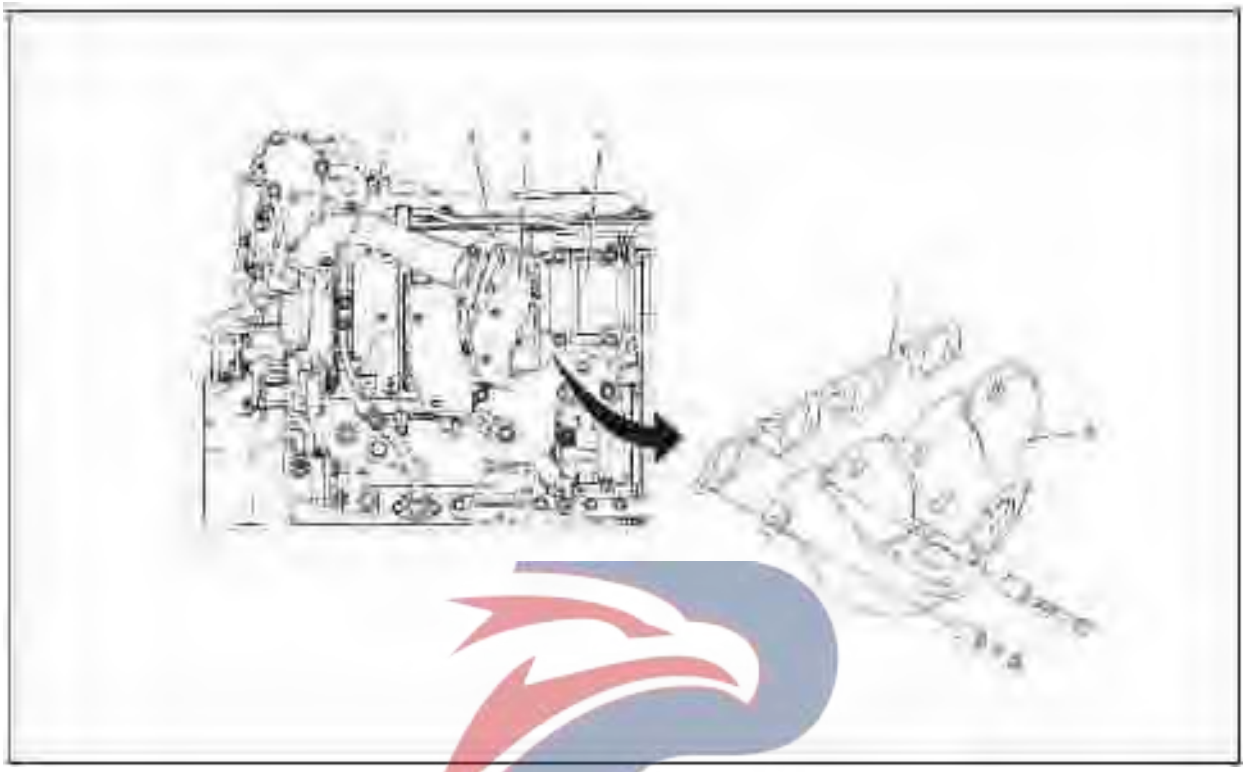
Tightening torque - Overview



(a) 22 N·m {2.2kgf·m }
(b) 24 N·m {2.4kgf·m }
(c) 24 N·m {2.4kgf·m }

Exhaust manifold

Component parts



Key

1.Turbocharger assembly
2. EGR cooler piping
3. EGR cooler pipe insulation board
4. Air conditioning compressor
5. Seal gaskets
6. Exhaust manifold

Disassembly

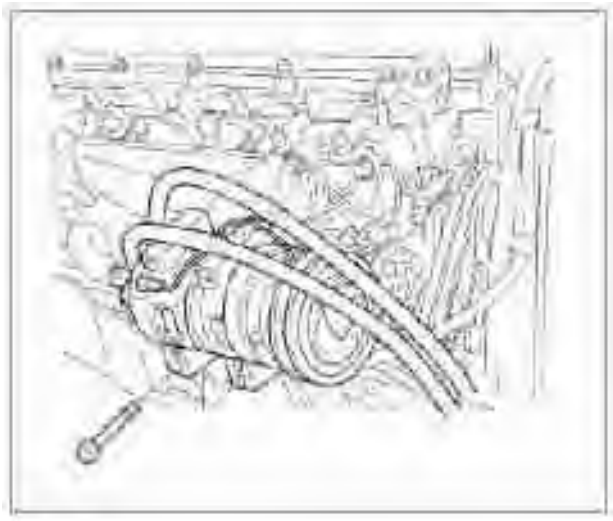
1. Remove the turbocharger assembly.

Refer to Intake System 1J (4HK1) - Section Turbocharger Assembly.

2. Remove the compressor harness connector from the air conditioner.

3. Remove the A/C compressor.

• Do not remove the compressor hose from the air conditioner and remove the compressor from the bracket.



4. Remove the air conditioner compressor bracket.

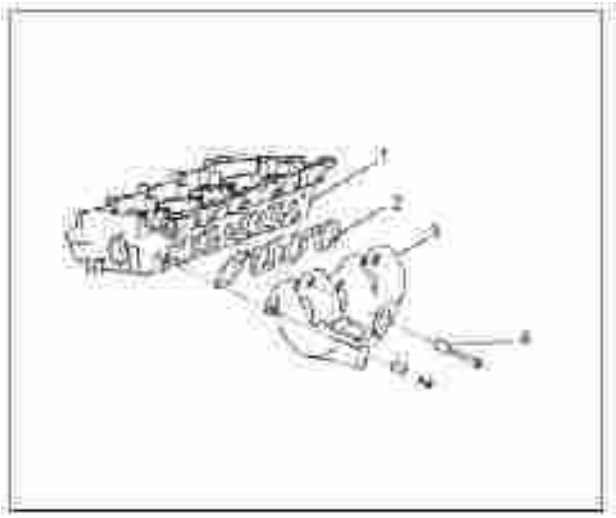
5. Remove the EGR cooler piping.

• Remove the heat shield (2).

• Remove the EGR cooler conduit (1).

6. Remove the exhaust manifold.

• Remove 2 nuts and 6 bolts and remove the exhaust manifold.



Key

1.Cylinder head cover

2. Seal gaskets

3. Exhaust manifold

4. Isolator

Inspection

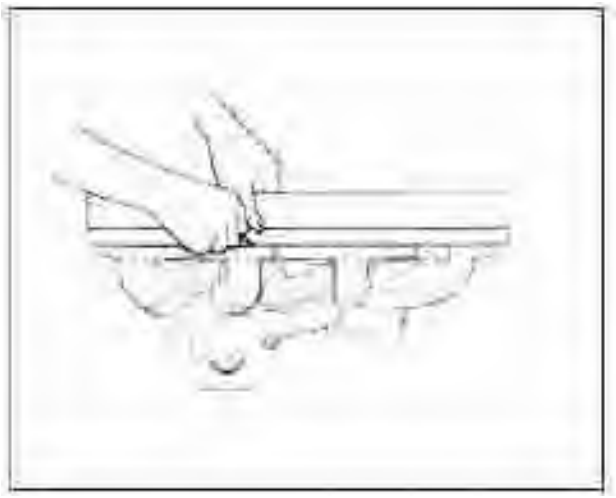
1. Check exhaust manifold

• Check the flatness of the manifold and cylinder head mounting surfaces.

Collector mounted ceiling	mm
Standard value	＜0.7(0.3)
Maintenance limit	0.5

Mark:

If the flatness exceeds the service limit, replace it.



• Visually inspect the exhaust manifold for cracks.

2. For Turbocharger Assembly Inspection, please see the Turbocharger Assembly 1J (4HK1) section.

Installation

1. Insert the gasket and install the exhaust manifold.

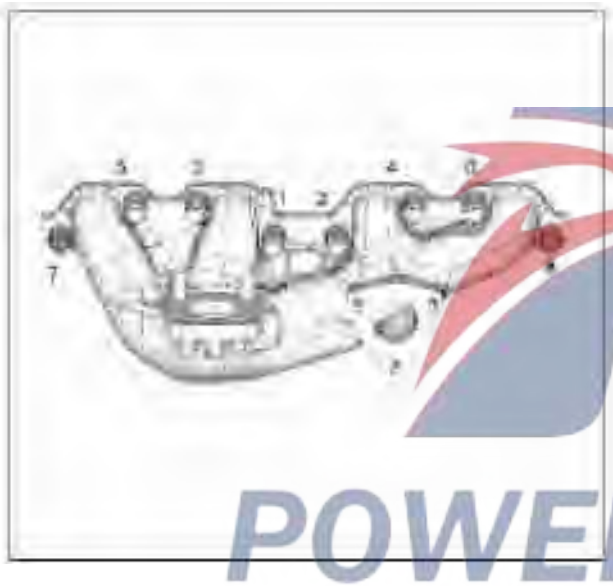
• Install 2 nuts and 6 bolts and tighten in the order shown.

Mark:

Do not overtighten to prevent the collector from expanding due to heat.

Bolts(1), (2)(3), (4), (5), (6)and nuts(7), (8)

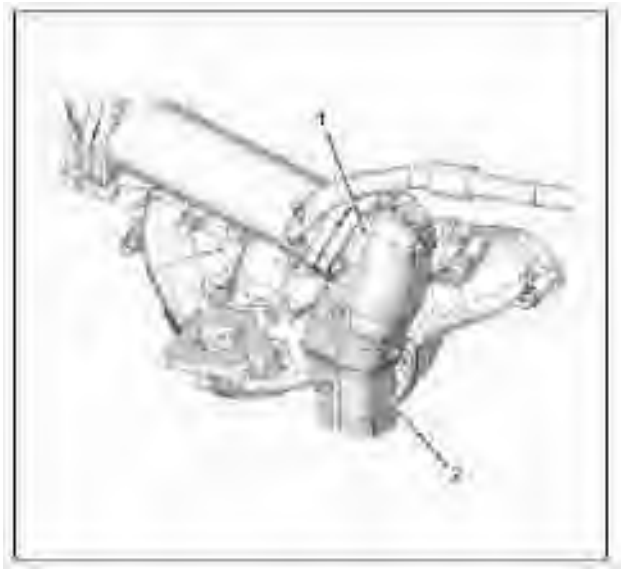
Tightening torque : 34 N•m {3.5kgf•m}



2. Install the EGR cooler conduit.

• Install EGR cooler conduit (1).

• Install heat shield board (2).



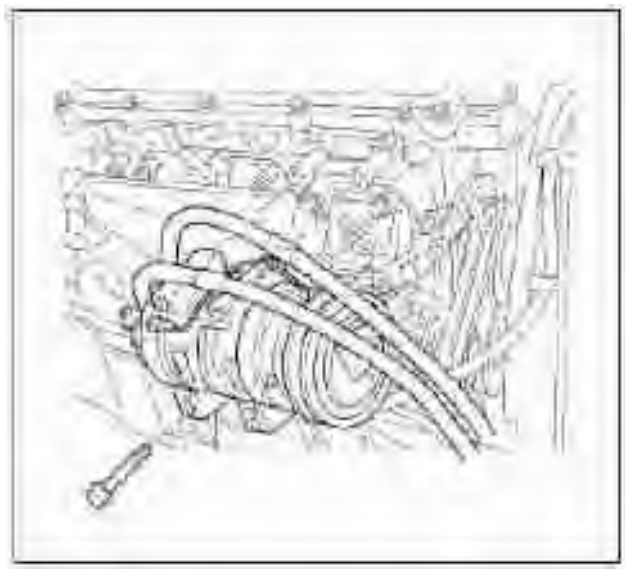
3. A/C compressor bracket.

• Mount the air conditioner compressor bracket to the cylinder head and tighten it to the specified torque.

Tightening torque : 48 N•m {4.9kgf•m}

4. Install the air conditioner compressor on the bracket and tighten it to the specified torque.

Tightening torque : 24 N•m {2.4kgf•m}



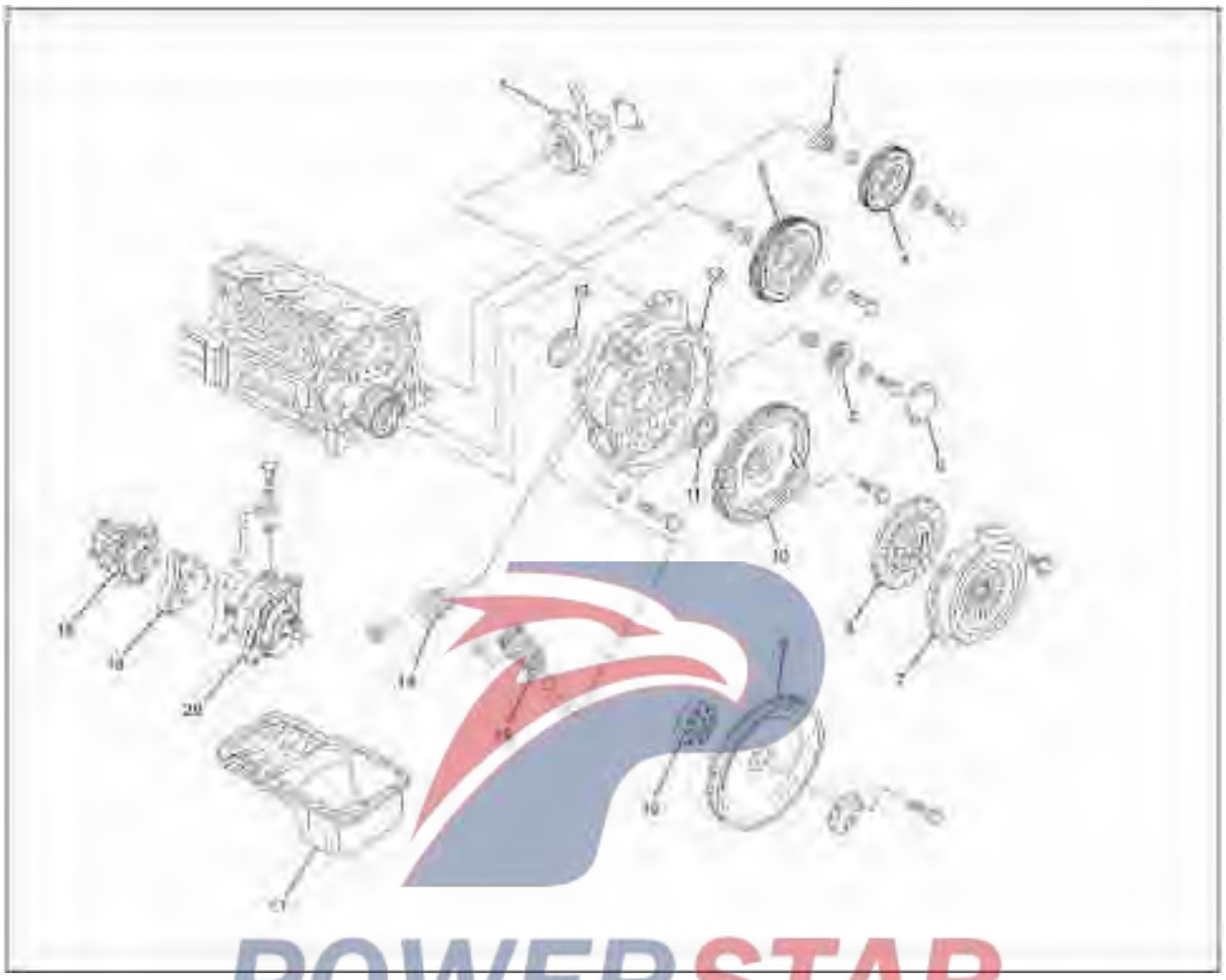
5. Install the air conditioner compressor harness connector.

6. Install the turbocharger assembly.

Refer to Intake System 1J (4HK1) - Section Turbocharger Assembly.

Timing gear train

Component parts



Key

Power steering pump
2. Idler B axis
3. Idler A
4. Idler B
5. Power steering pump idler
6. Power steering pump idler cover
7. Clutch pressure plate (M / T type)
8. Clutch plate (model M / T)
9. Hot Plate (Smoother – Ex type)
10. Flywheel (M/T type)
11. Rear oil seal
12. Flywheel housing
13. Oil drop ring
14. Plug
15. Crankshaft position sensor
16. Crankshaft end spacer(Smoother-Ex type)
17. Oil sump
18. Oil feed pump
19. Feed pump support
20. Vacuum pump

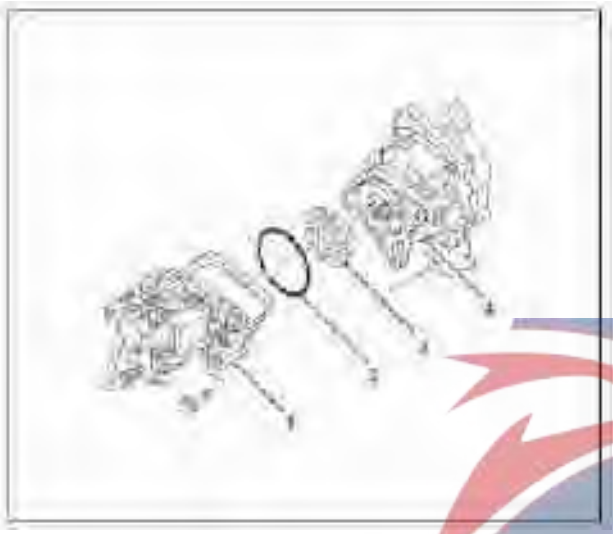
Disassembly

1. Remove the cylinder head cover.
Refer to the cylinder head cover in this chapter.

2. Remove rocker assembly.
Refer to the rocker assembly in this chapter.

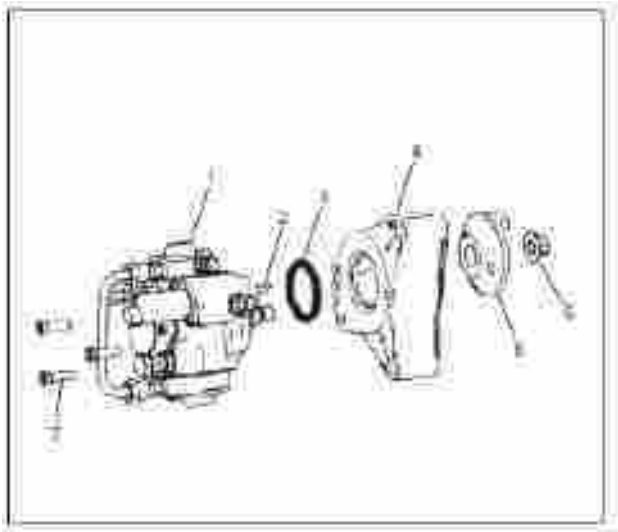
3. Remove the camshaft assembly.
Refer to camshaft Assembly in this chapter.

4. Remove the bolt assembly.
Refer to the bolts in this chapter.
5. Remove the clutch plate and clutch plate.
6. Remove the oil supply pump (1) and the coupling (3).
• Remove the fastening screw from the fuel supply pump (including the bracket) and remove the supply pump from the vacuum pump (4).
• Remove the coupling (3) and O-ring.



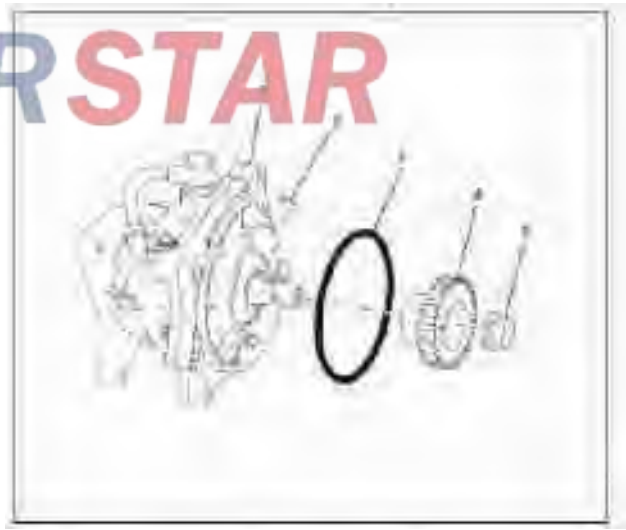
Key
1. Feed pump (including support)
2. O-ring
3. Coupling
4. Vacuum pump

7. Remove the fuel supply bracket (4).
• Tighten the 2 bolts in the threaded hole of the coupling (6) and remove the nut.
• Hook the two bolts fixed in the threaded holes of the coupling (6) to the gear extraction tool, and then remove the coupling (6).



Key
1. Oil feed pump
2. Key
3. O-ring
4. Feed pump support
5. Nuts
6. Coupling
7. Flange bolts

8. Remove the vacuum pump (1).
• Remove the bolts and nuts and remove the vacuum pump (1).
9. Remove the gear (4) from the vacuum pump (1).



Key
1. Vacuum pump
2. Key
3. O-ring
4. Gear
5. Nuts

10. Remove the steering wheel.

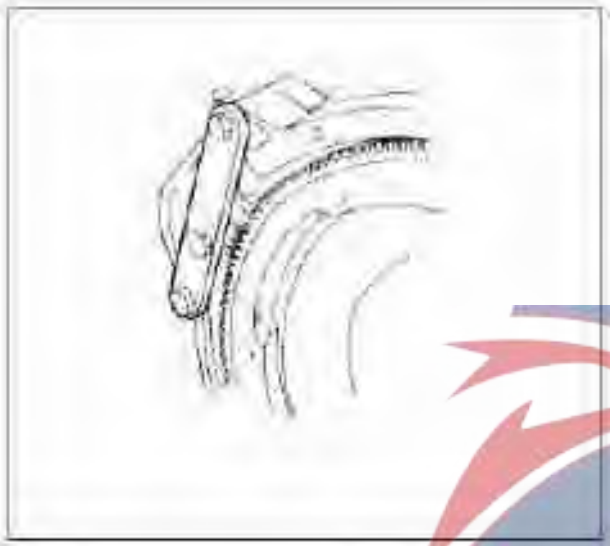
• Install the crankshaft stopper in the starter mounting section of the flywheel housing, being careful not to turn the crankshaft.

Mark:

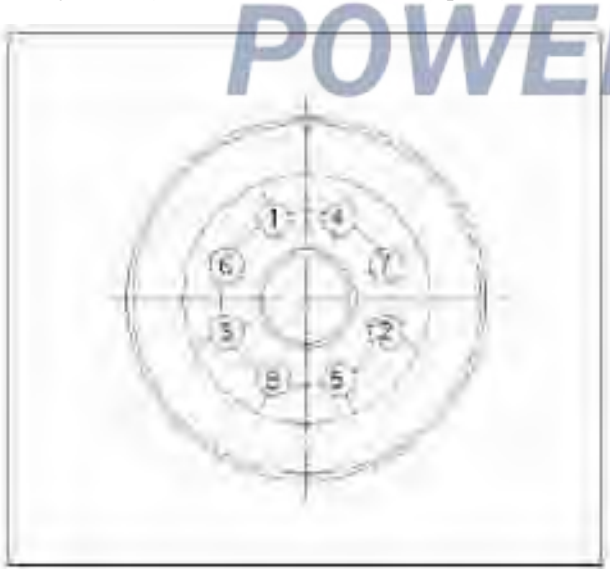
Make sure the plug is properly inserted into the ring.

Special tools

Crankshaft stopper:5-8840-2230-0



• Loosen the bolt little by little in the order shown in the figure, remove the crankshaft stopper and remove the flywheel (Smoother Ex is a flexible plate).



11. Remove the rear oil seal and baffle plate.

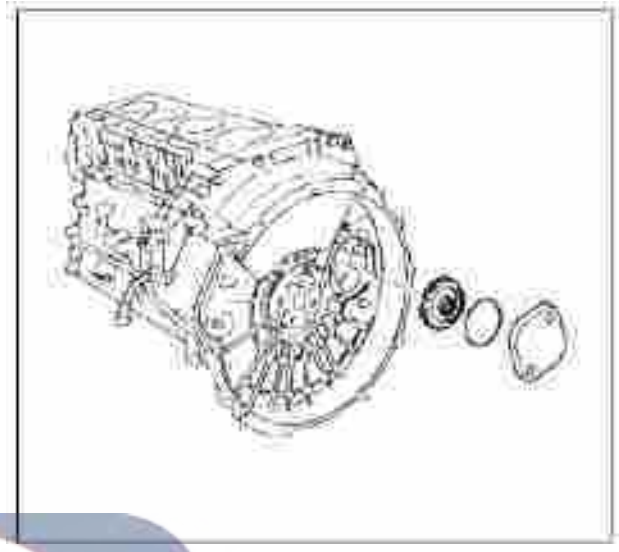
Refer to the front oil seal of the crankshaft in this chapter.

12. Take out the oil sump.

13. Disassemble power steering pump.

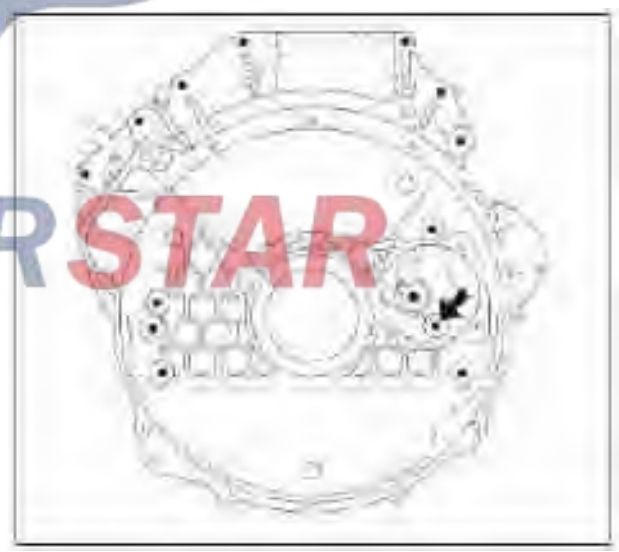
14. Remove the power steering pump idler cover.

15. Remove the power steering pump sprocket.



16. Remove the flywheel shell.

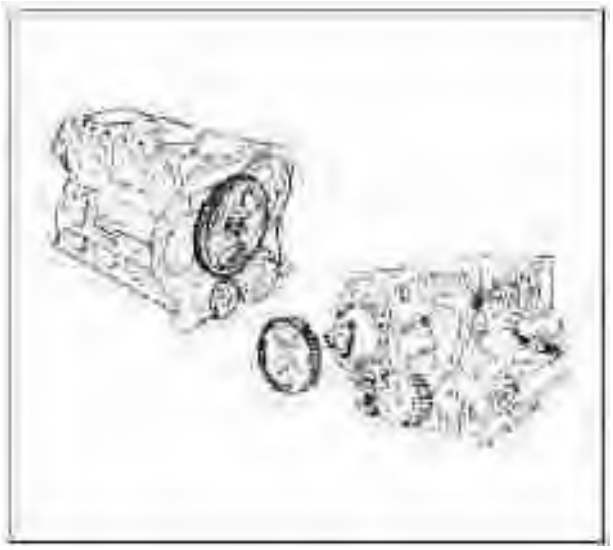
• Remember to remove the bolt shown by the arrow in the figure.



17. Remove idler A.

18. Remove the idler B.

19. Remove the idler B axis



Inspection

1. Measuring idler clearance

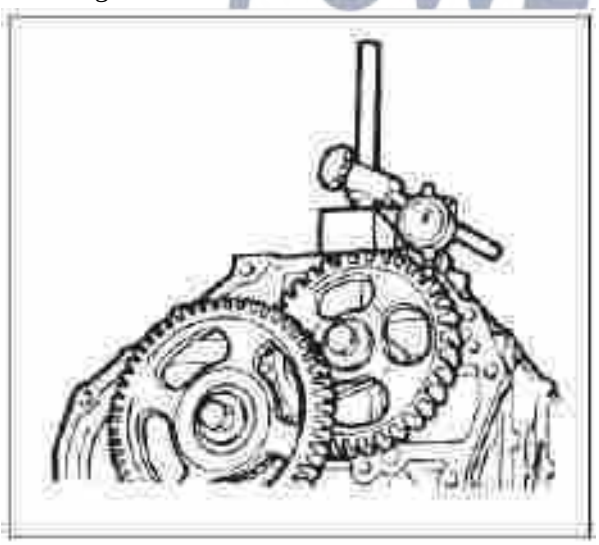
• Install the dial indicator on the idler teeth to be measured, and rotate the gear gently to read the dial gauge. (The opposite gear must be installed.)

• When the measured value exceeds the limit, the return idler must be replaced.

A set of synchronization gears

Standard value	0.100 mm—0.170 mm
Standard value	0.300 mm

• The idler A clearance must be measured before removing the idler.



2. Measure the axial clearance of the idler

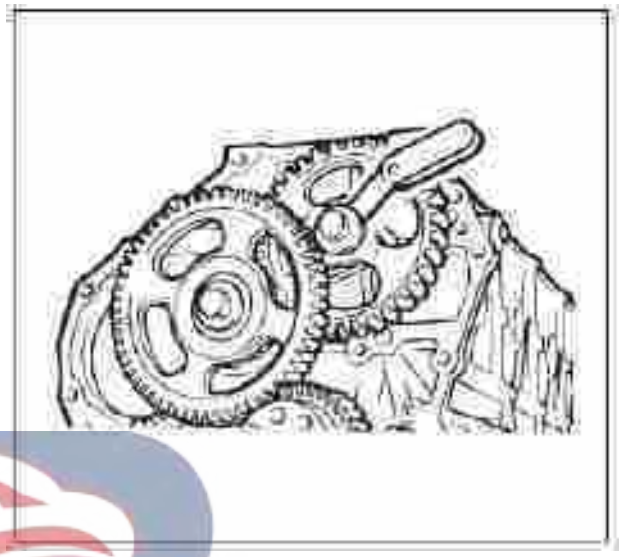
• Insert a feeler gauge between the idler and the thrust sleeve and measure the clearance.

• When the measured value exceeds the limit, the idler or thrust sleeve must be replaced.

Axial clearance of idle gear

Standard value	0.080 mm—0.155 mm
Standard value	0.200 mm

• Measure the idler clearance before removing idler B.



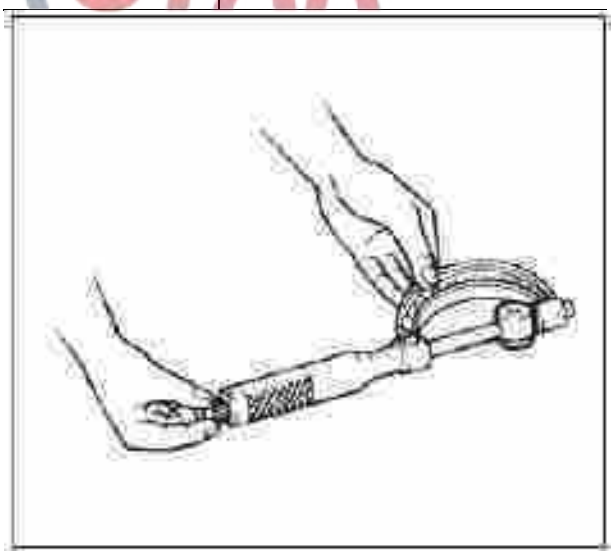
3. Outer diameter of idler axis

• Use a micrometer to measure the outer diameter of each idler axis.

• When the measured value exceeds the limit, replace the shaft.

Outer diameter of idler axis

Standard value	29.959 mm — 29.980 mm
Standard value	29.800 mm



4. Idler and idler axis clearance

• Measure the inner diameter of the middle ring to calculate the clearance between the middle roller and the middle shaft.

• When the measured value exceeds the limit, replace the countershaft or countershaft.

Idler and idler axis clearance

Standard value	0.020 mm — 0.062 mm
Standard value	0.200 mm

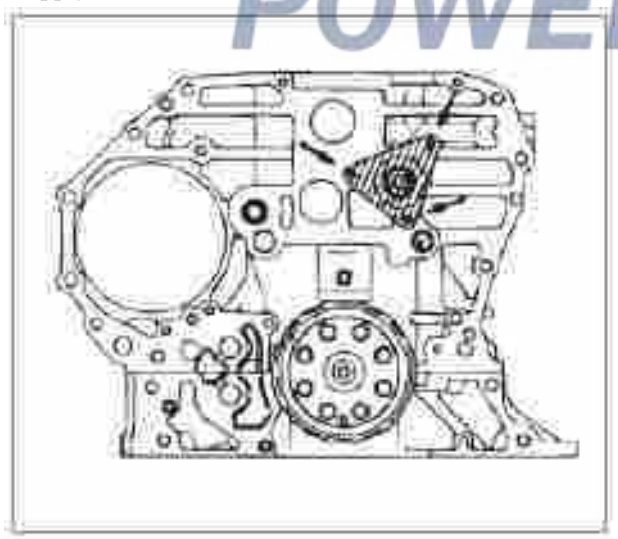
Installation

1. Install the idler B axis.

• Tighten the idler B axis with the specified torque.

Tightening torque : 31 N•m {3.2kgf•m}

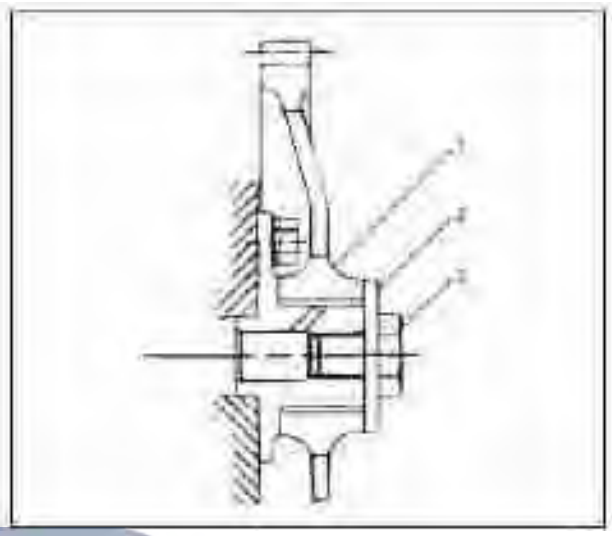
• Apply oil to shaft after installation.



2. Install the idler (1)B.

• Install the idler B in the direction shown and tighten the mounting bolts (3) to the specified torque.

Tightening torque : 110N·m {11.2kgf·m}



Key

1. Idler
2. Thrust sleeve
3. Bolt

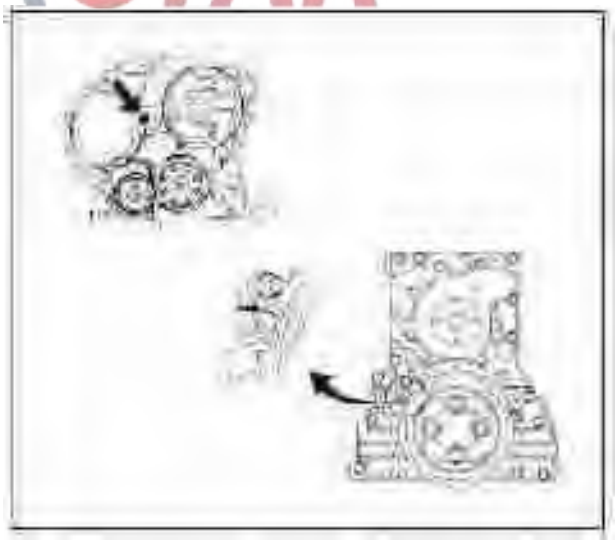
3. Install the idler A

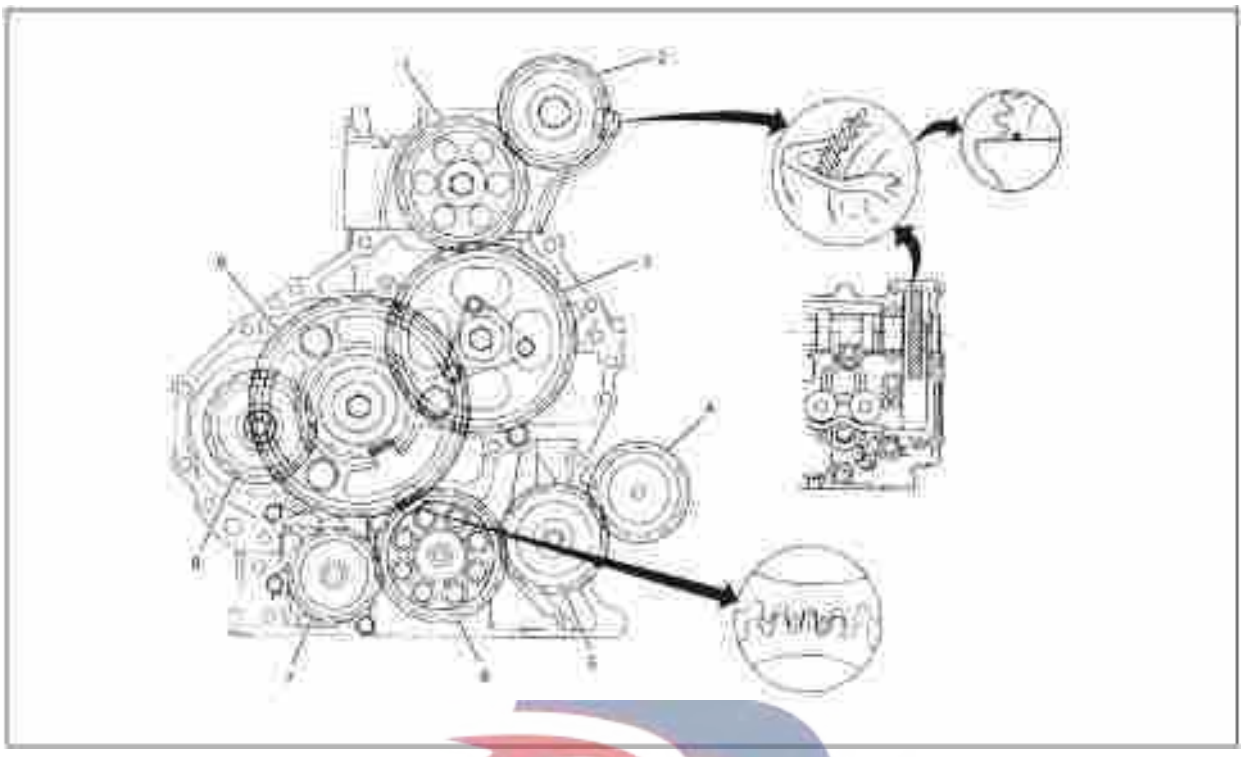
• Turn the crankshaft so that the piston of the first cylinder is at top dead center.

• Align the crank idler (6) and idler A (9) marks and assemble them to the cylinder block.

• Tighten the fixing bolts to the specified torque.

Tightening torque : 133 N•m {13.6kgf•m}





Key

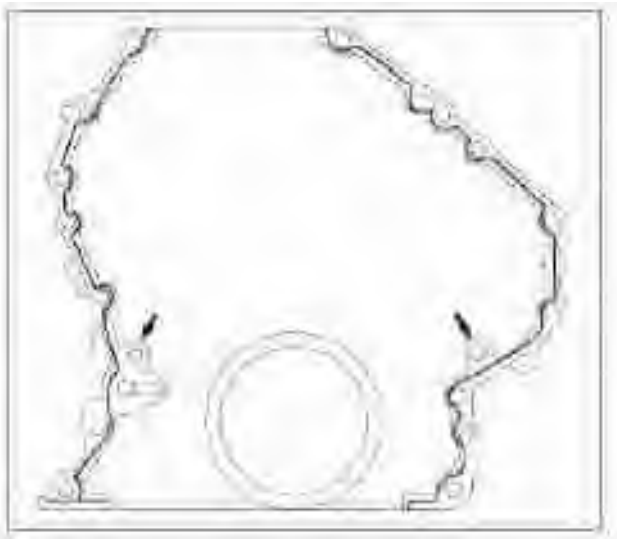
3. Idler C
2. Camshaft gear
3. Idler B
4. Power steering pump sprocket
5. Power steering pump idler
6. Crankshaft gear
7. Oil pump drive gear
8. Feed pump idler
9. Idler A

4. Install the flywheel housing.

• Clean the rear of the cylinder block.

In particular, during the installation of the housing, remove the spilled sealing fluid.

• Apply liquid sealant (TB1207C) uniformly to the bolt hole (except for the bolt hole shown by the arrow) as shown in the figure.



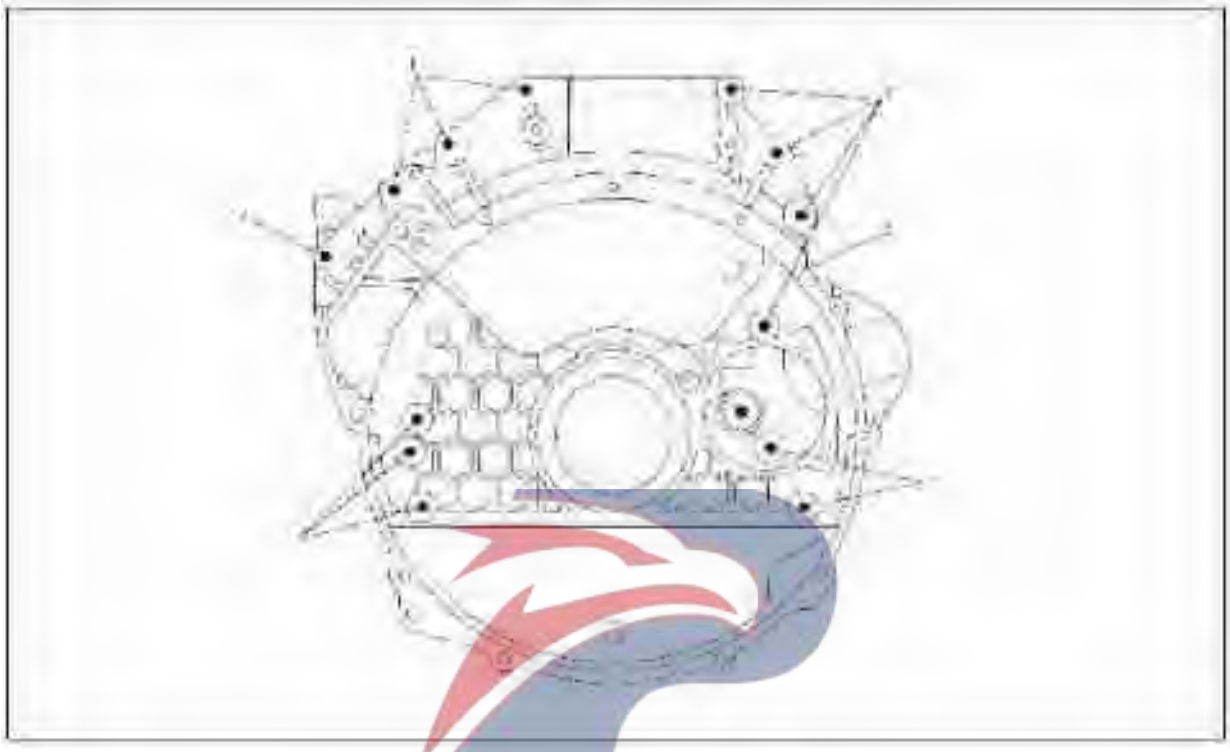
• Align the cylinder positioning pins and install the flywheel housing.

Flywheel shell tightening torque:

N·m {kgf·m}

1=96 {9.8} 2=48 {4.9} 3=38 {3.9}

• Symbol 3 is tightened on the side of the cylinder block.

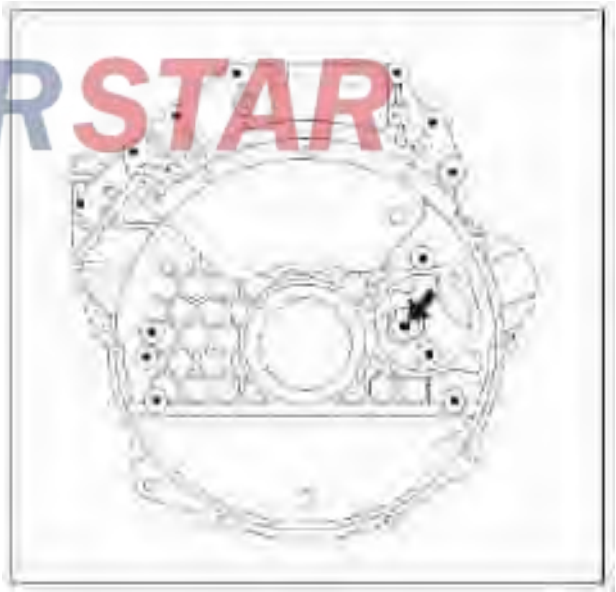


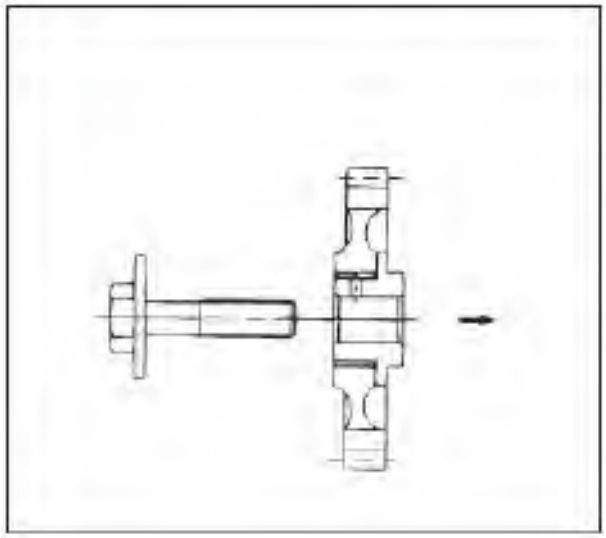
5. Install the power steering pump idler.

• Apply oil to countershaft gears.

• Assemble the countershaft and return shaft and install it in the position shown in the figure and tighten it to the specified torque.

Tightening torque : 133 N•m {13.6kgf•m}

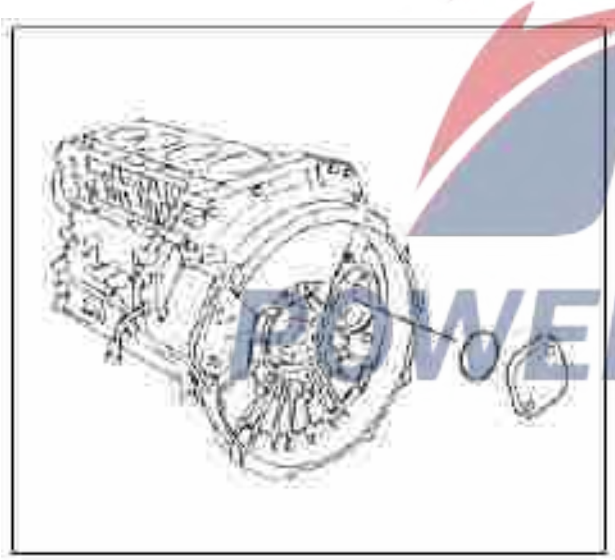




6. Install the power steering pump idler cover onto the flywheel housing.

• Install an O-ring on the idler cover and tighten the bolts to the specified torque.

Tightening torque : 19 N•m {1.9kgf•m}

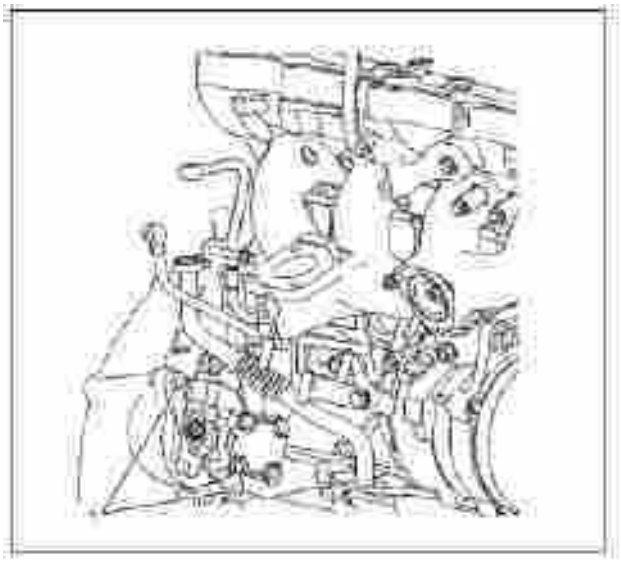


7. Install the power steering pump.

• Install the power steering pump and tighten it to the specified torque.

Power Steering Pump Mounting Bolt (1)

Tightening torque : 50 N·m {5.1kg·m}



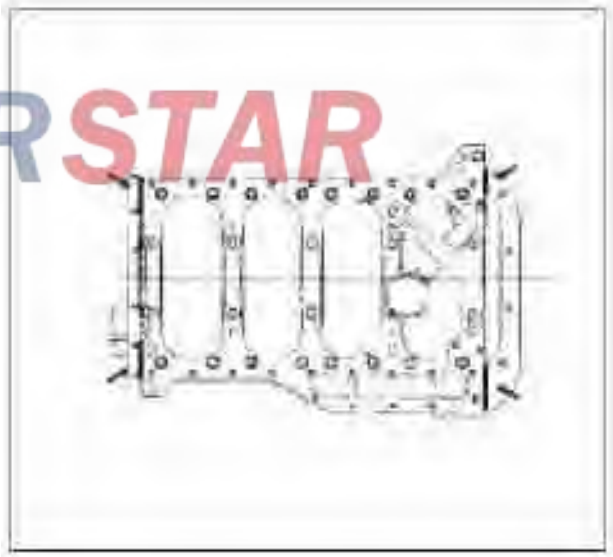
Key

1. Install bolts of power steering pump

8. Install the oil sump.

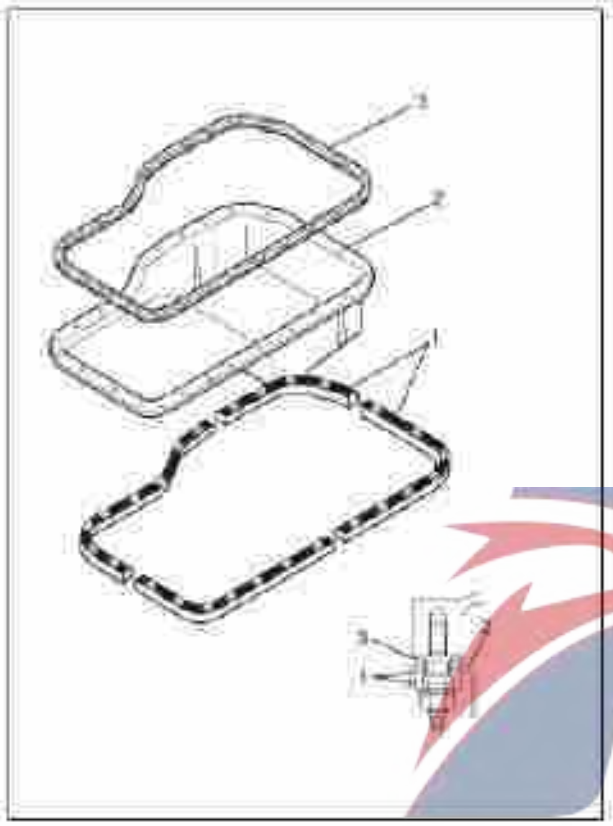
• Apply a 3 mm wide (TB 1207C) liquid sealant to the gasket between the cylinder block and the front cover and flywheel housing.

• After using the liquid sealant, install the oil sump within 5 minutes.



• Use the bolts on the front cover and housing to guide the flywheel housing, install the gasket (3) and install the oil sump (2).

Then, the rubber pad assembly (1) is assembled to the oil sump and fastened and fixed with bolts and nuts.

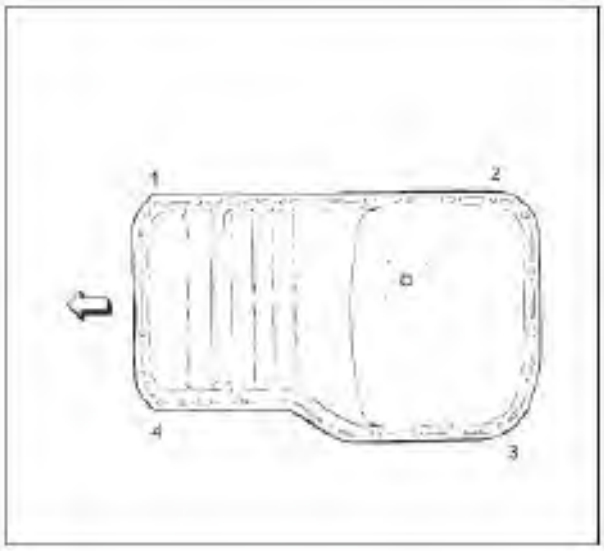


Key

1. Rubber pad assembly
2. Oil sump
3. Seal gaskets

• Tighten (1), (2), (3), (4) oil groove and tighten other parts. (Auto Order)

Tightening torque : 11 N•m {1.1kgf•m}



9. Install the oil ring after the oil seal.

Refer to the front oil seal of the crankshaft in this chapter.

10. Install the flywheel .

• Install the flywheel on the crankshaft locating pin and tighten to the specified torque in the order shown.

Tightening torque:

First time = 78 N·m{8.0kgf·m}

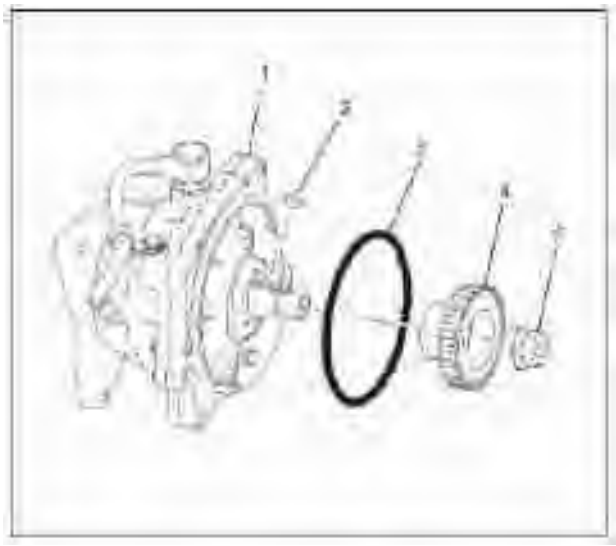
The second time = 120º ~ 150 º

11. Install the gear (4) on the vacuum pump (1).

• Install the key (2) on the vacuum pump shaft (1).

• Insert the gear (4) into the shaft and tighten the nut (5) to the specified torque.

Tightening torque : 137 N•m {14.0kgf•m}



Key

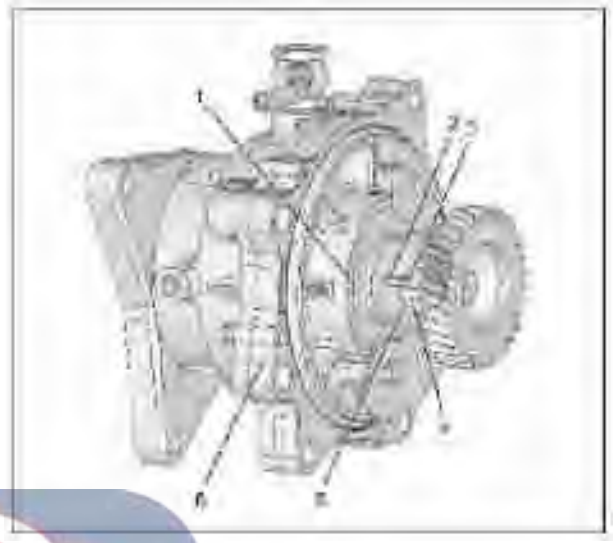
1. Vacuum pump
2. Key
3. O-ring
4. Gear
5. Nuts

12. Turn the crankshaft and place the first cylinder at top dead center (BTDC 0°).

13. Remove the cap (observer hole).
14. Install the vacuum pump on the cylinder block.
• Install the O-ring on the vacuum pump.
• Align the casting line (1) with the gear slot (2) on the side of the vacuum pump.
• Mount the vacuum pump on the cylinder head bolts as a guide.
• Observe that the gear groove (4) is near the center of the hole from the sight hole (5) of the flywheel housing.

Caution:

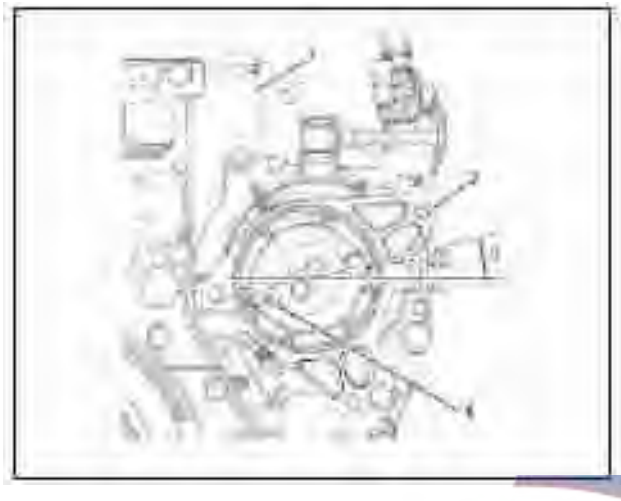
If the slot is offset, reinstall it.



Key

1. Casting line
2.Groove
3. Insert the front position of the groove
4 Position of the slot after insertion
5. Observation hole
6. Vacuum pump

• As shown in the figure, when the jaws are connected to the motor centerline (4), the pump assembly (2) observes the inclination of the distal end of the motor with respect to the horizontal plane by 15°, indicating a normal installation state.



Key

1. Cylinder block
2. Vacuum pump
3. About 15°
4. Claw

• Tighten the vacuum pump to the specified torque.

Tightening torque:

M10 Nut = 40 N•m {4.1kgf•m}

M10 Bolts = 48 N•m {4.9kgf•m}

M12 Bolts = 75 N•m {7.7kgf•m}

Caution:

Tighten in diagonal order.

15. Assemble the fuel supply pump (1) and the fuel pump bracket (4).

• Firstly, install the O-ring (3) on the fuel supply pump (1) and then on the oil supply bracket (4).

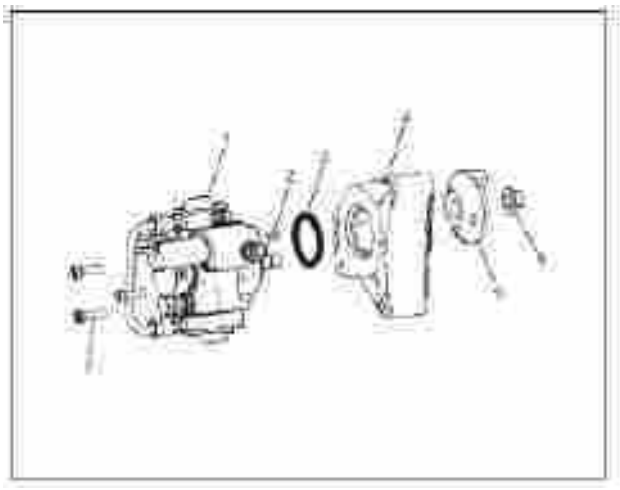
• Tighten the screws (7) in diagonal order.

Tightening torque : **19 N•m {1.9kgf•m}**

• Install the key (2) on the shaft of the oil supply pump and install the coupling (6).

• Tighten the 2 bolts on the threaded hole of the coupling (6), fix it and tighten the nut (5) to the specified torque.

Tightening torque : **64 N•m {6.5kgf•m}**



Key

1. Oil feed pump
2. Key
3. O-ring
4. Feed pump support
5. Nuts
6. Coupling
7. Flange bolts

16. Install the fuel supply pump (1) on the vacuum pump.

• Insert the coupling (3) with a shock absorber into the vacuum pump (4).

Caution:

Check the position of the rubber damper of the coupling (3) for misalignment.

• Install the O-ring (2) in the feed pump bracket and install the feed pump on the vacuum pump.

Caution:

Do not align the claws of the fuel supply pump (1).

• Tighten the bolts to the specified torque in diagonal order.

Tightening torque : 52 N·m {5.3kg·m}

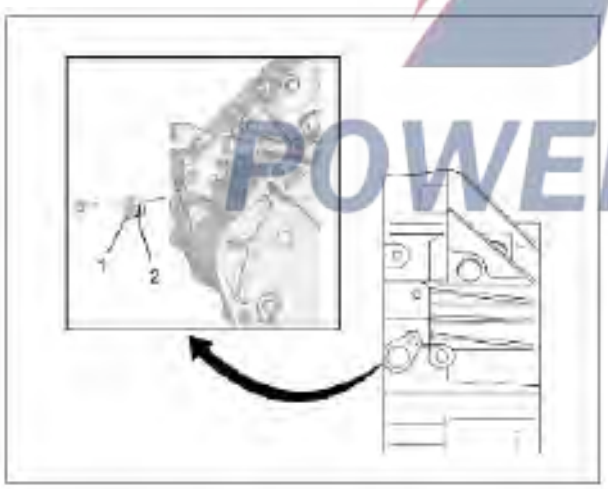
Key

1. Oil feed pump
2. O-ring
3. Coupling
4. Vacuum pump

17. Install the plug (1) in the manhole and tighten it to the specified torque.

Tightening torque : 8 N·m {0.8kg·m}

• Apply a small amount of oil to the O-ring (2) and install it.



Key

1. Plug
2. O-ring

18. Install the clutch plate, clutch pressure plate.

19. Install the cylinder head See the cylinder head in this chapter.

20. Install the camshaft assembly.

Refer to camshaft Assembly in this chapter.

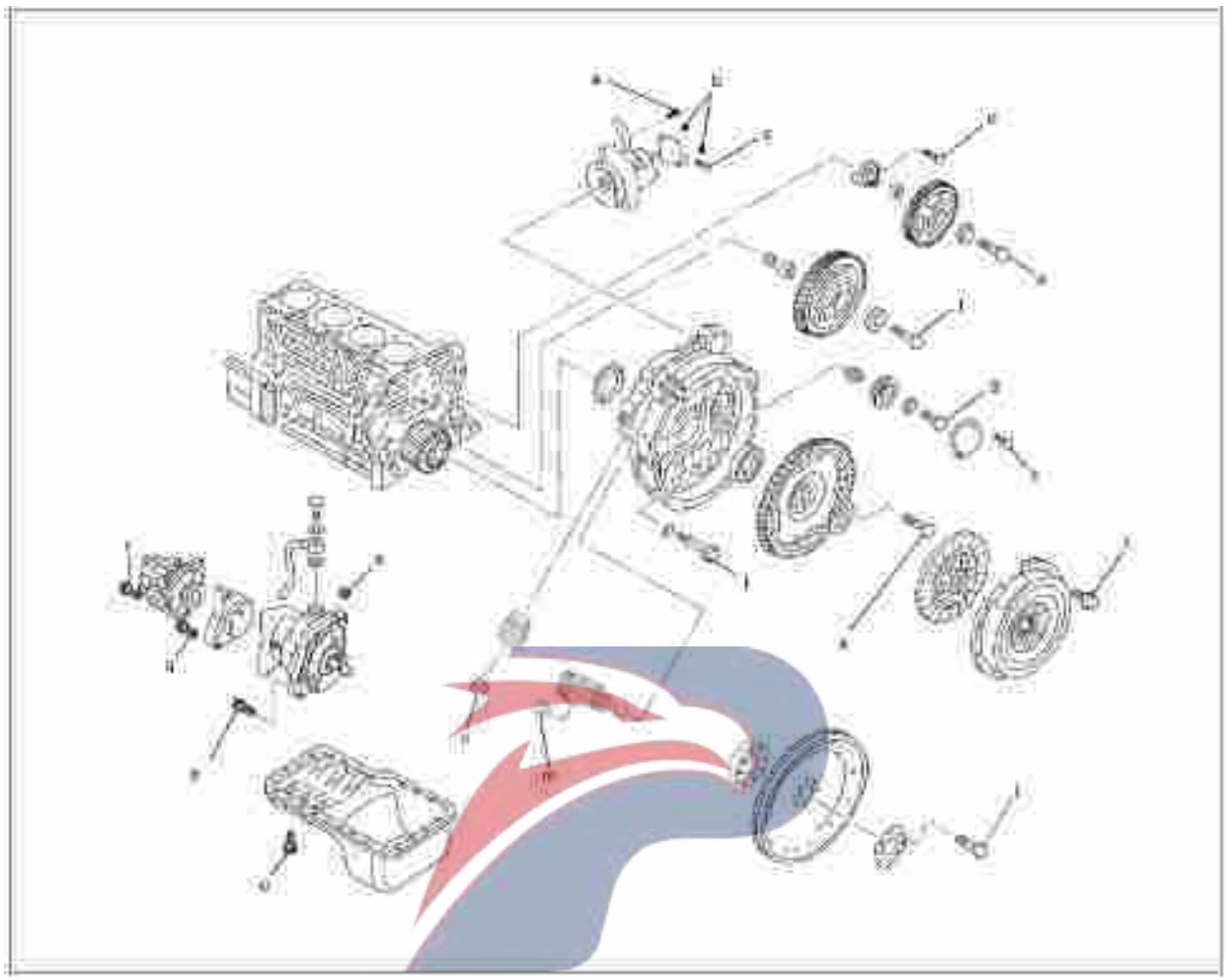
21. Install the rocker assembly.

Refer to the rocker assembly in this chapter.

22. Install the cylinder head cover.

Refer to the cylinder head cover in this chapter.

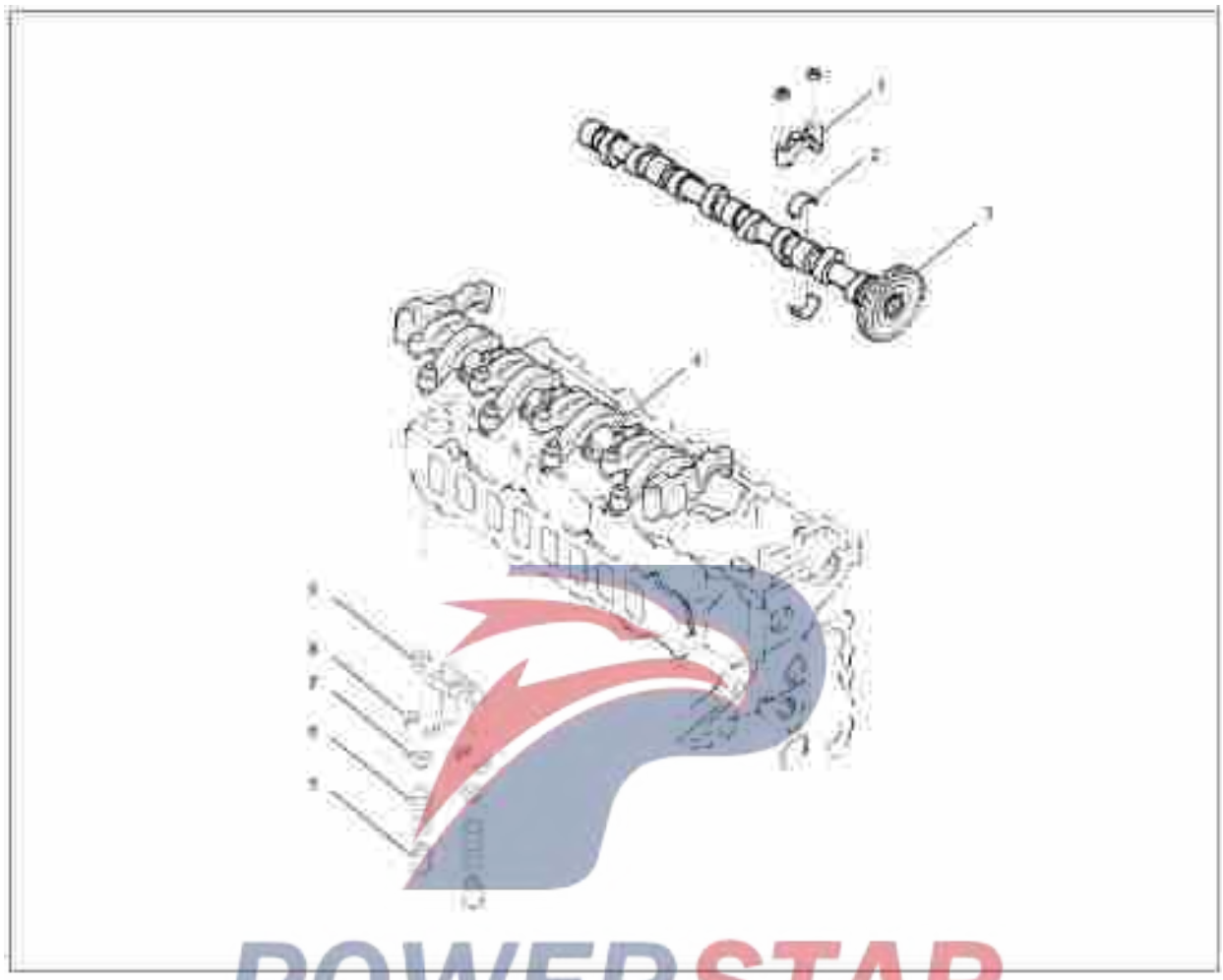
Tightening torque - Overview



(a) 43 N·m {4.4kgf·m}
(b) 24 N·m {2.4kgf·m}
(c) 44 N·m {4.5kgf·m}
(d) 31 N·m {3.2kgf·m}
(e) 110 N·m {11.2kgf·m}
(f) 134 N·m {13.6kgf·m}
(g) 134 N·m {13.6kgf·m}
(h) 19 N·m {1.9kgf·m}
(i) 40 N·m {4.1kgf·m}
(j) 176 N·m {17.9kgf·m}
(k) 78 N·m {8.0kgf·m}→120°∽150°
(I) 78 N·m {8.0kgf·m}→120°∽150°
(m) 8 N·m {0.8kgf·m}
(n) 8 N·m {0.8kgf·m}
(o) 11 N·m {1.1kgf·m}
(p) 73 N·m {7.4kgf·m}
(q) 48 N·m {4.9kgf·m}
(r) 19 N·m {1.9kgf·m}
(s) M10; 40 N·m {4.1kgf·m}
M12; 73 N·m {7.4kgf·m}

Valve seals and valve springs

Component parts



Key

1 Camshaft bearing cap
2. Camshaft bearings
3. Camshaft assembly
4. Rocker arm shaft assembly
5. Valve seal
6. Valve spring
7. Lock ring
8. Spring seat
9. Bridge parts

Disassembly

1. Remove the cylinder head.

Refer to the bolts in this chapter.

2. Remove the deck cover (1).
3. Remove the bridge part (2).

Caution:

Avoid the deck cover falling into the gear box at the rear of the cylinder head and into the oil return hole.

Mark:

The bridges and deck covers that have been removed must be stored so that they can be installed in their original position when they are used again.

Key

1.Bridge cover

2. Bridge parts

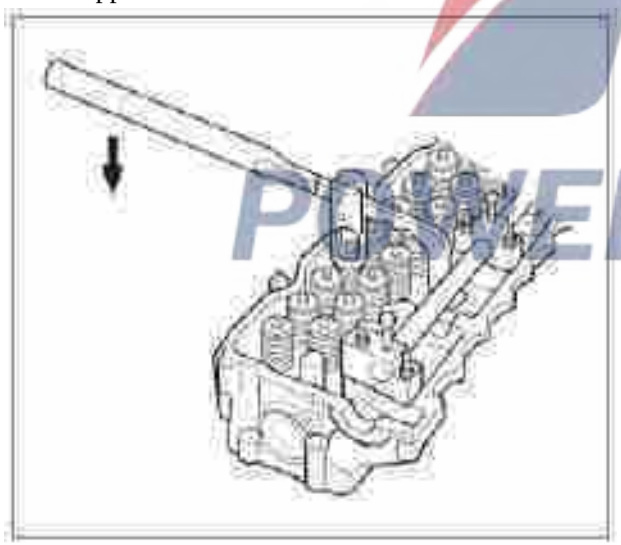
4. Remove the lockout ring.

Using a detacher, squeeze the valve spring and remove the locking sleeve from the valve.

Special tools

Valve spring disassembler: 5-8840-2621-0

Pivot support: 5-8840-2808-0



5. Remove the spring seat.

• Remove the special tool and remove the seat.

6. Remove the valve spring.

The valve spring removed must be stored according to the cylinder number.

7. Remove the valve seal.

Remove the oil seal with pliers.

Mark:

The removed seal can no longer be used.

Inspection

Check valve springs.

Mark:

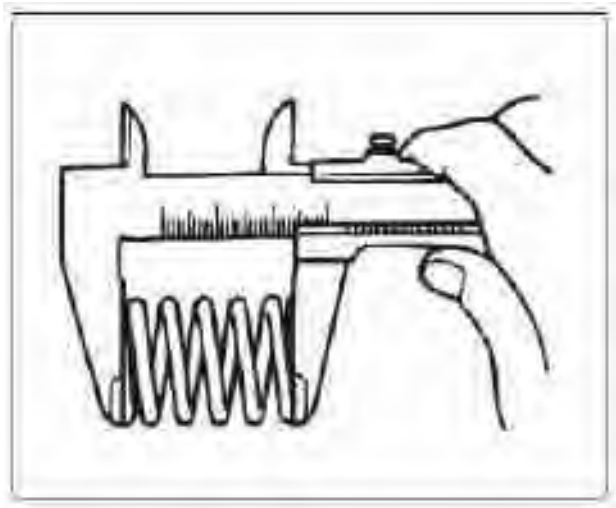
Visually inspect the valve spring and replace the valve spring if there is any obvious damage or abnormal wear.

1. Free height

Measure the free height of the spring. If it is below the specified limit, replace the spring.

Free height of valve spring mm

	Intake	Exhaust
Standard value	59.9	70.3
Standard value	56.9	67.3

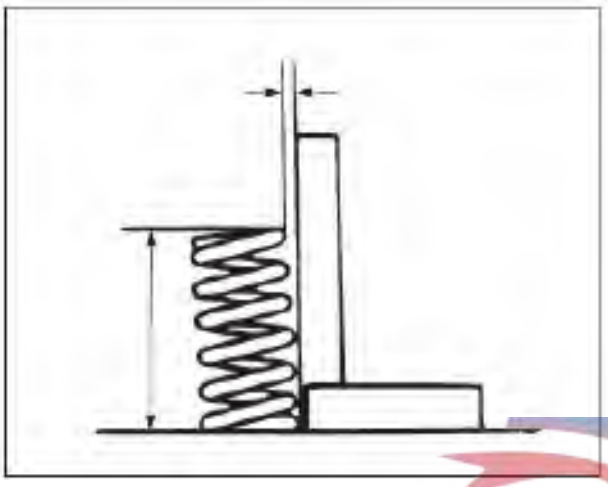


2. Verticality

• Measure squareness using a square When the measured value exceeds the limit, replace the valve spring.

Valve spring verticality mm

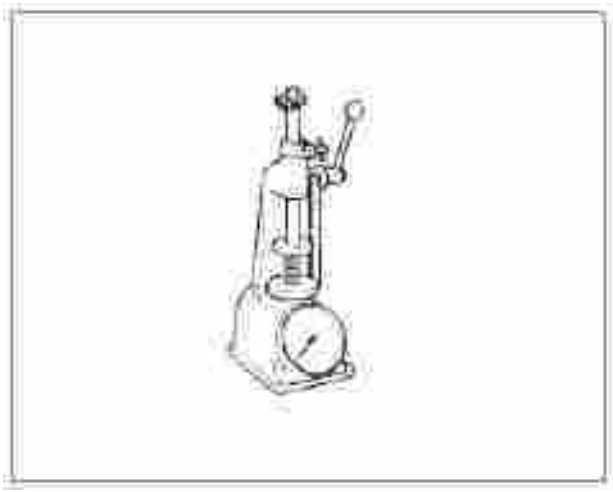
Standard value 1.0



3. Voltage

• Use a spring tester to compress the spring to mounting height. Measure the tension of the compression spring. When the measured voltage is below the limit, replace the spring.

Valve spring tension		N {kg}
	Intake	Exhaust
Height of installation	47.0	47.0
Standard value	333 {34.0}	490 {50.0}
Standard value	315 {32.2}	463 {47.3}



Installation

7. Install the valve seal.

• Apply oil to the outer circumference of the valve guide and install the oil seal using the stem seal installation tool.

Mark:

After installing the valve oil seal, make sure that the oil seal is fully inserted into the deepest position, check whether the oil seal is tilted, and whether the clamping spring has come off.

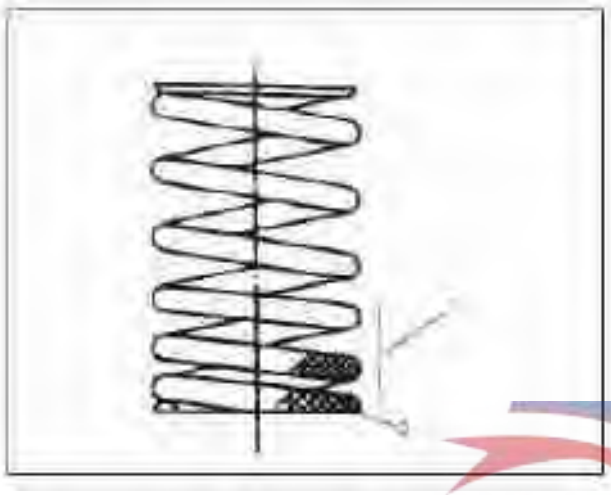
Special tools

Valve stem seal installer: 5-8840-2833-0

2. Install the valve spring.

• When installing, place the side of the cover mark (2) or small spring distance (1) underneath (side of the head).

	Spray mark
Intake	Blue
Exhaust	Red



Key

1. Spring spacing
2. Spray mark

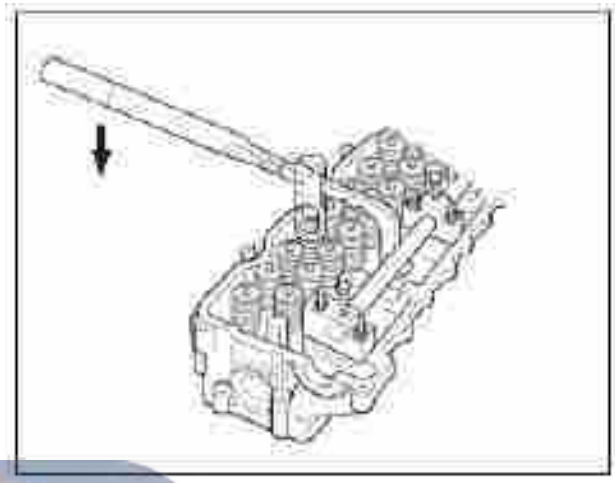
3. Install the spring seat.
4. Install the valve locking sleeve.

• Use a detacher to compress the valve spring and install the locking device from the valve.

Special tools

Valve spring disassembler: 5-8840-2621-0

Pivot support: 5-8840-2808-0



5. Apply engine oil to the bridge (2) and install it.

Mark:

Move up or down to see if you can move normally without stagnation.

Apply engine oil to deck cover (1) and install.

Caution:

Avoid the deck cover falling into the gear box at the rear of the cylinder head and into the oil return hole.

Key

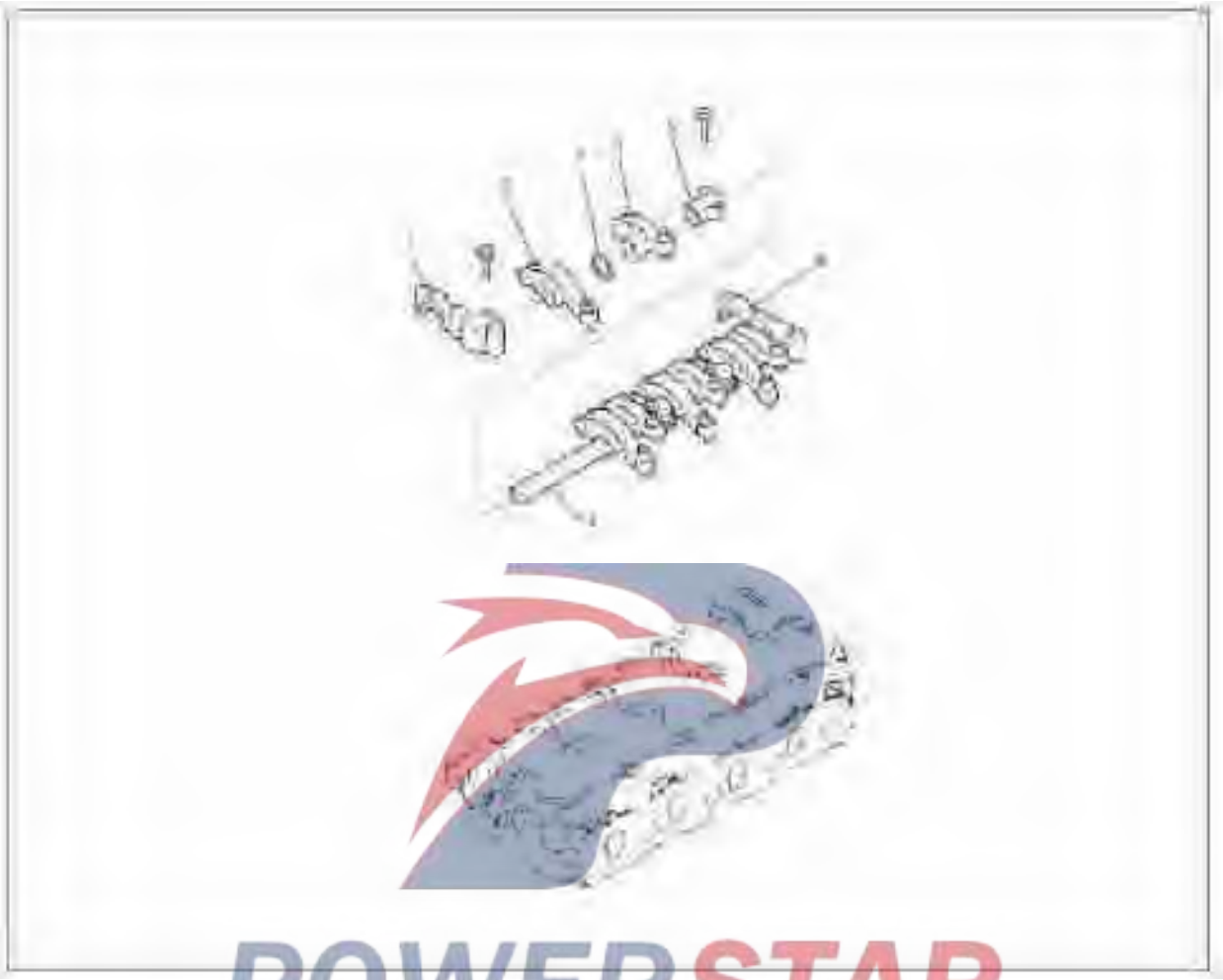
1.Bridge cover
2. Bridge parts

7. Install the cylinder head.

Refer to the bolts in this chapter.

Rocker arm shaft assembly

Component parts



Key

1. Camshaft support
2. Rocker arm
3. Wave washer
4. Rocker arm
5. Rocker support
6. Camshaft support
7. Rocker arm axis

Disassembly

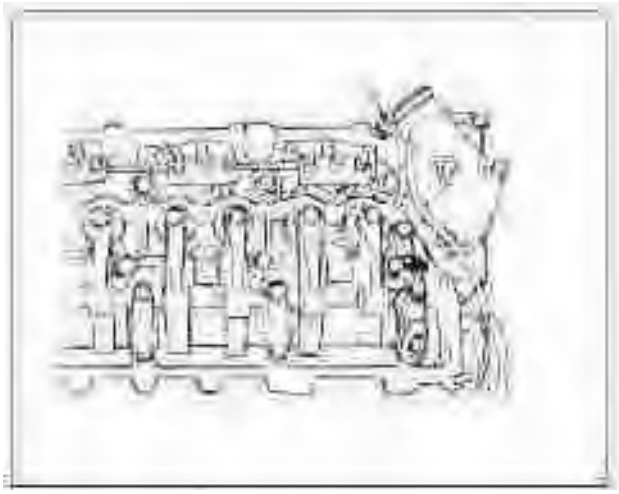
1. Remove the cylinder head cover.

Refer to the cylinder head cover in this chapter.

2. Remove rocker assembly.

• Remove the camshaft bracket and rocker shaft at the same time.

• The bolts shown in the figure are bolts used to hold the rocker shaft and will not be removed at this time.



Caution:

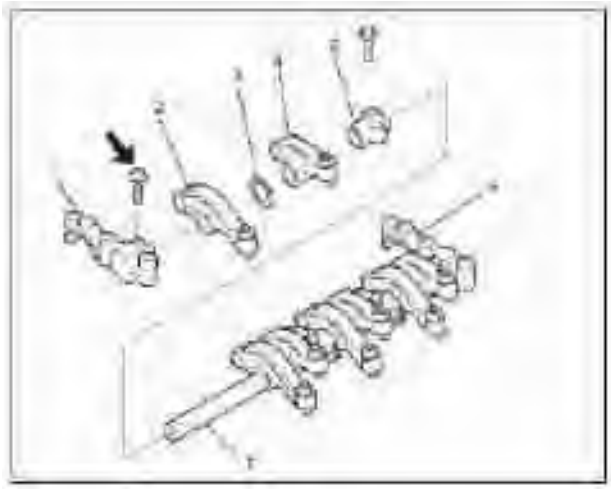
Avoid the deck cover falling into the gear box at the rear of the cylinder head and into the oil return hole.

Disassembling

1. Remove the camshaft bracket (1).
2. Remove rocker arm (2).
3. Remove the wave washer (3).
4. Remove rocker arm (4).
5. Remove the dial holder (5).

• Disassemble in the following order (2) to (4).

6. Remove the camshaft bracket (6) and remove the shaft.

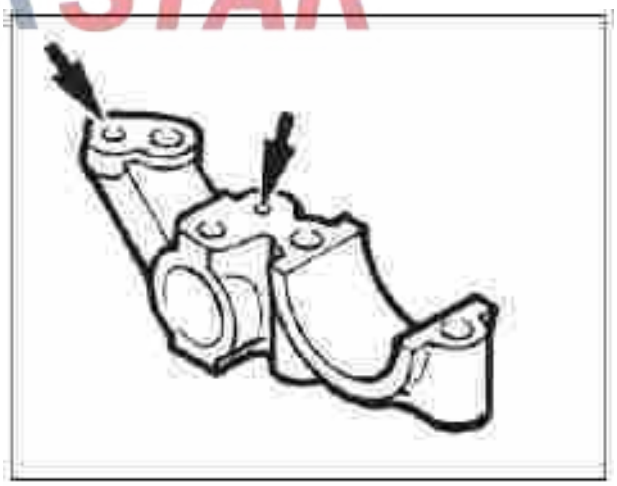


Key

1. Camshaft support
2. Rocker arm
3. Wave washer
4. Rocker arm
5. Rocker support
6. Camshaft support
7. Rocker arm axis

Inspection

1. Check the oil hole in the camshaft bracket (rear) for obstructions.



2. Check the bending of the rocker shaft.

• Place the rocker shaft on the V-block.

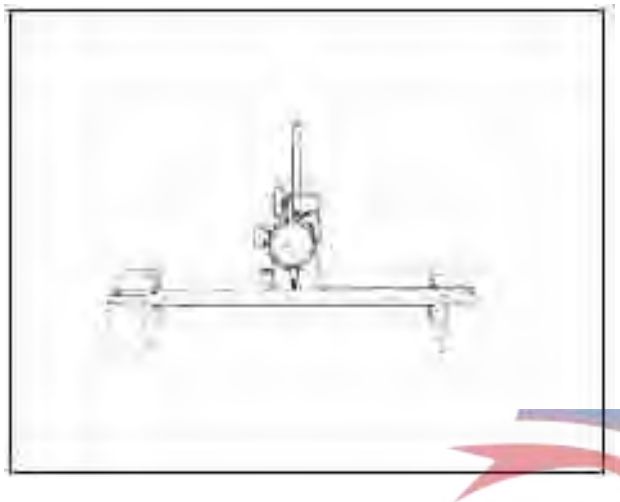
• Place the dial gauge in the center of the shaft and check the elbow while rotating the shaft.

• When the measurement curvature is low, press (Cold) for correction.

• When the bending exceeds the limit, replace the shaft.

Bending arm axis mm

Standard value	0.3



3. Check the rocker shaft wear.

• Use a micrometer to measure the eight parts of the scale.

• Replace the shaft when the measured value is below the limit.

Rocker shaft diameter mm

Standard value	21.979 - 22.000
Standard value	21.85

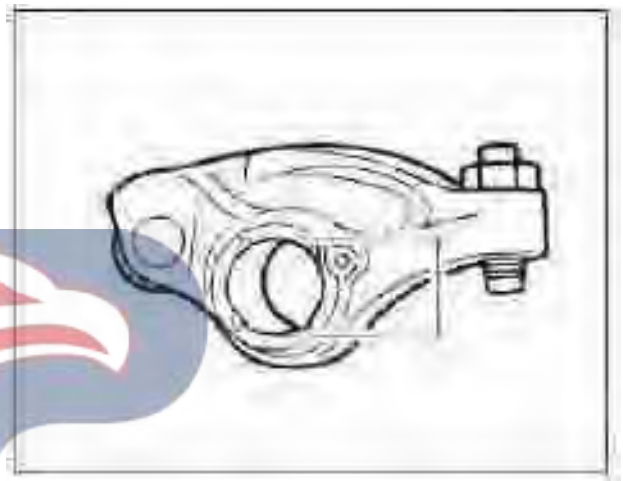
4. Check the clearance between the rocker arm and the rocker shaft.

• Using a bore comparator, measure the inner diameter of the inclined bushing and measure its clearance with respect to the shaft outer diameter.

• When the measured value exceeds the limit, replace the rocker arm and rocker arm shaft.

Rocker arm and rocker clearance mm

Standard value	0.010 - 0.056
Standard value	0.2



5. Check the clearance between the rocker arm and the pin.

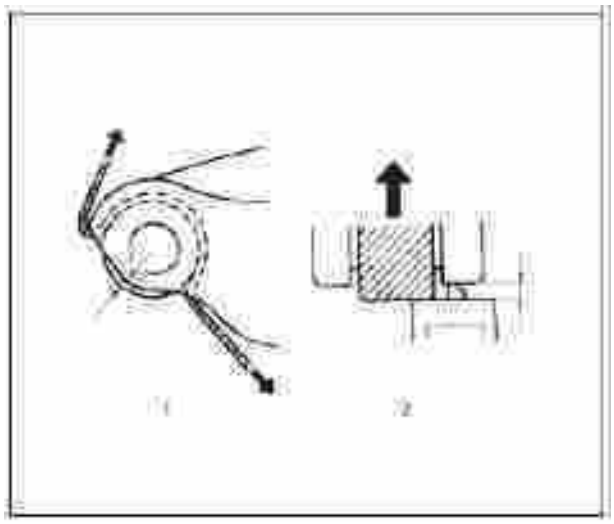
a. Pass a rope or similar object through the gap between the rocker arm and the roller, and forcefully pull the rope in the direction of the arrow to push the roller while measuring the height difference between the rocker arm and the roller. (Figure(1))

b. Make a mark at the measuring point, remove the rope, push the drum fully into the deepest position, and then measure the height difference at the mark position. (Figure(2))

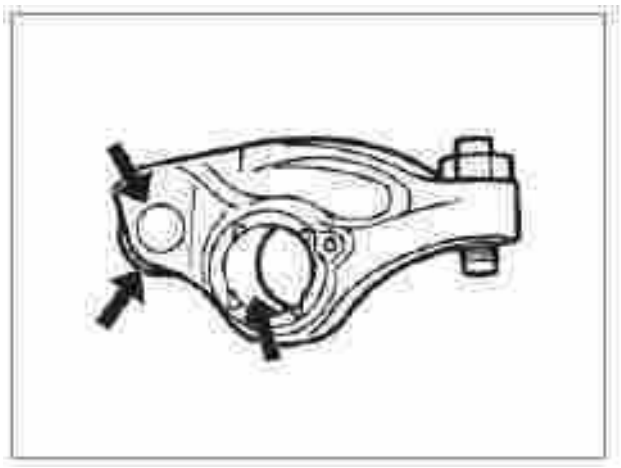
c. The difference between the dimension measured in step a and the dimension measured in step b is the distance between the roller and the pin. When the game exceeds the limit, replace the rocker arm.

Clearance between roller and pin mm

Standard value	0.068 - 0.100
Standard value	0.2



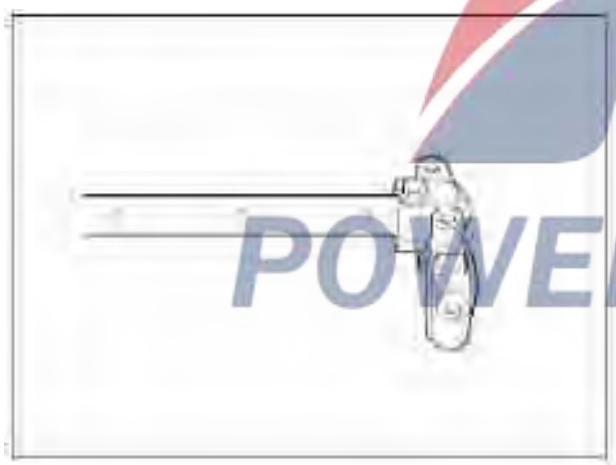
• Apply oil to the inner diameter of the rocker arm and the roller and spring pin and install it on the rocker shaft.



Assembly

1. Mount the camshaft bracket on one side of the rocker shaft. First, pre-assemble should be needed, after mounting the rocker arm assembly on the cylinder head, tighten it to the specified torque.

• Assemble in the reverse order of time.



2. Install the rocker arm.

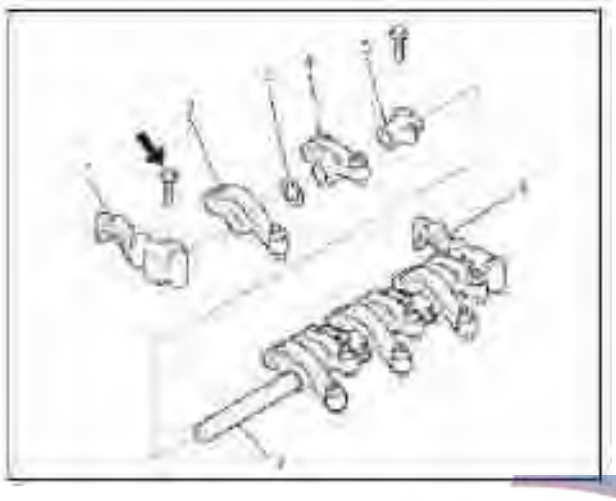
3. Install the wave washer (3) on the rocker arm.

4. Install the scale bracket (5)

• When installing the bracket on the rocker shaft (7), pay attention to the installation direction.

5. Finally, install the camshaft bracket on the other side.

• Mount the camshaft bracket (1) on the rocker shaft (7). At this time, tighten the bolt indicated by the arrow in advance, and attach the rocker arm assembly to the cylinder head, and tighten the bolt to the specified torque.



Key

1. Camshaft support
2. Rocker arm
3.Wave washer
4. Rocker arm
5. Rocker support
6. Camshaft support
7. Rocker arm axis

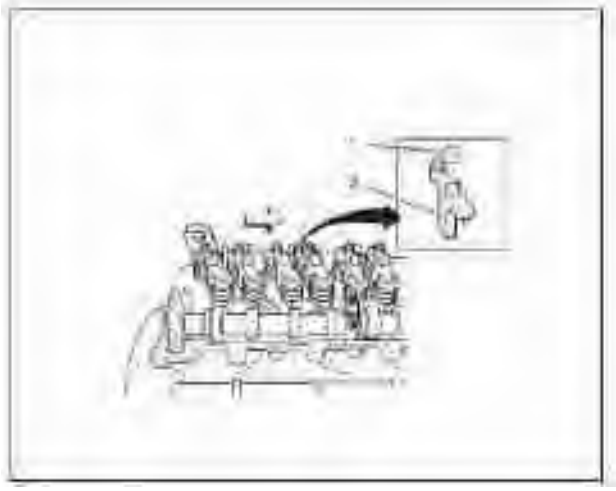
Installation

1. Install the rocker assembly.

• If the bridge cover (1) has been removed, apply oil to the inside of the bridge cover and install it on the deck (2).

Caution:

Avoid the deck cover falling into the gear box at the rear of the cylinder head and into the oil return hole.



Key

1.Bridge cover

2. Bridge parts

• Loosen the rocker arm adjustment screw to apply oil to the rocker arm and install it on the cylinder head.

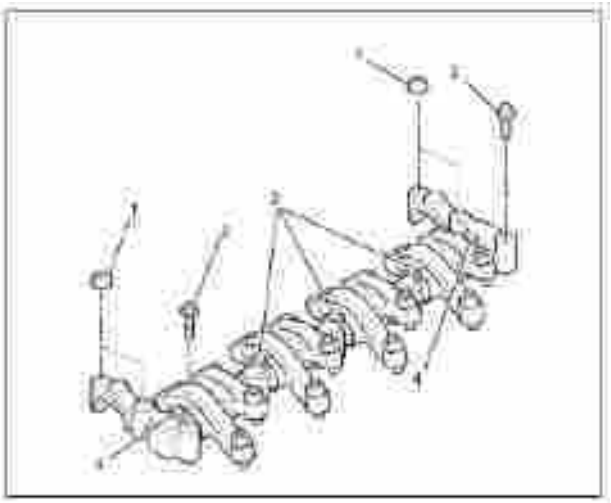
• Loosen the bolt indicated by the arrow slightly to make installation easier.

• Apply oil to threaded portions of bolts and nuts.

• Tighten the bolts (2), (3) of the rocker arm assembly from the rocker side nut (1) and tighten the rocker arm assembly horizontally.

Tightening torque: N·m {kgf·m}

Blots(3)	Nut(1), Bolt(2), (4)
56 {5.7}	27 {2.8}

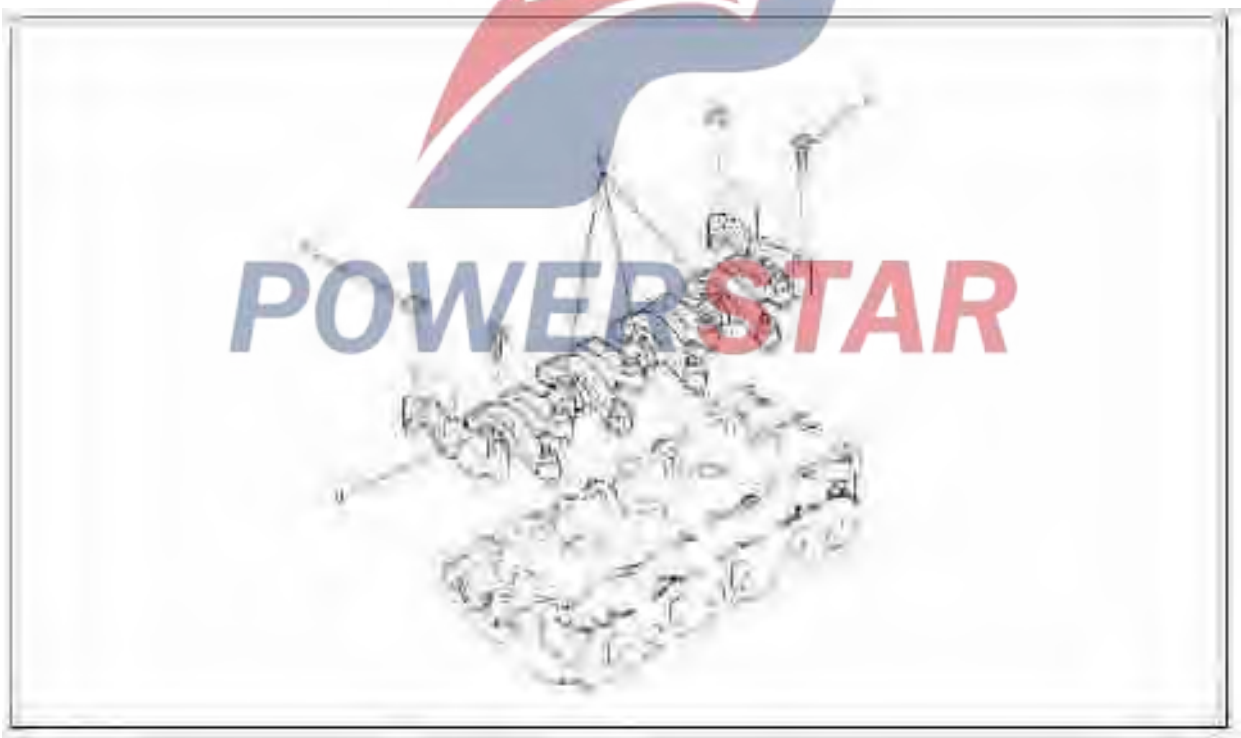


2. Adjust the valve clearance.
3. Install the cylinder head cover.
Refer to the cylinder head cover in this chapter.

Key

1. Nuts
2. Bolt
3. Bolt
4. Bolt

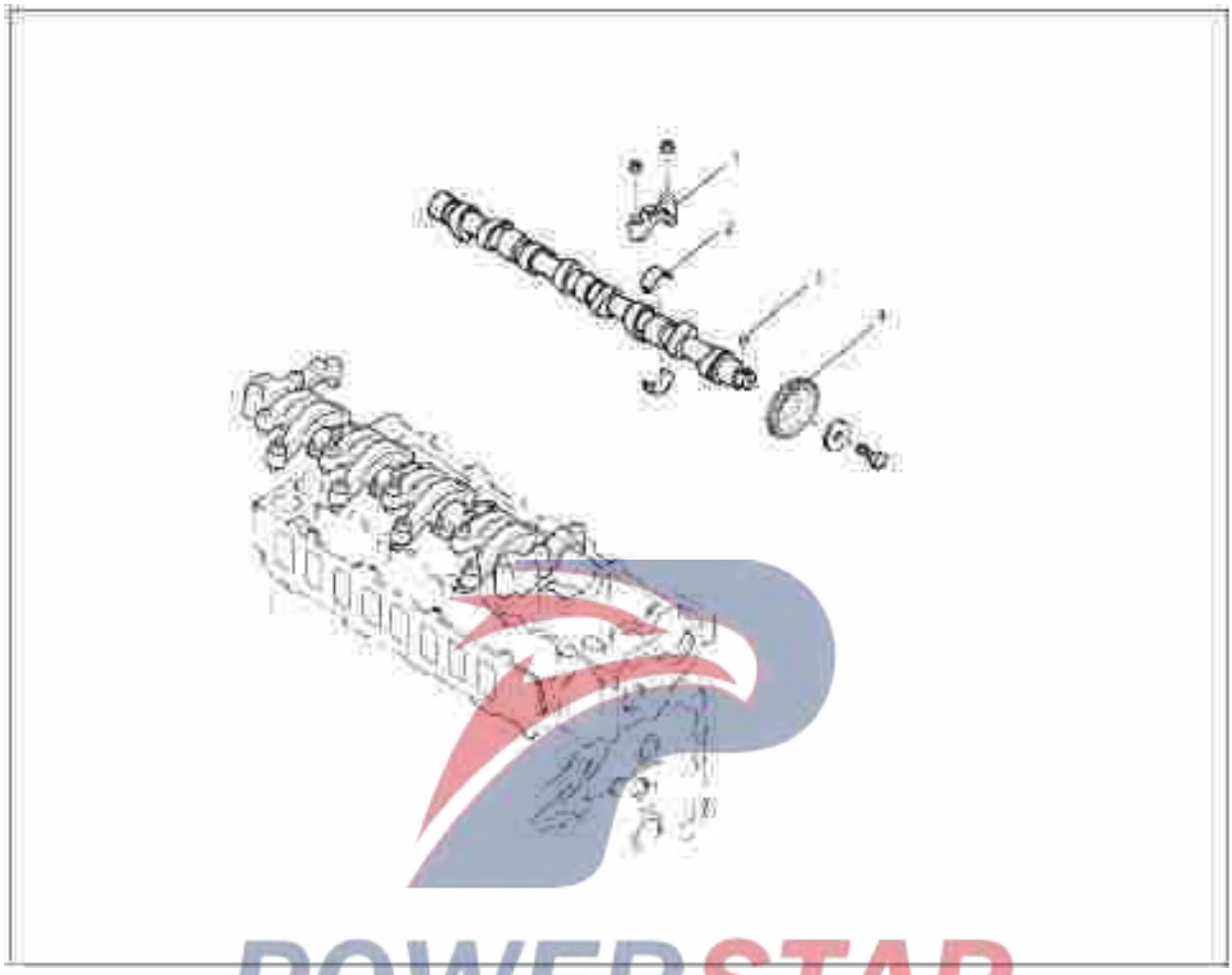
Tightening torque - Overview



(a) 27 N·m { 2.8kgf·m }
(b) 56 N·m { 5.7kgf·m }
(c) 27 N·m { 2.8kgf·m }
(d) 27 N·m { 2.8kgf·m }

Camshaft assembly

Component parts



Key

1. Bearing cap
2. Bearing
3. Dowel pin
4. Camshaft gear

Disassembly

1. Remove the cylinder head cover.

Refer to the cylinder head cover in this chapter.

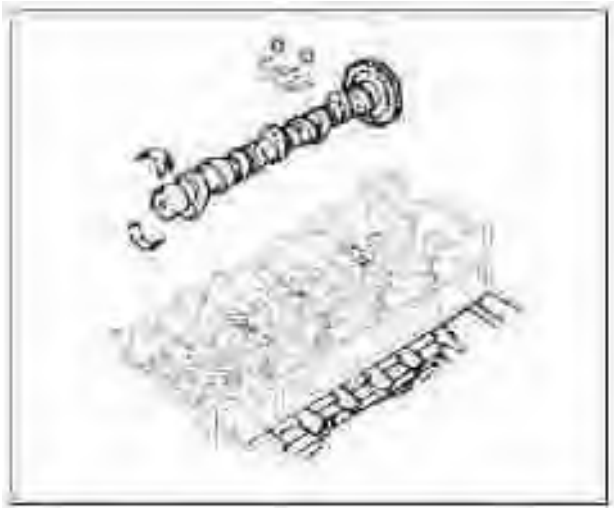
2. Remove rocker assembly.

Refer to the rocker assembly in this chapter.

3. Remove the camshaft bearing cap.
4. Remove the upper bearing.
5. Remove the camshaft assembly.
6. Remove the lower bearing.

Mark:

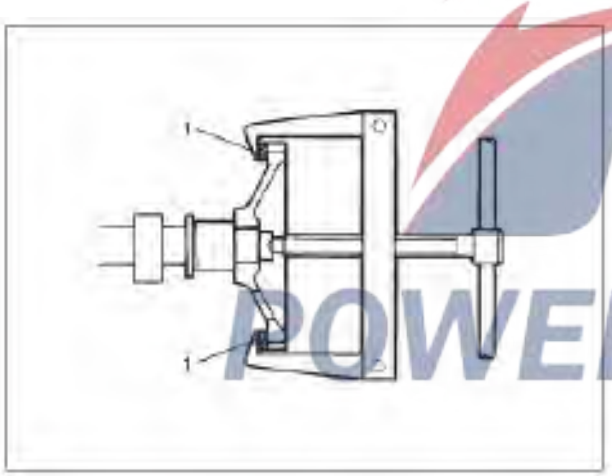
The disassembled bearings are to be stored and stored in accordance with each cylinder, using labels, etc.



Disassembling

1. Remove the gear from the camshaft.

• Remove the camshaft gear fixing screw, insert the board (1) into the suction tool, and remove the gear from the camshaft.



Key

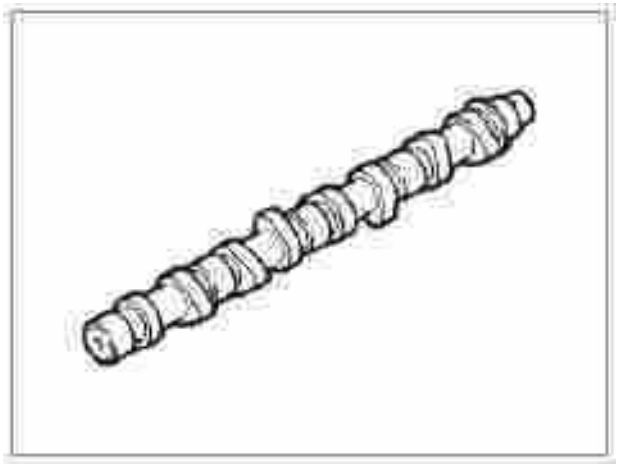
1.Wood pieces

2. Remove the positioning pin

Inspection

1. Visually inspect the camshaft.

• Check wear and scratches on camshaft journals and camshafts and replace if not normal.

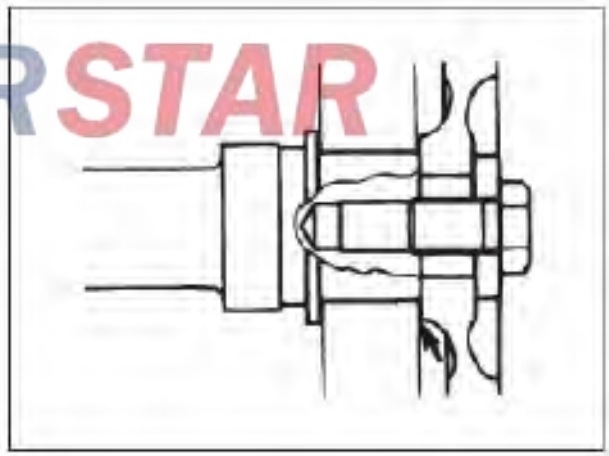


2. Check the axial clearance of the camshaft.

• Use a feeler gauge to measure the clearance between the camshaft gear and the camshaft support.

• When the measured value exceeds the limit, replace the camshaft gear or camshaft.

Axial clearance of camshaft	mm
Standard value	0.05 - 0.17
Standard value	0.25

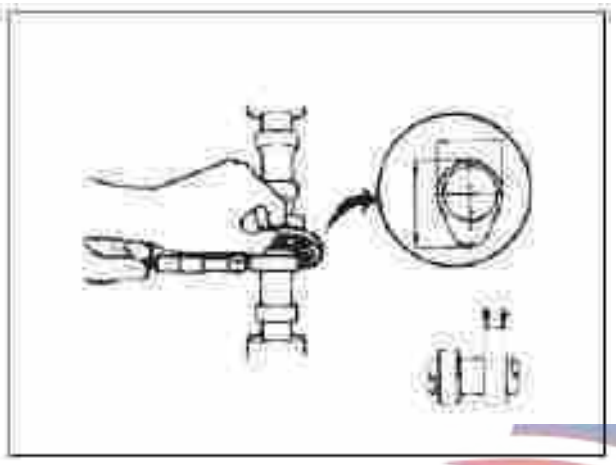


3. Check if the cam protrusion is worn.

• Use a micrometer to measure the height of the cam lobe.

• Replace the camshaft when the cam nose height is below the limit.

Cam increases the size		mm
	Intake	Exhaust
Standard value	52.8	54.5
Standard value	51.8	53.5



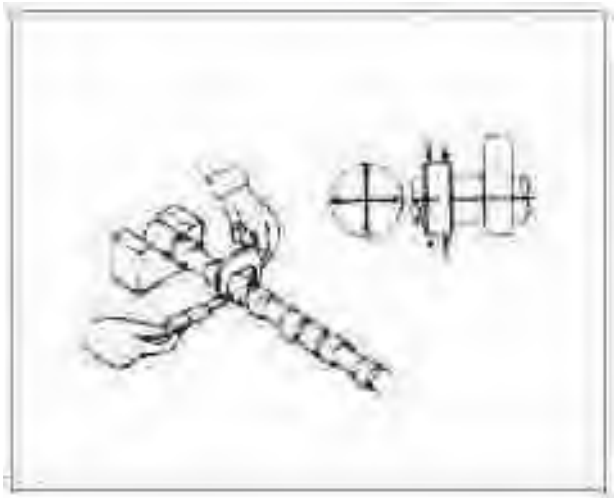
4. Check the camshaft journal for wear.

• Use a micrometer to measure the diameter and uneven wear of the camshaft journal.

• When the wear exceeds the limit, replace the camshaft.

Outer diameter of camshaft	mm
Standard value	39.950 — 39.975
Standard value	39.850

Camshaft journal part wear	mm
Standard value	0.05

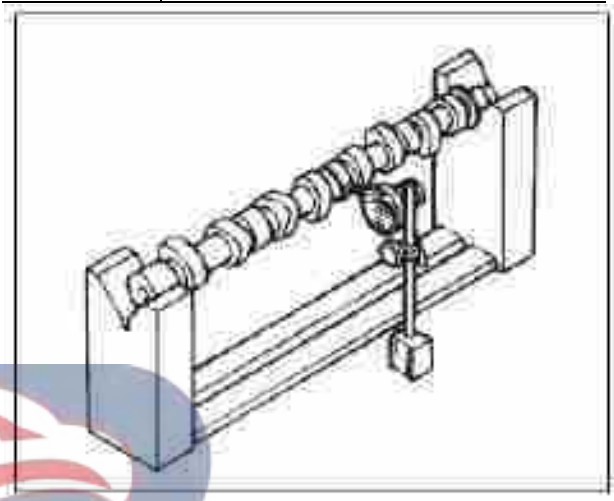


5. Check if the camshaft is bent.

• Place the camshaft on the V-block and use a dial indicator to measure the bend.

• Slowly turn the camshaft and observe the radial web of the dial gauge. When the radial eccentricity exceeds the limit, the camshaft must be replaced.

The radial axis of the camshaft	mm
Standard value	0.05



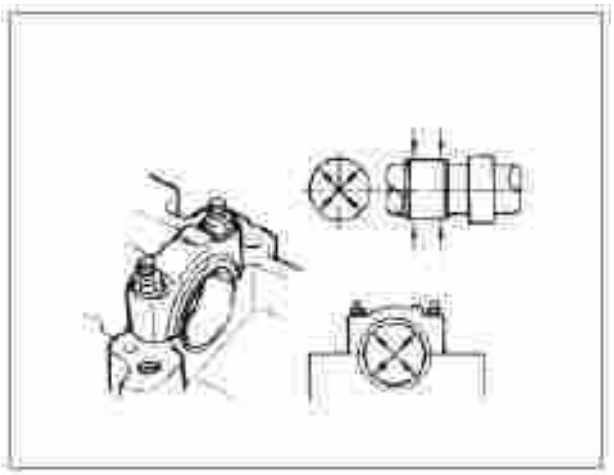
6. Measure the oil film space of the camshaft journal.

a. Use the bore gauge to measure the inside diameter of the camshaft bearing.

b. Please read the difference between the inner diameter of the camshaft bearing and the diameter of the camshaft journal.

When the film gap exceeds the limit, the camshaft bearing must be replaced.

Shaft neck clearance	mm
Standard value	0.025 - 0.087
Standard value	0.15



Assembly

1. Install the positioning pins.

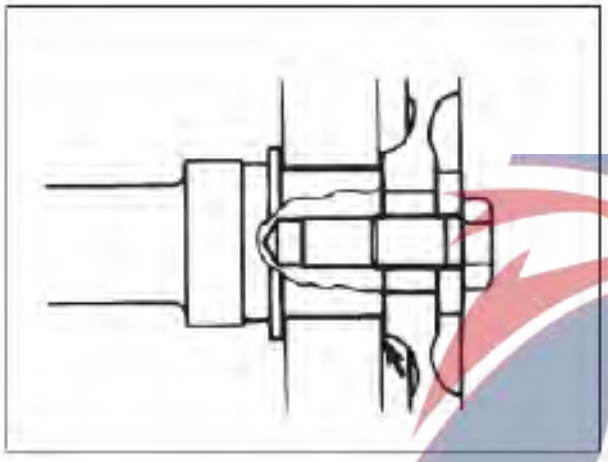
2. Install camshaft gears.

• Point the protruding end of the center wheel hub of the camshaft gear toward the camshaft, align the dowel pin and install the camshaft gear.

Tightening torque: 142 N•m {14.5 kgf•m}

Mark:

When squeezing gears, be careful not to scratch the cams and neck.



Installation

1. Turn crankshaft and place first cylinder at compression top dead center.

2. Install the lower bearing of the camshaft.

• Apply engine oil to the lower bearing of the camshaft and assemble it to the cylinder head.

3. Install the camshaft assembly.

• When installing the camshaft assembly, align the "•" mark on the camshaft gear face with the top surface of the bolt.

Mark:

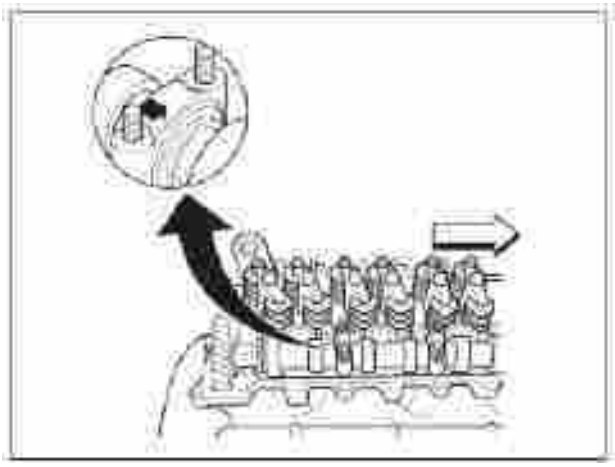
After tightening, make sure that the "•" mark is aligned.

4. Install the upper bearing on the bearing cap.

5. Install the bearing cap.

• Apply engine oil to the upper bearing.

• The front of the bearing cap faces the front of the engine and is fixed to the cylinder head in numerical order.



• Apply oil to the threads and tighten the bearing cap to the specified torque.

Tightening torque: 27 N•m {2.8 kgf•m}

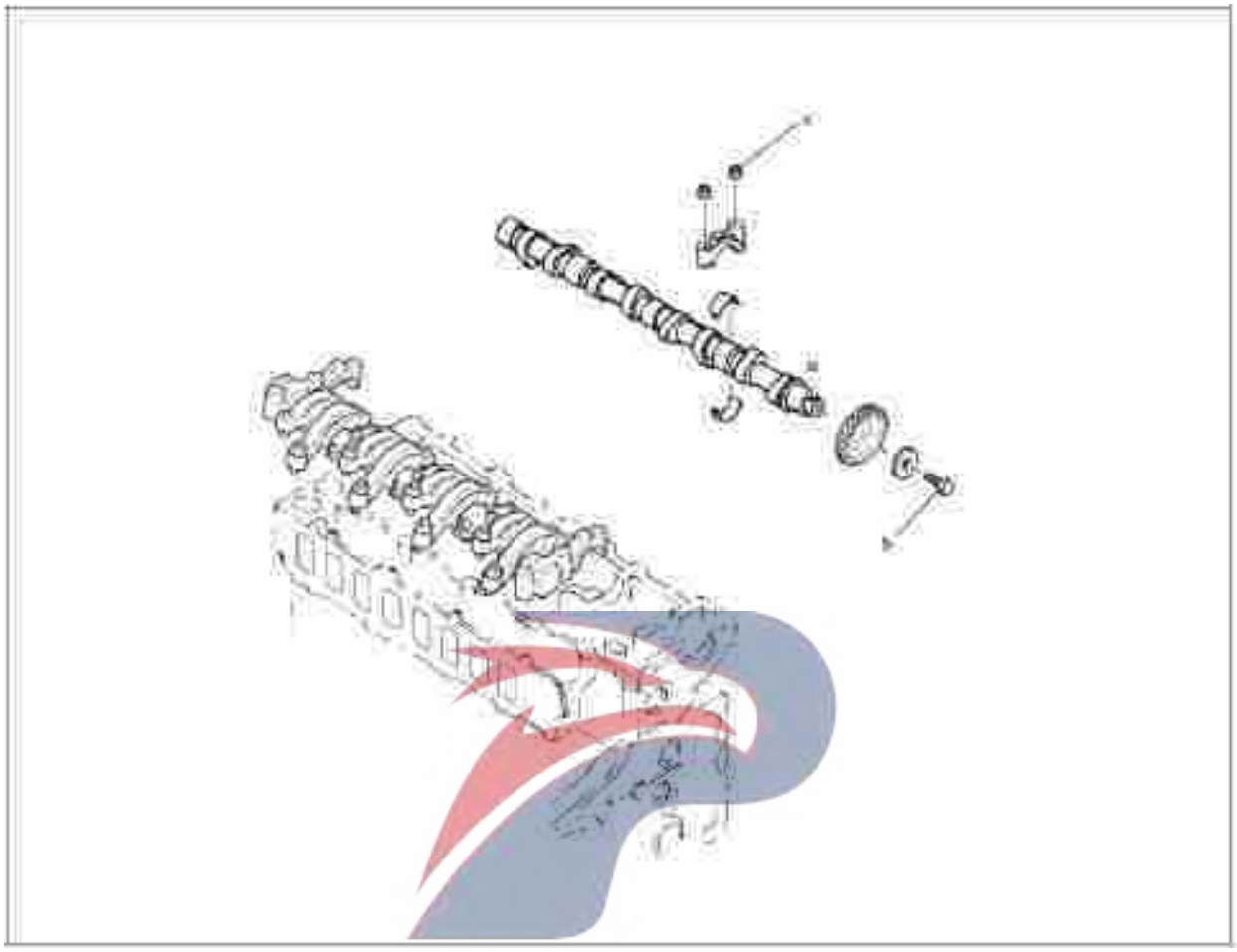
6. Install the rocker assembly.

Refer to the rocker assembly in this chapter.

7. Install the cylinder head cover.

Refer to the cylinder head cover in this chapter.

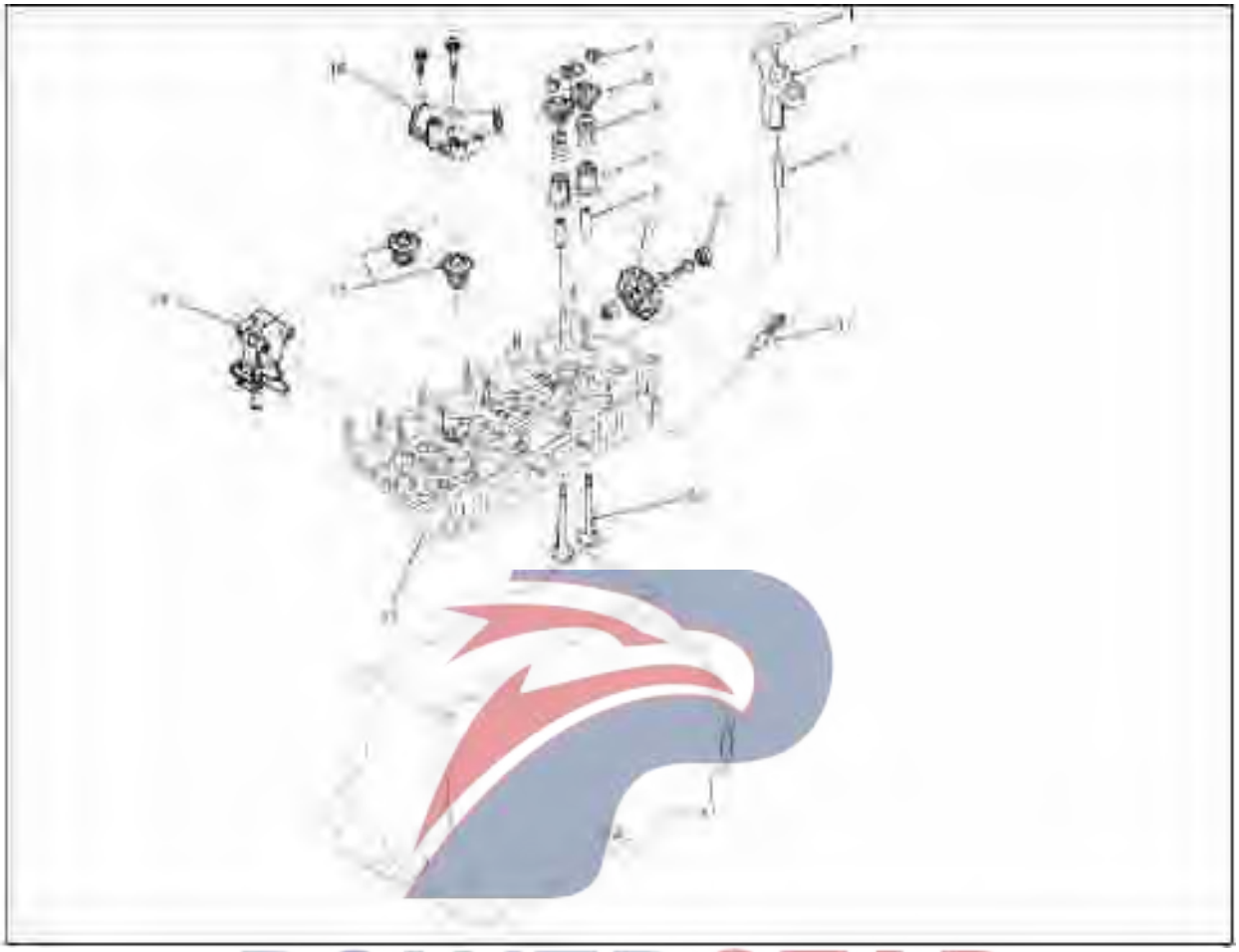
Tightening torque - Overview



(a) 27 N·m {2.8kgf·m}
(b) 142 N·m {14.5kgf·m}

Cylinder head

Component parts



Key

1. Deck cover
2. Bridge parts
3. Catheter bridge
4. Valve lock
5. Spring seat
6. Valve spring
7. Valve seal
8. Valve guide
9. Idler C cover
10. Idler C
11. Glow plug
12. Inlet and exhaust valves
13. Cylinder head
14. A/C compressor bracket
15. Thermostat
16. Outlet pipe

Disassembly

1. Discharge the coolant.

2. Remove front exhaust pipe A and exhaust brake assembly.

• Remove front exhaust pipe A and turbocharger mounting nut.

• Remove the nuts that secure the front exhaust pipe A and the exhaust brake.

At the same time, remove the exhaust brake assembly.

• Remove the mounting bolts from the exhaust pipe bracket on the right side of the transmission.

3. Remove the intake pipe from the turbocharger.

• Remove the PCV hose (1) from the intake hose.

• Loosen the fastening strap (5) of the intake manifold of the turbocharger.

4. Remove the turbocharger inlet tube (2).

• Loosen the strap (3) that holds the inflatable hose.

• Remove the fixing screws for the intake pipe (4).

5. Remove the connector (6) from the turbocharger actuator.

6. Remove the engine harness.

7. Remove the water pipe from the radiator.

8. Remove the dipstick and oil ladder guide.

9. Remove the cooling water pipe (2), EGR pipe (3), EGR cooling pipe (5), EGR cooler (1) and EGR valve (4).

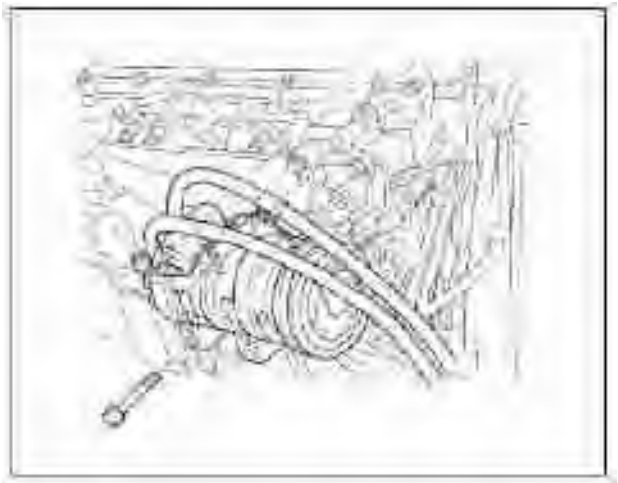
10. Remove the perforated bolts from the turbocharger to cool the water pipes and hoses.

11. Remove the compressor drive belt from the A/C.

• Loosen the tensioner nut (1) and adjustment screw (2) and remove the drive belt.

12. Remove the A/C compressor.

• Remove the compressor harness connector from the air conditioner, remove the compressor from the air conditioner compressor bracket, and secure it with hoses and other wires.



13. Remove the cylinder head cover.

Refer to the cylinder head cover in this chapter.

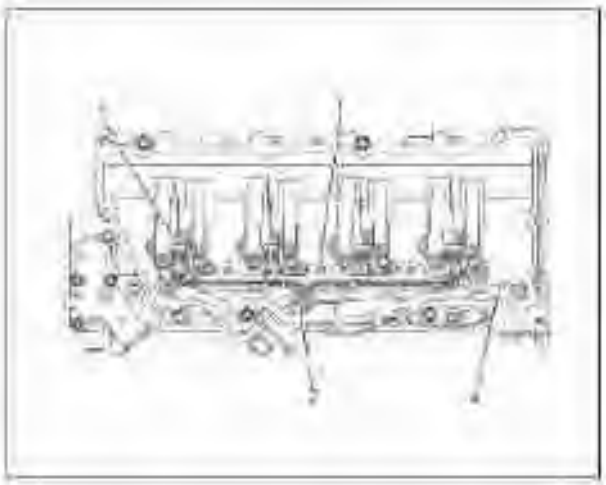
14. Evenly loosen the connecting nut of the injector (3) and remove the terminal.

15. Loosen the injector harness support bolts, remove the inner seal (2) and remove the harness holder (1).

Caution:

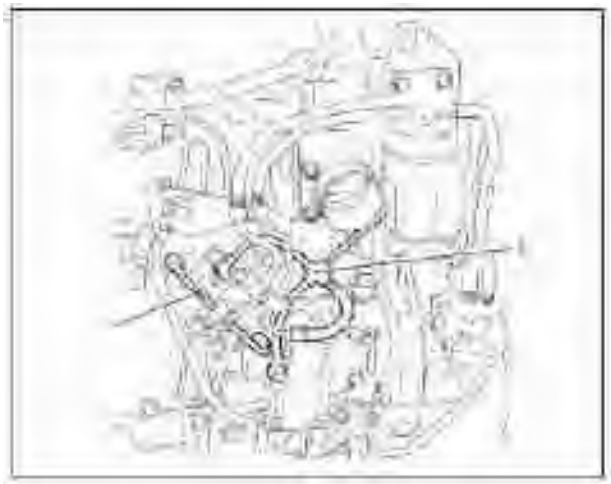
The syringe's ID code is used to identify each syringe, so do not remove the ID code from the syringe's syringe.

16. Remove the return pipe from the nozzle (4).



17. Remove the return hose.

18. Remove the return pipe (2).

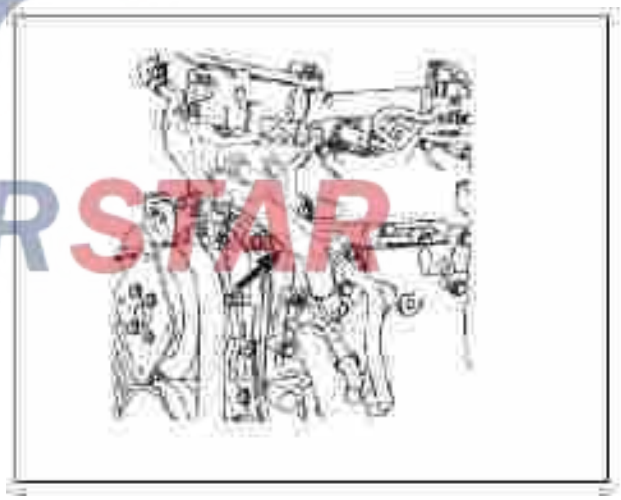


Key

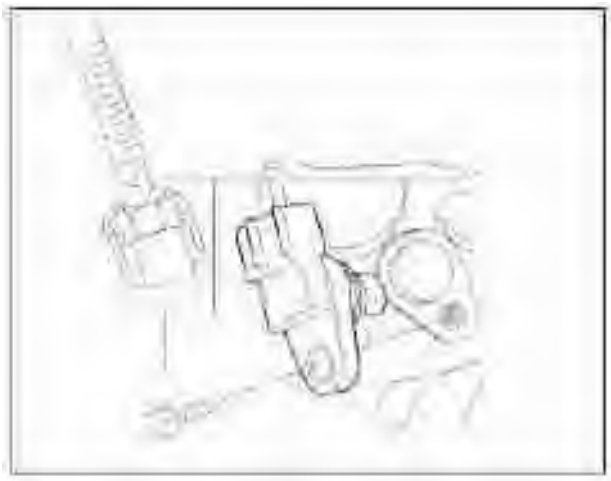
1. High pressure tube
2. Return to the pipeline

19. Disconnect the engine coolant temperature sensor connector.

20. Remove the water separator from the side of the cylinder head.



21. Disconnect the camshaft position sensor connector.



22. Remove rocker assembly.

Refer to the rocker assembly in this chapter.

23. Remove the camshaft assembly.

Refer to camshaft Assembly in this chapter.

24. Take care when disassembling to prevent the deck cover from falling into the interior of the engine.

25. Remove the bridge.

Mark:

The bridges and deck covers that have been removed must be stored so that they can be installed in their original position when they are used again.

26. Remove the plug from the glow plug.

27. Remove the glow plug.

28. Remove the collar (2) from the syringe barrel and remove the syringe (1).

29. Disconnect the common rail pressure sensor connector.

30. Remove the common rail.

31. Remove the injector bracket.

32. When the syringe is difficult to remove, place the syringe removal tool (2) into the syringe return tube mounting section (3).

Use the slide hammer (1) to pull the syringe upwards.

Special tools

Syringe removal tool 5-8840-2826-0

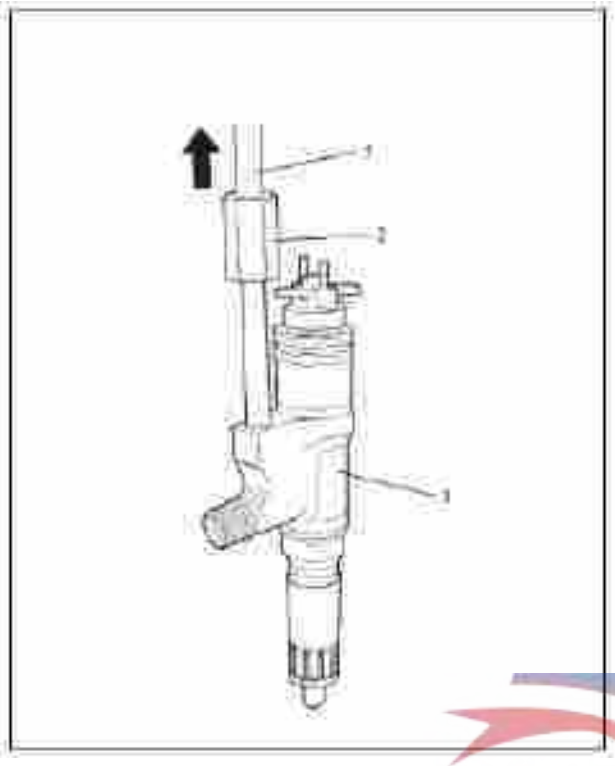
Slide hammer: 5-8840-0019-0

Caution:

• The injector identification code is used to identify each injector, so do not confuse it with other injector identification code cards.

• When replacing the injector, use the diagnostic tool to program the identification code in the ECU (engine control unit). The programming method involves the programming of the IA motor control system part.

• When removing the injector using a special tool, be careful not to remove the injector cap during operation.



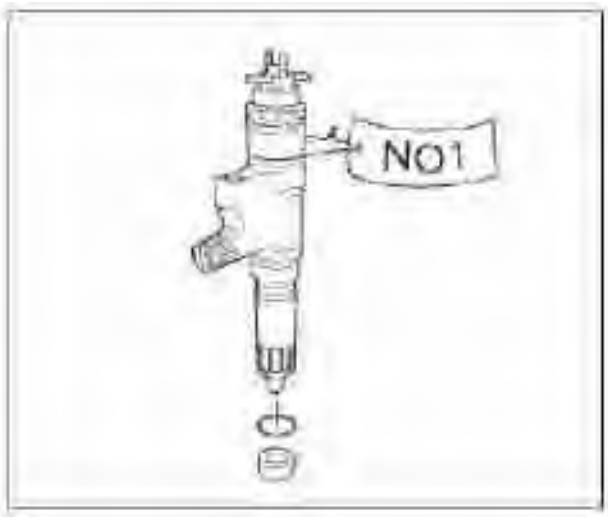
Key

1. Slide hammer
2. Syringe removal tool
3. Syringe assembly

Mark:

Remove the injector and write down the cylinder number of the guard.

Be careful not to touch the oil hole.



33. Remove the bolt assembly.

• Evenly loosen the cylinder head bolts in the order shown.

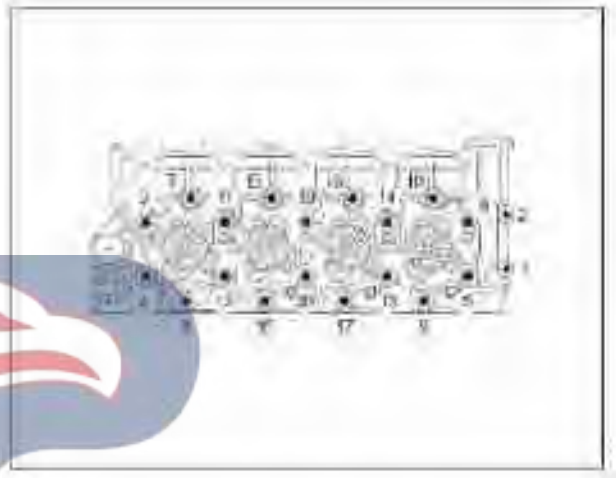
Mark:

(1), (2) is secured with bolts M10, on the flywheel housing, careful not to forget to remove.

• Remove the cylinder head gasket.

Mark:

Disassembled cylinder head gasket cannot be used again



Disassembling

1. Remove the turbocharger assembly and washers.

• Remove the turbocharger mounting nut.

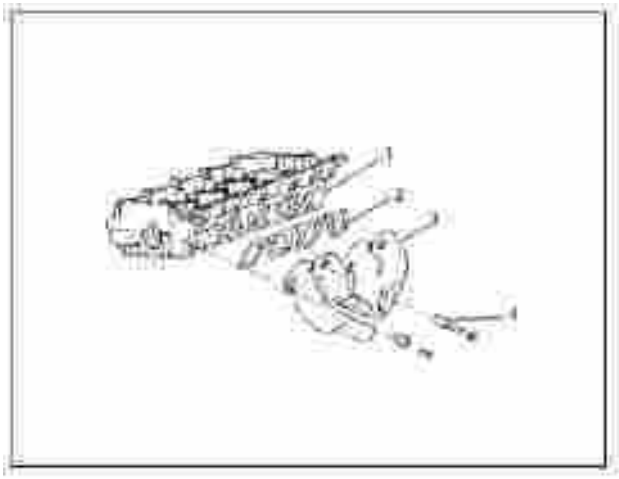
• Remove the bolt from the exhaust adapter bracket.

• Use a vent connector to remove the turbocharger.

Caution:

Holding the actuator rod and lifting the turbocharger may cause deformation and malfunction, so do not handle the actuator rod to handle it.

2. Remove the exhaust manifold.



Key

1.Cylinder head

2. Seal gaskets

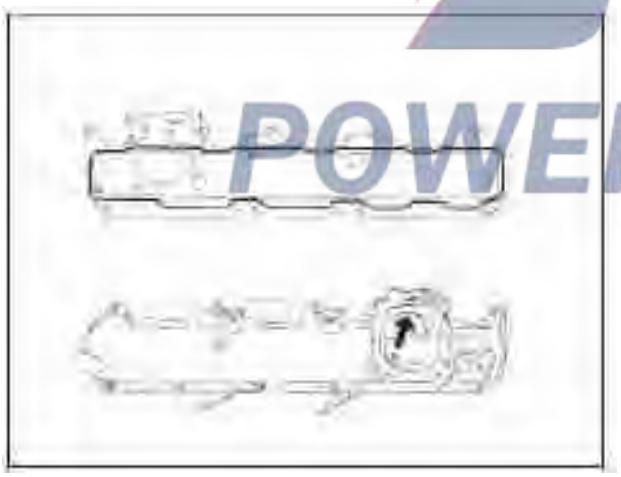
3. Exhaust manifold

4. Isolator

3. Remove the throttle valve assembly.

4. Remove the air intake cover.

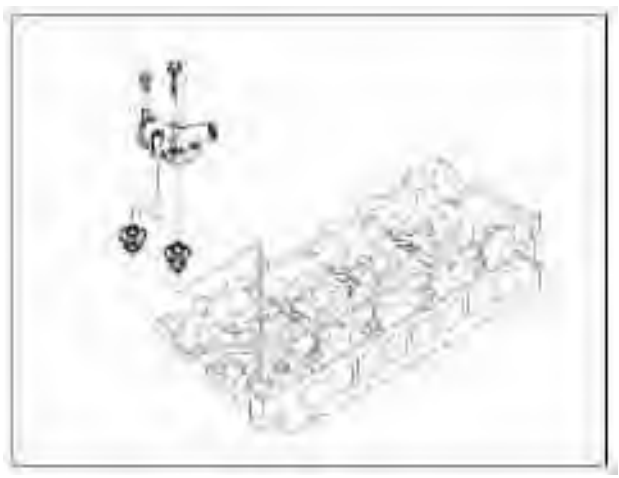
• Remove the sealant attached to the air intake cover.



5. Remove the air conditioner compressor bracket.

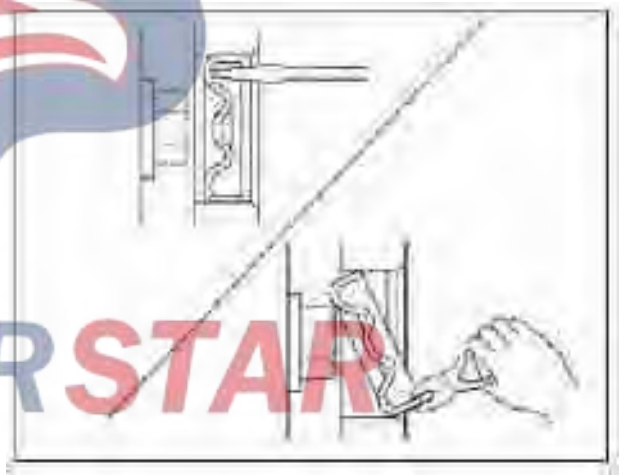
6. Remove the outlet pipe.

7. Remove the thermostat.



8. Remove the idler C cover.

• As shown in the figure, tap the outer circumference of the sealing cup with a screwdriver, turn the sealing cup over and remove it with pliers or similar device.



9. Remove the idler C.

Key

3. Idler C

2. Idler axis

3. Washers

4. Bolt

10. Remove the locking sleeve from the valve.

11. Remove the bomb upwards.

12. Remove the valve spring.

• Use a detacher to compress the valve spring and remove the locking device from the valve.

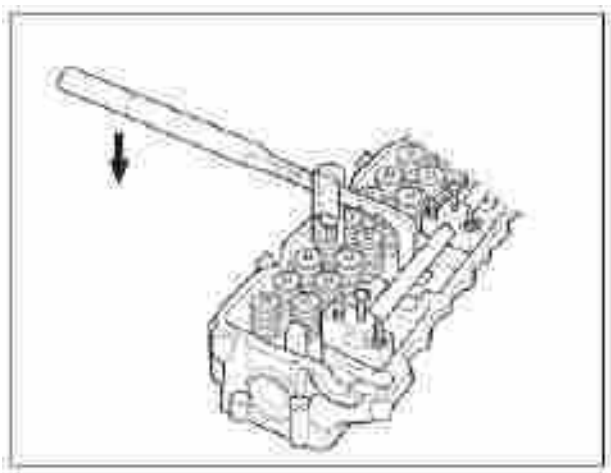
Special tools

Valve spring disassembler: 5-8840-2621-0

Pivot support: 5-8840-2808-0

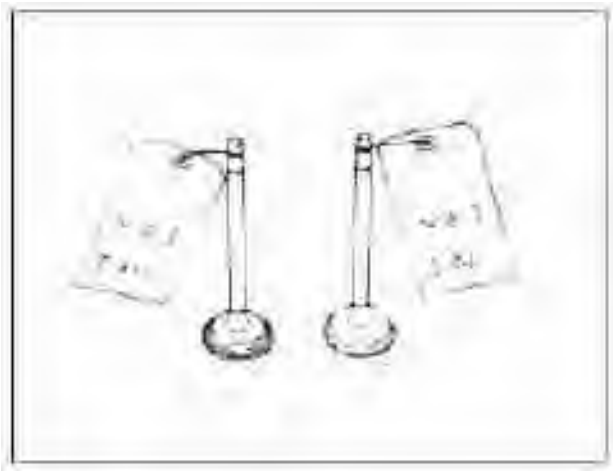
• Remove spring seat and valve spring.

The disassembled valve springs are stored in the cylinder number order.



13. Remove the intake and exhaust valves.

• The removed valve must be labeled and stored in a cylinder.



14. Remove the valve seal.

• Use pliers to remove the oil seal.

15. Remove the valve guide.

• Using a valve guide puller, drive the valve guide through the underside of the cylinder head.

Special tools

Valve guide disassembler: 5-8840-2628-0

16. From the bottom of the cylinder head, tap with the nozzle sleeve removal tool and remove the sleeve from the nozzle (1).

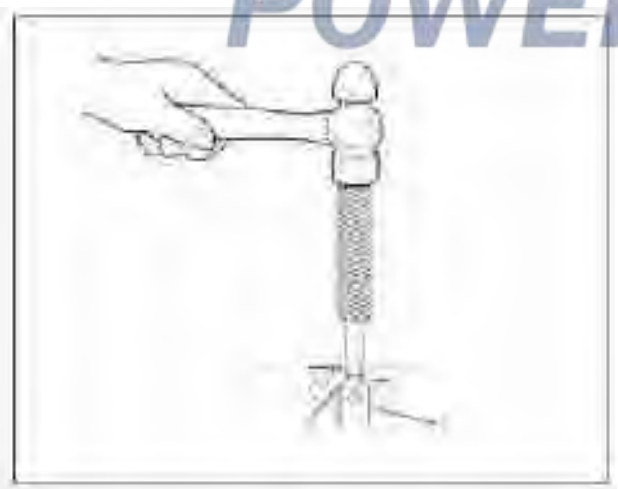
Nozzle Sleeve Removal Tool: 5-8840-2623-0

Mark:

• Be careful not to damage the lower part of the bolt.

• The extracted nozzle sleeve cannot be used anymore.

• Carefully remove the chips from the cylinder head threads.

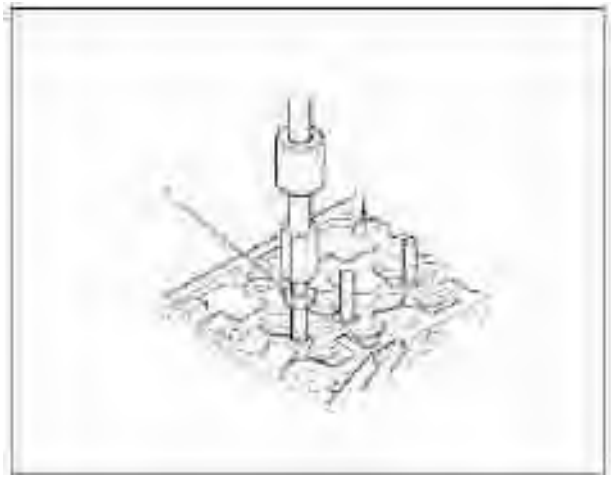


Key

1. Nozzle sleeve

17. Remove the bypass catheter.

• Weld the nut (1) onto the bridging catheter head, install the slide hammer and remove it.



18. Remove the oil seal.

• Hit the inner cover of the cylinder head and pull it out.

Inspection

1. Check valve guides.

Mark:

When the inside diameter of the valve stem and valve guide tube is scratched or abnormally worn, the valve guide tube must be replaced.

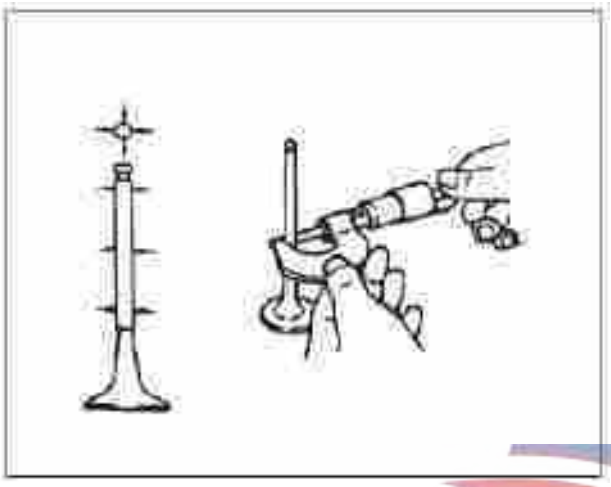
a. Measure the distance from the valve catheter.

• Use a micrometer to measure the stem diameter.

When the stem diameter is below the limit, replace the valve and valve guide in the complete assembly.

Outer diameter of valve stem mm

	Standard value	Standard value
Intake valve	8.946—8.961	8.88
Exhaust valve	8.921 — 8.936	8.80

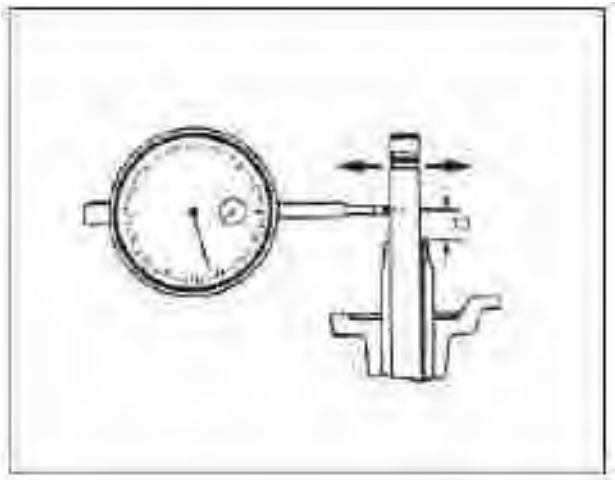


• Use a dial indicator to measure the gap between the valve guide and the valve stem within 10 mm of the valve guide.

• When the measured value exceeds the limit, replace the valve guide and valve in the complete assembly.

Valve guide and stem set mm

	Standard value	Standard value
Intake valve	0.039—0.071	0.20
Exhaust valve	0.064—0.096	0.25



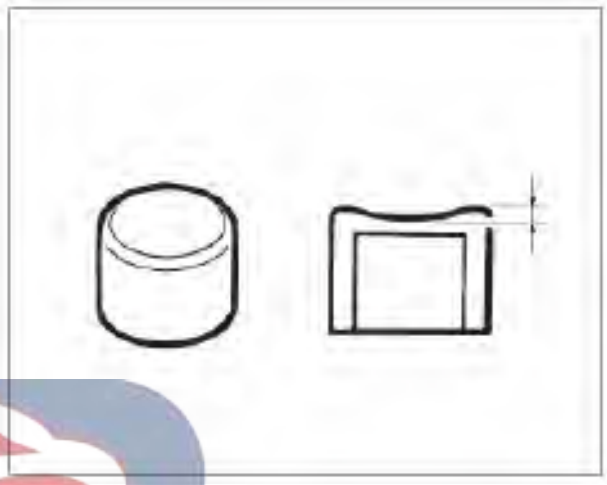
2. Inspect the deck cover for wear.

• Use a dial gauge to measure the contact area with the rocker arm rocker arm.

• When the wear exceeds the limit or abnormal wear (tape wear), replace the panel cover.

Bridge cover wear mm

Standard value	0.1



3. Check the valve.

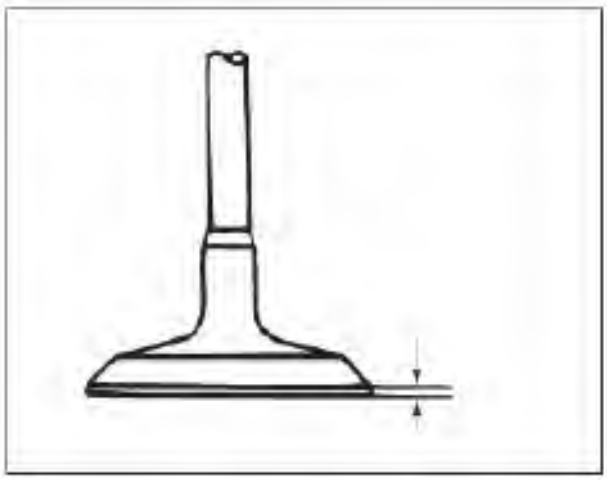
Valve thickness

• Measure the thickness of the valve.

• If the measured value exceeds the limit, replace the valve and valve guide.

Valve thickness mm

	Standard value	Standard value
Intake valve	1.71	1.3
Exhaust valve	1.75	1.3



Valve seat

• Remove carbon deposits, scales, etc. In the breech position.

Install the valve on the cylinder head.

Use a depth gauge or ruler to measure the valve recess under the cylinder head.

When the limit is exceeded, replace the valve and seat.

Valve depression (mm)

	Standard value	Standard value
Intake	0.80-1.03	2.3
Exhaust	1.24-1.47	2.8

• Measure the contact width of the valve seat. If the contact surface of the valve seat is damaged or rough, or if the contact surface wear exceeds the limit, it must be corrected or replaced.

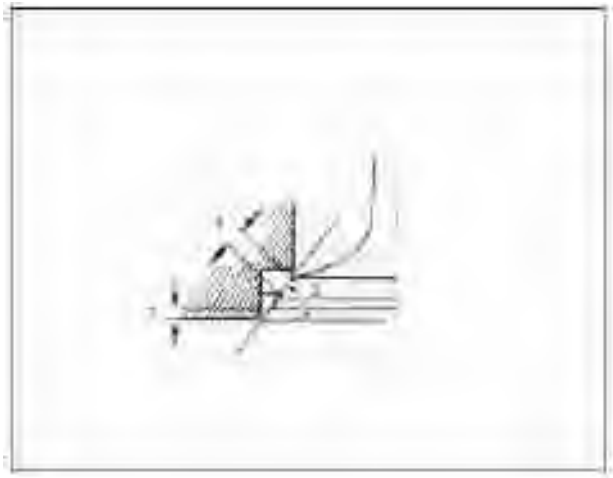
Seat contact width (mm)

	Standard value	Standard value
Intake valve	2.7	3.2
Exhaust valve	2.5	3.0

• Measure the contact surface of the valve seat.

When the contact surface of the valve seat is defective, it is necessary to correct or replace the valve, valve guide and valve seat.

	Contact angle
Intake	30°
Exhaust	45°



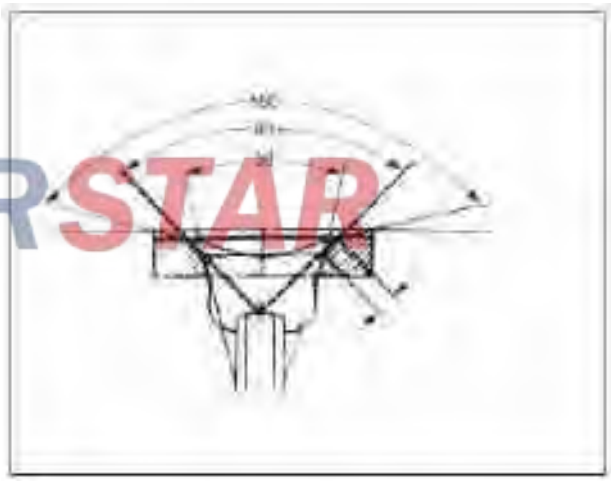
Key

1. Contact width
2. Depression
3. Contact surface angle

Seat surface correction

• Remove carbon deposits on the seat surface.

• Use a seat cutter (15°, 45°, 75°) to remove scratches and other irregularities in order to reduce the contact width to a standard value.



Mark:

Remove only scratches and irregularities. When using an adjustable valve tool guide, do not allow the valve tool guide to swing into the valve guide.

• Apply abrasive to the seat.
• Insert the valve into the valve guide.
• When turning the valve while applying abrasive to the seat surface, tap gently to ensure that the contact is even after rotation.

Mark:

After crushing, remove the abrasive completely.

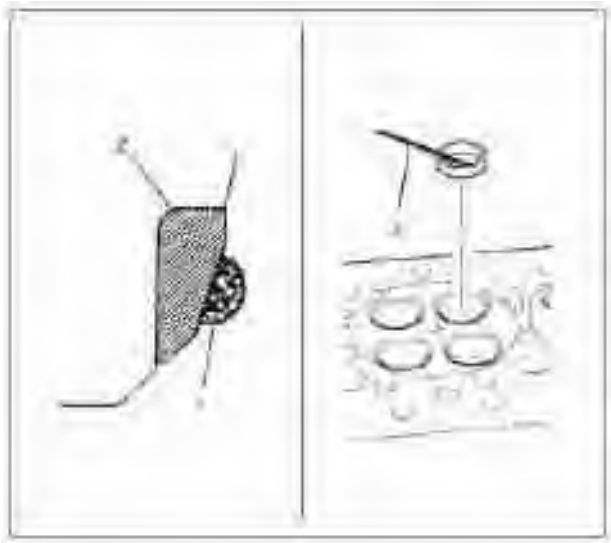
Replace valve seat

Remove valve seat

• The arc will weld the entire inner circumference (1) of the spool (2).
• Cool the seat for 2 to 3 minutes.

After cooling and retraction, it is easy to remove the valve seat from the valve.

• Remove the seat using a screwdriver (3). Be careful not to damage the cylinder head.

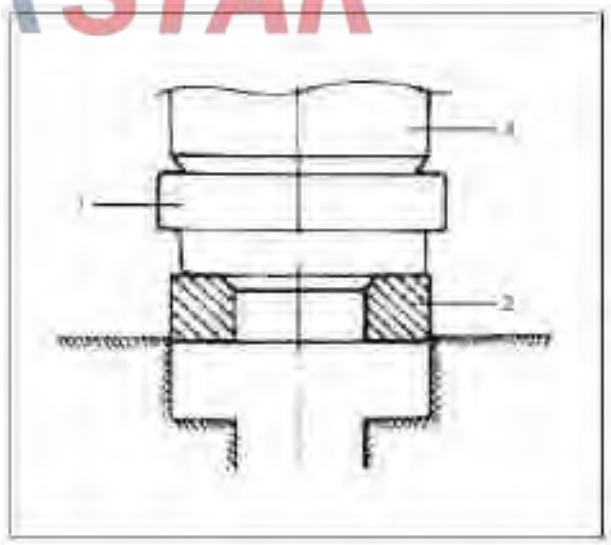


Install valve seat

• Carefully dry the damper (1) on the spool (2) with a smaller outer diameter than the spool.
• Use a press (3) to slowly apply pressure to the baffle and press down on the seat.

Mark:

Do not apply excessive pressure when using the press. Apply abrasive on the seat surface. While rotating the valve, tap it gently to make sure it touches after one rotation.



4. Inspect the cylinder head assembly.

• Remove paint, coke and other metal surfaces. Fit the mounting surface with a wire brush, etc. Be careful not to scratch the sealing surface.

• If there is any abnormality such as leakage, corrosion, or air leakage on the seal surface of the cylinder head, check the following reasons.

- Bad installation

- The cylinder head is tightly tightened

- Warpage of the lower surface of the cylinder head and the upper surface of the cylinder block

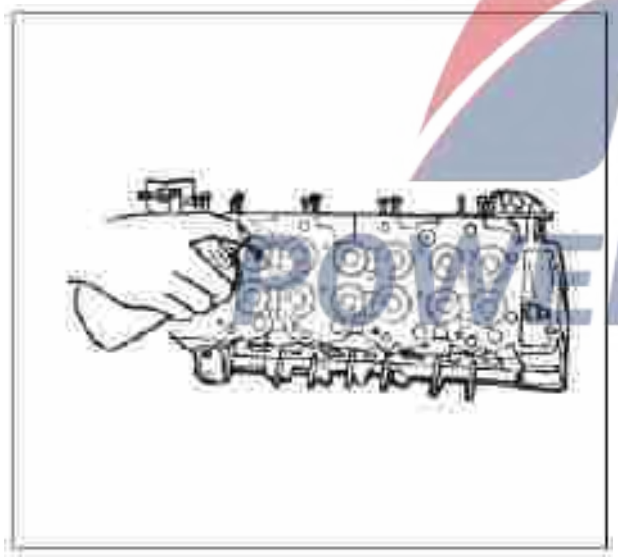
a. Check the bolt that has been damaged due to excessive torque.

Mark:

Replace suspicious bolts.

b. Combustion chamber, preheat hole

• Check the cylinder head between the valve seat and the exhaust port for cracks. If there is damage or cracks, replace the cylinder head. Dye detection if necessary.

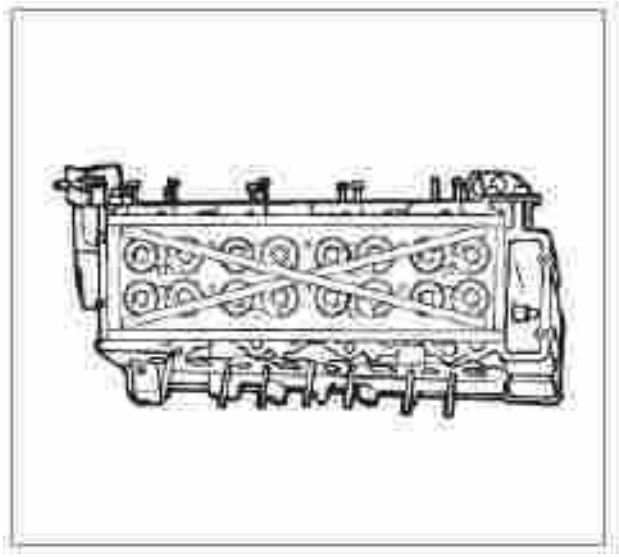


c. Flatness of cylinder head bottom surface

• Measure 4 sides and diagonals with a ruler and feeler gauge as shown, and replace it if it exceeds the limit.

Cylinder head lower surface fins mm

Standard value	＜0.05
Standard value	0. 20

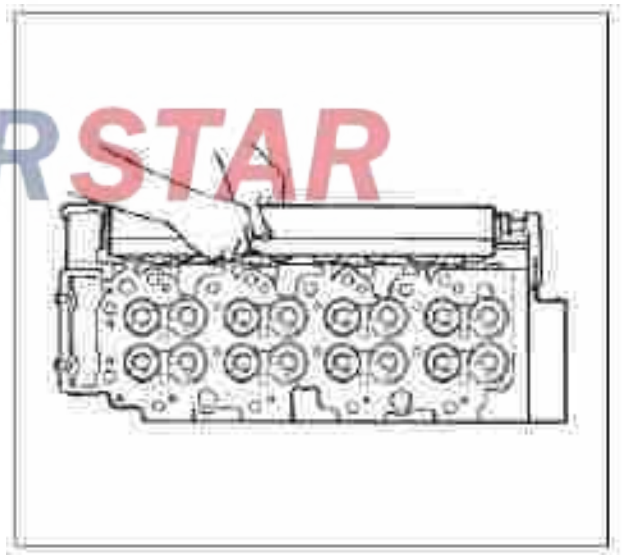


d. Flatness of the mounting surface of the exhaust manifold and intake cover

• Measure 4 sides and diagonals with a ruler and feeler gauge as shown, and replace it if it exceeds the limit.

Collector mounting surface and inlet cover warpage (mm)

Standard value	＜0.05
Standard value	0. 20

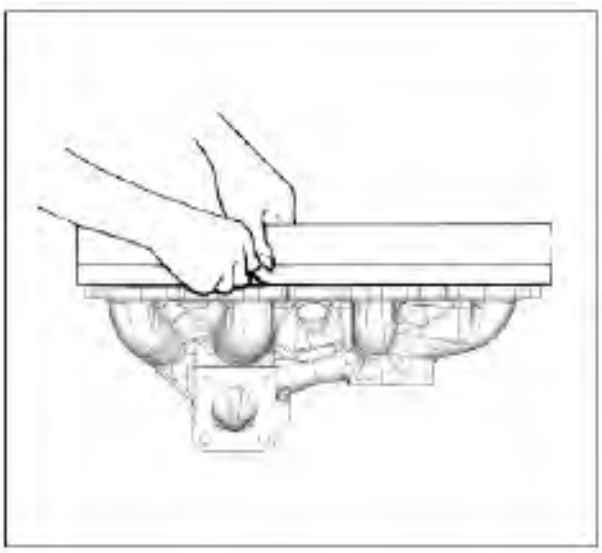


e. Flatness of exhaust manifold

• Use a ruler and a probe to measure flatness. If the limit is exceeded, replace the exhaust manifold.

Exhaust manifold deformation mm

Standard value	＜0(3)
Standard value	0. 50



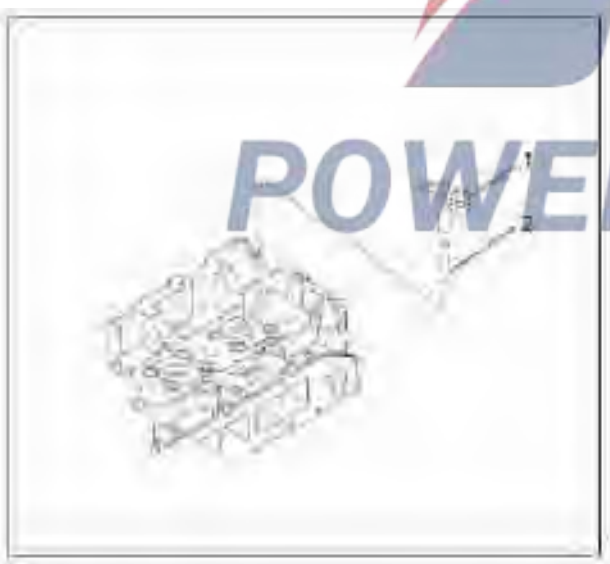
5. Bridge parts

• Check that the bridge (1) and bridge conduit (2) are blocked.

• Measure the gap between the bridge (1) and the bridge tube (2).

Clearance mm

Assembly standard	0.020∽0.056
Limit of use	0.1



Assembly

1. Install the oil seal

• Oil around the fuel hose insertion side.

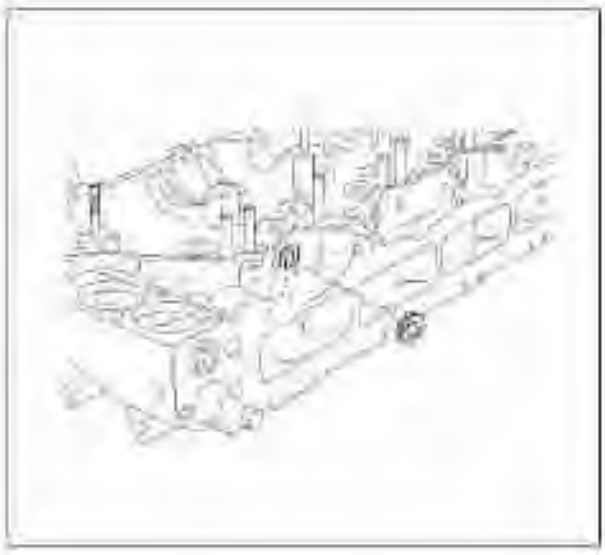
• Press firmly, taking care not to tilt the seal.

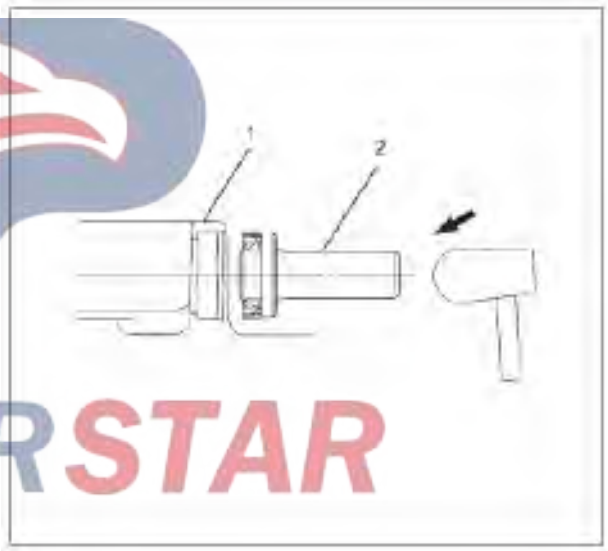
Caution:

Be careful not to damage your lips.

Special tools

Oil seal installer: 5-8840-2627-0





Key

1.Cylinder head

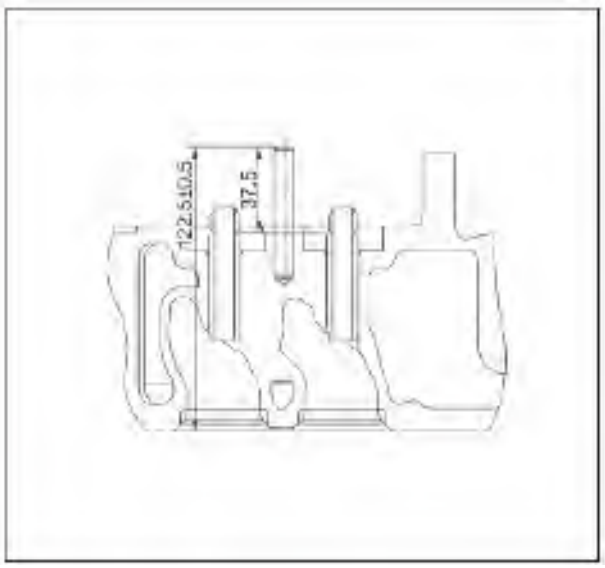
2. Oil seal installation procedure

2. Install the connecting guide..

• Apply engine oil to the outside of the pipe and use an installation tool to drill it deep into the bolt hole. (Reference: The top of the bridge tube is about 37.5 mm from the upper surface of the bolt)

Special tools

Bridge catheter installation tool:5-8840-2626-0

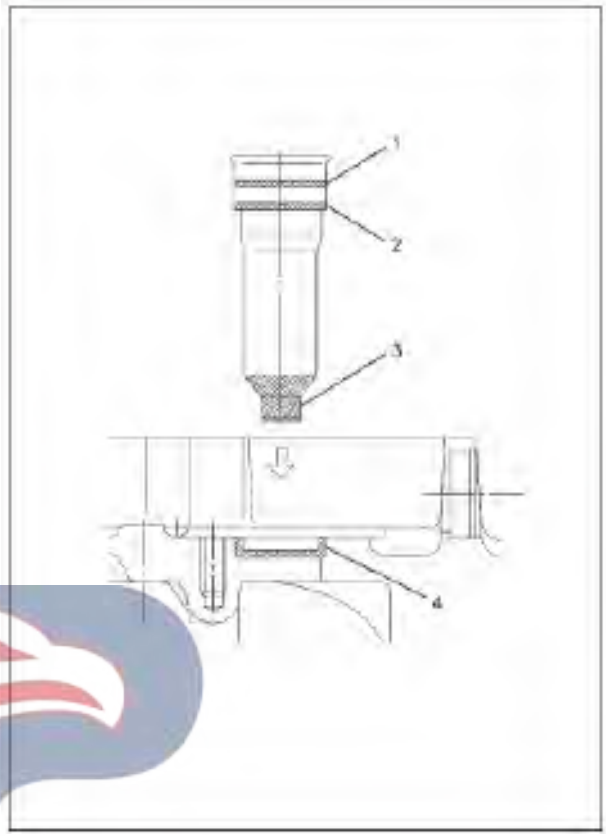


3. Nozzle spout

• Install O-rings (1) and (2) on the nozzle ring and apply oil.

• Apply Loctite No. LT290 to the cone (3) of the nozzle bushing.

• Apply (4) oil to the contact surface of the cylinder head spray ring.



Key

1. O-ring(white)
2. O-ring
3. Loctite smear location
4. The location of the oil smear

• Install the nozzle bushing (4) on the cylinder head and insert it into the guide bearing (3) of the injector installation tool (5-8840-2624-0).

• Push the nozzle bushing with the guide bearing (3) so that the nozzle bush fits completely under the cylinder head.

• Fix the guide bearing (3) with the collar (5) and the bolt (6).

• Ball (2) with ball bearing (3) (ball bearing 9.525 mm) through which punch (1) and hammer ball (2) pass.

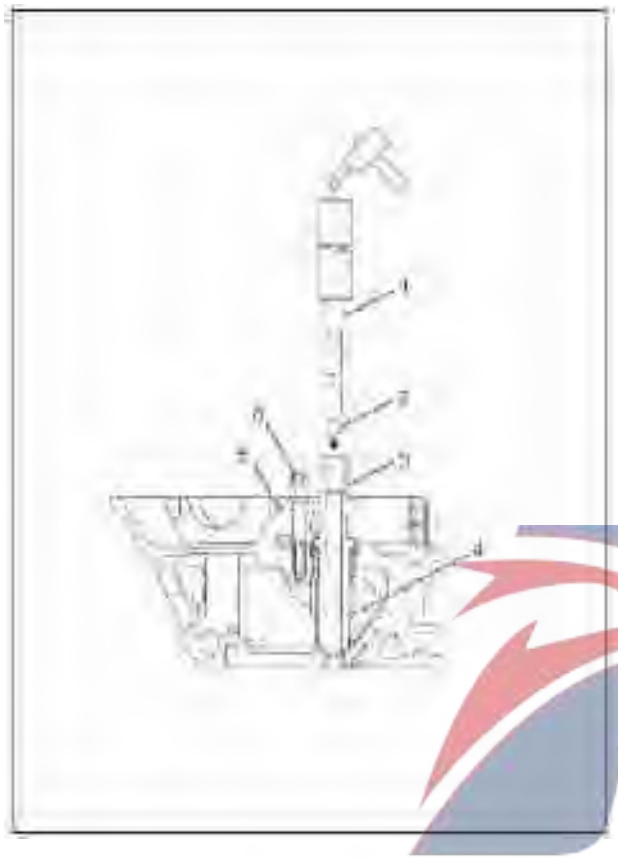
Mark:

• To allow the ball to penetrate from below, allow the head support to float.

Special tools

Nozzle socket installation tool:

5-8840-2624-0



Key

1. Punching rod
2. Ball
3. Guide bearing
4. Nozzle spout
5. Clips
6. Bolt

4. Install the valve guide.

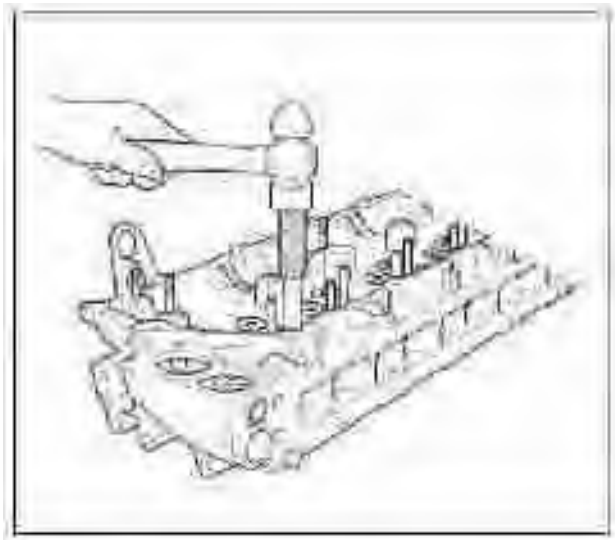
• Using the valve guide adapter, push the valve guide from the top of the cylinder head.

Mark:

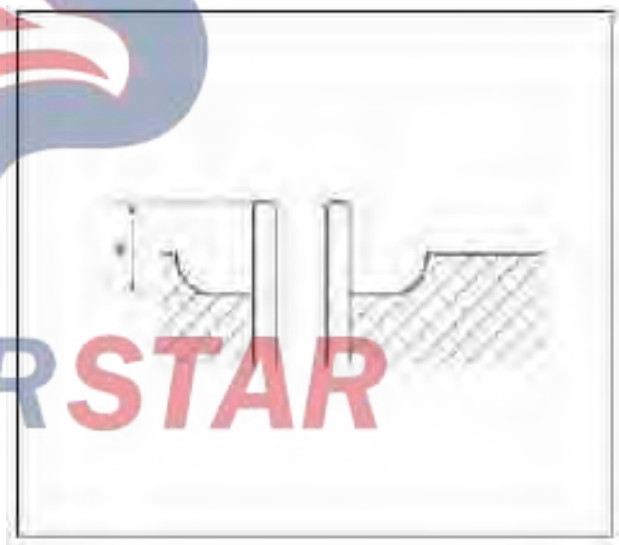
When replacing the valve guide, replace it with a valve.

Special tools

Valve guide disassembler: 5-8840-2628-0



Height of cylinder head at the end of valve guide tube (a): 18.6 mm - 19.4 mm



5. Install the valve seal

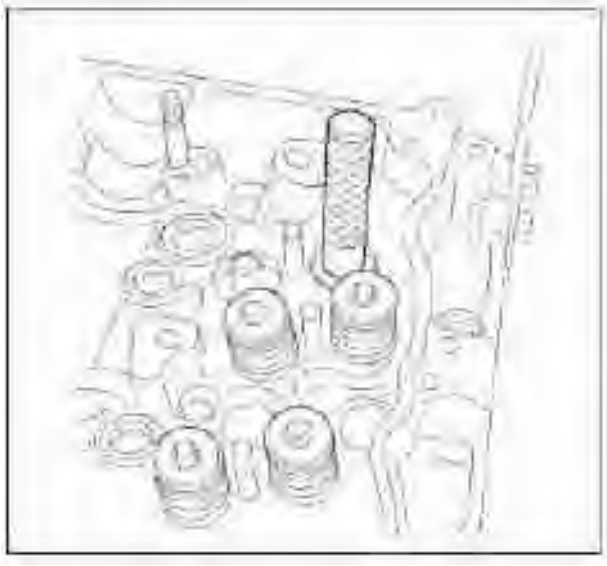
• Apply oil around the valve guide and install the seal using the valve seal installation tool.

Mark:

After installing the valve oil seal, check that the oil seal is fully inserted, tilt, and release the spring.

Special tools

Valve oil seal installer: 5-8840-2833-0

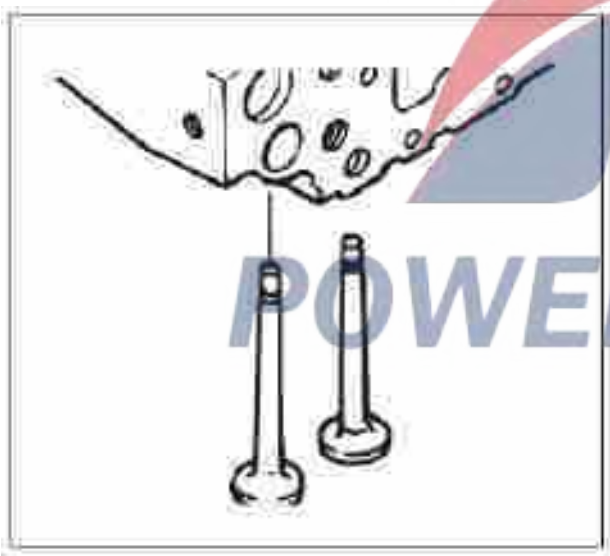


6. Install intake and exhaust valves.

• Apply engine oil to the stem and install the valve.

Mark:

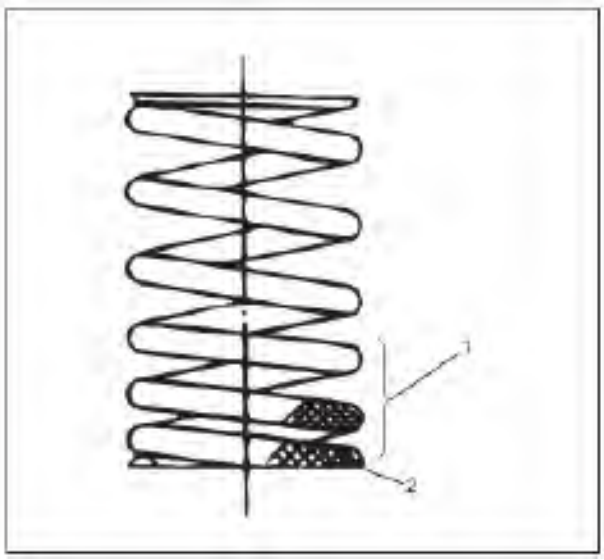
After assembling the valve, check that the installation is correct.



7. Install the valve plug.

• Place paint mark or narrow spring (1) on the lower side (cylinder head side).

	Paint mark
Intake side	Blue
Exhaust side	Red



Key

1. Spring spacing
2. Paint mark

8. Install the spring seat.

9. Install the valve locking sleeve.

• Use a detacher to compress the valve spring and install the locking device from the valve.

• After installation, tap the stem tip with a rubber hammer to secure the valve lock.

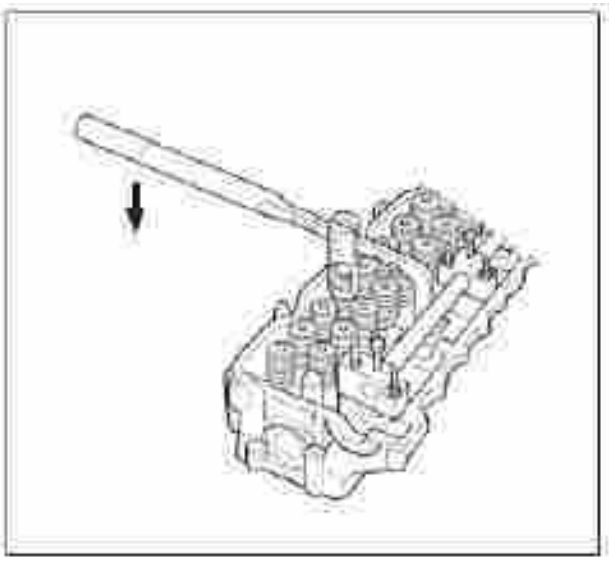
Special tools

Valve spring disassembler: 5-8840-2621-0

Pivot support: 5-8840-2808-0

Mark:

Make sure that the locking ring is properly seated in the groove of the stem.



10. Install the idler C.

a. Assembly idler C.

Mark:

If the idler C is disassembled before, it is difficult to position the C-axis of the idler. Therefore, the following points should be noted when assembling:

1. Align the mark on the crankshaft pulley with the mark on the front cover and place the first cylinder on compression top dead center.

2. If idler B is already assembled, idler C must be inserted from above the bolt.

• Apply engine oil to the inner circumference of the idler C and the thrust receiving surface.

3. Pass the oil on the shaft through the hole in the rear of the cylinder head through the center hole of the gear.

4. Apply engine oil to both sides of the thrust sleeve, apply molybdenum to the threads and contact surfaces of the bolts, and assemble them. Do not use tools and tighten them by hand when tightening bolts. (Activity of idler C)

Key

1. Insertion direction
2. Axis
3. Thrust sleeve
4. Bolt
5. Idler C.
6. Bush

b. Assemble the camshaft gear.

1. Install the bottom bearing of the cam on the cylinder head. Apply oil to the inner circumference of the bearing.

2. Engage the gear camshaft with the idler C-bearing cylinder mounted on the cylinder head for installation.

When the scale line of the crankshaft pulley is aligned with the front cover assembly marking (top dead center of compression of the first cylinder), the assembly mark (1) on the camshaft is aligned with the upper surface of the cylinder head.

3. Install the upper cam bearing onto the camshaft cover and apply oil to the inner circumference of the bearing.

4. Assemble the cover of #2, #3, #4, #5 (1).

Apply engine oil to the mesh and mating surfaces.

Acorn bolt 27 N•M {2.8kgf•M}

Acorn nut 27 N•M {2.8kgf•M}

Mark:

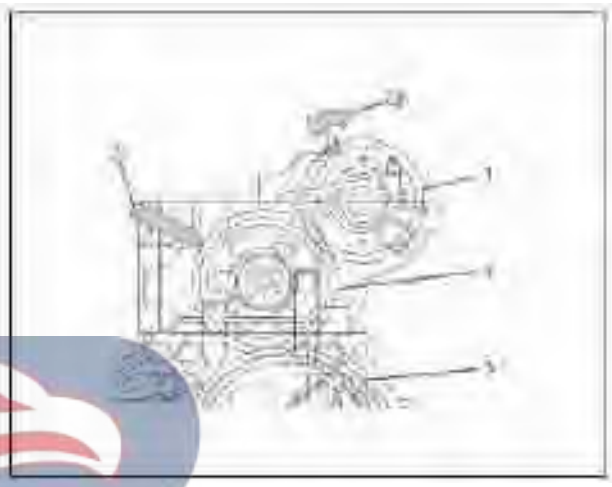
Unassembled rocker

c. Tighten the idler C bolts.

1. Turn the camshaft gear to the left (see the rear of the motor, 2 in the illustration), and gently insert the diverting idler C in the direction of the arrow 1 in the figure to adjust the position of the idler C axis.

Mark:

When turning the camshaft gear, be careful not to use too much force to make the game too small.



Key

① Lightly insert the idle C

② Rotate the camshaft gear to the left

1. Camshaft gear

2. Idler C

3. Idler B

2. Press the camshaft gear by hand while tightening the idler C to the specified torque.

Apply molybdenum to the mesh and contact surfaces

Idler C bolts 71 N•M {7.2kgf•M}

Mark:

Do not move the C-axis of the idler too much when tightening.

3. After tightening idler C, check that the clearance is within the following standard values.

Idler C between ~camshaft 15 ~ 146μm

Idler C between~ Idler B 15 ~ 217μm

Rotate the camshaft gear by hand If you cannot click and move the gear, it may be because the game is too narrow. At this time, confirm the game and readjust it.

Mark:

When the game cannot be adjusted, use the idler C axis (8-97186-398-1) to perform the assembly.

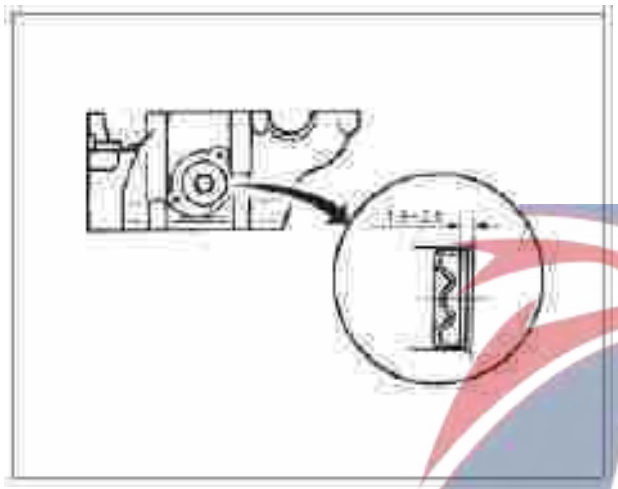
4. Remove the end of the camshaft cover and assemble it on the scale assembly.

11. Install the idler C cover.

• Apply liquid sealant (Loctite 262) to the periphery of the idler C cover and press using the seal cup installation tool as shown.

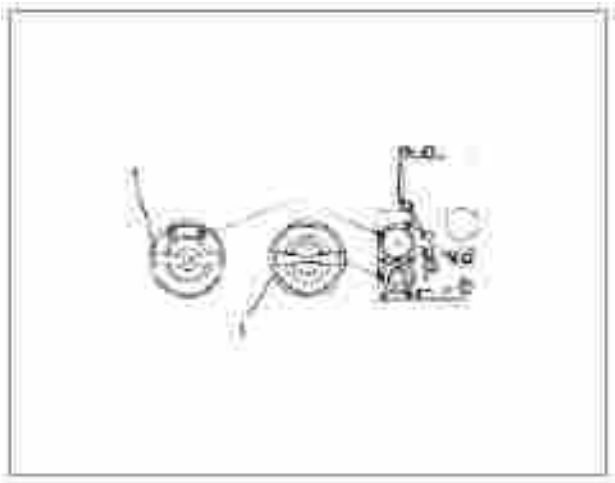
Special tools

Seal cup installation tool: 5-8840-2222-0



12. Install the thermostat.

• Install the thermostat (1) in the position shown in the illustration.



Key

1. Thermostat

13. Install the outlet pipe.

• Tighten the outlet hose to the specified torque.

Tightening torque: 24 N•m {2.4 kgf•m}

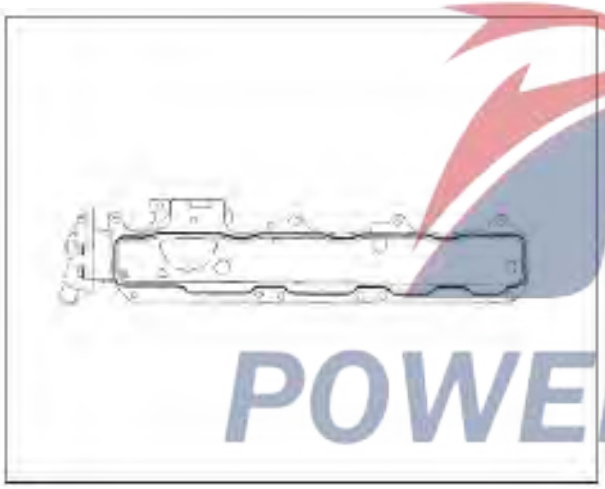
14. Install the air conditioner compressor bracket and tighten the bolts to the specified torque.

Tightening torque: 48 N•m {4.9 kgf•m}

15. Install the intake cover.

• Apply a 2.5 to 5.5 mm (TB 1207C) liquid sealant along the groove of the inlet plug.

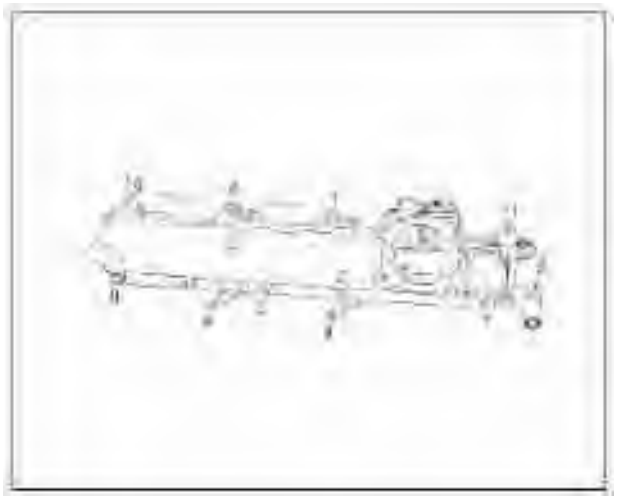
After the spread, assembly must be completed within 5 minutes.



• Tighten the numbers in the order shown.

• Screws (6) and (9) are fixed with common rails.

Tightening torque: 22 N•m {2.2 kgf•m}



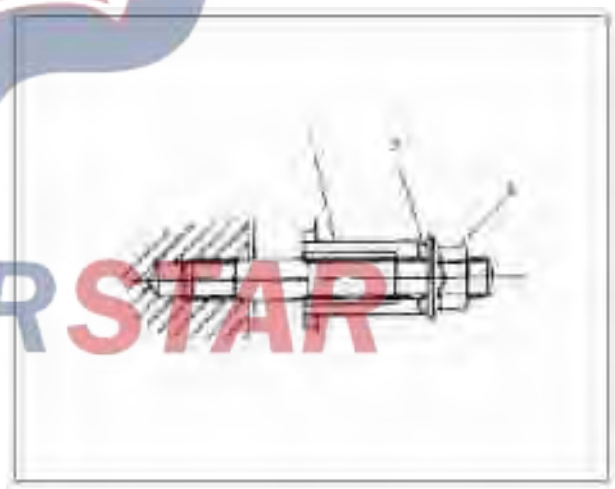
16. Install the throttle valve and washer and tighten it to the specified torque.

Tightening torque =24N·m {2.4 kgf·m}

17. Install the exhaust cushion.

18. Install the exhaust manifold.

• Install washer (1), throttle spring (2) and nut (3) one after another on cylinder head bolts.



Key

1. Isolator
2. Butterfly Spring
3. Nuts

• Tighten the exhaust manifold to the specified torque in the numerical order shown.

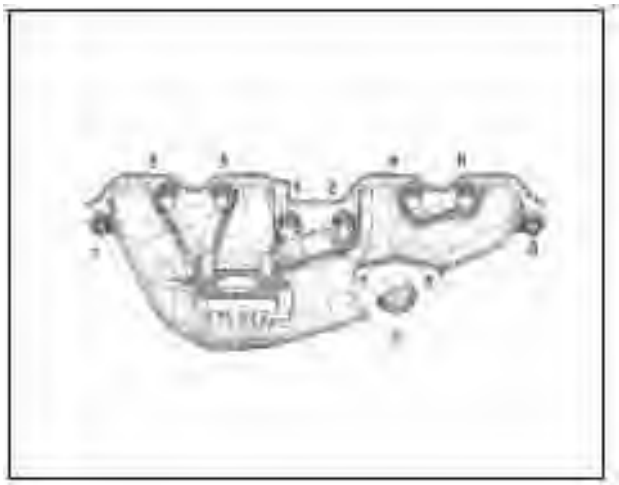
Bolts(1),(2),(3),(4),(5),(6)

Nuts (7),(8)

Tightening torque :34N·m{3.5kgf·m}

Mark:

Since the collector expands after being heated, do not over-tighten it.



19. Install the turbocharger assembly.

• Install the turbocharger assembly and washers and tighten the nuts to the specified torque.

Tightening torque: 52 N•m {5.3 kgf•m}

Installation

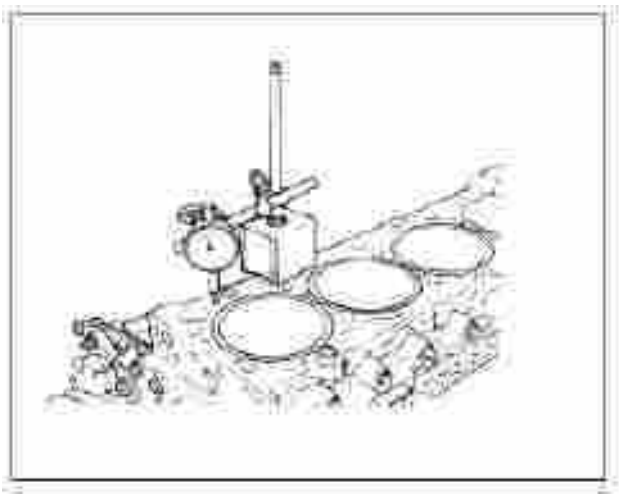
1. Install the cylinder head gasket.

• Select cylinder head gasket.

• Clean the piston head and the upper surface of the cylinder block.

• Use a dial gauge to measure the amount of piston protrusion. Two measurements per cylinder.

• The measurement point of the piston head and the reference point on the cylinder block side are as follows.



Measuring point: Piston head (2) • (3) point

Reference point: Upper surface of cylinder block (1)

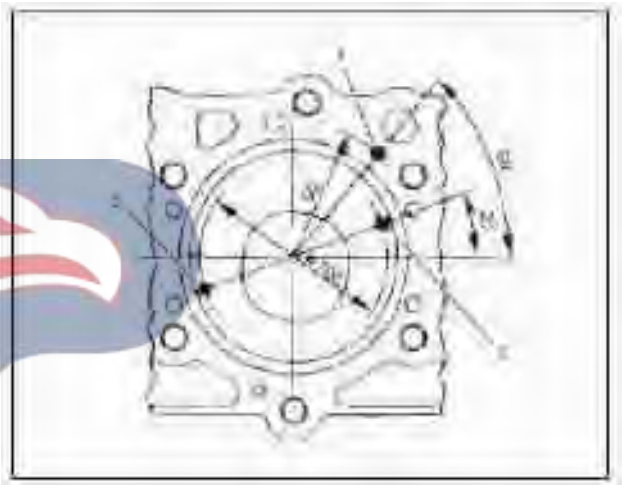
Mark:

Depending on the amount of piston protrusion, there are three options for the cylinder head gasket, as shown in the table below.

• Calculate the average (Ti) of the piston protrusion of each cylinder.

• Find the maximum value (Timax) for each cylinder's average (Ti).

According to Timax choose the appropriate sealing level.



Sealing pad level	Recognition	Piston protrusion amount (Timax)
A	No hole	0.520 ∽0.600
B	1 hole	0.601 ∽0.680
C	2 holes	0.681 ∽0.760

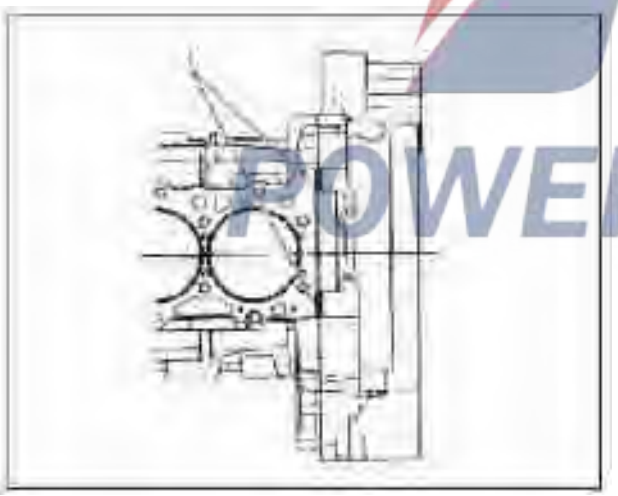
Key

1. Level identification hole

• Apply liquid sealant.

• Apply a 3mm wide liquid sealant (TB-1207C) to the seam (1) between the cylinder block and the flywheel housing as shown.

• After applying the liquid sealant, install the cylinder head within 5 minutes.

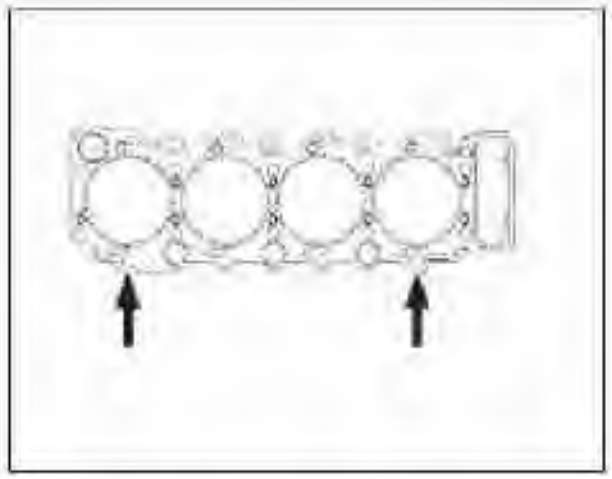


Key

1. Apply liquid sealant position

• Install the cylinder head gasket.

• Install the stamped part number cylinder head and align the cylinder head with the pin at the rear of the cylinder head.



2. Install the bolt assembly.

• Align the cylinder block pin and slowly raise the cylinder head.

Mark:

When installing, be careful not to scratch the cylinder head gasket.

• Apply molybdenum disulfide to the threads and mating surfaces of the M14 cylinder head bolts and apply oil to the threads of the M10 cylinder head cap bolts and mating surfaces.

• Use a torque wrench and dipstick to tighten the cylinder head bolts in the order shown.

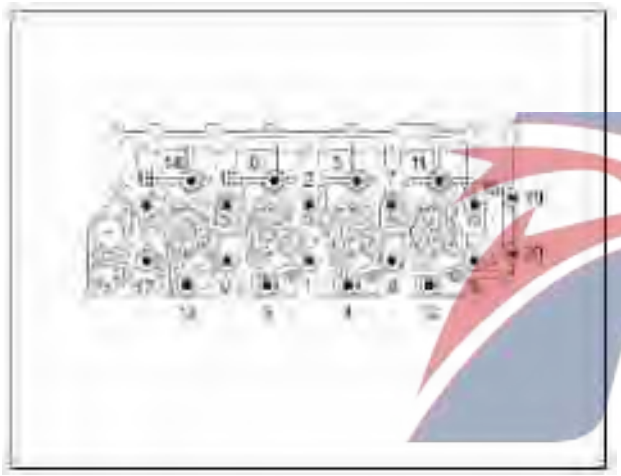
Cylinder head tightening torque: N·m {kgf·m}

M14	First time	98 {10.0}
(1∽18)	Second time	147 {15.0}
	Third time	30°∽60 °
MlO		38 {3.9}
(19,20)		

(16) Use double-head screws

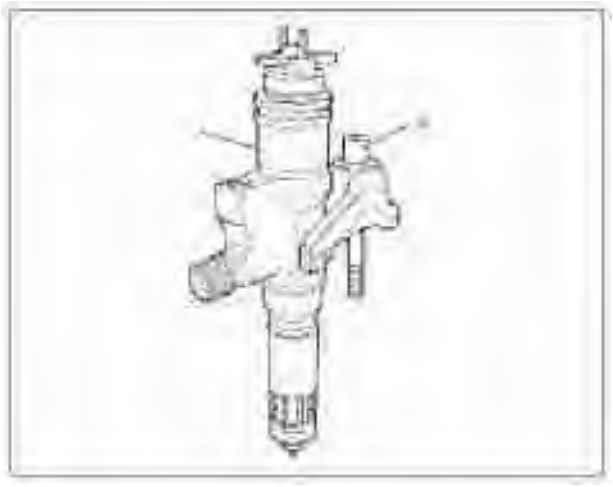
Special tools

Angle meter:5-8840-0266-0



3. Install the gasket into the injector (1) and install it on the cylinder head.

4. Apply molybdenum disulfide on the threaded portion of the syringe fixing bolt (2) and the contact surface to preload it.



Key

1. Injector
2. Fixing bolts

5. Install the common rail.

Tightening torque : 19 N•m {1.9kgf•m}

• Install common rail pressure sensor connector.

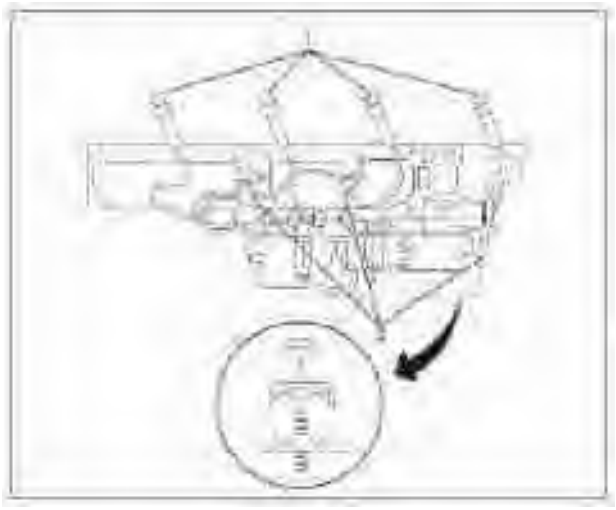
6. Install the fuel injection hose (1).

• Apply a light coat of oil around the fuel injector nut on the injector side and assemble it.

• Use a wrench to gently tighten the sleeve nut so that the sleeve nut matches the syringe and common rail.

• Tighten the sampler hose clamp (2) to the specified torque.

Tightening torque: 6 N•m {0.6 kgf•m}

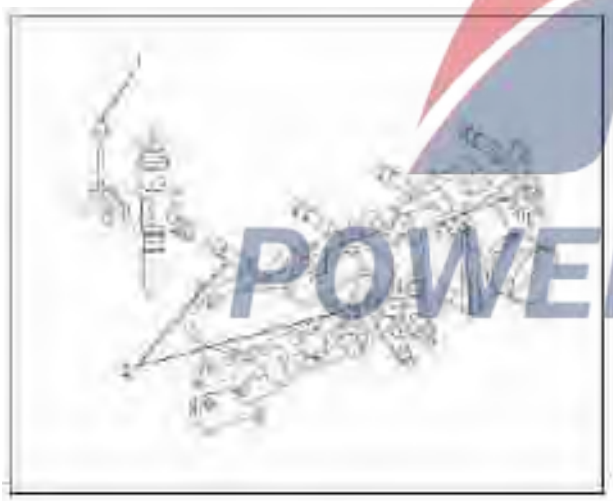


7. Tighten the clamp of the prestress injector (1) to the specified torque.

Tightening torque: 30 N•m {3.1 kgf•m}

8. Tighten the injection hose (2) to the specified torque.

Tightening torque: 44 N•m {4.5 kgf•m}



Key

1. Fixing bolts

2. Fuel injection pipe.

9. Install glow plugs.

Tightening torque: 20 N•m {2.0 kgf•m}

Mark:

Be careful not to over-tighten it, otherwise it will destroy it.

10. Fasten the glow plug connector to the specified torque.

Tightening torque: 1.2 N•m {0.12 kgf•m}

11. Apply engine oil to deck (2) and assemble.

Mark:

Move up and down to confirm that he can move normally and there is no blockage.

12. Apply a light coat of oil to the inside of the deck cover (1) and assemble it.

Caution:

Be careful not to place the deck lid in the gear box at the rear of the cylinder head and place it in the front oil return hole.

13. Install the camshaft assembly.

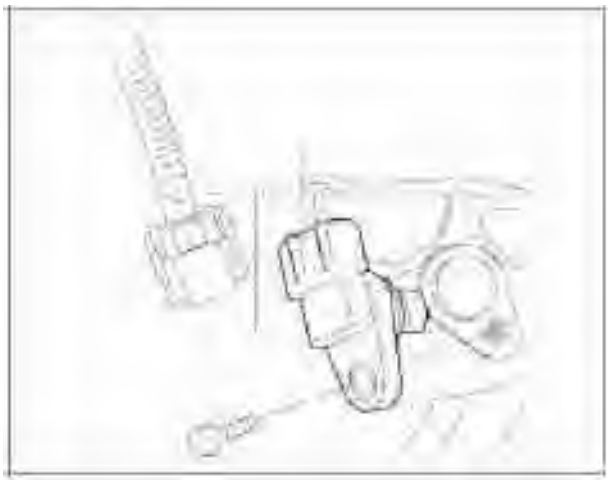
Refer to the camshaft Assembly in this chapter.

14. Install the rocker assembly.

Refer to the rocker assembly in this chapter.

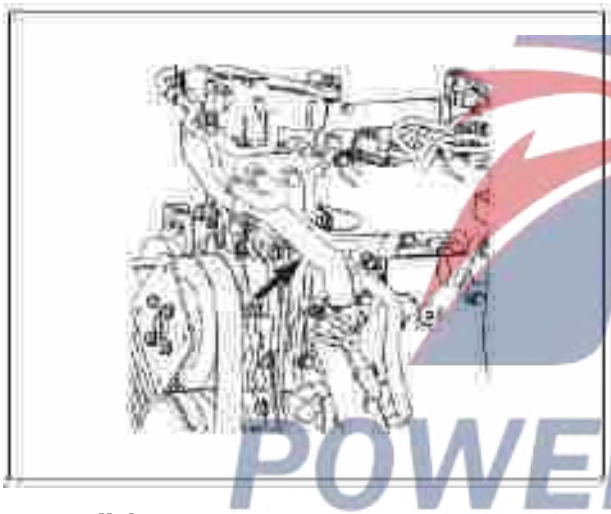
15. Tighten the camshaft position sensor to the specified torque.

Tightening torque: 8 N•m {0.8 kgf•m}



16. Install the bypass pipe.

• Install the engine coolant temperature sensor connector on the thermostat body.



17. Install the return pipe.

Tightening torque of return pipe:

Tightening torque : 12N·m{1.2kgf·m}

18. Install the return hose.

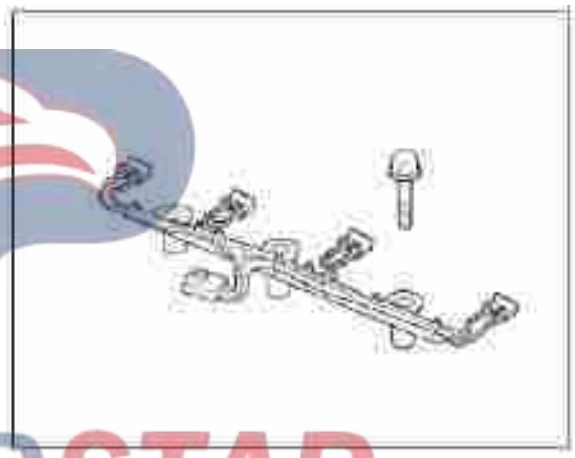
• Install the return pipe on the return pipe and secure it with a hose clamp.

19. Insert a new seal over the return line of the nozzle and install it back into the tubing.

Tightening torque : 12N·m{1.2kgf·m}

20. Install the injector harness connector from the inside and tighten the harness bracket to the specified torque.

Tightening torque: 48 N•m {4.9 kgf•m}



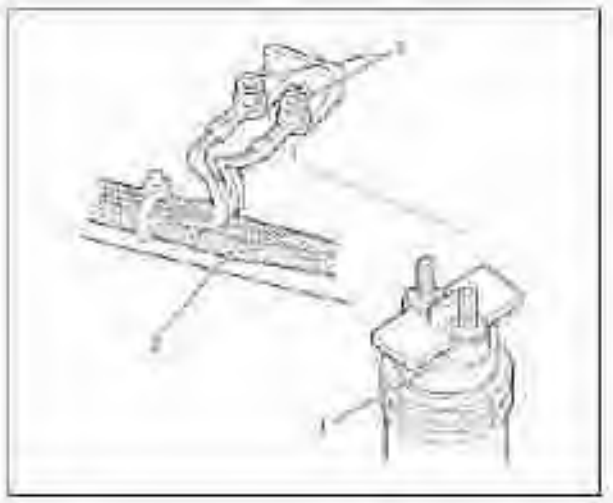
21. Install the wiring nut (3) on the injector (1).

Tightening torque: 2 N•m {0.2 kgf•m}

Mark:

• The wiring nuts are integrated and do not tighten on one side when tightening and must be tightened at the same time.

• Do not overtighten the nuts, otherwise the bolts may be damaged.



Key

1. Injector
2. Harness connector
3. Wire nut

22. Install the cylinder head cover.

Refer to the cylinder head cover in this chapter.

23. Install the water pipe from the radiator.

24. Install A/C compressor.

• Install the air-conditioning compressor bracket and tighten it to the specified torque.

Tightening torque: 24 N•m {2.4 kgf•m}

• Install A/C compressor harness connector

25. Install the air conditioner compressor drive belt and adjust the belt tension.

• Refer to the Cooling System 1C (4HK1) chapter of the drive belt.

26. Install the water pipe and piping on the turbocharger.

Refer to Intake System 1J (4HK1) - Section Turbocharger Assembly.

27. Install EGR cooler, EGR hose, EGR valve and water pipe.

• Install EGR coolers in the order of the steps.

Refer to the exhaust gas purification system 1F (4HK1) - EGR valve and EGR cooler.

28. Install scales and tubing.

29. Install the water pipe from the radiator.

30. Install the left and right intake manifolds of the engine to the intercooler.

31. Install the air intake tube to the turbocharger inlet tube (2) and tighten the clamp to the specified torque.

• Use new clamp.

Tightening torque: 10 N•m {1.0 kgf•m}

32. Install the intake hose on the turbocharger.

• Connect the intake manifold collar (5) at the turbocharger inlet to the specified torque. Use new clamp.

Tightening torque: 6 N•m {0.6 kgf•m}

• Install the PCV hose (1) on the intake hose.

33. Install the connector (6) on the turbocharger actuator.

34. Install front exhaust pipe A and exhaust brake and tighten them to the specified torque.

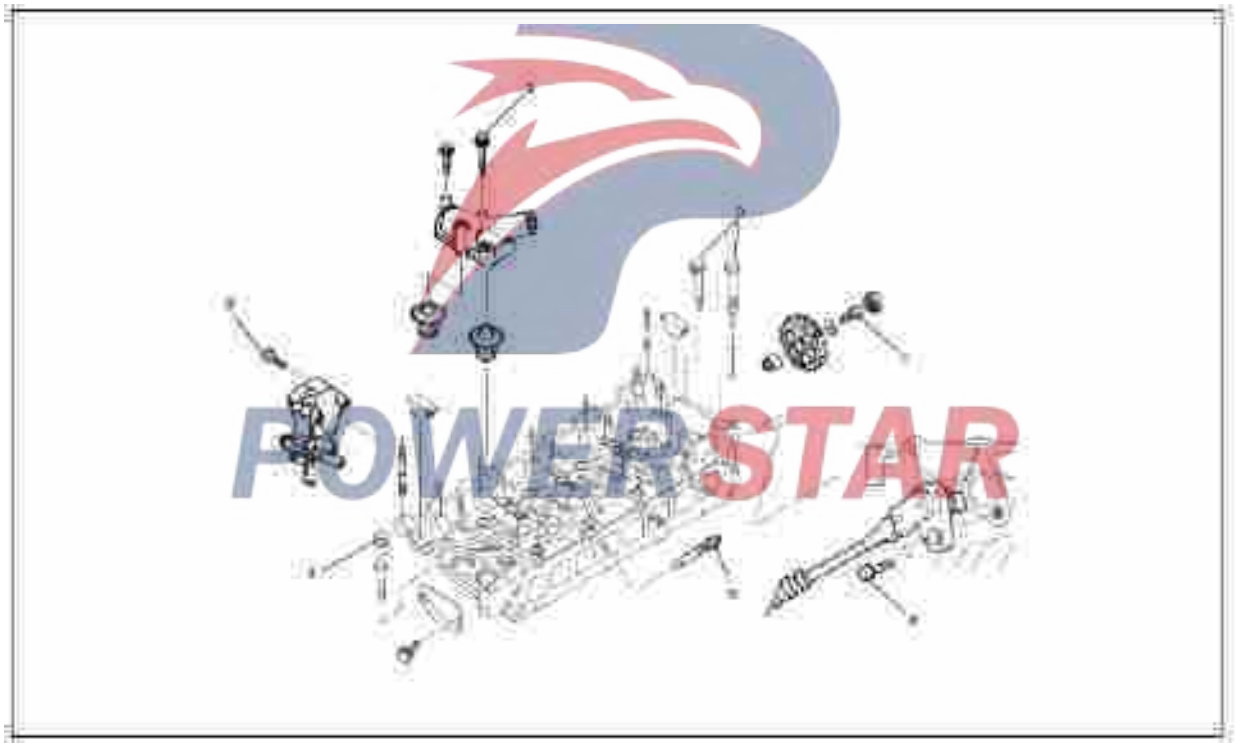
Tightening torque:

Turbocharger side nut	67N·m{6.8kgf·m}
Exhaust pipe support bolt	18N·m{1.8kgf·m}
Exhaust brake nut	27N·m{2.8kgf·m}

35. Install the engine wiring harness.

36. Inject the coolant.

Tightening torque - Overview



(a) 24 N·m { 2.4 kgf·m }

(b) 38 N·m { 3.9 kgf·m }

(c) 95 N·m { 9.7 kgf·m }

(d) 8 N·m { 0.8 kgf·m }

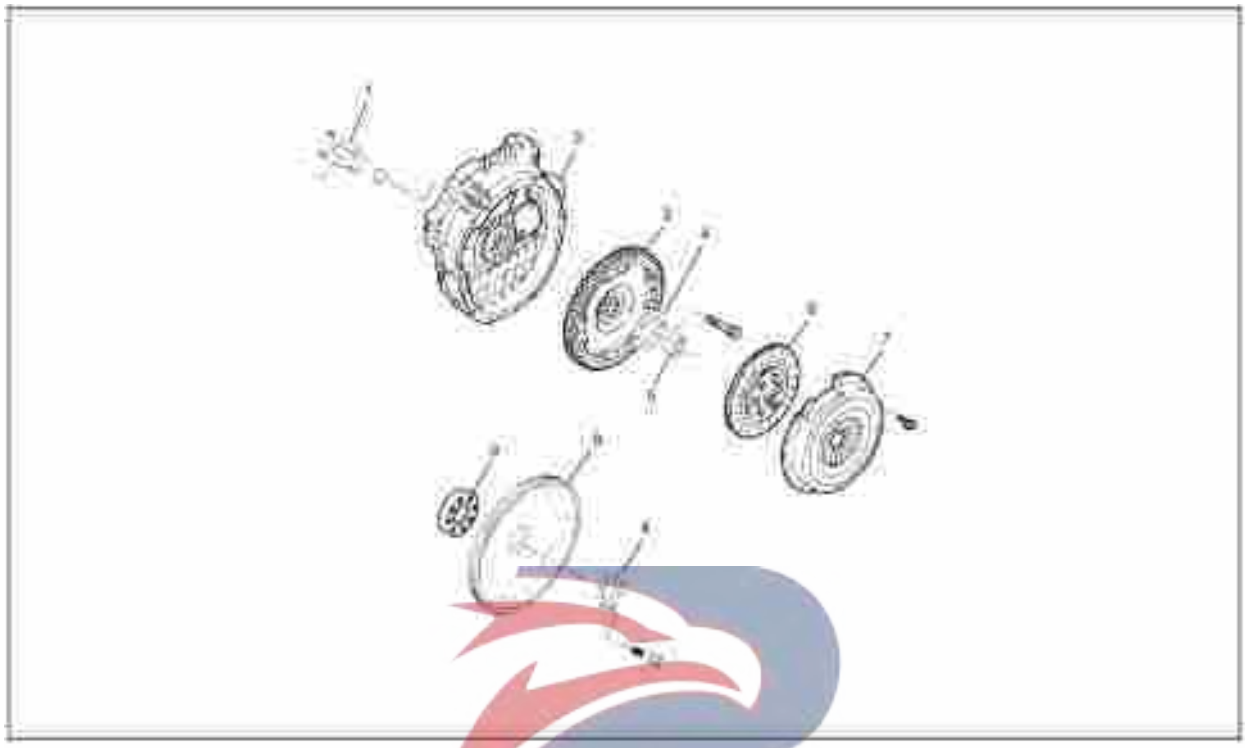
(e) 20 N·m { 2.0 kgf·m }

(f) 98 N·m { 10 kgf·m } → 147 N·m { 15 kgf·m }— 30°∽60 °

(g) 48 N·m { 4.9 kgf·m }

Flywheel

Component parts



Key

1. Crankshaft position (CKP) sensor
2. Flywheel housing
3. Flywheel assembly (M/T type)
4. Washers
5. Guide bearing (M/T type)
6. Clutch plate (model M / T)
7. Pressure plate (type M / T)
8. Hot Plate (Smoother - Explosion-Proof Type)
9. Crankshaft end spacer(Smoother-Ex type)

Disassembly

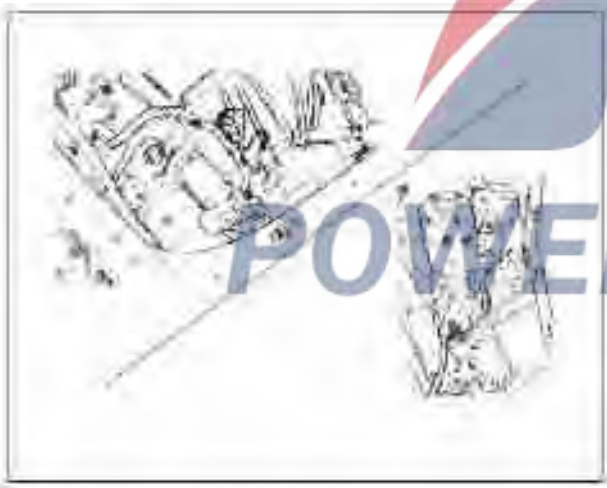
1. Remove the starter.

• Remove starter ground wire.

• Disconnect the front frame harness connector next to the transmission control box and remove the harness clip.

• Remove the 2 upper and lower bolts to install the starter and remove the starter from the clutch housing.

• To avoid disassembling the transmission, fix it in place with a wire.



2. Remove the transmission assembly.

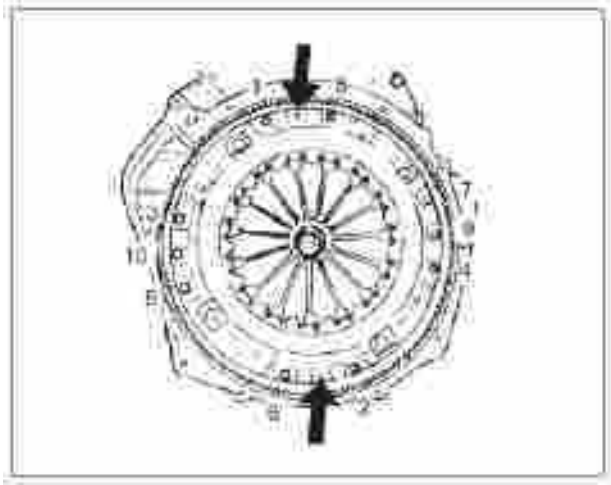
M/T models, see transmission control cable in MLD section 5C manual transmission.

3. Remove the clutch plate.

• Insert the clutch puller into the spline of the clutch plate.

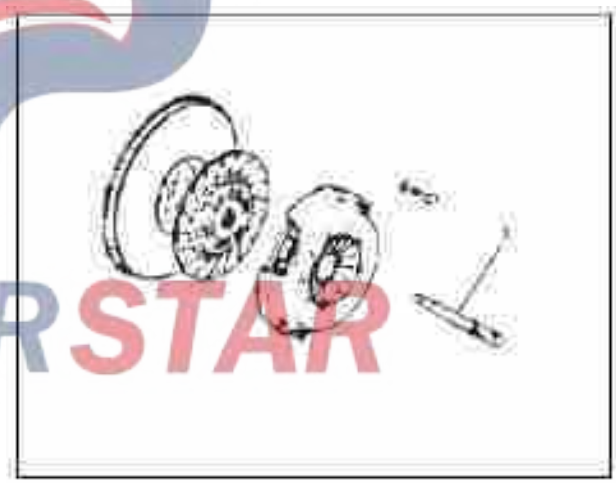
• Loosen deck mounting bolts one by one in the order shown.

• Remove the flywheel disk.



4. Remove the clutch plate.

• Use a clutch remover (1) to remove the clutch plate from the flywheel.



Key

1.Clutch disassembly

• Mount the crankshaft stopper to the flywheel housing starter mounting section so that the crankshaft cannot rotate.

Mark:

Make sure that the crank stop is properly inserted into the ring gear.

Special tools

Crankshaft stopper:5-8840-2230-0

4. Remove the CKP sensor.

• When removing the flywheel, the sensor will be disassembled to avoid interference.

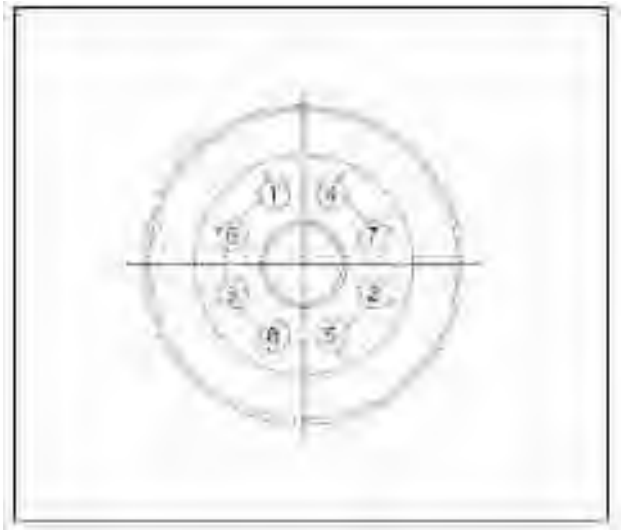
• The CKP sensor is weak in impact resistance, so be careful not to throw or drop it.

5. Remove the gasket.

6. Remove the steering wheel.

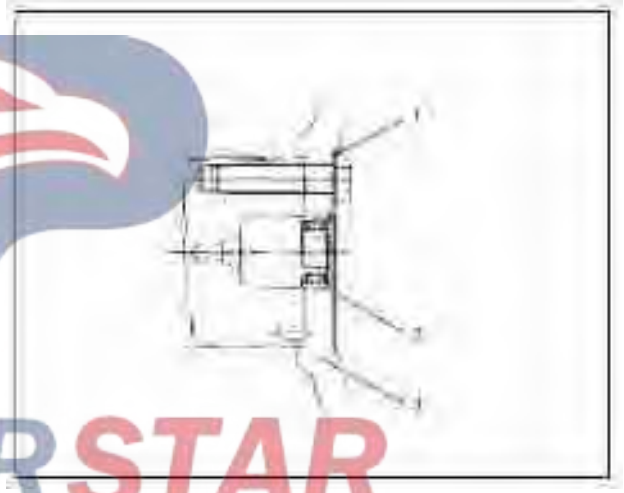
• Slowly loosen the flywheel mounting bolts in the order shown while ensuring that the steering wheel does not turn.

• After loosening the bolt, get off the stopper and remove the steering wheel.



7. Disassemble the guide bearing.

• Remove the guide bearing from the flywheel.



Key:

1. Washers
2. Guide bearing
3. Flywheel

8. Remove the ring gear.

• Remove it with a hammer and lever press ring.

Inspection

1. Visual inspection

• Make sure that the friction surface of the flywheel is not broken or damaged. If a malfunction occurs, correct or replace it.

• Check the gear teeth and replace them when worn or worn.

2. Measuring the friction surface

• Measure the depth of the friction surface of the steering wheel.

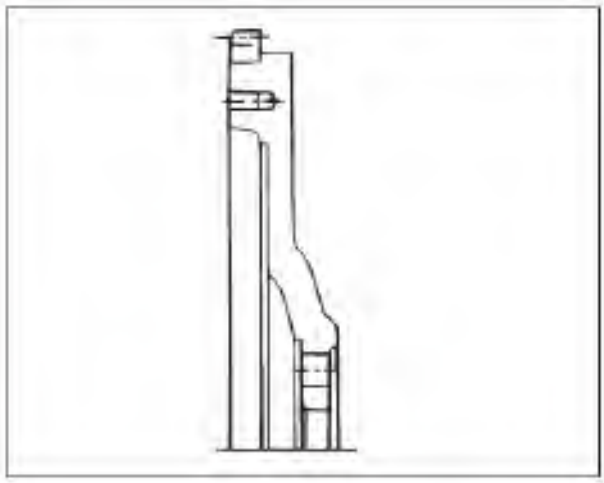
• If the measured value is between the standard value and the limit value, smash the steering wheel.

• If the measured value exceeds the limit, replace the steering wheel.

Flywheel friction surface depth mm

Standard value	19
Standard value	20

Depth = distance between the platen mounting surface and the friction surface.



Installation

1. Install the ring gear.

• Evenly heat the crown with a torch and push it into the flywheel.

Heating temperature must be less than 200°C

• Apply a load of 68.6kn {7000kg} to keep the cooling ring cool when hot.

Mark:

• Mount the chamfer of the ring in your direction.

• After thermal installation, make sure that the crown and flywheel are correctly adjusted.

2. Install the flywheel .

3. Install washers .

M/T specification

• Install the flywheel on the crankshaft locating pin and tighten in the order shown.

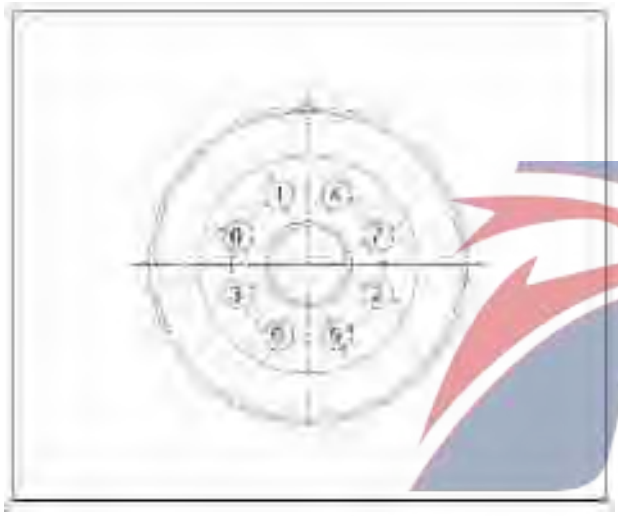
• Apply molybdenum disulfide to the threads and contact surfaces of the bolts.

• Install the crankshaft stopper on the starter mounting area of the flywheel housing.

Steering wheel torque:

First time=78 N·m{8.0 kgf·m}

Second time=120°∽150°



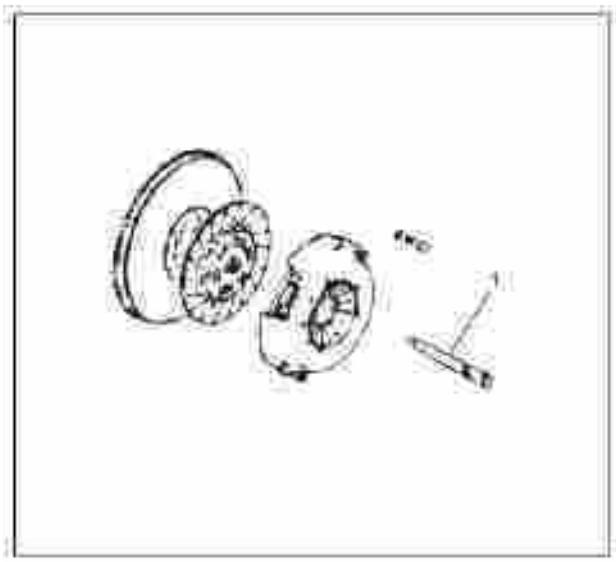
4. Install the CKP sensor and tighten it to the specified torque.

Tightening torque: 8 N•m {0.8 kgf•m}

5. Push in the guide bearing until it touches the end of the crankshaft.

6. Install the clutch plate.

• Use the clutch puller (1) to install the clutch plate on the flywheel.



Key

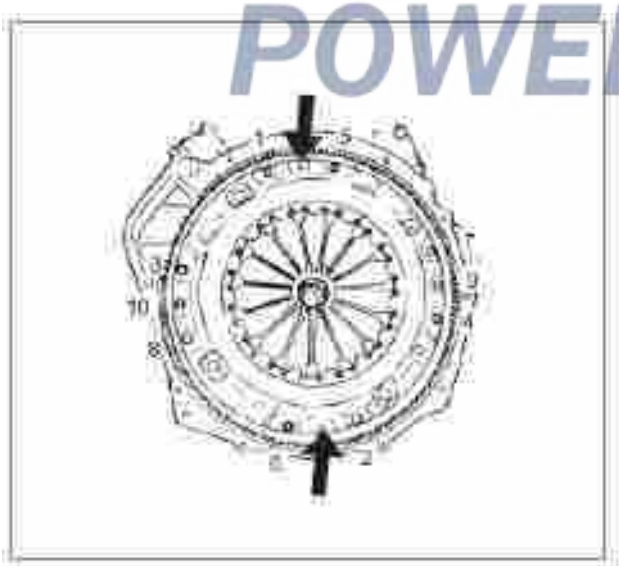
1.Clutch disassembly

7. Install the clutch plate.

• Align the platen mounting holes with the flywheel alignment pins, and then attach the platen to the flywheel.

• Tighten the cylinder in the order shown below.

Tightening torque: 40 N•m {4.1 kgf•m}



8. Install the transmission assembly.

M/T models, see transmission control cable in MLD section 5C manual transmission.

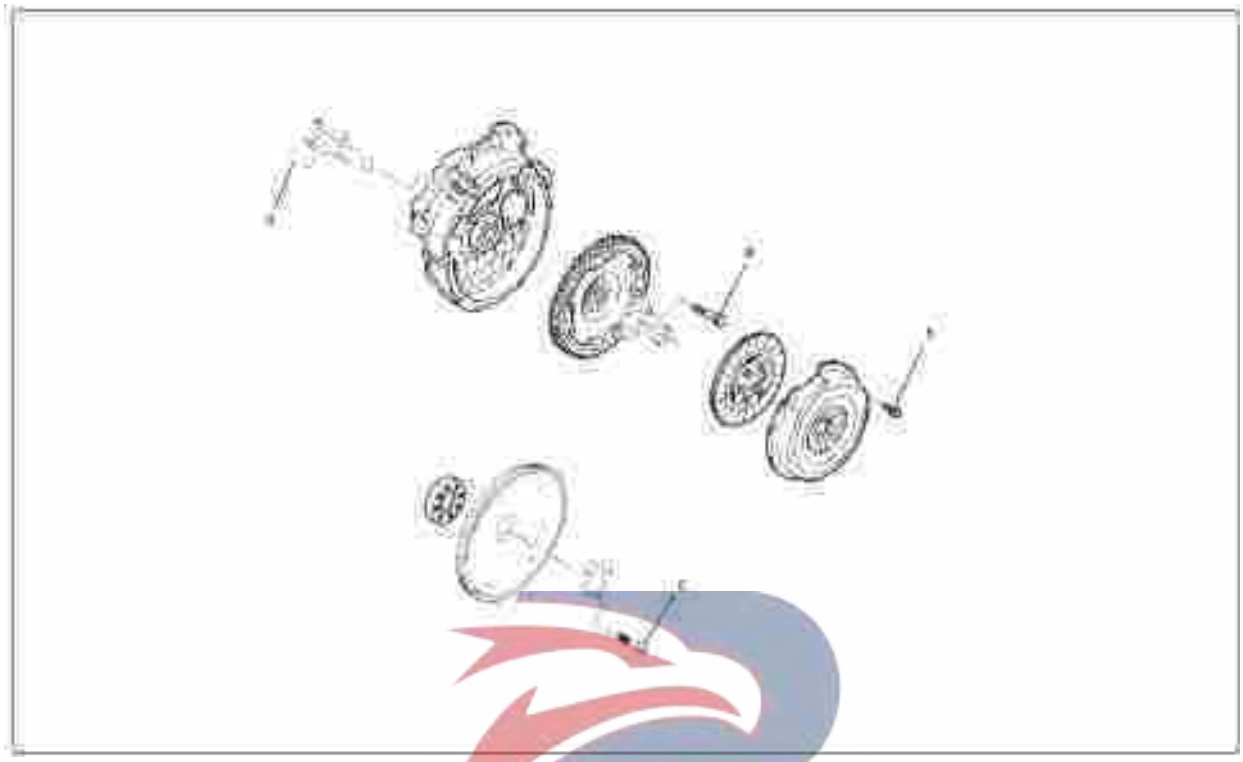
9. Install the starter on the clutch housing and tighten the bolts to the specified torque.

Tightening torque: 76 N•m {7.7 kgf•m}

• Install the starter ground wire.

• Connect the front bezel harness connector.

Tightening torque - Overview



(a) 78 N·m {8.0 kgf·m} → 120º∽150 º

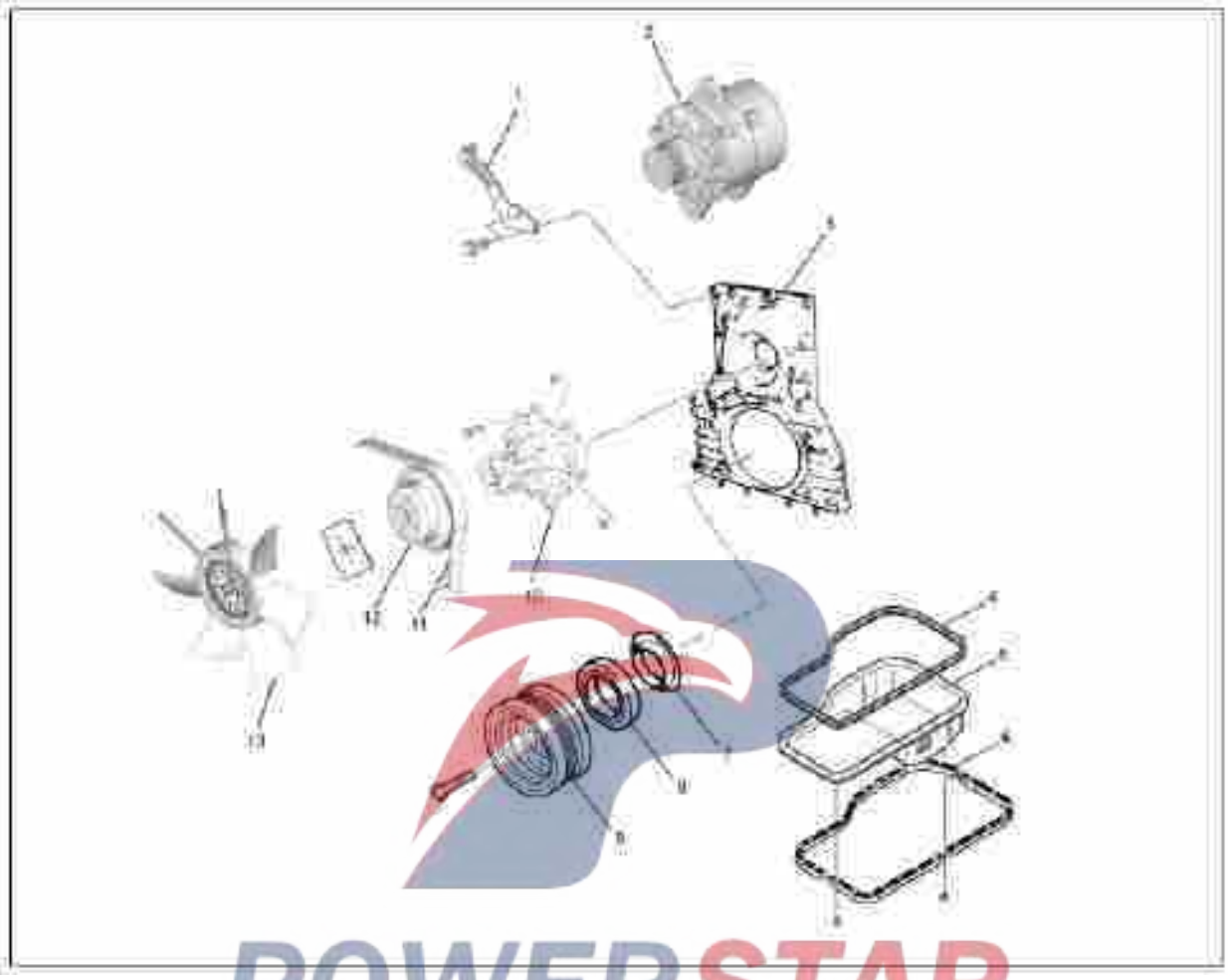
(b) 40 N·m {4.1 kgf·m}

(c) 78 N·m {8.0 kgf·m} → 120 º∽150 º

(d) 8 N·m {0.8 kgf·m}

Front cover

Component parts



Key

1. Adjust support
2. Generator
3. Front cover
4. Oil pan gasket
5. Oil sump
6. Rubber buffer assembly
7. The front oil drop ring
8. Front seal
9. Crankshaft pulley
10. Water pump assembly
11. Fan belt
12.Water pump pulley
13. Fan assembly

Disassembly

1. Remove the front oil seal.

Refer to the front oil seal of the crankshaft in this chapter.

2. Remove the oil sump.

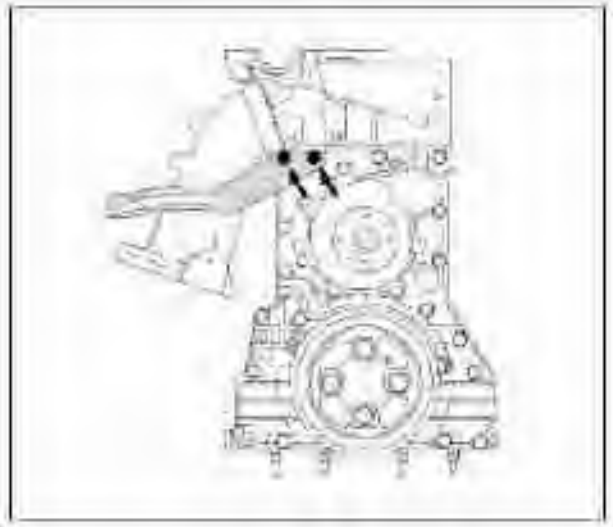
Refer to Lubrication System 1H (4HK1) - Fuel Tank Cover

3. Disassemble the pump.

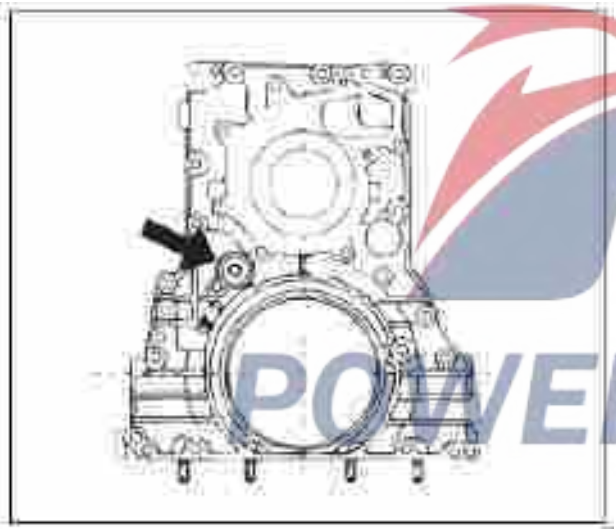
Refer to cooling system 1C (4HK1) - Water Pump.

4. Remove the front cover.

• Remove the generator adjustment bracket.

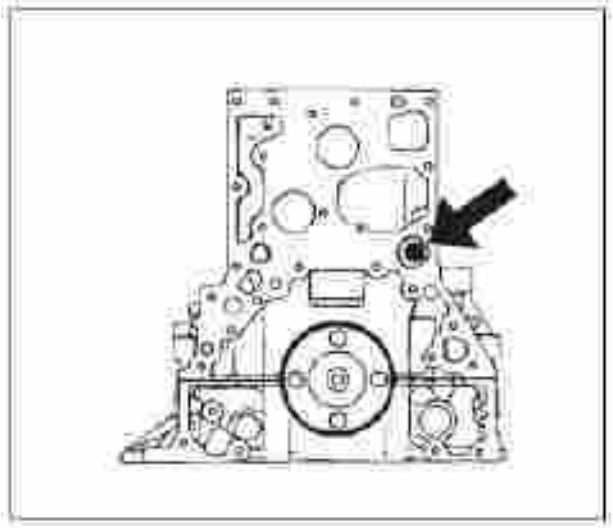


• Remove the drain valve (arrow), loosen the mounting bolts on the front cover, and remove the front cover.



5. Remove the oil cooler bypass valve.

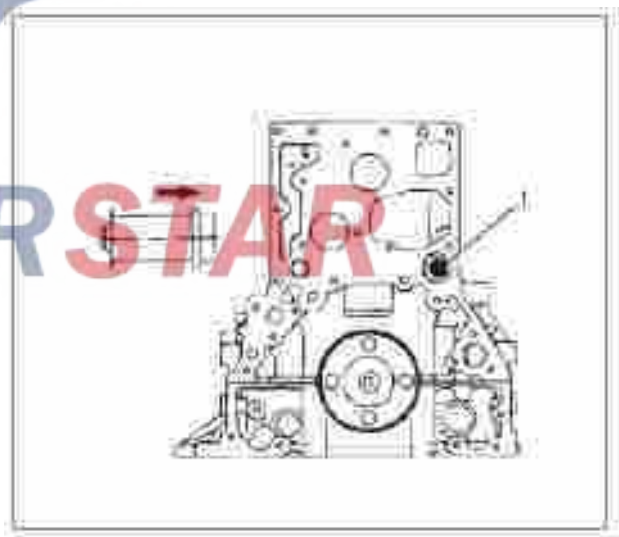
• Remove the bypass valve of the oil cooler from the cylinder block.



Installation

1. Install the oil cooler bypass valve.

• Insert the oil cooler bypass valve into the cylinder block boom. Be careful not to confuse the insertion direction.



2. Install the front cover.

• Clean the front of the cylinder block. In particular, remove the sealing fluid from the crankcase installation.

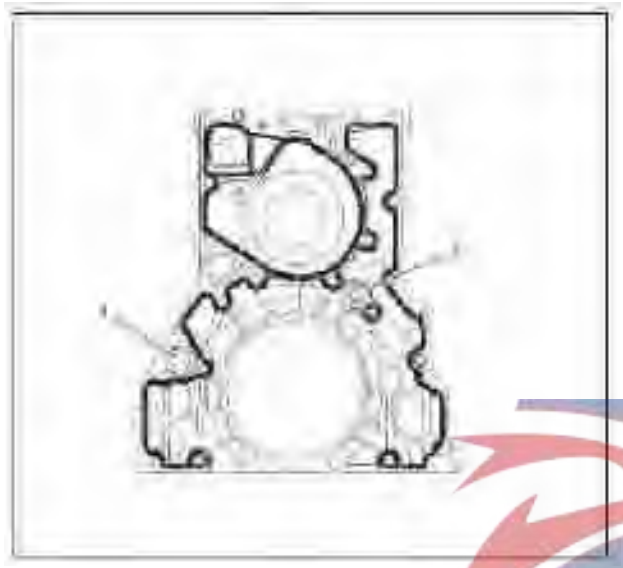
• Install O-rings (2 pieces) and apply liquid sealant (TB-1207B) or (TB-1207C) or (TB-1207F) to the groove on the front cover mounting surface.

Width	1.5∽5mm
Height	0.3~1.5mm from the joint surface

• After using the liquid sealant, install it within 5 minutes.

Mark:

When using liquid sealant, do not apply it on the O-ring (1).



Key:

1. O-ring

• Install the front cover with the dowel pin on the cylinder block.

Mark:

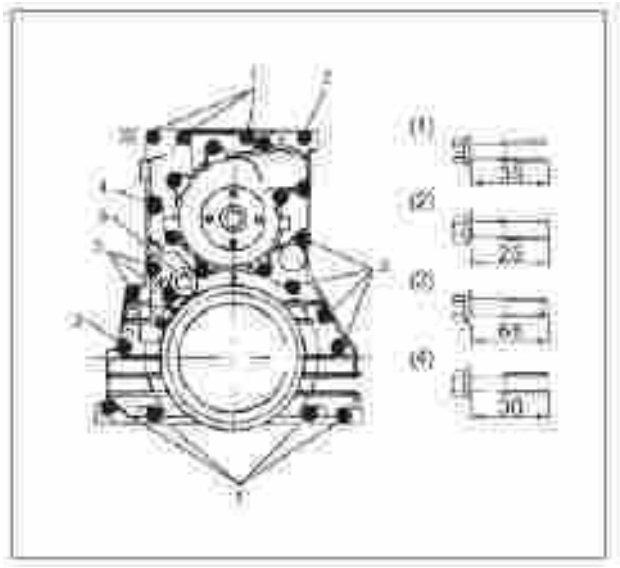
When installing the front cover, install the entire pump (no drying time in the sealing fluid).

Tightening torque: 24 N•m {2.4 kgf•m}

• Some bolts (※) must be tightened with a generator adjustment bracket.

• Tighten the oil pressure relief valve (5) according to the specified torque.

Tightening torque: 39 N•m {4.0 kgf•m}



3. Install the water pump.

Refer to cooling system 1C (4HK1) - Water Pump.

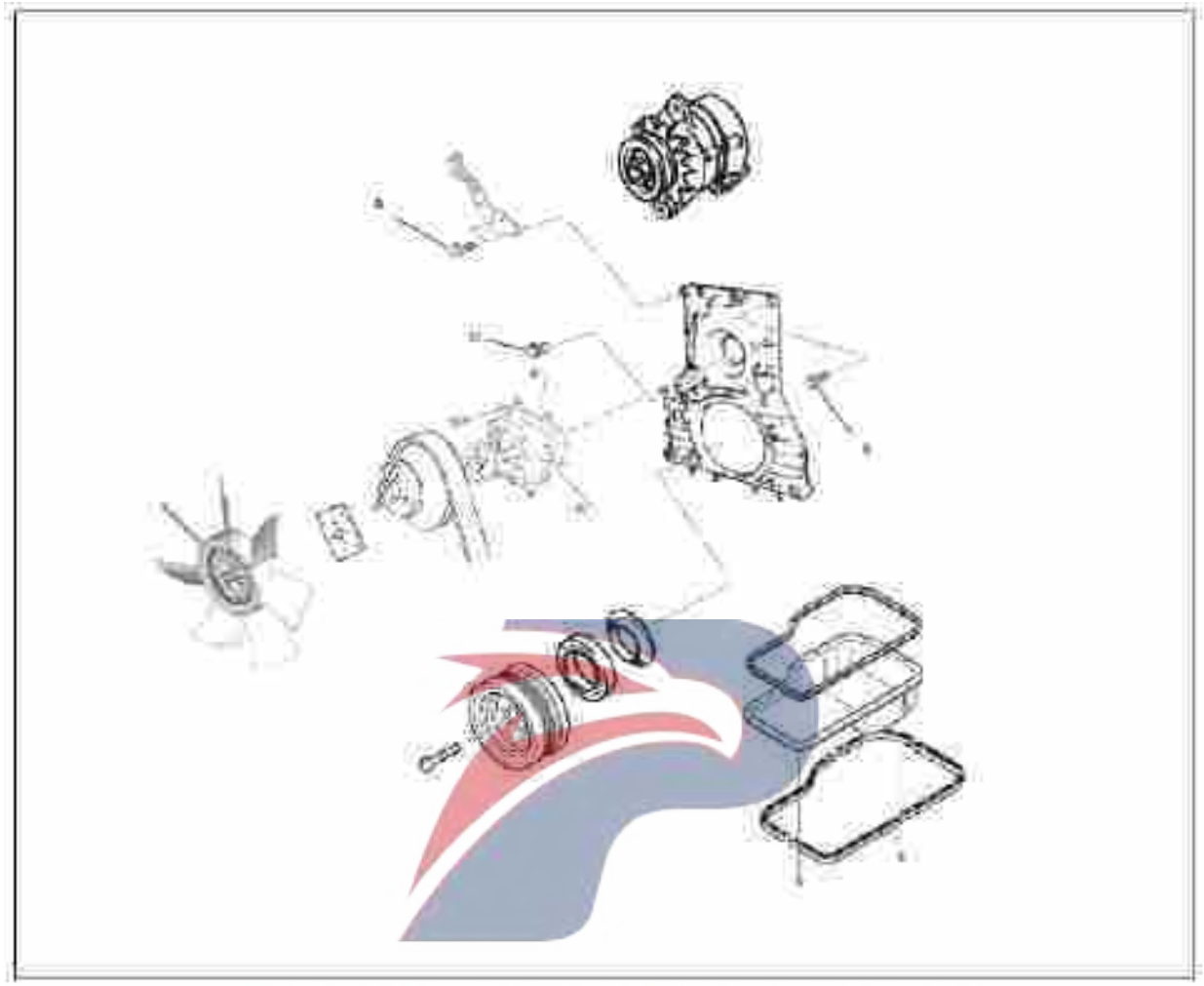
4. Install the oil sump.

Refer to Lubrication System 1H (4HK1) - Fuel Tank Cover

5 Install the front oil seal.

Refer to the front oil seal of the crankshaft in this chapter.

Tightening torque - Overview



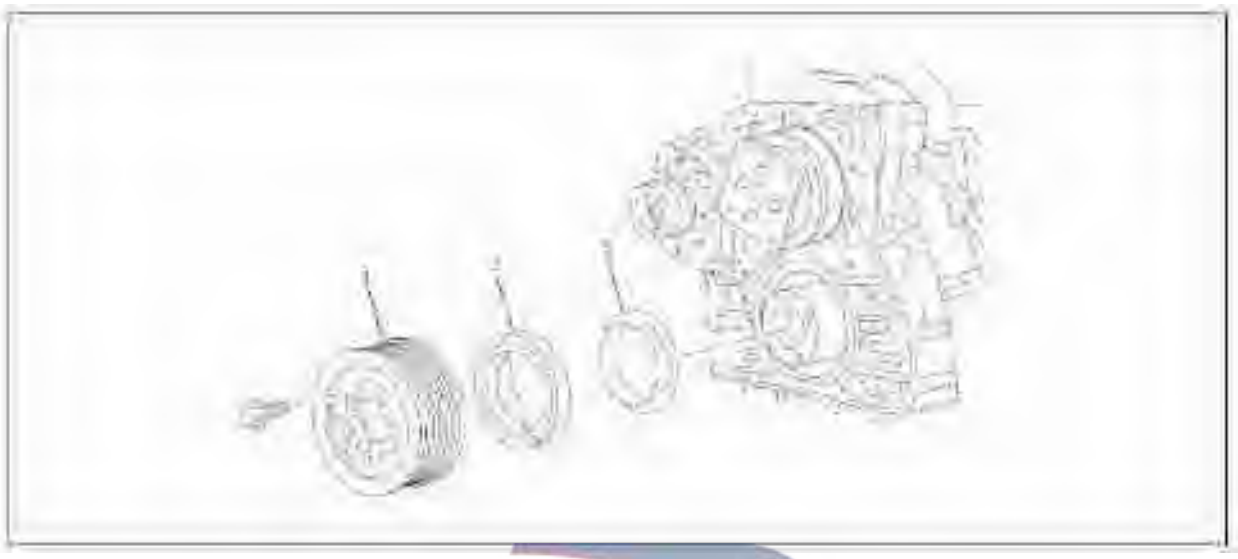
(a) 24 N·m {2.4 kgf·m}

(b) 39 N·m {4.0 kgf·m}

(c) 24 N·m {2.4 kgf·m}

Front oil seal of Crankshaft

Component parts



Key

1. Crankshaft pulley
2. Front oil seal of Crankshaft
3. Crankshaft front oil emission ring

Disassembly

1. Discharge the coolant.
2. Remove the starter.

• Remove the starter ground wire.

• Disconnect the front frame harness connector next to the transmission control box and remove the harness clip.

• Remove the 2 upper and lower bolts to install the starter and remove the starter from the clutch housing.

• Fix it in place with a wire, etc.

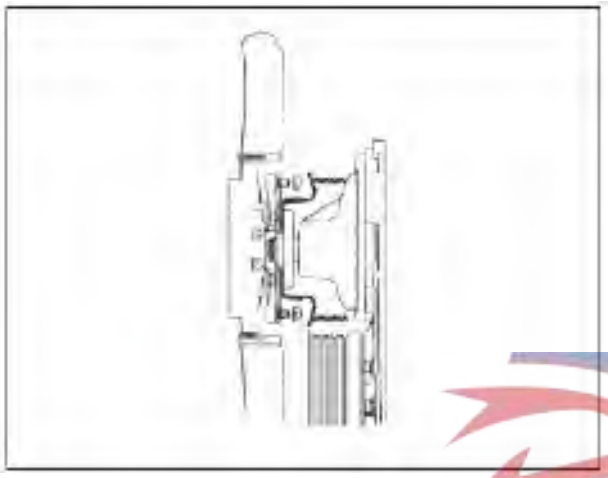
3. Remove the intake hose connected to the intercooler.
4. Remove the water pipe from the radiator on the engine side.
5. Remove the hose from the coolant manifold on the radiator side.
6. Remove the radiator drain from the engine side.

7. Remove the brackets (with fan guard) on the left and right sides of the heat sink and remove the heat sink.

8. Remove the fan assembly.

• Take off 4 mounting nuts and remove the fan assembly.

9. Remove the fan belt.



10. Remove the crankshaft pulley.

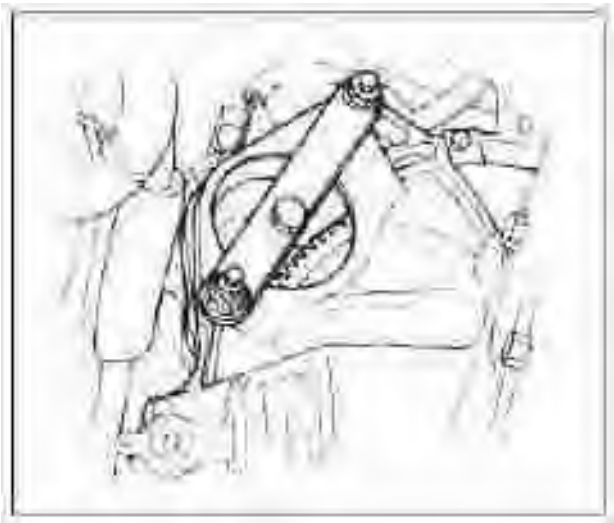
• Install the crankshaft stopper to the flywheel housing starter mounting area to loosen the pulley nut while ensuring that the crankshaft does not rotate.

Mark:

Make sure that the crank stop is properly inserted into the ring gear.

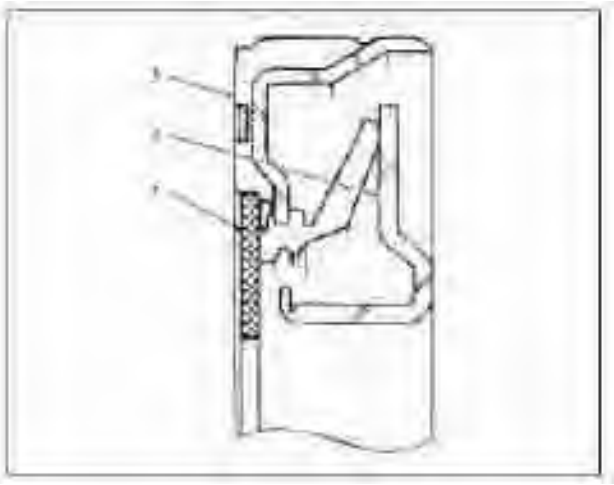
Special tools

Crankshaft stopper:5-8840-2230-0



11. Remove the front crankshaft seal.

• Use a screwdriver to lift the oil seal and remove it, taking care not to scratch the oil seal mounting surface and the front cover shaft.



Key

1.Felt

2. Oil drop ring

3. Oil seal

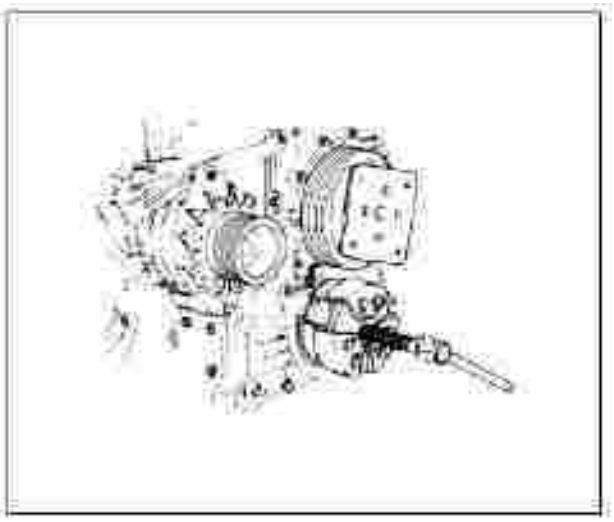
12. Remove the front oil transmitter from the crankshaft.

• Use an extraction tool to remove the baffle.

(Pull out the outer circumference of the tool with pliers.)

Special tools

Accelerator Extractor Tool: 5-8840-2360-0



Installation

1. Install the oil ring before installation.

• Use the oil seal mounting kit to press the bezel.

Key

1. The front oil drop ring
2. Adapter (front)
3. Fixing bolts
4. Sleeve(Front)
5. Washers(Front)
6. Center bolt

Special tools

Oil Seal Installer Kit: 5-8840-2703-0

(The front-end oil seal uses the items listed in the table below.)

No.	Number	Name	Oil drop ring	Oil seal
1	5-8840-2704-0	Sleeve(Front)	○	○
2	5-8840-2705-0	Adapter (front)	○	○
3	5-8840-2706-0	Join the ring (front)	-	○
4	5-8840-2707-0	Washers(Front)	○	○
5	5-8840-2713-0	Center bolt	○	○
6	5-8840-2714-0	Fixing bolts	○	○

• Insert the slinger into the front end of the front adapter and install the adapter on the crankshaft.

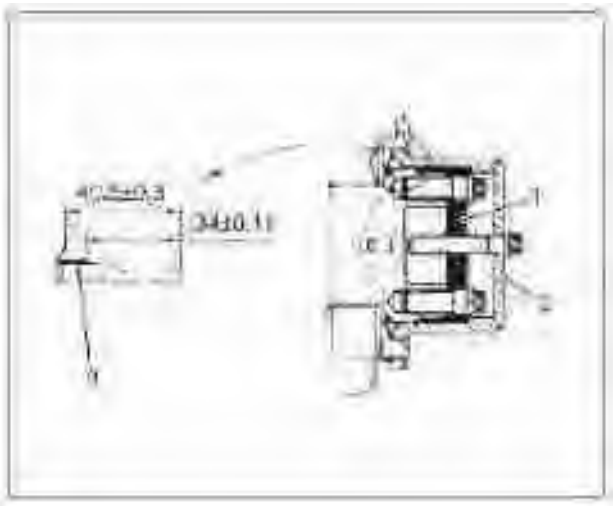
• Fix the clamping sleeve, top of the windshield washer in the center of the bolt, and tighten the bolt until the socket contacts the adapter.

• After pushing in the flinger, measure the dimensions from the crankshaft face to the lip of the oil seal. Make sure the baffle does not vibrate. (4 directions)

Flange push-in size (Front)	mm
Assembly standard	40.2 ∽40.8

Mark:

When installing the bezel, do not confuse the installation direction with the front and rear. Afterwards, Slinger 4 took a line to the right, before Slinger 4 took a left-handed line. When replacing the Froller and the seal, it must be replaced.



Key

1. Adapter
2. Sleeve
3. Oil drop ring

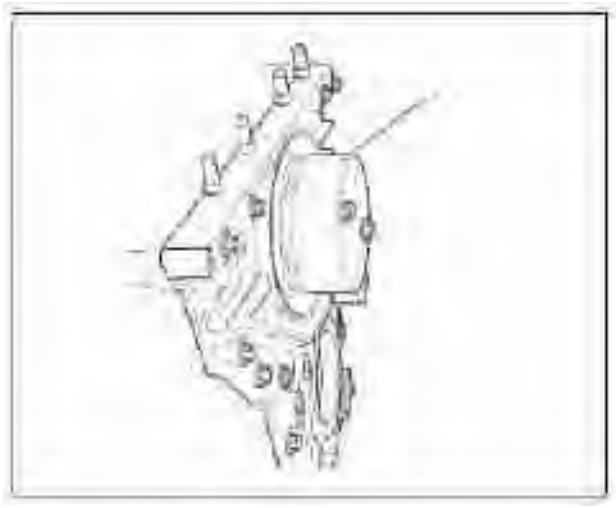
2 Install the front oil seal.

• Press in the oil seal using the oil seal mounting kit.

Key

1. Oil seal
2. Adapter (front)
3. Join the ring (front)
4. Fixing bolts
5. Sleeve(Front)
6. Washers(Front)
7. Center bolt

• Mount the adaptor (1) to the crankshaft using fixing bolts.



Key

1. Adapter

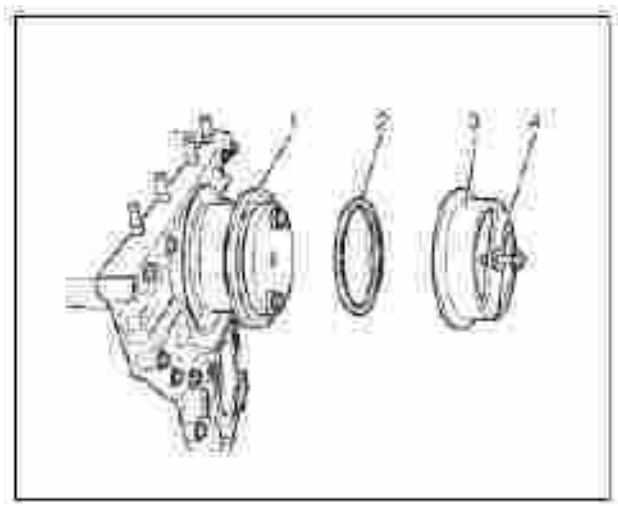
• Apply a thin layer to the lip of the engine oil seal (1) and assemble it to the input adapter.

Mark:

Be sure to apply oil to the lip of the oil seal.

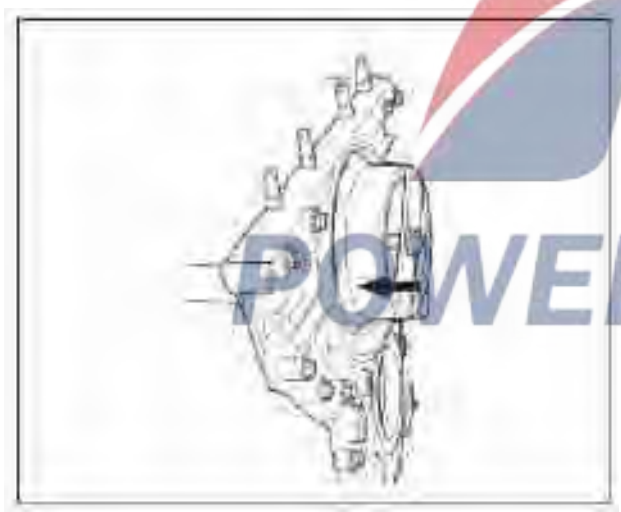
• The front of the mating ring (2) in the sleeve (3) is assembled to the adapter's center bolt and washer (4).

• Secure the sleeve until it contacts the adapter and press the front oil seal.



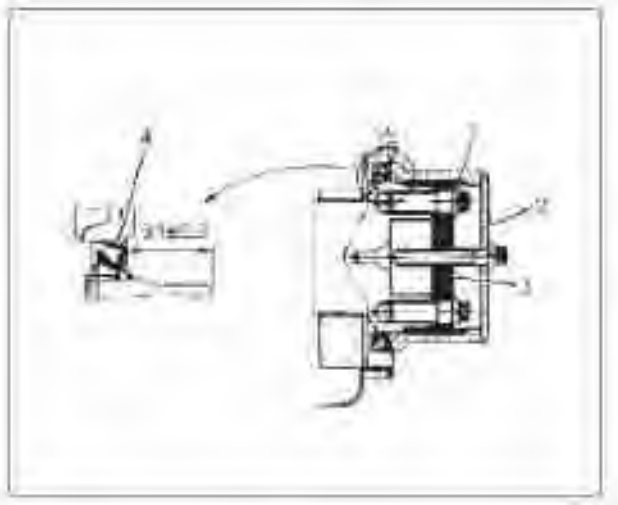
Key

1. Oil seal
2. Sealing ring
3. Sleeve
4. Washer



• After pushing in the front oil seal, measure the size of the crankshaft end face to the oil seal surface and confirm that the oil seal does not oscillate (4 directions).

Oil seal push-in size (Front)	mm
Assembly standard	30.7∽31.3



Key

1. Sealing ring
2. Sleeve
3. Adapter
4. Oil seal

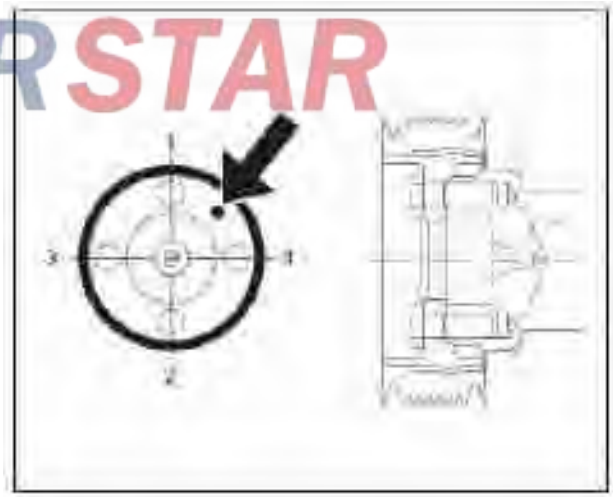
3. Install the crankshaft pulley.

• Apply oil to the threaded portion of the mounting bolts.

• Align the crankshaft locating pin with the installed crankshaft pulley.

• Tighten in the order shown below.

Tightening torque: 200 N•m {20.4 kgf•m}

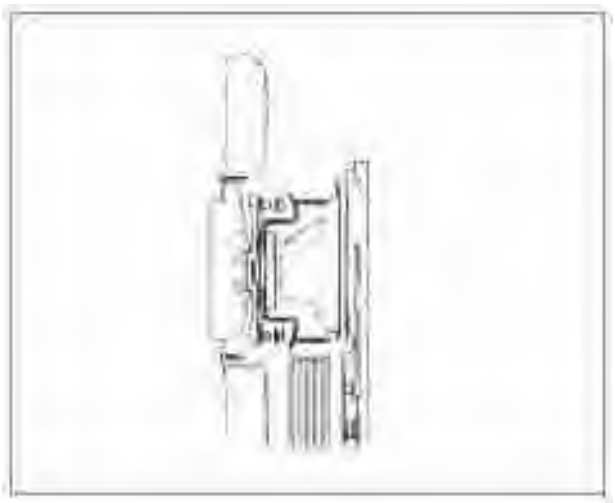


4. Install and adjust the fan belt.

Refer to the 1C Cooling System (4HK1) chapter of the drive belt.

5. Install the fan assembly and tighten it to the specified torque.

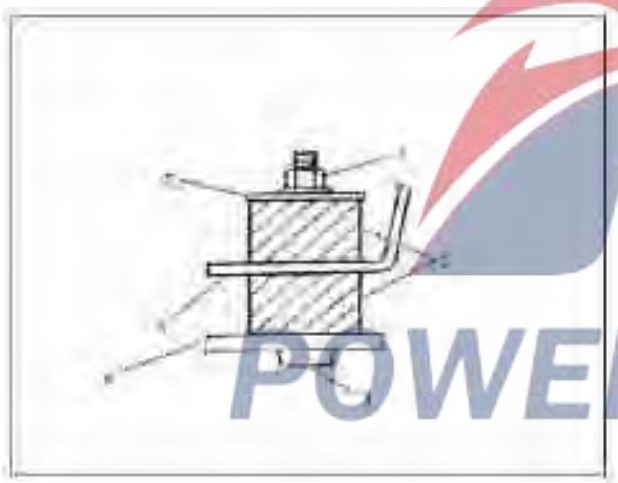
Tightening torque: 24 N•m {2.4 kgf•m}



6. Install the heat sink.

• Brackets for securing the left and right brackets of the frame as shown.

Tightening torque: 55 N•m {5.6 kgf•m}



Key

Flange nut

2. Rubber

3. Stud bolts

4. Side bracket

5. Heatsink side bracket

6. Washer

7. Install the radiator hose.

8. Install the coolant reservoir hose.

9. Install the water pipe from the radiator.

10. Install the air intake pipe to the intercooler.

11. Tighten the starter to the clutch housing and tighten it with the specified torque.

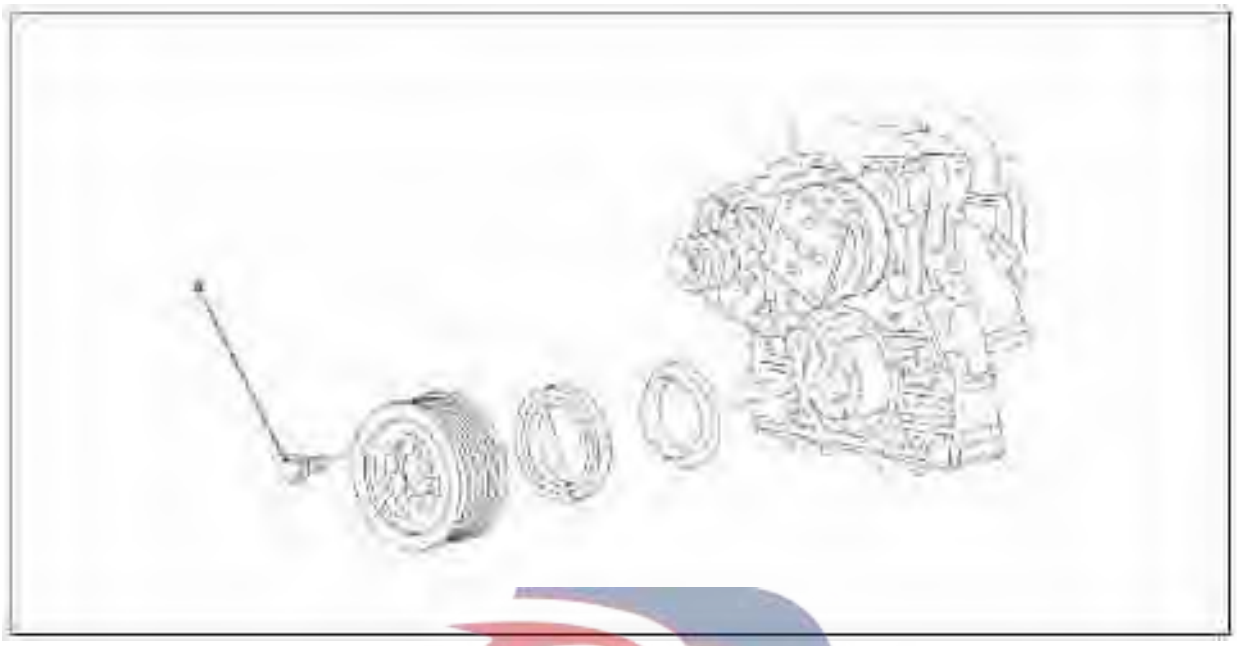
Tightening torque: 76 N•m {7.7 kgf•m}

• Install the starter ground wire.

• Connect the front bezel harness connector.

12. Inject the coolant.

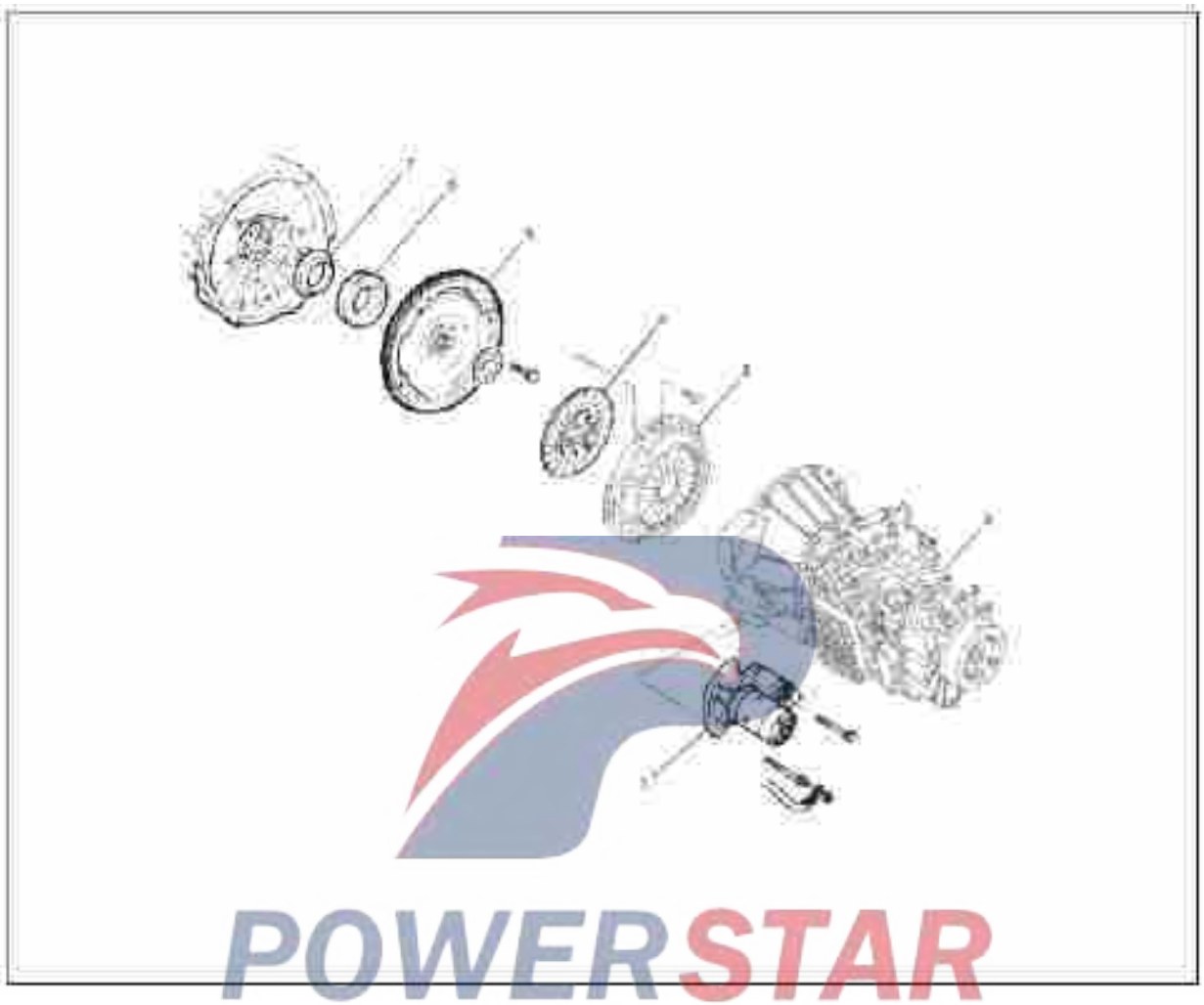
Tightening torque - Overview



(a) 200 N·m {20.4 kgf·m}

Rear oil seal of Crankshaft

Component parts



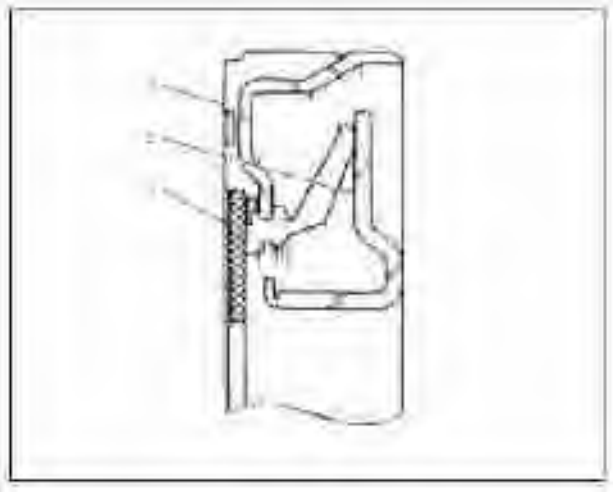
Key

1.Starter
2.Transmission assembly
3. Clutch pressure plate (M / T type)
4. Clutch plate (model M / T)
5. Flywheel (M/T type)
6. Rear oil seal of Crankshaft
7. Crankshaft rear oil transmitter

Disassembly

1. Remove the transmission assembly.
M/T models, see transmission control cable in MLD section 5C manual transmission.
2. Remove the steering wheel.
Refer to the flywheel in this chapter.
3. Remove the rear oil seal

• Use a screwdriver to remove the seal and be careful not to scratch the oil seal surface and the flywheel housing shaft.



Key

1.Felt

2. Oil drop ring

3. Oil seal

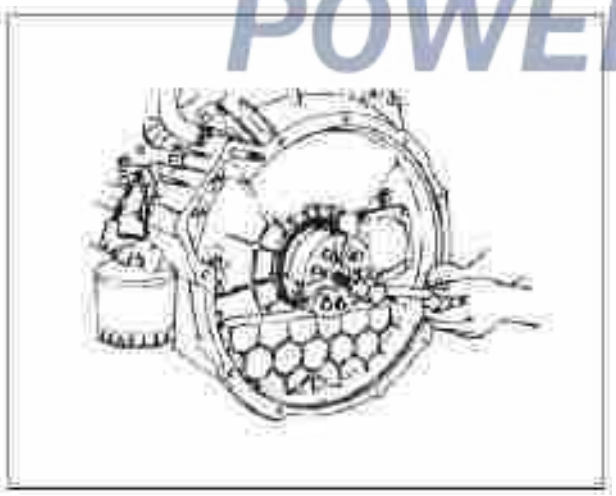
4. Remove the rear oil emitter.

• Use an extraction tool to remove the baffle.

(Use pliers to remove the tool for easy removal.)

Special tools

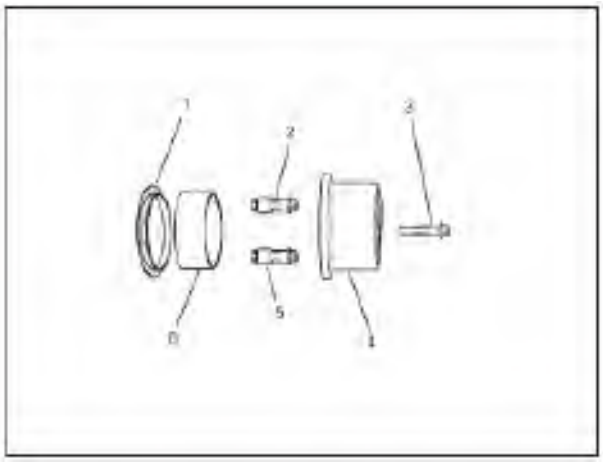
Accelerator Extractor Tool: 5-8840-2360-0



Installation

1. Install the rear oil throwing ring

• Use the oil seal mounting kit to press the bezel.



Key

1. Rear oil throwing ring

2. Fixing bolts

3. Center bolt

4. Sleeve(Rear)

5. Ring (Rear)

6. Adapter (Rear)

Special tools

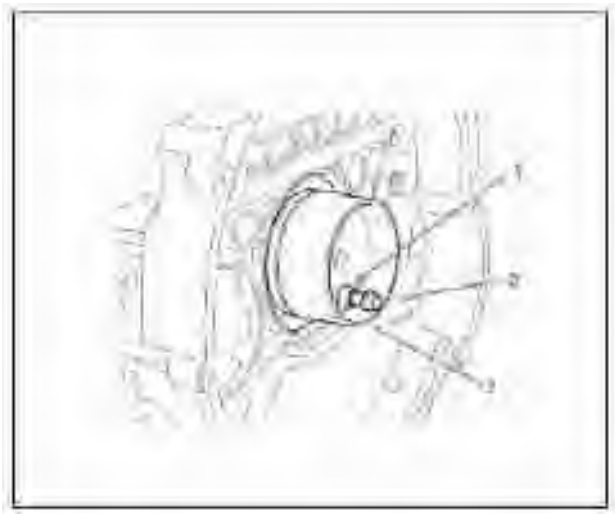
Oil Seal Installer Kit: 5-8840-2703-0

No.	Number	Name	Oil drop ring	Oil seal
1	5-8840- 2708-0	Sleeve(Rear)	○	○
2	5-8840- 2709-0	Adapter (Rear)	○	○
3	5-8840- 2710-0	Ring (Rear)	○	○
4	5-8840- 2711-0	Join ring (Rear)	-	○
5	5-8840- 2713-0	Center bolt	○	○
6	5-8840- 2714-0	Fixing bolts	○	○

Mark:

The seal mounting element supporting the motor includes the forward sleeve 93.5 (5-8840-2712-0) but no motor is used.

• Insert the slinger into the front end of the rear adapter (3), install the collar (1) on the mounting bolt (2), and then attach the adapter to the crankshaft.



Key

1. Ring
2. Fixing bolts
3. Adapter

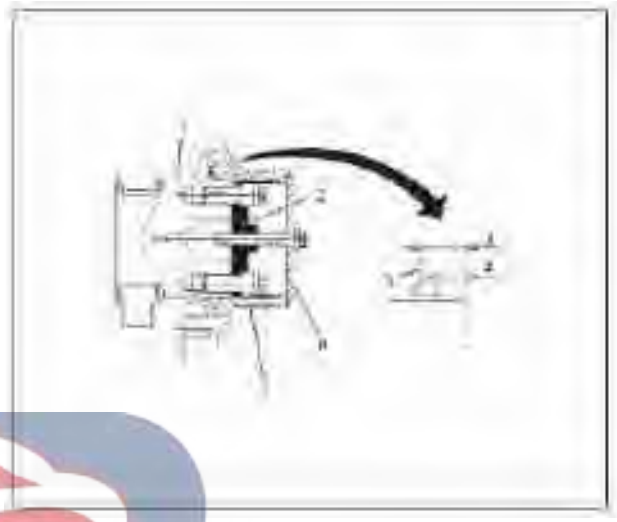
• Put on the sleeve adapter and tighten the screws until the socket contacts in the middle of the adapter are pushed into the Slinger.

• After pushing the slinger, measure the distance from the crankshaft end face to the oil seal lip and confirm that the slinger has no warpage (4 directions).

Flange push-in size (Rear)	mm
Assembly standard	17.0∽17.6

Mark:

When installing the bezel, do not confuse the installation direction with the front and rear. Afterwards, Slinger 4 took a line to the right, before Slinger 4 took a left-handed line. Small pieces and washers must be replaced in groups.

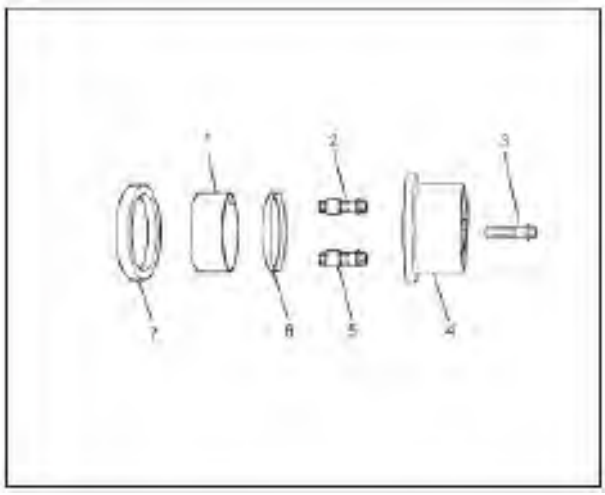


Key

1. Crankshaft
2. Adapter
3. 17.3±0.3mm
4. 10.8±0.1mm
5. Oil drop ring
6. Sleeve
7. Ring

2. Install the rear oil seal

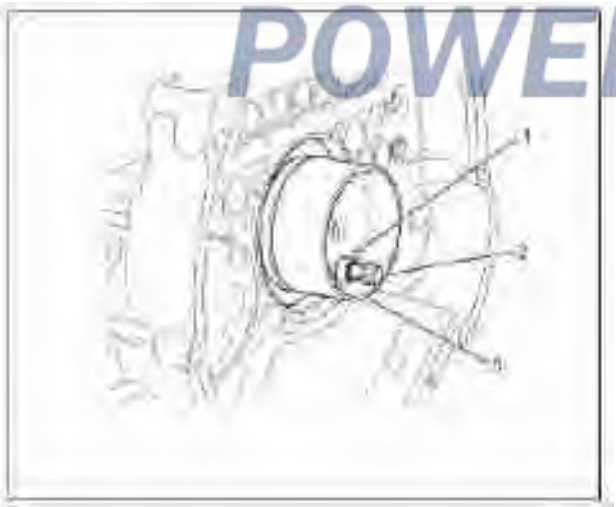
• Press in the oil seal using the oil seal mounting kit.



Key

1. Adapter (Rear)
2. Fixing bolts
3. Center bolt
4. Sleeve(Rear)
5. Ring (Rear)
6. Join ring (Rear)
7. Oil seal

• The ring (1) is mounted on the mounting bolt (2) and the adapter (3) is mounted on the crankshaft.

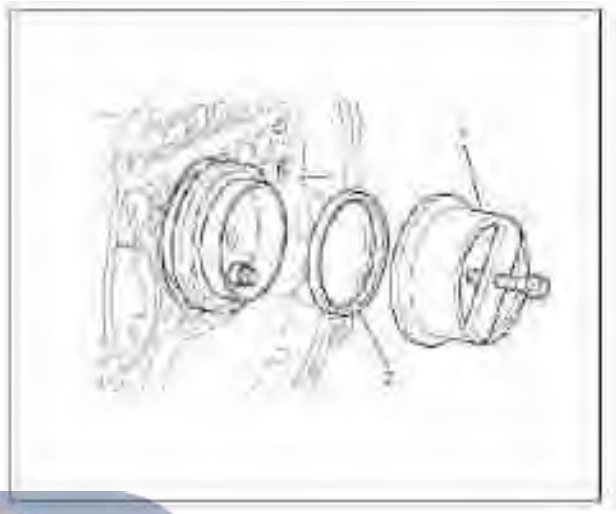


Key

1. Ring
2. Fixing bolts
3. Adapter

• Apply a thin layer of oil to the engine oil seal lip and oil seal and fit it to the return adapter.

• Install the rear adapter ring (2) into the sleeve (1), fix it to the adapter, and install the center bolt.



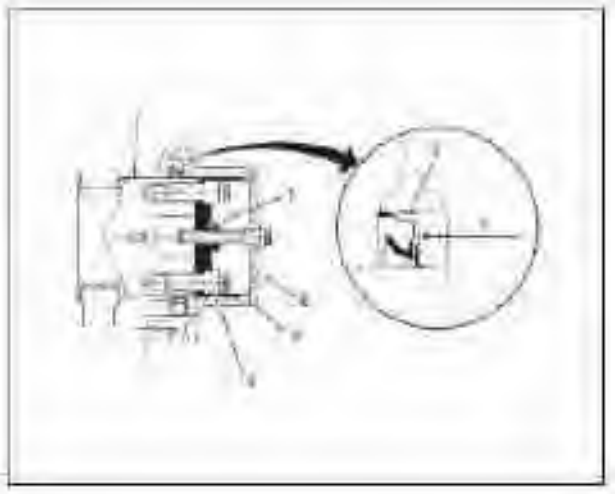
Key

1. Sleeve
2. Sealing ring

• The center bolt clamps the adapter until the sleeve contacts and seals against the fit.

• After the oil seal is pressed in, measure the distance from the end face of the crankshaft to the oil seal, and confirm that there is no warpage in the oil seal (4 directions).

Sealing press dimension (rear)	mm
Assembly standard	7.5∽8.1



Key

1. Crankshaft
2. Oil seal
3. 7.8±0.3mm
4. Ring
5. Sealing ring
6. Sleeve
7. Adapter

3. Install the flywheel.

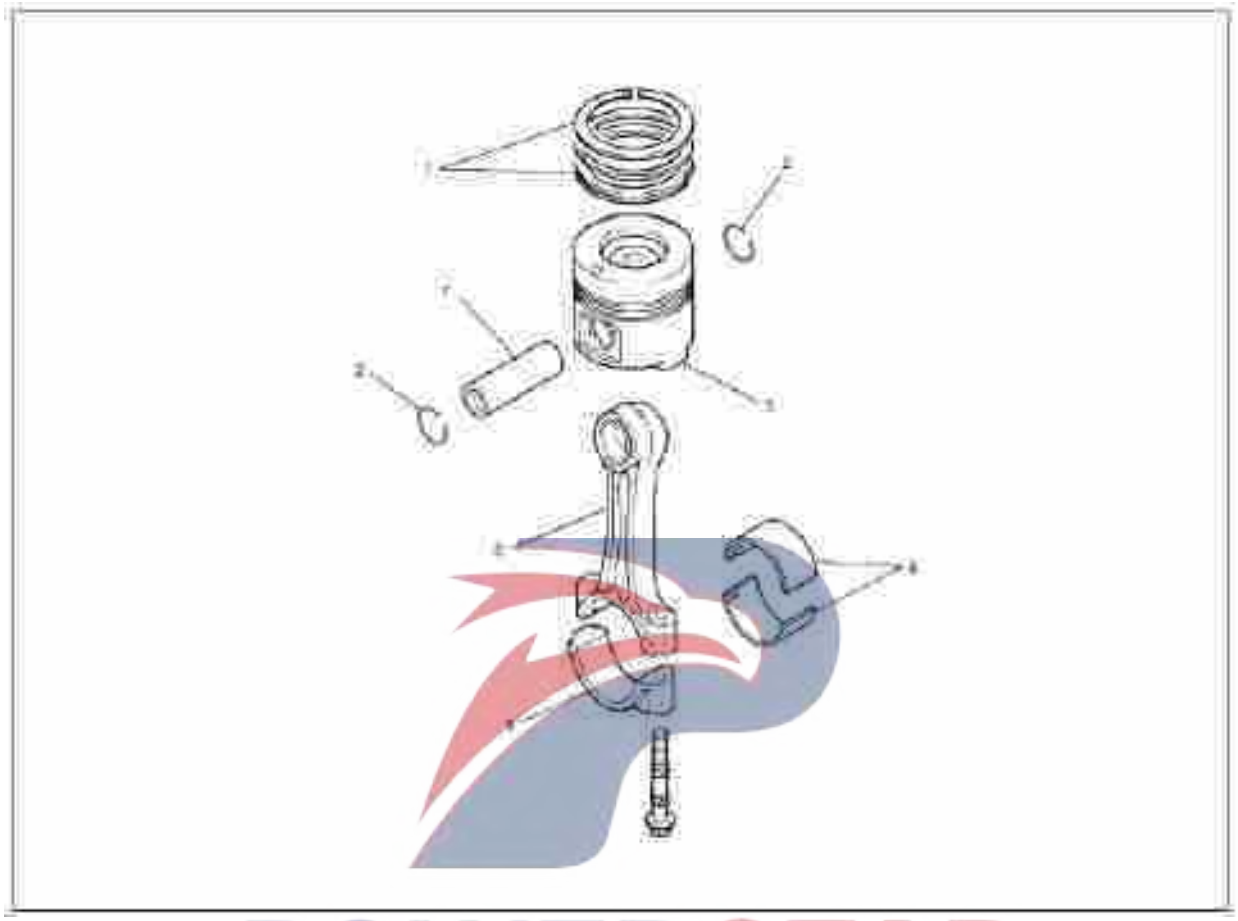
Refer to the flywheel in this chapter.

4. Install the transmission assembly.

M/T models, see transmission control cable in MLD section 5C manual transmission.

Piston and Connecting Rod

Component parts



Key

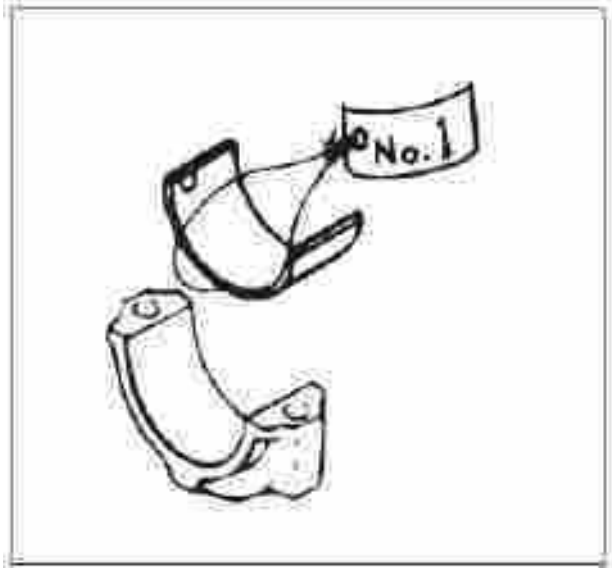
1. Piston ring
2. Snap ring
3. Piston
4. Connecting rod bearing
5. Connecting rod bearing cover
6. Connecting rod
3. Piston pin

Disassembly

1. Remove the oil sump.
Please refer to Oil Sump in Chapter 1H Lubrication System (4HK1).
2. Take down the cylinder head cover.
Refer to the cylinder head cover in this chapter.
3. Remove the assembly from the rocker shaft.
Refer to the rocker shaft assembly in this chapter.
4. Remove the camshaft assembly.
Please refer to camshaft assembly in this chapter.
5. Remove the bolts.
Please refer to the cylinder head in this chapter.
6. Remove the connecting rod bearing.

Mark:

The label is affixed to the removed connecting rod bearing, and the cylinder number is marked in its place for classification management.



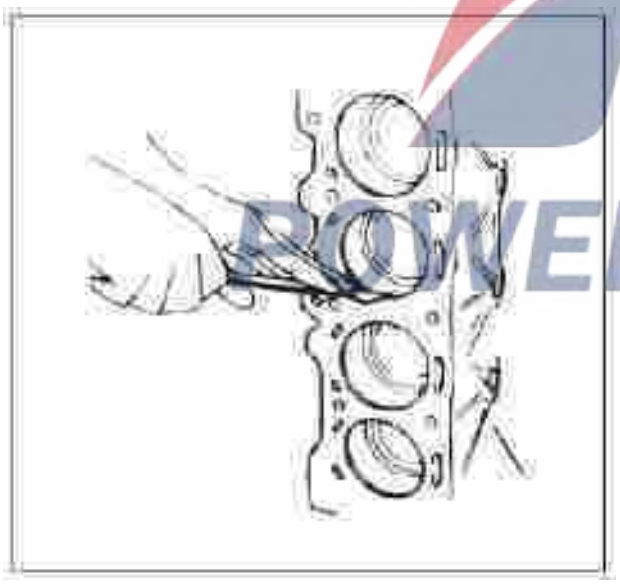
7. Remove the piston, connecting rod.

• Use a spatula to clean the carbon deposit on the cylinder liner.

• Pull the piston and connecting rod to the side of the cylinder head.

Mark:

When ejecting the connecting rod, be careful not to damage the nozzle and cylinder liner.



8. Remove the connecting rod bearing.

Mark:

If you need to reinstall the connecting rod bearings, classify them according to the cylinder and avoid confusion with the bearings of other cylinders.

Disassembling

1. Remove the piston ring.

• Use segmented pliers to remove the piston ring.

Mark:

If the piston rings are to be reinstalled, the piston rings must be sorted and sized according to the cylinders to avoid confusion with the pistons and other cylinder sections.

2. Remove the elastic ring.

3. Remove the piston pin (1).

Mark:

Remove the piston pin, piston and piston rod grouped according to the cylinder and classified.

4. Remove the piston rod.

5. Piston

• Carefully remove carbon deposits adhering to the piston head and ring groove.

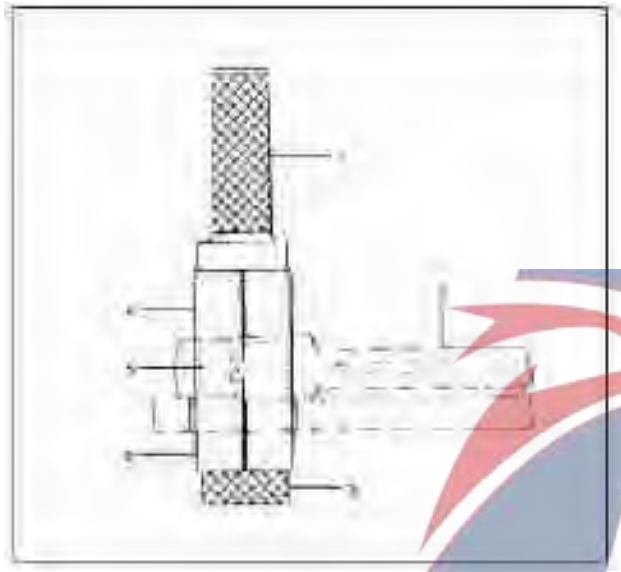
Mark:

You cannot use a wire brush to clean the piston. Visually inspect the piston for cracks, seizures and other serious wear. If the piston is not working, replace the piston.

6. Remove the bushing

• Fit the collar (6), the connecting rod (2) and the collar (4) to the adjusting rod (1) as shown below.

• Tighten the nut (3).



Key

Adjustment rod

2. Connecting rod

3. Nuts

4. Ring

5. Bush

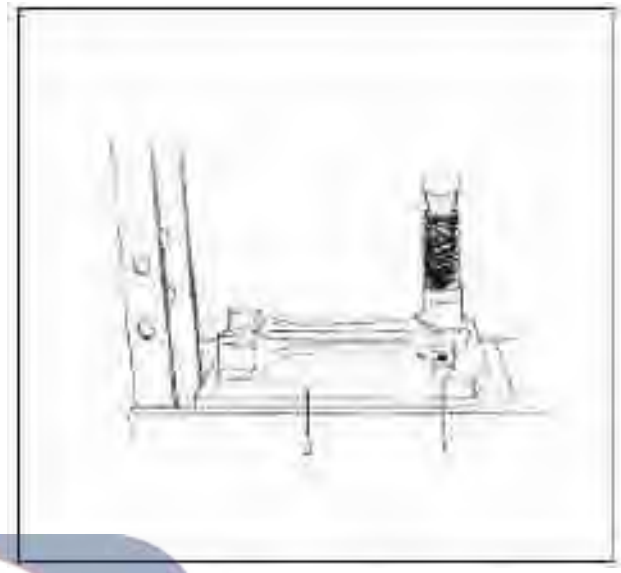
6. Ring

• Place the drawbar holder (2) on the punch and tighten the fastening screw (1).

• Use a bench press to press the socket.

Special tools

3. Connecting rod bushing changer: 5-8840-2340-0



Key

1. Fixing bolts

2. Abutment

Inspection

1. Measure the clearance between the piston and the inner diameter of the cylinder liner.

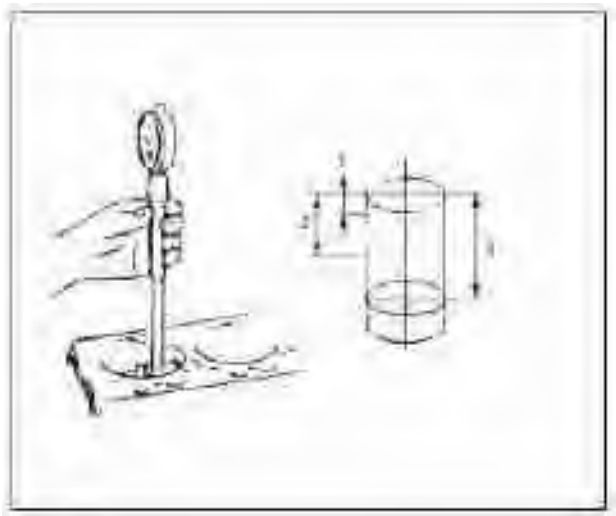
Inner diameter of cylinder liner

• Use a cylinder bore dial gauge to measure the thrust and radial diameter of the cylinder liner at the specified position.

• Measurement position (from cylinder block upper surface) 1.20 mm 2.110 mm 3.190 mm

• Based on the average value of the actual measurements at the 6 positions, the cylinder liner inner diameter is obtained.

Cylinder liner inner diameter	mm
115.031∽115.050	



Piston outer diameter

• Use a micrometer to measure the outside diameter of the piston perpendicular to the piston axis at the specified position.

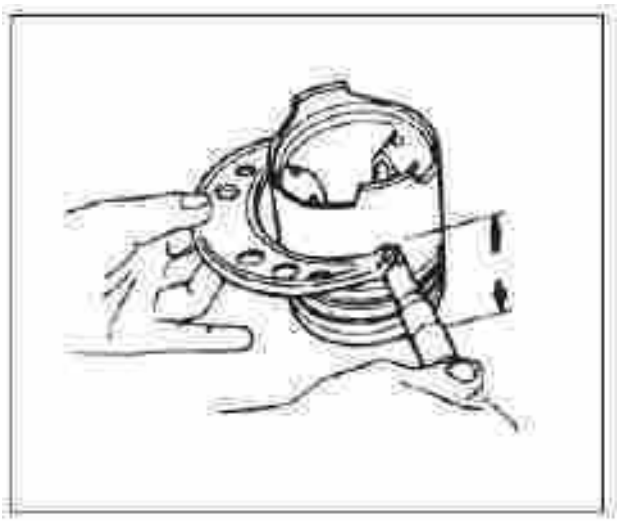
• Measurement area (up to the top surface of the piston) 81 mm

Piston outer diameter	mm
Standard value 114.944∽114.979	
Clearance between piston and cylinder liner	mm
Standard value 0.052∽0.106	

Mark:

• The dimensions of the above cylinder liner and piston are the standard sizes for maintenance supplements.

• If the piston and piston clearance exceed a standard value, replace the piston or cylinder liner.



2. Replace the piston

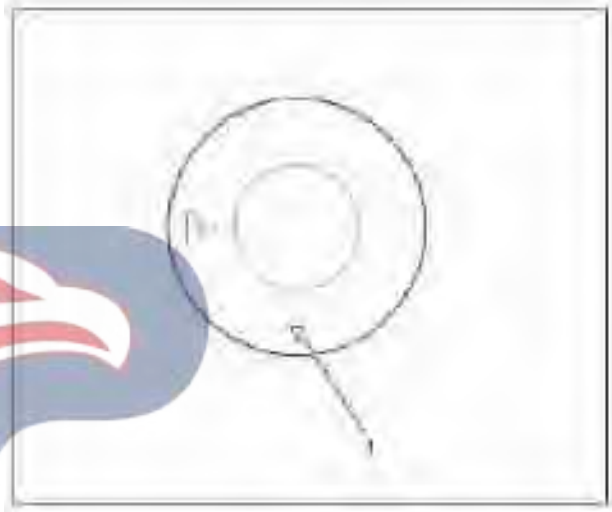
• The piston and sleeve have only one inner diameter, so no size choices are required.

But, when replacing the cylinder liner, there are two types of outer diameters of the cylinder liner (1X, 3X), so the cylinder block (1, 2, 3) must be selected.

• When replacing a cylinder liner, refer to the cylinder block in this chapter.

Mark:

The A, B, and C grades are engraved on the piston's head when delivery of goods from the factory.



Key

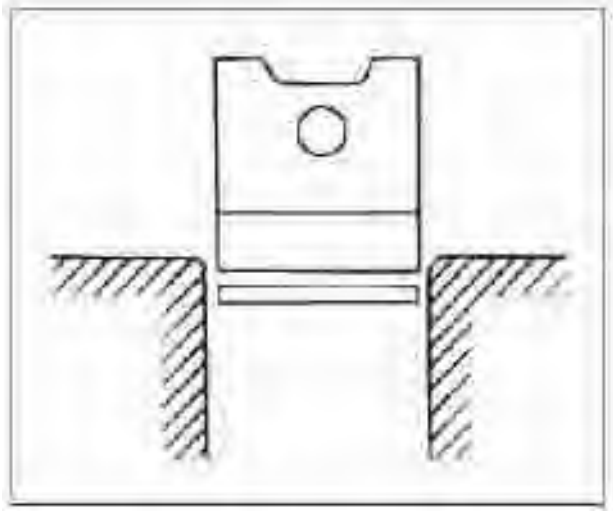
2. Front mark

3. Check the piston ring.

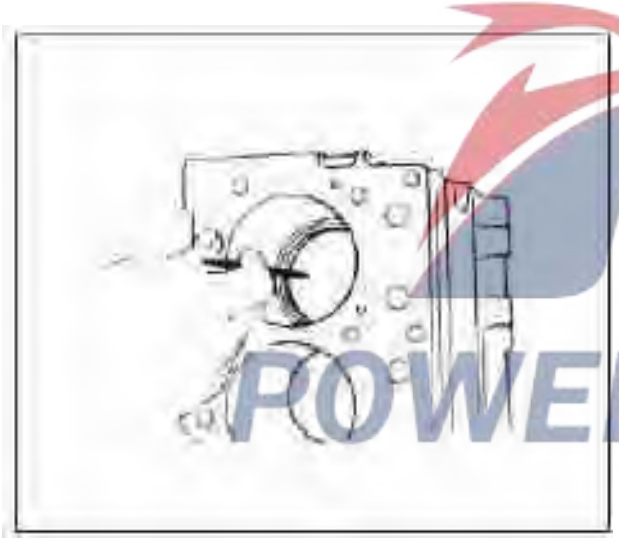
Measure 1 opening of the piston ring (clear carbon deposit at the piston ring opening).

• Insert the piston ring into the cylinder liner.

• Use a piston to push the piston ring into the lower end of the cylinder liner.



• Use a feeler gauge to measure the opening clearance of the piston ring.



• When the measured value exceeds the limit, replace the piston ring.

Piston ring opening clearance: mm

Piston ring:	Standard value	Limit
The first compression ring	0.27-0.46	1.20
Second compression ring	0.37-0.61	1.20
Oil ring	0.27-0.56	1.20

Measure the gap between the groove of the piston ring and the piston ring.

• Remove carbon deposits in the ring groove.

• Place the piston ring in the groove of the piston ring and use a feeler gauge to measure the clearance.

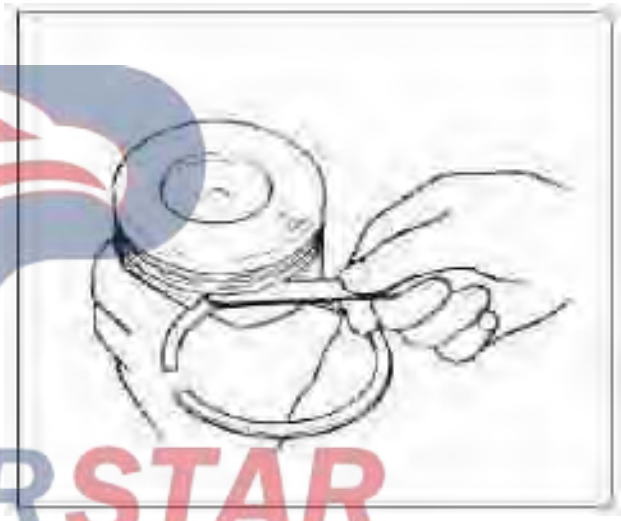
• When the gap between the piston ring groove and the piston ring exceeds the limit, replace the piston and piston ring.

Mark:

Since the first compression ring is a semi-trapezoidal piston ring, measurement cannot be performed.

Clearance between piston ring and piston ring groove: mm

Piston ring:	Standard value	Limit
The first compression ring	—	—
Second compression ring	0.015—0.055	0.15
Oil ring	0.03-0.07	0.15



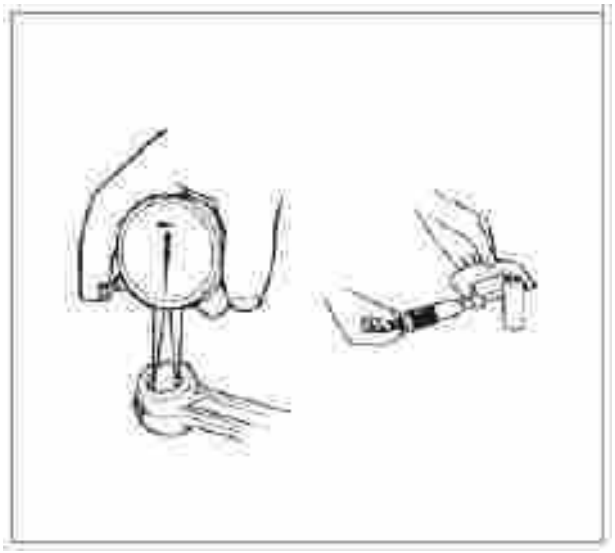
4. Check the piston pin.

• Visually inspect the piston pin for cracks, defects, and other damage, and replace if necessary.

• Use a micrometer to measure the outside diameter of the piston pin. Replace the piston pin when the measured value exceeds the limit.

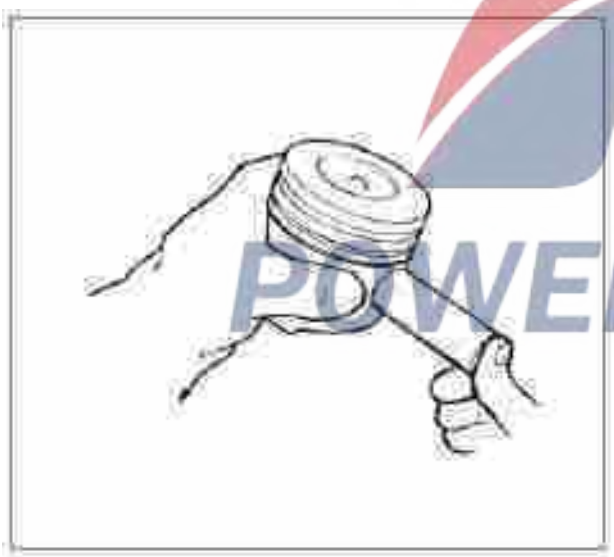
Piston pin outside diameter mm

Standard value	39.995 - 40.000
Standard value	39.970



• Check that the piston pin is pressed into the piston and there is slight resistance at room temperature.

• If you feel a lot of play at room temperature, replace the piston or piston pin.



• Measure the inner diameter of the small end sleeve of the connecting rod.

If the gap between the inner diameter of the bushing and the outer diameter of the piston rod exceeds the limit, replace the bushing or connecting rod and pin.

Spacing between the small end of the connecting rod and the outer diameter of the piston pin mm

Standard value	0.012—0.027
Standard value	0.05

5. Measure the gap between the piston and the piston pin.

• Apply oil to the piston pin, then use your fingers to push the pin into the piston hole and allow it to rotate. If the pin is not loose and it can turn smoothly, the game is normal. If there is a drama, measure the gap. When the game exceeds the limit, replace the piston and piston pin.

Clearance between piston and piston pin mm

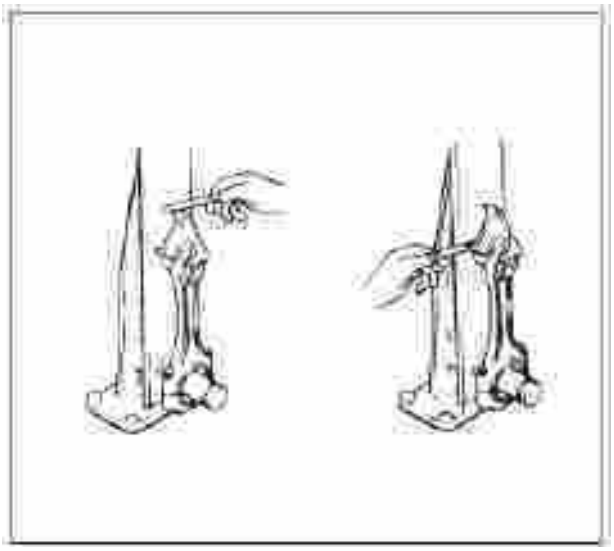
Standard value	0.009—0.022
Standard value	0.04

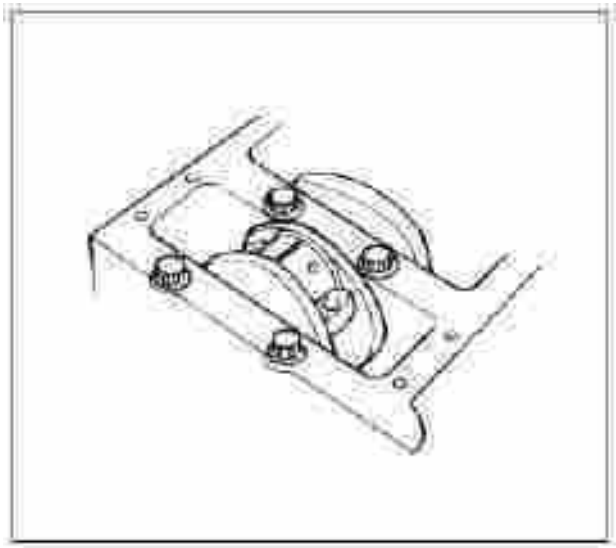
6. Connecting rod correction.

• Use a link corrector to measure the degree of deformation and parallelism between small and large end holes. If the measured value exceeds the limit, replace the connecting rod.

Connecting rod correction (100 mm) mm

	Standard value	Standard value
Warp angle	0.05	0.20
Parallel degree	0.05	0.20





7. Measure the oil film clearance of the connecting rod bearing.

• Measure the oil film gap between the main bearing and crankshaft pin as follows.

- Remove the connecting rod bearing cover. The removed rod bearing caps are arranged according to the cylinder number.

- Clean bearings and crank pins.

- Check the connecting rod bearings. If you notice damage and severe wear, replace the entire bearing.

• Place a plastic gap gauge on the crank pin.

• Reinstall the bearing cap and tighten the bolts to the specified torque.

Apply molybdenum disulfide on threads and contact surfaces.

Tightening torque: N·m { kgf·m}

First time	39 {4.0}
Second time	Rotation angle 60°
Third time	Rotation angle 30°

Mark:

Do not rotate the crankshaft.

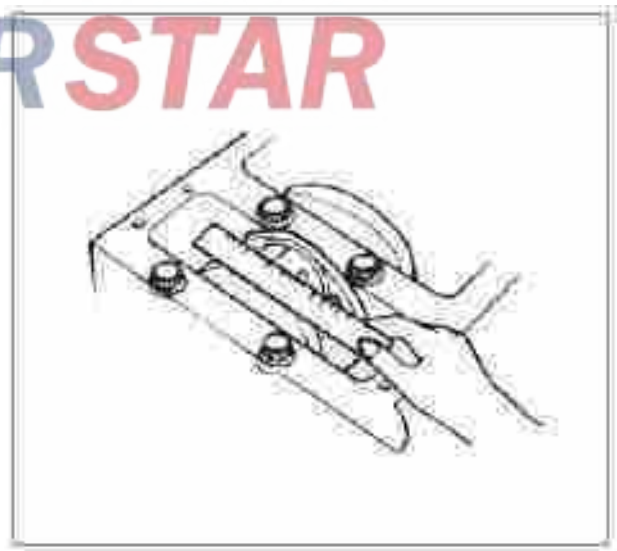
- Remove the connecting rod bearing cover.

- Measure the widest part of the plastic gap gauge to obtain the oil film gap. When the game exceeds the limit, replace the bearing in the game.

Oil film game in spit mm

Standard value	0.036-0.077
Standard value	0.10

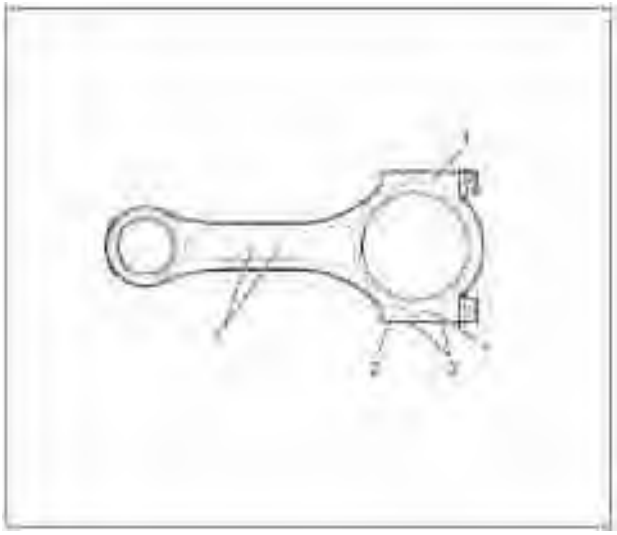
- Remove the plastic gap gauge from the bearing and crank pin.



8. Select the connecting rod bearing.

• When installing a new connecting rod or replacing a bearing in use, select the connecting rod bearing according to the bearing selection table.

• When selecting and installing bearings, pay attention to the large end of the connecting rod.



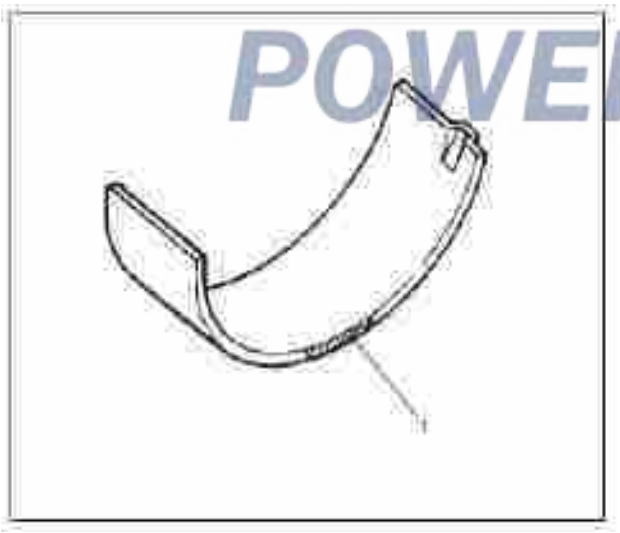
Key

1. Determine the owner of the table
2. Large end aperture level marking
3. Cylinders number

Bearing selection table

Large end-point bore level bearings identify color oil film gaps

A	Green	0.037-0.076
B	Yellow	0.037-0.076



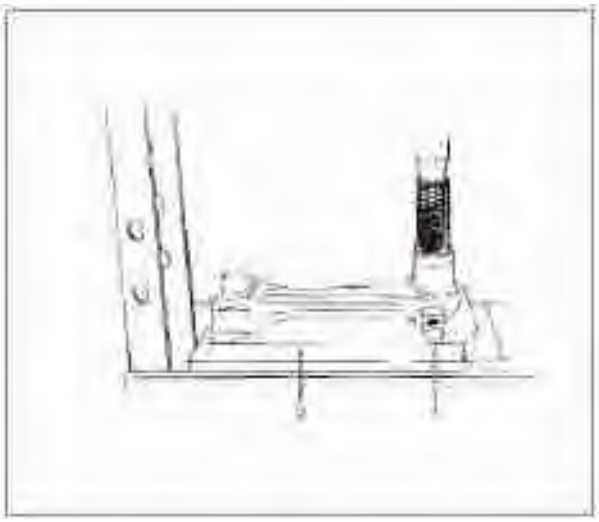
Key

1. Level identification color

Assembly

1. Install the bushing

• Place the connecting rod end bearing stopper (2) on the table punch, tighten the fixing screws (1) after connecting the connecting rods.



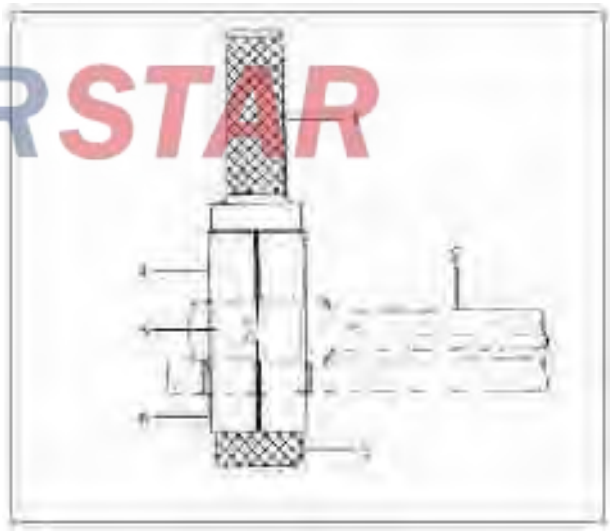
Key

1. Fixing bolts
2. Abutment

• Install the collar (6), the new collar (5) and the collar (4) on the adjustment lever (1) as shown in the illustration.

• Tighten the nut (3).

• Align the oil hole of the connecting rod with the oil hole of the ring, then use the table punch mounting ring.



Key

Adjustment rod
2. Connecting rod
3. Nuts
4. Ring
5. Bush
6. Ring

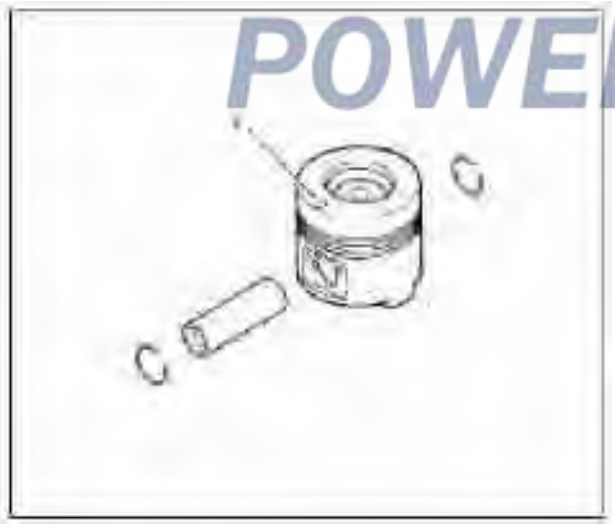
• After installing a new bushing, use a grinder to machine the pin hole in order to achieve a clearance with the pin.

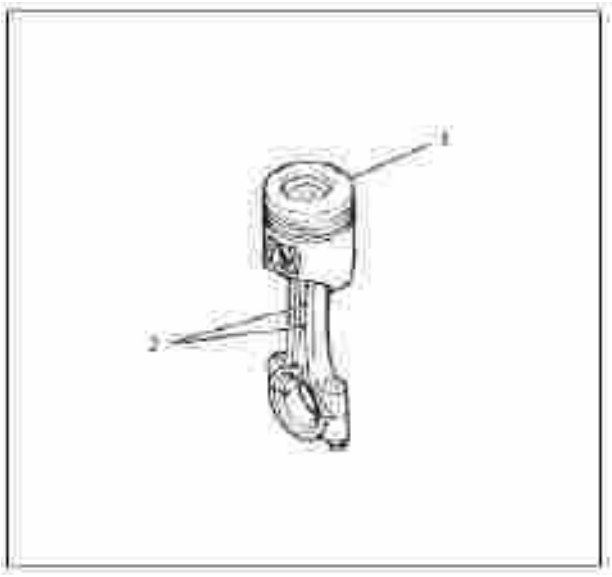
2. Install the piston.

3. Install the connecting rod.

• When mounting, place the front mark (1) of the piston head and the convex mark (2) of the connecting rod in the opposite direction.

• Use a needle nose pliers to mount the one-sided elastic ring.





Key

2. Front mark

2. Convex mark

4. Apply sufficient oil to the piston pin and push it into the piston and big end ^ 5.

5. Use needle nose pliers to install the snap ring.

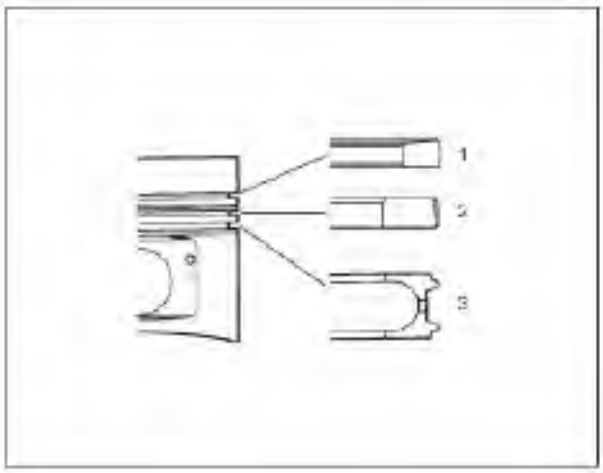
Mark:

Check that the snap ring is fully inserted in the groove. In addition, check the link's sliding condition.

6. Install the piston ring using a split clamp.

• When installing the oil ring, turn the piston ring and coil spring 180° in the opposite direction.

• Place the compression ring marked "2N" or "IN" upwards and install it in the order of the second compression ring and the first compression ring.



Key

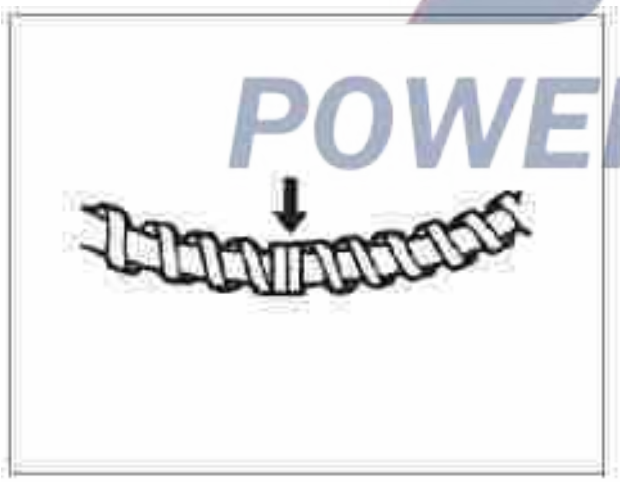
1.The first compression ring

2.Second compression ring

3. Oil ring

Mark:

After installing the spiral expansion spring of the oil ring, check for clearance in the area indicated by the arrow in the figure.



Installation

1. Install the connecting rod bearing.

• Mount the bearing on the connecting rod and apply the oil to the bearing.

2. Install the piston and connecting rod assembly.

• Apply sufficient oil to the piston ring, ring groove and piston side.

• As shown, move the first compression ring (1), the second opening of the compression ring (3) and the opening of the oil ring (2) by 120°.

• With the piston forward, use the installation tool to push the piston into the cylinder liner.

Mark:

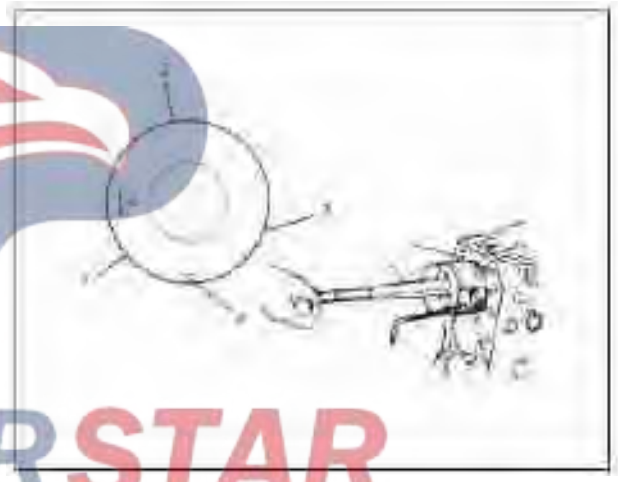
• When pressing the piston, press the mounting tool against the cylinder liner. If pressed without full contact, the piston ring will be damaged.

• When pushing the piston, be careful not to hit the connecting rod with an oil jet.

• When inserting the piston, be careful not to scratch the inside of the cylinder liner.

Special tools

Piston Installer: 5-8840-9018-0



Key

1. First open the compression ring

2.Second compression ring

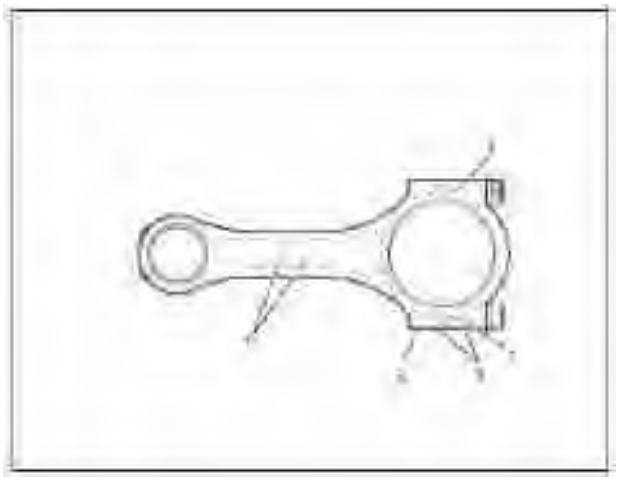
3. Open the oil ring

4. Front mark

3. Install the connecting rod bearing cover.

• Mount the bearing on the connecting rod bearing cap and apply the oil.

• Align the numbered markings (1, 2, 3, 4) on the cover and linkage and install the cover.



4. Install the cylinder head.

Please refer to the cylinder head in this chapter.

5. Install the camshaft assembly.

Please refer to camshaft assembly in this chapter.

6. Install the rocker assembly.

Refer to the rocker shaft assembly in this chapter.

7. Install the cylinder head cover.

Refer to the cylinder head cover in this chapter.

8. Install the oil sump

Please refer to Oil Sump in Chapter 1H Lubrication System (4HK1).

Key

1. Determine the owner of the table
2. Large end aperture level marking
3. Cylinders number

• Apply molybdenum disulfide to the threads and mating surfaces of the mounting bolts and tighten to the specified torque.

Tightening torque:

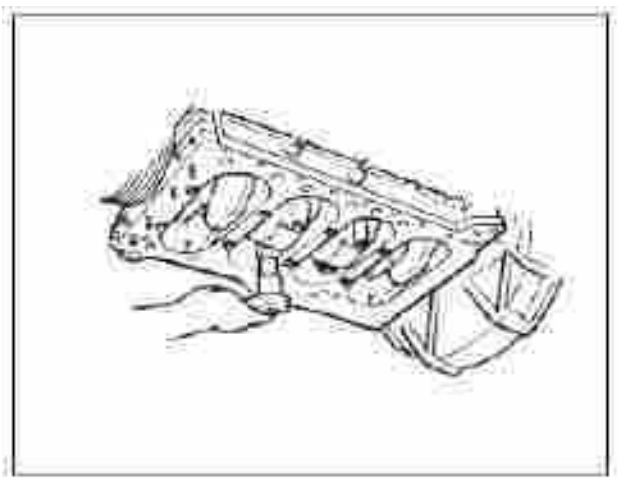
First time	First time=39 N·m{4.0 kgf·m}
Second time	60°
Third time	30°

Special tools

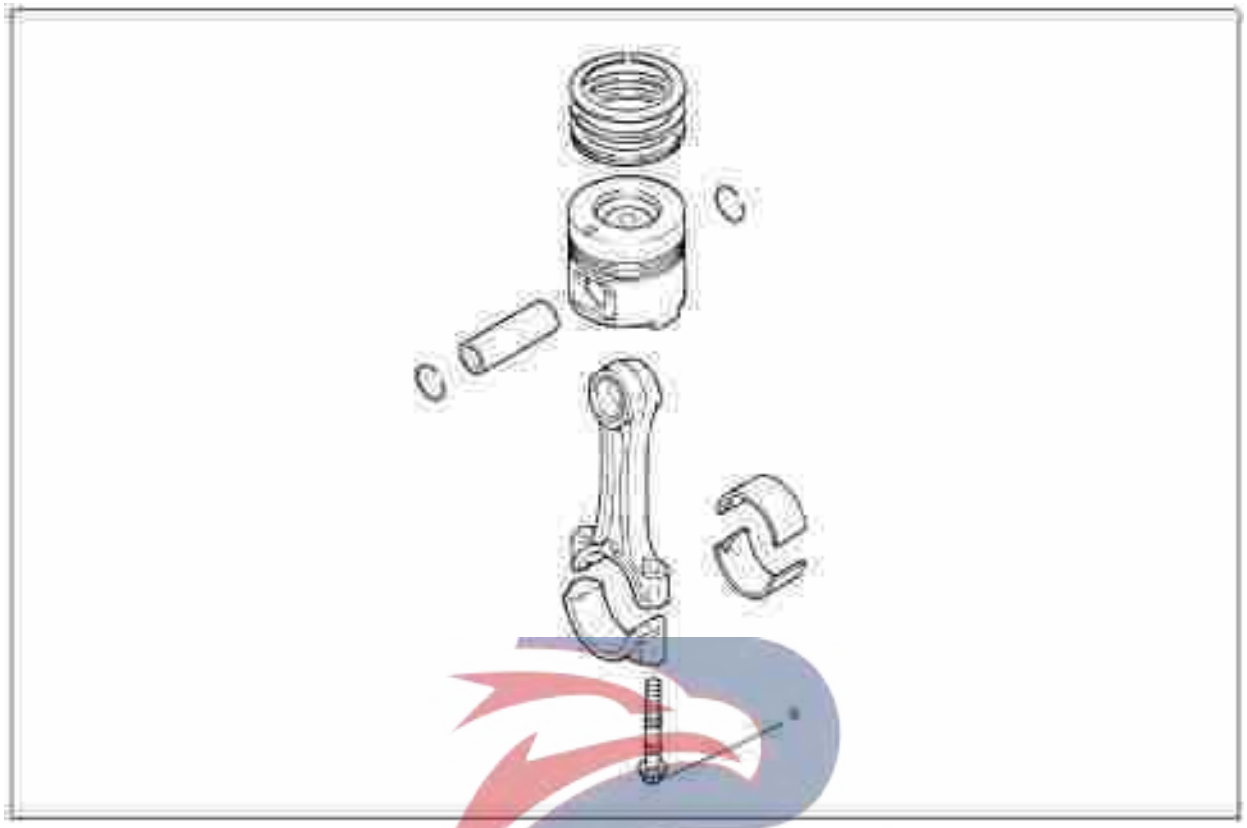
Angle meter:5-8840-0266-0

Mark:

Check if the crankshaft can rotate smoothly.



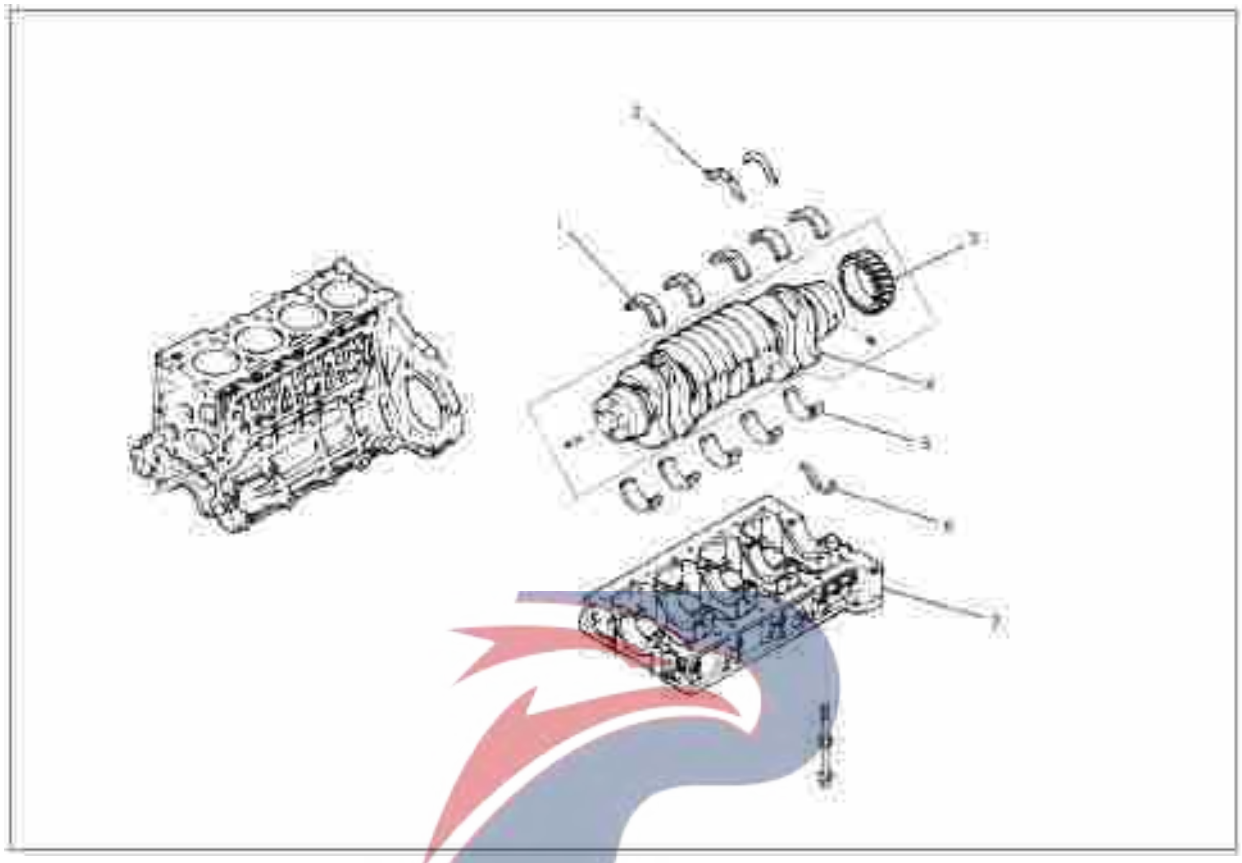
Tightening torque - Overview



(a) 39 N·m {4.0 kgf·m } → 60º→ 30 º

Crankshaft

Component parts



Key

Crankshaft bearing
2. Upper thrust bearing
3. Gear
4. Crankshaft
5. Lower crankshaft bearing
6. Lower thrust bearing
7. Crankcase

Disassembly

1. Remove engine components from the vehicle.

See Motor Components in this chapter.

2. Remove the bolts.

Please refer to the cylinder head in this chapter.

3. Remove the fuel pump.

Refer to fuel pump in Chapter 1D Fuel System (4HK1).

4. Remove the oil sump.

Please refer to Oil Sump in Chapter 1H Lubrication System (4HK1).

5. Remove the pump.

Please refer to Chapter 1C Pumps in Cooling System (4HK1).

6. Remove the front cover.

Please refer to the cover of this chapter.

7. Remove the gear box gear.

Please refer to the gear distribution system in this chapter.

8. Remove the front oil seal from the crankshaft.

Please refer to front crankshaft oil seal in this chapter.

9. Remove the seal after the crankshaft.

Please refer to rear crankshaft seal in this chapter.

10. Remove the pump.

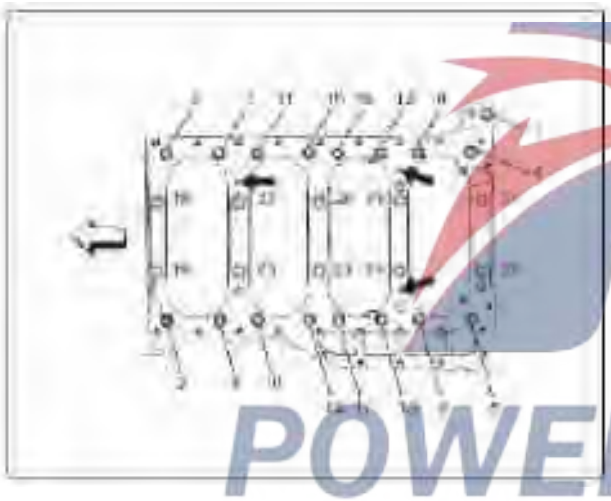
Please refer to the oil pump in Chapter 1H Lubrication System (4HK1).

11. Remove the piston and connecting rod.

Please refer to pistons and connecting rods in this chapter.

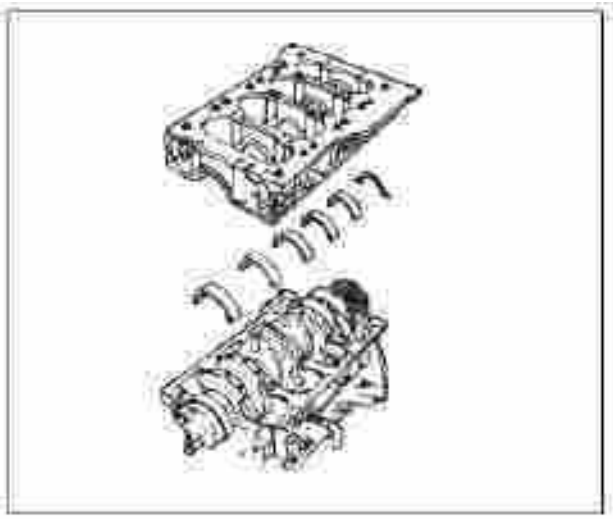
12. Remove the crankcase.

• Slowly loosen the crankcase retainer screws in the order shown in the illustration and remove them with the three holes in the changer (arrows in the figure).



13. Remove the lower thrust bearing.

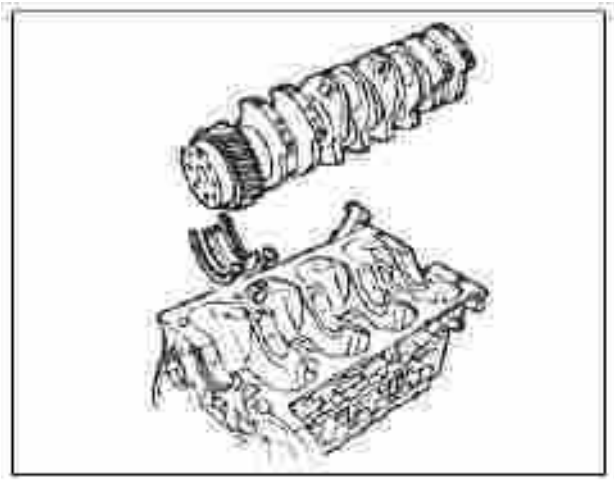
14. Remove the lower bearing from the crankshaft.



15. Remove the crankshaft assembly.

16. Remove the upper thrust bearing.

17. Remove the upper bearing from the crankshaft.



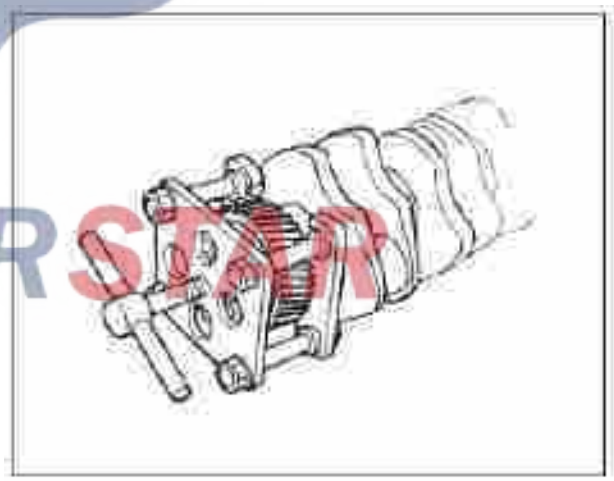
Disassembling

1. Remove the gear.

• Use a gear puller for disassembly.

Special tools

Crankshaft gear extraction tool: 8-94396-818-0



Assembly

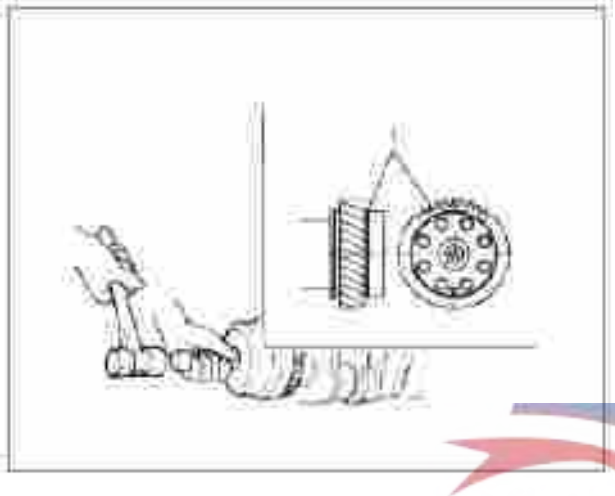
1. Install the gear.

• Heat the gear to 170-250°C first, then install the sprocket side groove on the pin at the rear of the crankshaft.

• When mounting, place the assembly mark “s”(1) on the front of the gearbox and insert the flanges one at a time. At low temperatures, use a locksmith to knock it to the bottom.

Special tools

Crankshaft gear placement machine: 8-94396-819-0



Key

1. Assembly mark (S)

Inspection

1.Thrust clearance

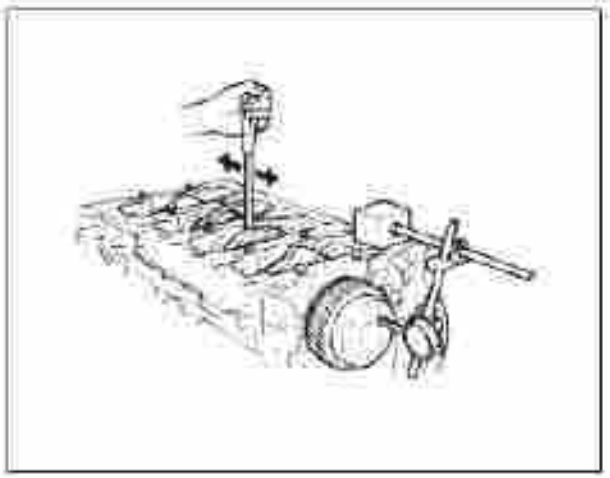
• Install the dial gauge as shown and measure the crankshaft thrust clearance.

• When the thrust clearance exceeds the limit, replace the thrust bearing in group.

Axial clearance of crankshaft	mm
Standard value	0.104∽0.205

Mark:

The thrust game is measured before it is exploded.



2. The main bearing clearance

• Remove the crankcase.

The main bearings are sorted in numerical order.

• Remove the crankshaft and remove the main bearing.

• Clean crankshaft journals and upper and lower crankshaft bearings.

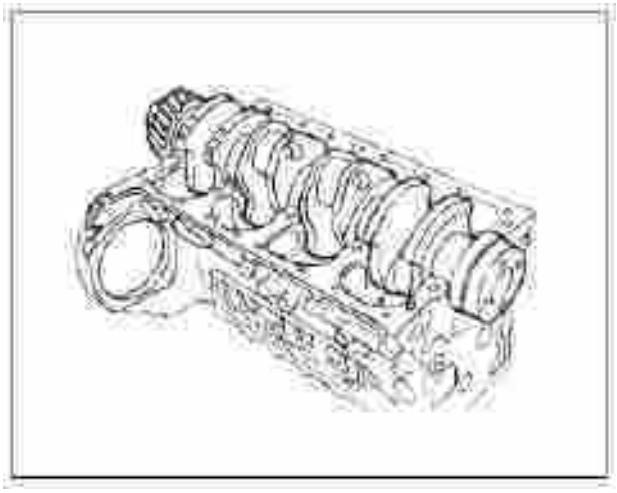
• Inspect the bearing for damage and excessive wear.

If finding damage and excessive wear, replace the bearing in the kit.

• Mount the crankshaft upper bearing and crankshaft on the cylinder block. Once installed, keep the crankshaft level.

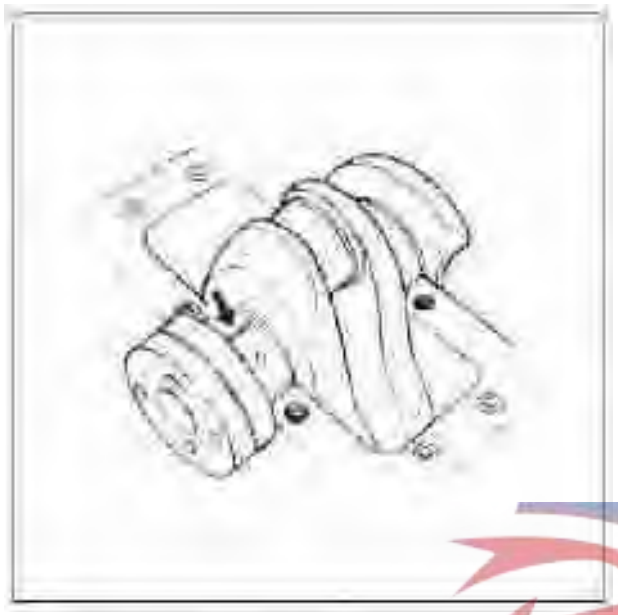
Mark:

Turn the crankshaft about 30°, then stabilize the bearing.



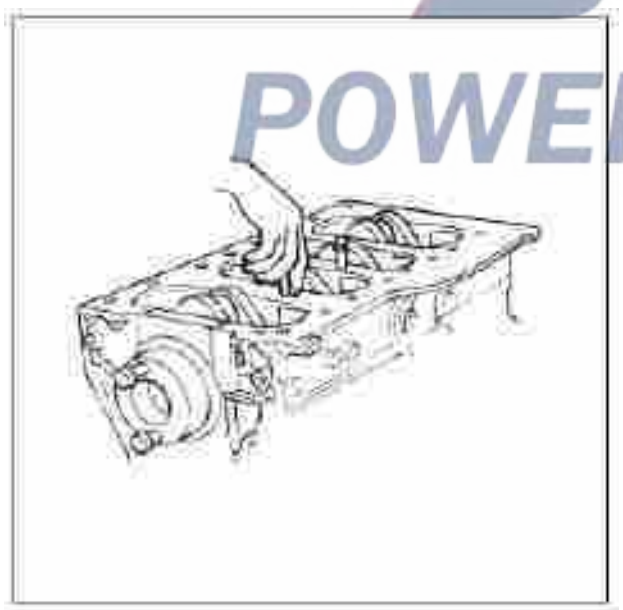
• Place the plastic line gap on the crankshaft journal as shown.

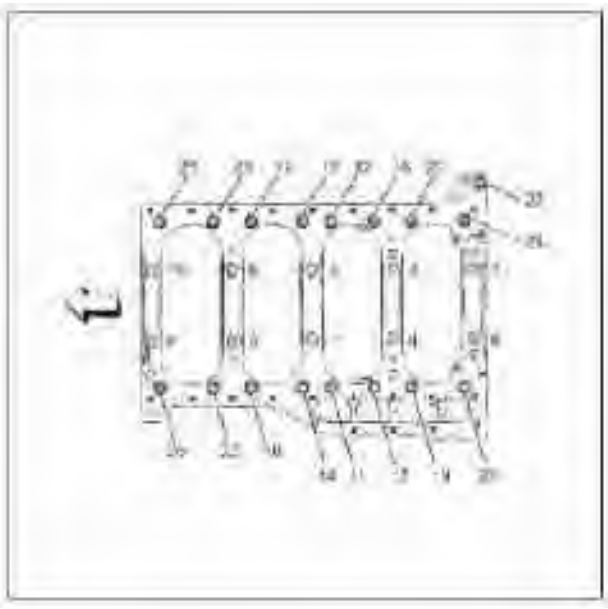
• Install the lower bearing in its original position in the crankcase.



• Install the housing and tighten the bolts to the specified torque.

• Use a torque wrench and dipstick to tighten the housing in the order shown.





M14		M10	
First time	Second time	Third time	Fourth time
1∽10	1∽10	1∽10	11∽27
98N·m {10.0 Kgf·m}	132N·m {13.5 Kgf·m}	30∽60°	37N·m {3.8 kgf·m}

• Tighten 1 to 10 bolts (M14) in the tightening direction and check that the tightening torque is 167 N•M {17 kgf•M} or more.

Special tools

Angle meter:5-8840-0266-0

Mark:

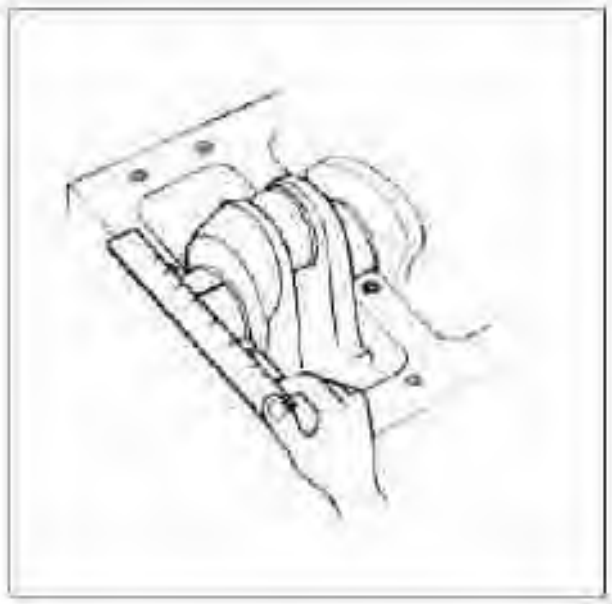
After fixing the crankcase, do not rotate the crankshaft.

• Loosen the bolt and remove the housing carefully.

• Measure the maximum width of the plastic gauge in the process of fixing the crankcase and determine the size of the space.

Release oil film from neck and neck (mm)

	Standard value
No.1, 2, 4, 5	0.039∽0.070
No.3	0.053∽0.084



• Replace the main bearing or crankshaft when the oil film gap exceeds the limit.

• Remove the plastic wire gauge from the bearing and crankshaft.

Check crankshaft

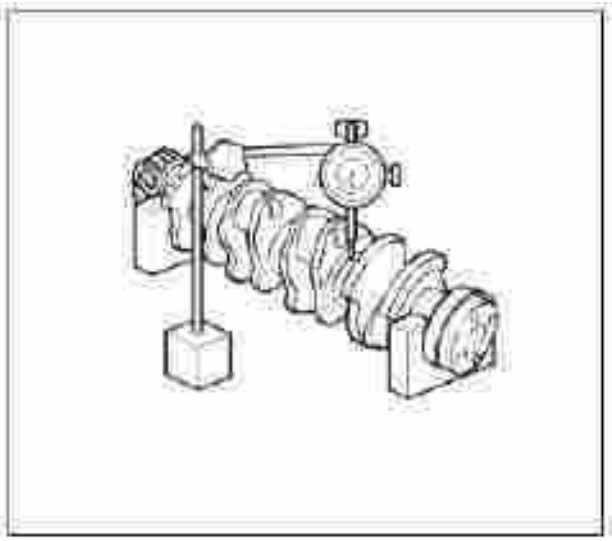
• Check that the crankshaft journal surface and crank pin are not worn or damaged. Check the seal mounting surface for excessive wear and damage.

• Check for blocked oil holes.

3. The radial tapping of the crankshaft

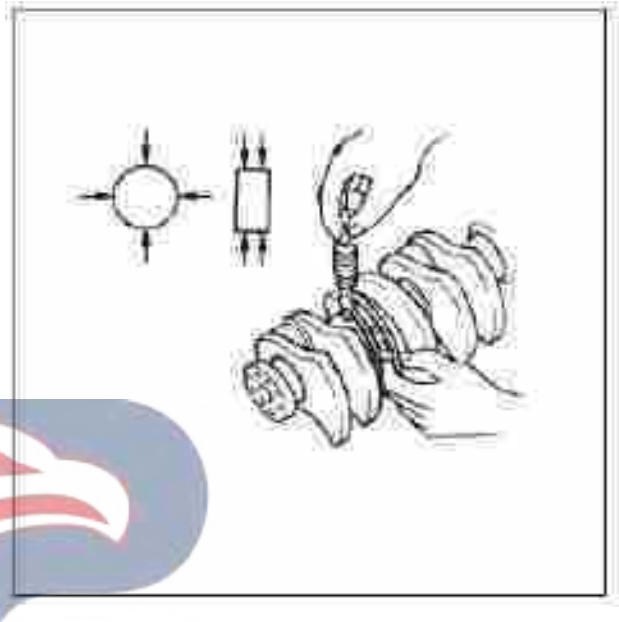
Place the crankshaft gently on the V-block. Rotate the crankshaft slowly to measure the radial beat of the crankshaft. When the crankshaft crankshaft exceeds the limit, the crankshaft must be replaced.

Radial crankshaft pulse millimeter	mm
Standard value	＜0.05



4. Determine the diameter and uneven wear of the journal and crank pins.

• Use a micrometer to measure the outside diameter of the journal and crankpin and calculate the difference between the maximum and minimum values. Measurements were made at a total of 4 locations on the log and crank pin.



Crankshaft outer diameter (mm)

	Standard value
Shaft neck #1,2,4,5	81.905∽81.925
Shaft neck #3	81.891∽81.911
Crank pin	72.902∽72.922

Mark:

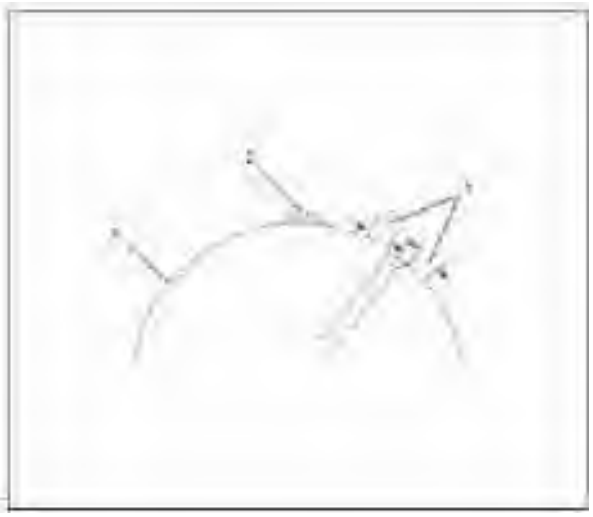
In order to increase the crankshaft resistance, a diffusion nitriding method (nitrocarburizing treatment) is used so that polishing correction cannot be performed.

Check the diffusion nitride layer of the crankshaft

1. Thoroughly clean the crankshaft with an organic cleaner. There will be no oil at the test site.

2. Prepare 5-10% ammonium chloride and copper solution (dissolved in dilution water).

3. Use a syringe to apply the solution to the test area. Keep the test surface completely level and avoid solution flow.



Key

1. Discarded areas
2. Drop the part of the test solution
3. Crank pin or journal sliding surface

Mark:

Do not touch the solution near the oil hole.

Judgment

• Wait 30 to 40 seconds.

• After 30 to 40 seconds, crankshaft can be used if there is no discoloration. (indicating that the diffusion nitrided layer is still present) If a discoloration occurs (the test surface turns to copper color), the crankshaft must be replaced.

Caution:

• Because the test solution is highly corrosive, wipe the surface to be tested with cloth or similar immediately after the test and clean it with water, steam or a similar product.

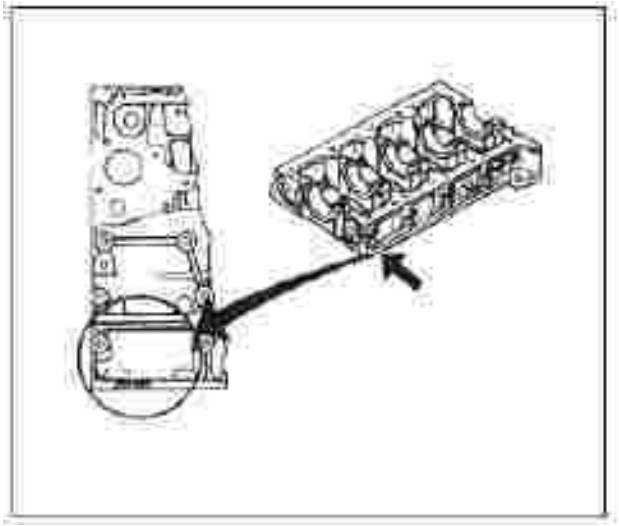
• Be careful not to apply the test solution to eyes, hands or clothes. If you come into contact with your eyes, rinse immediately with plenty of water and then go to the hospital for examination.

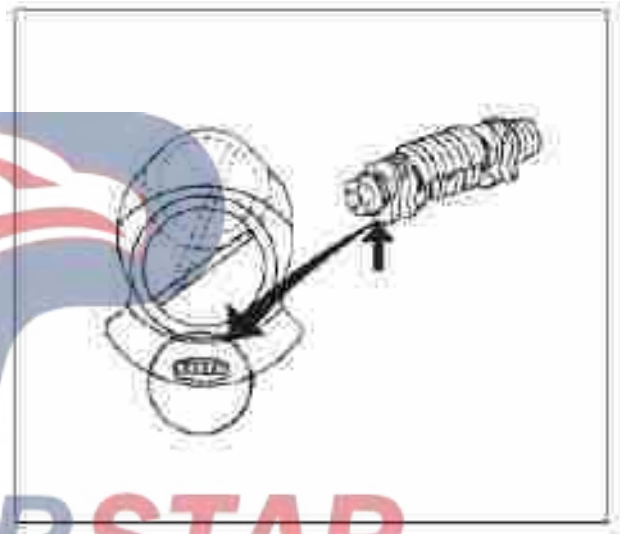
Crankshaft bearing selection

• When installing a new crankshaft bearing or replacing a bearing, refer to the bearing selection table.

• When selecting a new bearing, pay attention to the inner diameter of the cylinder and the diameter of the crankshaft.

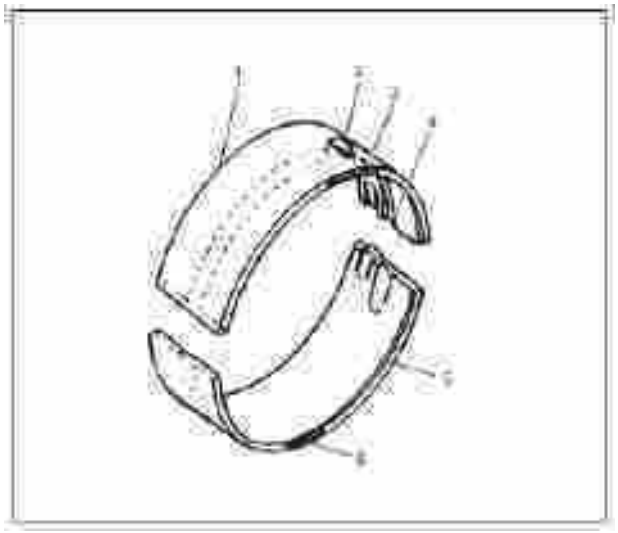
• The shaft neck number is from left to right #1 to #5.





Mark:

Pay attention to the shape of the bearing during installation.



Key

Crankshaft bearing

2. Oil holes

3. Classification to identify colors

4. oil grooves

5. Lower crankshaft bearing

6. Classification to identify colors

Bearing selection table

Combination of grades			Oil clearance	
Cylinder block grade	Crankshaft neck level	Bearing identification color	#1, 1, 4, 5	#3
1	1	Black	0.041∽0.068	0.055∽0.082
1	2	Brown	0.039∽0.065	0.053∽0.079
2	1	Blue	0.043∽0.070	0.057∽0.084
2	2	Black	0.041∽0.067	0.055∽0.081

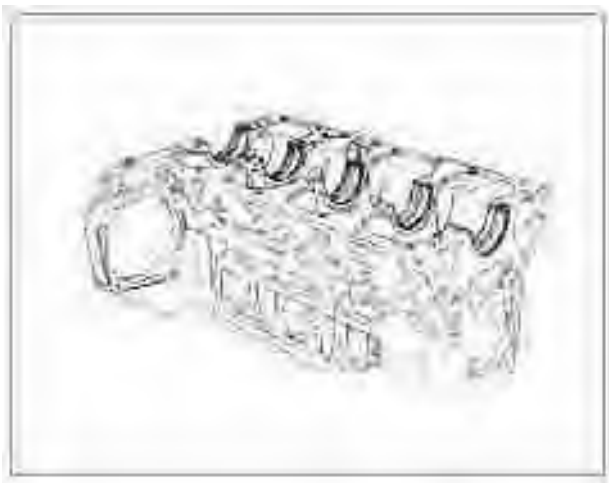
Installation

1. Install the crankshaft bearing.

• Install the crankshaft upper bearing on the cylinder block and apply oil.

Mark:

When replacing the crankshaft bearing, select according to the height of the crankshaft bearing. Do not apply oil to the bearing surfaces of the cylinder block bearing and the periphery of the bearing.



2. Install the thrust bearing

• Mount the upper thrust bearing to the front of the shaft neck of the No. 5 cylinder block. At this time, the upper thrust bearing can also be combined with the cylinder using grease. But, wipe out the spilled grease.

Mark:

When installing, contact the oil groove of the thrust bearing with the crankshaft.

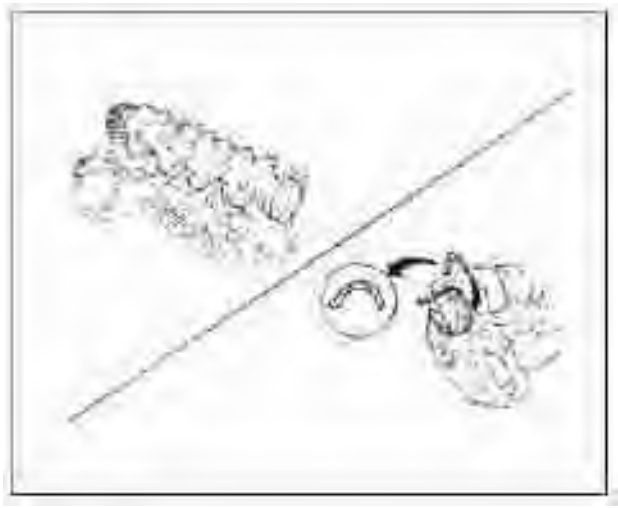
3. Install the crankshaft assembly.

• Apply oil to the crankshaft shaft neck and gently snap it onto the cylinder.

• Push the crankshaft backwards and insert the upper thrust bearing into the rear of the 5th neck of the cylinder block.

Mark:

When installing, contact the oil groove of the thrust bearing with the crankshaft.

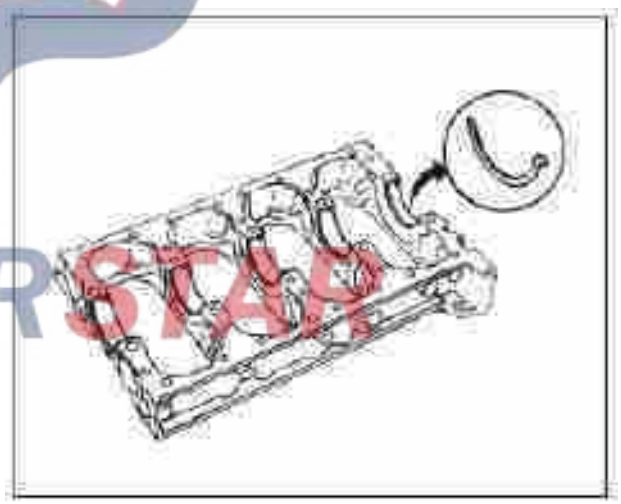


4. Install the lower bearing from the crankshaft.

5. Install the lower thrust bearing.

• Install the lower thrust bearing on the back of crankcase journal #5.

• When installing, contact the thrust bearing oil groove with the crankshaft.

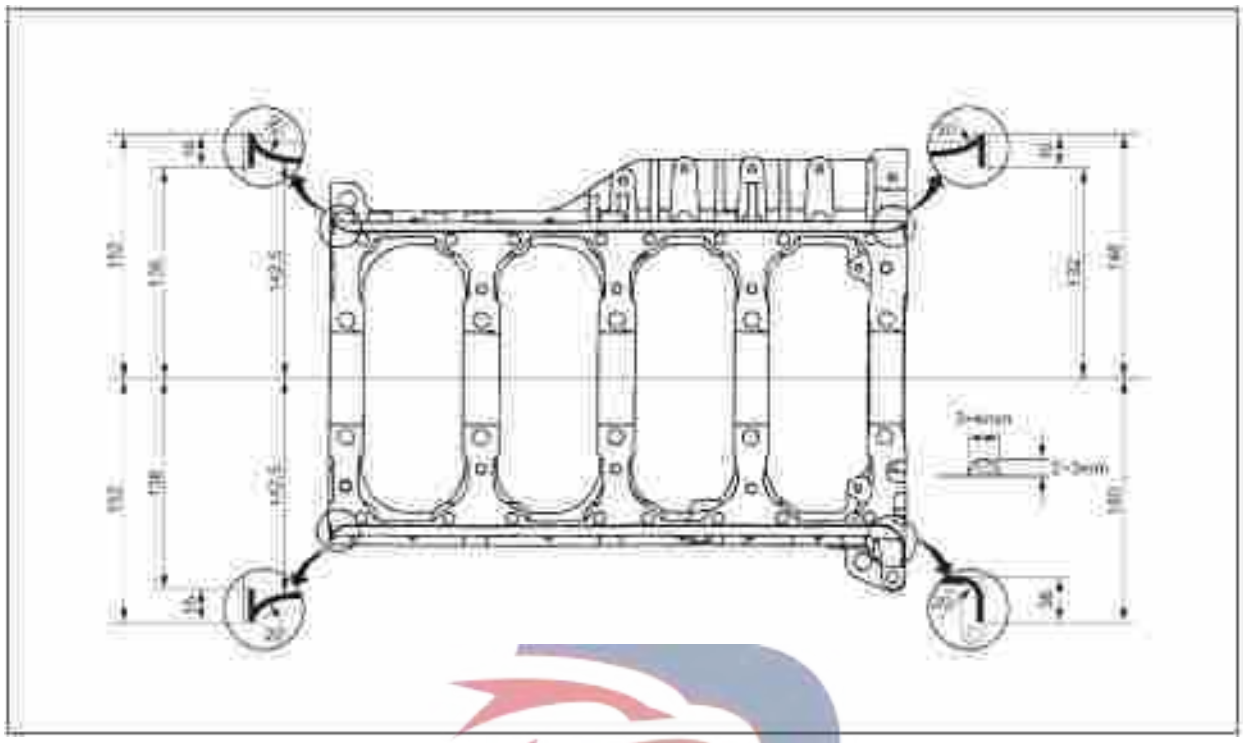


6. Install the crankcase.

• Apply a 3 to 4 mm wide liquid sealant (TB-1207C) to the crankcase.

• After using the liquid sealant, install it within 5 minutes.

• Gently place the crankcase on the cylinder block.



• Apply molybdenum disulfide to the threads and contact surfaces of M14 bolts and tighten in the order shown.

• Do not apply oil to the M10 bolts.

M14	M14	M14	MlO
First time 1∽10	Second time 1∽10	Third time 1∽10	Fourth time 11∽27
98N.m {10.0kgf·m}	132Nnn {13.5Kgf·m}	30°∽60	37N·m {3.8 kgf·m}

• Tighten 1 to 10 bolts (M14) in the tightening direction and check that the tightening torque is 167 N•M {17 kgf•M} or more.

Special tools

Angle meter:5-8840-0266-0

Mark:

Check if the crankshaft can rotate smoothly.

7. Install the piston and connecting rod.

Please refer to pistons and connecting rods in this chapter.

8. Install the oil pump.

Please refer to the oil pump in Chapter 1H Lubrication System (4HK1).

9. Install the gear box gear.

Please refer to the gear distribution system in this chapter.

10. Install the rear oil seal from the crankshaft.

Please refer to rear crankshaft seal in this chapter.

11. Install the front cover.

Please refer to the cover of this chapter.

12. Install crankshaft front oil seal.

Please refer to front crankshaft oil seal in this chapter.

13. Install the pump assembly.

Please refer to Chapter 1C Pumps in Cooling System (4HK1).

14. Install the oil sump

Please refer to Oil Sump in Chapter 1H Lubrication System (4HK1).

15. Install the oil supply pump.

Refer to fuel pump in Chapter 1D Fuel System (4HK1).

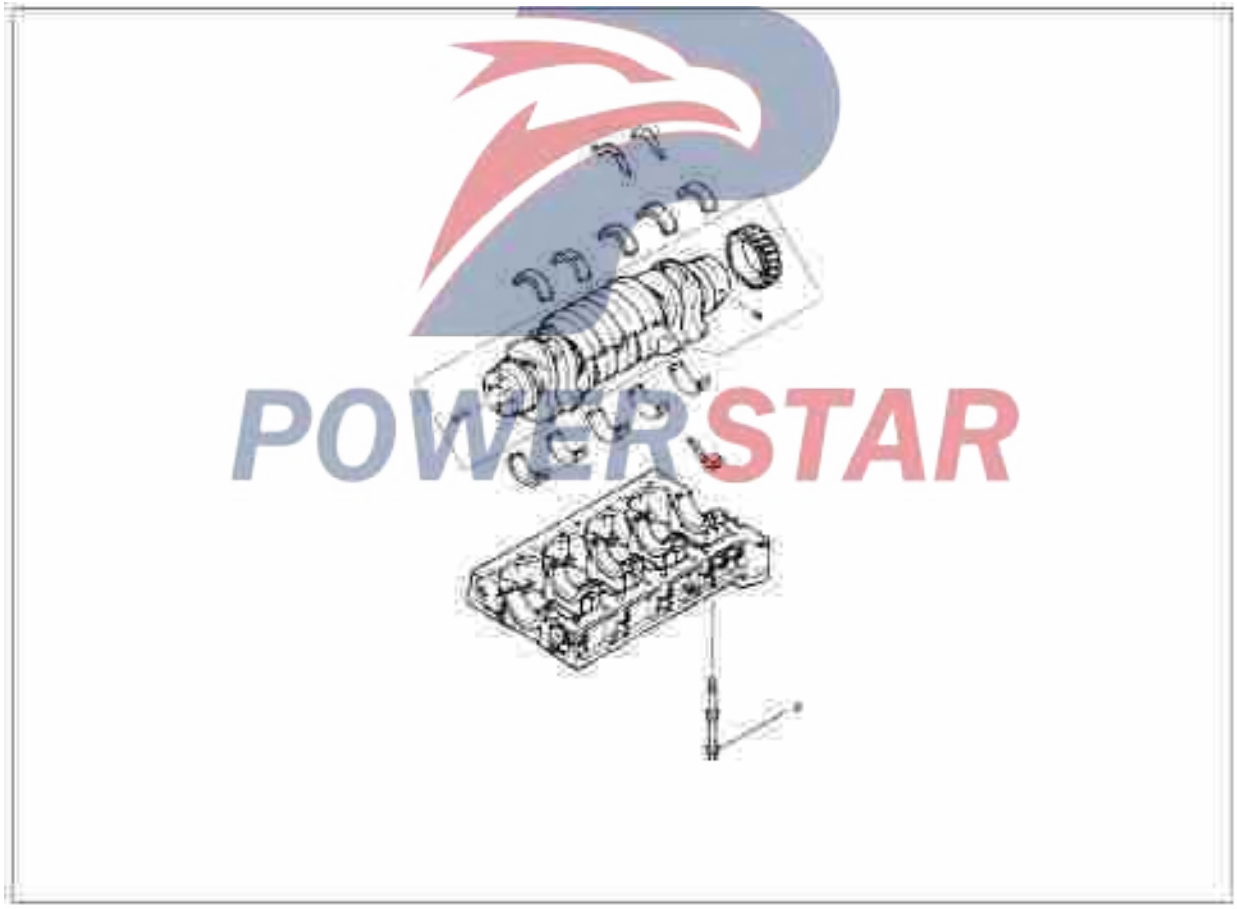
16. Install the cylinder head.

Please refer to the cylinder head in this chapter.

17. Vehicle engine assembly.

See Motor Components in this chapter.

Tightening torque - Overview

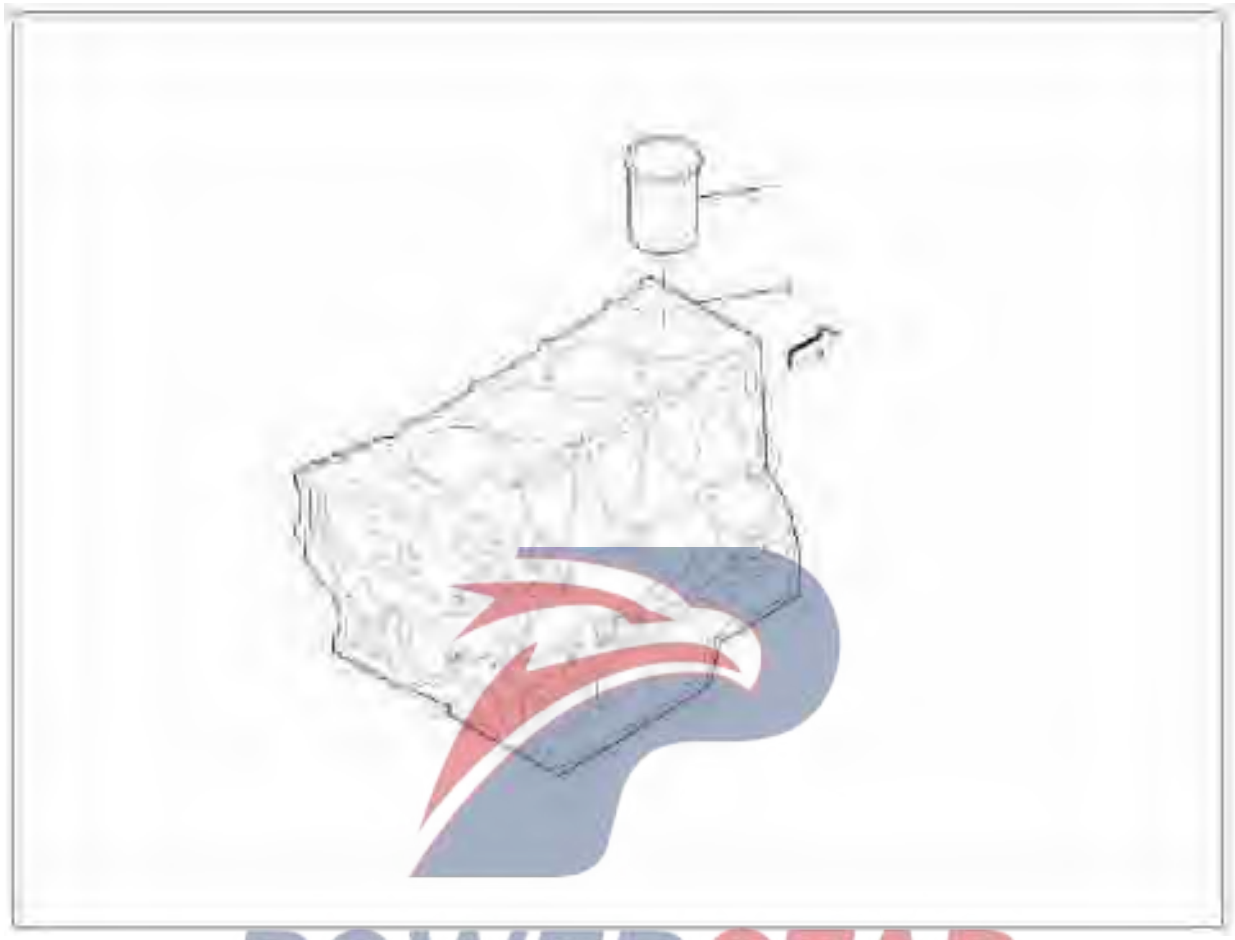


(a) M14：98 N·m {10.0 kgf·m}—132 N·m{13.5 kgf·m}→30º∽60 º

M10：37 N·m {3.8 kgf·m}

Cylinder block

Component parts



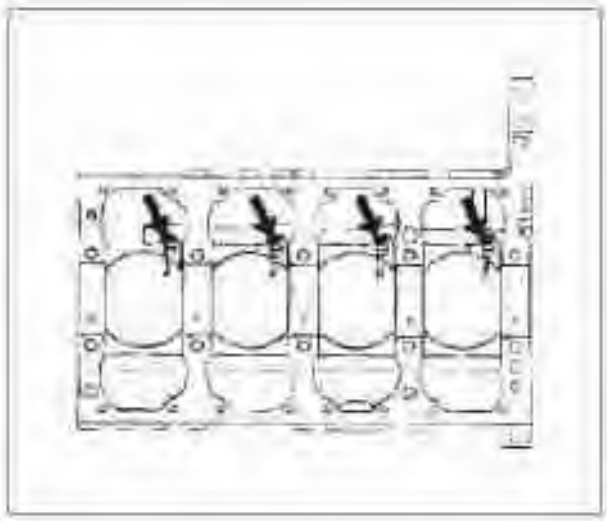
Key

1. Cylinder liner
2. Cylinder block

Disassembly

1. Remove engine components from the car.
See Motor Components in this chapter.
2. Remove the bolts.
Please refer to the cylinder head in this chapter.
3. Remove the fuel pump.
Refer to fuel pump in Chapter 1D Fuel System (4HK1).
4. Remove the oil sump.
Please refer to Oil Sump in Chapter 1H Lubrication System (4HK1).
5. Remove the pump.
Please refer to Chapter 1C Pumps in Cooling System (4HK1).
6. Remove the front cover.
Please refer to the cover of this chapter.
7. Remove the gear box gear.
Please refer to the gear distribution system in this chapter.
8. Remove the pump.
Please refer to the oil pump in Chapter 1H Lubrication System (4HK1).
9. Remove the piston and connecting rod.
Please refer to pistons and connecting rods in this chapter.
10. Remove the crankshaft.
Please refer to the crankshaft in this chapter.

11. Remove the nipple from the piston.



12. Remove the cylinder liner.

Inspection

1. Carefully remove foreign objects such as scales from the cylinder block.

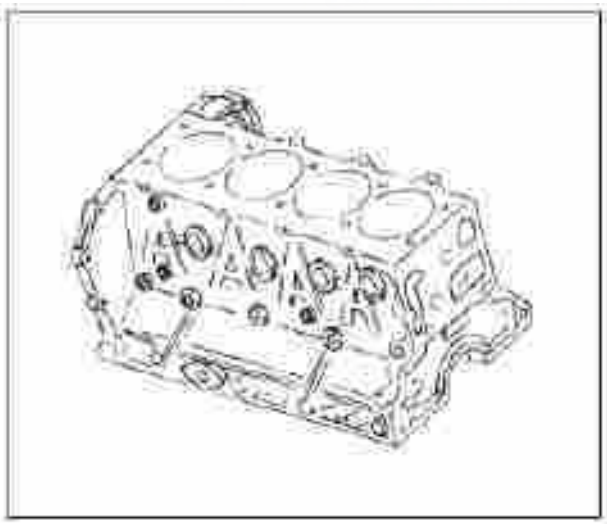
• Be careful not to damage the cylinder block.

2. Gently remove the seal fluid from the crankcase mounting surface.

3. Clean up the cylinder.

4. Visually inspect the cylinder block.

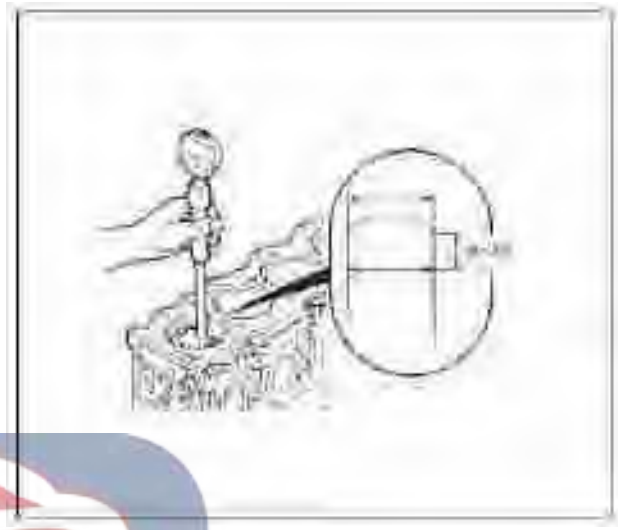
• Dye test and water pressure (or air pressure) test If a crack or other damage is detected, replace the cylinder block.



5. Measure the wear of cylinder liner

• Check the inside of the shirt for defects and damage.

• When mounted on the cylinder block (wear in high rotation direction), the maximum wear pad distance measured at the inner diameter of the end face is approximately 15 to 20 mm. In the field, when the measured value exceeds the limit of use, replace the cylinder liner.



Cylinder liner inner diameter	mm
Standard value	115.021∽115.050
Standard value	115.20

Mark:

There is only one type of inner diameter (inner diameter) for replacing the cylinder liner and there is no need to select the liquid level.

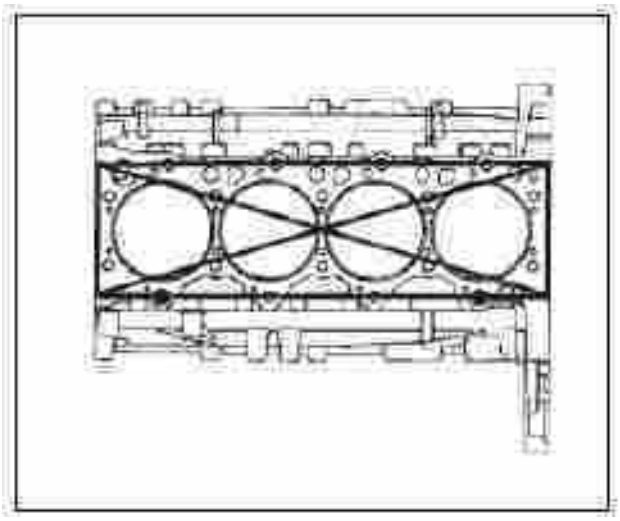
6. Measure straightness level.

• Remove the cylinder liner and carefully remove the balance from the cylinder block.

• Using a ruler and feeler gauge, measure the 4 sides and 2 diagonals above the cylinder block.

• When the measured value exceeds the limit, replace the cylinder block.

Cylindrical upper surface warping	mm
Standard value	＜0.7(0.05)
Standard value	0.20



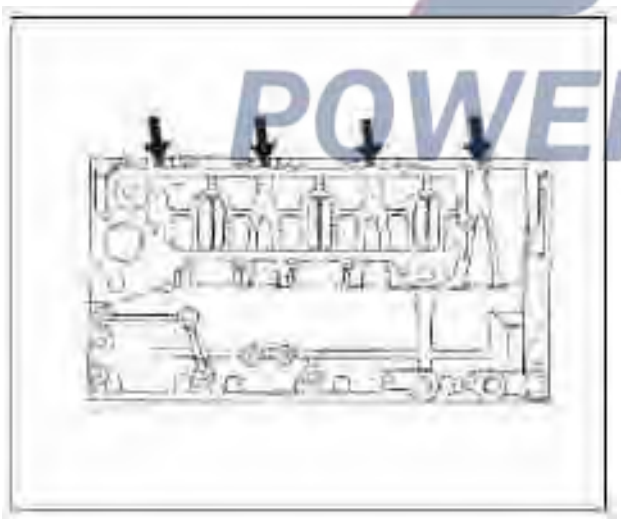
Installation

1. Select the quality of the cylinder liner.

• In the figure, the inner diameter of the cylinder block is engraved on the boom of the cylinder block, and the cylinder sleeve corresponding to the outer diameter is selected.

• The cylinder block corresponds to the outer diameter of the cylinder liner.

Cylinder body (printed)	1, 2	3
Outer diameter of the cylinder liner.	IX	3X



Cylinder bore diameter, cylinder liner (reference) level mm		
Grade	(1, 2) • (1X)	(3) • (3X)
Cylinder block inner diameter	118.001∽118.020	118.021∽118.030
The outer diameter of the cylinder	117.991∽118.000	118.001∽118.010

(Reference)

When replacing a cylinder liner in the form of a "cylinder liner assembly", if the cylinder liner outer diameter dimension is specified and the piston size corresponds to the cylinder liner inner diameter, each cylinder may be replaced.

2.Install the cylinder liner.

• Mounted directly in the cylinder block.

• Do not hit or apply force when inserting the cylinder liner.

Mark:

Clean cylinder and liner, dry them before installation.

3. The amount of protrusion of the cylinder liner

Use a dial gauge to measure the amount of protrusion in each cylinder liner. The height difference between the projections of two adjacent cylinder liners should not exceed 0.03 mm.

Projection cylinder sleeve	mm
Standard value	0.05∽0.10

Mark:

After replacing the cylinder liner, the amount of protrusion of the cylinder liner must be measured.

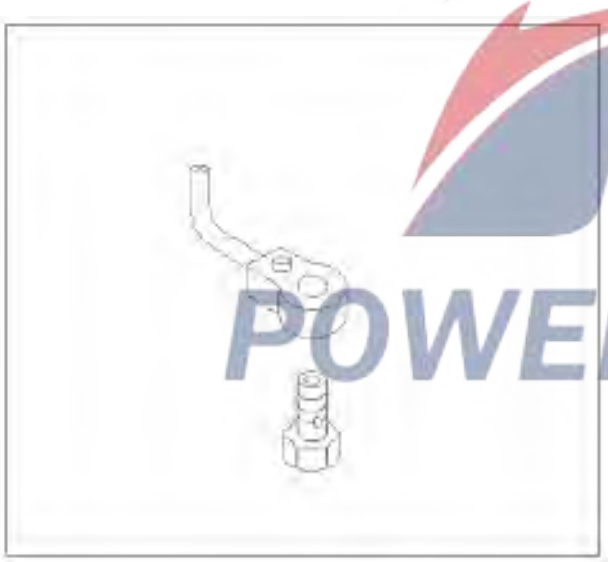
4. Install the piston nipple.

• Align the nipple pins with the cylinder pin holes and tighten with check valves.

Tightening torque: 21 N•m {2.1 kgf•m}

Mark:

Be careful not to deform or damage the nozzle.



5. Install the crankshaft.

Please refer to the crankshaft in this chapter.

6. Install the piston and connecting rod.

Please refer to pistons and connecting rods in this chapter.

7. Install the oil pump.

Please refer to the oil pump in Chapter 1H Lubrication System (4HK1).

8. Install the gear box gear.

Please refer to the gear distribution system in this chapter.

9. Install the front cover.

Please refer to the cover of this chapter.

10. Install the pump assembly.

Please refer to Chapter 1C Pumps in Cooling System (4HK1).

11. Install the oil sump

Please refer to Oil Sump in Chapter 1H Lubrication System (4HK1).

12. Install the oil supply pump.

Refer to fuel pump in Chapter 1D Fuel System (4HK1).

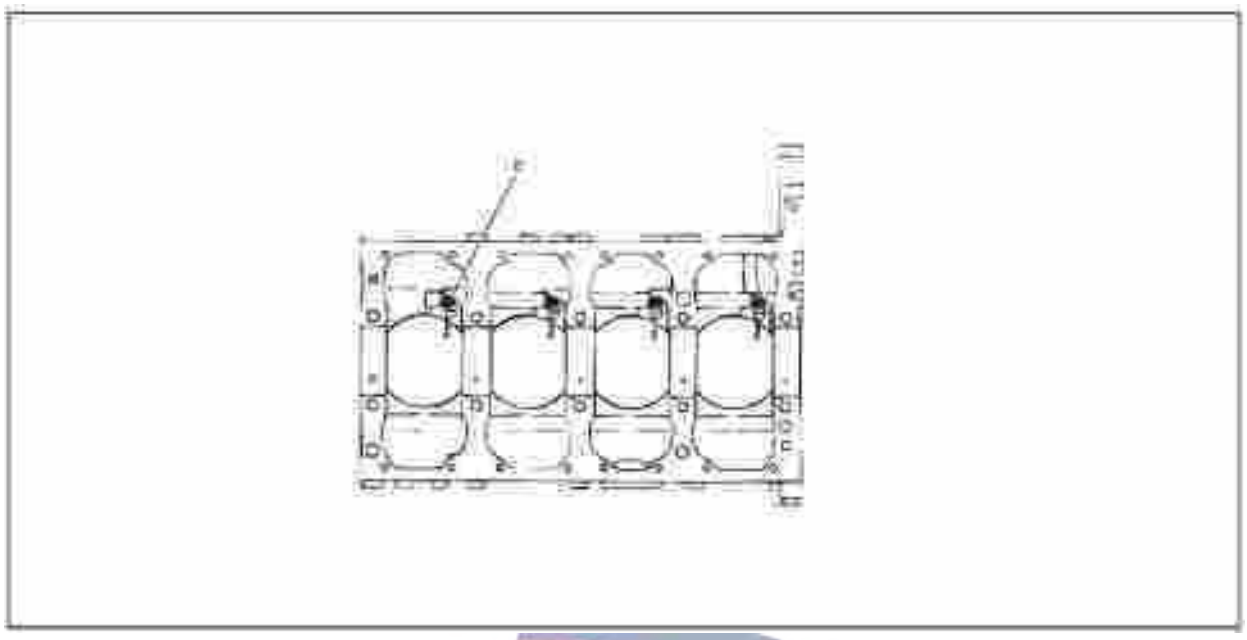
13. Install the cylinder head.

Please refer to the cylinder head in this chapter.

14. Install the engine assembly.

See Motor Components in this chapter.

Tightening torque - Overview



(a) 21 N·m { 2.1 kgf·m }

Section 2C

Engine Mechanical System

Table of Contents

Cooling system

Precautions

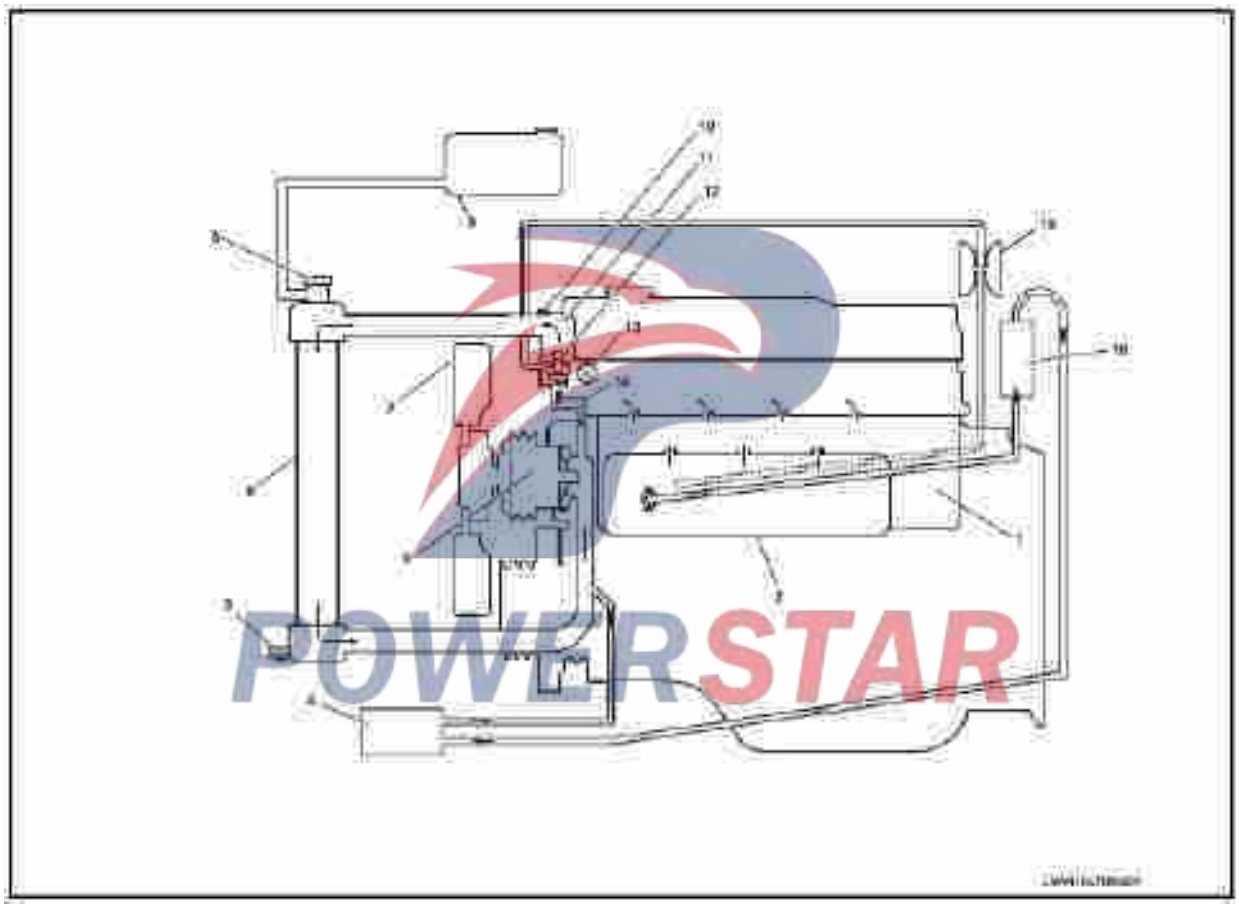
Warning

Do not loosen or remove the radiator cap when the coolant temperature is high. It can be burned by steam and boiling water. After cooling, the liquid is cooled, put on a thick cloth blanket, slowly release the lid, and then take out other antihypertensive drugs.

Function and working principle

Cooling system

The cooling system is a forced circulation type and consists of a water pump, a thermostat, and a radiator.



Key

Water jacket

2. Oil cooler

3 Water pump

4. Heater core

5. Drain plug

6. Radiator

7. Cooling fan

8. Radiator cover

9. Auxiliary water tank

10. Exhaust plug

11. Outlet pipe

12. Thermostats (2 pieces)

13. Temperature Sensor

14. Bypass the channel

15. Turbocharger

16.EGR cooling

Water pump

The water pump is a centrifugal rotor pump driven by a motor fan belt.

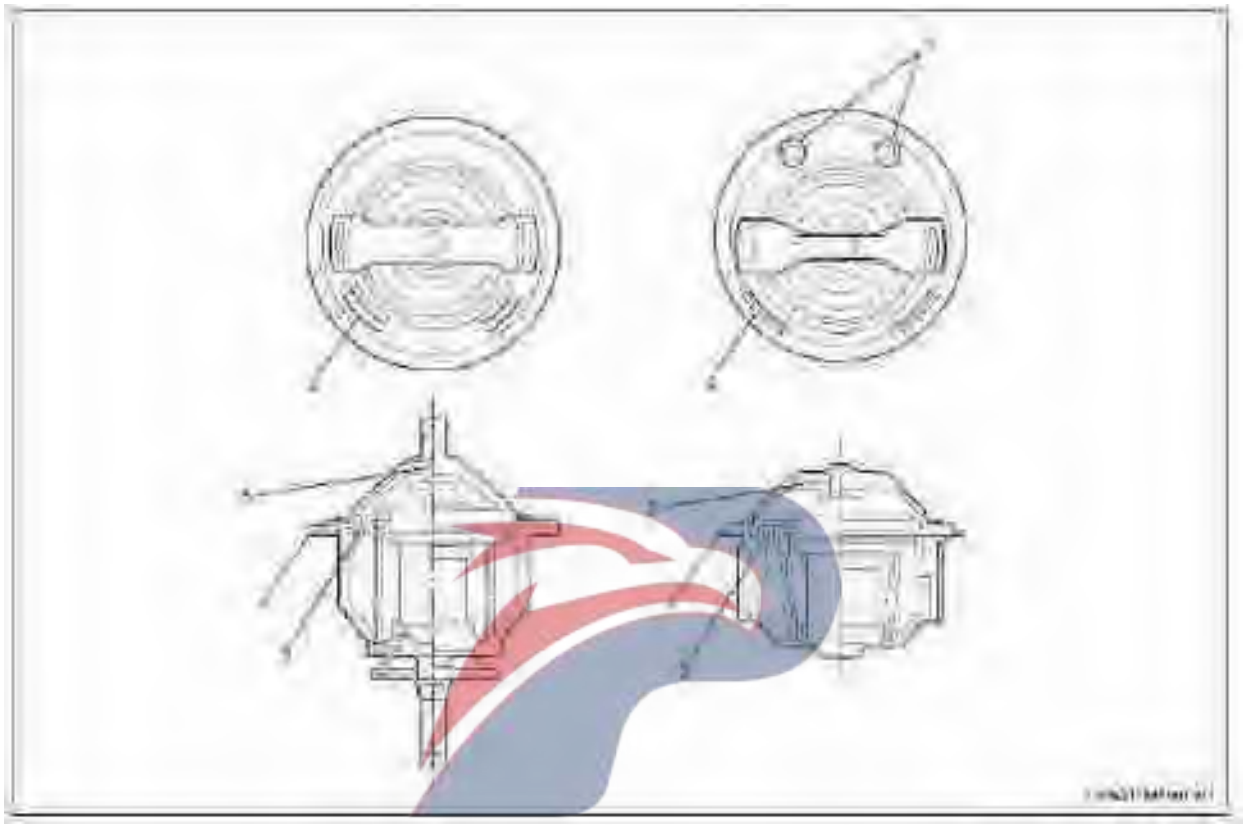
The pump is a water pump that cannot be disassembled. If a malfunction occurs, replace the pump directly.

Key

1. Fan Concentrator
2. Fan belt pulley
3. Bearing
4. Oil seal device
5. Impeller
6. Liquid sealant coating tank

Thermostat

The thermostat is a wax particle that uses two valves with opening temperatures of 82℃ (bypass) and 85 ℃ (tandem) to precisely adjust the water temperature. It is installed in the thermostat housing.



Key

1. (on thermostat) exhaust valve
2. Open the temperature print
3. Valve
4. Seal gaskets
5. Piston

Radiator

Radiator is tube-belt type, in order to increase the boiling point of coolant, radiator opening pressure is 93 ~ 122kPa {0.9 ~ 1.2 kg / cm2}.

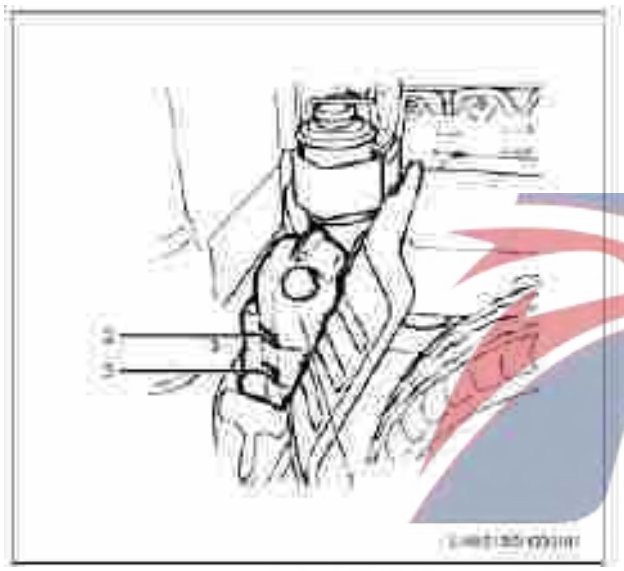
Functional check

Check the amount of coolant

If necessary, check the amount of coolant in the subtank in the MAX (upper limit) and MIN (lower limit) ranges. If the coolant is insufficient, remove the cap from the sub tank and mix the water and long-lived coolant (LLC) in a 1:1 ratio near the MAX line. Use Qingling Pure LLC long-life coolant.

Reference value Coolant volume (L) 17.1 (within MIN-MAX range)

Change every 2 years or 40,000 kilometers



Key

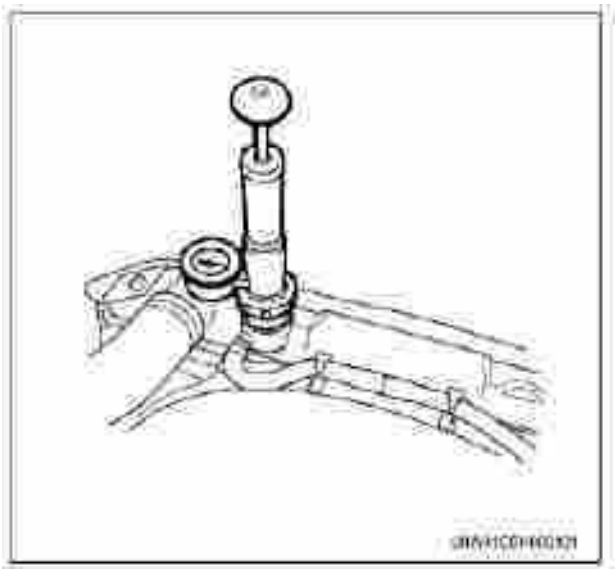
1. Auxiliary water tank
2. MAX line (upper limit)
3. MIN line (lower limit)

Check for coolant leaks

• Apply a pressure of 200 kpa (2.0 kg/cm2) using the radiator cap tester to detect leaks at the following locations.

- Radiator group
- Water pump assembly
- Radiator hose
- Heating pipe

• Inspect radiator hoses, radiator hoses for damage, deterioration, and loose hose clamps.



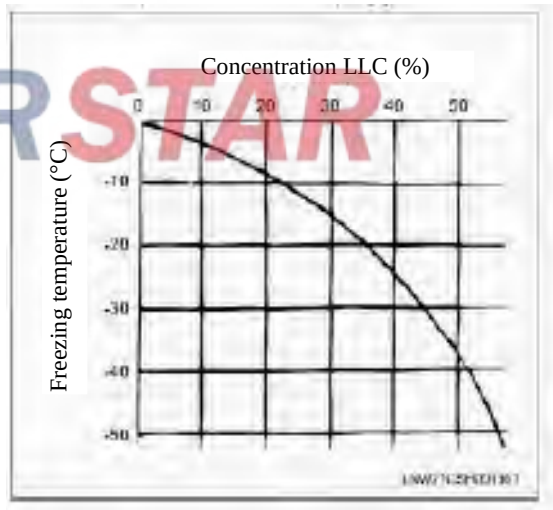
Check the concentration of coolant

1. About the concentration of LLC

• The freezing temperature varies depending on the CLL concentration, and the concentration should be adjusted according to the lowest temperature.

• Use Qingling Pure LLC long-life coolant.

• When the mixing ratio of LLC is more than 60%, it is easy to overheat, and when the mixing ratio is lower than 30%, corrosion cannot be sufficiently prevented, so 30% to 60% should be used.



Reference temperature	Mixing ratio (L)		The concentration of LLC
	LLC	Water	
-18 0C	6.0	11.1	35%
-25 0C	7.2	9.9	42%
-35 0C	8.6	8.6	50%
-40 0C	9.1	8.0	53%

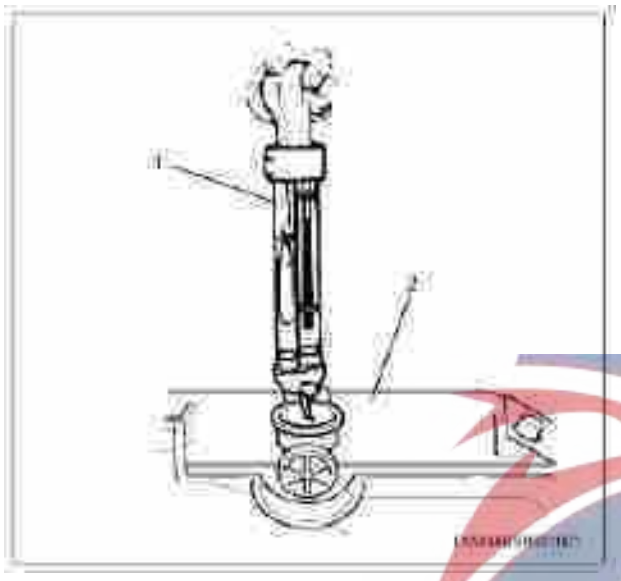
2. Measuring the concentration of LLC

Specific gravity measurement

• Use an antifreeze hydrometer and thermometer to measure the coolant density and temperature.

Removing the cover while the engine is hot can cause the coolant to cool.

• Use containers that are deeper than hydrometers.

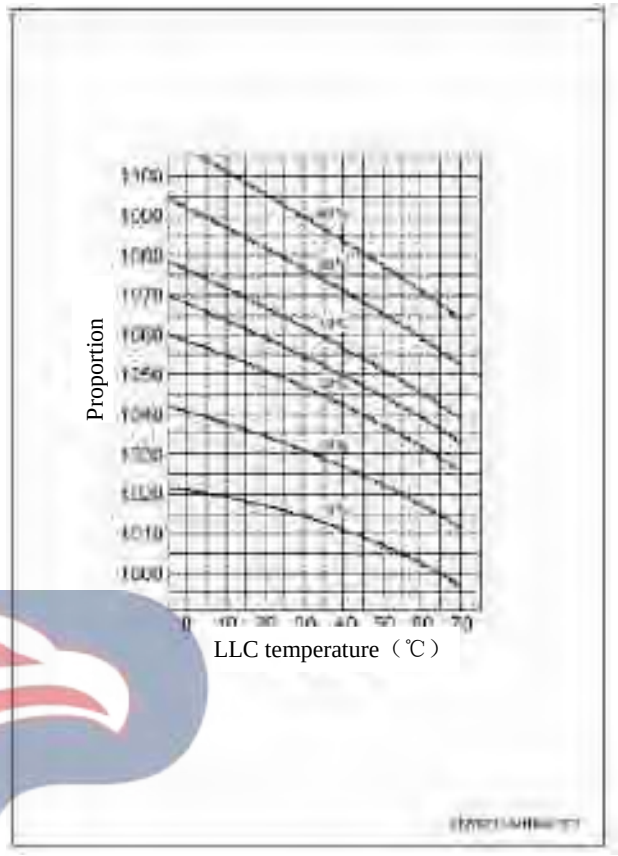


Key

1. Hydrometer
2. Radiator

• Coolant temperature must be between 0 and 50℃

• After determining the temperature and density, calculate the concentration from the table below.



Hydrometer with coolant

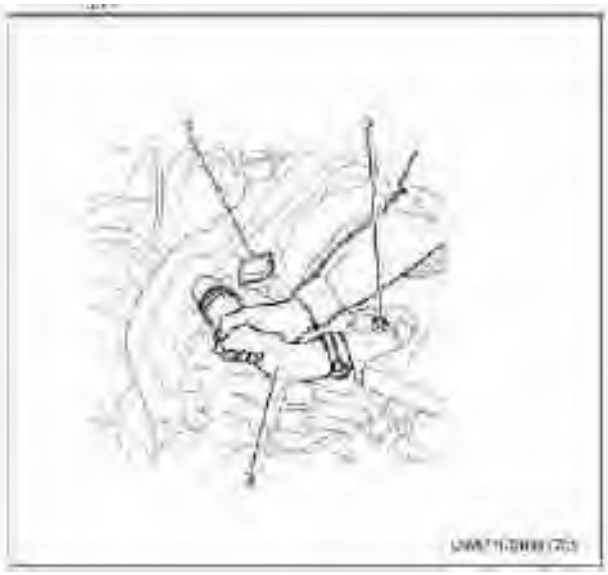
• Use a pycnometer to measure the concentration.

Reference

Filling points for coolant (when coolant is completely replaced)

1. Confirm engine cooling.
2. Open the radiator cap.
3. Loosen the vent plug of the outlet tube.
4. Fill the filling nozzle with coolant.

5. After filling the coolant, press and hold the radiator hose 2 or 3 times. If the water level drops after the hose is depleted, some coolant should be added.



Key

1. Radiator cover
2. Exhaust plug
3. Water pipe

6. Fill the "MAX" line of the auxiliary tank with coolant.

7. Install the outlet pipe drain plug.

8. Close the radiator cap and start the engine. After 2 to 3 minutes of idling, stop the engine and open the radiator cover again. If the water level drops, you need to refill.

Warning:

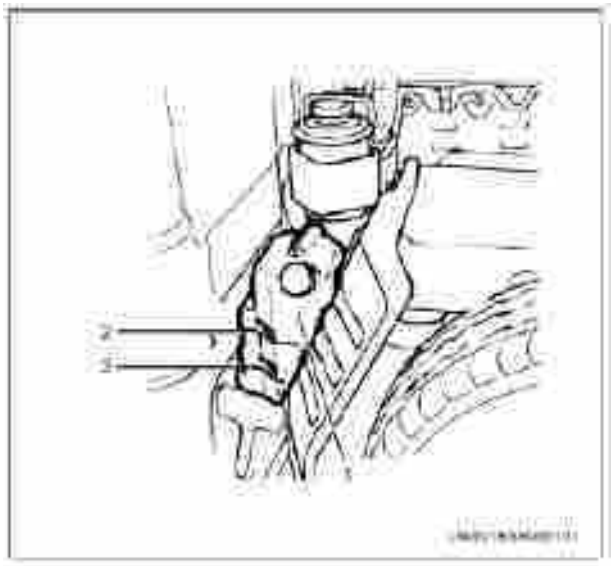
Do not loosen or remove the radiator cap when the coolant temperature is high. It can be burned by steam and boiling water. After the coolant cools, place a thick cloth on the radiator cap, slowly rotate and release the lid, then lower the lid to remove it.

9. After installing the radiator cap, heat the engine to 2000 RPM.

10. If it is confirmed that the pointer of the water temperature gauge is higher than the center and the thermostat is on, continue idling for about 5 minutes and stop the engine.

11. Once the engine has cooled sufficiently, check the water level at the injection nozzle and refill it if necessary. If the coolant is critically low, check the cooling system hose and auxiliary tank hose for leaks.

12. Fill the "MAX" line of the auxiliary tank with coolant.



Key

1. Auxiliary water tank
2. MAX line (upper limit)
3. MIN line (lower limit)

Symptom: Engine overheating

Symptom	Probable causes	Treatment measures
Engine overheating	Insufficient coolant	Supplement
	Abnormal temperature	Replace
	Abnormal water pump	Replace
	Clogged radiator screen	Sweep or replace
	Radiator cover is abnormal	Replace
	Insufficient engine oil or poor engine oil adaptability	Add or replace oil
	Bad cylinder head gasket	Replace
	Fan belt	Adjust or replace
	Exhaust system blockage	Clean or replace
	Excessive fuel injection	Diagnostic Engine Control System
	Fuel injection time is incorrect	Diagnostic Engine Control System
	Fuel injection starting pressure is too low	Diagnostic Engine Control System

Symptom: Engine is too cold

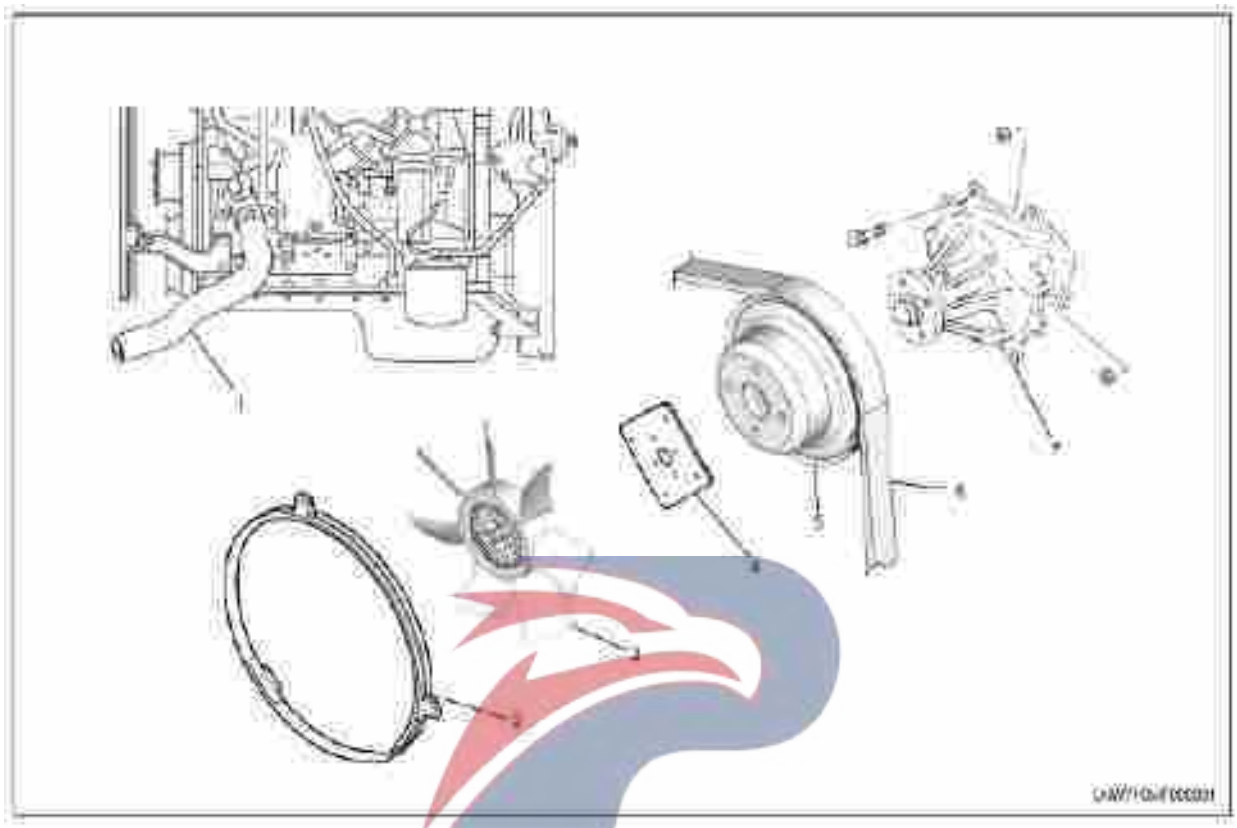
Symptom	Probable causes	Treatment measures
Engine is too cold	Abnormal temperature	Replace

Main parameters

Cooling system		Forced circulation
Radiator		Tube-belt type
Heat elimination capacity	kW {Kcal/h}	103.8 {89268}
Heat dissipation area	m^2	18.15
Front area	m^2	0.365
Net quality	kg	15(M/T type)
Radiator cover		
Open pressure	kPa {kg/cm^2}	93∽123 {0.9∽1.3}
Coolant capacity	L	2.7(M/T type)
Water pump		Centrifugal impeller type
Pulley ratio		1.190
Thermostat		Types of wax pills
Open temperature	℃	85 (with exhaust valve) / 82 (without exhaust valve)
Full temperature	℃	100 (with exhaust valve) / 95 (without exhaust valve)
Total coolant capacity	L	17.1 (with radiator)

Water pump

Component parts



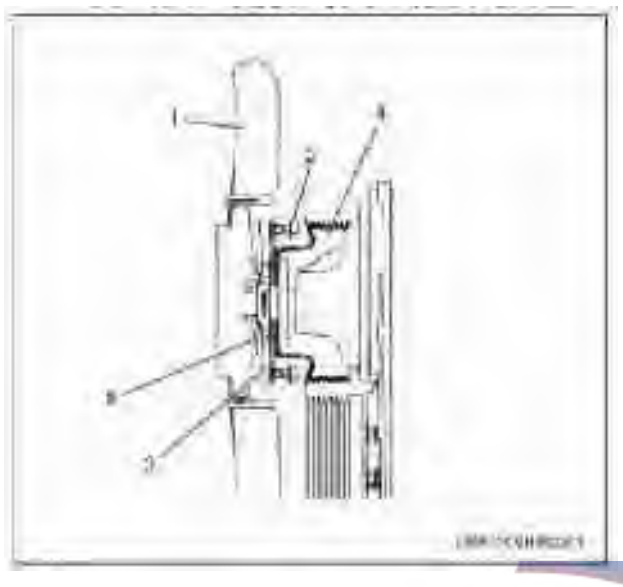
Key

1. Radiator heatsink
2. Fan cover
3. Fan
4. Mounting plate
5. Water pump pulley
6. Fan belt
7. Water pump assembly

Disassembly

1. Discharge the coolant.
2. Remove the radiator hose from the radiator side.
3. Remove the fan guard from below.

4. Remove the 4 mounting nuts and remove the fan assembly. At this point, loosen the 4 bolts that secure the pump impeller and mounting plate.

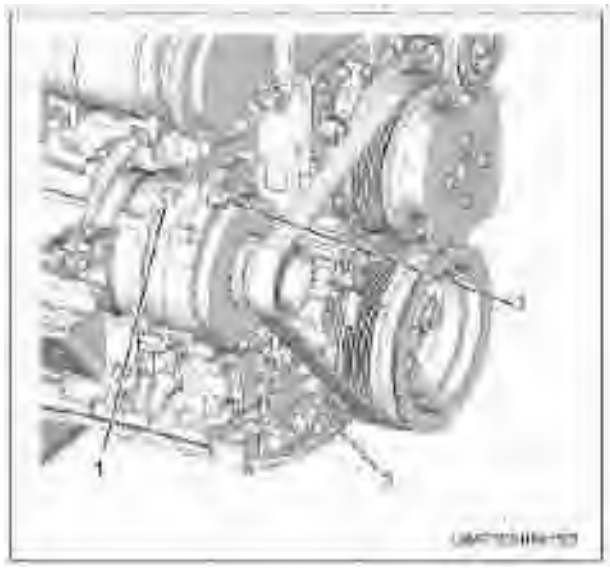


Key

1. Fan
2. Fan assembly mounting nut
3. Mounting plate
4.Water pump pulley
5. Fixing bolts

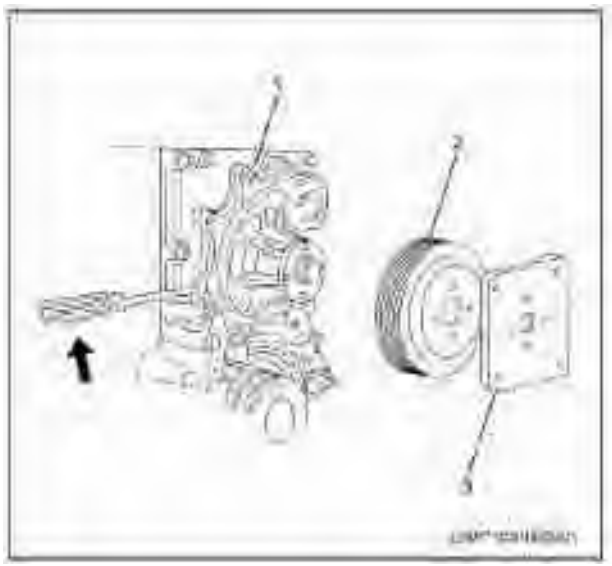
5. Loosen the lock nuts and bolts (3) of the adjustment bracket (2).

Loosen the generator adjustment screw (1) and remove the fan belt.



6. Remove the mounting plate and pump pulley

7. Insert the screwdriver in the position shown in the illustration to open and remove the pump assembly.



Key

1. Water pump
2.Water pump pulley
3. Mounting plate

Inspection

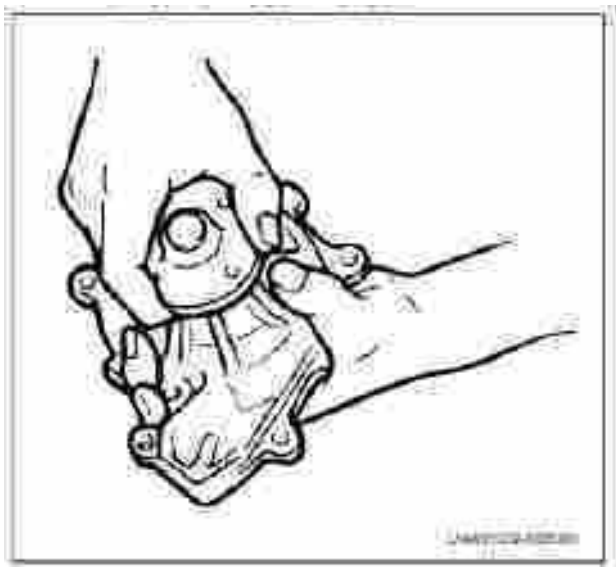
1. Visual inspection

• Check the pump for cracks and damage.
• Check the impeller for cracks and corrosion.
• Check for leaks in the oil seal.
• If abnormal, replace the entire pump.

2. Check the bearing unit

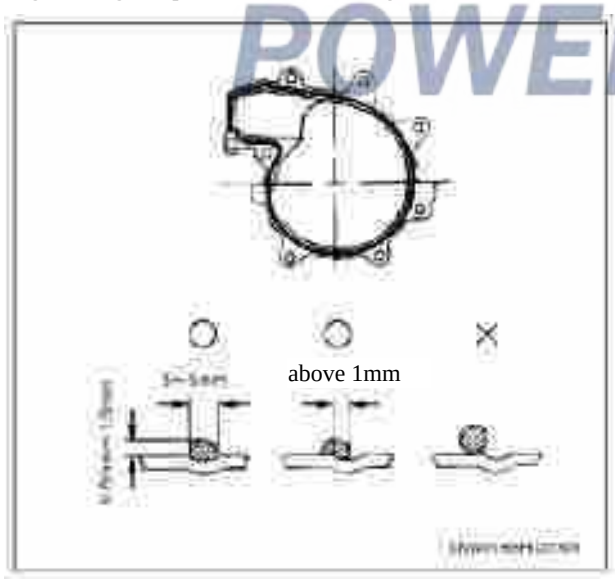
Rotate the pump impeller radially and check for obvious squeaks and abnormal sounds.

• If abnormal, replace the entire pump.

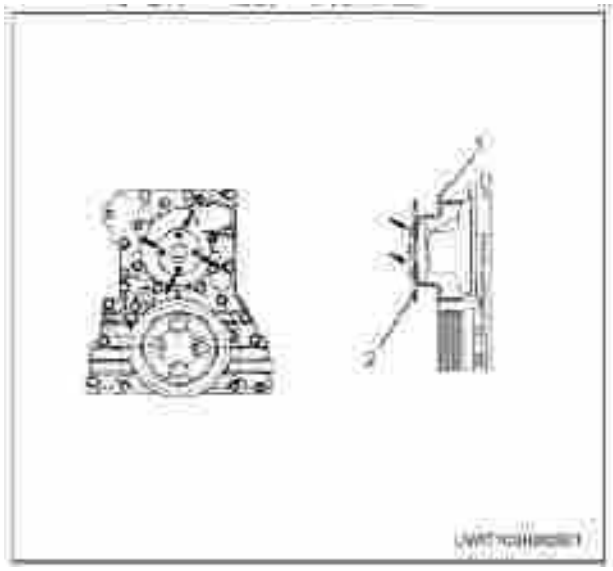


Installation

1. Install the pump assembly.
• Align the 3 to 5 mm wide liquid sealant (TB1207C) with the groove on the pump mounting surface.
• Apply liquid sealant as shown below.
• After using the liquid sealant, install it within 5 minutes.
• Align the bolts on the front cover and install the pump.
Tightening torque: 24 N•m {2.4 kgf•m}



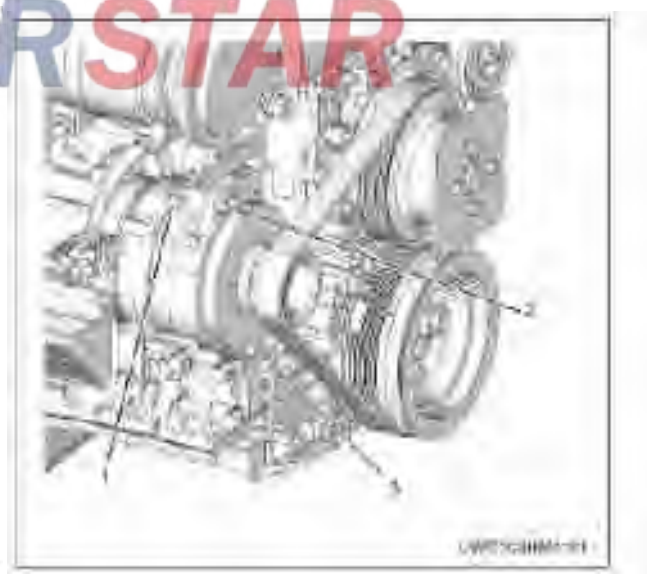
2. Tighten the bolts before installing the impeller (1) and mounting plate (2) onto the pump assembly.



Key

1. Fan belt pulley
2. Mounting plate

3. Install the fan belt, tighten the generator adjustment bolts and adjust the tension.
• Refer to the drive belt in this chapter.
4. After adjusting the fan belt, tighten the specified torque to tighten the generator.
Tightening torque: Nuts (2) =24 N•m {2.4 kgf•m}
Bolts (3) =40 N•m {4.1 kgf•m}



Key

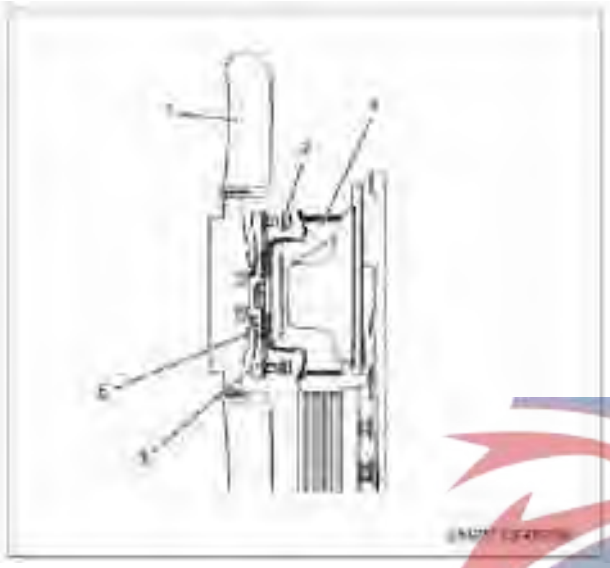
1. Adjust the bolt
2. Adjust the bracket lock nut
3. Bolt

5. After adjusting the fan belt, tighten the fan pulley and fix the mounting plate to the specified torque.

Tightening torque: 24 N•m {2.4 kgf•m}

6. Install the fan assembly and tighten it to the specified torque.

Tightening torque: 24 N•m {2.4 kgf•m}

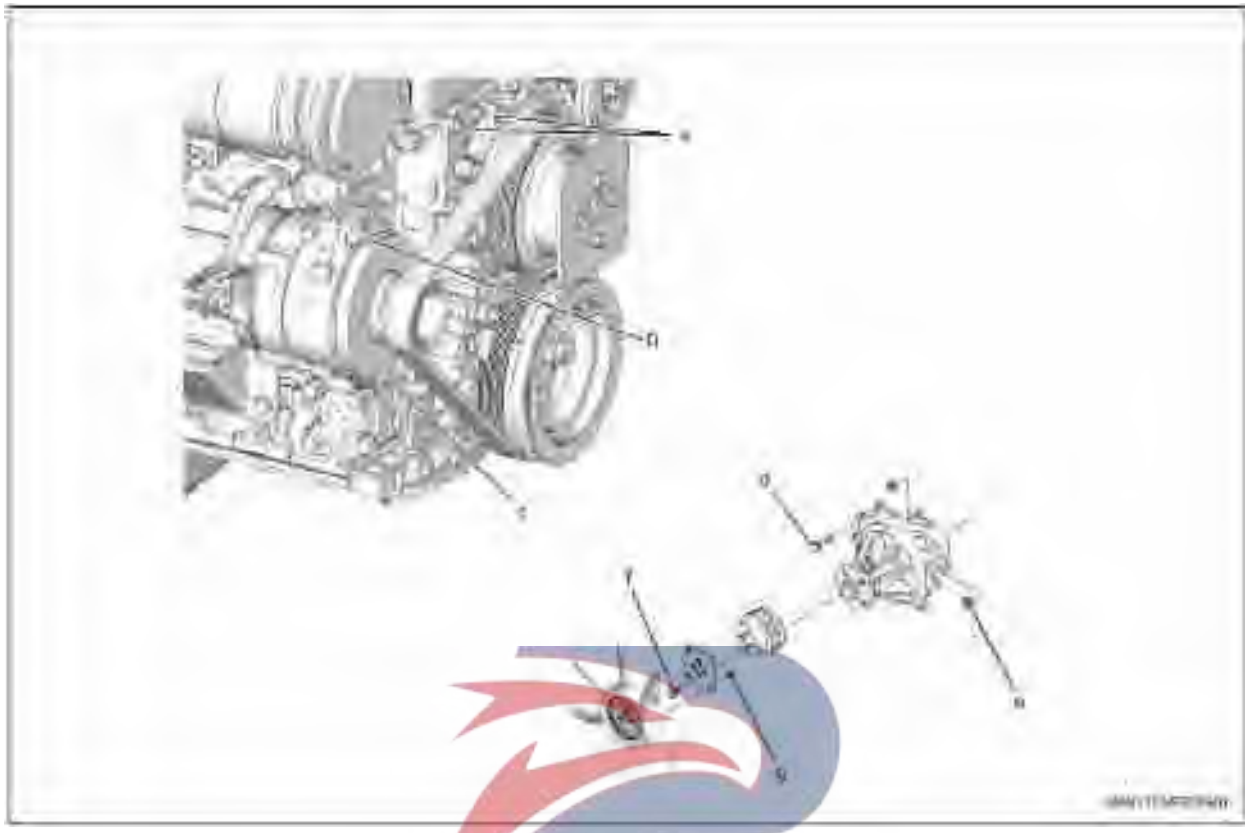


Key

1. Fan assembly
2. Fan mounting nuts (4)
3. Mounting plate
4. Fan belt pulley
5. Fixing bolts

7. Install the fan cover.
8. Install the radiator hose.
9. Inject the coolant.

Tightening torque - Overview



(a) 24 N·m {2.4 kgf·m}

(b) 24 N·m {2.4 kgf·m}

(c) 40 N·m {4.1 kgf·m}

(d) 24 N·m {2.4 kgf·m}

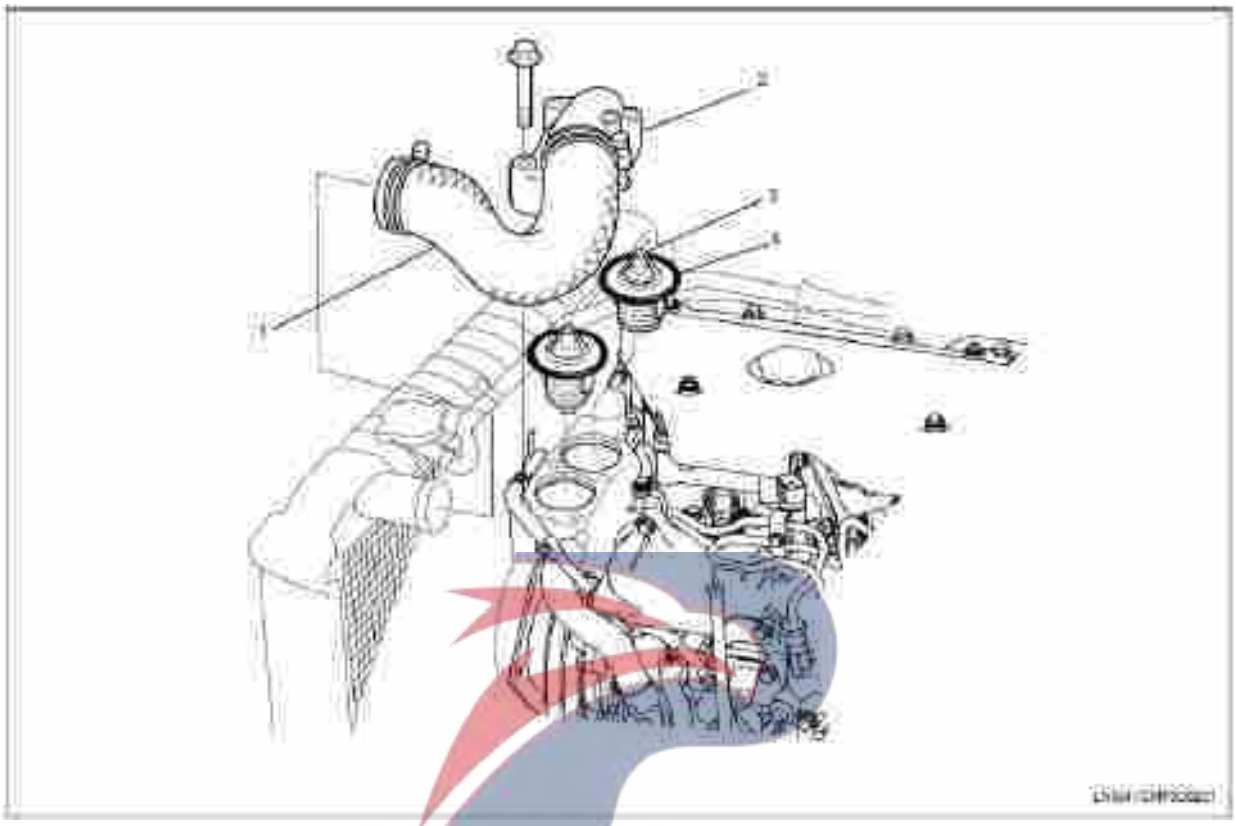
(e) 24 N·m {2.4 kgf·m}

(f) 24 N·m {2.4 kgf·m}

(g) 24 N·m {2.4 kgf·m}

Thermostat

Component parts



Key

1. Radiator water line
2. Outlet pipe
3. Thermostat
4. Seal gaskets

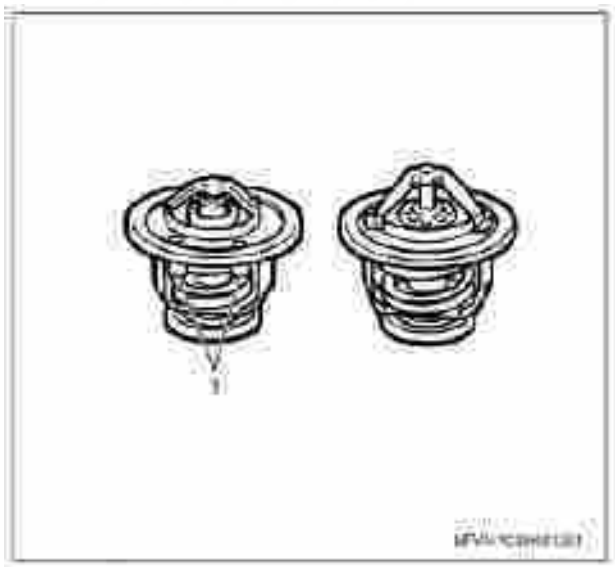
Disassembly

1. Discharge the coolant. Prepare the coolant container when reinstalling the thermostat, it can be replenished with the discharged coolant. The coolant is drained until the coolant does not escape from the thermostat housing.
2. Remove the radiator hose from the radiator side.
3. Remove the outlet tube.
4. Remove the thermostat.
5. Remove the thermostat gasket.

Inspection

1. Check the corrosion of the water pipe.
2. Check the thermostat.

• Inspect the mold, spring, shaft, exhaust valve and rivet area for damage.

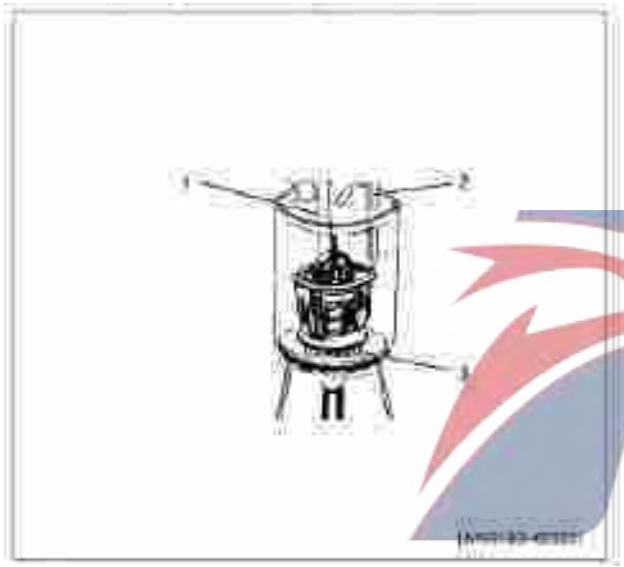


• Check the operation of the thermostat.

• Put the thermostat in the water, slowly raise the water temperature, measure the initial opening temperature, fully open the temperature and raise.

Initial opening temperature (without exhaust valve) (with exhaust valve)	82±2℃ 85±2℃
Fully open temperature (without exhaust valve) (with exhaust valve)	Above 95℃ Above 100℃
Lift	More than 8mm

• The wax thermostat has a large heat capacity, and there is only a slight difference in valve movement when the water temperature changes.



Key

1. Stir bar
2. Thermometer
3. Wood pieces

Note:

In order to not directly heat the thermostat, wood chips can be placed on the bottom of the container or hung. During the inspection, hot water is frequently stirred to avoid temperature differences.

3. Inspect the seals for cracks and damage.

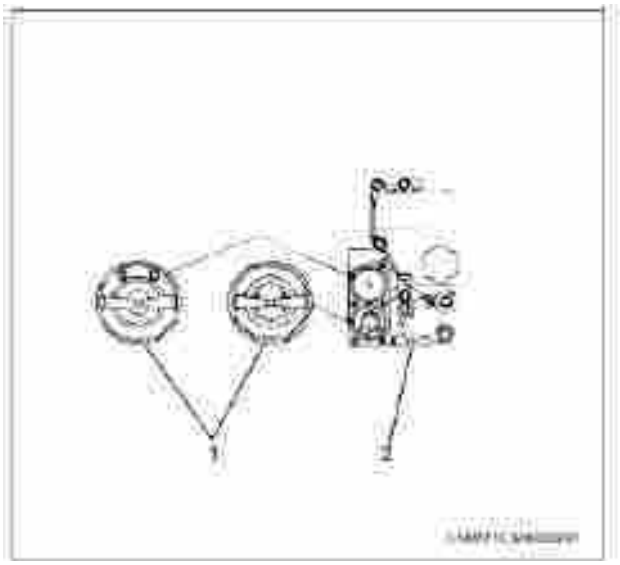
Installation

1. First install the gasket on the thermostat and install it in the position shown in the figure.

• When installing washers, be careful not to place the edges of the thermostat pads on the cylinder head cover.

Note:

Do not confuse the assembly site with the direction.



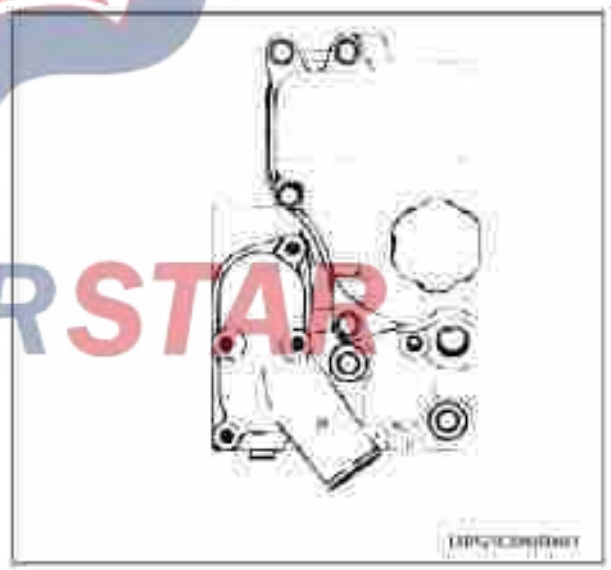
Key

1. Thermostat
2. Cylinder head

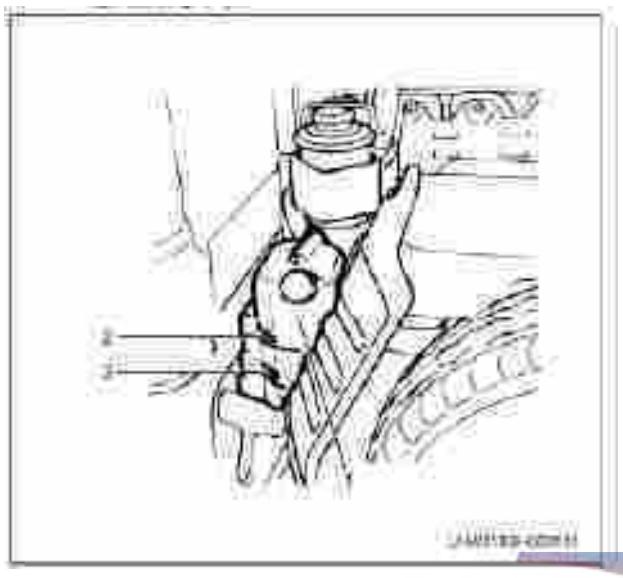
2. Install the outlet pipe.

Tightening torque: 24 N•m {2.4 kgf•m}

3. Install the water pipe from the radiator.



4. Use the previously unloaded coolant to replenish and confirm that the coolant has reached the specified level.



Key

1. Storage tank
2.MAX line (upper limit)
3. MIN line (lower limit)

Engine coolant temperature sensor

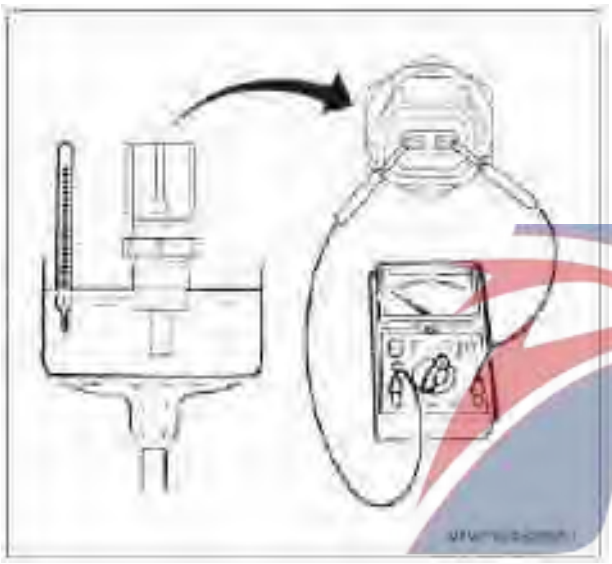
Disassembly

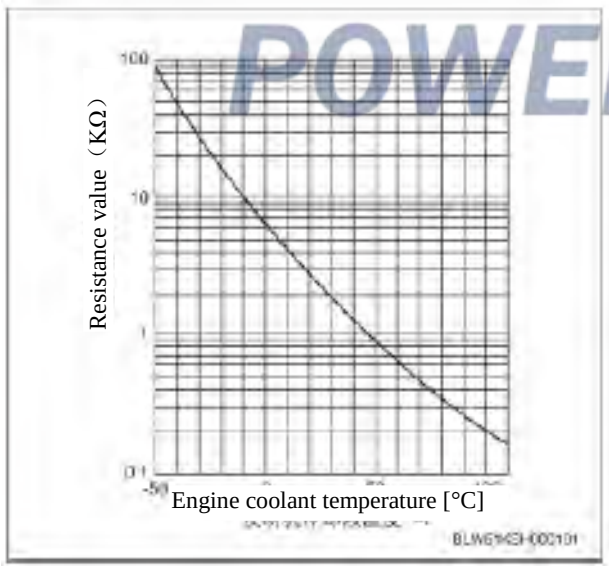
1. Remove the line connector.
2. Remove the engine coolant temperature sensor.

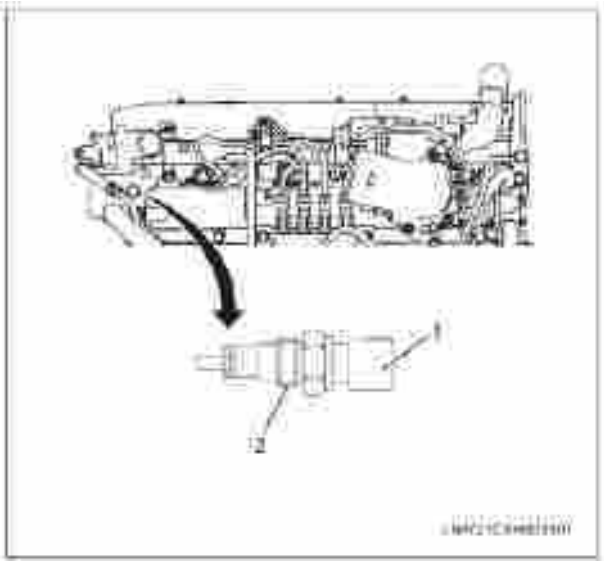
Inspection

Check the engine coolant temperature sensor.

• Put the engine coolant temperature sensor temperature sensor into the water and observe whether the resistance value changes as shown in the figure when changing the water temperature.







Key

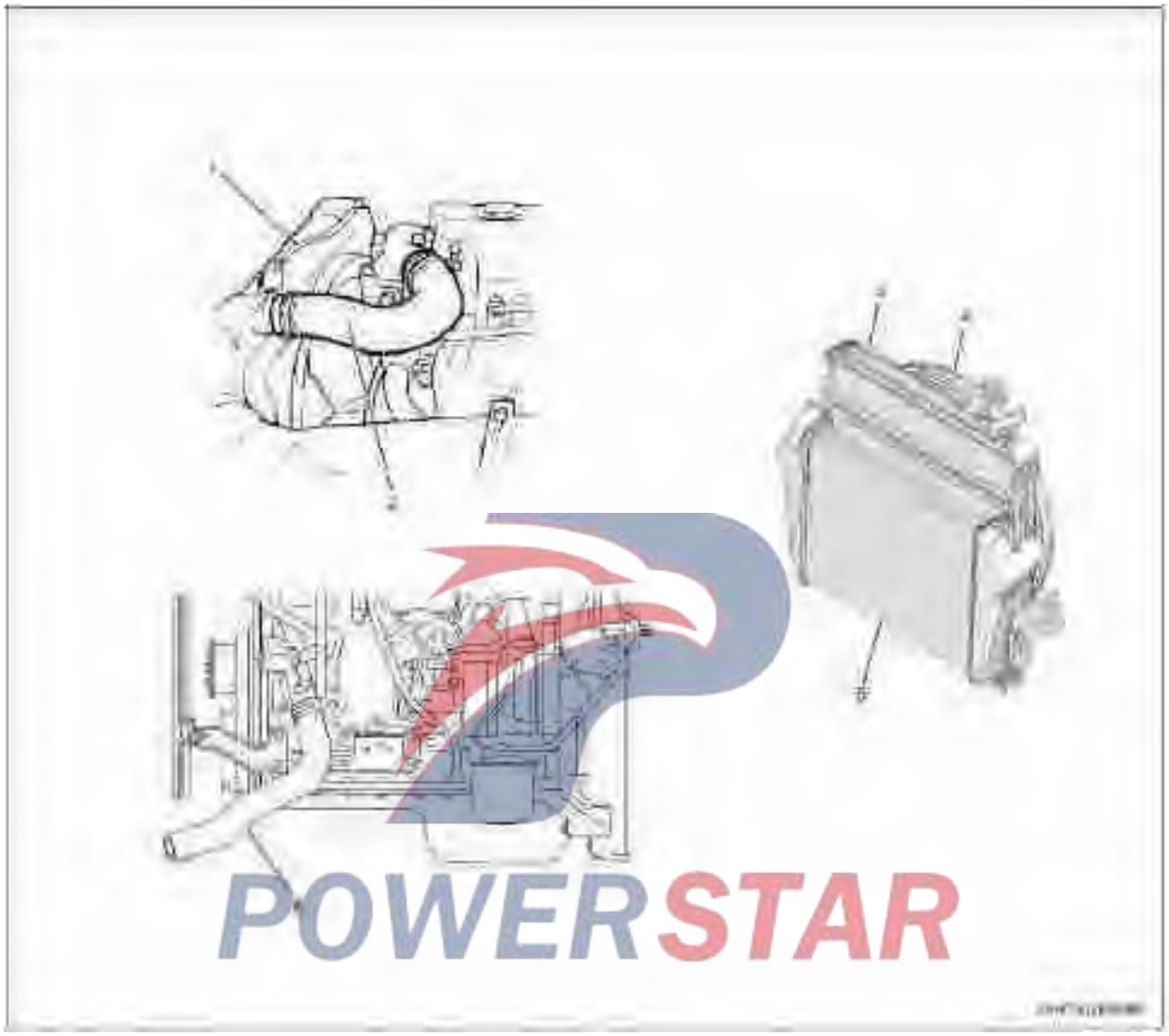
1. Engine coolant temperature sensor
2. Loctite smear

Installation

1. Apply Loctite 262 or 962 to the engine coolant temperature sensor thread and tighten as shown.
Tightening torque: 25 N•m {2.5 kgf•m}
2. Install the line connector.

Radiator

Component parts



Key

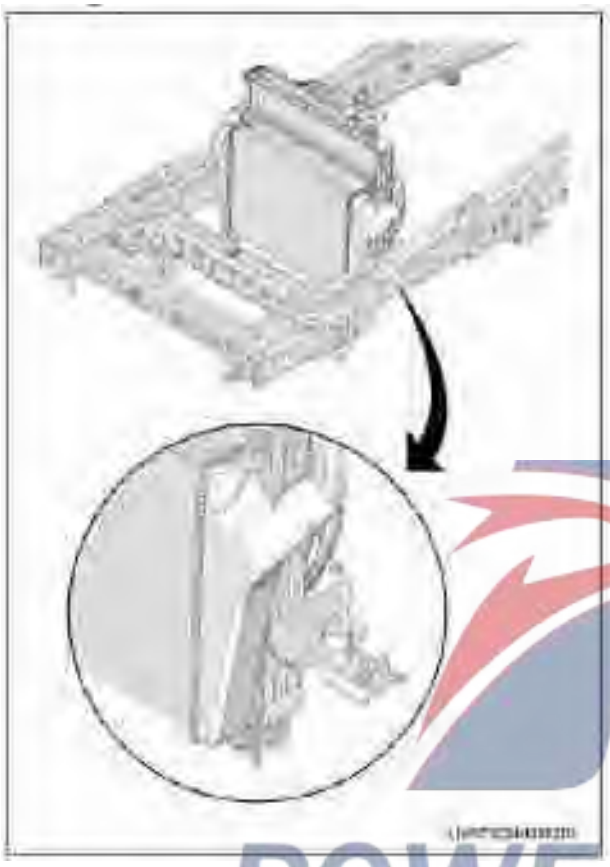
1. Coolant tank hose
2. Radiator water line
3. Radiator
4. Fan cover
5. Intercooler
6. Radiator heatsink

Disassembly

1. Loosen radiator drain plug and drain coolant.
• After draining, tighten the drain plug.
2. Remove the air hose from the aftercooler.
3. Remove the water pipe from the radiator side.
4. Remove the drain hose from the radiator side.
5. Remove the auxiliary coolant reservoir hose from the radiator side.
6. Remove the fan guard from below.

7. Remove the radiator with the aftercooler.

Remove the nuts that secure the left and right heat sink brackets, and then remove the heat sink. Be careful not to damage the radiator core with fan blades.



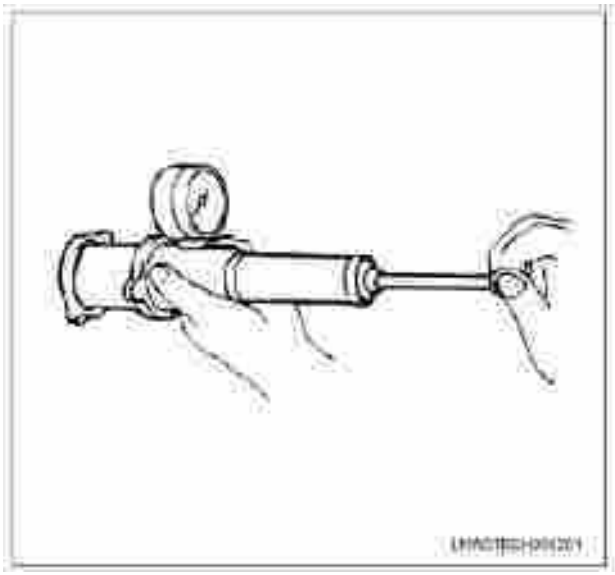
8. Remove the intercooler from the radiator.

Inspection

Radiator cover

1. Check the opening pressure with the radiator cap tester. If the opening pressure deviates from the standard value, replace the radiator cap.

Open pressure=93∽123 kPa 0.9∽1.3 kg/cm^2}



2. Check the condition of the vacuum valve in the center of the valve seat on the radiator cap. If the valve seat cannot work properly due to rust, waste, etc., clean or replace the radiator cap.

Radiator core

1. Remove dust and other foreign materials.

Distortion of the heat sink can reduce heat dissipation and cause overheating, so correct the heat sink. Make sure not to damage the radiator parts during the correction process.

Radiator cleaning

1. Rinse radiator and coolant channels with water and neutral detergent. Remove all scale and rust.

Installation

1. Install the radiator and intercooler.

• Install the radiator bracket on the rack side bracket and tighten it to the specified torque. Be careful not to damage the radiator core with fan blades.

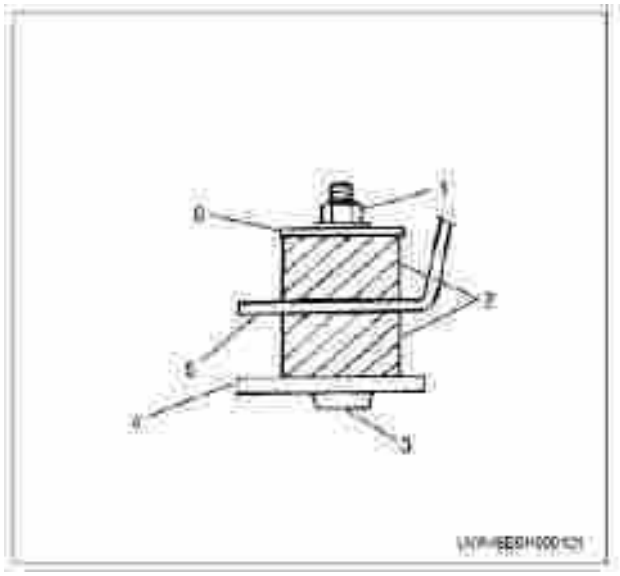
From radiator bracket to frame side bracket

Tightening torque: 25 N•m {2.6 kgf•m}

When removing the side bracket from the frame and reassembling it, tighten it to the following torque.

From the side of the frame to the frame

Tightening torque: 55 N•m {5.6 kgf•m}



Key

1. Nuts
2. Rubber
3. Stud bolts
4. Side bracket
5. Heatsink side bracket
6. Washer

• Install an intercooler.

Tightening torque: 15 N•m {1.5 kgf•m}

2. Install the fan cover.

• Fit the fan guard (1) exactly on the bracket in the center of the fan ring (2).

3. Install the coolant manifold hose to the radiator.

4. Install the radiator hose.

5. Install the water pipe from the radiator.

6. Install the air intake tube to the after-cooler and tighten the hose clamp to the specified torque.

Tightening torque: 10 N•m {1.0 kgf•m}

Note:

New clips must be used.

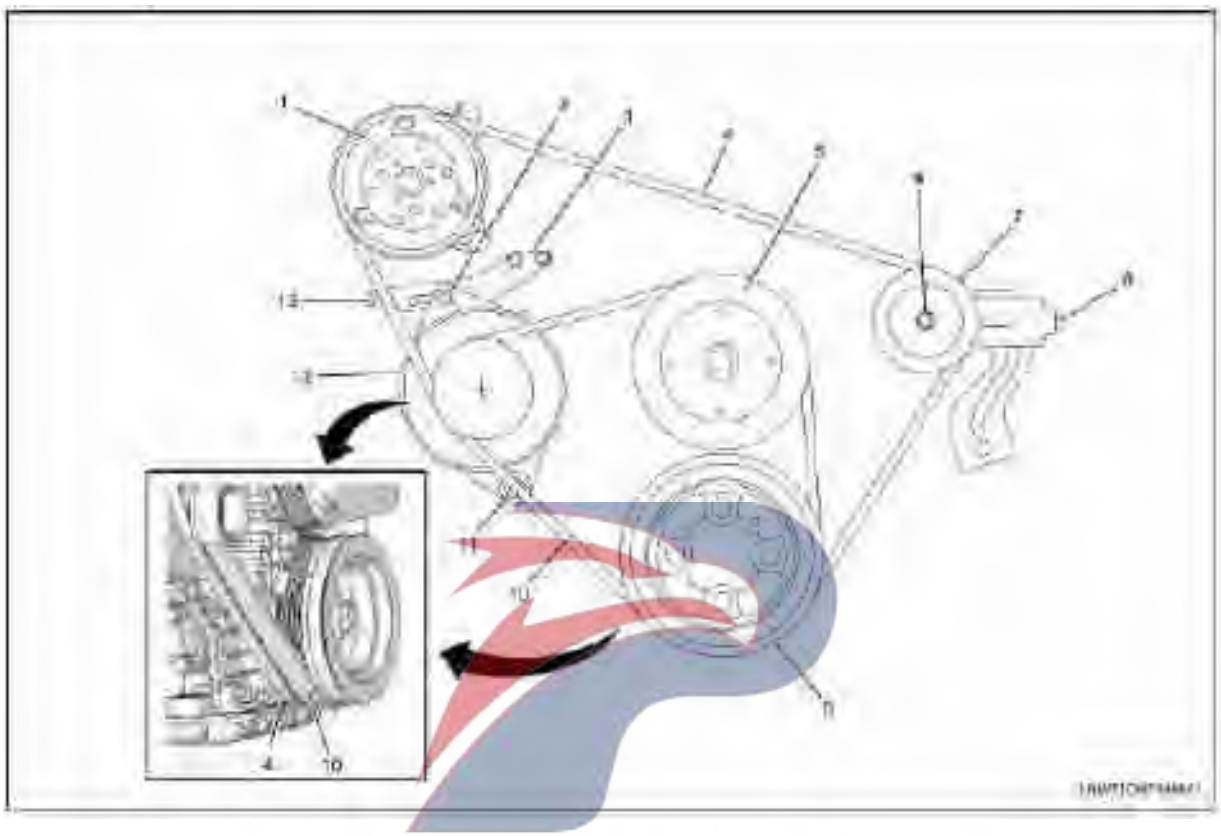
7. Inject the coolant.

• For coolant injection methods, Refer to cooling system in this chapter.

Drive belt

Component parts

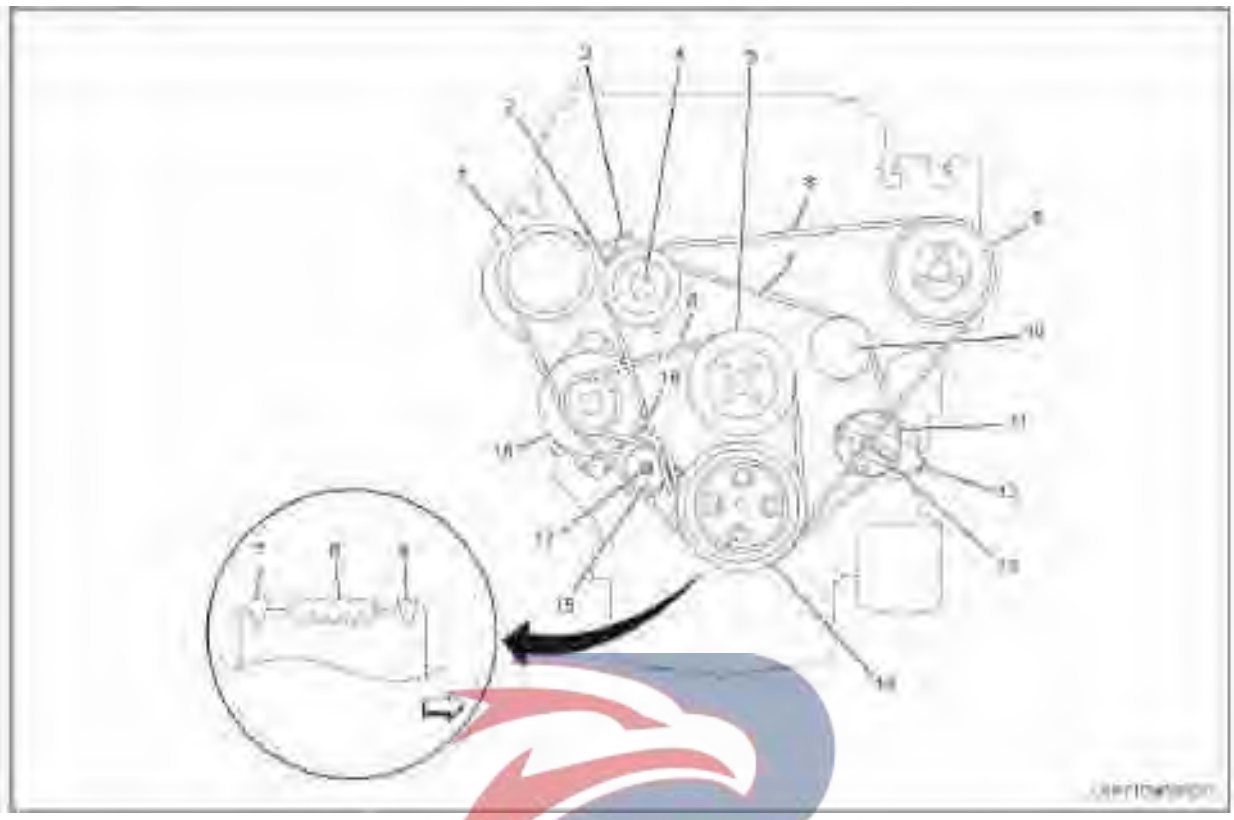
(50A specifications)



Key

1. Air conditioning compressor
2. Adjust the bracket lock nut
3. Adjust support
4. Air conditioning compressor drive belt
5. Water pump pulley (fan pulley)
6. Tension wheel locknut
7. Tension pulley
8. Tension pulley adjustment bolt
9. Crankshaft pulley
10. Fan belt
11. Generator fixing bolts
12. Generator
13. Adjust the bolt

(80A specifications)



Key

1. Air conditioning compressor
2. Tension pulley (for refrigerator compressors)
3. Tension adjustment bolt (for refrigerator compressors)
4. Tension wheel locknut (for refrigerator compressors)
5. Water pump pulley (fan pulley)
6. Fan belt
7. Air conditioning compressor drive belt
8. Compressor drive belt
9. Freezer compressor
10. Deflection pulley (for air conditioning compressors)
11. Tensioning pulley (for air conditioning compressors)
12. Tension adjustment bolt (for air conditioning compressors)
13. Tension wheel locknut(for air conditioning compressors)
14. Crankshaft belt pulley
15. Tension pulley (for fan belt)
16. Tension adjustment bolt (for fan belt)
17. Tension pulley lock nut (for fan belt)
18. Generator

Inspection

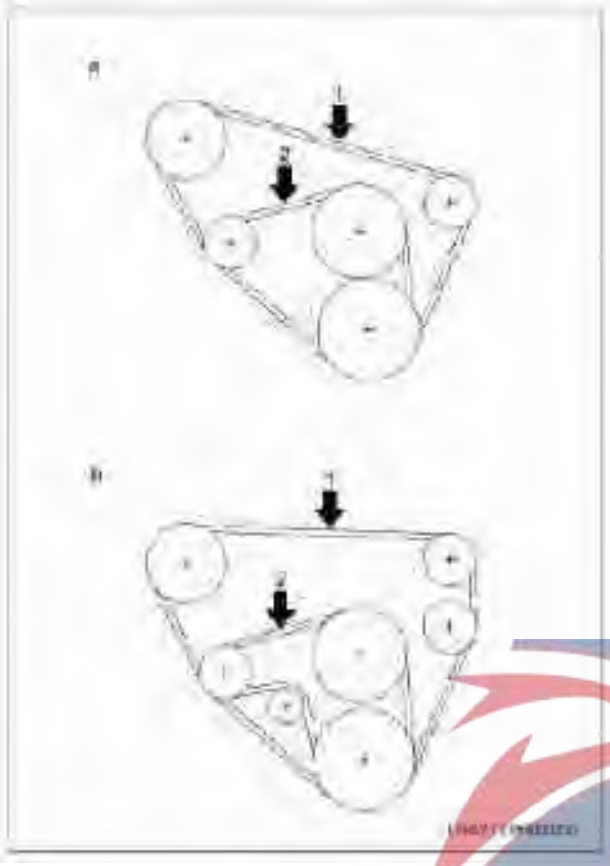
Check worn or damaged drive belts and replace if necessary. In addition, check the belt tension and adjust if necessary.

Verify basic elements

With a force of 98N {10kgf}, press each part of the belt to check the curvature.

Voltage between pulley and A/C compressor (1)	
The amount of bending of the belt	18∽23mm(New belt time)
	24∽27mm(Old belt time)

Between generator pulley and fan pulley (2)	
The amount of bending of the belt	5∽7mm(New belt time)
	6∽8mm(Old belt time)



Key

(A) 50A specifications

(b) 80A specifications

Reference

Note:

The fan belt is a ribbed V-belt that requires more precise tension adjustment than previous V-belts. If the voltage is insufficient, the life and noise of the belt will be reduced. Tension meters can be used to confirm the correct settings.

Belt type		Bending amount (mm)	Vibration frequency (Hz)
Fan belt (50A specifications)	New belt time	5~7	208~232
	Old belt time	6~8	178~190
Fan belt (80A specifications)	New belt time	5~7	187~209
	Old belt time	6~8	161~173
Air conditioning compressor drive belt	New belt time	18~23	59~73
	Old belt time	24~27	51~59

Adjustment

Both the fan belt and the compressor drive belt are pulled tight.

Mark:

Adjust the fan belt and adjust the compressor drive belt.

50A specification fan belt adjustment

1. Loosen the lock nuts and adjusting bolts of the air compressor compressor drive belt tensioner to loosen the belt.
2. Loosen the lock nut on the adjustment bracket and the through bolt.
3. Turn the adjusting screw to adjust the fan belt.
4. After adjustment, tighten the carrier lock nut and bolt to the specified torque.

Tightening torque: locknut = 24N•m {2.4kgf•m}

Through bolts = 40 N•m {4.1kgf•m}

80A specification fan belt adjustment

1. Loosen the lock nuts and adjusting bolts of the air compressor compressor drive belt tensioner to loosen the belt.
2. Loosen the lock nut on the fan belt tensioner.
3. Turn the fan belt tensioner adjustment screw to adjust the fan belt.
4. After adjustment, tighten the fan belt and tighten the pulley lock nut to the specified torque.

Tightening torque: locknut = 41N•m {4.2kgf•m}

Adjusting air conditioner compressor belt

1. Loosen the tension nut of the tensioner.
2. Turn the tensioner adjustment bolt to adjust the belt.
3. After adjustment, tighten the locknut to the specified torque.

Tightening torque: locknut = 27N•m {2.8kgf•m}

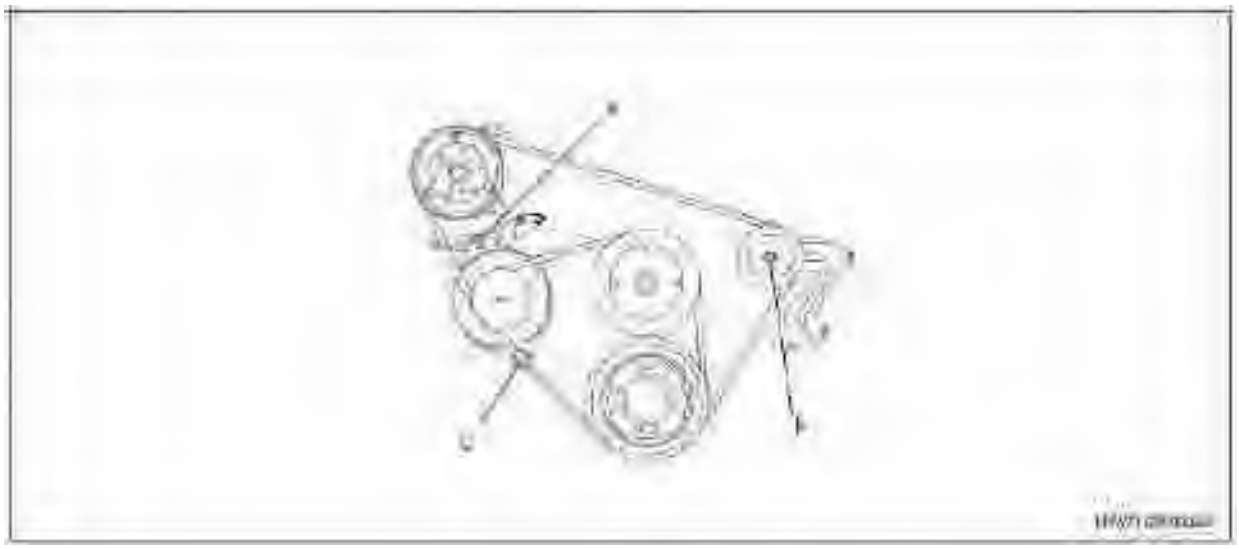
Adjust the refrigerator compressor drive belt

1. Loosen the tension nut of the tensioner.
2. Turn the tensioner adjustment bolt to adjust the belt.
3. After adjustment, tighten the locknut to the specified torque.

Tightening torque: locknut = 27N•m {4.1kgf•m}

Tightening torque - Overview

50A specifications

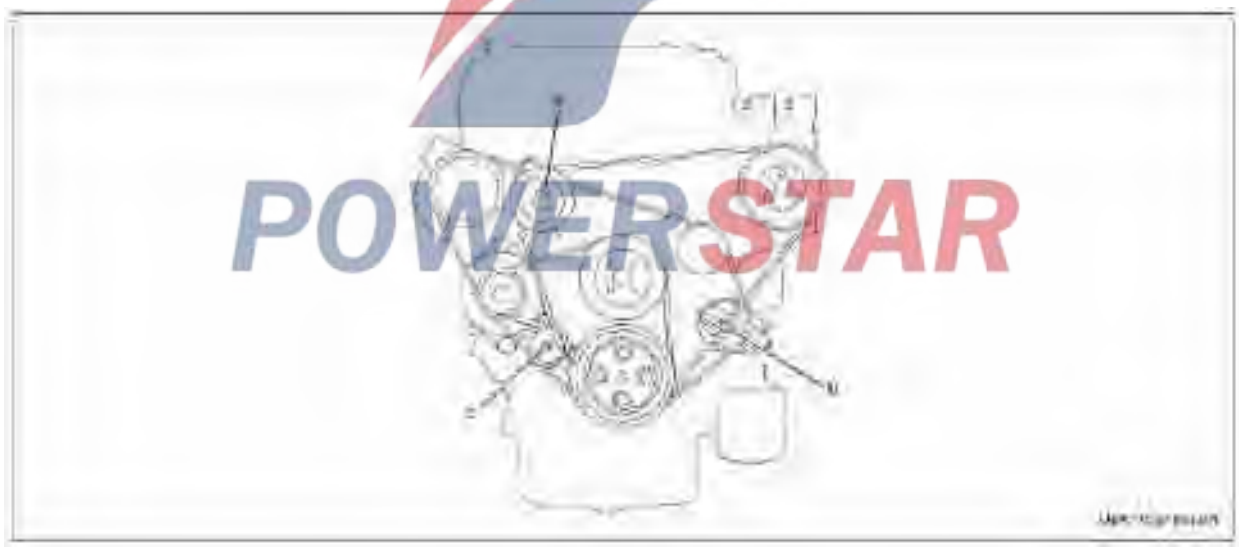


(a) 24 N•m {2.4kgf•m}

(b) 27 N·m {2.8kgf·m}

(c) 40 N·m {4.1kgf·m}

80A specifications



(a) 40 N·m {4.1kgf·m}

(b) 27 N·m {2.8kgf·m}

(c) 41 N·m {4.2kgf·m}

Section 4D

Engine Fuel System

Table of Contents

Fuel System

Precautions

Inside the fuel injector, the holes and gaps of the fuel passages of the fuel system undergo high precision polishing. To prevent foreign matter from entering and causing a malfunction, the lid or lid must be closed after removing the parts.

The identification plate of the syringe is unique to each syringe and cannot be confused with other syringe identification cards.

When replacing the injector assembly, use the analysis tool to program the ID code into the ECM (engine control module). The programming method is described in the section of the IA engine control system (4HK1).

The water-removing agent in the fuel will draw moisture into the fuel and cause rust, so do not use water-removing agent in the fuel tank.

Operational essentials

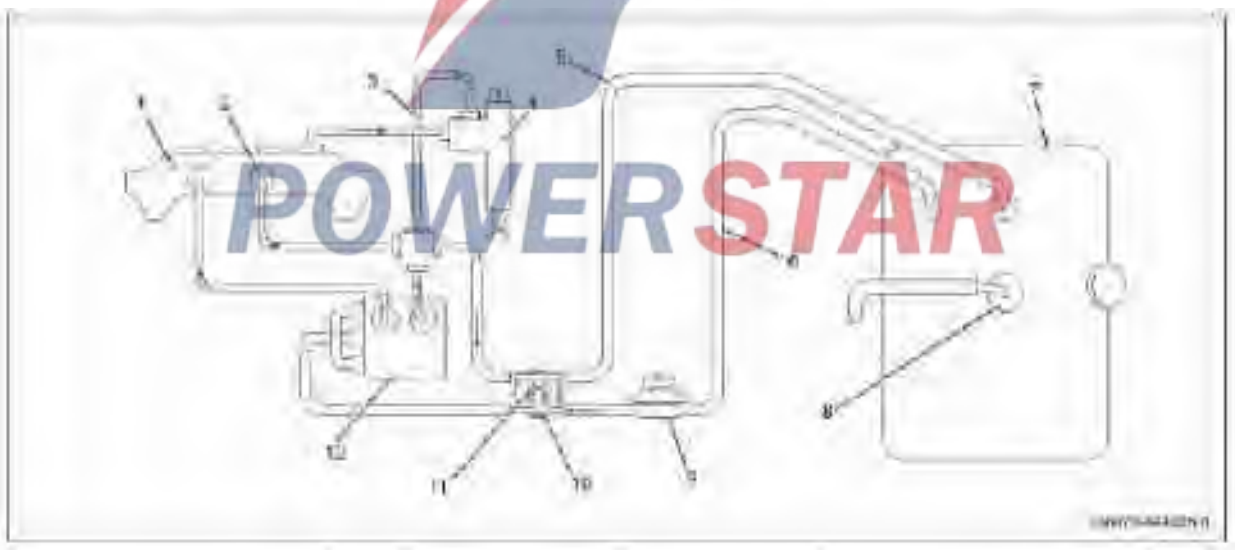
• When disassembling fuel hoses, fuel hoses, fuel injectors, fuel pumps, and common rails, the fuel ports should be sealed in time.

• Drilling bolts and seals should be stored in a clean room with lid to prevent foreign matter from adhering.

• Fuel leaks may cause a fire, so remove the escaped fuel after completion. After starting the engine, make sure there is no fuel leak.

Function and working principle

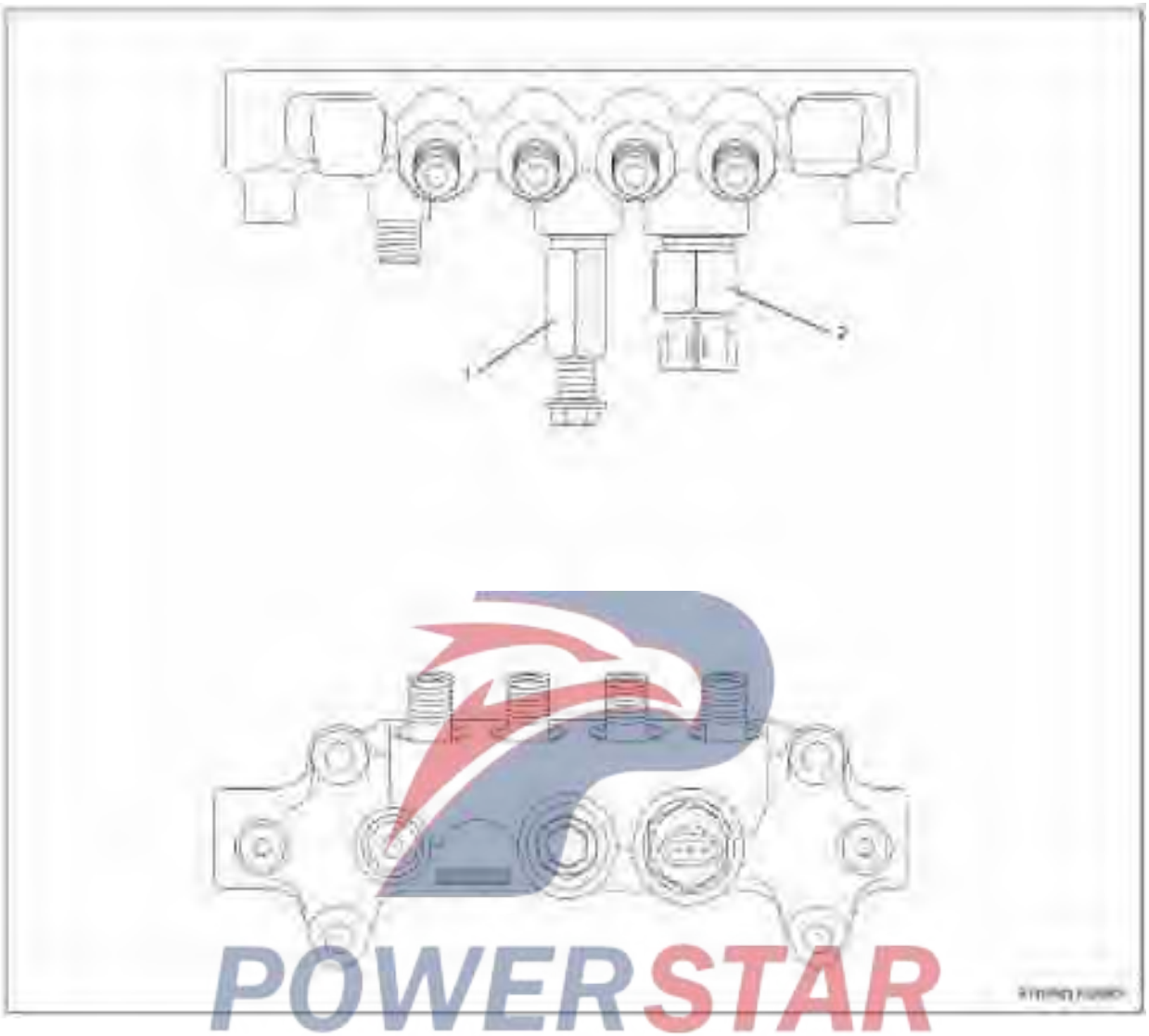
Fuel system diagram



Key

1. Common Rail
2. Pressure limiting valve
3. Return to the pipeline
4. Injector
5. Fuel return pipe
6. Fuel supply pipe
7. Fuel tank
8. Breather valve
9. Starter pump
10. Fuel filter (with oil-water separator)
11. Return valve
12. Oil feed pump

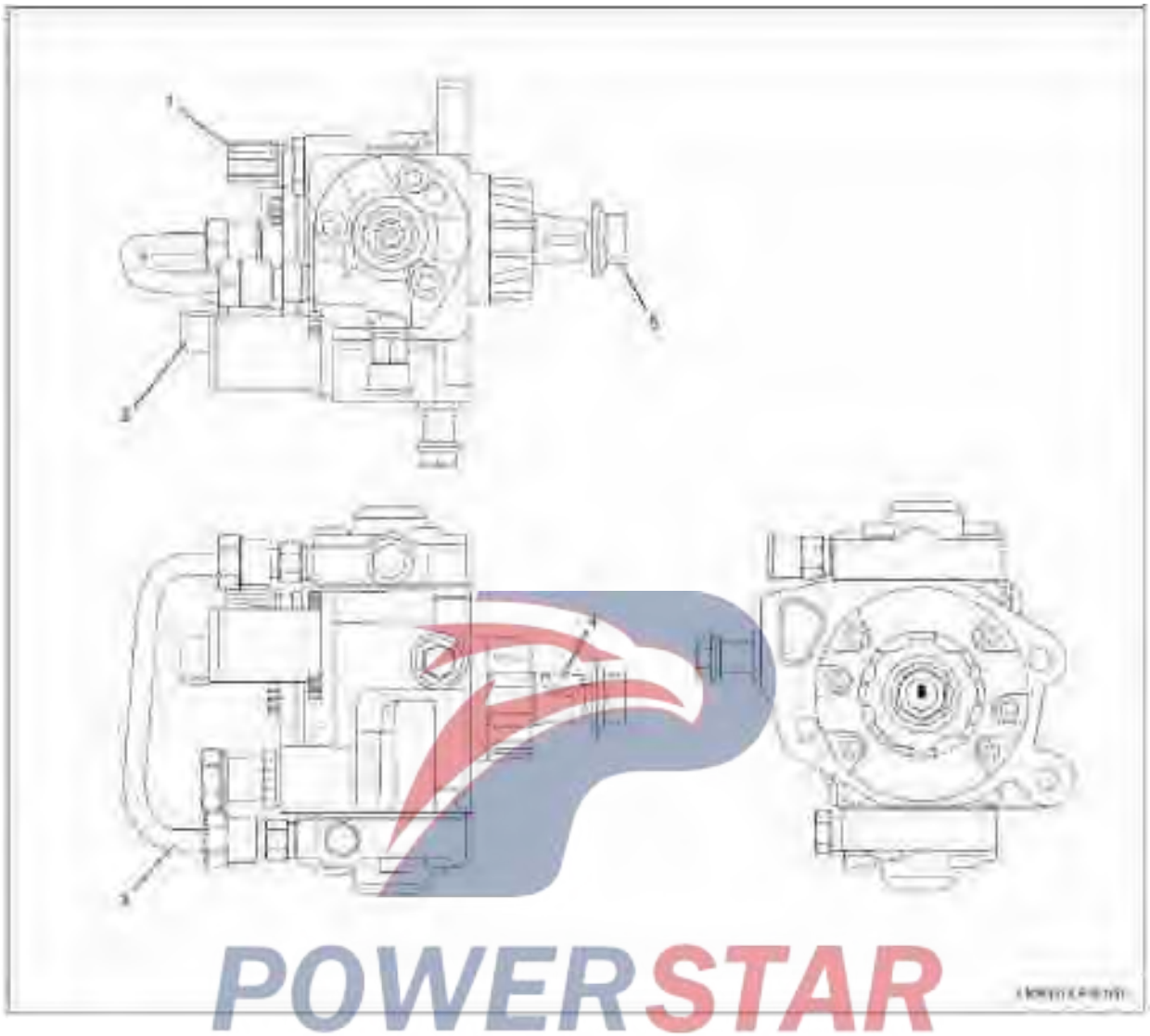
Common rail



Key

1. Pressure limiting valve
2. Remove the fuel pressure sensor

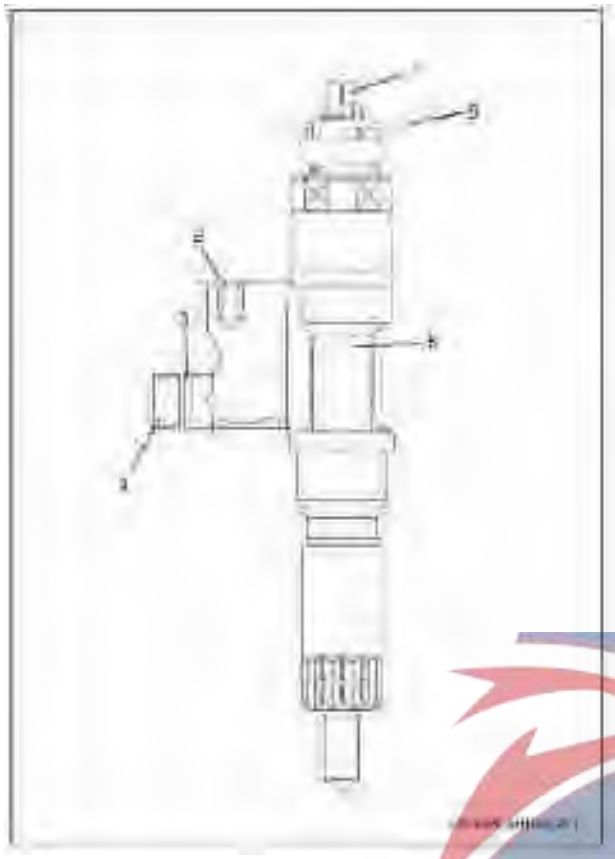
Oil feed pump



Key

1. Fuel temperature sensor
2. SCV intake control valve
3. High pressure tube
4. Camshaft key
5. Camshaft nuts

Injector



Key

1.Cable lugs

2. Return to the pipeline installation department

3. O-ring

4. Injection pipe installation part

5. Identification mark (4 digits after the electronic part number)

6. Injector ID code

Fuel Filter

Key

1. Element

2. Return valve

3. Filter body

4. Housing

5. Drain plug

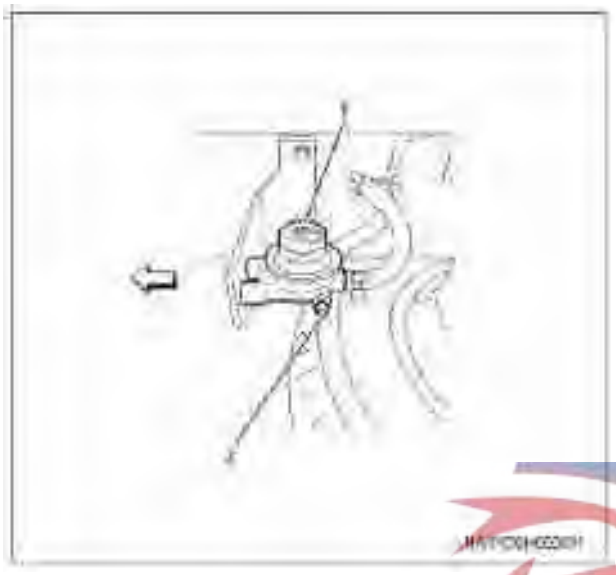
6. Switch connector

Functional check:

Exhaust (when fuel is exhausted)

1. Before starting the engine

a. Install the vinyl tube on the vent plug (2) and place the fuel tank (standpipe) under the vinyl tube.



b. Release the stop completely and press the priming pump (1) until there is no more air mixture.

c. Fully tighten the cap, wipe the surrounding fuel and press the main pump more than 10 times to transfer air from the fuel pump's fuel supply circuit to the return line.

d. Start the starter and start the engine.

2. After starting the engine

a. Without pressing the accelerator pedal, turn the starter and start the engine.

b. After starting, keep idle for 5 seconds.

c. Push the accelerator pedal to the end and raise it to full speed. Repeat this process several times.

Note:

If the exhaust gas is insufficient, the engine operation will be unstable, so it is necessary to perform the correct exhaust sequence after the engine is started.

Exhaust (after changing the fuel filter)

1. Before starting the engine

a. Install the vinyl tube (1), etc. On the fuel filter vent plug (2) and place the fuel tank (riser) under the vinyl tube.

b. Release the stop completely and press the starter pump until there is no more mixed air fuel.

c. Fully tighten the cap, wipe the surrounding fuel and press the main pump more than 20 times to transfer air from the fuel pump's fuel supply circuit to the return line.

d. Start the starter and start the engine.

2. After starting the engine

a. Without pressing the accelerator pedal, turn the starter and start the engine.

b. After starting, keep idle for 5 seconds.

c. Push the accelerator pedal to the end and raise it to full speed. Repeat this process several times.

Note:

If the exhaust gas is insufficient, the engine operation will be unstable, so it is necessary to perform the correct exhaust sequence after the engine is started.

Drainage

The indicator lights when the amount of water exceeding the specified amount (approximately 160cc) is accumulated in the water separator. At this point, follow the steps below to drain.

1. Install the vinyl tube at the front end of the drain plug.

2. Place the container on the front end of the vinyl hose installed on the drain plug.

3. Open the loose water plug.

4. Press several times to start emptying the pump.

5. After evacuation, tighten the drain plug.

6. Press the pump several times to check for fuel leaks.

7. Make sure the LED is off.

Mark:

Since the waste water contains fuel, it must be disposed of in accordance with the disposal regulations established by each region.

Symptom: Difficult starting

Symptom	Presumed reason	Treatment measures
Difficult starting	Empty fuel tank	Additional fuel
	Fuel freezing	Spray hot water, etc. To make the fuel filter and fuel supply pump warm.
	Tank ventilation pipe plugged	Clean tank fuel tank
	Mixed air in the fuel system	Exhaust
	Fuel line blocked or damaged. Loose connection of fuel hose	Repair or replace hose clamps to hoses connected to fuel lines
	Plugged fuel filter	Replace filter (except when fuel is frozen)
	Supply of chestnut oil decomposition	Replace oil supply pump
	Turn on the regulator	Replace control valve
	Injector connection nozzle	Replace the fuel injector
	Engine control system failure	Diagnostic Engine Control System For more information, Refer to IA Motor Control System (4HK1) Chapter Engine Control System

Symptom: Slow-motion surge

Symptom	Presumed reason	Treatment measures
Slow-motion surge	Fuel freezing	Slowly warm up and increase engine return temperature
	Blocking the tank vent pipe	Clean tank fuel tank
	Mixed air in the fuel system	Discharge air into the fuel system
	Fuel system leaks or plugs	Repair or replace the fuel system
	Water is mixed in the fuel system	Replace fuel
	Plugged fuel filter	Replace filter (except when fuel is frozen)
	Injector connection nozzle	Replace the fuel injector
	Injector lowers opening pressure, poor spraying conditions	Replace the fuel injector
	Fuel pump failure	Replace oil supply pump
	Engine control system failure	Diagnostic Engine Control System For more information, Refer to IA Motor Control System (4HK1) Chapter Engine Control System

Symptom: Insufficient power

Symptom	Presumed reason	Treatment measures
Insufficient power	Blocking the tank vent pipe	Clean tank fuel tank
	•Inclusion of air in fuel system.	Exhaust air from the fuel system
	Fuel system leaks or plugs	Repair or replace the fuel system
	Water is mixed in the fuel system	Replace fuel
	Plugged fuel filter	Replace filter (except when fuel is frozen)
	Injector connection nozzle	Replace the fuel injector
	Engine control system failure	Diagnostic Engine Control System For more information, Refer to IA Motor Control System (4HK1) Chapter Engine Control System

Symptom: Engine does not stop

Symptom	Presumed reason	Treatment measures
The engine does not stop	Engine control system failure	Diagnostic Engine Control System For more information, Refer to IA Motor Control System (4HK1) Chapter Engine Control System

Symptom: Exhaust is blue or black

Symptom	Presumed reason	Treatment measures
Exhaust is blue or black	Injector lowers opening pressure, poor spraying conditions	Replace the fuel injector
	Engine control system failure	Diagnostic Engine Control System For more information, Refer to IA Motor Control System (4HK1) Chapter Engine Control System

Main parameters

Fuel pump specifications

Item	Parameter
Type of fuel injection pump	Electronically controlled fuel injection system (common rail type)
Feed pump type	HP-3 (electrical equipment manufacturing)
Rotation direction	Observe on the left side of driving direction
Diameter of diver	Ø8.5×2
Open the pressure of the valve MPa{kgf/cm2}	0.5 {5.1}
Oil feed pump	Rotor type

Injector specifications

Item	Parameter
Injector type	D×1534
Nozzle hole diameter × number of holes	Ø 0.14mm×7

Special tools

Illustration	Tool number Tool name
	5-8840-0019-0 Slide hammer
	5-8840-2826-0 Syringe removal tool

Fuel filter element

Precautions

• Replace the fuel filter element every 10,000 kilometers or every 6 months.

Disassembly

1. Drain the fuel into the filter housing.

A. Loosen the drain plug at the bottom of the filter housing.

B. Loosen the exhaust plug of the filter body and discharge the fuel.

2. Remove the water separator connector from the filter housing.

3. Use a socket wrench (29 mm) or universal wrench to remove the filter housing.

4. Remove the filter element and remove the O-ring around the filter.

5. If foreign matter builds up on the inner periphery of the filter body, wipe it with a cloth or similar object.

Note:

Do not use blowers (fans) or other equipment to remove foreign objects and prevent foreign objects from blowing into clean channels, causing the fuel pump to malfunction.

Key

1. Filter body
2. Filter element housing
3. Drain plug
4. Floater
5. Seal gaskets(outside)
6. Seal gaskets(inside)
7. Clean the end hole
8. The corresponding element of the filter element
9. O-ring groove
10. Sleeve mounting section
11. Exhaust plug

Installation

1. Insert the O-ring into the groove on the outside of the filter. Be careful not to damage the O-ring in the threaded portion of the filter body.

2. Add clean fuel to the inner and outer seals of the filter element and insert the filter element into the deepest part.

Mark:

Prevent foreign matter from entering the four holes next to the inner seal.

3. Apply clean fuel to the inner surface of the filter housing or O-ring and turn the filter clockwise until it contacts the filter body and avoid biting. In the O-ring.

If the filter body is not touched, it means that the depth of the filter insert is insufficient, and therefore the filter element is pressed while rotating the filter element.

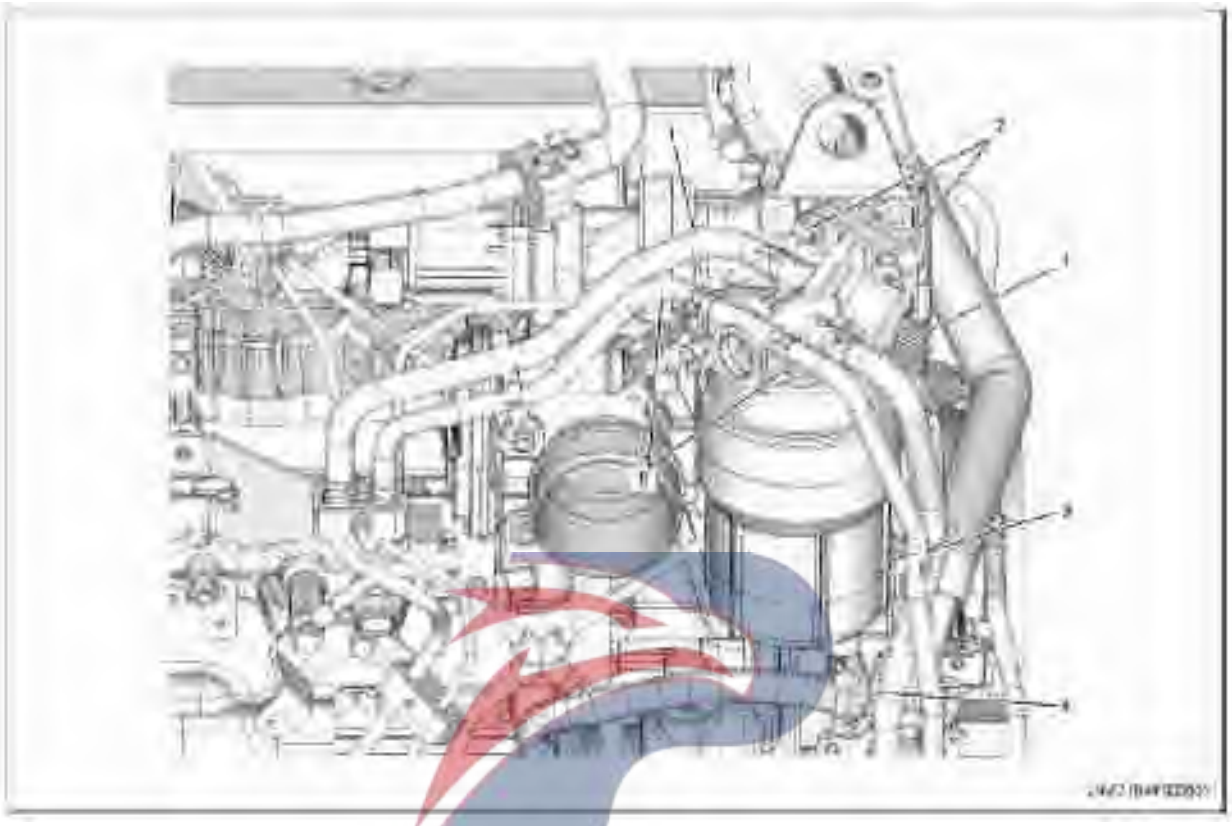
4. Tighten the filter housing to the specified torque.

Tightening torque : 33 N•m {3.4kgf•m}

5. Retighten the filter housing drain plug and connect the water separator harness connector.

Fuel filter assembly

Component parts



Key

1. Fuel supply hose
2. Nuts
3. Fuel filter assembly
4. Water separator harness connector
5. Fuel return hose

Disassembly

1. Disconnect the water separator connector.
2. Remove the supply line and the fuel filter return line.

• Connect hoses and plugs to prevent spillage of fuel. In this case, prevent foreign matter from mixing in. Do not use rusted bolts, etc.

3. Remove the nut fixing the fuel filter.
4. Remove the fuel filter assembly.

Installation

1. Install the fuel filter assembly.
2. Install the nut fixing the fuel filter.
3. Install the oil supply pipe and return pipe.
4. Install the water separator harness connector.
5. Exhaust.

Refer to the power system in this chapter.

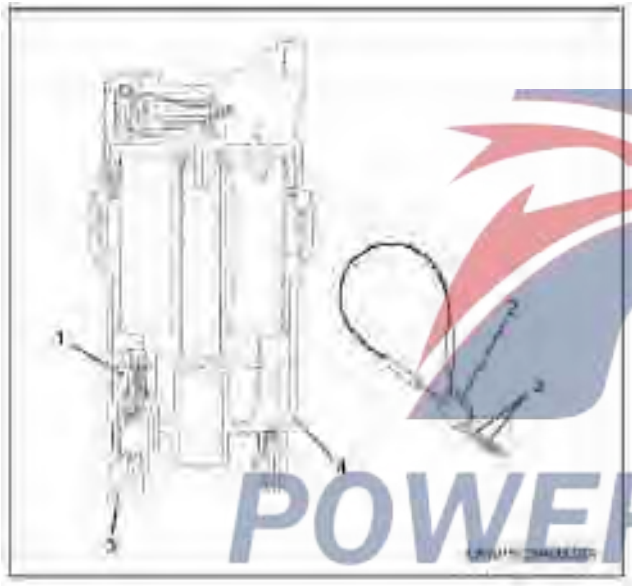
Water separator switch

Inspection

1. Remove the filter element housing and turn it over to check if the switch connector terminals are connected when the buoy floats.

2. Turn on the ignition switch and disconnect the engine harness connector on the water separator connector to make sure the water separator indicator lights up when the engine harness connector terminals are open.

If a malfunction occurs, replace the fuel filter housing or repair the circuit and make the wrong connection and disconnection.

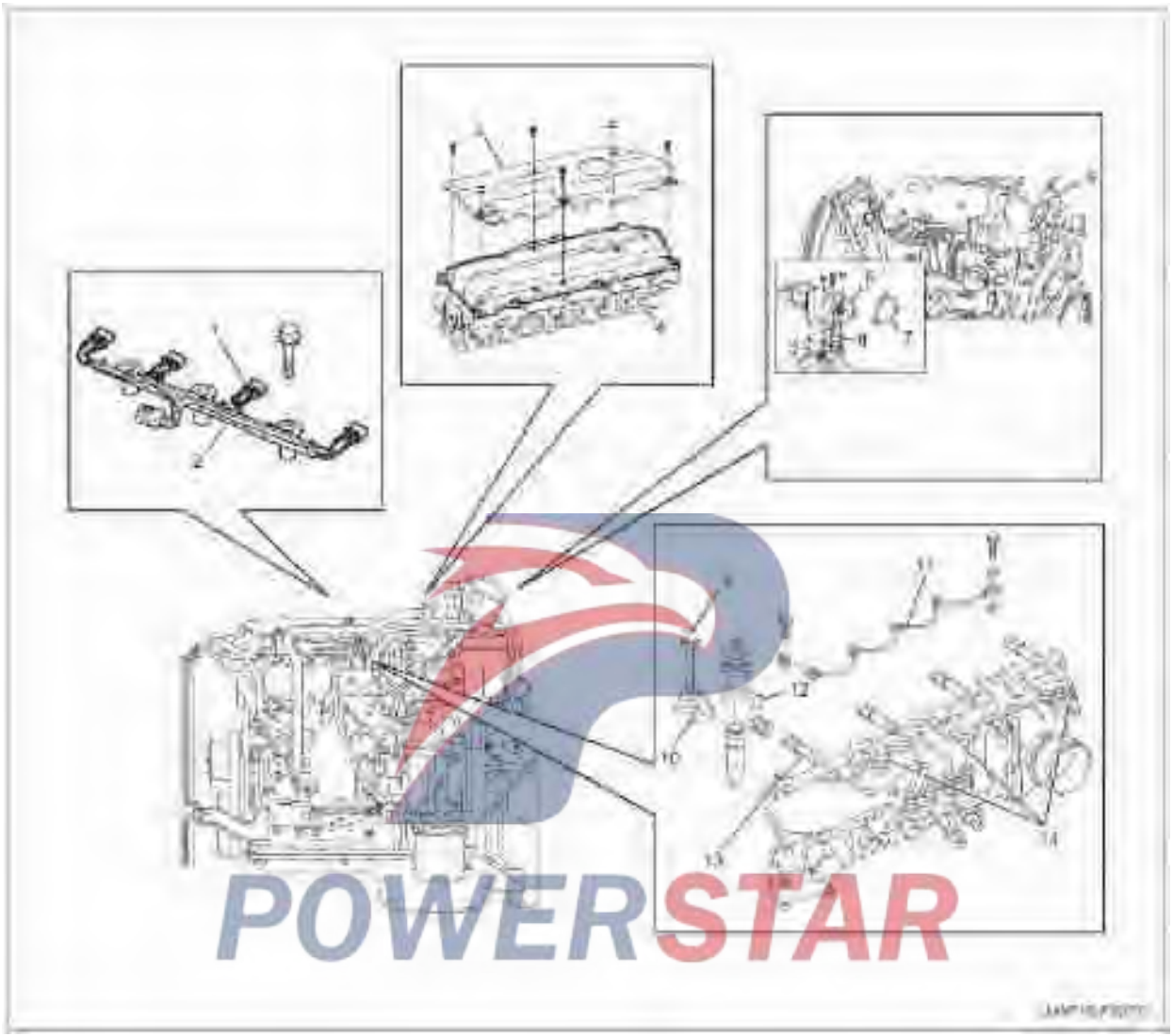


Key

1. Floater
2. Engine harness connector
3. Engine wiring harness
4. Filter element housing
5. Switch connector

Injector

Component parts



Key

Terminal syringe
2. Syringe harness bracket
3. Noise cover
4..Cylinder head cover
5.EGR (Exhaust Gas Recirculation) Adapter
6. EGR valve
7. Seal gaskets
8. Seal gaskets
9. Injector fixing bolt
10. Syringe pressure plate
11. Return to the pipeline
12. Injector
13. Fuel injection pipe.
14. Clip

Inside the fuel injector, the holes and gaps of the fuel passages of the fuel system undergo high precision polishing. To prevent foreign matter from entering and causing a malfunction, the lid or lid must be closed after removing the parts.

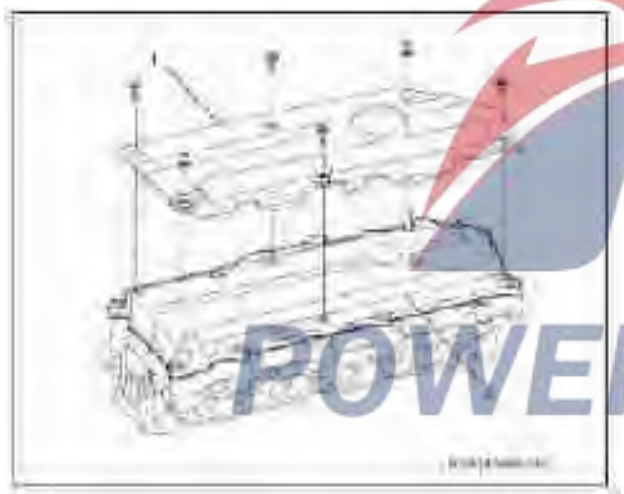
Disassembly

1. Remove the EGR valve and injector connector.
2. Remove the EGR adapter (1) and EGR valve (2).

• Cover the end opening of the EGR housing with tape or other material to prevent foreign matter from entering.

3. Remove the noise enclosure.

4. Remove the cylinder head cover.



Key

1. Soundproof cover

2..Cylinder head cover

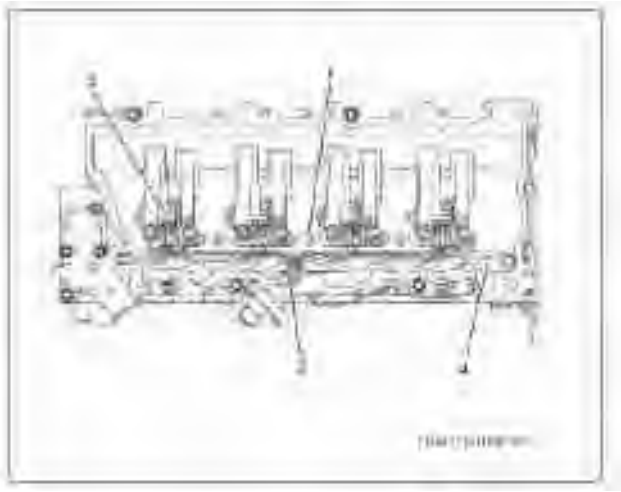
5. Evenly loosen the coupling nut of the injector (3) and remove the terminal.

Mark:

The syringe's ID code is unique to each syringe and must be accompanied by a digital label for safekeeping to avoid confusion with other syringes.

6. Loosen the injector harness bracket bolts, remove the internal connector (2), and remove the harness holder (1).

7. Disassemble the injector return line (4).



Key

1. Harness bracket
2. Harness connector
3. Wire nut
4. Return to the pipeline

8. Remove the hose clamp (2) from the fuel injection hose and remove the fuel injection hose (1).

9. Loosen the mounting bolts of the injector platen.

10. When the syringe is difficult to remove, install the special tool syringe removal tool (2) over the syringe return line mounting section (3) and toward (1). Out.

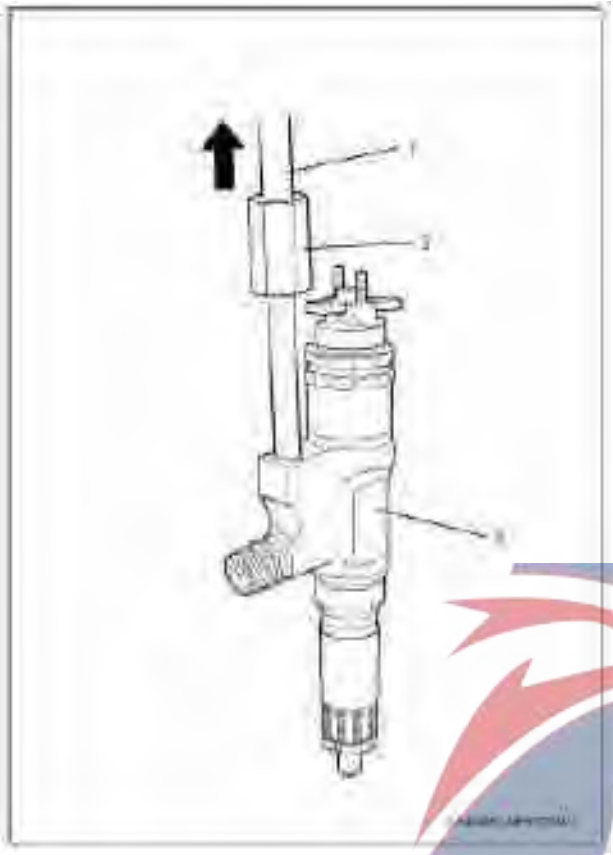
Special tools

Syringe removal tool 5-8840-2826-0

Slide hammer: 5-8840-0019-0

Mark:

When using the special tool to pull the injector, be careful not to remove the nozzle from the injector.



• The removed fuel injector must have a cylinder number attached for safekeeping. Be careful not to touch the fuel injection hole.

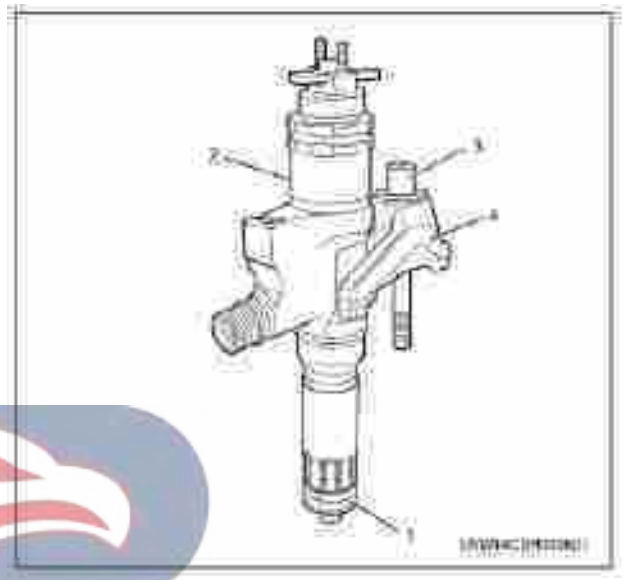
Caution:

Do not touch the oil filling hole to prevent the electromagnetic part of the syringe from dropping and being damaged.

Installation

1. As shown in the assembly drawing, insert the new washer and O-ring (1) onto the cylinder head when inserting the injector plate.

• Apply oil to the contact surfaces of the threaded parts and mounting bolts to preload them.



Key

1. Washers and O-rings
2. Injector
3. Bolt
4. Pressure plate

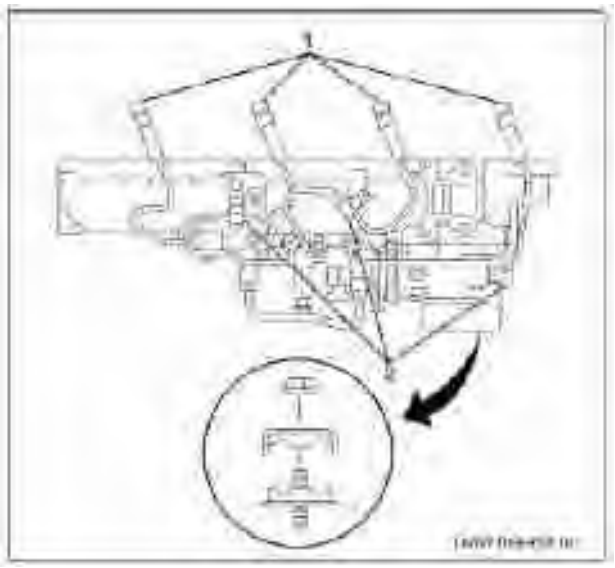
2. Use a hose clamp to fix the fuel spray hose in place on the assembly drawing.

• Apply a small amount of oil to the outer circumference of the syringe-side sleeve nut and assemble it.

• Lightly tighten the socket nut with a wrench until the injector and common rail are tight.

• Tighten the injector hose clamps according to the specified torque.

Tightening torque : 6N·m{0.6kgf·m}



Key

1. Fuel injection pipe.

2.Tube hoop

3. Tighten the injector mounting bolts before tightening the specified torque.

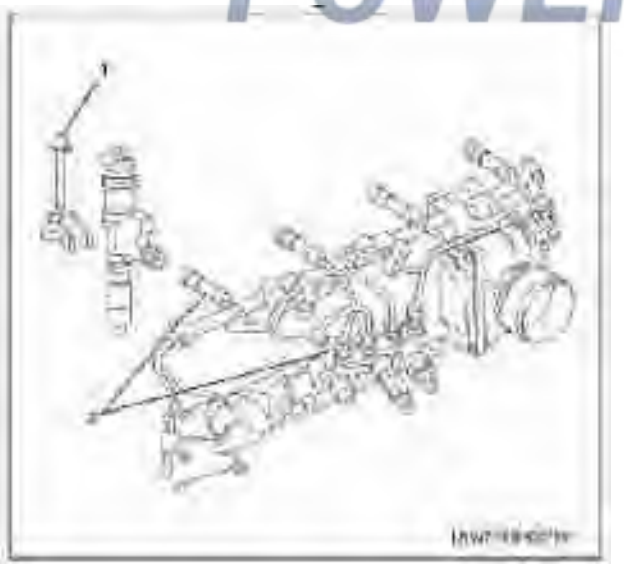
Tightening torque : 30 N•m {3.1kgf•m}

4. Tighten the fill hose to the specified torque.

Tightening torque:

Common Rail 25 N•m {2.5kgf•m}

Injector side 30 N•m {3.1kgf•m}



Key

1. Fixing bolts

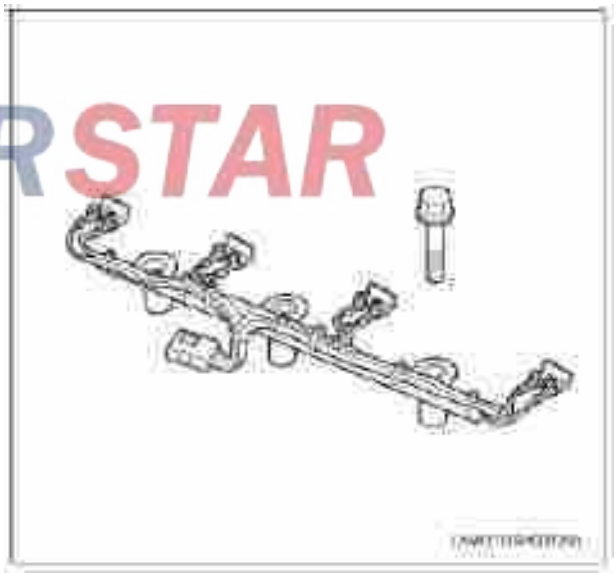
2. Fuel injection pipe.

5. Insert a new gasket, install the injector return line, and tighten the drill bolts to the specified torque.

Tightening torque : 12 N•m {1.2kgf•m}

6. Install the injector harness connector from the inside and tighten the harness carrier to the specified torque.

Tightening torque : 48 N•m {4.9kgf•m}



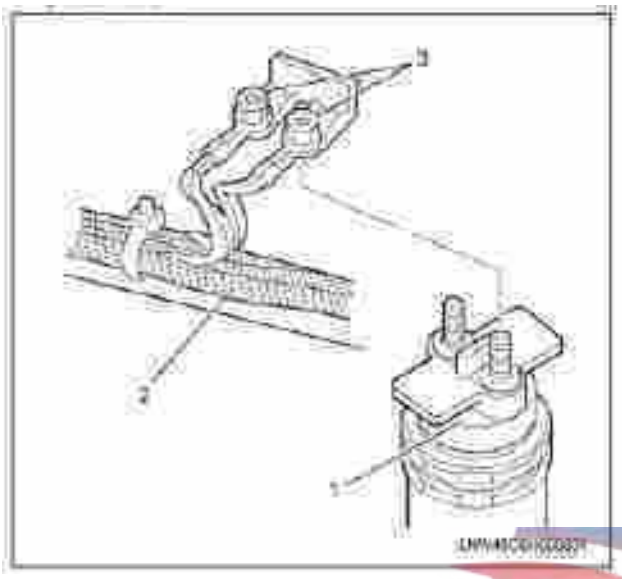
7. Install the wiring nut to the injector and tighten to the specified torque.

Tightening torque : 2 N•m {0.2kgf•m}

• Since the wiring nuts are fixed together, they must be tightened alternately 2 to 3 times instead of tightening first.

Caution:

Overtightening the nuts can damage the studs and do not over-tighten them.

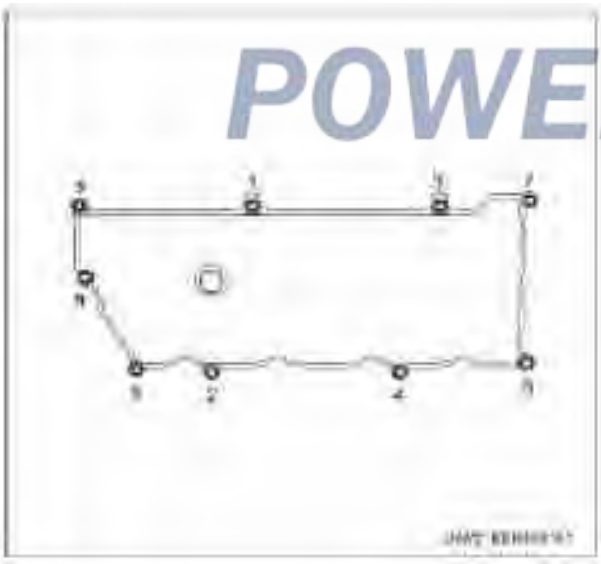


Key

1. Injector
2. Wire harness
3. Wire nut

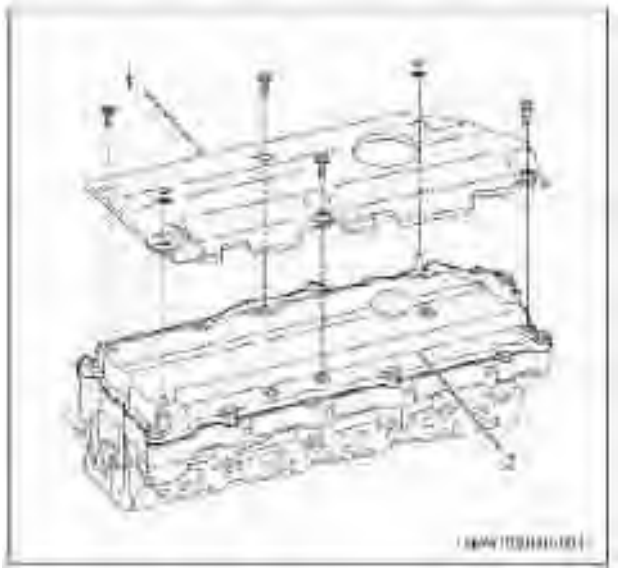
8. Install the cylinder head cover and washers and tighten them to the specified torque in the order listed.

Tightening torque : 18 N•m {1.8kgf•m}



9. Install the noise barrier and tighten it to the specified torque.

Tightening torque : 7 N•m {0.7kgf•m}



Key

1. Noise cover
2..Cylinder head cover

10. Install washers on EGR valve (2) and EGR adapter (1) for preassembly.

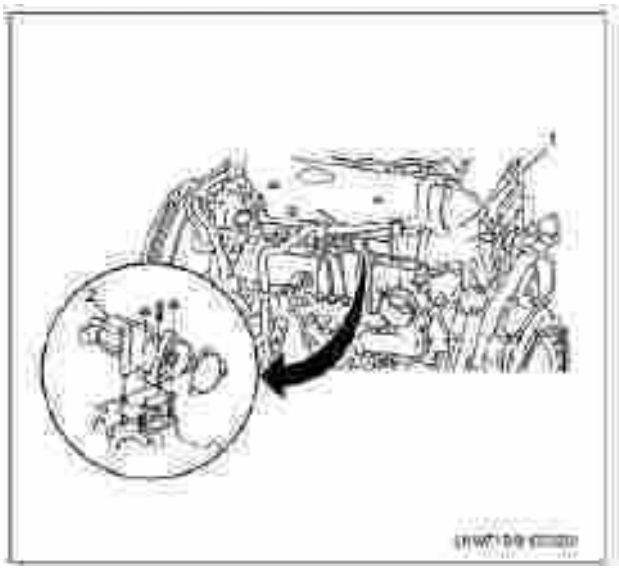
11. Fix the EGR valve (2) to the intake cover according to the specified torque.

Tightening torque : 24 N•m {2.4kgf•m}

12. Tighten the EGR adapter (1) to the specified torque.

Tightening torque:

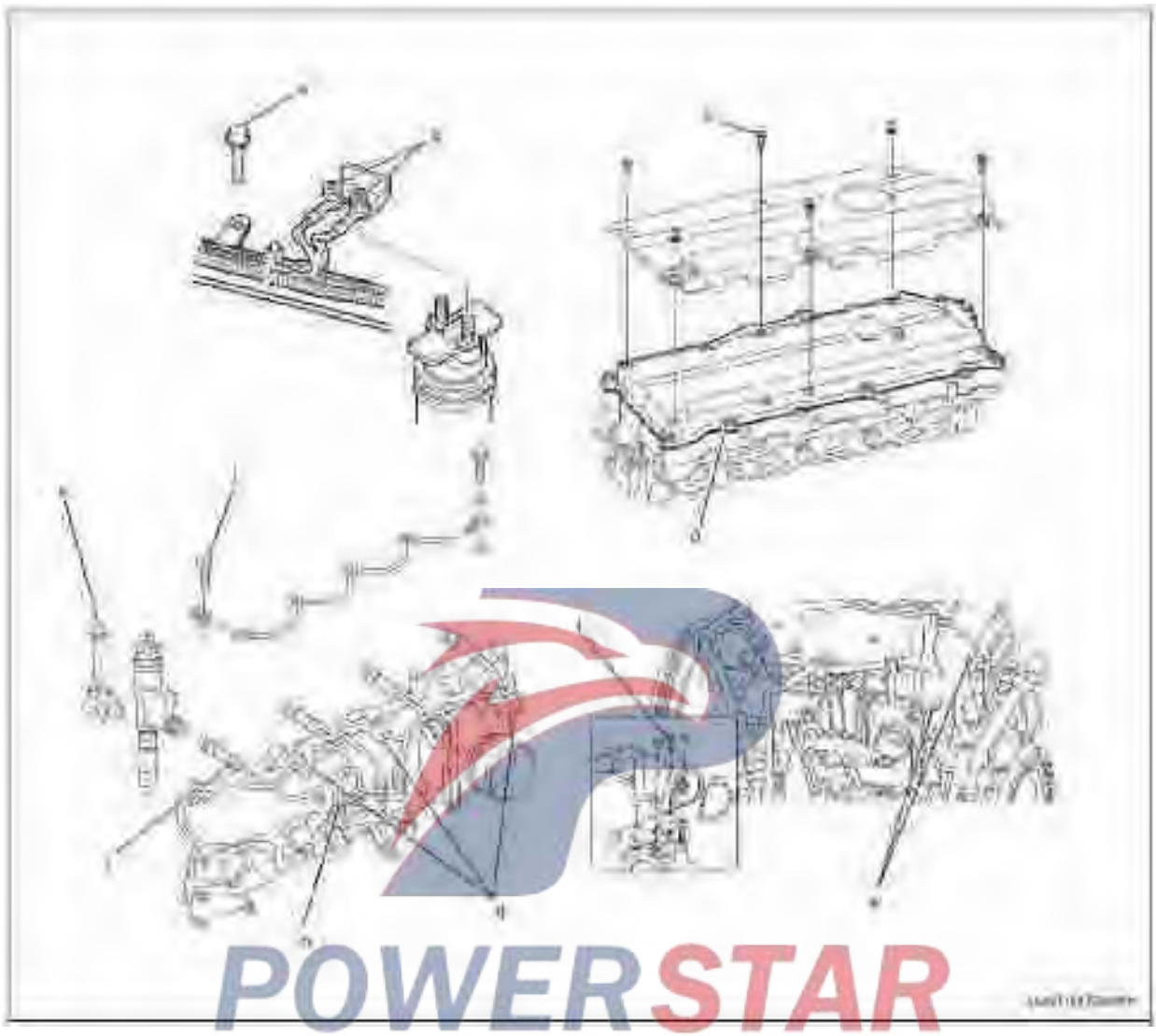
EGR valve side	24N•m {2.4kgf•m}
Cylinder cover side	104N•m {10.8kgf•m}
EGR cooler side	48 N•m {4.9kgf•m}



13. Install each motor harness connector.

• Adjust the fittings accurately until you hear a "cough sound."

Tightening torque - Overview



(a) 48 N·m {4.9kgf·m}

(b) 2 N·m {0.2kgf·m}

(c) 7 N·m {0.7kgf·m}

(d) 18 N·m {1.8kgf·m}

(e) 24 N·m {2.4kgf·m}

(f) 24N·m{2.4kgf·m}

(g) 6 N·m {0.6kgf·m}

(h) 25 N·m {2.5kgf·m}

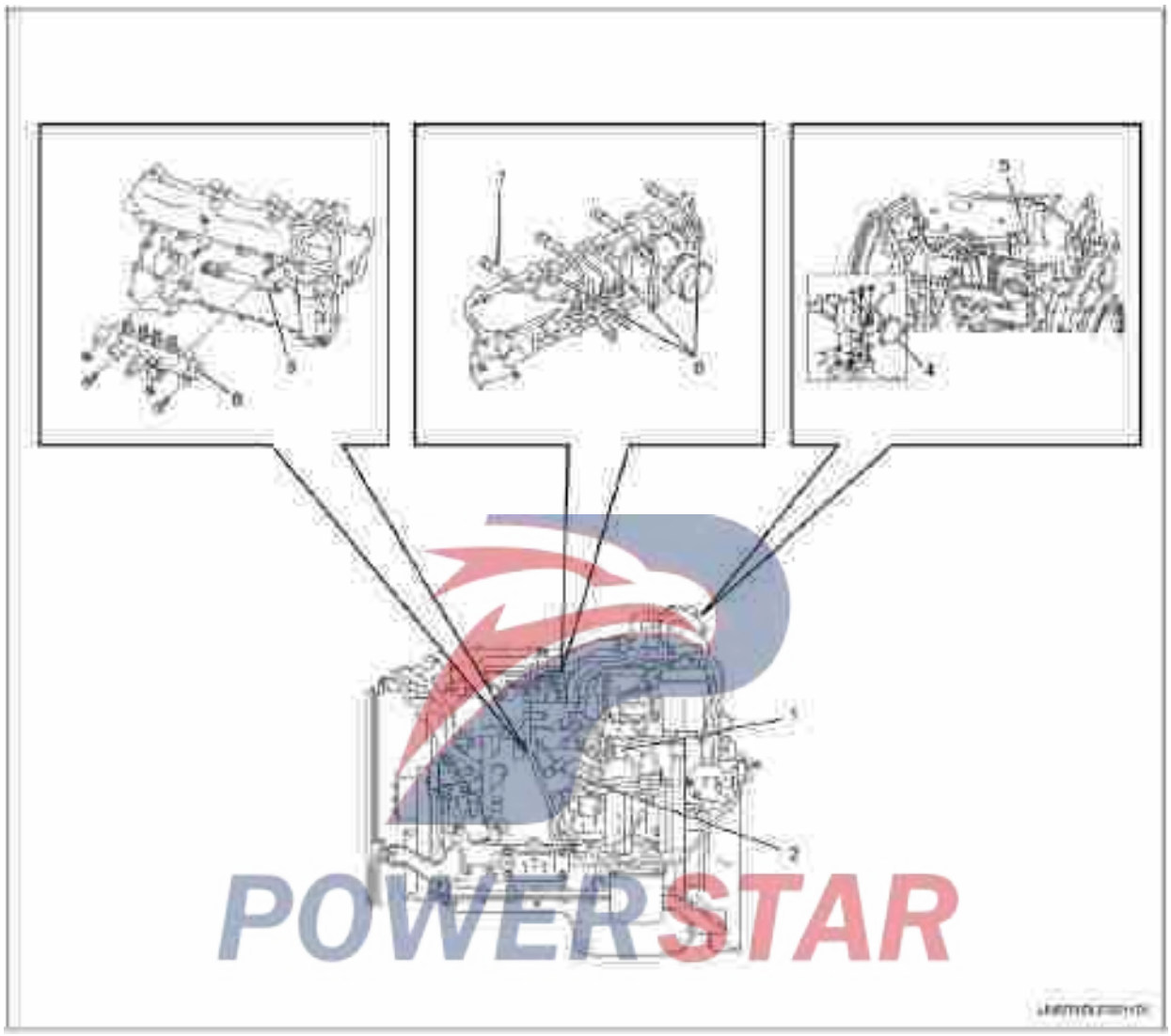
(i) 30 N·m {3.1kgf·m}

(j) 12N·m{1.2kgf·m}

(k) 30N·m{3.1kgf·m}

Common rail

Component parts



Key

1. Fuel return pipe
2. Fuel hose
3. EGR valve
4. EGR valve seal pad
5. EGR Adapter
6. Spray hose clamp
7. Fuel injection pipe.
8. Common Rail
9. Common Rail Support

Inside the fuel injector, the holes and gaps of the fuel passages of the fuel system undergo high precision polishing. To prevent foreign matter from entering and causing a malfunction, the lid or lid must be closed after removing the parts.

Disassembly

1. Remove intake hose.

Key

1. Intake pipe
2. Intake pressure sensor

2. Remove the common rail fuel pressure sensor connector and EGR valve connector.

3. Remove the oil return hose from the return line.

• The removed fuel hose must be covered with a stopper and fixed upward with a wire or the like.

4. Remove the EGR adapter (1) and EGR valve (2).

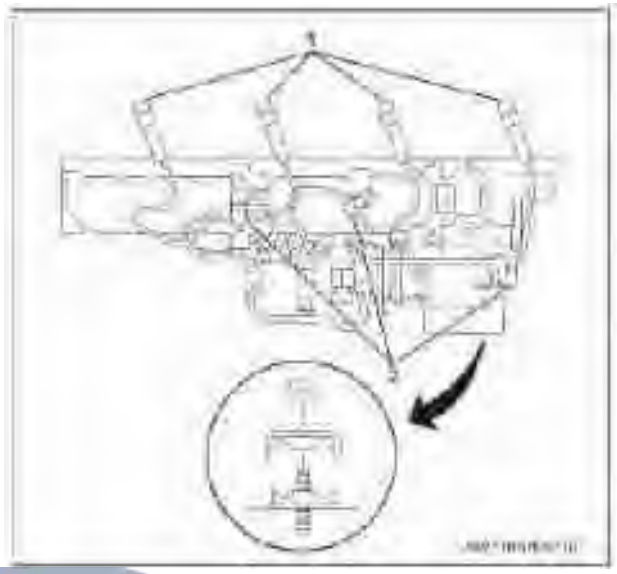
• To prevent foreign matter from entering the opening of the EGR housing, seal it with tape or the like.

Key

1. EGR Adapter
2. EGR valve

5. Remove the dipstick and remove the catheter.

6. Remove the fuel hose clamp (2) and remove the fuel hose (1).

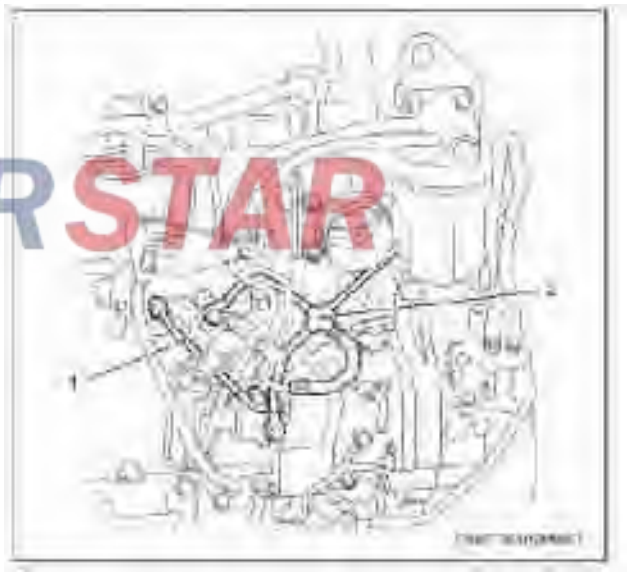


Key

1. Fuel injection pipe.
2.Tube hoop

7. Remove the fuel line (1).

8. Remove the ring and remove the return line (2).



Key

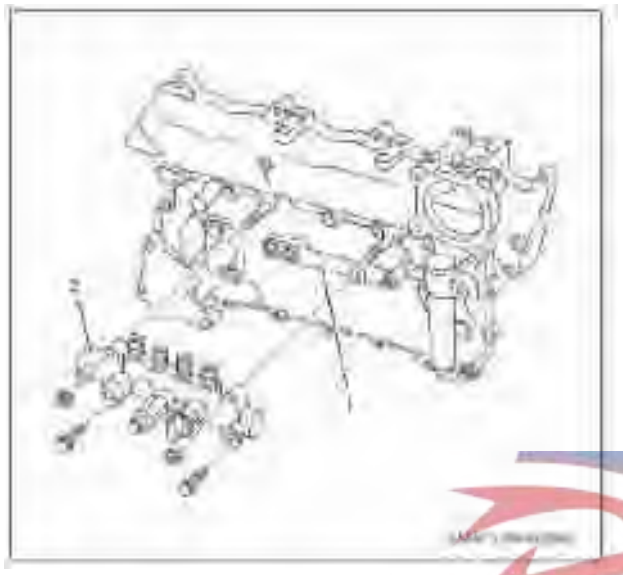
1. Fuel hose (high pressure)
2. Fuel return pipe

9. Remove the common rail (2) and common rail bracket (1).

Mark:

• Avoid using pressure relief valves and pressure sensors when removing common rail bodies.

• Be careful not to damage the connector part of the pressure sensor.



Key

1. Support

2. Common Rail

Installation

1. Install the common rail bracket (1) and tighten it to the specified torque.

Tightening torque : 19 N•m {1.9kgf•m}

2. Install the common rail (2) and tighten it to the specified torque.

Tightening torque : 19 N•m {1.9kgf•m}

Key

1. Support

2. Common Rail

3. Install the fuel return pipe (1) and tighten the hole bolts and clamp to the specified torque.

Tightening torque (2): 10 N•m {1.0kgf•m}

(3): 12N·m{1.2kgf·m}

(4): 8 N·m {0.8kgf·m}

4. Install the fuel hose (5) and tighten the nut to the specified torque.

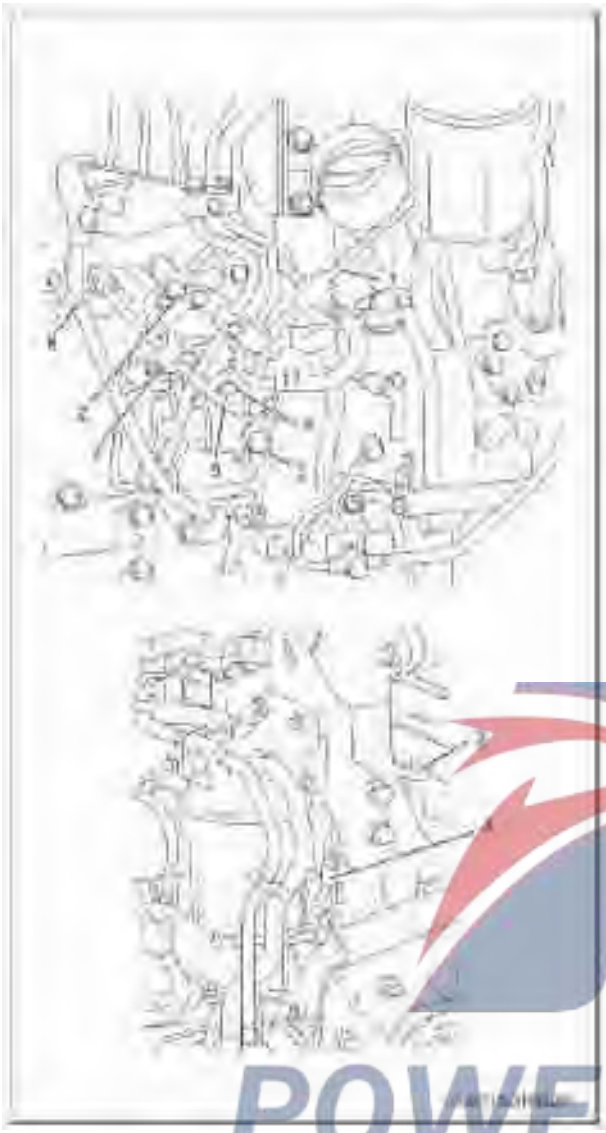
Tightening torque (6): 44 N•m {4.5kgf•m}

(7): 6 N·m {0.6kgf·m}

(8): 44 N·m {4.5kgf·m}

Mark:

The fuel pipe (4) has directionality. When installing, the surface of the sleeve nut on the common rail side should be colored yellow and the side of the oil supply pump should be green.



5. Install the fuel injection hose and clamp and tighten to the specified torque.

• Apply a small amount of oil to the outer circumference of the syringe-side syringe nut and assemble it.

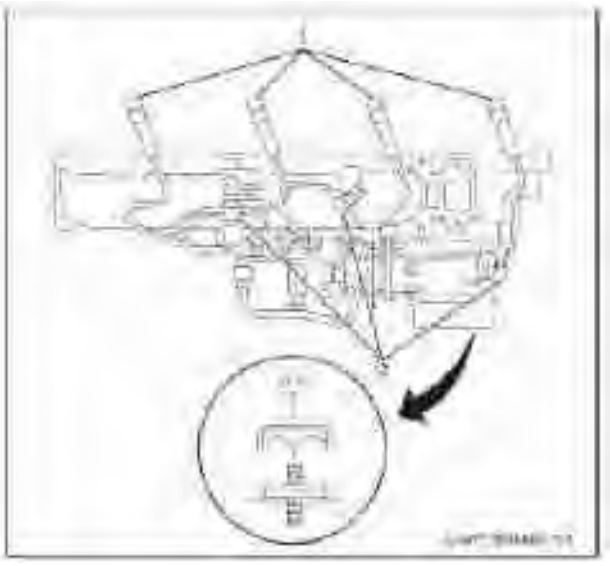
Tightening torque of sleeve nut

Common Rail 25 N•m {2.5kgf•m}

Injector side 30 N•m {3.1kgf•m}

Pipe loop

Tightening torque : 6 N•m {0.6kgf•m}



Key

1. Fuel injection pipe.

2.Tube hoop

6. Install scales and tubing.

7. Install seals on EGR valve (2) and EGR adapter (1) for preassembly.

8. Fix the EGR valve (2) to the intake cover according to the specified torque.

Tightening torque : 24 N•m {2.4kgf•m}

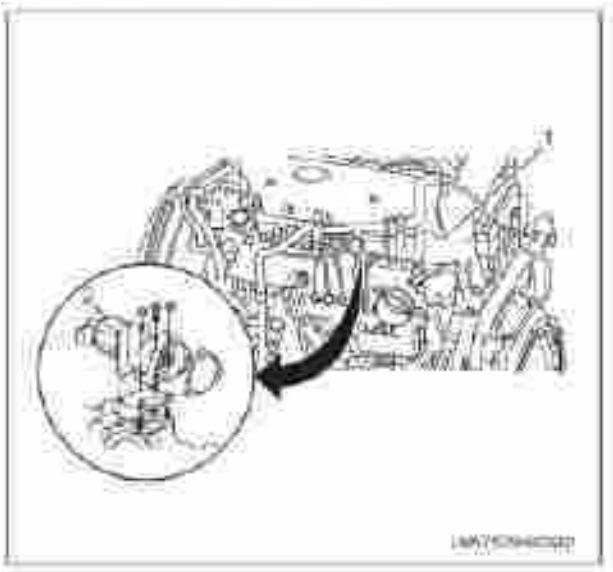
9. Tighten the EGR adapter (1) to the specified torque.

Tightening torque:

EGR Valve side 24 N•m {2.4kgf•m}

Cylinder cover side 104 N•m {10.8kgf•m}

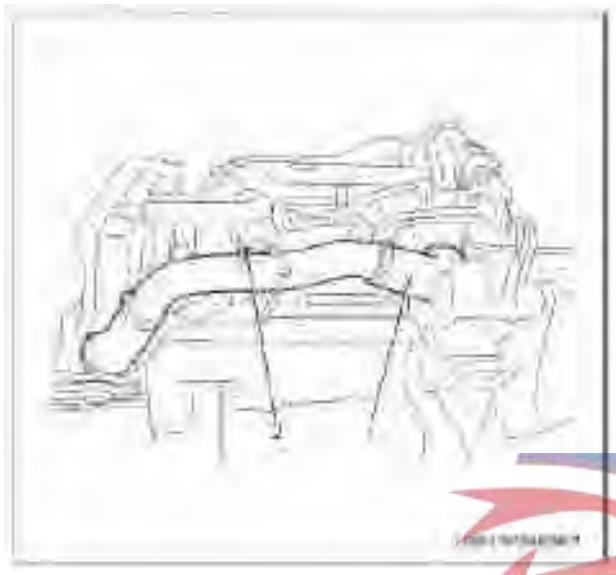
EGR cooler side 48 N•m {4.9kgf•m}



10. Install the oil return hose on the return line and secure it with a hose clamp.

11. Assemble the motor harness connector properly until it clicks into place.

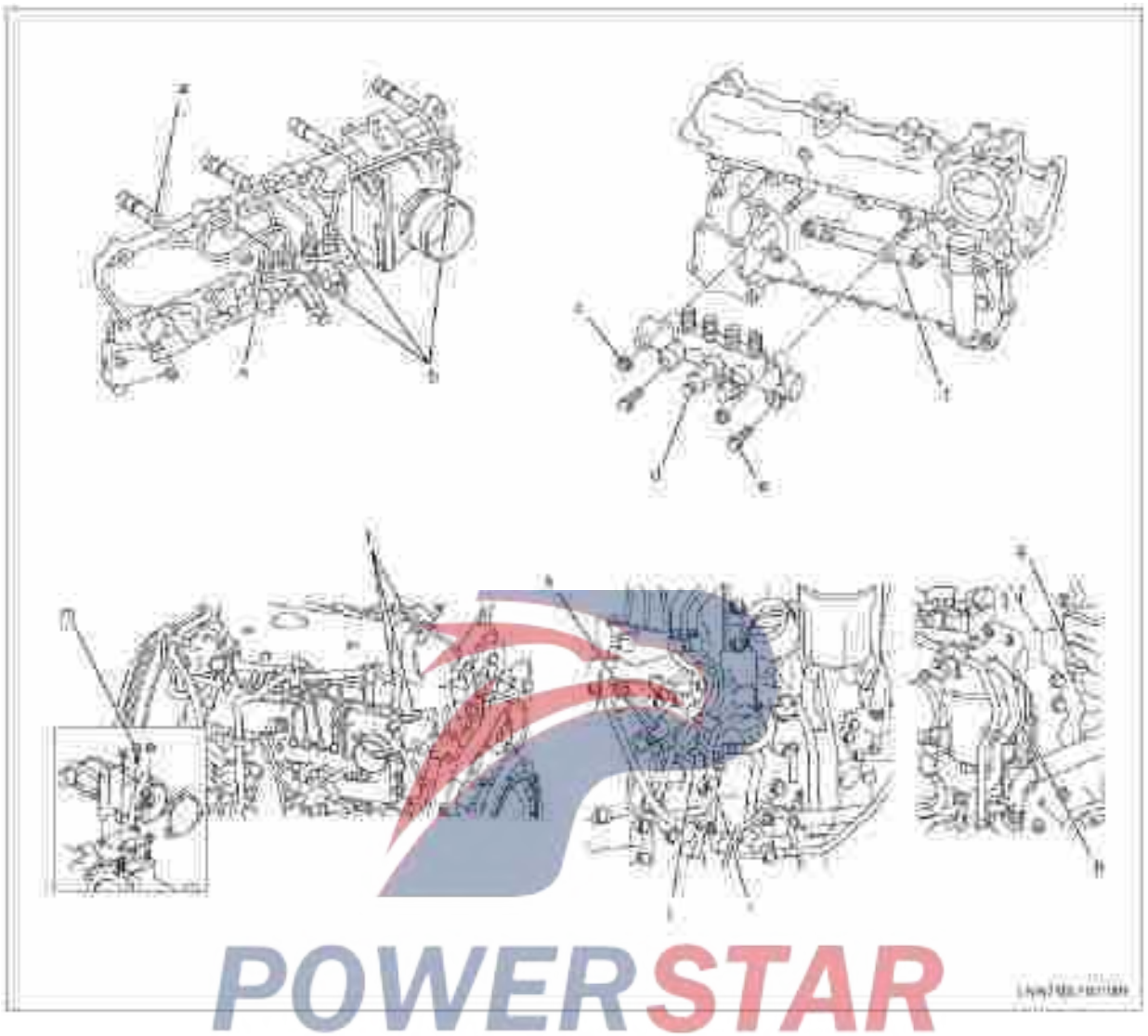
12. Install the air intake hose.



Key

1. Intake pipe
2. Intake pressure sensor

Tightening torque - Overview



(a) 30N·m {3.0kgf·m}

(b) 6 N·m {0.6kgf·m}

(c) 19 N·m {1.9kgf·m}

(d) 172 N·m {17.5kgf·m}

(e) 24 N·m {2.4kgf·m}

(f) 22 N·m {2.2kgf·m}

(g) 12 N·m {1.2kgf·m}

(h) 8 N·m {0.8kgf·m}

(i) 10 N·m {1.0kgf·m}

(j) 44 N·m {4.5kgf·m}

(l) 6 N·m {0.6kgf·m}

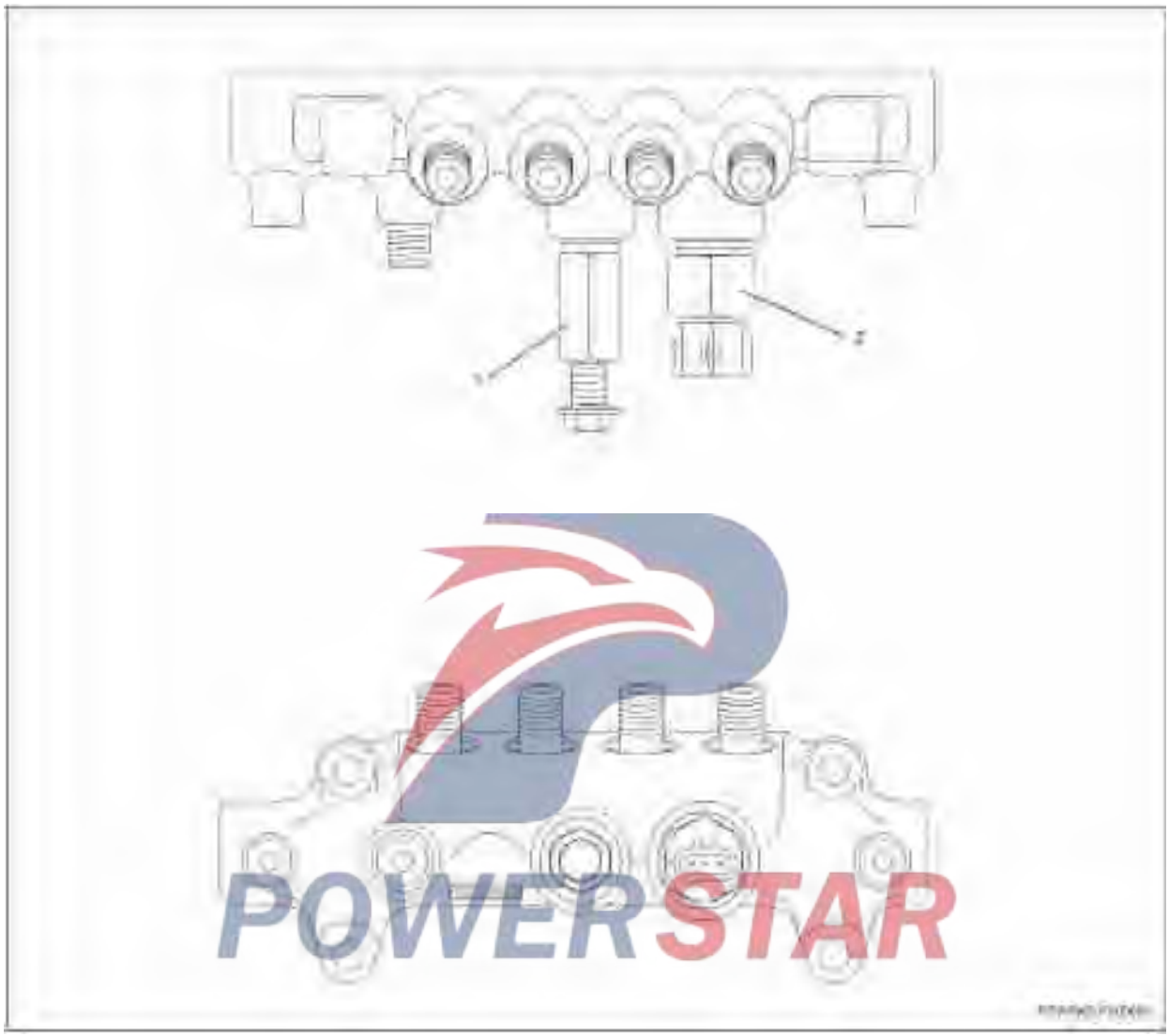
(k) 24 N·m {2.4kgf·m}

(m) 24 N·m {2.4kgf·m}

(n) 25 N·m {2.5kgf·m}

Puel pressure sensor (Common rail).

Component parts



Key

1. Pressure limiting valve
2. Fuel pressure sensor

Precautions

Precautions

• Before cleaning, add cleaner to the steam cleaner in the state of engine components and thoroughly clean the sensor and common rail.
• Dry the water with a blower (fan).
• Check that foreign matter is completely removed before starting operation.
• Check the fuel leak carefully after starting the engine.
• After replacing a different sensor, use the analysis tool to confirm that the error code is cleared and working properly.

Disassembly

Fuel pressure sensor

1. Disconnect the fuel pressure sensor harness connector.

2. Remove the fuel pressure sensor.

Key

1. Common Rail
2. Fuel pressure sensor
3. Pressure limiting valve

Key

1. Common Rail
2. Fuel pressure sensor
3. Pressure limiting valve

2. Install the fuel pressure sensor harness connector.

Installation

Fuel pressure sensor

1. Install the fuel pressure sensor.

• After applying grease to the threaded part of the sensor, install it.

• Be careful not to interfere with the connector terminals during installation.

Tightening torque : 98 N•m {10.0kgf•m}

Mark:

• Do not remove the protective cap before assembling.

• Be careful not to allow water, foreign objects, etc. To enter. Inside the connector.

• Remove any foreign matter that has adhered to the wire. Make sure that there is no foreign object on the mounting section before mounting.

Pressure limiting valve (common rail)

Disassembly

• Remove pressure limiting valve.

Mark:

• The removed sensor and seal can no longer be used.

• When removing washers, do not touch the seat surface.

Key

1. Common Rail
2. Fuel pressure sensor
3. Pressure limiting valve

Key

1. Common Rail
2. Pressure Sensor
3. Pressure limiting valve

Installation

• Install the pressure limiting valve.

Tightening torque : 172N·m{17.5kgf·m}

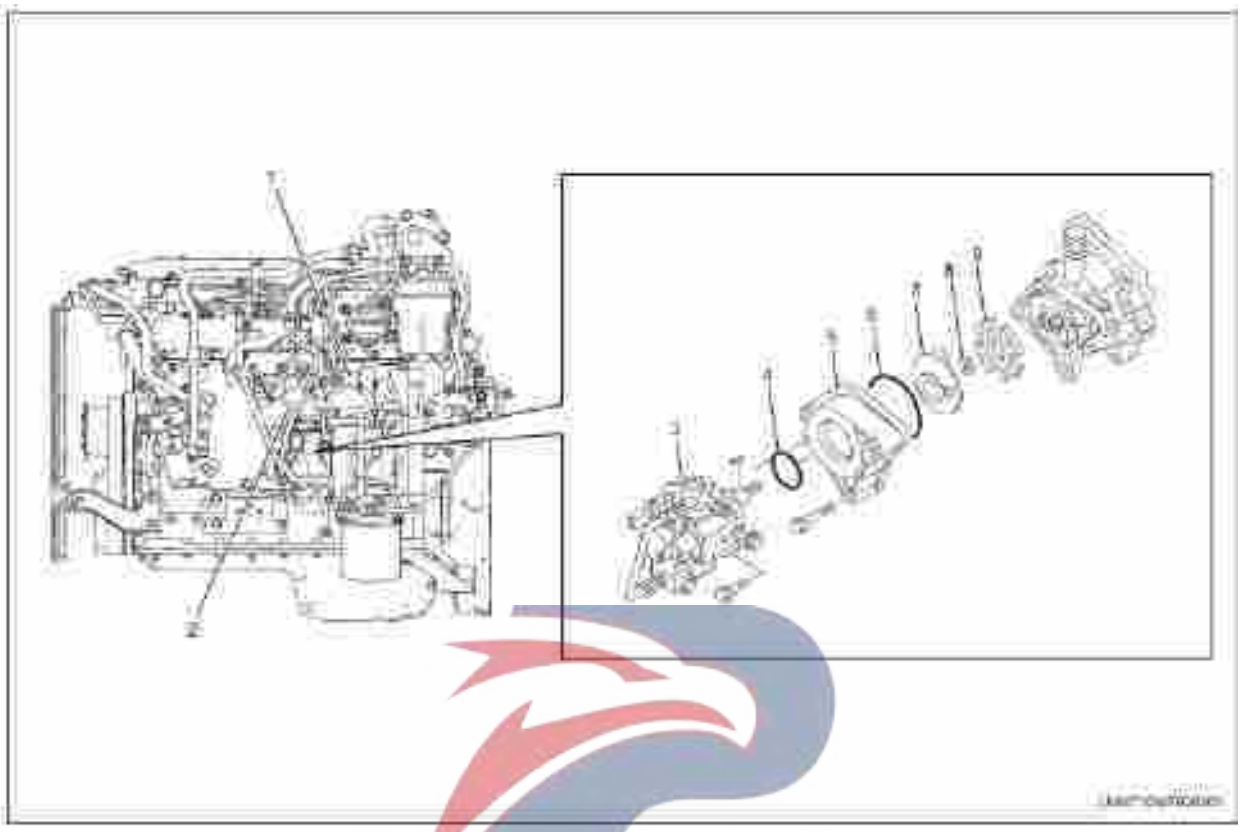
Mark:

• After confirming that there is no foreign object in the mounting area, install it.

• Tighten the 19 mm wide areas on both sides.

Oil feed pump

Component parts



Key

1. Fuel return pipe
2. Fuel hose
3. Oil feed pump
4. Feeding pump O-ring
5. Feed pump support
6. Fuel pump support O-ring
7. Coupling
8. Connection nut
9. Coupling

The fuel system is guided from inside the injector, and the holes and spaces of the fuel channel have been subjected to high-precision polishing. The sensitivity to foreign matter detection is high, so foreign matter must be completely prevented from invading and foreign matter should be prevented from entering the driving problem.

Disassembly

1. Remove the intake pipe between the aftercooler and the intake pipe.

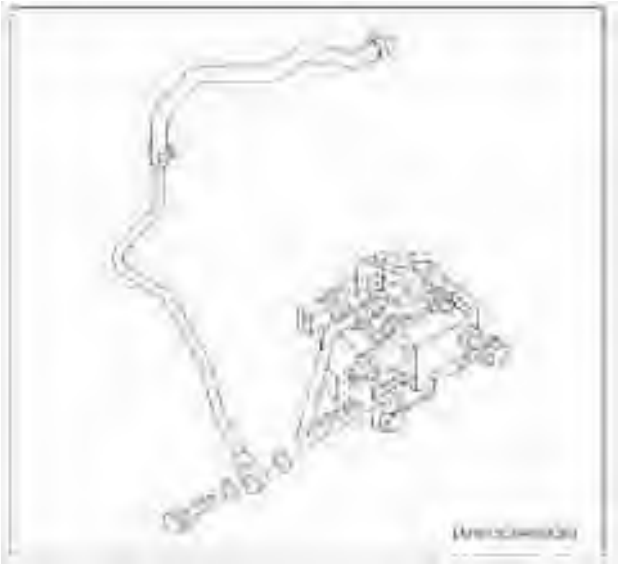
2. Remove the fuel pipe bracket (with engine oil dipstick).

3. Remove the fuel line (between the fuel pump and the common rail).

4. Remove the power rail bracket.

5. Remove the fuel temperature sensor and SCV connector from the fuel supply control valve on the fuel supply pump.

6. Remove the fuel supply hose and hose.

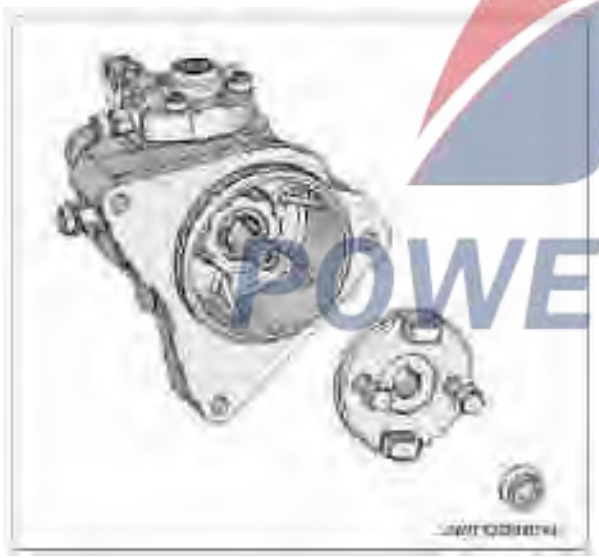


7. Remove the fuel return pipe.

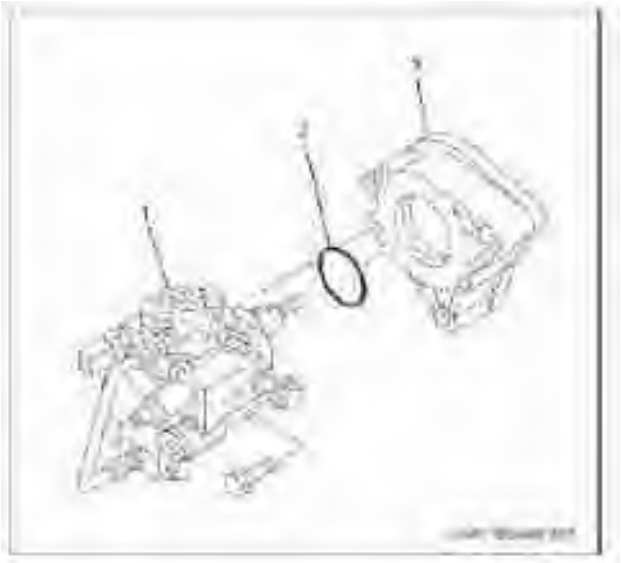
8. Remove the fuel pump.

• Remove the coupling and O-ring.

9. Remove the coupling from the fuel supply pump.
• Tighten the two bolts in the threaded holes of the coupling. After stopping the rotation, remove the nut.
• Place the extraction tool on the two fastening bolts of the coupling and remove the coupling.



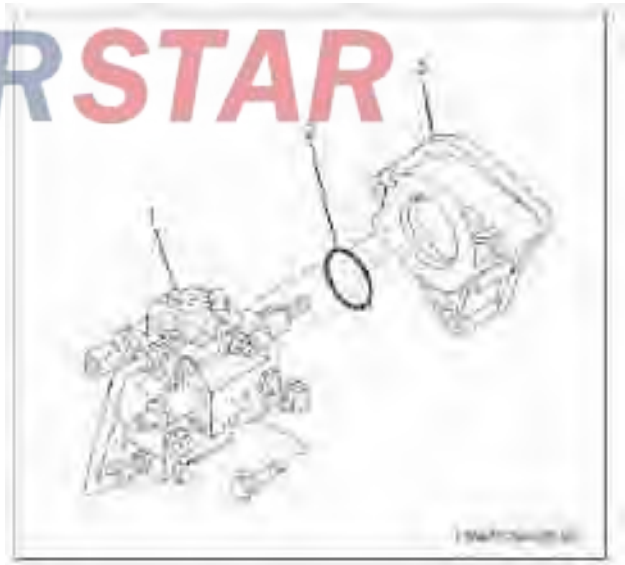
10. Remove the 3 bolts and remove the fuel pump bracket (3).
• Remove the O-ring (2).



Key
1. Oil feed pump
2. O-ring
3. Feed pump support

Installation

1. Install the O-ring (2) on the fuel supply pump (1) and install it to the fuel supply bracket (3) with the specified torque using 3 bolts.
Tightening torque : 19 N•m {1.9kgf•m}
• Be careful not to move the O-ring.



Key
1. Oil feed pump
2. O-ring
3. Feed pump support

2. Align the oil pump's shaft key with the coupling and tighten the nut to the specified torque.

• Tighten the 2 bolts in the threaded holes of the coupling and stop it.

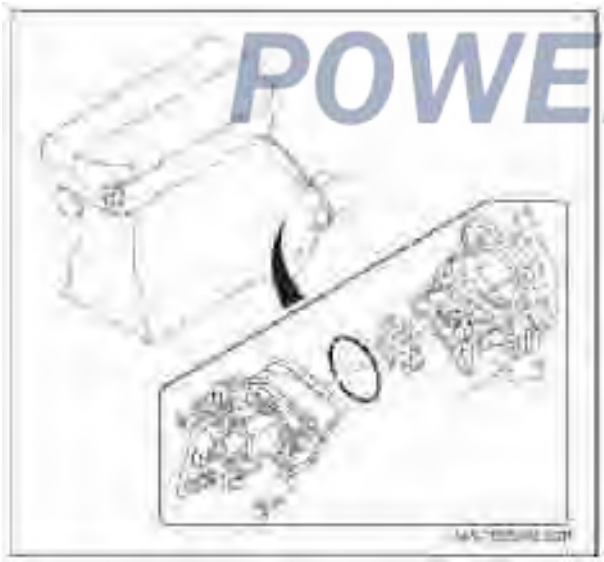
Tightening torque :24N·m{6.5kgf·m}

3. Install the O-ring on the fuel supply pump and install it on the vacuum pump via the coupling.

Mark:

It is not necessary to align the claws of the fuel supply pump.

Tightening torque : 48 N•m {4.9kgf•m}



4. Install the fuel return pipe.

Tightening torque:

Upper hole bolt	12 N•m {1.2kgf•m}
Bolt on the side of the hole	10 N•m {1.0kgf•m}
Support nut	8 N•m {0.8kgf•m}

5. Install the fuel supply hose and hose.

Tightening torque : 17 N•m {1.7kgf•m}

6. Install the SCV connection of the fuel temperature sensor and the suction control valve to the fuel pump.

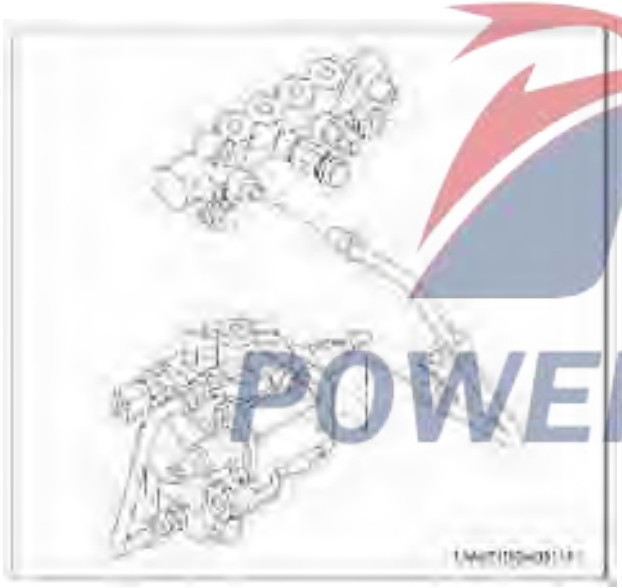
7. Install the fuel pipe bracket

Tightening torque : 6 N•m {0.6kgf•m}

8. Install the fuel pipe(between the fuel pump and the common rail).

Tightening torque : 44 N•m {4.5kgf•m}

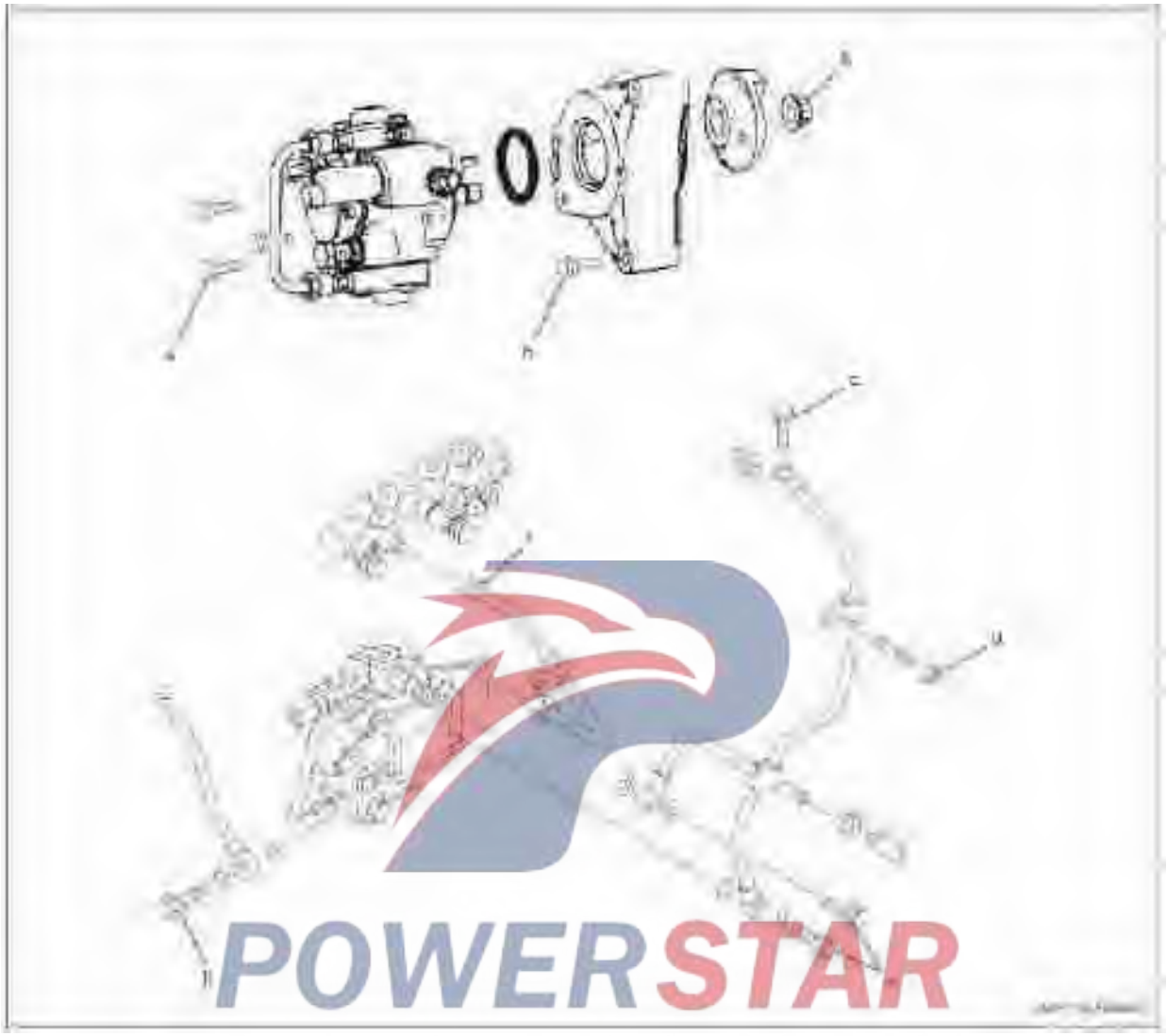
10. Install the intake pipe between the after cooler and the intake manifold.



9. Install the fuel pipe bracket(with engine oil dipstick)

Tightening torque : 24 N•m {2.5kgf•m}

Tightening torque - Overview



(a) 19 N·m {1.9kgf·m}

(b) 64 N·m {6.5kgf·m}

(c) 12 N·m {1.2kgf·m}

(d) 8 N·m {0.8kgf·m}

(e) 10 N·m {1.0kgf·m}

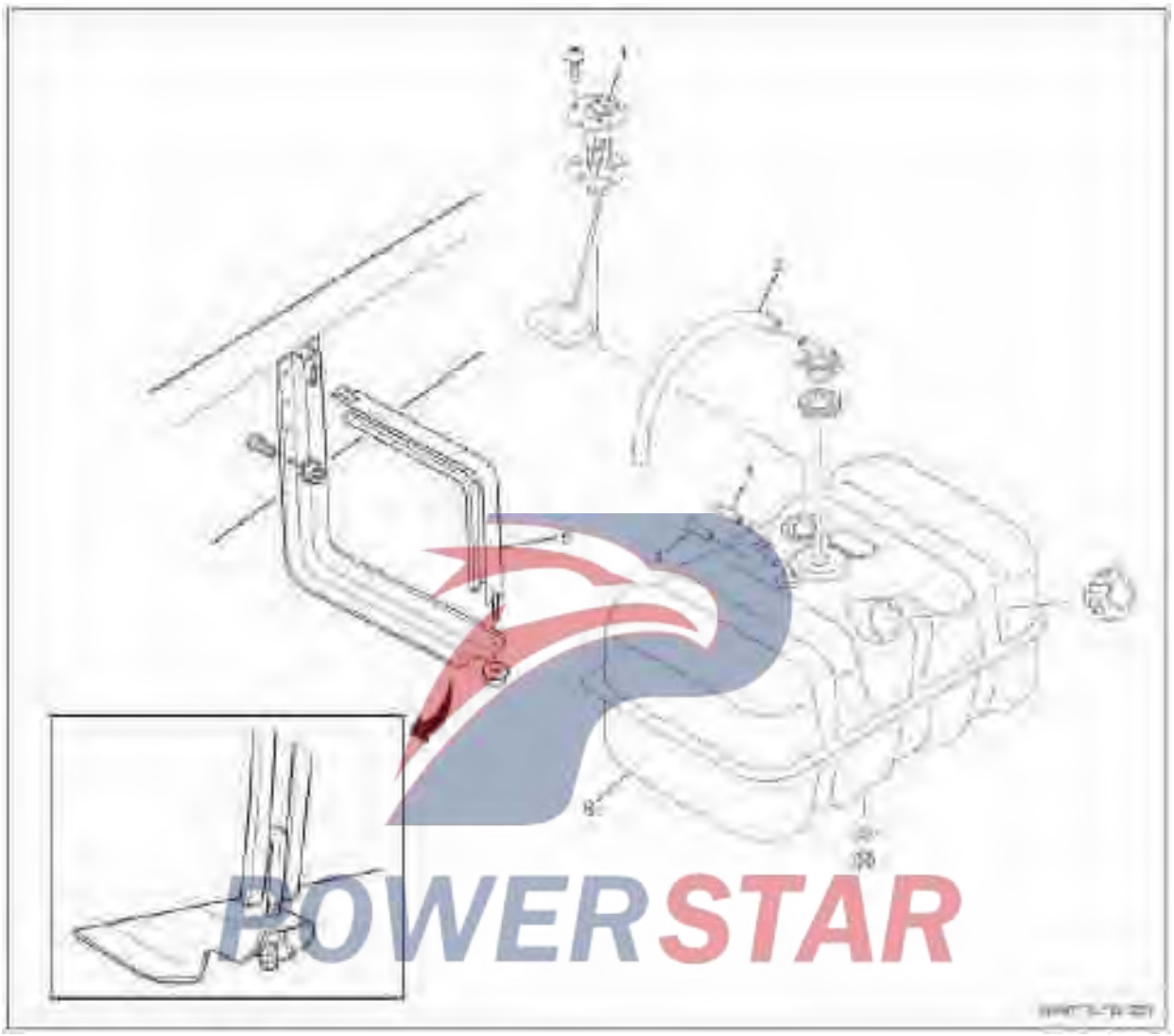
(f) 44 N·m {4.5kgf·m}

(g) 17 N·m {1.7kgf·m}

(h) 48 N·m {4.9kgf·m}

Fuel tank

Component parts



Key

1. Fuel sensor
2. Exhaust pipe
3. Fuel return hose
4. Fuel supply hose
5. Strap
6. Fuel tank

Disassembly

1. Release the fuel tank cap.
2. Drain the fuel from the drain plug.
3. After emptying the fuel, tighten the drain plug to the specified torque.

Tightening torque : 20 N•m {2.0kgf•m}

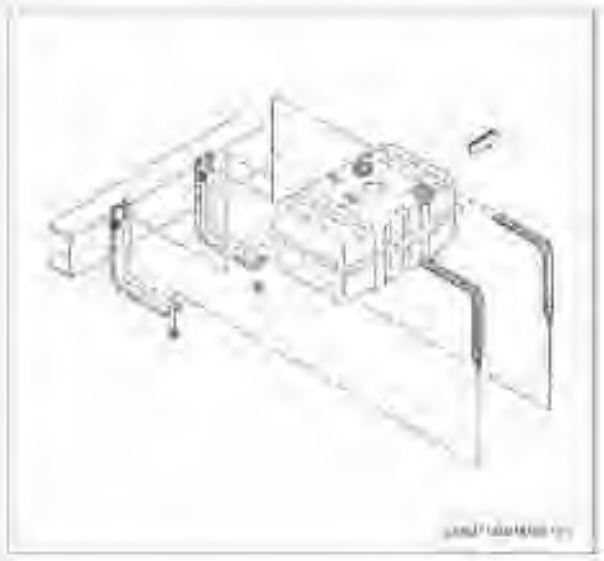
4. Disconnect the fuel sensor connector.
5. Remove the exhaust pipe.
6. Remove the fuel supply hose.
7. Remove the fuel return hose.

• Insert a hose cap to prevent spillage of fuel and connect it to the side of the frame.

8. Remove the fuel tank retaining nut and remove the front side of the side belt from the chassis.
9. Pull out the tank.

Mark:

When it is not possible to remove the fuel tank, remove the bracket first and pull the tank down.



Installation

1. Install the fuel tank.

Mark:

If you remove the bracket while removing the tank, attach the bracket to the rack and tighten it to the specified torque.

Tightening torque : 47 N•m {4.9kgf•m}

In addition, when the fuel tank is mounted on the bracket, the rubber parts stuck to the tank must be precisely placed on the bracket.

2. Install the cuff on the fuel tank and tighten the nut to the specified torque.

Tightening torque : 13 N•m {1.3kgf•m}

3. Install the fuel return hose.

4. Install the Fuel supply hose.

• Insert the tube into a tube with a depth of more than 25 mm.

5. Install the exhaust hose.

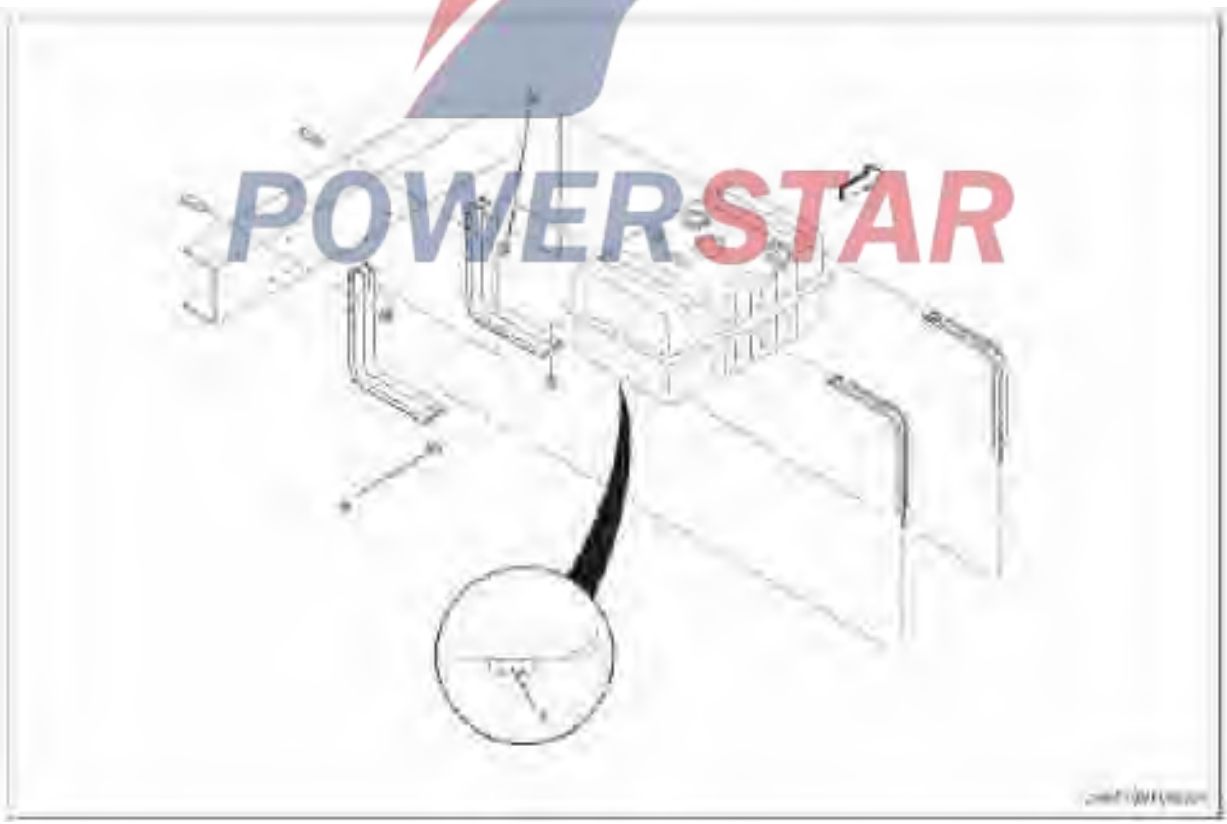
• Fill the fuel tank with fuel and tighten the fuel tank cap.

• Connect the battery ground wire.

• After starting the engine, check the hose connector for fuel leaks.

6. Connect the fuel sensor connector.

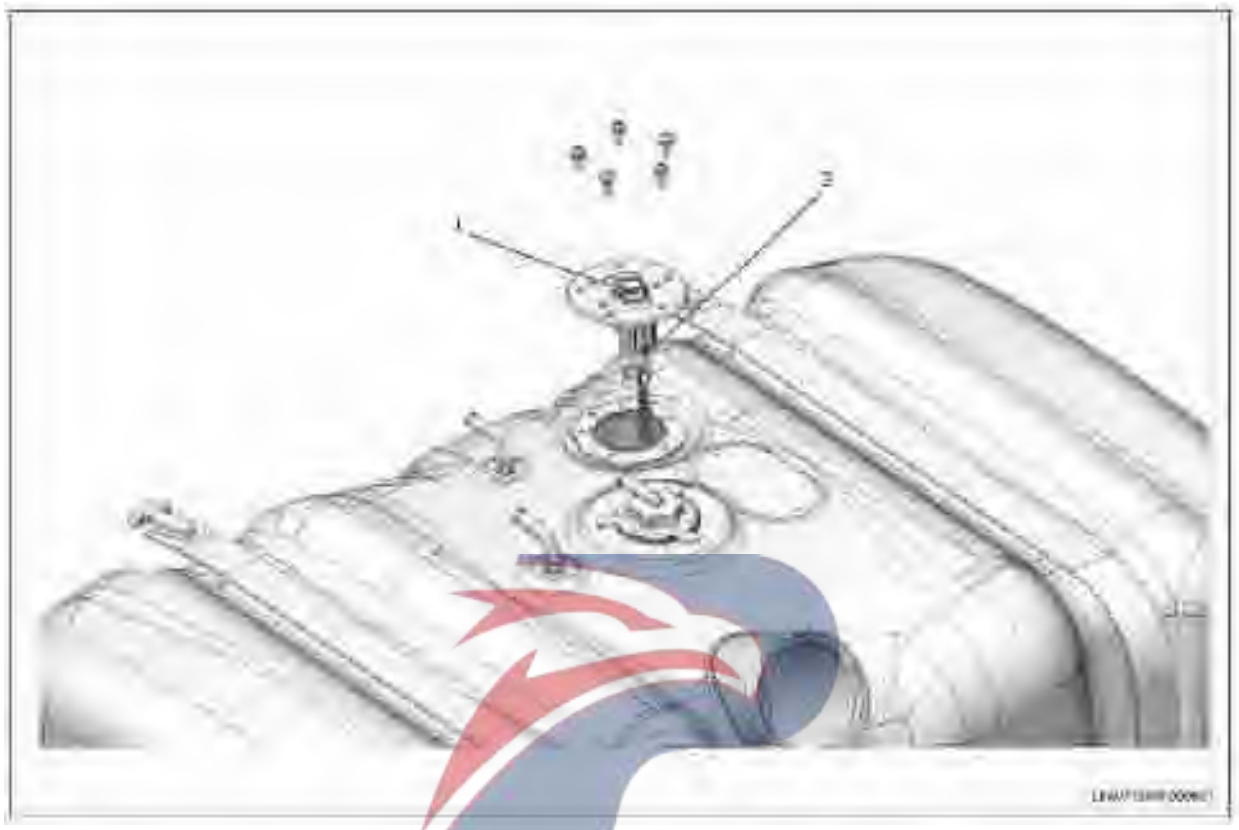
Tightening torque - Overview



(a) 13 N·m {1.3kgf·m}
(b) 47 N·m {4.9kgf·m}
(c) 20 N·m {2.0kgf·m}

Fuel sensor

Component parts



Key

1. Fuel sensor connector.
2. Fuel sensor

Disassembly

1. Remove the fuel sensor line connector.

2. Remove the mounting screws and remove the fuel sensor.

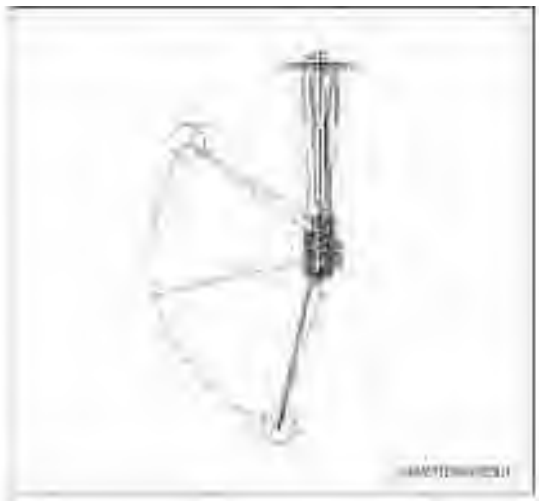
Mark:

When handling fuel sensors, be careful not to disturb the environment and prevent arm deformation.

In addition, after disassembling the fuel sensor, it is necessary to cap the lid to prevent waste and the like from entering the tank.

Inspection

The fuel unit changes the internal resistance and the deviation of the fuel gauge according to the float position sensor (liquid height).

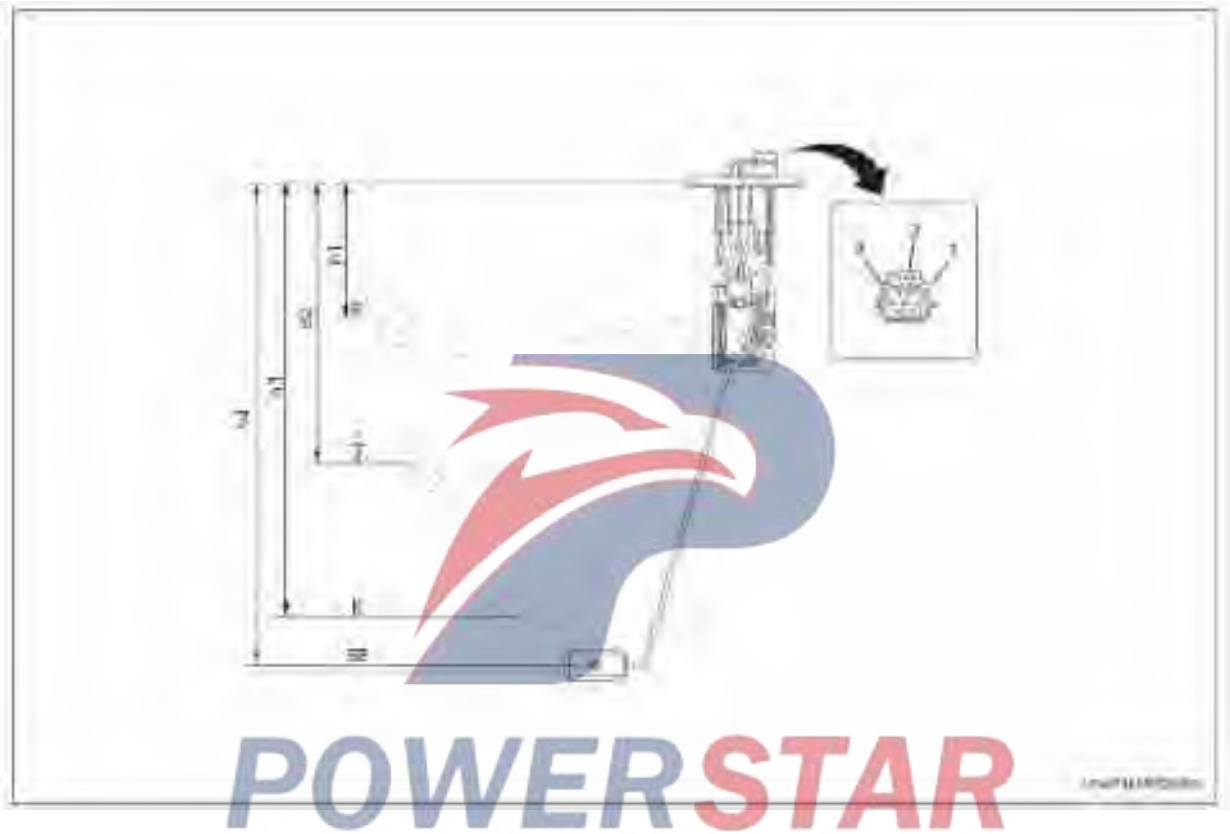


1. When the float changes from "E" to "F", check the resistance value between the common terminal J-28-2-2J-28.

2. When the float is in the "E" position, check if the remaining lamps are lit.

If abnorbal, replace it with a normal product (no abnormal product).

Float position	Resistance value(Ω)
F point (h1)	14
1/2 point (h2)	44
E point (h3)	100



	F point (h1)	1/2 point (h2)	E point (h3)	SE point (h4)
Distance from flange (mm)	76.0	192.9	313.4	332.3
Fuel tank capacity (L)	89.5	51.0	12.0	6.0

Installation

Follow the reverse procedure for disassembly.

Install the fuel sensor.

Connect the tubing connector to the fuel sensor.

Section 1E

Electrical system of engine

Table of Contents

Starting system

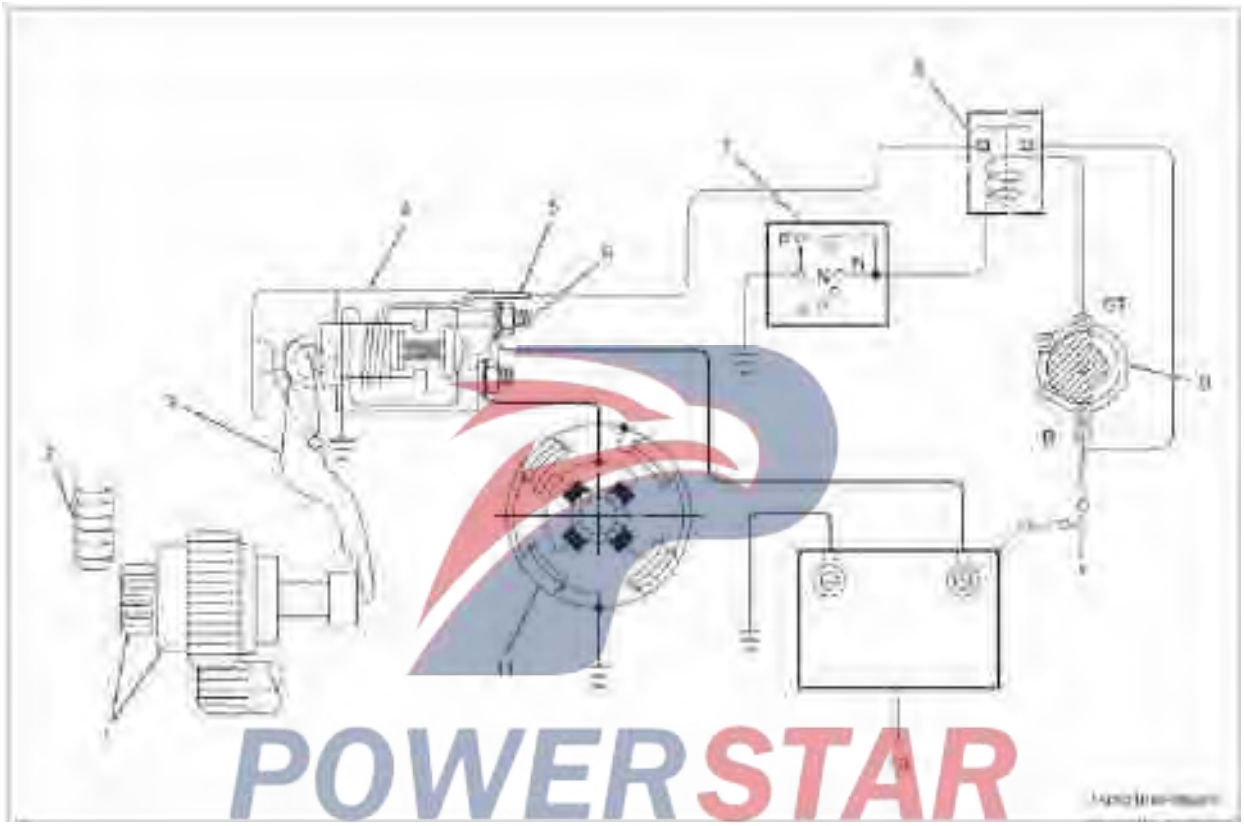
Precautions

When servicing the electrical system, make sure that the starter switch, light switch, etc. Are turned off and the battery's negative terminal must be removed.

Function and working principle

Starting circuit

From battery system, starter, starter switch, circuit breaker (A/T only), starter relay and other components, main wiring components,



Key

4. Driving gear clutch

Speed loop

2. shift fork

4. Magnetic switch

5. "S" terminal

6.”B” Terminal

7. Cut-off switch (A/T only)

8. Starter relay

9. Starter switch

10. Battery

11. Armature

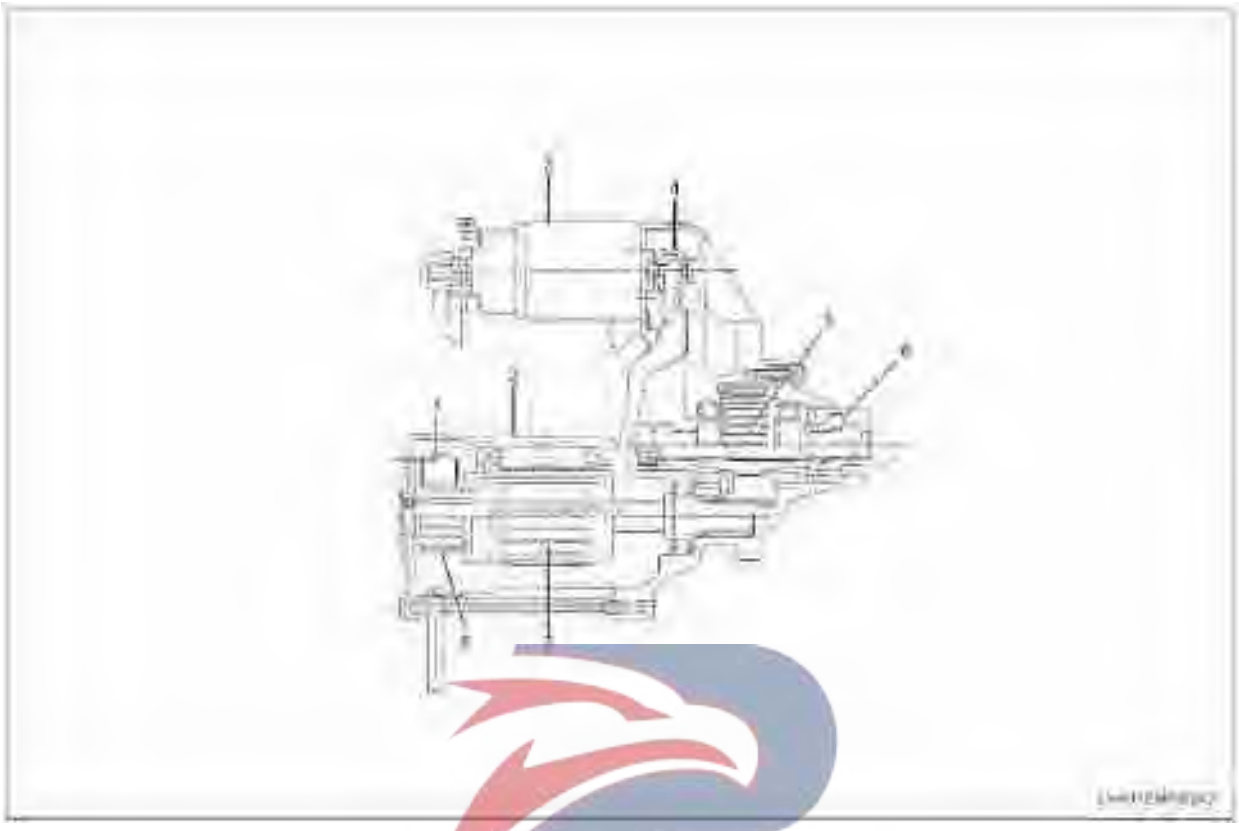
Starter

The starter is a magnetic offset type and is an external gear type deceleration starter.

After the start switch is turned on, the contacts of the magnetic switch are closed and the armature rotates. At the same time pulling the piston, the fork pushes the forward gear to engage the ring gear, and then the ring gear rotates to start the engine.

After starting the engine, when the starter switch fails, the piston returns and the drive gear disengages the crown and the frame stops. If the rotation of the motor is earlier than the driving gear, the driving gear rotates instead, and the driving gear idles and does not cause an armature.

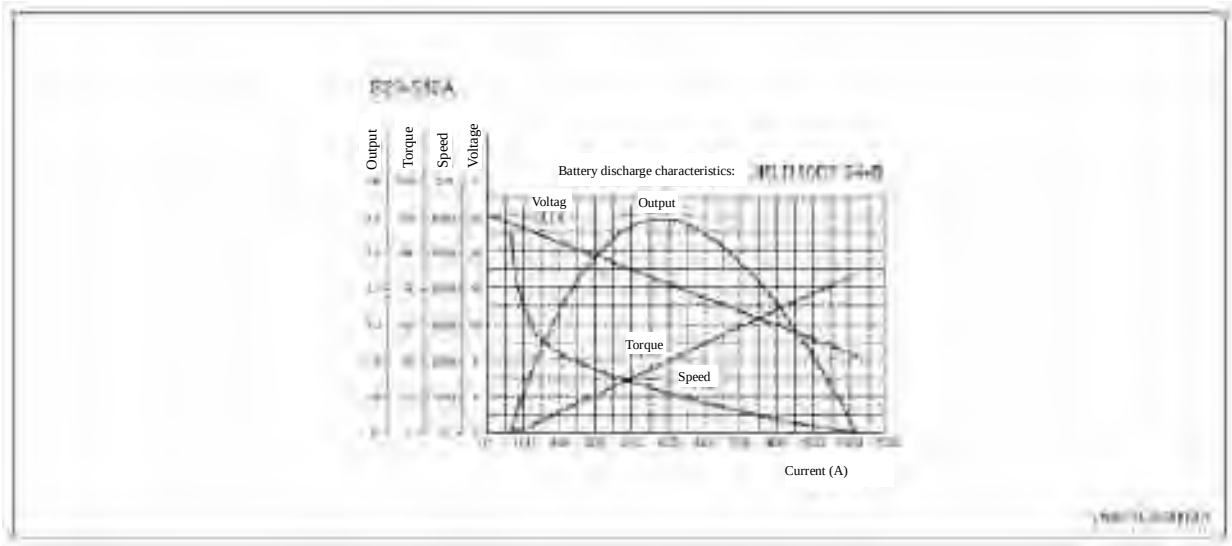
Starter motor



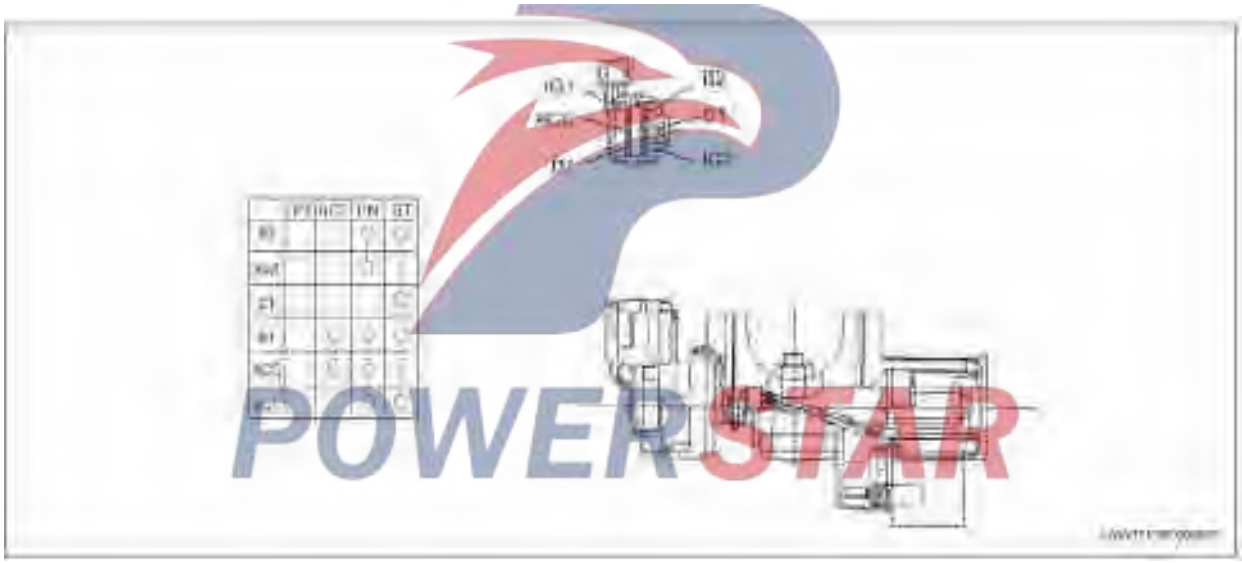
Key

1. Electric brush
2. Yoke of iron
3. Magnetic switch
4. Twisted spring
5. Clutch
6. Training
7. Armature
8. Switch

Output characteristics



Starter switch



Failure phenomenon - Overview

• The starter does not work after starting the switch

• Drive gear advances but does not mesh with gears

• Drive gear, engine is running but engine is not running

• Train gears engaged, but engine does not run

• After starting the engine, the starter will not stop even if the ignition switch is off

Symptom: The starter does not work after starting the switch

Symptom	Probable causes	Treatment measures
The starter does not work after starting the switch	The battery is fully discharged	Replace battery
	Open circuit or poor contact	Maintenance
	Ignition switch contact bad, or weak terminal	Repair or replace
	Poor contact of starter relay contact, or poor contact of inserted terminal	Repair or replace
	Magnetic switch coil short-circuited or damaged	Replace

Symptom: rive gear advances but does not mesh with gears

Symptom	Probable causes	Treatment measures
Drive gear advances but does not mesh with gears	Battery discharged completely	Charge the battery
	Wear of drive gear or casing tip	Replace drive sprocket or crown
	Dust adheres to the drive shaft	Maintenance

Symptom: Drive gear, engine is running but engine is not running

Symptom	Probable causes	Treatment measures
Drive gear, engine is running but engine is not running	Clutch slip	Replace clutch or starter
	Reducer gear damage	Replace gear or starter motor

Symptom: Train gears engaged, but engine does not run

Symptom	Probable causes	Treatment measures
Train gears engaged, but engine does not run	Battery discharged completely	Charge the battery
	The terminal of the circuit is not firm	Maintenance
	Armature or magnetic field coil	Replacement initiator
	Commutator fouling	Repair or replace starter motor
	Brush spring weakens or brush wears	Replace brush spring or brush
	Shake the bearing	Replace bearing or starter motor
	Poor contact of magnetic switch contacts	Replace magnetic switch

Symptom After starting the engine, the starter will not stop even if the ignition switch is off

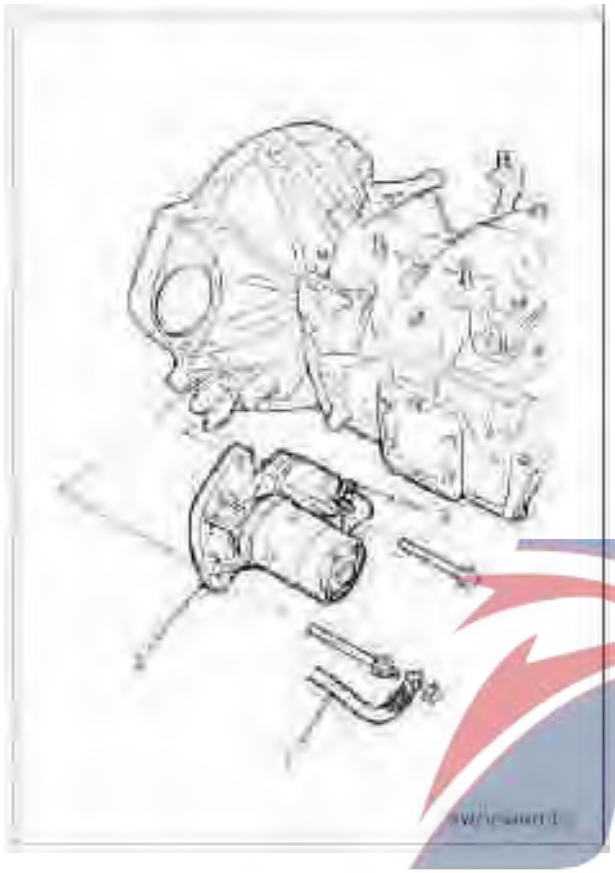
Symptom	Probable causes	Treatment measures
After starting the engine, the starter will not stop even if the ignition switch is off	Start switch contact does not return normally	Replace starter switch
	Bad start relay contact	Replace starter relay
	Magnetic switch coil short circuit	Replace magnetic switch

Main parameters

Specification (Hitachi, Ltd.)		S25-512A
Rated value		
Voltage	V	24
Output	kW	4.5
Time	second	30
Drive gear teeth		11
Rotation direction (view from transmission gear side)		Left
Quality (approx.)	kg	7.6
No charging characteristics		
Voltage and current	V/A	＜23/120
Speed	rpm	＞3500
Load characteristics		
Voltage / current	V/A	＜14.3/400
Torque	N·m {kgf·m}	＞25 {2.5}
Speed	rpm	＞1000
Locking feature		
Voltage and current	V/A	＜10/1200
Torque	N·m {kgf·m}	＞47 {4.8}

Starter

Component parts



Key

1. Grounding starter wire
2. Starter assembly
3. Start the terminal

Disassembly

1. Remove the starter ground wire.

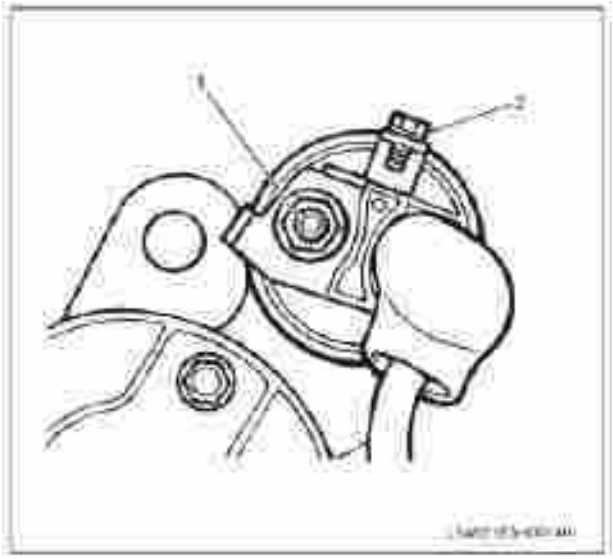
• Loosen the nuts for installing the starter ground wire first, and then remove the ground wire.

• Near the transmission control box, disconnect the front frame harness connector and remove the harness clip.

2. Remove the terminal from the harness.

• Disconnect the harness from terminal S of the magnetic switch (2).

• Disconnect the harness from terminal B of the magnetic switch (1).



Key

1. B Terminal
2. S Terminal

3. Remove the starter assembly.

• Loosen the 2 upper and lower bolts and remove the starter from the clutch housing.

Inspection

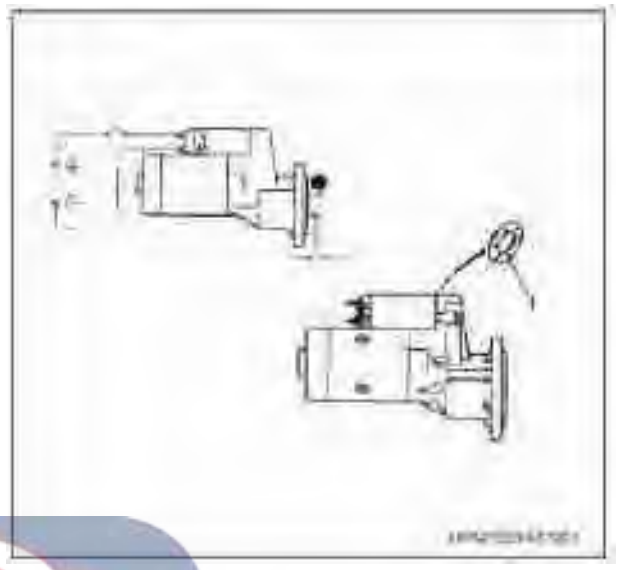
Check the position of the transmission gear

• Loosen the M terminal wire, connect the (+) end of the battery cable to the S terminal, connect the (-) end to the M terminal, open the switch and push the drive pinion to the crankshaft's rotational position. Then release the (-) side and the armature stops rotating.

• Gently press the front end of the clutch shaft with your hand to measure the movement of the clutch shaft.

• When the amount of movement exceeds the specified value, adjustments can be made by increasing or decreasing the spacer (1) between the magnetic switch and the gearbox.

Momentum of transmission gear = 0.1~0.3mm



Magnetic switch check

Magnetic test

• Connect the negative (-) leads (2) and (5) to the magnetic switch terminal “M” and its case, and connect the positive (+) cable (1) to the “S” terminal to check for beats.

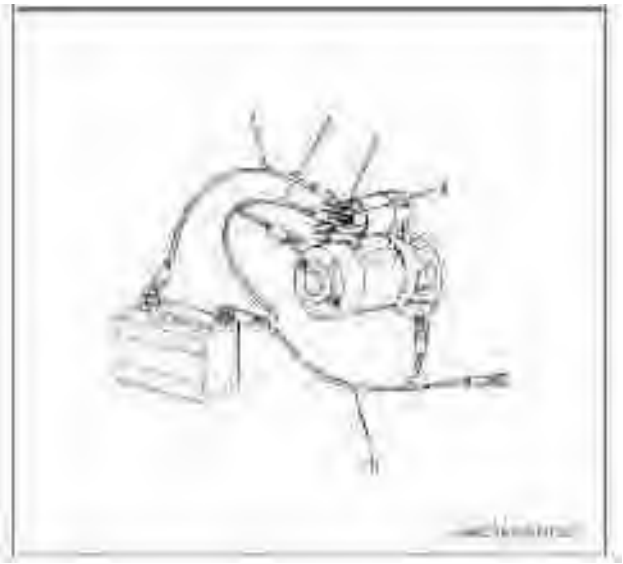
Continue testing

• When the above magnetic test is completed, when the negative (-) (2) cable on the “M” terminal is released, check if the drive gear continues to bounce.

Return to test

• After the above maintenance test is completed (release of the negative (-) cable), check that the drive pinion (piston) returns immediately when the negative (-) cable of the housing is released.

• When an abnormal condition is detected during the magnetic test, the hold test and return test must be replaced.



Installation

1. Install the starter assembly.

• Install the starter on the actuator housing with screws and tighten to the specified torque.

Tightening torque : 76 N•m {7.7kgf•m}

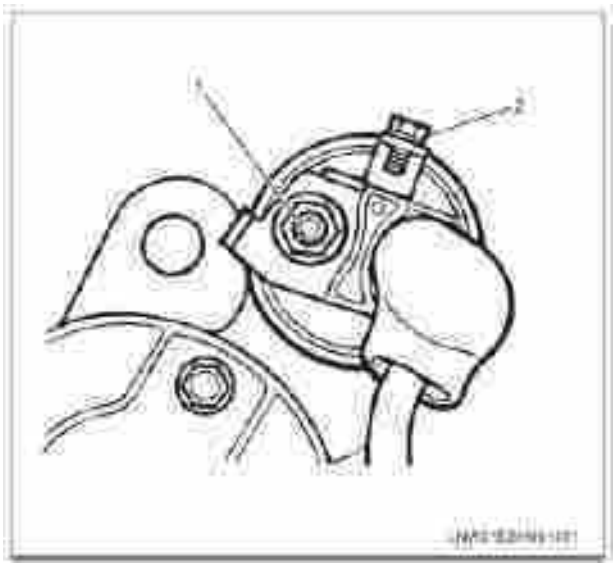
2. Install the harness terminal.

• Install terminal S(2) and tighten to the specified torque.

Tightening torque :1∽1.5N·m{10 ∽15kgf·cm}

• Install terminal B(1) and tighten to the specified torque.

Tightening torque :7.5∽1.5N·m{75 ∽100kgf·cm}

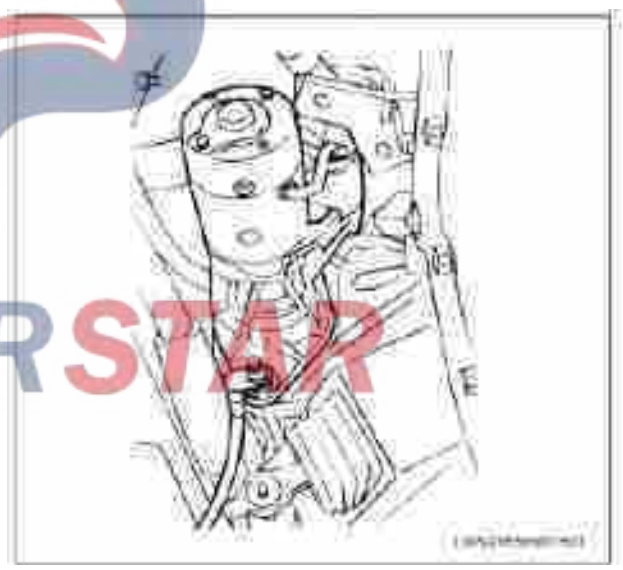


Key

1. Terminal B
2. S Terminal

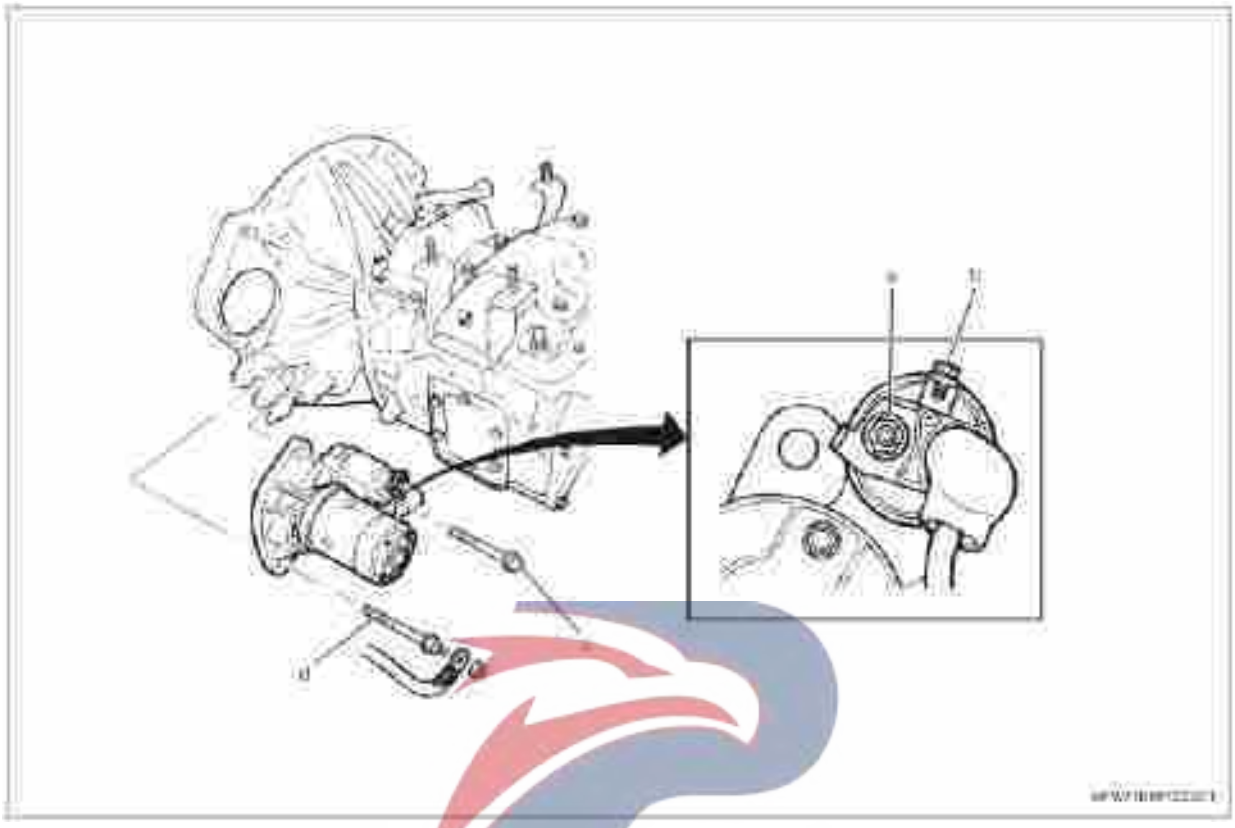
3. Install the starter ground wire.

• Install the starter ground wire.



• Connect the connector to the front bezel.

Tightening torque - Overview



(a) 7.5∽10 N·m {75∽100kgf·cm}

(b) 1∽1.5 N·m {10∽15kgf·cm}

(c) 76 N·m {7.7kgf·m}

(d) 76 N·m {7.7kgf·m}

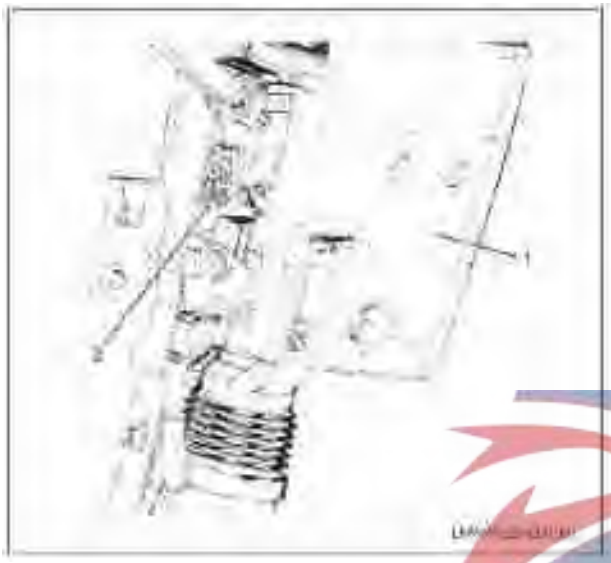
Starter switch

Disassembly

1. Remove the steering cover (1).

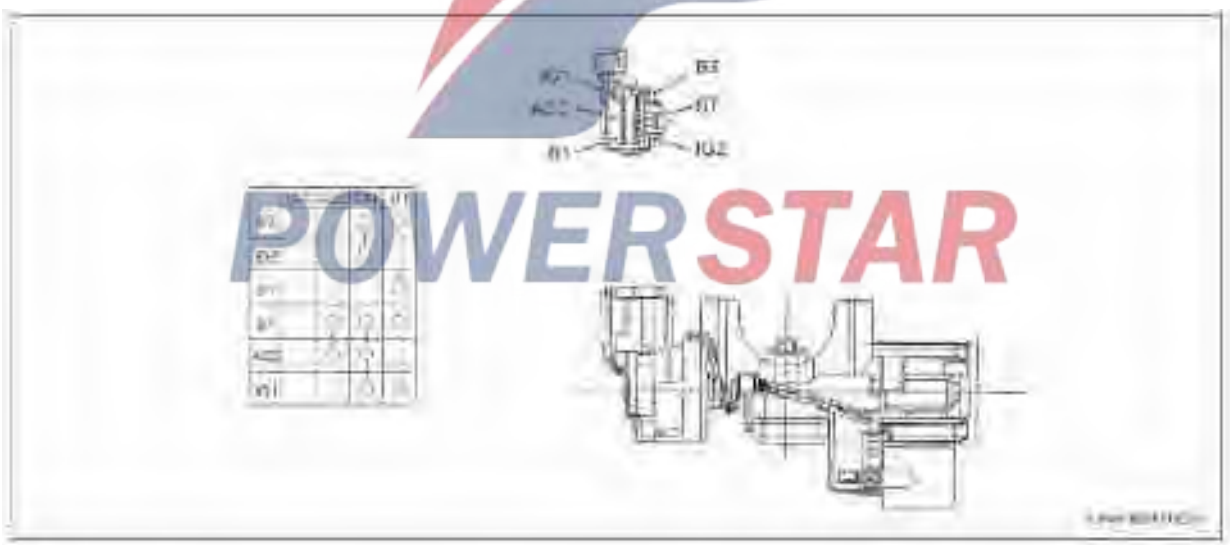
• Remove the screw and release the cap.

2. Disconnect starter switch connector (2).



Inspection

Check the continuity of the ignition switch terminal. If it is not normal, it must be repaired or replaced.



Installation

Install the lamp in the sequence opposite to the removal.

Charging system

Precautions

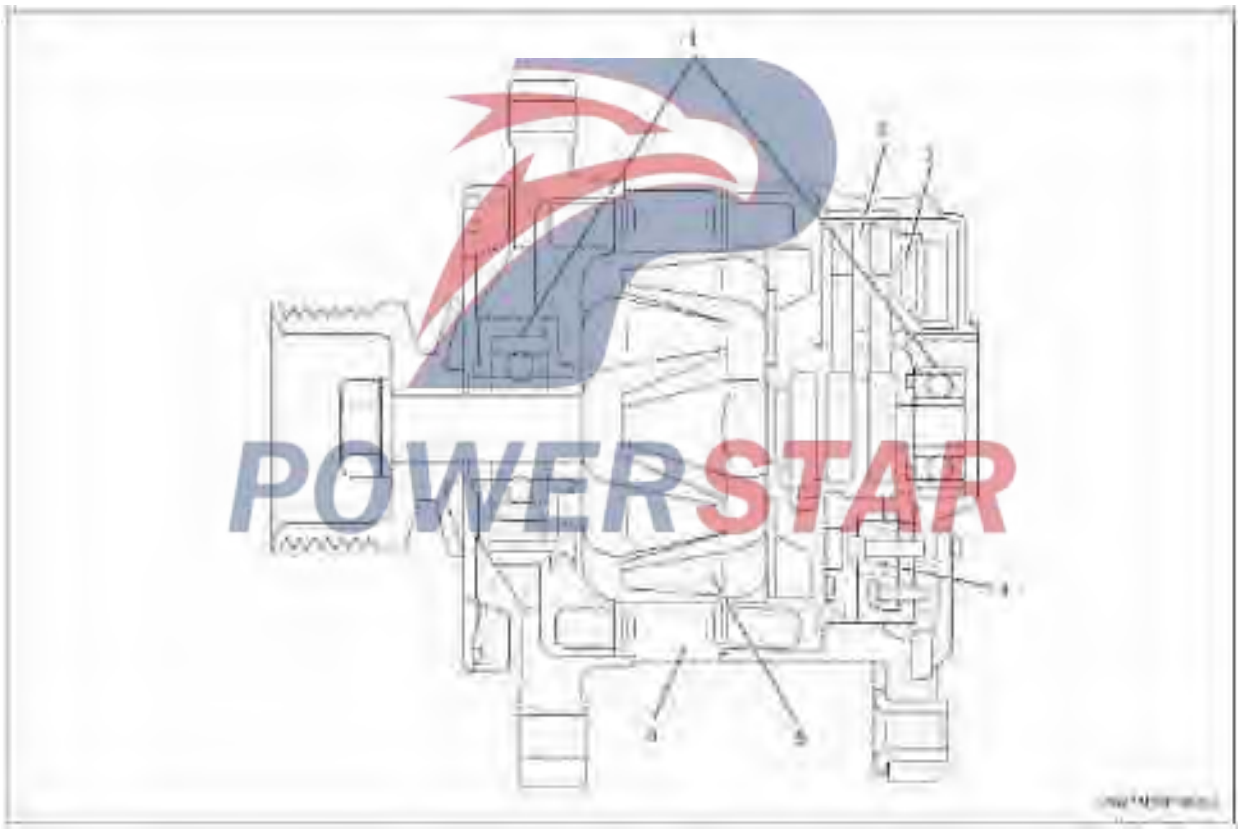
When servicing the electrical system, make sure the starter switch, light switch, etc. Are turned off and the (-) terminal of the battery has to be removed.

Function and working principle

The charging system is the overall adjustable load system of the IC. The wiring of the main components is shown in the figure below.

The regulator is an integrated semiconductor type that is mounted on the back cover of the brush holder assembly and integrated into the generator.

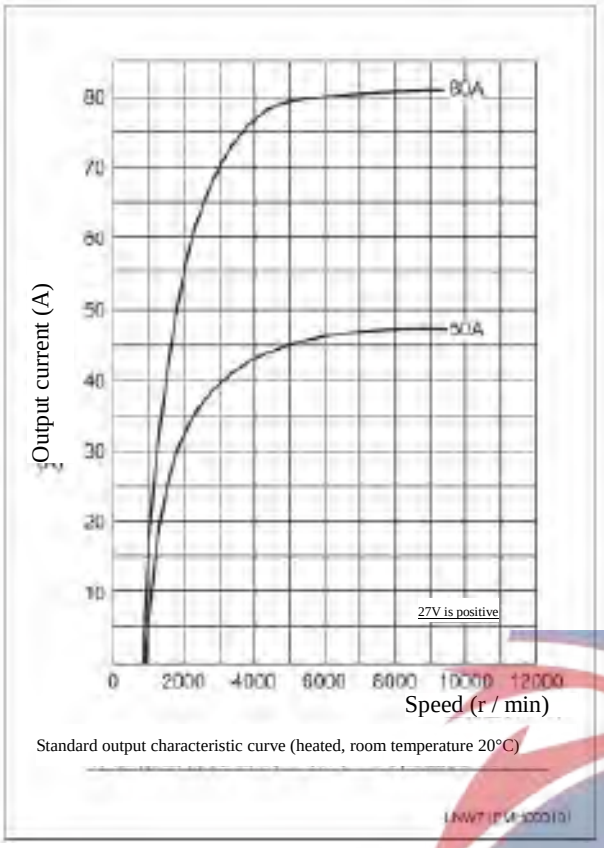
Generators do not require maintenance, such as voltage regulation. There are 6 diodes connected to the stator coil on the rectifier, which converts the AC voltage to DC voltage. This DC voltage is connected to the output terminal of the generator.



Key

1. Ball bearing
2. Electric brush
3. Regulator
4. Rectifier
5. Rotor
6. Stator

Output characteristics



Standard output characteristic curve (heated, room temperature 20°C)

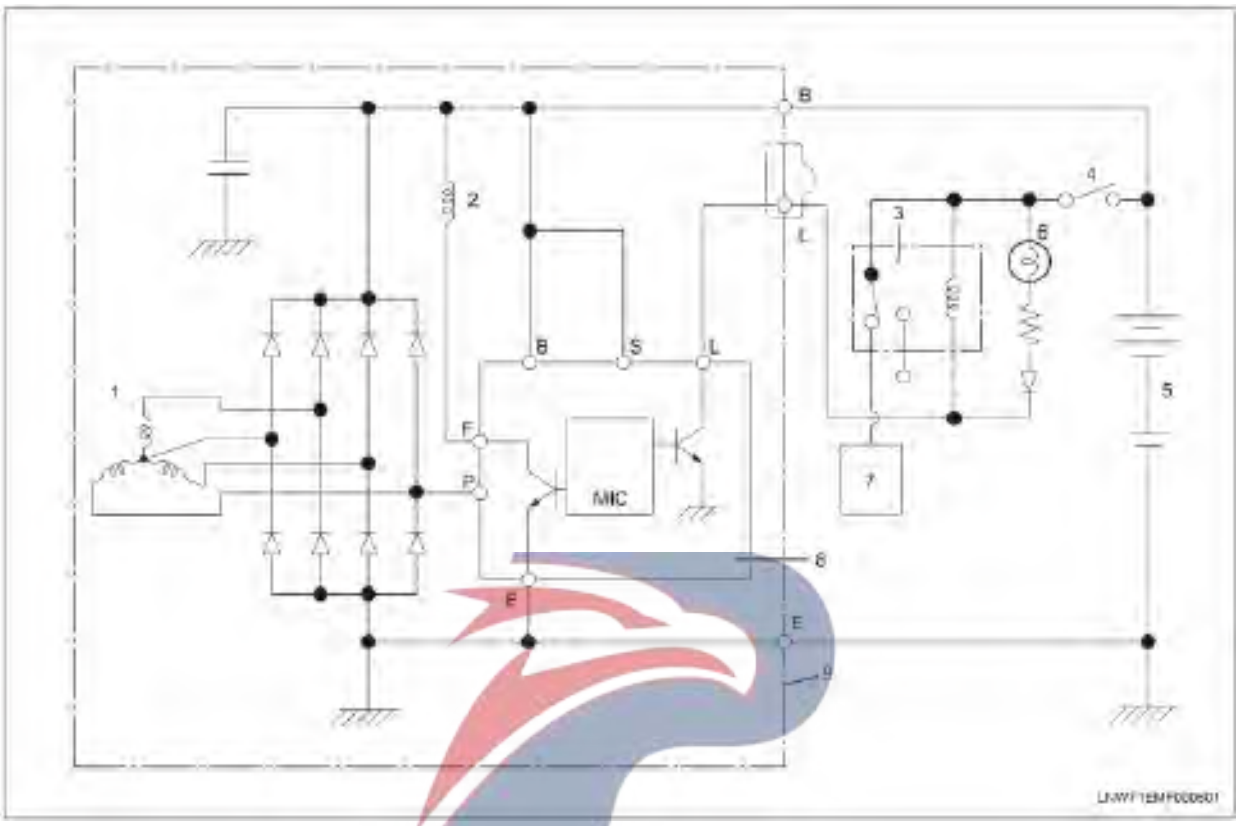
IC regulator multifunction

• Troubleshooting features

When the power coil circuit is activated, the charge indicator lights up if overvoltage occurs.

Circuit diagram

Circuit 50A



Key

1.Stator

2. Rotor

3. Load relay

4. Key switch

5. Battery

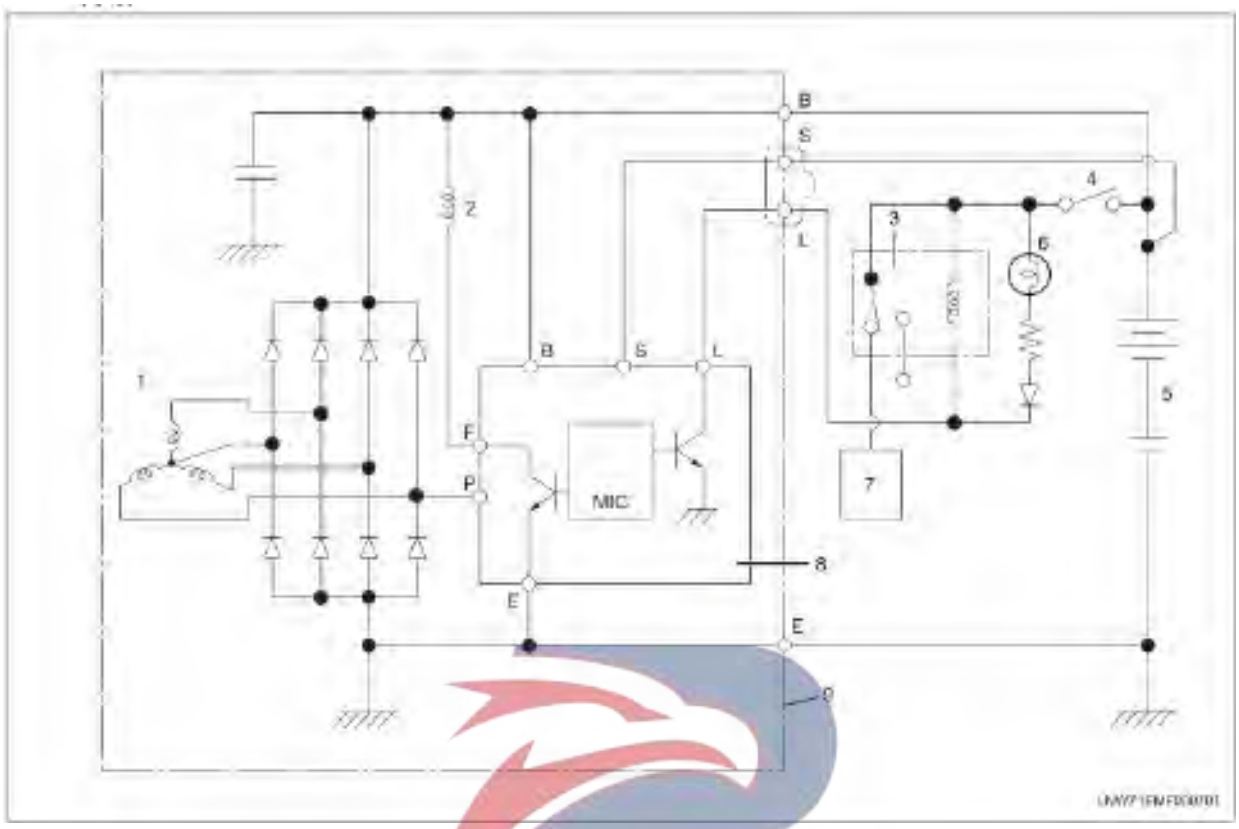
6. Charge indicator

7. Heater relay

8.Regulator

9. Generator

80A specifications



Key

1.Stator
2. Rotor
3. Load relay
4. Key switch
5. Battery
6. Charge indicator
7. Heater relay
8.Regulator
9. Generator

Main parameters

Specification		ACG50A	ACG80A
Type (Hitachi, Ltd.)		LR250-708C	LR280-708B
Rated voltage	V	24	24
Rated output	A	50	80
Rotation direction (on the pulley side)		Right	Right
The effective diameter of the pulley	mm	65	65
Quality	kg	6.1	8.2

Functional check:

General on-vehicle inspection

The charge warning light indicates whether the charging system is working properly. When the start switch is turned on, the indicator lights up. When the indicator light goes out after the engine starts, the system is normal. If the LED indicates an error or the battery is low or overloaded, troubleshoot according to the list of failure symptoms.

Symptom: Not charging at all

Symptom	Probable causes	Treatment measures
Not charging at all	Battery abnormality	Replace
	Broken wire, short circuit and short circuit current counter, or disconnected	Maintenance
	Cracks, masses, short circuits and diode interruptions in each generator coil	Replace
	Regulatory agency anomalies	Replace
	Poor contact of regulator terminals	Maintenance

Symptom: Poor charging

Symptom	Probable causes	Treatment measures
Insufficient charging	**Battery abnormality**	**Replace**
	Broken wire, short circuit or disconnection	Maintenance
	Relaxation of generator drive belt	Adjust the tension of the belt
	Inter-layer short circuit of stator coil	Replace
	Diode abnormality	Replace
	Poor contact in each terminal	Maintenance
	Regulatory agency anomalies	Replace
	Poor contact of regulator terminals	Maintenance

Symptom: Overcharged

Symptom	Probable causes	Treatment measures
Squeeze	Regulatory agency anomalies	Maintenance

Symptom: Instable charging current

Symptom	Probable causes	Treatment measures
Instable charging current	Intermittent contact or intermittent interruption of wiring	Maintenance
	Relaxation of generator drive belt	Adjust the tension of the belt
	Rectifier coil short circuit, interrupt indication	Maintenance
	Poor contact in each terminal	Maintenance
	Regulatory agency anomalies	Replace
	Poor contact of regulator terminals	Maintenance

Symptom: Generator abnormal sounding

Symptom	Probable causes	Treatment measures
Generator abnormal sounding	Relaxation belt	Adjust the tension of the belt
	Abnormal bearing	Replace bearing
	Contact between rotor core and stator core	Maintenance
	Diode abnormality	Replace
	Rectifier coil short circuit, interrupt indication	Replace

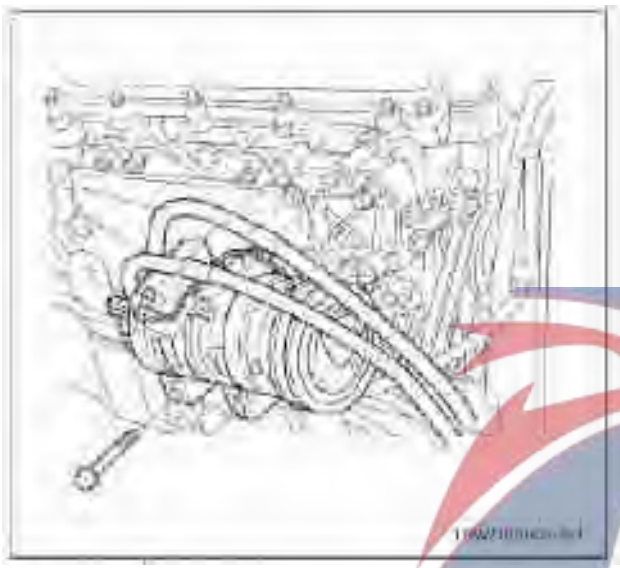
Generator

Disassembly

1. Remove the compressor drive belt from the air conditioner.

2. Remove the air conditioning compressor.

• Loosen the A / C compressor harness connector and remove the compressor from the A / C compressor bracket and secure it with a hose.



3. Remove the generator beam.

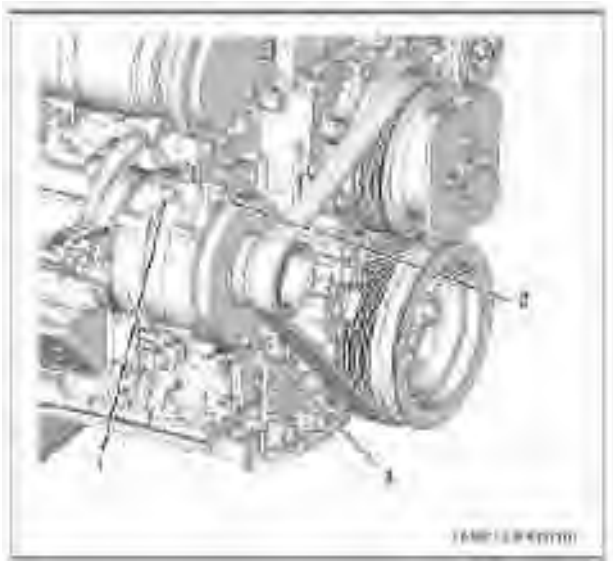
• Remove the B terminal cable and generator harness connector.

4. Remove the fan belt.

a. 50A specifications

• Loosen the lock nuts (2) and through nuts (3).

• Loosen the AC generator adjustment screw (1) and remove the belt.



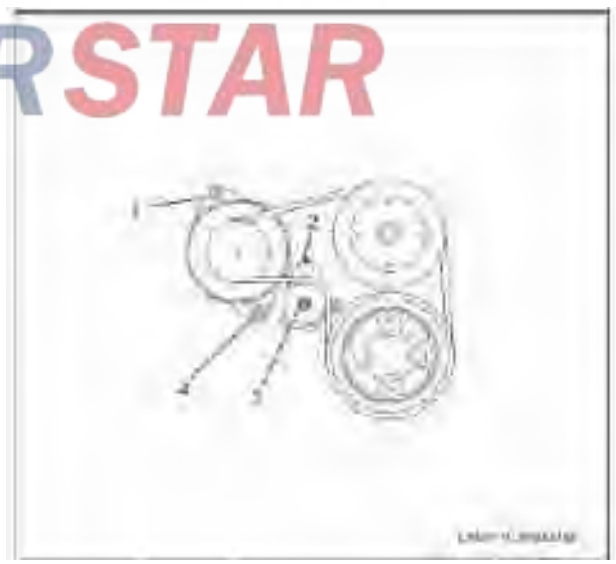
Key

1. Adjust the bolt
2. Adjust the bracket lock nut
3. Through bolt

b. 80A specifications

• Loosen the lock nut (3) when tightening the pulley.

• Loosen the tensioner adjusting screw (2) and remove the belt.



5. Disassemble the generator.

Installation

1. Install the generator.

a. 50A specifications

• Pre-install the generator on the bracket and adjustment bracket.

Mark:

• After adjusting the fan belt, tighten the generator to the specified torque.

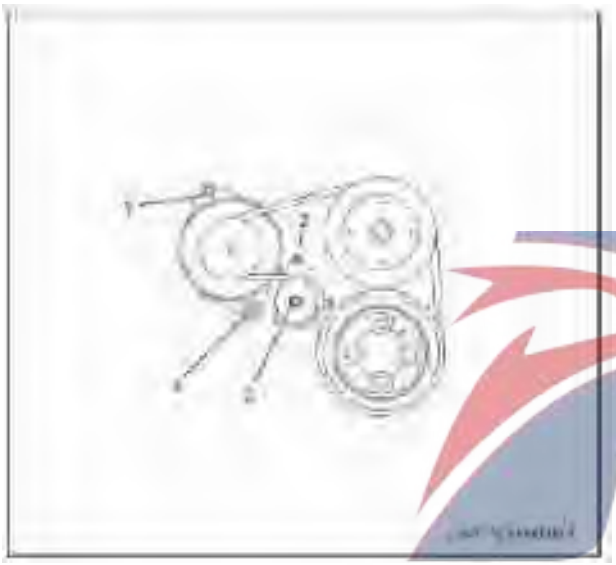
b . 80A specifications

• Install the generator and tighten it with the specified torque.

Tightening torque:

Upper surface (1) 24 N•m {2.4kgf•m}

Lower surface (4) 40 N•m {4.1kgf•m}



2. Install the fan belt.

• Install the fan belt and adjust the belt tension.

For the setting method, refer to the drive belt in the IC Cooling System (4HK1) section.

3. Tighten the preloaded part of the generator according to the specified torque. (50A specifications)

Tightening torque:

Locknut	24 N•m {2.4kgf•m}
Through bolts	40 N•m {4.1kgf•m}

4. Install the alternator harness.

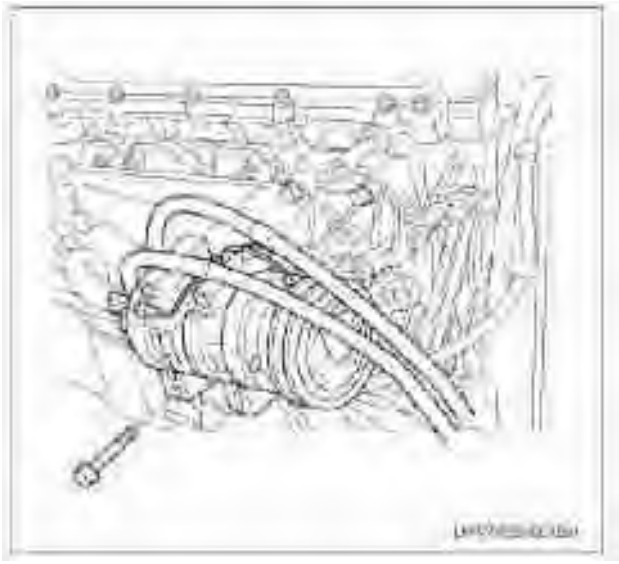
• Install the harness connector (1 pole) and terminal cable B on the generator.

5. Install air-conditioning compressor, tightening torque as required.

Mark:

Tighten the two mounting bolts on the rear of the compressor and tighten the two front bolts.

Tightening torque : 25 N•m {2.5kgf•m}



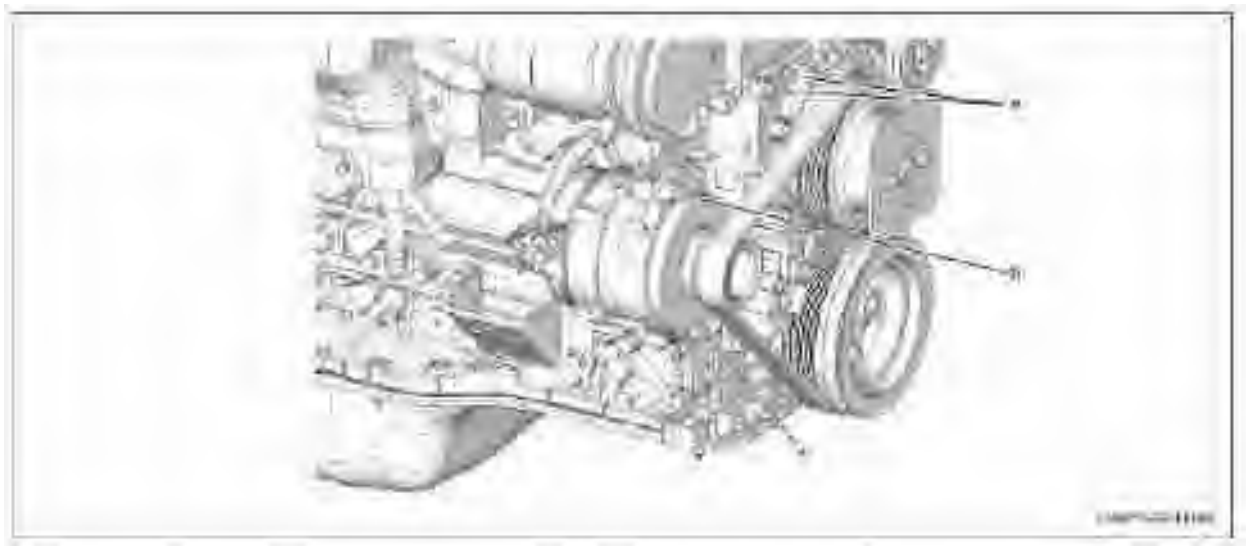
6. Install the air conditioner compressor harness connector.

1. Install the drive belt of the A/C compressor.

• Install the drive belt and adjust the belt tension.

For the setting method, refer to the drive belt in the IC Cooling System (4HK1) section.

Tightening torque - Overview



(a) 24 N·m {2.4kgf·m}

(b) 24 N·m {2.4kgf·m}

(c) 40 N·m {4.1kgf·m}

Preheating system

Function and working principle

• Preheating system reduces white smoke and improves heating and heating.

• Intake throttle preheating system, EGR valve, exhaust brake valve configuration, according to the engine coolant conditions, close each valve, the engine load exhaust pressure increases, and then through the engine's cylinder block heat energy release Into the coolant to increase preheating and heating.

• The system controls the throttling of intakes, exhaust brakes, and injectors to increase fuel, increase exhaust temperatures, and increase engine coolant temperatures to promote warming and cooling. Heating. In addition, by the operation of the exhaust brake valve, the residual combustion gas in the cylinder, the temperature of the combustion chamber, and the temperature of the exhaust gas are increased, thereby limiting the amount of power generation to generate white smoke due to the unburned gas, and white smoke is reduced.

• The QWS control unit uses the ECM to control injectors, EGR, QWS, QOS, throttle, exhaust brakes, etc. Just like QOS. For more information, please refer to Engine Control System in Chapter IA Engine Control System (4HK1).

Functional check:

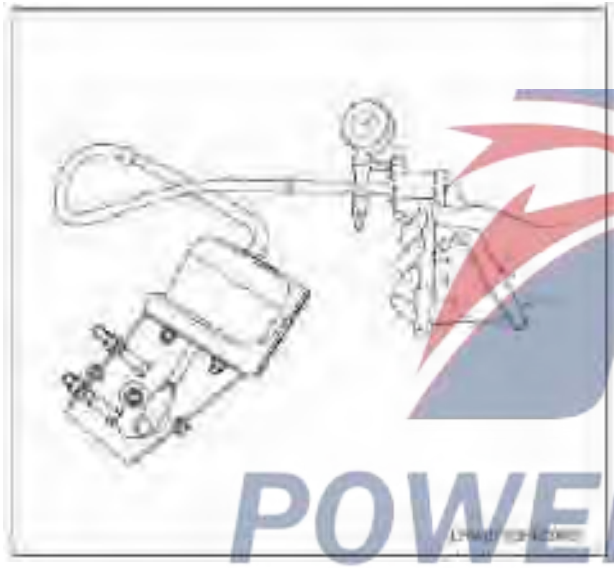
Exhaust brake valve

Works

• Check the sound of the valve that comes into contact with the valve when the exhaust brake is idling. In addition, check whether the valve returns smoothly when closed.

Monomer

• After using a vacuum pump to apply a negative pressure of 66.7 to 93.3 kpa (500 to 700 mmhg) to the power chamber, the exhaust brake valve should be able to open and close flexibly.



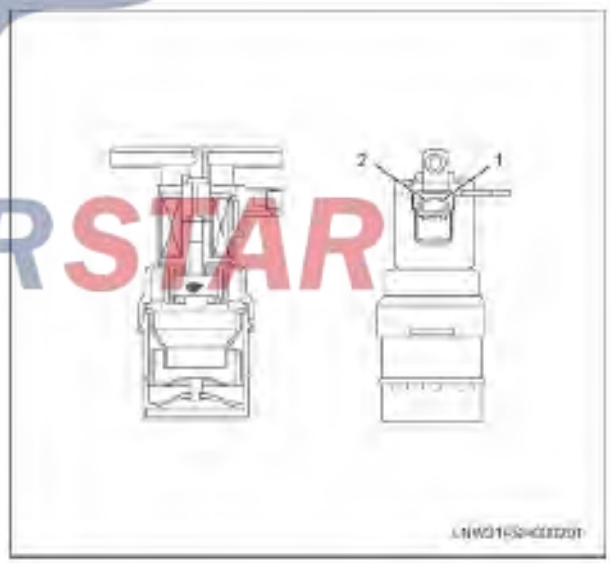
• The application of 86.7 to 93.3 kpa {650 to 700 mmhg} to the supply chamber (1), valve (5) and notch (3) of the housing (4) must be the same. When the deviation value deviates from the standard value, the adjustment bolt (2) must be used for adjustment.

Average clearance mm	Minimum clearance mm
0.1∽0.25	0.1

Exhaust brake solenoid valve

Inspection

Connect the terminals (1) of the solenoid valve connector to the (+) terminal of the battery, connect the terminal (2) to the (-) terminal and check the connection between the interfaces.



Section 1F

Engine exhaust purification system

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EGR system

Precautions

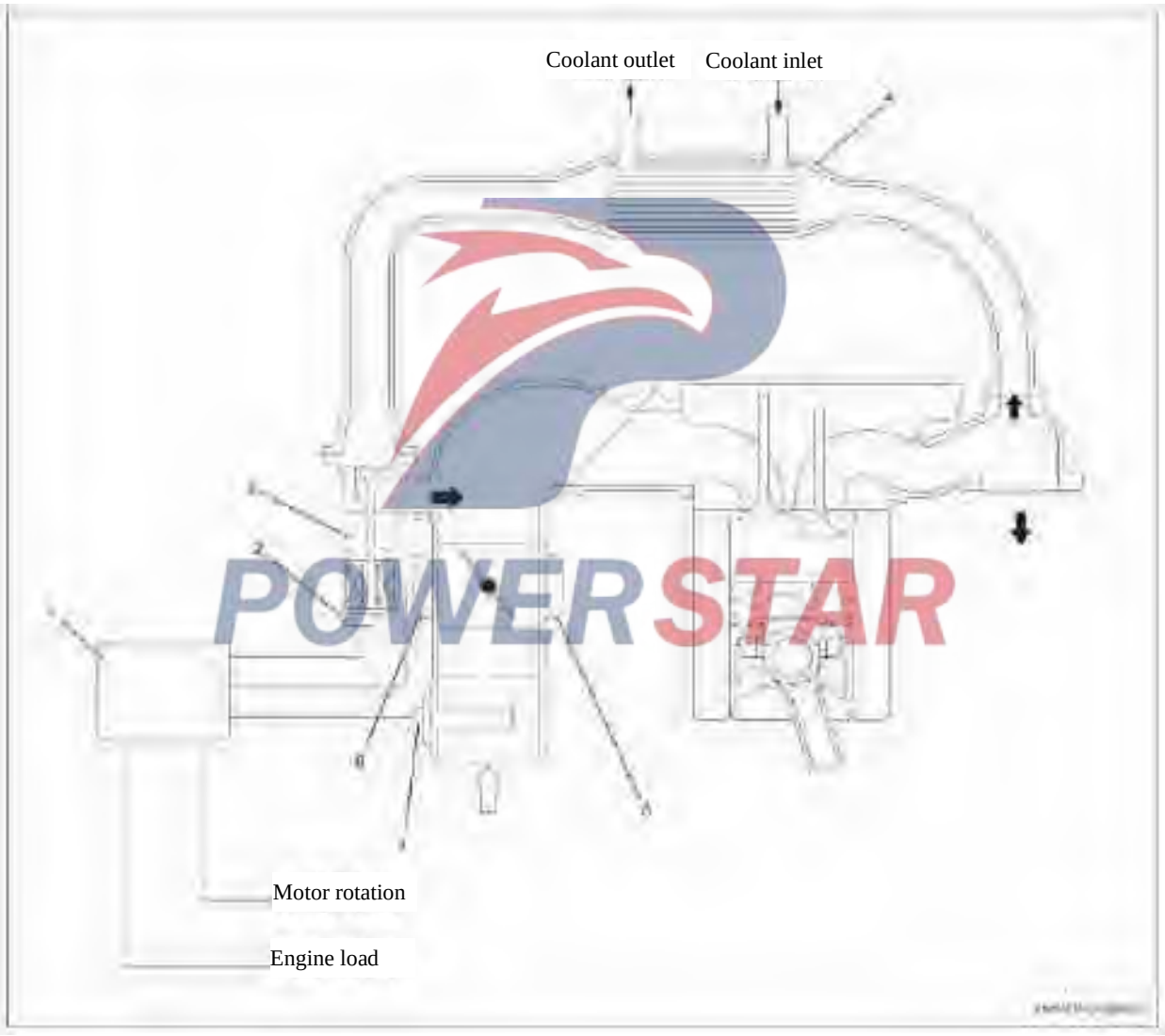
When performing EGR mounting, do not exert excessive force on the parts as pre-installation and tightening must be performed sequentially.

Function and working principle

The EGR system recirculation a portion of the exhaust gas to the intake manifold. After the inert gas is mixed in the intake air, the combustion temperature is reduced, thereby controlling the nox production.

The system applies EGR converter control mode to control the motor (ECM) control current module, DC motor operation, EGR valve control to ensure low emissions and operability.

For troubleshooting of EGR systems, refer to Engine Control System in chapter IA Engine Control System (4HK1).

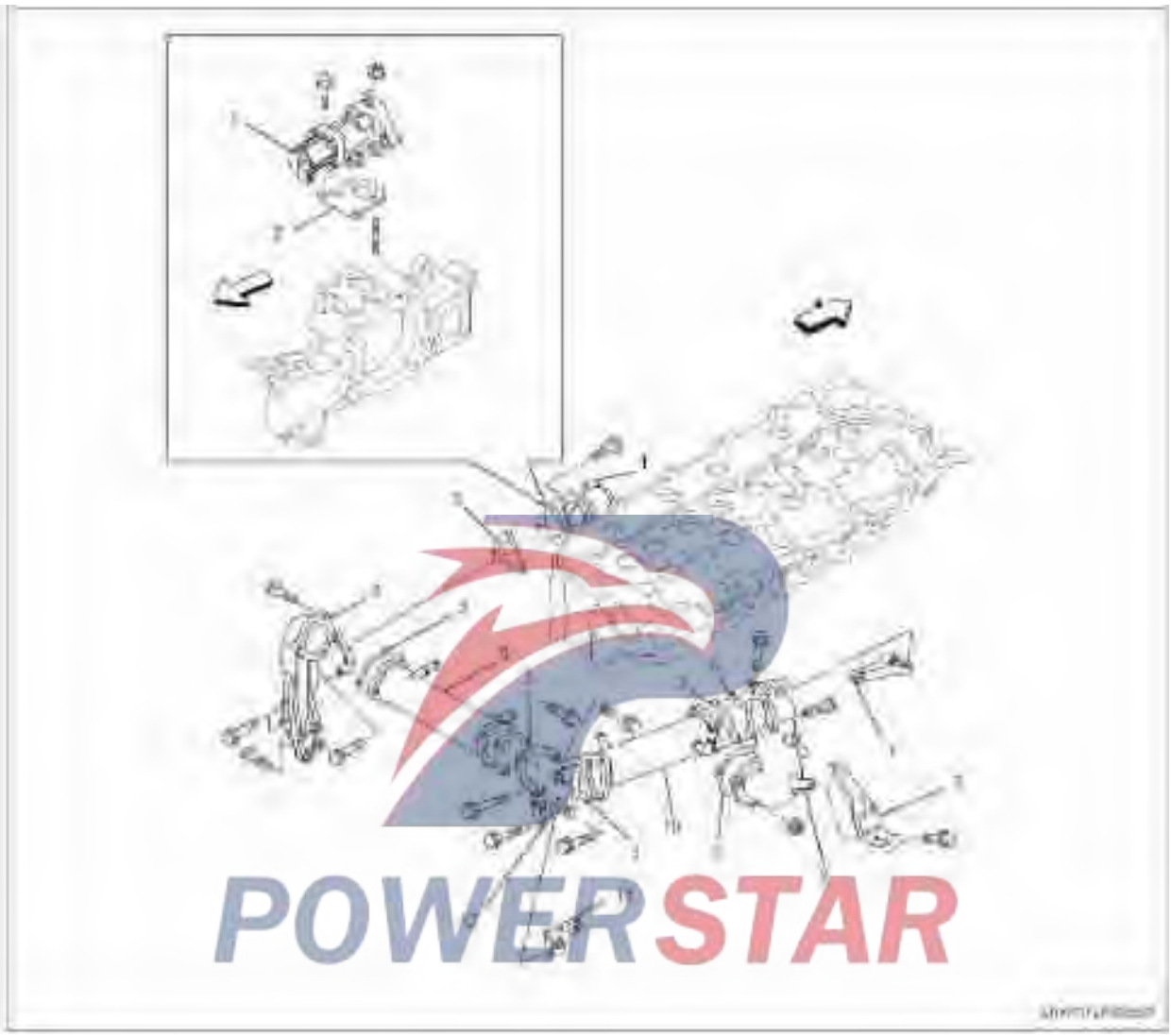


Key

1. ECM
2. EGR position sensor
3. EGR valve
4. EGR cooler
5. Intake throttle valve
6. Throttle position sensor
7. MAF sensor

EGR valve and EGR cooler

Component parts



Key

1. EGR valve
2. EGR valve gasket
3. EGR pipe gasket
4. EGR pipe
5. EGR cooler assembly: 2nd
6. Board
7. Support
8. EGR cooler insulation board
9. EGR cooler piping
10. EGR cooler: 1st (Qingling does not have this device)
11. Support
12. EGR cooler piping

Disassembly

1. Discharge the coolant.
2. Remove the connector from the EGR valve.
3. Remove the water pipe.
4. Remove the insulation plate from the EGR cooler.
5. Remove the EGR cooler conduit: 1st .

Mark:

After removing the EGR cooler tube, seal it to prevent foreign matter from entering.

6. Remove the EGR cooler assembly: 1st. (Qingling does not have this device)
7. Remove the EGR cooler conduit: second.

Mark:

After removing the EGR cooler tube, seal it to prevent foreign matter from entering.

8. Remove EGR cooler assembly: second.

9. Remove the EGR pipe.

10. Remove the EGR valve.

Mark:

After removing the EGR valve, seal it to prevent foreign matter from entering. Check for leaks

Check

Leak Check

• Check for leaks in different parts of the EGR gas passage.

If abnormal, repair or replace the parts.

EGR valve check

• If there is carbon deposit, please clean it.

• EGR solenoid valve on-site inspection method, engine control system reference IA (4HK1) - Chapter engine control system.

Installation

If the assembly sequence and method of the EGR device are incorrect and the leaking of the pipe may cause cracking, it must be performed in the following order.

1. Install the EGR valve on the intake cover.

• Place the shirt and pre-install the EGR valve.

2. Install the EGR pipe.

• Place the shirt and pre-install the EGR pipe.

3. Install the EGR cooler conduit on the rear side.

• Place the folder and pre-install the EGR cooler piping.

4. Install the EGR cooler assembly: 2nd.

• Install seals on both sides of the EGR cooler assembly for preassembly.

5. Install the EGR cooler conduit on the front side.

• Place the folder and pre-install the EGR cooler piping.

6. Install the EGR cooler assembly: 1st. (Qingling does not have this device)

• Install seals on both sides of the EGR cooler assembly for preassembly.

After pre-installation, tighten to the specified torque.

7. Fix the EGR valve and intake cover according to the specified torque.

Tightening torque : 24 N•m {2.4kgf•m}

8. As shown in FIG. 8, according to the serial number in the figure, tighten the torque required for the EGR duct, EGR cooler, and EGR cooler duct assembly.

a. EGR and EGR valve bolts (1)

Tightening torque: 24 N•m {2.4 kgf•m}

b. EGR pipe and bolt (2)

Tightening torque: 104 N•m {10.8 kgf•m}

c. EGR cooling pipe and bracket bolts (3)

Tightening torque: 48 N•m {4.9 kgf•m}

d. EGR pipe bolts and EGR coolers (4)

Tightening torque: 48 N•m {4.9 kgf•m}

e. Bolts for EGR cooler piping and EGR cooler assembly (3)

Tightening torque: 48 N•m {4.9 kgf•m}

f. Bolts for EGR cooler piping and EGR cooler assembly (6)

Tightening torque: 48 N•m {4.9 kgf•m}

g. Bolts for EGR cooler piping and EGR cooler assembly (7)

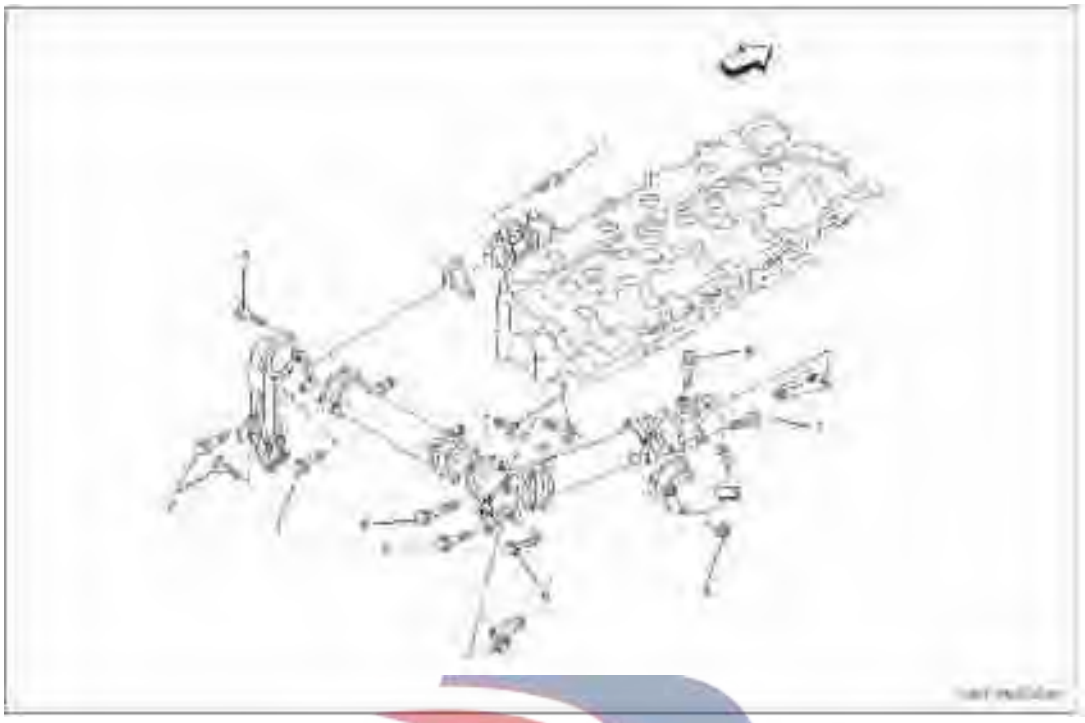
Tightening torque: 28 N•m {2.9 kgf•m}

h. EGR cooler manifold and exhaust manifold nut (8)

Tightening torque: 28 N•m {2.9 kgf•m}

i. EGR cooler conduit and support bolts (9)

Tightening torque: 48 N•m {4.9 kgf•m}



9. Install the EGR cooler insulation plate and tighten it to the specified torque.

Tightening torque: 10 N•m {1.0 kgf•m}

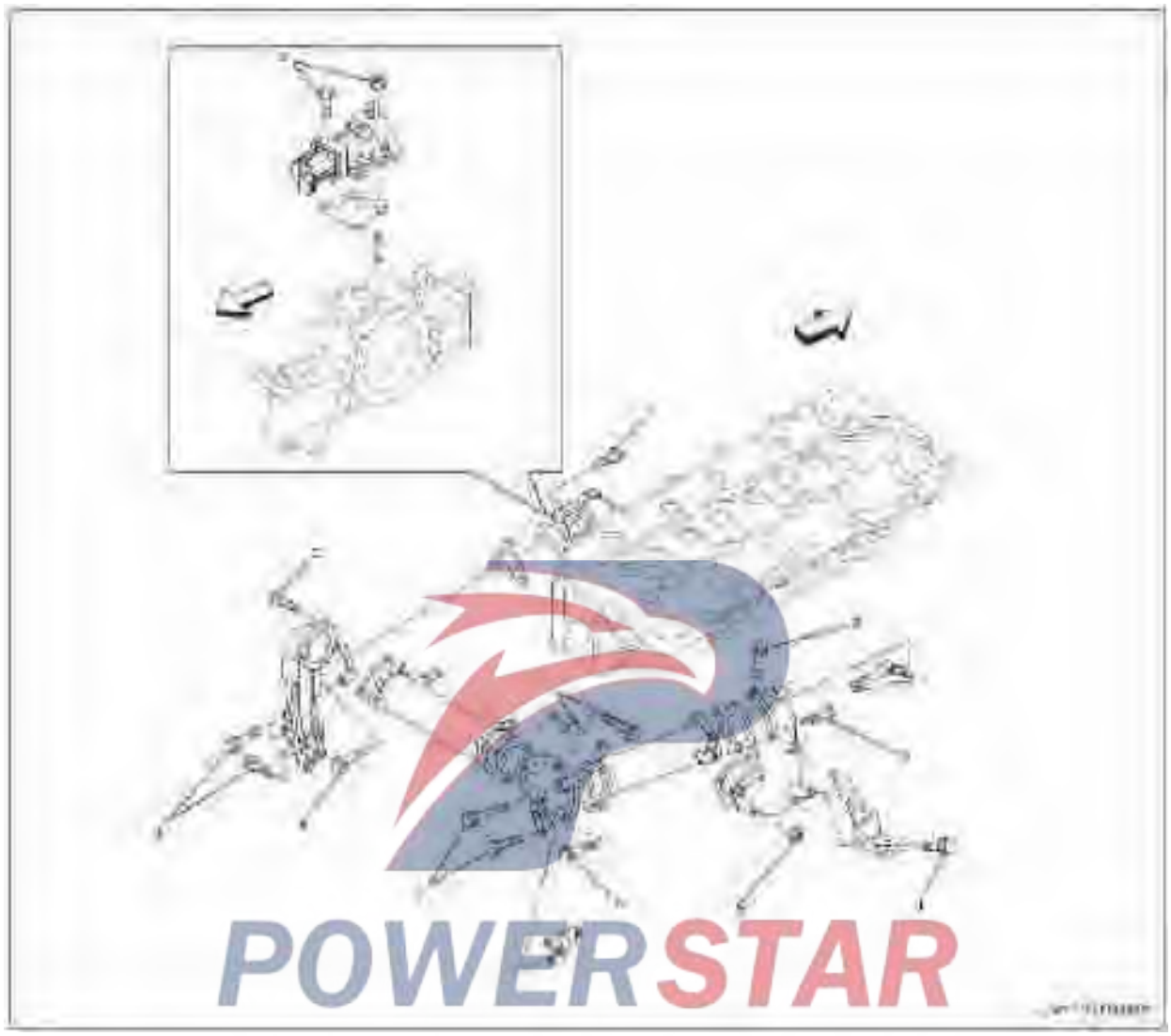
10. Install the water pipe.

• Install the clip in the designated location.

11. Install the EGR valve connector.

12. Supplement the coolant.

Tightening torque - Overview



(a) 24 N·m {2.4 kgf·m}

(b) 24 N·m {2.4 kgf·m}

(c) 48 N·m {4.9 kgf·m}

(d) 48 N·m {4.9 kgf·m}

(e) 28 N·m {2.9 kgf·m}

(f) 10 N·m {1.0 kgf·m}

(g) 28 N·m {2.9 kgf·m}

(h) 48 N·m {4.9 kgf·m}

(i) 48 N·m {4.9 kgf·m}

(j) 48 N·m {4.9 kgf·m}

(k) 24 N·m {2.4 kgf·m}

(I) 104 N·m {10.8 kgf·m}

Section 1G

Engine exhaust system

Table of Contents

Exhaust system

Precautions

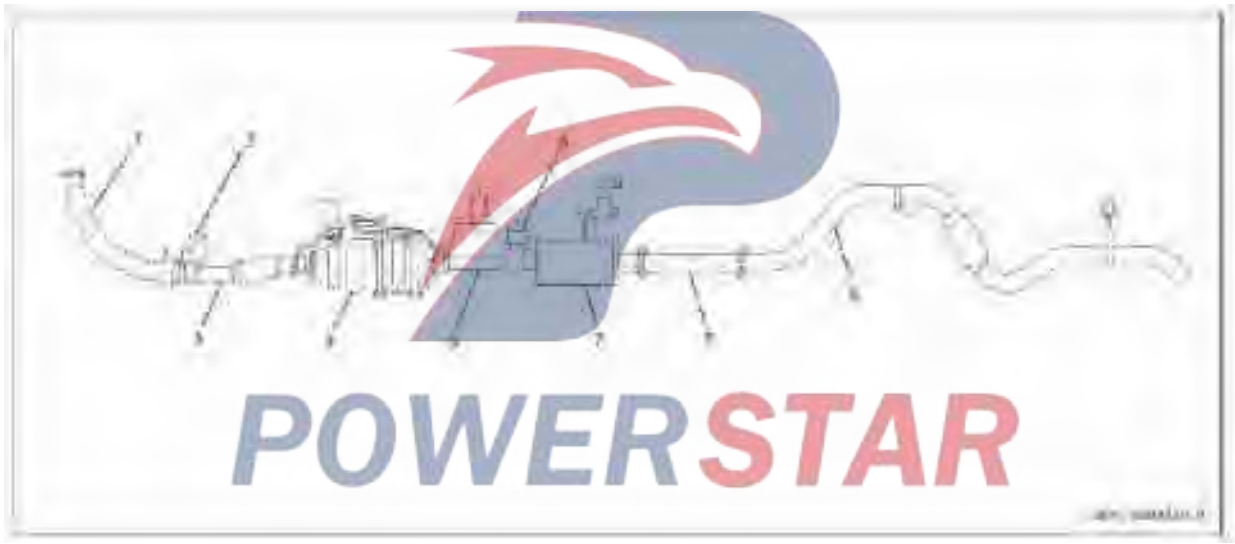
Movement during assembly may cause vibration and abnormal noise in the exhaust system. Before positioning all parts, tighten the bolts and nuts first, then tighten them on the motor side of the rear end.

Function and working principle

The exhaust brake is equipped with a valve in the exhaust pipe. By closing the valve, the resistance of the exhaust stroke increases, which increases the braking effect of the engine. In addition, rapid engine warm-up (QWS) is performed by adjusting the exhaust pressure.

A rear muffler is provided on the rear hose to increase noise reduction. The main components consist of the front exhaust pipe, exhaust brake, exhaust brake valve, muffler and exhaust pipe.

(The figure shows a model with a wheelbase of 3,815 mm)



Key

1. Front exhaust pipe A
2. Exhaust brake assembly
3. Front exhaust pipe B
4. DPD assembly (Qingling does not have this device)
5. Transmission tube(only for models with a wheelbase of 3815 mm)
6. Exhaust brake valve assembly
7. Muffler
8. Extension tube (only for models with a wheelbase of 3815 mm)
9. Rear tail tube

Functional check:

• When checking or repairing the exhaust system, make sure that there is sufficient space between the floor and the body.

• Damage caused by heat and vibration generated from the body panel may introduce exhaust gas into the room, which requires special attention.

• Check for loose and damaged connections and leaks.

• Inspect the clamps and rubber for damage, cracks, and damage.

• If the hose or muffler is damaged or concentrated, repair or replace it.

• Check for punctures or cracks due to dents, damage, and corrosion, and check for unusual noise during operation.

Symptom: Exhaust system vibrates and rattles

Symptom	Probable causes	Treatment measures
Exhaust system vibrates and rattles	Components are loose or incompatible	Tighten the alignment fittings or check the hooks, and if the mounting brackets and clamps are damaged.

Symptom: Exhaust system blockage

Symptom	Probable causes	Treatment measures
Exhaust system blockage	Exhaust brake and exhaust brake valve activated	Check the maintenance control system. Please refer to engine control system engine control system (4hk1). Check whether the exhaust brake shaft and the exhaust brake valve are astringent (not smooth). If not, replace it.
	Block the exhaust pipe	Repair or replace the exhaust pipe.

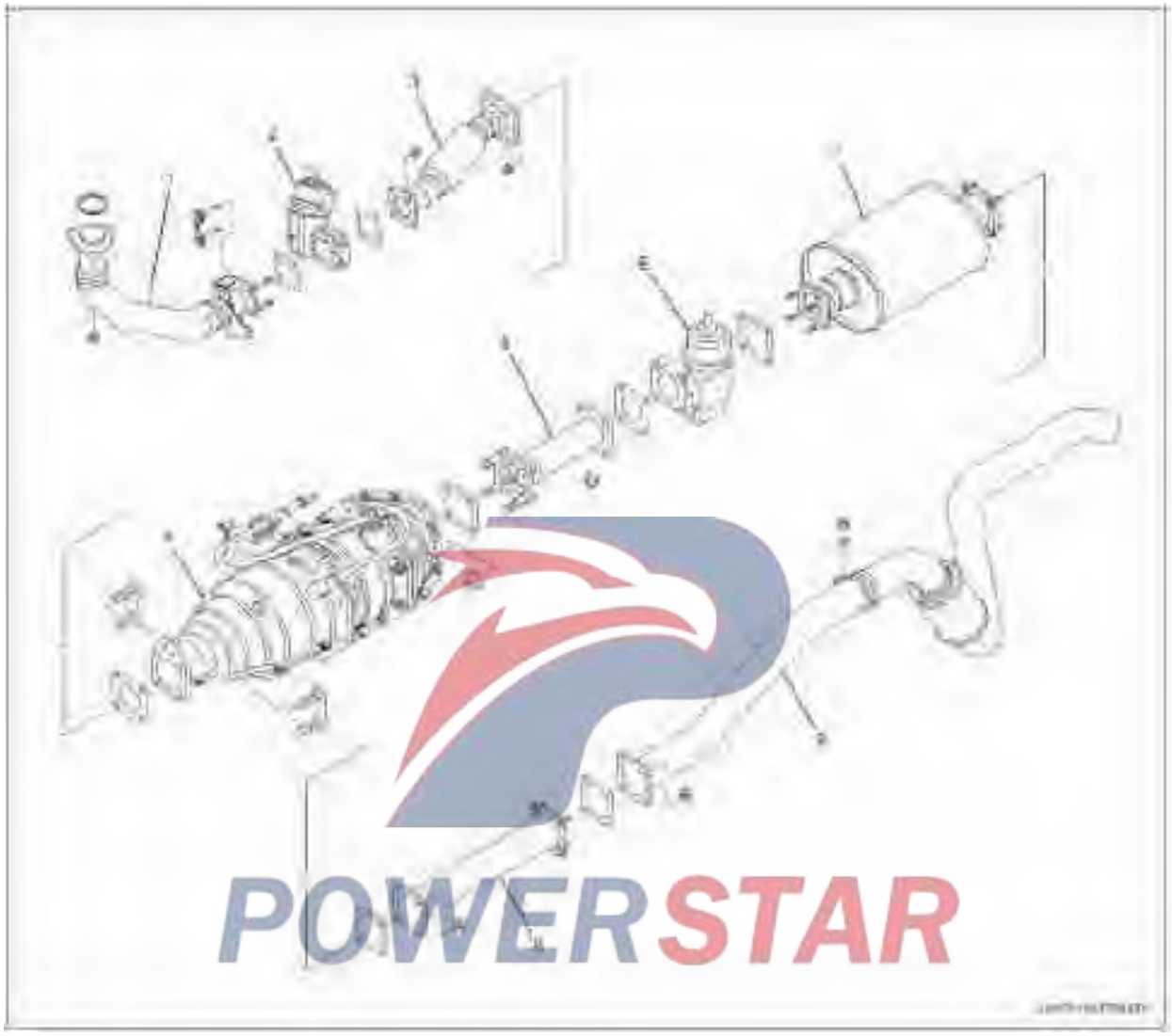
Symptom: Exhaust leakage, noise

Symptom	Probable causes	Treatment measures
Exhaust leakage, noise	Improper or inadequate installation	Align the seal and tighten it.
	Bad exhaust system components (hose clamps, hoses, mufflers)	Replace unused parts.

Exhaust pipe

Component parts

(The figure shows a model with a wheelbase of 3,815 mm)



Key

1. Front exhaust pipe A
2. Exhaust brake assembly
3. Front exhaust pipe B
4. DPD assembly (Qingling does not have this device)
5. Transmission tube(only for models with a wheelbase of 3815 mm)
6. Exhaust brake valve assembly
7. Muffler
8. Extension tube (only for models with a wheelbase of 3815 mm)
9. Rear tail tube

Disassembly

1. Remove the rear exhaust pipe.

• Remove the collar and remove the rear exhaust pipe.

2. Remove the extension tube.

(only models with a wheelbase of 3815mm)

3. Remove the suction hose from the exhaust brake valve.

4. Remove the exhaust brake valve assembly and muffler.

5. Remove the transfer tube.

• (Only models with a wheelbase of 3815mm).

Installation

1. Pre-install the exhaust brake valve assembly and muffler.

2.Install the suction hose from the exhaust brake valve.

3. Pre-installed extension tube

(only models with a wheelbase of 3815mm)

4. Pre-installed rear tail pipe.

After pre-installation, tighten to the specified torque.

5. From the front exhaust pipe A to the turbocharger

Tightening torque: 67 N•m {6.8 kgf•m}

6. From a bracket on the front exhaust pipe to the right side of the transmission

Tightening torque: 18 N•m {1.8 kgf•m}

7. Exhaust brake

Tightening torque: 27 N•m {2.8 kgf•m}

8. Exhaust brake valve assembly and silencer

Tightening torque =27N·m {2.8 kgf·m}

9. The front end of the extension tube

(only models with a wheelbase of 3800mm)

Tightening torque: 50 N•m {5.1 kgf•m}

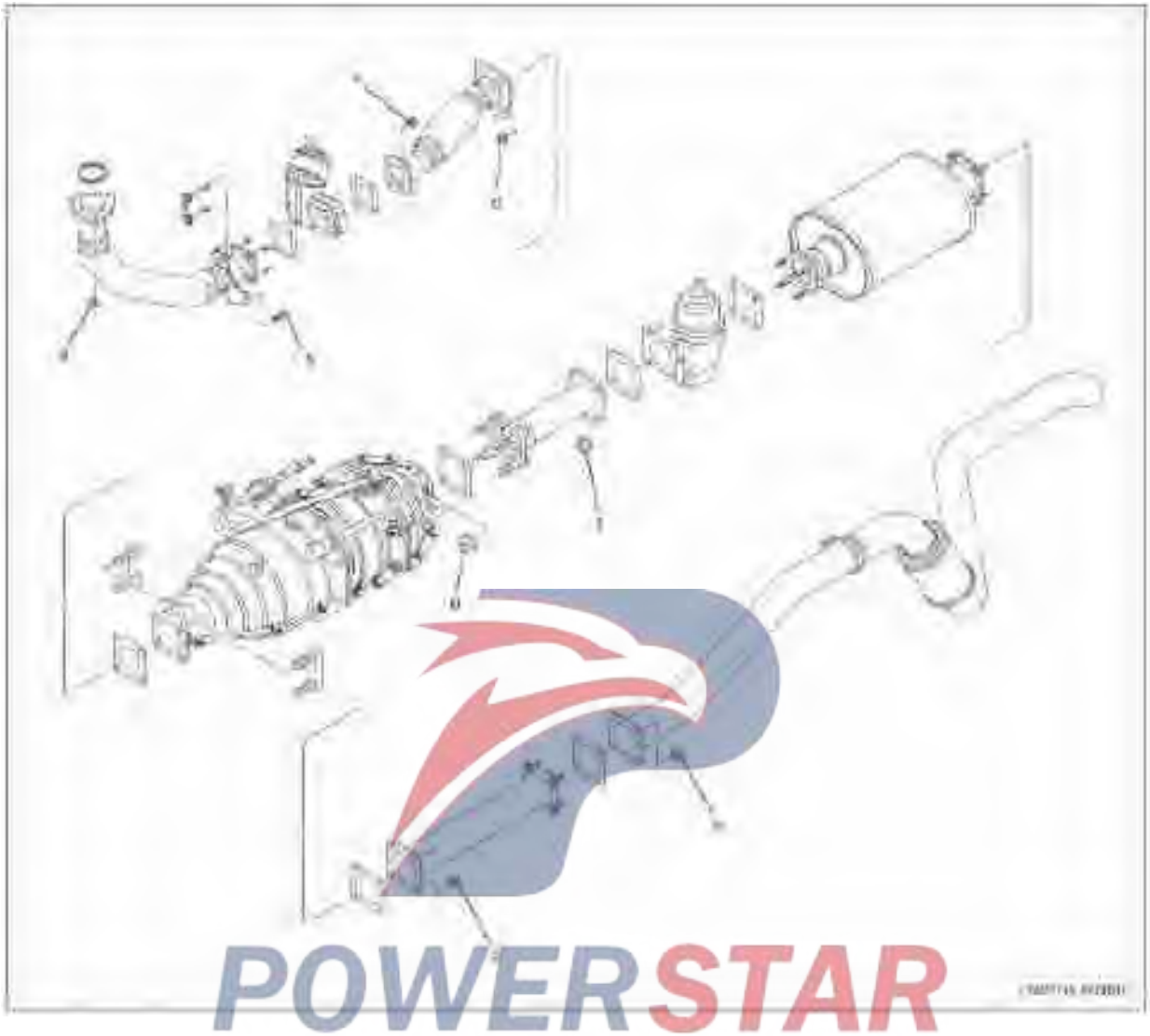
10. Rear tail tube

Tightening torque: 50 N•m {5.1 kgf•m}

11. After tightening the tube seal, tighten the collar.

After assembling the parts, start the engine and check each seal for leaks or vibrations.

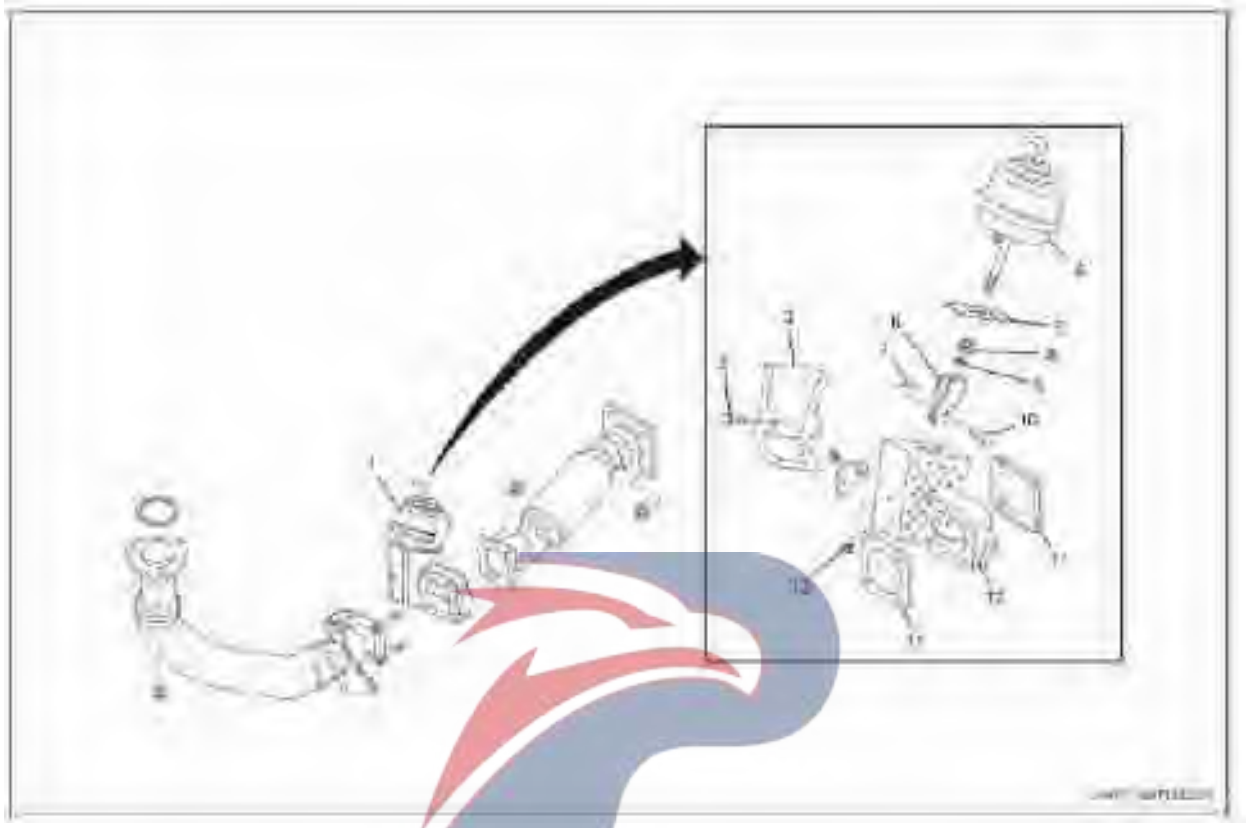
Tightening torque - Overview



(a) 67 N·m {6.8 kgf·m}
(b) 18 N·m {1.8 kgf·m}
(c) 27 N·m {2.8 kgf·m}
(d) 22 N·m {2.2 kgf·m}
(e) 20 N·m {2.0 kgf·m}(No)
(f) 27 N·m {2.8 kgf·m}
(g) 50 N·m {5.1 kgf·m}
(h) 50 N·m {5.1 kgf·m}

Exhaust brake

Component parts



Key

1. Exhaust brake assembly
2. Bolt
3. Cover
4. Pneumatic room
5. Seal gaskets
6.U type connector
7. Cotter pin
8. Bearing
9. Nuts
10.Pin
11. Seal gaskets
12. Exhaust brake valve
13. Nuts

Functional check:

Operation check

• When the exhaust brake is activated at idle, check that the valve collides with the stop.

Disassembly

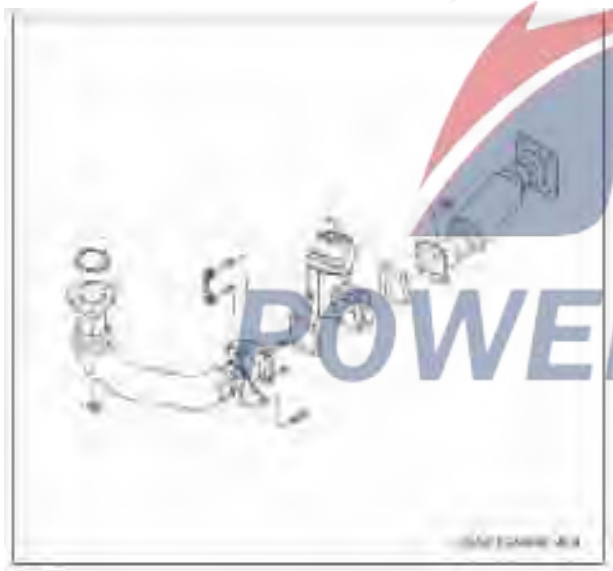
1. Remove suction hose and exhaust brake valve assembly collar.
2. Remove front exhaust pipe A and exhaust brake assembly.

• Remove front exhaust pipe A and turbocharger mounting nut.

• Remove the nuts that secure the front exhaust pipe A and the exhaust brake.

Remove the exhaust brake assembly at the same time.

• Remove the mounting bolts from the exhaust pipe bracket on the right side of the transmission.



Disassembling

1. Remove the split pin.
2. Remove the lock nut.
3. Remove the U connector.
4. Remove the pneumatic parts.

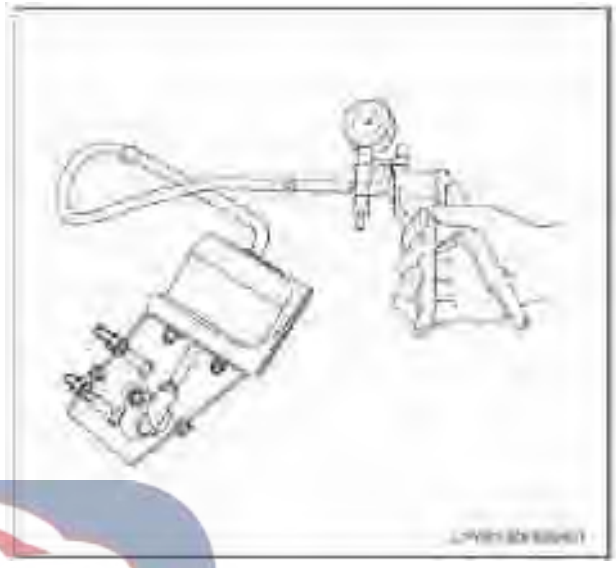
Inspection

Check the following parts for damage, deterioration.

• Exhaust brake valve
• Exhaust brake shaft
• Butterfly valve
• Ring
• Pneumatic room

Monomer inspection

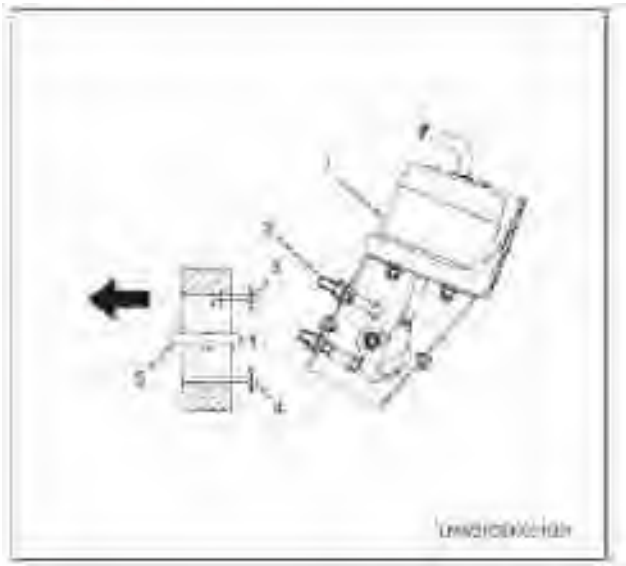
• When the vacuum chamber is moved to a negative pressure of 66.7 to 93.3 kpa (500 to 700 mmhg) by the vacuum pump, the exhaust brake valve should open and close normally and there is no seizure.



• When the vacuum chamber (1) is depressurized to a vacuum of 86.7 to 93.3 kpa (650 to 700 mmhg) by the vacuum pump, the gap between the valve (5) and the valve body must be the average value (3) and (4) . When the clearance exceeds the standard value, adjust with adjusting screw (2).

Average clearance mm	Minimum clearance mm
0.1～0.25	0.1

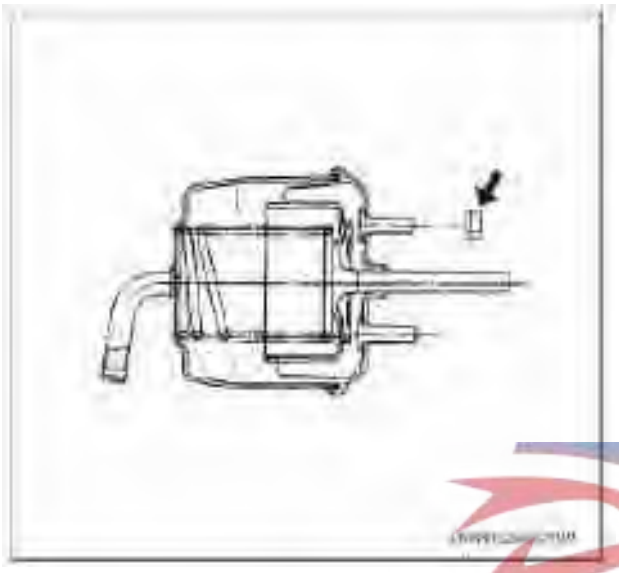
Tightening torque: M6 = 6 N·m {0.6 kgf·m}



Assembly

1. Install the pneumatic parts.

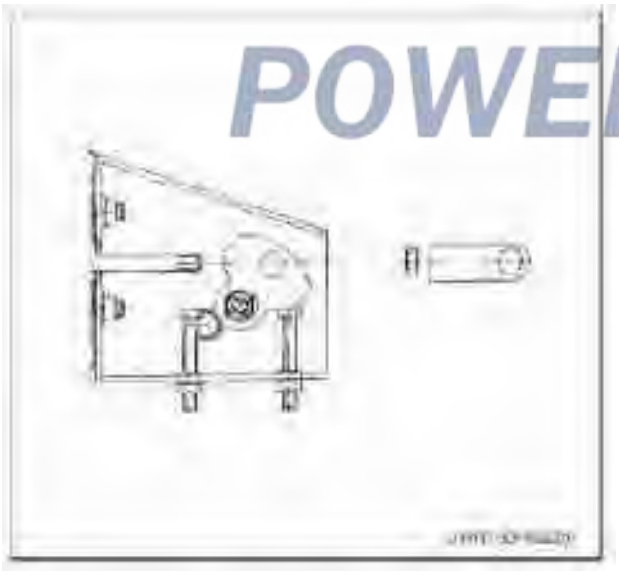
Tightening torque: 14 N•m {1.4 kgf•m}



2. Install the lock nut.

3. After installing the U-shaped connector, tighten the lock nut to the specified torque.

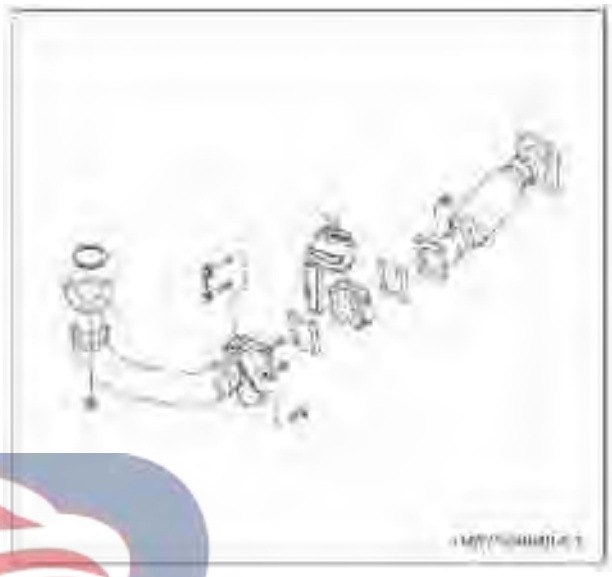
Tightening torque: 13 N•m {1.3 kgf•m}



4. Install the cotter pin.

Installation

1. Pre-install exhaust pipe A and exhaust brake for pre-tightening.



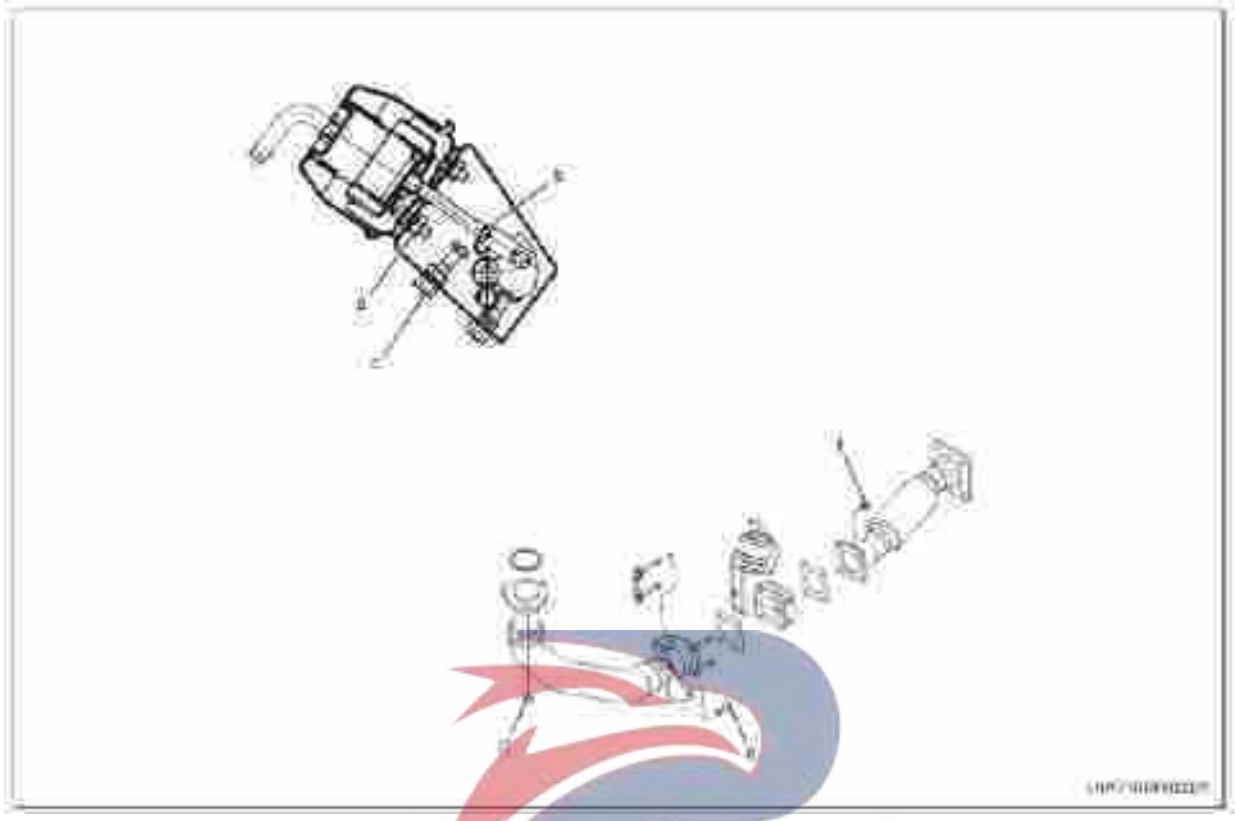
2. Tighten the fastening bolts and nuts to the specified torque.

Tightening torque:

Lateral turbine nut	67 N•m {6.8 kgf·M}
Exhaust pipe support bolt	18 N•m {1,8 kgf•m}
Exhaust brake side nut	27 N•m {2.8 kgf•m}

3. Install suction hose and collar.

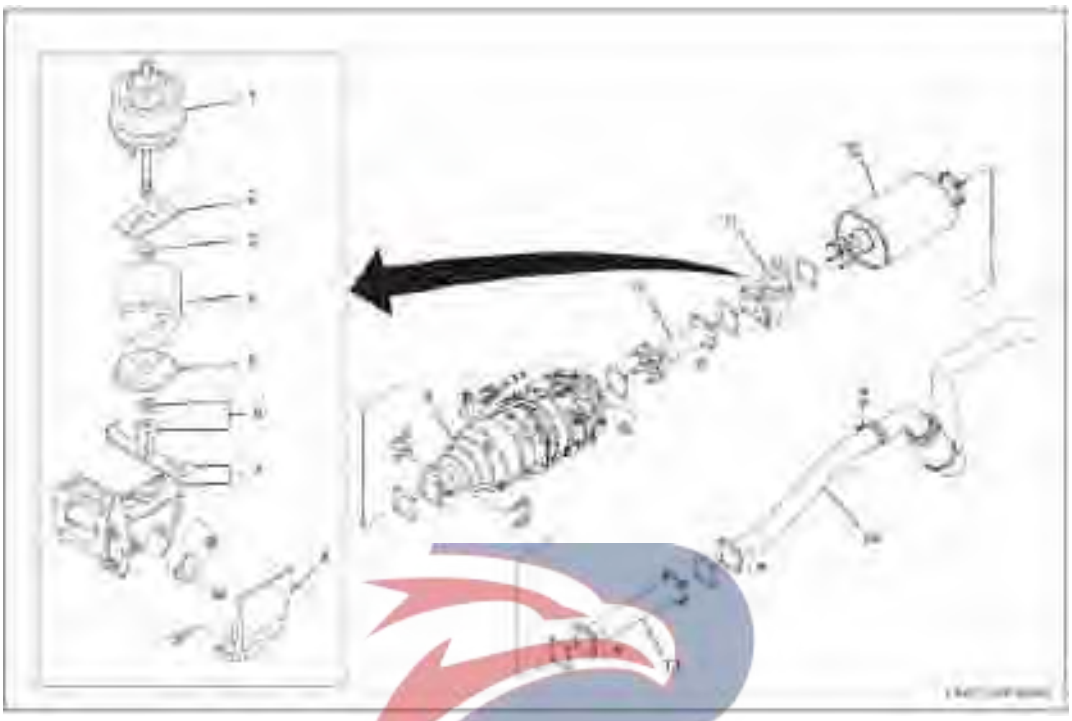
Tightening torque - Overview



(a) 14 N·m {1.4 kgf·m}
(b) 13 N·m {1.3 kgf·m}
(c) 6 N·m {0.6 kgf·m}
(d) 67 N·m {6.8 kgf·m}
(e) 18 N·m {1.8 kgf·m}
(f) 27 N·m {2.8 kgf·m}

Exhaust brake valve

Component parts



Key

1. Pneumatic room
2. Seal gaskets
3. Bearing
4. Insulation body
5. Protective device
6. Lock nut and U-shaped connector
7. Pins and cotter pins
8. Cover
9. DPD assembly (Qingling does not have this device)
10. Transmission tube (model of wheelbase 3815mm)
11. Exhaust brake valve assembly
12. Muffler
13. Extension tube (model of wheelbase 3815mm)
14. Rear tail tube

Disassembly

1. Remove the nut.
2. Remove the rear exhaust pipe.
3. Remove the extension tube.
(only models with a wheelbase of 3815mm)
4. Remove the muffler.
5. Remove suction hose and exhaust brake valve assembly collar.
6. Remove the exhaust brake valve assembly.

Disassembling

1. Remove the split pin.
2. Remove the lock nut.
3. Remove the U connector.
4. Remove the pneumatic parts.

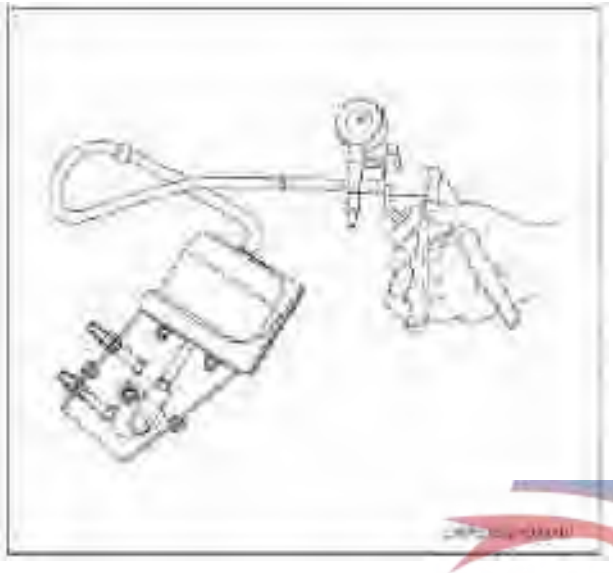
Inspection

Check the following parts for damage, deterioration, etc.

- Exhaust throttle valve
- Exhaust brake valve shaft
- Butterfly valve
- Pneumatic room

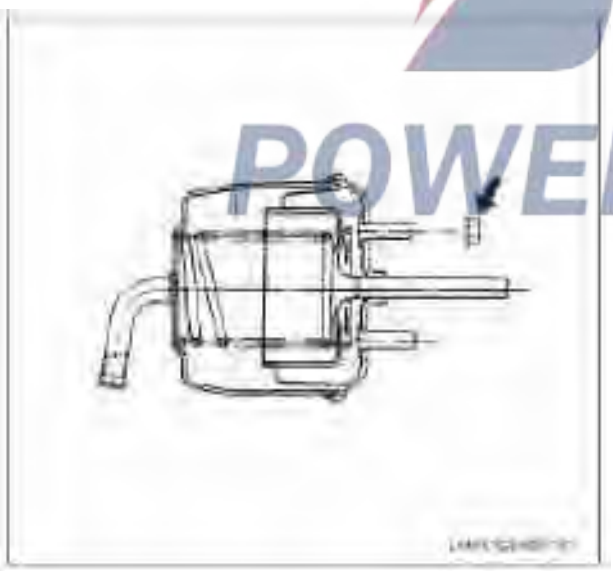
Monomer inspection

• When a vacuum pump is used to achieve a negative pressure of 75 to 93.3 kpa (560 to 700 mmhg), the throttle valve should normally be able to open and close without stalling.



Assembly

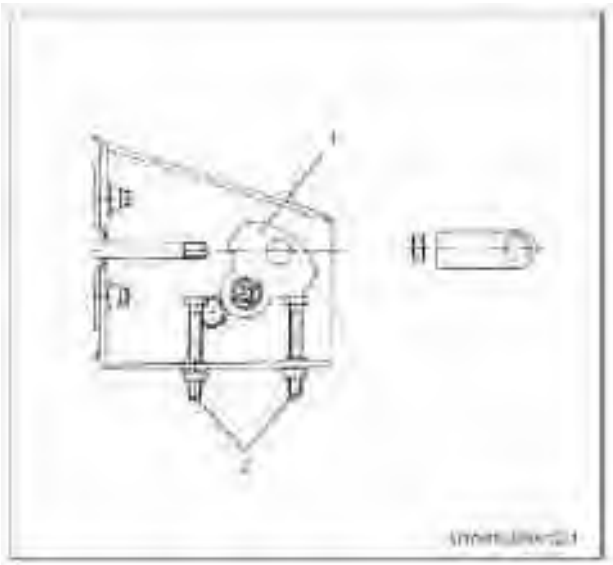
1. Install the pneumatic parts.
Tightening torque: 14 N•m {1.4 kgf•m}



2. Install the lock nut.
3. After installing the U-shaped connector, tighten the lock nut to the specified torque.
Tightening torque : 13 N•m {1.3kgf•m}

Mark:

Do not adjust or remove the adjustment bolts.
Do not remove the lever.



Key

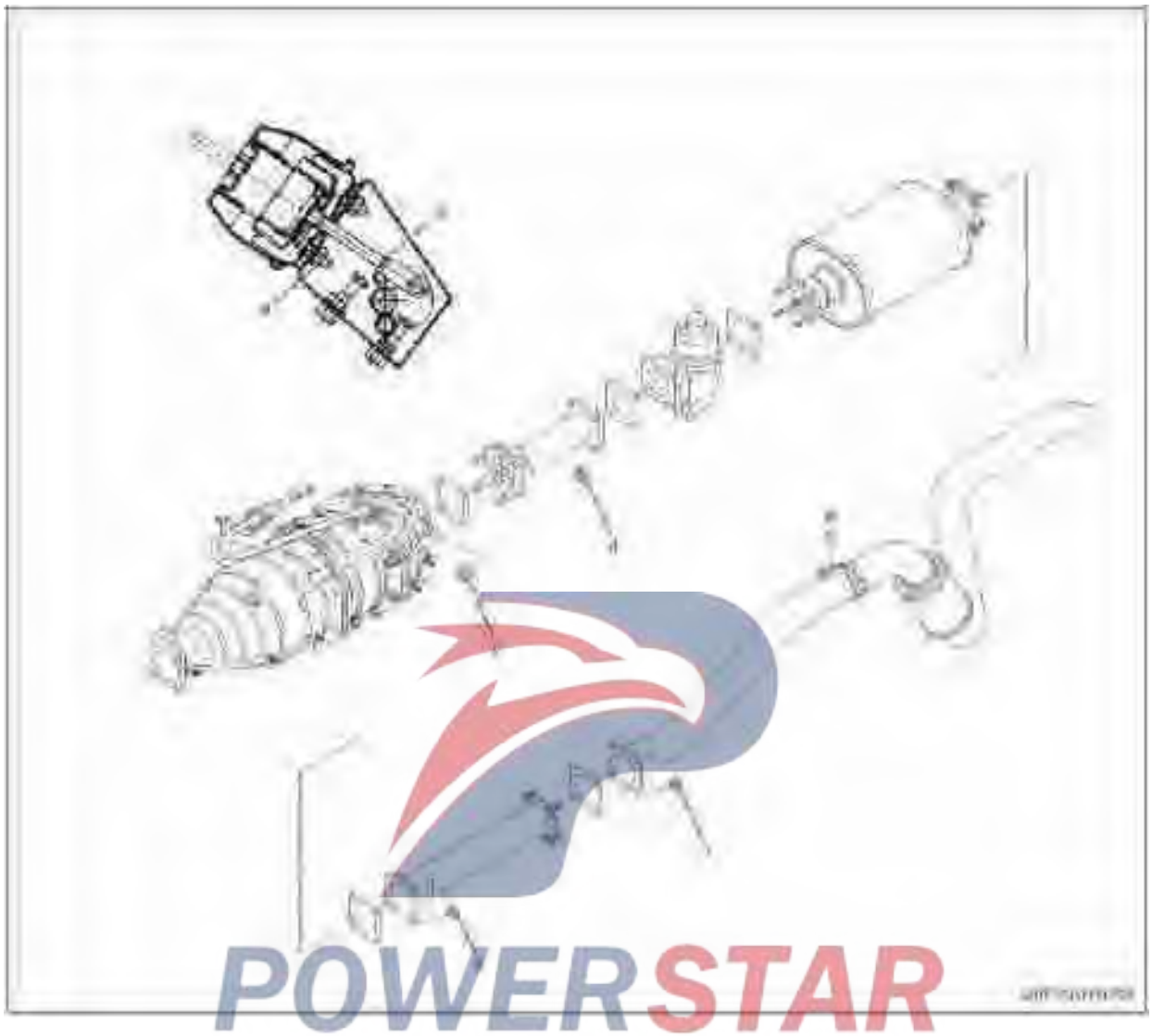
1. Rod
2. Adjust the bolt

4. Install the cotter pin.

Installation

1. Install the exhaust brake valve assembly and muffler to preload.
2. Install the extension tube and preload it.
(Only the wheelbase is 3,815mm)
3. Install tailpipes and pre-tighten.
4. Install the suction hose and hose clamp.
5. If the transfer tube has been removed, tighten the torque nut to the specified torque when reinstalling.
(only models with a wheelbase of 3815 mm)
Tightening torque : 20N·m{2.0kgf·m}
6. Tighten the exhaust brake and muffler valve tightening nut to the specified torque.
Tightening torque : 27N·m{2.8kgf·m}
7. Tighten the tightening nut of the muffler and extension tube to the specified torque.
(only models with a wheelbase of 3800mm)
Tightening torque: 50 N•m {5.1 kgf•m}
8. Tighten the exhaust pipe to the specified torque.
Tightening torque: 50 N•m {5.1 kgf•m}

Tightening torque - Overview



(a) 14 N·m {1.4 kgf·m}

(b) 13 N·m {1.3 kgf·m}

(c) 20 N·m {2.0 kgf·m}(No)

(d) 27 N·m {2.8 kgf·m}

(e) 50 N·m {5.1 kgf·m}

(f) 50 N·m {5.1 kgf·m}

Section 1H

Engine lubrication system

Table of Contents

Lubrication system

Precautions

• When removing the liquid sealant, use a spatula to completely remove the old sealant, clean the oil, moisture, dust, etc. Use cotton thread and apply the specified liquid sealant.

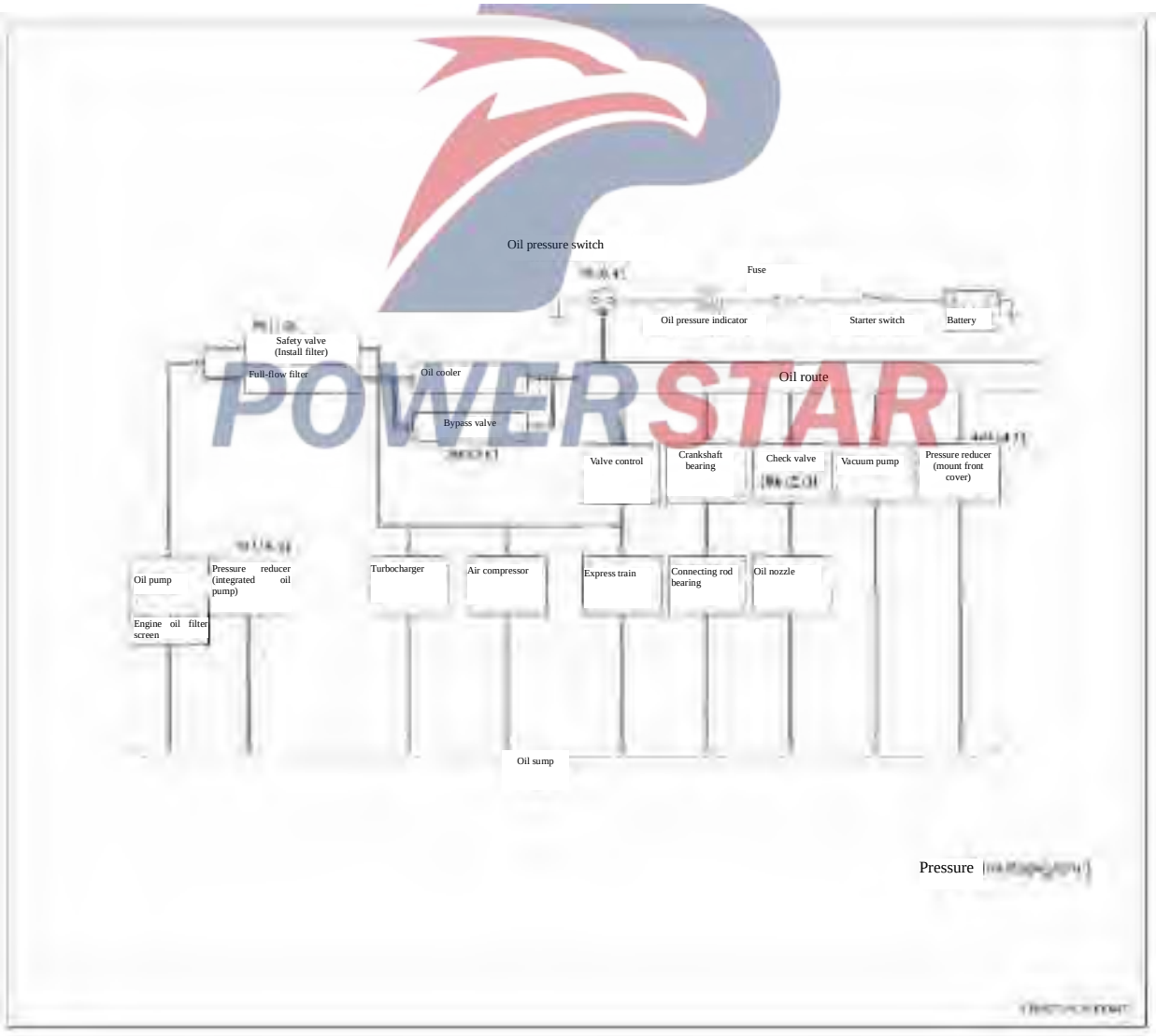
Apply a proper amount of liquid sealant. Do not apply too much or not enough. Excessive application can block the oil passages and nozzles and cause burns because insufficient application can cause oil and water to leak.

Apply at the beginning and end, need to overlap the smear.

Function and working principle

In the lubrication system, full-diameter one-piece filter elements, water-cooled oil coolers and piston cooling nipples are used.

Lubricating system drawing



Functional check:

Check oil pressure

1. Check the engine oil level. Make up for the lack of oil.

2. Install the hydraulic gauge.

Key

1. Oil filter cartridge filter
2. Adapter
3. Joints
4. Hose
5. Pressure gauge

3. Fully heat up the engine.

4. Measure the oil pressure condition at 1700 rpm and exceed 294kpa {3.0kg/cm2}.

5. Stop the engine.

6. Remove the hydraulic gauge.

7. Install the oil pressure switch.

8. Start the engine and confirm that there is a leakage of mineral oil.

Mark:

Check the engine oil for abnormal dirt and water. In case of abnormally mixed water, investigate the cause, take appropriate measures, and change the oil.

Use engine oil

• Level (API) Level CF-4

Viscosity (SAE) 10W-40 BESCO CLEAN SUPER (The viscosity grade should be selected according to the temperature at the time)

Mark:

The above engine oil should be used on this engine. Check engine oil

• Park the vehicle on level ground and check before starting the engine or stopping the engine for 30 minutes.

• How to check the amount of oil

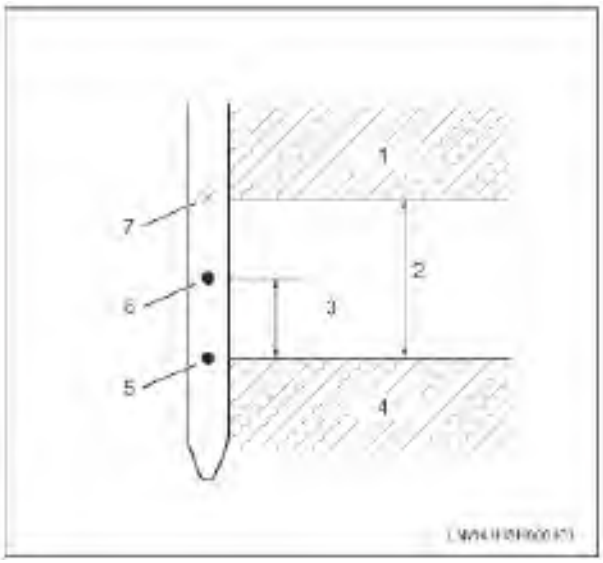
- Remove grease and wipe off the attached oil.

- Reinsert completely and slowly remove. If the oil is between MIN and MAX, the condition is good.

- If the oil level exceeds the MAX check, replace the oil.

- When the engine oil is low, it is necessary to supplement the MAX (maximum) supplement.

Engine oil change time: every 15,000 kilometers or every 1 year



Key

1. Must change oil
2. Normal oil
3 can be added to the quote via MAX
4. Need to add
5.MIN (minimum)
6. MAX Supplement (Maximum)
7. Use MAX (maximum)

Engine oil leak

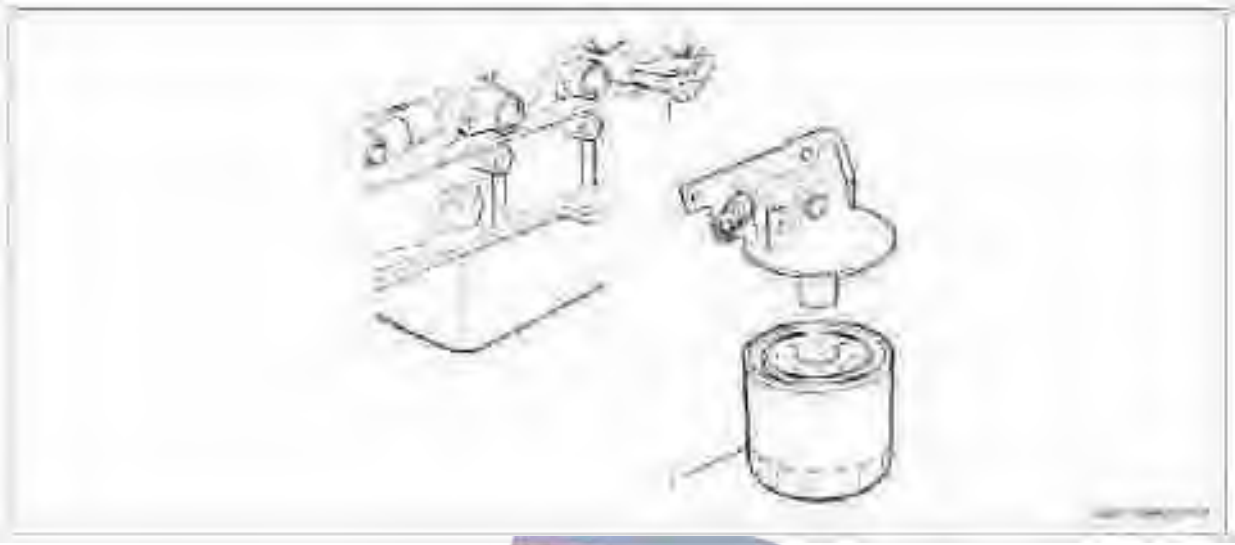
• Check for leaks in oil seals, cylinder head covers, oil pans, etc.

Special tools

Illustration	Tool number Tool name
	1-8522-1097-0 Engine oil filter wrench

Oil filter cartridge filter

Component parts



Key

1. Oil filter cartridge filter

Disassembly

1. Place the tray on the underside of the oil filter element.

2. Use an oil filter wrench to remove the oil filter.

Special tools

Engine oil filter wrench: 1-85221-097-0

Mark:

When handling the cartridge filter, be careful not to trap the CKP sensor beam.

Installation

1. Install the filter of the oil filter.

• Apply grease to the seal of the cartridge filter (BESCO L2 or L3) or install using an oil filter wrench.

• Tighten the ink cartridge filter to the specified torque.

Tightening torque: 64 N•m {6.5 kgf•m}

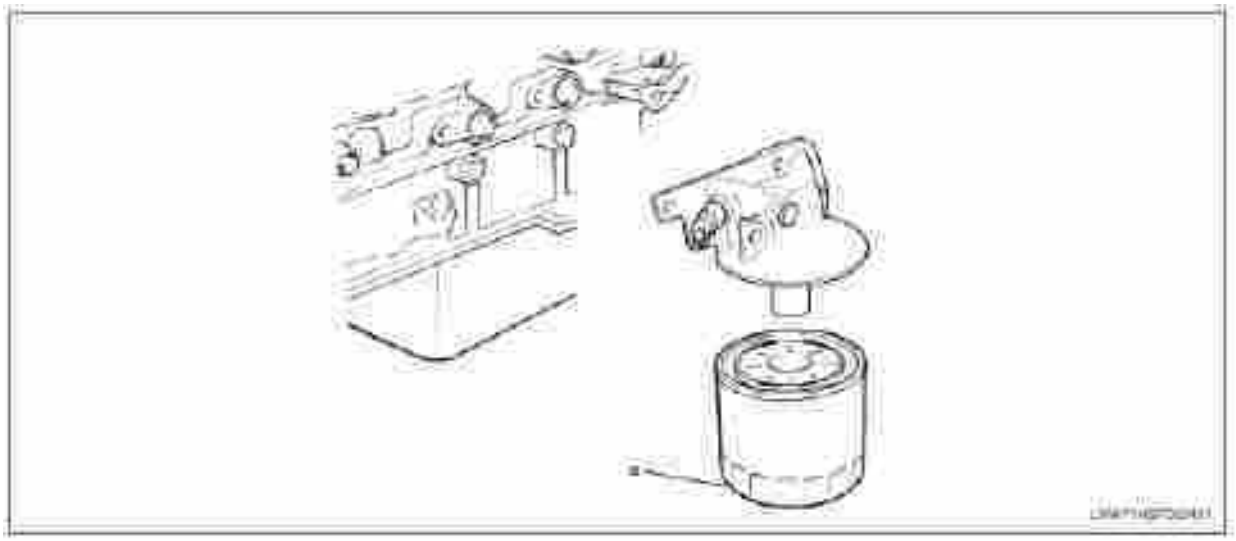
or

After contacting the oil seal, rotate for 1 week and rotate 1/4 turn.

Special tools

Engine oil filter wrench: 1-85221-097-0

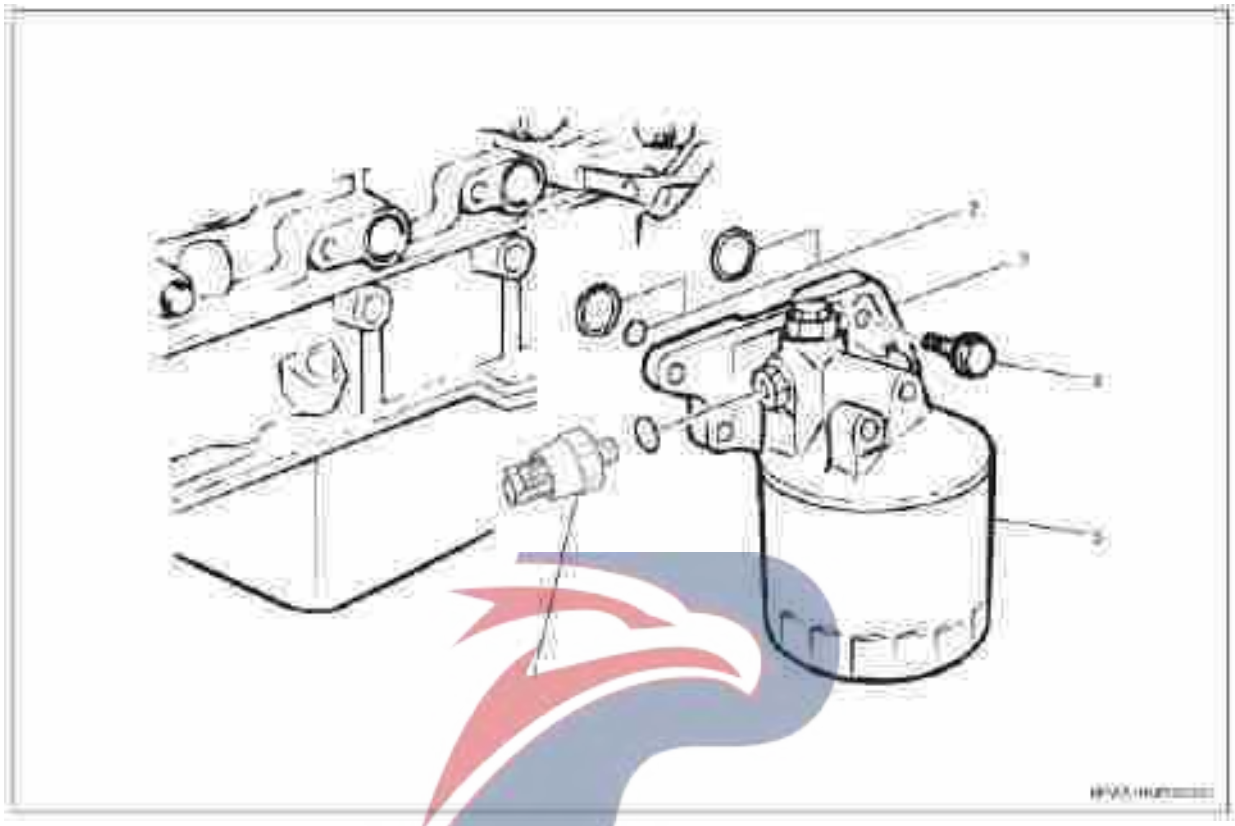
Tightening torque - Overview



(a) 64 N·m {6.5 kgf·m}

Oil filter assembly

Component parts



Key

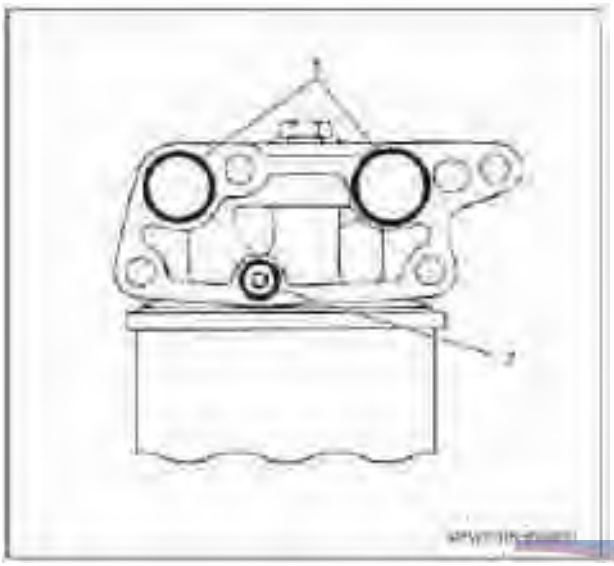
1. Oil pressure switch
2. O-ring
3. Oil filter body
4. Bolt
5. Oil filter cartridge filter

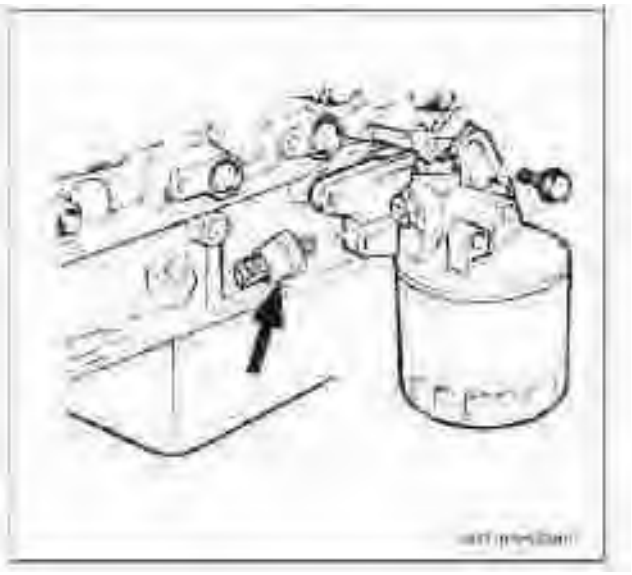
Disassembly

1. Place the bin under the oil filter assembly.
2. Remove the oil pressure switch.
3. Remove the oil filter body.
4. Remove the O-ring.

Installation

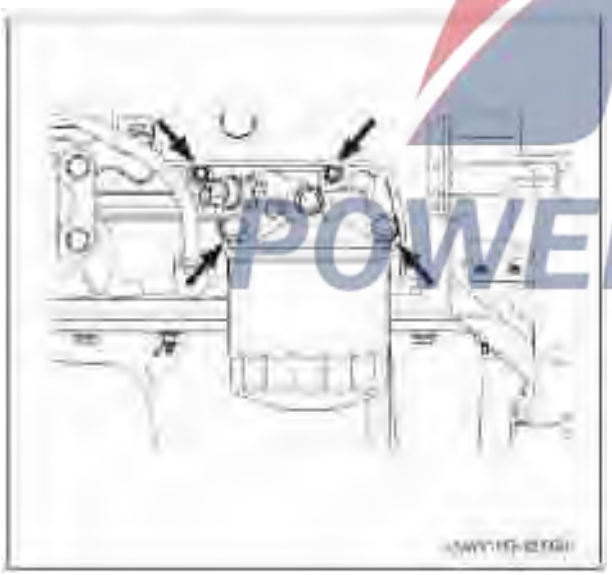
1. Install O-rings (1) and (2) on the oil filter housing.





2. Install the oil filter body on the cylinder block and tighten it to the specified torque.

Tightening torque: 48 N•m {4.9 kgf•m}

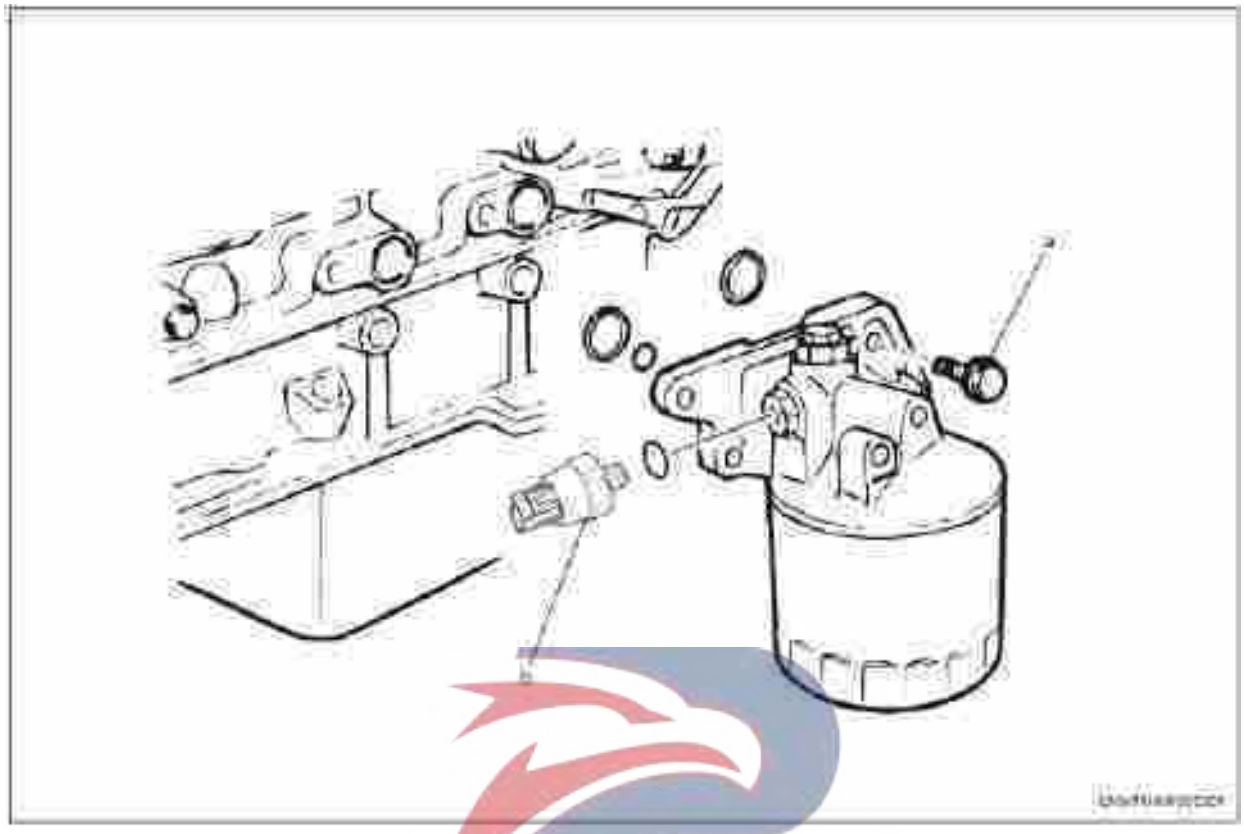


3. Install the oil pressure switch on the oil filter body.

• Apply liquid sealant (Loctite screw Na262) from the top of the threaded portion of the oil pressure switch to the 2nd to 3rd teeth and install it in the position shown in the figure.

Tightening torque: 13 N•m {1.3 kgf•m}

Tightening torque - Overview

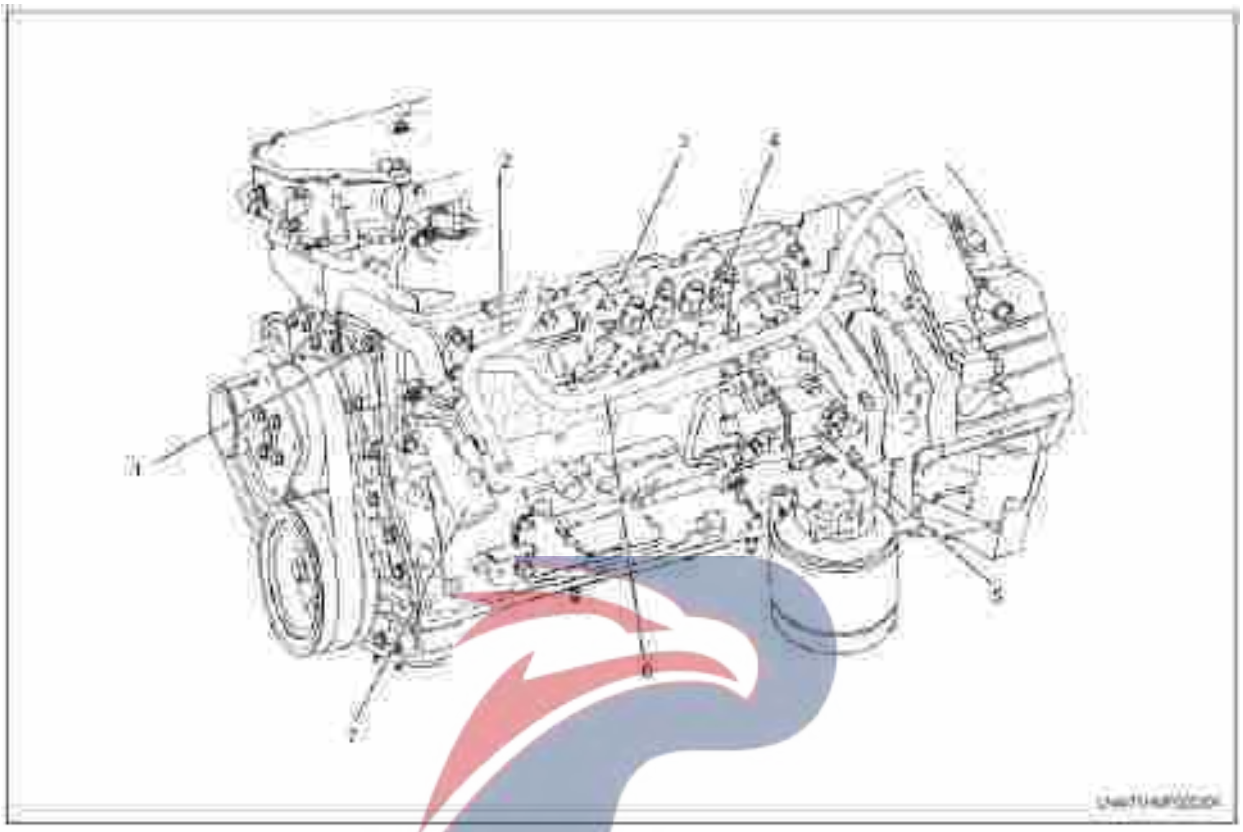


(a) 48 N·m {4.9 kgf·m}

(b) 13 N·m {1.3 kgf·m}

Oil cooler

Component parts



Key

1. Bypass hose
2. EGR cooler water pipe (OUT)
3. Oil cooler
4. Common Rail
5. Oil feed pump
6. EGR cooling water pipe (IN / IN)
7. Water inlet pipe

Disassembly

1. Remove the common rail.

Refer to common rail in section 1D Power Supply (4HK1).

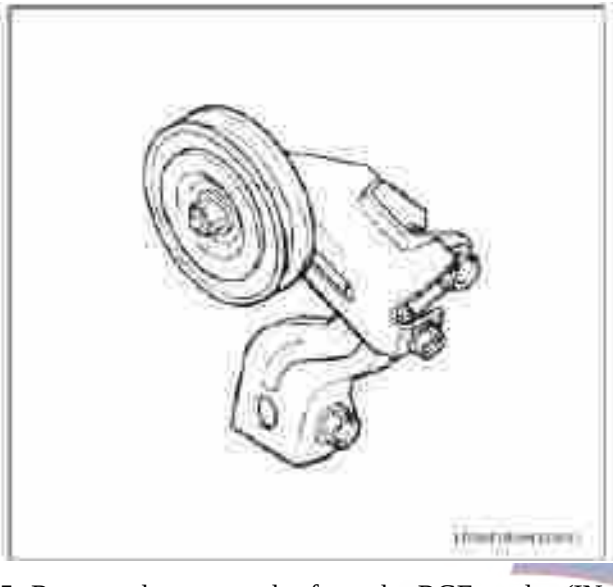
2. Remove the fuel pump.

Please refer to the fuel supply section of the ID Power System (4HK1).

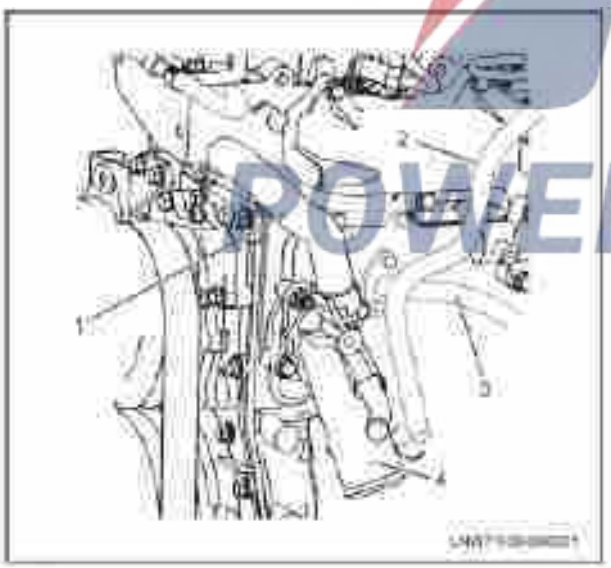
3. Remove the drive belt from the air conditioner.

4. Remove the idler bracket.

• Remove the air conditioning drive belt, remove the mounting bolts from the bracket, and then remove the bracket using turnbuckles and an idler pulley.



5. Remove the water tube from the RGE cooler (IN, OUT).
6. Remove the clamp from the side of the cylinder head and remove the bypass and intake pipes from the assembly.

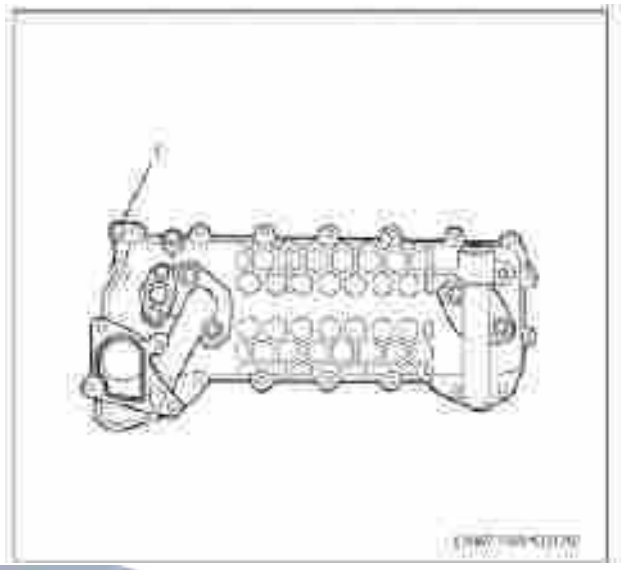


Key

1. Bypass hose
2. EGR cooler water pipe (OUT)
3. EGR cooler water pipe (IN)
4. Water inlet pipe

7. Remove the oil cooler assembly.

• Screw the removed oil cooler mounting bolts into the adapter port of Figure 1 and remove the oil cooler.



8. Remove the O-ring.

Disassembling

1. Remove the filter fixing bolts.
2. Remove the filter element (1).
3. Remove the O-ring(2).

Assembly

1. Install the O-ring (2) on the oil cooler body.
2. Install the filter element (1).
3. Tighten the filter fixing bolts to the specified torque.

Tightening torque: 20 N•m {2.0 kgf•m}

Installation

1. Install O-rings (1, 2).

• Apply liquid sealant (TB-1207C) along the groove (3) on the flange surface.

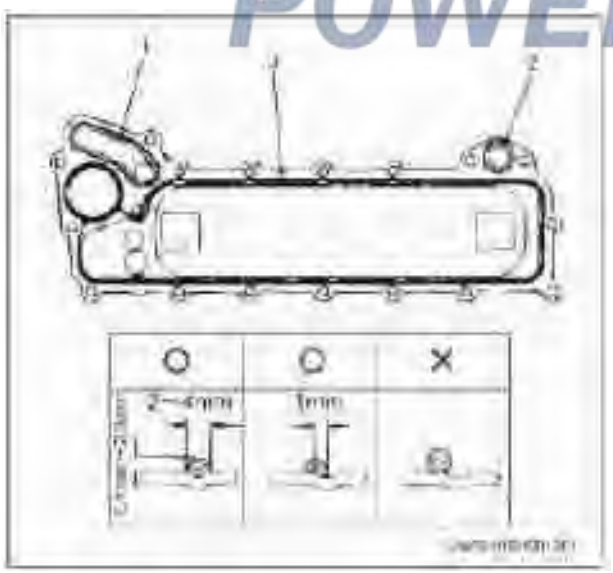
• Install O-rings at the inlet and outlet of the oil gallery.

Mark:

Do not stick liquid sealant to o-rings.

• After using the liquid sealant, install it within 5 minutes.

• The positional deviation of the sealing fluid allows the following diagram.



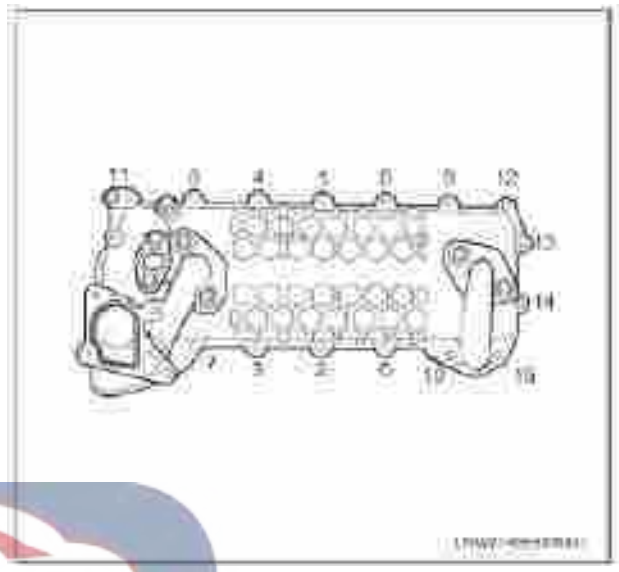
Key

1. O-ring
2. O-ring
3. Liquid sealant

2.Install the oil cooler assembly.

• Align the bolts (13) on the cylinder block and install the oil cooler as shown in the sequence, and then tighten to the specified torque.

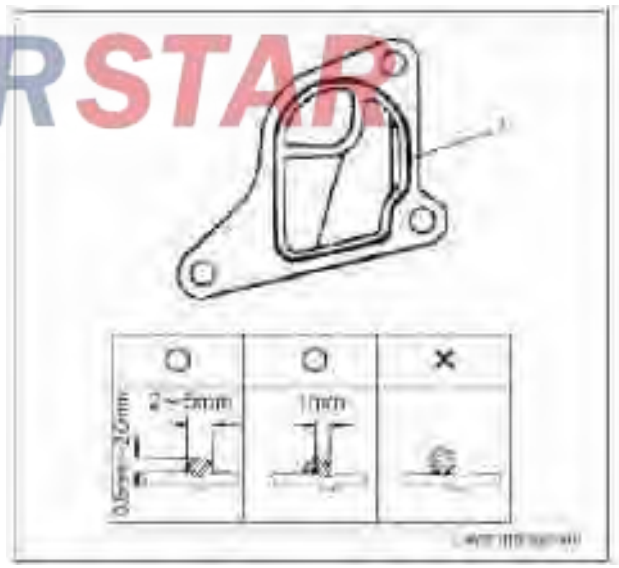
Tightening torque: 24 N•m {2.4 kgf•m}



3 Install the inlet pipe.

• Use a liquid sealant (TB1207C) with a width of 2 to 5 mm in the slot (1) aligned with the face of the inlet pipe flange.

• The positional deviation of the sealing fluid allows the following diagram.



Key

1. Liquid sealant

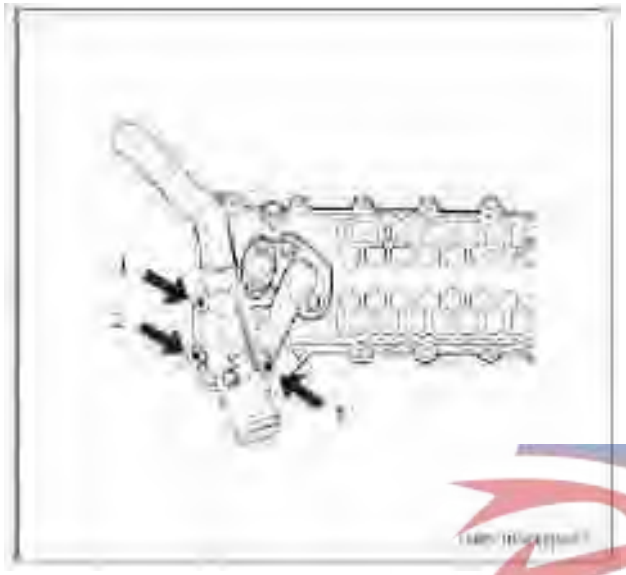
• Install it in the position shown in the figure and tighten it with the oil cooler.

Tightening torque: 24 N•m {2.4 kgf•m}

• (1) is a nut.

Mark:

After installing the oil cooler, install the inlet hose. (Because you use liquid sealant, tighten together).

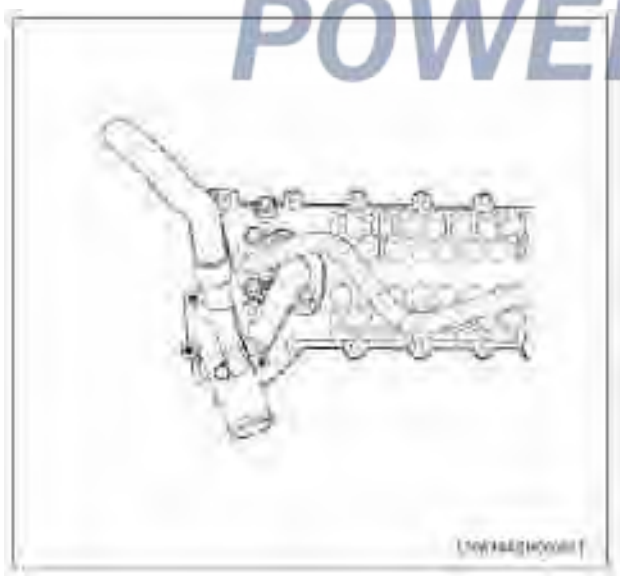


Key

1. Nuts
2. Bolt

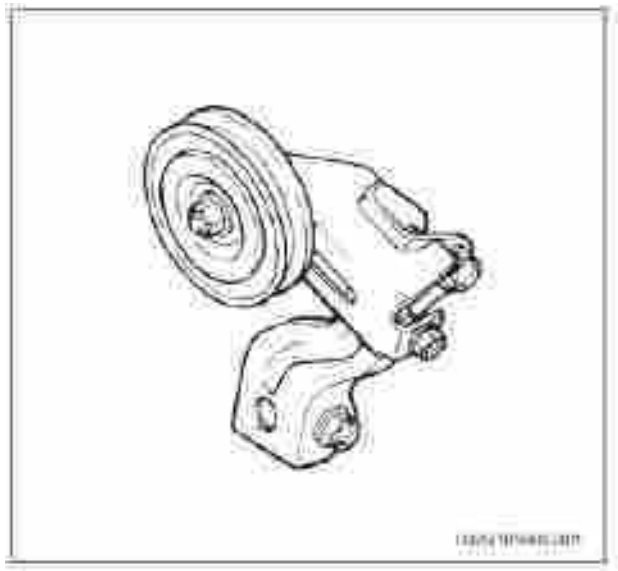
4. Install EGR cooler water pipe.

Tightening torque: 24 N•m {2.4 kgf•m}



5. Install the idler pulley bracket and tighten it to the specified torque.

Tightening torque: 24 N•m {2.4 kgf•m}



6. Install the air conditioning drive belt and adjust it.

Refer to the drive belt section of the IC Cooling System (4HK1) section.

7. Install the oil supply pump.

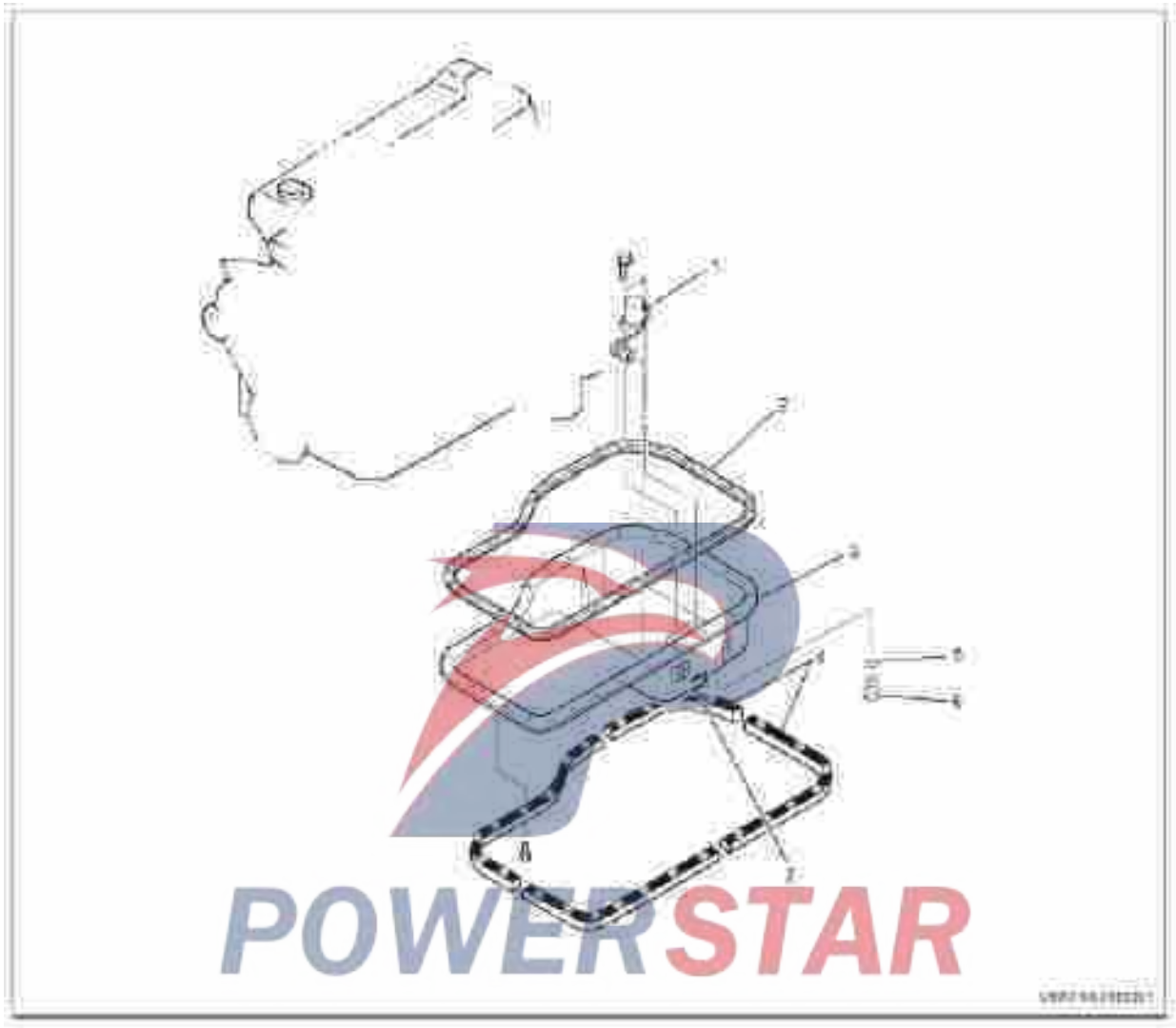
Please refer to the fuel supply section of the ID Power System (4HK1).

8. Install the common rail.

Refer to common rail in section 1D Power Supply (4HK1).

Oil sump

Component parts



Key

1. Oil level switch
2. Oil pan gasket
3. Oil sump
4. Oil sump rubber pad
5. Seal gaskets
6. Drain plug
7. Clip

Disassembly

1. Drain the engine oil.

• After draining the oil, tighten the drain plug to the specified torque.

Tightening torque: 83 N•m {8.5 kgf•m}

Mark:

Do not forget to tighten the drain plug.

2. Remove the oil level switch connector.
3. Remove the oil sump.
4. Remove the oil level switch from the oil shell.

Installation

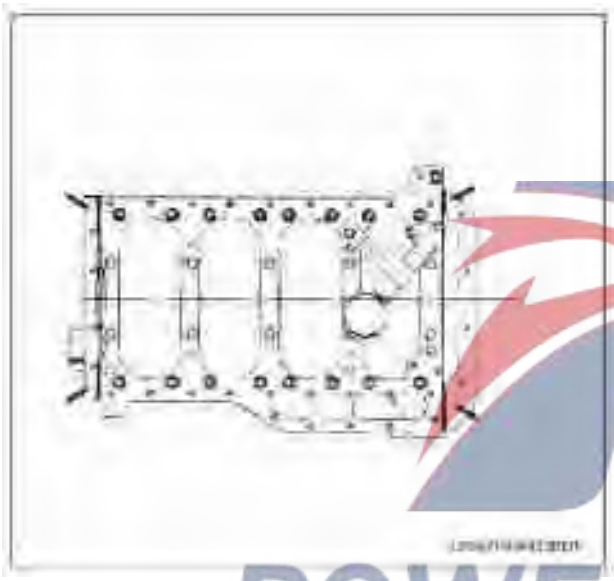
1. Install the oil level switch on the oil shell.

Tightening torque: 9 N•m {0.9 kgf•m}

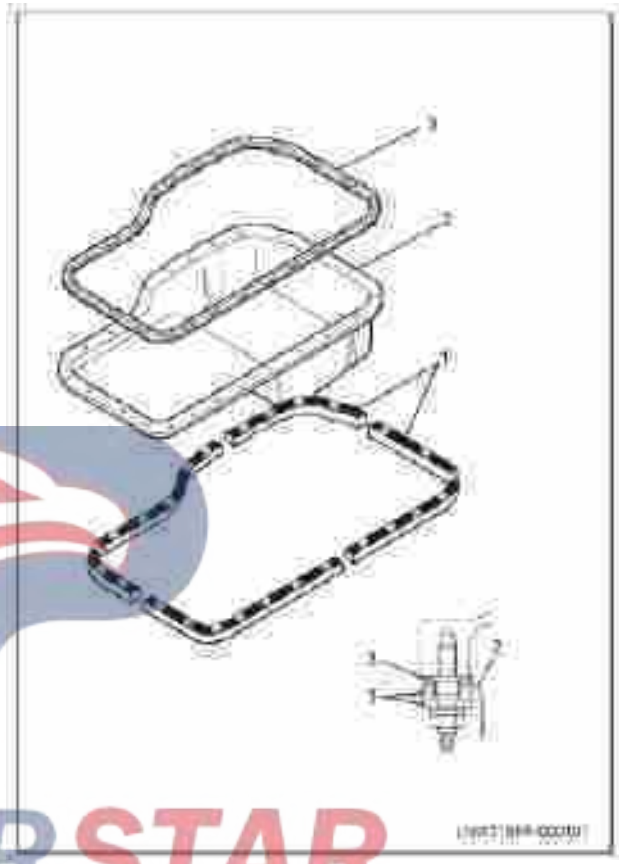
2. Install the oil sump.

• Apply liquid sealant (TB1207C) to the gasket (four-headed arrow) between the cylinder block and the front cover and flywheel housing. The standard width is 3 mm.

• After using the liquid sealant, install the oil pan within 5 minutes.



• Install the oil pan gasket (3) together with the flywheel housing and the front cover and crankcase bolts as guide rails, then install the oil pan (2). Then, the rubber seal assembly of the oil pan (1) is mounted on the oil pan and fastened and fixed with bolts and nuts.

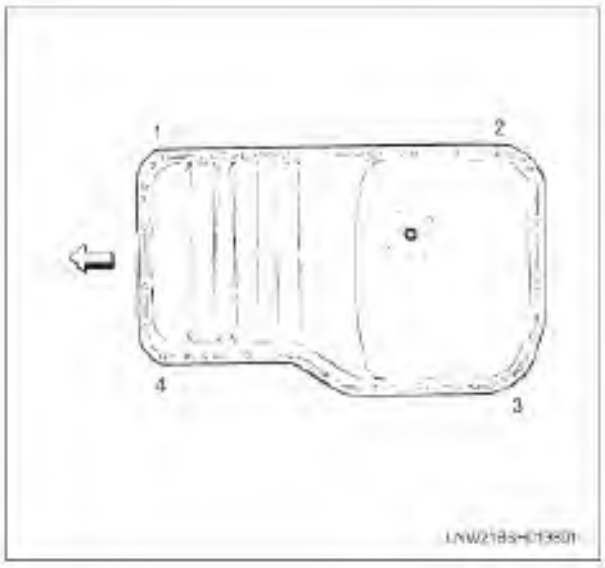


Key

1. Oil sump rubber pad
2. Oil sump
3. Oil pan seal

• Tighten the (1), (2), (3), and (4) shown in the illustration, and attach other parts. (variable order)

Tightening torque: 11 N•m {1.1 kgf•m}



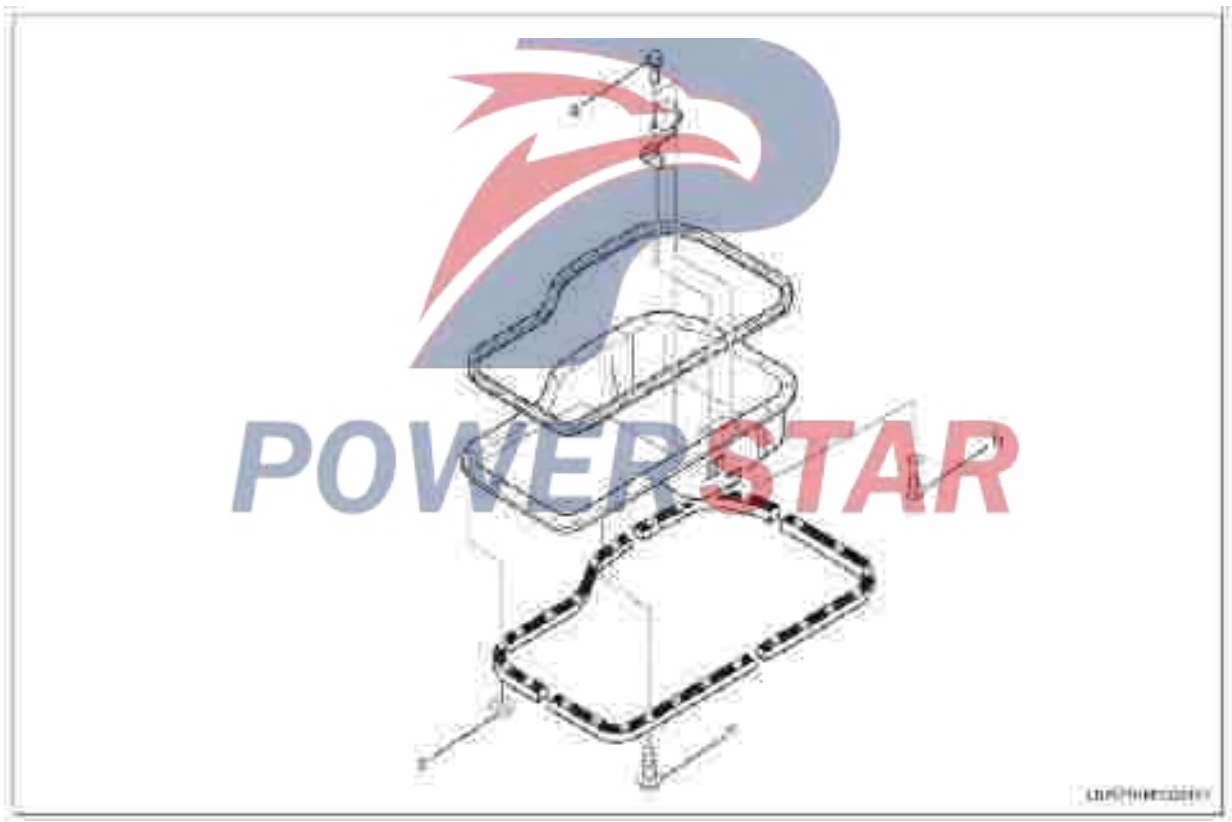
Mark:

Check again whether the drain plug on the oil pan is tight.

3. Install the oil level switch connector.

4. Add engine oil.

Tightening torque - Overview



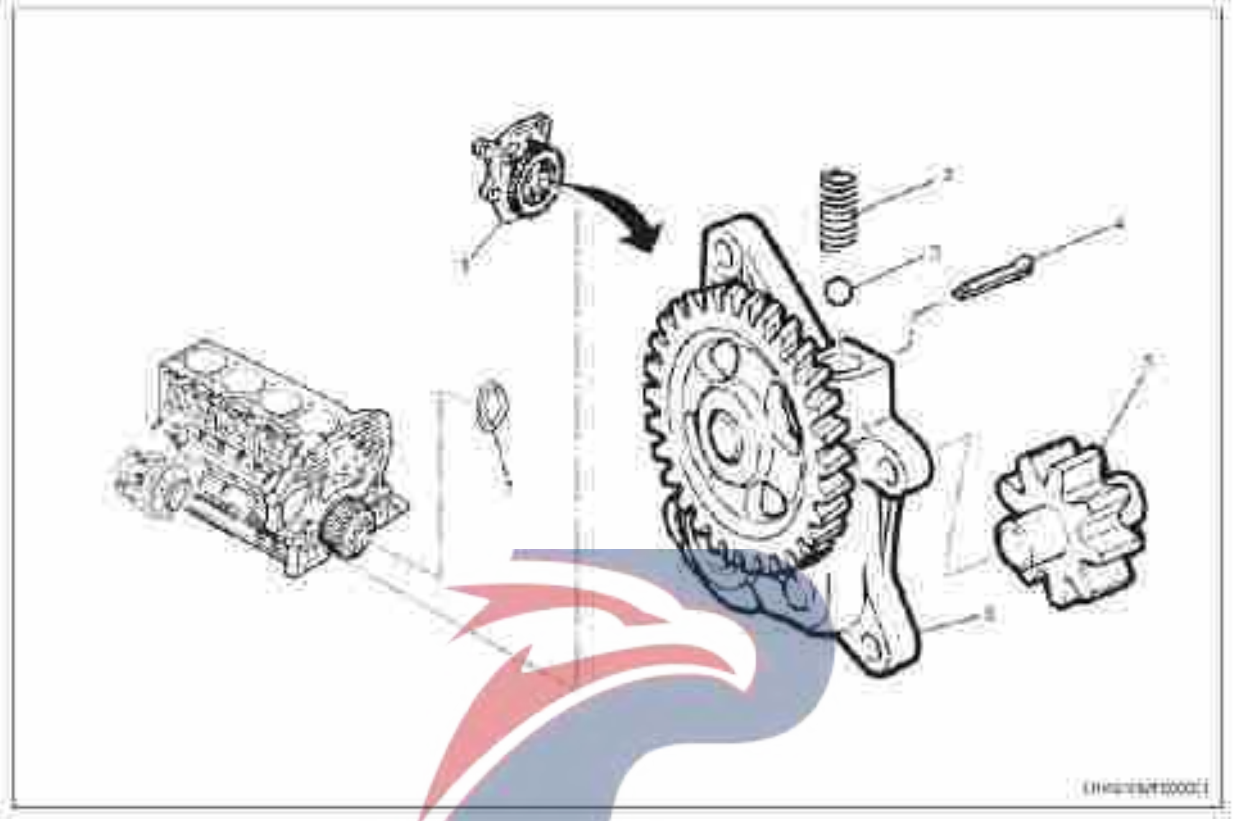
(a) 9 N·m {0.9 kgf·m}

(b) 83 N·m {8.5 kgf·m}

(c) 11N·m{1.1kgf·m}

Oil pump

Component parts



Key

1. Oil pump assembly
2. Spring
3. Ball
4. Cotter pin
5. Passive gears and shafts
6. Oil pump body
7. Oil drop ring

Disassembly

1. Drain the engine oil.
2. Discharge the coolant.
3. Remove the transmission assembly.

For the M/T model, refer to the 5C manual transmission section (MLD) of the transmission assembly.

4. Remove the bolt assembly.

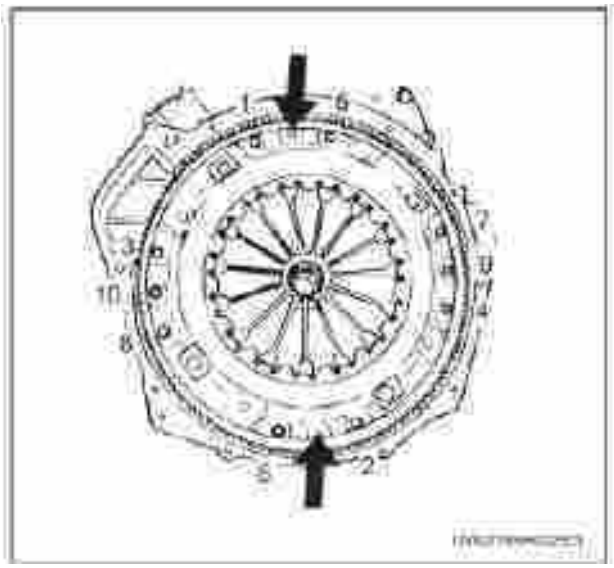
Refer to the cylinder head in the mechanical system section of the IB motor (4HK1).

5. Clutch pressure plate

• Insert the clutch extractor (1) into the groove of the clutch plate.

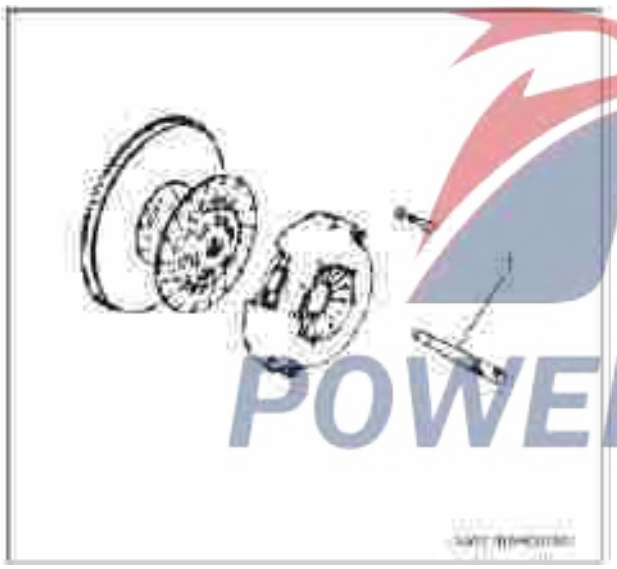
• Remove the fixing bolts in the order shown.

• Remove the flywheel disk.



6. Clutch plate

• Remove the clutch puller (1) and the clutch from the flywheel at the same time.



Key

1. Clutch disassembler_

7. Remove the oil supply pump assembly.

Please refer to the fuel supply section of the ID Power System (4HK1).

8. Remove the steering wheel.

Please refer to Engine Mechanical System IB (4HK1) Engine Flywheel.

9. Remove the rear oil seal from the crankshaft.

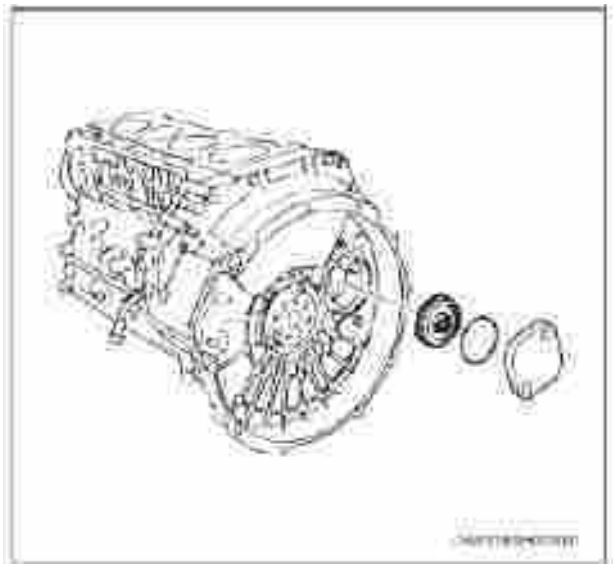
Please refer to IB Engine Mechanical System (4HK1) crankshaft rear oil seal.

10. Remove the oil sump.

11. Disassemble power steering pump.

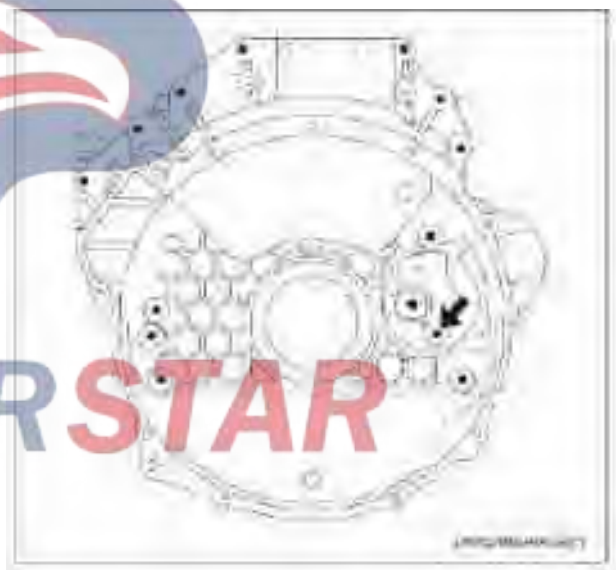
12. Remove the power steering roller cover.

13. Remove the power steering pump sprocket.

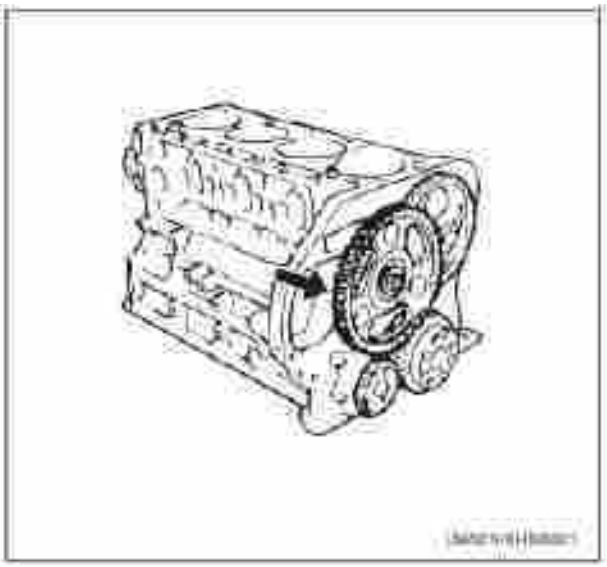


14. Remove the flywheel shell.

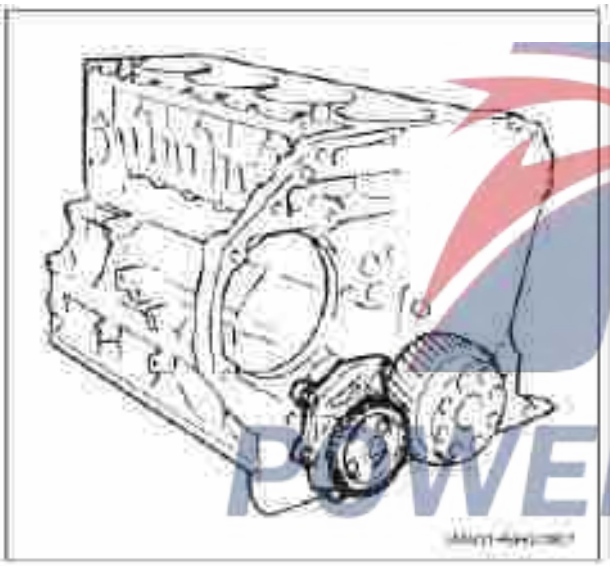
• Be careful not to forget to remove the bolts shown on the illustration.



15. Take off the roller A.



16. Remove the oil pump assembly.



Disassembling

1. Remove the driven gear and shaft.
2. Remove the split pin.
3. Take out the spring.
4. Remove the ball.

Inspection

1. Measure the gap between the gear and the oil pump body wall.

• Use a feeler gauge to measure the gap between the gear and the oil pump.

• When the clearance between the gear and the inner wall of the pump exceeds the limit, replace the gear or the driven gear.

Clearance between gear and pump inner wall mm

Standard value 0.125∽0.220

Standard value 0.30

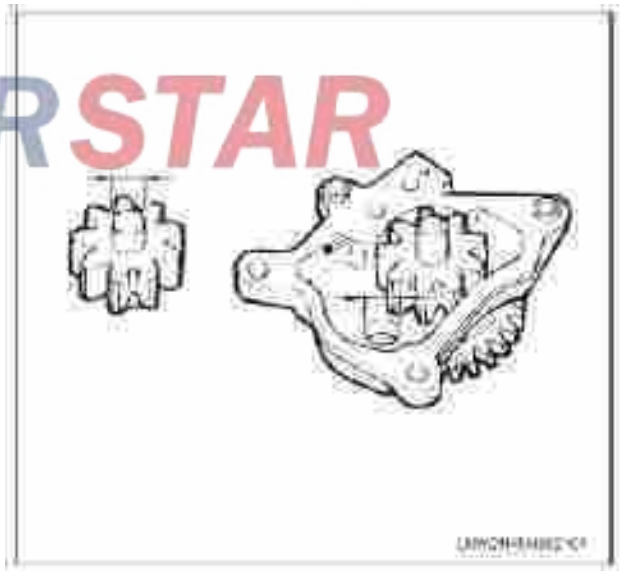
2. Measure the clearance between the driven gear shaft and the sleeve.

• Measure the outer diameter of the driven gear shaft with a micrometer.

Passive gear shaft outer diameter mm

Standard value 15.989∽16.000

Standard value 15.900



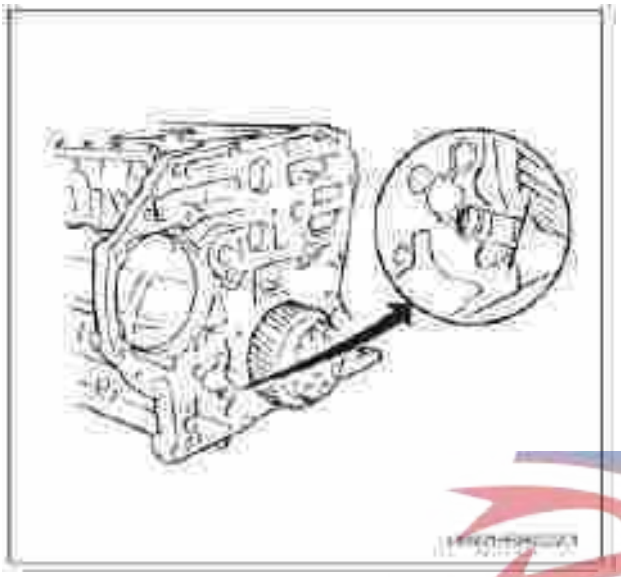
• Use a dial gauge to measure the inner diameter of the oil pump housing and cylinder block.

• When the clearance between the driven gear shaft and the bushing exceeds the limit value, replace the driven gear.

Passive gear shaft and sleeve assembly mm

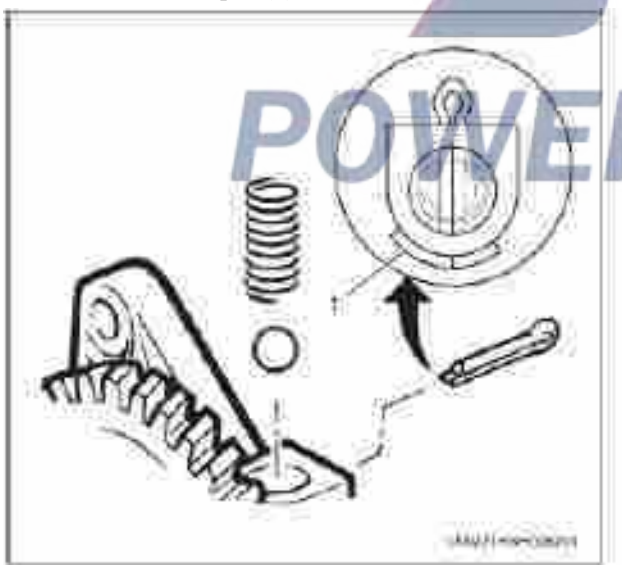
Standard value 0.04∽0.07

Standard value 0.20



Assembly

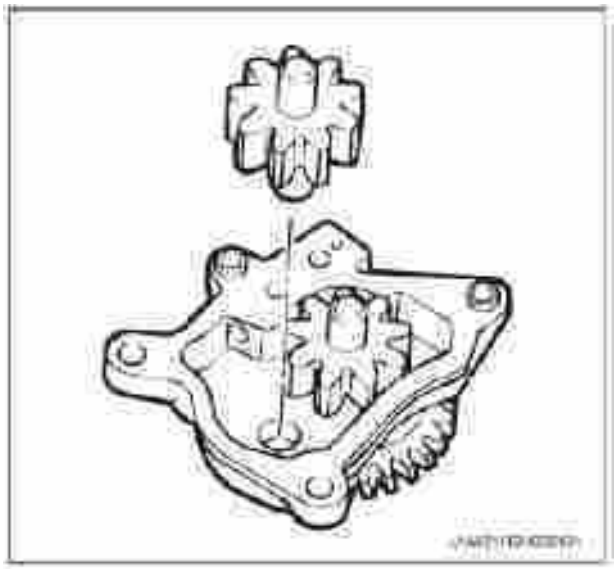
1. Install the ball.
2. Install the spring.
3. Install the cotter pin (1) as shown in (1) and bend it.



Key

1. Cotter pin

1. Apply oil to the drive gear and shaft and install it on the main body of the oil pump.



Installation

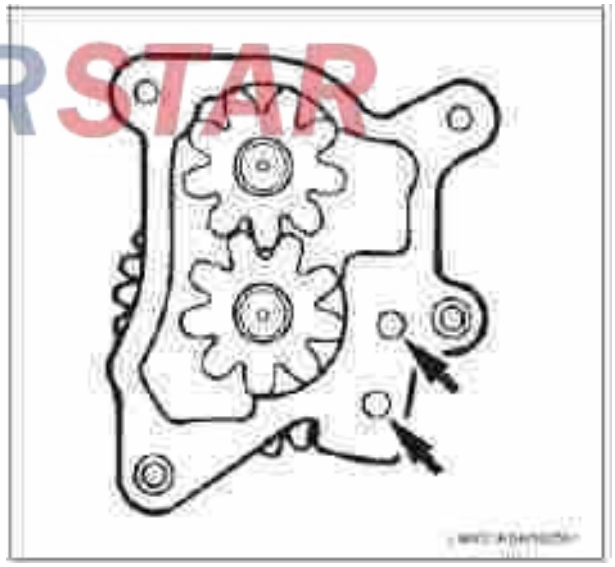
1. Install the oil pump assembly.

• Apply liquid sealant (TB1141E) as shown and install it on the cylinder block within one hour.

Tightening torque: 24 N•m {2.4 kgf•m}

Caution:

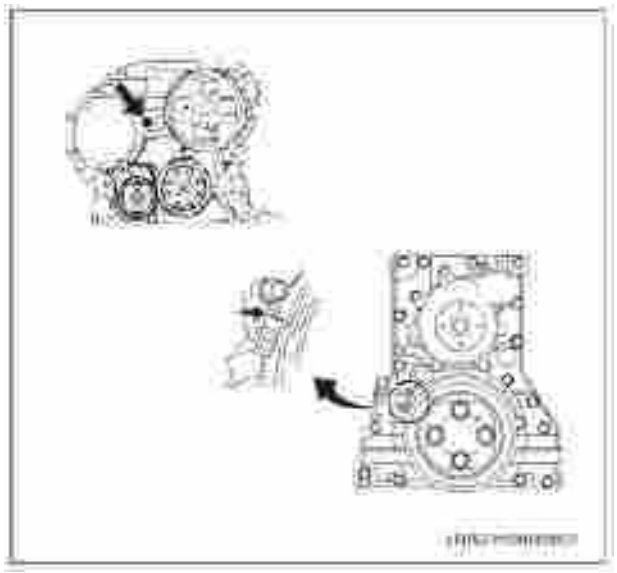
When using a liquid sealant, be careful not to let the liquid sealant enter the hole of the oil pump, the gear and the body as shown by the arrow in the figure. .



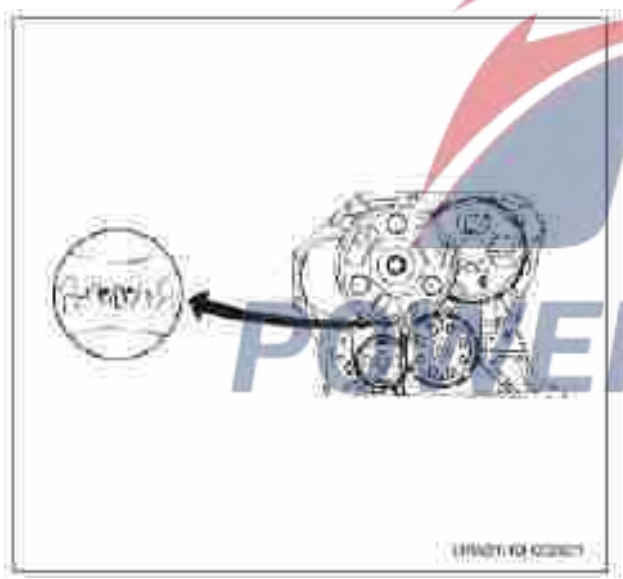
2. Install idler A.

• Insert the intermediate shaft into the position shown in the illustration and apply oil to the shaft.

• Turn the crankshaft to align the piston of the first cylinder with top dead center.



• Align the alignment mark on the crank gear with the freewheel gear A and fix it to the cylinder block.



• Tighten the fixing bolts to the specified torque.

Tightening torque: 133 N•m {13.6 kgf•m}

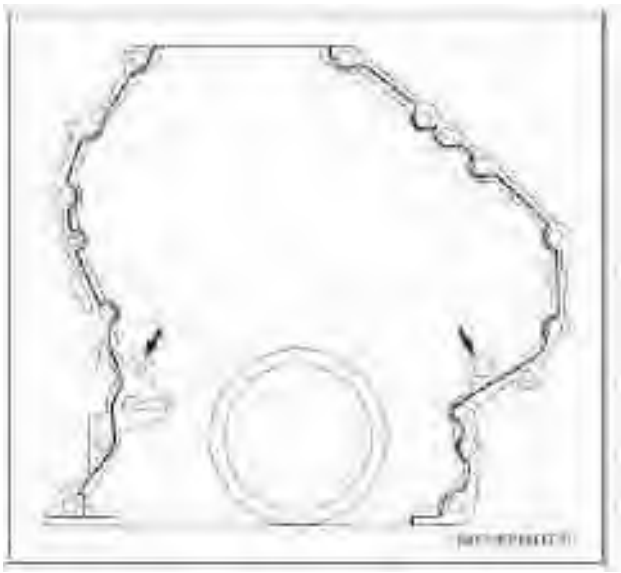
3. Install the flywheel housing.

• Clean the rear of the cylinder.

In particular, the already dispersed sealing fluid is removed during the installation of the housing.

• Apply liquid sealant (TB1207C) uniformly to the bolt hole (except for the bolt hole shown by the arrow) as shown in the figure.

• After using the liquid sealant, install it within 5 minutes.

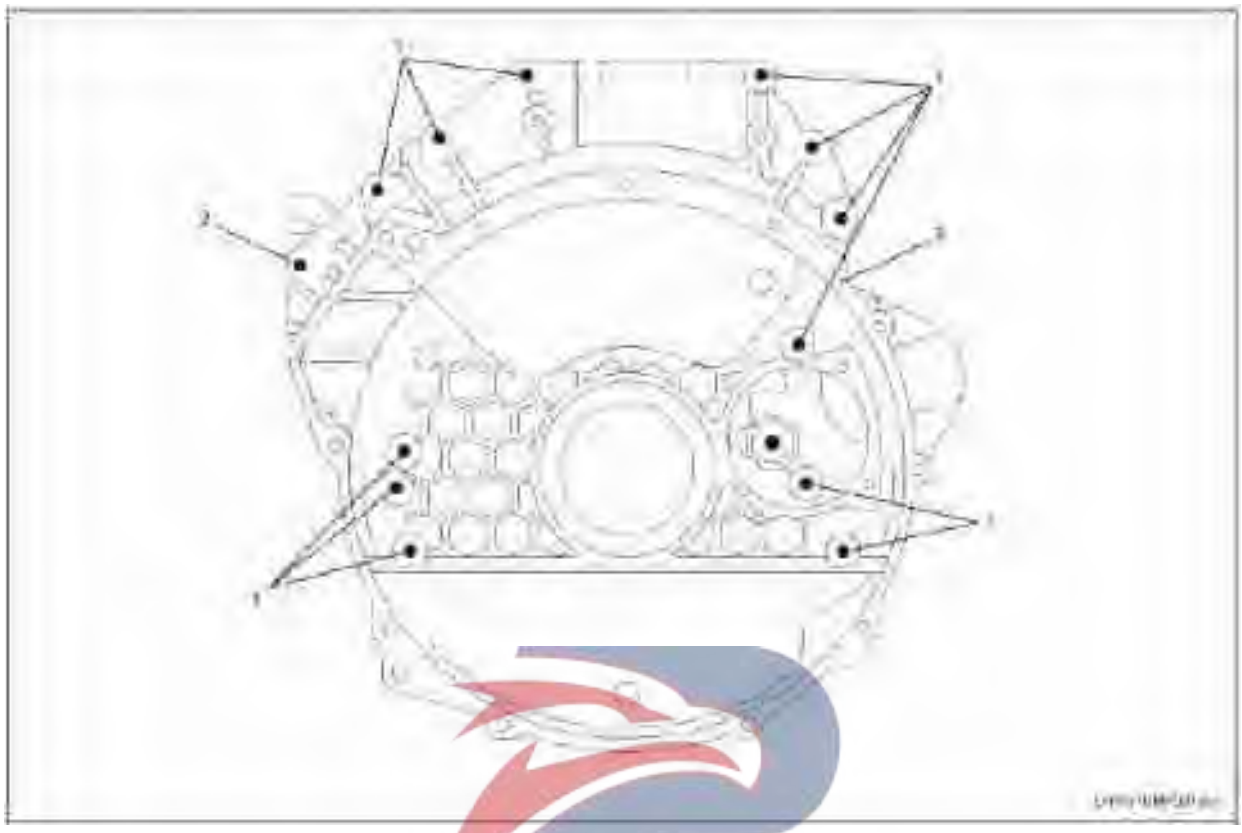


• Align the cylinder positioning pins and install the flywheel housing.

Flywheel shell tightening torque: Nnn {kgfTn}

(1)	(2)	(3)
96 {9.8}	48 {4.9}	38 {3.9}

(3) Tighten the side of the cylinder.

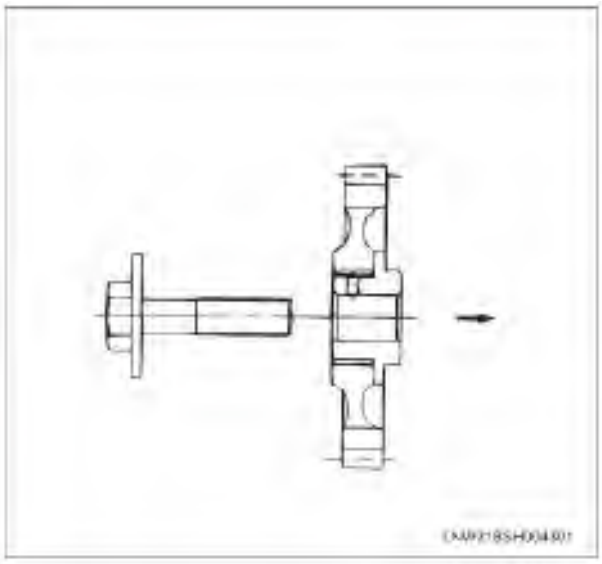


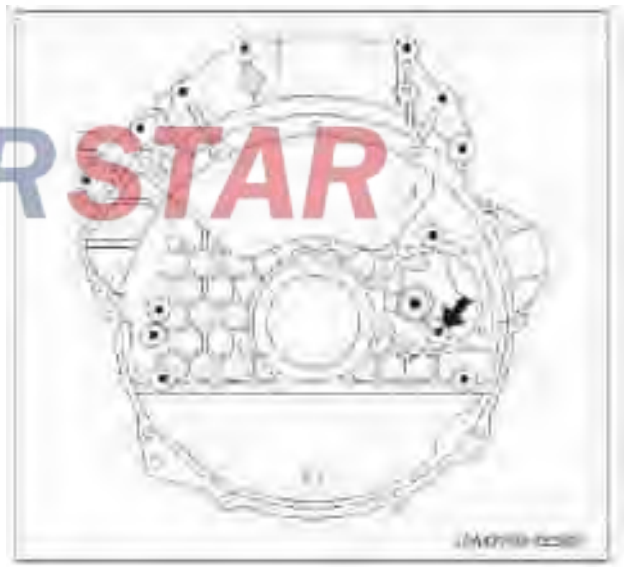
4. Install the power steering pump gear.

• Apply oil to countershaft gears.

• Assemble the countershaft and shaft in the direction shown in the figure and tighten them to the specified torque after mounting on the flywheel shell.

Tightening torque: 133 N•m {13.6 kgf•m}

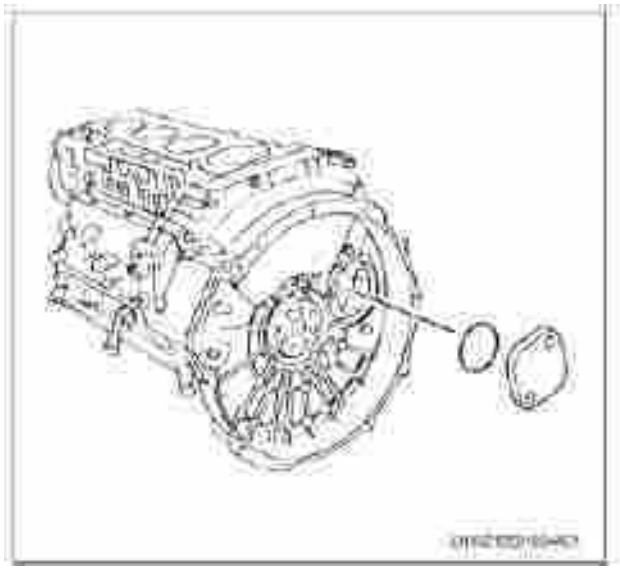




5. Install the idler cover of the power steering pump.

• First install the O-ring on the cover, then attach the cover to the flywheel housing and tighten the mounting bolts to the specified torque.

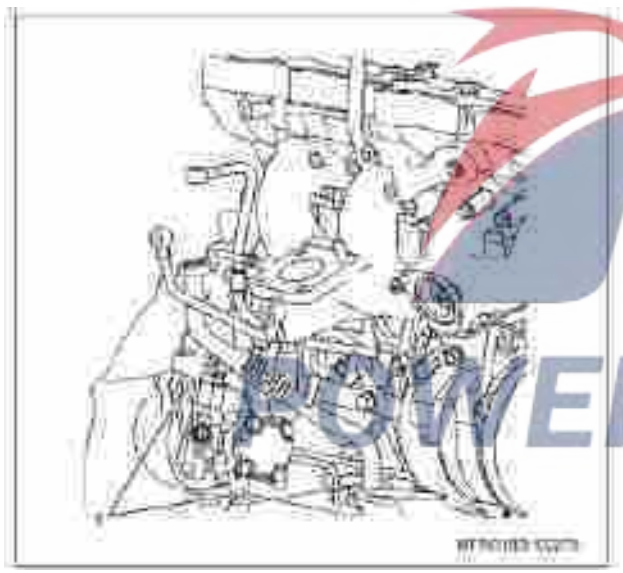
Tightening torque: 19 N•m {1.9 kgf•m}



6. Install the power steering pump and tighten it to the specified torque.

Power Steering Pump Mounting Bolt (1)

Tightening torque : 50N·m{5.1kgf·m}



Key

1. Install bolts of power steering pump

7. Install the oil sump.

See the oil shell in this chapter.

8. Install the rear oil seal from the crankshaft.

Please refer to IB Engine Mechanical System (4HK1) crankshaft rear oil seal.

9. Install the flywheel .

Please refer to Engine Mechanical System IB (4HK1) Engine Flywheel.

10. Install the oil supply pump assembly.

Please refer to the fuel supply section of the ID Power System (4HK1).

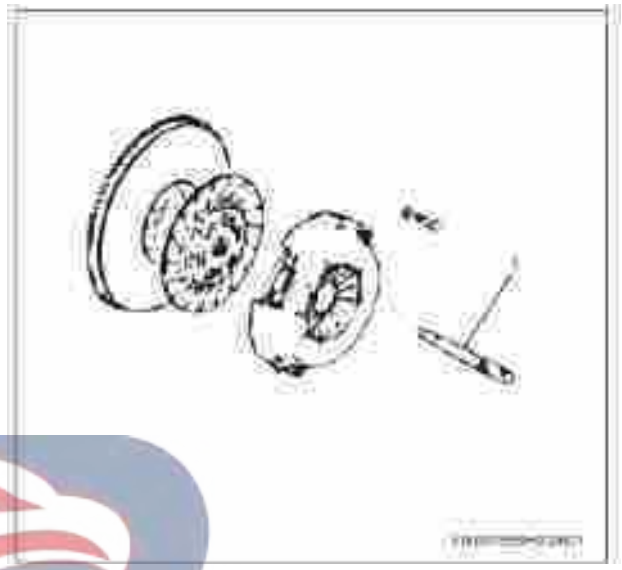
11. Install the clutch plate.

12. Install the clutch plate.

• Insert the clutch extractor (1) into the groove of the clutch plate.

• Mount the clutch plate to the flywheel.

• Align the mounting holes on the turret with the flywheel alignment pins and install the turret on the flywheel.

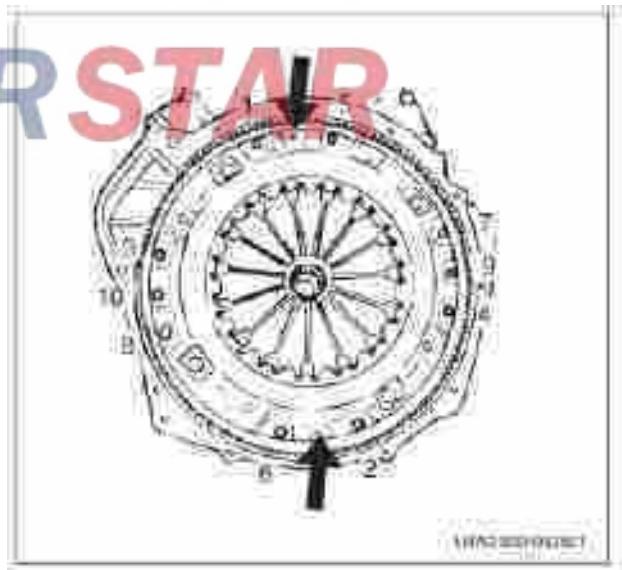


Key

1.Clutch disassembly

• Tighten the cylinder to the specified torque in the order shown.

Tightening torque: 40 N•m {4.1 kgf•m}



13. Install the transmission assembly.

MJT models, see transmission control cable in MLD section 5C manual transmission.

14. Install the bolt assembly.

Refer to the cylinder head in the mechanical system section of the IB motor (4HK1).

15. Fill the coolant.

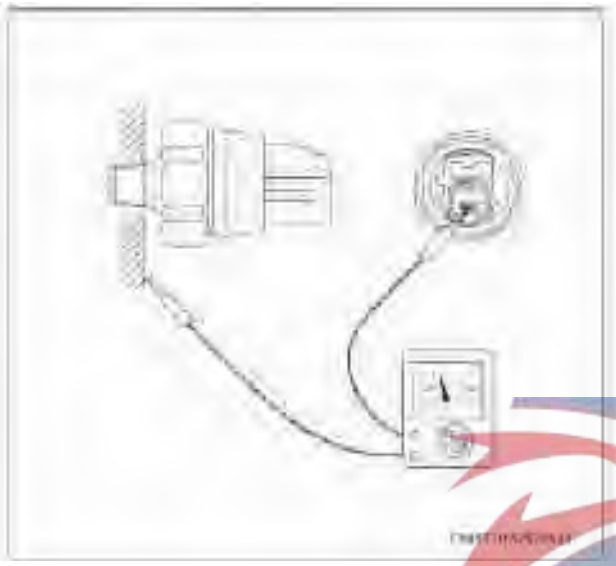
16. Engine oil supply.

Oil pressure switch

Inspection

Under no-load conditions, check the connection between the switch terminals and ground.

If not connected, replace the switch.

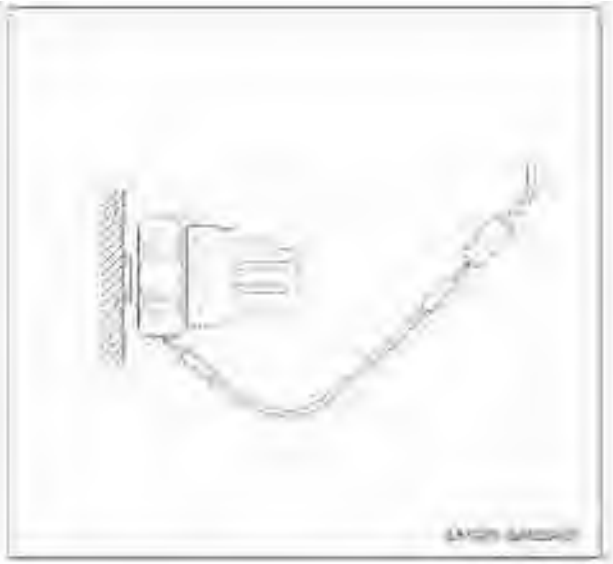


Circuit inspection

1. Turn on the starter switch.

2. When the oil pressure switch connector is removed and the harness side connector is grounded, the oil pressure warning lamp lights up.

If there is no light, check the circuit between the meter and the oil pressure switch and repair the damaged part.



Section 1I

Engine acceleration control device

Table of Contents

Accelerator pedal assembly

Component parts

Key

1. Nuts
2. Accelerator Pedal Position (APP) sensor
3. Leverage and support
4. Accelerator pedal
5. Bolt

Disassembly

1. Remove the mounting nut from the lever and bracket.
2. Remove the bolts holding the accelerator pedal.
3. Remove the APP sensor harness connector.

Mark:

When removing the harness connector, remove the ground wire from the battery.

Installation

1. Install the APP sensor harness connector.
2. Install the bolts holding the accelerator pedal.
3. Install the lever and bracket assembly.

Section 1J

Engine intake system

Table of Contents

Air cleaner element

Disassembly

1. Disassembly the 3 clamps and remove the air filter cover.

2. Remove the air filter element from the shell.

Inspection

• Check the filter element for dirt or damage. Clean the dust or block the indicator when it is lit. If it is damaged, it must be replaced.

Clean once every 6 months

Replacement time is 40,000 kilometers or once every 2 years

Clean

<When dust and other dry dust are attached>

• Rotate the filter element and blow filter dust from the inside with less than 690 kpa (7 kg/cm2).

<When smoke is emitted>

• Dissolve neutral detergent in water and soak the filter for about 30 minutes. Then rinse thoroughly with water and allow the filter element to dry naturally (2 to 3 days).

Do not use compressed air or open flame for drying.

Mark:

Although neutral detergents can be dissolved in water for cleaning, if the contamination is serious, replace the filter element.

Installation

1. Install the air filter element.

2. Align the claws of the air filter cover with the opening of the housing and secure with three clips.

Turbocharger assembly

Precautions

• The turbocharger is precision-machined and operates at high speeds without decomposition. If there is a slight abnormality in the blade or housing, such as a crease or scratch, replace the entire turbocharger.

• During inspections, foreign objects are prevented from entering the turbine housing, the compressor housing, the air inlet and the air outlet.

• After the supercharger is completed, inject 3 to 5 cc of clean oil into the oil supply port and fill the line.

• When the booster is lifted by the push rod, it deforms and causes a malfunction. It is not possible to grasp the push rod but to directly lift the turbocharger.

Tightening torque - Overview

•The engine is normal, but the output is reduced

• The turbocharger is normally normal but the output is reduced

• Turbocharger abnormal vibration

• Exhaust or intake leak, white smoke

• Excessive noise from the turbocharger

Symptom: The engine is normal, but the output is reduced

Symptom	Probable causes	Treatment measures
The engine is normal, but the output is reduced	Turbine blades, deformed or damaged compressor blades	Replace the entire turbocharger
	Blade and shell contact	Replace the entire turbocharger
	Turbine vents have large amounts of carbon deposits that come in contact with turbine blades	Replace or clean entire turbocharger
	The crankshaft in the hand feels stuck or spinning seriously	Replace the entire turbocharger
	Turbine has large axial and rotational clearance	If the measurement gap exceeds the specified value, replace it

Symptom: The turbocharger is normally normal but the output is reduced

Symptom	Probable causes	Treatment measures
Turbochargers are normally normal, but production is reduced (fuel systems and other mechanical systems are normal)	Exhaust gas leakage	Repair or replace
	Exhaust pipe resistance caused by muffler deformation, carbon lock, etc.	Repair or replace
	Air filter element contamination	Clean or replace
	Screen to connect the intercooler cooling area	Clean
	Exhaust brake valve combination	Repair or replace
	Intake pressure sensor abnormal	Replace
	Braking delays and other causes of the vehicle	Maintenance

Phenomenon: Turbocharger Abnormal Vibration

Symptom	Probable causes	Treatment measures
Turbocharger abnormal vibration	The bearing is damaged and comes into contact with the rotating part. Deterioration of oil, foreign matter in the filler tube, plugging of the oil filter, and repeated starting and stopping may cause bearing failure.	Replace the entire turbocharger
	If there is no abnormality in the lubrication system and it is determined that the rotating part is in contact with its periphery causing damage, it can be inferred that the rotating part is unbalanced and the tree is bent. This is because the bearings wear or foreign matter is mixed into the turbine and the compressor impeller.	Replace the entire turbocharger

Symptom: Exhaust or intake leak, white smoke

Symptom	Probable causes	Treatment measures
Leakage from exhaust or intake pipe produces white smoke (normal engine)	Return pipe clogged, cracked or deformed	Repair or replace
	Turbine shaft clearance too large	If the measurement gap exceeds the specified value, replace it
	Engine oil deterioration	Replace engine oil

Phenomenon: Excessive turbocharger noise

Symptom	Probable causes	Treatment measures
Excessive turbocharger noise	Leakage of rubber hose connector or exhaust system on the exhaust side of the leak compressor	Maintenance
	Turbine blade and casing contact	Replace the entire turbocharger
	Inhalation of foreign materials leads to internal damage	Replace the entire turbocharger
	Worn or plugged turbine shaft bearings	Replace the entire turbocharger

Component parts

Key

1. Oil supply pipe
2. Seal gaskets
3. Turbocharger intake duct
4. Turbocharger heat insulation sheet
5. Return to the water pipe
6. Exhaust adapter
7. Exhaust adapter heat shield
8. Exhaust adapter gasket
9. Water supply pipeline
10. Return to the pipeline
11. Turbocharger assembly
12. Turbocharger seal
13. Exhaust manifold

Disassembly

1. Discharge the coolant.

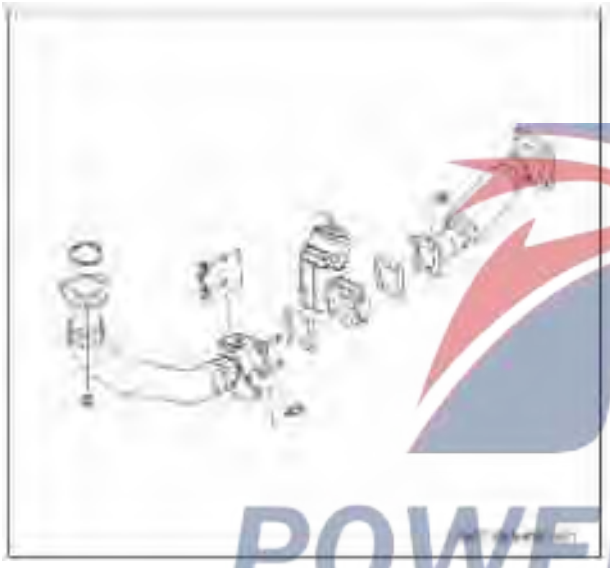
2. Remove front exhaust pipe A and exhaust brake.

• Remove front exhaust pipe A and turbocharger mounting nut.

• Remove the nuts that secure the front exhaust pipe A and the exhaust brake.

At the same time, remove the exhaust brake assembly.

• Remove the bolt that secures the exhaust pipe bracket to the right side of the transmission.



3. Remove the intake pipe from the turbocharger.

• Remove the PCV hose (1) from the intake hose.

• Loosen the fastening strap (5) of the intake manifold of the turbocharger.

4. Remove the turbocharger inlet tube (2).

• Loosen the air hose clamp (3).

• Remove the fixing screws for the intake pipe (4).

5. Remove the connector (6) from the turbocharger actuator.

6. Remove the perforation bolts from the turbocharger.

7. Remove the perforated bolts from the top supply pipe of the turbine.

8. Remove the perforation bolts from the turbocharger water supply hose.

9. Remove the water supply hose.

10. Remove the return line.

11. Remove the turbocharger assembly and washers.

• Remove the turbocharger mounting nut.

• Remove the bolt from the exhaust adapter bracket.

• Use a vent connector to remove the turbocharger.

Inspection

Visual inspection and sound check

When visually inspecting the turbocharger, remove the adapter at the turbine housing outlet and the rubber hose at the compressor housing inlet.

Do not disassemble or adjust the turbocharger unit.

• Check the turbocharger for abnormal sound while driving.

• Check that the compressor cover and the turbine housing are in contact with the blades, with any hooks or cracks.

• Check for leaks in the housing.

• Check for large amounts of carbon deposits at the turbine exhaust and contact the blades

• Start the turbine shaft and check for smoothness or blockage.

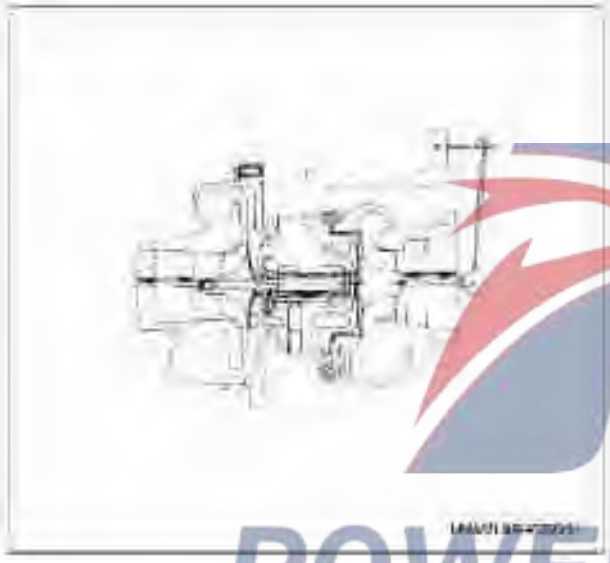
• Shake the shaft and check for excessive axial and rotational directions.

Axle axial clearance

• Use a dial gauge to measure the axial clearance of the axle.

• Apply approximately 12 N {1,2 kg} of force alternately to the end of the compressor impeller.

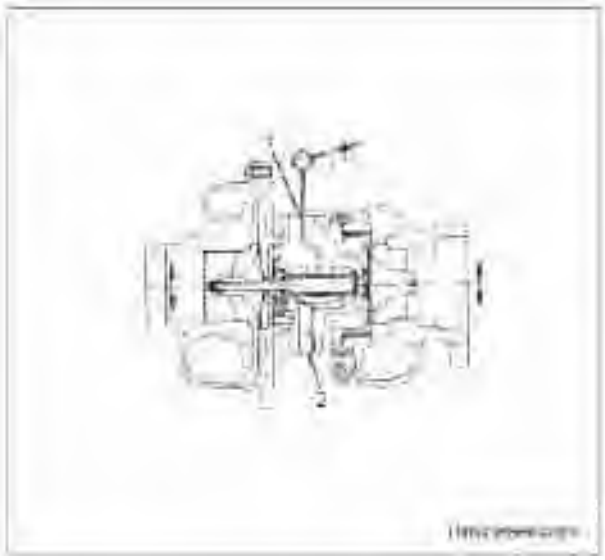
Clearance	mm
Standard value	0.03∽0.08
Standard value	0.09



Axles and bearing sets

• Use a dial gauge to measure the clearance between the axle and the bearing.

Clearance	mm
Standard value	0.08∽0.10
Limit	0.17



Key

1. Oil outlet
2. Oil inlet

Installation

1. Install the turbocharger assembly.

• Install the gasket and turbocharger assembly and tighten the nut to the specified torque.

Tightening torque: 52 N•m {5.3 kgf•m}

2. Install O-rings on both ends of the return line and tighten the bolts to the specified torque.

Turbocharger side

Tightening torque: 9 N·m {0.9 kgf·m}

Cylinder side

Tightening torque: 22 N·m {2.1 kgf·m}

3. Install the water supply pipe.

• Install the bolt on the cylinder side of the water supply hose and tighten it to the specified torque.

Tightening torque (cylinder side): 41 N•m {4.2kgf•m}

• Install bolts on the turbocharger side and tighten to the specified torque.

Tightening torque: (turbine side) 27 N•m {2.8 kgf•m}

4. Install the oil supply pipe.

• Install the piercing bolt on the supply pipe above the turbine and tighten it to the specified torque.

Tightening torque: 17 N•m {1.7 kgf•m}

5. Install the return pipe.

• Tighten the pierced bolt of the return hose to the specified torque.

Tightening torque: 27 N•m {2.8 kgf•m}

• Connect the rubber hose between the return pipe and the thermostat housing.

6. Install the exhaust adapter on the turbocharger and tighten to the specified torque.

Tightening torque : 32N·m{3.3kgf·m}

• Bolt the exhaust adapter and exhaust manifold.

Tightening torque : 3N•m {3.3 kgf·M}

7. Install insulation and tighten with bolts.

Tightening torque: 8 N•m {0.8 kgf•m}

8. Install the turbocharger inlet tube (2).

• Install the booster hose on the turbocharger intake manifold and tighten the collar (3) to the specified torque.

Tightening torque: 10 N•m {1.0 kgf•m}

Mark:

Use a new collar.

• Tighten the tightening screw (4) of the turbocharger inlet duct to the specified torque.

Tightening torque: 10 N•m {1.0 kgf•m}

9. Install the intake hose on the turbocharger.

• Tighten the intake manifold (5) at the turbocharger inlet to the specified torque.

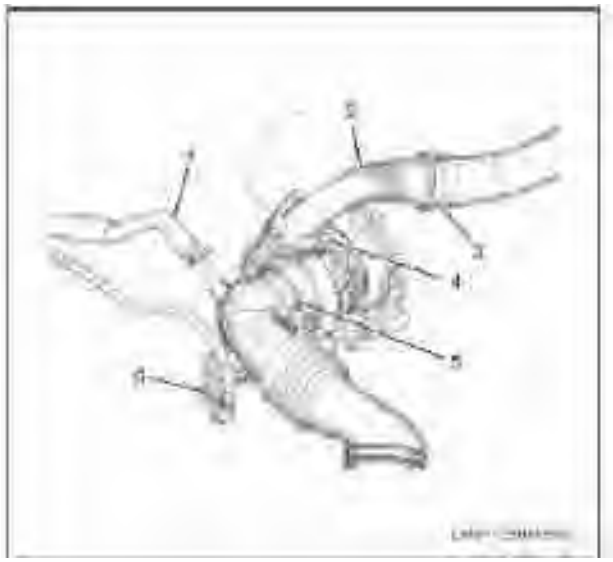
Tightening torque: 6 N•m {0.6 kgf•m}

Mark:

Use a new collar.

• Install the PCV hose (1) on the intake hose.

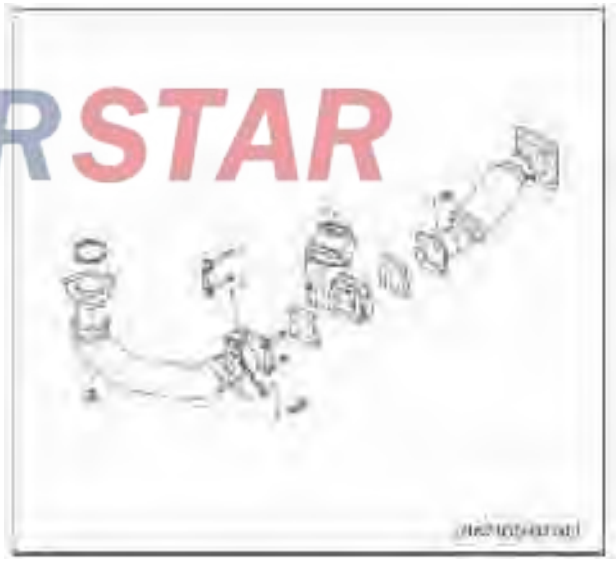
10. Install the connector (6) on the turbocharger actuator.



11. Install exhaust pipe A and exhaust brake assembly before installation and tighten to the specified torque.

Tightening torque:

Turbine side nuts	67 N•m {6.8 kgf•m}
Exhaust pipe support bolt	18 N•m {1,8 kgf•m}
Exhaust brake side nut	27 N•m {2.8 kgf•m}



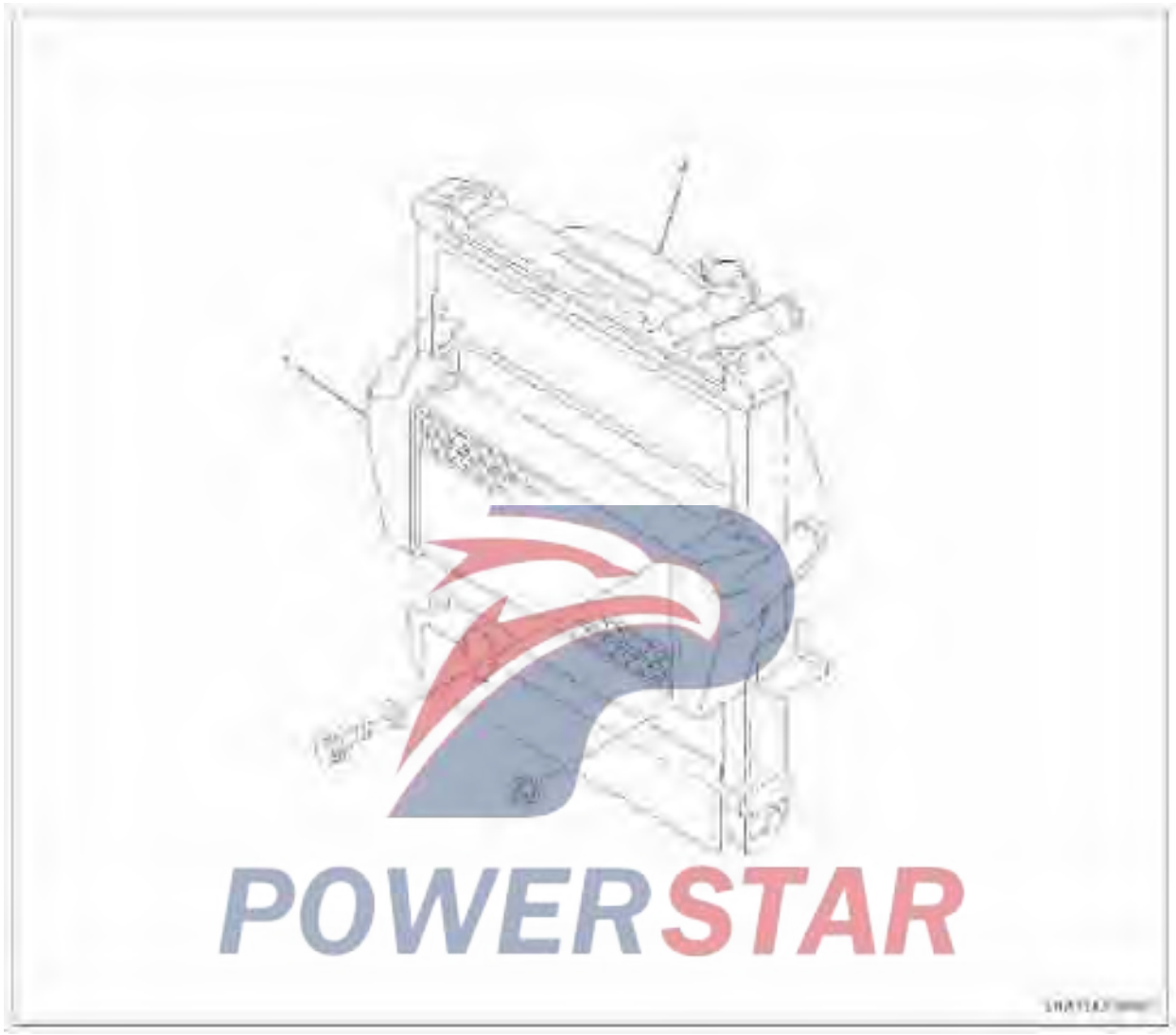
12. Inject the coolant.

Tightening torque - Overview

(a) 6 N·m {0.6 kgf·m}
(b) 10 N·m {1.0kgf·m}
(c) 10 N·m {1.0 kgf·m}
(d) 27 N·m {2.8 kgf·m}
(e) 32 N·m {3.3 kgf·m}
(f) 24 N·m {2.4 kgf·m}
(g) 17 N·m {1.7 kgf·m}
(h) 10 N·m {1.0kgf·m}
(i) 8 N·m {0.8 kgf·m}
(j) 24 N·m {2.4kgf·m}
(k) 27 N·m {2.8 kgf·m}
(I) 24 N·m {2.4kgf·m}
(m) 32 N·m {3.3 kgf·m}
(n) 8 N·m {0.8 kgf·m}
(o) 41 N·m {4.2kgf·m}
(p) 24 N·m {2.4 kgf·m}
(q) 27 N·m {2.8 kgf·m}
(r) 22 N·m {2.2 kgf·m}
(s) 9 N·m {0.9 kgf·m}
(t) 52 N·m {5.3 kgf·m}

Intercooler

Component parts



Key

1. Intercooler
2. Radiator assembly

Disassembly

1. Disconnect the inlet of the intercooler.
2. Remove the intercooler from the entire radiator.

Inspection

1. The deformation of the radiator of the intercooler will affect the cooling effect and cause the engine performance to degrade. If you find this fault, please correct the radiator. Be careful not to damage the radiator's mounting base when servicing.

2. Check the interior of the intercooler for dust. If there is more dirt, rinse with water.

Installation

1. Install the intercooler on the heat sink.
2. Install the intake hose on the intercooler.

Crankcase ventilation

Component parts

Key

1. Support
2. Crankcase ventilation
3. Ventilation tube
4.PCV hose

Disassembly

1. Remove the ventilation bracket from the crankcase with a rubber hose.
2. Connect the kpcv pipe and remove the vent pipe.
3. Remove the crankcase ventilation from the flywheel shell.

Installation

1. Install crankcase ventilation.

• Insert the crankcase ventilation into the flywheel shell tube.

2. Install the exhaust pipe with a PCV tube and tighten it to the specified torque.

Tightening torque: 8 N•m {0.8 kgf•m}

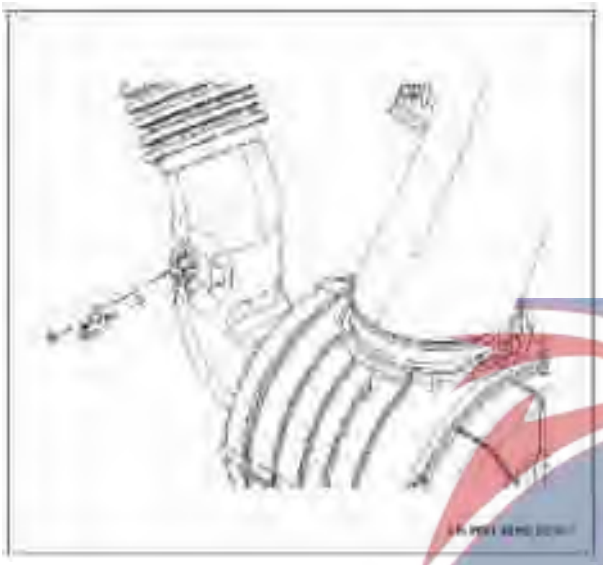
3. Mount the bracket with a rubber hose and tighten it to the specified torque.

Tightening torque: 8 N•m {0.8 kgf•m}

Intake air temperature (IAT) sensor

Disassembly

1. Starter switch is shut down.
2. Remove the harness joint.
3. Remove the IAT sensor.



Inspection

Key

1. Intake temperature sensor signal
2. Grounding of the intake air temperature sensor

Intake temperature sensor

Measure the resistance between terminals 1←→2.

Temperature condition (℃)	Resistance characteristics
0	6kΩ
80	290 ∽390Ω

IAT sensor

Check for dirt and damage.

Caution:

Do not allow solution or lubricant to stick to the sensor's detection area.

Installation

1. Install the IAT sensor.

Tightening torque: 3.5 N • m {0.8 kgf•m}

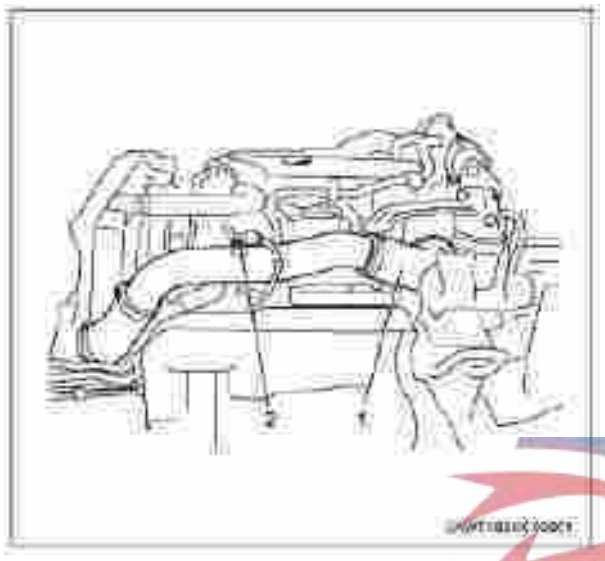
2. Install the harness connector.

Intake pressure (BPS) sensor

Disassembly

1. Remove the harness joint.

2. Remove the BPS sensor.



Key

1. Intake pipe

2. Intake pressure sensor

Intake temperature sensor

Measure the resistance between terminals 1←→2.

Temperature condition (℃)	Resistance characteristics
0	6kΩ
80	290 ∽390Ω

Installation

1. Install the BPS sensor.

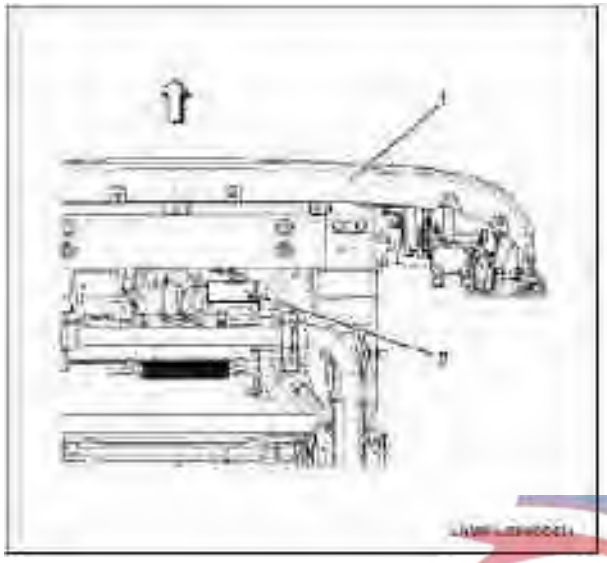
Tightening torque: 2.5 N • m {0.8 kgf•m}

2. Install the harness connector.

VNT control module

Disassembly

1. Disconnect the harness connector on the VNT control module.



Key

1. Front bumper
2. VNT control module

2. Remove the VNT control module and bracket.
3. Remove the VNT control module.

Installation

1. Mount the VNT control module on the bracket.

Tightening torque: 6.5 N • m {0.65 kgf•m}

2. Install the VNT control module and bracket.

3, Connect the harness connector of the VNT control module.

Section IK

Engine warming system

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Preheating system

Precautions

Do not overtighten the glow plug to prevent the glow plug from cracking.

Function and working principle

Warming-up control system

The Preheat control system is a system that can start at low temperatures and reduce white smoke and noise generated after start-up. When the ignition switch is turned on, the ECM detects the engine coolant temperature based on the ECT signal and changes the warm-up time to get the correct starting conditions. At the same time, according to the subsequent heating function of the glow plug, the idling operation after starting can be stabilized. The ECM determines the preheat time based on the engine coolant temperature, allowing the preheating relay and preheat lamp to operate.

For more information on the reheat control system, please refer to engine control system in chapter ia engine control system (4hk1).

Functional check:

Preheat verification and correction system

1. System check

• Disconnect the engine coolant temperature sensor connector.

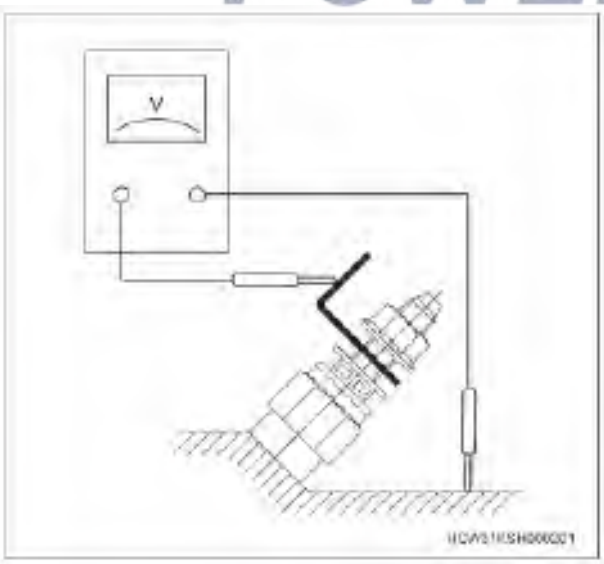
• Connect the voltmeter between the glow plug and the motor ground.

• Turn on the start switch (engine off) and check the following items:

- Prewarm means you cannot open the bulb for 3.5 seconds.

- The voltmeter indicates a continuous 18 second supply voltage.

• If abnormal, check the preheat relay, engine coolant temperature sensor and glow plug. If normal, check the engine control system.

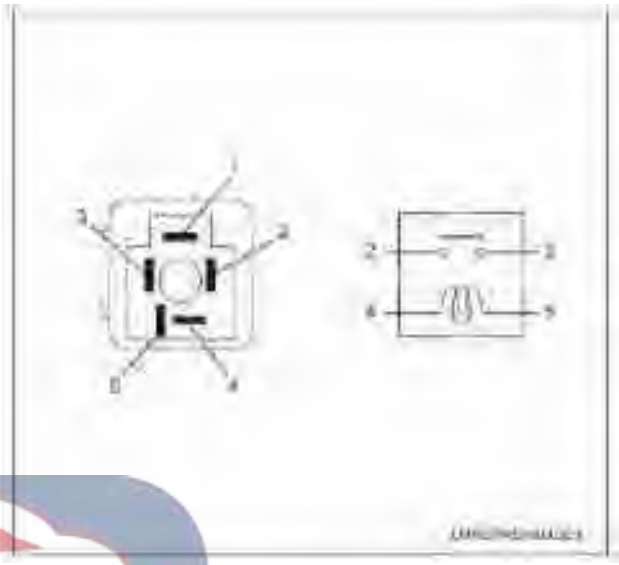


2. Check the preheat relay

• Measure the resistance of the preheat relay (4-5) with a circuit tester.

• If the measurement results deviate from the specified value, replace the preheat relay.

The preheat relay has a resistance of approximately 100Ω

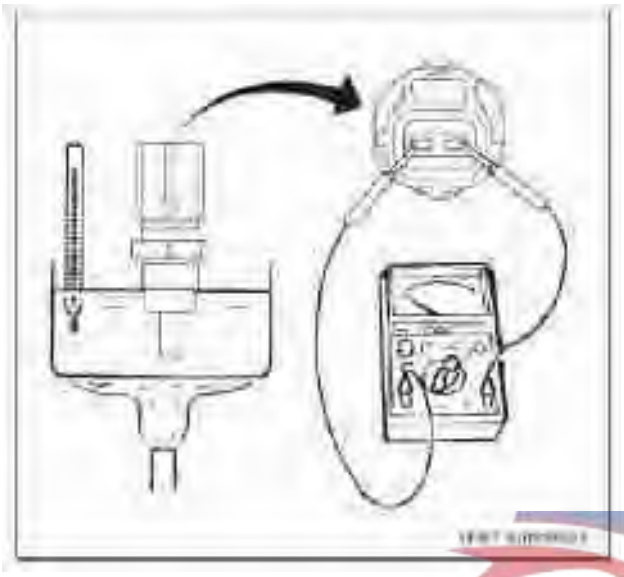


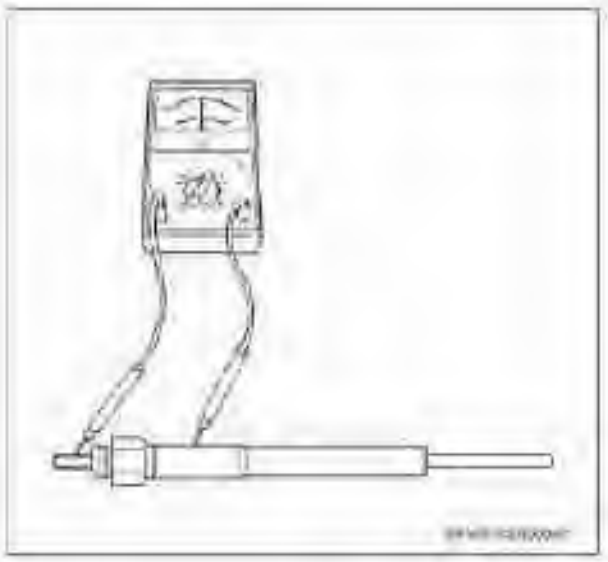
• Preheat relay installation site:

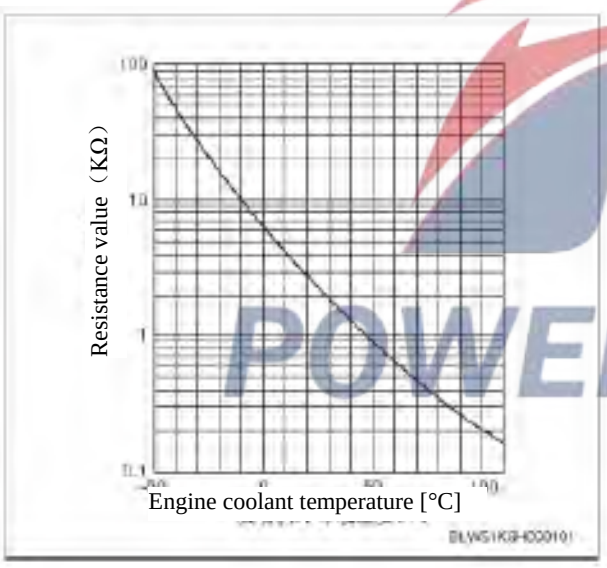
Outdoor relay box

3. Check the engine coolant temperature sensor

• While changing the water temperature, place the temperature sensor of the engine coolant temperature sensor into the water and check that the resistance value changes as shown in the figure.







• Replace if not normal.

4. Check the preheat plug

• Use a circuit tester to measure the resistance of the preheat plug.

• If the measurement results deviate from the specified value, replace the preheat plug.

Preheat plug resistance = about 6Ω (at room temperature)

Mark:

Use 4 matching preheat plugs from the same manufacturer.

Symptom: The glow indicator light is not on.

Symptom	Probable causes	Treatment measures
Preheat indicator is extinguished	Slowly blow fuses	Replace slow fuse
	Barbecue fuse	Replace the fuse
	Indicator light bulb burns out	Replacement indicator bulb
	Motor control system is abnormal	Please refer to engine control system engine control system ia (4hk1).

Symptom: Do not preheat

Symptom	**Probable causes**	**Treatment measures**
Do not preheat	Slowly blow fuses	Replace slow fuse
	Relay connector contacts are abnormal	Reinstall or replace the preheat relay
	Motor control system is abnormal	Please refer to engine control system engine control system ia (4hk1).

Symptom: Preheating time is too long or too short

Symptom	**Probable causes**	**Treatment measures**
Preheating time is too long or too short Too short	Abnormal temperature sensor or open circuit, short circuit	Replace temperature sensor, repair circuit
	Preheat plug abnormalities	Replace or repair preheat plugs
	Motor control system is abnormal	Please refer to engine control system engine control system ia (4hk1).

Main parameters

Item	**Model**
Preheater type	Preheat plug•QOS
Preheat plug rated voltage, current	23 - 3.5

Section 2B
Front suspension

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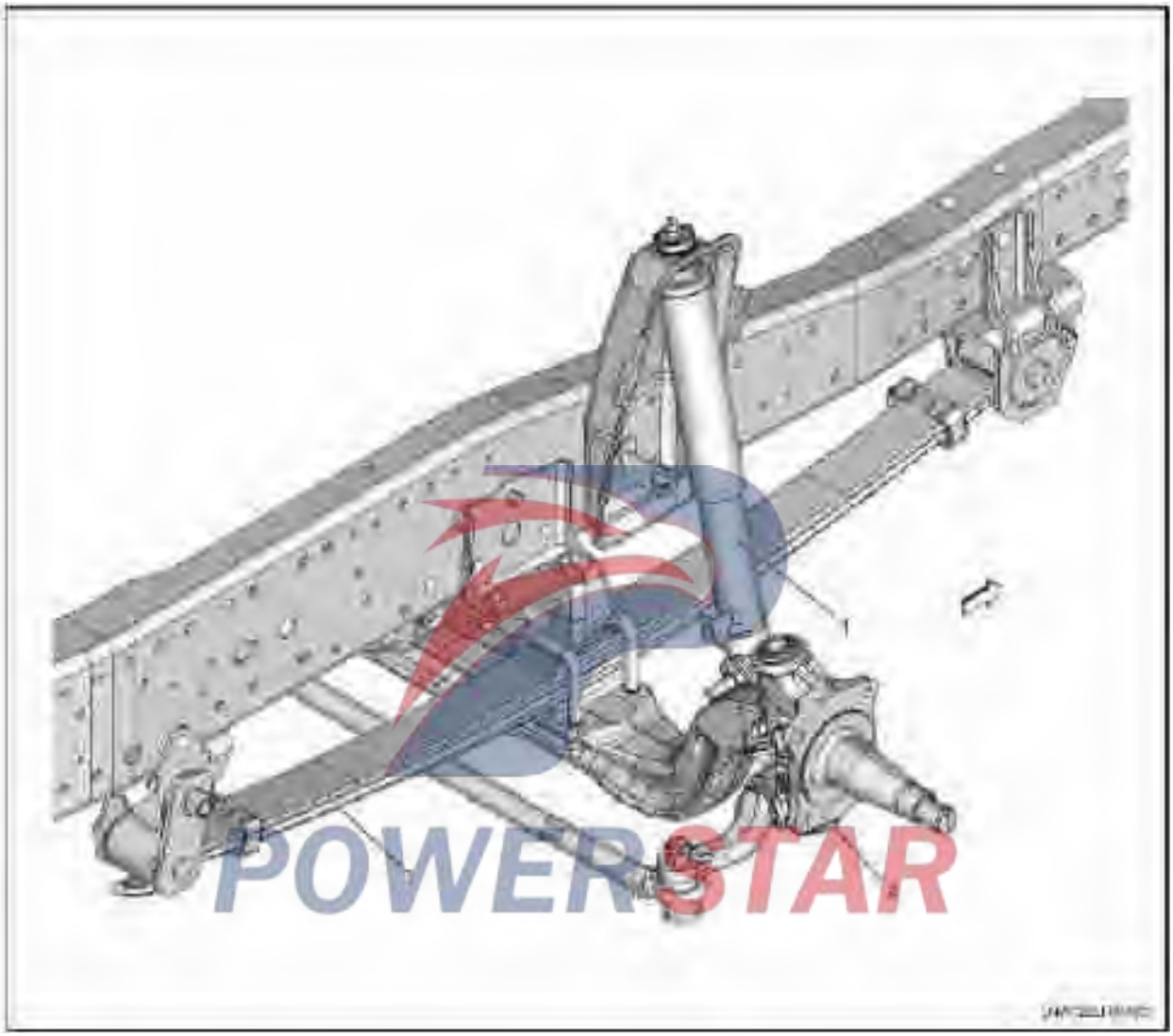
Front suspension system

Function and working principle

Front suspension with rigid blade



Key:

1. Front shock absorber
2. Steering knuckle
3. Front steel plate spring

Functional check

Check before work

Tire and wheel check

● Check the difference in size and whether there are obvious differences in wear between the left and right sides.

● Check for cracks and damage on the ground plane and on both sides of the vehicle.

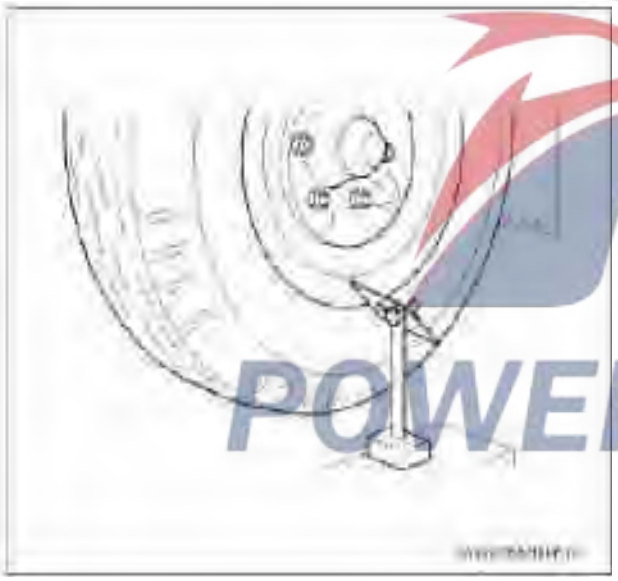
● Check tire pressure.

When checking the tire pressure, see the air pressure label on the door opening or check the maintenance method.

● Check the yaw of the wheel.

Limit =3mm

● Check if the wheels turn and if there is noise.



Check the release of relevant parts of the front axle

● Check if there are no free pins.

● Check the steering arm, etc.

● Check the release of the steering pin.

● Check the bearing clearance of the hub.

Inspection steering device

● Check spare parts.

● When checking the maximum steering angle, check for the presence of a limit screw and whether the tire and steering rod are in contact with other parts.

Fault diagnosis

When diagnosing various steering systems, suspensions, wheels, and tire defects, it is necessary to consider the entire steering system, suspension, wheels, and tires. Firstly, we must test to confirm the failure phenomenon. Then all abnormalities found during the next inspection are adjusted to normal.

1. Check that the tire pressure is normal and there is no abnormal wear.

2. Lift the vehicle and check for loose or damaged front and rear suspensions and power steering components.

3. Turn the front wheels to check if the tires are not balanced, if the rims are bent, and if the wheel bearings are loose.

Symptom	Probable causes	Process
Steering wheel failure	Tire combinations are not coordinated or have different levels of wear.	Replace tires.
	Tire pressure is abnormal.	Adjust tire pressure.
	The radial force of the radial tire is too large.	Replace tires.
	The front wheel alignment is abnormal.	Check the alignment of the front wheels.
	Wheels are locked.	Adjust the brakes.
	Loose, twisted or damaged front or rear suspension components.	Tighten or replace the suspension parts.
	Shock absorber malfunctions.	Replace shock absorbers.
Abnormal tire wear	Deformed or damaged spring.	Replace the spring.
	Tire imbalance.	Adjust tire balance or replace tires.
	The front wheel alignment is abnormal.	Check the alignment of the front wheels.
	Damper is abnormal.	Replace shock absorbers.
	Driving is not flexible.	Replace tires.
	Tire does not turn.	Replace tires or turn tires.
	Wheel bearings are worn or loose.	Replace wheel bearing.
	Wheel or tire shake.	Replace wheels or tires.
	Tire pressure is abnormal.	Adjust the air pressure.
Inconsistent wheel operation	The tire has bubbles or bulges.	Replace tires.
	Damper function is abnormal.	Replace shock absorbers.
Steering wheel vibration (sail, jitter)	Tire or wheel imbalance.	Adjust the balance of the wheels or replace the tires and wheels.
	Wheel bearings loose.	Replace wheel bearing.
	Turn to wear the ball head.	Replace the steering pin.
	Abnormal vibration wheel.	Correct or replace wheels and tires.
	The tire has bubbles or bulges.	Replace tires.
	The wobble of the tire/wheel assembly is due to the overweight of the vehicle.	Replace wheels and tires.
	The front wheel alignment is abnormal.	Check the alignment of the front wheels.
	The steering mechanism is loose or worn.	Tighten or replace the steering box.
	Release the mounting section of the power steering.	Tighten the fixing bolts.
	Tire pressure is abnormal.	Adjust the air pressure.
	Loosen bolts and nuts on various parts of the suspension.	Tighten.
	Shock absorber operation is abnormal.	Replace shock absorbers.

Symptom	Probable causes	Process
	Wheel bearing pre-tightening force is not adjusted properly.	Check and adjust wheel bearing preload.
Steering device operation is laborious	Defective spindle pin.	Replace the faulty parts of the steering gear.
	The front wheel alignment is abnormal.	Check the alignment of the front wheels.
	Incorrect adjustment of power steering.	Check and adjust the pretension of the power steering device.
	Tire pressure is abnormal.	Adjust the air pressure.
	Steering column loose.	Correct or replace.
	The power steering system is defective.	See Power Steering in Chapter 6B Electric Power Steering.
Large steering gear clearance	Wheel bearing wear.	Replace wheel bearing.
	The power steering or steering structure mounting parts are loose.	Retighten or replace.
	Incorrect adjustment of power steering.	Check and adjust the pretension of the power steering device.
	The shaft turns to the joint for wear and looseness.	Replace the steering shaft universal joint.
	Steering ball head pin worn.	Replace the abnormal part.
Poor reset	Defective spindle pin.	Replace the abnormal part.
	The steering column is not good.	Correct or replace.
	Poor power steering.	Check and correct the power steering. See Power Steering in Chapter 6B Electric Power Steering.
	The front wheel alignment is abnormal.	Check the alignment of the front wheels.
	Tire pressure is abnormal.	Adjust the air pressure.
	Steering wheel nut is loose.	Tighten the nut.
	Wheel bearing wear.	Replace wheel bearing.
Power steering device protected from noise	Part of the power steering installation is loose.	Tighten the fixing bolts.
Loose steering wheel	The installation of Loosing nuts.	Check the mounting nuts and screws. (Retighten with the specified torque).
Abnormal sound	Steering ball head pin worn, wet or loose.	Replace.
	Bad absorption.	Replace or correct.
	The stabilizer bar is loose.	Tighten or replace bolts.
	The wheel nut is loose.	Tighten the nut. If the wheel is damaged, replace it.
	Loosen nuts and bolts on various parts of the suspension.	Tighten.
	Wheel bearing damaged and damaged	Replace wheel bearing.
	Broken spring.	Replace the spring.

Symptom	Probable causes	Process
	Release the mounting section of the power steering.	Tighten.
	Poor power steering.	Check and adjust power steering. See Power Steering in Chapter 6B Electric Power Steering.
Poor steering stability	Tire combinations do not have the same degree of coordination or wear.	Change tires or adjust air pressure.
	Steering ball pin loose.	Replace the abnormal part of the transmission.
	Bad absorption.	Replace shock absorbers.
	The stabilizer bar is loose.	Tighten.
	The spring is broken or loose.	Replace the spring.
	Power steering adjustment is abnormal.	Check and adjust the pretension of the power steering device.
	The front wheel is poorly positioned.	Check the alignment of the front wheels.
Bad steering when operating brake	Wheel bearing wear.	Replace wheel bearing.
	Damage to the spring is loose.	Replace the spring.
	Brake fluid leaks to the wheel brake cylinder or caliper.	Correct or replace wheel brake cylinders and brake calipers.
	The brake disc is deformed.	Replace the brake disc.
	The brake linings wear badly.	Replace the brake pads.
	Brake drum deformed.	Replace the brake drum.
	Tire pressure is not uniform.	Adjust the air pressure.
	Bad wheel brake cylinder.	Replace or correct wheel brake cylinders.
Running high, low or unequal cars	Damage to the spring is loose.	Replace the spring.
	The vehicle is overweight.	Check the load.
	The spring is not suitable.	Check the replacement spring color logo.
Dangling key bottom	The vehicle is overweight.	Check the load.
	The spring is not suitable, broken or loose.	Replace the spring.
Tilted car	The spring is not suitable.	Check the replacement spring color logo.
	Spring breaks loose.	Replace the spring.
	The weight distribution of the vehicles (Left and right tires, front and rear tires) does not meet specifications.	Check the load.

Special tools

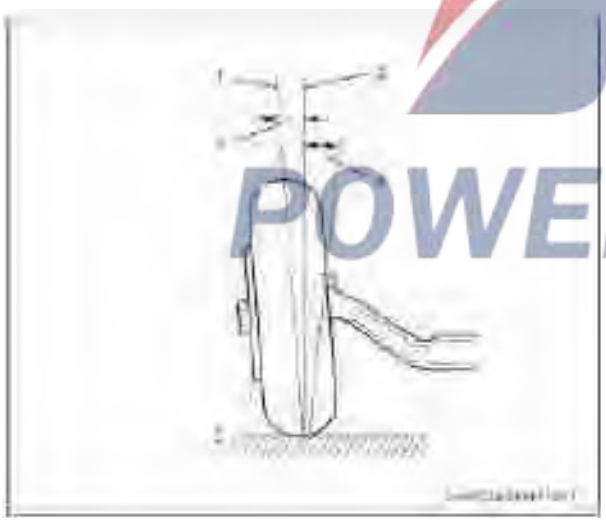
Illustration	Tool number Tool name
	5-8840-2207-0 Front wheel aligner adapter
	5-8840-2048-1 Spring bushing changes
	5-8840-2049-1 Spring bushing changes

Front wheel alignment

Function and working principle

Camber angle

The camber angle refers to the angle of the upper part of the tire outward or inward when the vehicle is viewed from the front. The reason that camber angle is an important front-wheel positioning item is that it greatly affects the characteristics of tires and tires. When the center of the tire is completely vertical, the camber angle is 0°. The camber angle indicates the inclination of the upper part of the wheel. In contrast, the negative camber indicates the inward slope. When the positive inclination is too large, the outer edge of the tire will wear. Conversely, when the negative angle is too wide, it causes internal wear. When the camber angle is irrational, not only does the tire wear excessively, but it also causes the tire to move in the direction of the wheel with a large outside rake angle, affecting the straight running of the vehicle. Angle curvature is represented by angles.

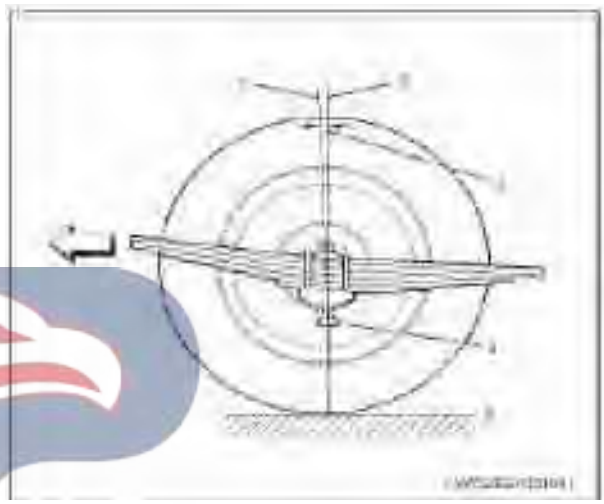


Key

1. Tire centerline
2. Vertical line
3. The angle of camber
4. Steering to the main pin
5. Horizontal line

Caster angle of king pin

The kingpin linkage angle refers to the angle at which the vehicle turns toward the kingpin when viewing the vehicle from the side. Both angles and angles are represented by angles. The kingpin inclination has a great influence on the straight driving ability, mobility, rudder retention and return ability of the vehicle.

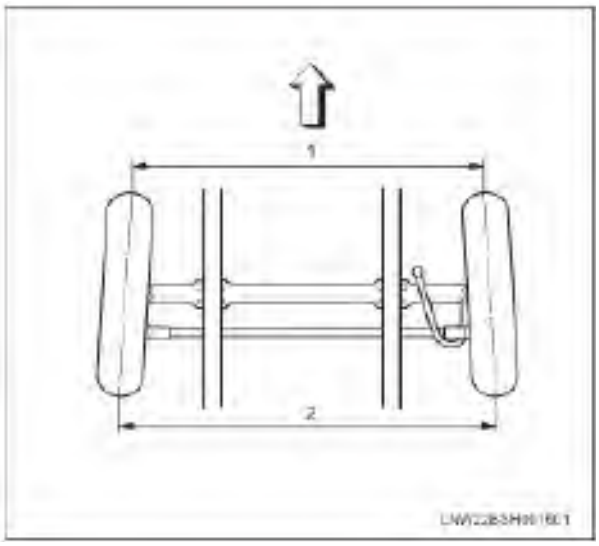


Key

1. Vertical line
2. Turn to the kingpin centerline
3. Master pin caster
4. Front axle
5. Horizontal line

Toe-in

When looking directly at the front wheel from the upper right, the wheels tilt slightly inward. We refer to this figure as the toe to the inside, usually expressed in mm. Toe-in (mm) = (2) — (1).



Functional check

Measure front wheel alignment conditions

● Measurement must be performed in the empty state.

● In a horizontal position.

● Reconfirm the location of the inspection before making adjustments.

Adjust the check before aligning the front wheels

● Check if the vehicle is in a normal position.

● Check if the front tire is loose.

● Check suspension release.

● Make sure the tire does not shake or tilt.

● Check if the lever is loose at the joint. Steering pivot loose.

Check the leaf springs for wear and tear.

● Check that the fixing bolts of each section are loose.

● Check the operation of the steering mechanism.

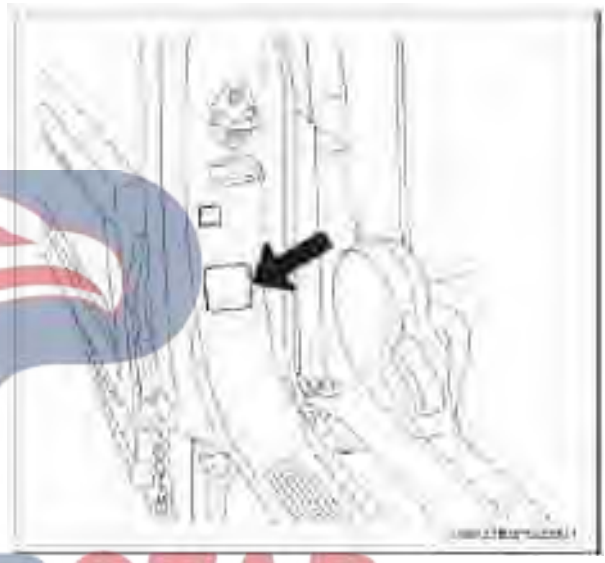
● Check that the tire size matches the vehicle to be measured.

● Make sure the tire pressure is normal.

● Confirm if the tire is significantly worn or partially worn.

Caution:

The tire size and the specified air pressure are attached to the driver's door opening.



Standard value for positioning the front wheels

Toe-in	=-2～2 mm
Angle of camber	=0º15’±30’
Hunting angle	=2º45’±60’
Steering pivot inclination	=12º00’±40’
Direction angle	
Internal = 42º±1º External = 34º’	

Measuring beam

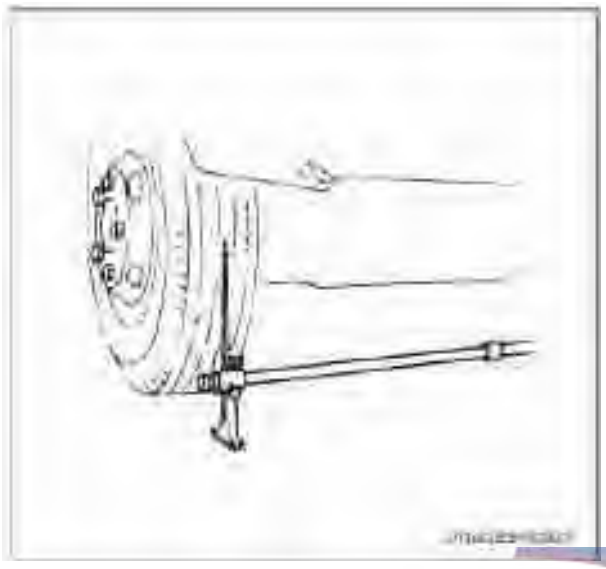
1. Align the front wheel.

2. Match the tip gauge to the center point of the right front and left wheels of the tire and mark it.

3. Measure the distance between two markers.

4. Turn the front wheel 180o.

5. Measure the distance between the left and right two marks on the front of the vehicle.



Adjust the toes

● Loosen the lock nut (left and right) at the end of the lever and turn the lever to adjust the length.

Caution:

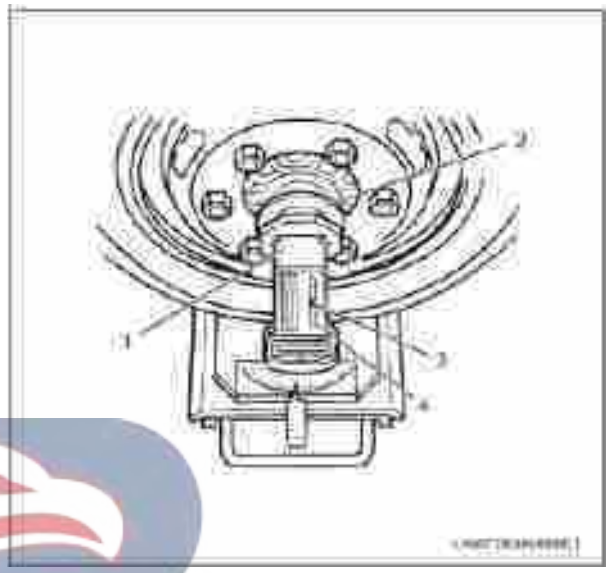
Tighten the lock nut after adjustment.

Tightening torque: 113 N • m {11.5 kgf • m}

Measure camber, swivel castor, swivel tilt

1. Lift the vehicle and remove the wheel and tire, hubcap, split pin, hub nut, and mounting adapter: 5-8840-2207-0 (2).

Use adapters to increase the accuracy of your measurements.



Key

1. Front wheel positioner
2. Adapter: 5-8840-2207-0
3. The angle of camber
4. Inclinometer

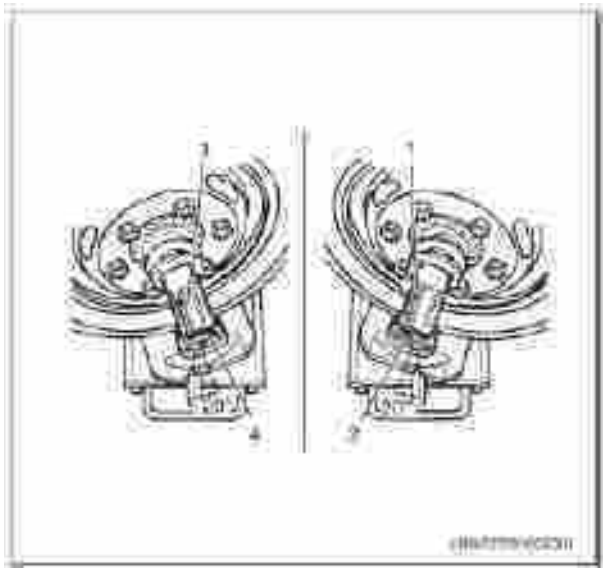
2. Tighten the adapter so that the hub bearings reach the specified preload, then install the wheels and tires.

3. Place the front wheel on the steering wheel gauge and place the rear wheel on the table to keep the gauge high.

4. Lock the turn radius to 0 o'clock and align the front wheels so that the pedal aligns with the center of the turn radius.

Caution:

After confirming that the vehicle is stable on the steering wheel gauge and stand, the locking pin can be removed.



Key

1. Rotary radius measuring instrument

5. Use the front wheel positioner level gauge to check if the instrument is level.

6. Measure the camber angle.

Camber angle=0º15’±30’

7. Measure swivel castors and swivel castors.

● Turn the right wheel 20 degrees to the right. In this state, the air bubbles of the swivel caster (1) and the swivel caster (2) are aligned with "0".

● Next, rotate the right wheel to the left by 20° to measure the caster (3) and the caster tilt (4).

Hunting angle=2º45’+0º to -2。

Steering pivot inclination=12º00

8. After the measurement is complete, remove the adapter.

9. Install the hub nut, adjust the hub bearing preload, then install the new bolt and hub cap.

10. The operation of the left wheel is the same.

Measure and adjust the steering angle

1. Use the turning radius to measure the steering angle.

2. Make sure the front wheels do not touch other parts.

3. Turn the steering wheel left or right to measure the steering angle.

Adjust by adjusting the height of the joint limit bolts.

Caution:

Tighten the nuts after adjustment.

Tightening torque : 49 N • m {5.0kgf • m}

Direction angle

NPR
Internal = 42º±1º External = 34°00’

NPR (4.5 tons or more load)

Steering angle Internal=43º00’ External=33º00’

Sliding measurement

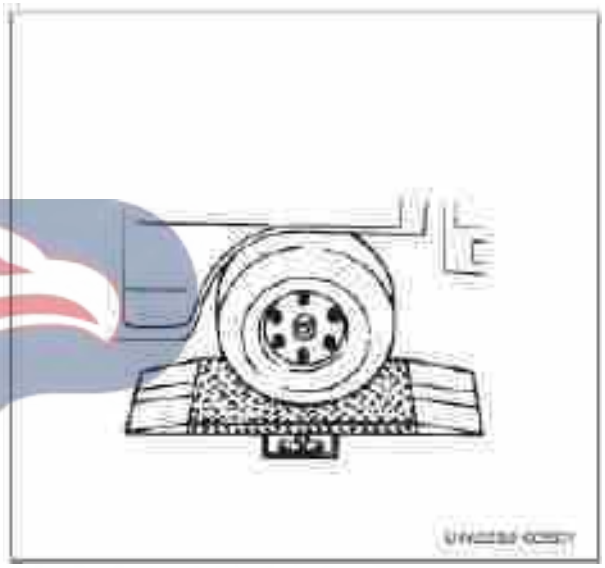
● After adjusting the front wheel alignment standard, use the side guides to measure the sideways slide.

Safety standards = driving within 1m ± 5mm

Assembly standard = driving within 1m ± 3mm

Caution:

Side tires cannot measure good lateral sliding and must be replaced before measurement.



Main parameters

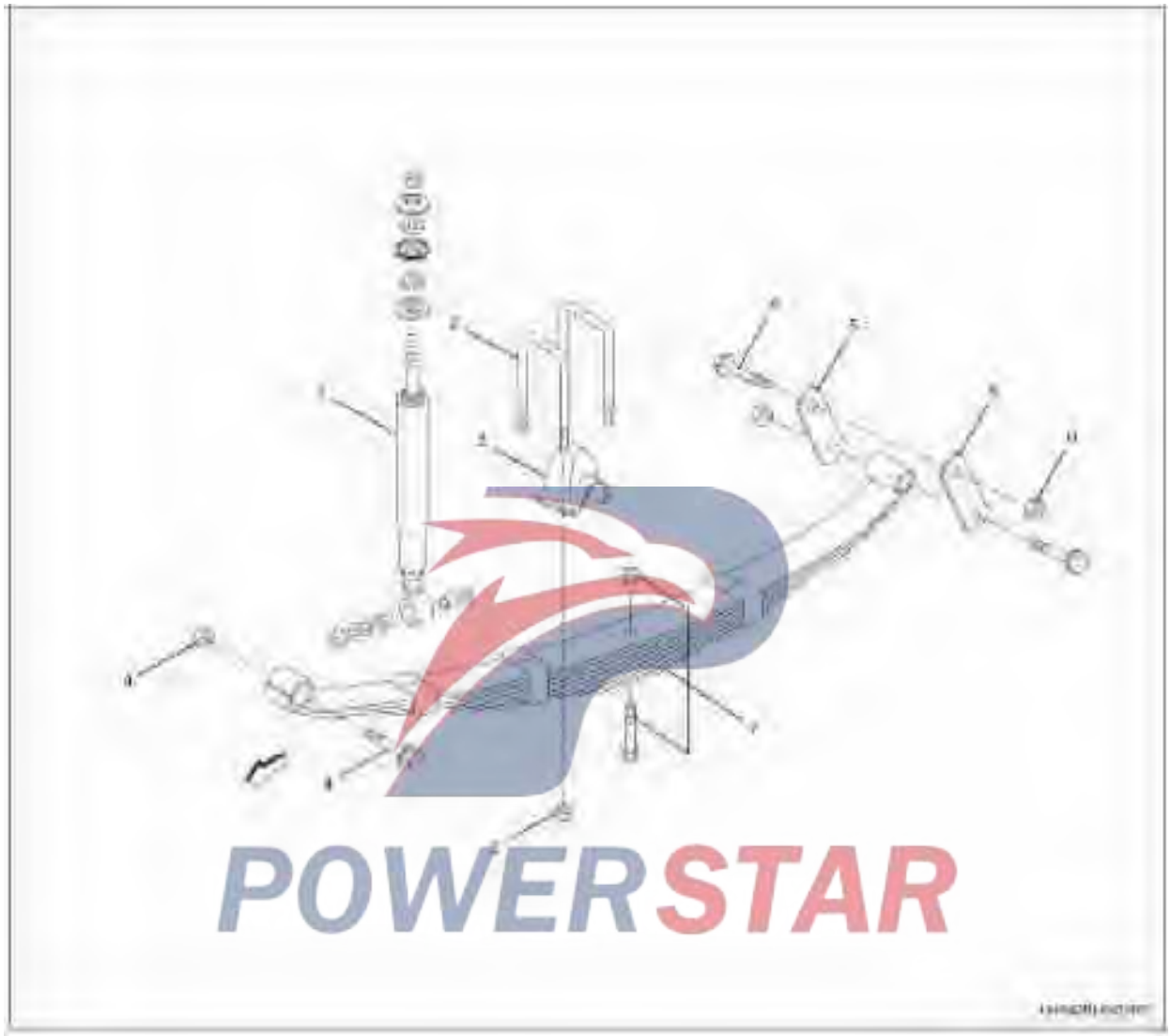
Front suspension with rigid blade

Front axle shape	Axle suspension, anti-fork section I
Toe-in (mm)	-2∽2
Camber angle (degrees)	0º15’±30’
Hunting angle(degree)	2º45’±60’
Steering pivot inclination (degrees)	12º±40’
Steering angle (degrees)	Internal = 42º±1º External = 34º00’

Front suspension

Component parts

Front suspension with rigid blade



Key

1. Shock absorber
2. U-bolt and nut
3. Rubber stamp
4. Spring pin, nut
5. Lifting lug
6. Suspended pin, nut
7. Steel plate spring

Disassembly

Front suspension

1. Lift the vehicle to support the chassis with the base.

For information on car lift points, see the OA Overview chapter.

2. Remove the front wheel.

View wheels, tires in 2D tires, parts of tires.

3. Use a jack to fix the front axle so that the leaf spring is free.

4. Remove the front stabilizer (only for vehicles with front suspension).

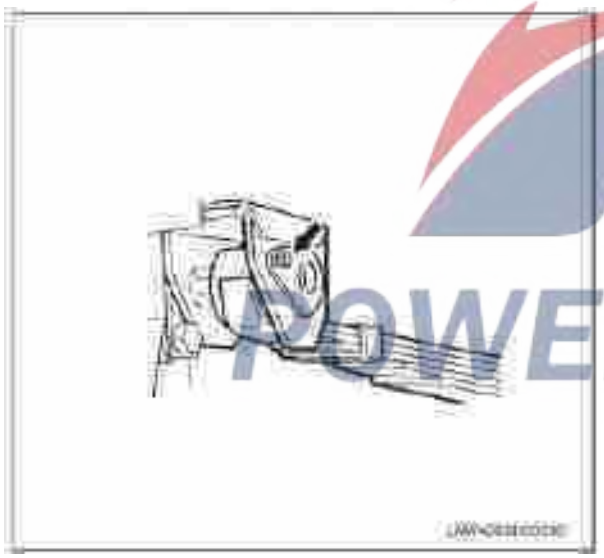
5. Remove the damper.

6. Remove U-bolts and rubber pads.

● If the caliper thread rusts, apply oil and loosen the nut.

7. Remove the latch.

a. Remove the bolt and remove the blade bolt.



b. Lower the jack and front axle until the spring leaves the rack-side leaf spring bracket.

Caution:

When using the jack, be careful not to excessively stretch the brake hose.

8. Remove the lifting ears.

9. Remove the leaf spring.

● When removing the leaf spring, be careful not to damage the steering rod and brake hose.

Front suspension

1. Remove the damper.

2. Remove U-bolts and rubber pads.

● If the U-bolt thread rusts, apply oil and loosen the nut.

3. Remove the latch.

● Lower the jack and front axle until the spring leaves the rack-side leaf spring bracket.

Caution:

When using the plug, do not overstretch the brake hose.

4. Remove the lifting ears.

● After releasing the pin nut, break the pin with a round bar or the like.

5. Take off the leaf spring

● When removing the leaf spring, be careful not to damage the steering rod and brake hose.

Inspection

1. Check the removed parts.

● Check the leaf spring for cracks, scratches, or cracks.

● Inspect the threaded portion of the hanging pin to ensure that it is not damaged.

● Check the socket for wear and damage.

● Check the U-bolts for damage and wear.

● Inspect the cushion rubber for signs of damage, delamination, and wear.

2. Check the shock absorbers.

● Check for obvious oil leaks.

● Check the temperature after driving on the wrong road. Do not increase the temperature indicates poor performance.

● Check function.

By rapidly pulling the compression damper to hold one end and applying high strength, the gap should disappear after multiple expansions and contractions.

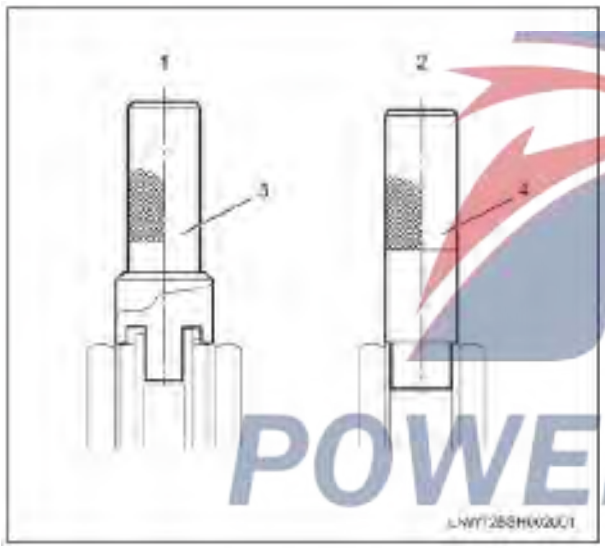
If the above phenomenon does not occur, the performance deteriorates.

Disassembling

1. Remove the leaf spring bushing.

a. Integral rubber sleeve uses a picker:

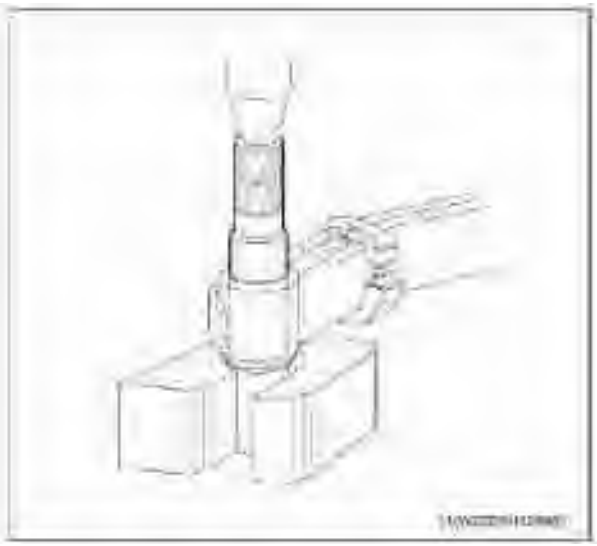
5-8840-2048-1 (3) Disassemble, replace metal sleeve with changer: 5-8840-2049-1 (4).



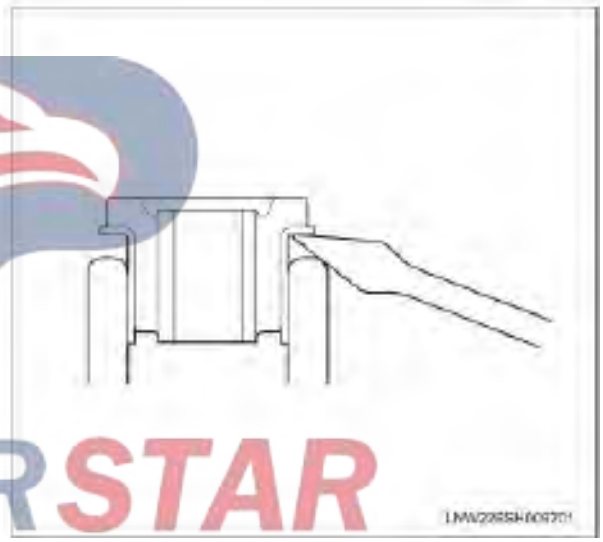
Key

1. Integral rubber bushing
2. Metal shrub
3. Replacement device: 5-8840-2048-1
4. Replacement device: 5-8840-2049-1

b. Install the leaf spring on the bench press, slowly increase the pressure and remove the socket.



c. Using a split rubber bushing, remove the bushing flange evenly with a tool such as a steel chisel.



2. Decompose the leaf spring.

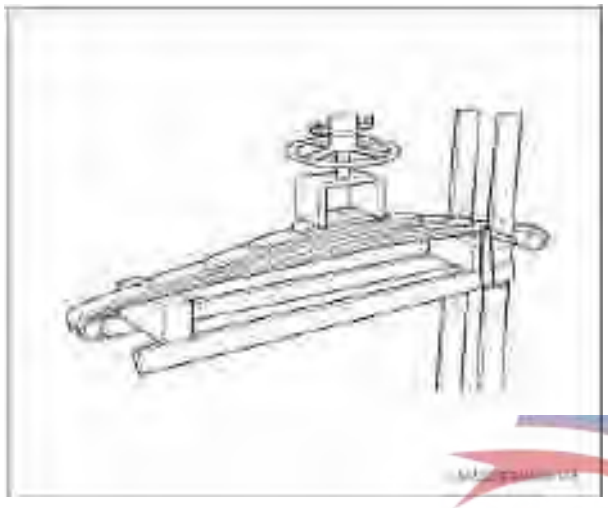
a. Make component markings on the sides of each leaf spring.

b. Press firmly on the spring assembly of the plate with a press.

c. Curved pliers.

d. Remove bolts and nuts from the center.

e. Reduce press pressure and remove each leaf spring.

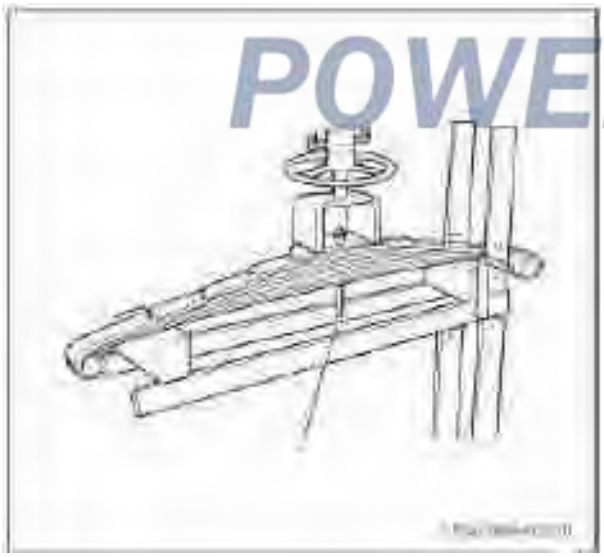


Assembly

1. Assemble the leaf spring.

a. Grease the sides of each blade (BESCO chassis grease).

b. Use the guide rail (1) to assemble the center bolt.



c. Press the leaf spring with the press and install the center bolt.

Use the new center bolt.

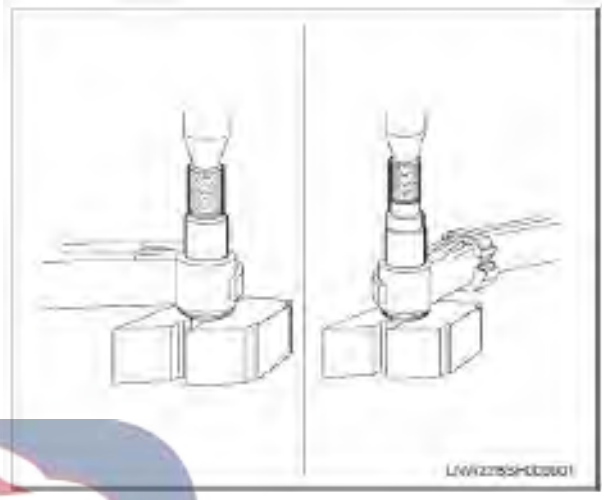
d. Reduce the pressure and tighten the center bolt to the specified torque.

Tightening torque: 39 N • m {4.0 kgf • m}

2. Push the ring into the leaf spring.

A. Mount the leaf spring on the bench press.

B. Slowly pressurize the outer diameter of the sleeve to the transducer: 5-8840-2048-1 (for integrated rubber rings) or change: 5-8840-2049-1 (for metal rings)



Installation

Front suspension

1. Install the leaf spring and spring pin.

a. Mount the leaf spring on the leaf spring bracket on the side of the rack and install the leaf spring pin.

b. Tighten the nuts of the blade bolts.

● Once the vehicle has landed, tighten the nut to the specified torque.

Tightening torque : 177 N • m {18.0kgf • m}

2. Install lifting lug

a. Place the leaf spring on the leaf spring bracket on the side of the frame and install the lugs and lugs.

b. Pre-tighten the suspension pin nut.

● Once the vehicle has landed, tighten the nut to the specified torque.

Tightening torque : 177 N • m {18.0kgf • m}

3. Install U-bolt and rubber pad.

a. Lift the front axle and install it on the steel plate spring.

● Install the center bolt of the steel plate spring on the center hole of the front axle bolt.

b. Mount cushion rubber on the leaf spring and install U-bolt.

c. Install the nut and tighten it with the specified torque.

When tightening the nuts, add oil to avoid damaging the threads.

Tightening torque: 127 N • m {12.9 kgf • m}

4. Install shock absorber

a. Mount washers and rubber bushes on the top of the impact.

● Check the uneven surface of the joints and pay attention to the installation order and installation direction.

b. Install a shock absorber on the vehicle and tighten the bolts and nuts to the specified torque.

● Check the uneven surface of the seal on the frame side, and pay attention to the installation sequence and installation direction.

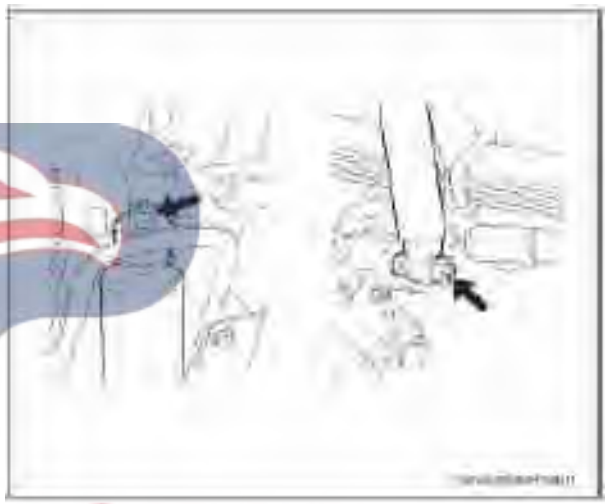
Tightening torque

Frame side= 20N • m {2.0kgf • m}

Frame side = 95N·M {9.7kgf·M}

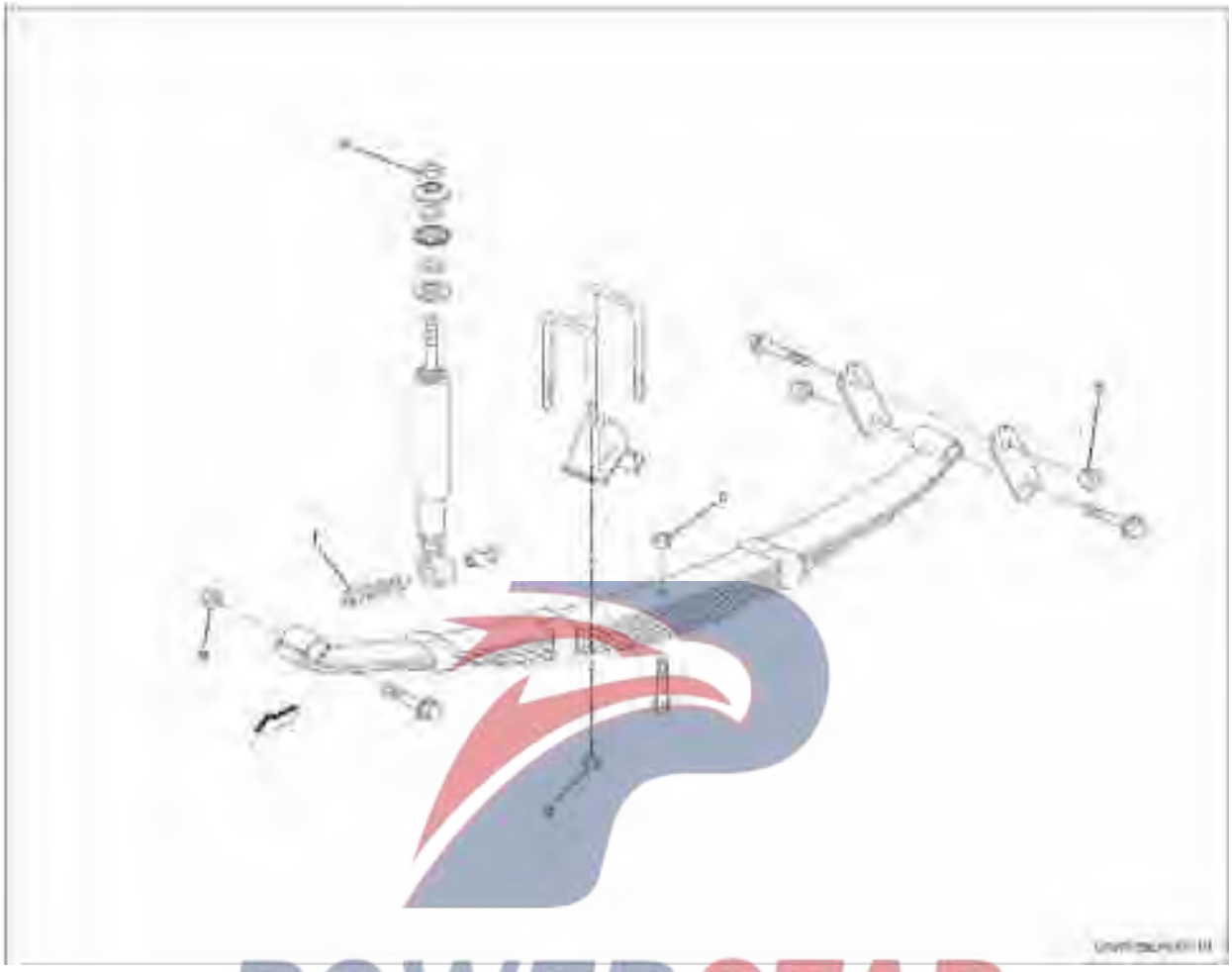
Caution:

Once the vehicle is lowered and the suspension is stable, tighten the bolts and nuts to the specified torque.



Tightening torque - Overview

Front suspension



Key

(a) 20 N • m{2.0 kgf • m}

(b) 177 N • m{ 18.0 kgf • m}

(c) 39 N • m{4.0 kgf • m}

(d) 127 N • m{ 12.9 kgf • m}

(e) 177 N • m{ 18.0 kgf • m}

(f) 95 N • m{9.7 kgf • m

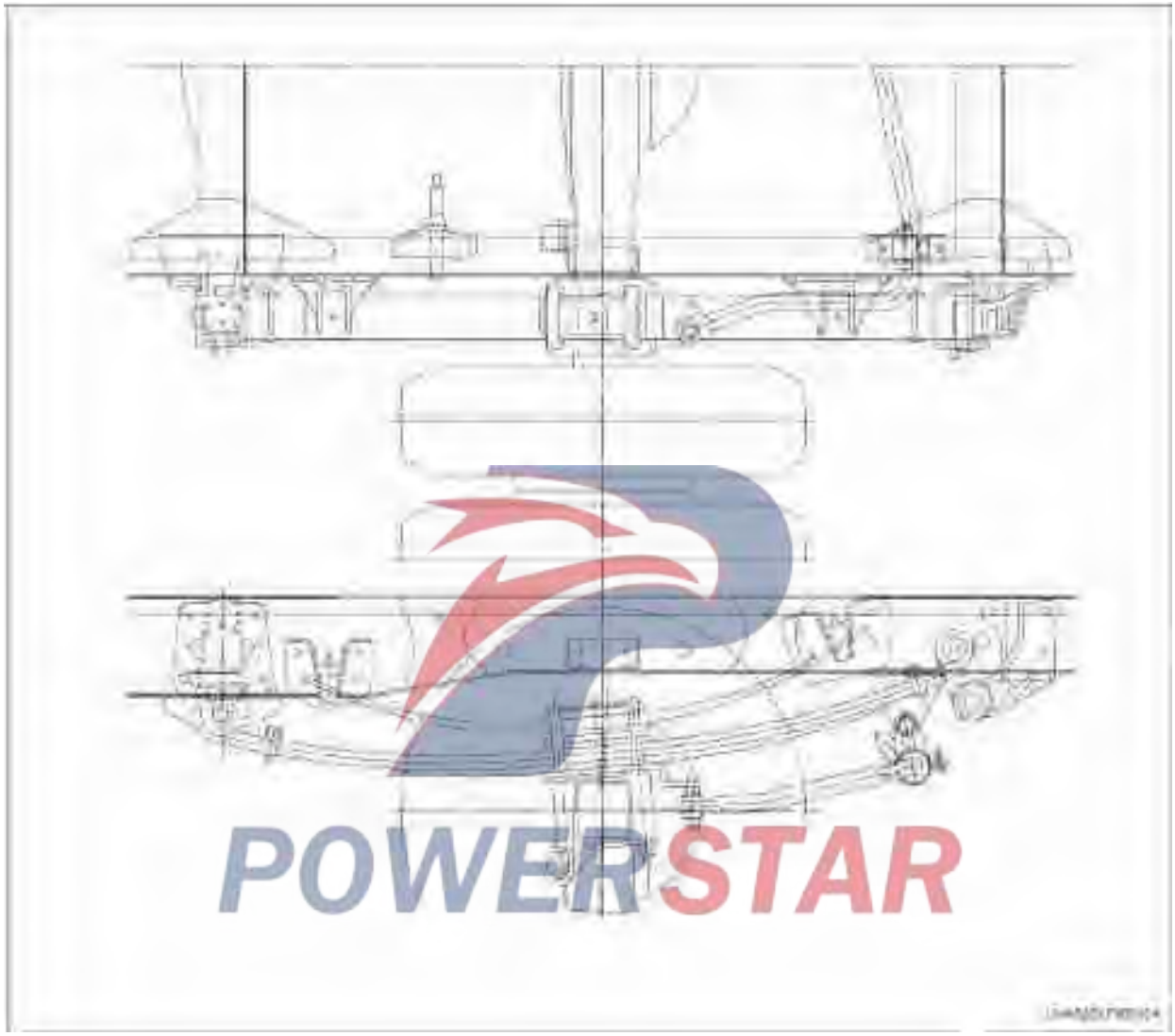
Section 2C
Rear suspension

Table of Contents

Rear suspension system

Function and working principle

Rear suspension with blade

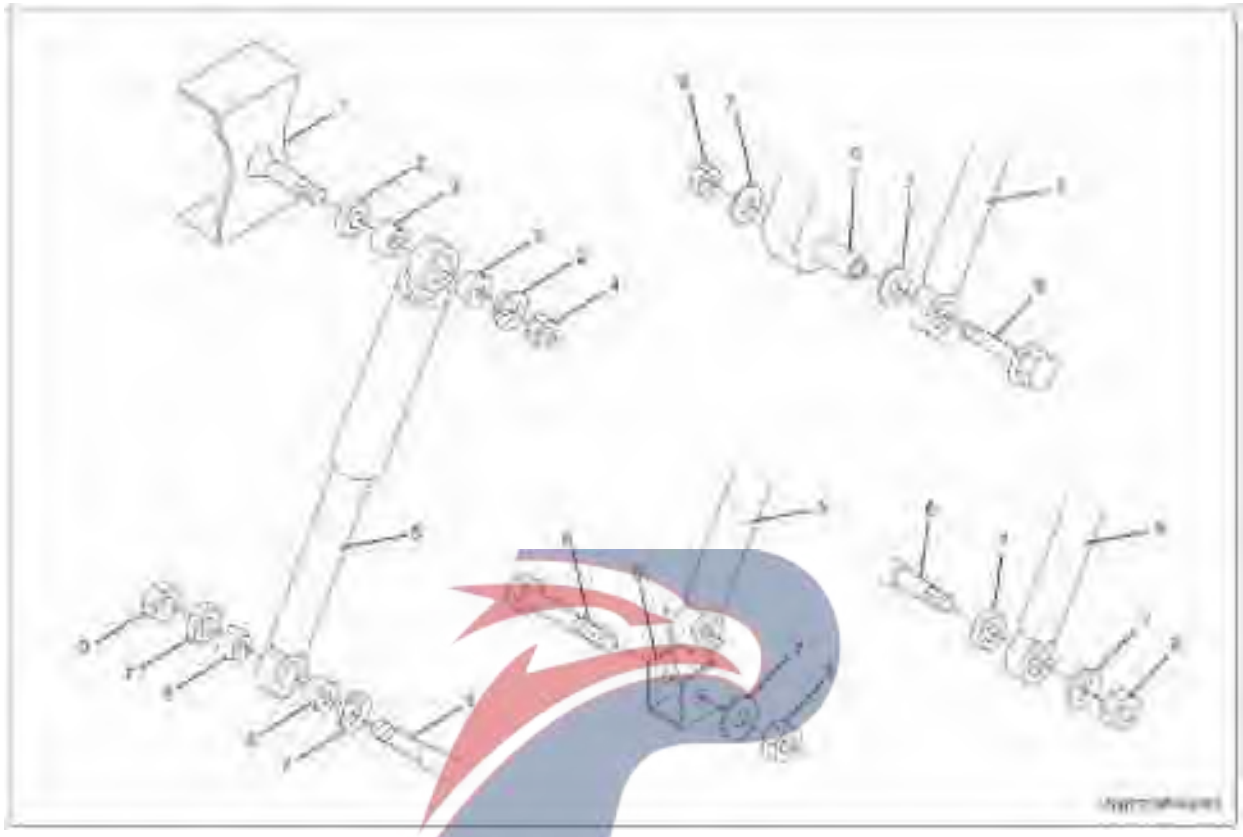


Special tools

Illustration	Tool number Tool Name
	5-8840-2048-1 Spring bushing changes
	5-8840-2049-1 Spring bushing changes

Shock absorber

Component parts



Key

1. Side bracket
2. Washers
3. Bush
4. Nuts
5. Shock absorber
6. Lateral support of shaft housing (lower splint)
7. Washers
8. Bush
9. Nuts(Bolt)

Disassembly

1. Remove the lower part of the damper.

● First remove the nuts (or bolts), washers and shock absorbers, then remove the sleeve from the axle box and lower jaw.

2. Remove the upper part of the damper.

● First remove the nuts and washers and then remove the shock absorbers and bushings from the chassis.

3. Remove the damper.

4. Check the shock absorber.

● Check for obvious oil leaks.

● Check the temperature after driving on the wrong road. If the temperature does not increase, the performance will decrease.

● Check performance.

Grab any end and quickly stretch the compression damper. You should feel a lot of resistance. This gap should disappear after several expansions.

If this is not the case, the performance will deteriorate.

5. Inspect the rubber boot for wear, damage, and other abnormalities.

Installation

1. Install the lower part of the damper.

● Mount shock absorbers, rings, washers on the frame and tighten them with nuts.

Tightening torque: 95 N • m {9.7 kgf • m}

2. Install the lower part of the shock absorber.

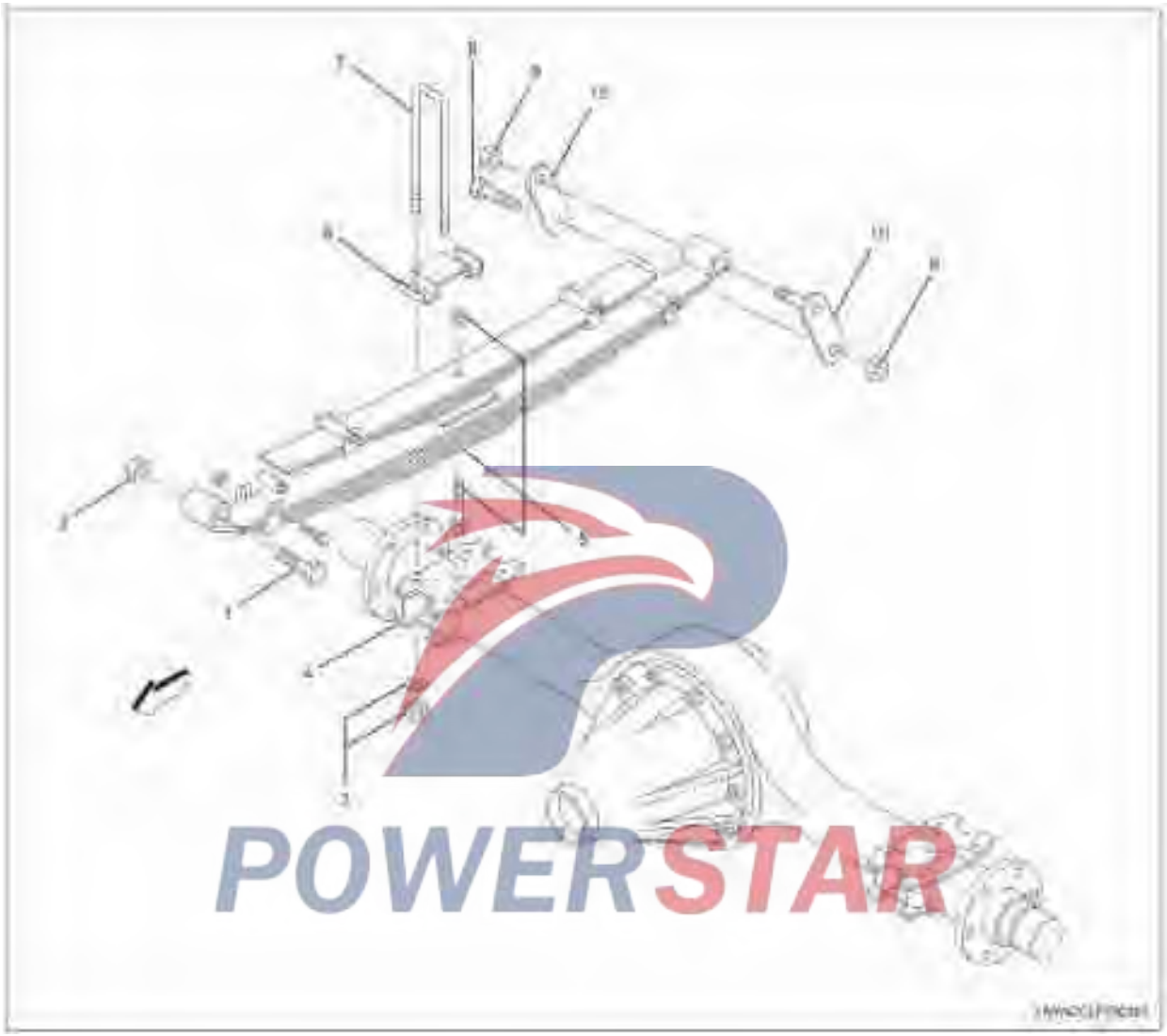
● Mount the shock absorber on the axle housing or the lower clamp plate and tighten it with a nut (or bolt).

Tightening torque: 40 N • m {4.1 kgf • m}

Steel plate spring

Component parts

Upper blade spring



Key

1. Leaf pin
2. Leaf spring pin nut
3. U-bolt nut, washer
4. Rear axle housing
5. Leaf spring
6. Upper splint
7. U-bolt
8. shackle pin
9. shackle pin nuts
10. shackle

Disassembly

1. Lift the vehicle and use the base to support the frame.

Please see "Automotive Highlights" in the OA Summary section.

2. Remove the damper.

See Shock in this section.

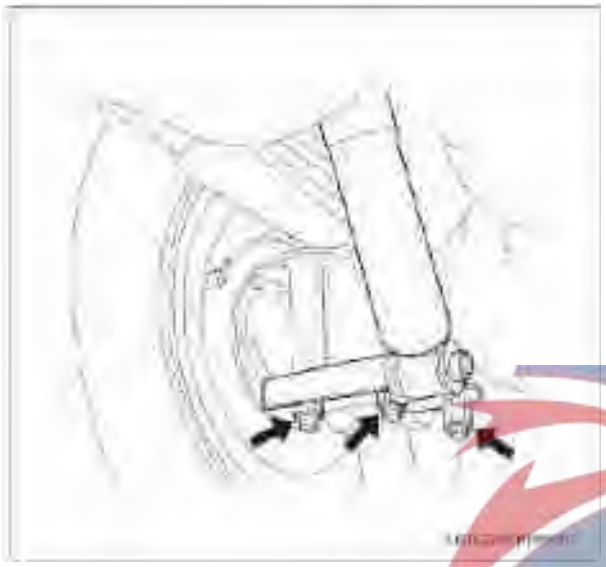
3. Dismantle the stabilizer (applies only to vehicles that have stabilizers installed).

4. Remove the nut from the U-bolt.

a. Place a jack on the rear axle housing to keep the leaf spring free.

b. Remove the nut and washer from the U-bolt and remove the chin (or damper branch).

If the U-bolt threads are rusted, apply oil to the thread first and then loosen the U-bolt nut.



c. Remove U-bolts and upper collar.

d. Operate the jack to keep the rear axle housing and the leaf spring in a separated state.

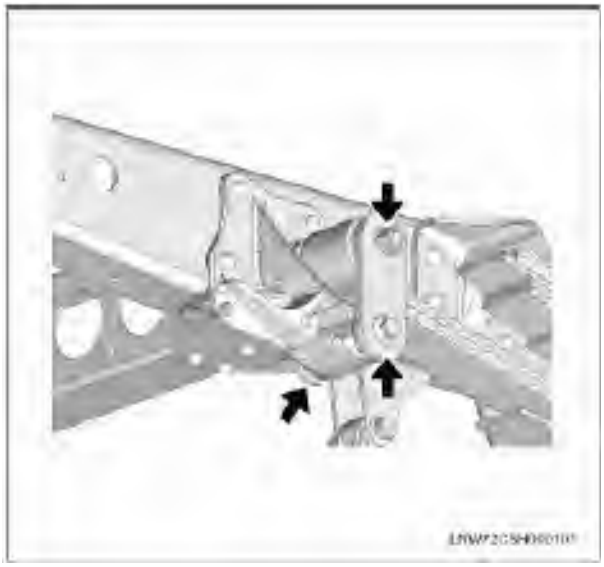
Caution:

Do not pull the brake hose too long.

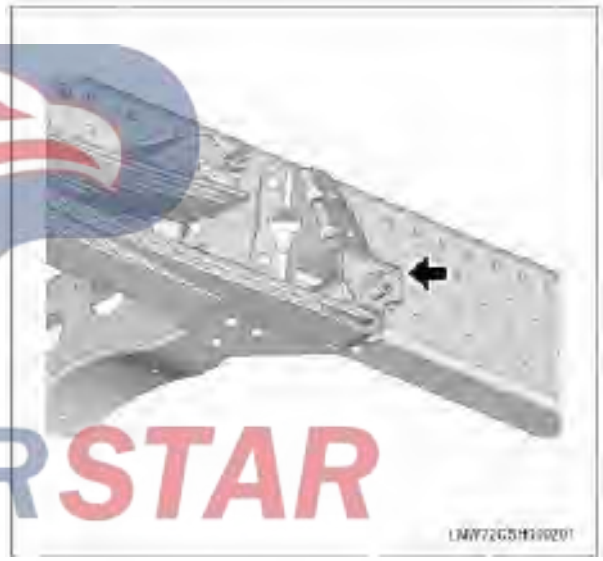
5. Remove the rings and ear pins.

a. If necessary, cylinder support leaf springs can be used.

b. Remove the lug nuts and washers before removing the pins and lugs.



6. Remove the spring pin.



7. Remove the leaf spring.

Inspection

● Check the leaf spring for cracks, scratches, or cracks.

● Check lug pin for damage.

● Check the ring for wear and damage.

● Inspect the threaded portion of the U-bolt for damage or tension.

● Check the cushion rubber for damage, peeling, and weakness.

● Measure the outer diameter of the lug and check the clearance between the bushing and the lug.

The outer diameter of the hanging pin

Standard value = 25.0 mm limit= 24.7 mm

Clearance between socket and pin

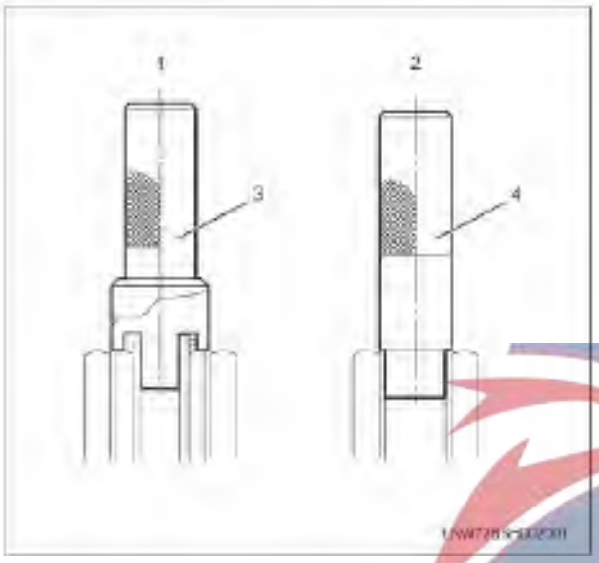
Standard value = 0.1mm limit= 0.5 mm

Disassembling

1. Remove the leaf spring ring.

a. Integral rubber sleeve uses a picker:

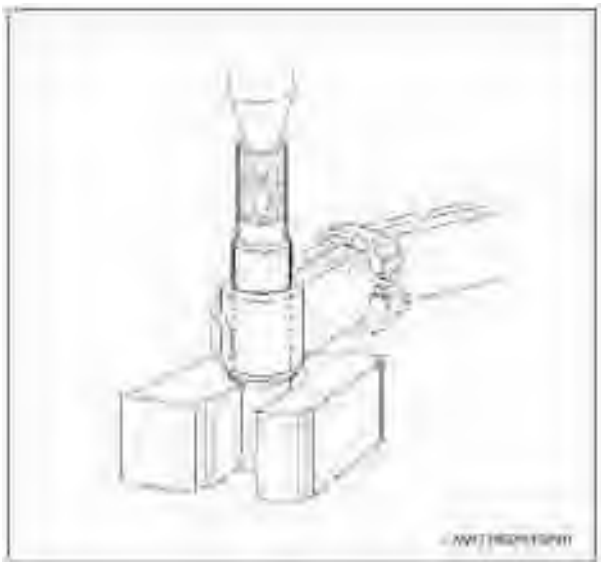
5-8840-2048-1 (3) Disassemble, replace metal sleeve with changer: 5-8840-2049-1 (4).



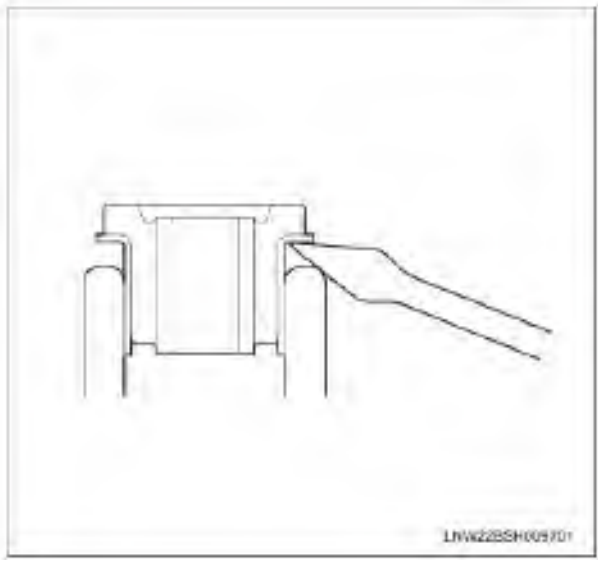
Key

1. Integral rubber bushing
2. Metal shrub
3. Replacement device: 5-8840-2048-1
4. Replacement device: 5-8840-2049-1

b. Connect the leaf spring to the bench press, slowly increase the pressure and pull out the socket.

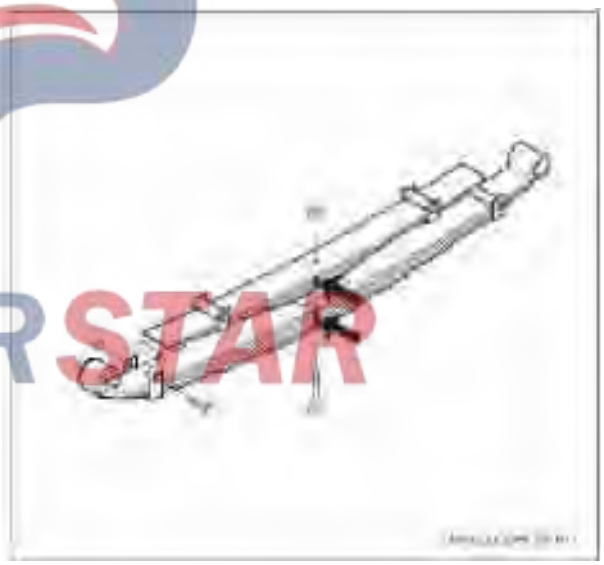


c. Tap the separate flange of the rubber ring with a tool such as a steel chisel and remove it.



2. Decompose the leaf spring.

a. Mark one side of each leaf spring.

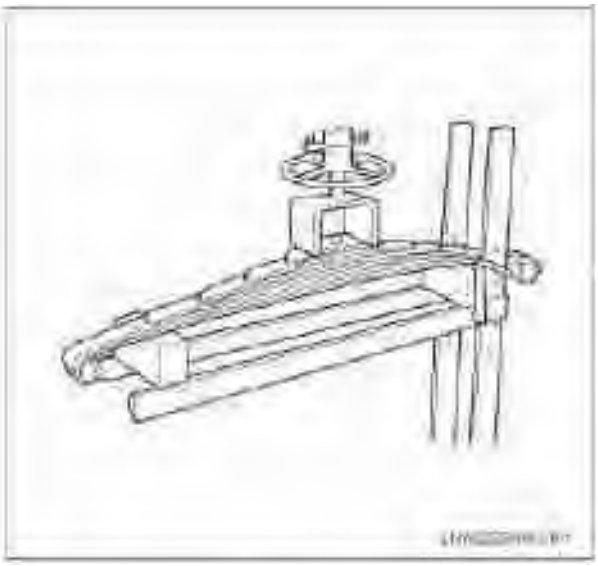


b. Press the leaf spring assembly completely with a press.

c. Folded pliers.

d. Remove the center bolt and nut.

e. Reduce press pressure and remove each leaf spring.

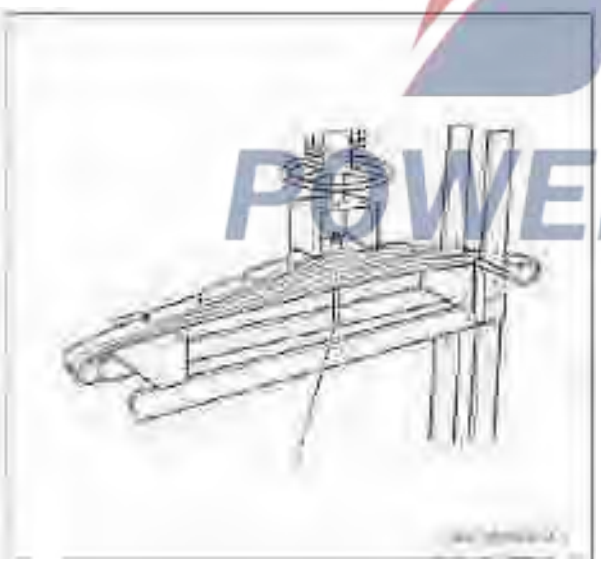


Assembly

1. Assemble the leaf spring.

a. Grease the sides of each leaf spring (BESCO chassis grease).

b. Use the guide rail (1) through the center bolt.



c. Use a press to fully press the leaf spring assembly and pass through the center bolt.

Use the new center bolt.

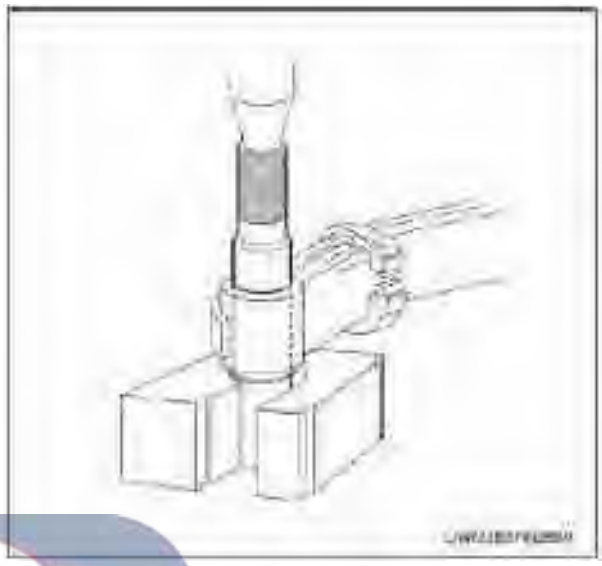
d. Reduce the pressure on the press and tighten the center bolts and nuts.

Tightening torque: 39 N • m {4.0 kgf • m}

2. Push the ring into the leaf spring.

a. Connect the leaf spring to the press table.

b. Make the changer 5-8840-2048-1 (for integral rubber bushes) or changer 5-8840-2049-1 (for metal bushings) contact the outside diameter of the bushing, and then slowly increase the pressure Press it in.

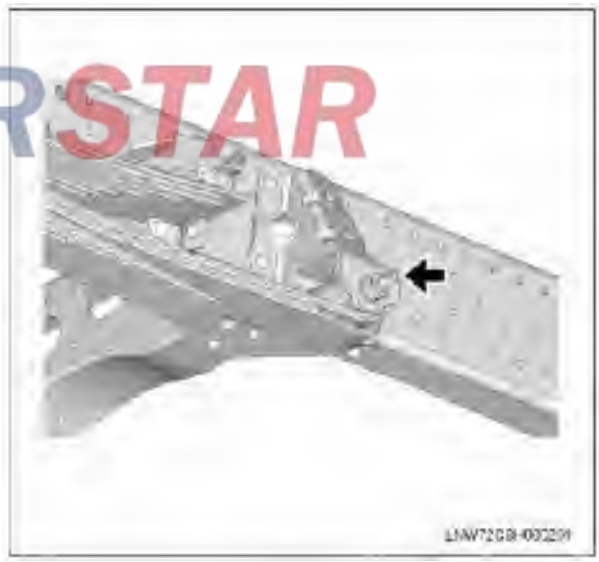


Installation

1. Install the leaf spring.

1. Install the leaf pin

● After the vehicle has landed, tighten the blade bolts and nuts to the specified torque.



3. Install lifting rings and lifting ears.

● After the vehicle has landed, tighten the casing nut to the specified torque.

4. Mount the rear axle housing on the leaf spring.

a. The rear axle housing is mounted to the leaf spring by jacking up. The center of the leaf spring is bolted to the positioning hole of the rear axle housing.

b. Install U-bolts, splints, and spring clips, then tighten washers and nuts.

Caution:

When tightening the nut, apply oil to avoid damaging the thread of the U-bolt.

Tightening torque : 284N • m{29.0kgf • m}

5. Install shock absorber

See Shock in this section.

6. After the vehicle has landed, tighten the leaf spring nut with the specified torque.

Tightening torque : 275N • m{28.0kgf • m}

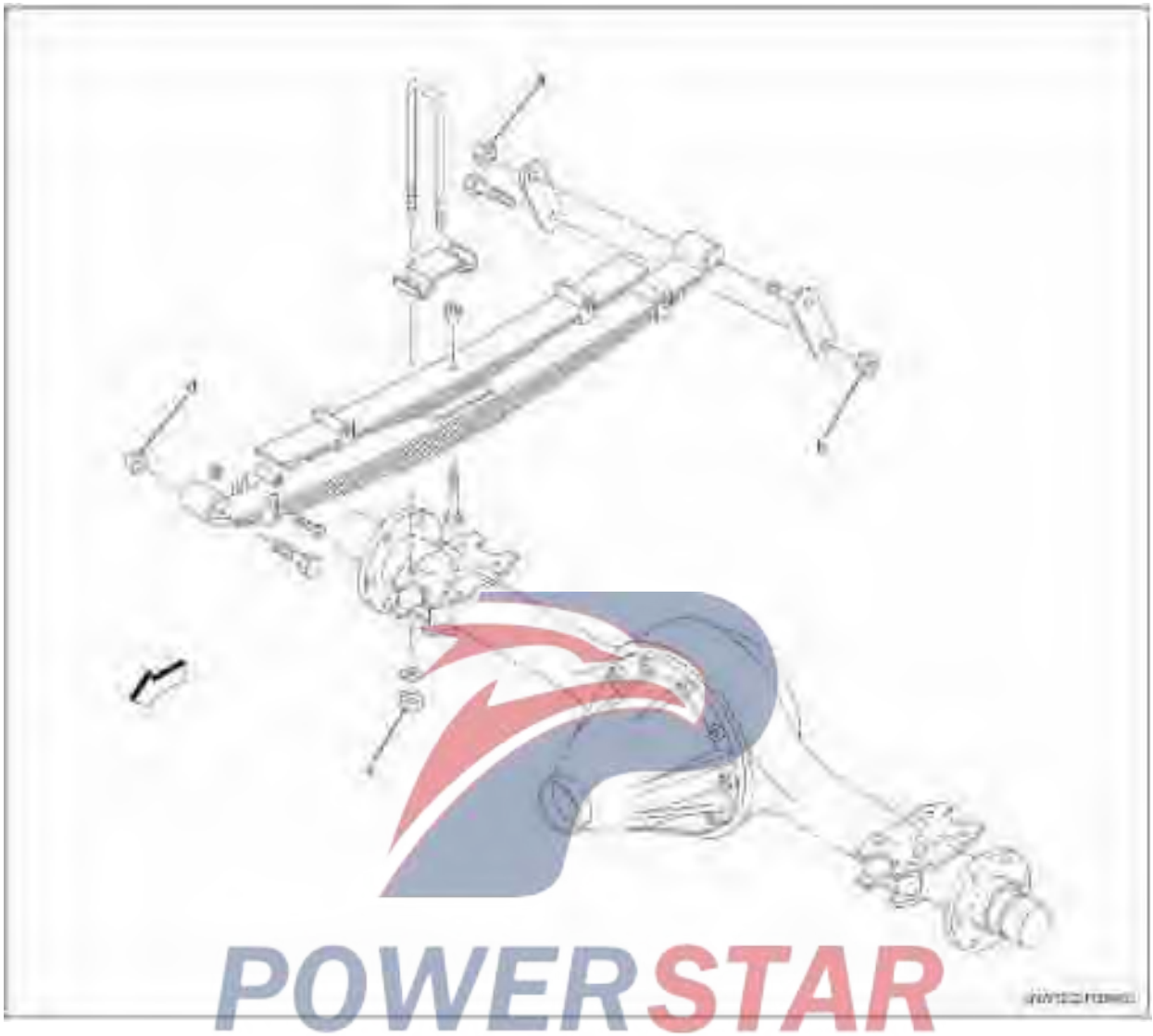
7. Install the wing nut to the specified torque.

Tightening torque

Frame ~Lifting lug =177 N • m{18.0kgf • m}

Leaf spring stock = 177 N • m {18.0kgf • m}

Tightening torque list



Key

(a) 177 N • m{ 18.0kgf • m}

(b) 177 N • m{ 18.0kgf • m}

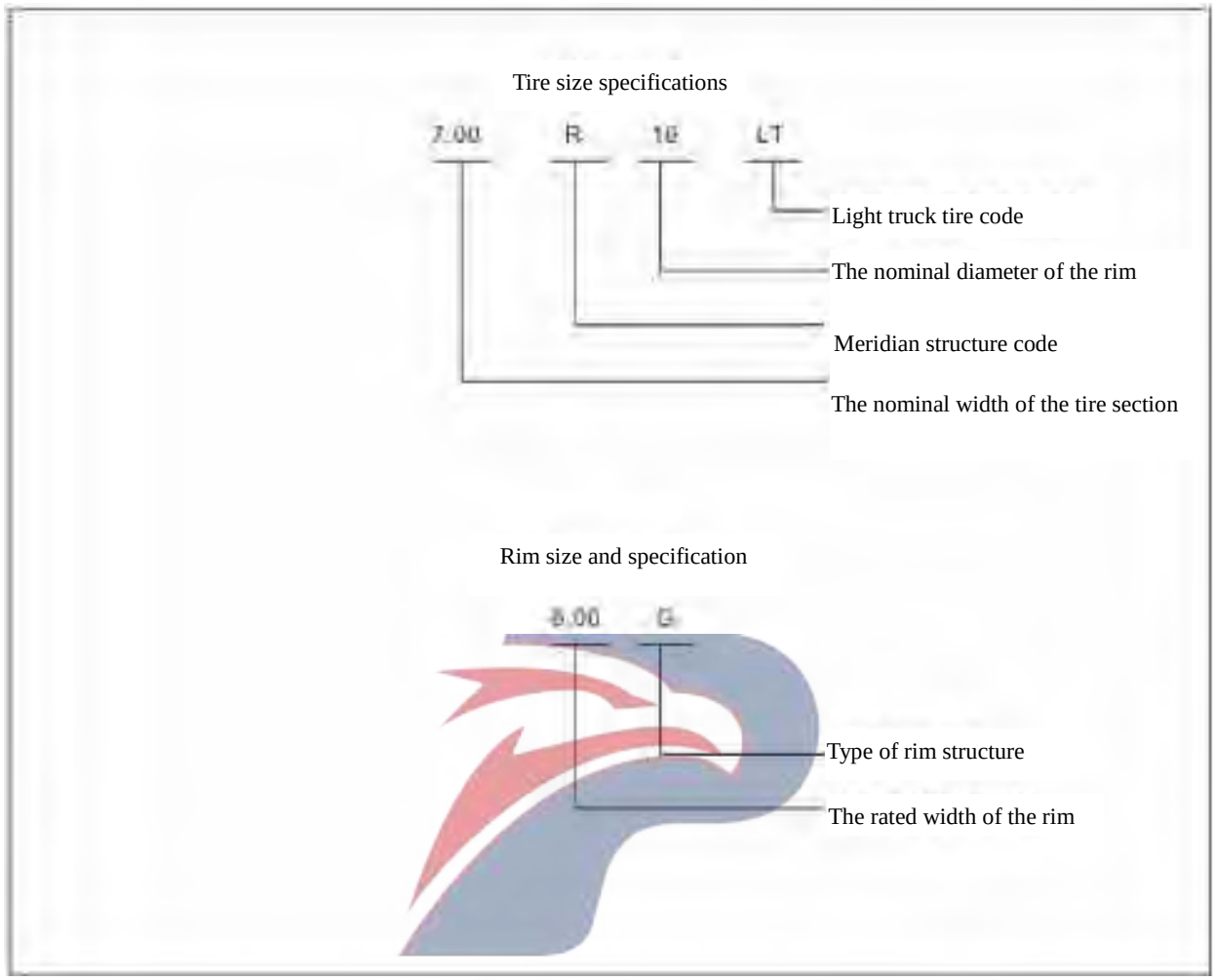
(c) 284 N • m{29.0kgf • m}

(d) 275 N • m{28.0kgf • m}

Section 2D
Wheel and tire

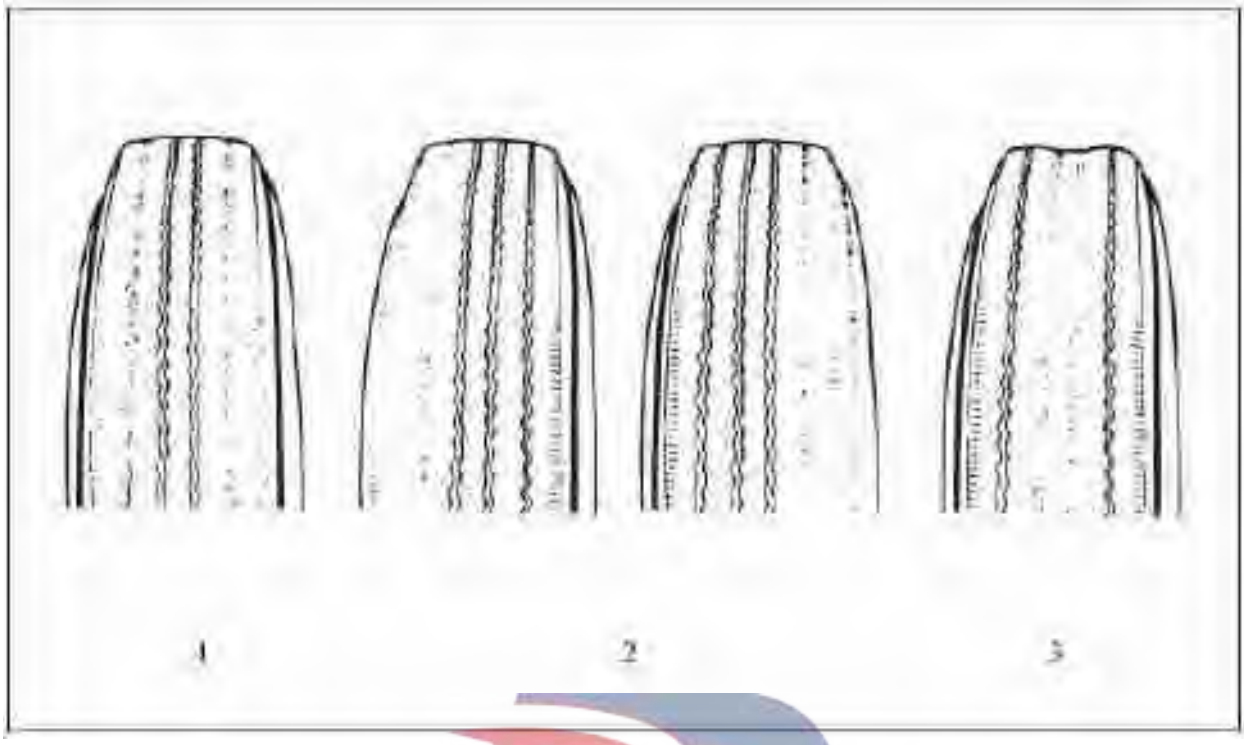
Table of Contents

Overview



Replace the wheel or tire. The new wheel or tire must have the same load capacity, specification, size and fastening mode as the original one. Inappropriate sizes and types will affect bearing life, braking performance, speedometer/odometer accuracy, ground clearance of vehicles, and the clearance of the tire with the body and chassis.

All vehicle models can be selectively fitted with metric steel belt radial tires. Correct tire pressure and driving habits have important impacts on tire life. Sharp turning, sudden acceleration and emergency braking all will result in accelerated wear and non-uniform wear of tires.



Abnormal wear of tires

1. The tire pressure is not enough, turning bright, poor wheel balance;

2. Inaccurate wheel alignment and inconsistent tire specifications

3. Tire pressure is too high, often rapid acceleration.

● There are many causes of premature wear and abnormal tire wear. If it is not a tire change, bad driving, tire positioning, etc. The main cause of premature wear is incorrect air pressure.

Caution:

Early abnormal wear of the crown portion of the radial tire is related to low tire pressure and loosening of the wheel nut. Wear and tire pressure are low and the wheel nut is not tight.

Tire transposition

● In order to balance tire wear and extend tire life, tires are used approximately 5000 KM and the following conditions must be changed.

- Inconsistent wear on front and rear tires.

- Inconsistent tread wear on each tire.

- Inconsistent wear of the front left and right front wheels.

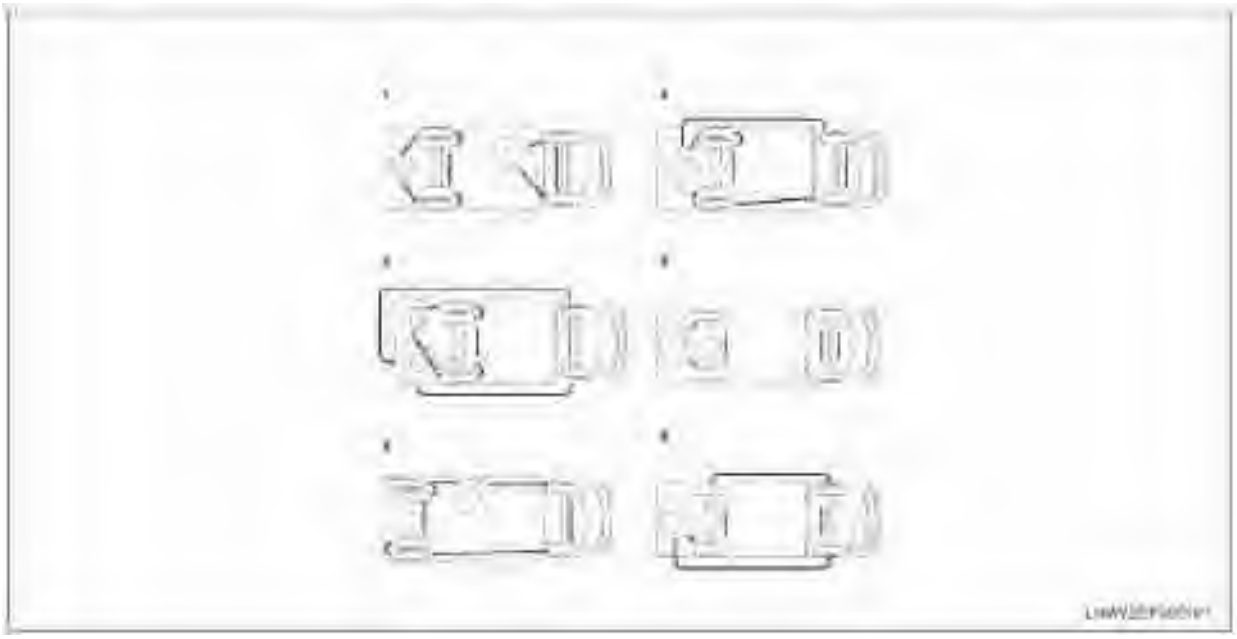
- Inconsistent wear of the front left and right rear wheels.

- Feather-like cracks on the front tires, tread edges or tire treads are considered to be scratches.

- Incorrect wear of tire components.

Mark:

After transposition of the tire, the mileage of the odometer must be recorded during the transposition. If necessary, reset the odometer mileage to zero. Refer to 9E "Instrument System for Instrumentation, Cab Information" for operation.



1. Standard flatbed;;
2. Long wheelbase flatbed;
3. Spare tire horizontal crane;
4. After the tire, carry out the crane;
5. After a single tire car;
6. After a single tire car;

Tire tread wear mark

● On the tire, there is evidence of tread wear indicating when the tire was replaced. When the tire wear limit is reached (the tread is 1.6mm deep from the bottom of the tread), no tread strip is marked on the tread and the tire needs to be replaced.

Tire pressure

● Check the tire pressure when the car is cold (the vehicle travels for more than 3 hours or travels less than 1 mile). As the tire moves, the pressure increases by about 15%. Tire pressure signs are located on the door frame.

Caution:

If you find abnormal tires, you should first check the tire pressure, tire pressure has a great influence on the wear. Second, if the wheel alignment check shows no problem, check the wheel balance.

Fault diagnosis

Caution:

When troubleshooting tires and tires, consider the effects of steering and suspension.

● See Non-Independent Front Suspension System 2B (NKR / NPR).

● See 2B Independent Front Suspension System (NNR / NPR).

Abnormal wear and premature wear

Incorrect tire pressure, incorrect tire replacement, improper positioning, etc., may cause abnormal wear and premature wear. Tire replacement must be performed in the following situations:

● The front and rear tires are not stable;

● It does not matter which tread is unevenly worn;

● The front left and rear tires wear unevenly;

● The front left and rear tires wear unevenly;

Mark:

After transposition of the tire, the mileage of the odometer must be recorded during the transposition. If necessary, reset the odometer mileage to zero. Refer to 9E "Instrument System for Instrumentation, Cab Information" for operation.

Check wheel alignment under the following conditions:

● Inconsistent wear of the front left and right front wheels;

● Uneven wear of the front tire tread;

● Uneven wear in the middle of the tread.

Pressure greater than the specified value, the following results

● Driving is not comfortable;

● Small steering force (handle the steering wheel indicator);

● The center of the tread is easy to carry.

Pressure greater than the specified value, the following results

● The tire emits abnormal sound when turning;

● Heavy-duty steering, reduced operability;

● Uneven wear on both sides of the tread;

● Damaged sidewalls;

● Layering, layering;

● Increase in tire temperature;

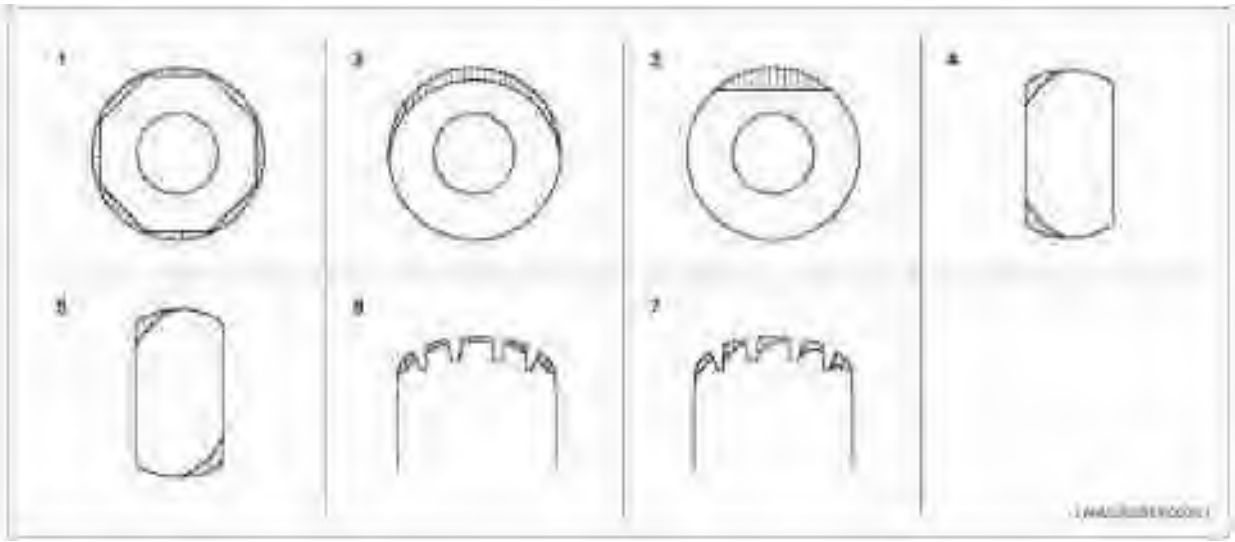
● Increase fuel consumption.

The same car tire pressure will lead to different

● Inconsistent braking force on both sides;

● The steering wheel swings.

Abnormal wear and causes of typical tires



Key number	Wear condition	Main site for wear and inspection
1	Irregular dress - worn on the shoulders. In extreme cases, the tire is polygonal.	Loss or deformation of the tire or rim. Loss or deformation of the tire or rim. Wear of wheel bearings or ball joints. Unbalanced rotating parts.
2	Unilateral lateral unilateral wear	Unbalanced rotating parts. Tires or rims other than tires. Tires or rims other than tires.
3	Tread local wear	Emergency braking and emergency starting can lead to uneven tread wear and increased local wear.
4	Shoulder correction (usually on the outer shoulder)	The camber or toe of the wheel is incorrect. Sharp turns are frequent.
5	Shoulder wear	Loss or deformation of the tire or rim. Wear of wheel bearings or ball joints.
6	Wear shoulders as soon as possible	Tire pressure is lower than the specified value or severely overloaded, resulting in excessive tire deformation.
7	Unilaterally worn edges	Sharp turns are frequent. The camber or toe of the wheel is incorrect.

Caution:

Due to the wear of the relevant parts of the suspension system, poor positioning of the wheels and tires can also result.

Meridian rotation

The wheel swing means that as the vehicle moves, the wheels swing from one side to the other because the tire's line is not straight. Wheels swing laterally, especially at low speeds, and mobility is not high at high speeds.

Check the tires in the following order:

1. Let the vehicle start to see which tires swing;

2. Replace the tire and rim assembly (the same model), if you can not determine the swing position, then start from the replacement of the rear wheel;

3. Drive again, if there is no change, replace the original

Radial deflection on radial tires

The walking deviation phenomenon refers to a direction in which the vehicle runs on a flat road and does not apply a steering force to the steering wheel, and the vehicle deviates from a straight line. The reasons are as follows:

1. Tires have quality problems;

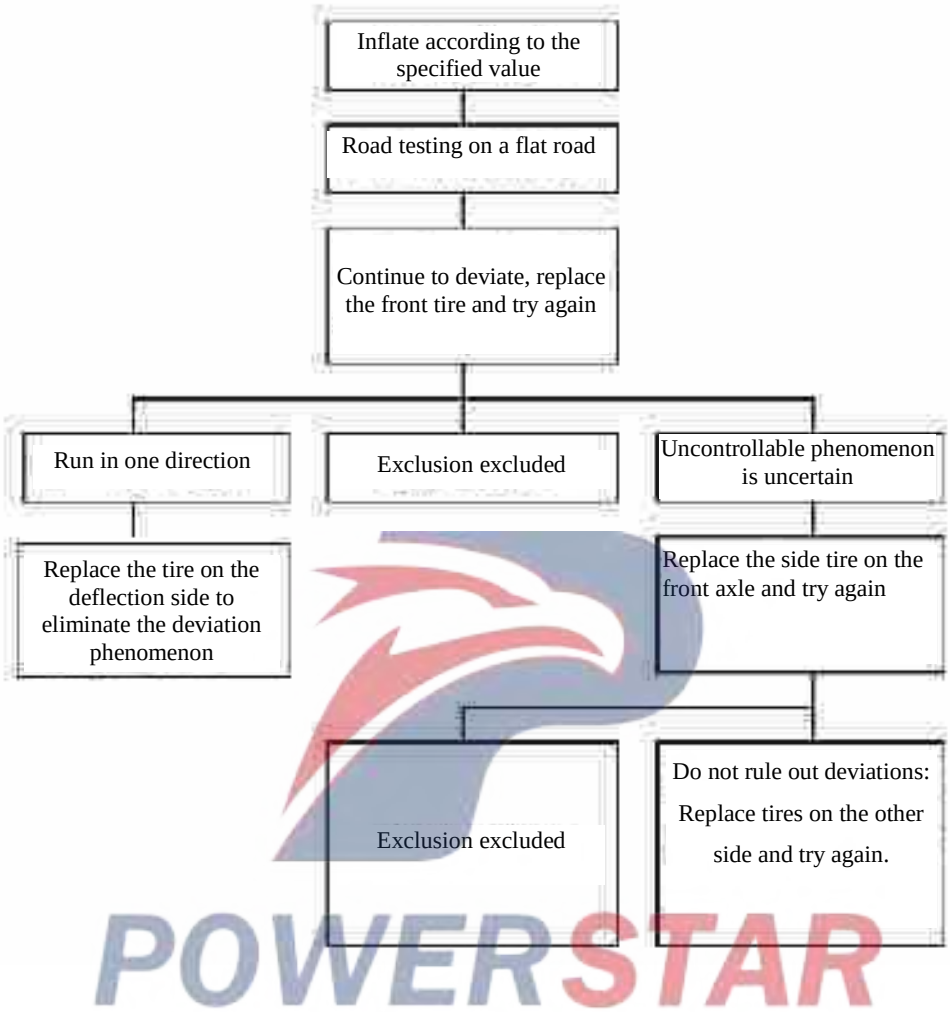
2. Uneven adjustment of the left and right brake gaps;

3. Wheel alignment is not good.

Please follow the figure below to deal with deviation phenomenon.

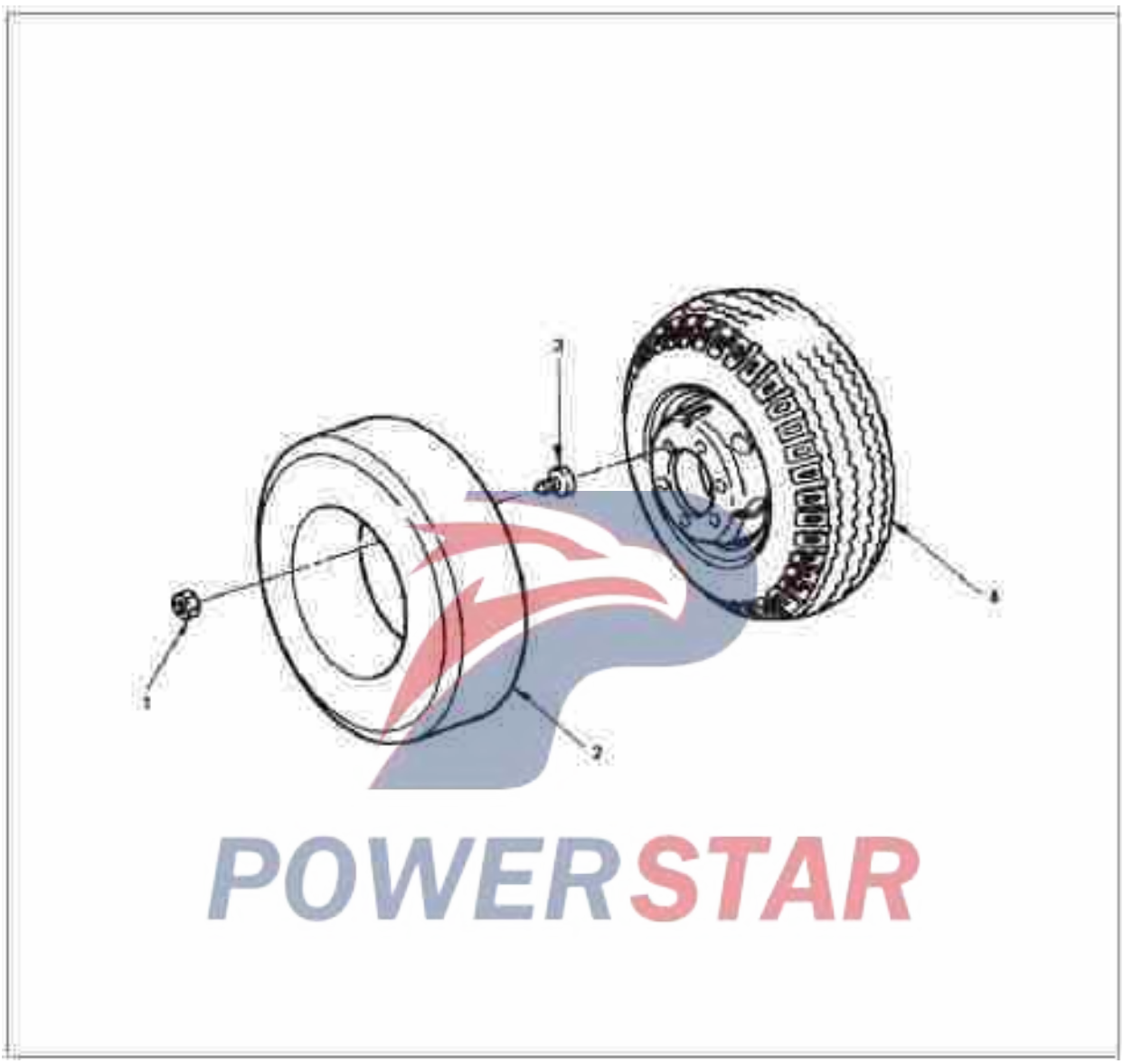
The rear wheel will not cause race deviation.

Deviation of vehicle deviation



On-board maintenance

Wheel and tire assembly

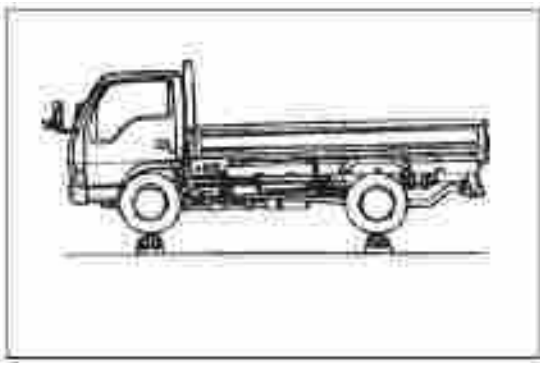


Dismantling sequence

1. Wheel nut (outer side)
2. Wheel and tire assembly(front or outer side)
3. Wheel nut (inner side)
4. Wheel and tire assembly(inner side)

Assembling sequence

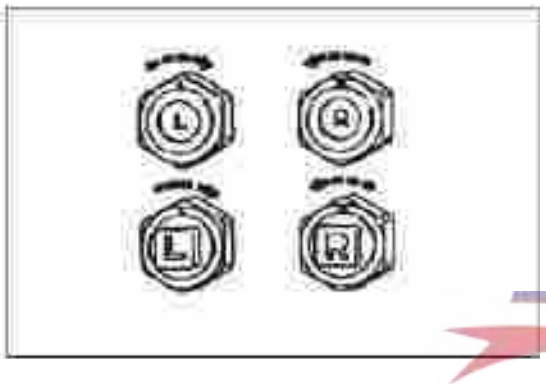
4. Wheel and tire assembly(inner side)
3. Wheel nut (inner side)
2. Wheel and tire assembly(front or outer side)
1. Wheel nut (outer side)



Dismantling sequence

Preparation work

● Raise the vehicle at the lifting point with a jack, and support the vehicle with safety support. Refer to the contents of “lifting point position” in Section O.



1. Wheel nut (outer side)

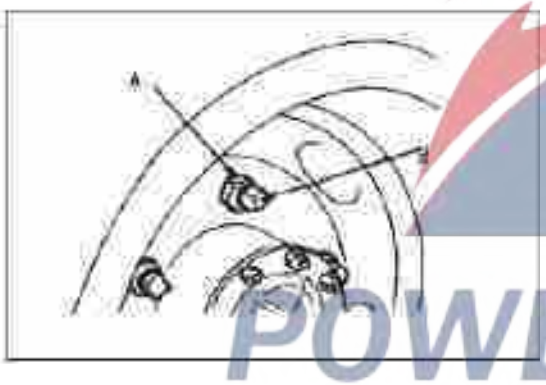
2. Wheel and tire assembly(front or outer side)

3. Wheel nut (outer side)

4. Wheel and tire assembly(inner side)

Use a wheel nut wrench to loosen the wheel nut.

The threads of the nut of the right wheel are right threads, and the threads of the nut of the left wheel are left threads.

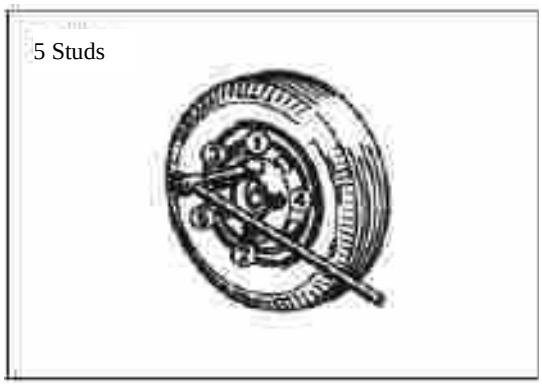


Replace the inner wheels of the rear wheels on the two sides:

1) Completely loosen the hexagonal outer wheel nut (A) with a wheel wrench.

2) Loosen the quadrangular inner wheel nut (B) by about one circle using the other end of a wheel wrench.

3) Repeat the above steps, and loosen the remaining inner and outer wheel nuts.



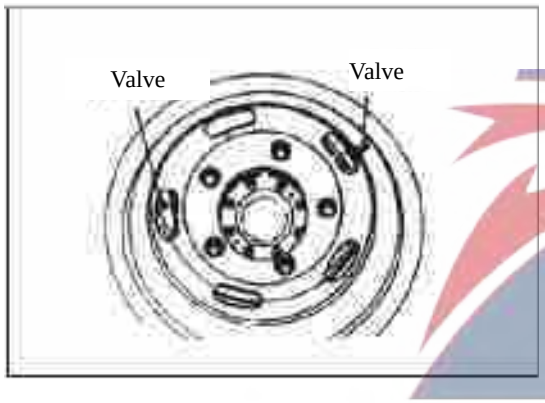
Assembling sequence

4. Wheel and tire assembly(inner side)
3. Wheel nut (inner side)
2. Wheel and tire assembly(front or outer side)
1. Wheel nut (outer side)

Tighten wheel nuts according to the number sequence.

Front wheel nut torque	N • M (kgf • M)
490(50)	

Rear wheel nut torque	N • M (kgf • M)
490(50)	



Caution:

Take care to stagger the valves of dual tires or expose the valve of the internal tire during rear wheel installation.

Single piece repair

Tires

Replace

In case of needing to replace it, ensure that its size is consistent with the original metric size. There is no strict corresponding relation between most metric tire size letters and digital codes.

It had better install new tires in pairs on the same axle. If only a tire must be replaced, its tread patterns shall be consistent with most tread patterns of the paired tire so as to obtain the same braking force.

Caution

Except in an emergency case, radial tires, ordinary bias tires and bias belted tires shall not be mixed for use, which may otherwise have a serious impact on vehicle manipulation and result in its out-of-control.

Tire dismantling

Dismantle the valve cap on the valve stem, and exhaust gas. Install or dismantle tires using tire changers. Operate according to the manufacturer’s equipment specification. Do not use only hand tools or tire levers during tire replacement, because this may damage tire beads or rims.

Tire assembling

Clear the lubricants and slight rust spots on the rim and bead seat using wire brushes or coarse steel brushes. Before installing the tire, lubricate the bead with the recommended lubricant.

Turn the wheel, and then inflate the tire to 196kPa (28psi), so that the tire bead can be completely seated. Install the valve cap onto the valve stem after inflation to the specified pressure.

Warning:

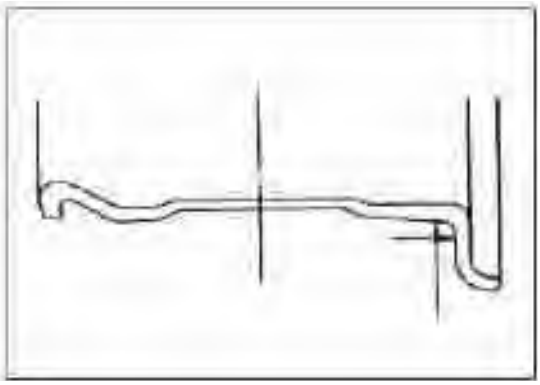
Do not stand beside tires during inflation. When the bead protrudes beyond the safe edge of the bead, the bead may break and cause serious injury. Do not exceed the specified air pressure when pumping water. If the tire bead cannot enter the tire bead seat yet after inflation to the specified air pressure, carry out deflation, and then lubricate and inflate again. Excessive inflation may lead to tire bead breakage and thus serious casualty accidents.

Tire repair

There are multiple different repair materials available on the market to repair tires. The manufacturer has issued the detailed manual for how and when to repair tires. If there is no such manual in the repair spares kit, you can ask for it from the tire manufacturer.

Wheel

Replace



If the wheel is damaged or the radial runout of the wheel is too great, replace the wheel.

Radial rotation of rim	mm (inches)
1.5(0.059) or less	

Caution

It is forbidden to repair wheels using the methods such as welding, heating and hammering. The wheel locknut shall be replaced if it has any of the following phenomena: bending, impression, too large axial or radiation run-out, gas leakage at the welding position, bolt hole elongation, failure to lock, or serious rustiness.

General balancing steps

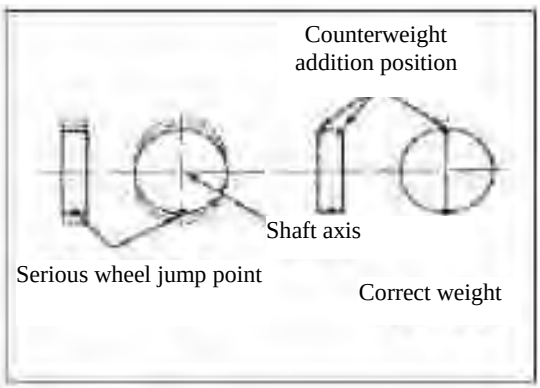
There is dirt such as slurry etc. on wheels, it shall be cleared from the inner side of rims.

Need to check the following tire conditions:

Check the matching installation paint mark; check for bending and uplifting of rims, for irregular wear of tires, and for correct tire size and inflation pressure. Then carry out balancing according to the equipment recommended by the manufacturer.

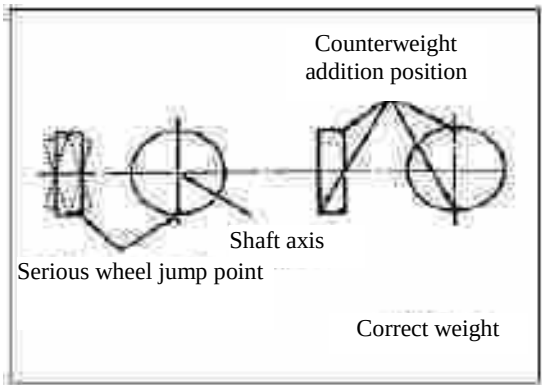
There are two balance modes of wheels and tires.

Static balance causes the weight around a wheel to be distributed uniformly.



The assembly with static unbalance will cause hopping movement, which is called jump vibration. This finally results in non-uniform wear of tires.

Balance means that the weight on both sides of the wheel axis is evenly distributed. When the wheel turns, the entire wheel will not move to one side. Dynamic imbalance components can cause oscillation.



Warning:

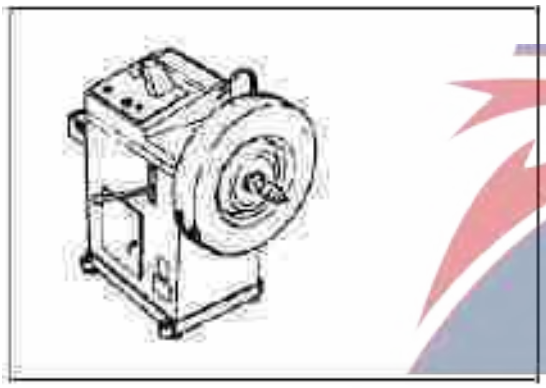
The stones in tread patterns shall be completely cleared so as to avoid personnel injury during dynamic balancing; in addition, this can obtain a good balance effect.

Balance of wheels and tires

Onboard balance

The onboard balance method is different with different equipment and tools of manufacturers.

Be sure to abide by the manufacturer's specification during balancing.



Off-the-vehicle balance

Most electronic off-the-vehicle balancing machines are more precise than on-the-vehicle rotary balancing machines. They are used conveniently and can be used to achieve dynamic balance. They are very accurate although they cannot correct the unbalance of the brake drum and brake disc (the unbalance can be solved by an on-board rotary balancing machine).

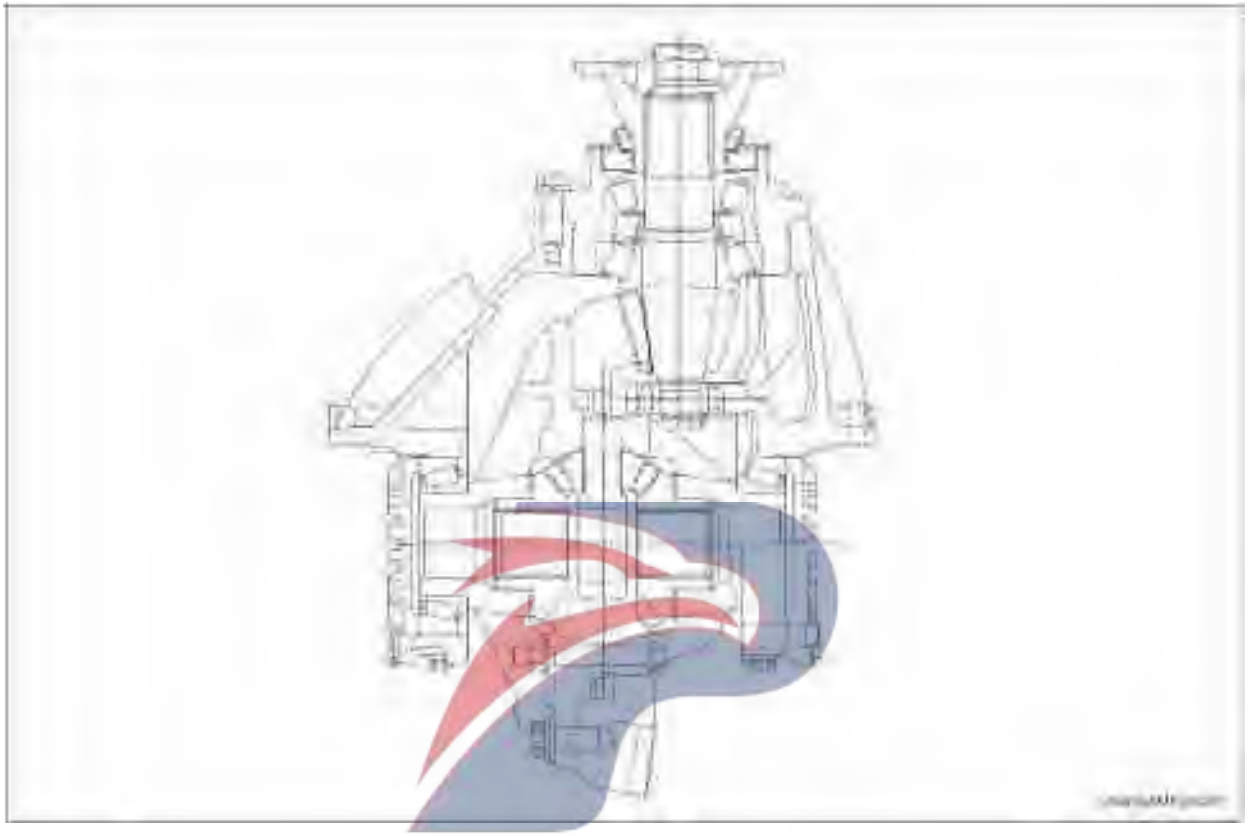
Section 3A2
Rear differential

Table of Contents

Rear differential system

Function and working principle

Main reducer assembly (ø320mm)



Main parameters

Gear transmission size (mm)	320
Gear line	Hyperboloid gear
Differential line	Four pinions
Reduction ratio	4.100 (41/10)
Amount of lubricating oil (reference value)	3.4L
Lubricant type	Gear grease GL-5 (SAE 80W-90)

Special tools

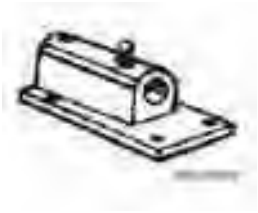
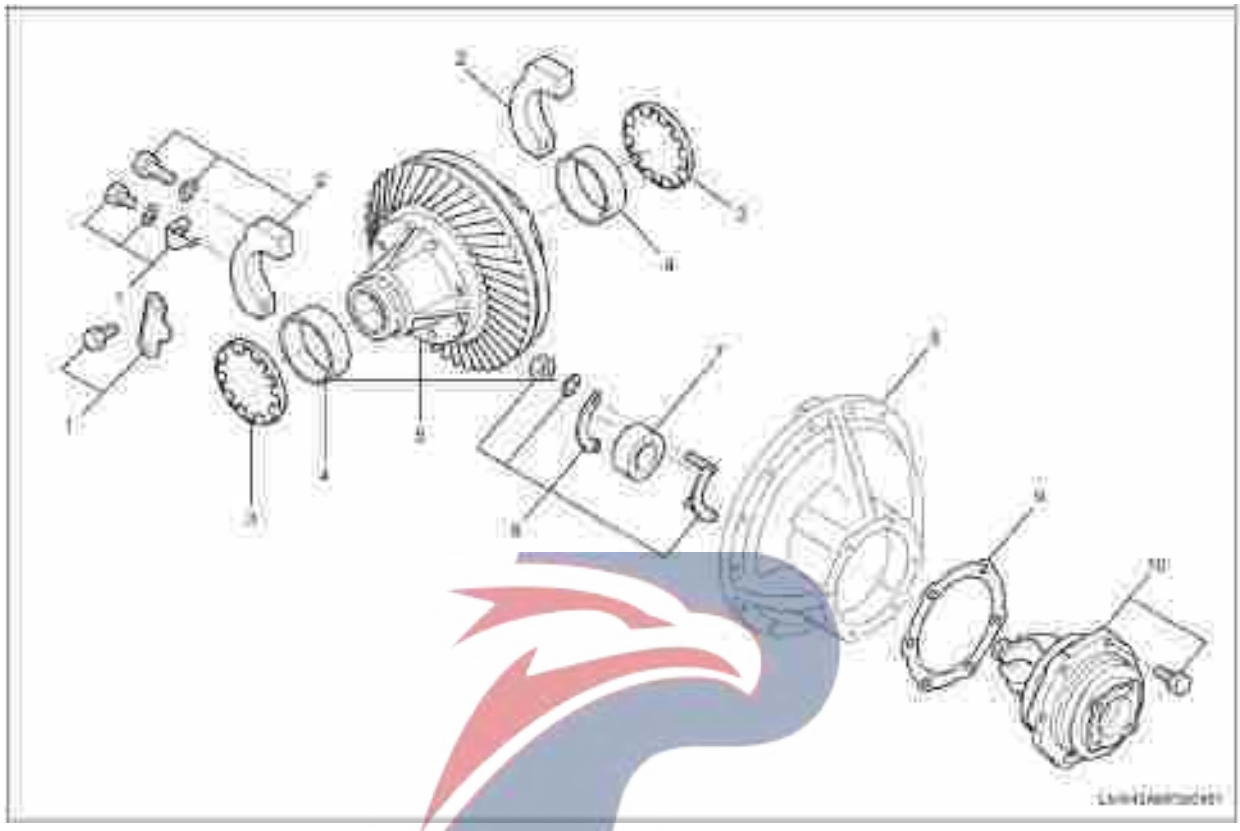
Illustration	Tool number Tool name
	5-8840-0003-0 Base
	5-8840-0007-0 Jaws
	5-8840-2030-0 Holder
	5-8840-2345-0 Bearing installer
	5-8840-2373-0 Bearing removal tool
	5-8840-2377-0 Oil seal installer

Illustration	Tool number Tool name
	5-8840-2379-0 Bearing installer
	5-8840-2830-0 Gear bolt wrench
	5-8840-2862-0 Universal support
	5-8840-2863-0 Onboard tool kit
	5-8840-2864-0 Step-by-step adapter set
	9-8521-2503-0 Bearing removal tool spindle

Illustration	Tool number Tool name
	9-8522-1607-0 Oil seal installer
	9-8522-1614-0 Bearing installer
	9-8522-1615-0 Bearing installer
	9-8529-2101-0 Flange support

Main reducer assembly (ø320mm)

Component parts



Key

1. Lock block
2. Bearing cap
3. Adjusting nut
4. End bearing outer race
5. Differential case assembly
6. Guide bearing cage
7. Guide bearing
8. Differential gear pedestal
9. Gasket
10. Driving gear housing assembly

Disassembly

1. Lift the vehicle and use the base to support the frame.

Refer to "Automotive lift points" in the OA Summary section.

2. Remove the rear wheel.

Refer to 2D wheels, wheels and tires in Tire Section.

3. Remove the oil from the differential.

4. Remove the rear driveshaft assembly.

Refer to the rear driveshaft assembly in section 3C1 Driveshaft.

5. Remove the rear axle.

Refer to the rear axle and hub in the 3C3 rear axle section.

6. Disconnect the height sensor.

● Loosen the nut and disconnect the height sensor linkage on the rod shaft bracket.

7. Remove the link support.

● Remove the link bracket from the shaft bracket.

8. Remove the shaft bracket.

● Remove the shaft bracket from the final drive.

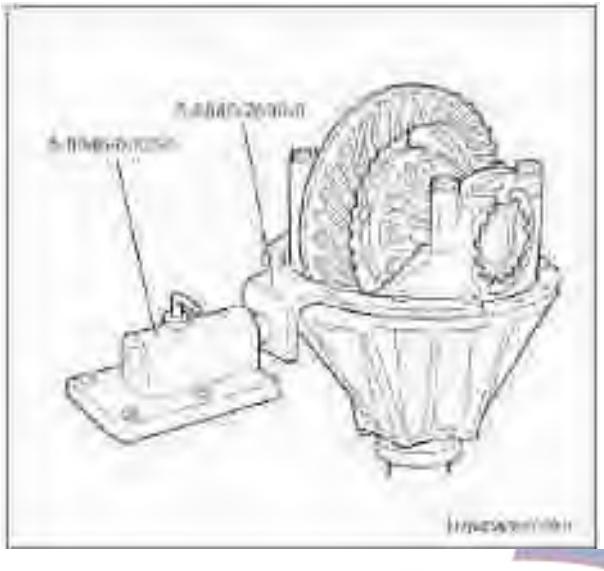
9. Remove the main gearbox assembly.

● Place the jack on the differential carrier.

Disassembling

1. Remove the moving gearbox assembly and washers.

a. Use the 5-8840-0003-0 base and the 5-8840-2030-0 holder to mount the final drive assembly on the operator station.

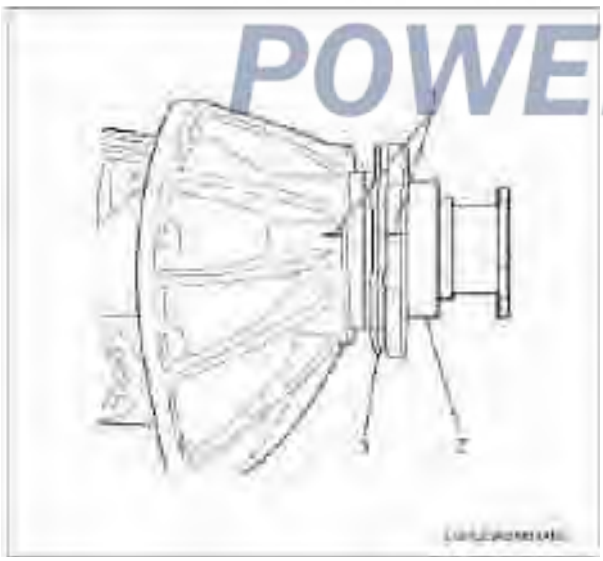


b. Mark the assembly mark (1) on the differential carrier and gearbox (2).

c. Remove the gearbox assembly and differential carrier seal (3).

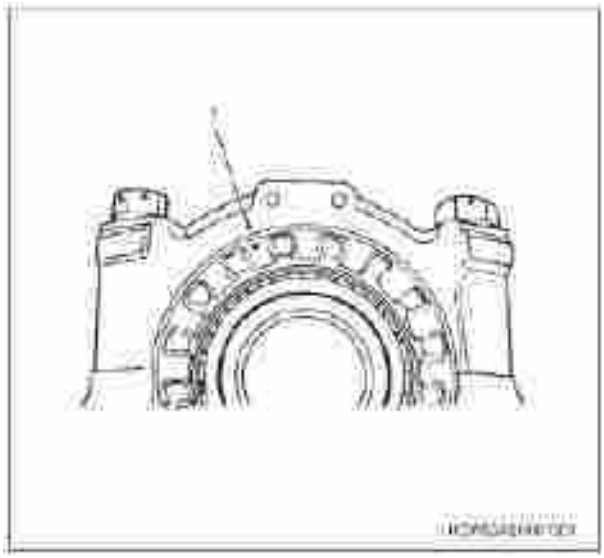
Annotation:

Several dismantled parts were removed. Be careful not to damage the seal.



2. Remove the lock block, bearing cover and adjusting nut.

a. Mark the assembly (1) on the adjusting nut and bearing cap.



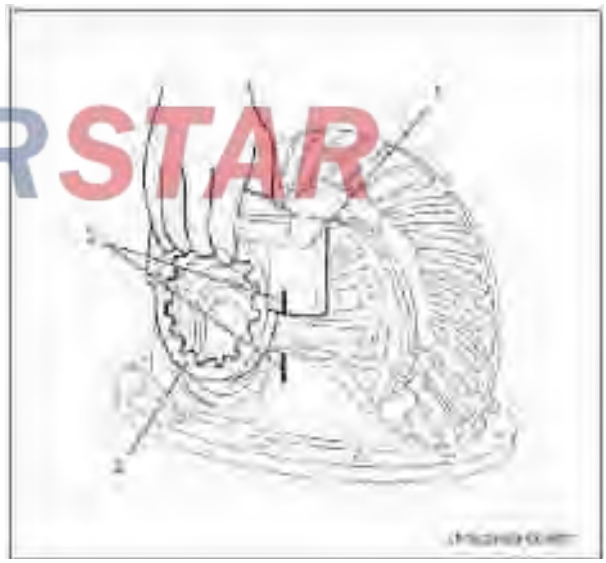
b. Mark the bearing cap and differential carrier with assembly marks.

c. Remove the lock block from the lock nut.

d. Remove the bolts on the bearing cap, remove the bearing caps and adjusting nuts.

Annotation:

In order not to confuse the left and right of the adjustment nut, mark it.



Key

1. Bearing cap
2. Adjusting nut
3. Conference sign

3. Remove the outer ring of the outer bearing.

4. Remove the differential box assembly.

Mark:

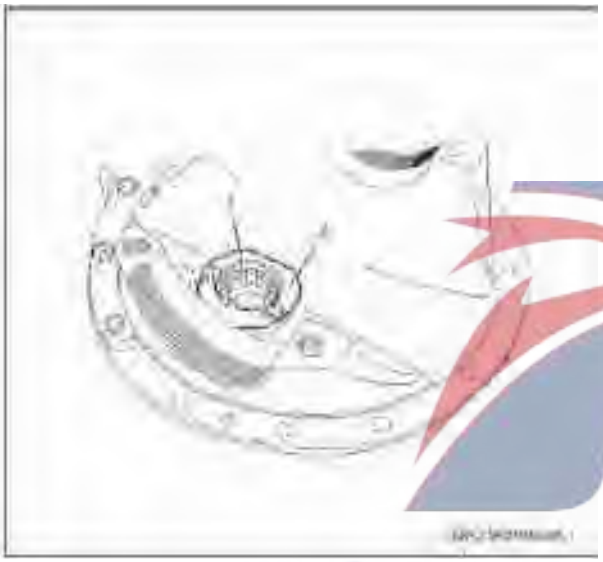
● To avoid confusion between the left and right ends of the end bearing outer ring, mark it.

● When removing the differential housing assembly from the differential carrier, be careful not to get stuck on the guide bearing retainer.

5. Remove the guide bearing and guide bearing retainer.

a. Loosen the guide nut of the guide bearing housing and remove the retainer (2).

b. Remove the guide bearing (1).



Inspection

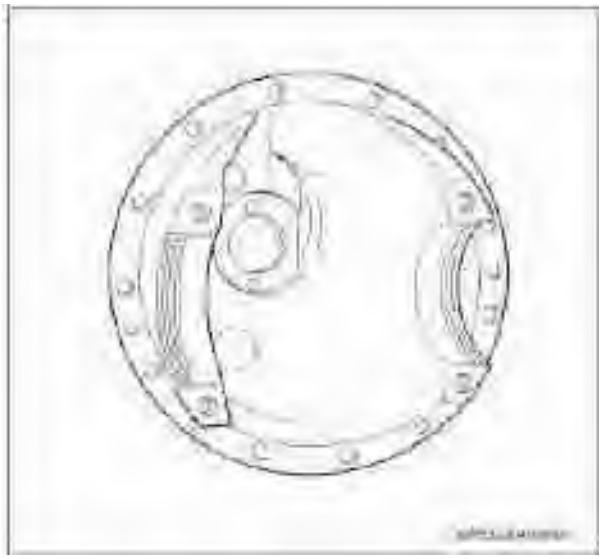
1. Check the removed parts and replace them if they are defective.

● Inspect the bearing for any flaws, crumbling, abnormal sounds, etc.

● Inspect the housing of the differential housing and the housing of the gearbox for cracks and damage.

● Inspect the cracks, end bearing mounting sections, bearing cap and differential nut threads are damaged.

● Inspect the differential bearing guide bearing inserts for cracks and damage.



Assembly

1. Install the guide bearing and guide bearing retainer.

a. Insert the guide bearing into the differential carrier.

b. Install the guide bearing housing and secure it with a retaining nut.

Tightening torque=6 N • m {0.6 kgf • m}

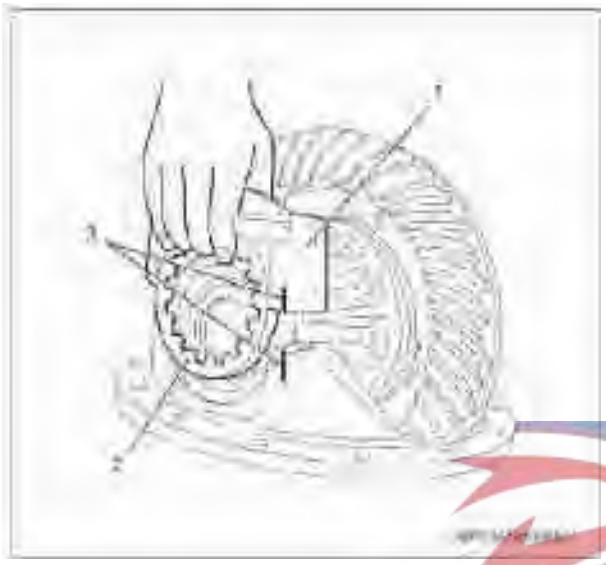
2. Install the differential housing assembly, the outer ring of the end bearing, the adjustment nut and the bearing cap.

a. First install the outer bearing of the end bearing on the differential housing assembly and then install the outer bearing on the differential carrier.

When installing the bearings, apply GL-5 gear oil (SAE 80W-90).

b. Align the mark on the adjustment nut (2) with the thread mark on the bearing cap (1) and align it with the thread mark (3) on the differential carrier before installation. Tighten the bearing cap bolts as the adjusting nut can also rotate.

Tightening torque=49 N • m {5.0 kgf • m}



Caution:

● Mount the bearing cap on the removed assembly mark.

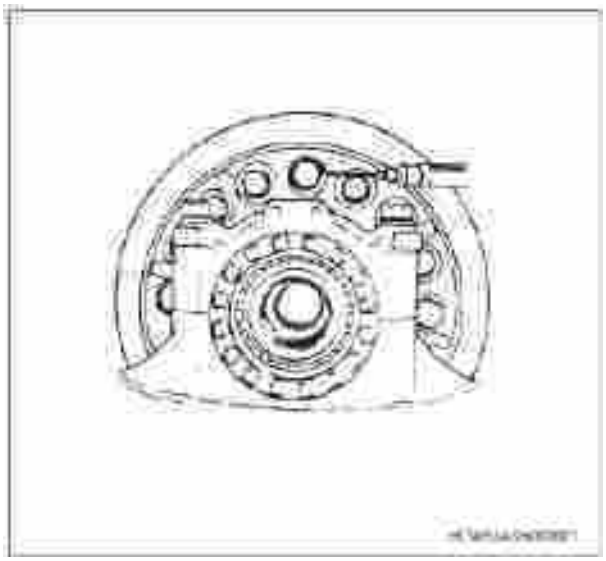
● When removing, install the adjustment nut on the assembly mark.

3. Adjust the bearing preload.

● The mounting bolt is provided in the spring balance of the head driven pinion, a key 5-8840-2862-0 universal tool (Ø292) or a tire lever (320) Ø rotary adjustment nut, thanks to what setting starts Turn to tangential force (rotary power).

End preload

NSK Bearing	
New bearing	=12～26N{1.2～2.7kgf}
Old bearing	=6～13N{0.6～1.3kgf}



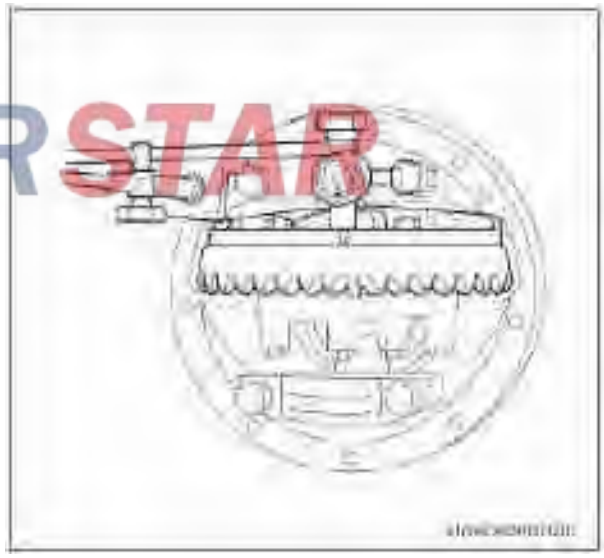
4. Measure the sail of the driven gear.

● Set the dial indicator on the rear of the driven gear and slowly rotate to measure the amount of vibration.

If the vibration exceeds the limit, replace the driven gear or differential case

Driven gear oscillation

Standard value = limit less than 0.08 mm = 0.25 mm

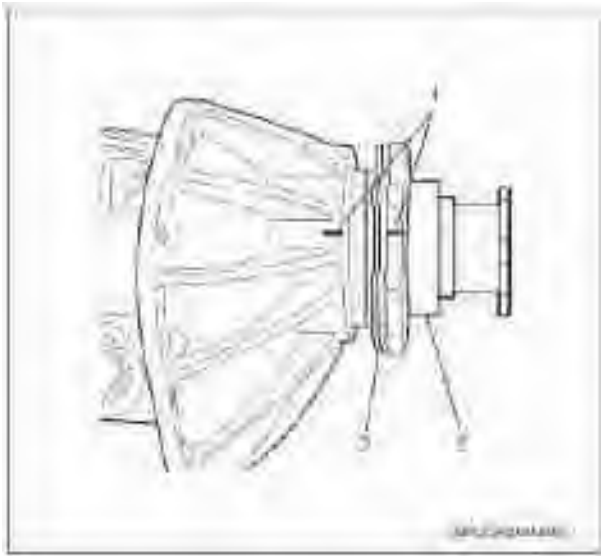


5. Install the drive sprocket box assembly and washers.

A. Assemble the drive gear assembly (2), the washer (3) and the O-ring, and install it on the differential carrier and align it with the assembly mark (1).

Seal type (thickness)

0.12mm, 0.15mm, 0.20mm, 0.25mm, 0.50mm



b. Install bolts as specified and tighten.

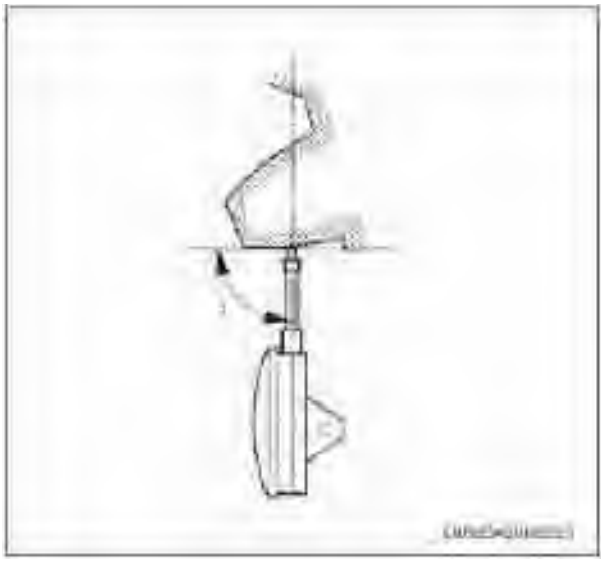
Tightening torque=72 N • m {7.3 kgf • m}

Mark:

When installing the gearbox and differential carrier, mark the assembly when disassembling or align the oil hole of the gearbox with the oil hole of the differential case.

6. Adjust the clearance of the main driven gear.

a. Install the dial gauge on the differential bearing so that the front of the watch is at right angles to the rear side of the driven gear.



Key

1. The contact point toward the normal direction.

b. Fix the pinion flange by hand and move the driven pinion slowly in the front-rear direction to measure the clearance.

Play between drive sprocket and driven sprocket

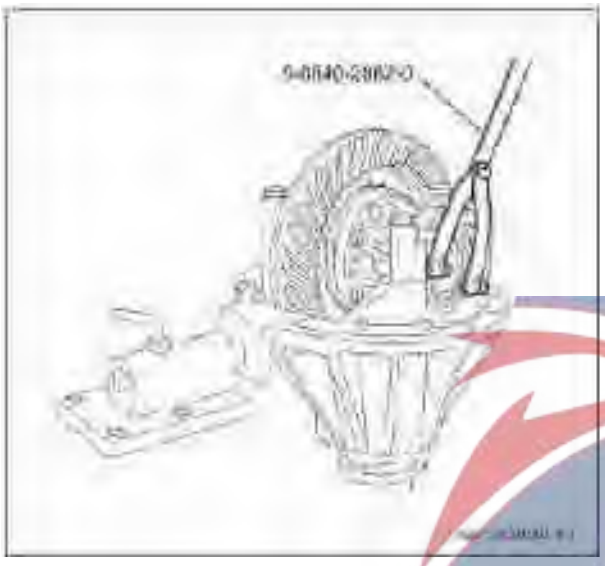
Standard value = 0.19 ~ 0.29mm

Annotation:

When measuring the game, measure 2 to 3 points on the circumference of the driven gear.

c. When the game cannot reach the standard value, a universal tool (such as a tire lever) turns the adjusting nut to adjust the position of the differential housing assembly.

At this time, in order not to change the preload of the end bearing, it is necessary to tighten the other adjusting nut when loosening the adjusting nut on one side. [Reference] The change in clearance of each groove is 0.07 mm.



d. When the clearance is insufficient, loosen the adjusting nut at the rear of the driven sprocket and tighten the adjusting nut at the tooth side.

When the game is excessive, loosen the adjusting nut on the tooth surface of the driven gear and fix the adjusting nut behind.

Mark:

At this time, in order not to change the preload of the end bearing, when loosening the adjustment nut at one end, it is necessary to tighten the same number of grooves of the adjustment nut at the other end. .

7. Check and adjust the tooth contact area of the main driven gear.

Check tooth contact between driven gear and driven gear If the gear position is incorrect, increase or decrease the number of washers on the gear box or adjust the distance between the driven gear and the gear.

a. Clean the tooth surfaces of the driven gear and the driven gear cleanly, and apply a thin layer of Dan on the tooth surfaces of the 7 to 8 teeth of the driven gear.

b. During braking, press the manual gear and turn the drive gear forward and backward.

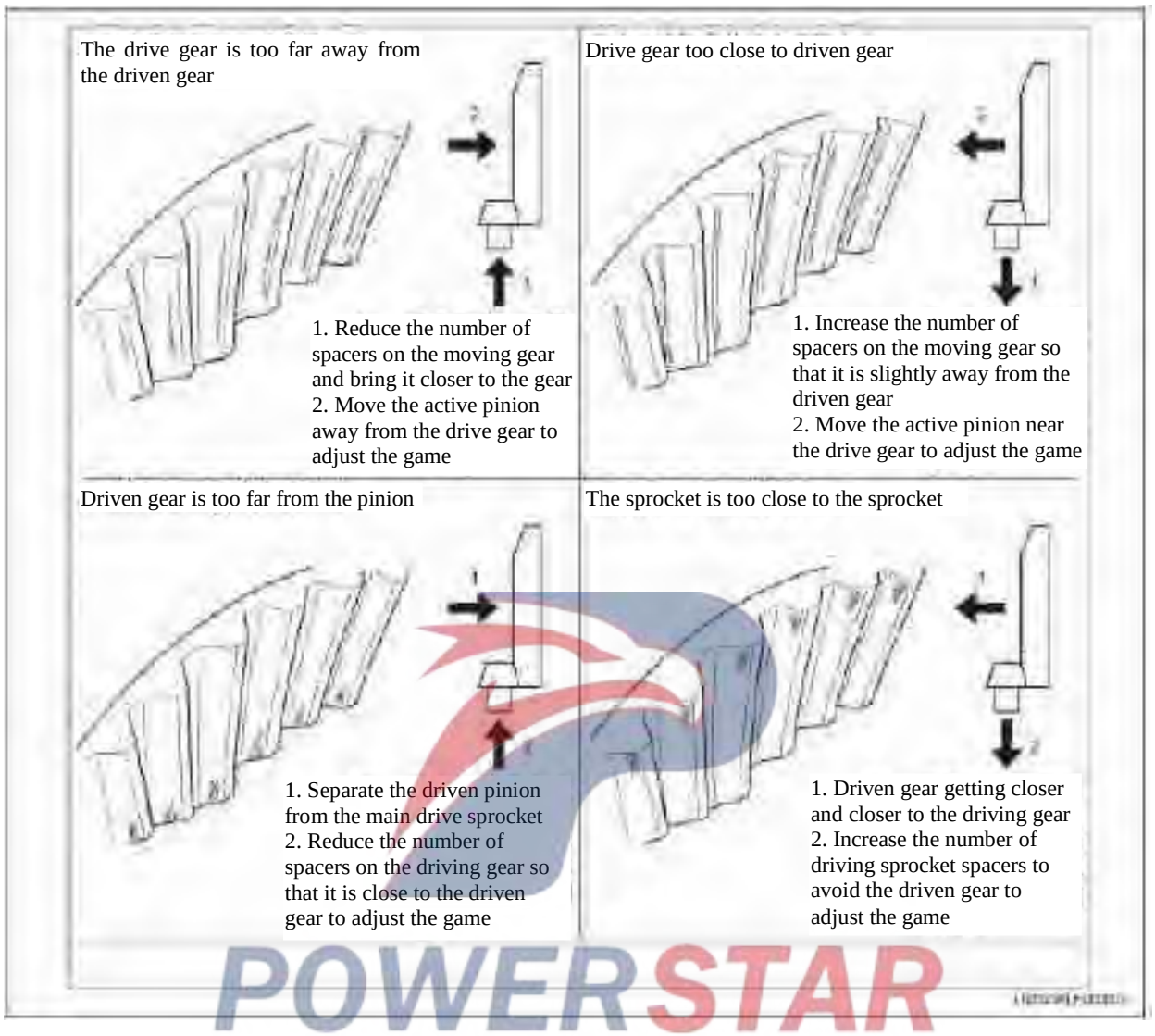
c. Check the tooth surface contact indentation of the driven gear If the impression is not normal, use the following method to adjust.

d. The correct contact of the teeth is maintained at the small (inner) end of the tip and the pinion on the large (outer) end of the bevel gear by approximately 5 mm, and the original line is approximately 70% of the gear length in contact with the teeth.

Correct dental contact

e. When the mark is abnormal, adjust the position of the driven gear (differential case assembly) and the drive sprocket assembly.

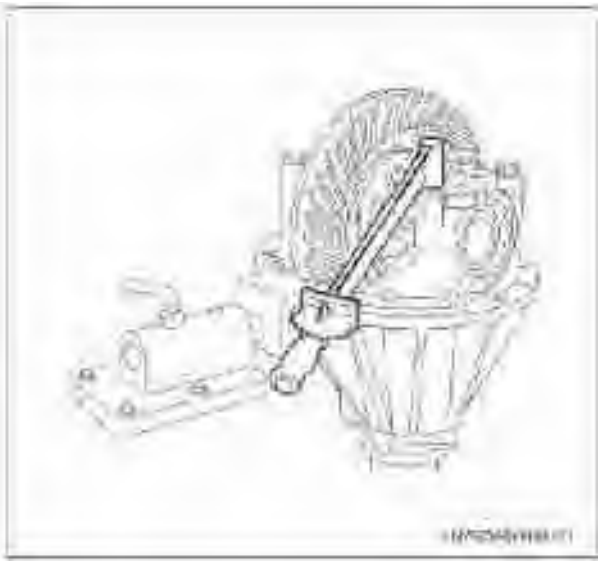
Adjust the surface contact area



8. Tighten the bearing cap bolts.

● After tightening with the specified torque, confirm the game again.

Tightening torque=157 N·m {16.0 kgf·m}



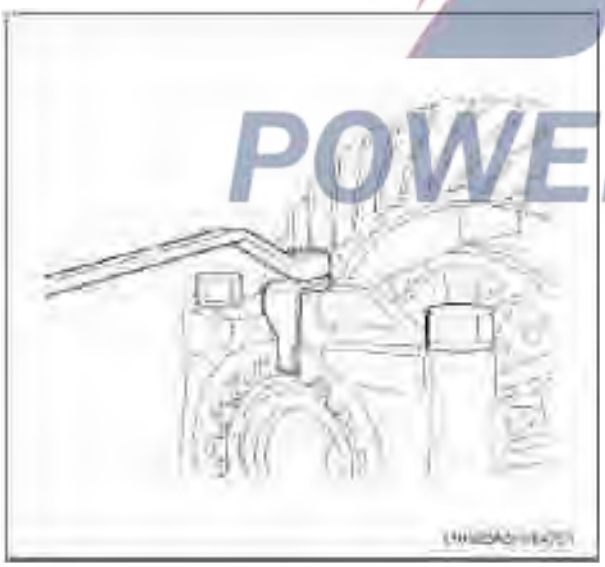
9. Install the lock block.

● Install the lock block on the bearing cap and lock the adjusting nut.

Tightening torque=13 N • m {1.3 kgf • m}

Mark:

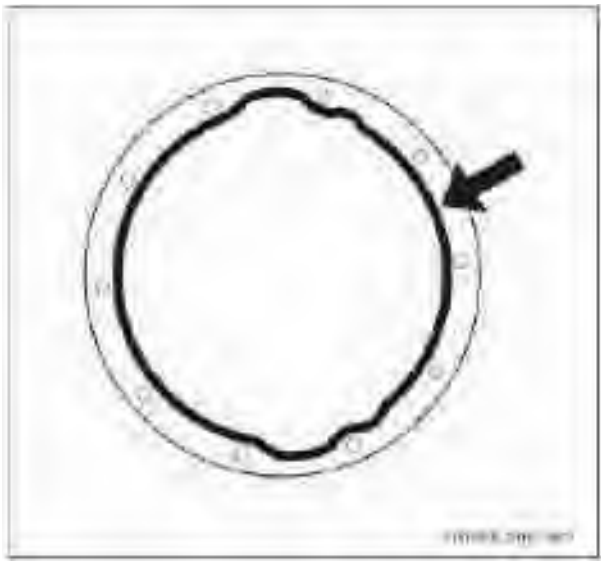
There are 2 types of lock blocks for adjusting when the nut is misaligned by 1/2 groove. Select the appropriate locking block during installation.



Installation

1. Install the main gearbox assembly.

a. Clean the mating surfaces of the axlebox and differential bearings and use the three-button TB1215 as shown.



b. Mount the final drive assembly to the axle housing and tighten the nut to the specified torque.

Tightening torque=64 N • m {6.5 kgf • m}

2. Install the axle bracket.

● Attach the shaft bracket to the final drive assembly.

Tightening torque=64 N • m {6.5 kgf • m}

3. Install the link shaft bracket.

● Attach the link bracket to the axle bracket.

Tightening torque=25 N • m {2.5 kgf • m}

4. Install the height sensor rod. (NLR / S, NMR / S fire engines, except HID vehicles)

● Attach the height sensor link to the attachment pin bracket and tighten the nut.

Tightening torque=25 N • m {2.5 kgf • m}

5. Install the rear axle.

Refer to the rear axle and hub in the 3C3 rear axle section.

6, After installing the shaft assembly.

Refer to the rear driveshaft assembly in section 3C1 Driveshaft.

7. Inject differential gear oil.

a. Firstly, install the gasket on the sleeve, then install the gasket on the drain plug.

Tightening torque=83N • m{8.5kgf • m}

a. Inject the specified amount of gear oil.

Gear lubricant brand

Gear grease GL-5 (SAE SAE80W-90)

Gear lubricant quantity [Reference value]

=3.4L

b. Install the gasket on the filler cap and install it on the axle box.

Tightening torque=83N • m{8.5kgf • m}

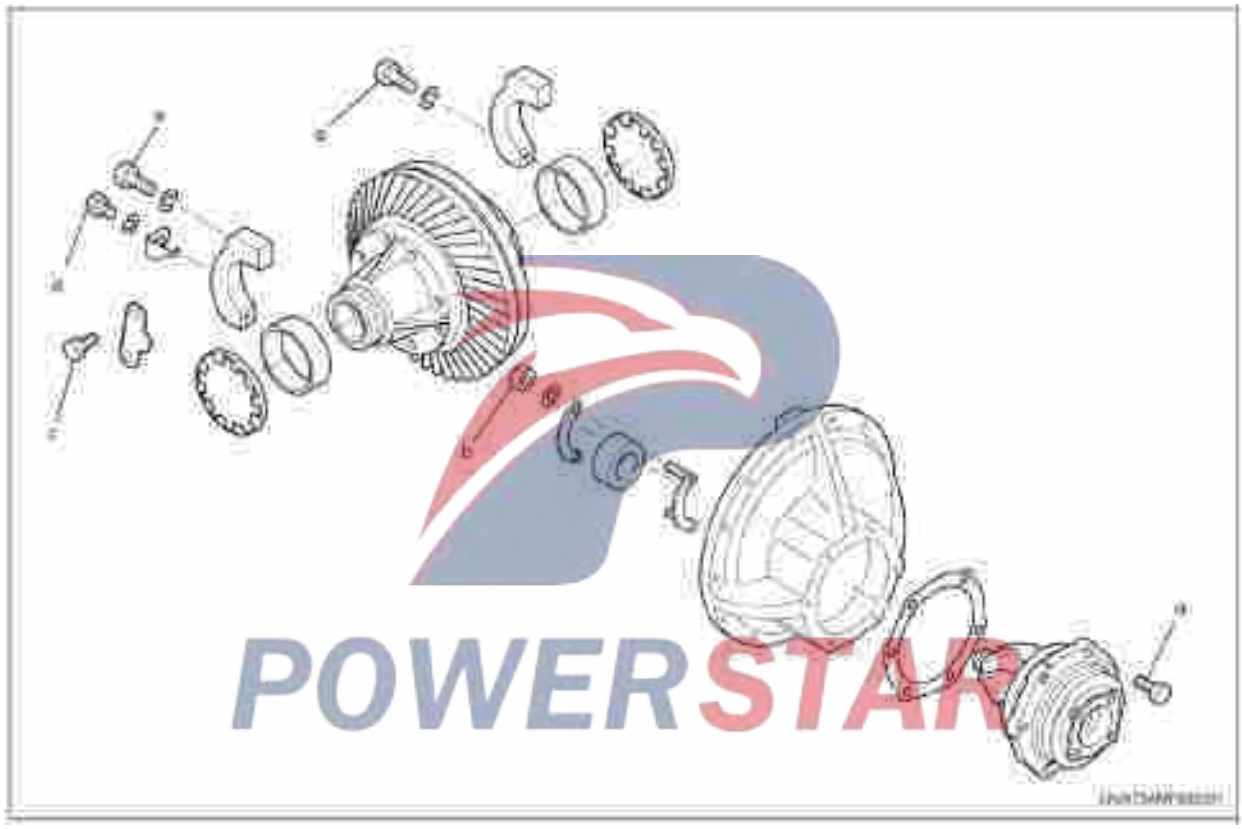
8. Install the rear wheel.

Refer to 2D wheels, wheels and tires in Tire Section.

9. After replacing the differential oil, the instrument reset data must be operated during maintenance.

Please refer to the measurement system in Section 9E Driving Information.

Tightening torque list



Key

(a) 72 N • m{7.3kgf • m}

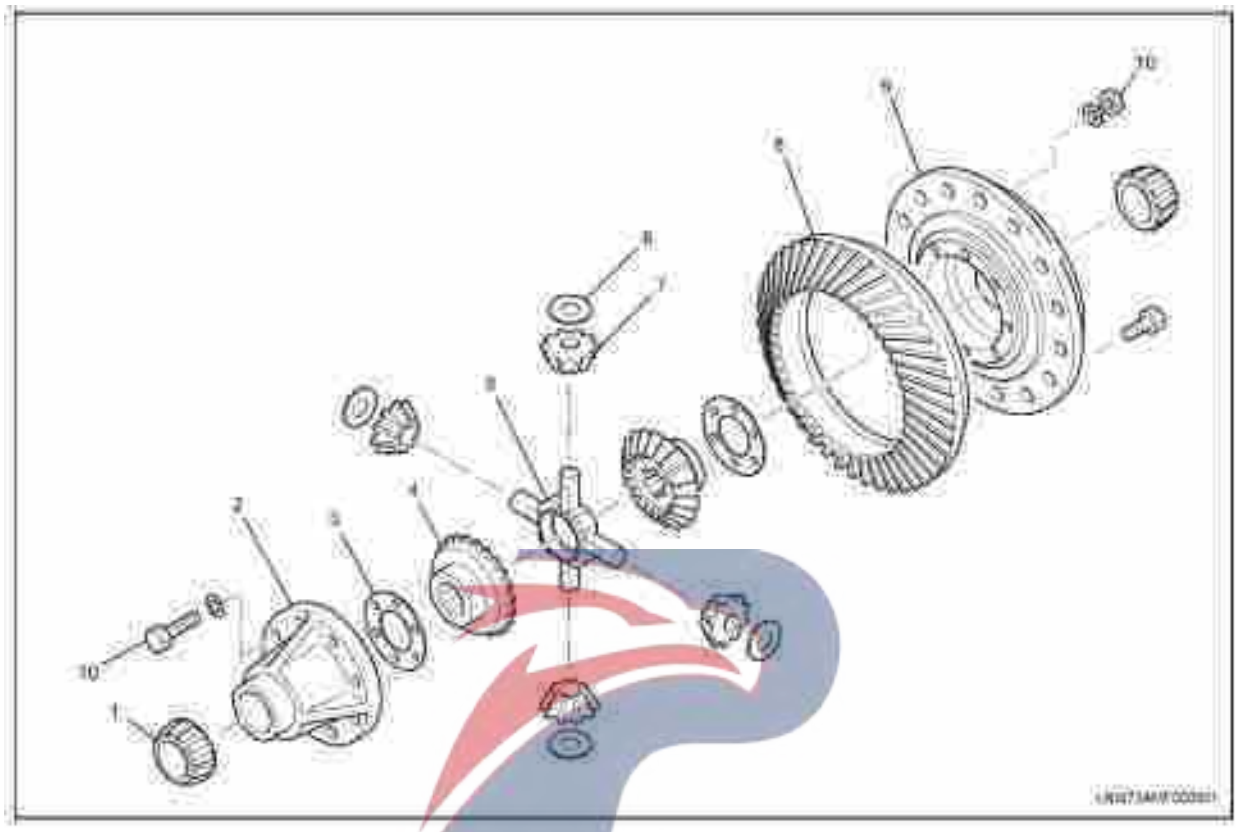
(b) 7 N • m{0.7kgf • m}

(c) 13N • m{1.3kgf • m}

(d) 157 N·m{16.0kgf • m}

Differential case assembly (Ø320mm)

Component parts



Key

1. End bearing race inner
2. Differential case B
3. Thrust washer
4. Semi-axle gear
5. Cross shaft
6. Small washing machine
7. Planetary gears
8. Driven gear
9. Differential shell A
10. U-bolt nut, washer

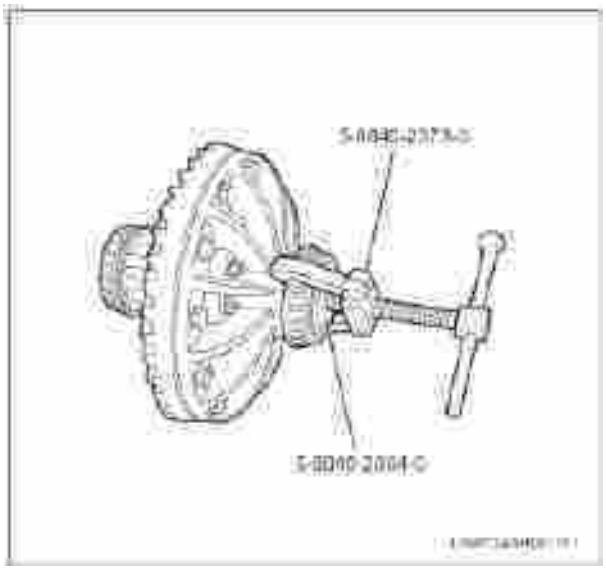
Disassembling

1. Remove the inner ring of the bearing.

● Use bearing removal tool: 5-8840-2373-0 and bearing adapter: 5-8840-2864-0 (item 8065) Remove the inner bearing ring.

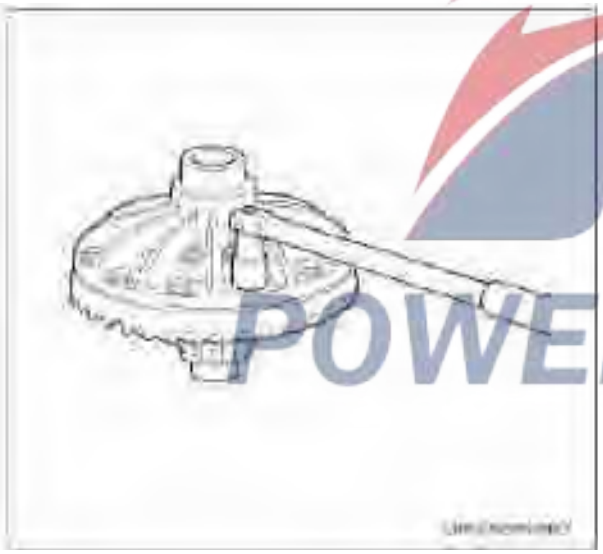
Mark:

Mark the left and right identification marks on each end bearing inner ring.



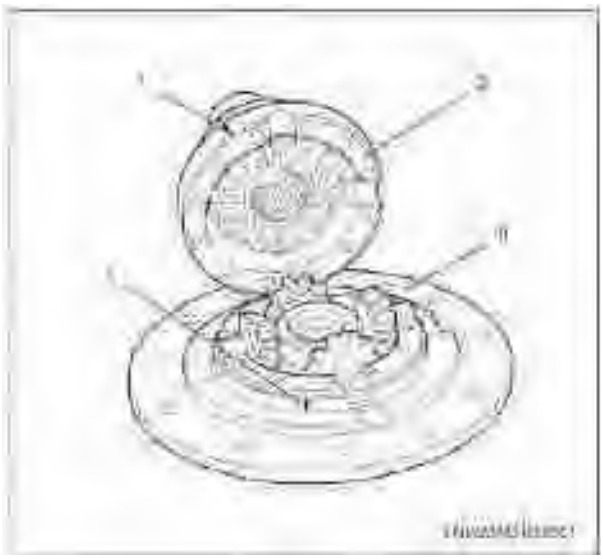
2. Remove the driven gear from the differential box A.

● Use a driven gear screw wrench: 5-8840-2830-0 Remove the set screw from the drive gear.



3. Remove the differential case B.

a. Remove the component mark (1) on the differential case A (3) and B (2).

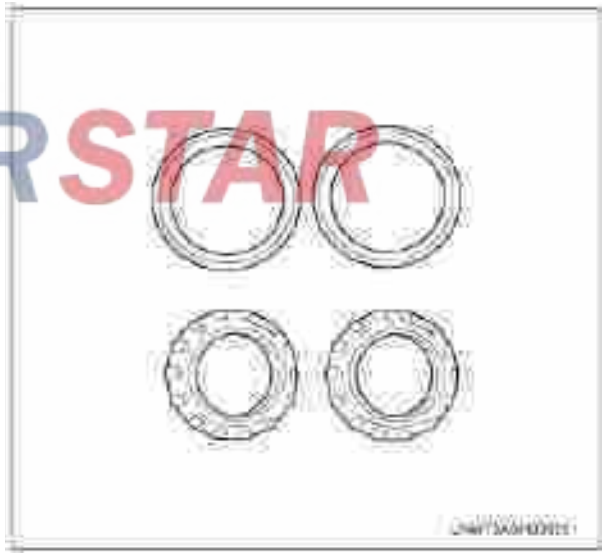


4. Remove shaft gear, thrust washer, sun gear, sprocket washer and differential shaft from differential housing A.

Inspection

1. Check the decomposition of different parts, replace defective products.

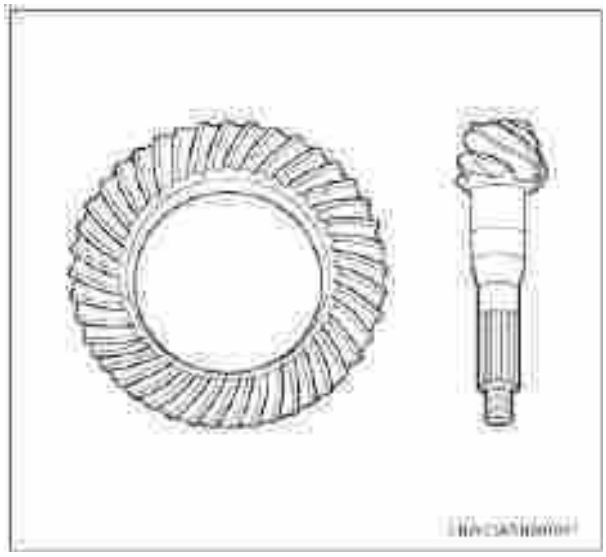
● Check the bearing for signs of jamming, falling off, and abnormal noise.



● Inspect the driven gear and inspect the gear contact surfaces (advance and retraction surfaces) for defects, cracks, spalling, worms, and tooth contact.

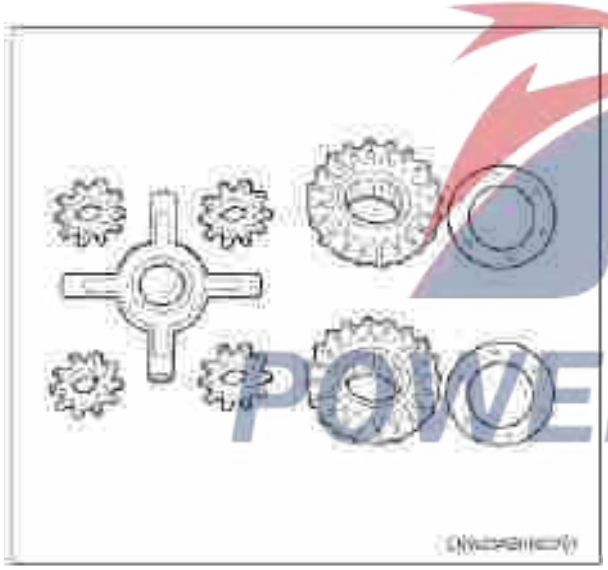
Caution:

Whether it is a driven gear or a faulty gear, it must be replaced as a whole.



● Check planet gears, side gears and cross shafts for wear, damage and looseness.

● Check the thrust washers for wear and damage.

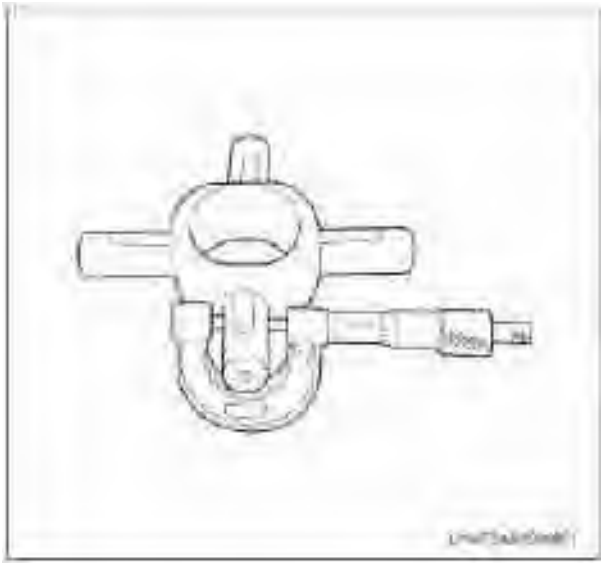


● Measure the game between satellites and spiders.

When the game exceeds the limit, replace the planet gear or spider.

Planetary gear and cross shaft play

Standard value = 0.05 ~ 0.13mm limit = 0.2mm

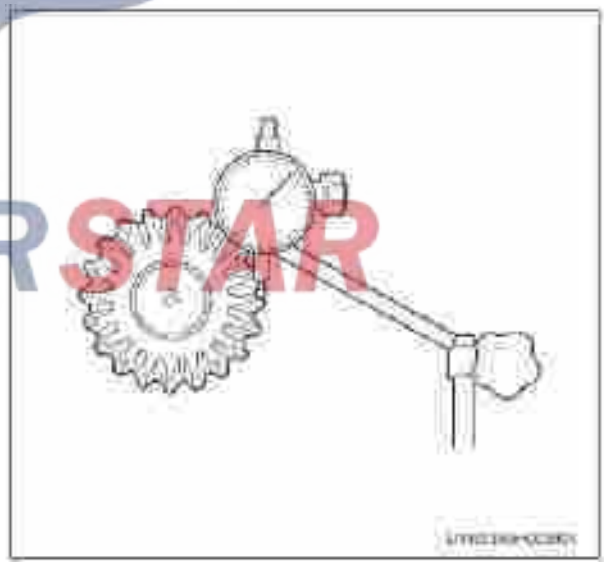


● Insert the gear into the slotted part of the axle and measure the clearance in the direction of rotation.

Replace shaft gear or shaft when clearance exceeds limit

Rotational direction gap

Standard value = limit = 0.5mm

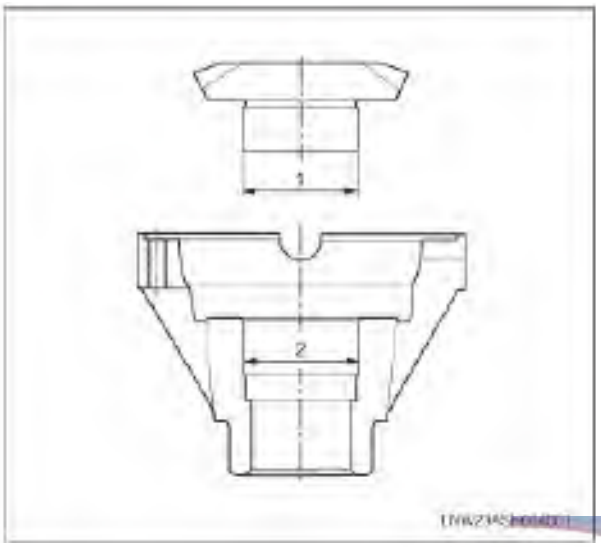


● Measure the difference between the inner diameter of the differential case and the outer diameter of the side gear.

When the clearance exceeds the limit, replace the shaft gear or differential case.

Diameter between the outside diameter of the side gear and the inner diameter of the differential bearing

Standard value = 0.13 ~ 0.20mm limit = 0.25mm



Key

1. Outside diameter of side gear

2. The inner diameter of the differential box

● Check the end bearing section, the horizontal axis mounting section, the side gear insertion section and the d section for cracks, wear, and damage. Driven gearboxes A(1) and B(2).

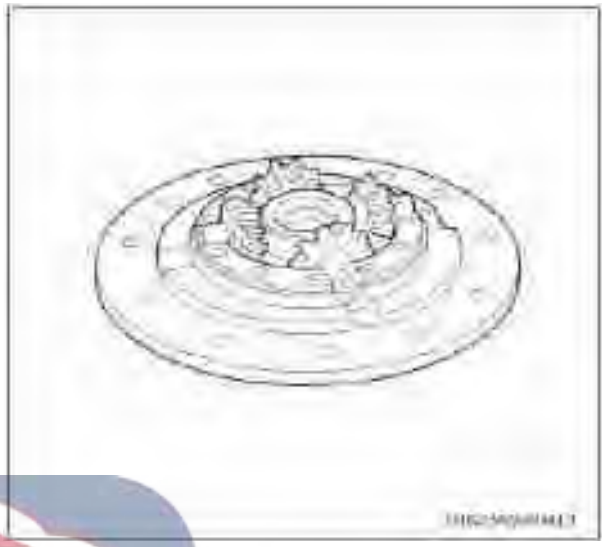
Assembly

1. Install shaft gears, thrust washers, planetary gears, gear washers and cross shafts.

a. Apply GL-5 gear lubricant (SAE 80W-90) to the cross shaft and gear.

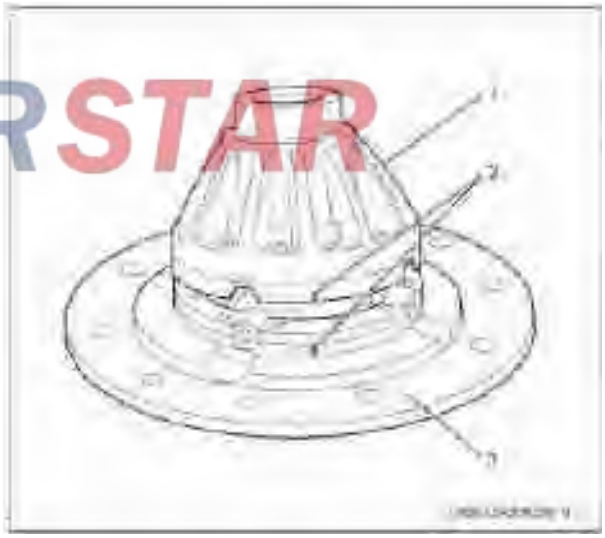
B. Insert the gear and thrust washer into the differential housing A.

C. Insert the planetary gears and pinion washers into the cross shaft, and then integrate them into the side gears on the side of the differential case A to be fed.



2. Install differential case B.

a. Insert the side gear and the thrust washer together into the differential case B side, and then assemble the assembly mark (2) of the alignment differential case A(3), B(1).



b. Screw the lubricant GL-5 gear (SAE 80W-90) on the threaded surface of the differential housing of the clamping bolt and tighten the nut with the specified torque.

Tightening torque=74 N • m {7.5 kgf • m}

3. Measure a set of side gears and planet gears.

● Insert a feeler gauge into the slot of the differential housing and measure the side gear clearance to determine the amount of clearance between the side gear and the sun gear.

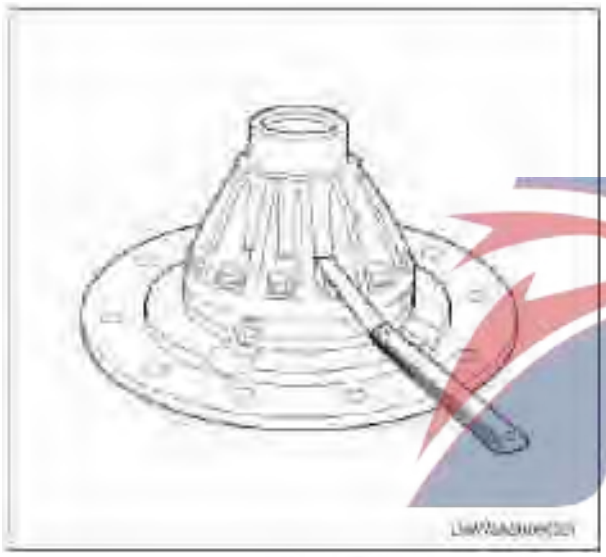
Replace thrust washers or side gears and planet gears when the clearance is significantly greater than the standard value.

Thrust washer type (thickness)

2.8mm,2.9mm,3.0mm,3.1mm,3.2mm,3.3mm,3.4mm

Side gears and planetary gear sets

Standard value = 0.15 ~ 0.20mm



4. The driven gear is mounted on the differential case A

a. Wash the threaded holes in the driven gear and mounting bolts with volatile oil.

b. The driven gear is mounted on the differential case A

c. Apply thread sealant 271 to the center of the straight part of the mounting bolt and to the threaded hole of the follower gear, and then tighten according to the specified torque.

Use driven gear bolt wrench:

5-8840-2830-0, Install the mounting bolts of the driven gear.

Caution:

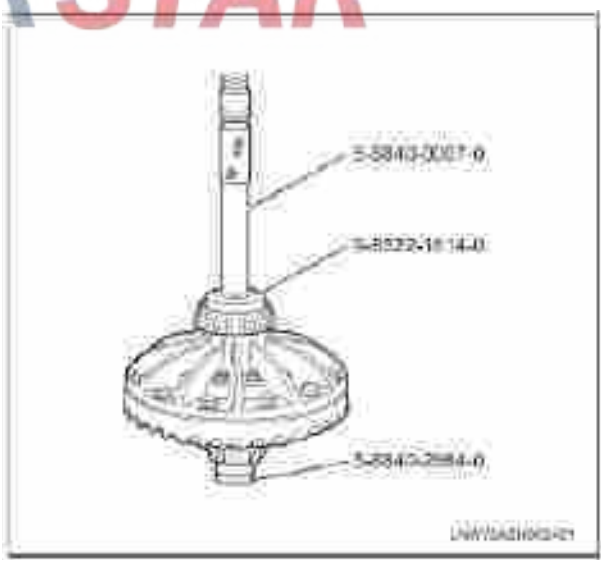
● Tighten the fixing screws diagonally evenly.

Tightening torque=333 N • m {34.0 kgf • m}

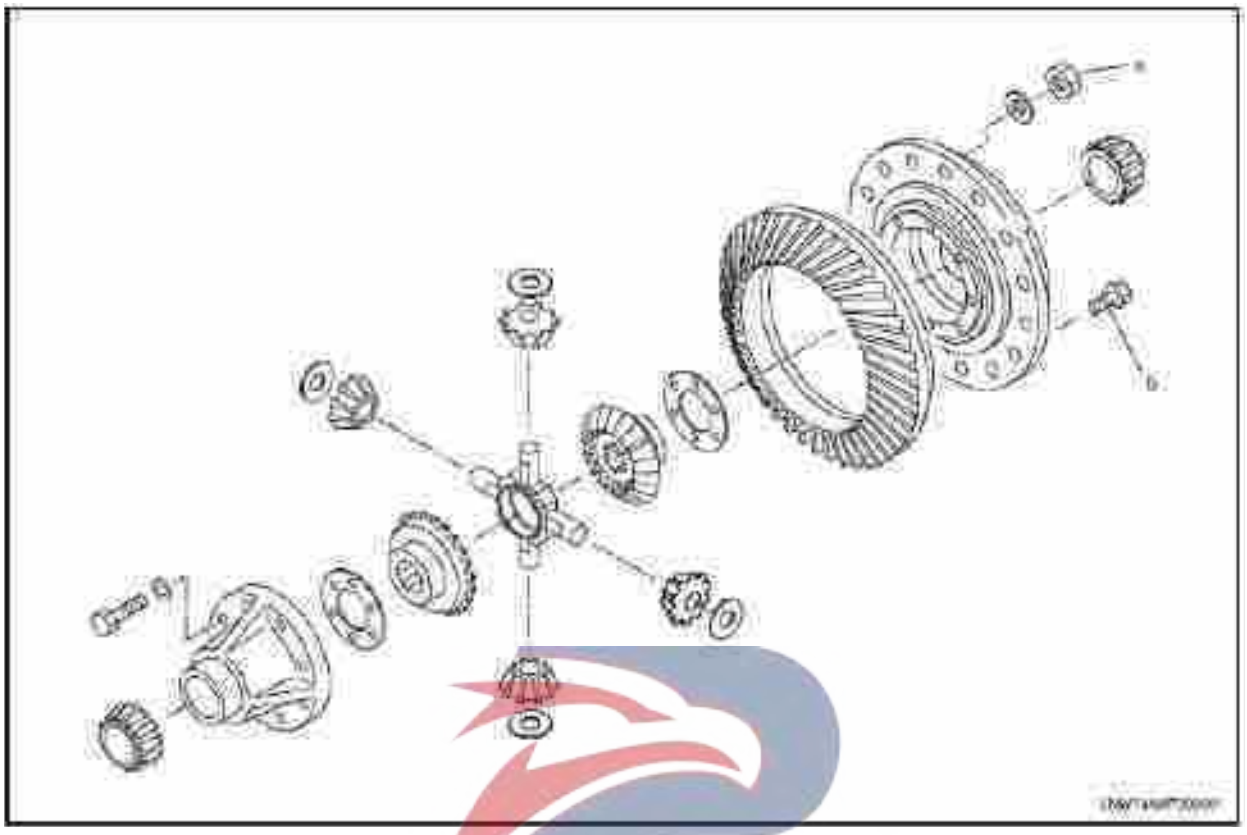
5. Install the end bearing race inner

● Use the housing: 9-8522-1614-0, clamp: 5-8840-0007-0, support plate adapter and mount in bearing inner ring (Ref. 8065). Terminate in the differential housing.

● When installing the bearing, use the bearing plate adapter (P / N 806) to support the differential housing assembly to prevent damage to the opposite bearing.



Tightening torque list



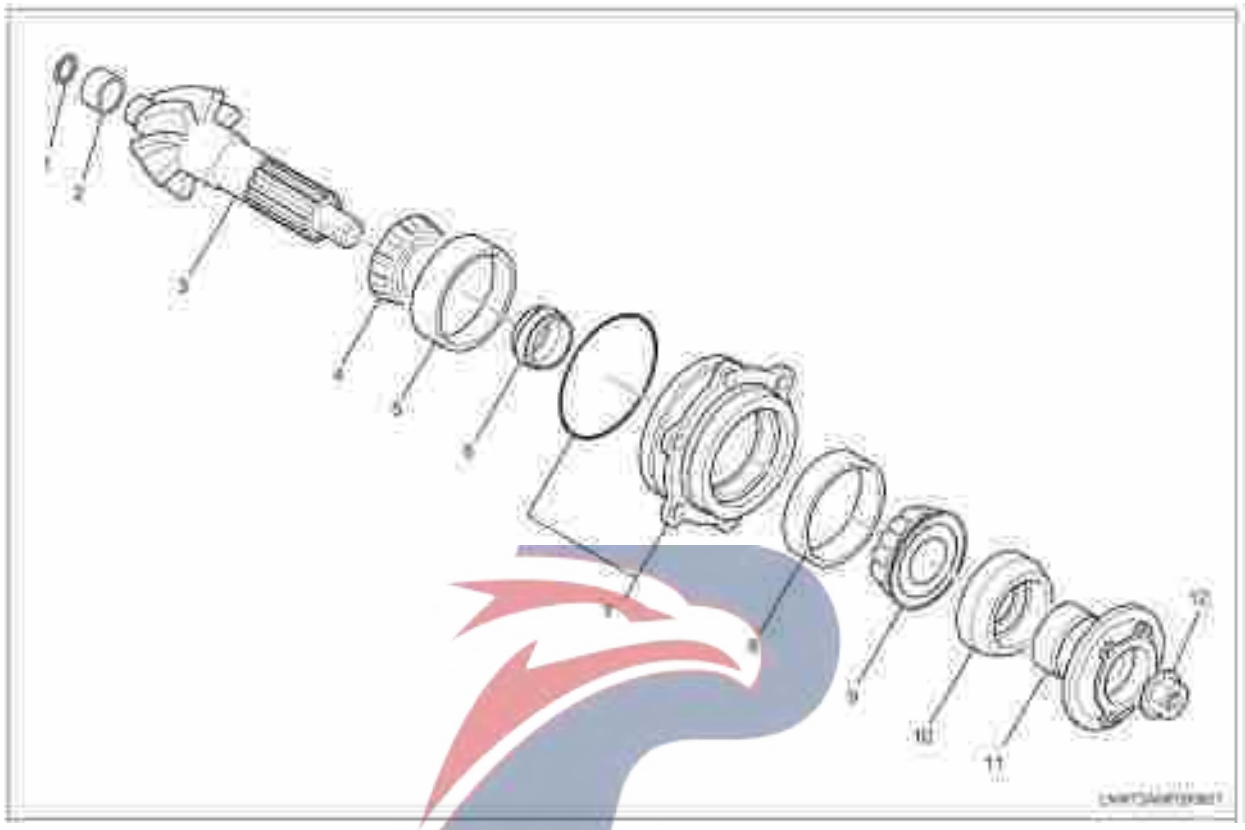
Key

(a) 74 N • m{7.5 kgf • m}

(b) 333 N • m{34.0 kgf • m}

Drive sprocket housing assembly (ø320mm)

The composition of the pieces



Key

1.Snap ring	7. Bearings and O-rings
2. Guide bearing	8. External bearing outer race
3. Driving gear	9. Outer bearing inner race
4. Inner bearing inner race	10. Oil seal device
5. Inner bearing outer race	8.Flange
6. Detachable spacer ring	12. Riveted flange nuts.

Disassembling

1. Remove the O-ring.

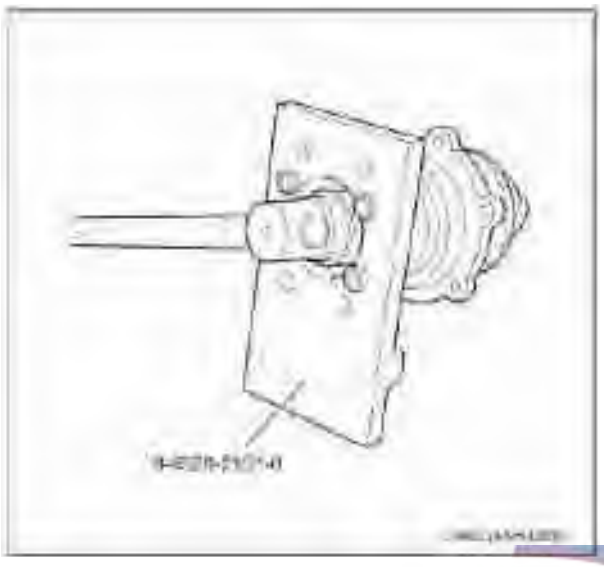
● Remove the O-ring from the gearbox.

2. Remove the flange nuts and flanges.

a. Connect the flange bracket: 9-8529-2101-0 to the vise and install the pinion flange.

b. Remove the riveted part of the flange nut completely and loosen the flange nut.

Then remove the flange nuts and flanges.

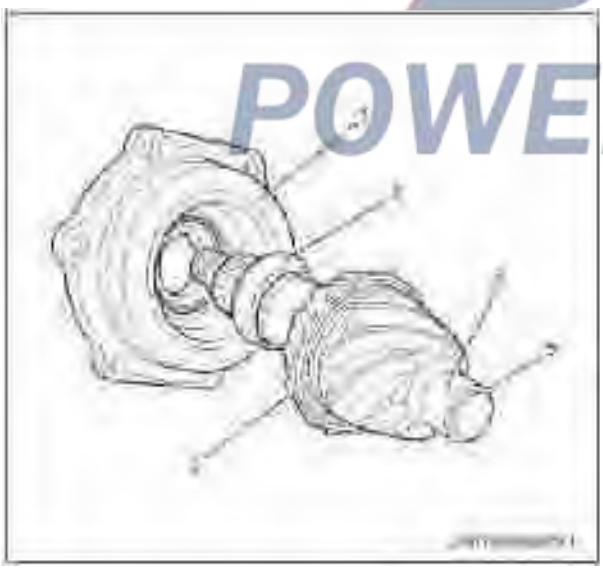


3. Remove the drive gear and removable gasket.

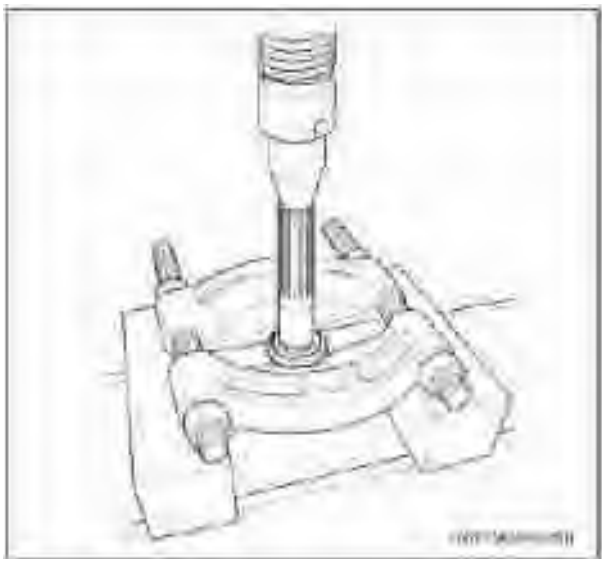
a. Remove the pinion assembly (3) from the gearbox (1).

b. Remove the removable spacer (2) from the pinion.

c. First remove the circlip (5) and then remove the guide bearing (4) from the sprocket.



4. Cut the bearing housing with a sharp chisel and remove the inner ring using a universal bearing shunt.



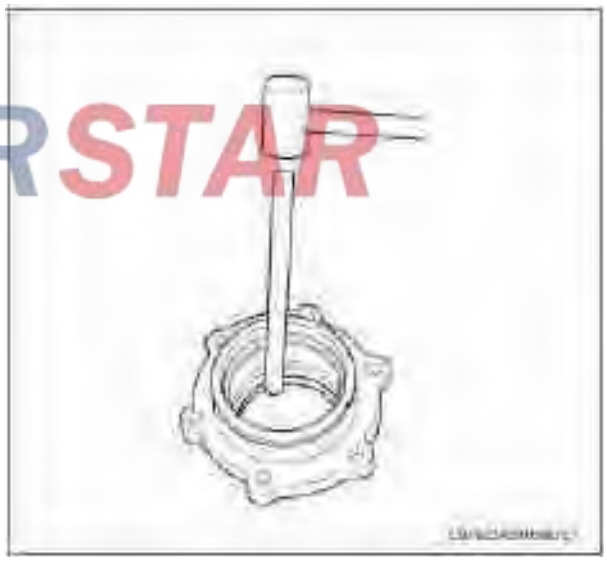
5. Remove the oil seal from the gearbox.

6. Remove the inner ring of the outer bearing from the gearbox.

7. Remove the outer ring of the inner bearing.

8. Remove the outer ring of the outer bearing.

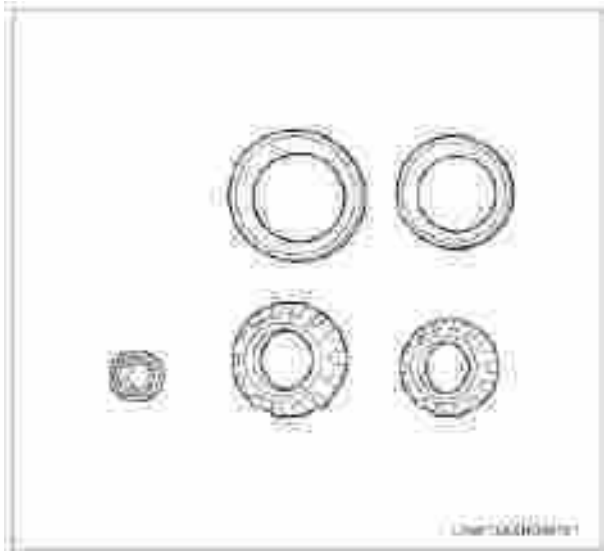
● Place the brass rod through the groove in the gear box on the outer ring of the bearing, then strike it with a hammer and remove it.



Inspection

1. Check the decomposition of different parts, replace defective products.

● Inspect the bearing for any flaws, crumbling, abnormal sounds, etc.



● Inspect bearings, oil seal fittings and gearbox flanges for cracks and damage.

● Check the flanges of the oil seal contacts, the splined parts for wear, and the flanges for cracks and damage.

● Check the splined part of the pinion and the guide bearing insert for cracks, damage, deformation and wear.

Caution:

Regardless of the driven gear and the faulty drive gear, it must be replaced as a whole.

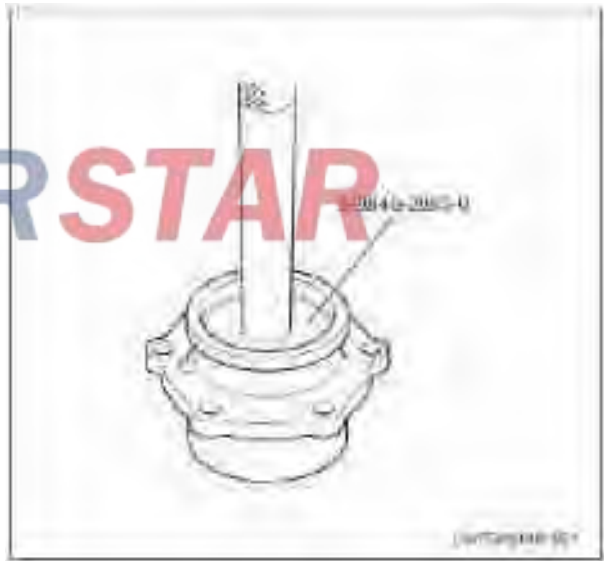
Assembly

Caution:

New oil seals, O-rings, removable washers and flange nuts must be used.

1. Install the inner bearing inner race

● Use the built-in tool: 5-8840-2863-0, mount the bearing outer race on the gearbox.



2. Install the outer bearing inner race

● Use the built-in tool: 5-8840-2379-0, mount the bearing outer race on the gearbox.

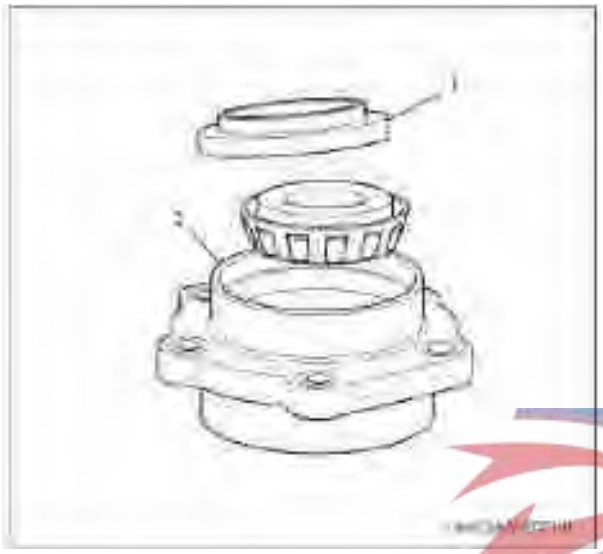
3. Install the inner ring of the outer bearing on the gearbox.

4. Install the oil seal

● Use the oil seal installation machine: 5-8840-2377-0 and install the oil seal (1) on the gearbox (2).

Caution:

If the oil seal is pushed in at an angle, oil leakage may result, so be careful when installing.



5. Install the inner bearing inner race

● Use a bearing mounter: 5-8840-2345-0 Mount the inner bearing on the pinion.

6. Install the driving gear and the movable washer on the gear box.

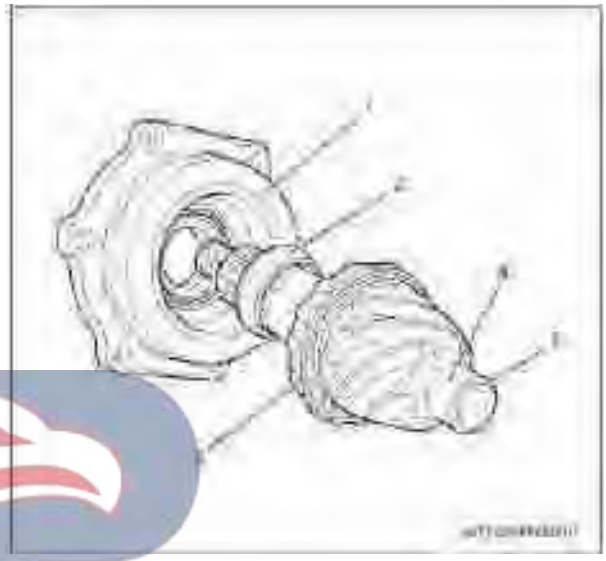
a. Apply GL-5 gear oil (SAE80W-90) to bearings and seals.

b. Mount the guide bearing and snap ring on the pinion.

c. Insert the removable spacer into the pinion and completely insert it into the gearbox.

Caution:

New removable spacers must be used. If you use an old removable spacer, the correct preload may not be guaranteed, which can cause the flange nuts to loosen.



Key

1. Small gear bearing
2. Detachable spacer ring
3. Driving gear
4. Guide bearing
5. Snap ring

7. Install the flange and flange nuts.

● First install the flange and tighten the flange nuts. Lubricate the flange nuts with GL-5 gear oil (SAE 80W-90) before assembly.

Caution:

New flange nuts must be used.

8. Adjust the pinion bearing box preload.

a. Connect the flange bracket: 9-8529-2101-0 to the vise and install the pinion flange.

b. Slowly tighten the flange nut with a torque wrench.

c. Place a spring balance on the pinion bolt hole and gently pull it in the direction of the wiring so that the spring scale value when the gear box starts rotating reaches the specified value and pre-charging is performed.

Pinion bearing accuracy (in the pin hole of the pinion housing)

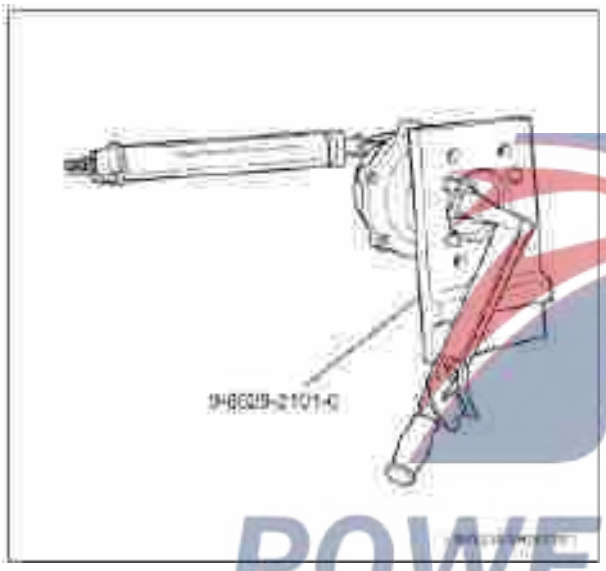
New bearing=27～39N{2.8～4.0kgf}

Old bearing = 13～19N{1.3～1.9 kgf • cm}

Pinion starting torque

Old bearing = 2.3 ~ 3.2N.m {23 ~ 16kgf • cm}

Old bearing = 1.2 ~ 1.6N.m {12 ~ 16kgf • cm}



d. When the specified preload amount is reached, the tightening torque of the flange nut must be within the specified value range.

Tightening torque=441～598 N • m {45.0～61.0kgf • m}

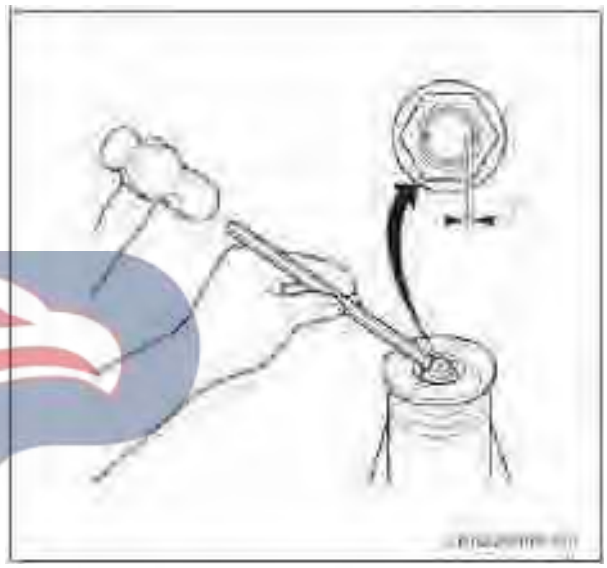
Caution:

If the tightening torque of the flange nut is less than the standard value but the correct preload is reached, replace the removable spacer.

9. Riveted flange nuts.

Caution:

The flange nut is a rivet nut and the new nut must be replaced. The nut tongue groove and the pinion gear are overlapped and two points are caulked with a steel chisel (the tip is approximately R1 x 60°) until the space between the caulked portions is less than 1.8 mm. After riveting is complete, check for cracks in the riveted area of the nut.



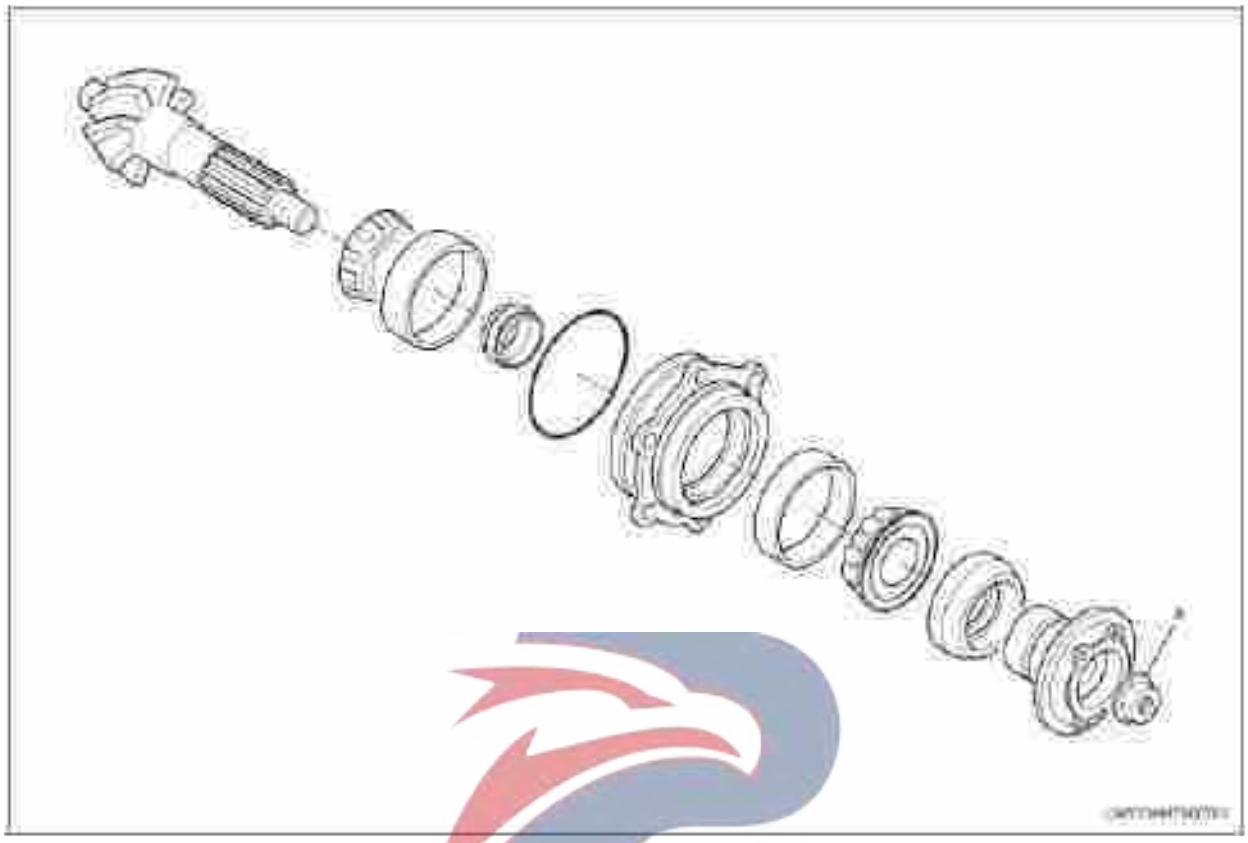
Key

1. Below 1.8mm

10. Install O-rings.

● Apply Besco L-2 Grease on the O-ring and install it on the sprocket box.

Tightening torque list



Key

(a) 441～598 N • m{45.0～61.0 kgf • m}

Section 3C1
Transmission shaft

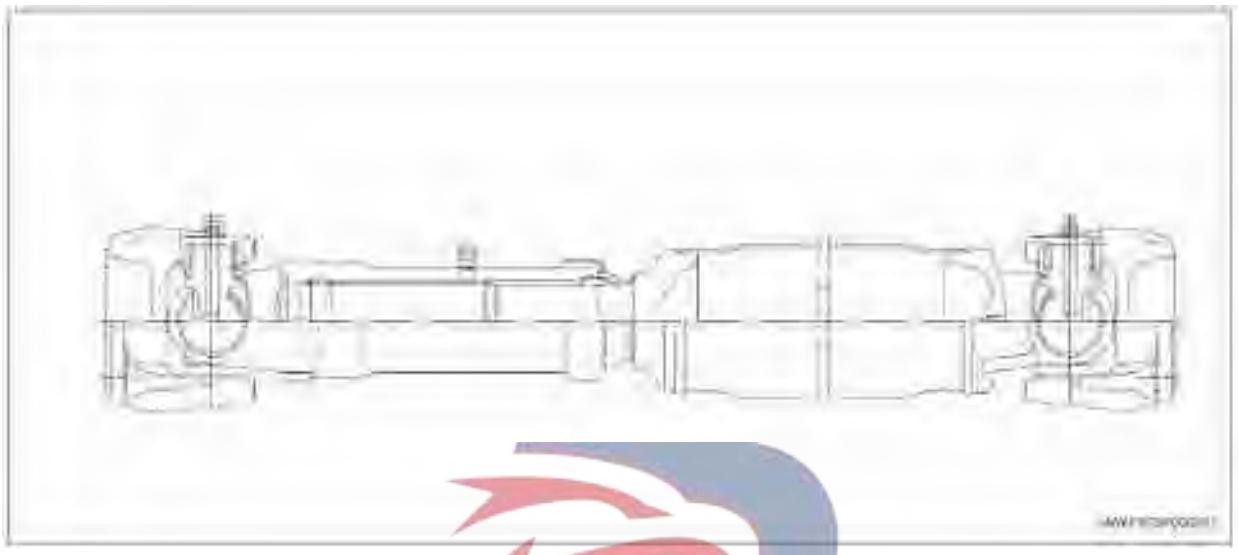
Table of Contents

Transmission shaft system

Function and working principle

Front transmission shaft

Front drive shaft



Rear drive shaft

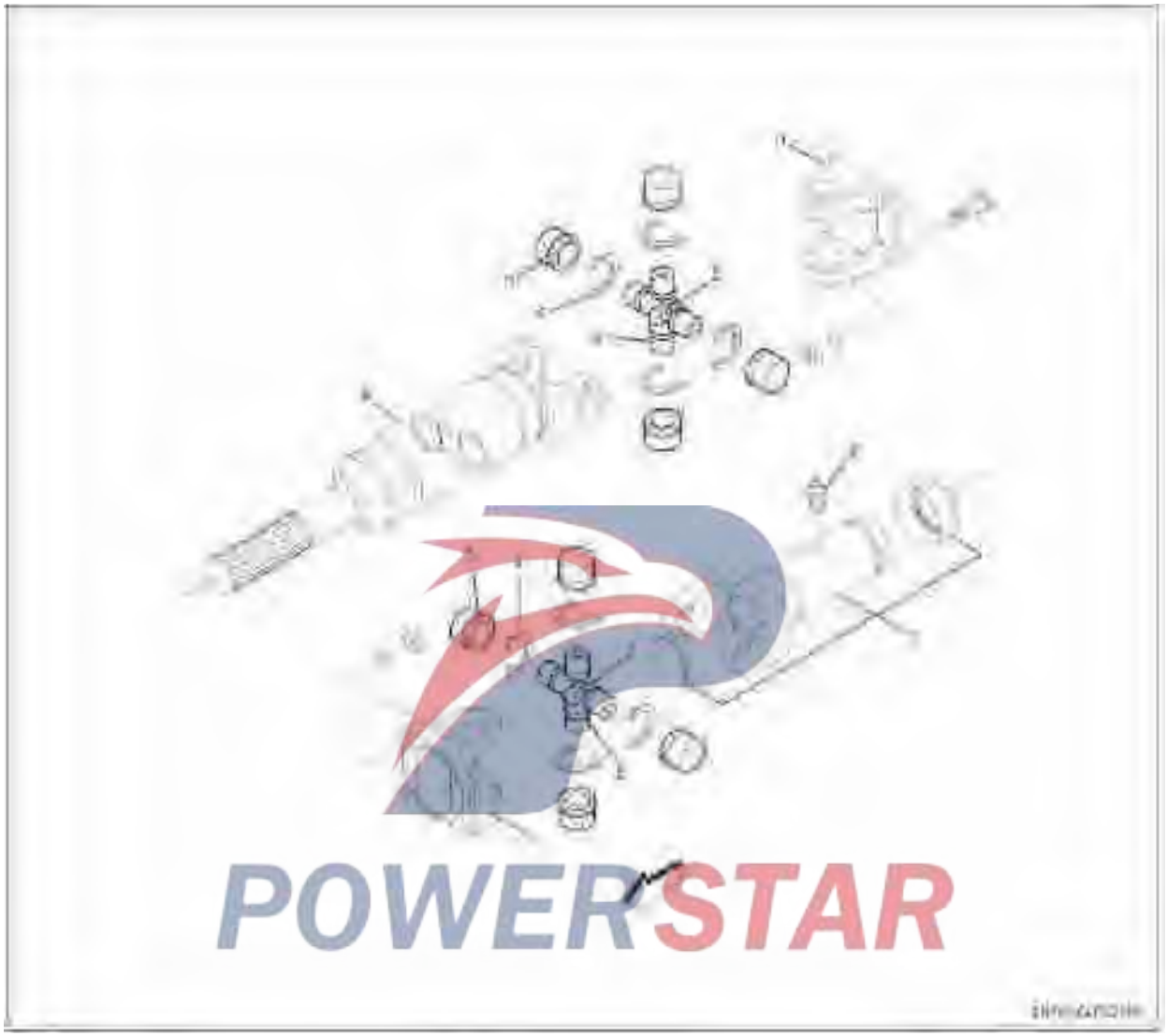
Rear drive shaft assembly

Special tools

Illustration	Tool number Tool name
	5-8840-2866-0 Dust cover

Front drive shaft

Component parts



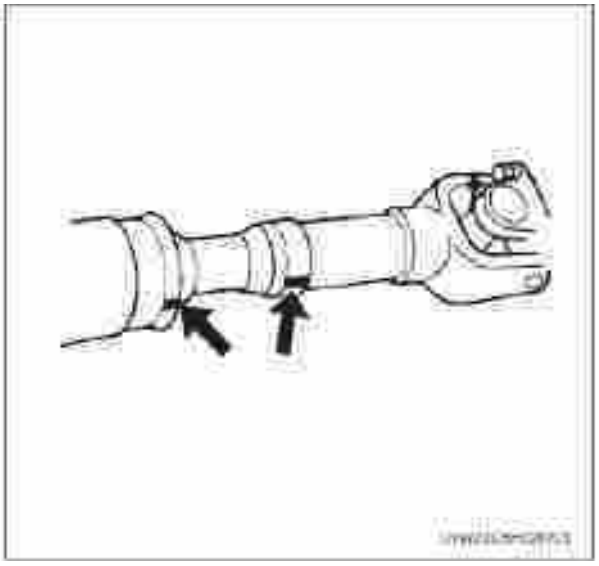
Key

1. Flange yoke
2. Grease nipple
3. Needle roller bearing
4. Snap ring
5. Cross shaft
6. Drive shaft
7. Spline fork

Disassembly

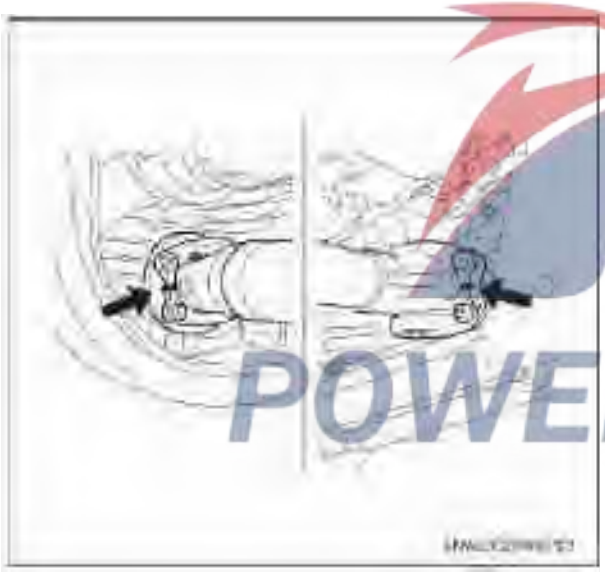
Note:

Since the drive shaft assembly performs precise balance control, assembly marks must be marked before each disassembly and disassembly.



1. Assemble the mark on the drive shaft assembly.

● Use mounting marks on the drive flange fork, front axle flange and drive flange.



2. Remove the shaft assembly from the front axle flange.

● Before removing the driveshaft assembly, remove the bolts, nuts and washers from the front axle flange.

3. Remove the shaft assembly from the drive flange.

● Before removing the drive shaft assembly, remove the bolts, nuts, and washers from the drive flange.

Disassembling

Note:

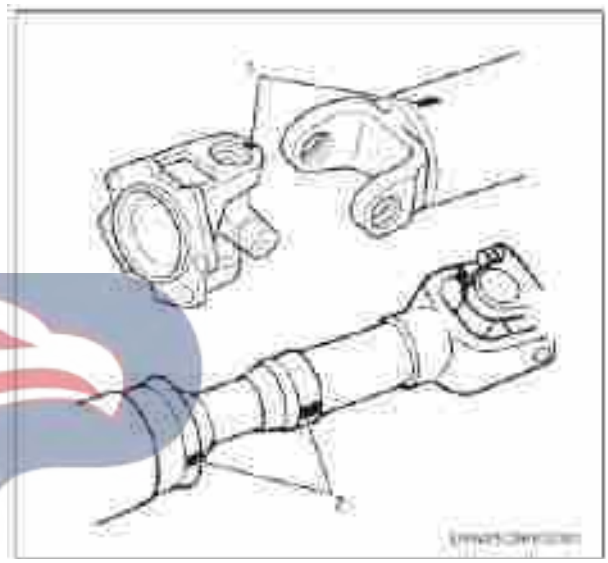
● Since the driveshaft assembly precisely controls the balance, assembly marks must be placed on the corresponding connectors before disassembly and disassembly.

● Check the direction of the lubricator and make sure to repeat the installation.

1. Place an assembly mark on the disassembled part of the drive shaft assembly.

● Mark the grooved fork and the connection mark on the drive shaft (2).

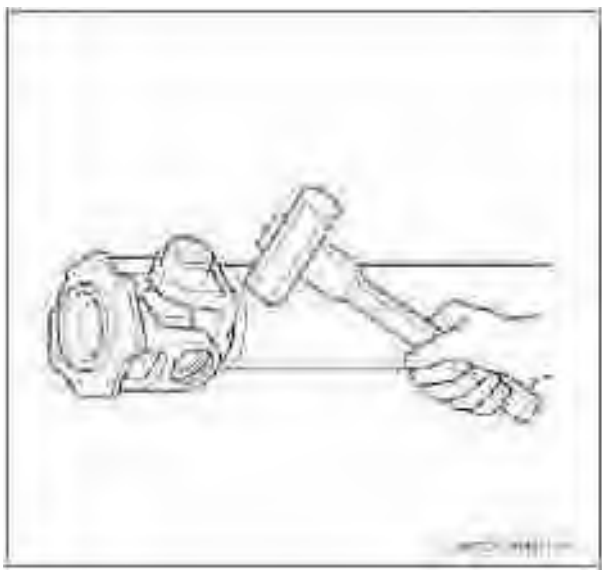
● Mark the fork, splined fork, and connecting pin on the drive shaft (1).



2. Remove the elastic ring.

3. Remove the needle roller bearing.

● Lightly tap the forked fork with a bronze hammer, etc., drive the shaft and fork, and remove the needle roller bearing.



4. Remove the fork and the cross shaft.

5. Remove the spline fork from the drive shaft.

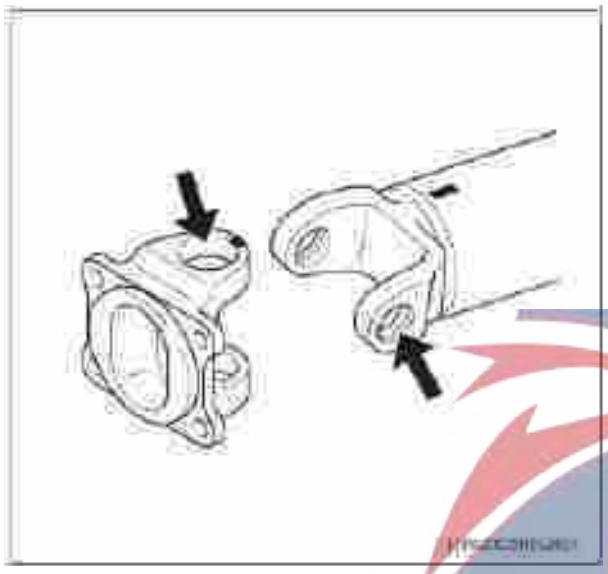
Inspection

Check the removed parts and replace them if found abnormal.

1. Check the universal joint.

● Check the flange bolt holes for wear and scratches.

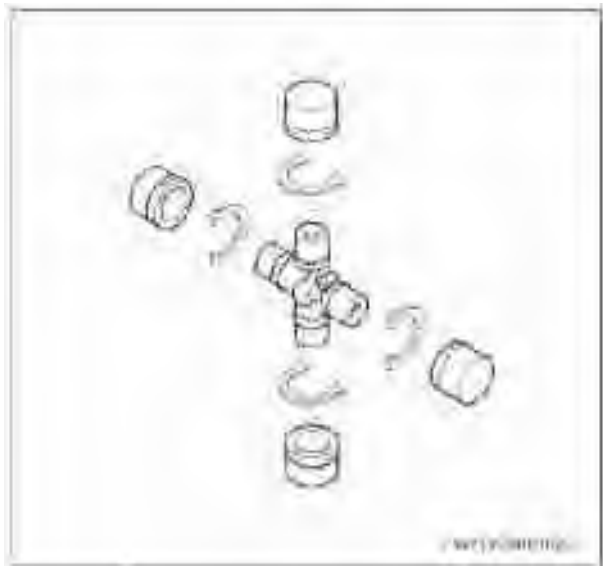
● Check the drive shaft, spline fork, flange fork, and needle roller joint for cracks, scratches, and wear.



● Inspect the cross shaft and needle roller bearings for irregular wear, scratches, rust and bite.

Note:

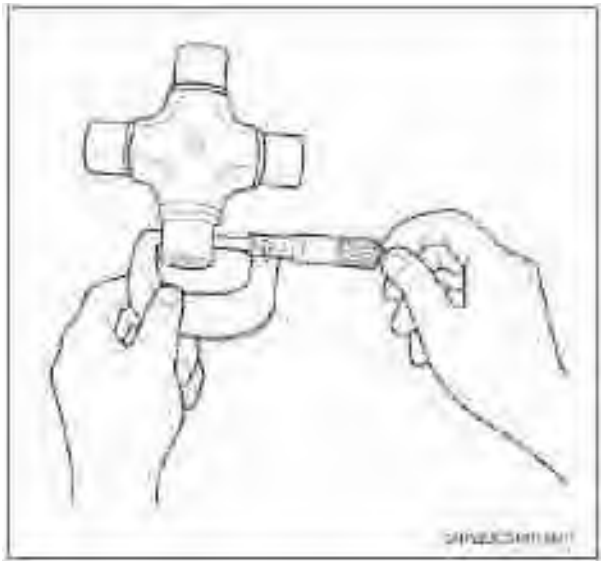
If you need to replace the cross shaft and needle roller bearings, replace the components directly.



Measure the outer diameter of the cross shaft.

The outside diameter of the horizontal axis

Standard value = 17.00mm limit = 16.90mm



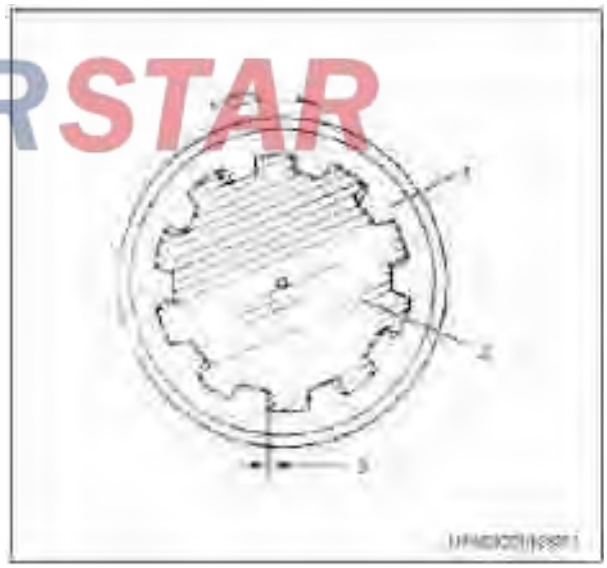
2. Check the fork and drive shaft.

● Insert the drive shaft (2) into the slotted tooth (1) and measure the gap (3) in the direction of rotation using the front end plunger.

● When the measured value exceeds the limit, replace the splined fork assembly or the drive shaft.

Spline rotation direction spacing (external splines)

Standard value = 0.1mm limit = 0.3mm



● Check that the axial movement of the drive shaft and grooved fork is normal and there is no jam.

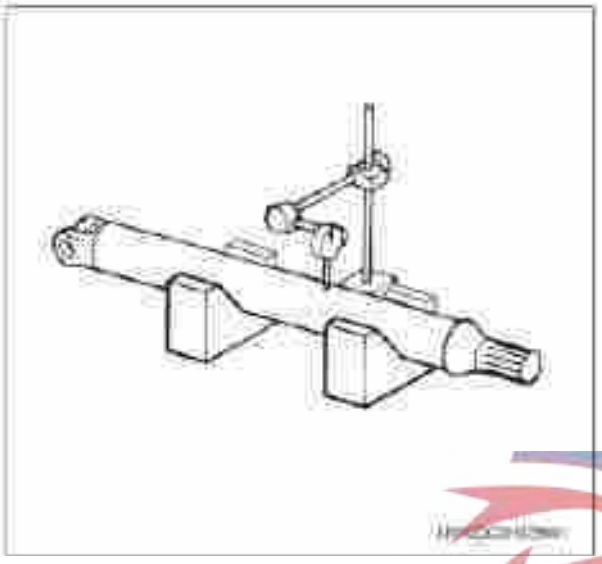
3. Check the drive shaft.

● Use V-blocks to hold both ends of the drive shaft, gently rotate the shaft and use a dial indicator to measure the yaw of the shaft center.

● If the amount of lace slightly exceeds the standard value, correct it, if it is significantly higher than the standard value, replace the entire pattern.

Tree deviation

Standard value = 0.5mm limit = 1.0mm



● Inspect the surface of the drive shaft and replace it if there is a bulge or crack.

Assembling

1. Mounting fork, horizontal axis, needle roller bearing, snap ring.

a. Insert the cross shaft into the fork.

b. Apply a small amount of BESCO L-2 lubricant to the needle bearing and install it on the fork.

c. When guiding the cross shaft, lightly tap it with a bronze hammer, etc., or use a vise to insert it into the depth where the retaining ring will be installed.

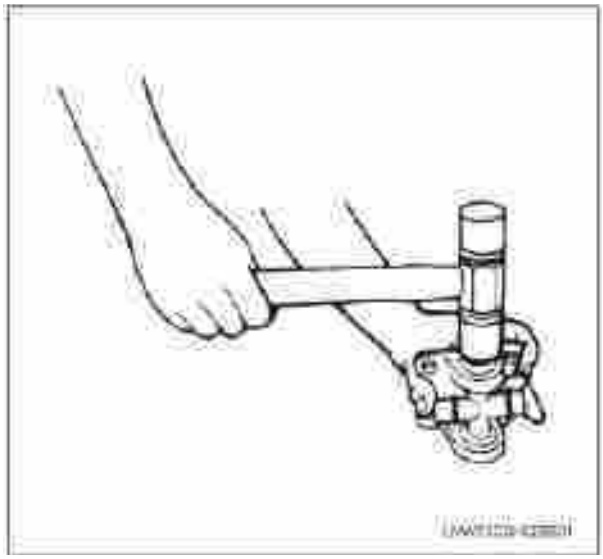
Note:

If the needle roller bearing is not installed correctly, the mounting angle of the flange fork may not be correct.

d. Install the elastic ring.

Note:

Elastic rings must use new products.



2. Repeat step 1 to install the needle roller bearing on the other side.

3. Install big mouth.

4. Install the fork on the shaft and the slot fork.

● Mount the fork on the drive shaft and the slot fork. Install according to the brand during disassembly.

● Follow step 1 to install needle bearing and circlip.

5. Check the horizontal axis of the axial gap.

● If the standard value is exceeded, reselect the stop ring to be set.

Horizontal axis of the game

Standard value < 0.1mm

Elastic ring type

1.50mm (blue), 1.53mm (white), 1.59mm (yellow) 1.62mm (green), 1.68mm (colorless)

6. Install the driveshaft assembly to the spline barb assembly.

a. Apply BESCOL-2 lubricant to the splined portion of the drive shaft.

b. Assemble the driveshaft assembly and splined bar assembly according to the markings on disassembly.

Installation

Note:

● When removing, install according to the brand of each connector.

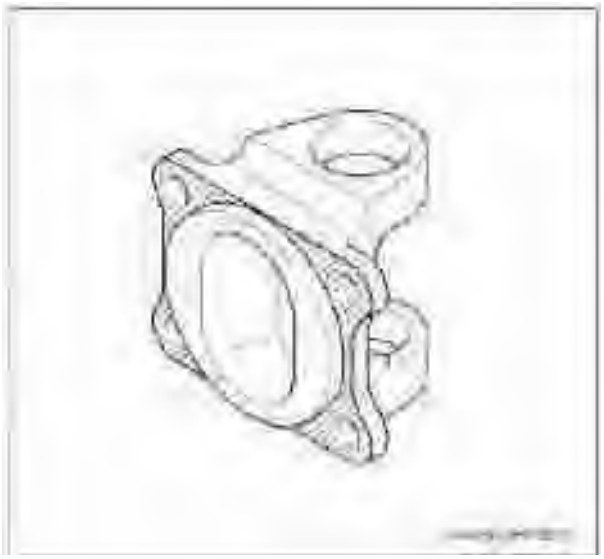
● The shaft and corrugated fork of the drive shaft must face in the same direction.

Key

1. The correct installation method
2. The incorrect installation method

Note:

The mounting surface of the fork and attachment mechanism must be cleaned to remove foreign materials such as grease, oil and paint.



1. Mount the driveshaft assembly on the drive flange.

a. Align the fork and the mark on the drive flange.

b. Install the shaft assembly with bolts, nuts, and washers.

Tightening torque=63 N • m {6.4 kgf • m}

2. Install the driveshaft assembly onto the rear axle flange.

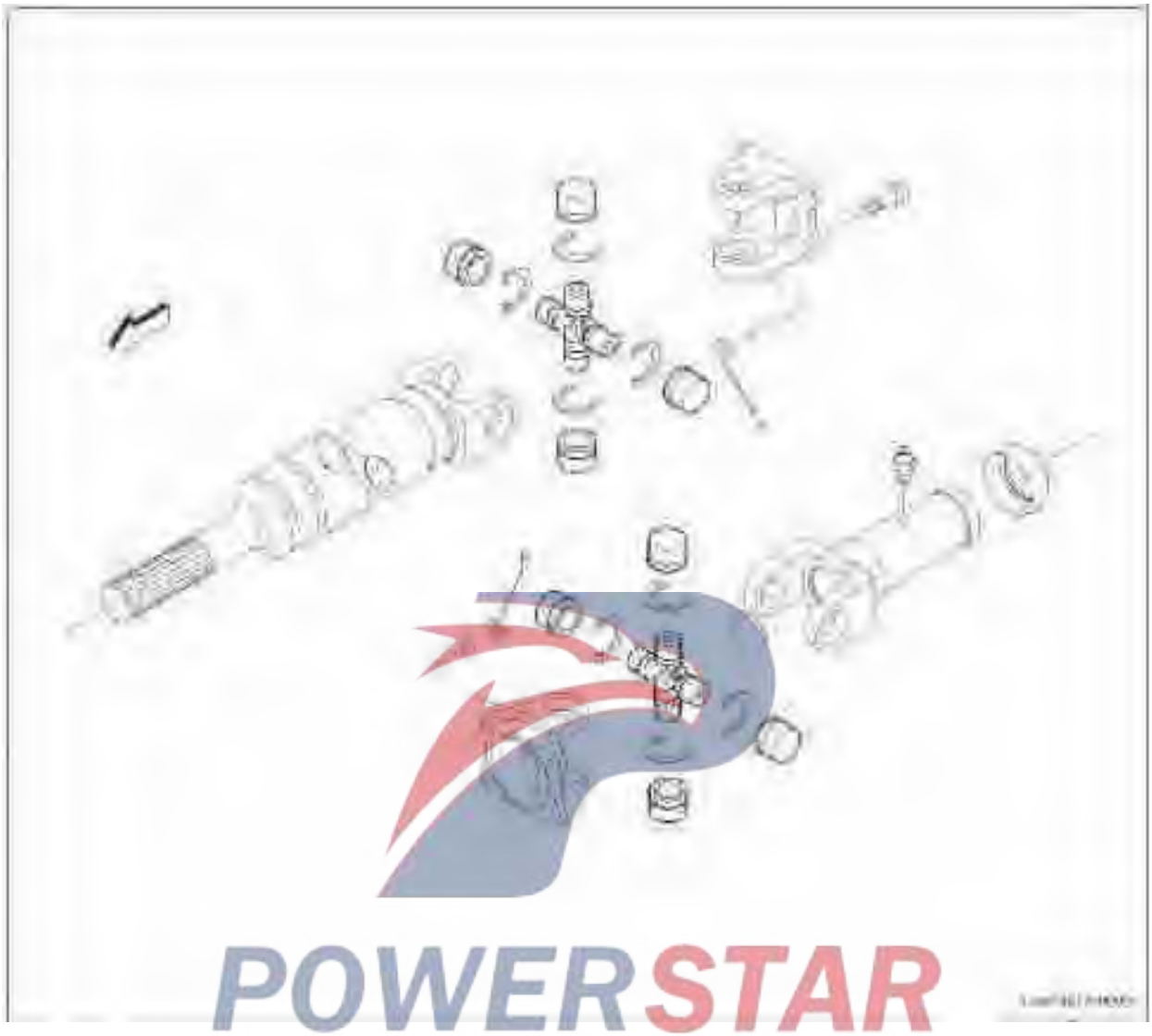
a. Align the fork on the drive flange with the mark on the front axle flange.

b. Install the shaft assembly with bolts, nuts, and washers.

Tightening torque=63 N • m {6.4 kgf • m}

3. Lubricate the drive shaft assembly.

Tightening torque list



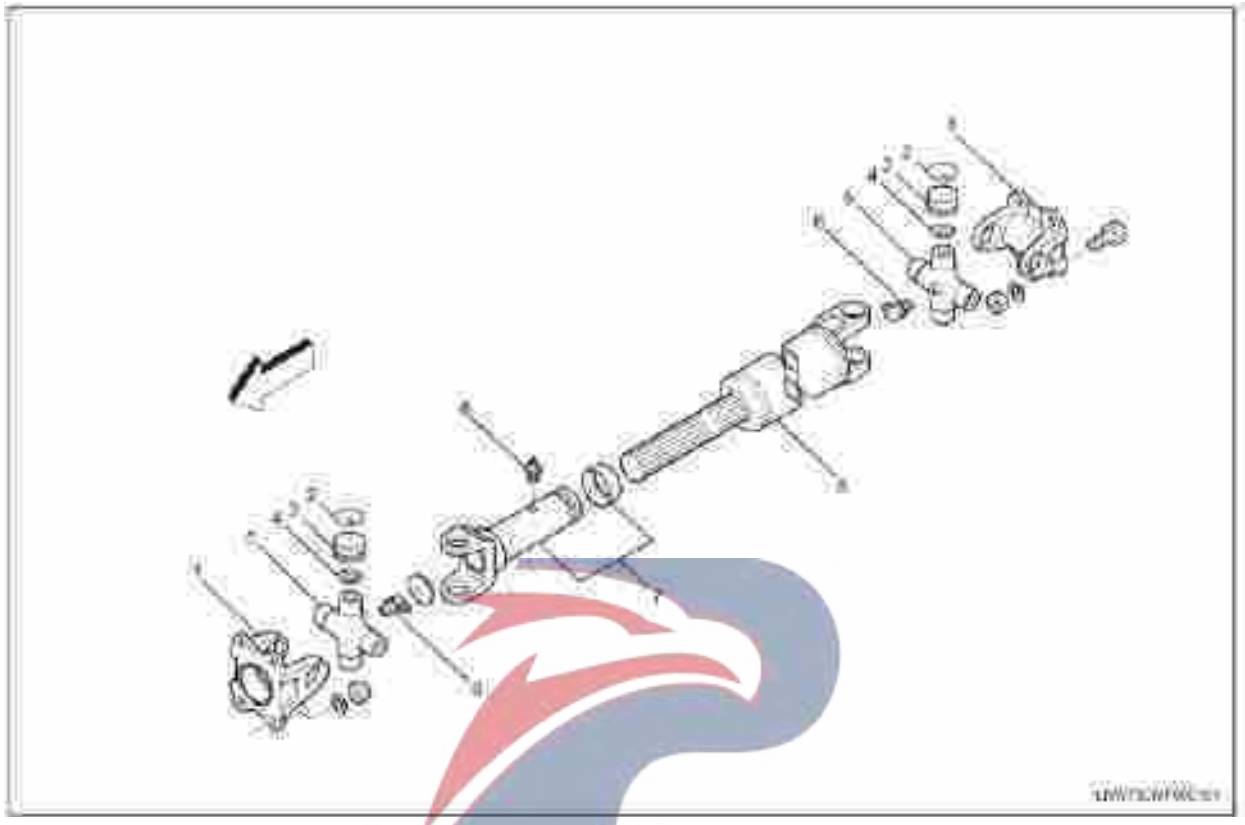
Key

(a) 63 N • m{6.4kgf • m}

(b) 63 N • m{6.4kgf • m}

Rear drive shaft assembly

Component parts



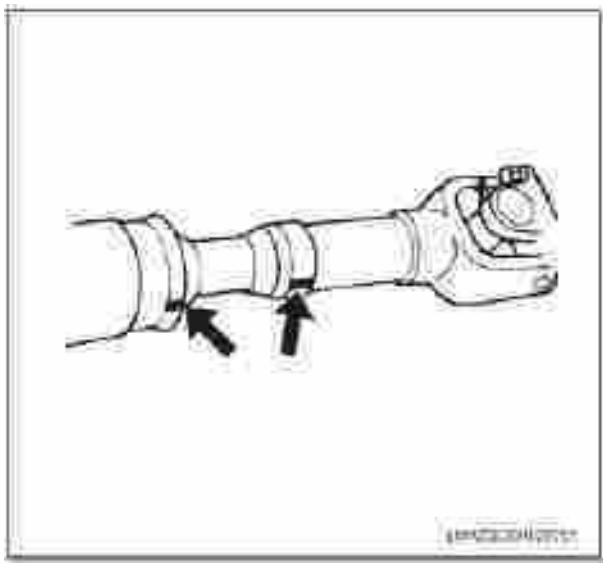
Key

1. Flange yoke
2. Snap ring
3. Needle roller bearing
4. Washer
5. Cross shaft
6. Grease nozzle
7. Spline fork
8. Transmission shaft

Disassembly

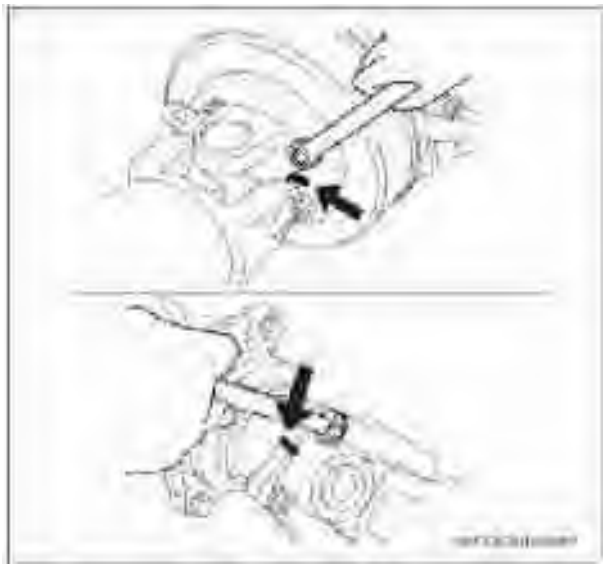
Note:

● Since the driveshaft assembly precisely controls the balance, assembly marks must be placed on the corresponding connectors before disassembly and disassembly.



1. Place the assembly mark on the drive shaft assembly.

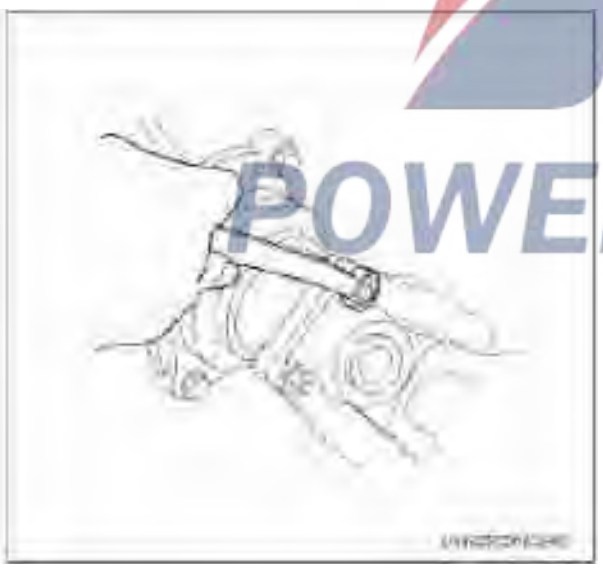
● Place mounting marks on the propeller shaft fork, rear axle flange and parking brake drum.



2. If necessary, remove the shaft guard.

3. Remove the driveshaft assembly from the rear axle flange.

● Before removing the driveshaft assembly, remove the bolts, nuts and washers from the rear axle flange.



4. Remove the shaft assembly from the parking brake drum.

● Remove the nuts and washers from the parking brake drum before removing the drive shaft.

Disassembling

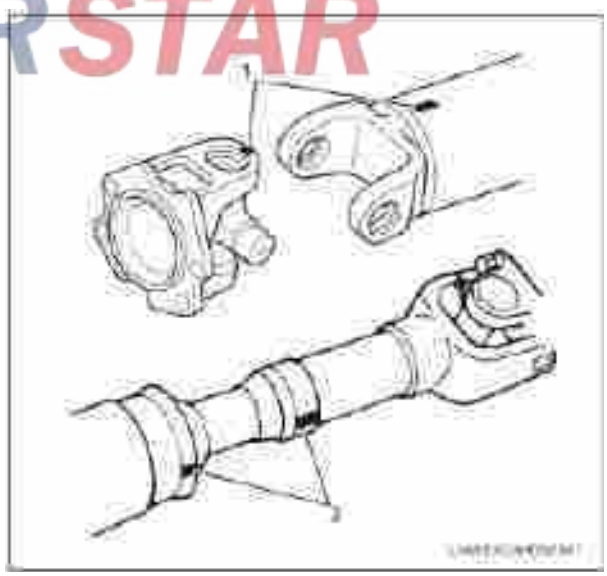
Note:

Since the driveshaft assembly precisely controls the balance, each seal must be marked before disassembly and disassembly.

1. Place the assembly mark on the disassembled part of the drive shaft assembly.

● Install the mounting mark (2) on the fork and drive shaft.

● Place the mounting mark (1) on the fork, jacket fork and drive shaft.



2. Remove the elastic ring.

3. Remove the needle roller bearing

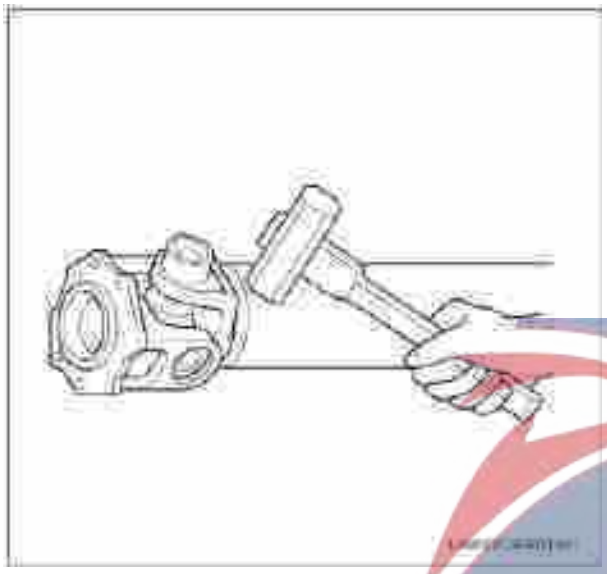
● Using a bronze hammer, gently tap the fork, spline fork and drive shaft fork, and remove the needle roller bearing.

4. Remove the fork, washers, horizontal axis.

● Remove the fork and the cross shaft.

Note:

Confirm the direction of the lubricator in advance to ensure correct orientation during reassembly.



5. Disconnect the fork and drive shaft.

6. Remove the gasket from the slot fork.

Inspection

1. Check the flange fork.

● Check if the ball inserted into the needle roller bearing is deformed or broken.

● Check the needle bearing inserts for wear.

2. Check the cross fork.

● Check if the ball inserted into the needle roller bearing is deformed or broken.

● Check the needle bearing inserts for wear.

● The same inspection must be carried out on the inserted part of the drive shaft needle roller bearing.

● Check that the plug (1) is not clogged or detached.

3. Check the needle roller bearings and washers.

● Make sure there are no signs of wear, scratches, and wear on washers and needle roller bearings.

Caution:

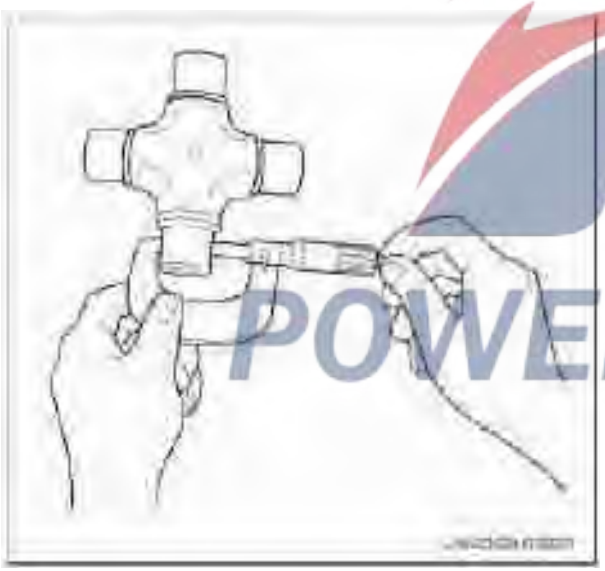
If you wish to replace the cross shaft, washers and needle bearings, replace the components directly.

4. Check the cross shaft.

● Measure the outer diameter of the trunnion journal.

The outer diameter of the trunnion

Standard value = 21.94mm limit = 21.84mm



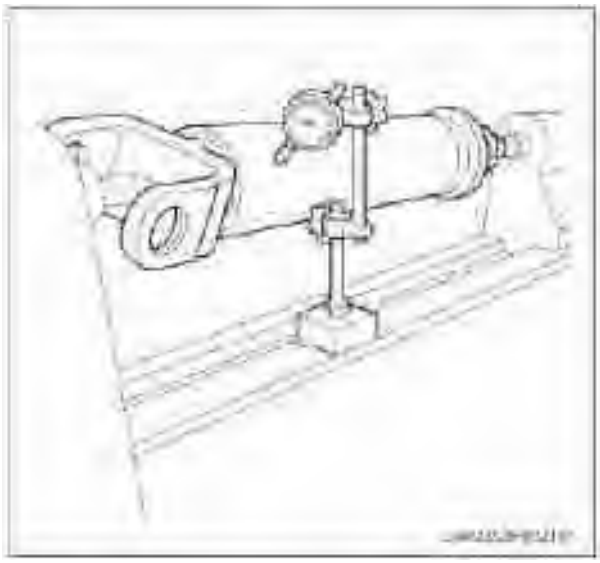
5. Check the drive shaft.

● Check if the pipe section is sagging, if the dust cover is damaged, and if the contact surface of the oil seal is worn.

● Measure the yaw of the drive shaft in the center of the pipe. If the amount of lace slightly exceeds the standard value, press to correct. If the value is significantly higher than the standard value, replace the component directly.

Tree deviation

Standard value = 0.3mm limit = 0.5mm



● Inspect the bearings on the drive shaft splines for wear.

● Use grindstones to correct minor signs of wear.

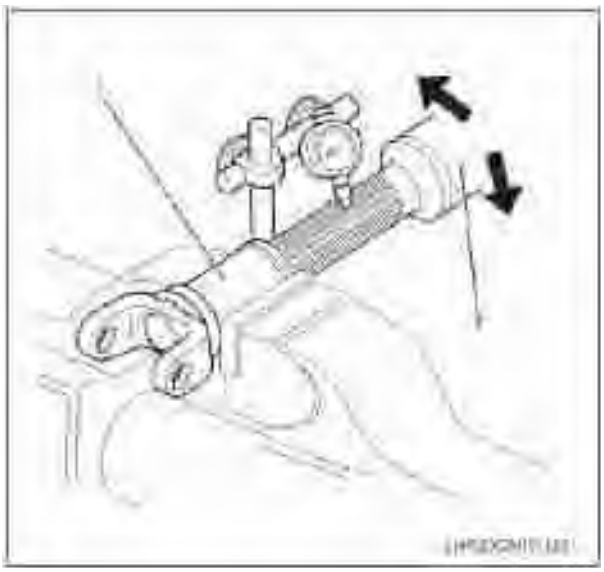
● Secure the slotted fork (1) with a vise, then insert the drive shaft (2). Set the dial indicator on the spline, and then gently rotate the shaft to check its direction of rotation.

Rotational direction gap

Standard value = 0.1mm limit = 0.3mm

Note:

In order to avoid the distortion of the slotted fork, a soft wooden block or piece or the like needs to be placed and cannot be tightened directly with a vise.



Assembling

Note:

● When removing, install according to the brand of each connector.

● The axis of the propeller shaft and the teeth must be in the same direction.

Key

1. The correct installation method

2. The incorrect installation method

1. Assemble forks, cross shafts, washers, needle bearings and coils.

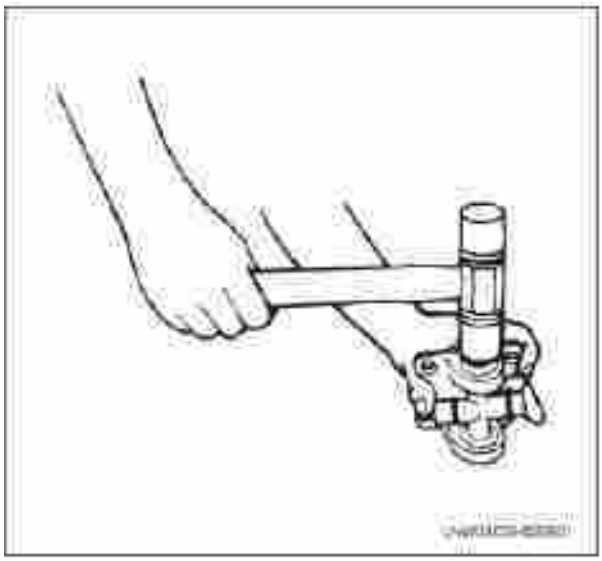
a. Insert the cross shaft into the fork.

b. Apply a small amount of BESCO L-2 lubricant to the needle bearing and install it on the fork.

c. When guiding the cross shaft, lightly tap it with a bronze hammer, etc., or use a vise to insert it into the depth where the retaining ring will be installed.

Note:

If the needle roller bearing is not installed correctly, the mounting angle to the flange will be incorrect. At this point, it is not possible to perform brutal operations and it is necessary to confirm the situation before proceeding.



d. Install the elastic ring. The elastic ring is installed at the required depth.

Caution:

Elastic rings must use new products.

2. Repeat step 1 to install the needle roller bearing on the other side.

3. Install big mouth.

4. Install the fork on the shaft and the slot fork.

● Mount the fork on the drive shaft and the slot fork. Install according to brand when disassembled.

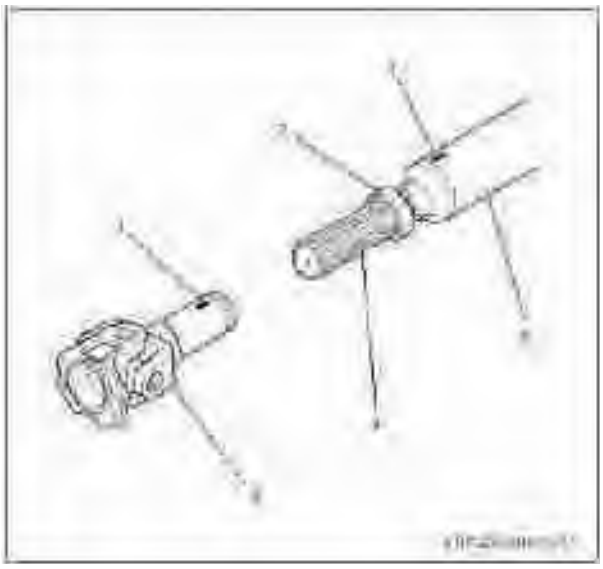
● Follow step 1 to install needle bearing and circlip.

Snap ring: 2.00mm (white)

5. Install the driveshaft assembly to the spline barb assembly.

a. Install the seal (2) on the drive shaft (5) and apply the BESCO L-2 lubricant on the splines (4).

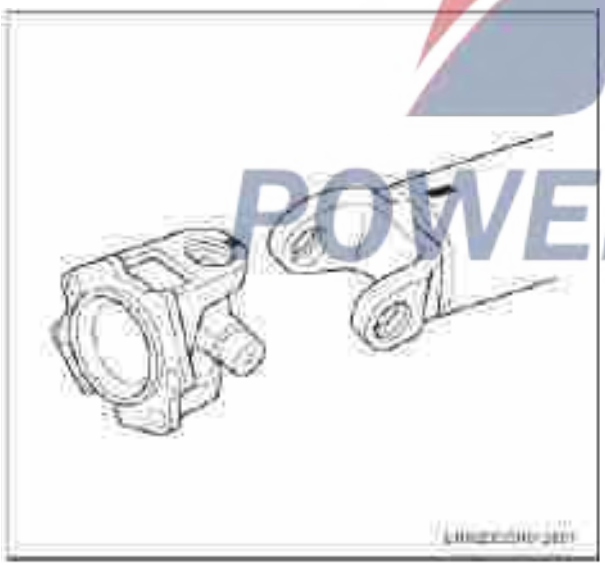
b. Assemble the pipe and groove fork (3) according to marking (1) when disassembling.



6. Install the fork on the drive shaft and on the slotted fork.

a. Install the fork (mounting the cross shaft and needle bearing) on the drive shaft and the grooved fork.

Install the front fork, drive shaft and ribbed fork according to the disassembled mark.



b. Follow steps 2 and 3 to install needle roller bearings and circlips.

c. Lightly tap the seal with a plastic hammer to fit the slot of the sleeve fork.

d. Using a bronze hammer, gently tap the sleeve's fork, drive shaft and fork to drop the bearing and check that the fork can move normally without jamming.

Installation

Note:

● When removing, install according to the brand of each connector.

● The axis of the propeller shaft and the teeth must be in the same direction.

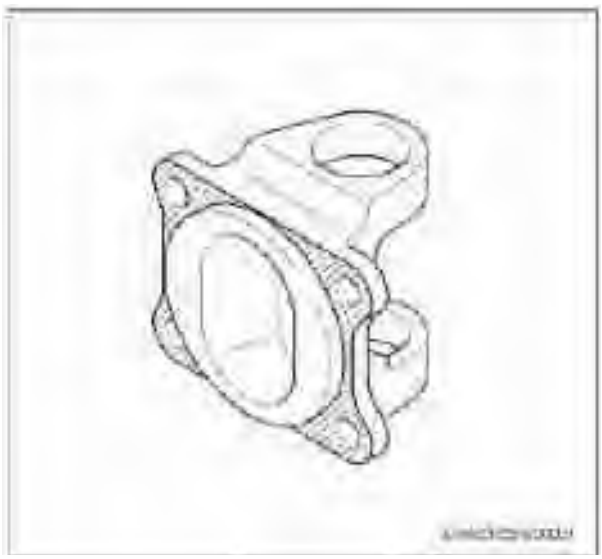
Key

1. The correct installation method

2. The incorrect installation method

Note:

To clean the mounting surface of the fork and coupling mechanism, remove foreign material such as grease, oil, and paint.



1. Mount the drive shaft assembly on the parking brake drum.

a. Align the drive shaft fork assembly mark with the parking brake drum.

b. Install the shaft assembly using nuts and washers.

Tightening torque=103 N • m{10.5kgf • m}

2. Install the driveshaft assembly onto the rear axle flange.

a. Align the mounting mark on the drive shaft fork with the rear axle flange.

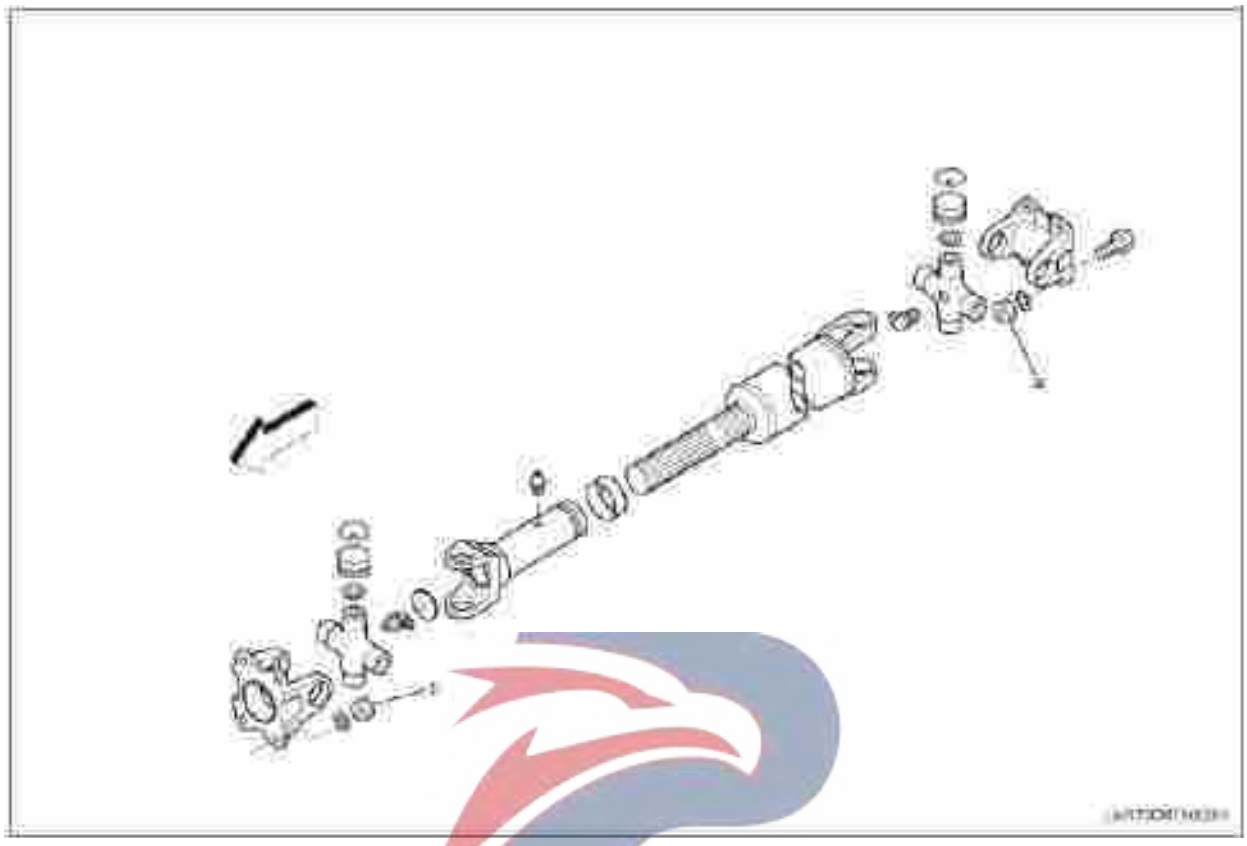
b. Install bolts, nuts and washers and tighten with the specified torque.

Tightening torque=103 N • m{10.5kgf • m}

3. Install the deflector of the drive shaft.

Tightening torque=40 N • m {4.1 kgf • m}

Tightening torque list



Key

(a) 103 N • m{10.5 kgf • m}

(b) 103 N • m{10.5 kgf • m}

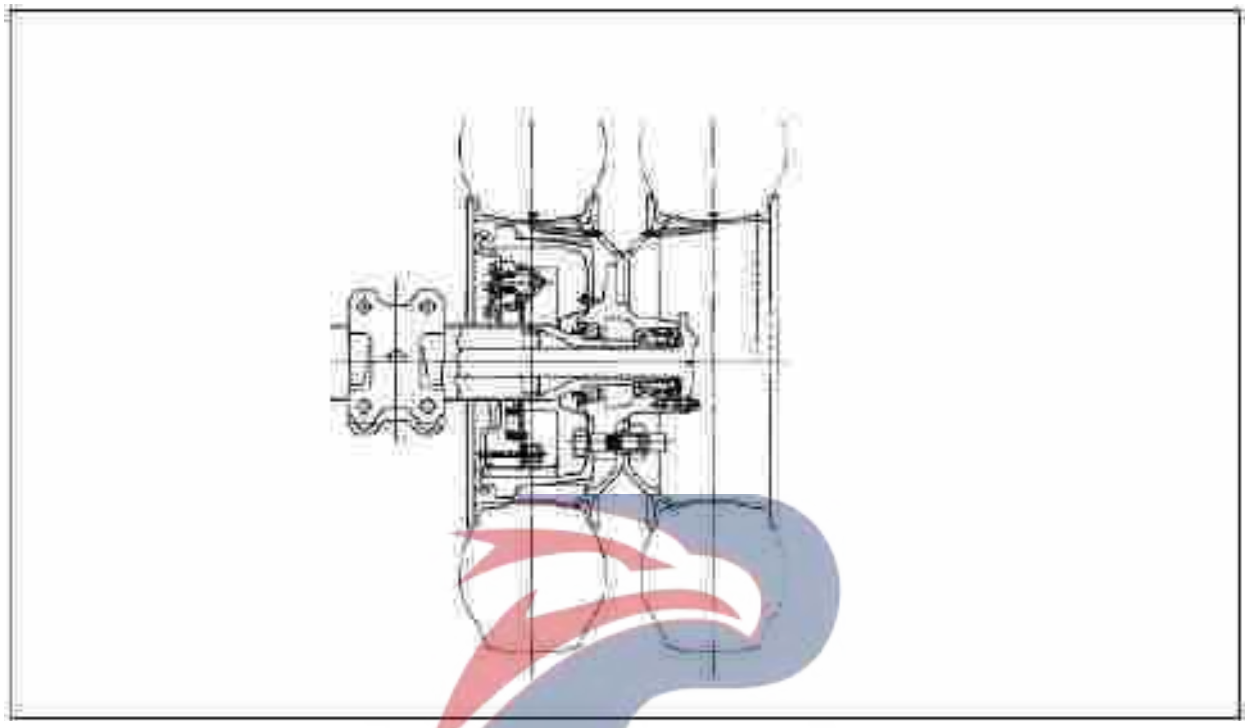
Section 3C3
Rear axle

Table of Contents

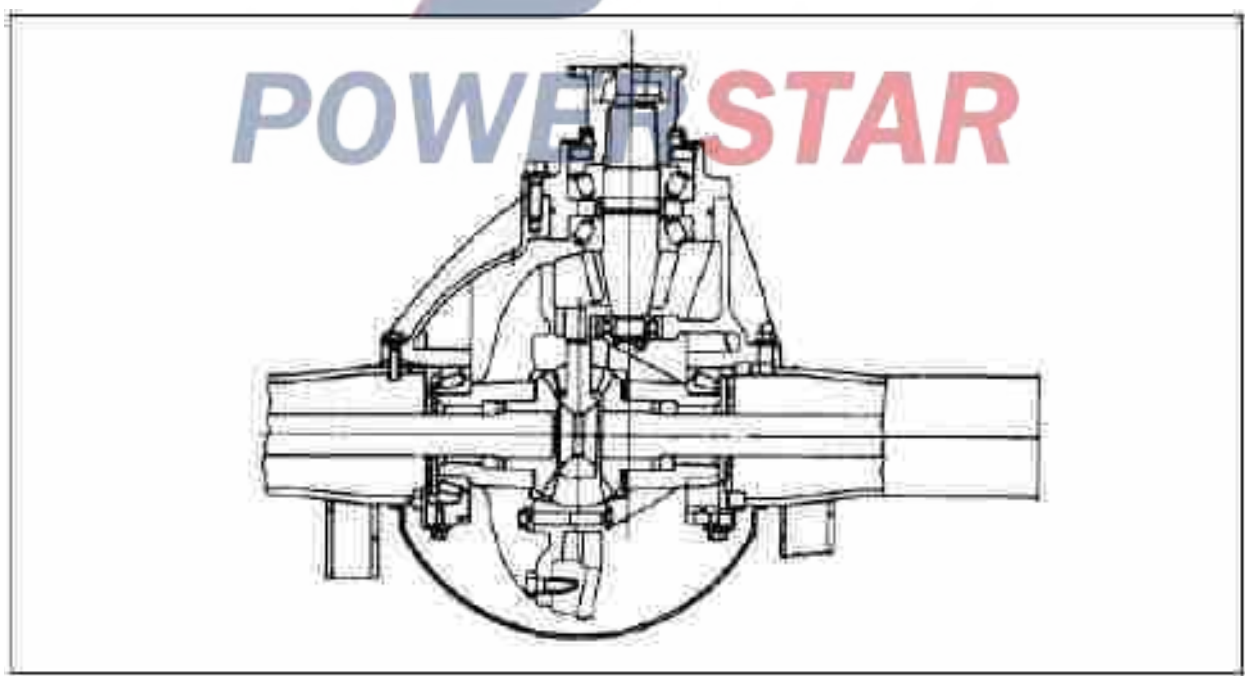
Overview

Wheel hub and brake drum

Double tires

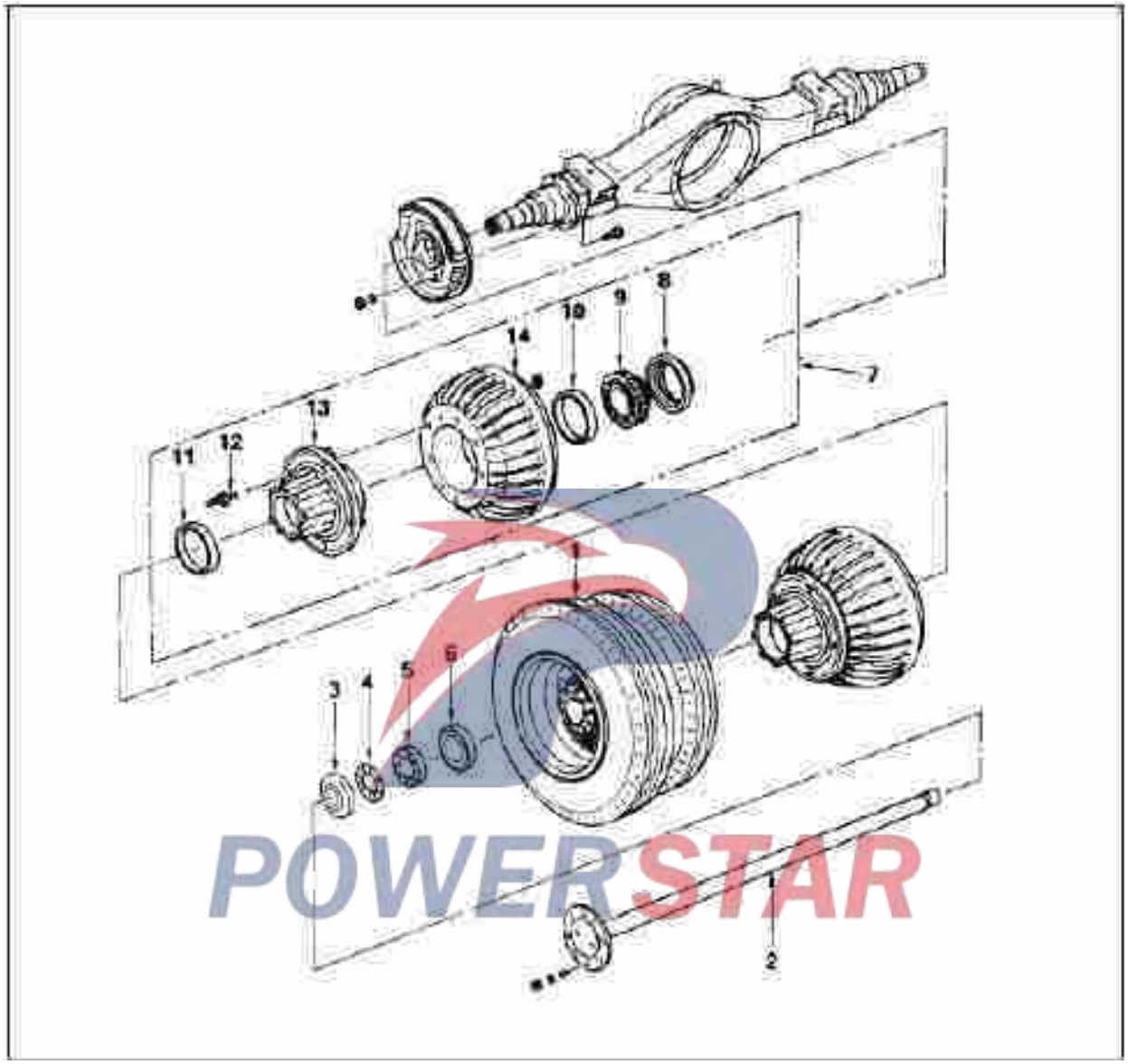


320mm (12.6in)



Rear hub and brake drum

(full float)

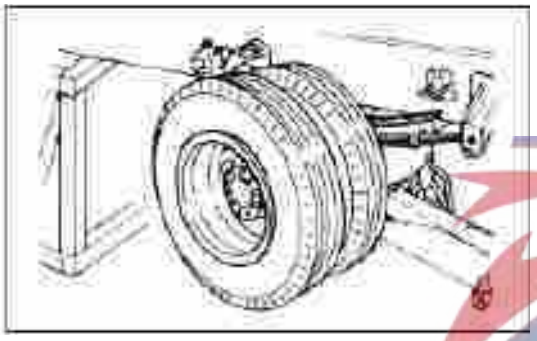


Dismantling sequence

1. Wheel and tire
2. Half-shaft
3. Outer oil seal
4. Locking gasket
5. Locknut
6. Outside bearing
7. Wheel hub and brake drum
8. Inner oil seal
9. Inside bearing
10. Inner bearing outer race
11. External bearing outer race
12. Wheel pin
13. Wheel hub
14. Brake drum

Assembling sequence

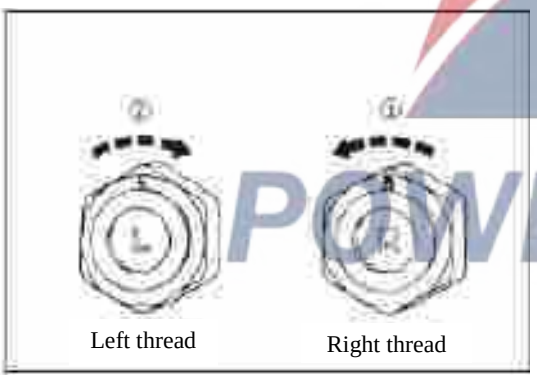
Assemble as per the sequence contrary to the dismantling sequence.



Disassembly

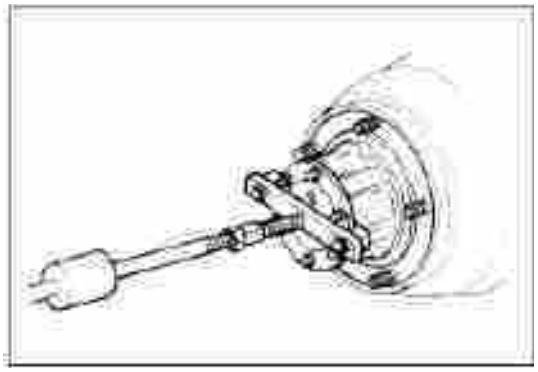
Preparations:

Raise the car with a jack and support it to the shelf.



1. Wheel and tire

The right wheel nut ① is right-handed. The left wheel nut ② is left-handed.

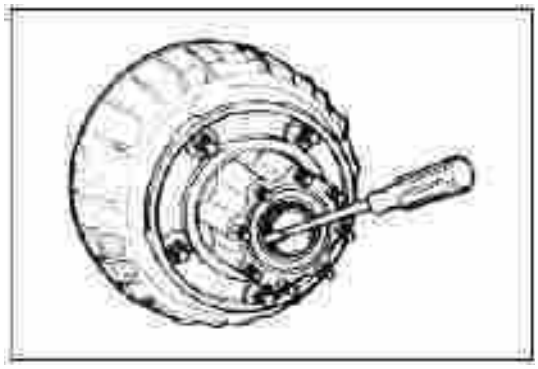


2. Half-shaft

Remove the half-shaft with a half-shaft puller and slide hammer.

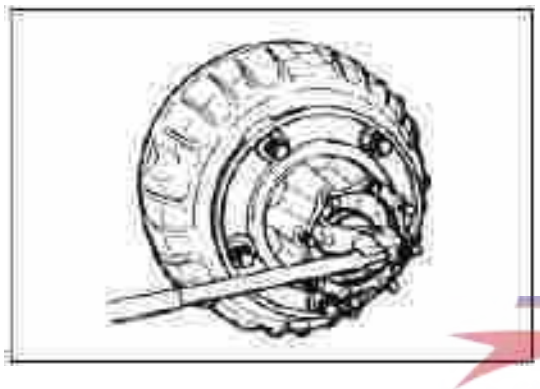
Half-shaft puller: 5-8840-2027-0

Slide hammer:5-8840-0084-0



3. Outer oil seal

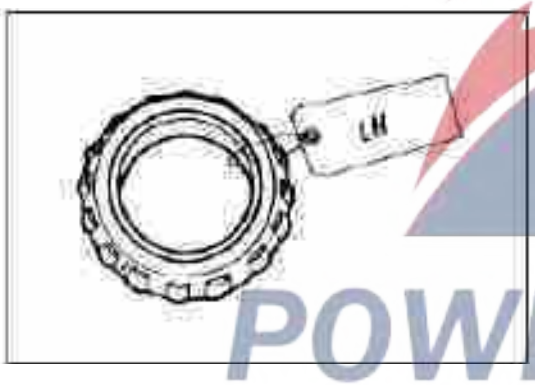
Use a crowbar to pry the seal off the hub.



4. Locking gasket

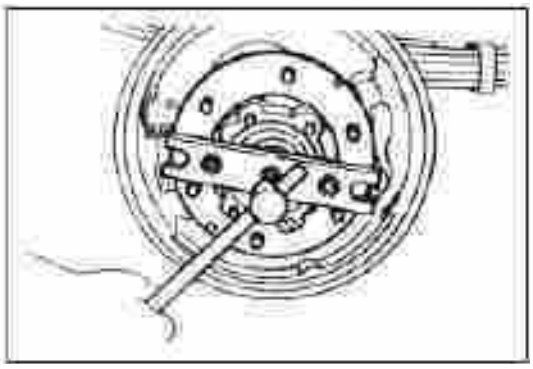
5. Locknut

Remove the locknut with a locknut puller.



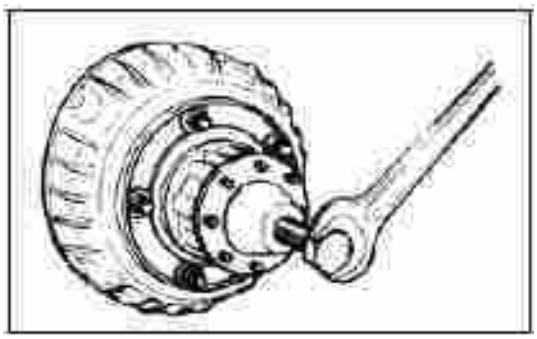
6. Outside bearing

If you need to reinstall the bearing, you must mark the bearing to indicate where it was removed.

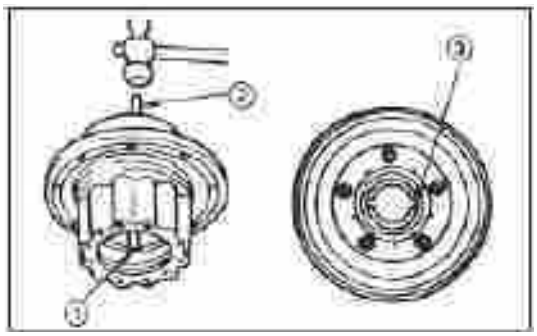


7. Wheel hub and brake drum

Remove the wheel hub and brake drum with a wheel hub puller.



Rear hub remover: 9-8521-0116-0



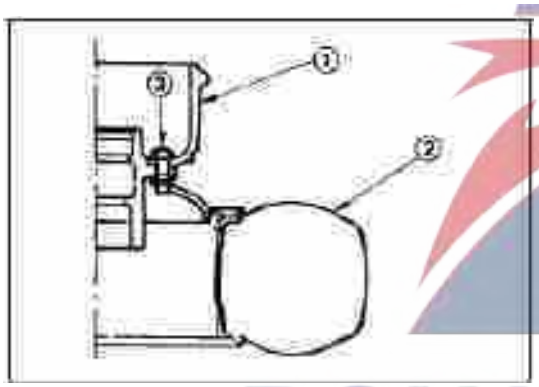
8. Inner oil seal

9. Inside bearing

10. Inner bearing outer race

11. External bearing outer race

Remove the outer race from the hub with the hammer and the copper rod at the two locations shown.



12. Wheel pin

1. The rear hub with the brake drum 1 is mounted on the wheel, and the tire 2 is removed from the vehicle in advance.

2. Turn the axle nut 5 counterclockwise to loosen. Wheel pin nuts on both sides of the car are counterclockwise to loosen.

3. Remove the brake drum from the rear hub.

4. Discard the removed pin and wheel nut.

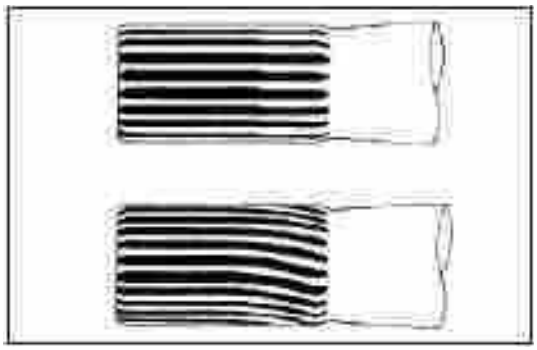
Wheel pin and nut can not be used again.

13. Wheel hub

14. Brake drum

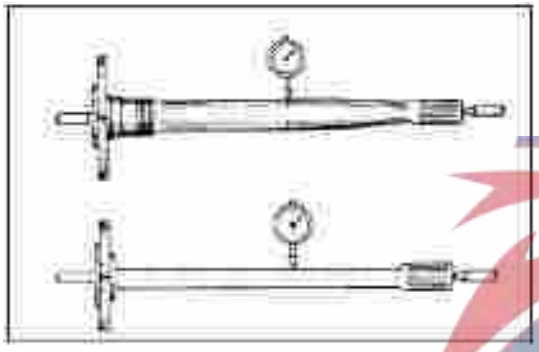
Inspection and repair

If any damage or wear is found by inspection, adjust, repair or replace the part.



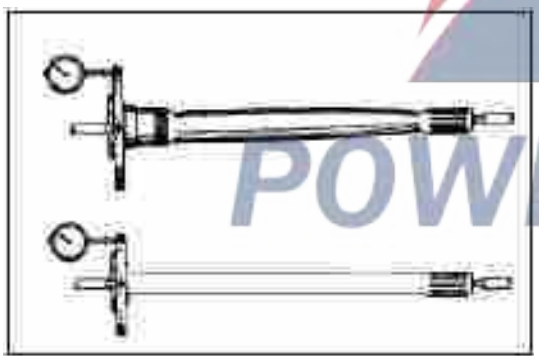
Semi- shaft spline

Check spline for wear, damage or other malfunction.



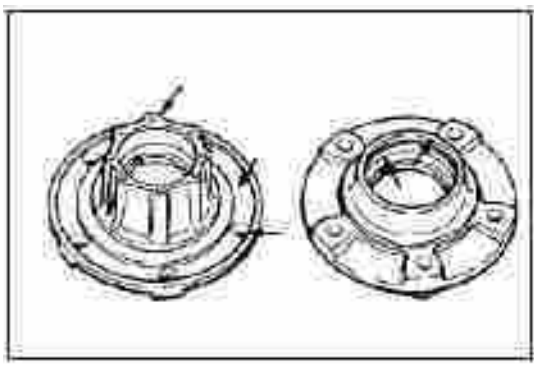
Semi-shaft radial runout

Limit	mm(in)
1.0 (0.039)	



Semi-shaft flange radial runout

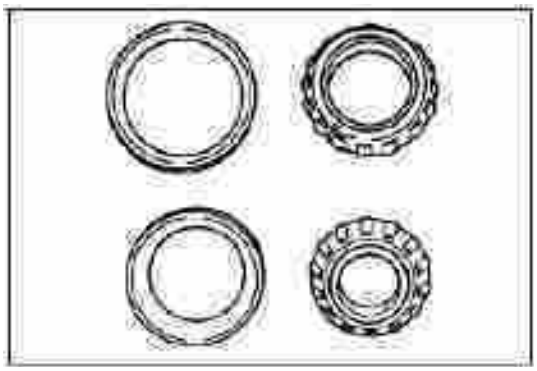
Limit	mm(in)
0.15 (0.00591)	



Wheel hub

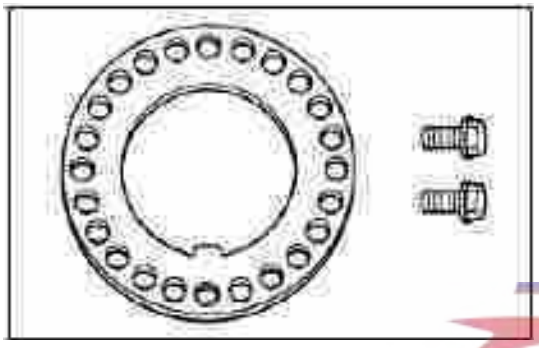
Check oil seal and bearing mating surfaces for excessive wear and damage.

Check wheel pin thread and stud thread for damage and cracks.



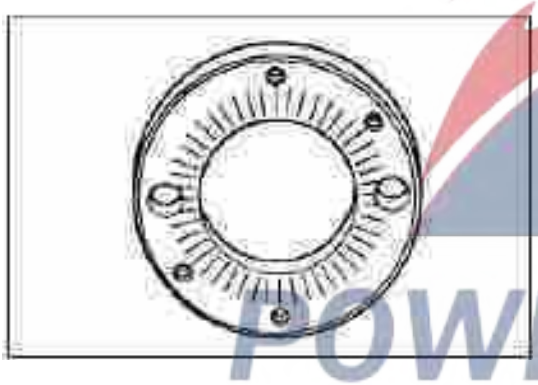
Bearings

Check bearings for excessive wear and tear, abnormal noise, unstable rotation and jamming conditions.



Locking gasket

Check the lockwasher for excessive wear, cracks, deformation, and other damage.



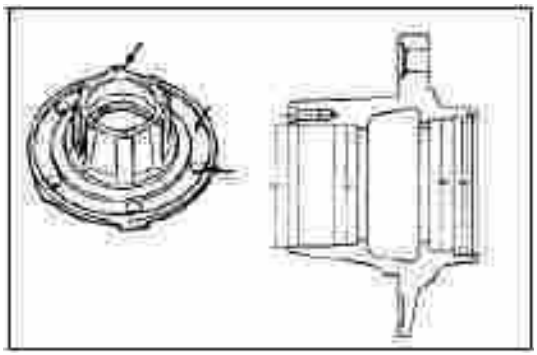
Bearing locknut

Check for excessive wear, deformation or other damage of the threads and contact surface of the bearing locknut.

Slight damage to the contact surface can be repaired with whetstone or fine sandpaper.

Assembling

15. Brake drum

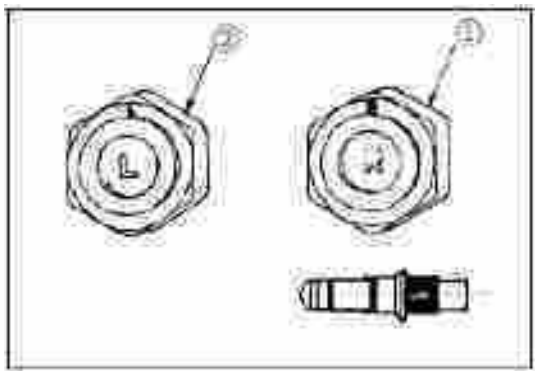


14. Wheel hub

(1) Clean the inside and outside surfaces of the hub.

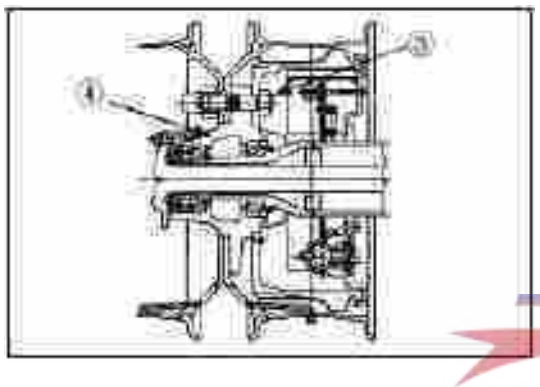
(2) Add bearing grease to the hub cavity.

Grease needed for hub bearings	g (oz)
305 (10.8)	



13. Wheel pin

(1) The right wheel hub pin 1 is a right-hand thread, and the left wheel hub pin 2 is a left-hand thread.



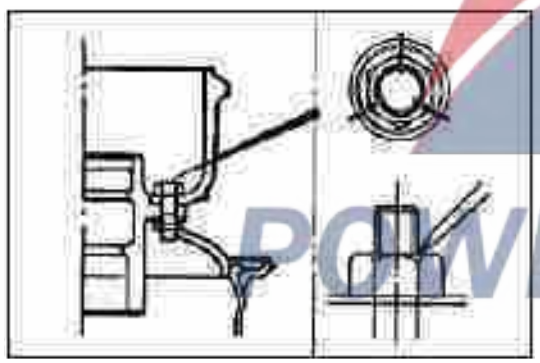
(2) Install wheel pin ③ onto hub ④. Note the installation direction as shown.

Hammer the wheel pin into the hub.

(3) Tightening torque of the wheel nut.

N • m(kgf • m)

Brake drum diameter mm 320mm	490(50)
Brake drum width 120mm	490(50)



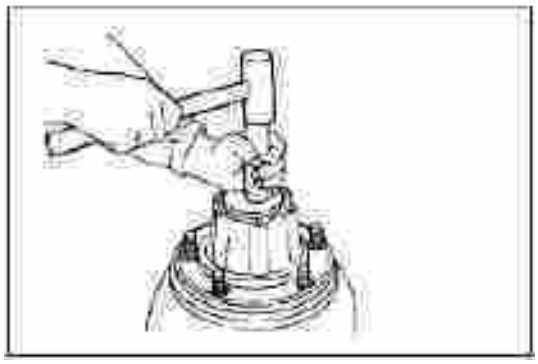
(4) Three key holes are punched on each thread of the axle nut to prevent loosening.

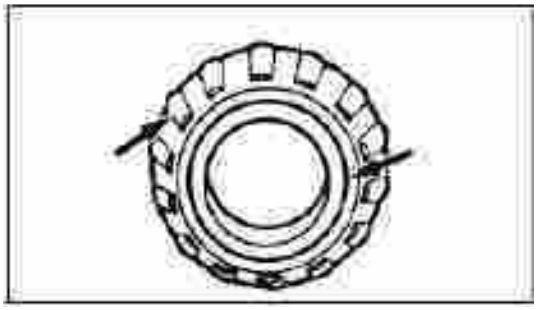
12. External bearing outer race

11. Inner bearing outer race

Attach outer race to hub with bearing outer race mount and mounting shank.

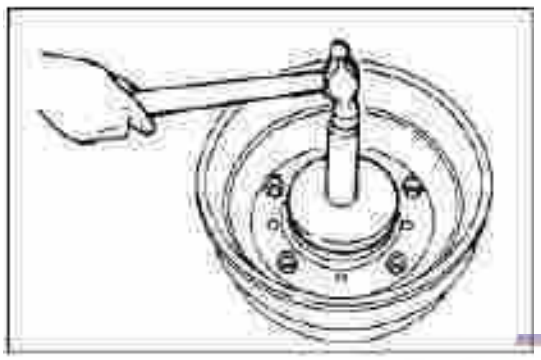
Outer bearing outer seat ring installer: 5-8840-2863-0





10. Inside bearing

Apply a sufficient amount of grease between the inner bearing and the bearing housing.



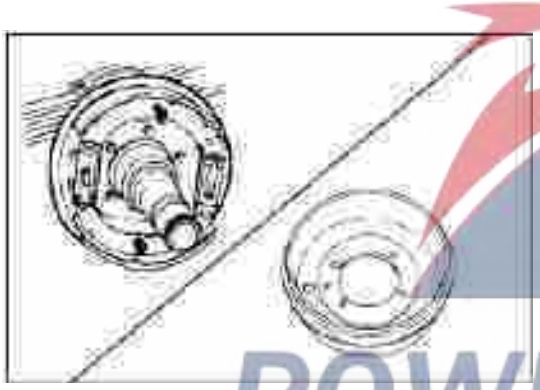
9. Inner oil seal

1. Apply grease to the inside and outside of the oil seal lip.

2. Install the oil seal on the hub with the oil seal mounter and mounting shank.

Oil seal installation procedure: 9-8522-1607-0

Mounting shank: 9-8522-1608-0



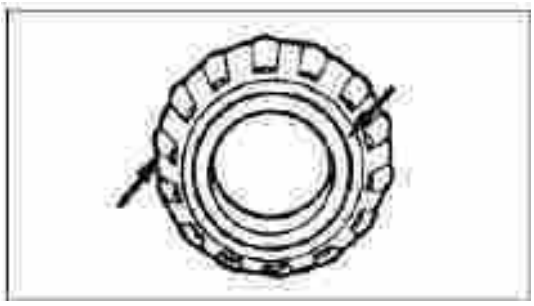
8. Oil ring

7. Wheel hub and brake drum

(1) Scrape the brake pads and the inner surface of the brake drum with oil and other contaminants.

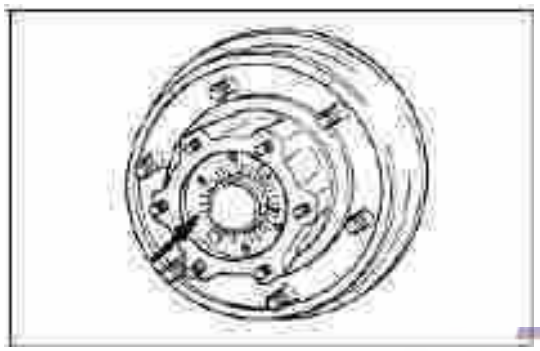
(2) Clean the mating surface of the rear axle housing.

(3) Mount the hub on the rear axle housing.



6. Outside bearing

Apply sufficient bearing grease between the inner bearing and the housing.



5. Locknut

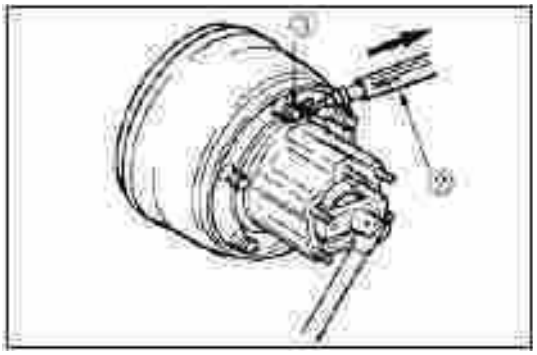
Install the locknut outward with a notch.

Wheel bearing top tension measuring method

(1) Turn the hub left and right several times to make the bearing even.

(2) Tighten the nut with the bearing nut ① until you turn the hub by hand.

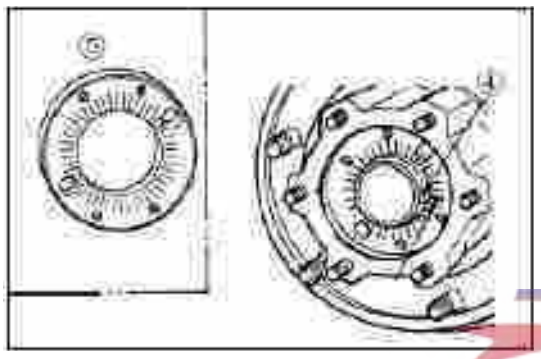
(3) Loosen the bearing nut until the hub rotates freely.



(4) Place the spring balance ② on the axle ③ as shown.

(5) Carefully pull the dial and observe the reading to measure the hub bearing preload.

Wheel bearing preload (wheel spindle)	(kg / lb)
42-52	
(4.3-5.3/9.5-11.7)	



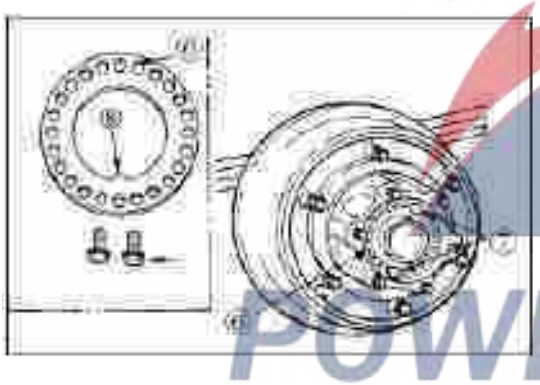
(6) Turn the hub back and forth several times.

(7) Measure the bearing preload again.

(8) Align the groove in the groove ④ on the axle box with the nearest bearing nut⑤.

Caution:

If the axle housing is hard to align with the bearing nuts, tighten the bearing nuts lightly.



4. Locking gasket

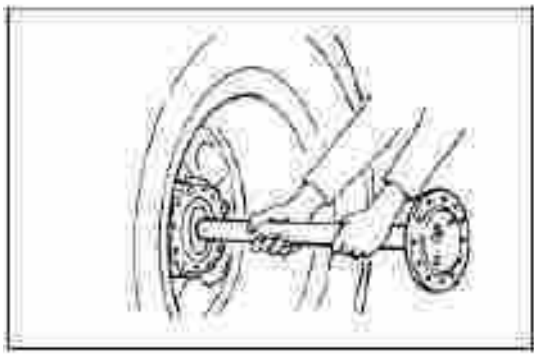
(1) Install the lock washer⑥ so that its tongue ⑧ is in the housing groove.

(2) Install the lock nut ⑦ to prevent the bearing nut from loosening.

(3) Check that the tab of the lock washer is in the groove of the housing.

3. Outer oil seal

Apply grease to the inner and outer circumferential surfaces of the iol seal lips.

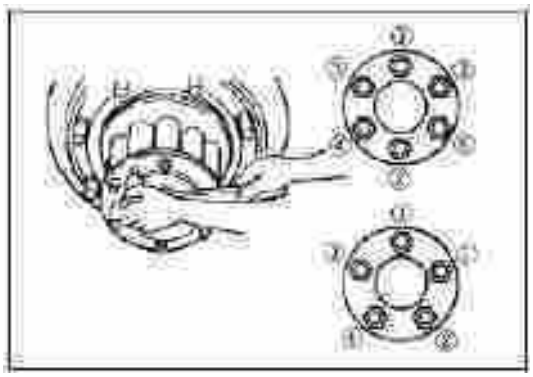


2. Half-shaft

(1) Clean the half-shaft.

(2) Apply gear oil to the spline of the axle.

(3) Insert the axle into the axle housing, being careful not to damage the seal.



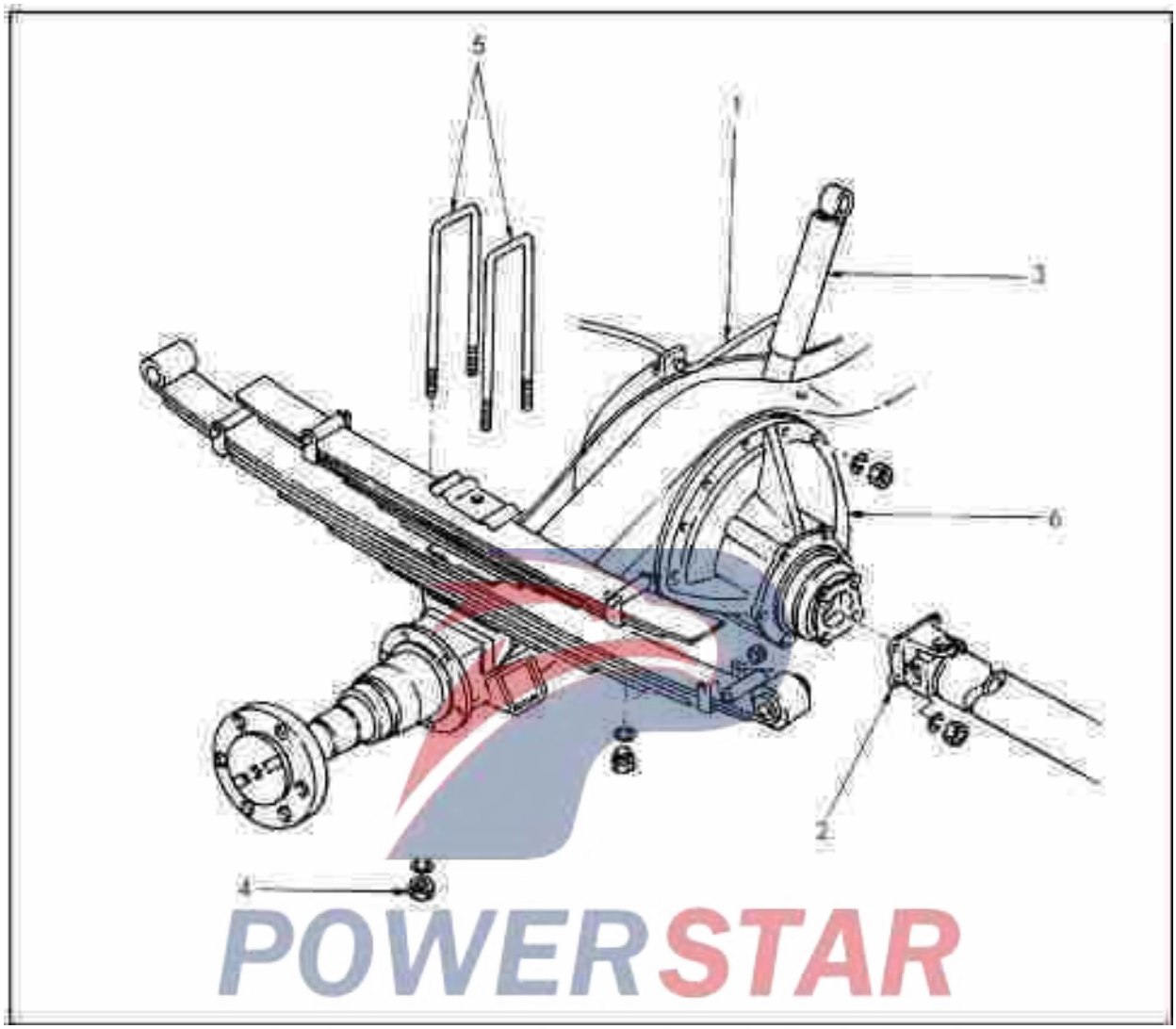
(4) Turn the shaft nut in the order shown to the specified torque.

Half Shaft Nut Torque	N • M(kgf·M/lb • Ft)
46(4.7/34)	

1. Wheel and tire

Wheel nut torque	N • M (kgf • M)
490(50)	

Rear axle assembly



Dismantling sequence

1. Rear brake oil pipe
2. Drive shaft
3. Rear shock absorber
4. Nuts and washers
5. U-bolt
6. Rear axle assembly

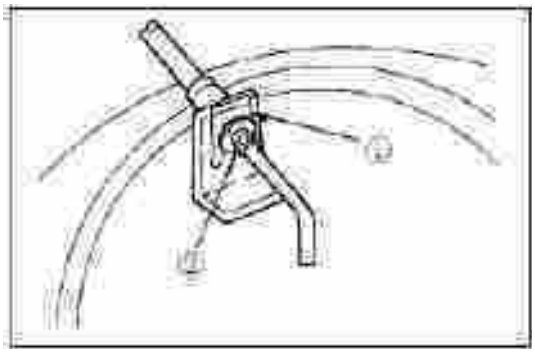
Assembling sequence

Assemble as per the sequence contrary to the dismantling sequence.

Disassembly

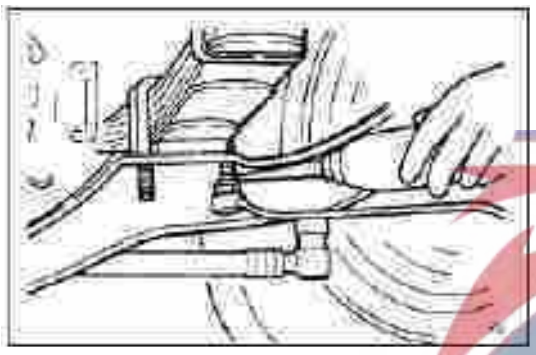
Preparations:

Raise the car with a jack and support it to the shelf.



1. Rear hose

Loosen nut ① and remove clamp ② .



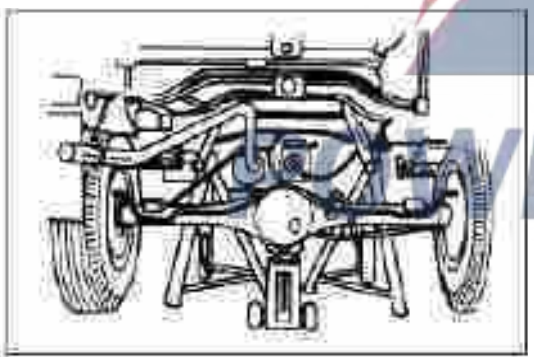
2. Rear drive shaft

3. Rear shock absorber

Remove the low end of the shock absorber.

4. Nuts and washers

If the U-bolt rust very powerful, should be loosened in the thread coated with oil to prevent stuck.



5. Lower clamping plate

6. U-bolt

7. Rear axle assembly

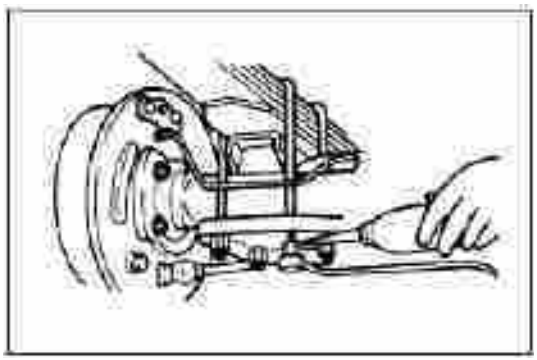
Move to the rear axle side.

Assembling

7. Rear axle assembly

6. U-bolt

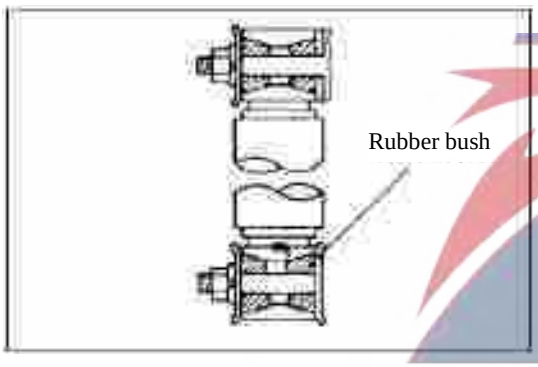
5. Lower clamping plate



4. Nuts and washers

When tightening the nut, apply oil as necessary to prevent damage to the threads.

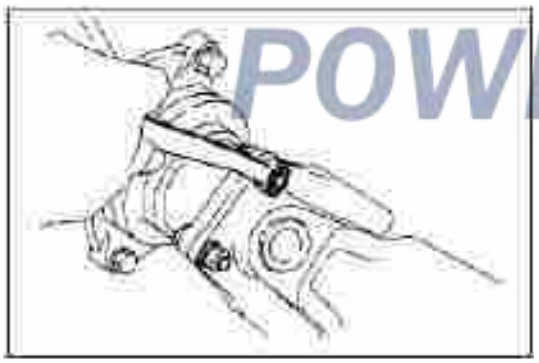
U-bolt nut torque	N • m(kgf • m/lb • ft)
177 (18.0/130)	



3. Rear shock absorber

Reference parts installation diagram

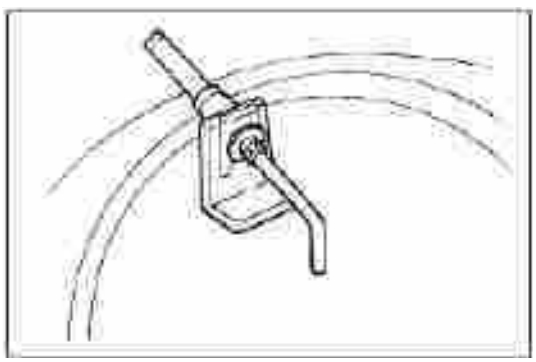
Shock absorber low nut torque	N • m(kgf • m/lb • ft)
Double tires	95(9.7/70)



2. Rear drive shaft

After tightening the U-bolt, connect the transmission shaft assembly.

Transmission axle nut torque	N • m(kgf • m/lb • ft)
M10	63(6.4/46)
M12	103(10.5/76)



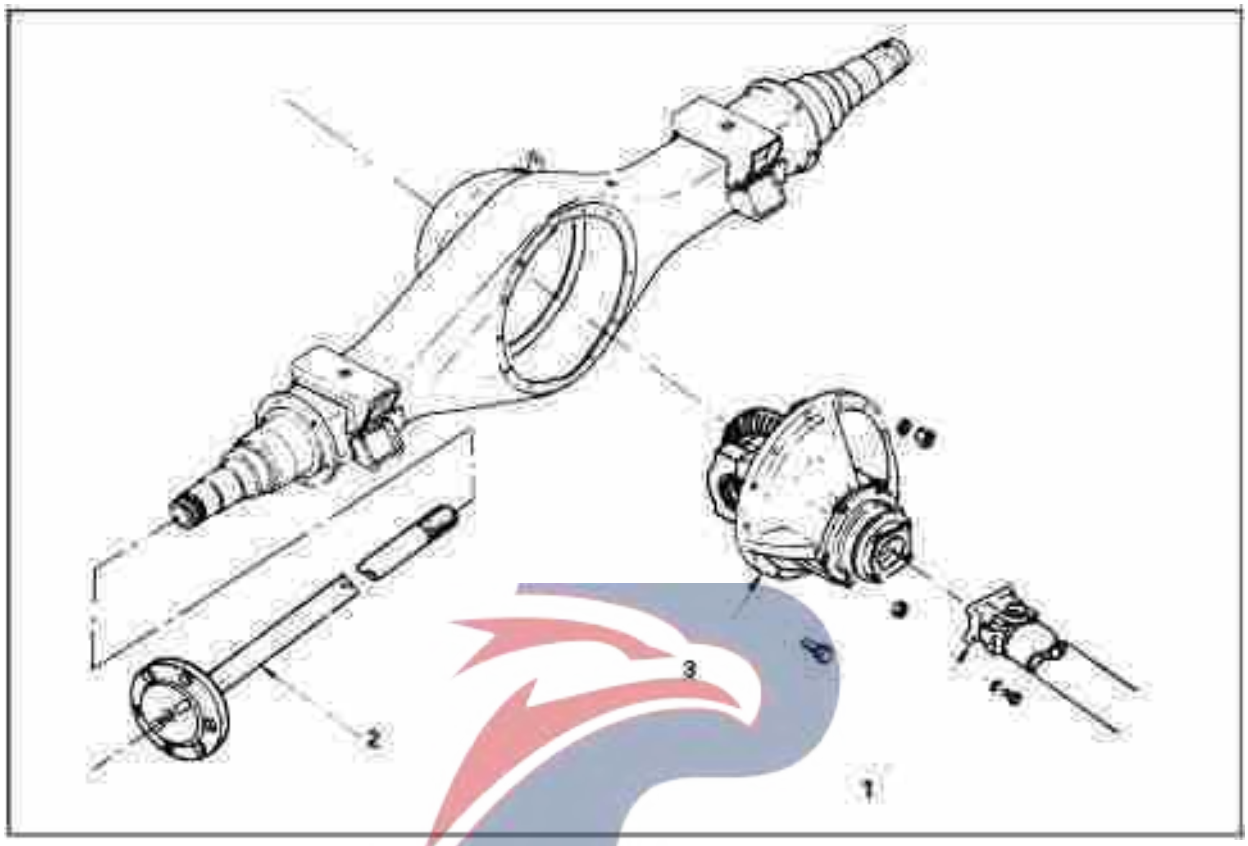
1. Rear brake hose

Install in reverse order of disassemble.

Taper nut torque	N • m(kgf • m/lb • ft)
16(1.6/12)	

After installing the brake hose, venting must be performed. Refer to Section 5 "Maintenance information" for the procedure for draining the brake oil.

Main reducer assembly



Dismantling sequence

1. Drive shaft
2. Half-shaft
3. Main reducer assembly

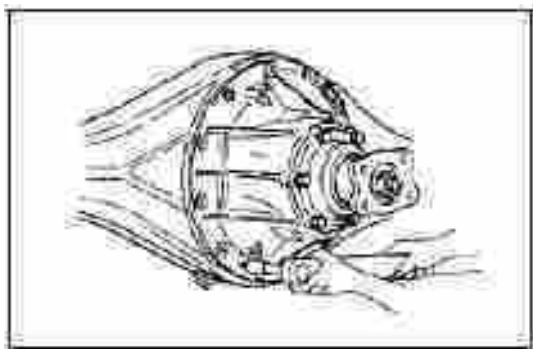
Assembling sequence

Assemble as per the sequence contrary to the dismantling sequence.

Disassembly

Preparation work

Release the oil in the axle housing



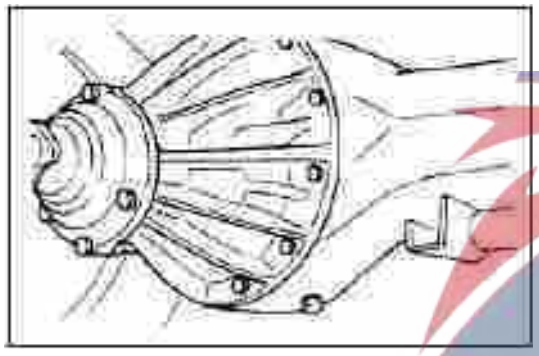
1. Drive shaft

2. Half-shaft

3. Main reducer assembly

When disassembling the main decelerator, screw the thrusting bolt into the screw hole of the main decelerator housing and remove the main decelerator assembly.

Assembling



3. Main reducer assembly

Apply liquid sealant (BELCO BOND4 or, equivalent) to the connection surface of the axle housing and the housing of the main reducer.

Main decelerator housing bolts and nuts torque

N·m(kgf·m/lb·ft)

320 mm, main reducer	Nuts	64(6.5/47)

2. Half-shaft

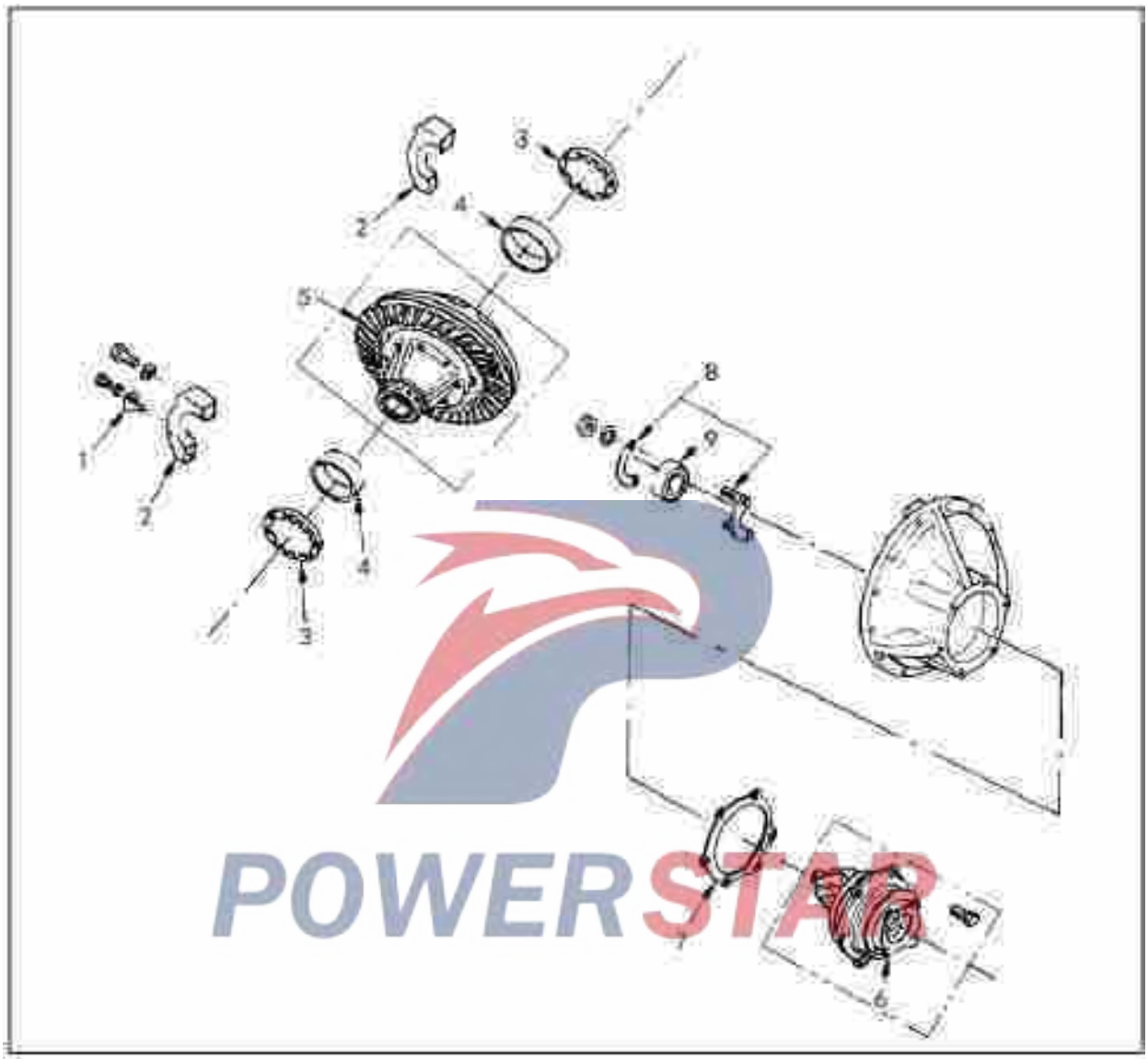
Half Shaft Nut Torque	N • M(kgf • M/lb • Ft)
	54(5.5/40)

1. Drive shaft

Transmission axle nut torque	N • m(kgf • m/lb • ft)
M10	65(6.7/48)
M12	103(10.5/76)

320 mm rear axle main reducer

Main components



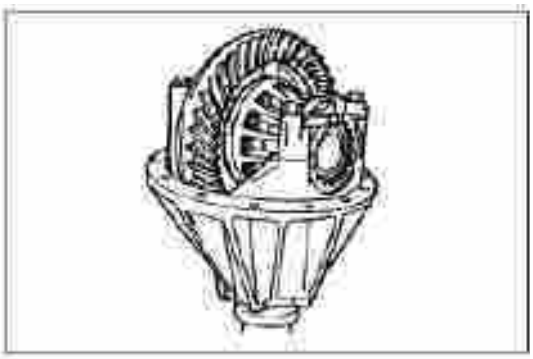
Disassembling sequence

1. Lock block
2. Bearing cap
3. Adjusting nut
4. End bearing outer race
5. Differential and driven gear assembly
6. Driving gear assembly
7. Gasket
8. Guide bearing retainer
9. Guide bearing

Reassembling sequence

9. Guide bearing
8. Guide bearing retainer
5. Differential and driven gear assembly
4. End bearing outer race
2. Bearing cap
3. Adjusting nut
7. Gasket
6. Driving gear assembly
1. Lock block

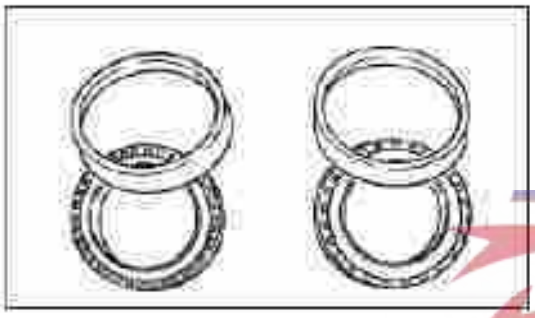
Disassembling



1. Lock block

2. Bearing cap

Main decelerator assembly is fixed on the special clamping device. Mark the left and right bearing caps to prevent mixing.

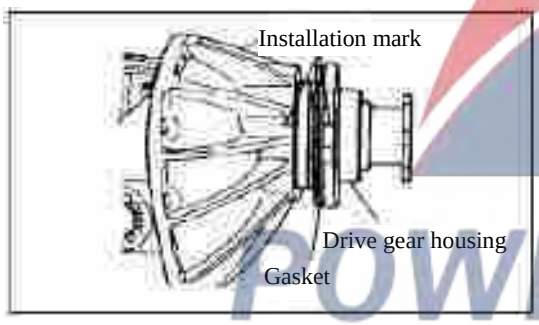


3. Adjusting nut

4. End bearing outer race

Separate storage the end bearing outer race and inner race to prevent mixing.

5. Differential and driven gear assembly



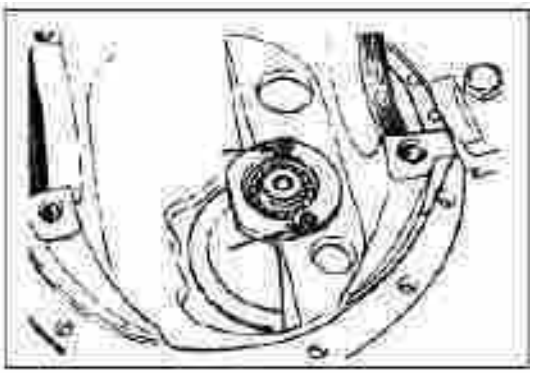
6. Driving gear assembly

7. Gasket

8. Guide bearing retainer

9. Guide bearing

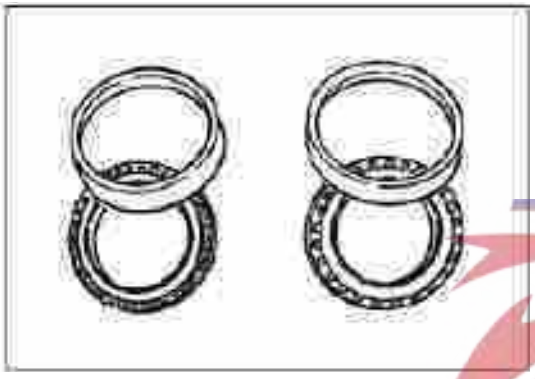
Reassembling



9. Guide bearing

8. Guide bearing retainer

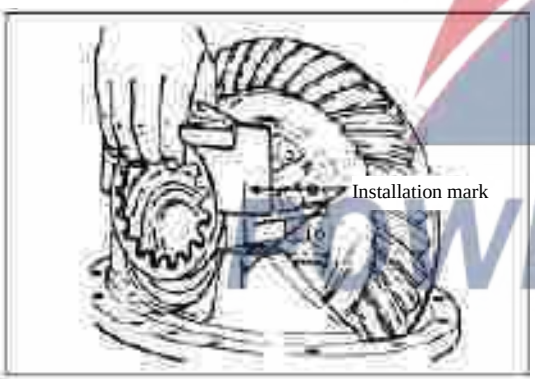
The fixing nut must be inside the housing.



5. Differential and driven gear assembly

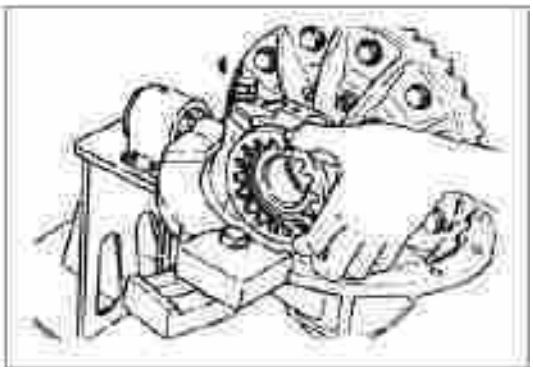
4. End bearing outer race

Install the inner and outer seat races, should to maintain the original combination.



2. Bearing cap

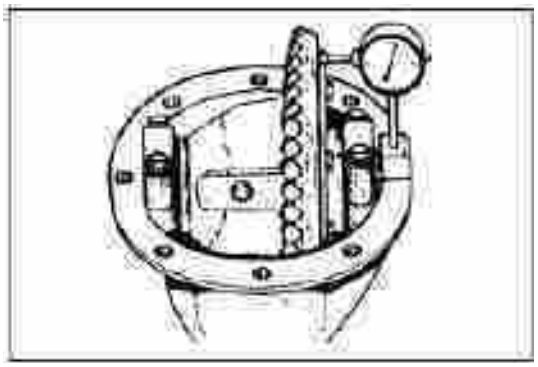
When installing the bearing cap, align the mounting marks at the time of disassembly.



3. Adjusting nut

(1) Align the thread groove on the nut with the thread groove on the housing.

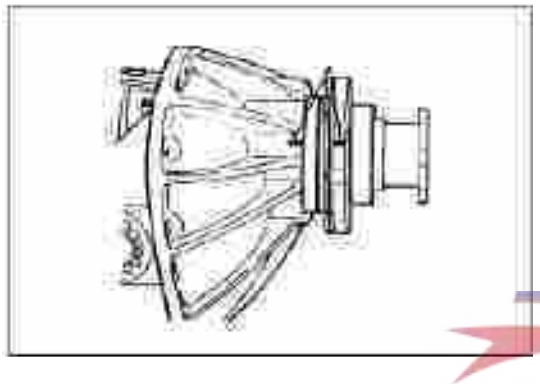
(2) After the adjustment nuts are screwed on and the bearing caps are mounted and half-tightened, these nuts should be able to rotate.



Driven gear radialr unout inspection

mm(in)

	Standard	Limit
320mm	0.08(0.003)	0.25(0.010)

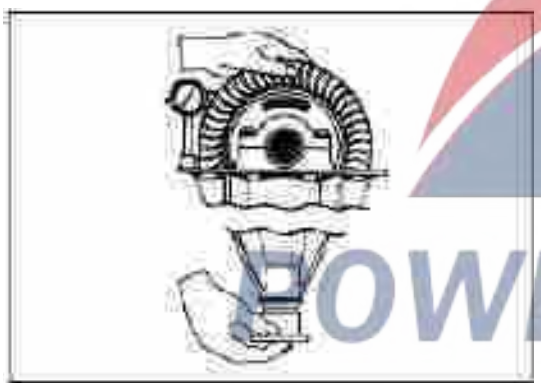


7. Gasket

6. Driving gear assembly

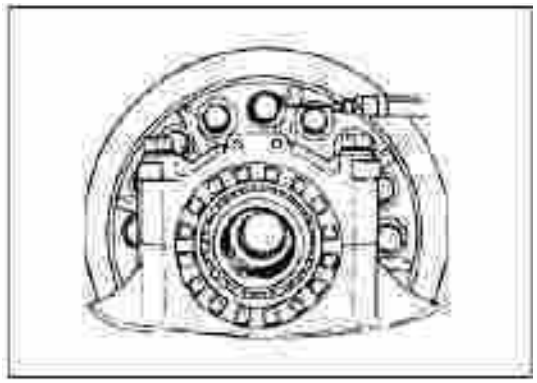
When installing the removed shims and driving gear, align the oil hole or the mounting marks at the time of removal.

Driving gear assembly bolt torque		N • m(kgf • m/lb • ft)
320mm	M12	69(7.0/51)
	M14	78(8.0/58)



Tooth Backlash between the driving and driven gears

Backlash	mm(in)
320mm	0.19-0.29 (0.007-0.010)

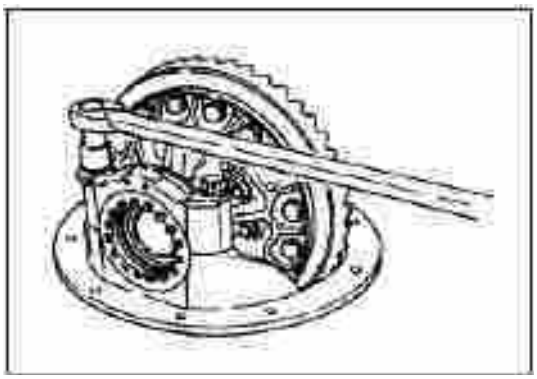


Bearing preload N (kg/lb)

N. S. K Bearing	5.7—13.0 (0.58—1.33/1.3—2.9)
Koyo Bearing	11.5—17.9 (1.17—1.83/2.6—4.0)

End bearing preload adjustment

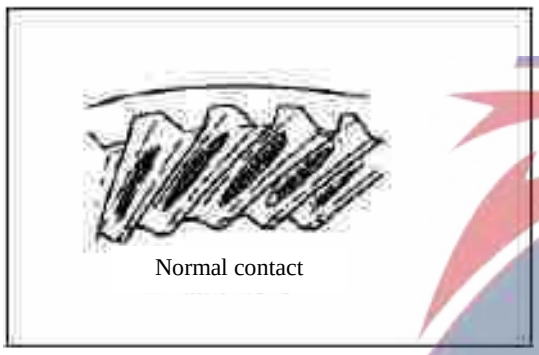
Screw the adjusting nut on the driven gear into two notches and adjust to the normal bearing preload, at this point both of the tooth gap and the tooth surface contact region should be normal.



Tighten all of the bearing cap nuts.

Bearing nut torque	N • m(kgf • m/lb • ft)
320mm	108(11/80)

After tighten the bearing cap nuts, check the tooth gap again.



Normal contact

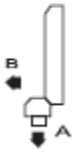
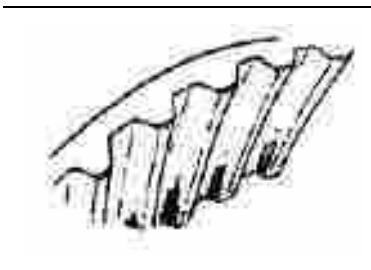
Inspection of the contact region between the driving gear and the driven gear tooth surface.

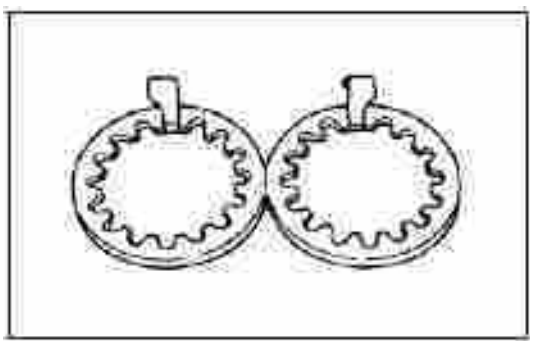
- Apply a thin layer of red pigment to the 7-8 teeth of the driven gear.
- Check for dents on the tooth surface contact area of the driven gear. If the dent in the contact area is abnormal, follow the instructions below to make the necessary adjustments.

Provides an adjustable seal

mm(in)

0.10, 0.12, 0.14, 0.16, 0.18, 0.20 (0.004, 0.0047, 0.0055, 0.0063, 0.0071, 0.0079)

Tooth contact region	Causes	Adjustment steps
	The driving gear is too far from the driven gear.	1. Decrease the thickness of the axial adjusting gasket of the driving gear, so that it approaches the driven gear. 2. Move the driven gear, so that it is far away from the driving gear to adjust the backlash. 
	The driving gear is too close to the driven gear.	1. Increase the thickness of the axial adjusting gasket of the driving gear, so that it is slightly separated from the driven gear. 2. Move the driven gear towards the driving gear to adjust the backlash. 
	The driven gear is too close to the driving gear.	1. Decrease the thickness of the axial adjusting gasket of the driving gear, so that it approaches the driven gear. 2. Move the driven gear, so that it is far away from the driving gear to adjust the backlash. 
	Driven gear too far from the drive gear.	1. Increase the thickness of the axial adjusting gasket of the driving gear, so that it is slightly separated from the driven gear. 2. Move the driven gear towards the driving gear to adjust the backlash. 

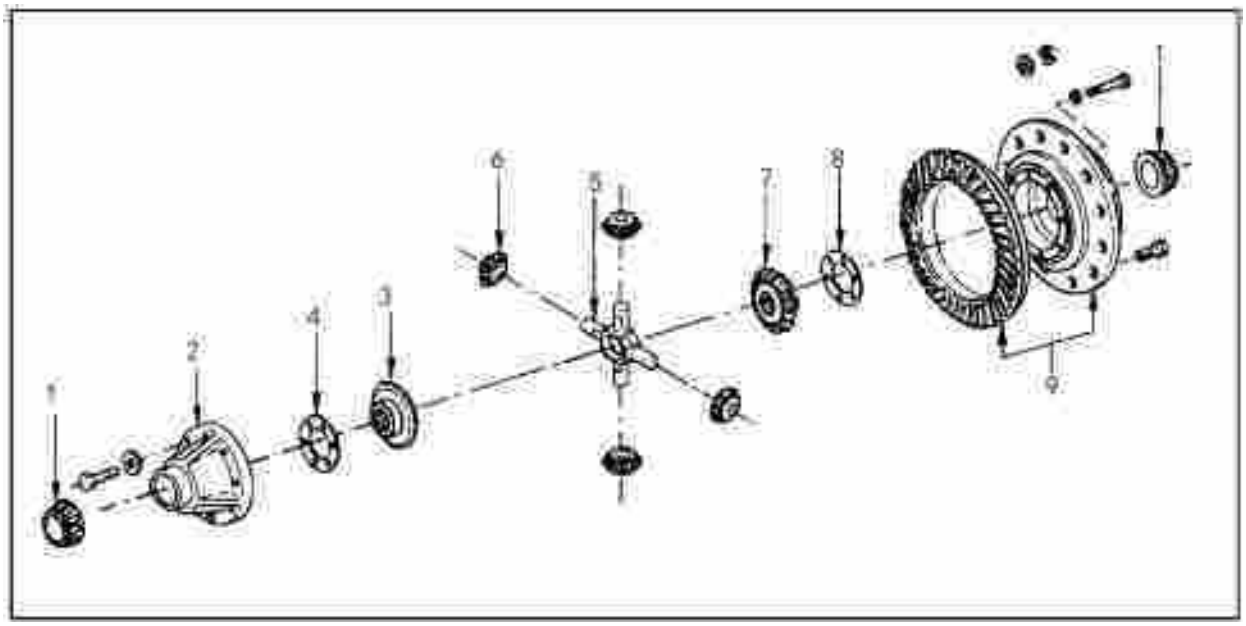


1. Lock block

Locking torque	N • m(kgf·M / lb·Ft)
320mm	13(1.3 / 10)

Two types of lock blocks are provided to adjust when the nuts are misaligned by 1/2 notch.

Differential case assembly



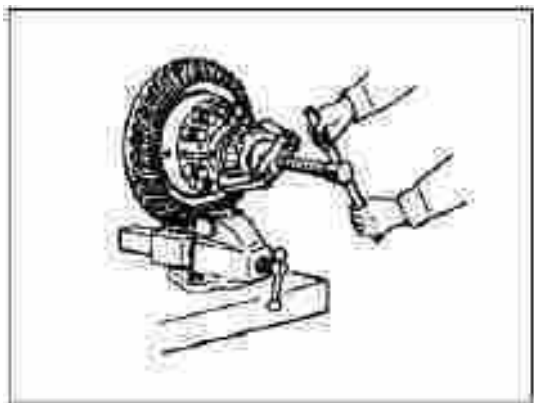
Disassembling sequence

1. End bearing race inner
2. Differential case B
3. Semi-axle gear
4. Thrust washer
5. Cross shaft
6. Planetary gears
7. Semi-axle gear
8. Thrust washer
9. Differential case A and driven gear

Reassembling sequence

Reassemble as per the sequence contrary to the disassembling sequence

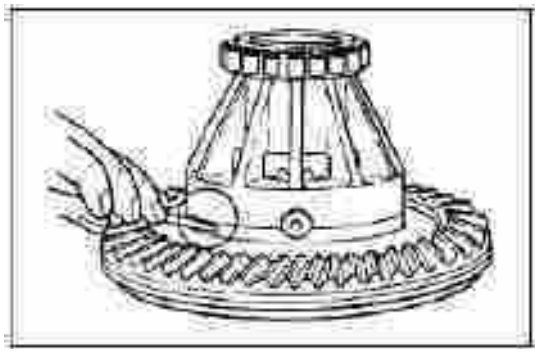
Disassembling



1. End bearing race inner

Half-shaft puller: 5-8840-2373-0

Connector 5-8840-2864-0



2. Differential case B

Before disassembling the differential case B, a mounting mark should be engraved to ensure that it is installed in place.

3. Semi-axle gear

4. Thrust washer

5. Cross shaft

6. Planetary gears

7. Semi-axle gear

8. Thrust washer

9. Differential case A and driven gear

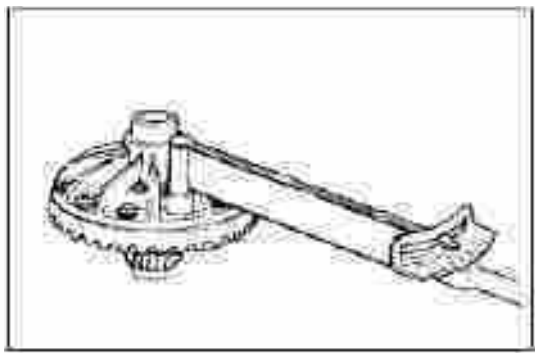
Inspection and repair

If the parts are found by inspection to be worn, damaged or otherwise malfunctioned, repair or replacement , should be carried out.

- Gear
- Bearings
- Oil seal
- Differential housing
- Planetary gears

Visual inspection

Check for wear, damage or other faults of the following parts.

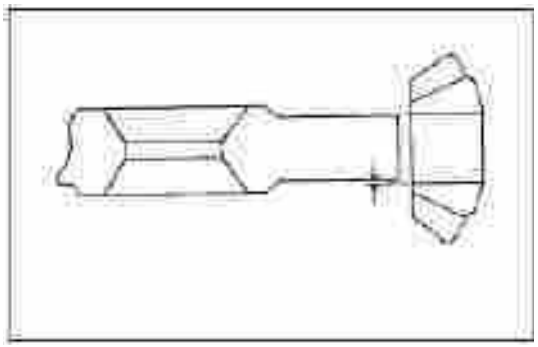


Driven gear replacement

The driven gear must be replaced in pairs with the driving gear.

When mounting the driven gear, apply LOCTITE 271 or equivalent to the bolt threads and threaded holes of the driven gear, then tighten and tighten the bolts to the specified torque.

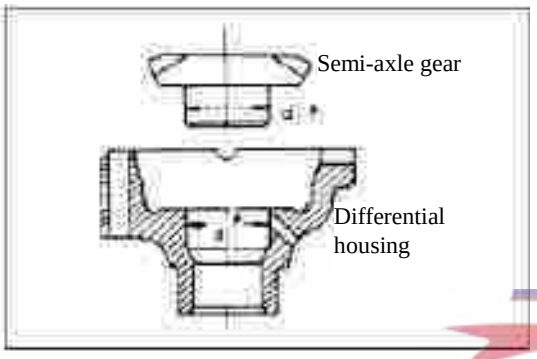
Driven gear tightening torque	N • m (kgf·M / lb • Ft)
320mm	333(34.0/246.7)



Clearance between spider and planetary gear

mm(m)

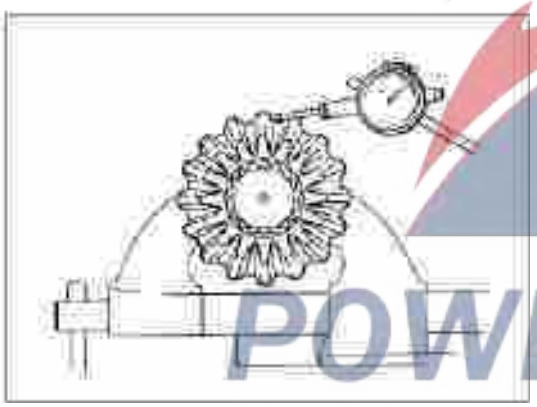
	Standard	Limit
320mm	0.05-0.13 (0.002-0.005)	0.2(0.008)



Clearance between side gear and differential housing

mm(in)

	Standard	Limit
320mm	0.13-0.20 (0.065-0.008)	0.25(0.01)



Clearance between axle gear and axle shaft spline

mm(in)

	Standard	Limit
320mm	0.2 (0.08)	0.5(0.02)

Reassembling

9. Differential case A and driven gear

8. Thrust washer

7. Semi-axle gear

6. Planetary gears

5. Cross shaft

4. Thrust washer

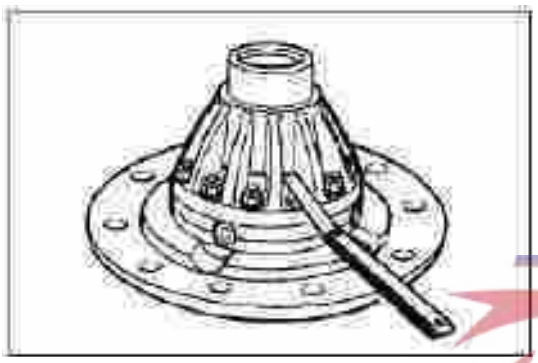
3. Semi-axle gear

2. Differential case B

1) When installing, align the installation mark.

2) Apply oil to the threaded portion of the bolt before installation.

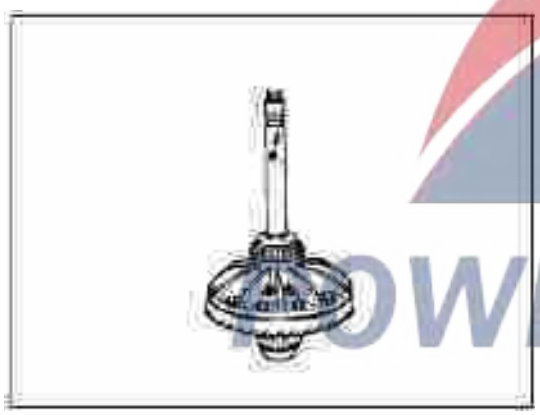
Differential nut torque		N • m (kgf • m / lb • ft)
320mm	M12	181(18.5/134)
	M14	333(34.0/247)



3) Insert a feeler gauge into the hole of the housing B, and measure the gap between the side gear rear surface and the differential housing B.

Gap	mm(in)
320mm	0.15-0.20(0.005-0.008)

If the gap exceeds the limit, should replace the thrust washers or semi-shaft gear.

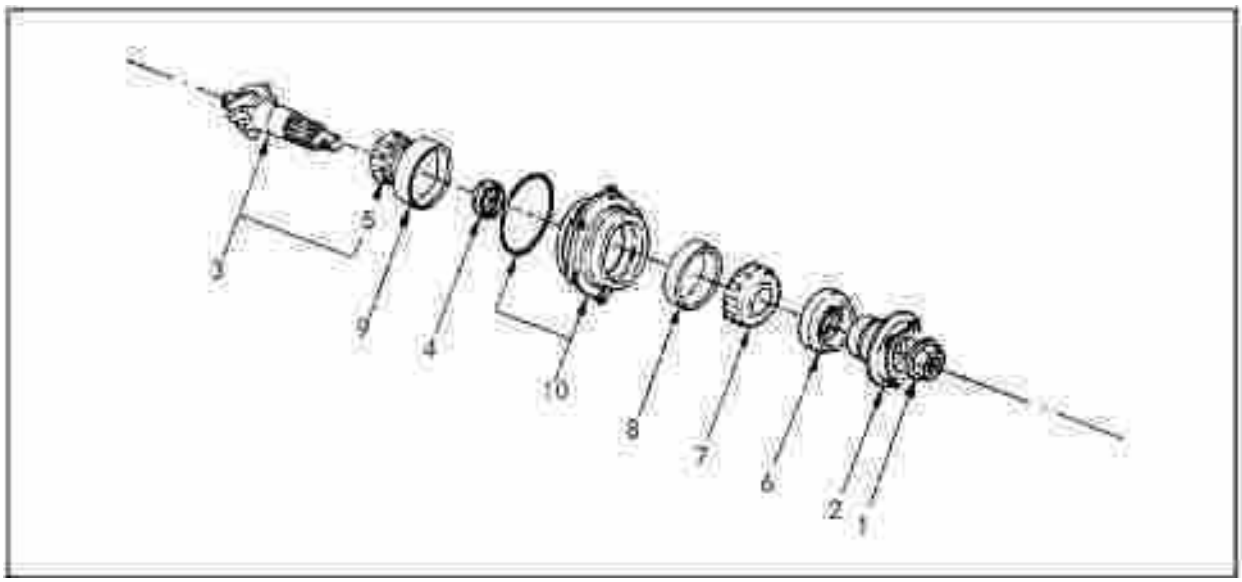


1. End bearing race inner

Installation procedure: 9-8522-1614-0

Fixture: 5-8840-0007-0

Driving gear housing assembly



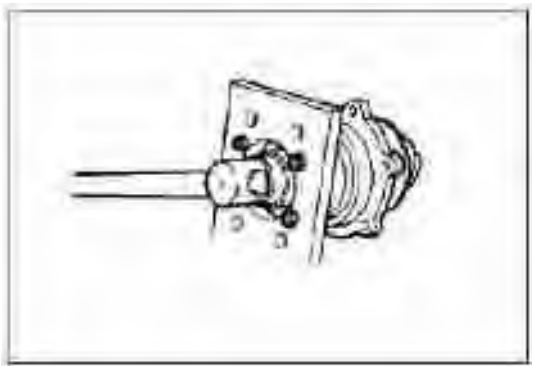
Disassembling sequence

1. Riveted flange nuts.
2.Flange
3. Driving gear
4. Detachable spacer ring
5. Inner bearing inner race
6. Oil seal device
7. Outer bearing inner race
8. External bearing outer race
9. Inner bearing outer race
10. Driving gear bearing seat and O-ring

Reassembling sequence

Reassemble as per the sequence contrary to the disassembling sequence

Disassembling



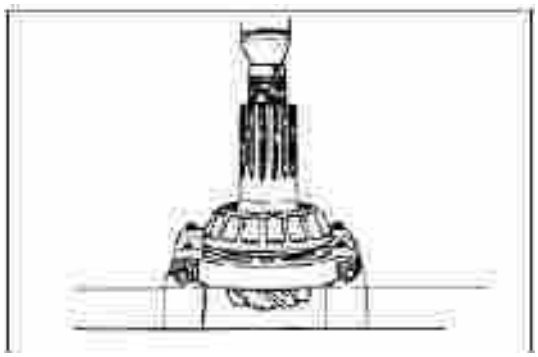
1. Riveted flange nuts.

Flange bracket: 9-8529-2101-0

2. Flange

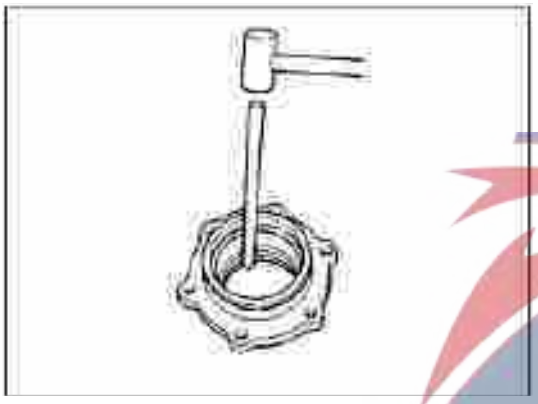
3. Driving gear

4. Detachable spacer ring



5. Inner bearing inner race

Half-shaft puller: 5-8840-0015-0



6. Oil seal device

7. Outer bearing inner race

8. External bearing outer race

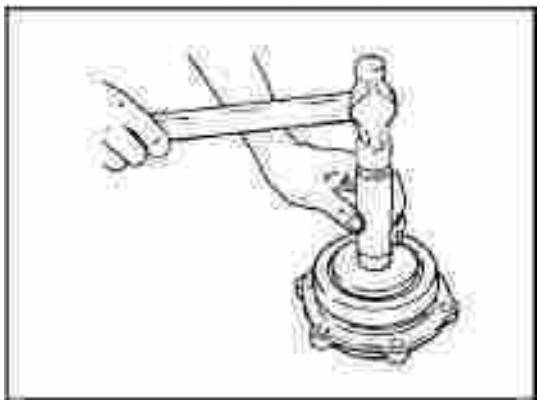
Using a suitable rod, remove the outer bearing outer seat race and outer bearing inner seat race together with the oil seal or inner bearing outer seat race by the two notches.

9. Inner bearing outer race

10. Driving gear bearing seat and O-ring

Reassembling

10. Driving gear bearing seat and O-ring



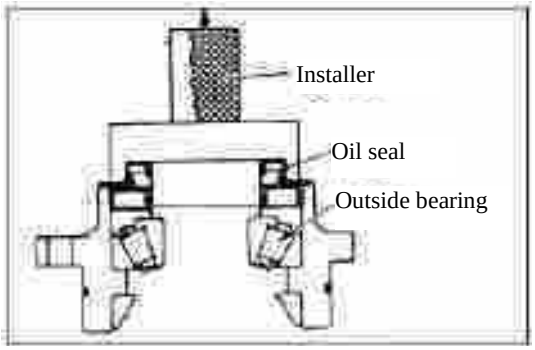
Can not use the old O-ring, install a new one.

9. Inner bearing outer race

Installation procedure: 5-8840-2379-0

8. External bearing outer race

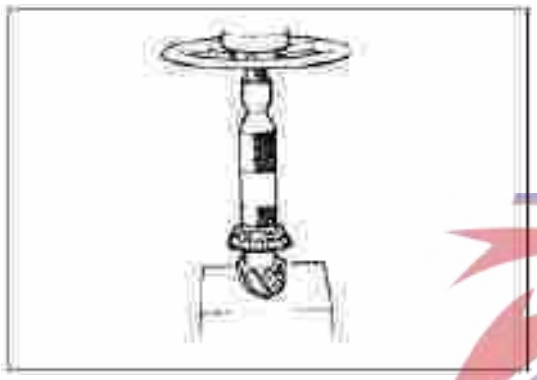
Installation procedure: 5-8840-3863-0



7. Outer bearing inner race

6. Oil seal device

Installation procedure: 5-8840-2377-0



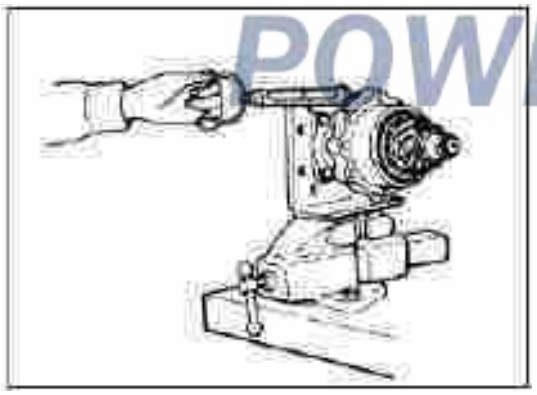
5. Inner bearing inner race

Installation procedure: 5-8840-2345-0

4. Detachable spacer ring

Can not use the old spacer, install a new one.

3. Driving gear



2. Flange

1. Riveted flange nuts.

When refitting, you can not use the old flange nut, install a new one.

Bearing preload adjustment

(1) Tighten the flange nuts with 245N·m (25kg·m/181lb·ft) of torque.

(2) Tighten the flange nuts until the specified bearing preload.

(3) When the specified pre-tightness is achieved, the torque of the flange nut shall be within the specified range.

Flange nut torque N•m (kgf•m/lb•in)

320mm	441-538 (45.0-61.0/324-399))

When tightening the nut, apply oil to the contact surface of the nut.

Preload of the bearing bracket fixing bolt holes N (kg/lb)

320mm	New bearing	27.0-39.0 (2.8-4.0/6.0-8.7)
	Used bearings	13.0-19.0 (1.3-1.9/2.9-4.2)

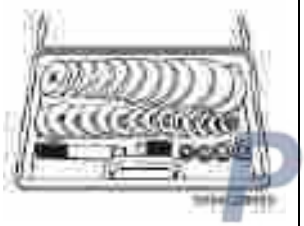
Starting torque N•m (kgf•m/lb•in)

320mm	New bearing	23.0-32.0 (2.3-3.2/5.1/7.1)
	Used bearings	12.0-16.0 (1.2-1.6/2.7-3.6)

(4) Use a special tool to punch two lock holes in the flange nut threads.

Punch tool: 5-8840-2293-0

Special tools

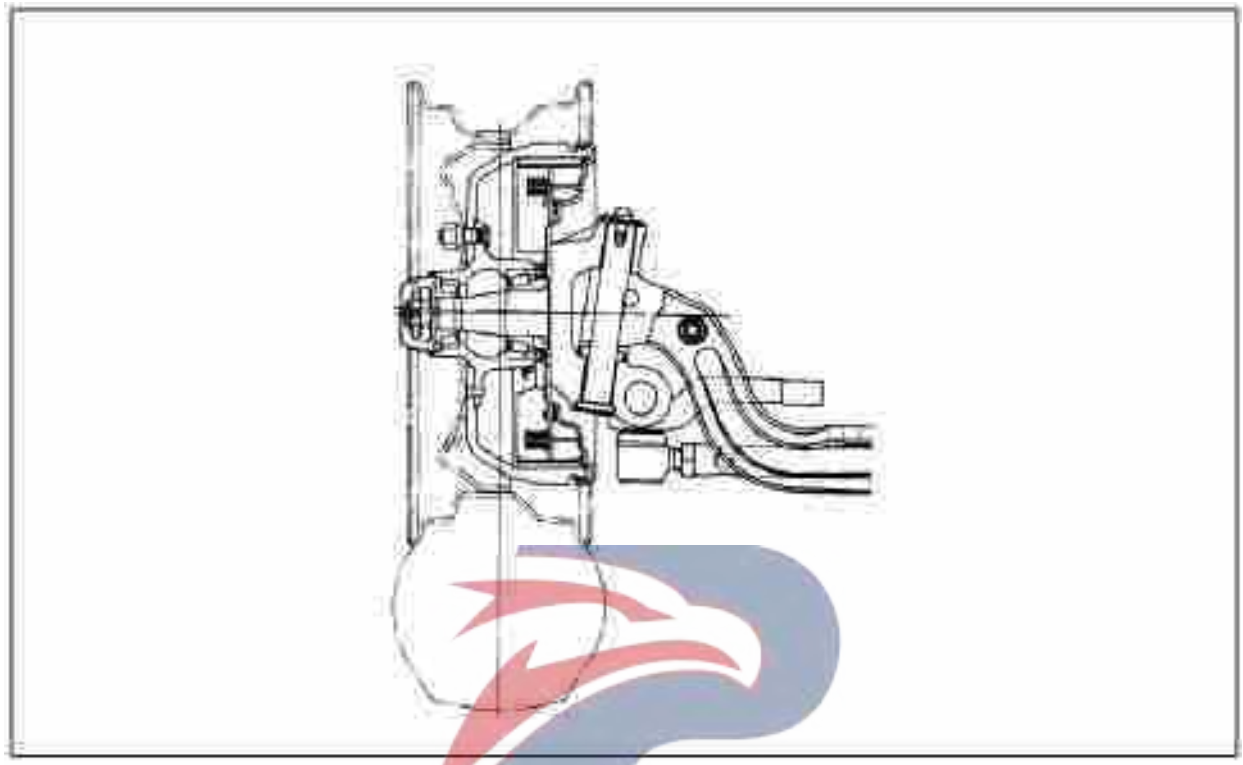
Graphic representation	Tool chart number	Graphic representation	Tool chart number
	5-8840-0084-0 Slide hammer		9-8521-2401-0 Hub disassembler screw
	5-8840-2027-0 Universal removal tool		9-8521-2501-0 Hub disassembler
	5-8840-2182-0 Wheel Bearing Locking Wrench		9-8522-1606-0 Wheel bearing nut wrench
	5-8840-2863-0 Onboard tool kit		9-8522-1607-0 Oil seal installer
	5-8840-2864-0 Pedal Adaptor Kit		9-8522-1608-0 Handle
	9-8521-0116-0 Hub disassembler		9-8522-1609-0 Bearing mounter

Section 3C2
Front axle

Table of Contents

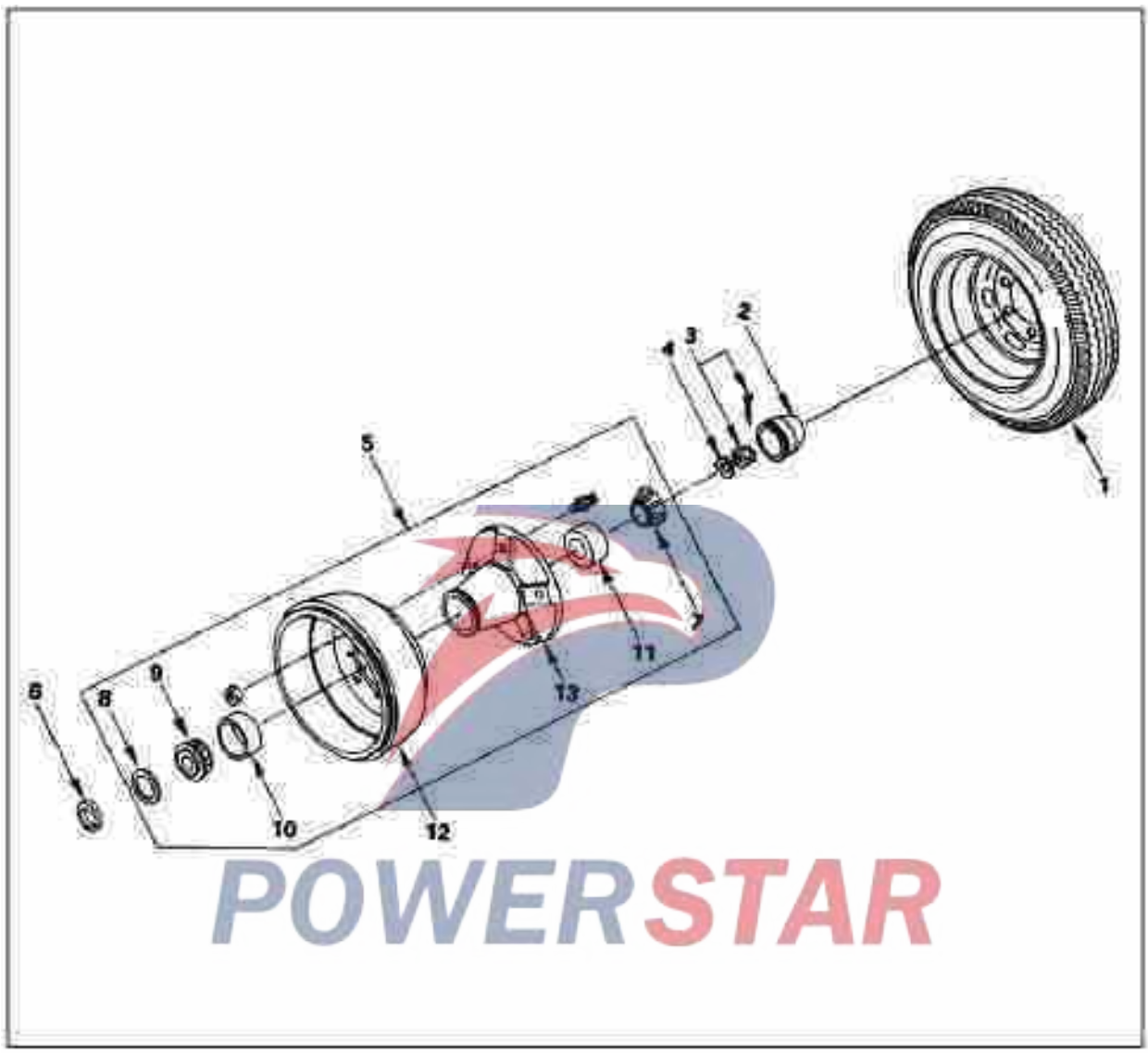
Overview

Front drum brake model (4×2 type)



On-board maintenance

Front wheel hub and brake drum (4×2 type)



Dismantling sequence

1. Wheel and tire
2. Wheel hub
3. Hub bearing nut
4. Locking gasket
5. Wheel hub assembly with brake drum
6. Spacer ring
7. Outside bearing
8. Oil seal device
9. Inside bearing
10. Inner bearing outer race
11. External bearing outer race
12. Brake drum
13. Wheel hub

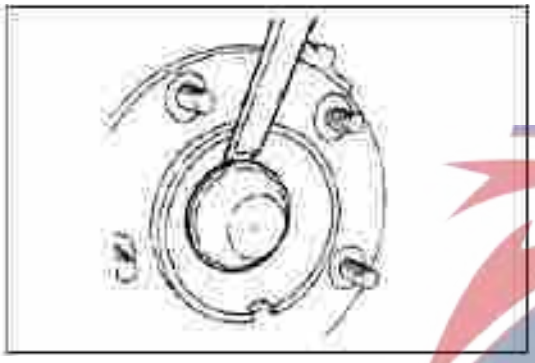
Assembling sequence

Assemble as per the sequence contrary to the dismantling sequence.

Disassembly

Preparation work

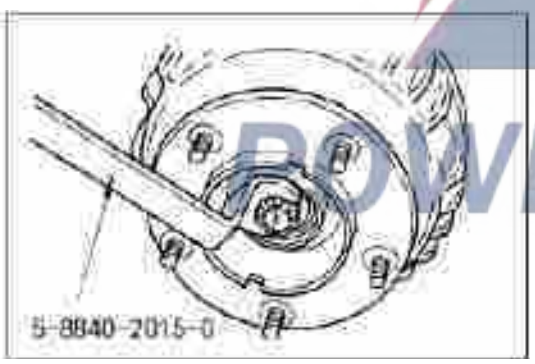
Raise the vehicle and support it on the stand.



1. Wheel and tire

2. Hubcaps

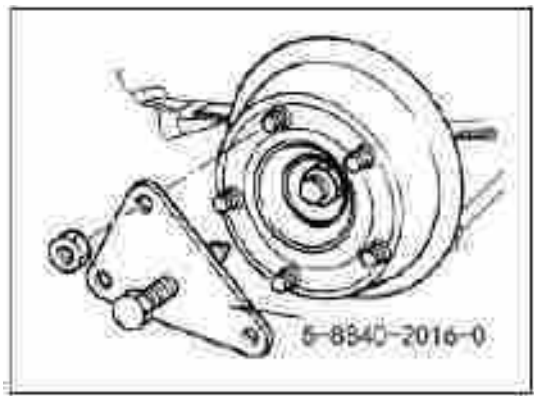
When removing the bearing cap, care must be taken, Do not bump the hub mounting surface or deform it.



3. Hub bearing nut

Wheel hub nut wrench: 5-8840-2015-0

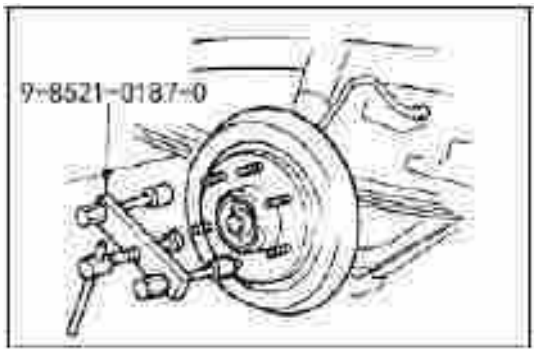
4. Locking gasket



5. Wheel hub assembly with brake drum

5 Stud type

Hub remover: 5-8840-2016-0

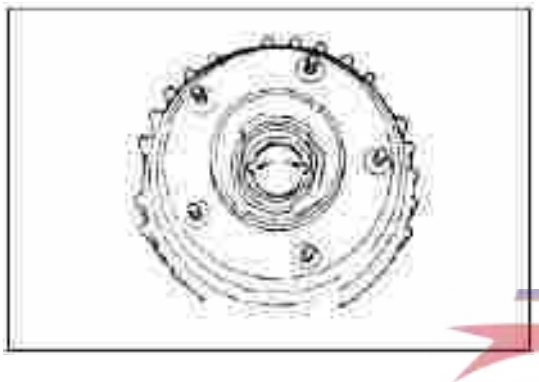


6. Spacer ring

7. Outside bearing

8. Oil seal device

9. Inside bearing



10. Inner bearing outer race

Using a suitable rod, remove the inner bearing outer seat race together with the oil sealby the two notches

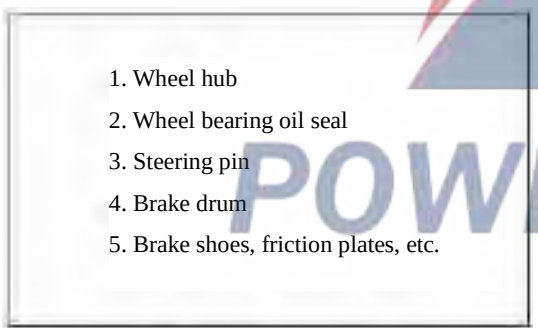
11. External bearing outer race

12. Brake drum

13. Wheel hub

Inspection and repair

In the inspection process, such as found parts wear and tear, damage and other failures, must be adjusted, repaired or replaced.



1. Wheel hub
2. Wheel bearing oil seal
3. Steering pin
4. Brake drum
5. Brake shoes, friction plates, etc.

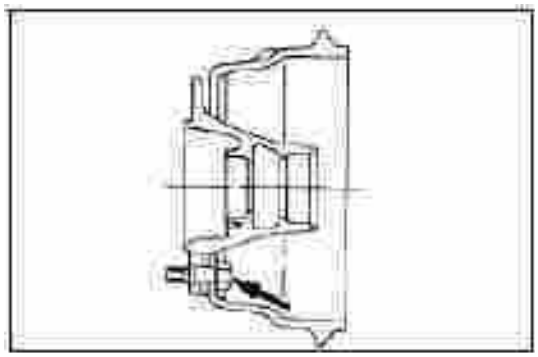
Visual inspection

Inspect the following parts for wear, damage or other malfunctions.

Assembling

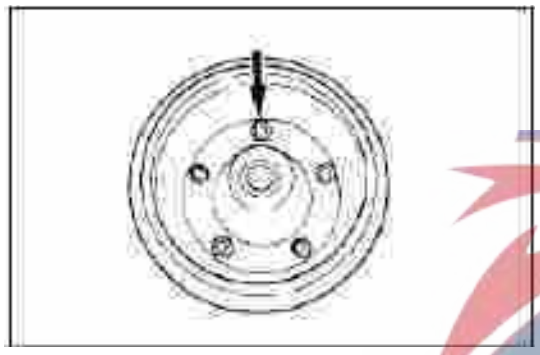
13. Wheel hub

12. Brake drum



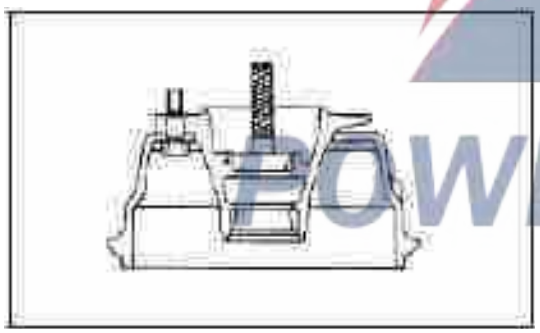
Screw the drum nut to the specified torque.

Wheel nut torque	N • m(kgf • m/ib • ft)
Brake friction plate width 120mm	343(35/253)



After replacing the hub or brake drum, punch three lock pockets on each wheel pin nut thread.

This figure refers to 5, stud type.

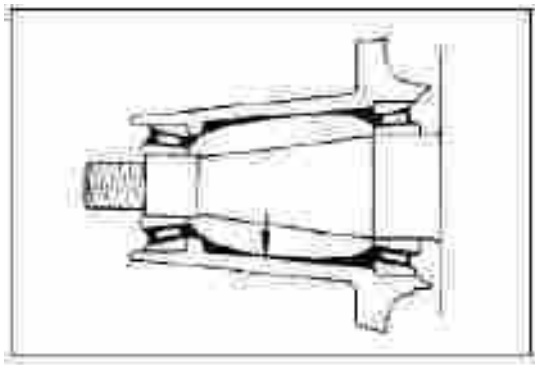


11. External bearing outer race

10. Inner bearing outer race

Bearing outer seat race installer

Part Number	Remark
9-8522-1148-0	Fixture
5-8840-2184-0	Inside bearing



Add the grease to the hub inner and bearing rollers

Hub grease quantity g(oz)

	Wheel hub	Hub cover
Double rear tires	160 (5.6)	40(1.4)

9. Inside bearing

8. Oil seal device

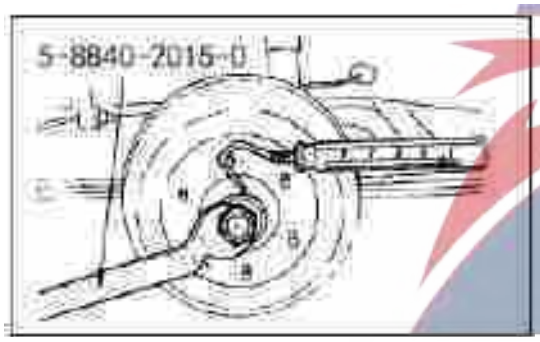
Press the oil seal into the hub

6. Spacer ring

7. Outside bearing

5. Wheel hub assembly with brake drum

4. Locking gasket



3. Hub bearing nut

First check brake lining clearance to avoid friction.

Adjust the wheel hub bearing preload at the wheel pin.

Hub bearing preload

(Wheel pin) N(kg/ib)

	New bearing	9.8-24.5 (1.0-2.5/2.2-5.5)
	Used bearings	4.9-19.6 (0.5-2.0/1.1-4.4)

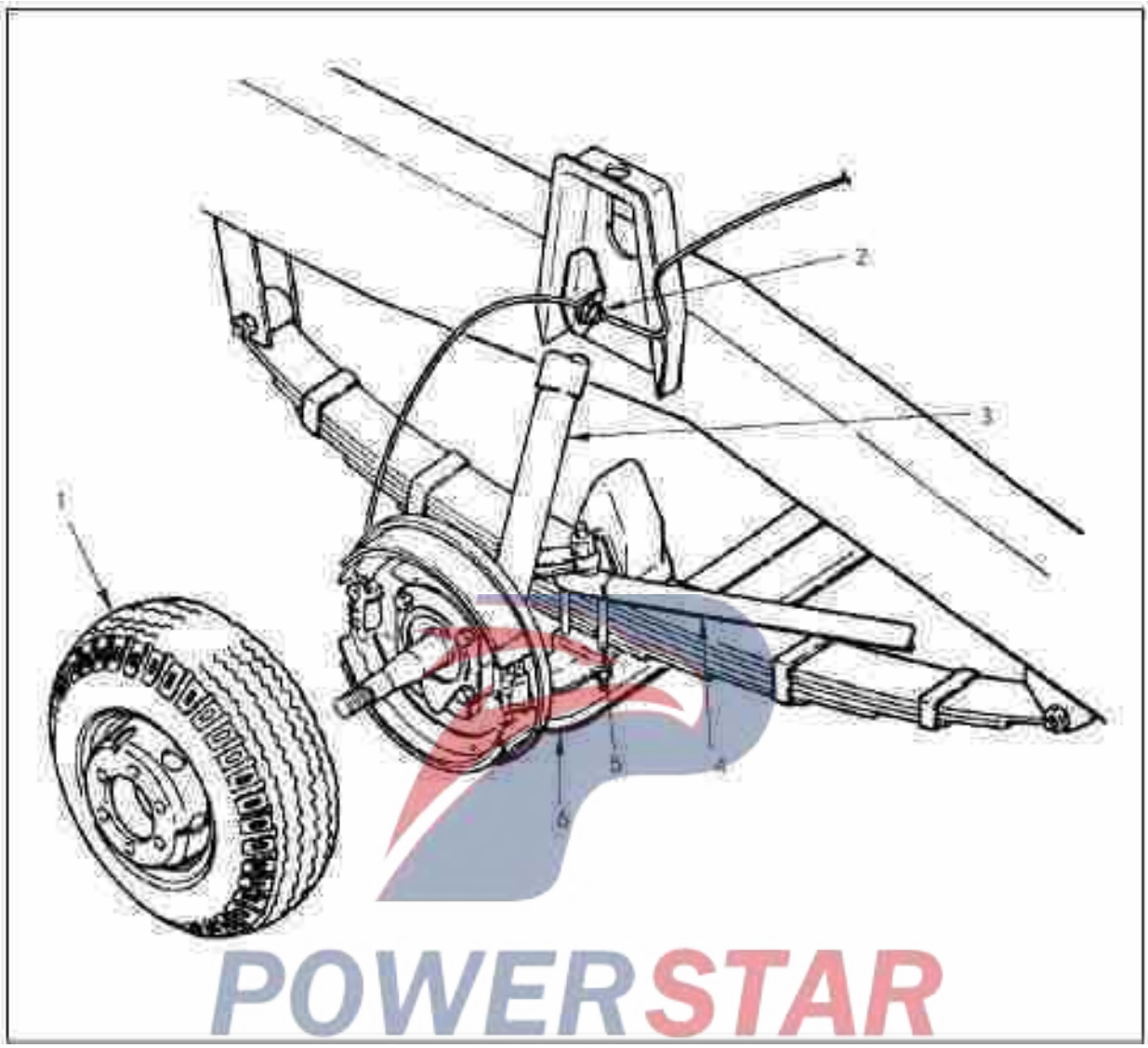
Wheel hub nut wrench: 5-8840-2015-0

When the lock hole is not aligned, it should be corrected by tightened direction.

2. Hubcaps

1. Wheel and tire

Front axle assembly (4×2 type)



Dismantling sequence

1. Wheel and tire
2. Brake fluid hose
3. Shock absorber
4. Drag link
5. U-bolt
6. Front axle assembly

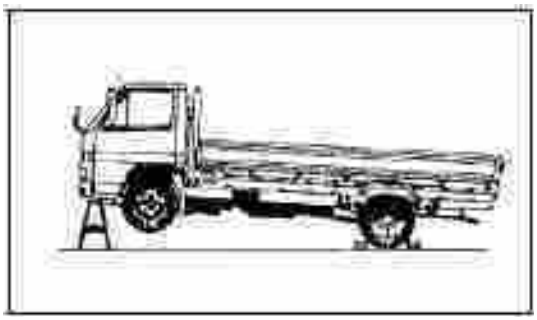
Assembling sequence

Assemble as per the sequence contrary to the dismantling sequence.

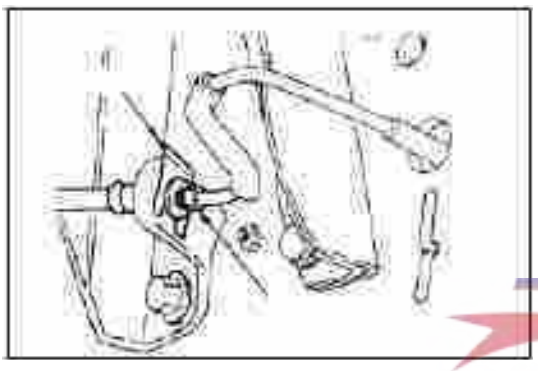
Disassembly

Preparation work

Raise the vehicle onto the bracket.



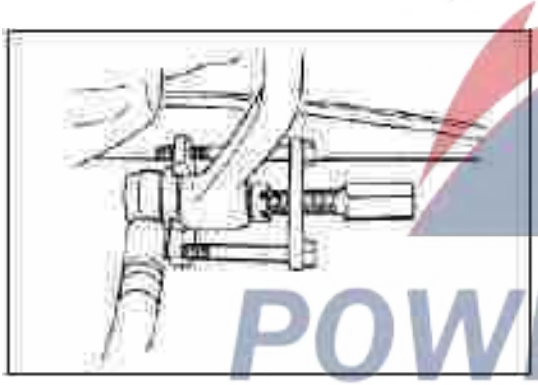
1. Wheel and tire



2. Brake fluid hose

Loosen the nut ② and pry off the clamp ①.

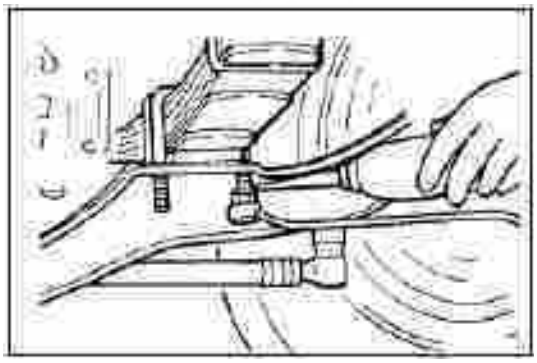
3. Shock absorber



4. Drag link

Use a special tool to open the longitudinal pull rod.

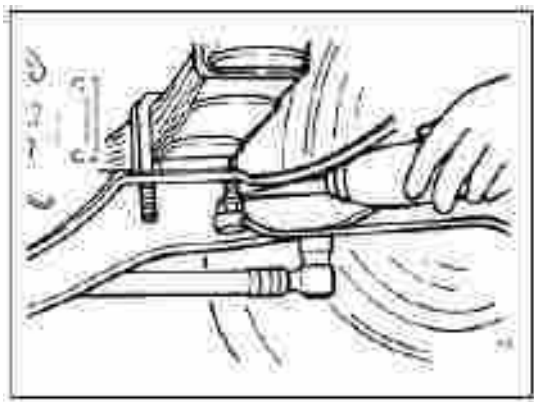
Half-shaft puller: 5-8840-2017-0



5. U-bolt

After using the jack to withstand the front axle, loosen the U-bolt. If the U-bolts rust, then apply some oil on the threads, so you can get rid of stuck.

6. Front axle assembly



Assembling

6. Front axle assembly

5. U-bolt and nut

Put the U-bolt and cushioning aids on the leaf spring assembly and lift the front axle with a jack until the leaf spring assembly slightly touches the front axle, aligning the U-bolts with the bolt holes.

When tightening the nut, apply oil to prevent damage to the threads.

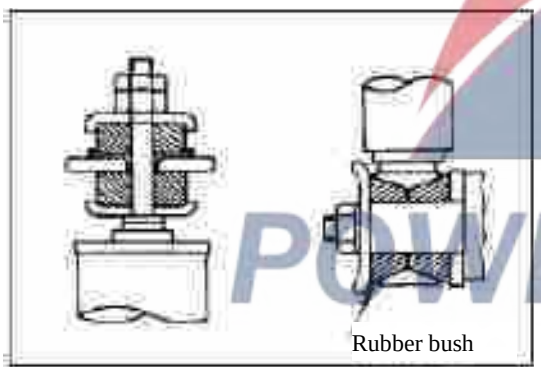
U-bolt nut torque	N • m(kgf • m/lb • ft)
	126(12.9/93)

4. Drag link

Tighten the straight rod nut to the specified torque or slightly tighter to align the cotter pin holes.

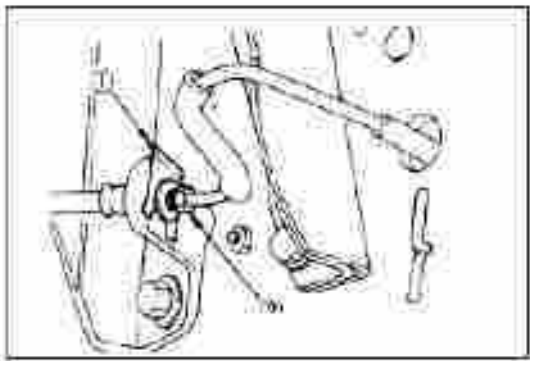
Install new cotter pins.

Straight rod nut torque	N • m(kgf • m/lb • ft)
	167(17/123)



3. Shock absorber

Refer to the illustration when installing shock absorbers, nuts, washers and rubber bushings.

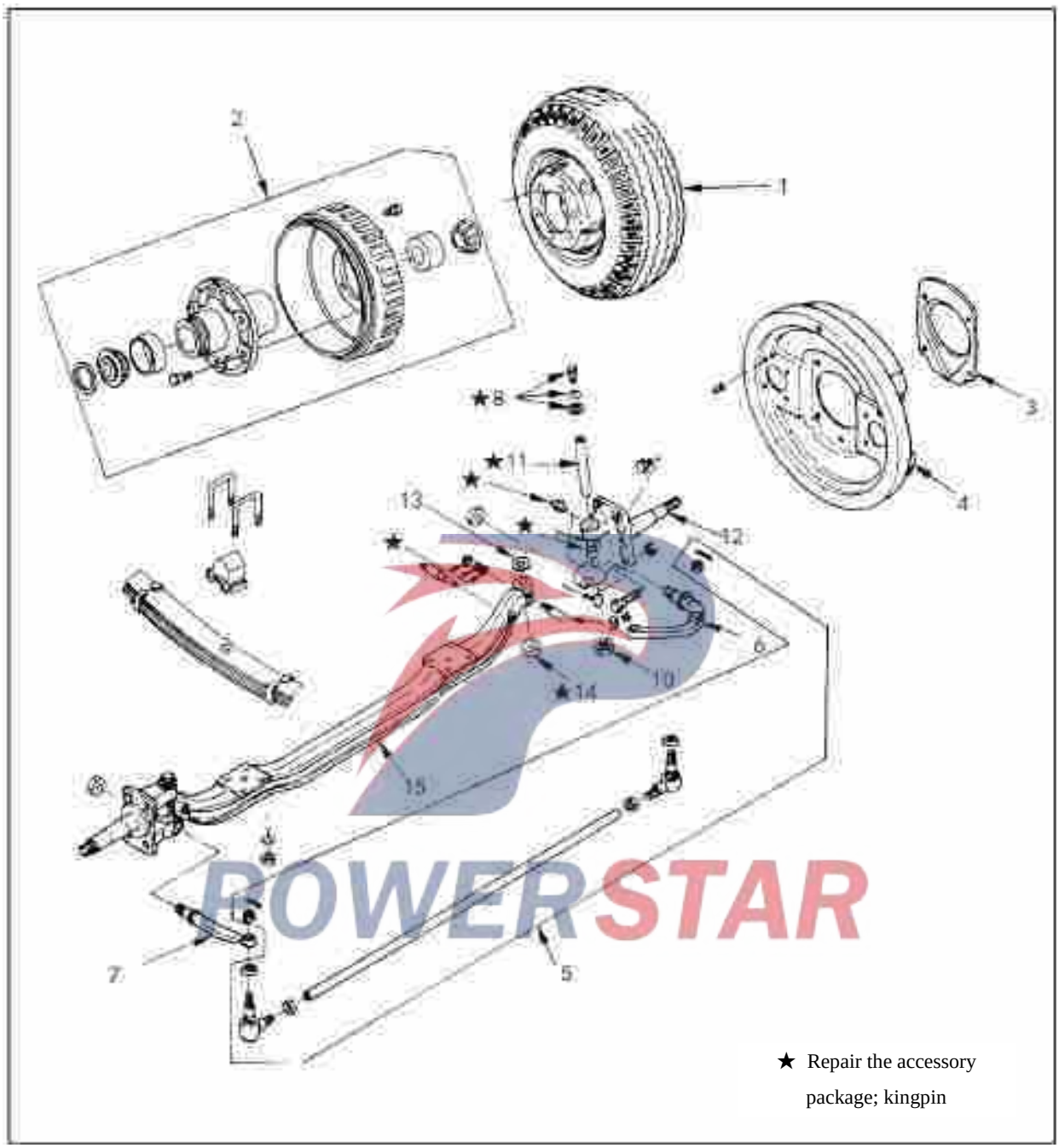


2. Brake fluid hose

First place the wheel in a straight position, and then use the clip ① to connect the brake fluid hose to the bracket without twisting the hose. Connect the brake hose and screw nut ② to the specified torque.

Brake fluid hose torque	N • m(kgf • m/lb • ft)
	16(1.6/12)

Steering knuckle and master pin (4 x 2 type)



Dismantling sequence

1. Wheel and tire
2. Wheels and tires
3. End cover
4. Wheel brake assembly
5. Steering tie rod assembly
6. Steering knuckle arm
7. Steering tie rod arm
8. King pin cover
9. Threaded locking pin
10. Flat plug
11. King pin
12. Steering knuckle
13. Adjusting gasket
14. Thrust bearing
15. I-beam

Assembling sequence

15. I-beam
12. Steering knuckle
14. Thrust bearing
13. Adjusting gasket
11. King pin
9. Threaded locking pin
8. King pin cover
10. Flat plug
7. Steering tie rod arm
6. Steering knuckle arm
5. Steering tie rod assembly
4. Wheel brake assembly
3. End cover
2. Wheels and tires
1. Wheel and tire

Disassembly

Preparation work

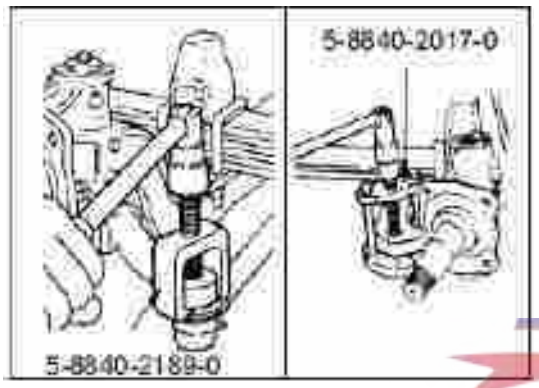
Raise the vehicle onto the bracket.

1. Wheel and tire

2. Wheels and tires

3. End cover

4. Wheel brake assembly

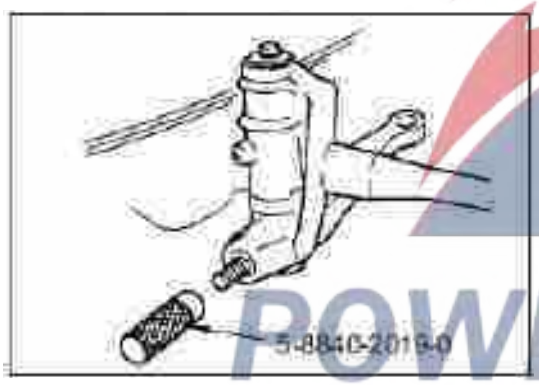


5. Steering tie rod assembly

Remover:

Drive side: 5-8840-2017-0

Booster side: 5-8840-2189-0



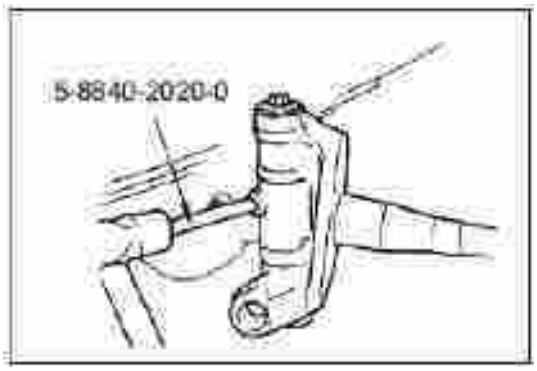
6. Steering knuckle arm

7. Steering tie rod arm

Half-shaft puller: 5-8840-2019-0

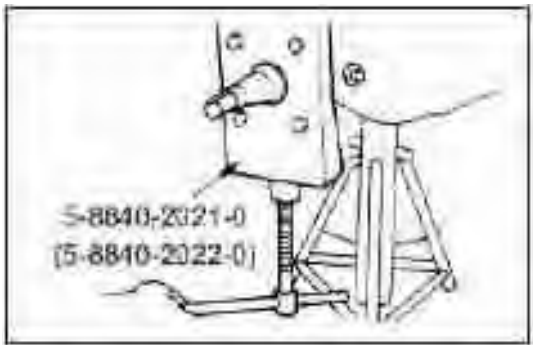
Hit out with a heavy hammer.

8. King pin cover



9. Threaded locking pin

Half-shaft puller: 5-8840-2020-0



10. Flat plug

11. King pin

Remover:

NKR 5-8840-2022-0

12. Steering knuckle

13. Adjusting gasket

14. Thrust bearing

15. I-beam

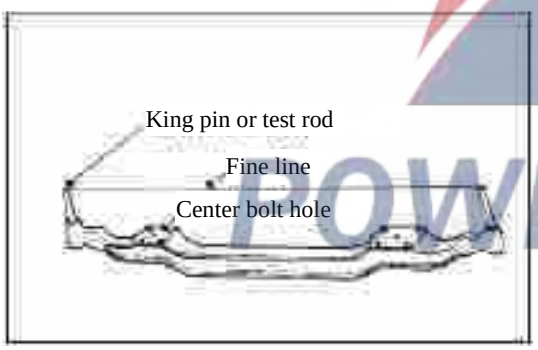
Inspection and repair

If any failures such as severe wear or damage are found through inspection, necessary adjustments, repairs, and replacements should be made.

1. I-shelf
2. Steering knuckle
3. Knuckle arm, steering tie rod arm
4. Steering tie rod, steering tie rod end connector
5. Master pin, sleeve, thrust bearing and washer
6. Spherical joint
7. Front hub, bearing and oil seal
8. Brake drum
9. Brake shoes, friction plates, etc.

Visual inspection

Check the following parts for cracks, damage or other malfunction.

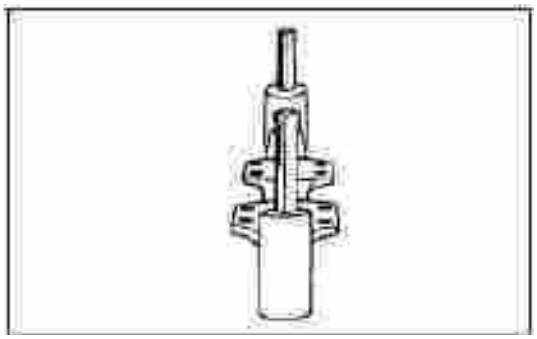


I-beam (if removed from vehicle)

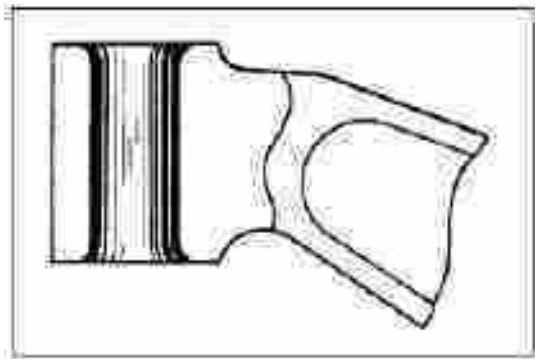
(1) Insert the main pin or test stick into the main pin hole.

(2) Pull a thin line through the center of two kingpin or test sticks.

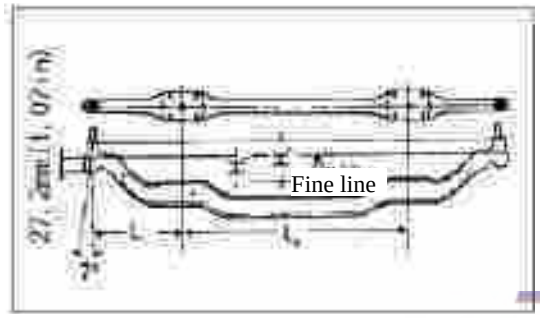
(3) From the top to the bottom, check if the thin line is on the same straight line as the connecting line between two spring center bolt holes.



(4) At the same time also check whether the two kingpin or test rod from the side to observe whether the vertical and alignment.



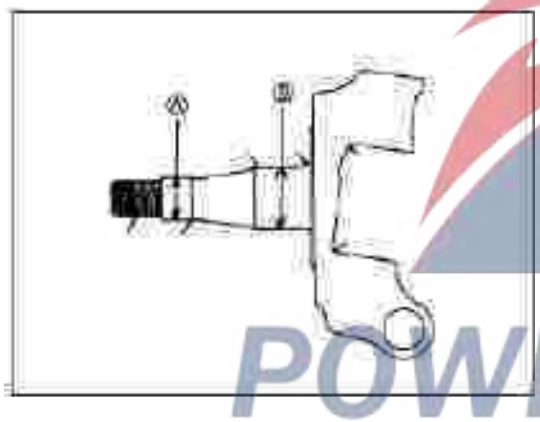
Check if the king pin hole is worn.



(5) Pull a wire to check the following dimensions.

mm (in)

	Hi	H2	Li	L2
	95	103	315	690



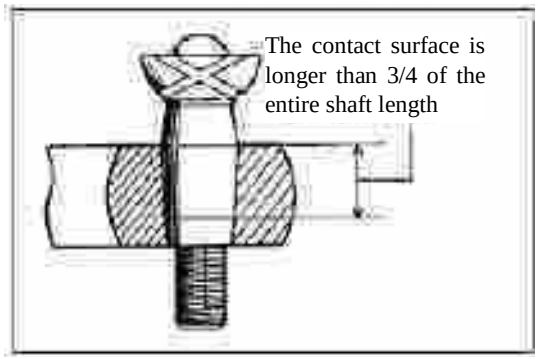
Knuckle crack

Check steering knuckles for cracks or damage, especially as indicated by the arrows.

Check with a magnetic flaw detector or red test solution.

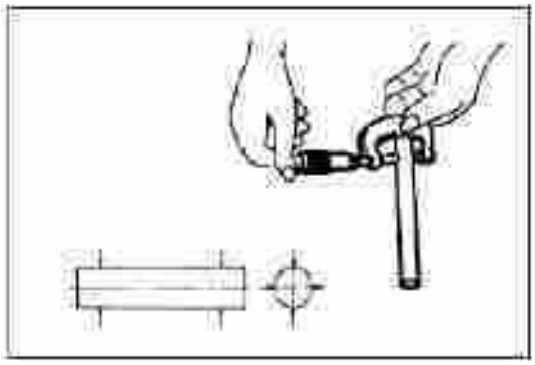
mm(in)

	A	B
	35(1.38)	50(1.97)



Knuckle arm and steering tie rod arm

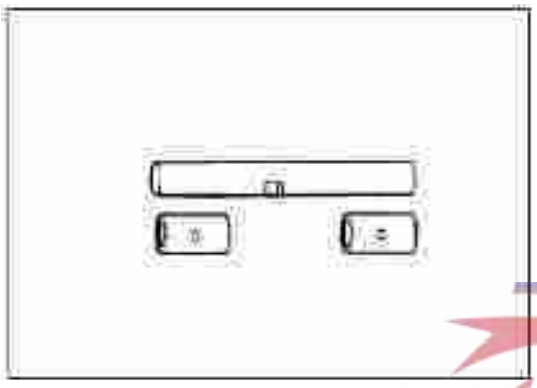
Check the contact condition of the knuckle cones of the knuckle arm and the tie rod arm by applying a thin layer of red test fluid paint evenly to the surface of the tapered shaft pin and inserting the shaft pin into the tapered bore, Then remove the shaft pin and check the contact indentation on the shaft pin. If the contact is not uniform or the contact area is less than 3/4 of the entire length of the pin, it must be repaired or replaced.



The kingpin diameter

mm(in)

Standard	Limit
30.0(1.181)	29.9(1.177)



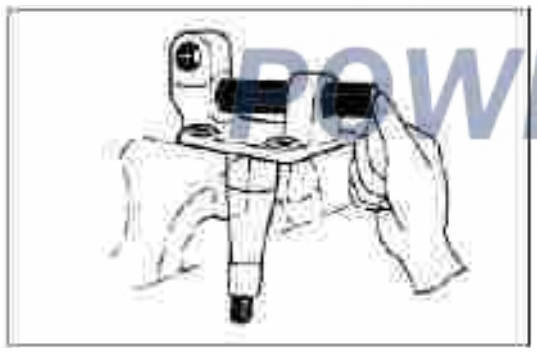
The gap between the king pin and the sleeve

mm(in)

Standard	Limit
0.06(0.0024)	0.15(0.0059)

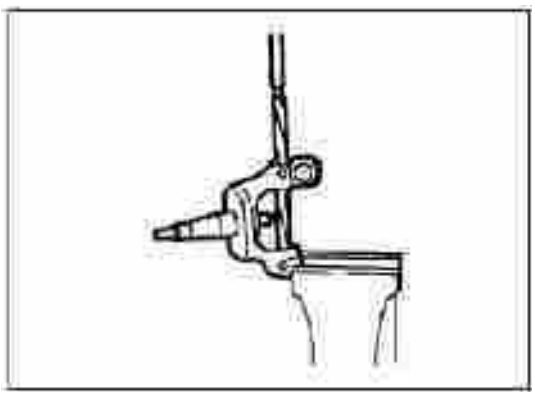
Caution:

When installing the king pin sleeve, align the grease hole of the kingpin sleeve with the grease hole of the knuckle.



Main pin into the king pin sleeve is appropriate, can be used the following methods of inspection.

Pinch the knuckle fitted with the king pin sleeve to the vise and then insert the kingpin into the sleeve and then push the kingpin end in the direction normal to the axis and check the radial clearance.

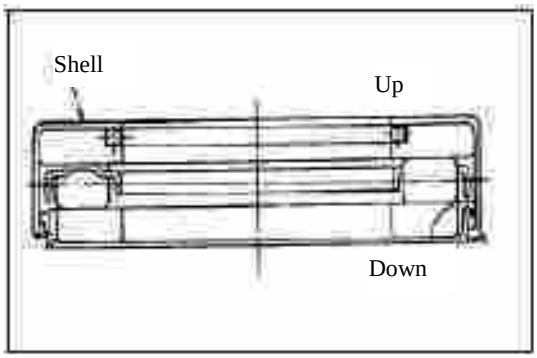


If the king pin into the sleeve too tight, the reamer can be used to carefully repair the inner surface of the sleeve so that the upper and lower steering knuckles have better coaxiality.

Assembling

15. I-beam

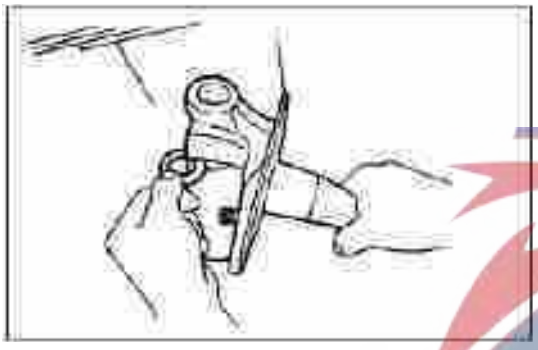
12. Steering knuckle



14. Thrust bearing

(1) Apply grease

(2) Face the bearing shell side up



13. Adjusting gasket

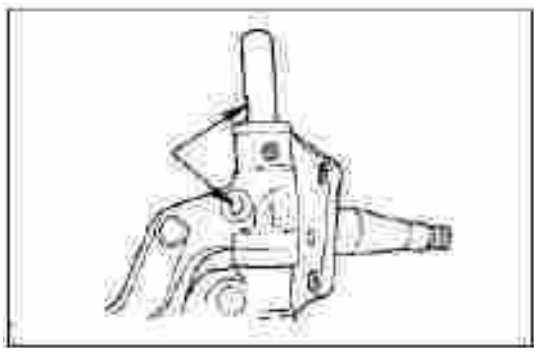
Check the gap between the steering knuckle and the front axle.

mm(in)

Standard	Limit
0-0.10(0-0.004)	0.20(0.0079)

Available pad mm (in)

Thickness	0.50(0.019)
	0.55(0.022)
	0.60(0.024)
	0.65(0.026)
	0.70(0.028)
	0.80(0.031)
	0.90(0.035)

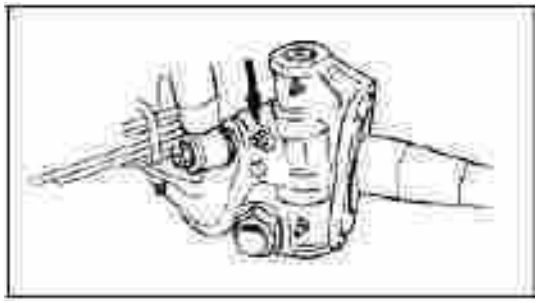


11. King pin

(1) Apply grease

(2) Align the lock pin groove with the front axle lock pin hole.

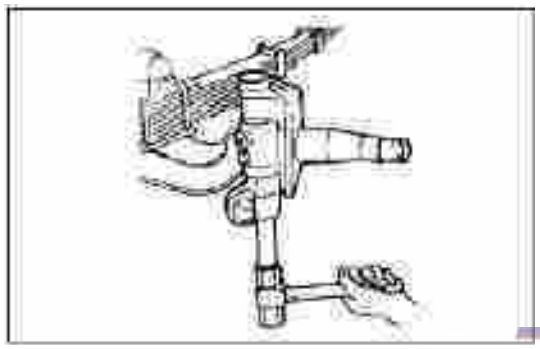
(3) fitted with the kingpin, check if the knuckle rotation is flexible.



9. Threaded locking pin

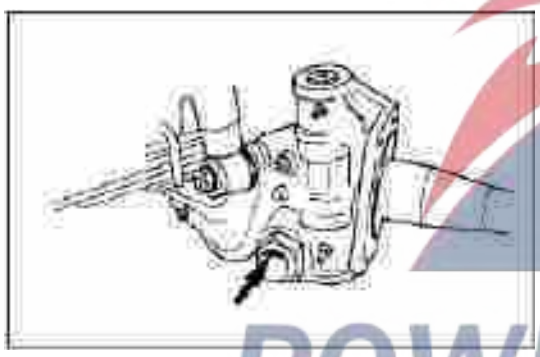
Locking torque	N • m(kgf·M / lb • Ft)
32(3.3/24)	

8. King pin cover



10. Flat plug

With a suitable rod on the lower end, screw the plug up into place.



7. Steering tie rod arm

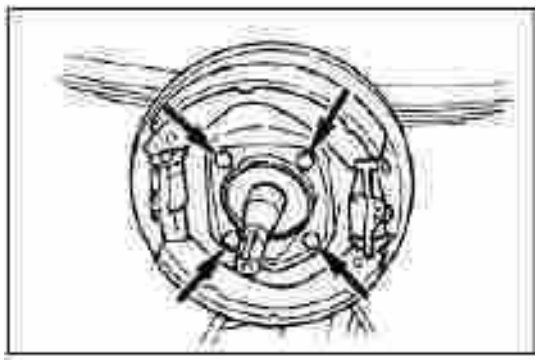
6. Steering knuckle arm

Coupling nut tightening torque	N • m (kgf·M / lb • Ft)
441 (45/325)	

After tightening, the nut will punch a few lock pits.

5. Steering tie rod assembly

Connecting rod nut tightening torque	N • m (kgf·M / lb•Ft)
108 (11.0/79.7)	



4. Wheel brake assembly

3. End cover

Tightening torque for wheel brake bolts	N • m (kgf·M / lb • Ft)
69(7/51)	

2. Wheels and tires

1. Wheel and tire

Special tools

Graphic representation	Tool chart number
	5-8840-2236-0 Oil seal installer
	5-8840-2314-0 Wheel bearing nut disassembler
	5-8840-2316-0 Oil seal installer
	5-8840-2366-0 Tie rod remover
	5-8840-2368-0 Brake disk mounter
	5-8840-2863-0 Onboard tool kit

Graphic representation	Tool chart number
	9-8521-0187-0 Wheel bearing remover

Graphic representation	Tool chart number
	5-8840-2016-0 Hub disassembler
	5-8840-2017-0 Steering tie rod connector remover
	5-8840-2019-0 Knuckle arm remover
	5-8840-2020-0 Master pin bolt remover
	5-8840-2021-0 Main pin puller
	5-8840-2022-0 Main pin puller

Graphic representation	Tool chart number
	5-8840-2182-0 Wheel bearing nut disassembler
	5-8840-2183-0 Bearing installer
	5-8840-2184-0 Bearing installer
	5-8840-2187-0 Oil seal installer
	5-8840-2189-0 Tie rod remover
	5-8840-2234-0 Brake disk mounter

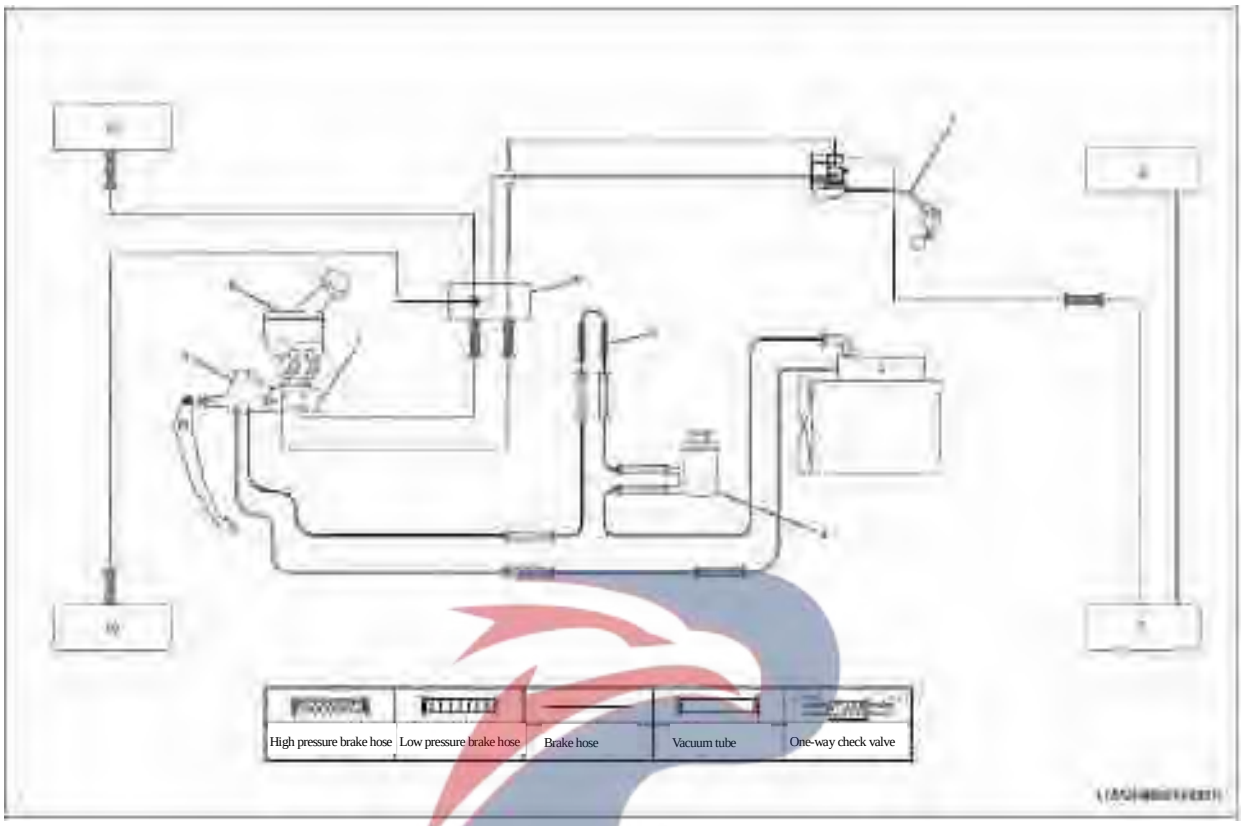
Section 4B

Brakes

Table of Contents

Hydraulic brake system

HBB type with LSPV (Pressure proportional to load)



Key

1.LSPV (charge ratio pressure regulator)

2.Rear brake

3. Hydraulic booster

4. Brake fluid header

5. Cooling tube

6. Six-way connector

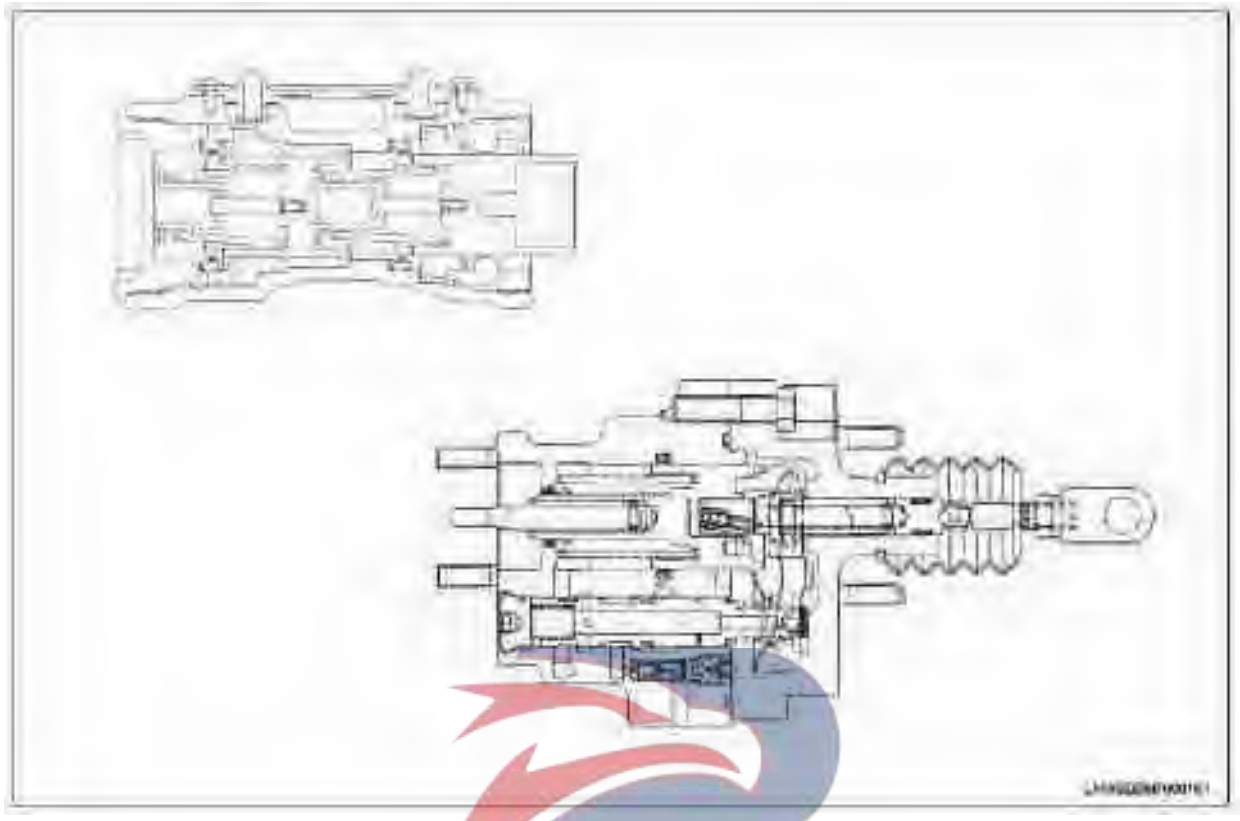
7. Brake master cylinder

8. Brake fluid tank

9. Hydraulic booster

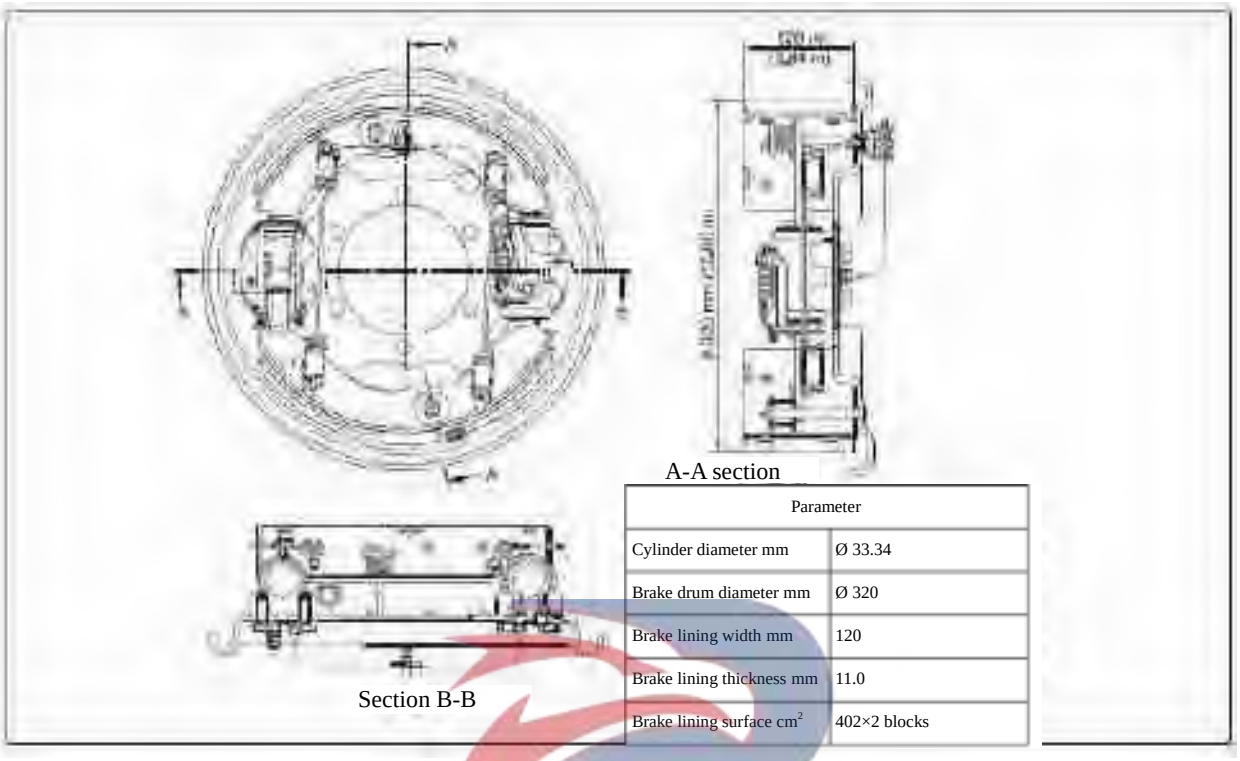
10. Front brake

Hydraulic brake cylinder and booster



Front drum brake

Ø320×120-15 / 16" (with two-way double clutch, automatic clearance adjustment)



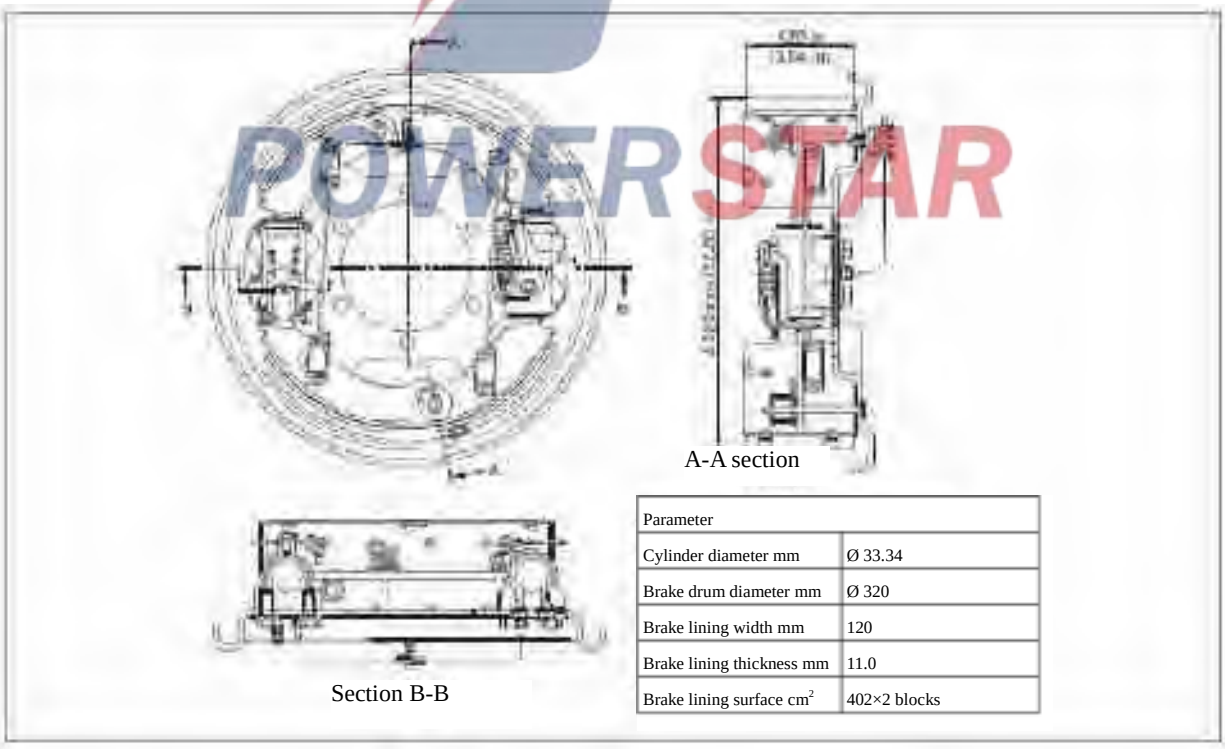
A-A section

Section B-B

Parameter	
Cylinder diameter mm	Ø 33.34
Brake drum diameter mm	Ø 320
Brake lining width mm	120
Brake lining thickness mm	11.0
Brake lining surface cm^2	402×2 blocks

Rear drum brake

Ø320×120-15 / 16" (with two-way double clutch, Automatic regulator)



A-A section

Section B-B

Parameter	
Cylinder diameter mm	Ø 33.34
Brake drum diameter mm	Ø 320
Brake lining width mm	120
Brake lining thickness mm	11.0
Brake lining surface cm^2	402×2 blocks

Front and rear brake main parameters

Front brake	Model and specifications	Braking type	Brake disc outside diameter × brake drum width or inside diameter × width (mm)	Thickness of brake lining or thickness of brake pad (mm)	Brake cylinder inner diameter (mm)
3X	4 tons	Drum type	320×120	11.0	33. 34
Rear brake	Model and specifications	Braking type	Drum inner diameter × width (mm)	Brake lining thickness (mm)	Brake cylinder inner diameter (mm)
3X	4 tons	Drum type	320×120	11.0	33. 34

Main brake cylinder, main brake

Model and specifications		Booster size (inch)	Brake cylinder size (mm)
3X	With the HBB model		33.75

Special tools

Illustration	Tool number Tool Name
	5-8840-2862-0 Universal support
	5-8840-2369-0 Spanner
	Punch tool: 5-8840-2370-0 Spanner
	5-8840-2190-0 Brake oil pressure gauge

Functional check

Check on the road

Brake test

The brake test was conducted on a dry, flat asphalt road.

In the brake test, tests are performed by changing the speed and changing the brake pedal force. However, be careful not to block the tire during braking. Once the tire is locked, the braking distance increases and true braking capacity cannot be confirmed.

External factors related to braking performance

1. Tire: If the tire is uneven on the road, the braking force will not be balanced. Use a tire of the specified size and set the tire pressure within the specified range.

2. Charging: Increasing the vehicle load will require stronger braking force.

3. Positioning the front wheel: When the wheel is abnormally positioned (especially when the camber angle and the caster angle are too large), it will cause deflection during braking.

Check for leaking brake fluid

At idle, move the selector lever to the neutral position and continue to step on the brake pedal with a certain degree of depression. In this state, if the pedal's stride gradually increases, it can be inferred that the hydraulic system is leaking. Then, perform a visual inspection to confirm if there is a leak.

Braking system check

Standard braking system

Please check according to the troubleshooting table in this chapter.

Fault diagnosis

Symptom	Probable causes	Treatment measures
Abnormal straightness (deviation, braking stroke)	The tire pressure is not suitable.	Adjust the left and right tire pressures to the specified pressure.
	The front wheel alignment is abnormal.	Check and adjust the alignment of the front wheels.
	Different tire sizes on the same axis.	Use the same size tires on the same shaft.
	Lock the brake hose and brake hose.	Replace.
	Brake caliper and wheel brake cylinder malfunction.	Check brake caliper and wheel brake cylinder assembly for freezing, blocking or abnormal operation.
	Brake pads and decorative parts are damaged or abnormal.	Replace (assembly status).
	Suspension of bulk components.	Check the installation of each part of the suspension and tighten it if necessary.
	Brake caliper loose.	Check mounting bolts and tighten as required.
	LSPV adjustment is abnormal.	Adjust the LSPV.
The brakes do not work properly and there are abnormal sounds (pulses).	The brake disc has a large horizontal sail.	Check the sails of the brake disc and replace it when it exceeds the standard.
	The thickness of the brake disc varies greatly.	Check the brake disc thickness change and replace it when it exceeds the standard.
	Hub bearings have a large axial clearance.	Replace.
	The brake pad is installed in the wrong direction.	Replace the brake pads. Correct the brake disc if necessary.
	Brake drum worn.	Measure the inner diameter of the brake drum and perform grinding correction.
The brake pedal has a strong pedaling force.	Brake booster has failed.	Check the condition of the supercharger and replace it if necessary.
	The hydraulic system is abnormal.	Check and correct hydraulic system
	The caliper piston and the wheel brake cylinder are stuck or operate abnormally.	Re-decompose and assemble brake caliper and wheel brake cylinder.

Symptom	Probable causes	Treatment measures
	Vacuum leaks from the brake booster.	Check for damaged or loose straws.
	Brake seals and brake linings are not normal.	Replace.
	LSPV adjustment is abnormal.	Adjust the LSPV.
Unusual pedal travel.	The hydraulic system is abnormal.	Check and correct the hydraulic system.
	Brake fluid is insufficient.	Add to the specified amount of brake fluid and check for leaks.
	The hydraulic system is mixed with air.	Drain the air in the hydraulic system.
Brakes brake delay.	The piston of the master cylinder is abnormally reset.	Readjust the length of the brake booster lever and reassemble the master cylinder as needed.
	Brake hoses and hoses are clogged.	Replace.
	Brake pedal deviation is abnormal.	Readjust the length of the brake booster lever.
	Brake caliper and brake cylinder.	Check and clean, replace if necessary.
	Suction hose is abnormal or improperly installed.	Replace, correct the installation.
Braking, braking deviation	Brake booster performance is abnormal	Check the operating status and replace it according to the situation
	Corrosion of brake components	Clean
Abnormal brake sound.	Brake linings and brake linings wear.	Replace.
	Brake disk corrosion.	Correct or replace.
Abnormal brake operation	The master cylinder is working abnormally.	Check master cylinder operation and reassemble. Replace if necessary.
	Brake booster is working abnormally.	Check the operating status and replace it if necessary.
	Brake fluid is insufficient.	Add to the specified amount of brake fluid and check for leaks.
	The hydraulic system is mixed with air.	Drain the air in the hydraulic system.

Add brake fluid

• To maintain a proper amount of brake fluid in the tank, do not mix air and moisture in the hydraulic system.

• Clean the can lid, taking care not to allow dust to enter the tank.

• Remove the lid and add brake fluid as needed.

• Make sure the brake fluid level is below the tank's "maximum" level.

Caution:

• Brake fluid should not be mixed with other brands of products.

• Use BESCO brake fluid (or according to product instructions).

• Allow the engine to cool.

• When adding, be careful not to mix dust and water in the brake fluid reservoir.

• Do not allow brake fluid to adhere to the surface of the coating.

• Brake fluid is periodically replaced and each brake must be replaced with the specified brake fluid.

Deterioration of brake fluid

• If you use a non-specific brake fluid, or mix mineral oil, water, etc., in the brake fluid, the boiling point of the brake fluid decreases, resulting in air resistance and deterioration of the rubber parts of the hydraulic circuit.

• The brake fluid must be replaced within the specified replacement time.

• When the rubber parts deteriorate, the hydraulic system must be completely decomposed and cleaned with alcohol. Dry the air to remove alcohol from the system before reassembling parts. Replace hoses and all rubber parts in other systems.

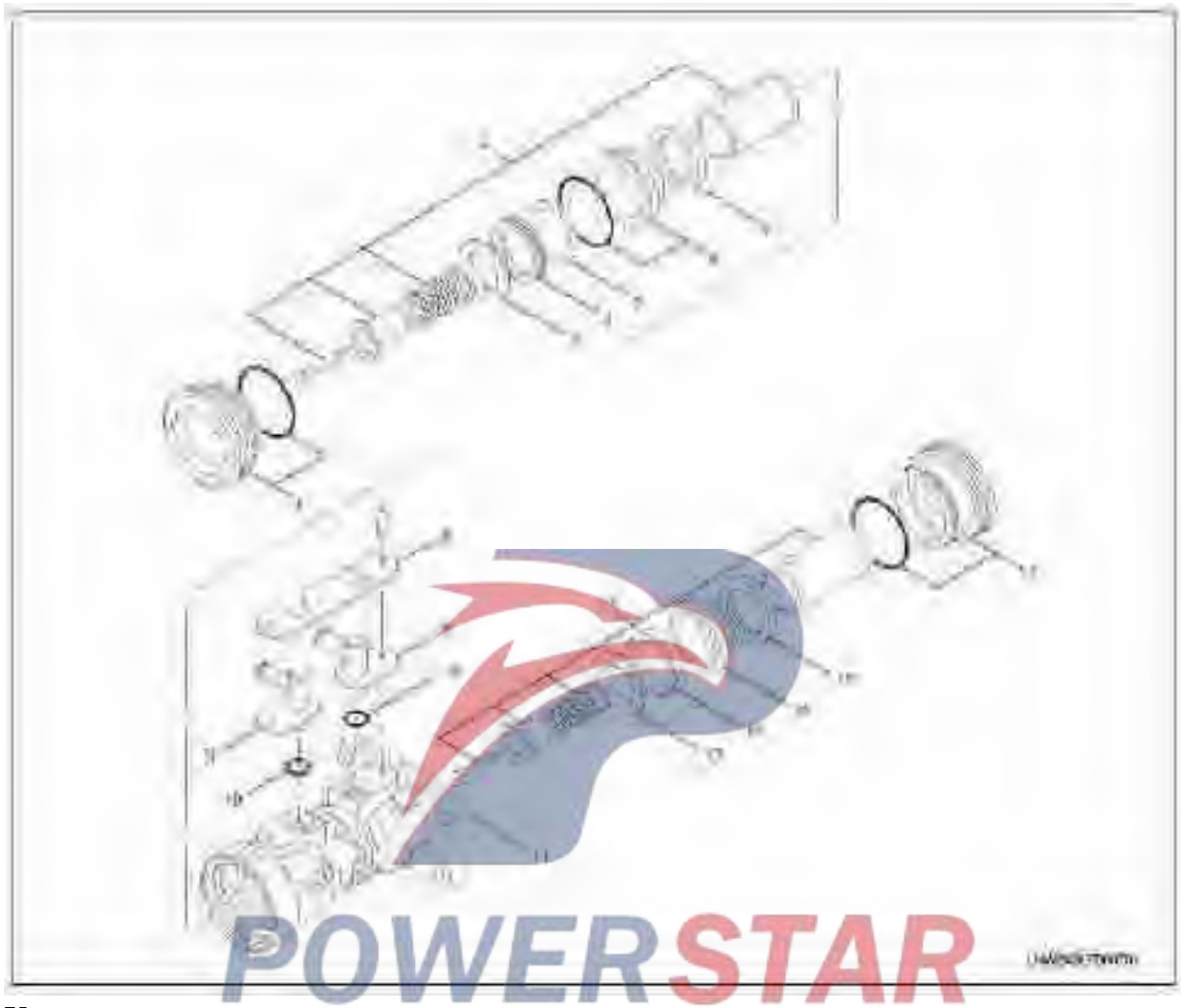
Hydraulic exhaust system

1. Once air is mixed into the hydraulic system, it needs to consume air.

2. Pull the parking brake and start the engine.

Brake master cylinder

Component parts



Key

1. Plug, O-ring
2. Deputy piston assembly
3. Support
4. Main bowl (brake master cylinder)
5. Spacer
6. Ring, O-ring
7. Vice Cup
8. Support
9. Hose connector
10. O-ring
11. Cylinder block
12. Main piston assembly
13. Support
14.Main bowl
15. Bush
16. Vice Cup
17. Plug, O-ring

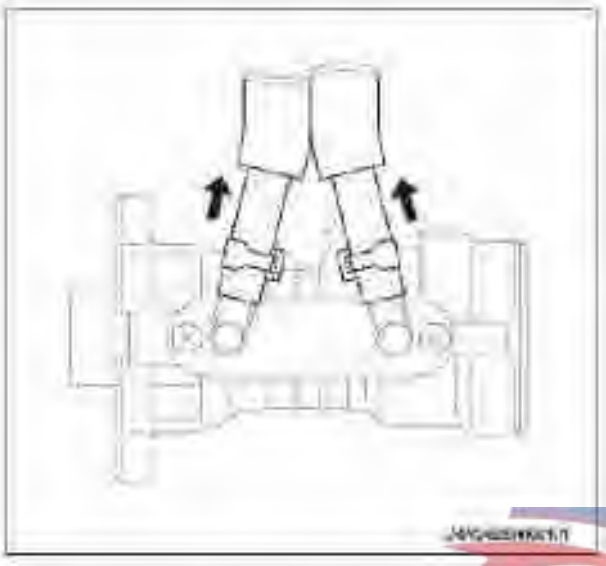
Disassembly

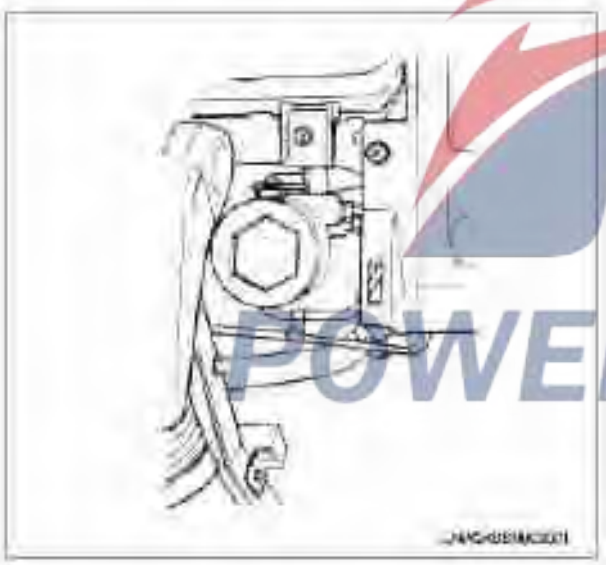
1. Remove the integrated instrument panel.
2. Remove the connector from the switch.
3. Remove the brake pipe from the master brake cylinder.
4. Remove the brake hose from the master cylinder.

• Grab the claws of the pliers, move them sideways and pull out the hose.

Caution:

When pulling the brake hose, do not shake it and remove it vertically. Be careful not to allow brake fluid to adhere to the surface of the coating. Clean the brake fluid if it adheres to the surface.





5. Remove the brake cylinder.

• Remove brake booster retaining nut and remove brake master cylinder.

Disassembling

1. Remove the hose connector.

a. Remove the screw and remove the bracket.

b. Remove the hose connector.

c. Remove the O-ring from the fitting.

2. Remove the cap and O-ring.

a. Mount the master brake cylinder on the universal bracket:

5-8840-2862-0 (1), then attached to the offender.

b. Use a special tool to remove the lid.

Special tools

Spanner

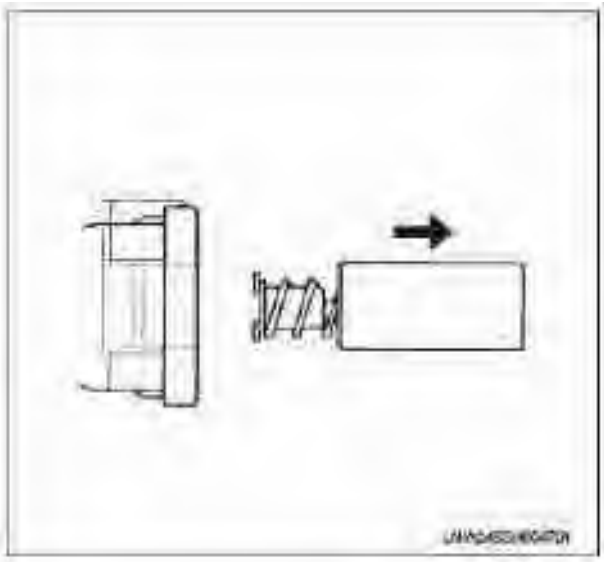
Cylinder diameter Ø28.5 mm= 5-8840-2369-0

Cylinder diameter Ø31.7 mm= 5-8840-2370-0

c. Remove the O-ring from the socket.

3. Remove the main piston assembly.

Pull the piston assembly by hand to avoid damaging the piston.



2. Disconnect the main piston assembly.

a. Remove the dish.

b. Remove the bushing.

c. Remove the main bowl.

d. Remove the bracket.

3. Remove the plug and O-ring.

a. Mount the master brake cylinder on the universal bracket:

5-8840-2862-0 (1), then attached to the offender.

b. Use a special tool and wrench to remove the plug.

Special tools

Spanner

Cylinder diameter Ø28.5 mm= 5-8840-2369-0

Cylinder diameter Ø31.7 mm= 5-8840-2370-0

c. Remove the O-ring from the socket.

4. Remove the auxiliary piston assembly.

5. Disconnect the auxiliary piston assembly.

a. Remove the bracket.

b. Remove the main bowl.

c. Remove the gasket.

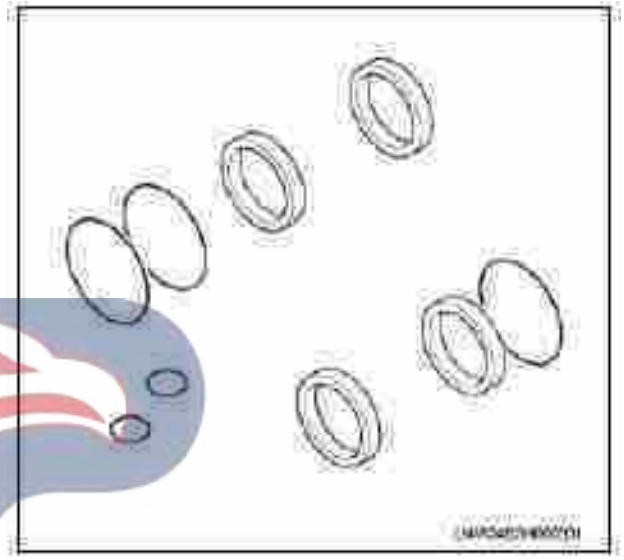
d. Remove the bushing and O-ring.

e. Remove the dish.

Assembly

4. Clean the removed parts with a clean brake fluid and check for signs of wear, deterioration, and damage.

• Replace the parts in the illustration below.



Caution:

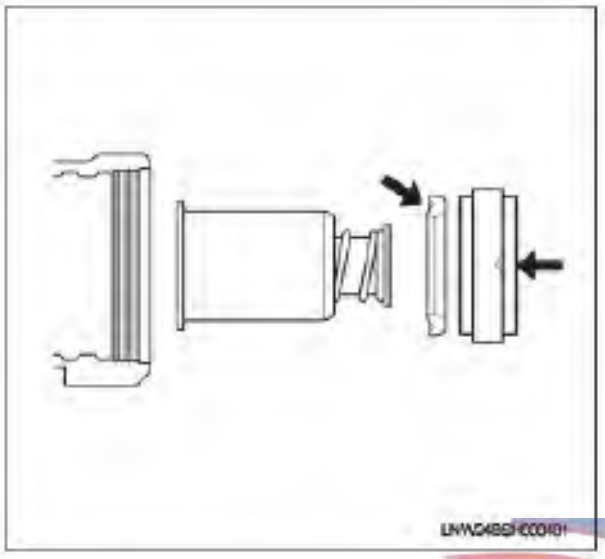
When assembling, apply a proper amount of adhesive (metal rubber #20) to the rubber parts, cylinder block and piston.

2. Install the auxiliary piston assembly.

Install the O-ring on the bushing.

a. Mounting bushing and O-ring.

b. Install the auxiliary cup and bushing on the secondary piston in the direction shown below and press firmly into the bushing until it contacts the pitch on the cylinder block.



c. Install washer, master cylinder and bracket on the auxiliary piston into the cylinder.

3. Install the plug and O-ring.

a. Mount the master brake cylinder on the universal bracket:

5-8840-2862-0 (1), then attached to the offender.

b. Install the o-ring into the container and mount the container on the master cylinder.

c. Use a special wrench, tighten the plug as shown.

Special tools

Spanner

Cylinder diameter Ø28.5 mm= 5-8840-2369-0

Cylinder diameter Ø31.7 mm= 5-8840-2370-0

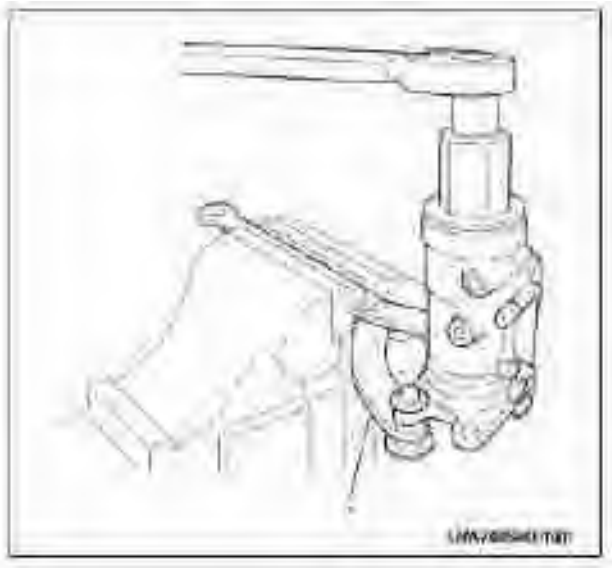
Tightening torque

Cylinder diameter Ø28.5 mm= 40 N·m{4.1kgf·m}

Cylinder diameter Ø31.7 mm= 44 N·m{4.5kgf·m}

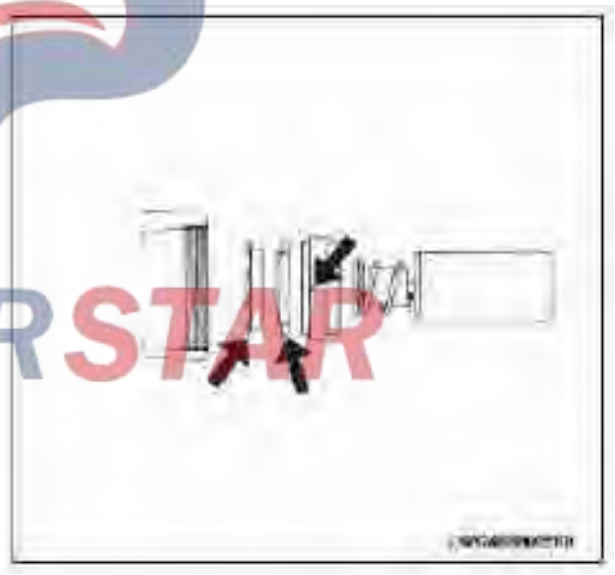
Caution:

According to the torque tightening regulations, if the plug is higher than the cylinder, it must be removed and the assembled parts must be corrected and reinstalled.



4. Install the auxiliary piston assembly.

a. Install the bracket, master cylinder, and ring on the master piston in the orientation shown below, and then press the socket firmly until it contacts the step in the cylinder block.



b. When disassembling the main piston separately, be careful not to let the ring get out of the step.

5. Install cups, stoppers, o-rings.

a. Mount the master brake cylinder on the universal bracket:

5-8840-2862-0 , then attached to the offender.

b. Install O-rings and auxiliary cylinders on the stopper in the direction shown.

c. Use a special key to install the plug with the specified torque.

Special tools

Spanner

Cylinder diameter Ø28.5 mm= 5-8840-2369-0

Cylinder diameter Ø31.7 mm= 5-8840-2370-0

Tightening torque

Cylinder diameter Ø28.5 mm= 40 N·m{4.1 kgf·m}

Cylinder diameter Ø31.7 nun = 44 N·m{4.5 kgf·m}

Caution:

After tightening as required, if the cover is higher than the cylinder, disassemble it and correct the assembly problem and reinstall it.

6. Install the main piston assembly.

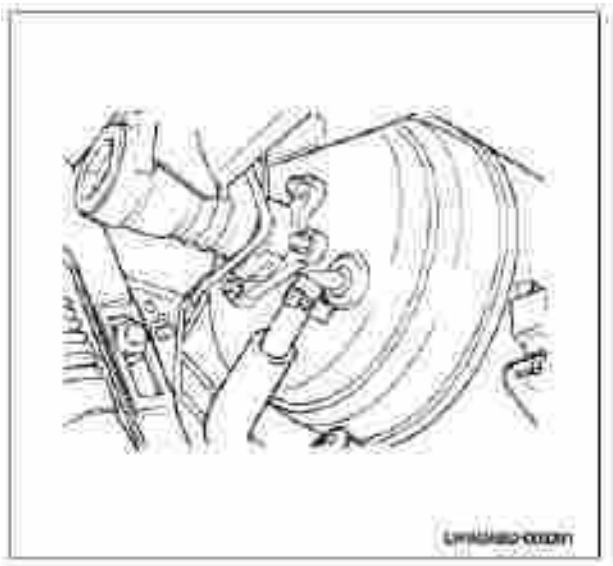
• Insert the main piston assembly into the cylinder to make sure it slides easily.

7. Install pipe fitting O-rings and brackets.

Installation

1. Install the brake cylinder on the brake booster according to the specified torque.

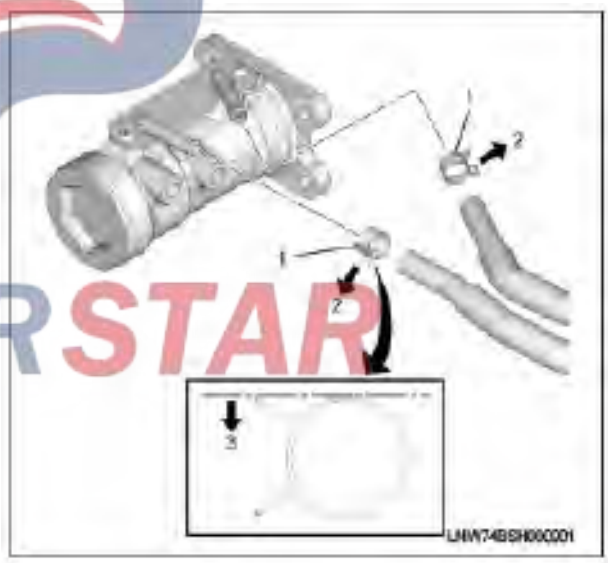
Tightening torque: 14 N•m {1.4 kgf•m}



2. Connect the brake hose to the master cylinder.

Mark:

When the claw (1) is mounted, the claw faces outward (2). In addition, the jaws are mounted on the underside (3) of the outer diameter of the tube.



3. Connect the brake hose to the master brake cylinder.

Tightening torque: 12 N•m {1.2 kgf•m}

4. Connect the switch connector.

5. Install the integrated dashboard.

Caution:

After installing the master cylinder, new brake fluid must be added and the air must be completely evacuated.

Hydraulic booster

Function and operation instructions

Caution:

After removing the fastener, always return the fastener to its original position. If you need to replace the bracket, replace it with a bracket of the correct part number. If fasteners with appropriate part numbers cannot be used, other fasteners with the same size and strength can be used.

Disposable fasteners and fasteners that require the use of anti-loosening thread oils will be used. When installing the fasteners, the correct torque value must be used. Failure to observe the above conditions may damage the parts or the system.

Hydraulic booster assembly instructions

When using the brake pedal, the hydraulic brake booster exerts a force on the master cylinder. Due to the brake pedal, the liquid flowing through the booster cap is controlled.

The fluid pump flywheel from the hydraulic brake booster and the power to the input of the amplifier then pass through the valve seat, then through the output flow switch, and return to the hydraulic brake booster pump.

The piston rod of the hydraulic brake booster is connected to the piston via a slider. When pressure is applied to the brake pedal, the assembly moves.

The drawer restricts the flow of liquid and exerts pressure on one side of the piston. This pressure exceeds the resistance of the return spring and moves the piston to the equilibrium position. When the piston moves, it simultaneously pushes the piston rod to apply pressure to the master cylinder.

The pump's internal safety valve limits the pressure to 11,770 kpa (20 kgf/cm2). This pressure level is sufficient to ensure good braking without damaging the brake line or brake hose. When driving the safety valve, let the liquid bypass the piston.

Liquid and liquid transport instructions

The system does not use special liquids. However, you should use suitable liquids with care. The master cylinder and brake system use brake fluid, and the hydraulic brake booster pump uses power steering fluid.

Non-compliant or contaminated liquid

Caution:

Hydraulic brake systems use two separate and incompatible liquids. Power steering fluid is used in hydraulic brake assist systems. Brake fluid is used for the master cylinder and the brake pipe that connects the wheels. Be careful when selecting the brake fluid or the brake system seal, otherwise it may be damaged. See Section OA - Overview - "Recommended Fluids, Lubricants, and Diesel Fuels" for proper fluid selection.

Caution:

Do not reuse brake fluid. Do not mix power steering fluid with brake fluid. The swelling and aging of rubber parts may be due to liquid contamination. This can lead to reduced braking performance and eventually loss of braking capability.

The contaminated liquid will swell due to the aging of the rubber element, which will lead to a drop in braking performance and ultimately to a loss of braking capacity. Check the fluid regularly and note any abnormal consistency. There may be signs of contamination and the color of the liquid. Do not reuse brake fluid. Discard used liquid. Do not mix power steering fluid with hydraulic brake fluid. If contamination occurs, flush the hydraulic brake booster system with clean power steering fluid.

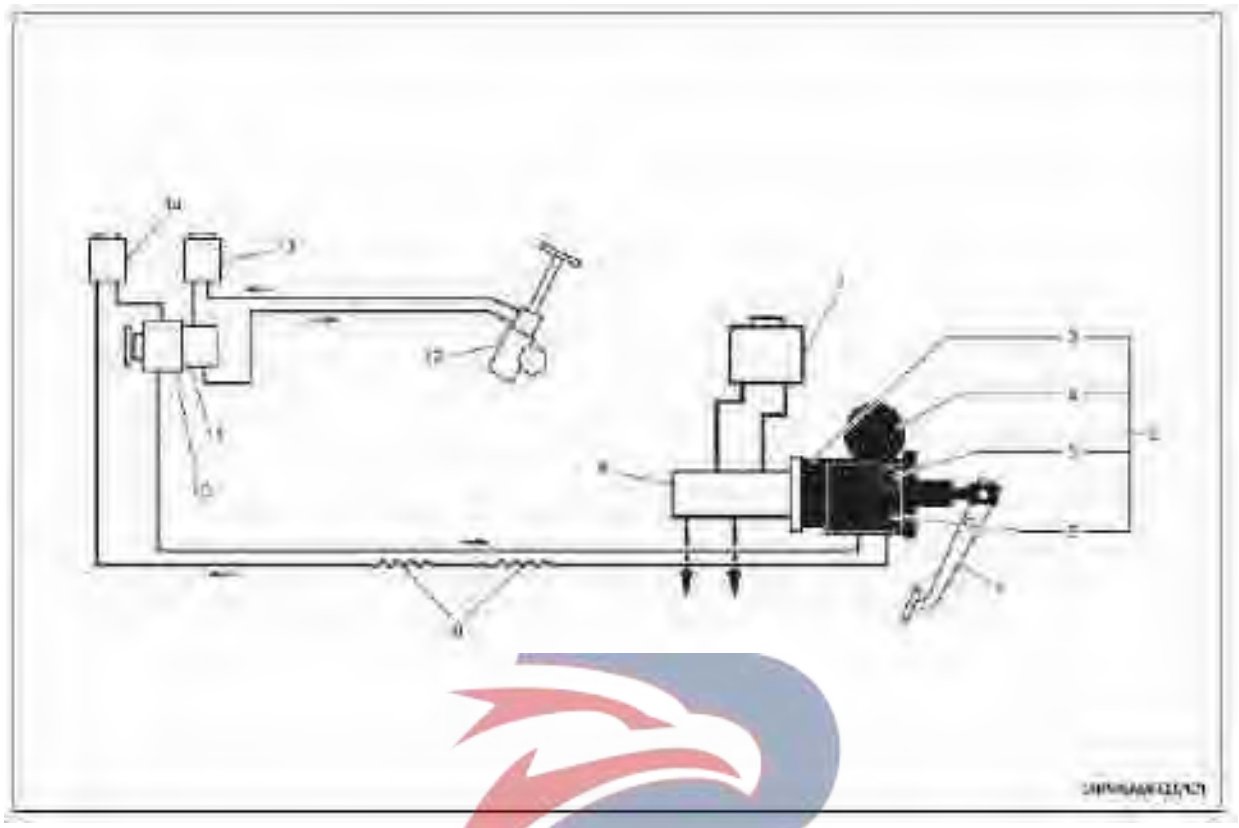
The brake booster component bench must be serviced in a clean work area separate from the brake service area. Wash your hands before moving from the braking work area to the pressurized work area. Do not use the same container for holding liquids.

Flush hydraulic brake booster system

When dirt, mud or water is found in the system, flush them. Rinsing includes cleaning the liquid through the system until the discharged liquid resembles a cleaning liquid. Contaminated liquids in makeup systems can cause deterioration of rubber parts.

When replacing the hydraulic pump, the hydraulic brake system must be cleaned and flushed. Metal shavings from used hydraulic pumps often contaminate the system. All metal shavings in pipes and hoses must be removed and cleaned.

System Overview



Key

1. Brake fluid reservoir
2. Hydraulic booster components
3. Booster
4. Storage tank
5. Pressure Switch
6. Inflatable valve
7. Brake pedal
8. Main cylinder
9. Cooling tube
10. Hydraulic brake booster pump
11. Power steering pump
12. Power steering
13. Power steering fluid accumulator
14. Pressurized liquid hydraulic brake tank

A hydraulic brake servo system as a brake booster allows the brake to operate with less force than other methods. The system includes hydraulic brake boosters: servomotors, oil storage tanks and complete structures. Inflatable valves and pressure switches, accumulators and cooling tubes.

[Functions of main parts]

Booster:	Check the hydraulic fluid pumped out of the pump and increase pedal power.
Storage tank:	The cumulative pressure hydraulic oil is used for boosting after stopping the oil pump.
Inflatable valve:	When the tank oil pressure drops, a switching operation is performed and hydraulic oil is supplied to the tank.
Pressure Switch:	If the oil pressure in the tank is lower than the set pressure, the alarm buzzer will work.
Oil pump:	The motor rotates and the hydraulic brake fluid supplies hydraulic oil through the hose.
Pool	The pump stores the hydraulic fluid used to process the suction cup.
Cooling tube:	Located in front of the radiator, it is easy to dissipate the hydraulic oil in the system piping and prevent the oil temperature from rising.

As shown, other devices associated with the system include a power steering device, a pump and accumulator for the power steering device, a master cylinder that receives hydraulic brake fluid and activates the brake, and an accumulator dedicated to the master cylinder. Start the brake pedal of the brake booster.

Use the brake booster of the hydraulic brake booster assembly to lock the master cylinder. The dedicated power steering pump is integrated with dual pumps to share the hydraulic brake booster pump and gearbox. However, the hydraulic brake booster system is separate from the power steering system, and their accumulators are also separate.

Maintenance precautions

Precautions when replacing parts

1. Hydraulic brake booster is a precision device suitable for high pressure hydraulic oil. Do not disassemble any parts of the hydraulic brake booster other than replacing parts.

If you remove a non-replaceable part and use a non-replaceable part, or if it is poorly assembled, it may malfunction. For example, abnormal operation may occur and the brake may fail, or an improper seal may cause high pressure hydraulic fluid to flow under high pressure and cause burns.

2. The hydraulic fluid used in the hydraulic brake booster is the Dexron-IIE ATF. The use of any other hydraulic oil may affect the rubber parts and cause abnormal oil or work leakage.

In particular, the hydraulic fluid used for the hydraulic brake booster is very different from the brake fluid used in the master cylinder.

Note: The hydraulic brake booster must not touch the special brake fluid on the master cylinder, and the master cylinder components must not touch the special hydraulic oil of the hydraulic brake booster.

The hydraulic fluid of the hydraulic brake booster is mixed with the brake fluid for the master cylinder. This can cause damage (such as expansion of rubber parts), oil leakage or brake failure, or serious accidents. Fire).

3. When the engine is started and the oil pump is running, the brake booster oil temperature rises. In particular, repeated use of brakes can sometimes increase the hydraulic fluid temperature in the booster assembly to 100°C (212°F) or higher. Careful operation.

Before starting work (for example, removing the booster assembly from the vehicle), turn off the engine, wait for 30 minutes and confirm that the temperature has dropped.

4. After a long period of engine shutdown, the high pressure hydraulic oil in the hydraulic brake booster tank is still under pressure. Hydraulic Brake Booster Assembly Before removing the hose, or in the event of a power failure of the engine, the brake pedal must be repeated at least ten times and ensure that the hydraulic pressure in the tank has been reduced to atmospheric pressure before disassembling.

Especially when removing the tank from the spare parts of the hydraulic brake booster assembly, if the hydraulic oil in the tank is kept at a high pressure, the hydraulic oil may spatter, so be careful.

5. After removing the hydraulic booster assembly or piping and performing maintenance, do not drive until the next cleaning operation is complete and verify that everything is normal, including hydraulic booster and tank operations.

6. When the hydraulic brake booster is installed in the car, how can it be deflated?

a. Install the hydraulic brake booster and master cylinder on the vehicle and connect the hose.

b. Add hydraulic oil between the minimum and maximum values of the hydraulic brake booster box.

c. Start the engine for about 5 seconds.

d. Then turn off the engine and check the amount of hydraulic oil in the tank.

e. If the hydraulic oil is below the minimum, inject more hydraulic oil between the minimum and maximum ranges.

f. Repeat the above steps until the hydraulic fluid in the tank is no longer bubbling or changing. However, if the hydraulic oil blisters in the above steps, stop for a while and wait for the air bubbles to dissipate and continue.

g. When the engine starts, slowly depress the brake pedal several times.

h. Then turn off the engine and check the amount of hydraulic oil in the tank. If the hydraulic oil is below the minimum value, refill more hydraulic oil and place it between the minimum and maximum ranges.

i. Shut down the engine and operate the brake pedal several times, at least ten times.

j. Check the hydraulic fluid in the tank for air bubbles or changes. If bubbles still exist, stop and wait for the bubbles to disperse. Repeat steps 7)9) above.

k. The system k through the hydraulic system must be evacuated, for example: hydraulic wheel master cylinder or wheel cylinder, of course, step 10) above, and ensure that the engine is in the starting state.

1. When the engine starts, slowly depress the brake pedal and repeat the operation about 30 times (1-3 seconds each time) until the servo motor is in the full load position. Do not leave the pedal in a fully charged position (more than one second) during this operation.

m. Then, turn off the engine and brake pedal several times, at least ten times.

n. Check the condition of the hydraulic fluid in the tank and if there is any foam or oil level change. If bubbles still exist, stop and wait for the bubbles to disperse. Repeat steps 12)-14) above.

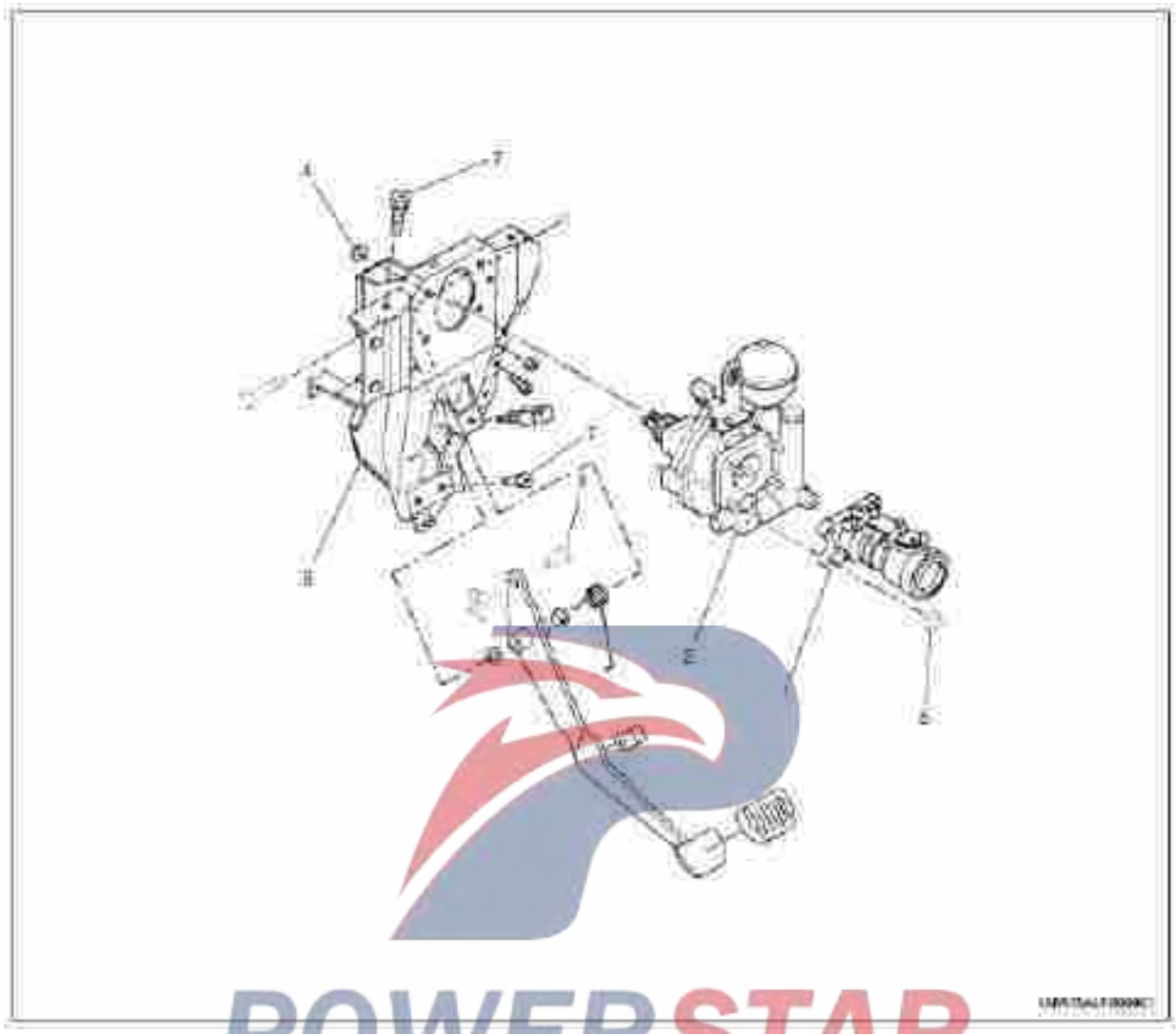
7. Precautions when the brake system is deflated

When performing an exhaust operation of a brake system (eg, a master cylinder or a hydraulic wheel brake cylinder), it is checked whether the hydraulic brake booster is empty and ensures that the engine is in an activated state. .

Note: If the brake system is deflated when the engine is stopped, operation cannot be performed.

If both are deflated in the hydraulic brake booster used for the deflation operation of the brake system, it is performed after completion of the deflation of the hydraulic brake booster described in the above step 7).

Components



Key

1. Main cylinder
2. Hydraulic booster
3. U-shaped pin
4. Hydraulic booster mounting nut
5. Master cylinder mounting nut
6. Brake pedal support
7. Install the brake pedal bracket nut

Disassembly

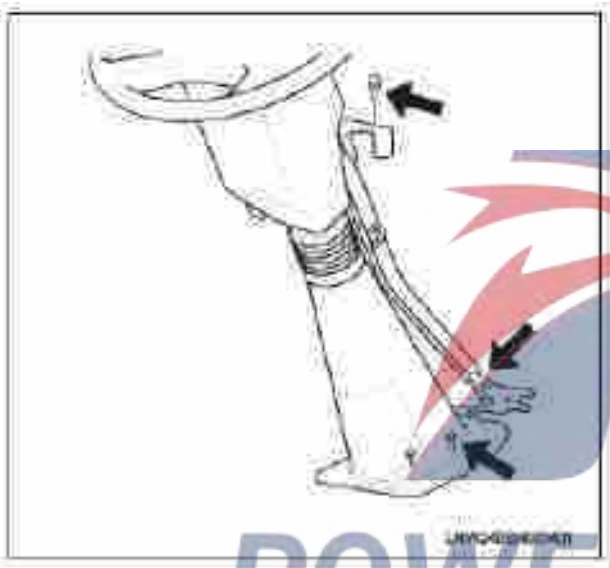
• Stop the wheel and use the parking brake.

• Disconnect the battery ground cable.

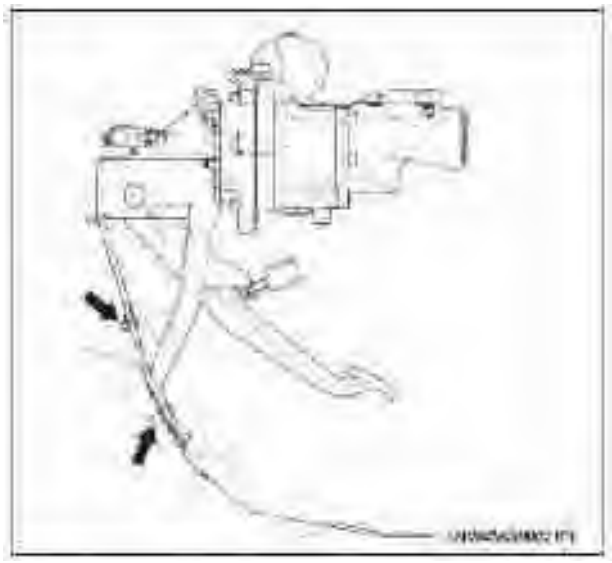
• When starting the engine, depress the hydraulic pressure in the tank by depressing the brake pedal. After confirming that the temperature of the hydraulic brake servo unit has dropped, remove the hydraulic brake from the engine. Car. Booster assembly.

1. Remove the entire dashboard. Refer to "Dashboard (Standard Cab)" or "Dashboard (Higher Education Cabin, Spacious Cab)" in Section 9K - Outdoor/Interior Decoration.
2. Remove the thermal protector located below the hydraulic brake booster.
3. Remove the steering wheel and steering column assembly.

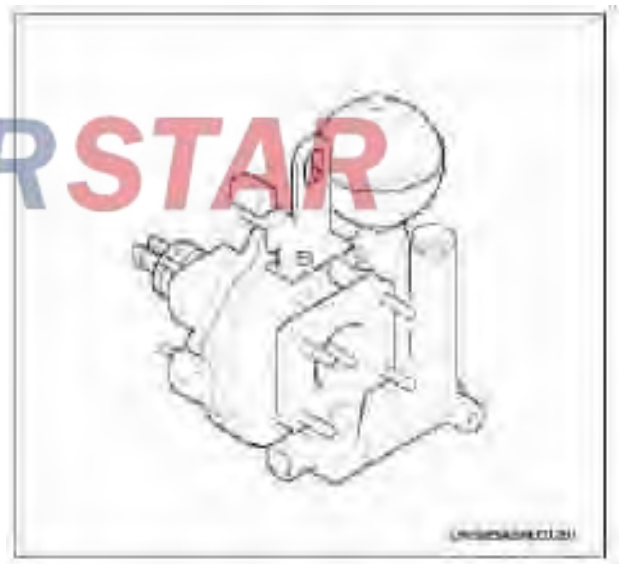
• Remove the inspection window (only for a single cab) and mark the shaft of the steering bolt and the Yoke fork.
Remove the key and nut.
Refer to section 6B - Steering - "Power Steering".
• Remove the screws and place the protective cover on the floor.
• Remove the bolts and nuts and place the bracket on the floor.
• Remove the bolt and place the steering column bracket on the rib assembly of the instrument.
• Remove the bolts and place the steering column bracket on the brake pedal bracket.



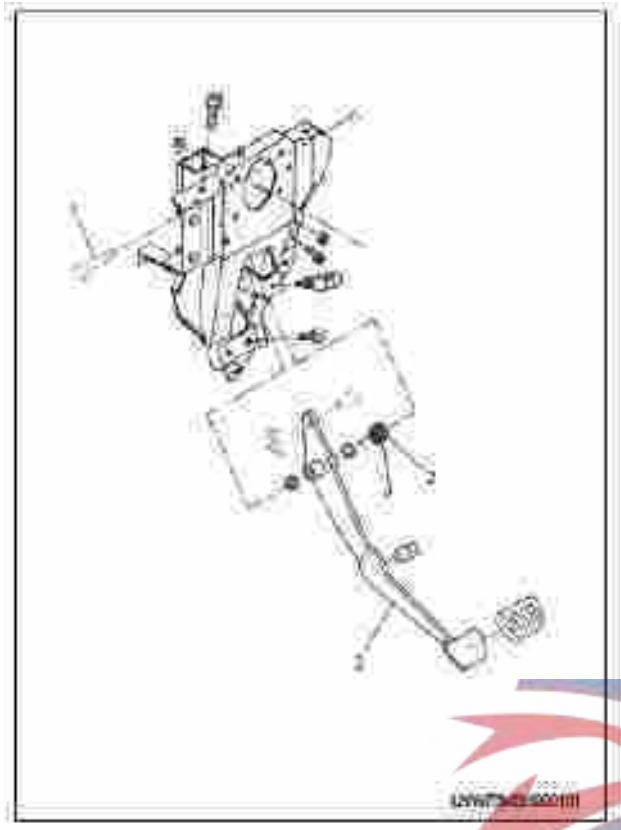
4. Remove the intake and exhaust hoses from the ATF.
• Remove the brake booster hose.
5. Remove front and rear brake hoses and brake hoses.
• Remove the hose and hose from the master brake cylinder.
6. Remove brake pedal assembly with master cylinder and hydraulic brake booster.
• Remove the accelerator pedal bracket.
• Remove the screw that secures the brake pedal bracket.
• Remove the radiator grille and remove the ATF air hose from the hose on the front of the radiator. Remove the ATF air intake.
• Remove the brake pedal assembly.



7. Remove the hydraulic brake booster and master cylinder assembly.
8. Remove the U-shaped pin.
9. Remove the four hydraulic booster mounting nuts on the pedal bracket.
10. Disassemble the master cylinder with a hydraulic brake booster.
11. Remove the four retaining nuts that connect the master cylinder and the hydraulic brake booster.



12. Remove the return spring.
13. Remove the pedal shaft from the brake pedal assembly.
14. Remove the brake pedal.



Key

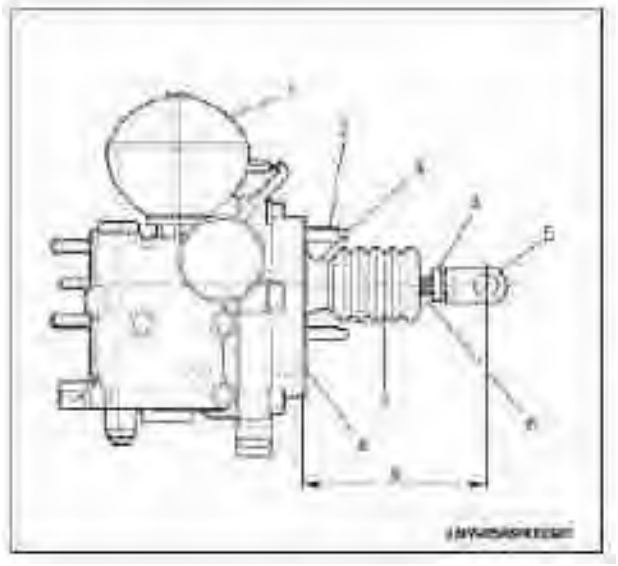
1.Pedal shaft
2. Reset spring
3. Brake pedal

Inspection

• Check the rings, return springs and bolts for wear.
• Replace defective parts found.

Disassembly

1. Install the hydraulic brake booster assembly to the device and use the four bolts on the flange to mount it to the vehicle.
2. Caution: Do not exert any eccentric load on the operating lever, loosen the lock nut, and remove the U-shaped clamp and lock nut.
3. Remove the protective cover from the housing boss slot and lever slot and remove the protective cover.
4. Use an oil filter wrench to remove the oil reservoir and O-ring.

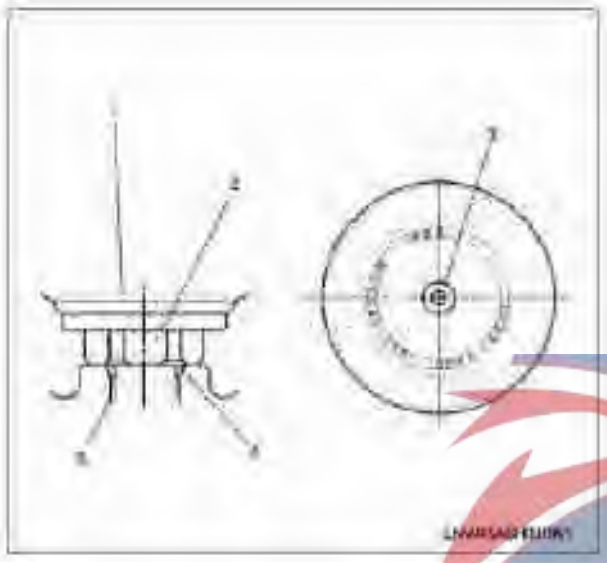


Key

1. Battery
2. Stud bolts
3. Seashell boss
4. Rivet the lock nut.
5. U-shaped clamp
6. Operating leverage
7. Protective blanket
8.Flange
9. U-clamp position dimension (A)

• How to deal with tanks?

To dispose of the storage tank, drill a hole in the position shown in the figure below according to the instructions printed on the tank, release the sealed nitrogen completely into the storage tank, and discard the tank. Like the hydraulic booster assembly, according to the above method, all the nitrogen in the storage tank is first discharged and then processed.



Key

1. Storage tank
2.Hex25
3. Special drill holes for releasing gas.
4. O-ring
5. Thread

Assembly

1. Make sure that no foreign objects stick to the tank screw or the brake booster-side connection.
2. Place a new hydraulic oil coated O-ring (ATF Dexron-IIE) into the screw section of the tank, being careful not to damage the tank. Always use new O-rings.
3. Using an oil filter wrench, hold the oil reservoir housing and tighten the housing with a wrench to obtain the specified torque.

Tightening torque =30N·m (3.1kgf·m)

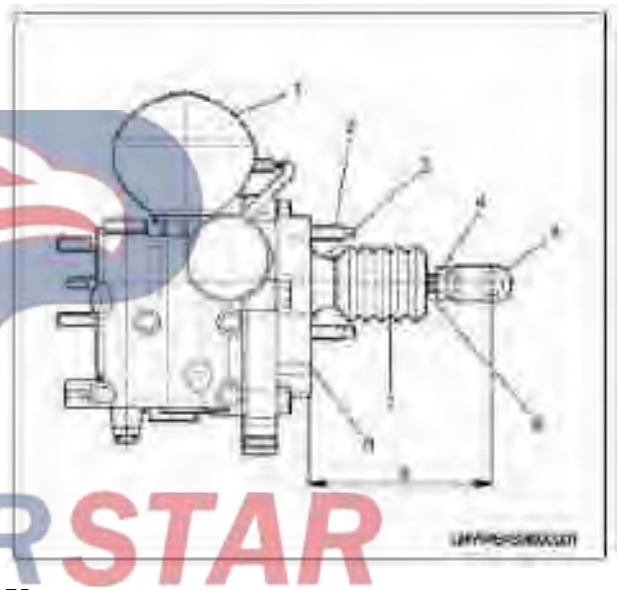
4 Thoroughly clean the exterior and anchor groove levers and retaining grooves with a dry cloth to ensure that no foreign objects are present.

The small-diameter hole portion of the end face of the protective cover is fitted into the fixing groove of the lever, and then the large-diameter hole portion is firmly fitted to the housing boss. Anchor the cracks.

6. Screw the lock nut and clevis into the lever.
7. Set the position of the U-shaped elbow return dimension (R size: from the center hole of the disc connected to the surface of the circuit board to the clamping device of the U-shaped flange) equal to 109 0.5 mm (4.29 to 0.020 in) Then tighten the lock nut to the specified torque.

Tightening torque=19N·m (1.9kgf·m)

When tightening the lock nut, be careful not to deform the clevis.

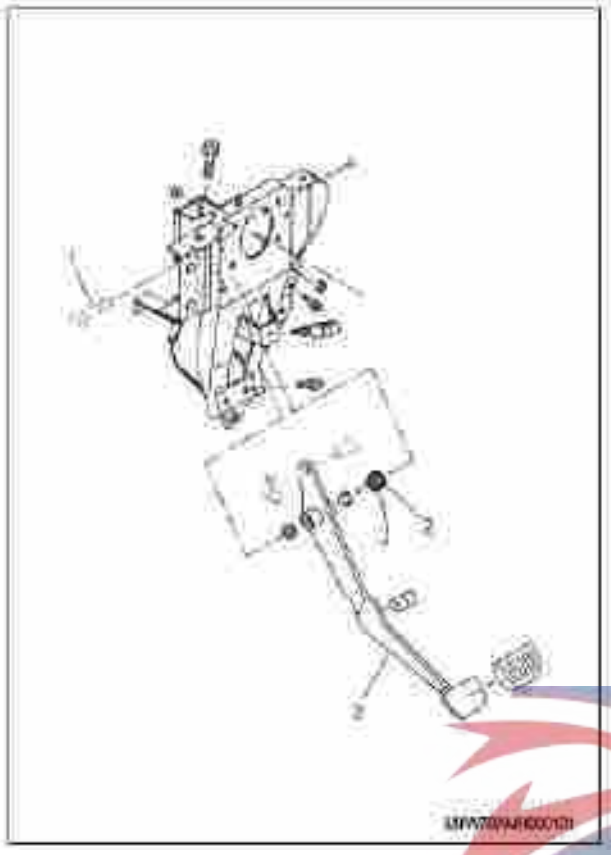


Key

1. Storage tank
2. Stud bolts
3. Seashell boss
4. Rivet the lock nut.
5. U-shaped clamp
6. Operating leverage
7. Protective blanket
8.Flange
9. U-clamp position dimension (A)

Installation

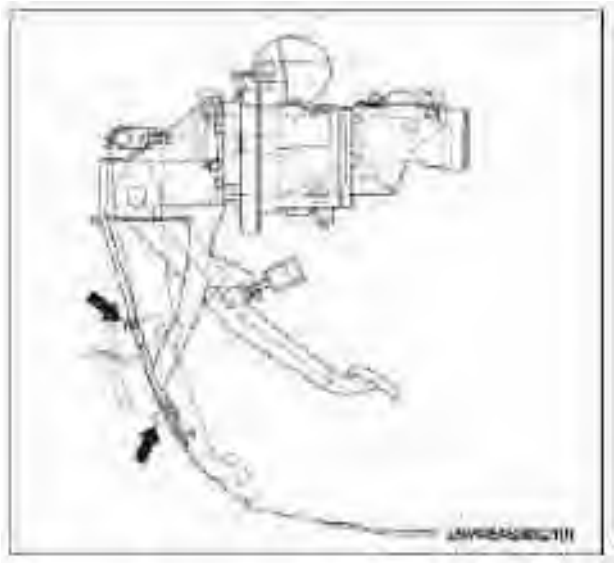
1. Install the pedal shaft on the entire brake pedal.
2. Install the return spring.



Key

1.Pedal shaft
2. Reset spring
3. Brake pedal

3. Install the hydraulic brake booster.
4. Install the master cylinder assembly.
Tightening torque=14N·m (1.4kgf·m)
5. Tighten the four nuts of the hydraulic brake booster on the pedal bracket.
Tightening torque=14N·m (1.4kgf·m)
6. Connect the servo and brake pedal and install the U-shaped pin.
7. Install the brake pedal assembly with master cylinder and hydraulic brake booster.
• Place the ATF air intake and install the brake pedal assembly.
Tightening torque =44N·m{4.3kgf·m}
• Connect the ATF air inlet and hose.
• Install the accelerator pedal bracket.
• Install the radiator grille.

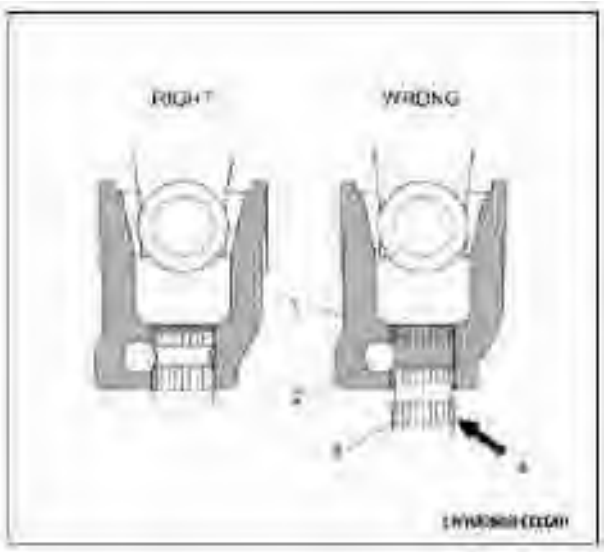


8. Install the ATF tube on the hydraulic brake booster.
9. Install the master cylinder's hydraulic line in the master cylinder.
10. Install the steering wheel and steering column assembly.
• Position the steering wheel and the entire steering column.
Refer to "Power Steering" in section 6B.
Power steering
• Install the mounting bolts, nuts and screws on the power steering.
• Install U-bolts and nuts.
Tightening torque =275N·m{2.5kgf·m}
• Installation check window.

Caution:

• The U-joint bolt (2) must be removed to install the steering shaft U-joint (1) on the steering gear input shaft (3).
• Be sure to insert the U-bolt bolt into the groove of the steering gear input shaft and put it back in place.

• When installing the steering shaft, make sure that the tooth flank (4) is not visible (if it is visible, the installation is incorrect).



11. Install the hydraulic brake booster thermal protector.

12. Install the dashboard assembly.

Refer to "Dashboard (Standard Cab)" or "Dashboard (Higher Education Cabin, Spacious Cab)" in Section 9K - Outdoor/Interior Decoration.

13. Connect the battery ground cable.

14. After installation, be sure to add new hydraulic fluid (ATF Dexron-IIE) and completely release the air inside the hydraulic brake booster.

15. Drain the brake line.

Refer to “Hydraulic Braking System” in this section.

16. Release the parking brake and remove the blank.

Adjust

Adjust the brake pedal

1. Loosen the lock nut of the stop lamp switch.

2. Loosen the nut on the hydraulic brake booster lever.

3. Install the piston until the distance between the centers of the U-shaped pin holes on the mounting surface of the brake pedal bracket is 109±0.5 mm (4.29±0.020 in).

When fixing according to the above steps, there is no need to adjust the height and free stroke of the brake pedal.

4. Tighten the lock nut of the push rod.

Tightening torque=19N·m (1.9kgf·m)

5. Install the parking light switch so that the threaded portion of the switch contacts the brake pedal for a period of time, and then the switch retracts half a turn.

Tightening torque : 20N·m{2.0kgf·m}

6. Check that the brake pedal is working properly.

Measuring

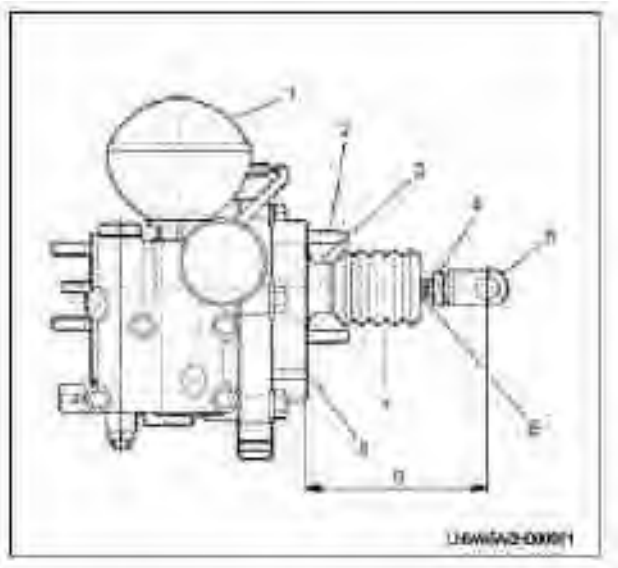
• Measure the free travel of the brake pedal after reducing the hydraulic pressure in the tank with at least 10 pedal operations when the engine is stopped.

Brake pedal stroke

Standard value
24-29 mm (0.94 -1.14 in)

When the engine starts, there is 294 N (30 kgf•m) of pedal pressure in front of the gap between the underside of the pedal bracket and the brake pedal lever.

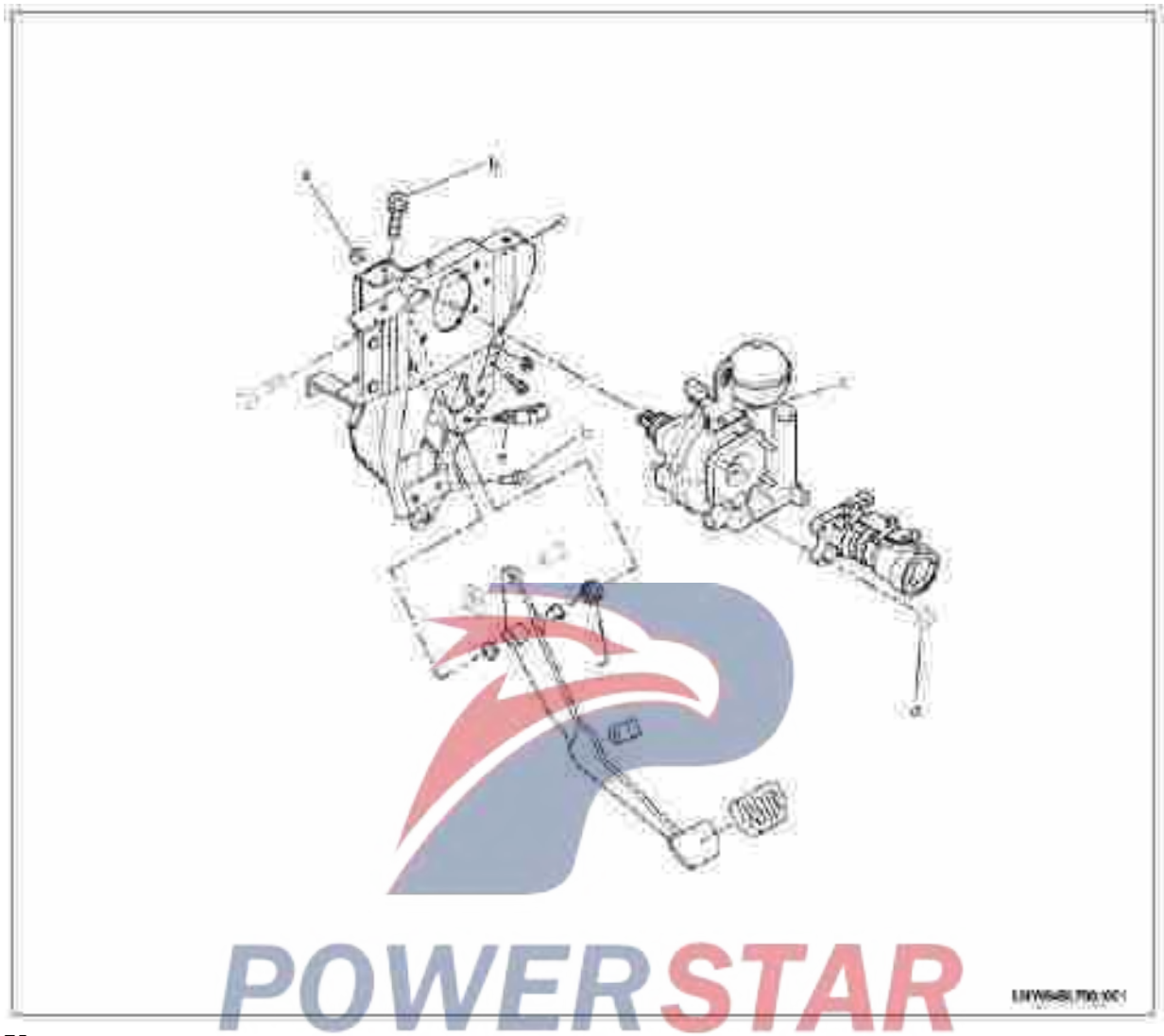
Braking type		Standard value
Front wheel disc brake / rear drum brake		35 mm (1.38 inches) or more
4-wheel drum brake mode	With automatic regulator	45 mm (1.38 inches) or more
	With manual regulator	45 mm (1.77 inches) or more



Key

1. Storage tank
2. Stud bolts
3. Seashell boss
4. Rivet the lock nut.
5. U-shaped clamp
6. Operating leverage
7. Protective blanket
8.Flange
9. U-clamp position dimension

Clamping torque table

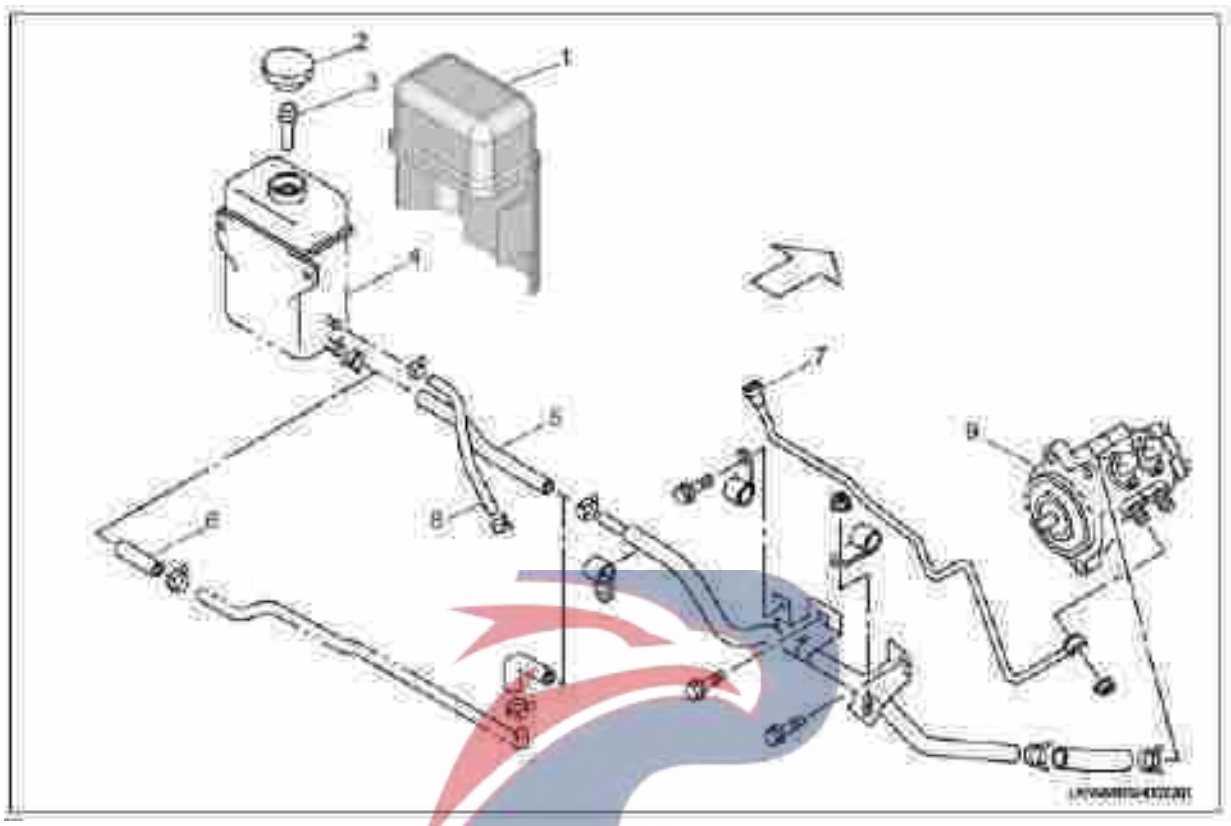


Key

(a) 14 N·m (1.4 kg·m /122 Ib·in)
(b) 42 N·m (4.3 kg·m/31 Ib·ft)
(c) 30 N·m (3.1 kg·m / 22 Ib·ft)
(d) 14 N·m (1.4 kg·m /122 Ib·in)
(e) 20 N·m (2.0 kg·m /14 lb·ft)

Hydraulic brake fluid and filter

Parts location map



Key

1.Housing

2. Cover

3. Filter

4. Hydraulic brake accumulator

5. Hose (single row cockpit)

6. Hose (double-row cockpit)

7. Piping (pump - hydraulic brake booster)

8. Return hose (hydraulic brake booster - accumulator)

9. Hydraulic booster and power steering pump

Disassembly

1. Remove the lid and lid.

2. Remove the filter

3. Clean the filter with clean solvent. Then dry the filter with compressed air.

4. Lift the vehicle until the tire is off the ground.

Support this framework.

5. Remove the reservoir hose from the hydraulic brake booster.

Drain the fluid in the tank.

Installation

1. Connect the hose.

Do not start the engine.

2. Install the filter.

3. Fill and drain the hydraulic system.

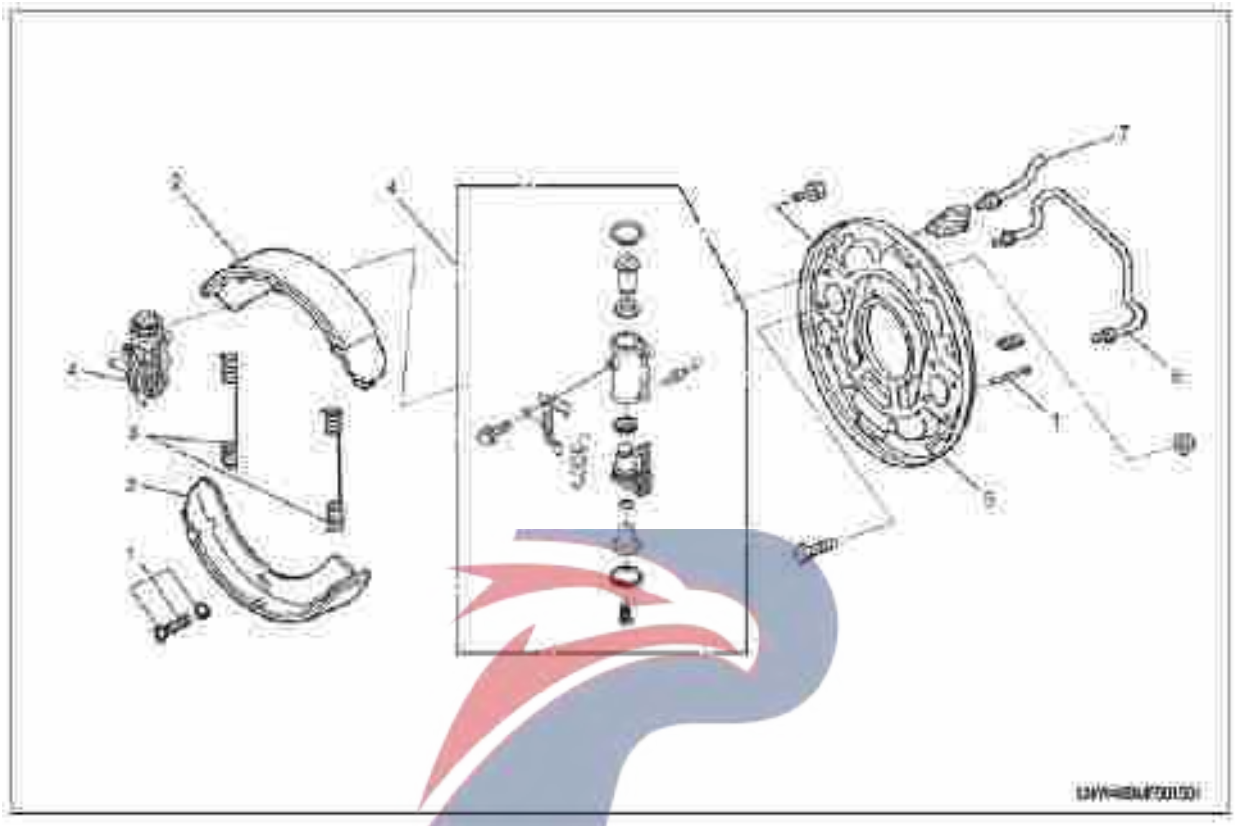
Refer to “hydraulic system booster” in this section.

4. Remove the lid and cover.

Front drum brake

Component parts

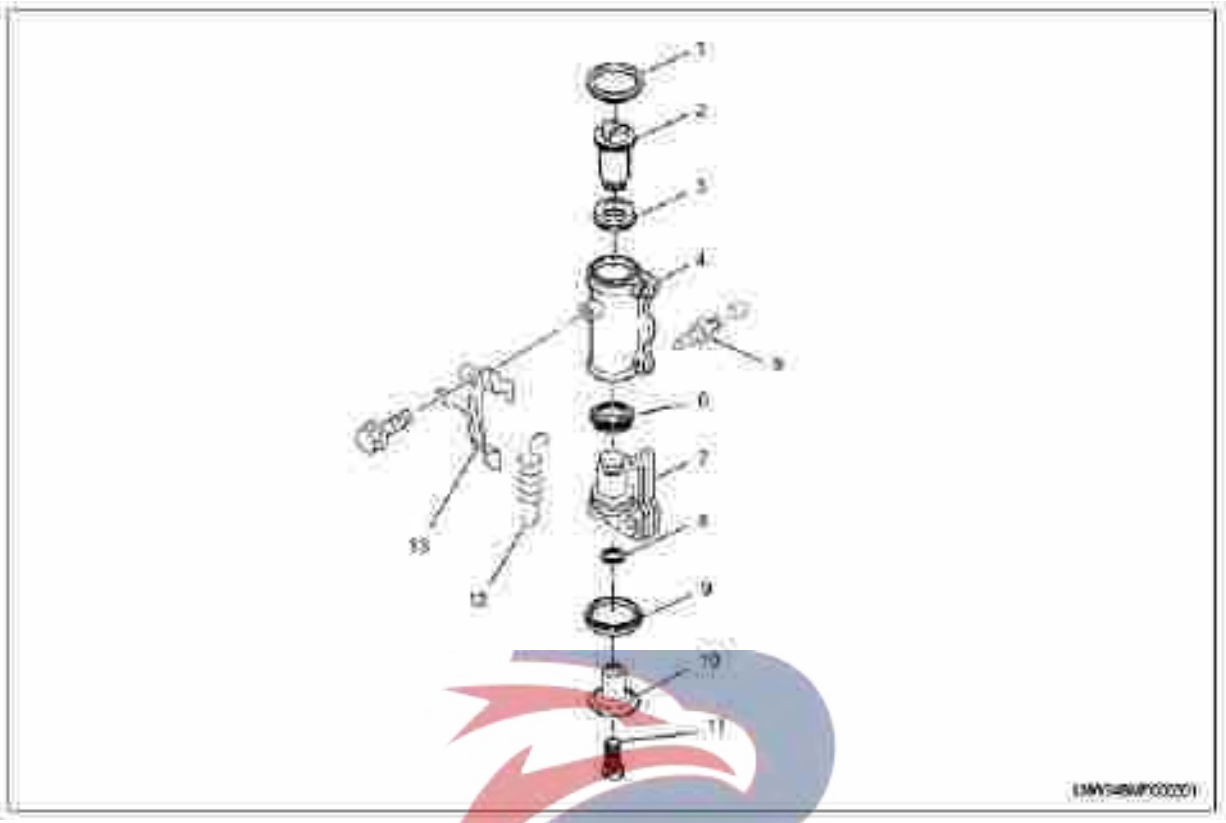
Drum brake assembly



Key

1. Brake shoe plate, brake shoe pressure spring, brake shoe pressure pin
2. Brake tire assembly
3. Return spring
4. Wheel brake cylinder assembly
5. Liner
6. Braking tube
7. Braking tube

Wheel brake cylinder



Key

1. Dust cover
2. Piston
3. Piston bowl
4. Cylinder block
5. Exhaust valve
6. Piston bowl
7. Piston
8. Washers
9. Dust cover
10. Adjust the gear
11. Adjust the screw
12. Adjust the spring of the rod
13. Adjustment rod

Disassembly

1. Lift the vehicle and use the base to support the frame.

Refer to the vehicle lift points in the OA overview section.

2. Remove the front wheel.

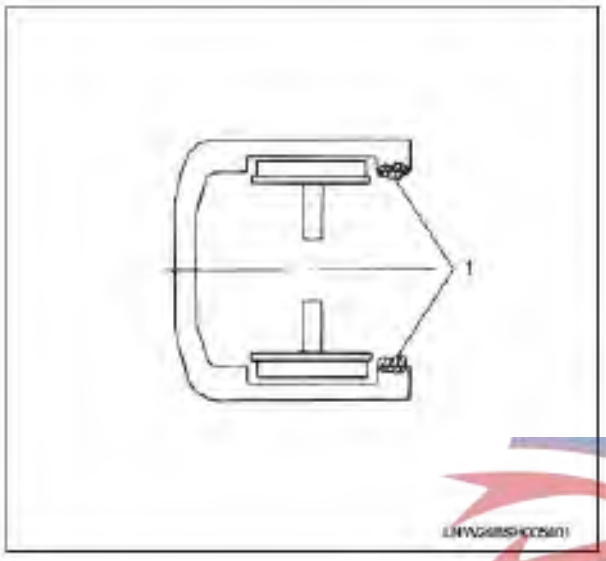
Refer to 2D wheels, wheels and tires in Tire Section.

3. Remove the brake drum and hub assembly.

Refer to front hub and brake disc on front axle section 3C2.

Caution:

The use of staggered brake drums and rust (1) wear at the ends of the brake drum may make it difficult to disassemble the brake drum. In this case, the brake shoes follow the steps of drums and drums.



4. Reduce the outer diameter of the brake shoe

a. Remove the adjustment hole cover (2) and adjust the lever clearance hole cover (1).

b. Insert the round bar (2) vertically into the clearance hole of the adjustment bar and push the adjustment bar (1) upwards.

c. After pushing the lever up, insert the flat-blade screwdriver (3) into the adjusting device hole and turn the adjusting pinion (4) towards the LOOSE arrow (toward the stopper).

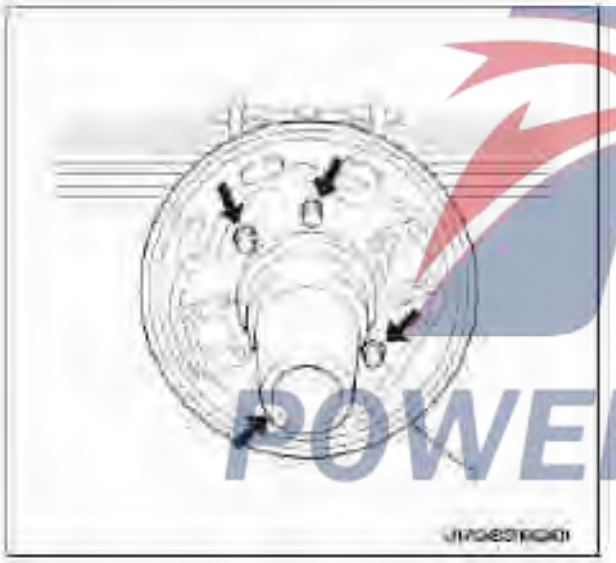
Caution:

If the adjustment gear is rotated without lifting the adjustment lever, the adjustment gear is locked by the adjustment lever and the pinion may be damaged. Therefore, it is necessary to turn the adjustment mechanism after lifting the adjustment lever.

Also, be careful not to damage the wheel brake cylinder boot when turning the adjustment mechanism and the upper support adjustment lever.

5. Remove pressure spring from brake shoe, brake shoe pressure plate and brake shoe pressure pin.

6. Remove the brake shoe and return spring.
7. Remove the brake hose and hose.
8. Remove the wheel brake cylinder assembly.
9. Remove the gasket (1).

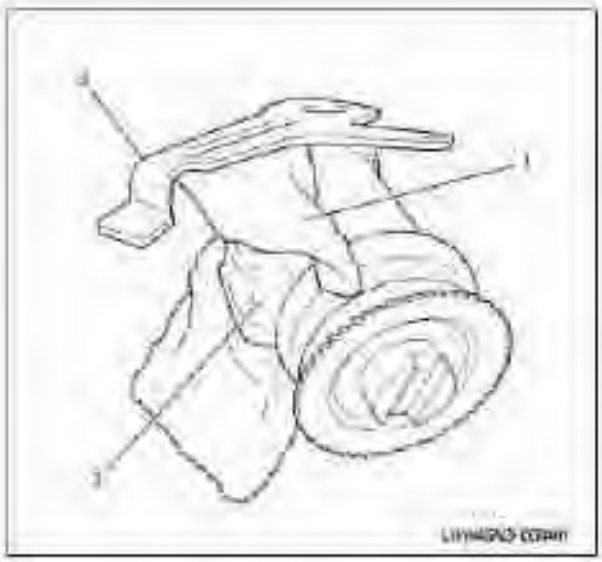


Disassembling

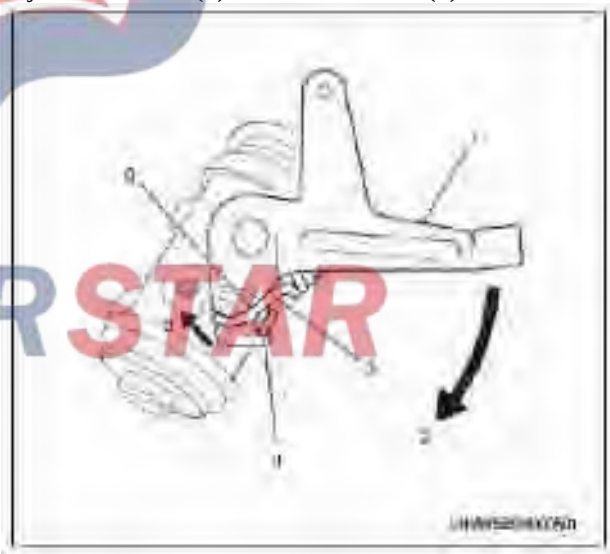
Follow the steps below to remove the eyelash adjuster.

1. In order not to damage the parts, a cotton thread head or the like must be inserted between the adjustment rod and the spring of the adjustment rod (1).

2. Remove the adjusting screw from the adjusting lever and place the adjusting lever (3) on the bracket (2).



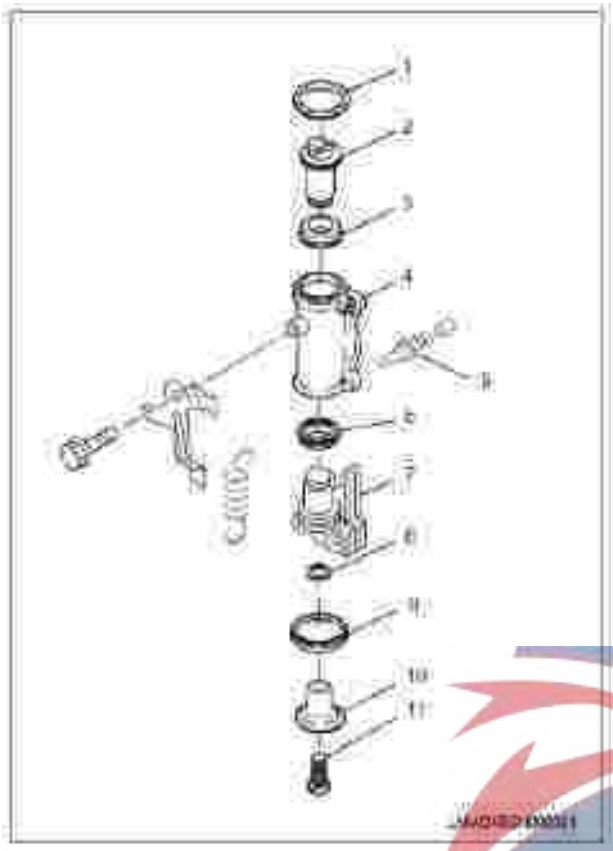
3. Using the contact point (3) of the adjustment lever (1) and the spring of the adjustment lever (6) as a fulcrum, turn the adjustment lever (2) to stretch the adjustment lever spring. Remove the bracket adjustment lever (4) from the bracket (5).



Follow the steps below to remove the wheel brake cylinder.

4. Adjust the screws and gears
5. Adjusting screw (11)
6. Adjust the gear (10)
7. Washers(3)
8. Pistons (7)
9. Dust cover(9)
10. Piston bowl(6)
11. Dust cover(1)
12. Pistons (2)
13. Piston bowl(3)
14. Cylinder (4)

15. Exhaust valve(5)



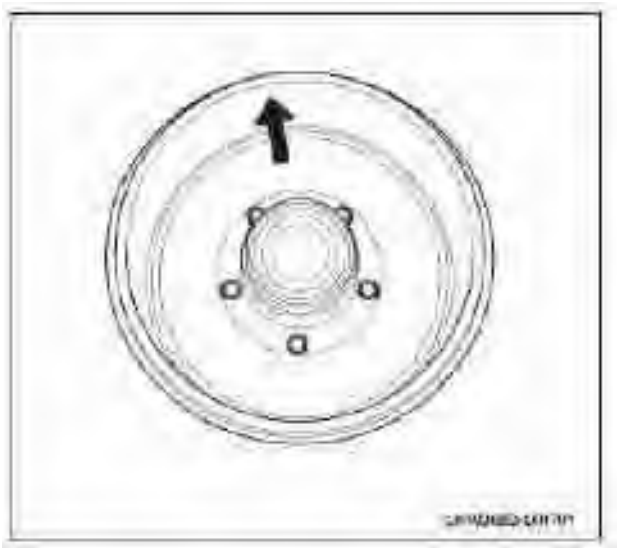
Inspection

1. Check the brake drum.

• Check the slide for damage, partial wear, graded wear, streaks, cracks, and contact with the liner.

Partial wear limit

0. 15 mm



- Measure the inner diameter of the drum.

The inner diameter of the brake drum

Standard value	Limit of use
320 mm	321. 5 mm

Caution:

When the inner diameter value is at the limit, correction is performed.

2. Check the brake linings.

• Check grease, etc.

• Check its contact with the brake drum.

Dash the brake drum with chalk and observe the friction with the pad.

Caution:

Exfoliate chalk traces after inspection.

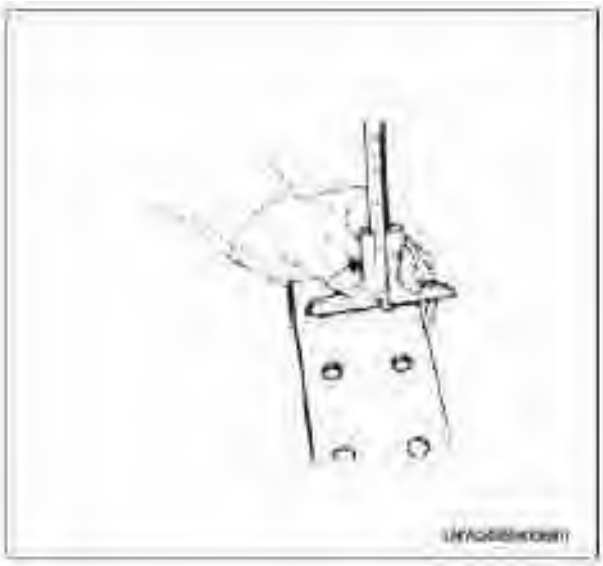
• Check if the brake pads are deformed and the spring holes are worn.

• Measuring pad wear.

Restriction of use of liners

1.0 mm

• Measure the depth of the rivet head at the rivet table.



• To prevent the brake from deflecting during replacement, place the left and right wheels together.

3. Check the spring.

• Check the return spring.

• Check the brake tire press spring and brake shoe press cover.

• Check for pressure pins that are not damaged, rusted, and deformed.

4. Check wheel brake cylinders.

• Use brake fluid for cleaning, air dry, check and replace any abnormal parts.

• Inspect the cylinder and piston for wear, corrosion, and damage.

• When the limit is exceeded, replace the wheel brake cylinder assembly.

Brake cylinder and piston group

Standard value	Limit
0. 02∽0. 105 mm	0. 15 mm

• Measure the inner diameter of the wheel brake cylinder and the outer diameter of the piston.

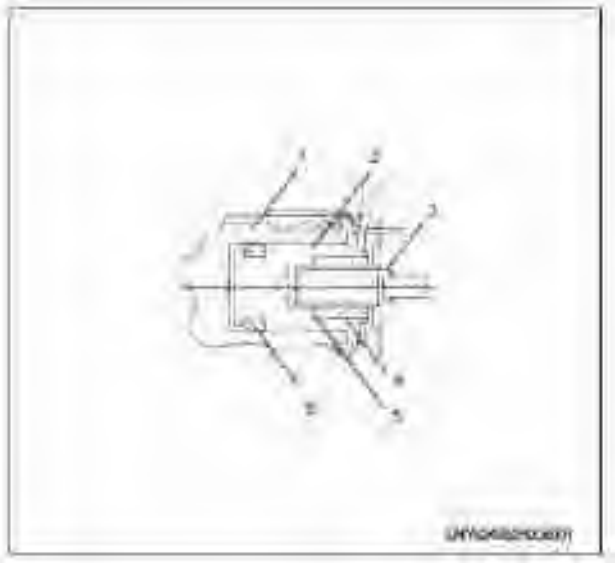
• Check the piston cup for damage.

Caution:

Even if the piston cup has only a little damage, replace it with a new one.

Assembly

Wheel brake cylinder assembly



Key

1. Cylinder
2. Piston
3. Adjust the screw
4. Adjust the gear (adjustment nut)
5. Washers
6. Piston bowl

When assembling, pay attention to the following points and follow the steps below to disassemble it.

• Inside the cylinder, the inhibitor of the part engages with the protective cover of the cylinder antirust painter (CCI-20).

• Apply BESCO Rubber Grease (product name) at the following locations.

- Adjustment screw and piston thread engagement

- Adjust the periphery of gear nuts and piston inserts

- Adjust the contact of the gear top nut with the washer

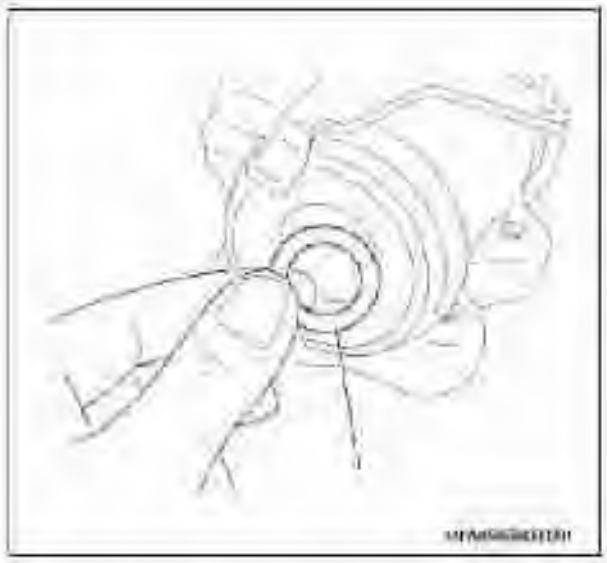
- Sliding part of piston flange and piston

• Install the front side of the piston cup in the cylinder. Be careful not to hurt the cup.

• Make sure you do not forget to install the seal (1). The seal must be installed so that the facing layer faces the side of the adjusting nut (bronze inwards).

Caution:

Forgetting to install accessories or counterfeiting installation directions will cause the automatic game to catch up, so pay close attention.

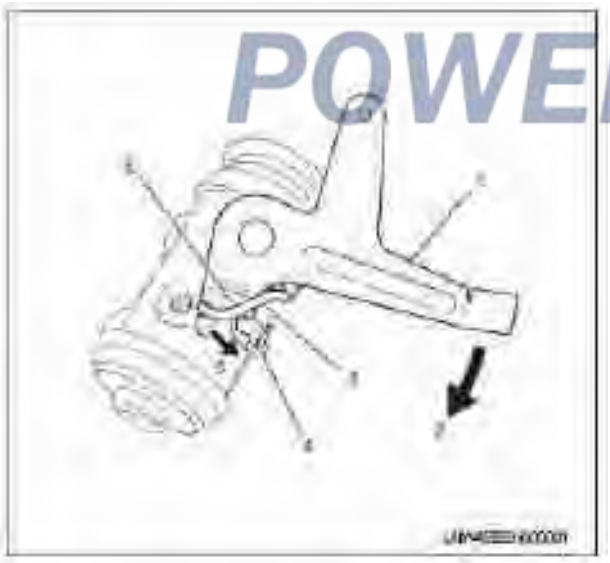


Installation

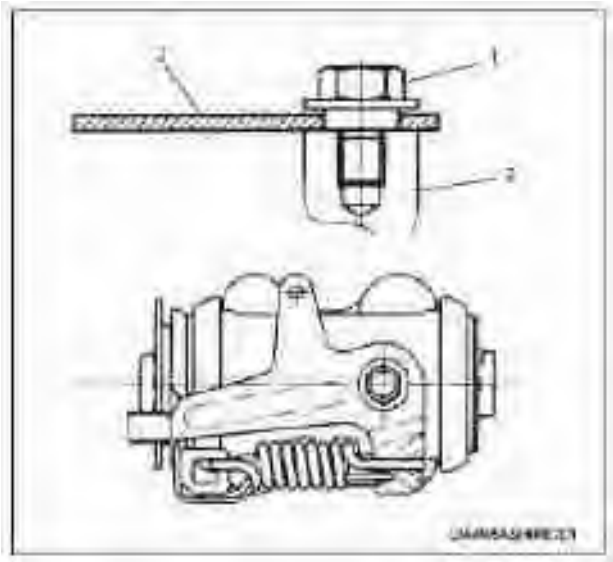
Install an automatic game adjuster

1. The spring hook part of the adjustment rod installed at the short end of the corner support hole is installed at the long end of the adjustment rod.

2. In order to adjust the lever (1) of the contact (3) and the adjusting lever spring (6) as the same basic disintegrating element of the pivot point (2) of the adjusting lever, the center is sealed from the cylinder body on one side to the adjusting rod mounting bracket Pieces (4).



3. Install the adjustment rod mounting bolts (1). In this case, be careful not to adjust the adjustment lever (3) caught in (2) the cylinder sleeve screw.



4. After tightening the bolts, make sure that the adjusting lever is fully pressed to adjust the speed.

Brake installation

1. Install the liner.

Tightening torque : 157 N•m {16.0kgf•m}

2. Install the wheel brake cylinder assembly.

• After tightening the brake hose, tighten the wheel brake cylinder assembly to the specified torque.

Tightening torque : 74 N•m {5kgf•m}

3. Install the brake hose and hose.

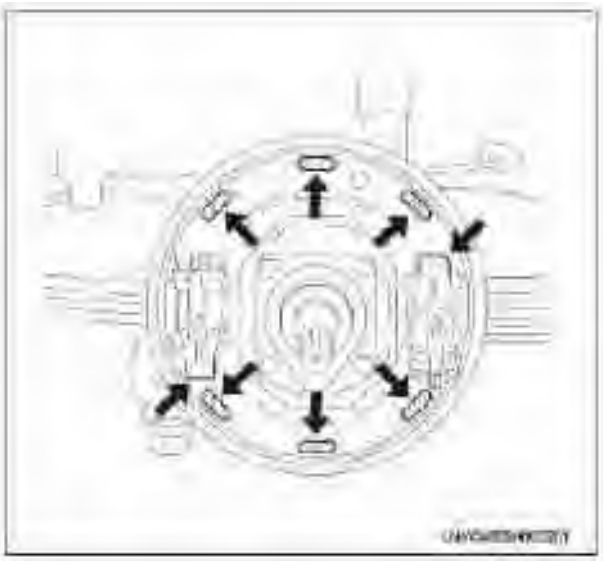
Tightening torque : 15 N•m {1.5kgf•m}

4. Install the brake shoe and return spring.

• Pay attention to the mounting direction of the brake shoe and return spring.

• Apply a small amount of heat-resistant grease to the following areas.

- The engagement groove of the piston brake shoe.
- shoe piston seals and sliding parts of seals.



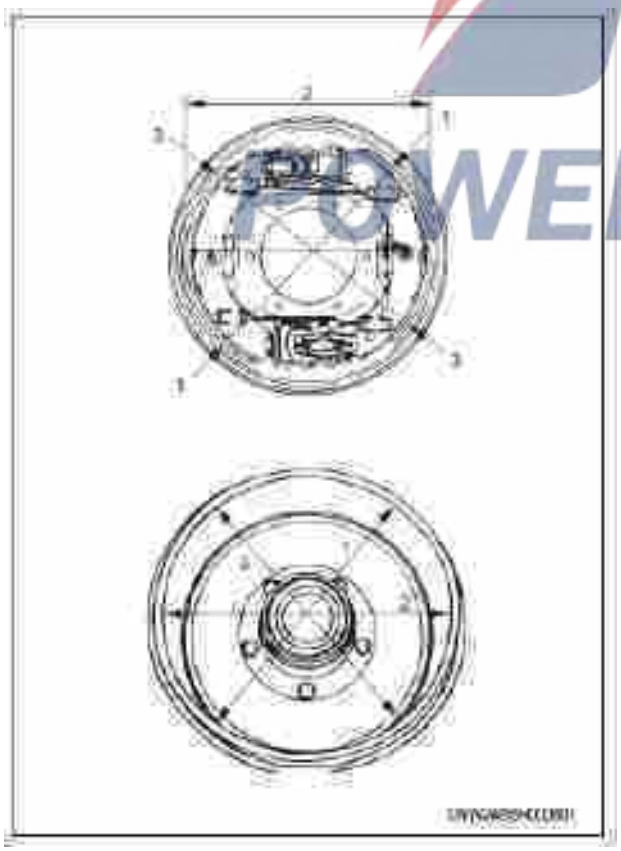
5. Install the pressure spring from brake shoe, brake shoe pressure plate and brake shoe pressure pin.

6. Install brake drum and hub assembly.

After replacing the brake lining, install the brake drum and hub assembly as described below.

• Measure the outer diameter of the brake shoe with the inner diameter brake drum, adjust the rotation of the gear, and adjust the outer diameter of the brake shoe. The inner diameter difference reaches 0.6mm.

• Measure the points (1), (2), (3)3 in the figure below.



7. Adjust the hub bearing preload.

• After installing the brake drum, adjust the hub bearing preload.

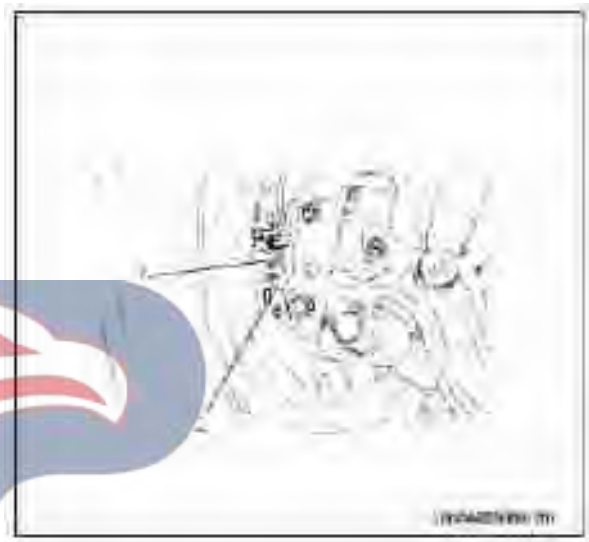
Refer to front hub and brake disc on front axle section 3C2.

8. Drain brake air.

Refer to hydraulic brake system in this chapter.

9. Adjust the brakes. (with automatic eyelash adjustment)

a. Remove the adjuster hole cover (2) and adjustment lever release hole cover (1).



b. Insert the round bar (2) vertically into the clearance hole of the adjustment bar and push the adjustment bar (1) upwards.

c. After adjusting the lever from the top, insert a flat-blade screwdriver into the adjusting hole (3) and insert the engraving plate with the reverse “loose” arrow (direction brake inward) to adjust the rotation of the gear (4).

Caution:

If the adjustment gear is rotated without lifting the adjustment lever, the adjustment gear is locked by the adjustment lever and the pinion may be damaged. Therefore, it is necessary to turn the adjustment mechanism after lifting the adjustment lever.

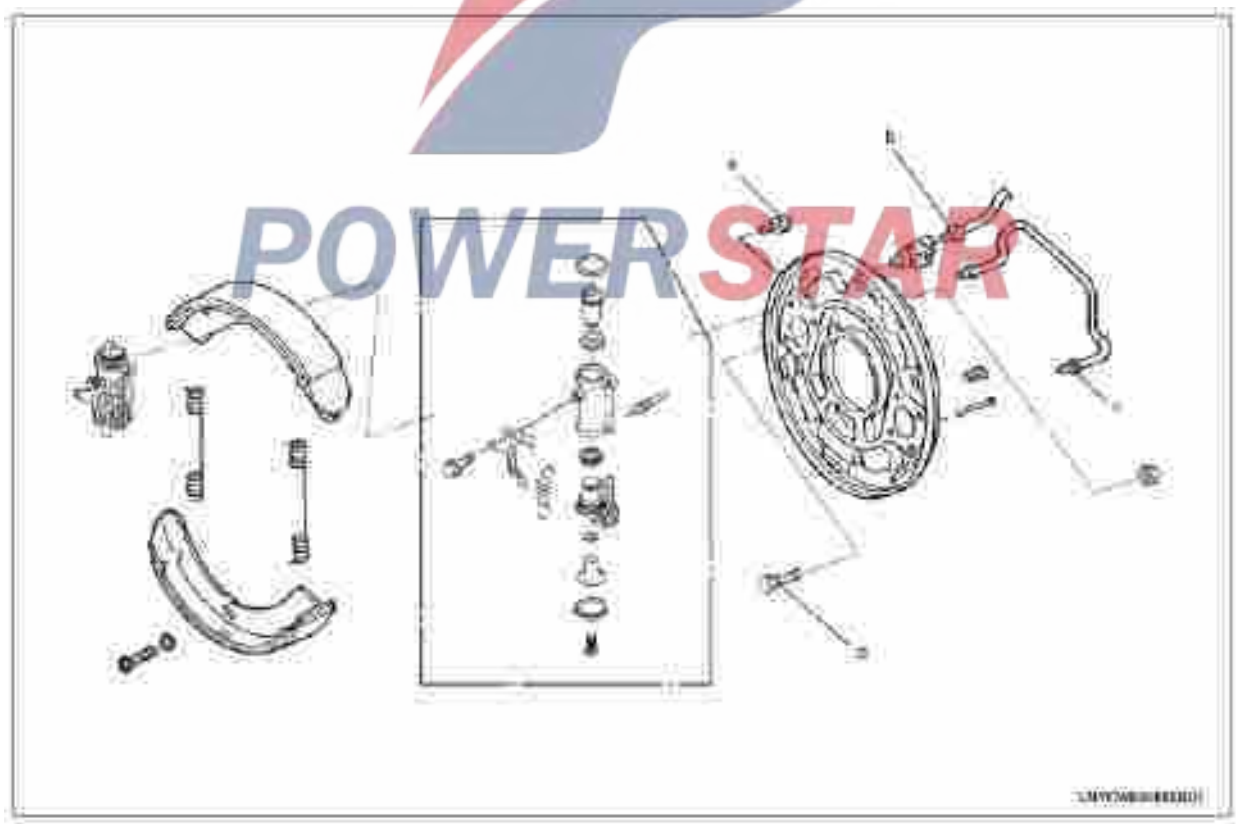
Also, be careful not to damage the wheel brake cylinder boot when turning the adjustment mechanism and the upper support adjustment lever.

d. In the direction of travel of the friction plate, the wheel brake cylinder rotates until the locking mechanism of the adjusting mechanism is braked.

e. Rotate the adjusting gear cylinder to gently rotate until the drum rotates.

f. The brake drum rotates in the forward direction or the actual movement of the vehicle, and the brake pedal is deepened several times and adjusted appropriately.

Tightening torque - Overview



Key

(a).74N·m{7.5kgf·m}

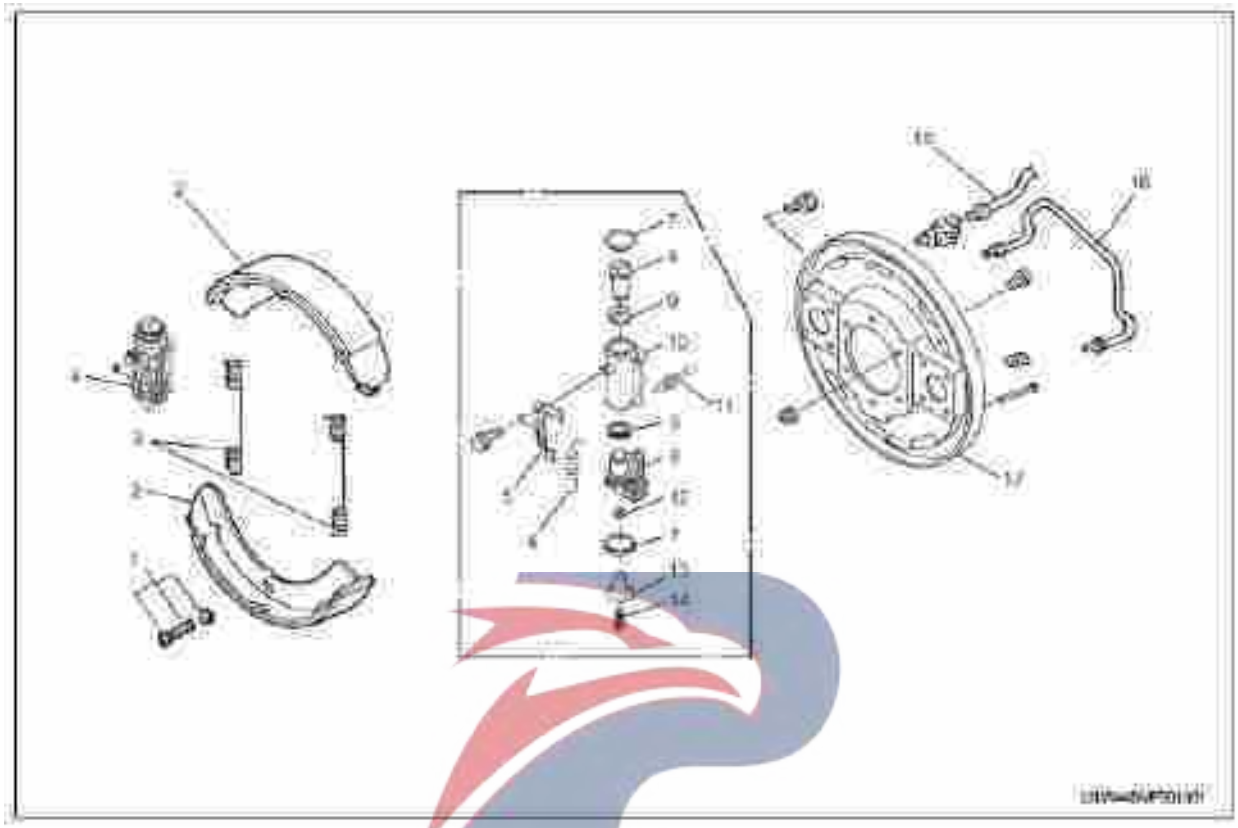
(b).15N·m{1.5kgf·m}

(c).15N·m{1.5kgf·m}

(d) 157N·m{16.0kgf·m}

Rear drum brake（Ø320mm）

Component parts



Key

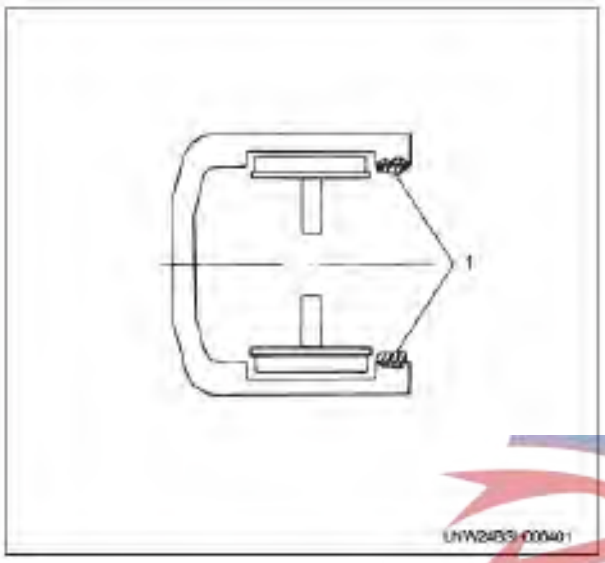
1. Compression spring for brake shoe, compression plate for brake shoe
Brake tire assembly
3. Return spring
4. Wheel brake cylinder assembly
5. Adjustment rod
6. Adjust the spring of the rod
7. Dust cover
8. Piston
9. Piston
10. Cylinder block
11. Exhaust valve
12. Washers
13. Adjust the gear
14. Adjust the screw
15. Braking tube
16. Braking tube
17. Liner

Disassembly

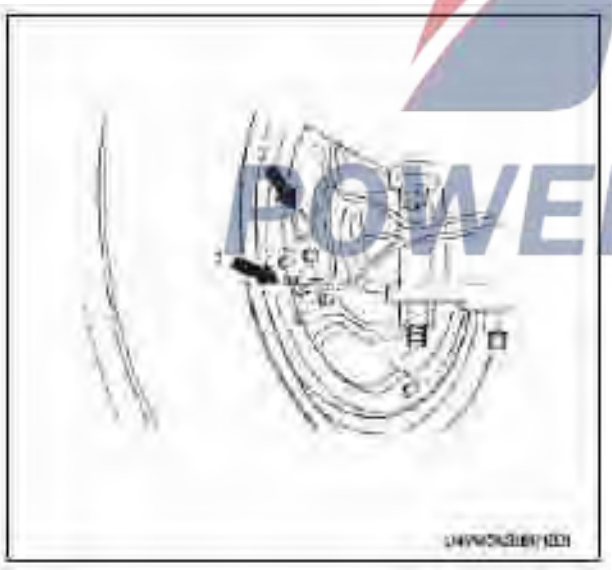
1. Lift the vehicle and use the base to support the frame.
2. Refer to the vehicle lift points in the OA overview section.
3. Remove the rear wheel.
Refer to 2D wheels, wheels and tires in Tire Section.
4. Remove the brake drum and hub assembly.
Refer to rear axle 3C3 rear axle section, wheel (single tire), axle or axle, hub (Double tires).

Caution:

The brake drum's shoulder wear and the brake drum's rust (1) make it difficult to remove the brake drum's end during manufacture. Please shrink the brake pad. (Break down the brake shoe and follow the steps below. Lower brake drum.

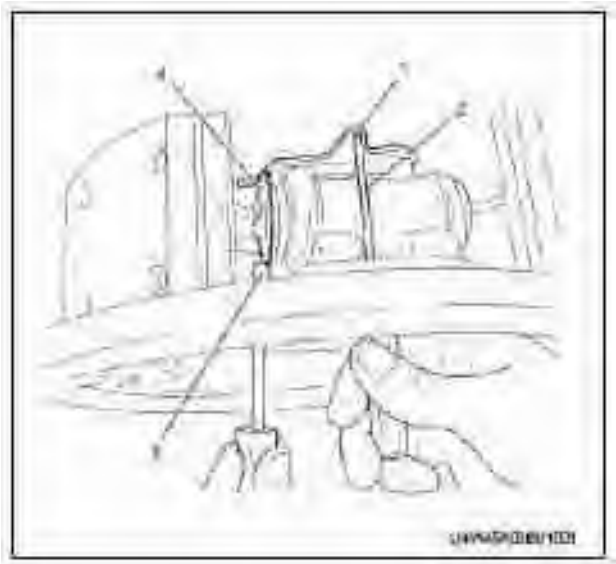


a. Remove the adjuster hole cover (2) and adjustment lever release hole cover (1).



b. Insert the round bar (2) vertically into the clearance hole of the adjustment bar and push the adjustment bar (1) upwards.

c. After adjusting the lever from the top, insert a flat-blade screwdriver into the adjusting hole (3) and insert the engraving plate with the reverse “loose” arrow (direction brake outward) to adjust the rotation of the gear (4).

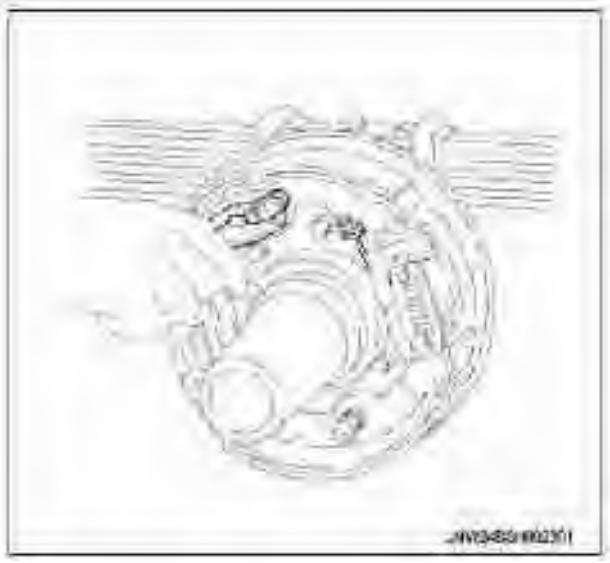


Caution:

Before turning the adjustment mechanism, the adjustment lever must be lifted. If the adjustment gear is rotated without lifting the adjustment lever, the adjustment gear is locked by the adjustment lever and the pinion may be damaged.

When rotating the adjustable gear and lifting lever, be careful not to damage the dust cover of the wheel brake cylinder assembly.

4. Remove pressure spring from brake shoe, brake shoe pressure plate and brake shoe pressure pin.



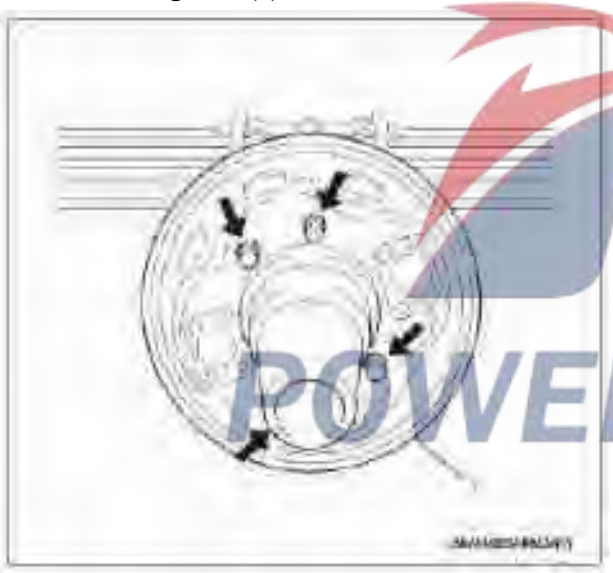
5. Remove the brake pads and return to the bomb.

6. Remove the brake hose.

7. Remove the wheel brake cylinder assembly.

8. Remove the gasket (1).

c. Using the contact point of the adjustment lever (1) and the spring of the adjustment lever (6) as a fulcrum, turn the adjustment lever (2) to stretch the adjustment lever spring. Remove (5) washer adjustment lever (4) from bracket.



9. Remove the automatic adjustment device from the gap.

a. In order not to damage the part, between the adjustment rod (3) for inserting the spring and the upper part of the wire adjustment rod (1).

b. Remove the adjusting screw from the adjusting lever and place the adjusting lever (3) on the bracket (2).

10. Decompose the entire wheel brake cylinder.

Follow the steps below to remove the wheel brake cylinder assembly.

a. Adjusting screw (11)

b. Adjust the gear (10)

c. Washers(8)

d. piston (7)

e. Dust cover(9)

f. Piston bowl(6)

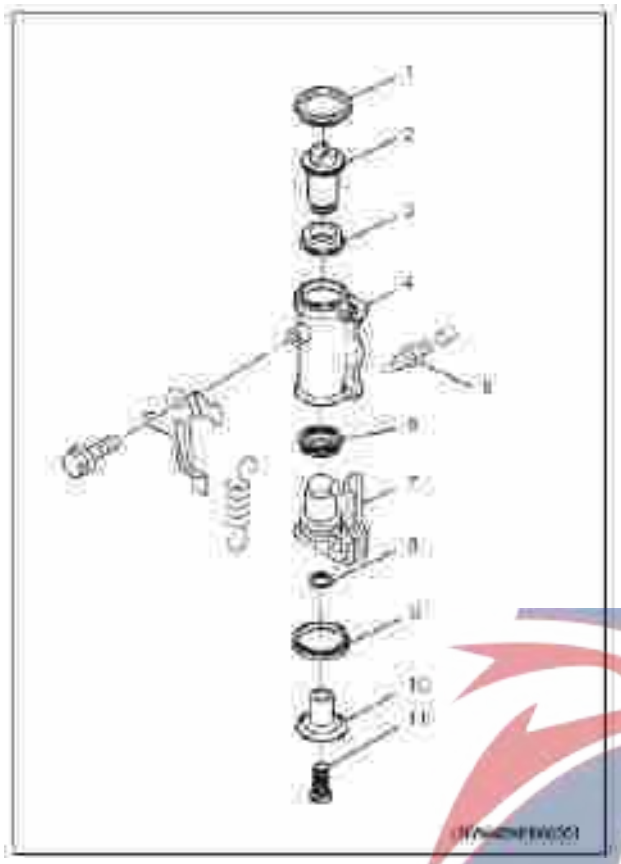
g. Dust cover(1)

h. Pistons (2)

i. Piston Cup (3)

j. Cylinder block(4)

k. Exhaust valve (5)

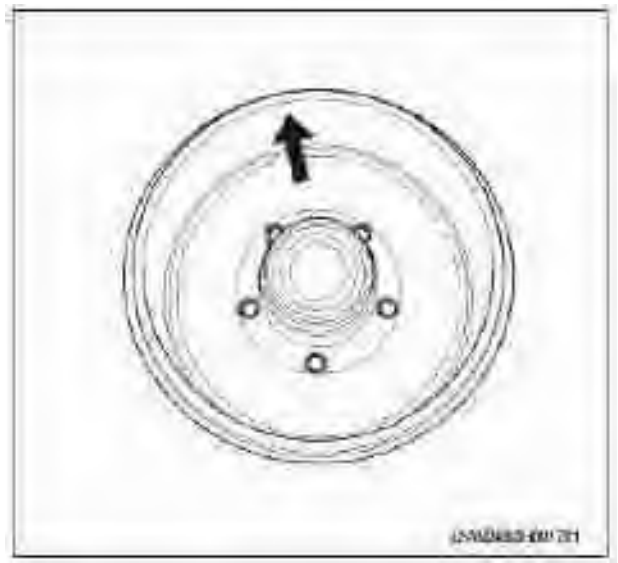


Inspection

1. Check the brake drum.

• Check the sliding parts for damage, uneven wear, staged wear, streaks, cracks and friction pads under contact conditions.

Partial wear limit = 0.15 mm



• Measure the inside diameter of the brake drum.

The inner diameter of the brake drum

Standard value = 320 mm limit= 321.5 mm

Caution:

When the inner diameter is at the limit, correction is performed.

2. Check the brake linings.

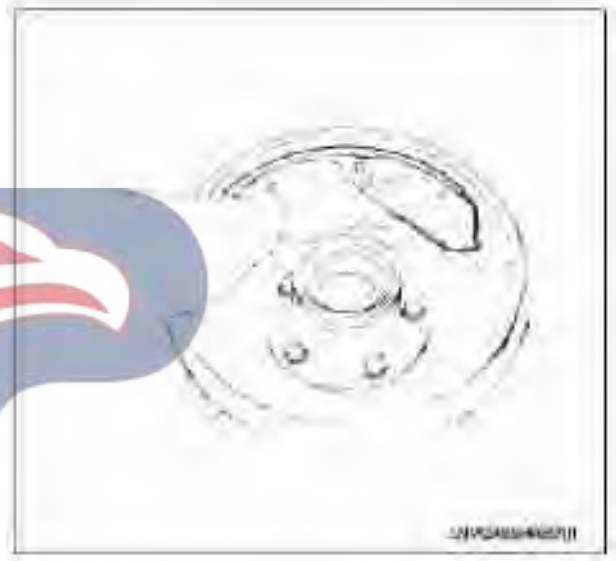
• Check the adhesion of substances such as grease.

• Check the contact with the brake drum.

Apply chalk to the brake drum and observe friction with the friction pad.

Caution:

After the inspection, wipe off the chalk.



- Check if the brake pads are deformed and the spring holes are worn.

• Measure the wear of the friction lining.

Restriction of use of friction coating = 1.0 mm

• Measure the distance between the rivet and the head of the rivet.

• To prevent the brake from deflecting during replacement, place the left and right wheels together.

3. Check the spring.

• Check the return spring.

• Check the brake shoe compression spring and brake shoe pressure plate.

• Check for pressure pins that are not damaged, rusted, and deformed.

4. Check wheel brake cylinders.

• Use brake fluid for cleaning, check and replace any abnormal parts after inspection.

• Inspect the cylinder and piston for wear, corrosion, and damage.

• Measure the inner diameter of the cylinder and the outer diameter of the piston. When the limit is exceeded, replace the wheel brake cylinder assembly.

Sleeve and piston

Standard value = =0.02∽0.105 mm limit= 0.15 mm

• Check the piston cup for damage.

Caution:

Even if the piston cup has only a little damage, replace it with a new one.

Installation

1. Assemble the entire wheel brake cylinder.

Key

1. Cylinder block
2. Piston
3. Adjust the screw
4. Adjust the gear
5. Washers
6. Piston bowl

When assembling, pay attention to the following, and follow the reverse procedure to disassemble it.

• Apply a rust inhibitor (CCI-20) inside the cylinder block and seal between the dust cover and the cylinder block.

• Apply BESCO rubber grease in the following areas.

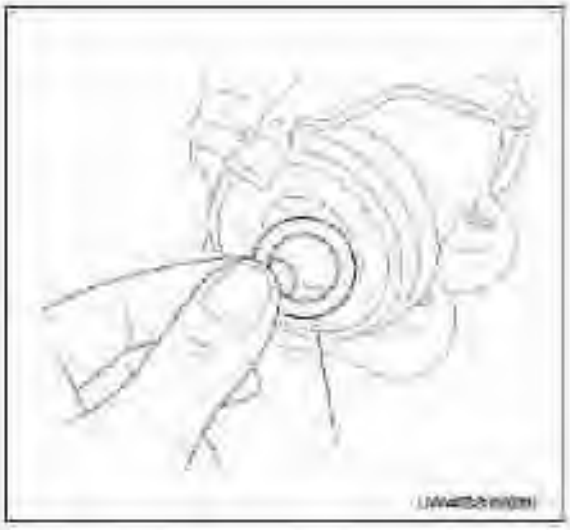
- Adjustment screw and piston thread engagement
- Adjust the periphery of gear nuts and piston inserts
- Adjust the contact of the gear top nut with the washer
- Sliding part of piston flange and piston

• Assemble the front opening side of the piston cup in the cylinder. Be careful not to hurt the cup.

• Make sure you do not forget to install the seal (1). Place the gasket painted surface toward the side of the adjustment gear (with the bronze surface facing inward) for installation.

Caution:

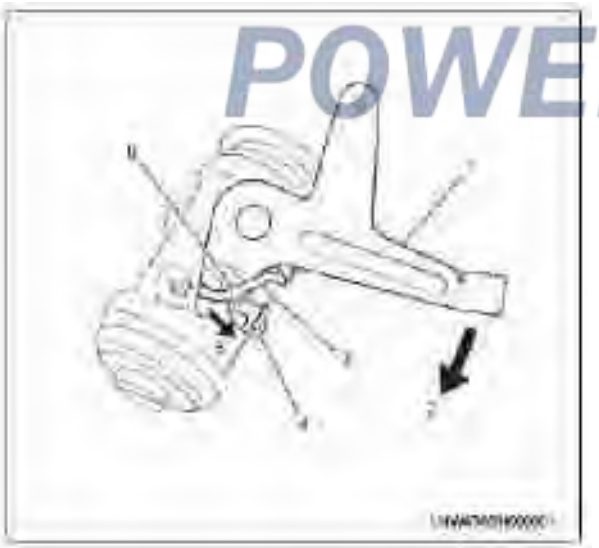
Forgetting to install a washer or misaligning the mounting direction will make the automatic lash adjuster unable to work properly. Pay special attention.



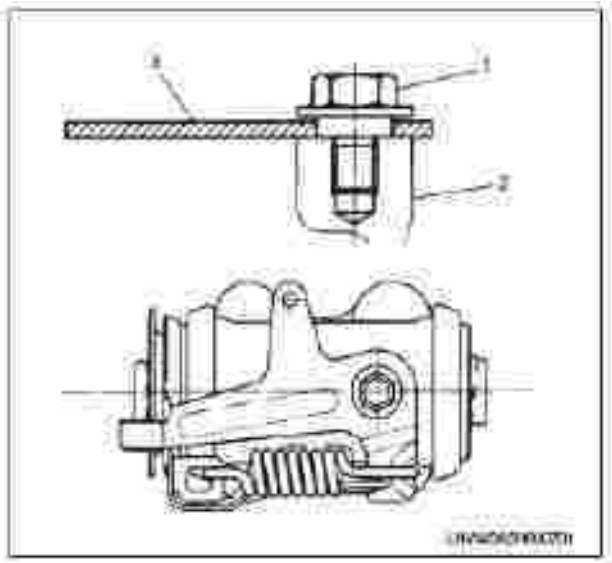
2. Install the automatic adjustment device from the gap.

a. Install the short end of the spring hook of the adjusting rod on the corner hole of the bracket, and install the long end on the adjusting rod.

b. In accordance with the same method as when disassembling, use the contact point (3) of the adjustment lever (1) and the adjustment lever spring (6) as the fulcrum, rotate (2) the adjustment lever, and install the adjustment lever from the center side of the cylinder block (5) to the joint (4) with the bracket.



c. Install the adjusting rod fixing bolt (1) and tighten it to the specified torque. At this time, be careful not to trap the adjusting rod (3) between the bolt sleeve portion and the cylinder block contact surface (2).



d. After tightening the bolts, make sure that the adjusting lever fully presses down on the adjustment mechanism.

3. Install the liner.

Liner nut tightening torque

Brake size	Tightening torque N·m {kgf·m}
Ø320×120	108(11.0}

4. Install the wheel brake cylinder assembly.

• After tightening the brake hose, tighten the wheel brake cylinder assembly to the specified torque.

Wheel brake cylinder assembly tightening torque

Brake size	Tightening torque
Ø 320×120	74 {7.5}

5. Install the brake pipe.

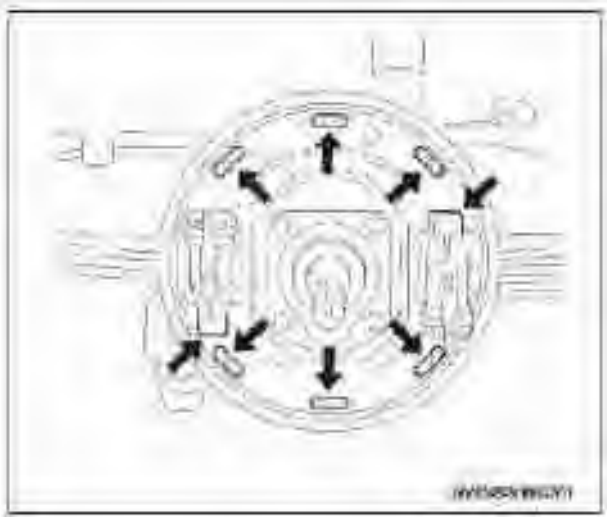
Tightening torque : 15 N•m {1.5kgf•m}

6. Install the brake shoe and return spring.

• Pay attention to the mounting direction of the brake shoe and return spring.

• Apply a small amount of heat-resistant grease to the following areas.

- The engagement groove of the piston brake shoe.
- Piston seals and brake shoe slides.



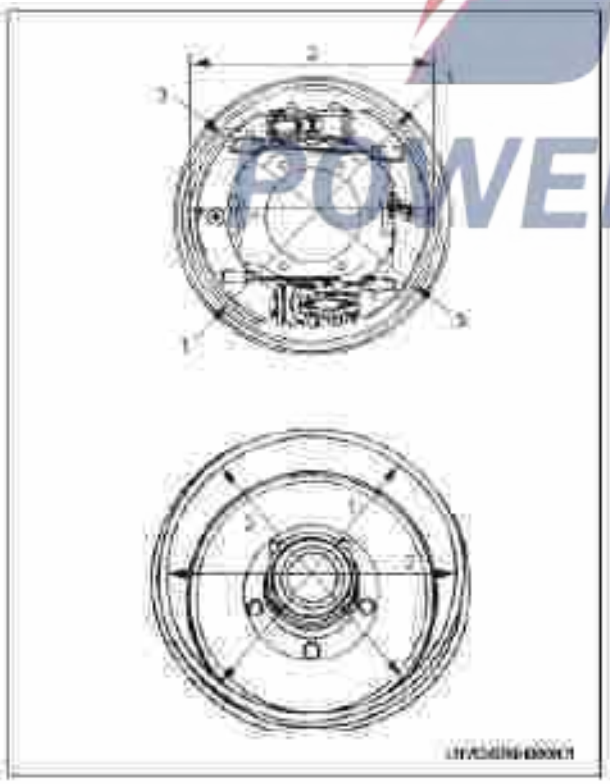
7. Install the pressure spring from brake shoe, brake shoe pressure plate and brake shoe pressure pin.

8. Install brake drum and hub assembly.

• After replacing the brake lining, follow the steps below to install the brake drum and hub.

- Measure the outer diameter of the brake pad and the inner diameter of the brake drum, adjust the rotation of the gear, and adjust the outer diameter of the brake pad. The internal difference of the outer diameter is 0.6 mm.

- Three points (1), (2) and (3) in the measurement table.



9. Adjust the hub bearing preload.

• After installing the brake drum, adjust the hub bearing preload.

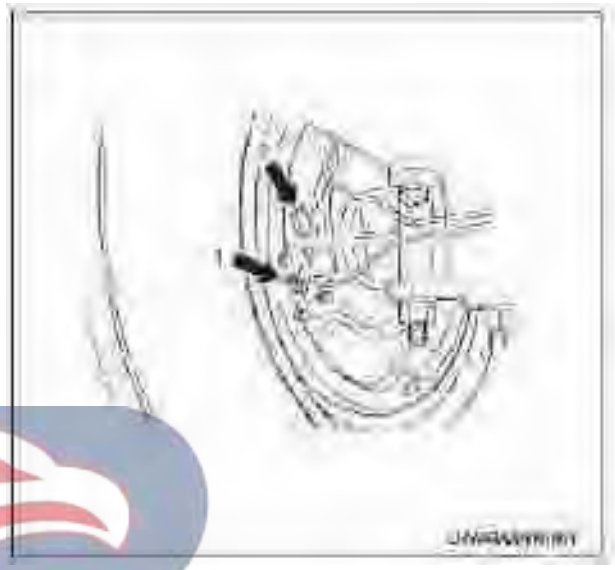
Refer to rear axle 3C3 rear axle section, wheel (single tire), axle or axle, hub (twin).

10. Drain brake air.

Refer to hydraulic brake system in this chapter.

11. Adjust the brakes. (with automatic eyelash adjustment)

a. Remove the adjustment hole cover (2) and adjust the lever clearance hole cover (1).



b. Insert the round bar (2) vertically into the clearance hole of the adjustment bar and push the adjustment bar upwards.

c. After adjusting the lever from the top, insert a flat-blade screwdriver into the adjustment hole (3), and adjust the gear (4) to rotate in the opposite direction to play the “indicating arrow (internal braking direction)” on the plate.

Caution:

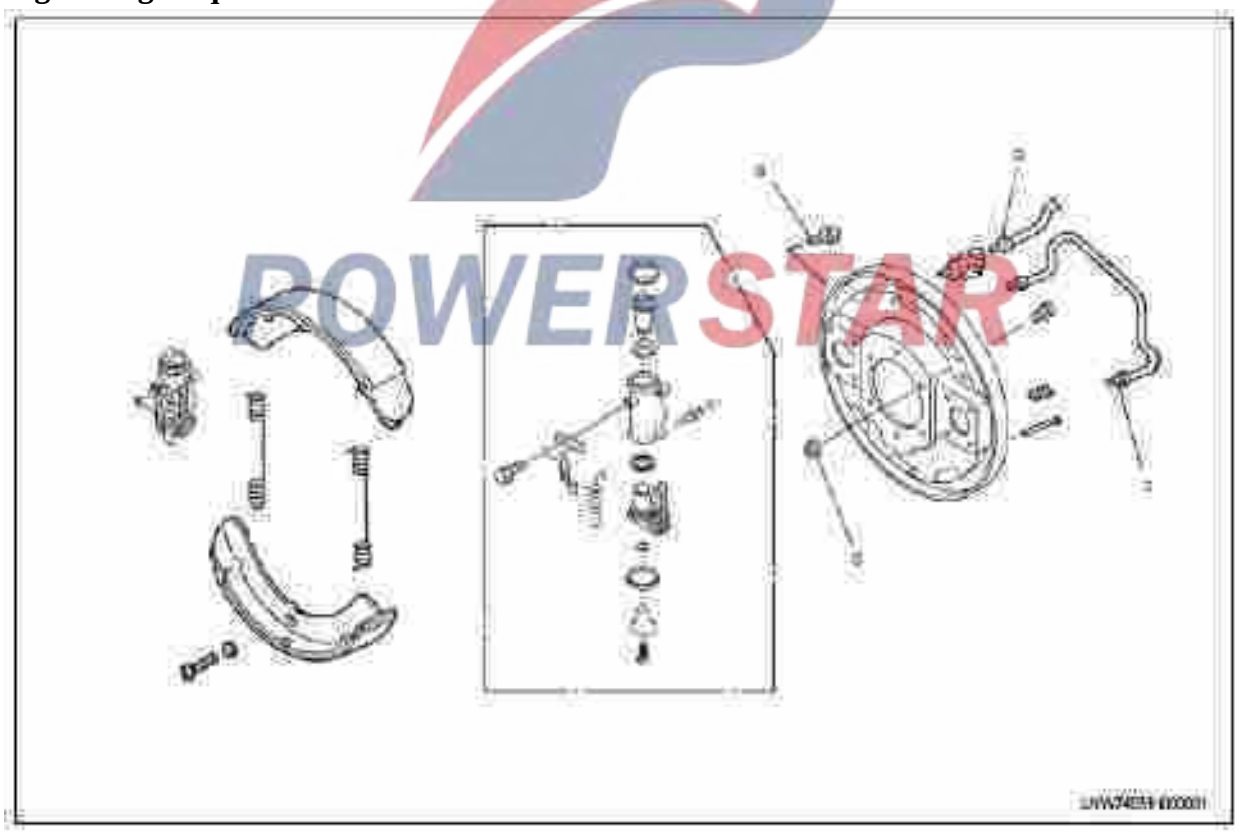
Before turning the adjustment mechanism, the adjustment lever must be lifted. If the adjustment gear is rotated without lifting the adjustment lever, the adjustment gear is locked by the adjustment lever and the pinion may be damaged. When rotating the adjustable gear and lifting lever, be careful not to damage the dust cover of the wheel brake cylinder assembly.

d. In the expansion direction of the friction plate, turn the adjustment gear of the wheel brake cylinder assembly until the brake drum is locked.

e. Turn the adjustment gear of the wheel brake cylinder assembly until the brake drum can easily rotate.

f. Rotate the brake drum forward or depress the brake pedal several times to make appropriate adjustments while driving.

Tightening torque - Overview



Key

(a) 74 N·m{7.5kgf·m} (Ø320×120)

(b) 15 N·m{1.5kgf·m}

(c) 15 N·m{1.5kgf·m}

(d) 108 N·m{11.0kgf·m}

LSPV (pressure regulator proportional to load)

Adjustment

Hydraulic measurement

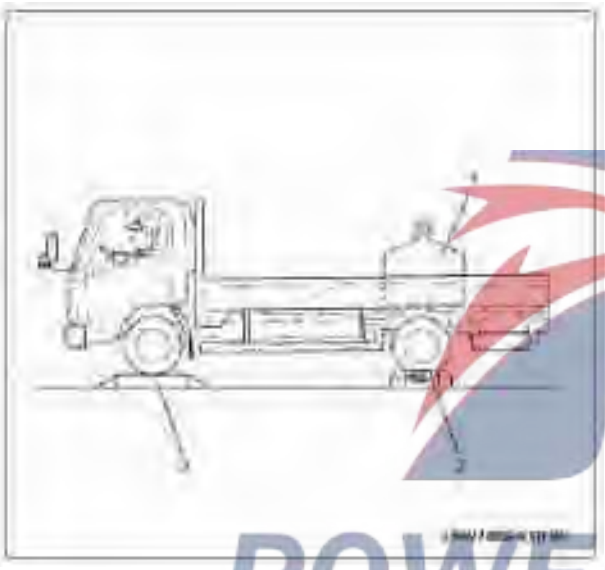
1. Adjust the weight of the rear axle

• Use the weight of the axle to adjust the weight of the rear axle.

The standard value of the axle weight... Please refer to the following LSPV adjustment value table.

Caution:

Sitting on the driver's seat, place the load (weight) behind the car to adjust the weight of the rear axle.



Key

1. Charge (weight)
2. Axis weight meter
3 bases (axis weight height)

2. Install the hydraulic meter

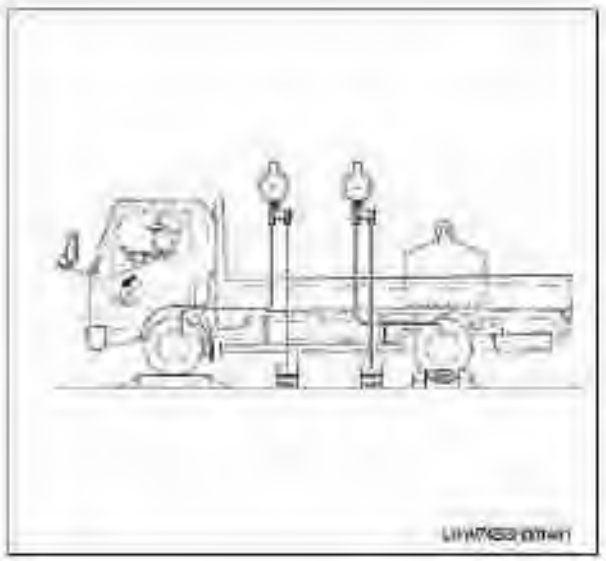
• Install the hydraulic dipstick on the car and drain the air inside the dipstick.

Caution:

Remove the front and rear vent valves and install the meter's metering tube.

Special tools

Brake oil pressure gauge:5-8840-2190-0



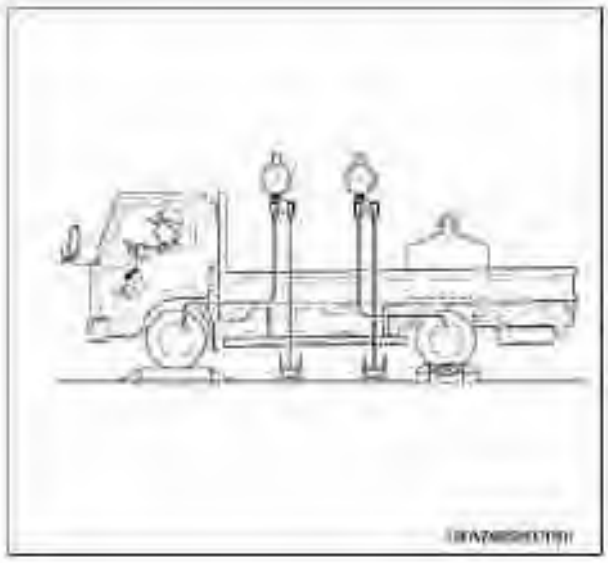
3. Measure the hydraulic pressure of the rear brake cylinder.

• After measuring the wheel cylinder hydraulic pressure, the brake pedal, the hydraulic cylinder has reached 7.85kpa {80kgf / cm2} before the wheel cylinder.

Caution:

The hydraulic value of the wheel brake cylinder is read 2 seconds after the start of the measurement. When measuring the hydraulic pressure of the LSPV, do not return the brake pedal.

Rear brake cylinder hydraulic pressure... Refer to the following LSPV adjustment value table



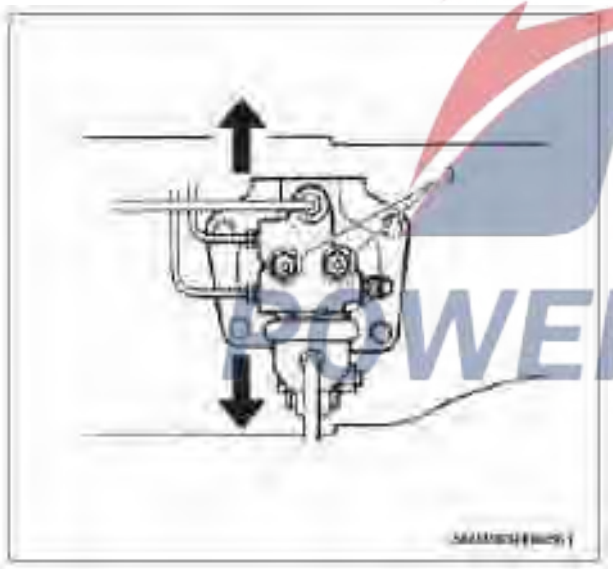
LSPV adjustment value

Model (wheelbase mm)	Adjust rear axle weight (kg)	Hydraulic pressure during adjustment (mpa {kgf / cm2})	
		Front wheel	Rear wheel
3815、4175、4475	1700	7.85(80}	5.03±0.58 {51.3 ±6}
5200	1150	7.85(80}	5.03±0.58 {51.3 ±6}

Adjust the LSPV.

• When the LSPV with spring clip cannot be adjusted, release the main body LSPV from the adjustment nut shown in (3) and move the LSPV up and down until the standard hydraulic system is reached.

In addition, after the LSPV is set, the length of the LSPV spring lug must be readjusted.



After adjustment, tighten the LSPV adjustment nut.

Tightening torque : 13 N•m {1.3gf•m}

Section 4D

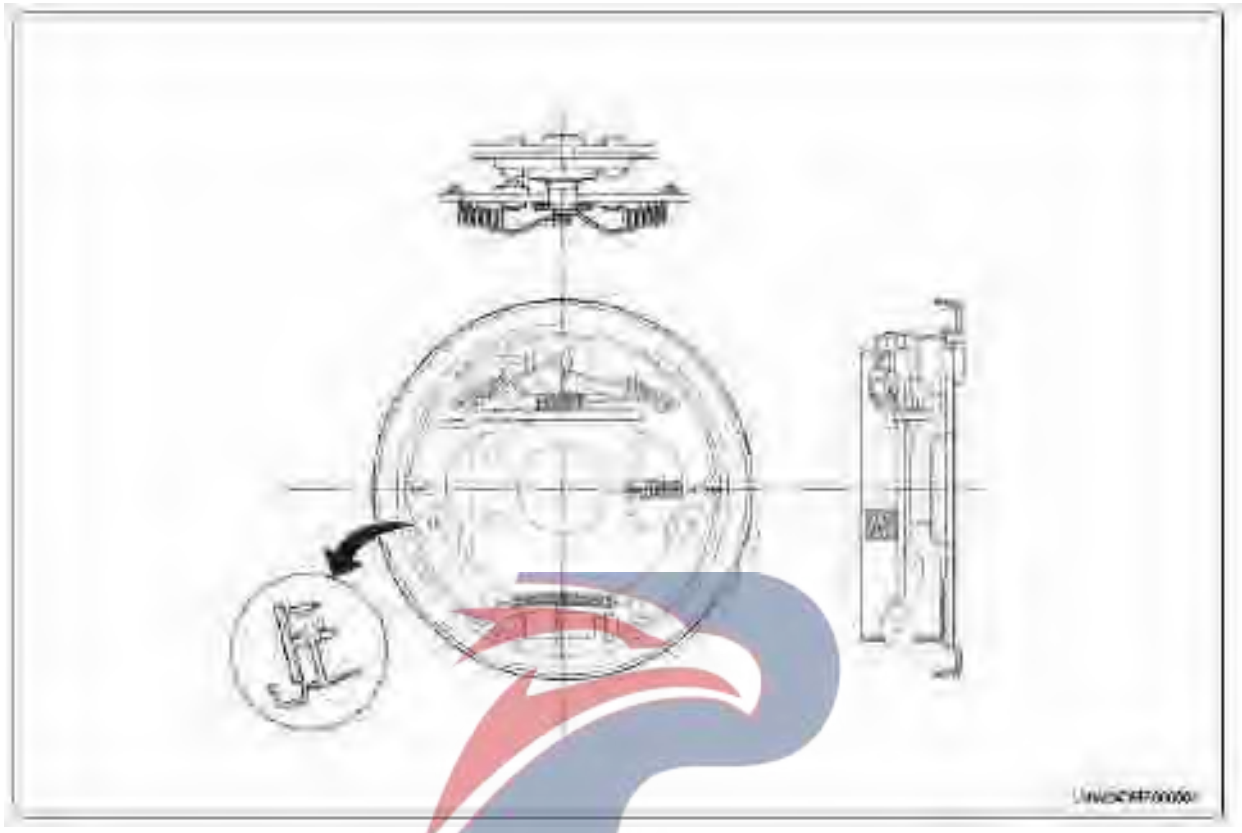
Brakes

Parking brake

Table of Contents

Parking brake system

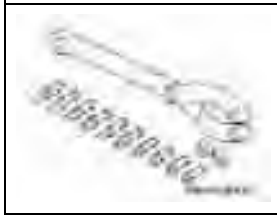
Function and working principle



Main parameters

Braking type	Autonomous two-way
Brake drum inner diameter X width (mm)	Ø254×55
Friction coating thickness (mm)	6.5
Friction coating area (cm2)	150×2
Friction coating material	L613

Special tools

Illustration	Tool number Tool Name
	5-8840-2862-0 Universal support

Parking brake lever

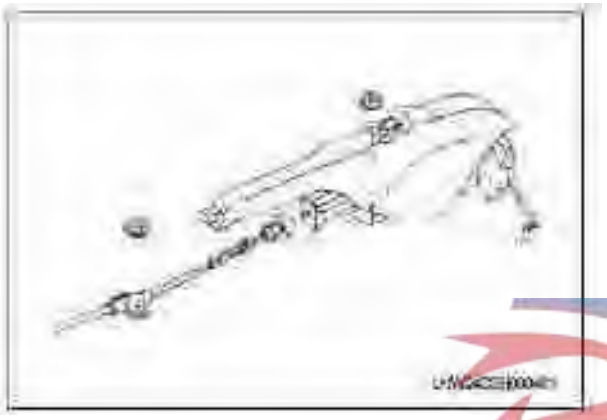
Disassembly

• Stop the wheel completely and open the parking brake lever.

1. Loosen the adjusting nut and remove the parking brake cable and parking brake lever.

2. Remove the harness connector from the parking brake switch.

3. Loosen the mounting nut and remove the parking brake lever assembly.



Inspection

• Pull rods and brackets

Check for wear.

• Parking brake cable

Check for damage and rust.

Installation

1. Install the parking brake lever and tighten the nut to the specified torque.

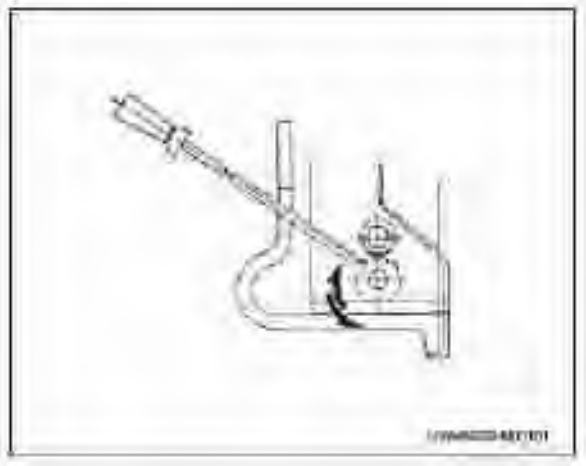
Tightening torque :24N·m{2.4kgf·m}

2. Connect the harness connector of the parking brake switch.

3. Connect the parking brake cable and tighten the adjusting nut correctly.

4. Adjust the pull stroke of the parking brake handle.

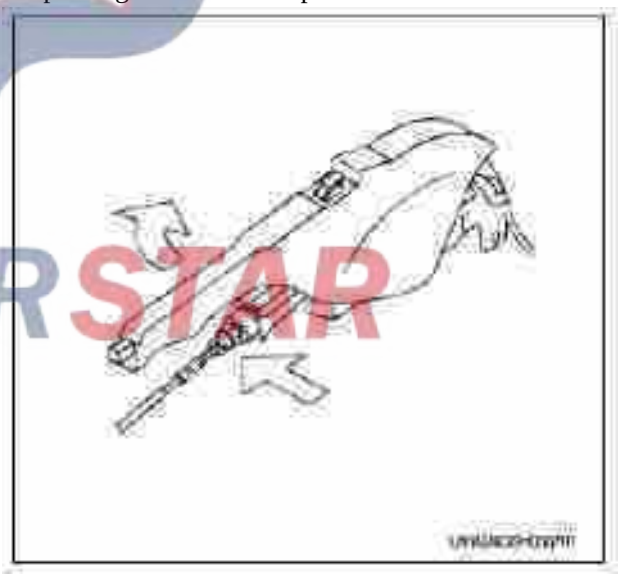
a. Turn the parking brake regulator to the bottom of the vehicle until the parking brake drum does not rotate.



b. Turn the parking brake adjuster to the specified number of cuts.

Rotary regulator: 30 incisions

c. Tighten the adjustment nut and adjust it so that when the manual control force is 147 N {15.0 kgf}, the parking brake lever stops to 6-8 cuts.

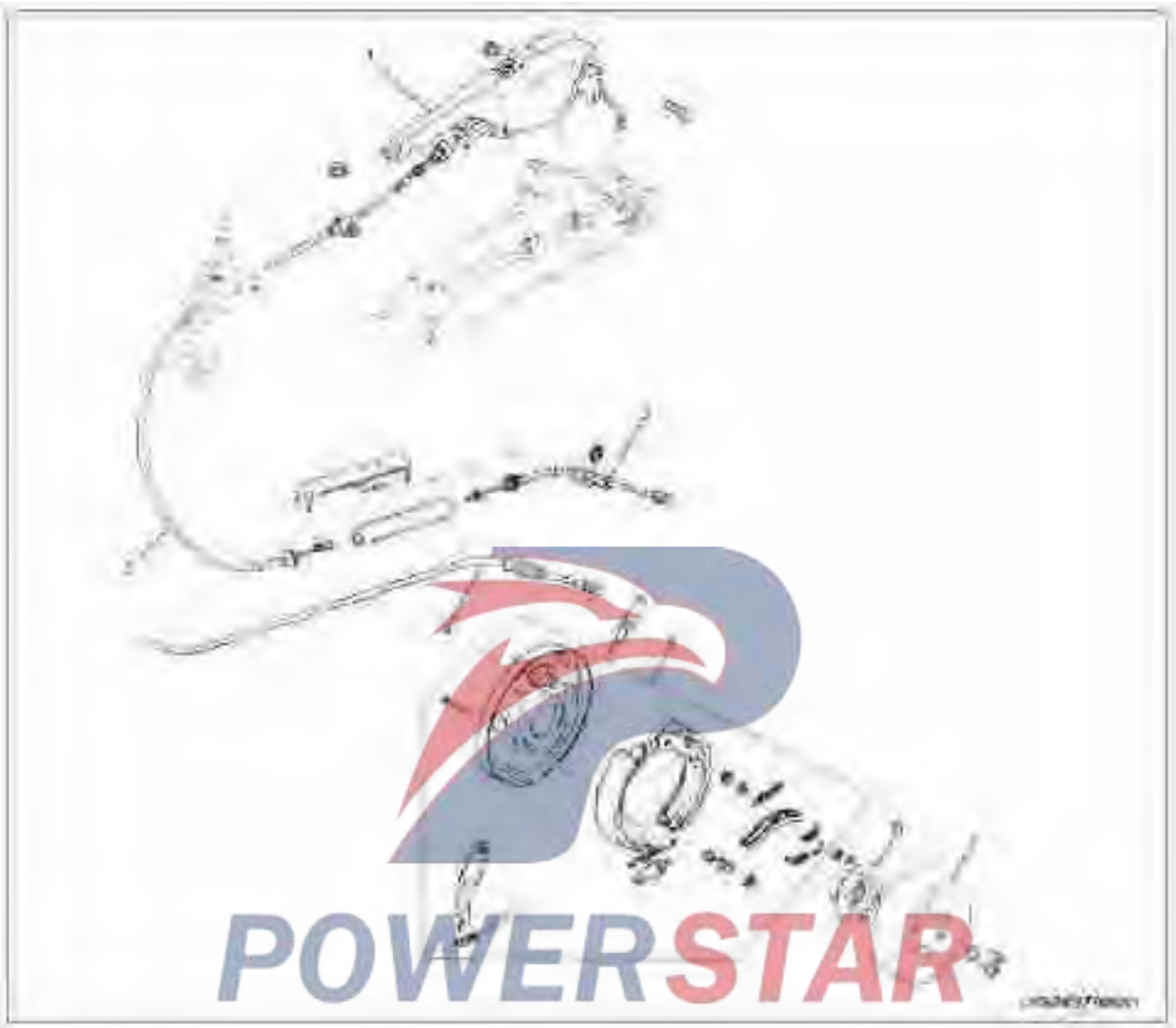


d. Check if there is brake drag.

e. Install the adjusting plug on the parking brake drum.

Parking brake

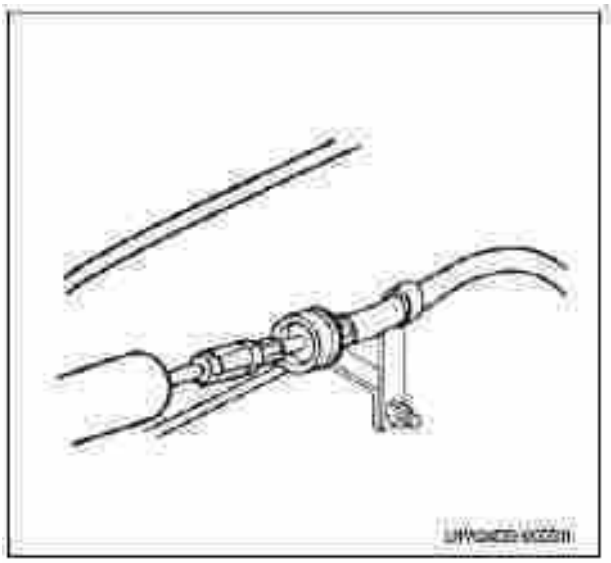
Component parts



Key

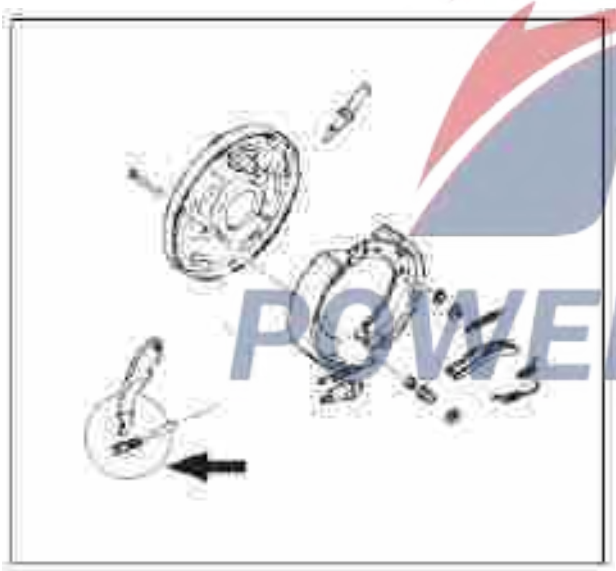
1. Parking brake lever assembly
2. Parking brake rear cable (cable divided into 2 segments)
3. Parking brake rear cable (cable divided into 2 segments)
4. Parking brake cable (type of 1 cable)
5. Parking brake assembly
6.Flange
7.Parking brake drum

- Loosen the front and rear cable lock nuts and remove them.



• 1 cable

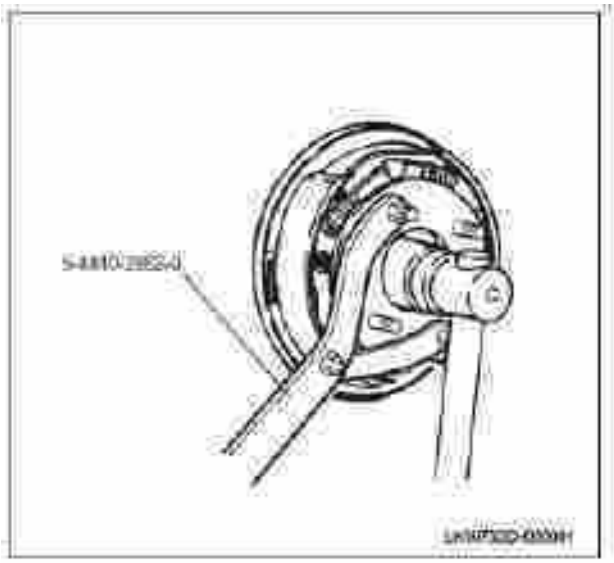
- Remove the parking brake drum. (Refer to the article below)



- Disconnect the cable from the parking brake assembly lever.

5. Remove the flange.

• Turn the riveted end of the lock nut (2 positions) and use the universal bracket: 5-8840-2862-0 to remove the lock nut.



6. Remove the parking brake assembly.

Disassembling

1. Remove the compression spring, pressure plate and brake shoe pin.
2. Remove the adjusting spring and return spring.
3. Remove the regulator.
4. Remove the parking brake assembly
5. Remove the bracket.
6. Remove the flat washer and brake shoe assembly.
7. Remove the joystick and stop.

Inspection

Check for disassemble parts.

• Brake linings and brake shoes

- Check the grease for wear and adhesion.

Restriction of use of friction coating = 1.0 mm

- Check if the brake pads are deformed and the spring holes are worn.

•spring

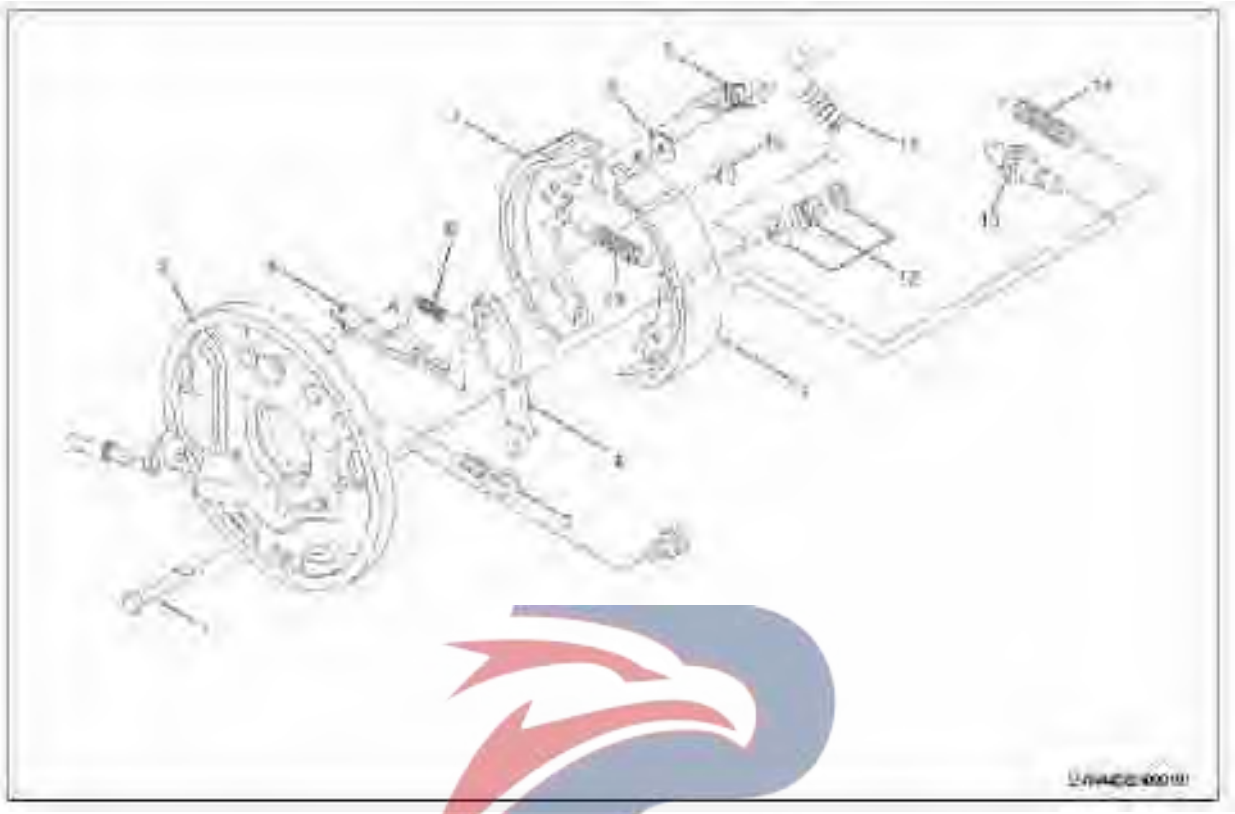
- Check for damage or breakage.

•Regulator

- Check the working condition and wear of threaded parts.

• Parking brake drum

Ø190mm Brakes



Key

1. Brake shoe
2. Liner
3.Parking brake cable
4. Operate the remote control
5. Support
6. Return spring (joystick ~ support)
7.Brake tire assembly
8. Flat washer
9. Return spring (fixer ~ brake shoe)
10. Block
11. Return spring (fixer ~ brake shoe)
12. Compression springs and pressure plates
13.Regulator
14. Regulator spring
15. Return spring

Disassembly

1. Lift the vehicle and use the base to support the frame.

Refer to the vehicle lift points in the OA overview section.

2. Remove the rear propeller shaft.

• Disconnect the drive shaft from the drive side.

• In the longer case, also remove the center bearing bracket. Refer to 3C1 Driveshaft Section or Rear Driveshaft Assembly in Reverse Driveshaft Assembly (reverse slide type).

3. Remove the parking brake drum.

• Remove the adjustment hole cover and remove the parking brake drum.

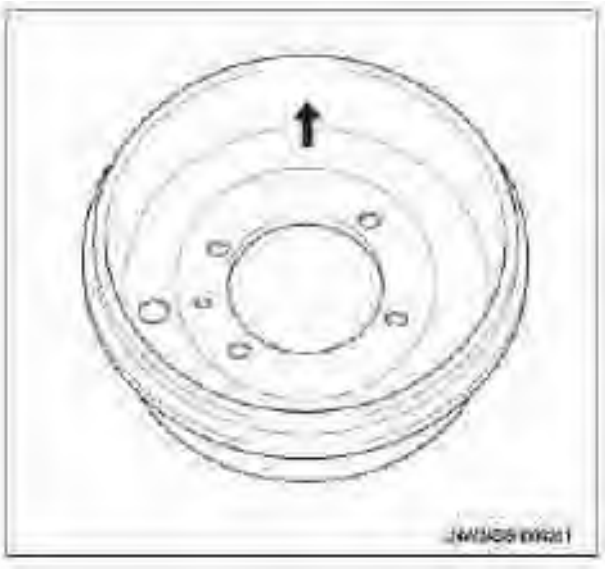
4. Remove the parking brake cable.

• The cable is divided into 2 segments.

- Remove the retaining clip from the rear cable.

- Remove the front cable holder and rear cable connection, and then move the cover to the side of the front cable.

- Check for damage, wear, wear and cracks, and correct or replace any faults.



- Measure the inner diameter of the drum.

Inner diameter of the drum(mm)	
Standard value	Standard value
254	255

Caution:

When the value of the inner diameter is within the use limit, corrective correction is performed.

Assembly

• Apply lubricant to the following areas when reassembling.

- 6 parts of the flange surface of the jacket connected to the brake rim
- Contact surfaces of fixing pins and strips

1. Install the joystick and stop.
2. Install the flat washer and brake shoe assembly.

Caution:

Pay attention to do not stick grease or grease on the surface of the brake lining.

3. Install the support.
4. Install the parking brake cable.
5. Install the regulator.
6. Install the regulator spring and return spring.
7. Install compression springs, pressure plates and brake shoe pins.

Installation

2. Install the parking brake assembly.

• Wash bolts and bolt holes with volatile oil (diluent, alcohol, etc.).

• Apply thread sealant #638 to the end of the threaded pin (guide shape) and bolt holes.

• Install M12 studs.

Tightening torque : 49N·m{5.0kgf·m}

• Install parking brake and tighten with M12 rivet nut.

Tightening torque : 126 N•m {12.9kgf•m}

Install the parking brake cable.

• Install the parking brake cable on the parking brake lever.

Caution:

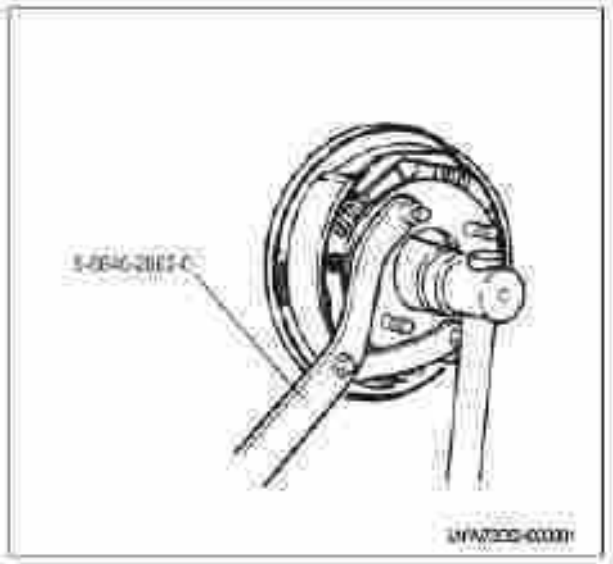
Make sure that the arrow section in the figure is installed.

3. Install the flange .

• Fasten the flange and O-ring to the spindle and tighten with a lock nut.

Use a universal bracket: 5-8840-2862-0 Tighten the lock nut.

Tightening torque : 284N·m{29.5kgf·m}



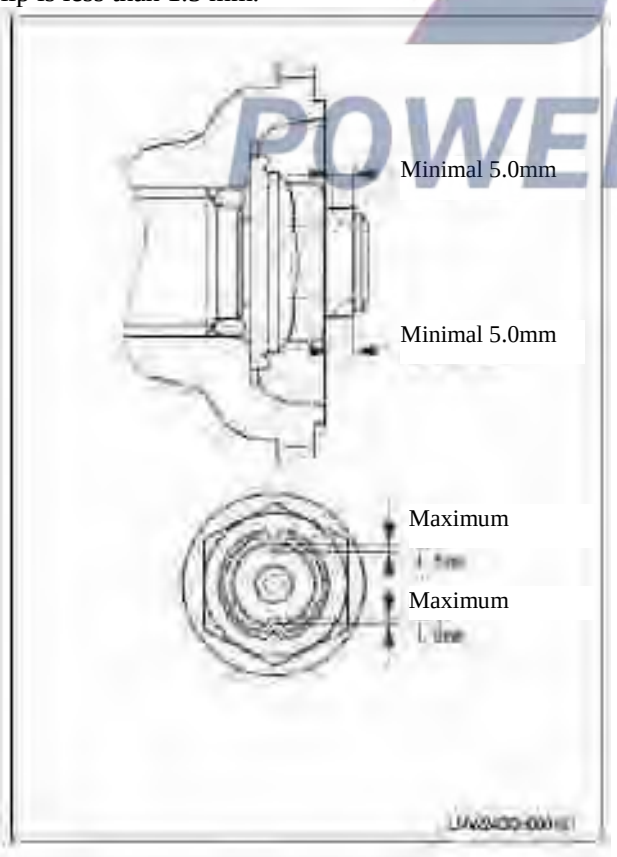
Caution:

• The lock nut is a rivet nut that uses a new screw and is installed after the oil is applied to the mating surface.

• Use a new O-ring and apply a small amount of lubricant after assembly.

4. Rivet the lock nut.

• Align the lip of the locknut with the V-groove at the top of the shaft and rivet the two points with a chisel (steel chisel tip: approximately 1mm x 60° radius). In order for the rivet length to be greater than 5 mm, the gap between the shaft's V-shaped groove and the nut lip is less than 1.5 mm.



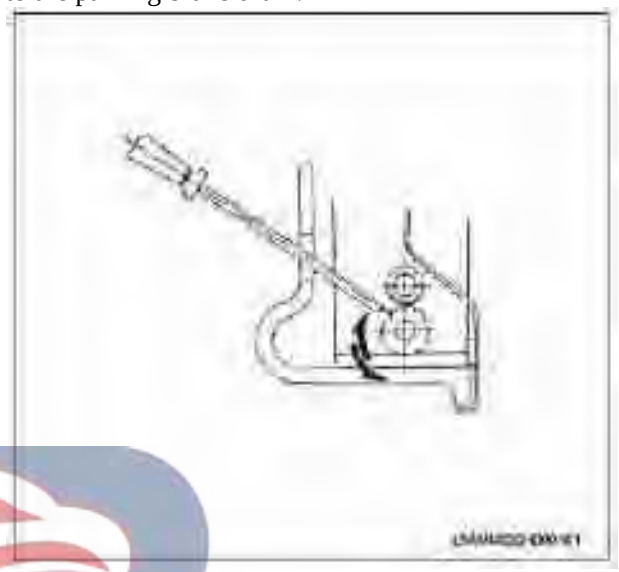
Caution:

After riveting the lock nut, check its riveted area. If there is a crack, replace the lock nut and retighten it.

5. Install the parking brake drum.

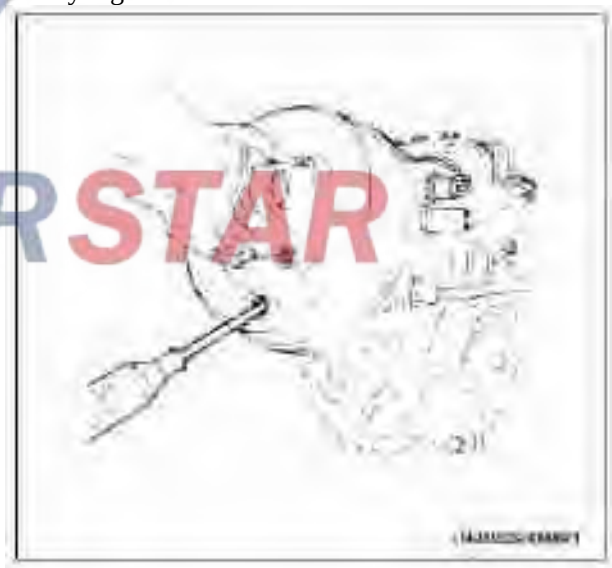
6. Adjust the parking distance of the parking brake lever.

i. Turn the parking brake controller under the vehicle to the parking brake drum.

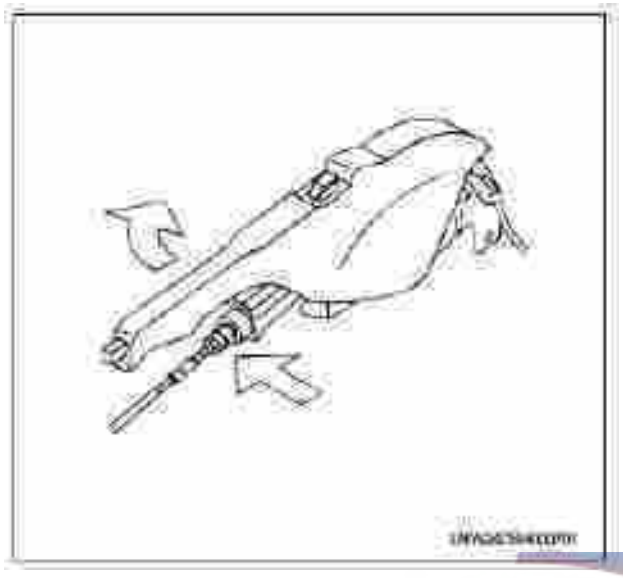


ii: Turn the adjuster with the specified number of notches.

Rotary regulator: 30 incisions



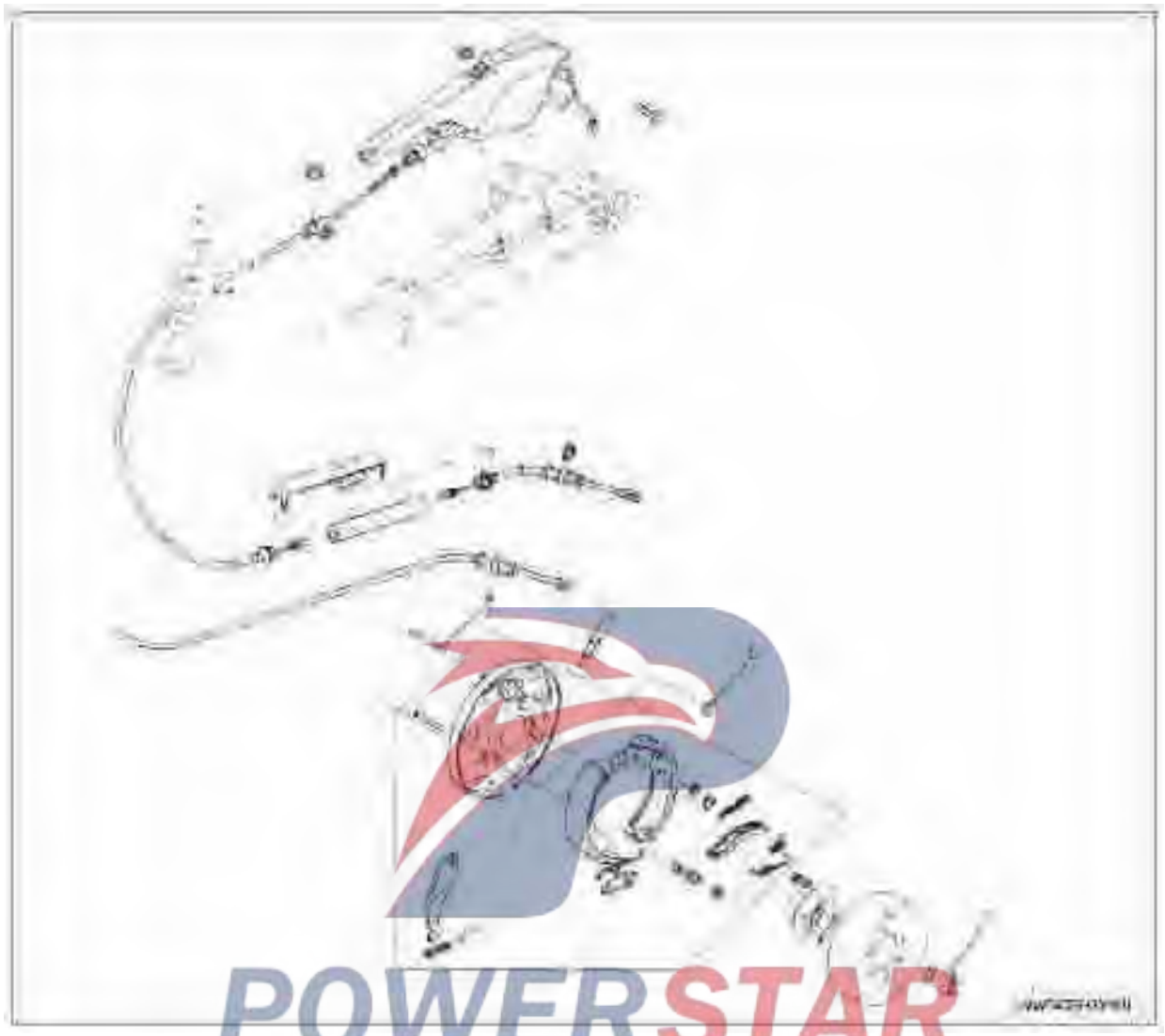
iii. Tighten the adjusting nut and adjust so that the parking brake stroke is 6 to 8 notches when the manual control force is 147 N {15.0 kgf}.



iv. Checks the brakes for any resistance.

v. Install the adjustment cover to the parking brake drum.

Tightening torque - Overview



Key

(a) 49N {5.0kgf·m}

(b) 126N m {12.9kgf·m}

(c) 289N m {29.5kgf·m}

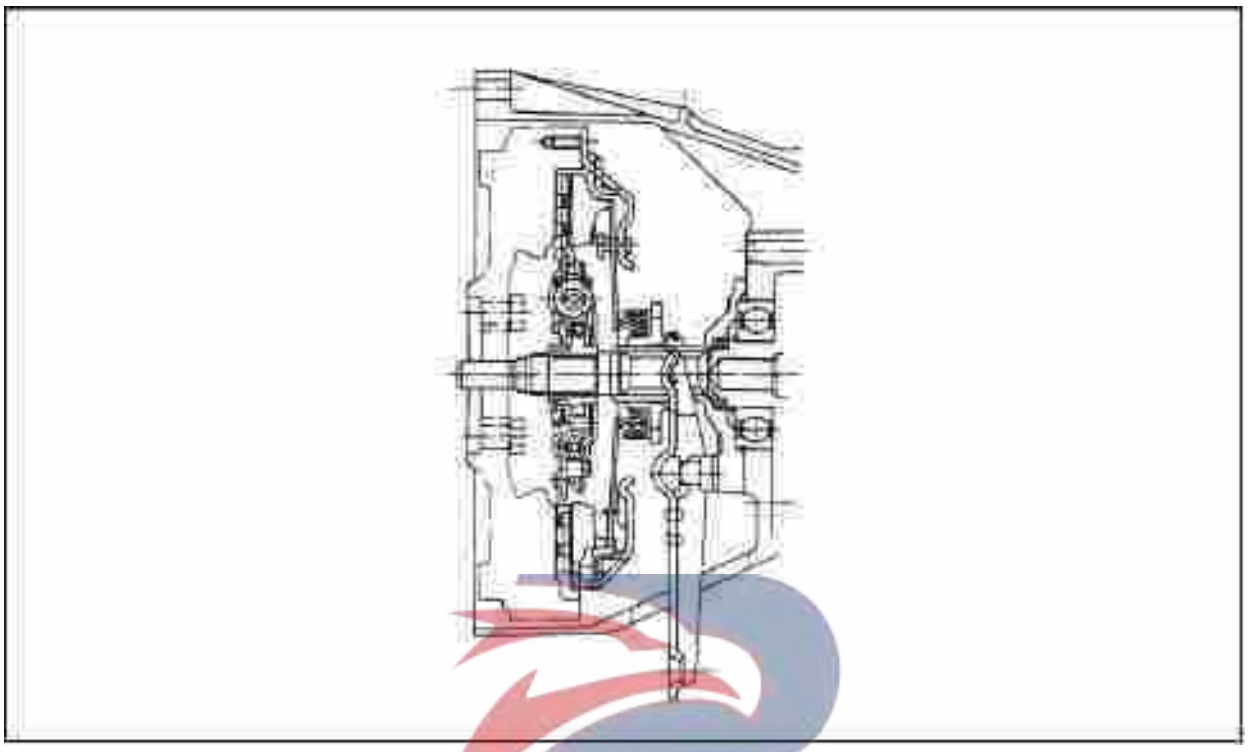
Section 5E

Clutch

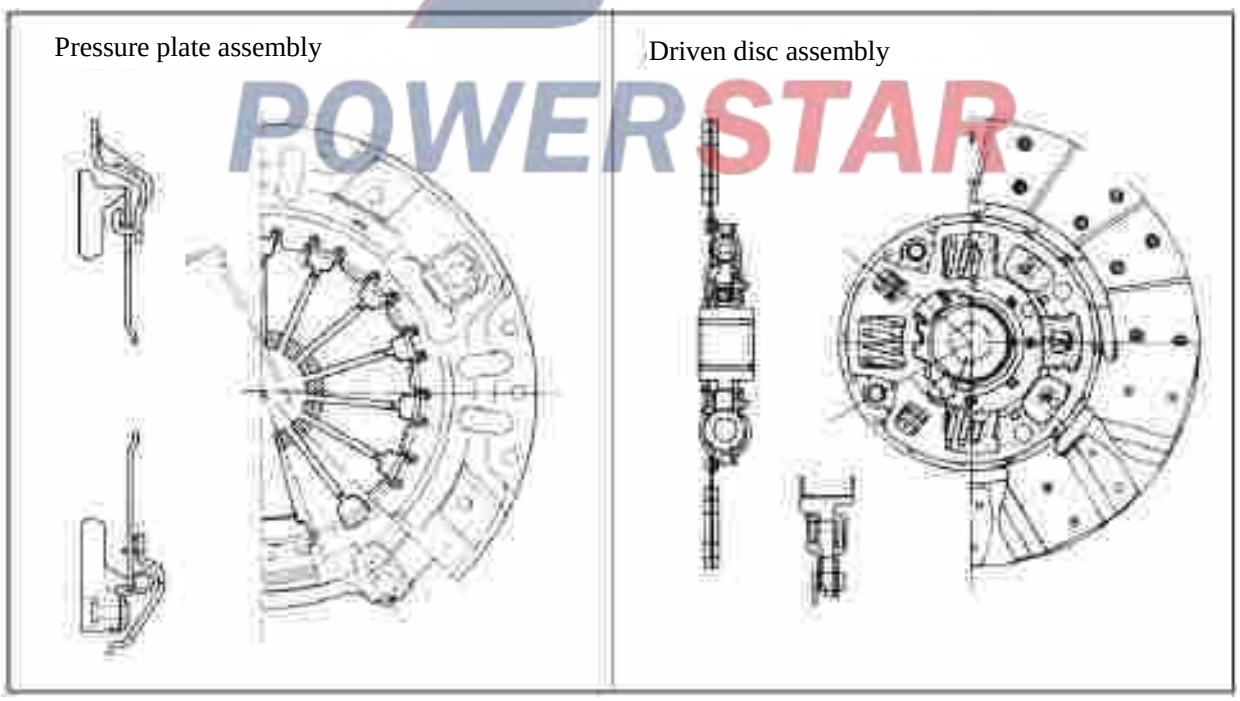
Table of Contents

Overview

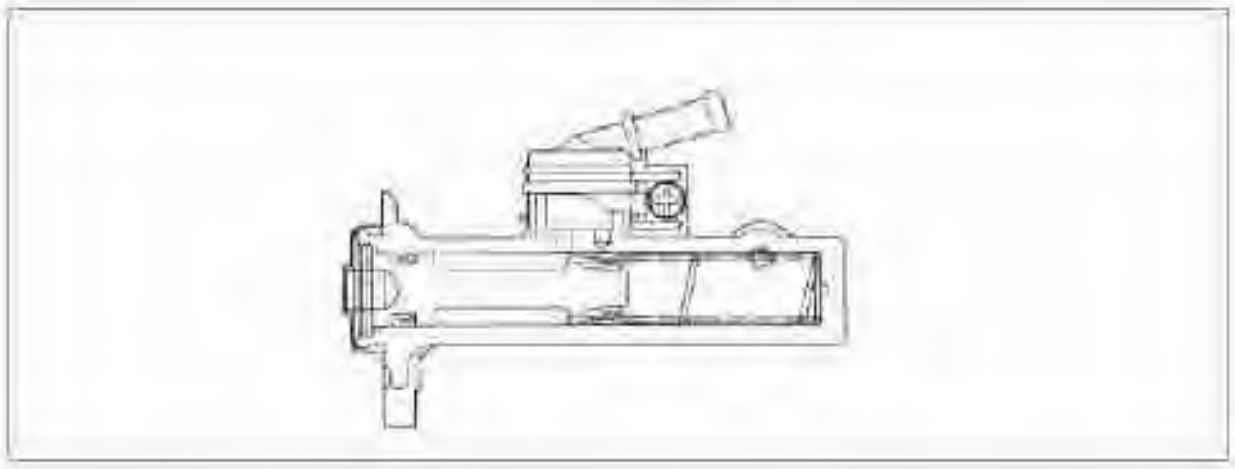
Clutch assembly



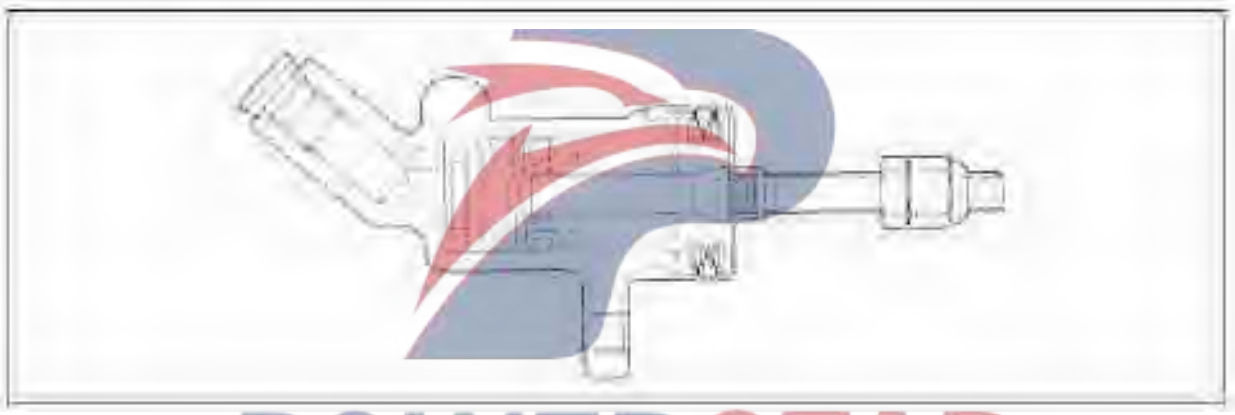
Pressure plate assembly and driven plate



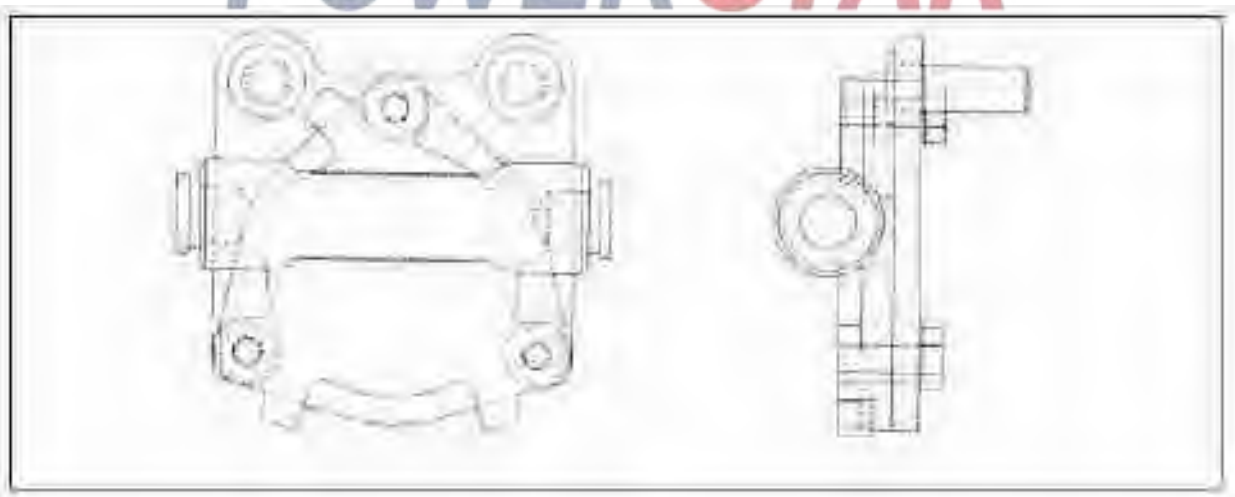
Main cylinder



Working cylinder



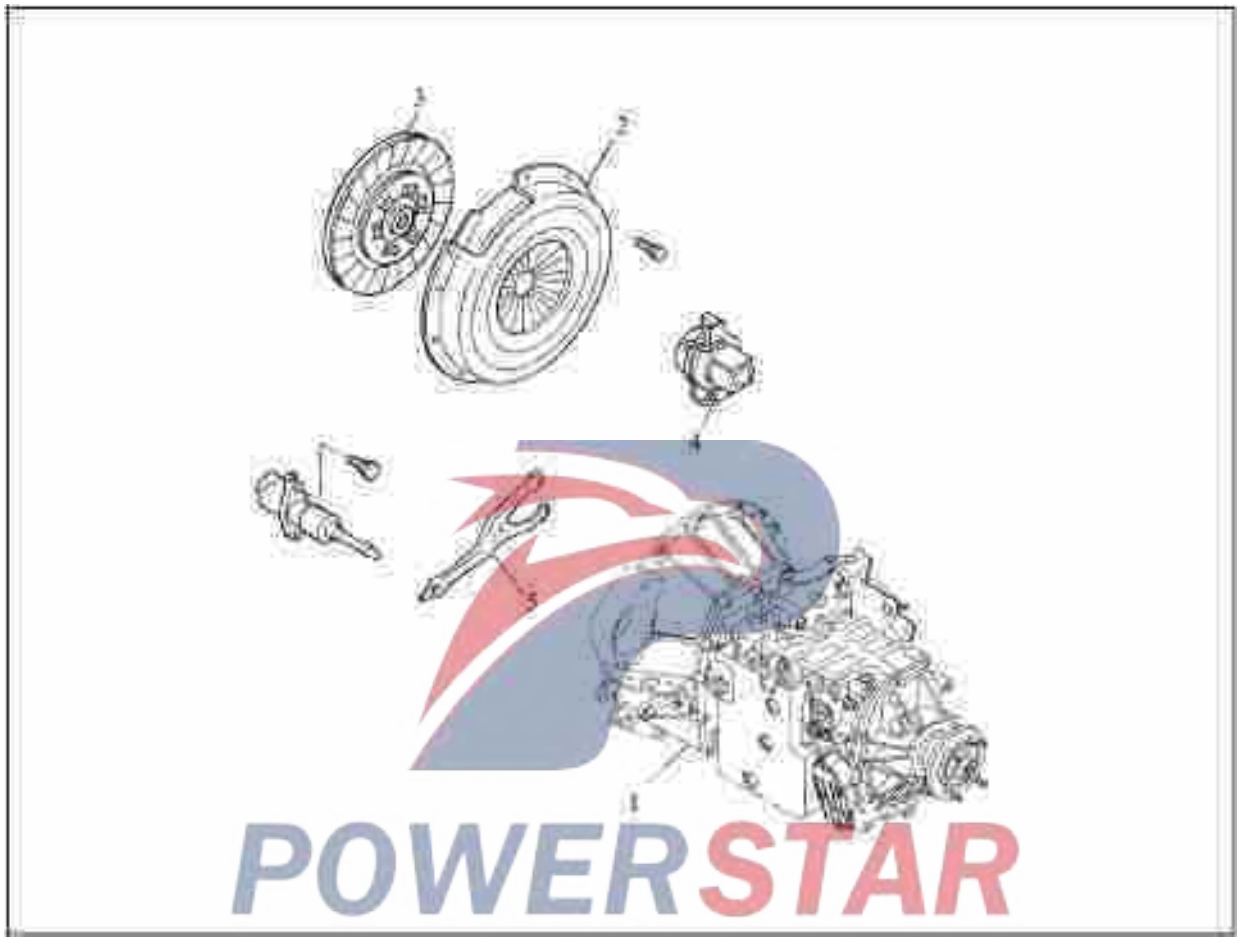
Clutch valve



On-board maintenance

Clutch assembly

Disassembly



Disassembling sequence

1.Transmission assembly
2.Pressure plate assembly
3.Driven disc assembly
4.Release sleeve assembly
5. Release fork

Disassembling sequence

• Lift the car and use the appropriate safety bracket to lift the car.

Caution

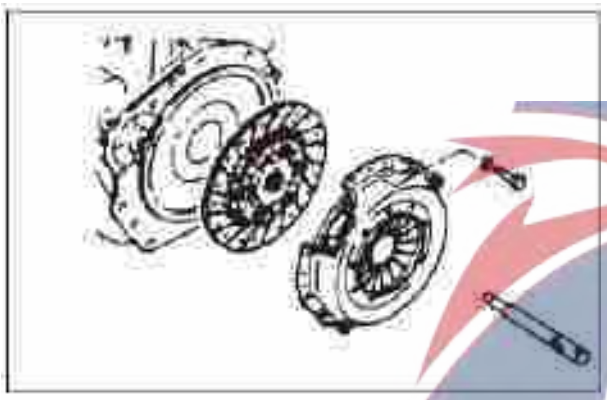
Do not let the clutch liquid splash on the surface of the paint on the vehicle.
If splashed, rinse off immediately.

1.Transmission assembly

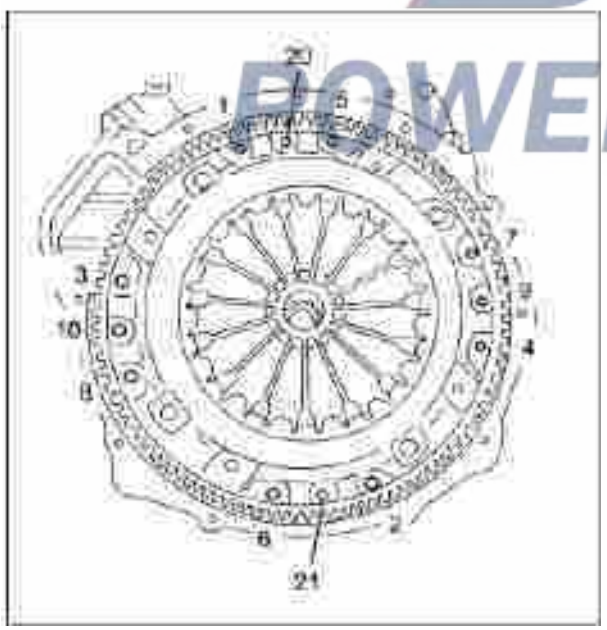
Refer to "Transmission Set" in Section 5C of this manual.

2.Pressure plate assembly

3.Driven disc assembly



• Remove with a guide locator to prevent free fall of the follower plate assembly.
Guide positioner: 5-8840-2790-0
• For alignment during installation, install markings on the flywheel and pressure plate flange.
• Loosen the platen assembly fixing bolts according to the order shown.



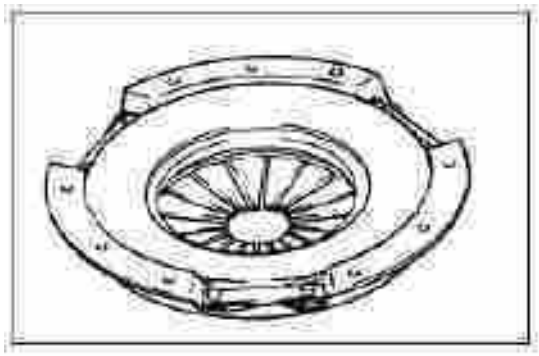
4. Release fork

5.Release sleeve assembly

• Remove the separation sleeve with a supporting spring.

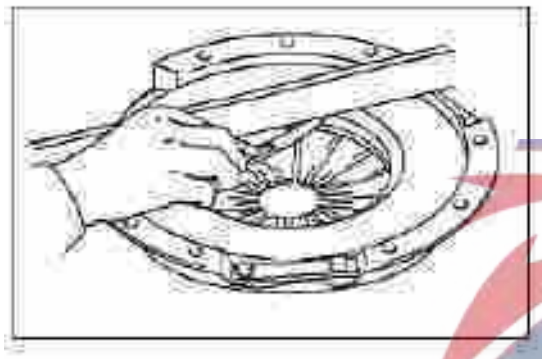
Inspection and repair

If excessive wear or damage is found in the inspection, necessary adjustment, repair and replacement of parts should be carried out.



Pressure plate assembly

• Visually inspect the friction surface of the pallet for excessive wear and tear due to overheating. If there is excessive wear and deep overheating cracks, the pressure plate assembly must be replaced.



Warpage degree of pressure plate

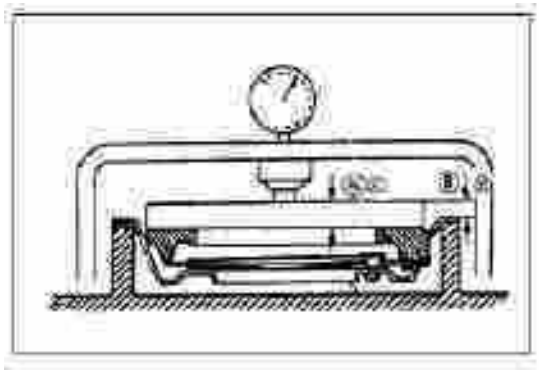
• Use a ruler and feeler gauge to measure the flatness of the platen friction surface in all 4 directions.
Any of the above measured values above the specified limit must be replaced by a pressure plate assembly.

Plate bending mm (in)

Limit
0. 3 (0. 01)

Clutch cover

• Visually inspect the clutch cover assembly for excessive wear, cracks, and other damage.
If any of these conditions are found, the pressure plate assembly must be replaced.



Clutch installation force

1) Position the pressure plate assembly with the pressure plate facing upwards.

2) On the pressure plate, place a metal sheet with "A" of 9.2 mm, (0.36 in).

3) Pressurizing the pressure plate so that the distance "B" is the specified value.

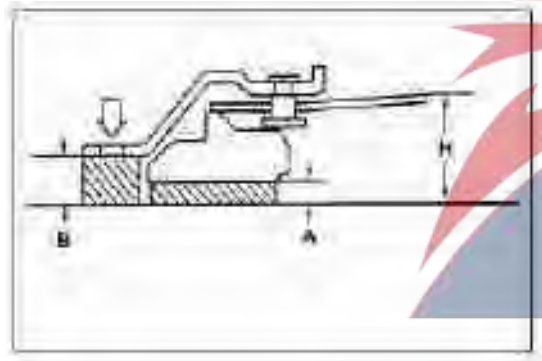
Thickness and distance mm(in)

A	B
9.2(0.36)	19(0.75)

4) Note the reading of platen indicator.

Clutch installation force N (kgf / lb)

Nominal	Limit
9512 (970/2138)	3785 (386/851)



Diaphragm spring finger height

1) The two separators are placed under the platen and the clutch cover respectively.

Bulkhead mm(in)

A	B
7.4 (0.29)	18(0.71)

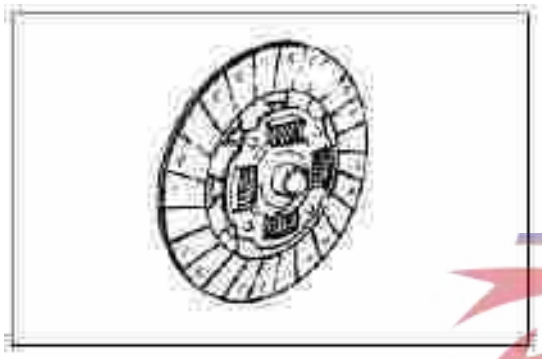
2) Completely press the assembly of the platen.

There are two ways to carry out this operation.

A. Apply a bench press to pressurize the top of the pressure plate assembly.
B. Tighten the retaining bolts of the pressure plate assembly.
3) Measure the height of the spring separation finger from the bottom to the top of the spring.

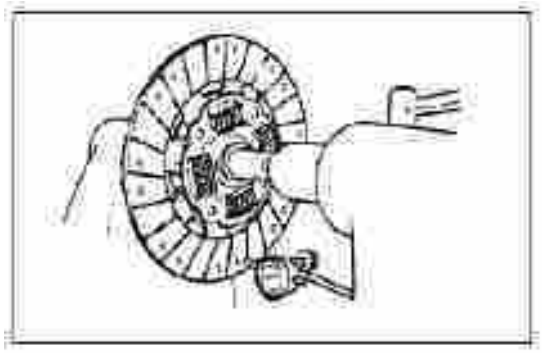
Spring separation height (H) mm(in)

Standard
61.8-63.8(2.43-2.51)



Driven disc assembly

• Visually inspect the springs of the torsional dampers to see if they are loose, broken, and the springs are weak.
Be sure to replace the driven disc assembly in case of finding any of the above phenomena.
• Visually inspect the surface of the friction plate for cracks and overheating.
Visually check whether the surface of friction discs has oil or grease. Be sure to clear the friction disc surface or replace the driven disc assy in case of finding any of the above phenomena.
• Check that the driven plate easily slides on the first drive spline.
If there is a small bulge on the first shaft, it can be removed by the oil stone or the pen type grinding wheel.



Disk deformation

• Insert the guide locator into the slotted hole in the driven plate.
The guide positioner must keep absolutely horizontal.

Guide positioner: 5-5828-3001-0

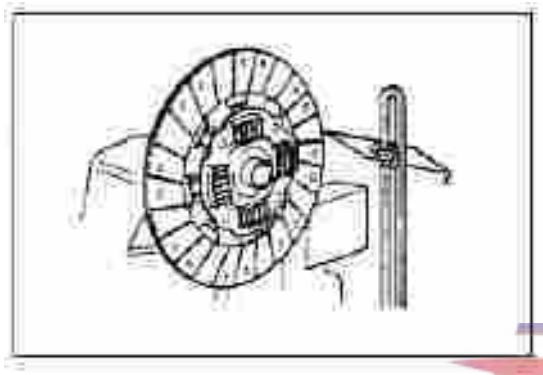
• Place the dial gauge on the surface of the driven plate near the outer circumference.
• Slowly turn the driven disc.

Rotate the driven plate, at the same time, read the readings of dial indicator.

If the measured value exceeds the specified limit, the driven plate assembly must be replaced.

Warping degree of the driven plate mm(in)

Standard	Limit
＜0.7(0.03)	1.0(0.04)



Wear of the splined hub and spline of the driven plate

• Clean the driven hub.

• The driven plate is mounted on the first spline of the drive shaft.

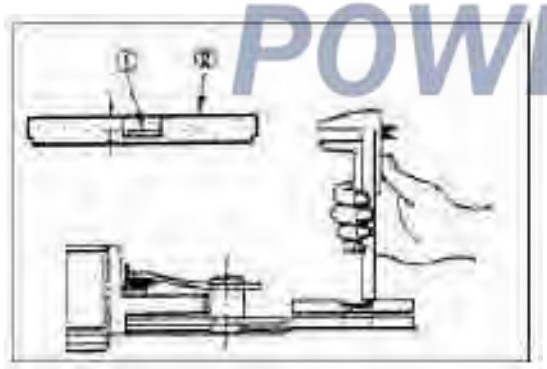
• Place a flat gauge near the outer circumference of the driven plate.

• Slowly turn the driven disc. At the same time, the rotation gap of the spline is measured.

If the measured value exceeds the specified limit, the driven plate assembly must be replaced.

Grooved spline drive wear mm(in)

Standard	Limit
＜0.5(0.02)	1.0(0.04)



Top depth of driven plate rivet

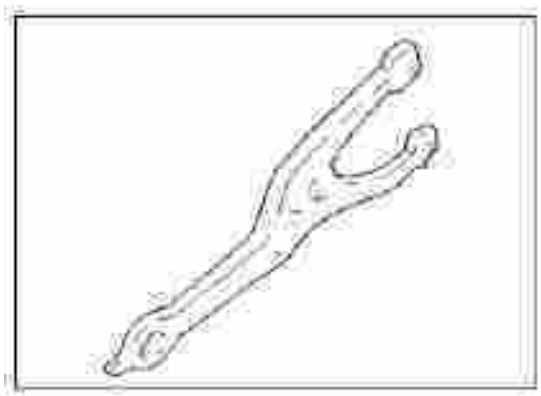
• Use a depth gauge or steel ruler to measure the depth of the friction surface to the top of the rivet.

The rivet top depth shall be measured on both sides of the driven plate.

If the measured value is less than the limit specified, the driven plate must be replaced.

Rivet top depth mm(in)

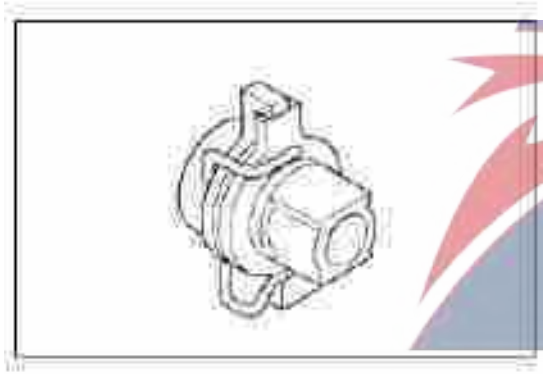
	A	B
	1. 8-2.4 (0.07-0.09)	1. 8-2.4 (0.07-0.09)



Release yoke and supporting bolt

• Visually inspect the contact surface of the clutch release fork and loosen the bearing bolts on the socket.

• Use grinding or grinding wheels to repair wear marks or surface irregularities. If there is damage which can not be repaired, the separation fork and / or support bolt should be replaced.



Release sleeve assembly

• Before disassembling, inspect the separation tube assembly for any of the following problems: Use oil or a pencil to repair small traces of wear or uneven surfaces. If damaged parts are damaged, they must be replaced.

Slightly rotate the bearing ring under slight pressure and check the bearing for irregular or noisy surfaces.

Is the separation sleeve irregular or damaged (contact surface with pallets or front cover).

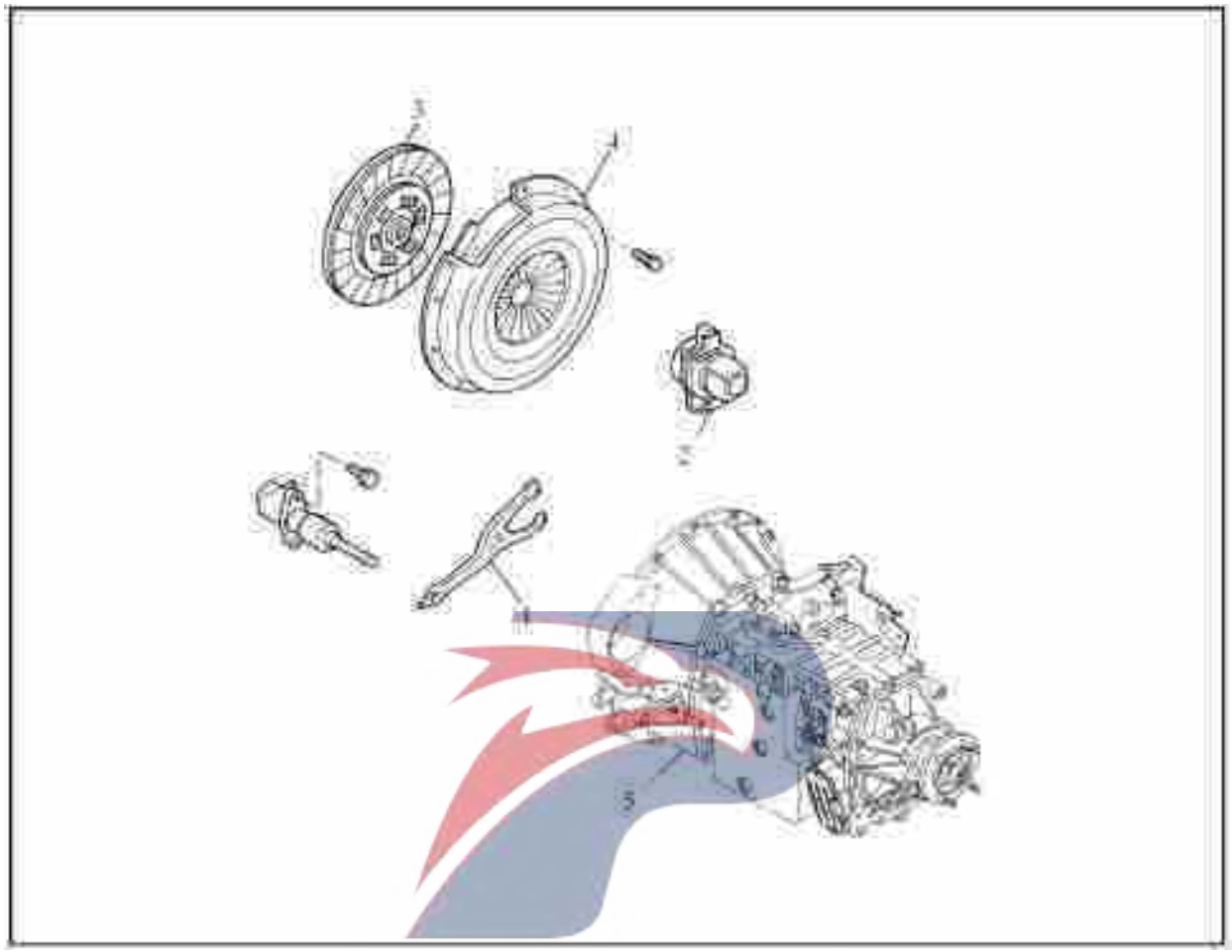
Caution

There is lube oil in the release bearing for long, so it cannot be soaked in cleaning solvents; otherwise, lube oil will be dissolved.

Caution:

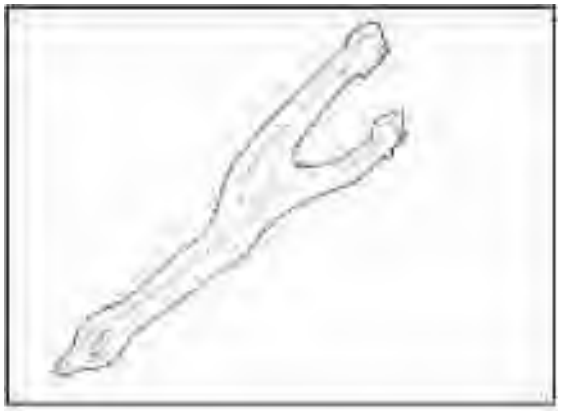
If no defects are found, do not completely remove the sleeve.

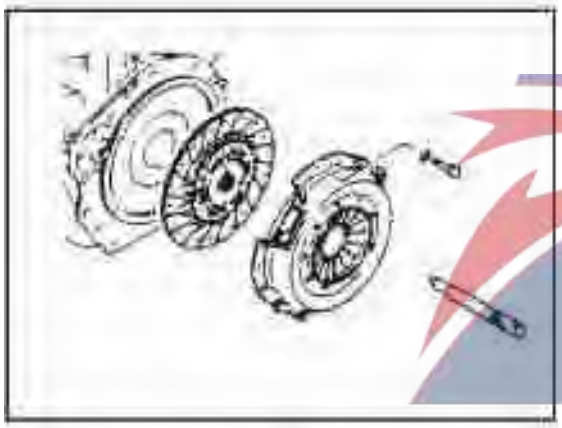
Assembling

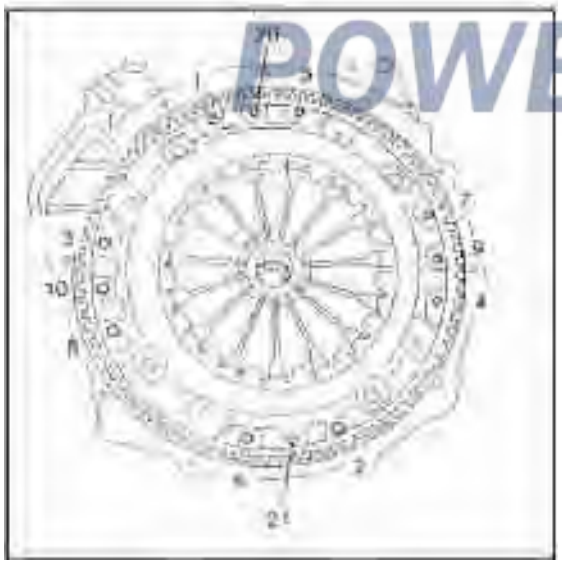


Assembling sequence

1. Release fork
2.Release sleeve assembly
3.Driven disc assembly
4.Pressure plate assembly
5.Transmission assembly







Assembling sequence

1.Release sleeve assembly

• Match the split sleeve to the mounting spring of the bracket.

2. Release fork

• Apply a multipurpose molybdenum disulfide grease on the contact surfaces of the separation sleeve and bearing bolt head.

3.Driven disc assembly

• Apply multi-purpose molybdenum disulfide grease to the spline of the driven hub.

• Use a guide locator to install the driven plate assembly.

Guide positioner: 5-5828-3001-0

4.Pressure plate assembly

• Tighten the platen assembly bolts in numerical order.

Platen fixing bolt torque	N·m(kgf·m/lb·ft)
	40(4.1)

• Remove the guide locator.

Caution:

When a new platen assembly is installed, the line used for protecting the diaphragm spring must be removed after the platen is tightened to the specified torque.

Remove clutch control mechanism

Disassembling sequence

Disassembling sequence

1. Clutch oil pipe and hose
2. Vacuum hose
3. Clutch pedal and bracket assembly
4. Clutch switch or limiting bolt
5. Axis
6. U-shaped fork pin
7. Return spring
8. Clutch pedal
9. Main cylinder
10. Flexible hose
11. Working cylinder
12. Clutch valve assembly

Preparation work

1. Instrument component

·Extract the instrument assembly and disconnect the harness connector.

2. Instrument assembly

• Remove the 5 mounting screws, then remove the meter assembly and disconnect the harness connector.

Disassembling sequence

• Discharge the clutch oil from the hydraulic clutch line.

Caution

Do not splash clutch fluid onto the painted surface. In the event of splashing, wash away immediately.

1. Clutch oil pipe and hose
2. Vacuum hose
3. Clutch pedal and bracket assembly
4. Clutch switch or limiting bolt
5. Axis
6. U-shaped fork pin
7. Return spring
8. Clutch pedal
9. Main cylinder
10. Flexible hose
11. Working cylinder
12. Clutch assembly

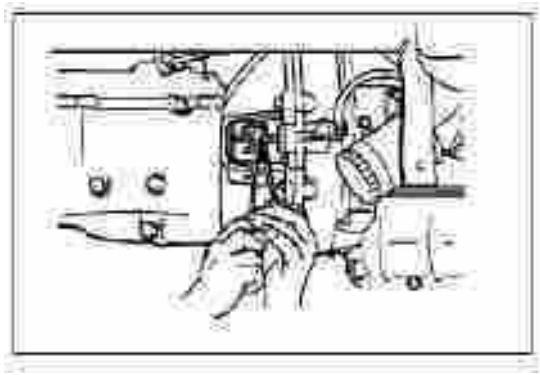
Inspection and repair

In case of finding excessive wear or damage during checking, carry out necessary adjustment, repair and replacement of parts.

Assembling

Assembling sequence

1. Clutch assembly
2. Working cylinder
3. Flexible hose
4. Main cylinder
5. Clutch pedal
6. Return spring
7. U-shaped fork pin
8. Axis
9. Clutch switch or limiting bolt
10. Clutch pedal and bracket assembly
11. Vacuum hose
12. Clutch oil pipe and hose



Assembling sequence

1. Clutch shock absorber and working cylinder

Cylinder bolt nut torque	N·m(kgf·m/lb·ft)
	40 (4.1/29.5)

• Adjust the cylinder before installing the return spring.

1) Loosen the lock nut of the push rod.

2) Turn the adjusting nut until it contacts the release fork.

3) Return the adjusting nut to 1.5 turns (approx. 2 mm/0.1 inch clearance).

4）Tighten the lock nut

Tightening torque for locknut	N•m(kgf·M / lb·Ft)
	16(1.6/12)

2. Flexible hose

3. Main cylinder

• Install the master cylinder assembly on the clutch pedal bracket.

Fixed bolt torque	N•m (kgf·M / lb·Ft)
	13(1.3/113)

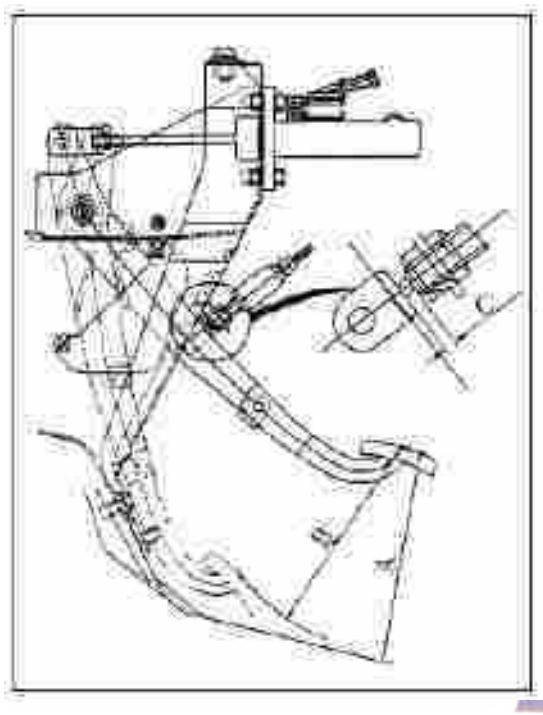
4. Clutch pedal

5. Return spring

6. U-shaped fork pin

7. Axis

8. Clutch switch or limiting bolt



9. Clutch pedal and bracket assembly

Clutch bracket bolt torque	N·m(kgf·m/lb·ft)
37 (3.8/27)	

• After installing the clutch control mechanism, adjust the clutch pedal.

Clutch pedal height and travel

1) Loosen the lock nut of the master cylinder push rod.

2) Turn the pusher to adjust the height of the pedal.

Clutch pedal height and travel	mm(in)
Height (A): 159-169 (6.3-6.7) (reference value)	
Stroke (B): 159-169 (6.2-6.7) (reference value)	

3）Tighten the lock nut

Tightening torque	N•m (kgf·M / lb·Ft)
13(1.3/113)	

4) Install the entire instrument and the entire instrument.

Free travel of clutch pedal

Clutch switch or limiting bolt

Adjust the clutch switch or the limiting bolt clearance after adjusting the clutch pedal height and the working cylinder.

1) Loosen the lock nut of the clutch switch or limit bolt.

2) Turn the clutch switch or limiting bolt to adjust the clutch switch or limiting bolt clearance.

Clutch switch or limit bolt clearance (C)	mm (in)
0.5-1.0 (0.02-0.04)	

Free travel of clutch pedal	mm(in)
15-25 (0.6-1.0) (reference value)	

3）Tighten the lock nut

	Tightening torque	N•m (kgf·M / lb·Ft)
		19(1.9/14)

10. Vacuum hose

11. Clutch oil pipe and hose

• Install the clutch control mechanism and drain the hydraulic line from the clutch.

The exhaust operation requires two people to cooperate.

1) Check the oil level in the tank and refill if necessary.

2) Remove the rubber cap from the vent screw and clean the vent screw. One end of the vinyl plastic tube is connected to the vent screw, and the other end is inserted into a transparent volume

3) Repeatedly press the clutch pedal and keep it pressed.

4) Loosen the bleeder screw of the clutch cylinder and pour the clutch liquid into the container with air bubbles and immediately tighten the bleeder screw.

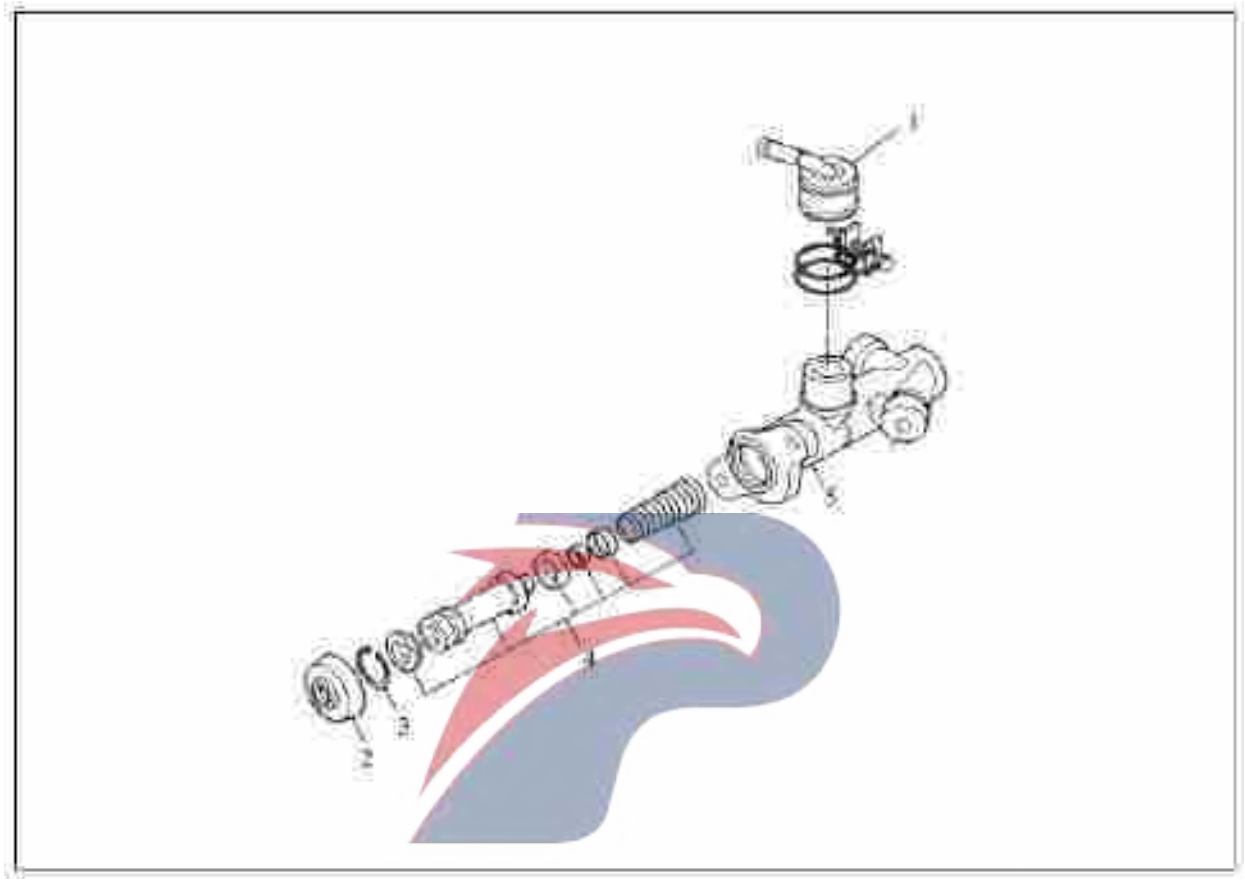
5) Release the clutch pedal with care. Repeat the above operation until the clutch oil is discharged into the container and no more bubbles appear. In the process of exhausting, it is necessary to keep the oil level of the oil storage room at the specified height.

Install the rubber cover.

Single piece repair

Main cylinder

Disassembling

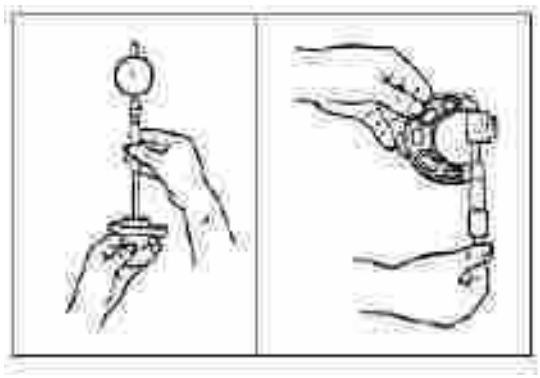


Disassembling sequence

1. Pipe joint
2. Dust cover
3. Snap ring
4. Piston assembly
5. Cylinder block

Inspection and repair

In case of finding excessive wear or damage during checking, carry out necessary adjustment, repair and replacement of parts.



Cylinder block

• Clean the hydraulic cylinder in the brake fluid.

• Check that the oil return port is blocked and remove it if necessary.

• Measuring aperture.

Master cylinder inner diameter mm(in)

Standard
Ø20.64 (0.8169)

Cylinder inner diameter and piston clearance mm(in)

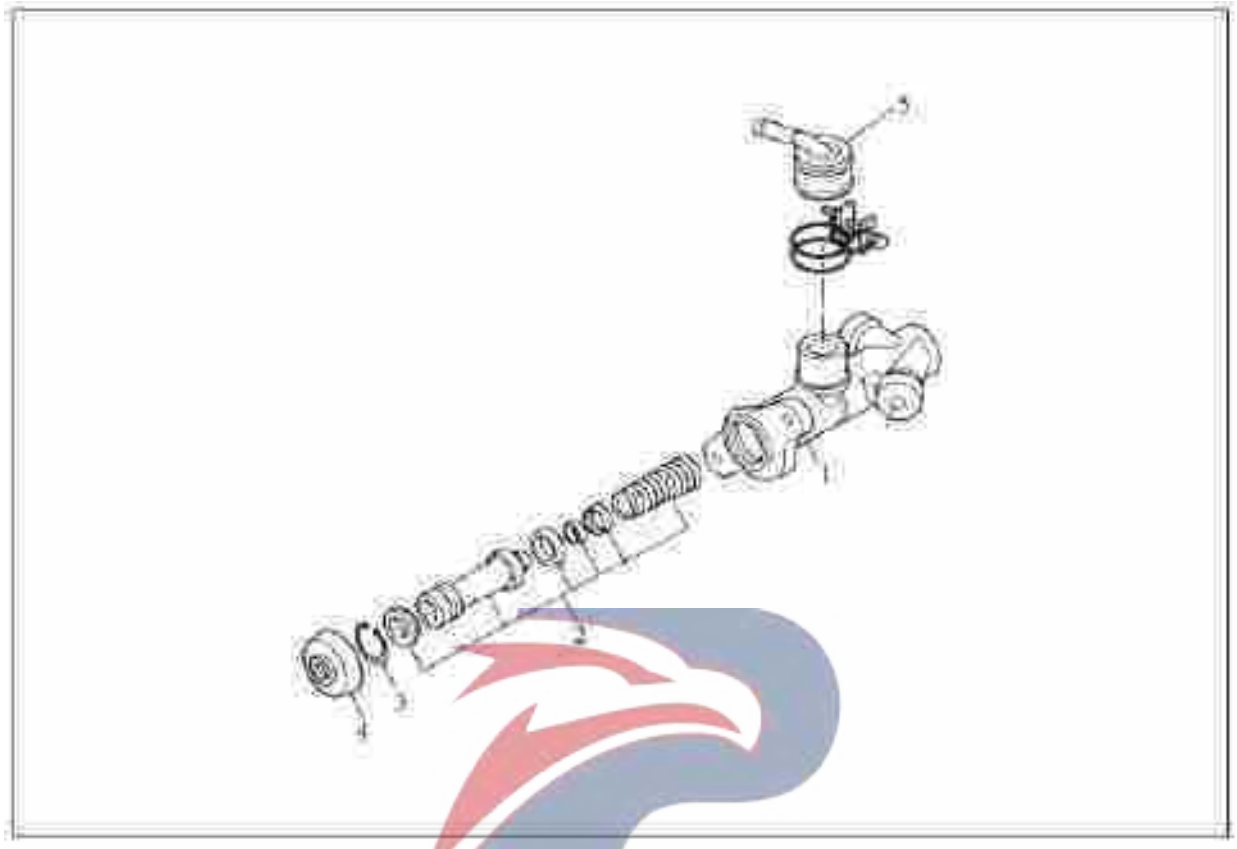
Standard	Limit
0.03-0.11 (0.001-0.004)	0.12(0.005)

• If excessive wear or other abnormal conditions occur, the entire master cylinder must be replaced.

Caution

If the main cylinder has been decomposed, the parts in the repair package must be replaced.

Reassembling



Reassembling sequence

1. Cylinder block
Piston assembly
3. Snap ring
4. Dust cover
5. Pipe joint

Reassembling sequence

1. Cylinder block

• Immerse the cylinder in clean brake fluid.

2. Piston assembly

• Apply a thin layer of rubber grease to the piston before installation.

Caution

Do not damage the lips of the pistons bowl.

3. Snap ring

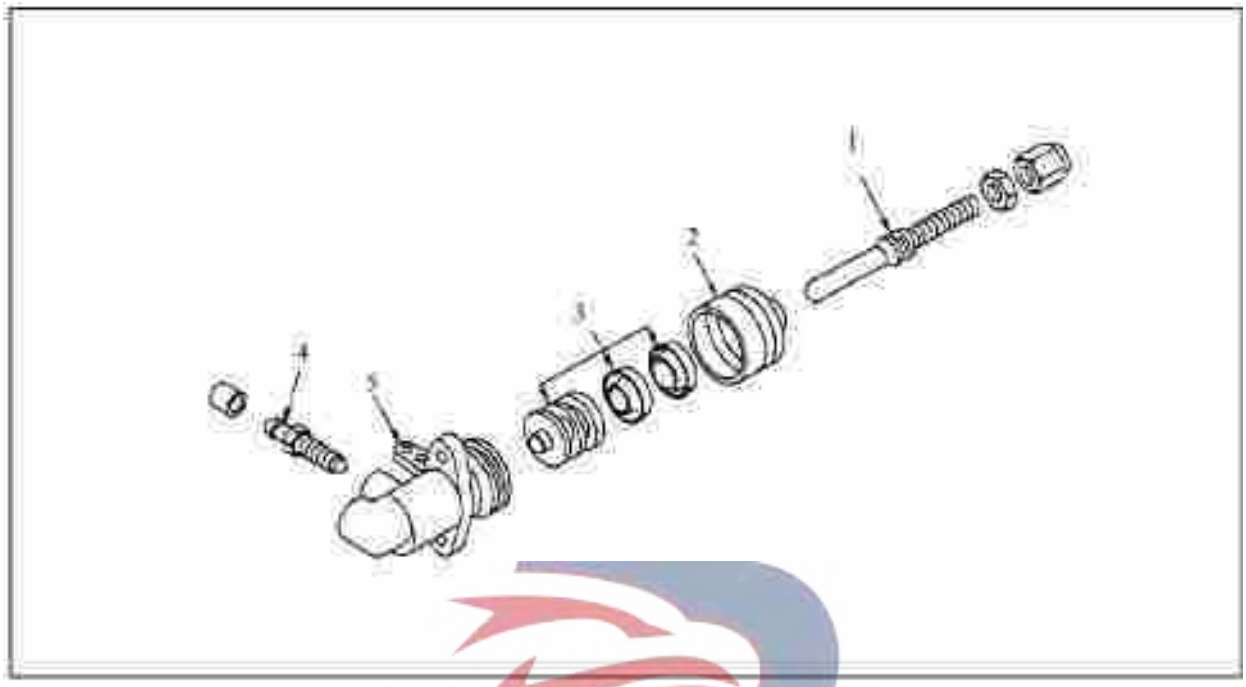
4. Dust cover

5. Pipe joint

Tightening torque	N•m (kgf·M / lb·In)
5 (0.5/43)	

Working cylinder

Disassembling



Disassembling sequence

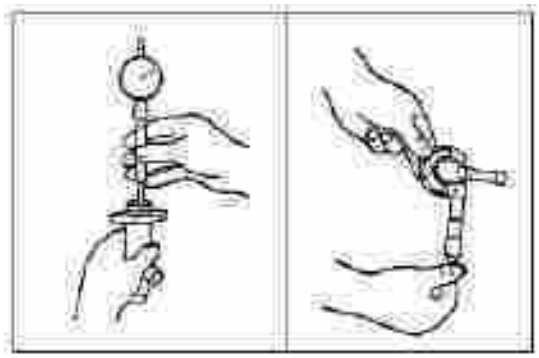
1. Push rod
2. Jacket
3.Piston assembly
4. Exhaust screw
5. Cylinder block

Disassembling sequence

1. Push rod
2. Jacket
3.Piston assembly
4. Exhaust screw
5. Cylinder block

Inspection and repair

In case of finding excessive wear or damage during checking, carry out necessary adjustment, repair and replacement of parts.



Cylinder block

• Clean the hydraulic cylinder in the brake fluid.

• Measure the size of the cylinder bore.

Bore diameter mm(in)

Standard
Ø26.990. -27.042 (1.0626-1.0646)

Cylinder inner diameter and piston clearance mm(in)

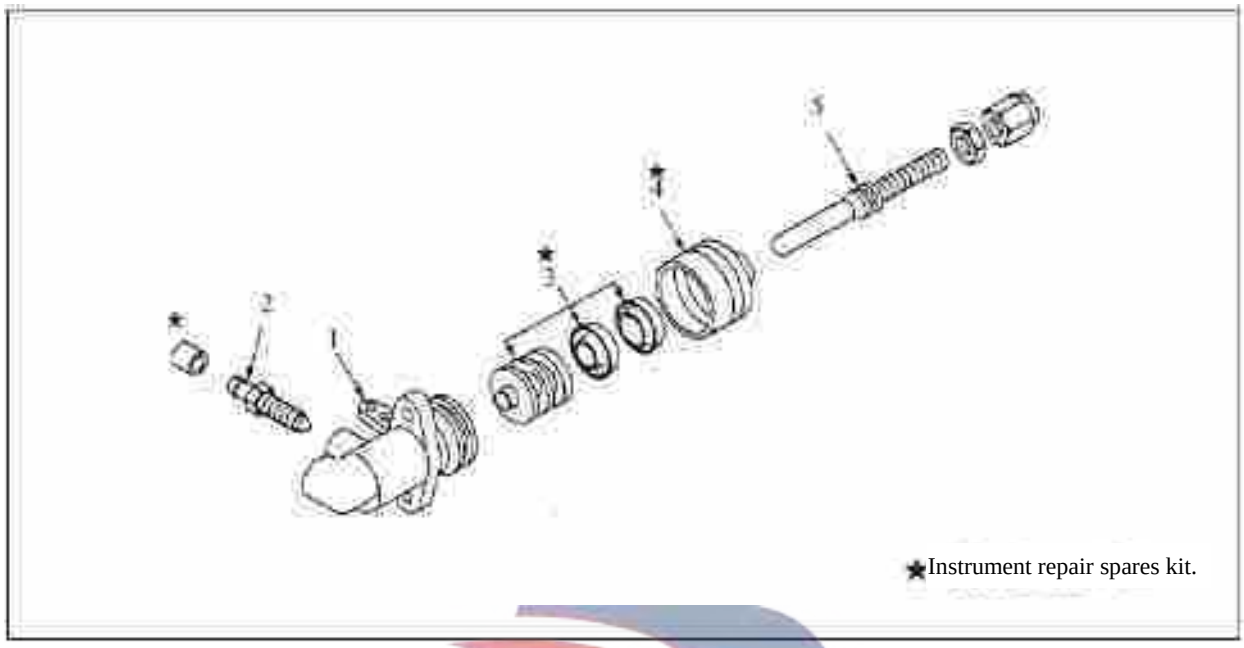
Standard	Limit
0.02-0.10 (0.0008-0.0039)	0.11 (0.0043)

• If excessive wear or other abnormalities occur, the cylinder assembly must be replaced.

Caution

If the working cylinder has been decomposed, the parts in the repair package must be replaced.

Reassembling



Reassembling sequence

1. Cylinder block
2. Exhaust screw
3.Piston assembly
4. Jacket
5. Push rod

Reassembling sequence

1. Cylinder block

2. Exhaust

3.Piston assembly

• Apply a thin layer of rubber grease to the piston before installation.

Caution

Do not damage the lips of the pistons bowl.

4. Jacket

5. Push rod

Section 5C

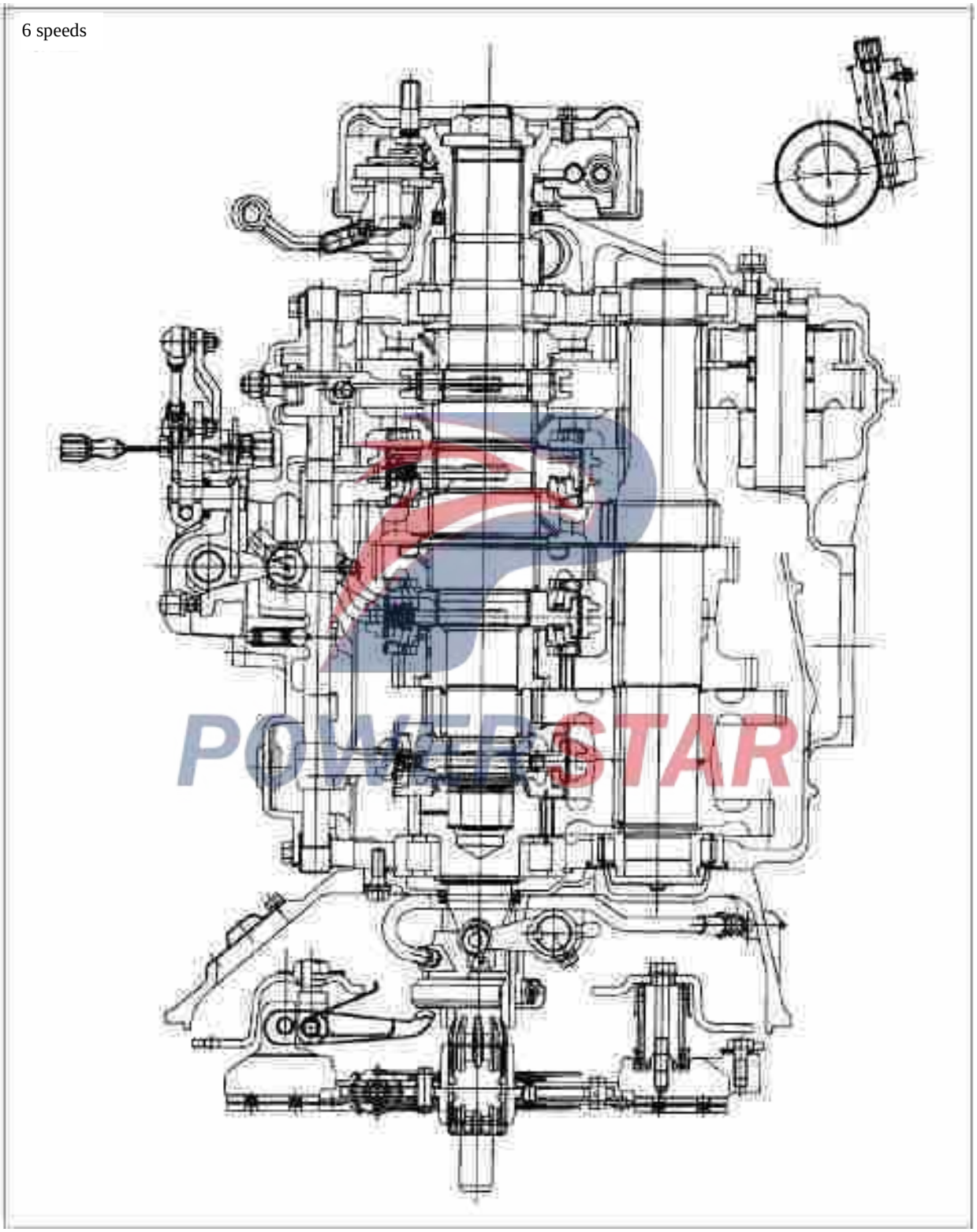
Manual Transmission

Table of Contents

Overview

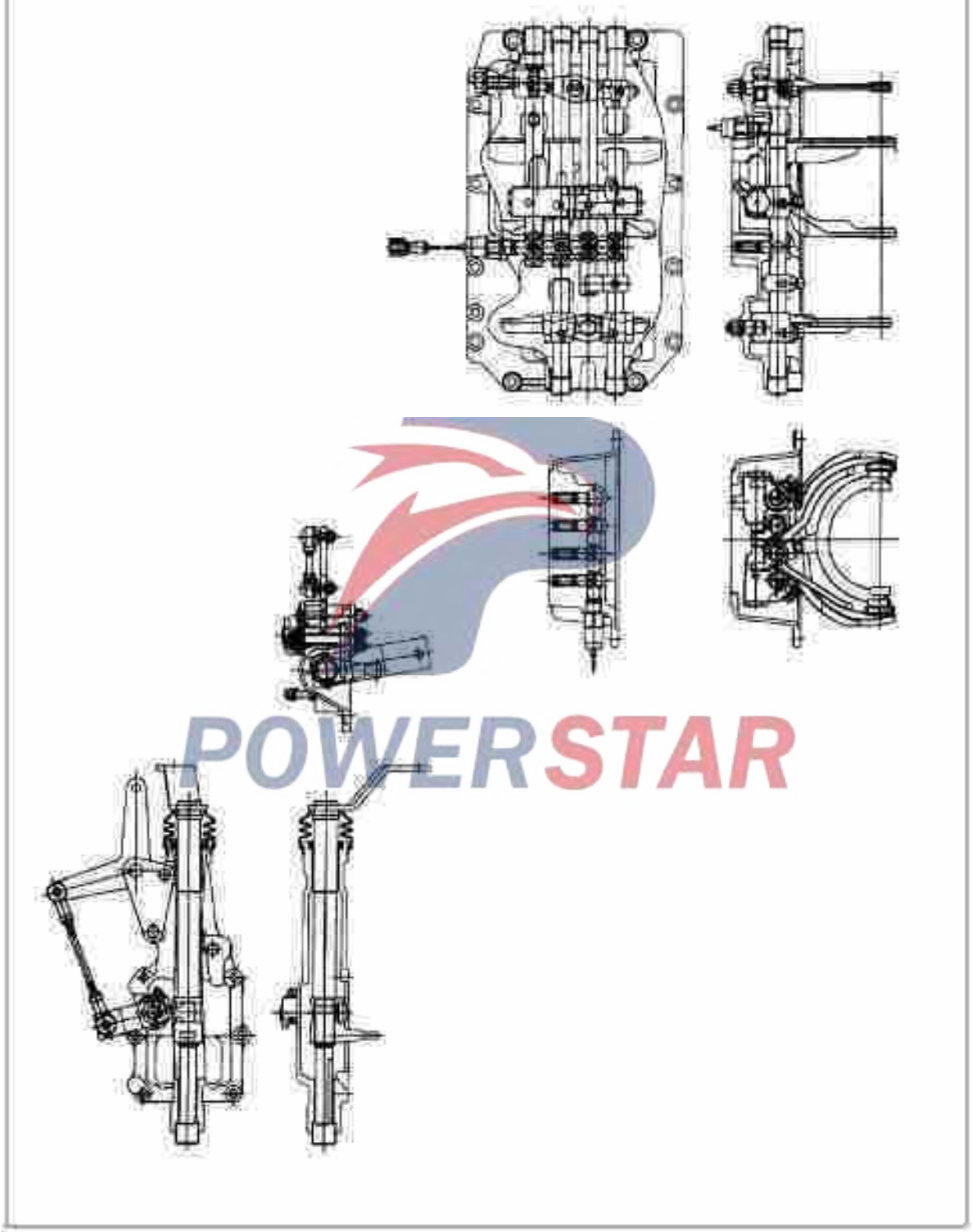
Transmission

6 speeds

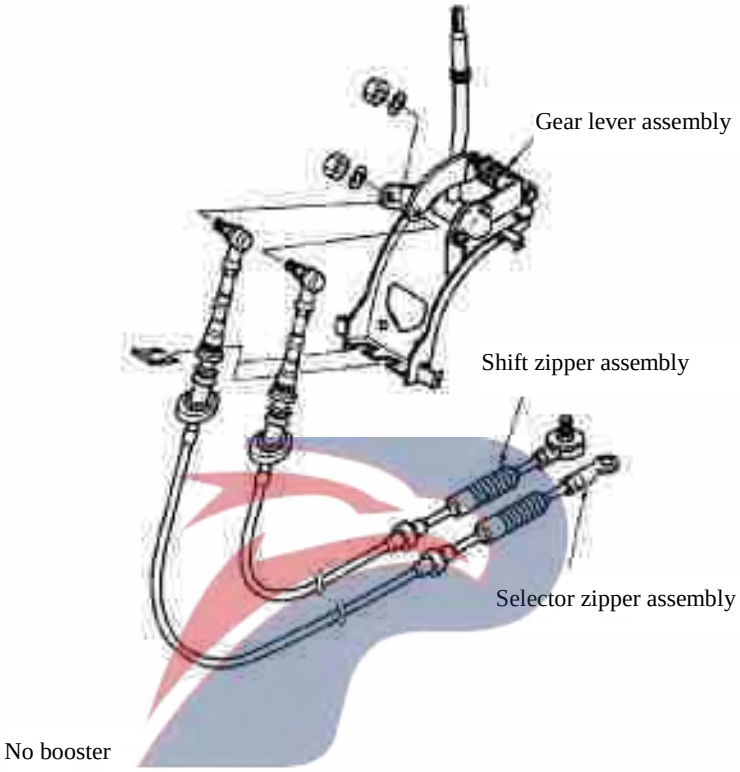


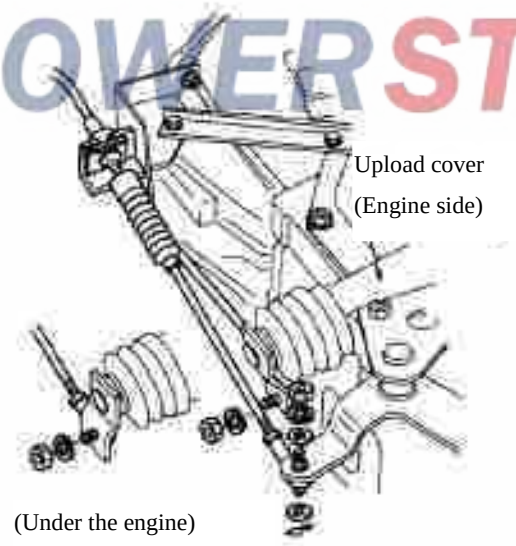
Transmission cover assembly

6 speed overspeed type



Transmission control mechanism





Operate the cable

Shift zipper assembly

Transmission side

Ribbon side

Shift zipper assembly

Transmission side

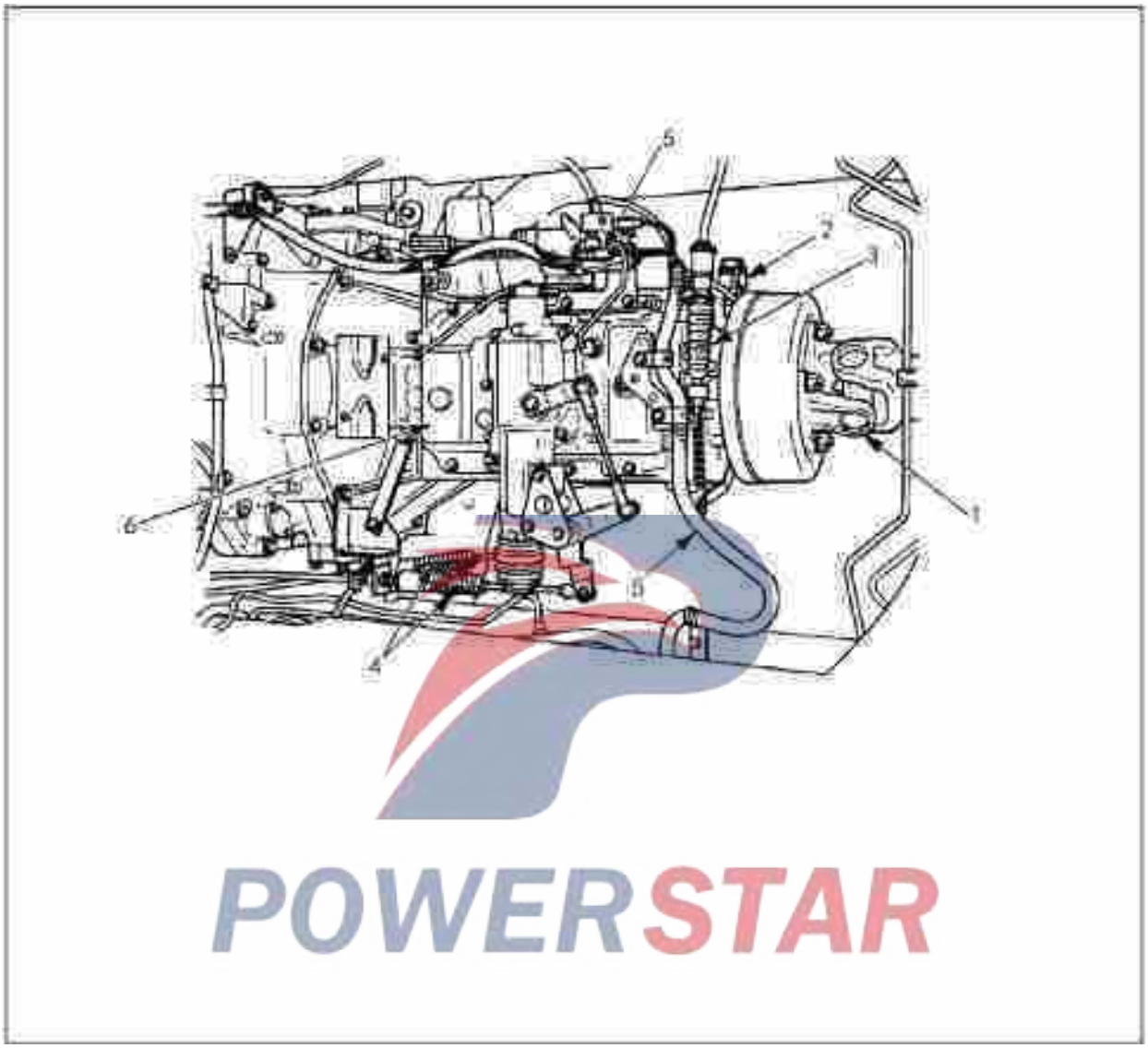
Ribbon side

(Type A)

(Type B)

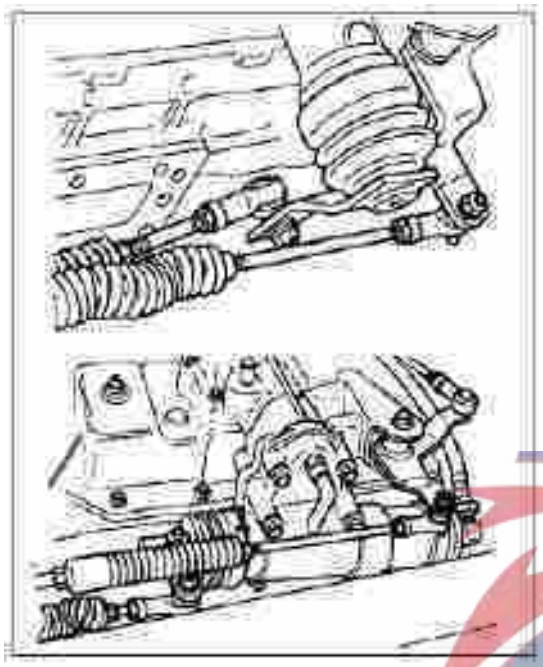
Transmission assembly

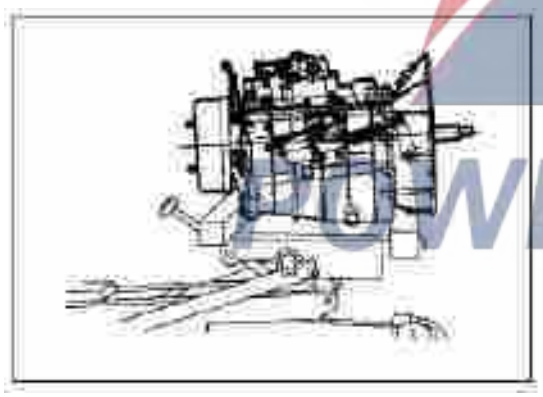
Disassembly



Dismantling sequence

1. Flange yoke
2. Sensor harness connector
3. Parking brake cable
4. Shift and shift control cable
5. Wiring harness
6. Transmission assembly





Dismantling sequence

1. Flange yoke
2. Sensor harness connector
3. Parking brake cable
4. Shift and shift control cable

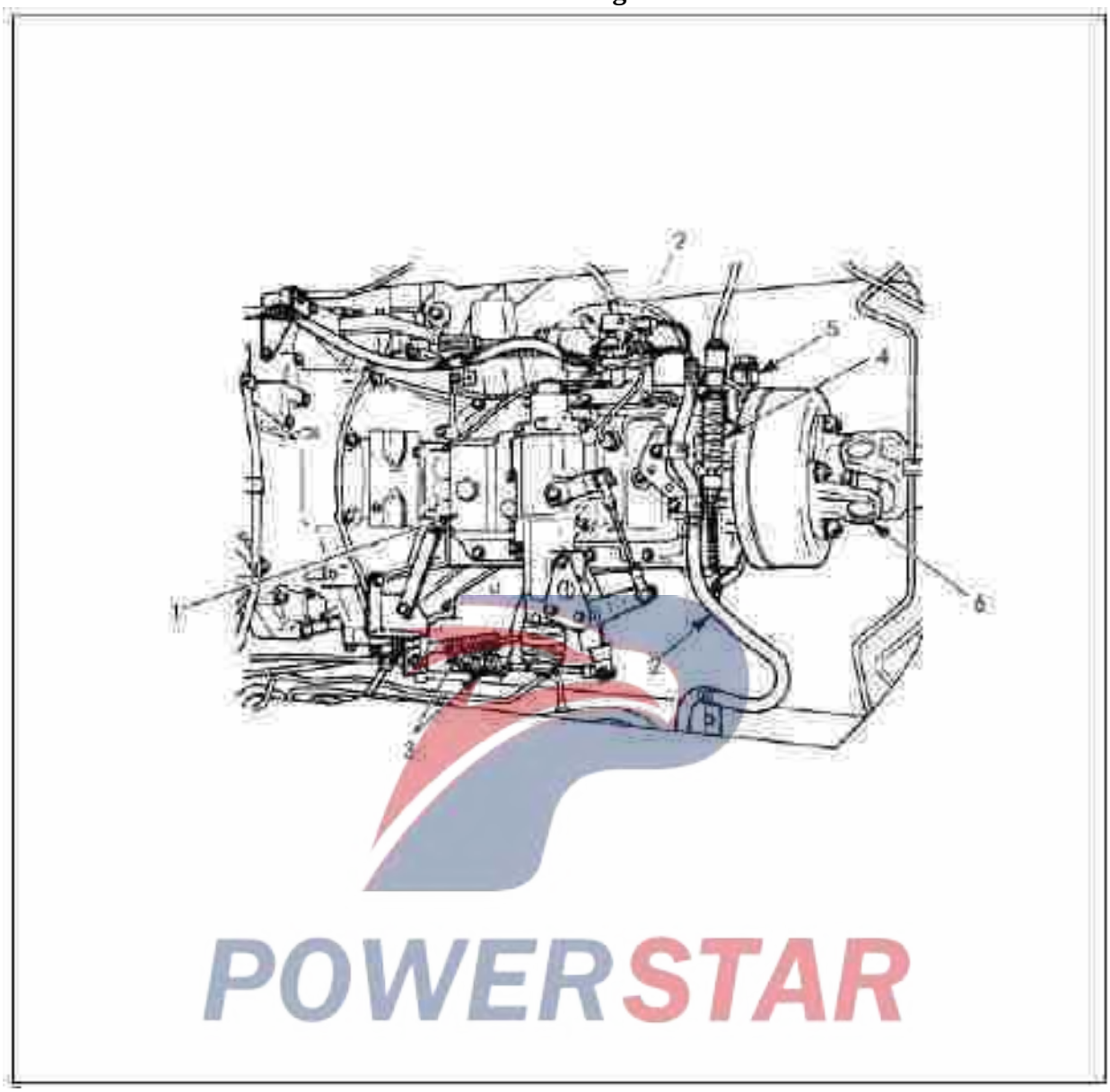
Remove the control cable in the position shown.

Place the transmission in neutral before disassembling the transmission.

5. Wiring harness
6. Transmission assembly

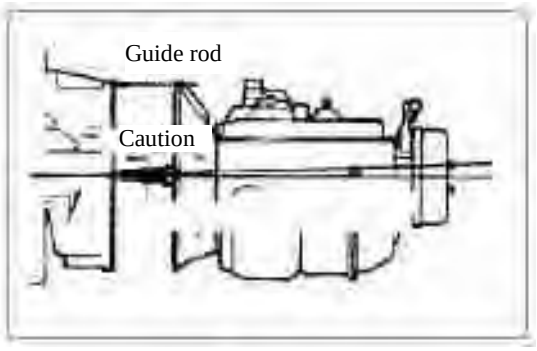
Use transmission elevators or equivalents.

Assembling



Assembling sequence

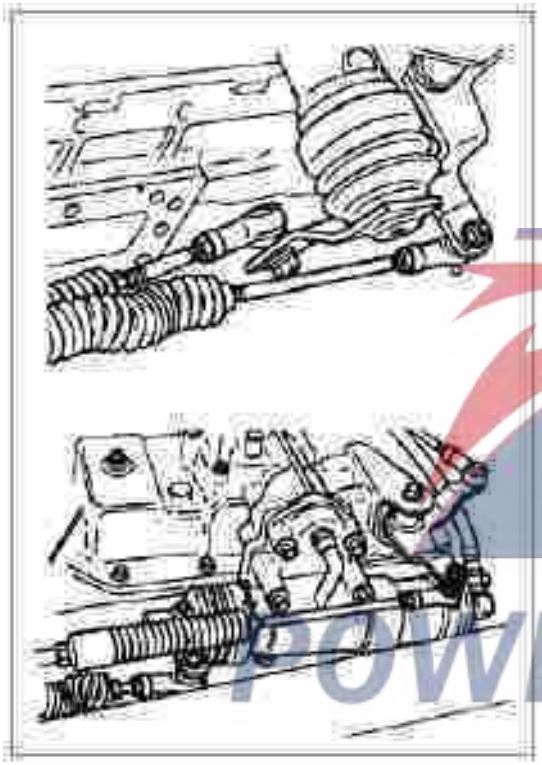
1. Transmission assembly
2. Wiring harness
3. Shift and shift control cable
4. Parking brake cable
5. Sensor harness connector
6. Flange yoke



Assembling sequence

1. Transmission assembly

1) Align the centerline of the transmission with the centerline of the tilt of the motor.
2) Turn the first shaft to align with the spline of the clutch plate.
3) Mount the transmission carefully on the motor.



2. Wiring harness

3. Shift and shift control cable

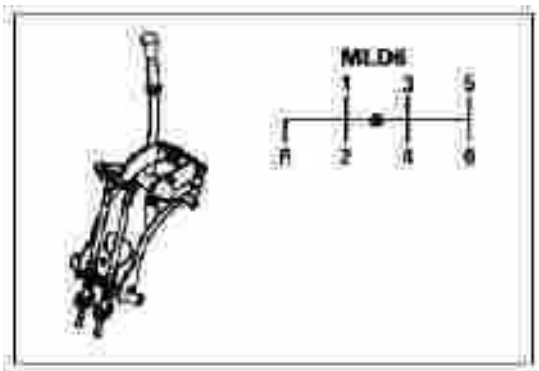
1) When installing the cable, the transmission must be in a neutral position.
2) Check the assembly length of the cable end.

Caution:

When adjusting the length of the assembly, hold the shift lever in the neutral position as shown to keep the transmission in neutral.

Adjust the length of the component.

For more details, see "Processing Components" in this section.



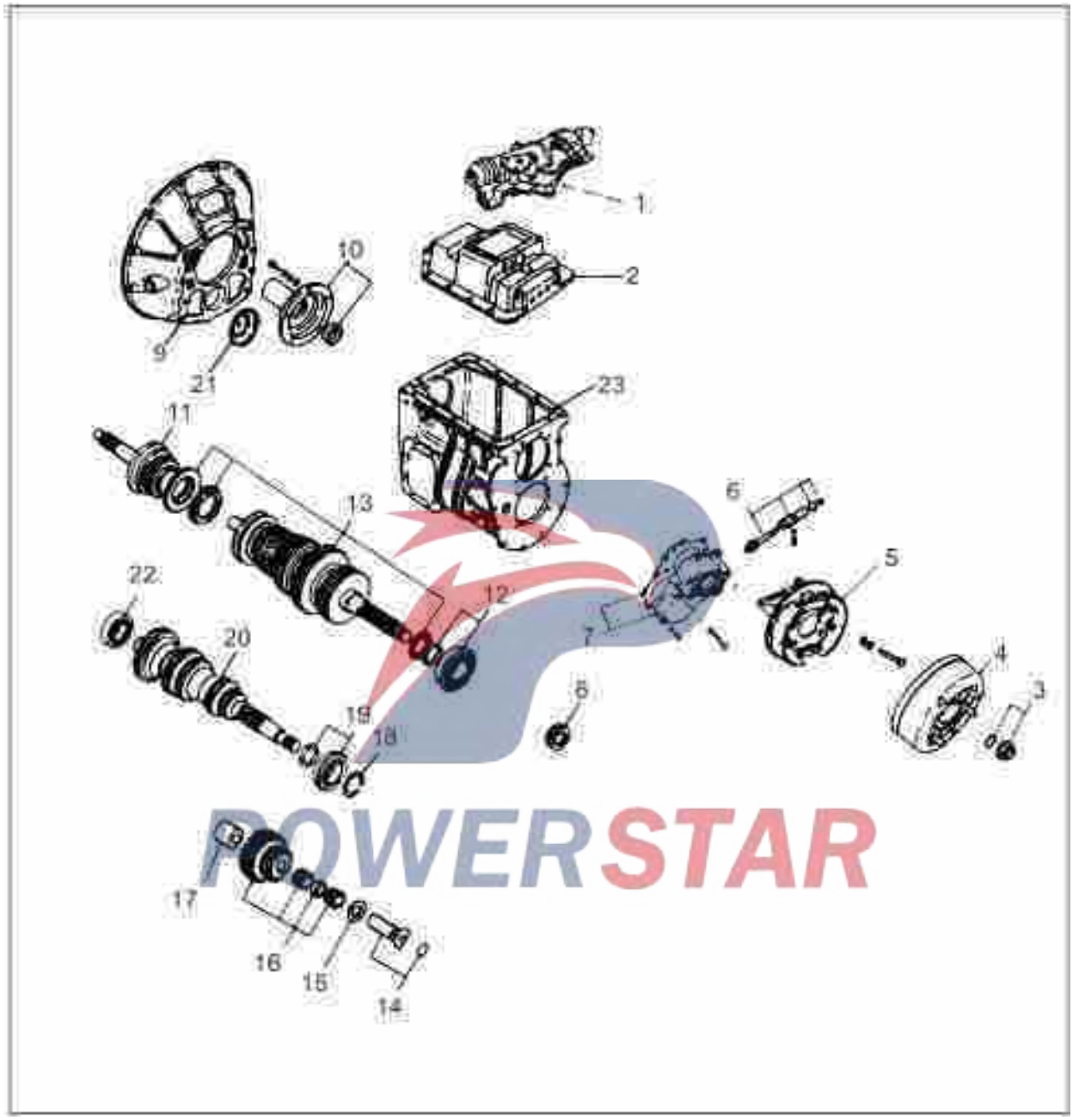
4. Parking brake cable

5. Sensor harness connector

6. Flange yoke

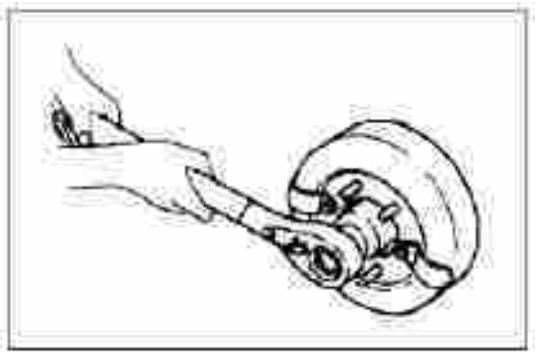
Transmission assembly

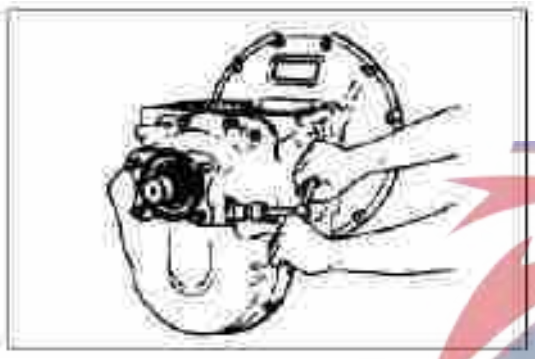
Disassembling



Disassembling sequence

1. Upload cover assembly
2. Lower gearbox cover
3. Flange nut and O-ring
4. Parking brake drum and flange
5. Parking brake assembly
6. Gear-driven gears, bushings, oil seals and O-rings
7. Rear cover
8. Speedometer driving gear
9. Clutch housing
10. Front cover and oil seal
11. First axis assembly
12. Second shaft rear bearing
13. A set of second shaft, synchronizer sleeve and thrust washer
14. Reverse shaft and O-ring
15. Thrust washer
16. Inverted intermediate gears, needle roller bearings and spacers
17. Sleeve
18. Countershaft rear bearing snap ring
19. Countershaft rear bearing
20. Intermediate shaft assembly
21. Countershaft front bearing end cap
22. Countershaft front bearing
23. Transmission hull





Disassembling sequence

1. Upper shift cover assembly

2. Lower gearbox cover

3. Flange nut and O-ring

Two pairs of gears are engaged at the same time, or a piece of hardwood is inserted between the gear and the transmission housing to prevent the second shaft from rotating. mm (in)

Spanner	50(1.97)

4. Parking brake drum and flange

5. Parking brake assembly

6. Gear-driven gears, bushings, oil seals and O-rings

Divide these parts if necessary.

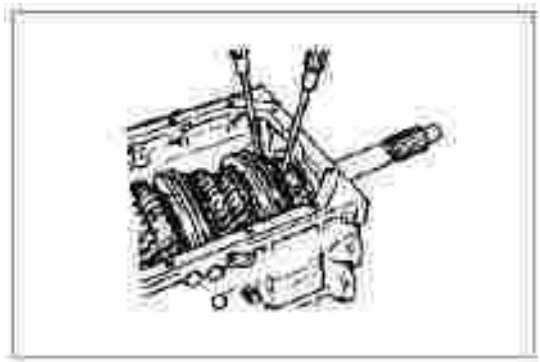
Remover:9-8521-0181-0

7. Rear cover

8. Speedometer driving gear

9. Clutch housing

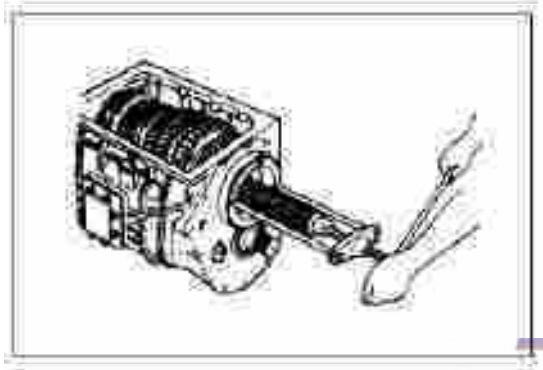
10. Front cover and oil seal



11. First axis assembly

1) Insert a screwdriver between the first gear of the shaft and the gear sleeve of the synchronizer. The synchronizer's toothed clutch can be separate from the first shaft.

2) Remove the first shaft assembly.

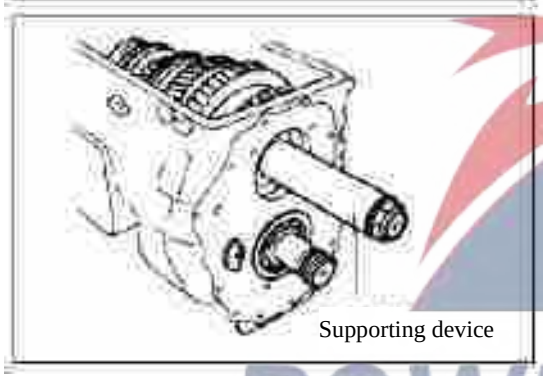


12. Second shaft rear bearing

Remover:9-8521-0192-0

1) Remove the elastic ring from the bearing.

2) Remove the bearing with a bearing remover.



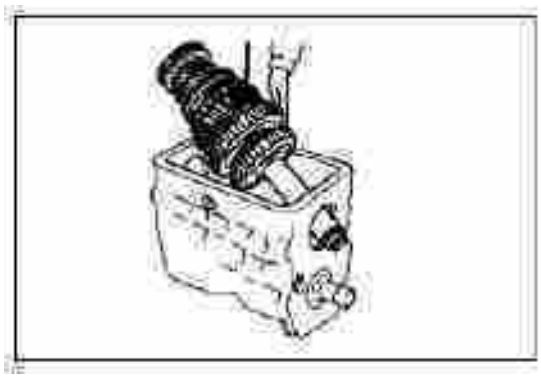
Supporting device

13. A set of second shaft, synchronizer sleeve and thrust washer

1) Attach the support device to the rear end of the second shaft with a wheel nut.

This prevents reverse gearing during the disassembly process. The first gear, second gear, and thrust washer loosen and come off.

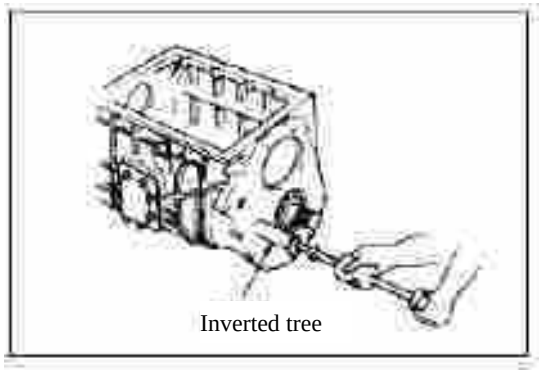
Supporting device	Size of length (reference)	Inner diameter	Thickness mm (in)
6 speeds	140(5.5)	57-60 (2.2-2.4)	3-5 (0.12-0.20)



2) Insert a piece of wire in the shift fork slot of the 1st gear to the 2nd gear.

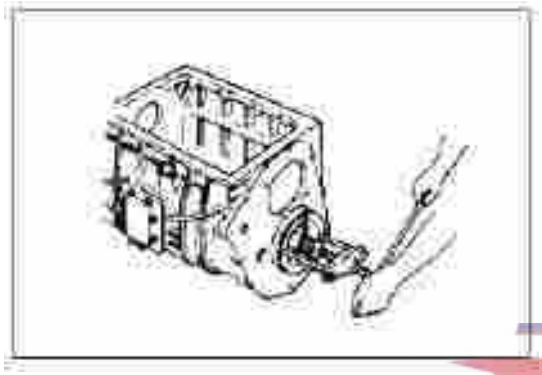
Make sure the threads are tight.

3) Lift the second shaft assembly with the gear sleeve of the gearbox synchronizer.



14. Reverse shaft and O-ring

Remover: 9-852l-0095-0



15. Thrust washer

16. Inverted intermediate gears, needle roller bearings and spacers

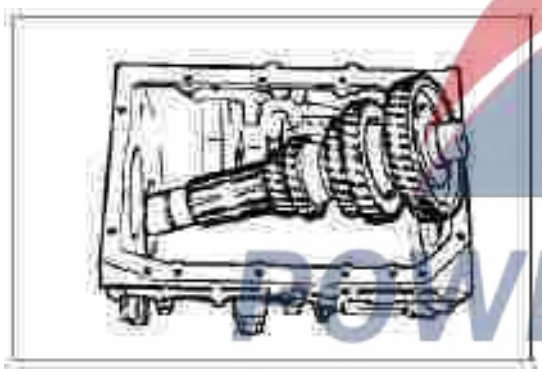
17. Sleeve

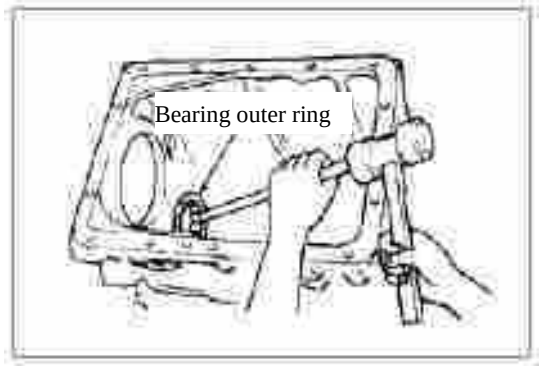
18. Countershaft rear bearing snap ring

19. Countershaft rear bearing

Remover:9-8521-0186-0

20. Intermediate shaft assembly





21. Countershaft front bearing end cap

22. Countershaft front bearing

Use a hammer and copper rod to remove the countershaft bearing and the front end of the bearing.

23. Transmission hull

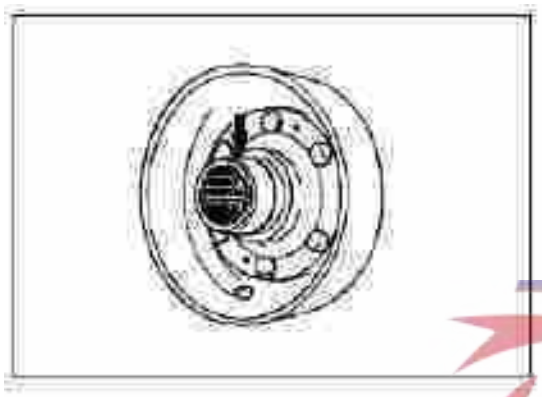
Inspection and repair

If any wear, damage, or other abnormalities are found during the inspection, repair or replace the parts.

Gear

Visually inspect the gear teeth and bearing surfaces of the drive gear for excessive wear or damage.

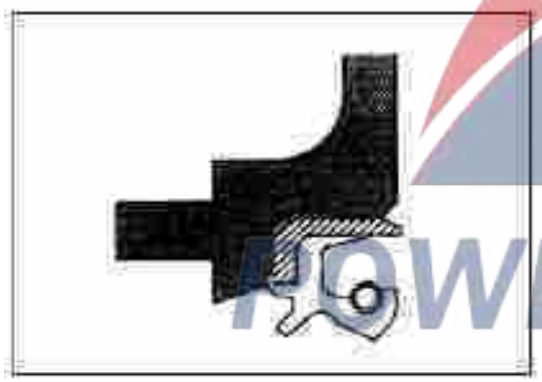
If excessive wear or damage is found during the inspection, replace the gear.



Bearings

Visually inspect the ball and needle for contact surface wear.

If worn and worn, replace the bearing.



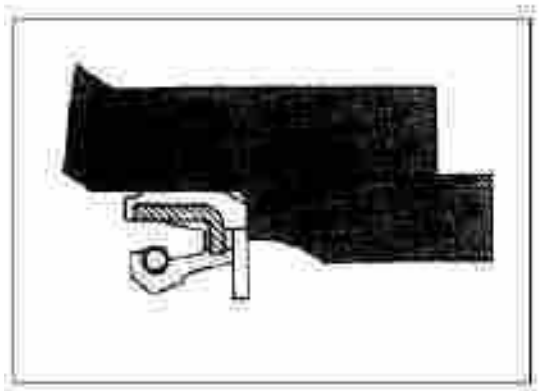
Flange and brake drum assembly

Visually inspect the lip seal faces, internal splines, and end faces for excessive wear and damage.

If excessive wear or damage is found during the inspection, replace the brake flange and roller.

The parking brake drum and drive axle fork are described in detail in the corresponding sections of the "Brake" or "Driveshaft" service manual.

During reassembly, be sure to tighten the brake drum flange and nut to the specified torque.



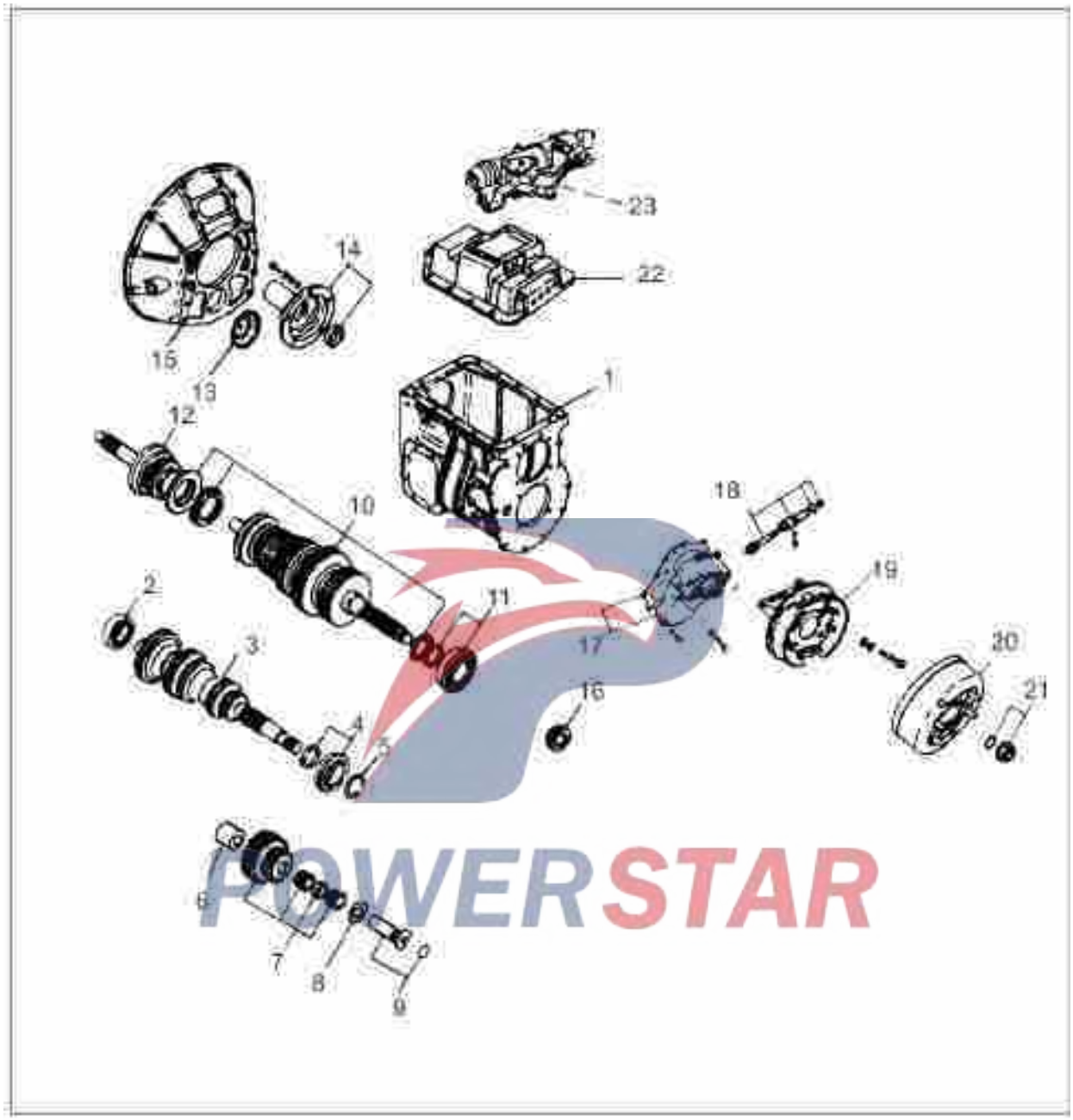
Replace front and rear cover oil seals

1) Pay attention to the installation direction of the oil seal.

2) Apply oil to the contact surface of the oil seal and lip.

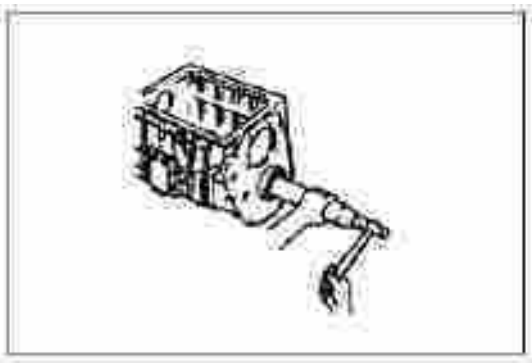
3) Install the oil seal so that it is properly installed.

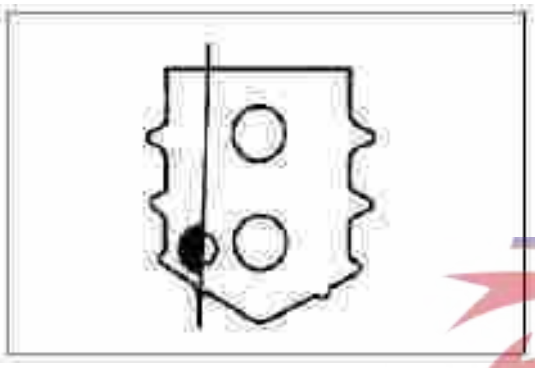
Reassembling

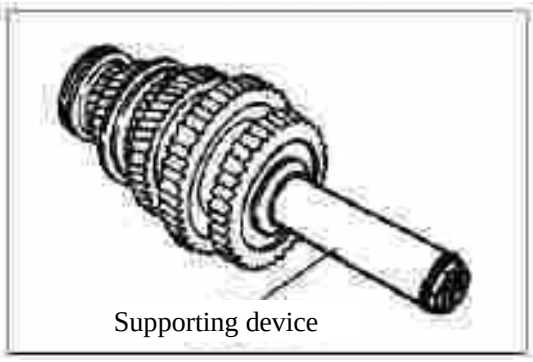


Reassembling sequence

1. Transmission hull
2. Countershaft front bearing
3. Intermediate shaft assembly
4. Rear axle of counter bearing
5. Countershaft rear bearing snap ring
6. Sleeve
7. Inverted intermediate gears, needle roller bearings and spacers
8. Thrust washer
9. Reverse shaft and O-ring
10. A set of second shaft, synchronizer sleeve and thrust washer
11. Second shaft rear bearing
12. First axis assembly
13. Countershaft front bearing end cap
14. Front cover and oil seal
15. Clutch housing
16. Speedometer driving gear
17. Rear cover
18. Gear-driven gears, bushings, oil seals and O-rings
19. Parking brake assembly
20. Parking brake drum and flange
21. Flange nut and O-ring
22. Lower gearbox cover
23. Upload cover assembly







Supporting device

Reassembling sequence

1. Transmission hull

2. Countershaft front bearing

3. Intermediate shaft assembly

4. Countershaft rear bearing

Mount the front and rear bearings of the countershaft with the bearing assembly.

Bearing installer: 9-8522-1248-0

5. Countershaft rear bearing snap ring

6. Sleeve

7. Inverted intermediate gears, needle roller bearings and spacers

8. Thrust washer

9. Reverse shaft and O-ring

During assembly, the notches on the shaft must be perpendicular to the upper surface of the gearbox housing.

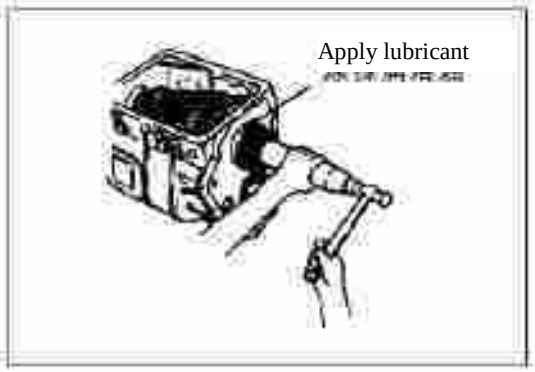
10. A set of second shaft, synchronizer sleeve and thrust washer

Check that the gears and washers are installed correctly.

Caution:

1) Mount the cone of the thrust washer on the rear bearing of the second shaft.

2) Mount the support device on the second shaft and then half-tighten the flange nuts used.



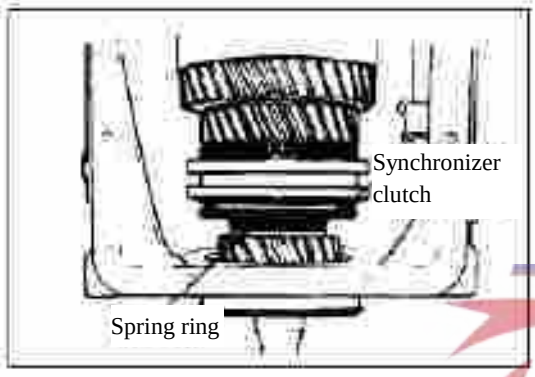
11. Second shaft rear bearing

1) The chamfered side of the inner ring should face the side of the gear.

2) Install the rear bearing of the second shaft with the elevator.

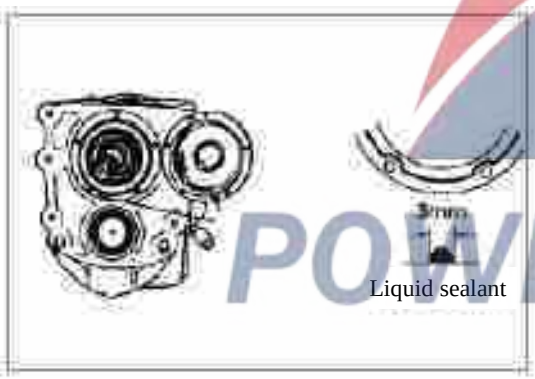
Bearing installer: 9-8522-1310-0

1-8522-1164-0



12. First axis assembly

Push the first shaft to force the synchronizer teeth into the first shaft.



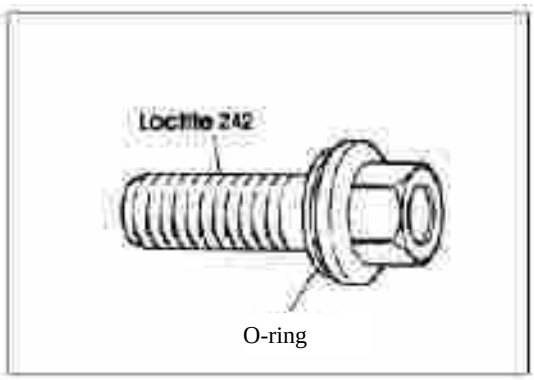
13. Countershaft front bearing end cap

14. Front cover and oil seal

1) When installing the front cover, be careful not to damage the seal lip.

2) Align the oil hole in the main housing with the oil groove in the front cover.

3) Apply the recommended liquid sealant (Loctite 17430) or equivalent to the contact surface of the front cover.



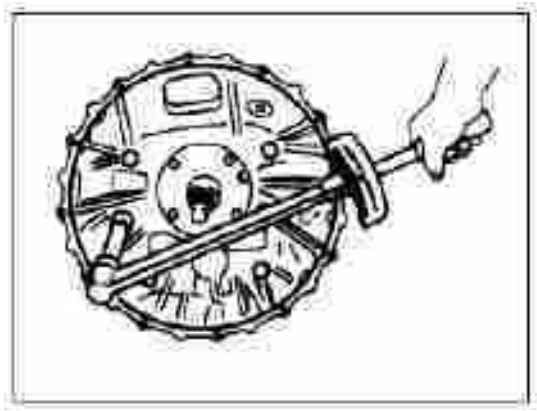
4) Tighten the front cover bolt to the specified torque (apply liquid sealant Loctite 242 or equivalent to the threaded part).

Front cover bolt torque	N•M (kgf•M / 1b•H)
	38(3.9/28)

Caution:

Use only new O-rings.

Do not install worn O-rings.



15. Clutch housing

Clutch housing tightening torque	N•M (kgf•M / 1b•H)
Bolt	46(4.7/62.4)

16. Speedometer driving gear

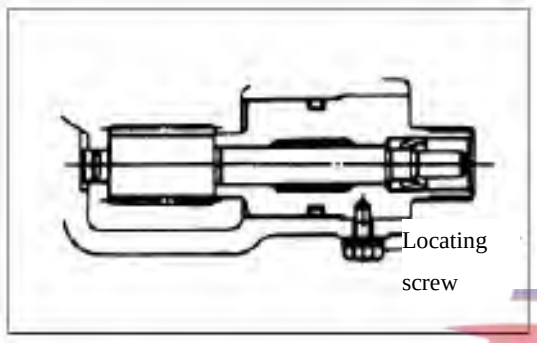
Apply chassis grease on the outer edge of the fuselage.

Pay attention to the direction of installation.

17. Rear cover

1) Tighten the rear cover bolts to the specified torque (the equivalent of the Loctite 242 coating or threaded portion).

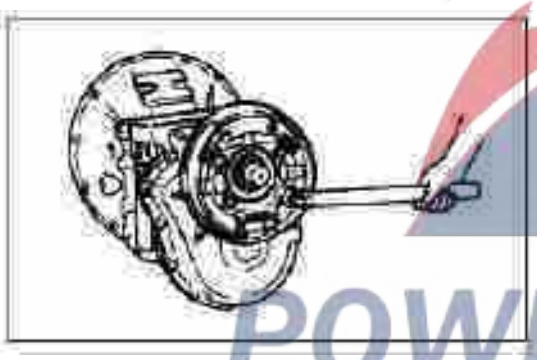
Rear cover tightening torque	N•M (kgf•M / 1b•Ft)
77(7.8/56)	



18. Gear-driven gears, bushings, oil seals and O-rings

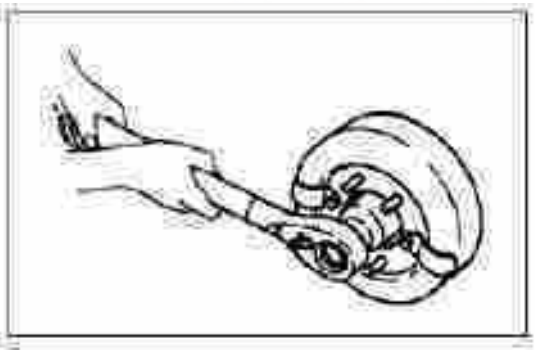
Align the hole in the drive gear set screw and install the gearbox driven gear assembly.

Fixing screw torque	N•M(kgf•Cm/1b•In)
10(100/87)	



19. Parking brake assembly

Parking brake torque N·M (kgf• M / 1b•Ft)
127(12.9/93)



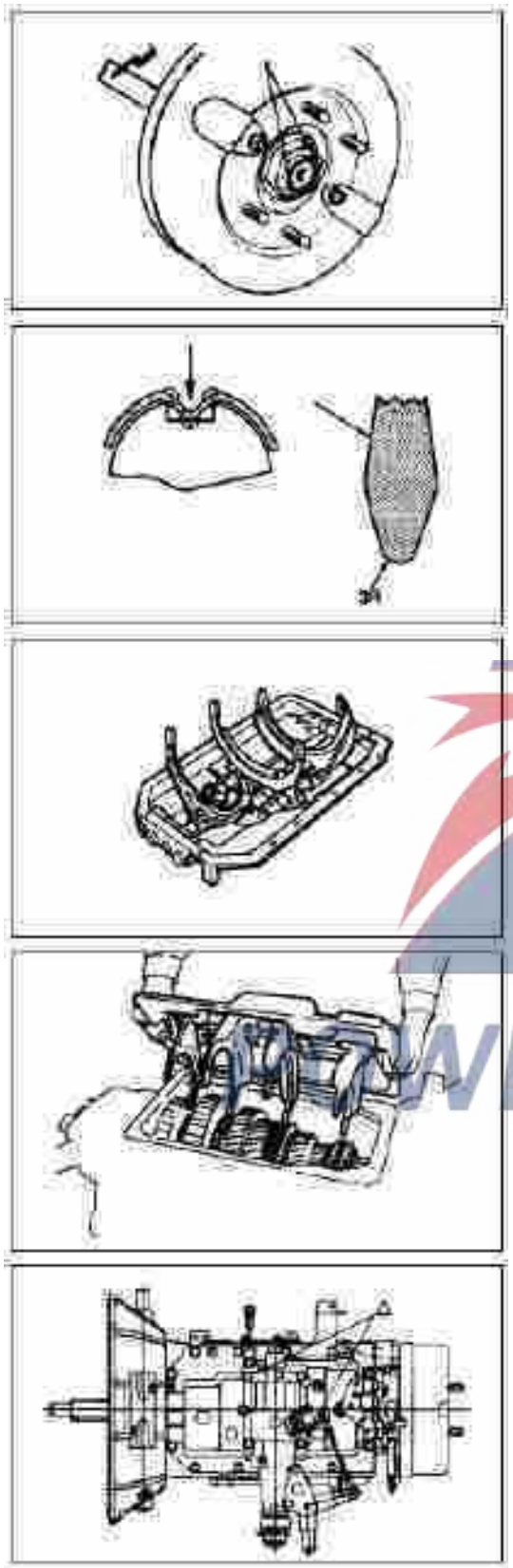
20. Parking brake drum and flange

21. Flange nut and O-ring

1) Tighten the flange nuts to the specified torque.

Torque nut torque	N•M (kgf•M / 1b•Ft)
785(80/579)	

Spanner: 50mm



2) After tightening, lock the nut in the groove of the second shaft.

During the fragmentation process, even if a small crack occurs in the transverse edge of the nut, it is necessary to ensure that the nut and the shoulder of the groove of the second shaft keep in contact with both the shoulder and the groove of the bottom.

22. Lower gearbox cover

1) Apply the recommended liquid sealant (Loctite 17430) or equivalent to the mating face of the upper gearbox assembly.

2) Check if the transmission gear is in the neutral position.

3) Check if the transmission cover fork is in the neutral position.

4) Align both ends with the sleeve.

5) Install the lower cover of the transmission.

6) Fill the gearbox with the specified new gear oil.

Lower gearbox cover

Tightening torque	N•M (kgf•M / 1b•Ft)
36(3.7/27)	

23. Top shift cover assembly

1) Apply the recommended liquid sealant (Loctite 17430) or equivalent to the mating face of the upper gearbox assembly.

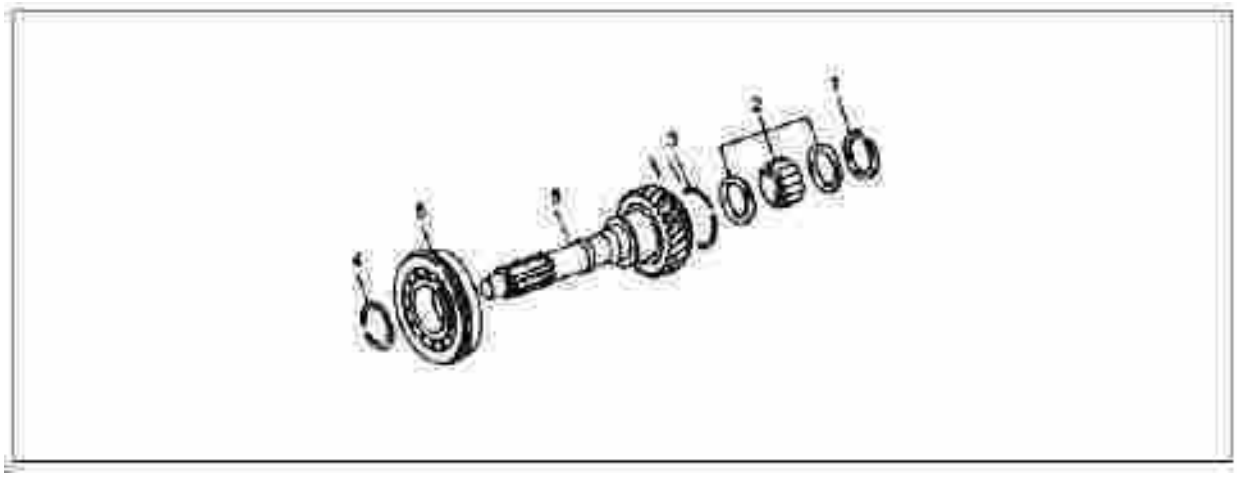
2) Install the close-fitting bolts with (⅄) first and then install the remaining bolts.

Upload cover

Fixed bolt torque	N•m (kgf·M / lb·Ft)
36(3.7/27)	

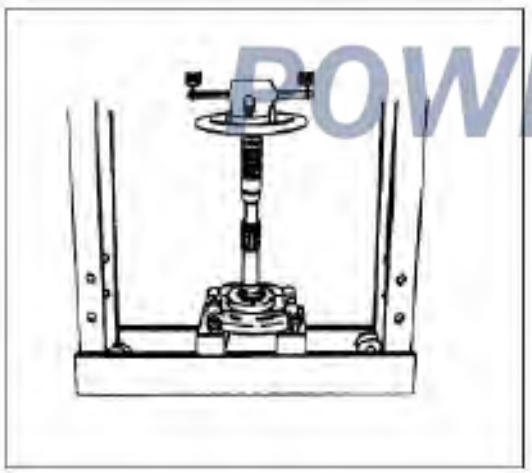
First axis assembly

Disassembling



Disassembling sequence

1. Snap ring
2. 1st shaft front bearing and washer
3. Spring ring
4. Snap ring
5. Bearings
6. 1st shaft



Disassembling sequence

1. Snap ring

2. 1st shaft front bearing and washer

3. Spring ring

4. Snap ring

5. Bearings

Use a horizontal press to remove the bearing.

6. 1st shaft

Inspection and repair

In case of finding excessive wear or damage during checking, carry out necessary adjustment, repair and replacement of parts.

Gear

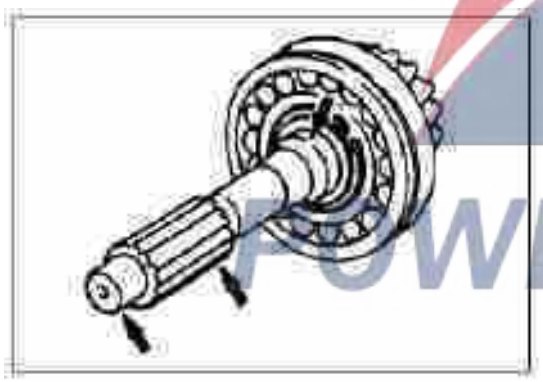
Visually inspect the gear teeth and bearing surfaces for excessive wear or damage.

If excessive wear or damage is found during the inspection, replace the gear.

Axis

Visually inspect the part of the tree.

Check bearing mating surfaces, face, splines and gears for excessive wear and damage.



1st shaft

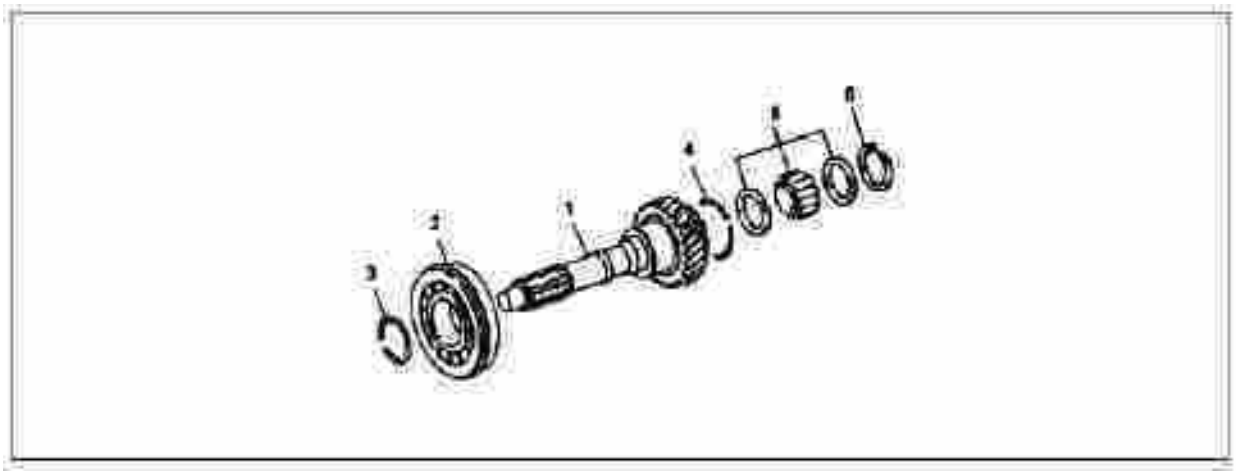
Visually inspect the lip seal faces and splines for excessive wear and deformation.

If excessively worn or deformed, replace the lip seals and splines.

Bearings

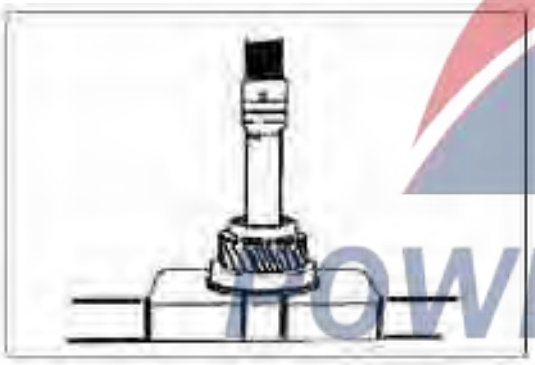
Visually inspect the ball and needle for contact surface wear.

Reassembling



Reassembling sequence

1. 1st shaft
2. Bearings
3. Snap ring
4. Spring ring
5. 1st shaft front bearing and washer
6. Snap ring



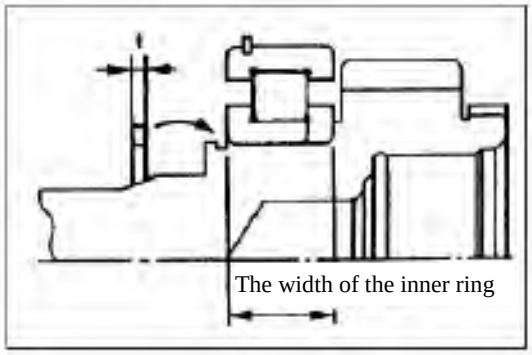
Reassembling sequence

1. 1st shaft

2. Bearings

3. Snap ring

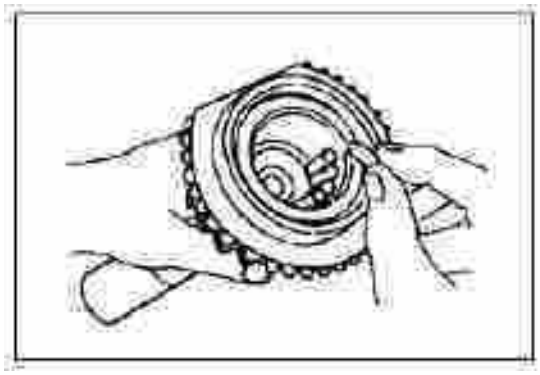
Connect a suitable rod and use a bench press.



Measure the width of the bearing inner ring and select the appropriate spring ring in the table below.

mm (in)

The width of the inner ring	Thickness of elastic ring (t)	Color
About 30.89(1.2146/1.2161)	2.61—2.66 (0.1028—0.1047)	Green
30.89—30.93 (1.2161—1.2177)	2.57—2.62 (0.1012—0.1031)	Blue
30.93—30.97 (1.2177—1.2193)	2.53—2.58 (0.0996—0.1016)	Yellow
30.97—31.00 (1.2193—1.2205)	2.50—2.55 (0.0984—0.1004)	White



4. Spring ring

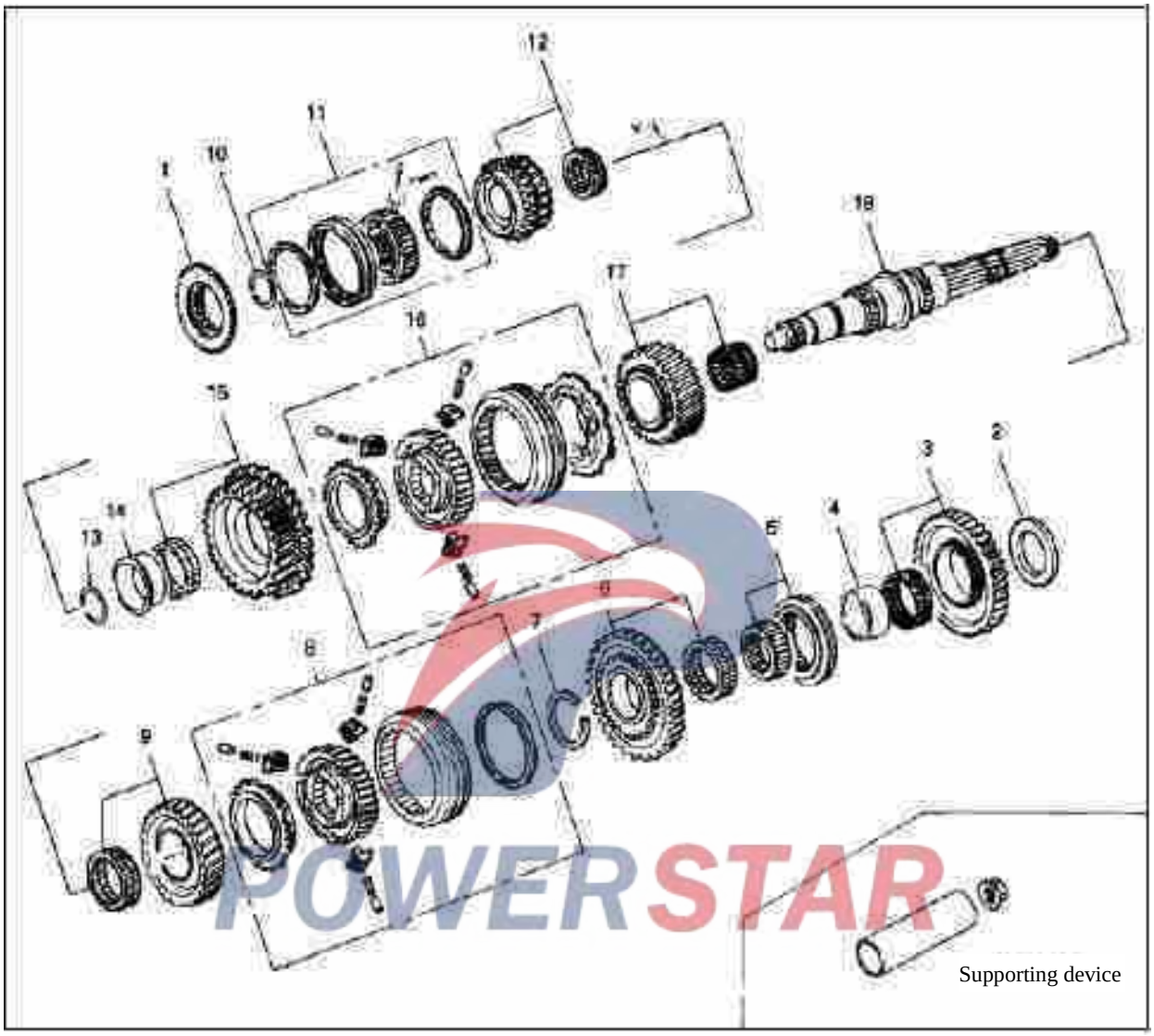
5. 1st shaft front bearing and washer

Lubricate the bearing shell first before installing the needle roller.

6. Snap ring

Second shaft assembly

Disassembling

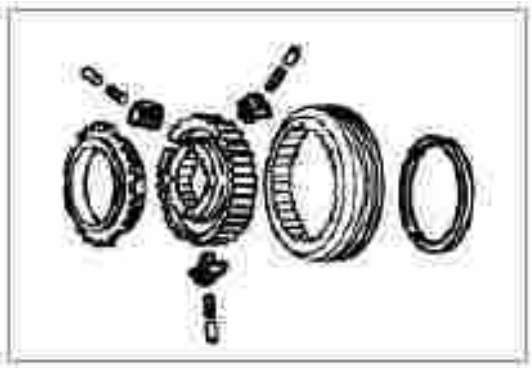


Disassembling sequence

1. Synchronizer clutch
2. Thrust washer
3. Inverter and needle roller bearing
4. Reverse sleeve
5. Reverse gear sleeve and spline hub
6. 1 gear and needle bearing
7. Snap ring
8. 1St and 2nd gear synchronizer assembly
9. 2 gear and needle bearing
10. Snap ring
11. 5th and 6th gear synchronizer assembly
12. 5 gear and needle bearing
13. Snap ring
14. 4 gear sleeve
15. 4 gear and needle bearing
16. 3th and 4th gear synchronizer assembly
17. 3 gear and needle bearing
18. Second shaft

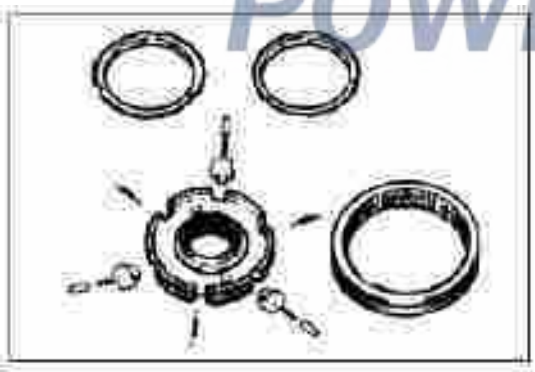
Disassembling sequence

1. Synchronizer clutch
2. Thrust washer
3. Inverter and needle roller bearing
4. Reverse sleeve
5. Reverse gear sleeve and spline hub
6. 1 gear and needle bearing
7. Snap ring
8. 1St and 2nd gear synchronizer assembly



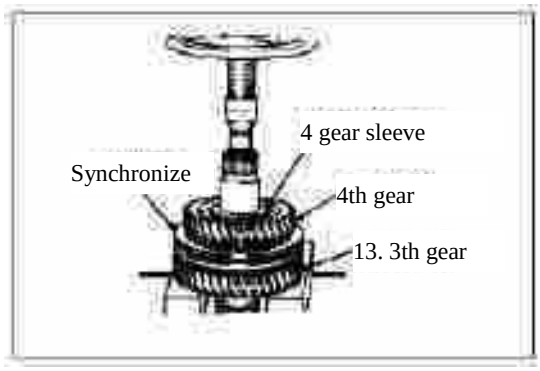
9. 2 gear and needle bearing
10. Snap ring
11. 5th and 6th gear synchronizer assembly

Use a puller to remove the synchronization assembly from the second shaft.



Disconnect synchronous ring assembly, timing ring, spring ring, clamping sleeve, slider, pin, spring and slotted hub.

12. 5 gear and needle bearing
13. Snap ring



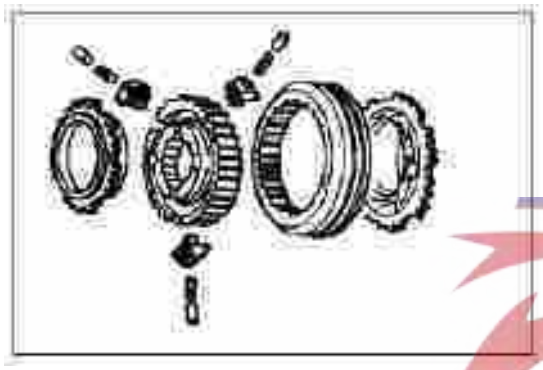
14. 4 gear sleeve

1) Use a lifting device to place the second shaft assembly on a bench press.

2) Remove the 4th bushing, the 4th, the needle bearing, the 3rd and 4th synchronizer, the 3rd gear and the needle bearing with the table.

15. 4 gear and needle bearing

16. 3th and 4th gear synchronizer assembly



17. 3 gear and needle bearing

18. Second shaft

Caution:

The assembly of the second shaft is heavy. If it falls, it may cause serious injury to maintenance personnel.

A bracket is mounted below the second shaft assembly to prevent it from falling.

Inspection and repair

In the event of wear, damage or other abnormal conditions during the inspection, the parts must be adjusted, repaired and replaced.

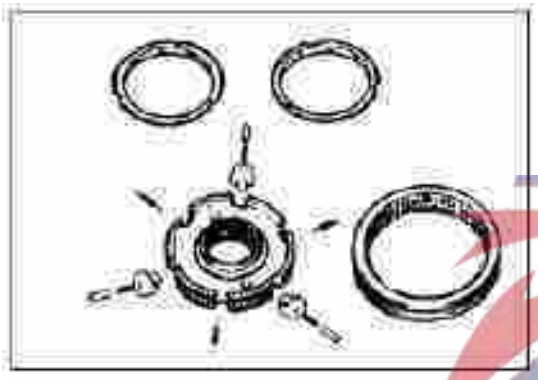
Gear

Visually inspect the gear teeth and bearing surfaces of the drive gear for excessive wear or damage.

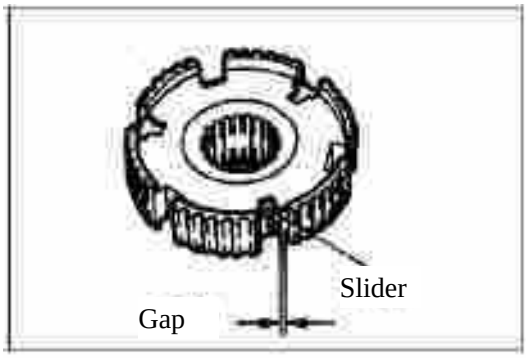
If excessive wear or damage is found during the inspection, replace the gear.

Synchronize

5 gear-6 gear synchronizer (synchronous ring type)



2 gears, 3 gears and 4 gear synchronizers (double cone type)



Spline hub

Visually inspect spline hubs, external splines, and clamps to make sure they are not worn.

If excessive wear is found during the inspection, replace the splined hub.

Measure the clearance between the slider and the spline hub.

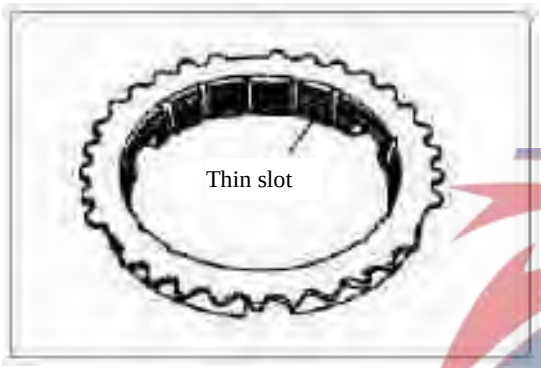
Clearance between slider and spline shaft mm(in)

Standard	Limit
0.1—0.4(0.0039—0.0157)	0.5(0.0197)

Spring slider

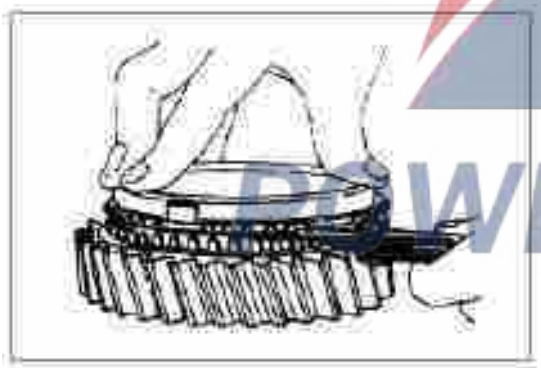
Spring slider free length mm (inches)

19.9(0.784)



Synchronizer ring

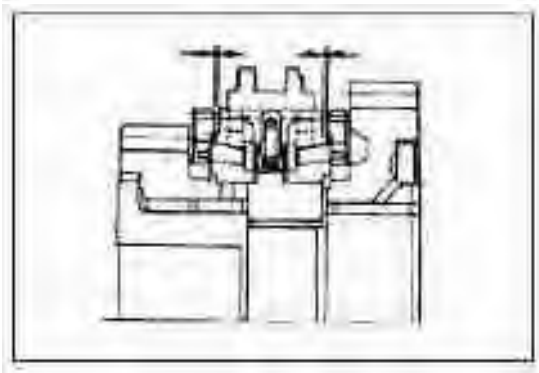
Visually inspect the inner surface of the synchronizer ring for excessive wear.



Measure the gap between the synchronizer ring and the sync taper.

Clearance between sync ring and sync front (mm)(in)

	Standard	Limit
6th - 5th	2.0(0.079)	0



2 gears, 3 gears and 4 gear synchronizers (double cone type)

Measure the gap between the synchronizer cone and the meshing teeth.

If the measured value exceeds the specified limit, the entire synchronizer must be replaced.

Clearance between engagement teeth and synchronizer mm(in)

Standard	Limit
1.5(0.059)	0

Axis

Visually inspect different parts of the shaft.

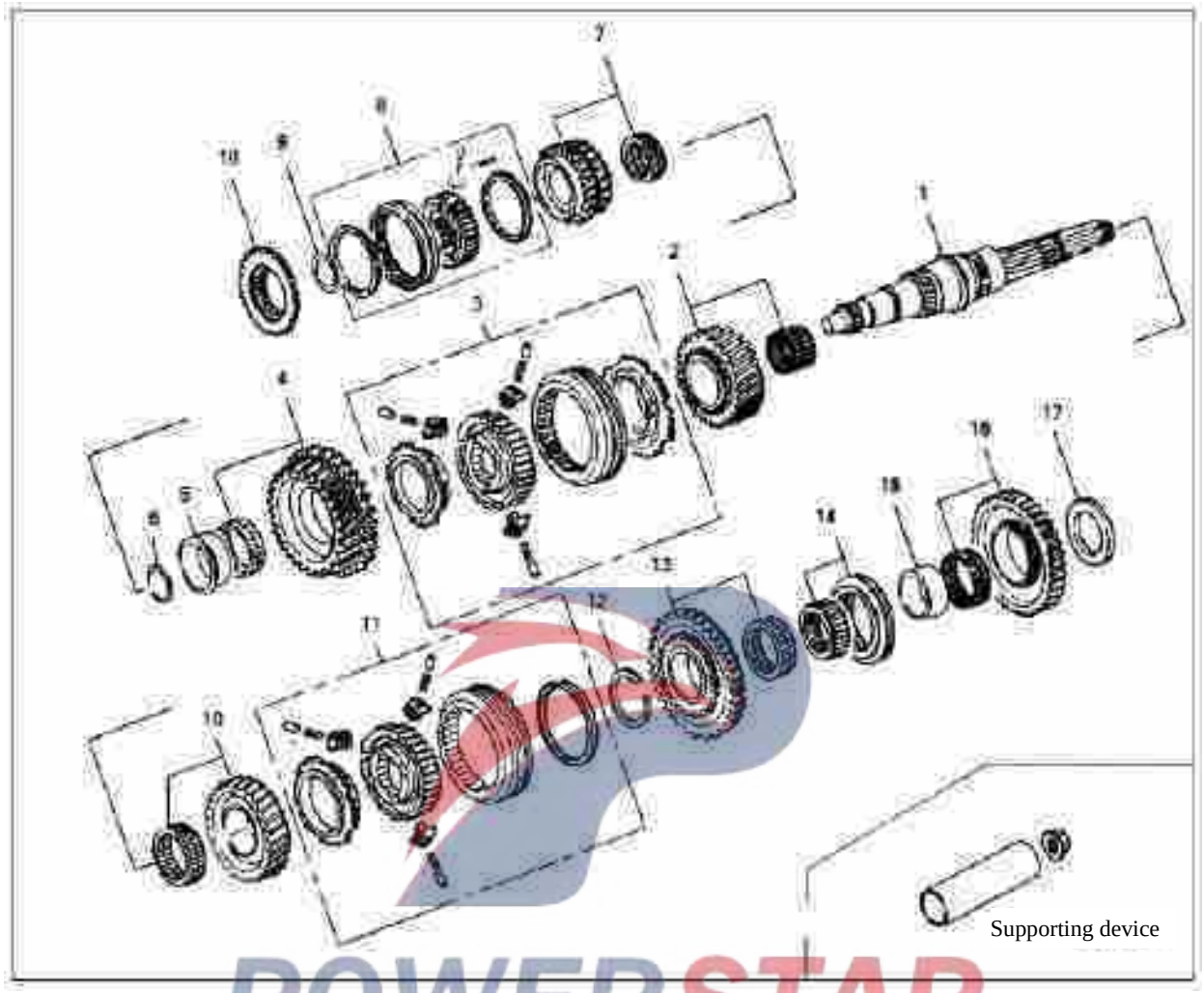
Check bearing mating surfaces, face, splines and gears for excessive wear and damage.

Bearings

Visually inspect the ball and needle for contact surface wear.

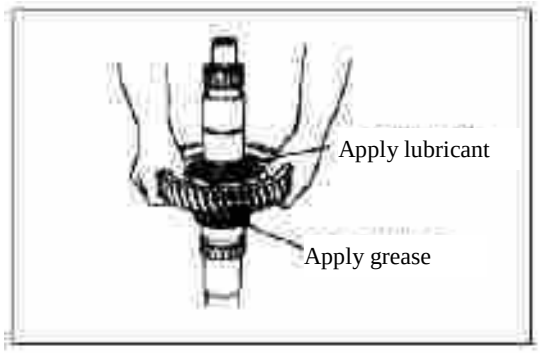
If worn and worn, replace the bearing.

Reassembling



Reassembling sequence

1. Second shaft
2. 3 gear and needle bearing
3. 3rd and 4th gear synchronizer assembly (non-directional clutch)
4. 4 gear and needle bearing
5. 4 gear sleeve
6. Snap ring
7. 5 gear and needle bearing
8. 5th and 6th gear synchronizer assembly (non-directional clutch)
9. Snap ring
10. 2 gear and needle bearing
11. 1st and 2nd gear synchronizer assembly (directional sleeve)
12. Snap ring
13. 1 gear and needle bearing
14. Reverse gear sleeve and spline hub (directional sleeve)
15. Reverse sleeve
16. Inverter and needle roller bearing
17. Thrust washer
18. Synchronizer clutch



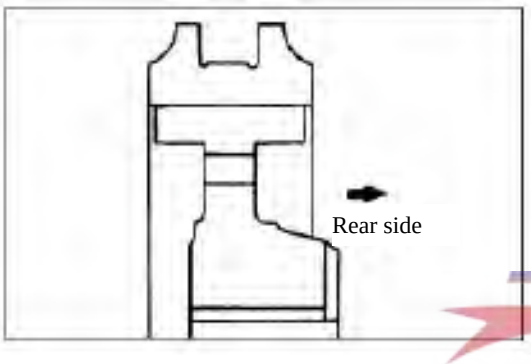
Reassembling sequence

1. Second shaft

2. 3 gear and needle bearing

1) Lubricate the second shaft with transmission oil.

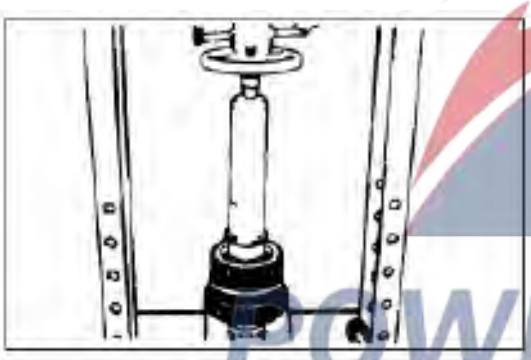
2) Apply grease to needle roller bearings.



3. 3th and 4th gear synchronizer assembly

Install the boss behind the spline hub.

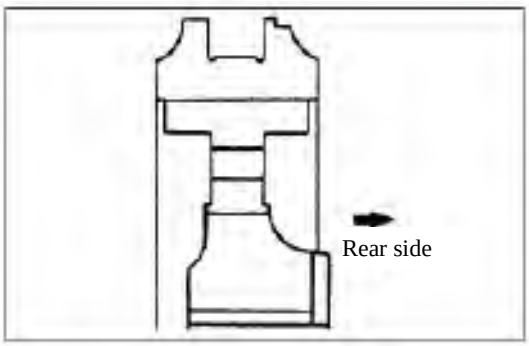
Install the synchronizer component. If you have trouble, tap with a hammer and brass rod.



4. 4 gear and needle bearing

5. 4 gear sleeve

Use proper sleeves and bench presses.



6. Snap ring

7. 5 gear and needle bearing

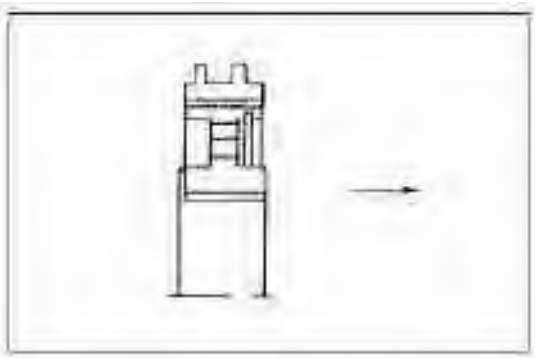
8. 5th and 6th gear synchronizer assembly

Install the spline hub backwards.

Install the synchronizer component. If you have trouble, tap with a hammer and brass rod.

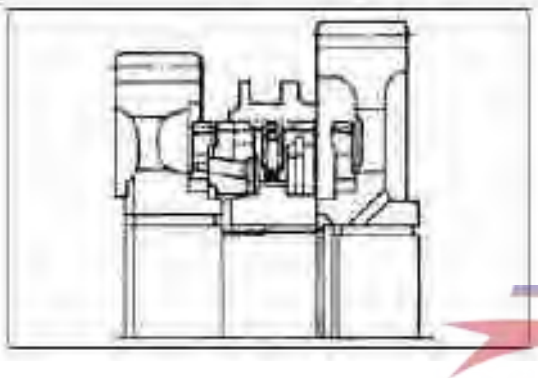
9. Snap ring

10. 2 gear and needle bearing

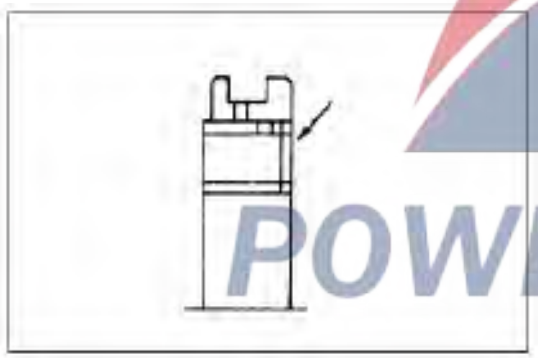


11. 1St and 2nd gear synchronizer assembly

Install the splined hub so that the groove of the snap ring faces backwards.
Install 2th gear synchronizer assembly (double-cone).



12. Snap ring
13. 1 gear and needle bearing

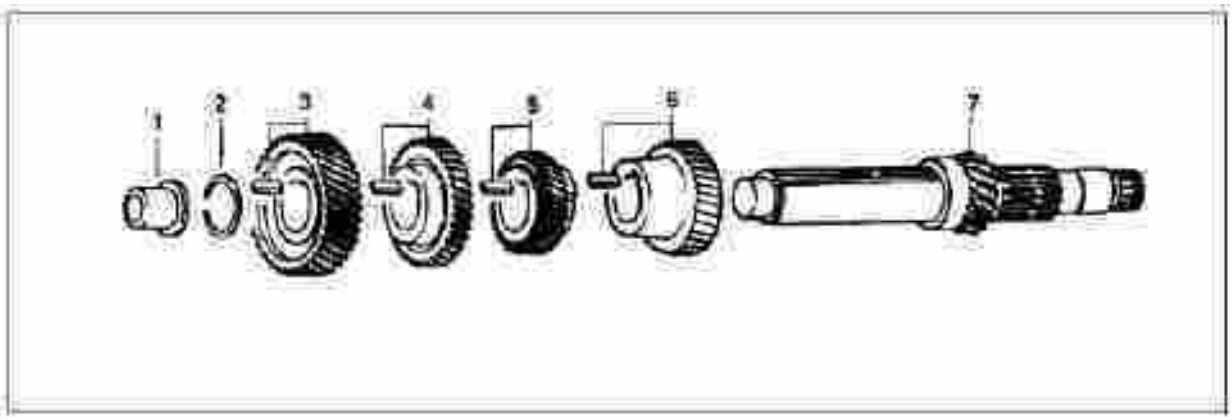


14. Reverse gear sleeve and spline hub
Install the splined hub to rotate the oil sump.

15. Reverse sleeve
16. Inverter and needle roller bearing
17. Thrust washer
18. Synchronizer clutch
Caution:
The assembly of the second shaft is heavy. Be sure to use the crane and cable suspension auxiliary shaft assembly.

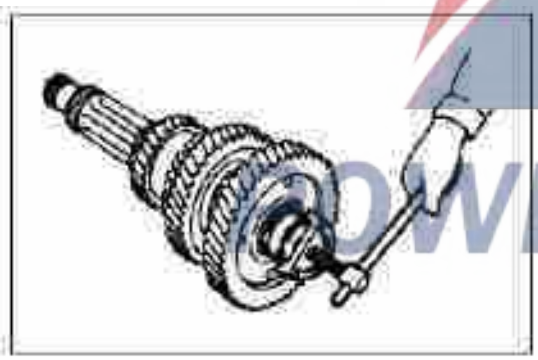
Intermediate shaft assembly

Disassembling



Disassembling sequence

1. Inner bearing ring
2. Snap ring
3. Gears and transmission keys with a constant mesh
4. 5th gear and buttons
5. 4th gear and buttons
6. 3th gear and buttons
7. Intermediate shaft

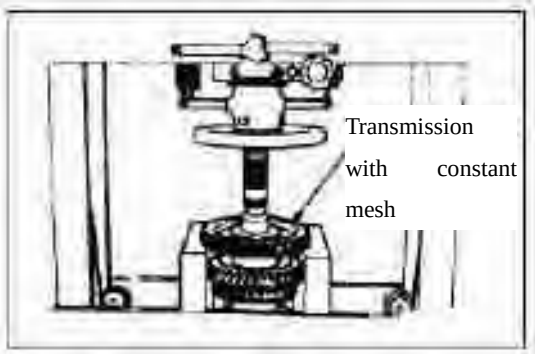


Disassembling sequence

1. Inner bearing ring

Use a bearing remover to remove the inner ring from the bearing.

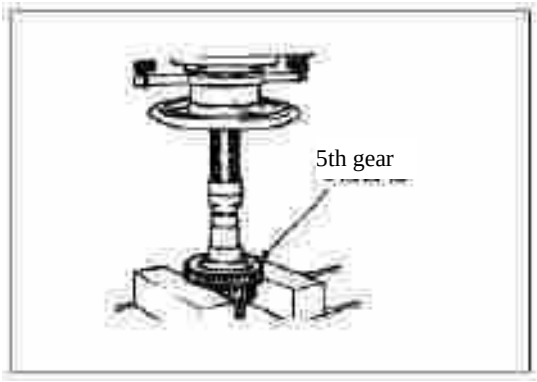
Bearing Remover: 9-8521-0129-0



2. Snap ring

3. Gears and transmission keys with a constant mesh

Use a horizontal press to remove the constant mesh drive gear and intermediate shaft assembly keys.



4. 5th gear and buttons

5. 4th gear and buttons

6. 3th gear and buttons

Use a horizontal press to remove each set of gears and keys.

7. Intermediate shaft

Inspection and repair

In the event of wear, damage or other abnormal conditions during the inspection, adjustments, repairs and replacements must be made.

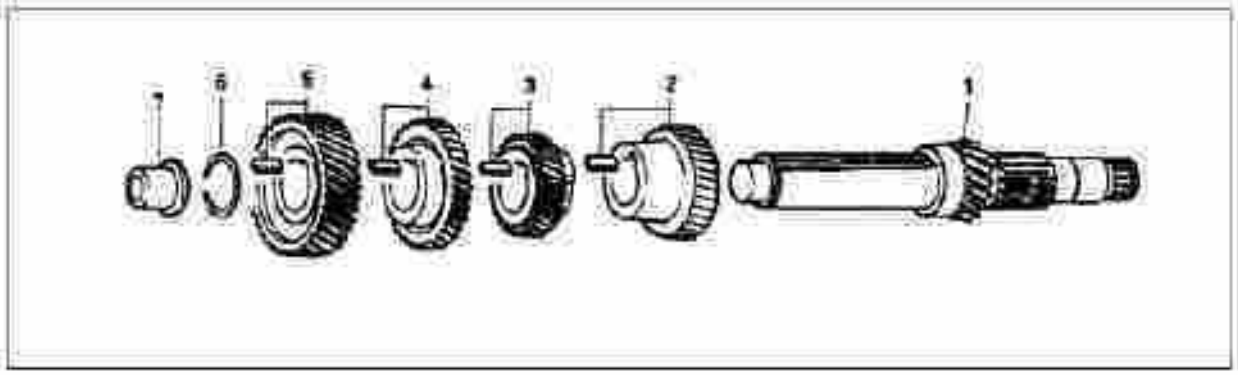
 **Gear**

Visually inspect the gear teeth and bearing surfaces of the drive gear for excessive wear or damage.
If excessive wear or damage is found during the inspection, replace the gear.

 **Axis**

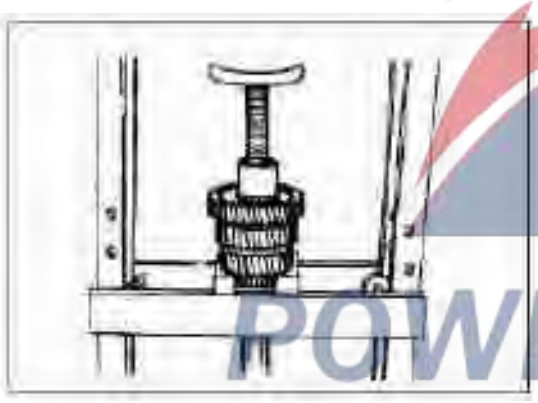
Visually inspect different parts of the shaft.
Check bearing mating surfaces, face, splines and gears for excessive wear and damage.

Reassembling



Reassembling sequence

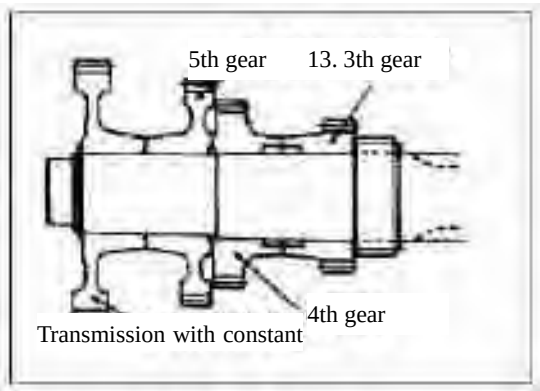
1. Intermediate shaft
2. 3th gear and buttons
3. 4th gear and buttons
4. 5th gear and buttons
5. Gears and transmission keys with a constant mesh
6. Snap ring
7. Inner bearing ring



Reassembling sequence

1. Intermediate shaft
2. 3th gear and buttons
3. 4th gear and buttons
4. 5th gear and buttons
5. Gears and transmission keys with a constant mesh

1) Lubricate the countershaft pin with transmission oil.
2) Use a bench press to place the gear and wrench on the intermediate shaft.



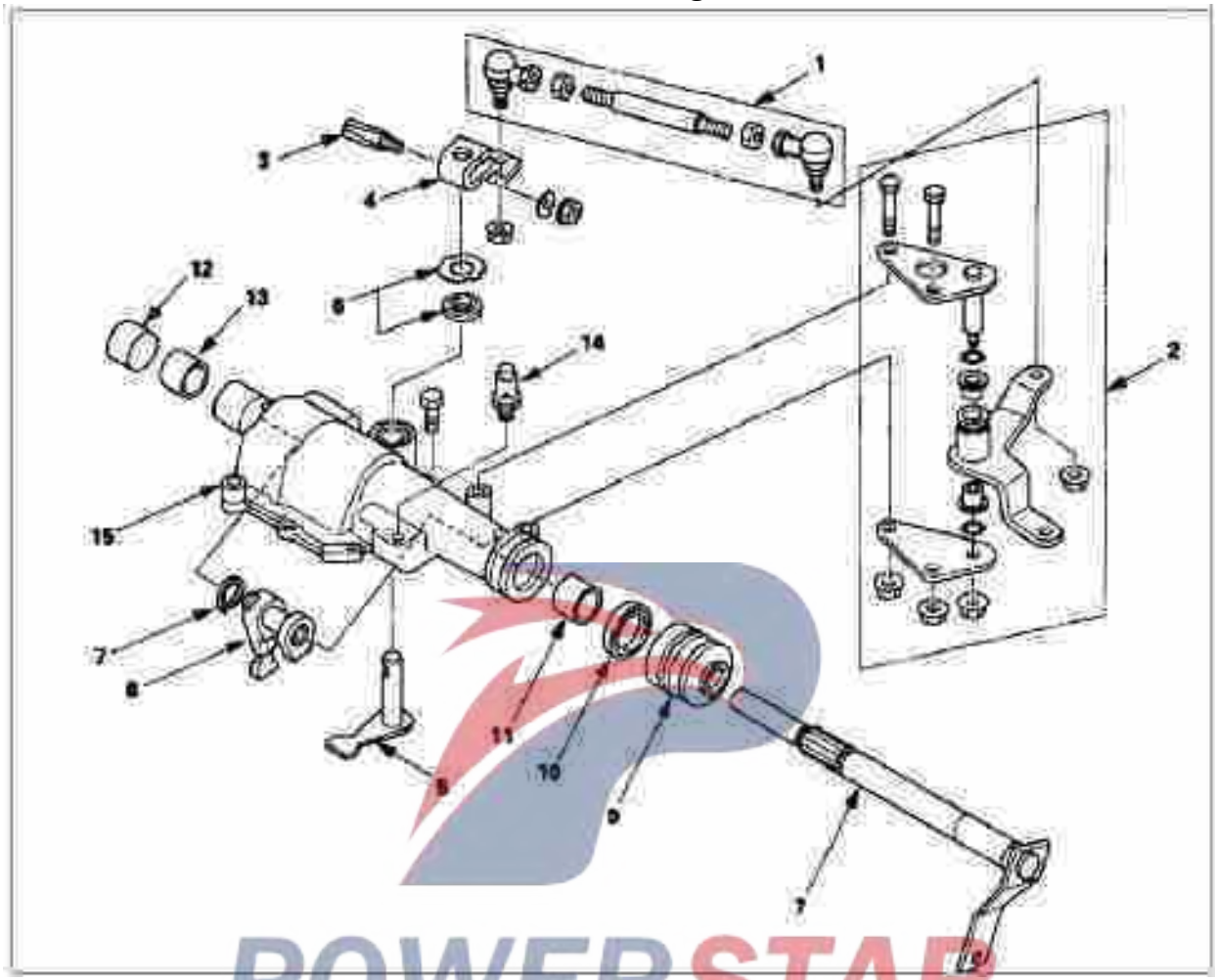
Caution:

The entire middle axis is heavy. Be sure to use a crane and wire rope to hang the second shaft.

6. Snap ring
7. Inner bearing ring

Upload cover assembly

Disassembling



Disassembling sequence

1. Pull rod assembly
2. Relay rod assembly
3. Key bolt
4. Outside the gear shifter
5. Shift lever
6. Gaskets and seals
7. Gear shaft and retaining ring
8. Shift lever
9. Protecting mask
10. Oil seal
11. Bushing
12. Blockage
13. Bushing
14. Vent plug
15. Upload cover

Disassembling sequence

1. Pull rod assembly
2. Relay rod assembly
3. Key bolt
4. Outside the gear shifter
5. Shift lever
6. Gaskets and seals
7. Gear shaft and retaining ring

Remove the snap ring from the snap ring groove on the shifter shaft and remove the shifter shaft.

8. Shift lever
9. Protecting mask
10. Oil seal
11. Bushing
12. Blockage
13. Bushing
14. Vent plug
15. Upload cover

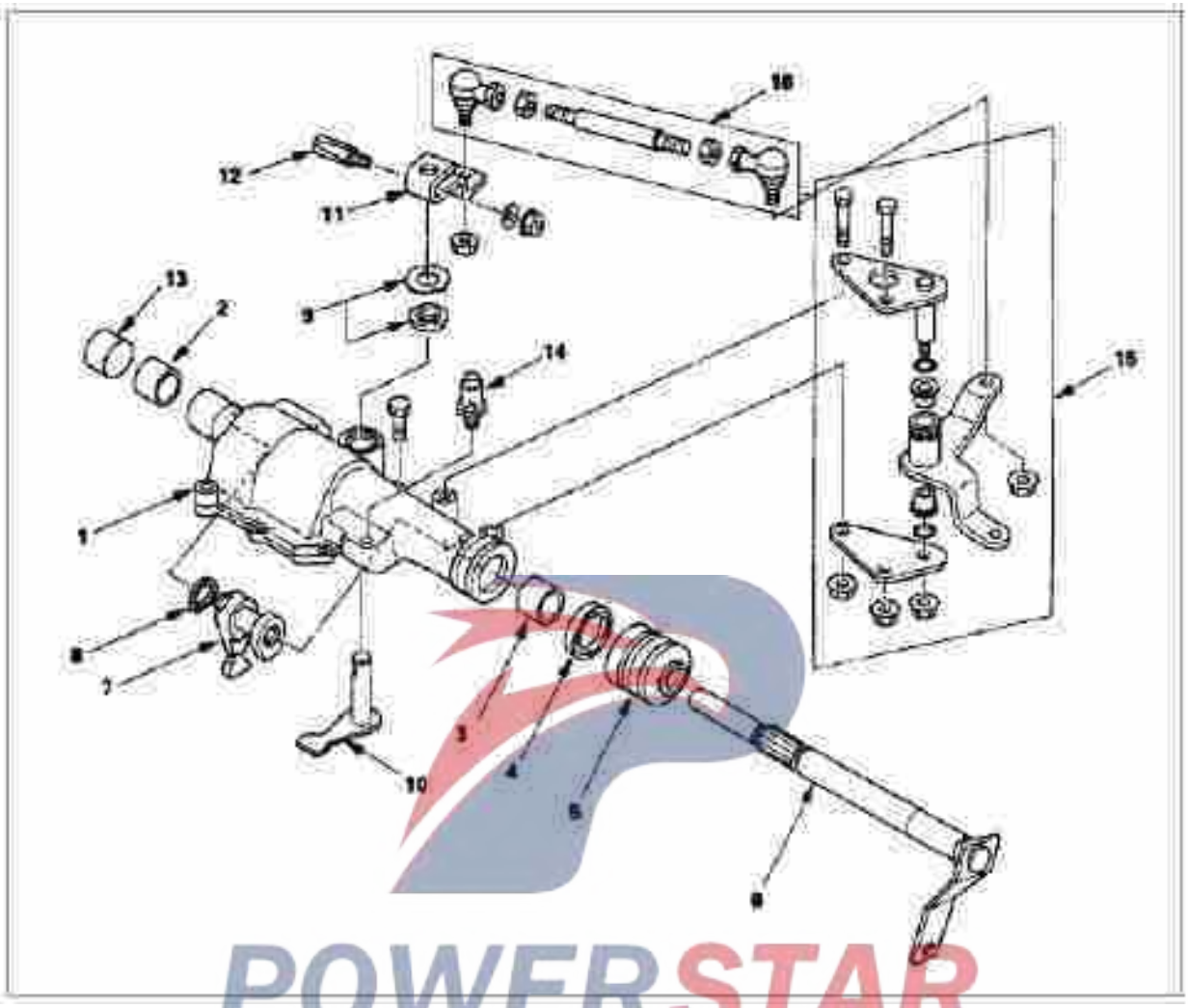
Inspection and repair

If any wear, damage, or other abnormalities are found during the inspection, repair or replace the parts.

Visual inspection

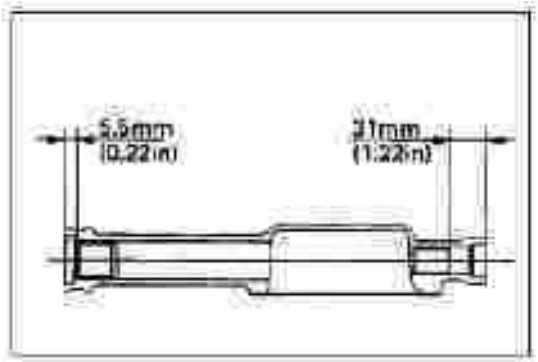
Inspect all damaged parts for wear, damage, or other abnormalities.

Reassembling



Reassembling sequence

1. Upload cover
2. Bushing
3. Bushing
4. Oil seal
5. Protecting mask
6. Shift shaft
7. Shift lever
8. Snap ring
9. Gaskets and seals
10. Inner lever position
11. Outpost position
12. Key bolt
13. Blockage
14. Vent plug
15. Relay rod assembly
16. Pull rod assembly



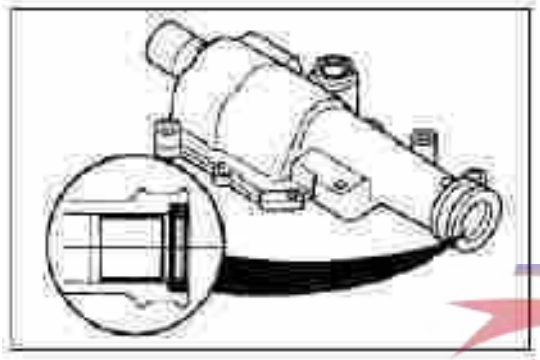
Reassembling sequence

1. Upload cover

2. Bushing

3. Bushing

Use a suitable lever to hold the socket and install it as shown.



4. Oil seal

Install the oil seal as shown.

5. Protecting mask

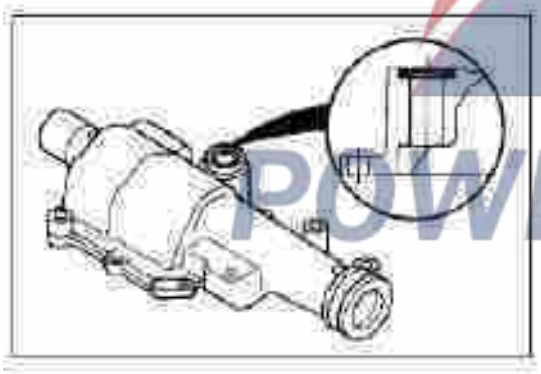
6. Shift shaft

7. Shift lever

8. Snap ring

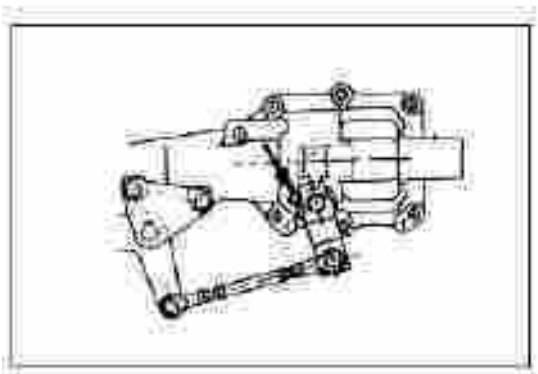
9. Gaskets and seals

Install the oil seal as shown.



10. Shift lever

11. Outside the gear shifter



12. Key bolt

Bolt Tightening Torque	N•M(kgf•Cm / 1b•In)
	13(130/113)

13. Blockage

14. Vent plug

15. Relay rod assembly

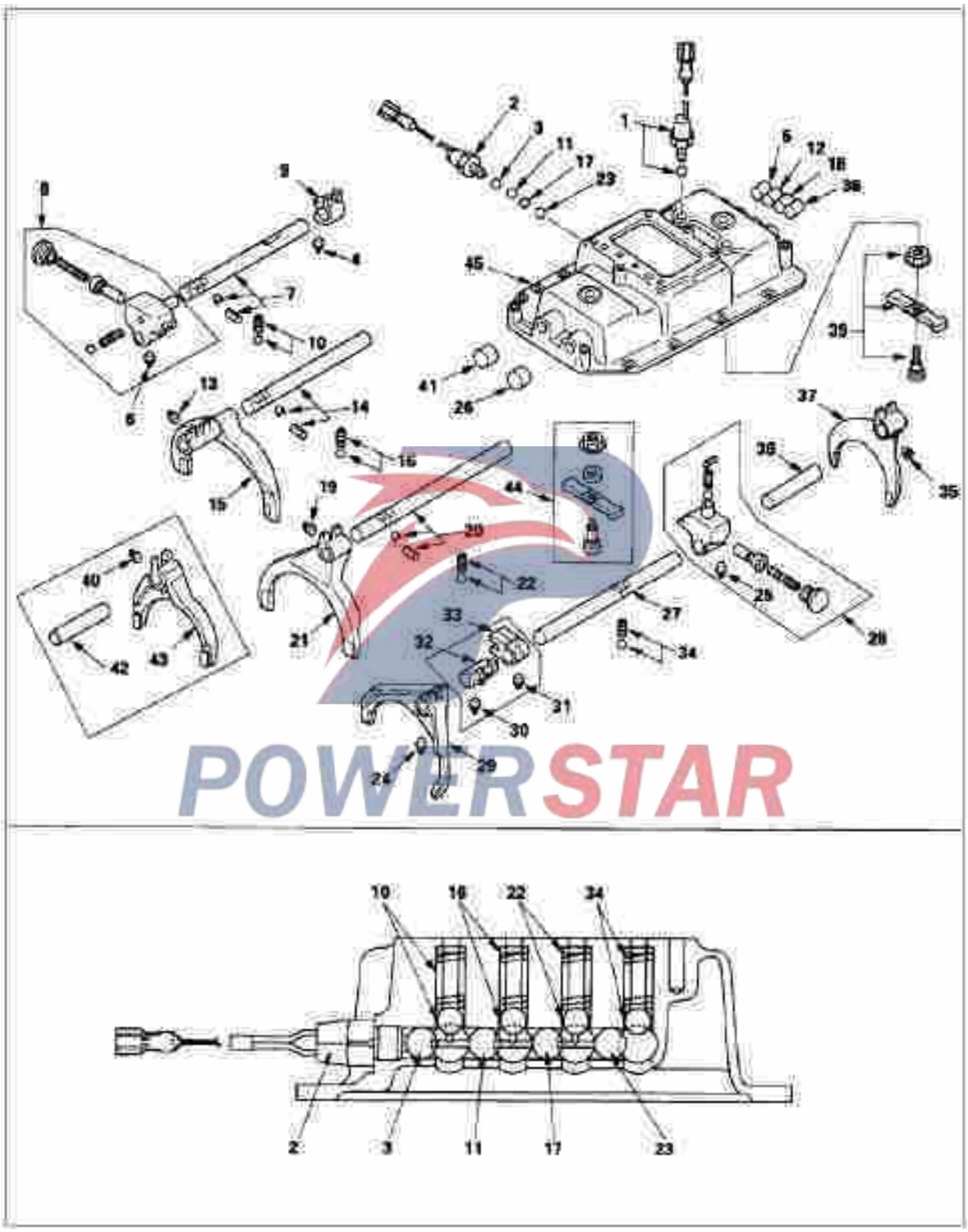
Bolt torque	N•M(kgf•Cm / 1b•In)
36(3.7/27)	

16. Pull rod assembly

Nut torque	N•M(kgf•Cm / 1b•In)
13(130/113)	

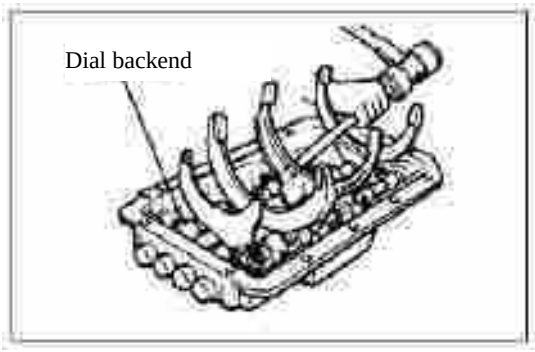
Lower gearbox cover

Disassembling



Disassembling sequence

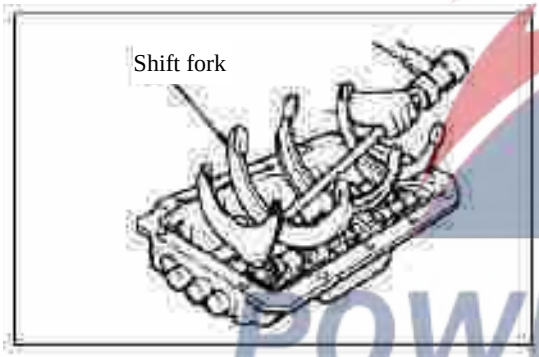
1. Reversing light switch, steel balls, and seals pad
2. Neutral switch and seal pad
3. Interlocking steel ball
4. Cone screws
5. Blockage
6. Cone screws
7. Inverted fork shaft, locking pin and spring pin
8. Reverse block assembly
9. Reverse dial rear end
10. Self-locking steel ball and spring
11. Interlocking steel ball
12. Blockage
13. Cone screws
14. 1st - 2nd gear fork shaft, locking pin and spring pin
15. 1st – 2nd gear fork
16. Self-locking steel ball and spring
17. Interlocking steel ball
18. Blockage
19. Cone screws
20. 3rd - 4th gear fork shaft, locking pin and spring pin
21. 3th –4th gear fork
22. Self-locking steel ball and spring
23. Interlocking steel ball
24. Cone screws
25. Cone screws
26. Blockage
27. 5th gear - 6th gear shaft
28. Shift block A
29. 5th gear – 6th gear shift fork A (DD6)
30. Cone screws(OD6)
31. Cone screws(OD6)
32. Shift block B(OD6)
33. Shift block C(OD6)
34. Self-locking steel ball and spring
35. Cone screws
36. Blockage
37. Reverse fork
38. Rear fork shaft
39. Gear lever, shaft pin, washer and nut
40. Cone screws(OD6)
41. Blockage
42. 5th gear – 6th gear shift fork shaft B(OD6)
43. 5th gear – 6th gear shift fork B(OD6)
44. 5th-6th gear shift levers, shaft pins, washers and nuts
45. Lower gearbox cover



Disassembling sequence

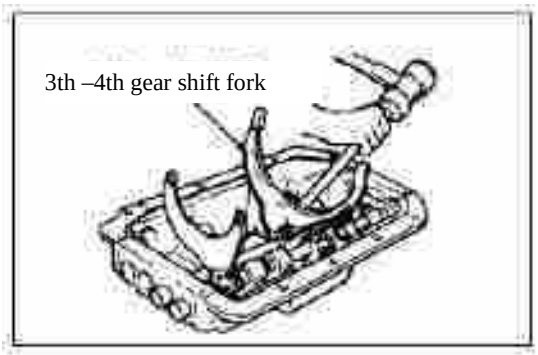
1. Reversing light switch, steel balls, and seals pad
2. Neutral switch and seal pad
3. Interlocking steel ball
4. Cone screws
5. Blockage
6. Cone screws
7. Inverted fork shaft, locking pin and spring pin
8. Reverse block assembly
9. Reverse dial rear end

1) Remove the single cone screw from the rear end of the reverse stopper.
2) Using a copper rod, hold the reverse block assembly and press the copper rod to move the fork shaft until the fork shaft locks.
3) Remove the cone screw from the reverse gear set.
4) Remove the fork shaft with the locking pin.
5) Remove the entire reverse block.
6) Remove the rear end of the reversal plate.



10. Self-locking steel ball and spring
11. Interlocking steel ball
12. Blockage
13. Cone screws
14. 1st - 2nd gear fork shaft, locking pin and spring pin
15. 1st – 2nd gear fork

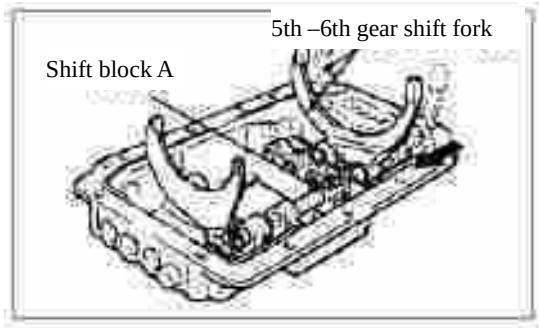
1) Fix the fork with a copper rod, press the copper rod to move the fork shaft, and remove the fork shaft plug.
2) Remove the taper screw from the fork.
3) Remove the fork shaft with the locking pin.
4) Remove the first and second gear shift forks.

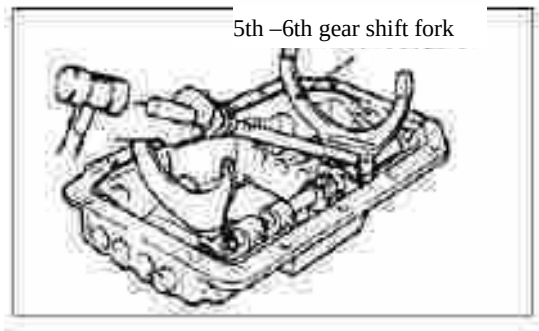


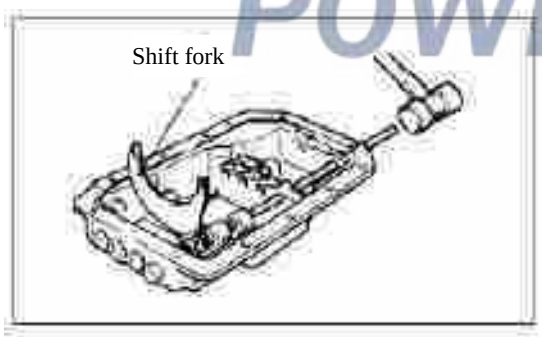
16. Self-locking steel ball and spring
17. Interlocking steel ball
18. Blockage
19. Cone screws
20. 3rd - 4th gear fork shaft, locking pin and spring pin
21. 3rd-4th shift fork

1) Fix the fork with a copper rod, press the copper rod to move the fork shaft, and remove the fork shaft plug.

22. Self-locking steel ball and spring
23. Interlocking steel ball







24，25. Cone screws

26. Blockage

27. 5th –6th gear shift fork shaft A

28. Shift block A

29. 5th –6th gear shift fork A(DD6)

1) Remove the cone screw from the fork.

2) Push the dial A with a copper rod and press the rod to move the fork shaft (forward).

3) Move the fork until the block B (OD6) is installed, then use a conical screw to fix the fork.

4) Remove the conical screw from the A-plate, fix the fork lever with copper rod, and press the copper rod to move the fork shaft until the fork shaft is completely locked.

5) Remove the cone screw from the fork.

6) Remove the fork shaft, block A and fork.

30，31. Cone screws

32. Shift block B(OD6)

33. Shift block C(OD6)

1) Remove the countersunk screws on block B and C.

2) Push the dial A with a copper rod and press the rod to move the fork shaft (forward).

3) Move the module C until the module B is connected, then use the taper screw to fix the module C.

4) Remove the conical screw from the A plate, support the C plate with a copper rod, and press the copper rod to move the fork shaft until the fork shaft is completely locked.

5) Remove the conical screw on dial C.

6) Remove the fork shaft, block A ,B and C.

34. Self-locking steel ball and spring

35. Cone screws

36. Blockage

37. Reverse fork

38. Rear fork shaft

Remove the cone screw from the fork, fix the fork shaft in the 5th and 6th positions with a copper rod, and then press the fork shaft down. At the same time, remove the plug from the fork shaft.

39. Gear lever, shaft pin and nut

40. Cone screws(OD6)

41. Blockage

42. 5th – 6th gear shift block B(OD6)

43. 5th – 6th gear shift block B(OD6)

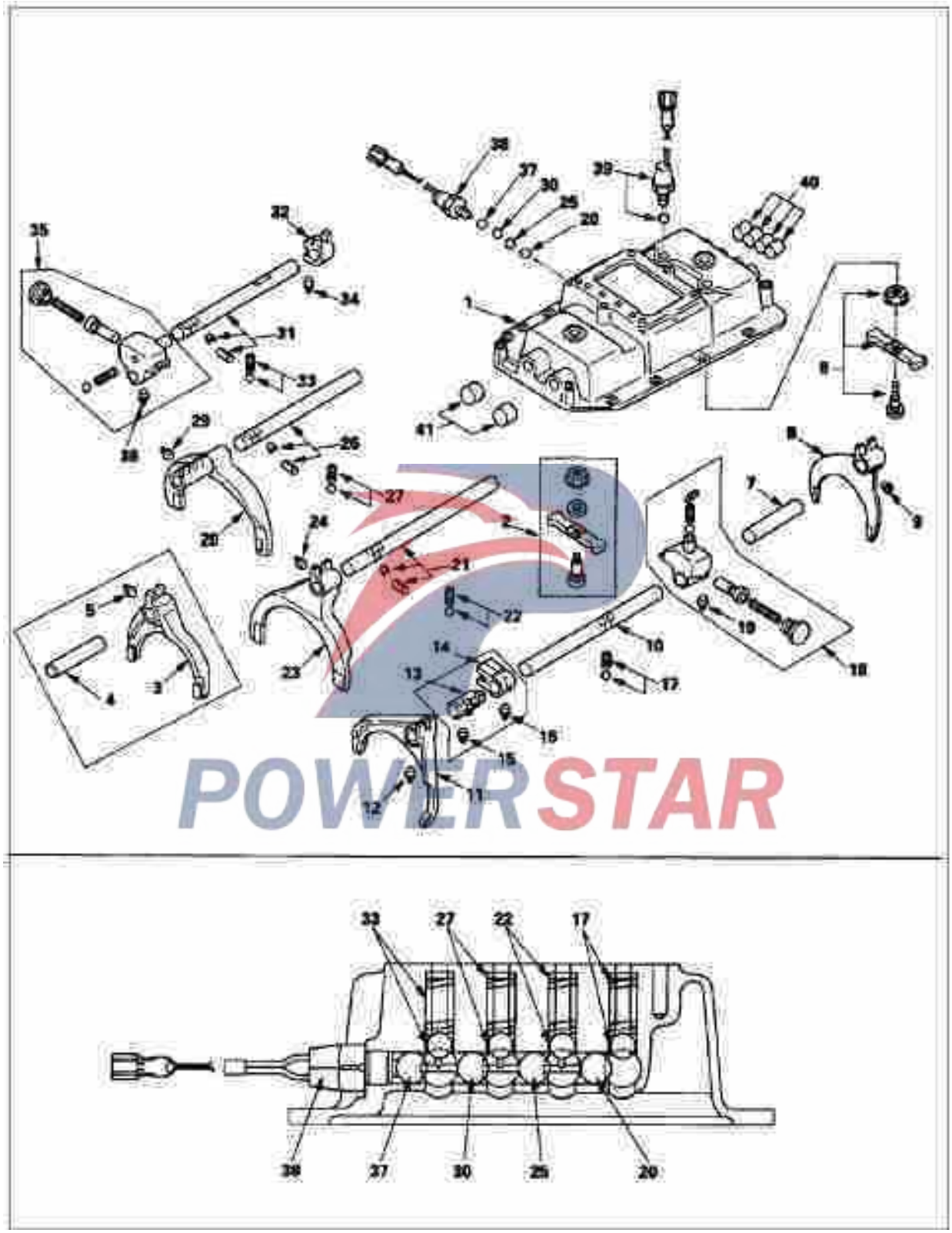
Remove the cone screw from the fork, fix the fork shaft between the 5th and 6th gear with a copper rod, and press to pull the fork axially forward.

At the same time, remove the plug from the fork shaft.

44. 5th-6th gear shift levers, shaft pins and nuts

45. Lower gearbox cover

Reassembling



Reassembling sequence

1. Lower gearbox cover
2. 5th-6th gear shift levers, shaft pins, washers
3. 5th – 6th gear shift block B(OD6)
4. 5th gear – 6th gear shift fork shaft B(OD6)
5. Cone screws(OD6)
6. Gear lever, shaft pin, washer and nut
7. Rear fork shaft
8. Reverse fork
9. Cone screws
10. 5th gear - 6th gear shaft
11. 5th gear – 6th gear shift fork A (OD6)
12. Cone screws
13. 5th gear – 6th gear dial C block (OD6)
14. 5th – 6th gear shift block B(OD6)
15. Cone screws(OD6)
16. Cone screws(OD6)
17. Self-locking steel ball and spring
18. Shift block A
19. Cone screws
20. Interlocking steel ball
21. 3rd - 4th gear fork shaft, locking pin and spring pin
22. Self-locking steel ball and spring
23. 3th –4th gear fork
24. Cone screws
25. Interlocking steel ball
26. 1st - 2nd gear fork shaft, locking pin and spring pin
27. Self-locking steel ball and spring
28. 1st – 2nd gear fork
29. Cone screws
30. Interlocking steel ball
31. Inverted fork shaft, locking pin and spring pin
32. Reverse dial rear end
33. Self-locking steel ball and spring
34. Cone screws
35. Reverse block assembly
36. Cone screws
37. Interlocking steel ball
38. Neutral switch and seal pad
39. Reversing light switch, steel balls, and seals pad
40. Blockage
41. Blockage

Reassembling sequence

1. Lower transmission cover

Lubricate the sliding surface of the lower transmission cover with transmission oil.

2. 5th-6th gear shift levers, shaft pins and nuts(OD6)

Nut torque	N•M (kgf•M / 1b•Ft)
62(6.3 / 46)	

3. 5th – 6th gear shift block B(OD6)

4. 5th gear – 6th gear shift fork shaft B(OD6)

5，9，12，15，19，24，29，34，36. Cone screws

Tighten the screws to the specified torque.

Conical screw torque	N•M (kgf•M / 1b•Ft)
47(4.8 / 35)	

Caution:

When installing the fork and fork in the threaded part of the fork shaft

Apply Loctite 242 or equivalent.

6. Gear lever, shaft pin and nut

Nut torque	N•M (kgf•M / 1b•Ft)
62(6.3 / 46)	

7. Rear fork shaft

8. Reverse fork

10. 5th gear - 6th gear shaft

11. 5th gear – 6th gear shift fork A (OD6)

13. 5th gear – 6th gear dial C block (OD6)

14. 5th – 6th gear shift block B(OD6)

17，22，27，33. Self-locking steel ball and spring

1) Press the automatic lock ball with a screwdriver.

2) Insert the fork shaft into the hole of the fork shaft.

18. Shift block A

20. Interlocking steel ball

21. 3rd - 4th gear Shift fork shaft, locking pin and spring pin

23. 3th –4th gear fork

25. Interlocking steel ball

26. 1st - 2nd gear Shift fork shaft, locking pin and spring pin

28. 1st – 2nd gear fork

30. Interlocking steel ball

31. Inverted fork shaft, locking pin and spring pin

32. Reverse dial rear end

35. Reverse block assembly

37. Interlocking steel ball

38. Neutral switch and seal pad

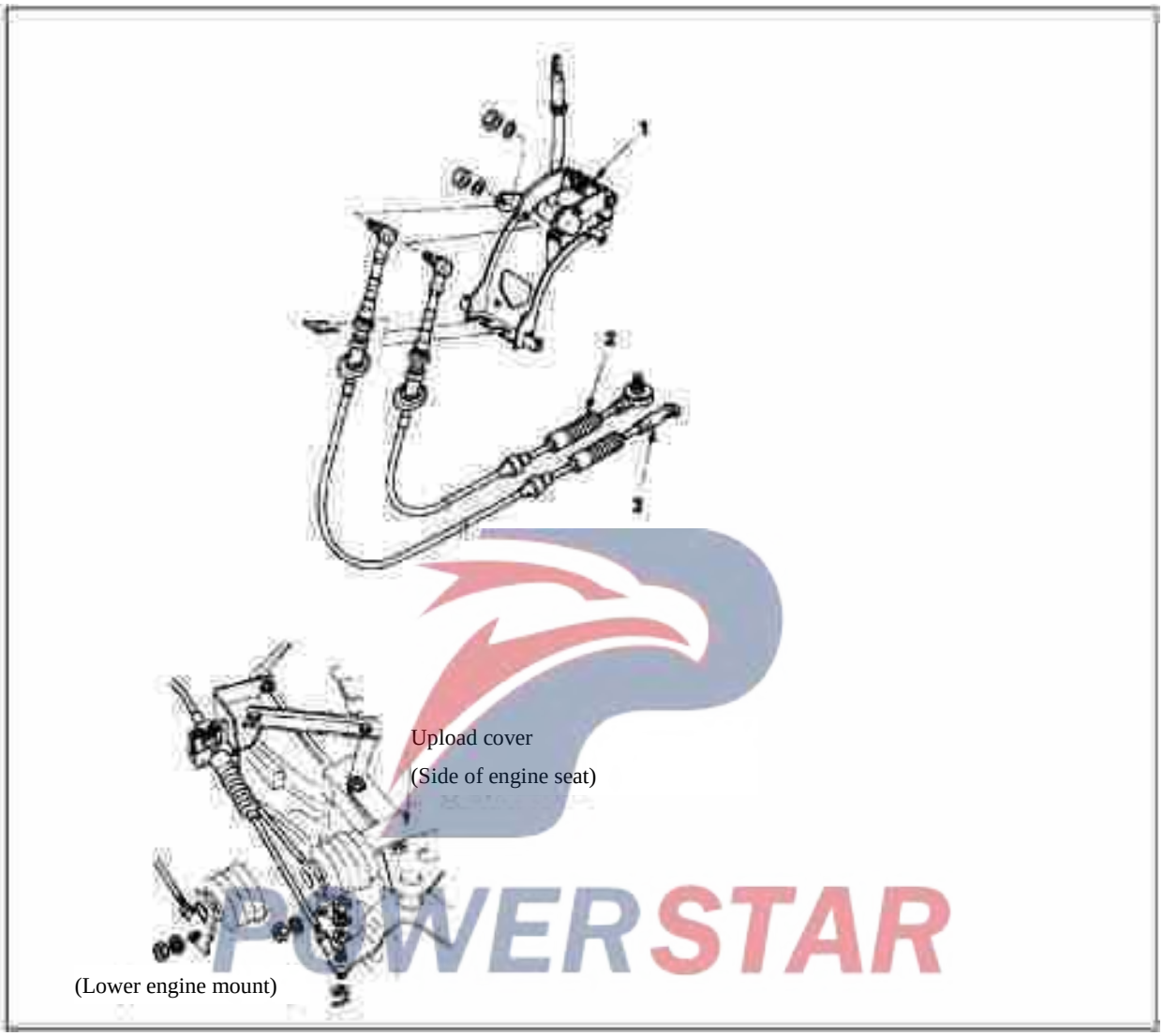
39. Reversing light switch, steel balls, and seals pad

40，41. Blockage

Apply Loctite 242 or equivalent.

Processing parts

Disassembly



Dismantling sequence

1. Gear lever assembly
2. Cable offset
3. Select cable assembly
4. Support

Dismantling sequence

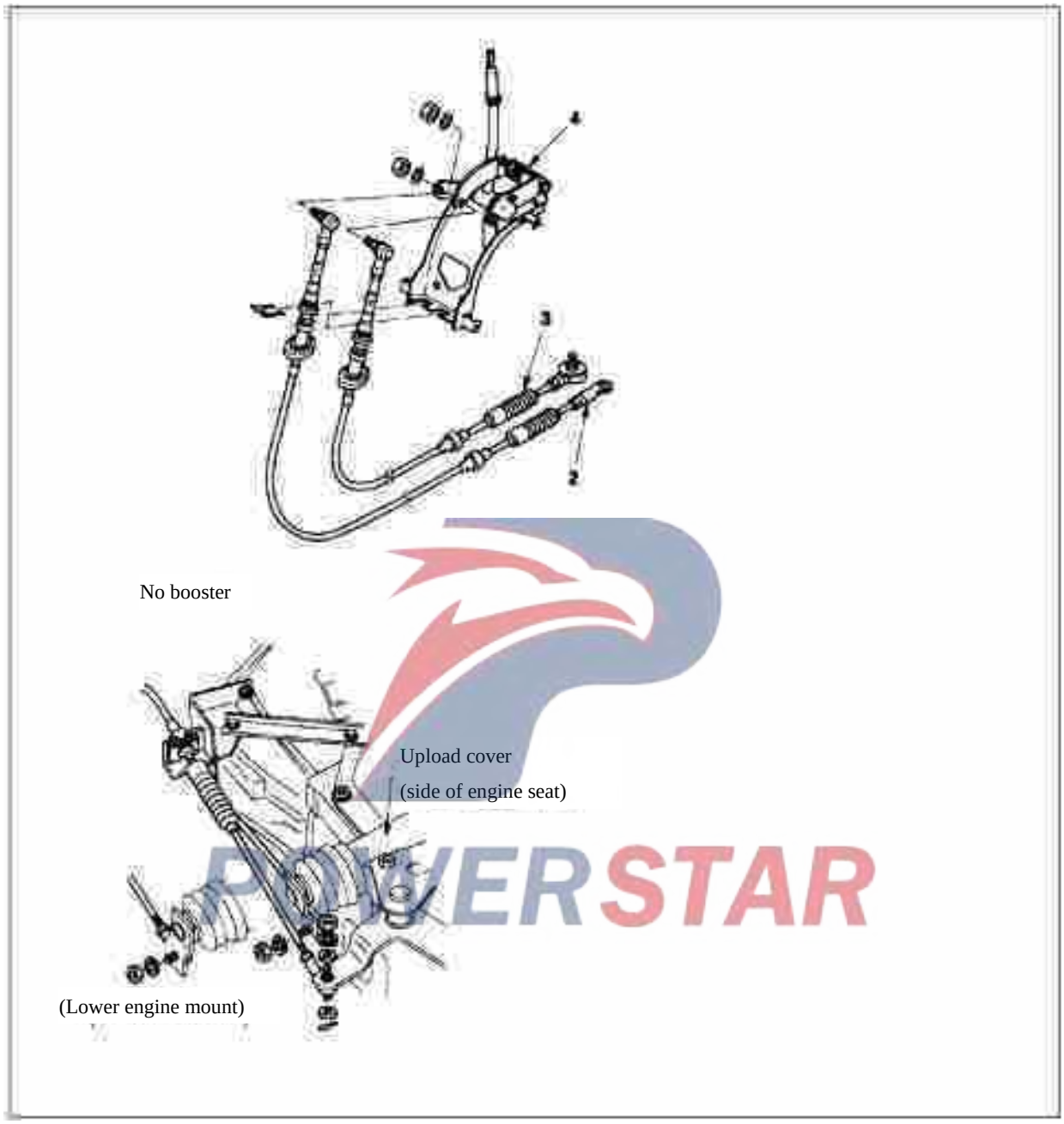
1. Gear lever assembly

2. Cable offset

3. Select cable assembly

4. Support

Assembling

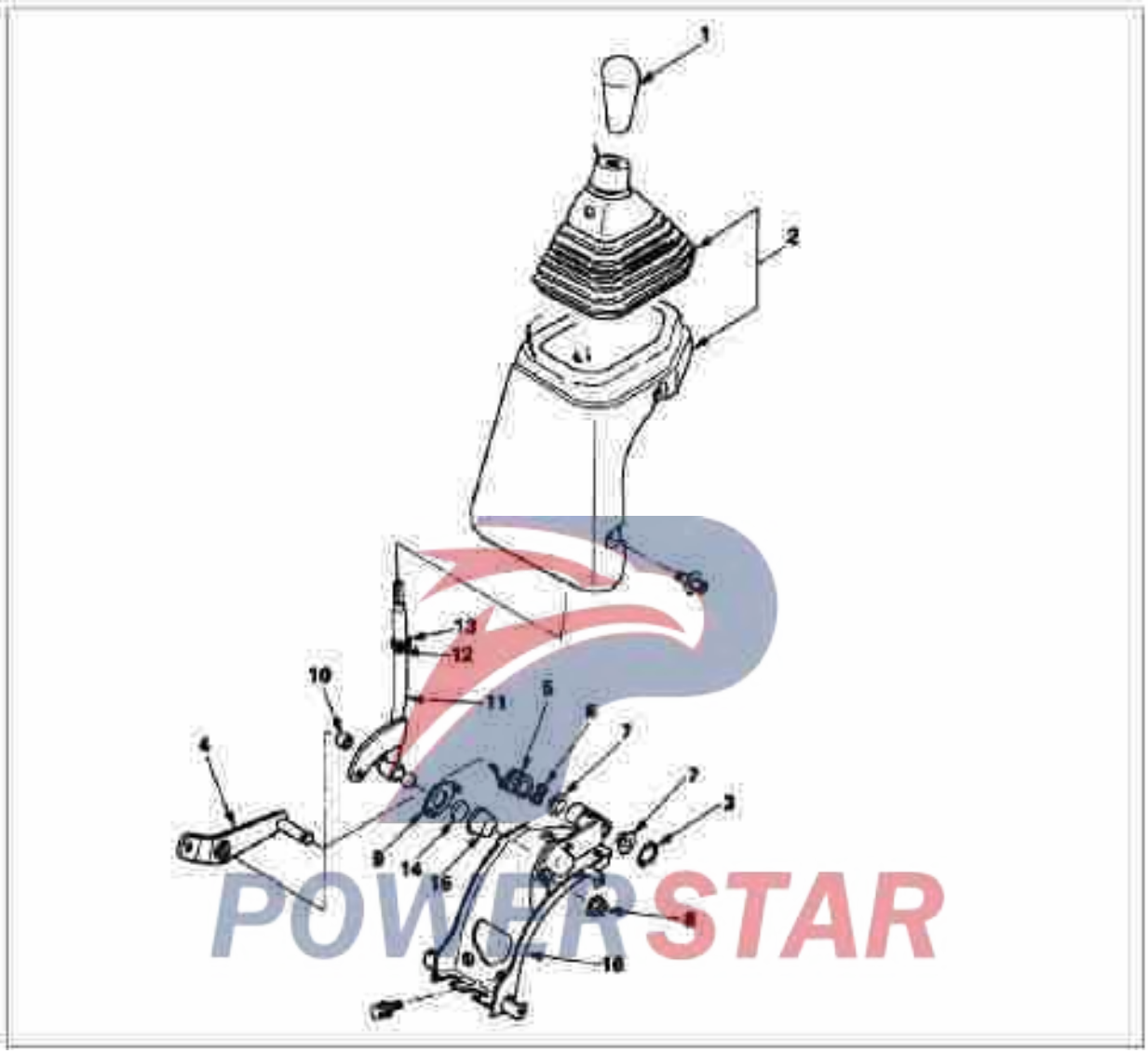


Assembling sequence

1. Support
2. Select cable assembly
3. Cable offset
4. Gear lever assembly

Gear lever assembly

Disassembling



Disassembling sequence

1. Shift lever handle
2. Gearshift dust cover assembly
3. E-ring
4. Selector lever assembly
5. Spring
6. Corrugated washer
7. Bushing
8. Nuts
9. Connection board
10. Support
11. Gear shift lever
12. Spring pin
13. Washer
14. Support
15. Rubber seat
16. Bracket assembly

Disassembling sequence

1. Shift lever handle
2. Gearshift dust cover assembly
3. E-ring
4. Selector lever assembly
5. Spring
6. Corrugated washer
7. Bushing
8. Nuts
9. Connection board
10. Support
11. Gear shift lever
12. Spring pin
13. Washer
14. Support
15. Rubber seat
16. Bracket assembly

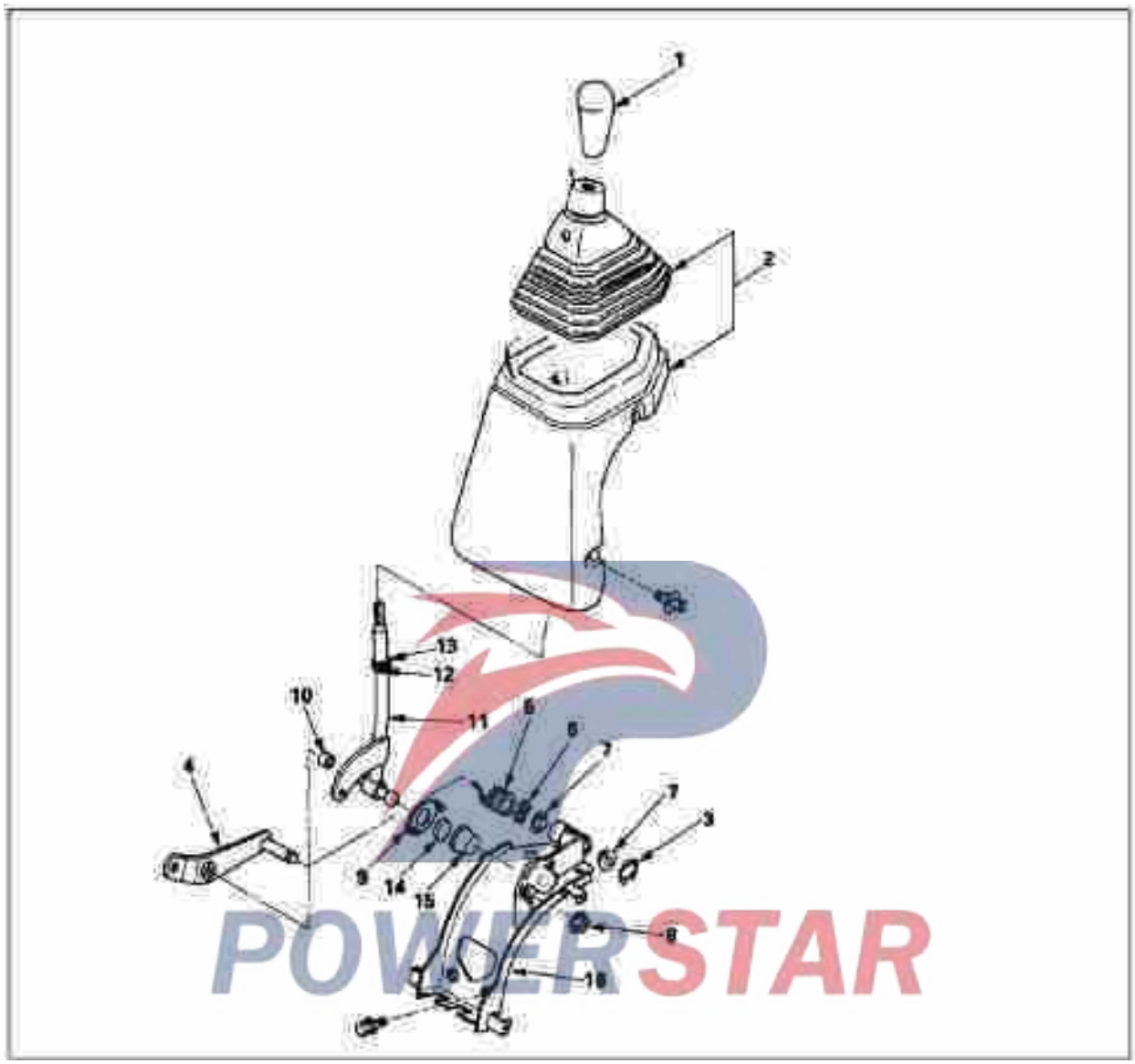
Inspection and repair

If any wear, damage, or other abnormalities are found during the inspection, repair or replace the parts.

Visual inspection

Inspect all damaged parts for wear, damage, or other abnormalities.

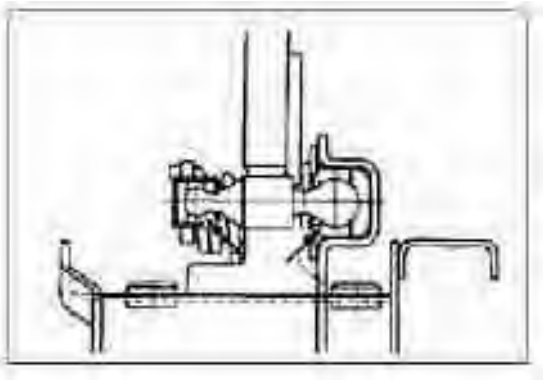
Reassembling



Reassembling sequence

1. Bracket assembly
2. Rubber seat
3. Support
4. Washer
5. Spring pin
6. Gear shift lever
7. Support
8. Connection board
9. Nuts
10. Bushing
11. Corrugated washer
12. Spring
13. Selector lever assembly
14. E-ring
15. Gearshift dust cover assembly
16. Shift lever handle

Reassembling sequence



1. Bracket assembly

2. Rubber seat

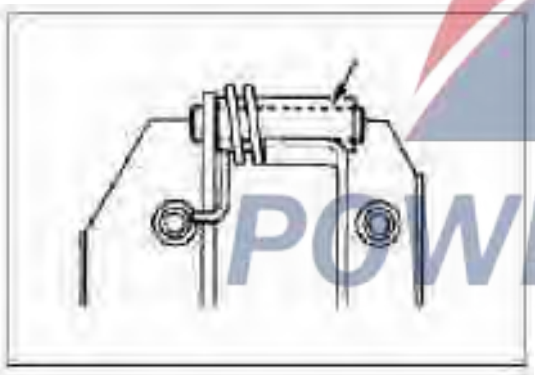
3. Support

4. Washer

5. Spring pin

6. Gear shift lever

Apply a layer of grease on the outer surface of the shift lever.



7. Support

8. Connection board

9. Nuts

10. Bushing

11. Corrugated washer

12. Spring

13. Selector lever assembly

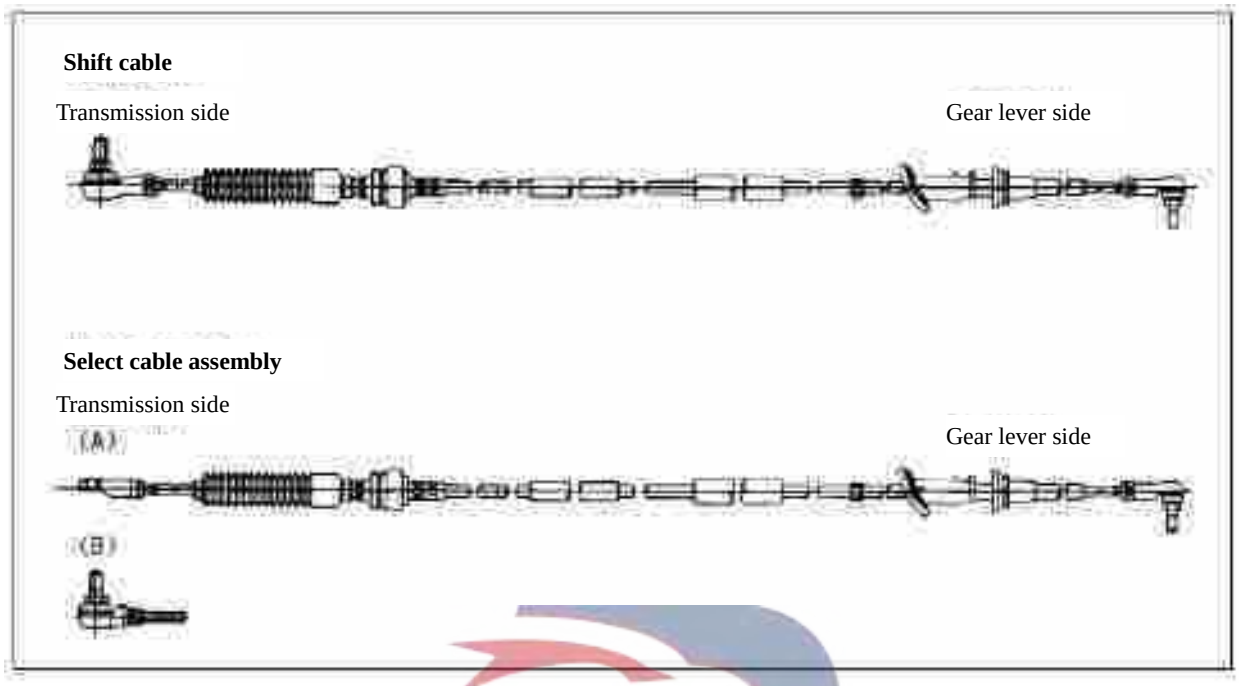
Apply a layer of grease to the selector lever.

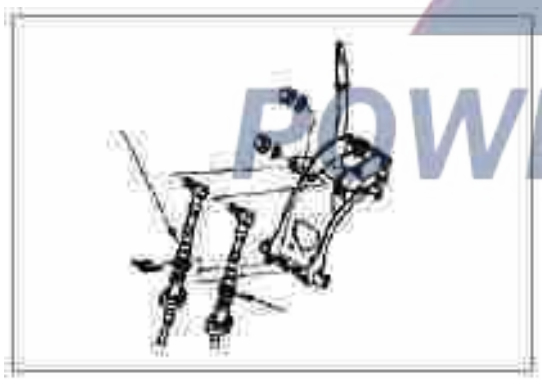
14. E-ring

15. Gearshift dust cover assembly

16. Shift lever handle

Operate the cable





Assembling sequence

1. Support

2. Select cable assembly

3. Cable offset

On the side of the shift lever

1) Connect each end of the cable to its own lever on the shift lever assembly.

Cable nut torque	N•M (kgf•M/lb•Ft)
19(1.9/14)	

2) Check that the cable clamp is installed correctly.

On the side of transmission

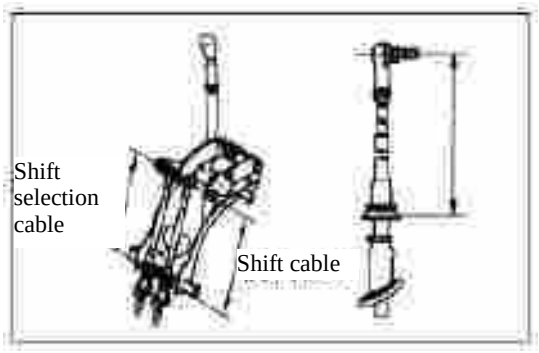
3) Connect each end of the cable to its own lever.

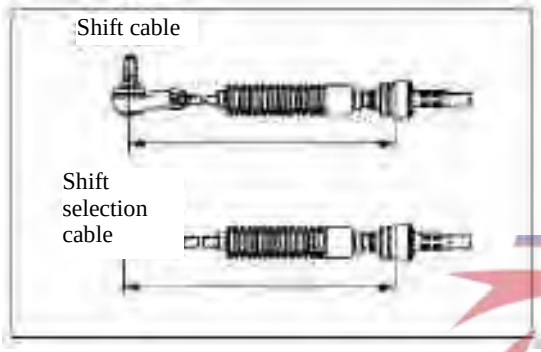
Cable nut torque	N•M (kgf•M / 1b•Ft)
19(1.9/14)	

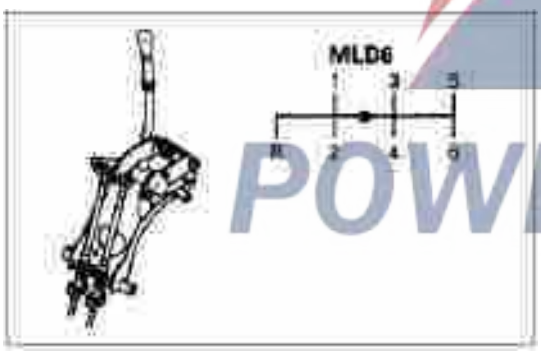
Caution:

1) The radius of curvature of the cable must not be less than 200mm.

2) For the procedure for setting the cable length, see "Cable Adjustment" on the next page.







Pull adjustment

On the side of the shift lever

1) Place the shift lever by hand in the center (•) position of the illustration.

2) Check the installation length of the cable.

Cable installation length	mm (in)
Shift selection cable	210 (8.27)
Shift cable	210 (8.27)

On the side of transmission

Select cable installation length	mm (in)
320 (12.6)	

Shift cable installation length:	mm(in)
280.0 (11.0)	

When the measured value exceeds or falls below the standard value, it is adjusted on the sending side.

Caution:

During the adjustment process, the shift lever should be kept in the middle position and the transmission should be kept in the neutral gear position.

3) Switch the shift lever to each gear, and if the pull cable is excessively bent, twisted, or otherwise damaged, perform necessary repairs.

4. Gear lever assembly

Maintenance Manual

ELF

Steering system

Section 6

Section 6A

Power steering

Table of Contents

Power steering system

Precautions

Install universal joints

• When installing a universal joint for the steering shaft and articulated shaft, pay attention to the following points.

Caution:

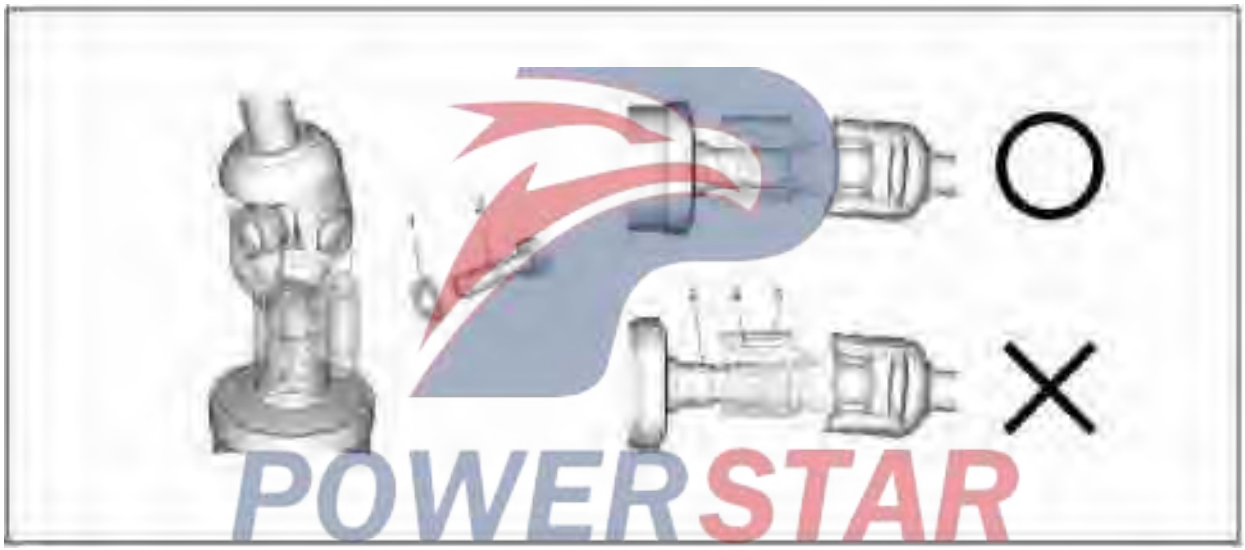
• Align the bolts (key bolts) on the universal joint with the recessed portions of the steering box penetration point and drive shaft and align the bolt holes on the washer.

Insert the keybolt after aligning and then hand.

• After aligning the position, it must be inserted into the key bolt hole. In addition, spring washers must be installed.

When bolts and spring washers are rusted and damaged, they must be replaced.

• After tightening the key bolt to the specified torque, visual inspection of the internal slot may not be visible as shown below.

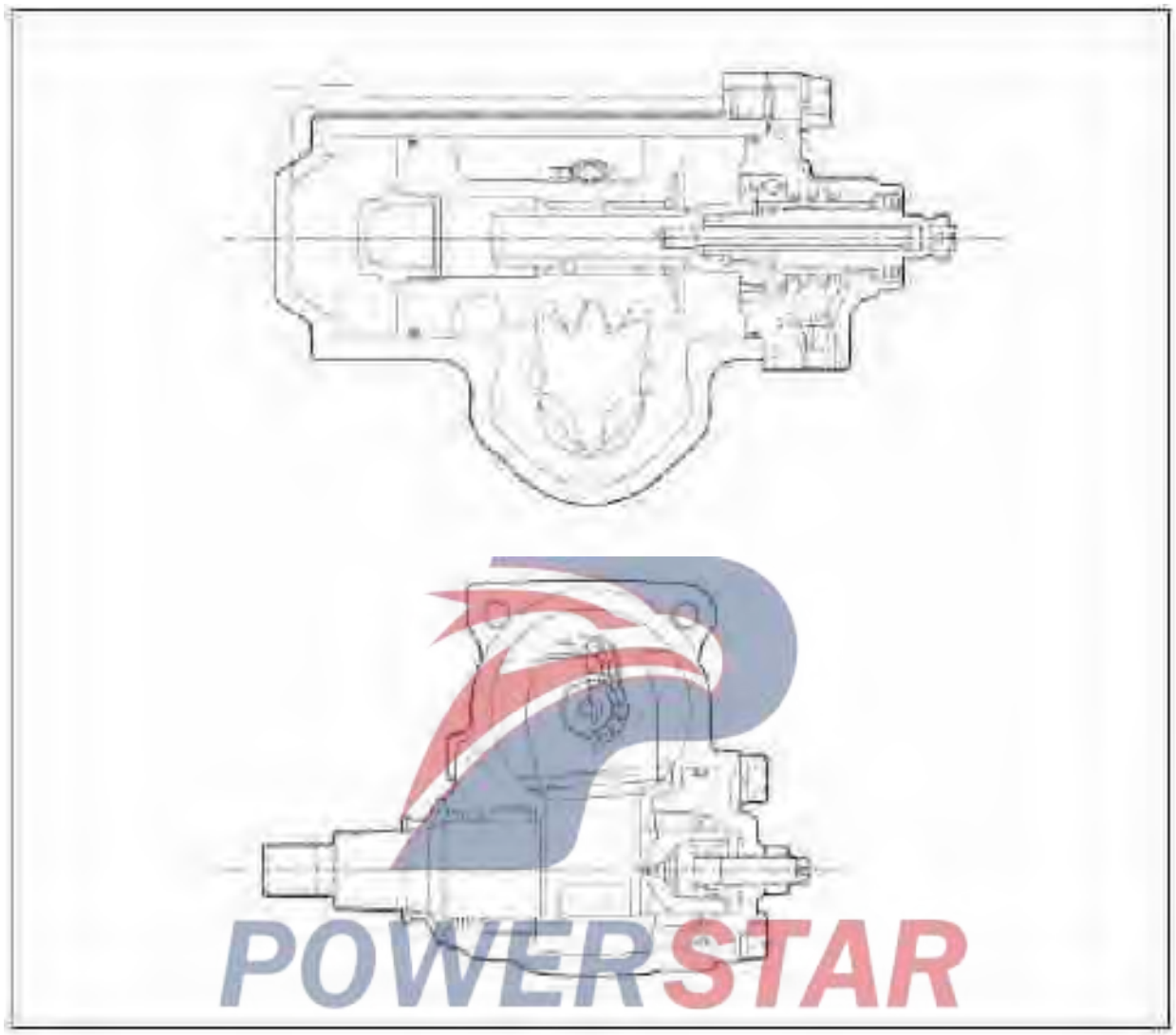


Key

1. Spring washer
2. Key bolt hole
3. Fine-tooth spline shaft
4. Key bolt hole
5. Yoke of iron

Function and working principle

Recirculating ball steering device



Functional check

Exhaust of air in power steering system

1. Hook the front wheel (in this case, it is recommended to place a turntable under each front left and right front wheel).

2. Fill the tank with power steering fluid Slowly move the steering wheel left and right (always at the left and right limits) with the engine off.

Caution:

In this state, the air in the power steering line forms a large amount of air bubbles and is discharged from the tank.

3. When the tank level drops, the same amount of power steering fluid needs to be added.

Caution:

The power steering fluid should not interrupt the observation level.

4. Start the engine and turn the steering wheel down several times while idling.

Caution:

The time needed to turn the steering wheel to bottom shall be less than 5 seconds. (For more than 5 seconds, the temperature of the power steering fluid rose sharply.)

5. When the engine is running, the steering wheel descending forward is rotated back and forth several times. When there is no abnormal noise, the exhaust is ended.

Caution:

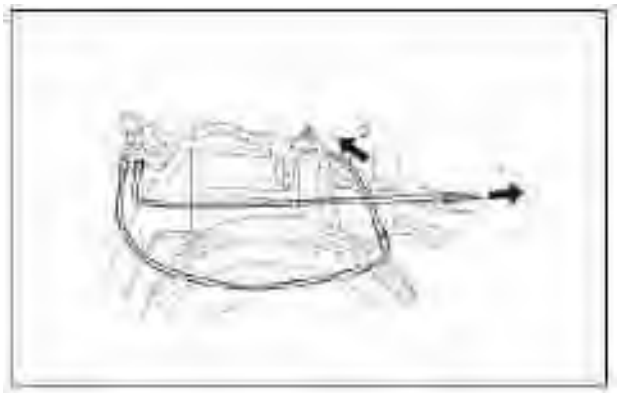
After completing step 5, if there is abnormal noise in the pipeline (wearing noise, etc.), the pipeline is still in the air and is not completely empty.

In this case, the steering wheel continues to rotate until the temperature of the power steering fluid rises to about 50-80°C. Then the engine will stop for about 5 minutes (5 minutes, air will collect), then start the engine again and turn the steering wheel repeatedly.

6. After exhausting, check the oil level in the power steering tank and ensure that all parts of the seal are leak free.

Measure the operating pressure of power steering

1. Connect the pressure gauge and shutoff valve to the discharge side (2) and direction (1) of the pump.



Special tools

Power steering oil pressure indicator

Support Components: 5-8840-0162-1

2. Check for leaks in the seals, shut-off valve fully open, and power steering working in the exhaust pipe.

3. When idling the engine, raise the oil temperature to 50-60°C.

4. When the engine idles at working pressure, the shutoff valve is fully open and the steering is completed at the end of the steering wheel (completely to the left, completely to the right, left and right in the entire direction).

The standard value of working pressure

Recirculating ball steering device

=10.8~12.0 MPa

{110~122kgf/cm^2}

At this point, if the working pressure is within the standard range, this is normal. When the operating pressure is lower than the standard value, the steering unit or the oil pump fails. (Checked according to the fifth point)

Caution:

The time required to finally turn the steering wheel must be less than 5 seconds (5 seconds, the temperature-dependent power steering fluid will increase significantly).

5. When working on the steering wheel, stop the valve completely and measure the working pressure.

The standard value of working pressure

Recirculating ball steering device

= 10.8~12.0 MPa

{110~122kgf/cm2}

At this time, if the working pressure is higher than the standard value, the oil pump is abnormal. (replace oil pump)

If the working pressure is lower than the standard value, check points 4 and 5 after replacing the oil pump.

Caution:

Do not extend the measurement to step 5. As the temperature of the power steering fluid rises significantly and causes a malfunction, the measurement is completed within 10 seconds.

Diagnosis of power steering system faults

Steering fluid sound

Power steering systems generate a lot of noise during operation. This is especially true for turning corners. This operation is directly related to the good performance of the steering system, so the sound becomes very loud when the steering valve is changed during operation.

Symptom	Probable causes	Process
Various abnormal sounds	The fixed part of the high pressure hose falls.	Fix the hose connection section.
	Loose turn rod ball head.	Repair or replace the ball joint of the steering rod.
	Part of the power steering installation is loose.	Tighten the mounting section of the power steering.
	Wrong direction adjustment.	Check and adjust the pretension of the power steering gear.

Caution:

When the operation is difficult and the abnormal sound (buzz, whistle, squeak) is in inches, when the power steering device is deduced or the power steering pump is abnormal. However, if the power steering fluid is mixed with air (the power steering fluid includes the formation of milky bubbles after opening the fuel tank cap), the same abnormal noise will be generated. In this case, check if the pipe (washer) screws are loose and if the pipe is damaged.

If the power steering fluid is not mixed in the air but is still not normal, check and repair the power steering pump or power steering.

Symptom	The reason for power steering	The reason for power steering pump
Abnormal operation	• There is an abnormality in left turn or right turn • There are different degrees of abnormality in turning left or right.	There is absolutely no electricity assistance.
Abnormal noise	Voice	“Wu” sound, “Ga” sound

Symptom	Probable causes	Process
Bad steering wheel center reset	Wrong direction adjustment.	Check the pre-tightening force of the power steering device.
	The power steering valve is stuck or blocked.	Replace the power steering valve.
	Air is mixed in the power steering system.	Exhaust.
When the steering wheel is turned right and left, the execution force suddenly increases.	Power steering internal leakage.	Assist steering is correct.
	Insufficient power steering fluid.	Supplement.
While parking, start the engine and lift the steering wheel.	Power steering pump pressure is insufficient.	Correct the entire power steering pump.
	Valves are glued for power steering.	Replace power steering.
	Insufficient power steering fluid.	Supplement.
Steering wheel game is abnormal.	Air is mixed in the system.	Air is discharged from the hydraulic system.
	The head of the power steering device is loose.	Tighten the steering assist ball joint.
	Wheel bearing wear.	Replace wheel bearing.
Steering operation is difficult or there is no electricity assistance.	Valves are glued for power steering.	Replace the power steering valve.
	Power steering pump lacks strength.	Correct the entire power steering pump.
	Power steering pump leakage is large.	Correct the entire power steering pump.
	The power steering device has a large leak.	Correct or replace power steering.
	Insufficient power steering fluid.	Supplement.

Diagnose power steering pump failure

Symptom	Probable causes	Process
Power steering pump pressure is low.	Pressure relief valve sticks or does not work.	Replace the pressure relief valve.
	The side plate is not flat enough for the cam ring.	Correct the side plate.
	Worn cam ring.	Replace the cam ring.
	The side plate or rotor is damaged.	Replace the side plate or rotor.
	The rotor and the groove are connected to the blade.	Correct or replace blades and rotors.
	Side panels are broken or damaged.	Replace the side plate.
	Internal leakage of power steering pump.	Correct leakage inside the power steering pump.
The pressure of power steering is very low.	Damaged cylinder bore.	Replace the cylinder.
Power steering pump becomes too hard	Hose or power steering can produce excessive back pressure.	Correct power steering or power steering pump.
	The side plate or rotor is damaged.	Replace the side plate or rotor.
	The cam ring wears.	Replace the cam ring.
Abnormal noise of power steering pump increases	Power steering fluid contains air.	Air is discharged from the hydraulic system.
	The power steering fluid has a low liquid level.	Supplement.
	The pump is loose.	Connect the mounting bolts.
The power steering pump has a beep.	The blade sticks to the groove of the rotor.	Correct or replace blades and rotors.
	Bad blade installation.	Correct rotor and blades.
Power steering pump is noisy.	Damaged safety valve	Replace the pressure relief valve.
The power steering pump has a buzzing sound.	The side plate and the blade are damaged.	Replace the side plates and blades.

Diagnostic steering column

Steering lock system

Symptom	Probable causes	Process
Unable to unlock	Damaged cylinder.	Replace the lock cylinder.
Unable to lock.	The lock spring is damaged or worn.	Replace the lock cylinder.
	Damaged cylinder.	Replace the lock cylinder.
	Starter Starter (Ignition).	Correct or replace the starter switch (ignition).
The key cannot be removed from the "locked" position.	Bad starter (ignition) switch.	Correct starter (ignition) switch.
	Damaged cylinder.	Replace the lock cylinder.
	Displacement of the locking mechanism.	Correct or replace.

Steering column

Symptom	Inferred reason	Process
Abnormal sound in the string.	The joint is loose.	Replace the steering shaft.

Steering Mechanism Fault Diagnosis

Caution:

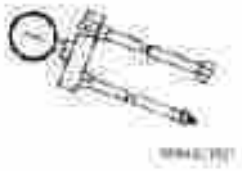
When diagnosing various steering, suspension, wheel and tire defects, the effects of steering, suspension, wheels and tires must be considered.

• Please refer to front suspension system in Chapter 2B Suspension Front Suspension System.

Main parameters

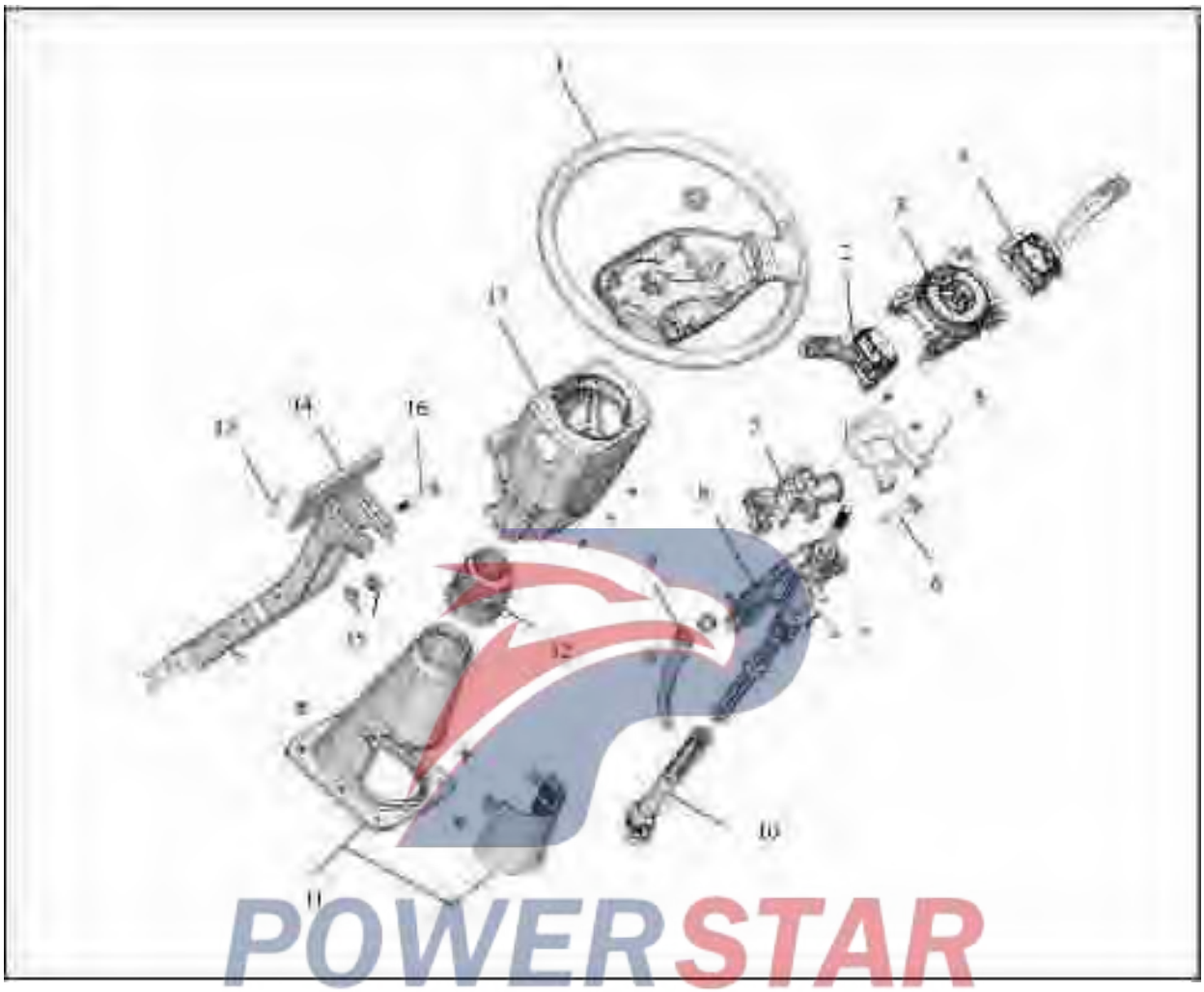
Cab specification	Model	Suspended form	Steering system
Extended cab	700P(3X)	Rigid suspension	Recirculating ball type

Special tools

Illustration	Tool number Key
	5-8840-0162-1 Power steering oil pressure indicator
	5-8840-2017-0 Bullet removal tool
	5-8840-2051-1 Turn to switch delete tool
	5-8840-2035-0 Removal tool

Steering column and steering shaft

Component parts



Key

1. Steering wheel
2. Combination Switch (Windshield Wiper)
3 Switch body combination
4. Combination switch (lighting)
5. Combination switch bracket
6. Angle adjustment bolt
7. Steering lock assembly
8. Tilting support and steering shaft
9. Angle adjustment rod
10. Flute Tree
11. Bottom cover
12. Dust cover
13. Cylinder spring
14. Tilt support
15. Separator
16. Bolt
17. Orientation cover

Disassembly

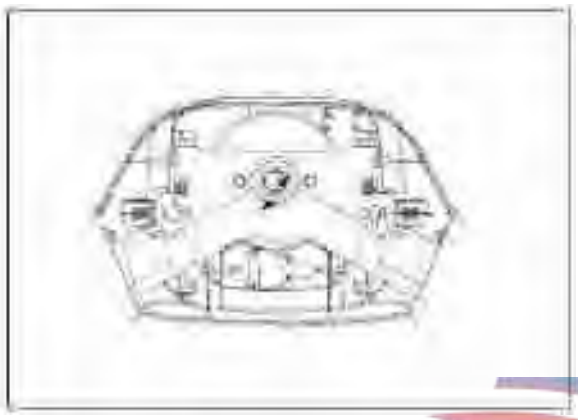
1. Move the steering wheel forward.
2. Turn the ignition switch to the "locked" position.

3. Remove the battery cable (1) and hold it for more than 15 seconds.

4. Remove the steering wheel.

a. Remove the nut.

b. In order to facilitate correct installation when reassembling, mark the steering wheel and steering shaft in advance.



c. Use extraction tool: 5-8840-2035-0 (1) Remove the steering wheel.

5. Remove the steering cover.

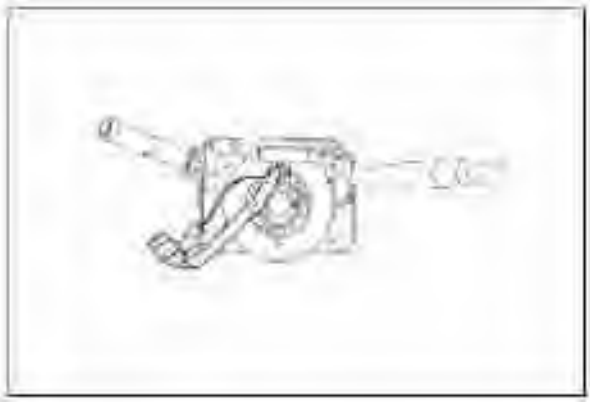
6. Remove the steering lock assembly (1).

• Since ordinary bolts (threaded heads after bolts) are used for fastening bolts, they must be removed using tools such as disassembly tools and tabletop faucets.

7. Remove the combination switch (windscreen wiper) (1) and combination switch (indicator light) (2).

8. Remove the combination switch assembly.

Remove the 2 connectors from the harness at the bottom of the steering column.



9. Remove the bracket from the combination switch (1).

10. Remove the steering shaft from the power steering.

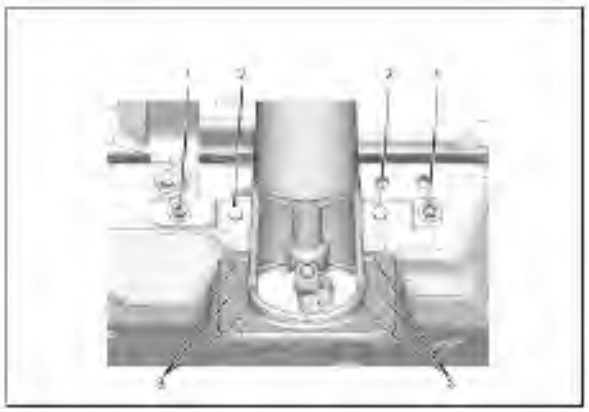
Remember:

Remove the inspection window on the bottom cover and mark the steering shaft and the fork.

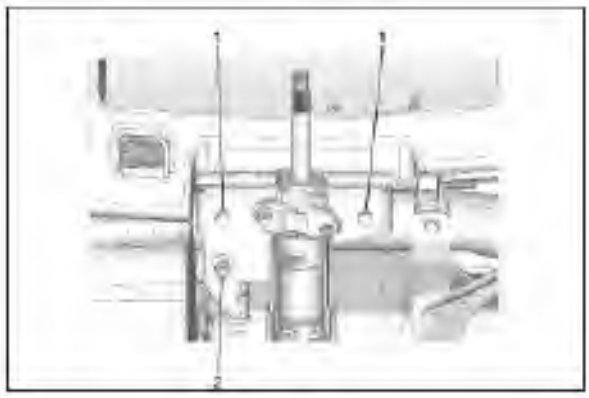
11. Remove the tilt bracket mounting bolts (2) and nuts (1).

Remove the clip or screw from the bottom cover (3).

2 clips (front) and 4 screws (rear)



12. Remove the tilt bracket mounting bolts (1) and nuts (2).



13. Remove steering column and steering shaft.

14. Remove steering column and steering shaft.

a. Remove the bottom cover (2) and the dust cover (1).

b. After marking the mounting mark on the tilt bar (2) and the nut (3), remove the tilt bar (2) and the bolt (1).

c. After finding the assembly mark on the tilt bolt (4) and tilt bracket (5), remove the nuts (3) and the tilt bolts (4).

d. Remove the bottom of the cylindrical spring first, then remove the bolt (1), and finally remove the tilt bracket (2).

e. First mark the spline shaft (2) and the steering shaft (1) with assembly marks, and then remove the spline shaft (2).

Check steering shaft, spline shaft

• Check for buckling.

• Inspect the sealing fork for cracks and deformation.

• Check for loose seal bearings.

Caution:

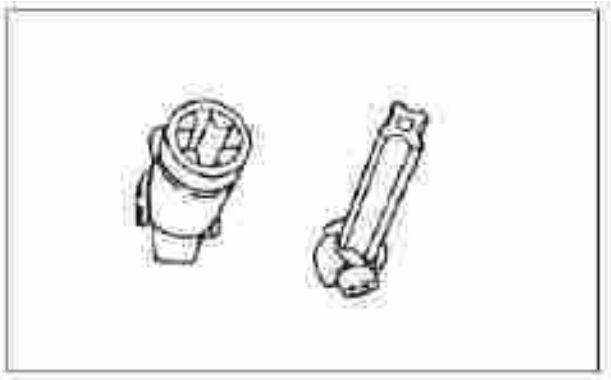
• The universal joint does not break down.

• Be careful not to damage the grooved area and avoid adhering to foreign objects.

• Check spline and steering shaft rotation for clearance.

• Check spline shaft and seal ring for looseness.

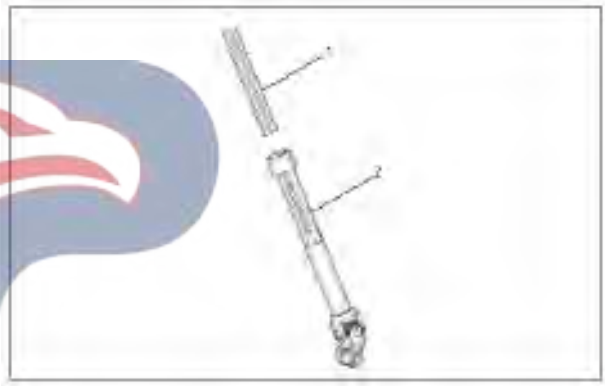
• Check the dust cover for cracks and deterioration.



Installation

1. Install steering column and steering shaft.

a. When disassembling, install the spline shaft (2) on the steering shaft (1) according to the assembly mark.



b. Install the tilt bracket (2) first, and then install the underside of the cylindrical spring and the bolt (1).

Tightening torque : 13 N•m {1.3kgf•m}

c. Install the mounting nuts (3) and angle adjustment bolts (4) when removing.

Tightening torque : 20 N•m {2.0kgf•m}

Caution:

In order to prevent the nut (3) from rotating, it must be installed during installation.

d. Remove the assembly mark, install the tilt bar (2) and bolts (1).

Tightening torque : 45 N•m {4.6kgf•m}

e. After overlapping the dust cover protrusions, install the lower cover (2) and the dust cover (1).

Caution:

Tightening torque must be observed.

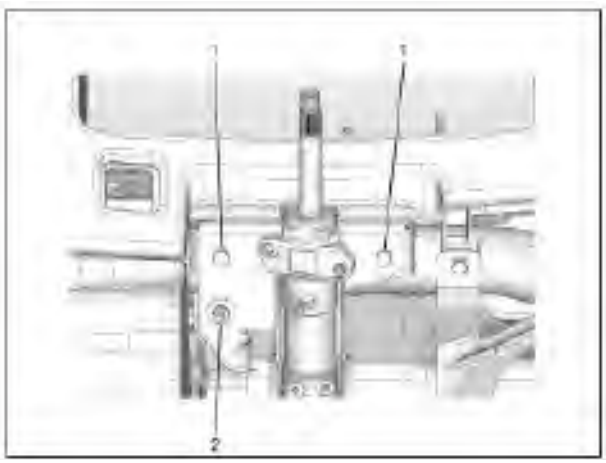
2. Install steering column and steering shaft.

3. Install the tilt bracket mounting bolts (1) and nuts (2).

Tightening torque

Bolts = 21 N•m {2.1kgf•m}

Nut = 19 N•m {1.9kgf•m}



4. Install the tilt bracket mounting bolts (2) and nuts (1).

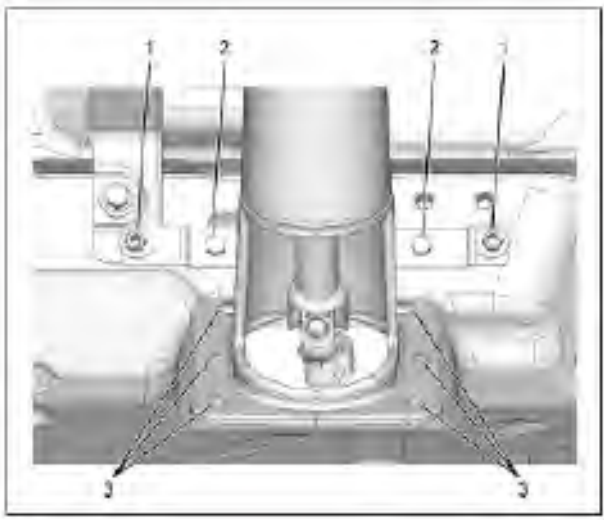
Install clips or screws on the bottom cover (3).

2 clips (front) and 4 screws (rear)

Tightening torque

Bolts = 21 N•m {2.1kgf•m}

Nut = 19 N•m {1.9kgf•m}



5. Connect the steering shaft to the power steering.

• Install the steering shaft according to the assembly mark when removing.

Tightening torque : 39 N•m {4.0kgf•m}

Caution:

Please refer to the power steering system installed in this chapter to install the steering shaft universal joint.

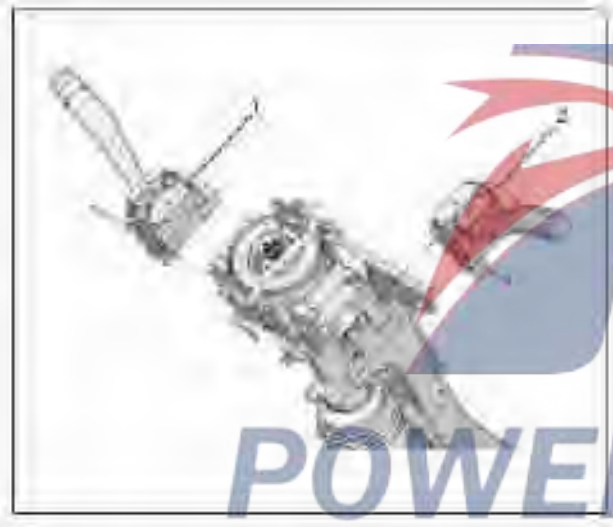
6. Install the bracket of the combination switch (1).

Tightening torque : 4 N•m {0.4kgf•m}

7. Install the combination switch housing into the assembly.

a. Connect the 2 harness connectors in the lower part of the steering column. Install the combination switch box (1).

8. Install combination switch (wiper) (1) and combination switch (indicator) (2).



9. Install steering lock assembly (1).

• Tighten the bolts to use ordinary bolts (after tightening the bolts, the bolt heads are threaded) and tighten the bolts until the bolt heads are damaged.

Tightening torque : 14 N•m {1.4kgf•m}

Caution:

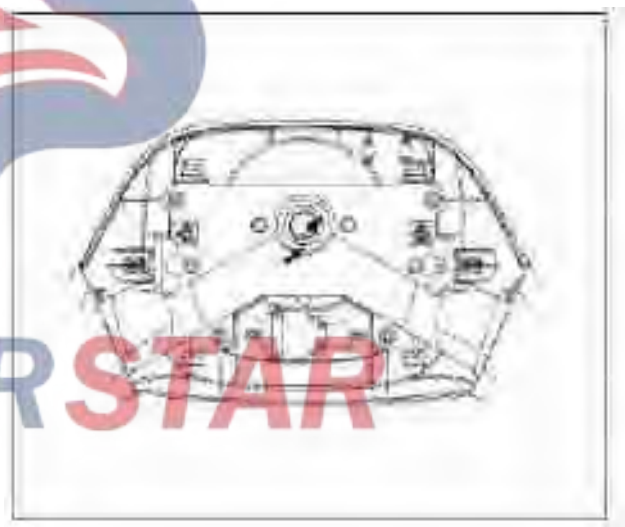
Use new common bolts.

10. Install the steering hood.

Tightening torque : 6 N•m {0.6kgf•m}

11. Install the steering wheel.

a. Connect the horn harness to the steering wheel and install the steering wheel according to the brand when it is removed.

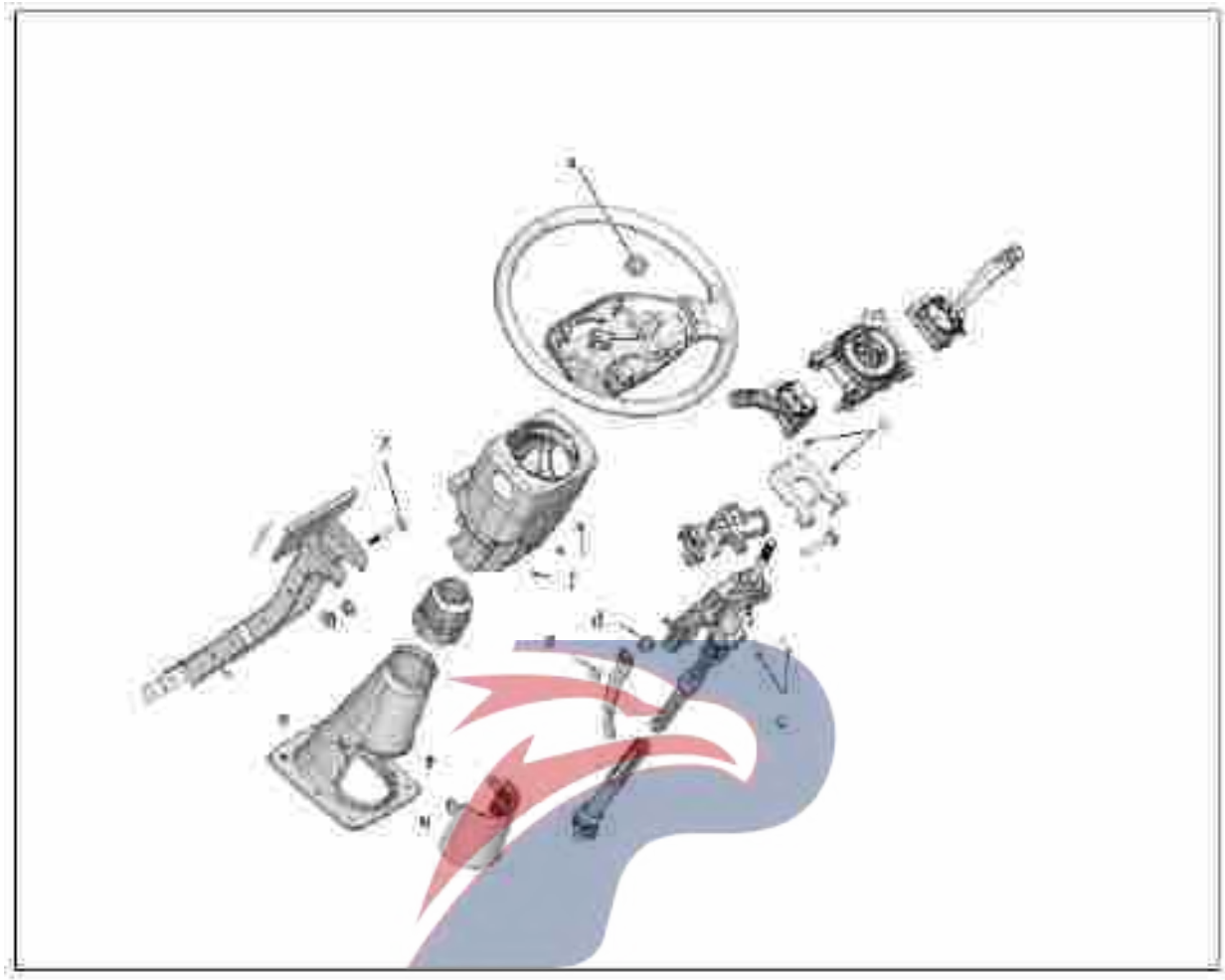


b. Tighten the nut to the specified torque.

Tightening torque : 42 N•m {4.3kgf•m}

12. Connect the battery cable (I).

Tightening torque list



Key

(a) Nut = 42 N•m {4.3kgf•m}

(b) 4 N·m{0.4kgf·m}

(c) 14N·m{1.4kgf·m}

(d) 20 N·m{2.0kgf·m}

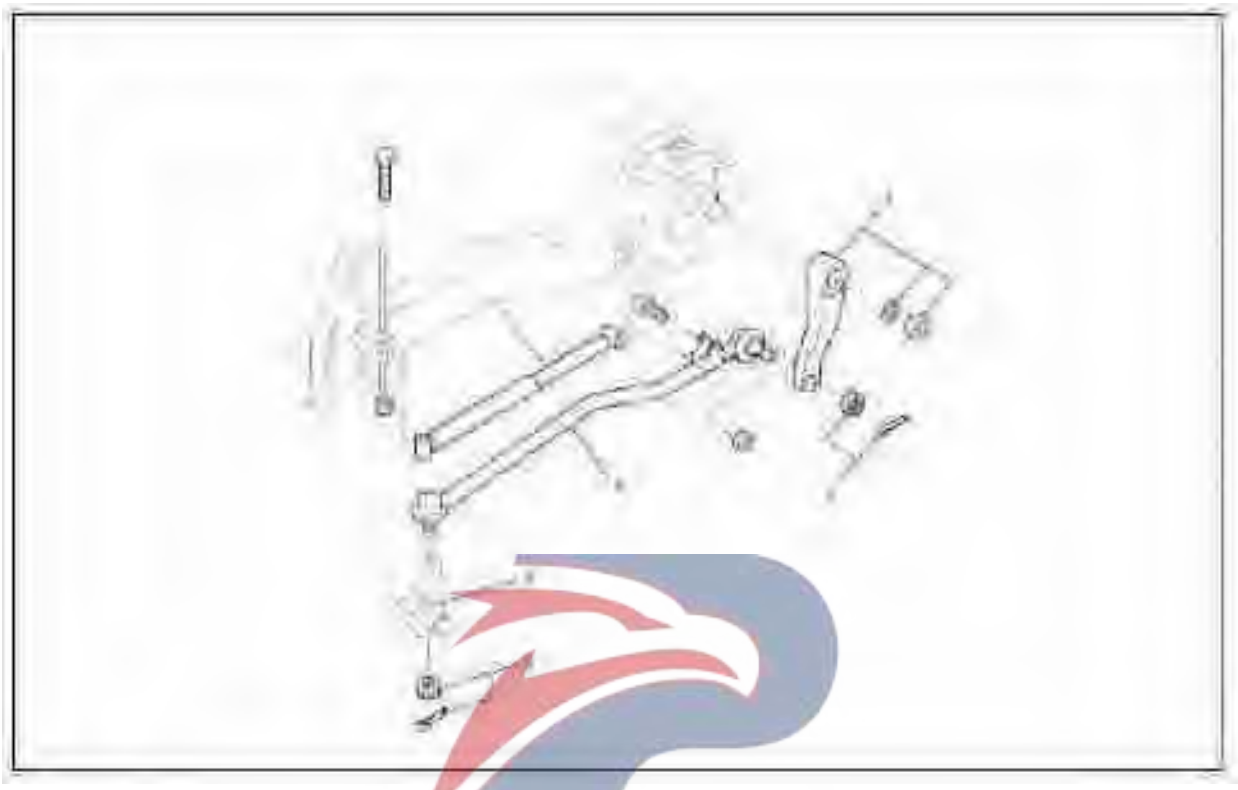
(e) Nut = 45 N•m {4.6kgf•m}

(f) 6 N·m{0.6kgf·m}

(g) 13 N·m{ 1.3kgf·m}

Longitudinal steering rod (rigid suspension)

Component parts



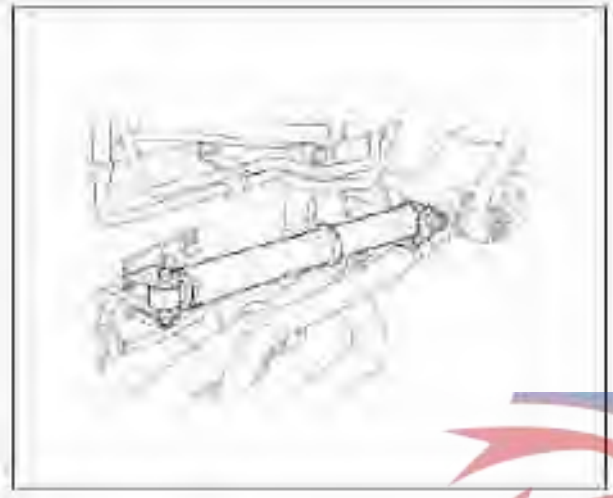
Key

1. Steering mechanism damper
2. Steering arm (Steering arm)
3. Cotter pin, lock nut
4. Vertical bars
5. Steering arm
6. Lock nut, split pin

Disassembly

1. Remove the steering damper. (Only for vehicles with this unit installed).

• Remove the mounting bolts and nuts on the side of the steering linkage and remove the steering damper connector.



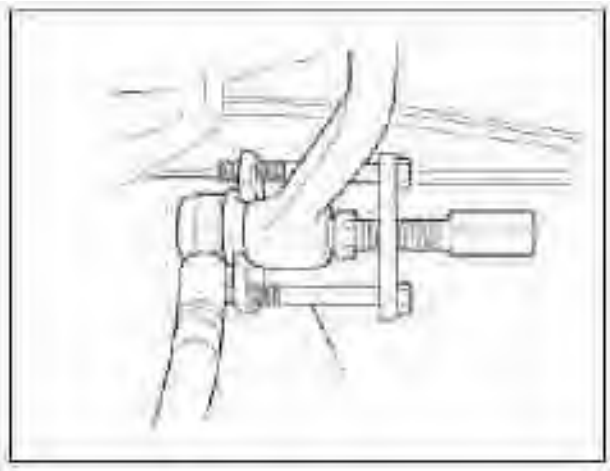
2. Remove the rear steering rod.

a. Remove the split pin at both ends of the steering rod and loosen the lock nut.

b. Using a rotary removal tool (ball joint): 5-8840-2017-0 (1), remove the tie rod connector to the direction latch and connect the steering rod to the steering arm respectively.

Caution:

When removing the tool with a ball stud (ball joint), first tighten the lock nut in the thread.



c. Remove the rear steering rod.

3. Check the direction bar.

Check the ball cap's dust cap for cracks, abrasion, and grease leakage.

4. Remove rocker arm (steering arm).

a. Loosen the nut and mark the steering arm and steering arm of the steering gear with assembly marks.

b. Using the steering rocker removal tool: 5-8840-2051-1, remove the steering column (the steering arm) from the steering wheel.

Installation

1. Install the rocker arm (the steering vertical arm).

a. Install the steering arm (steering vertical arm) on the steering device according to the marks generated during the disassembly process.

b. Tighten the washers and nuts to the specified torque.

Tightening torque : 294 N•m {30.0kgf•m}

2. Install the steering trailing rod.

a. Install the steering rocker arm on the steering rocker and steering arm and tighten the locknut to the specified torque.

Tightening torque : 167 N•m {17.0kgf•m}

b. Install the split pin and bend it precisely.

When the lock nut and the split pin hole are not aligned, align the lock nut in the tightening direction.

Caution:

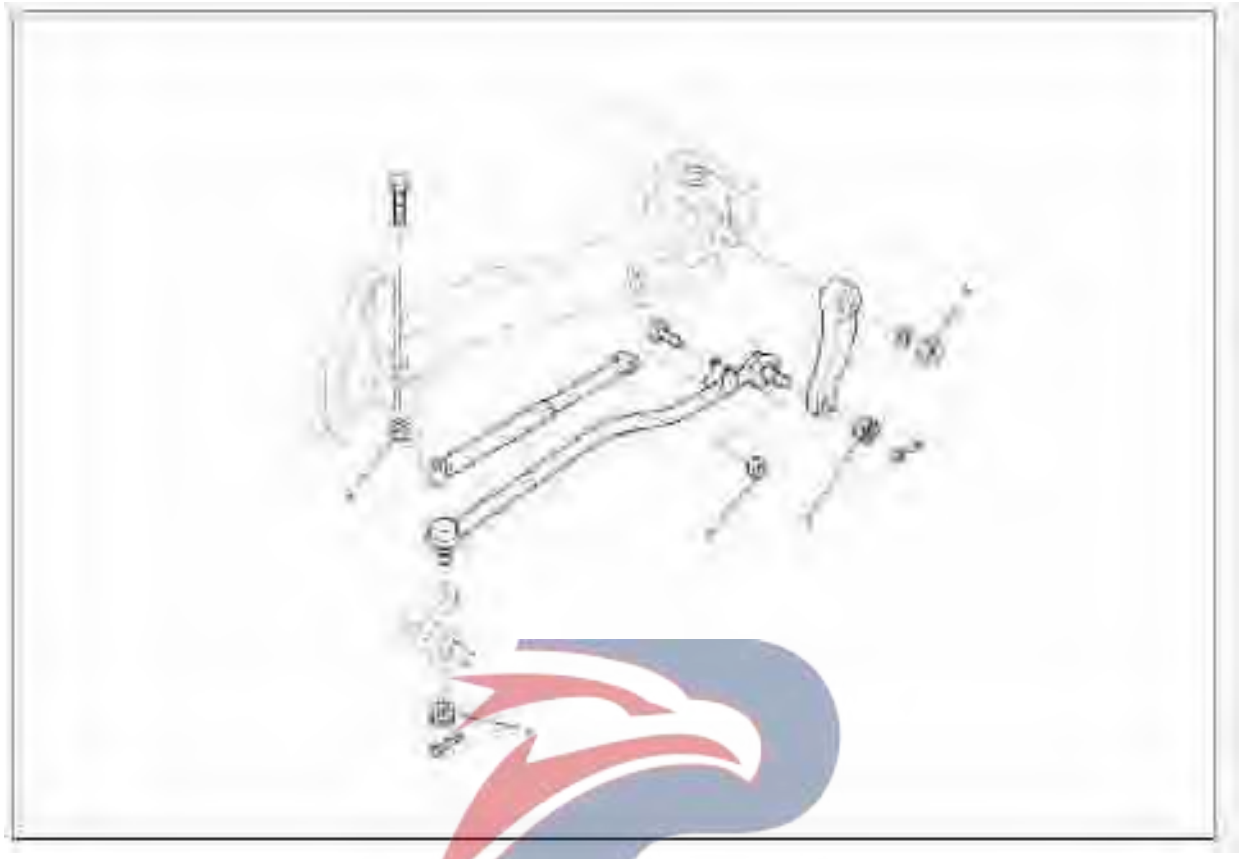
Use a separate pin.

3. Install the steering mechanism damper (Applies to vehicles equipped with this device only).

• Mount the steering damper on the rocker arm and tighten the bolt and nut to the specified torque.

Tightening torque : 50 N•m {5.1kgf•m}

Tightening torque - Overview



Key

(a) 50 N·m{5.1kgf·m}

(b) 216 N·m{22.0kgf·m} （NLR, NMR）

(b) 294 N·m{30.0kgf·m} （NJR, NKR, NPR）

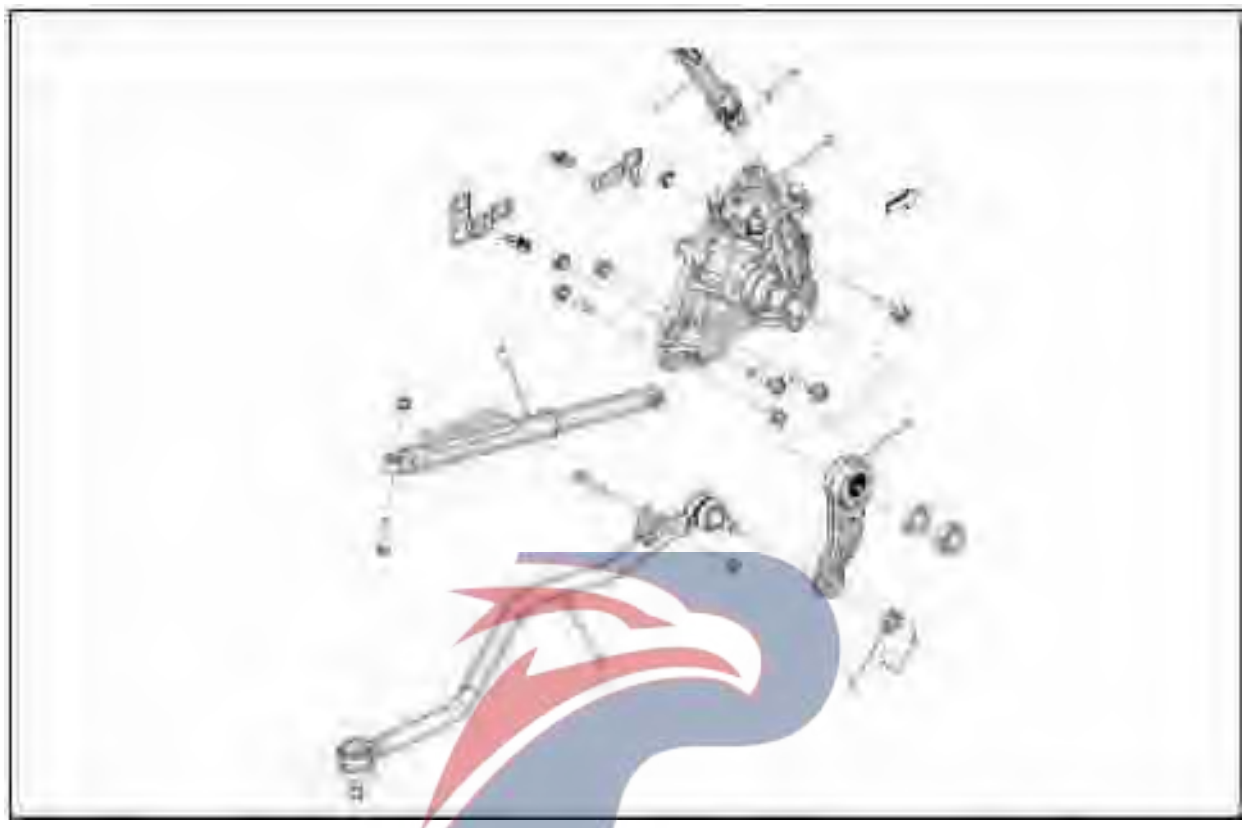
(c) 167N·m {17.0kgf·m}

(d) 50 N·m{5.1kgf·m}

(e) 167 N·m{ 17.0kgf·m}

Power steering (rigid suspension)

Component parts



Key

1. Steering shaft.
2. Power steering assembly
3. Steering arm (Steering arm)
4. Lock nut, split pin
5. Vertical bars
6. Steering mechanism damper

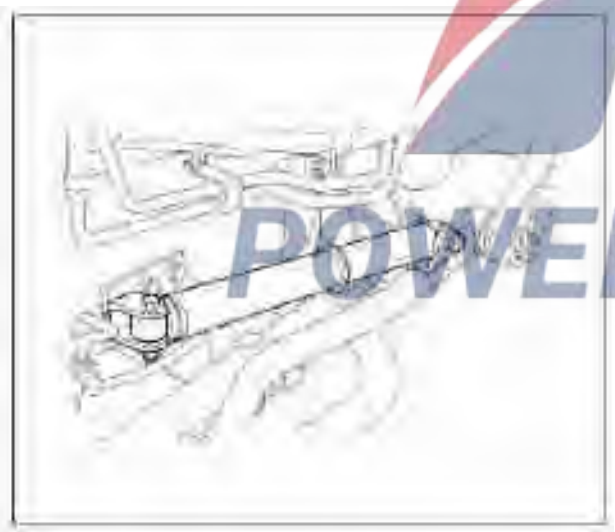
Disassembly

1. Use a jack to lift the front of the vehicle.
Refer to the vehicle lift points in the OA overview section.
2. Remove the power steering hose connection.
• Remove power steering tubing fittings in steering gear.
Caution:
When cleaning the exterior, do not allow foreign matter to enter the oil hole, tubing and plug after removal.
3. Turn the left or right side of the steering wheel to release the power steering fluid.
4. Disconnect the steering shaft.
a. Mark the shaft mounting shaft of the steering shaft and the input shaft of the power steering.

b. Remove the universal joint clamping bolt from the steering shaft and remove the steering shaft from the power steering.

5. Remove the steering damper.

• Remove the thumbscrews on the side of the crossbar and the side of the chassis and remove the steering damper.



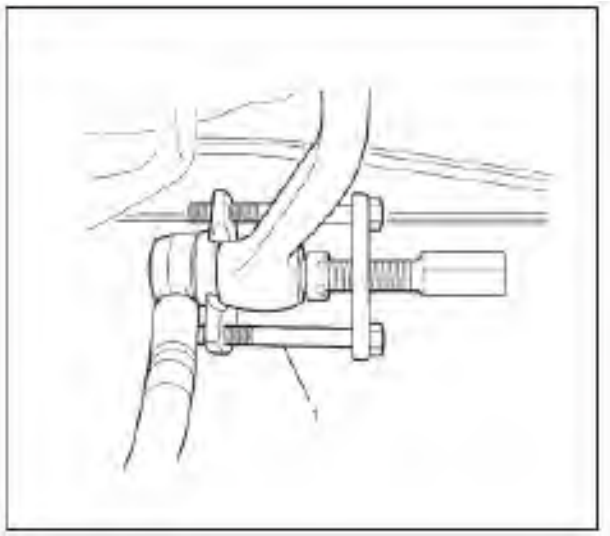
6. Remove the rear steering rod.

a. Remove the split pin and loosen the lock nut.

b. Use the ball to remove the disassembly tool: 5-8840-2017-0 (1), remove the lever from the steering rocker.

Cation:

When using the pin removal tool, first tighten the lock nut in the thread.



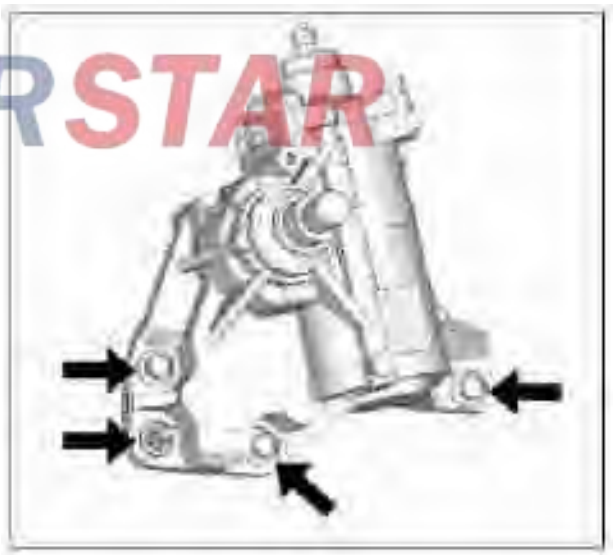
7. Remove rocker arm (steering arm).

a. Loosen the nut and mark the steering arm and steering arm of the steering gear with assembly marks.

b. Using the steering rocker removal tool: 5-8840-2051-1, remove the steering column (the steering arm) from the steering wheel.

8. Disassemble the power steering assembly.

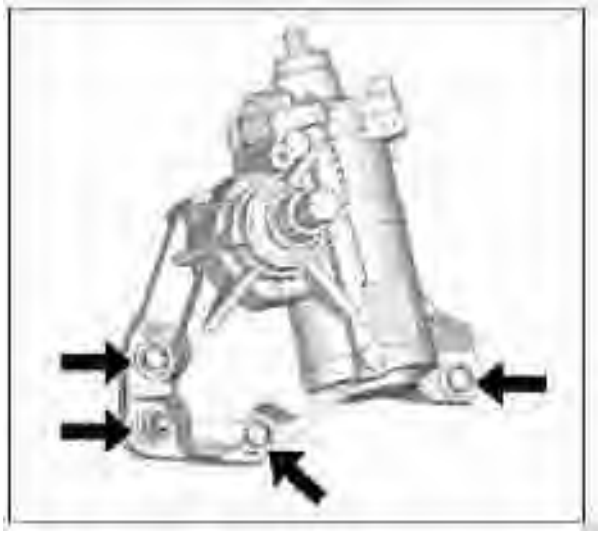
• Before removing the power steering assembly, remove the bolts and nuts.



Installation

1. Install the power steering assembly

Tightening torque : 103 N•m {10.5kgf•m}



2. Install the rocker arm (the steering vertical arm).

a. Install the steering arm (the steering vertical arm) on the steering device by aligning the mounting marks produced during the disassembly process.

b. Install the washer, nut and tighten it to the specified torque.

Tightening torque : 294 N•m {30.0kgf•m}

3. Install the steering trailing rod.

a. Install the rocker arm on the steering rocker arm (the steering vertical arm) and tighten with the lock nut.

Tightening torque : 167 N•m {17.0kgf•m}

b. Install the split pin and bend it precisely.

When the lock nut and the split pin hole are not aligned, align the lock nut in the tightening direction.

Caution:

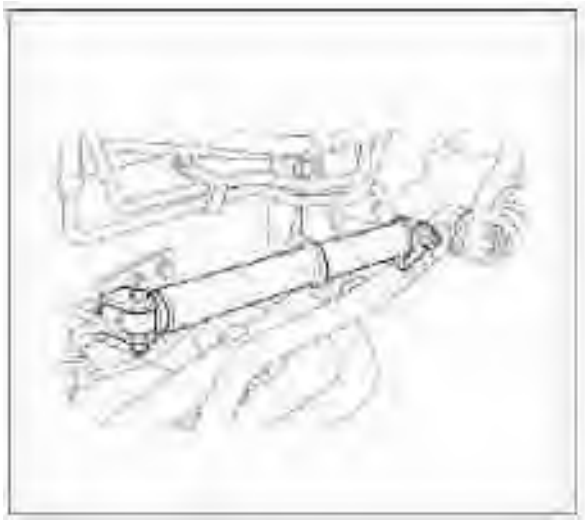
Use a new split pin.

4. Install the steering mechanism damper (Applies to vehicles equipped with this device only).

a. Install the steering damper on the steering rod and chassis.

b. Install bolts and nuts and tighten them to the specified torque.

Tightening torque : 50 N•m {5.1kgf•m}



5. Install the steering shaft.

Caution:

Refer to the power steering system in this chapter to accurately install the universal joint of the steering shaft.

a. Align the mounting marks produced during disassembly and install the steering shaft on the steering device.

b. Install the universal joint clamp bolt and tighten it to the specified torque.

Tightening torque : 26 N•m {2.7kgf•m}

6. Install power steering tubing.

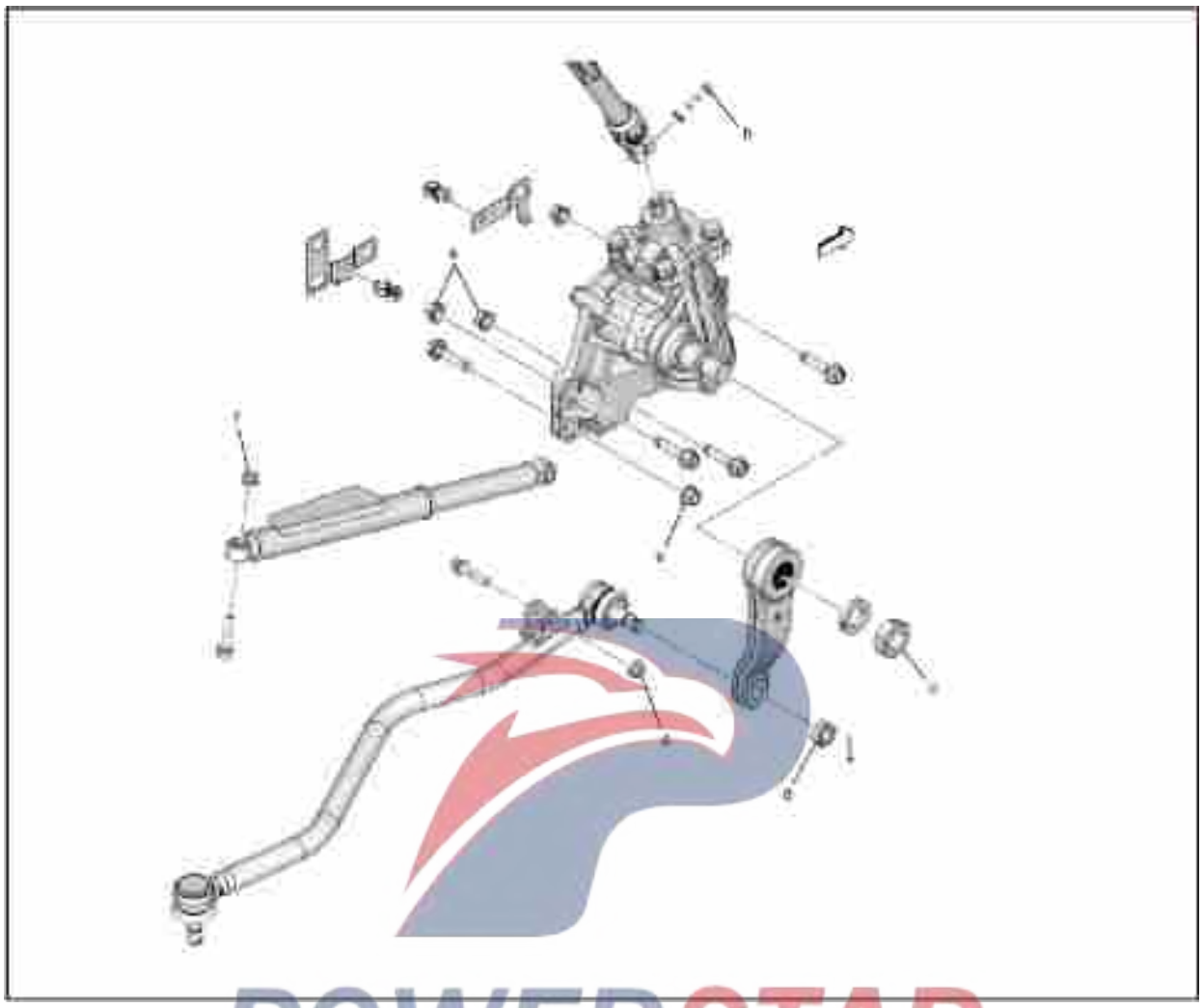
• Install a power steering oil line on the power steering.

Tightening torque : 44 N•m {4.5kgf•m}

7. Remove the air from the power steering system.

Refer to power steering in this chapter.

Tightening torque - Overview



Key

(a) 103 N·m{10.5kgf·m}

(b) 26 N·m{2.7kgf·m}

(c) 216N·m{22.0kgf·m}

(c) 294 N·m{30.0kgf·m}

(d) 167 N·m{ 17.0kgf·m}

(e) 50 N·m{5.1kgf·m}

(f) 50 N·m{5.1kgf·m}

Power steering pump (4HK1 engine)

Disassembly

1. Remove the front exhaust pipe.
2. Remove the fluid from the hose connected to the return port of the power steering pump.
3. Disconnect the fuel supply line.
4. Remove the three power steering pump mounting bolts (flywheel side (1), cylinder side (2)) and remove the power steering pump.

Tightening torque - Overview

Key

(a) 43 N·m{4.4kgf·m}

(b) 44 N·m{4.5kgf·m}

Installation

1. Install a new o-ring on the power steering pump and apply some oil on the o-ring.
2. Install the power steering pump and tighten the bolts to the specified torque.

Tightening torque

Flight side steering wheel = 43 N•M {4.4kgf•M}

Cylinder side = 44N·M {4,5kgf·M}

3. Install power steering tubing.
4. Install the front exhaust pipe.

Tightening torque

Manifold ~ tube = 43N·M {4.4kgf·M}

Tube ~ tube = 43N·M {4.5kgf·M}

Pipe hoop ~ tube = 43N·M {4.5kgf·M}

Section 7A
Heater, ventilator, air conditioner
Heater, ventilation

Table of Contents

Heater, ventilation system

Function and working principle

Heater

Once the engine is heated, the engine coolant is sent to the heater core and the heating system feeds warm air into the cab.

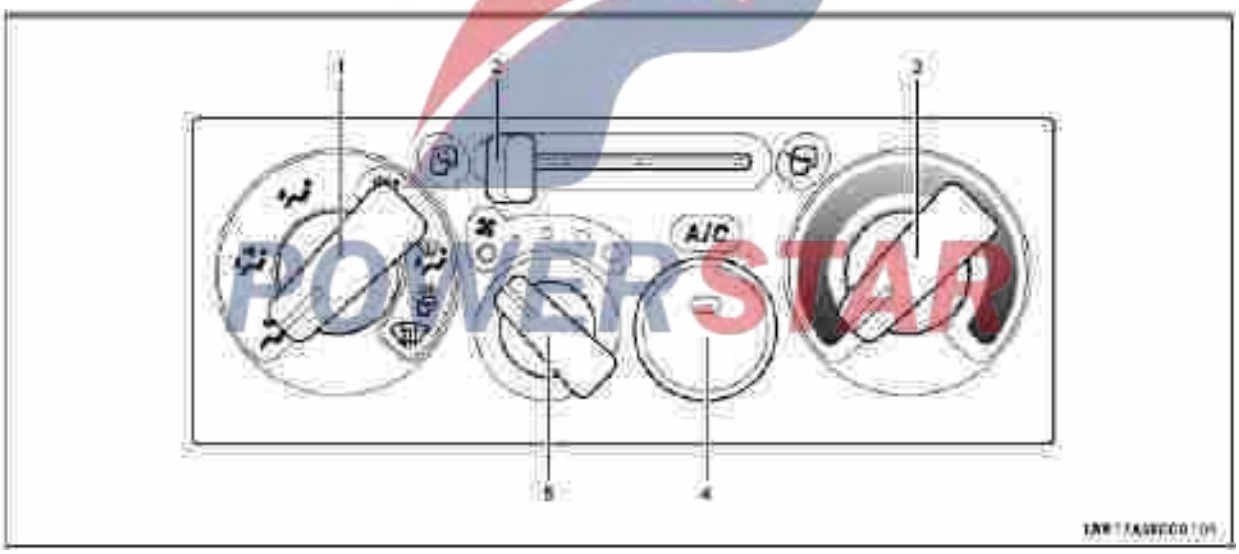
Outside air passes through the heating core of the heating unit and is introduced into the tank.

By controlling the mixing ratio of the outside air and the heating core, the most comfortable cabin temperature can be maintained.

By operating the temperature control knob, the opening and closing angle of the air mixing door of the heater is adjusted, and the temperature of the air passing through the heating core is controlled to control the indoor temperature.

By changing the nozzle switch button, the nozzle in the car can be arbitrarily selected.

Control rod assembly (manual A/C)



Key

1. Nozzle change button
2. Air source conversion rod
3. Temperature adjustment button
4. Air conditioning (A/C) switch
5. Fan button (fan control button)

Fan button (fan control button)

This knob controls the resistance of the blower to control the rotation of the blower motor to adjust the air volume of the nozzle. (A/C manual)

There are 4 buttons to set the position.

1. Low
2. Medium low
3. Medium high
4. High

Air source conversion rod (switch)

The left and right movement of the switching lever can be converted to "fresh" (fresh air) and "RECIRC" (in the air circulation).

● With automatic air conditioning, the vehicle presses the switch to achieve “fresh” (fresh air) and “RECIRC” (air circulation inside).

The air source change lever is a lever (switch) that selects "external fresh air introduction" or "internal air circulation". Select "FRESH (fresh air)" and outside air enters the cabin (mixing part of the internal air). Select 41 RECIRC (Air circulation), only internal air circulates without external air. At the moment, the temperature in the cabin rose rapidly. However, in general, select "FRESH" to prevent the air conditioner and the front window from being covered with fog.

Control rod assembly (manual car A/C)

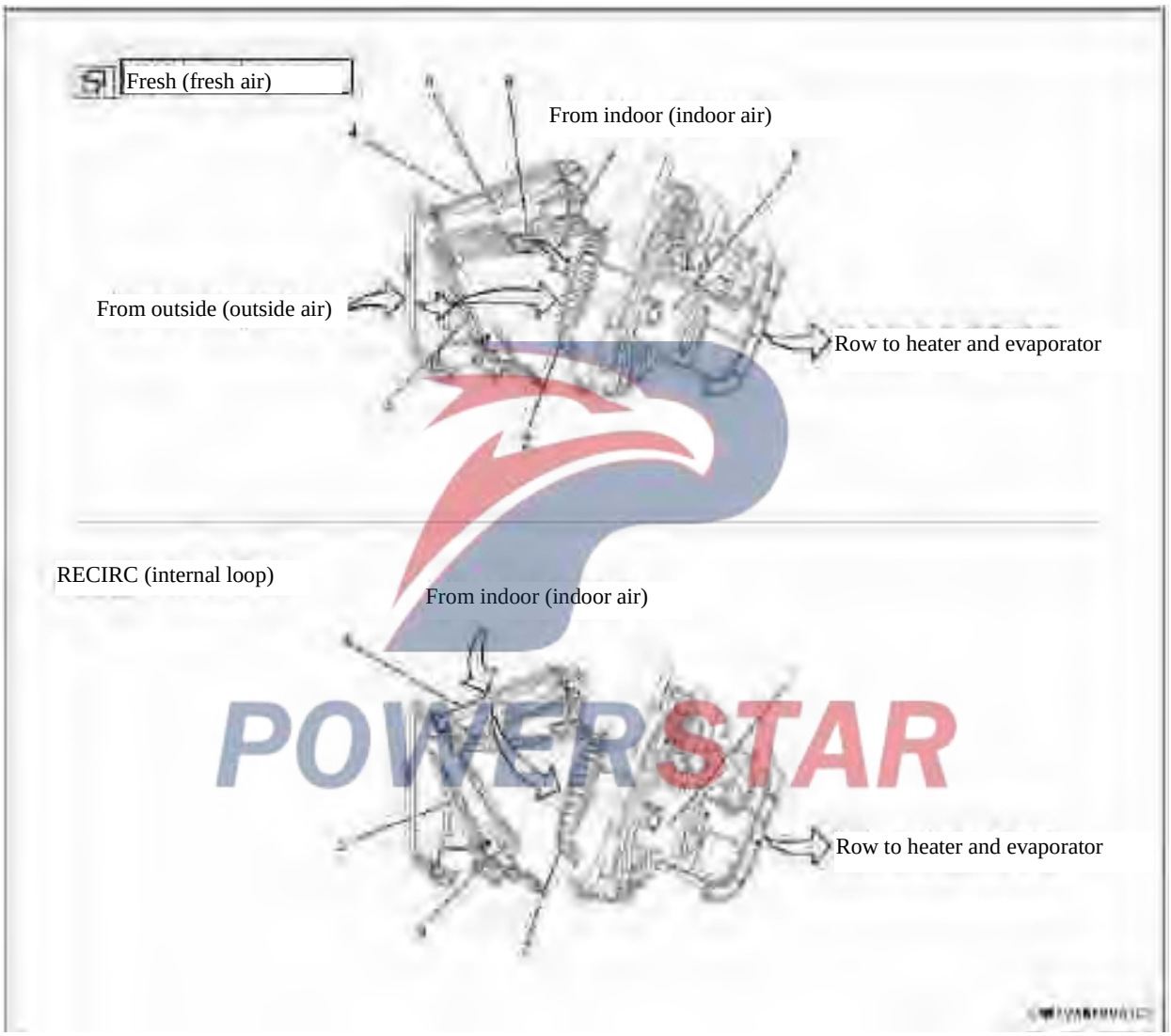
The control rod assembly utilizes cables to control the selection of heater nozzles and the temperature control and conversion of the gas source of the blower assembly. Fan resistance is used to control the air volume, and is divided into four wind speeds from "low" to "high".

Ventilation

Place the ventilation rod (switch) in the FRESH (fresh air) position to introduce fresh air to the outside. (In order to improve the heating performance, the internal air is mixed from the inside air inlet of the ventilation unit.)

The blower fan feeds outside air into the vehicle to provide adequate ventilation.

The gas supply lever (switch) pays attention to the change of the position of "RECIRC" (in the air circulation) and introduces not only the gas circulating in the outside air.



Key

1. Blower motor
2. Blower fan
3. Outside air filter
4. Internal air filter
5. Intake valve
6. Internal air mixture

Air outlet switch (switch)

Use this button (switch) to select the outlet. The nozzle changeover is achieved by adjusting the position of the two rotatable status doors in the heater. In this state, the door can be adjusted for each output hole area of the heating device to prevent the opening portion of the ventilation mode from being selected by performing six types of internal ventilation.

● FACE: In this position, air through the ventilation duct (2) is introduced into the vehicle. The air volume is controlled by the fan button (fan control knob).

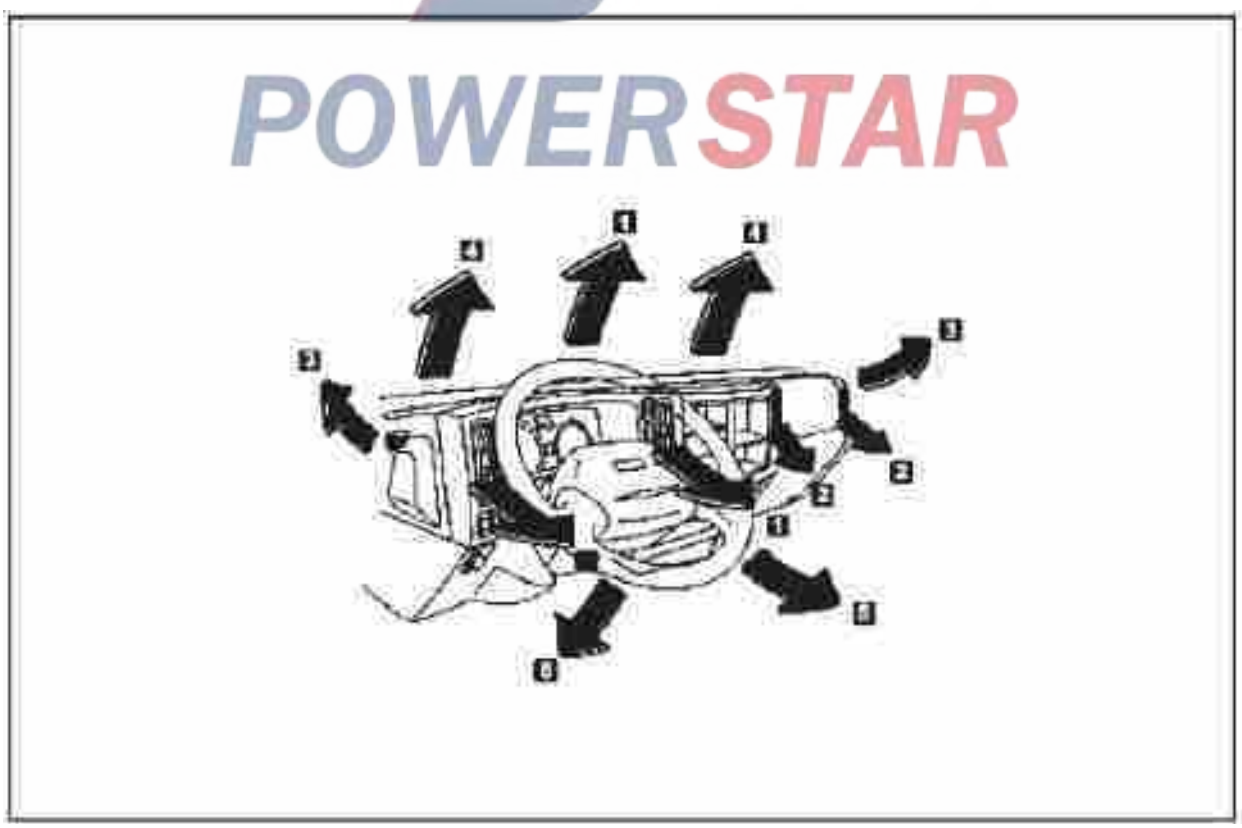
● BI-LEVEL: In this position, the air is divided into two parts in the heating device through the air duct (2) and the bottom outlet (5). Then, the temperature control knob is in the middle position, and the air blown between the floor and the foot (5) from the air ratio of the air duct (2) is high at the above temperature.

● FOOT (wind stage): In this position, all air supplied through the floor outlet leg member (5).

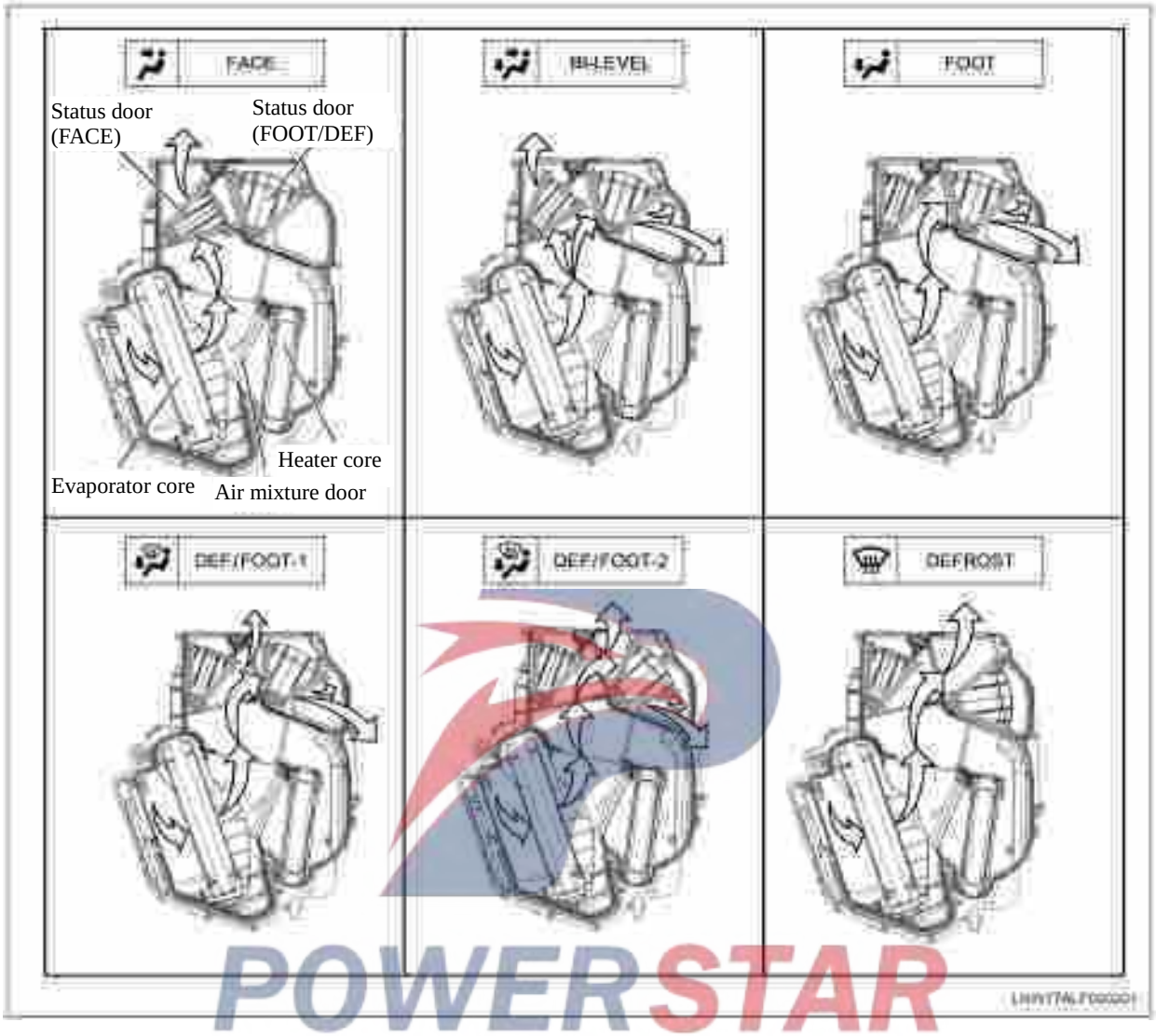
● DEF / PIED-1 (Defrost/Floor Wind-1): In this position, the air sent to the floor (5) passes through the defrost air outlet (3, 4) compared to the air volume of the athlete's foot (foot under wind conditions). A small amount of air.

● DEF/FOOT-2 (Defrost/Floor Wind-2): In this position, the volume of air is discharged from the defrost outlet relative to DEF/FOOT-1 (Defrost/Floor Wind-1) (3,4) The amount of air delivered to the floor nozzle (5) is reduced.

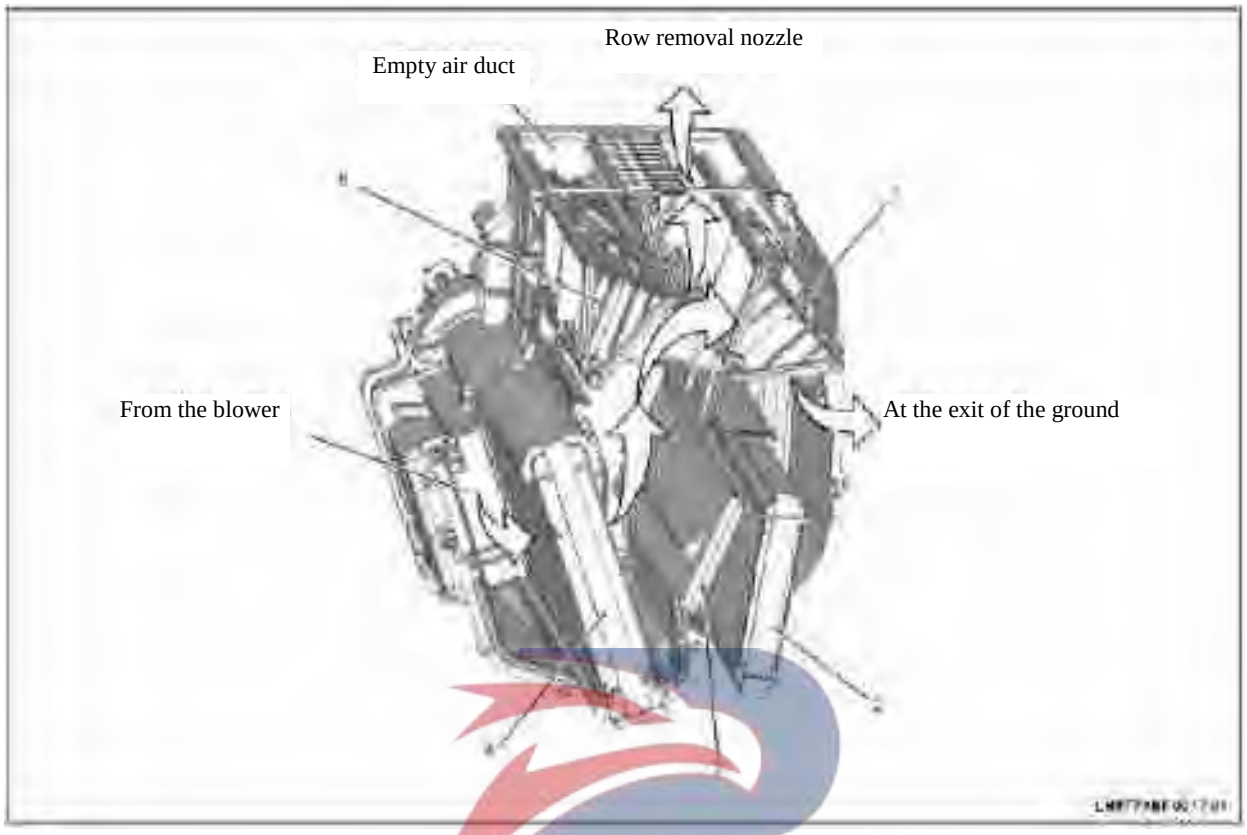
● Defrost (defrost status): In this position, air supplies most of the front window (4) and a small amount of air supply side window (3).



Operation diagram of the status door (air mixing door = MAX COOL (coldest))



State gate structure diagram (DEF / FOOT-2 mode)



Key

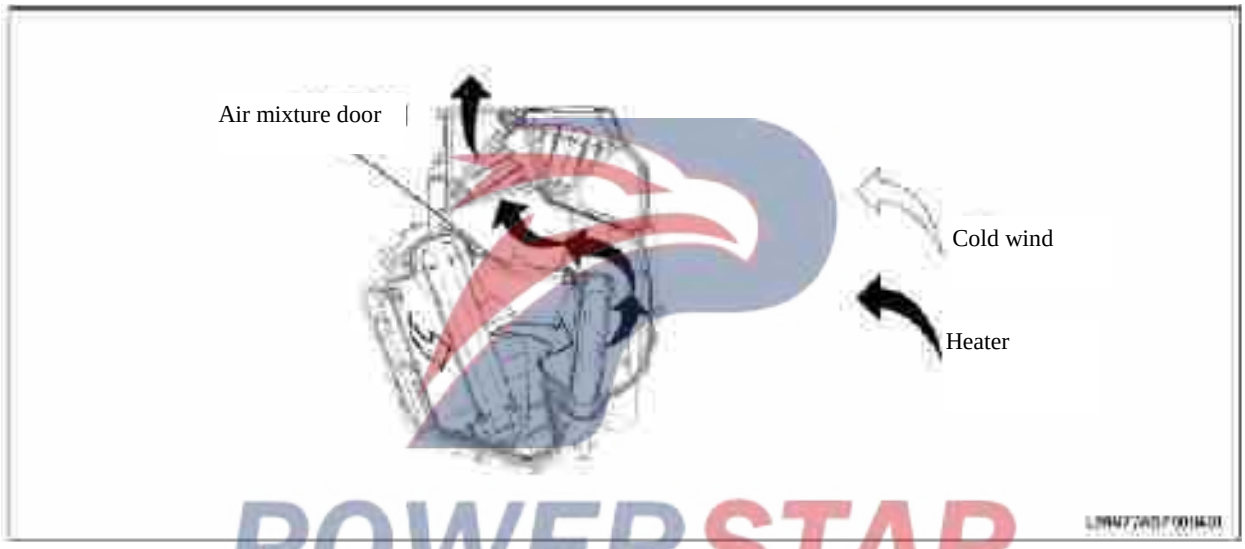
1. Country Door (DEF / FOOT "Defrost / Wind Bottom")
2. Heater core
3. Air mixture door
4. Evaporator core
5. Status Gate (face "face")

Temperature adjustment button

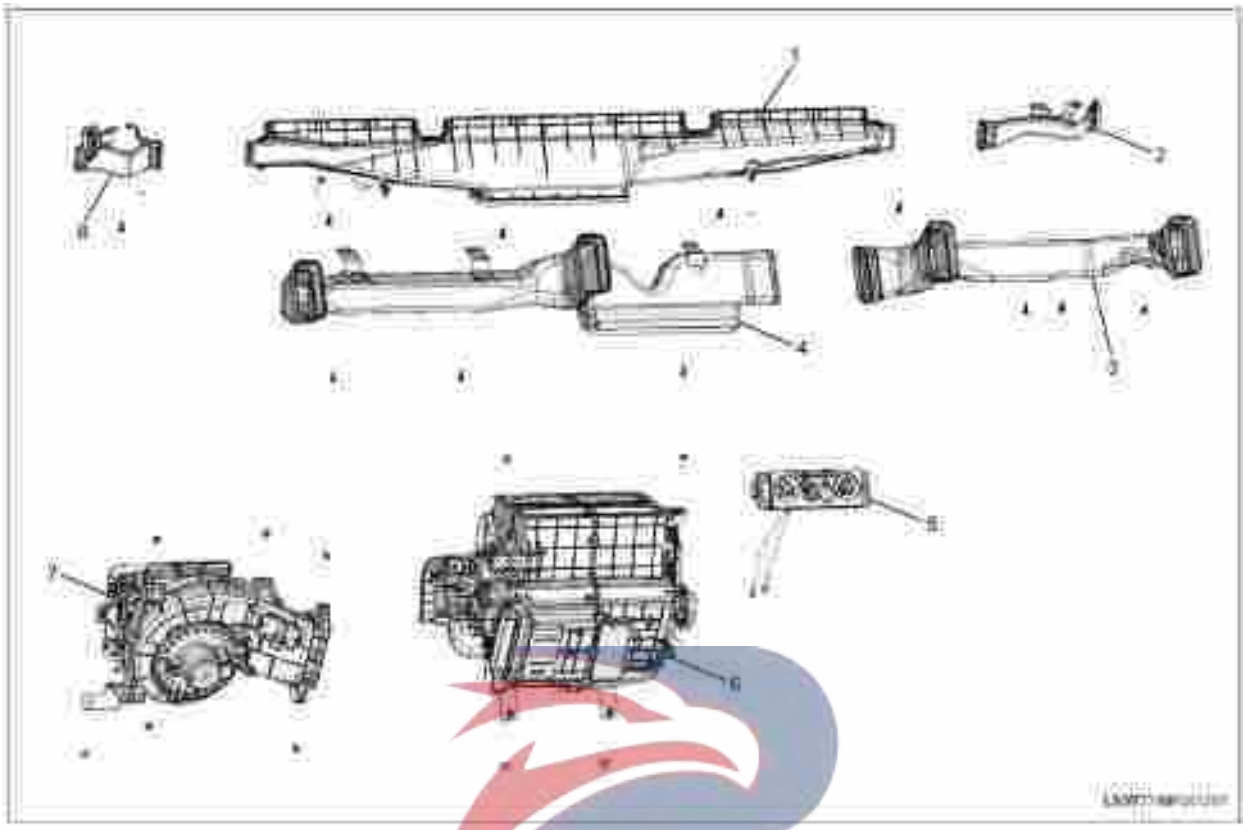
Use this knob to adjust the temperature of the air sent through the nozzle. When the knob is in the “MAX COLD” (18℃) position, the air mix door closes, preventing air from flowing into the heater core. When the knob is in the "MAXHOT" position (32℃), the air mixing door is fully open and the air passes through the heating core to heat the chamber.

When the (switch) button is in the center position, the temperature inside the car is adjusted by increasing or decreasing the airflow into the heater core.

MAX HOT (hottest) (FACE mode)



Parts configuration diagram



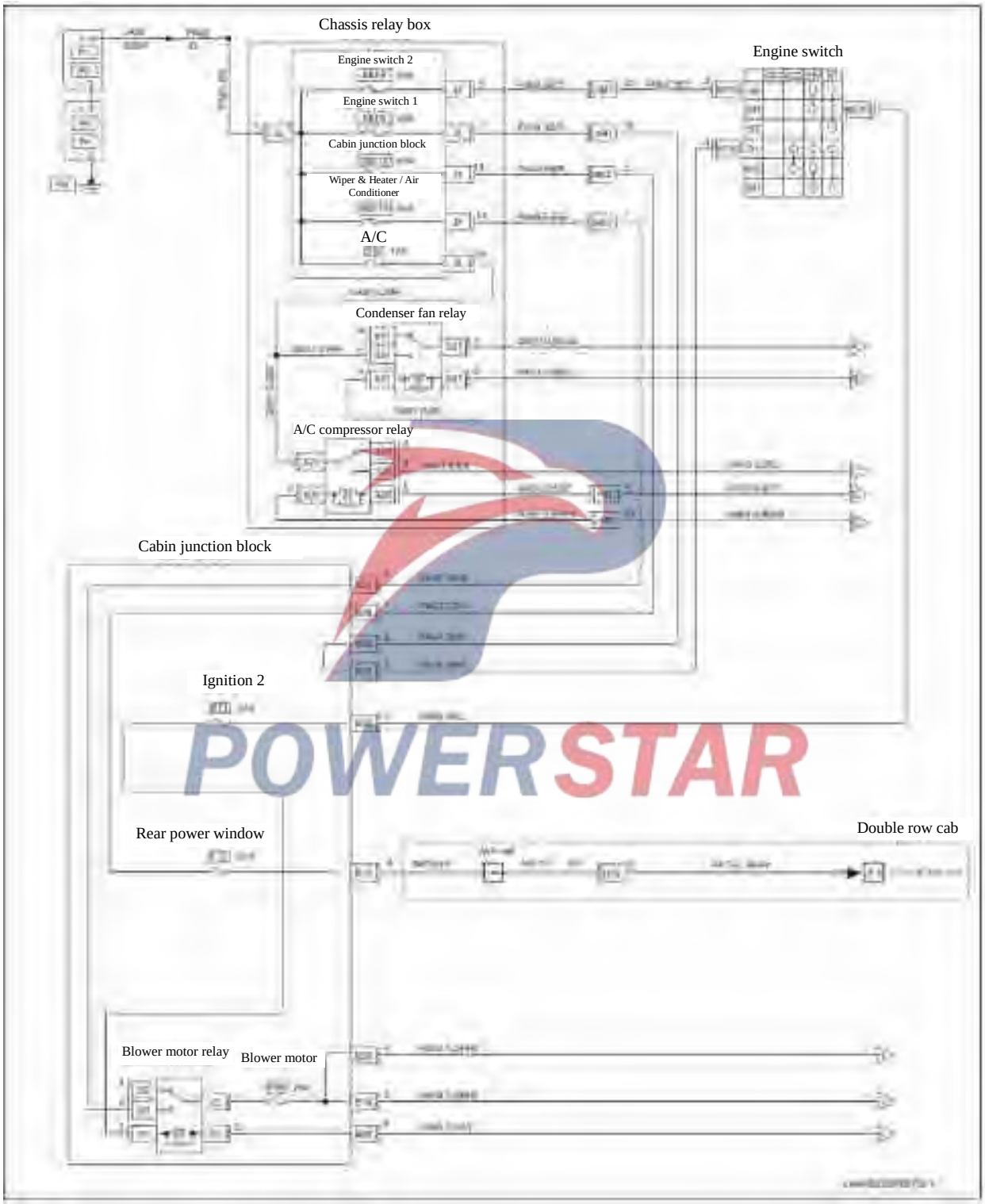
Key

1. Deicing nozzle
2. Side defrost nozzle (right)
3. Ventilation tube (right)
4. Ventilation tube (left)
5. Control rod assembly
6. Heating and Evaporation Devices
7. Blower assembly
8. Side defrost nozzle (left)

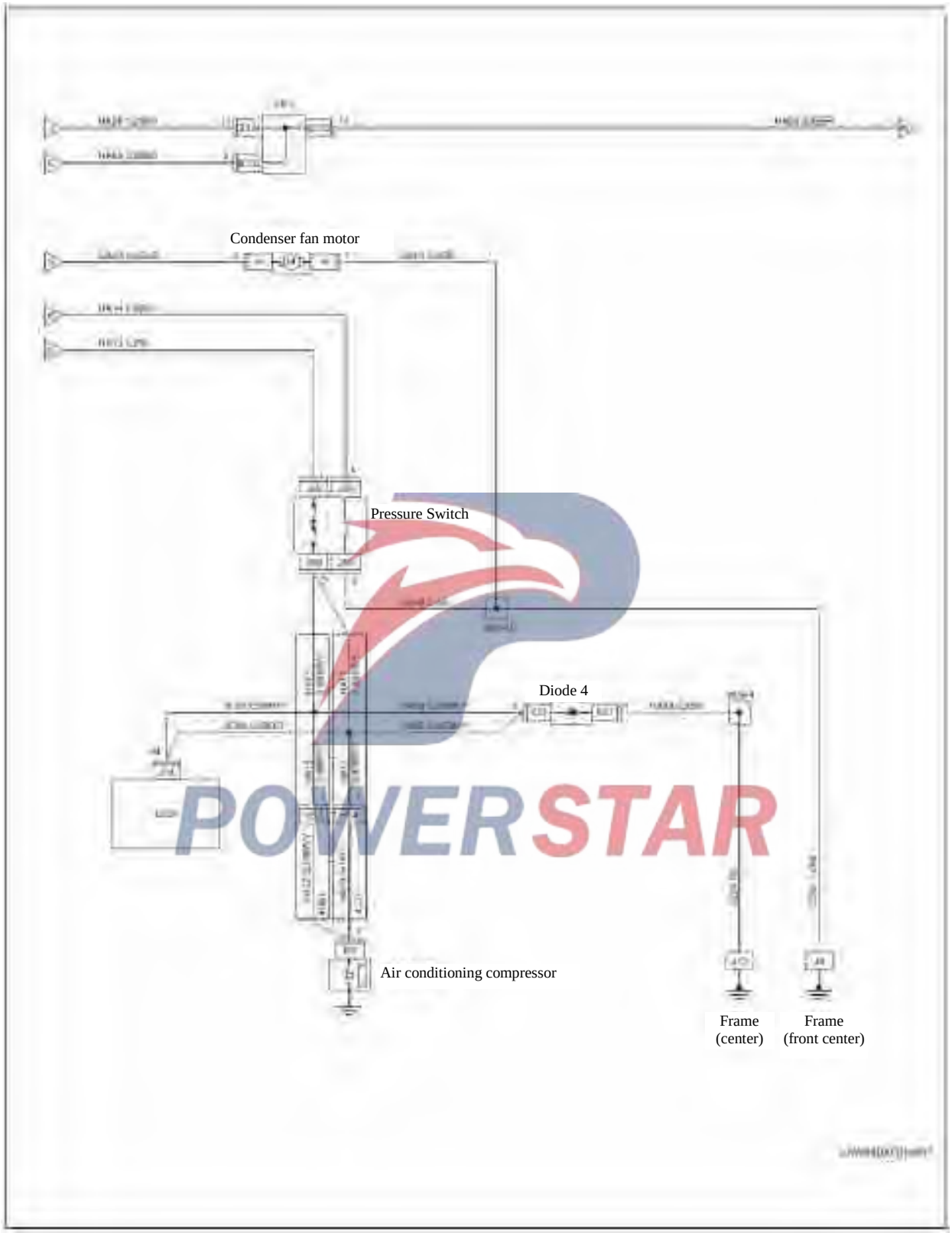
Heating and air conditioning (manual)

Circuit diagram

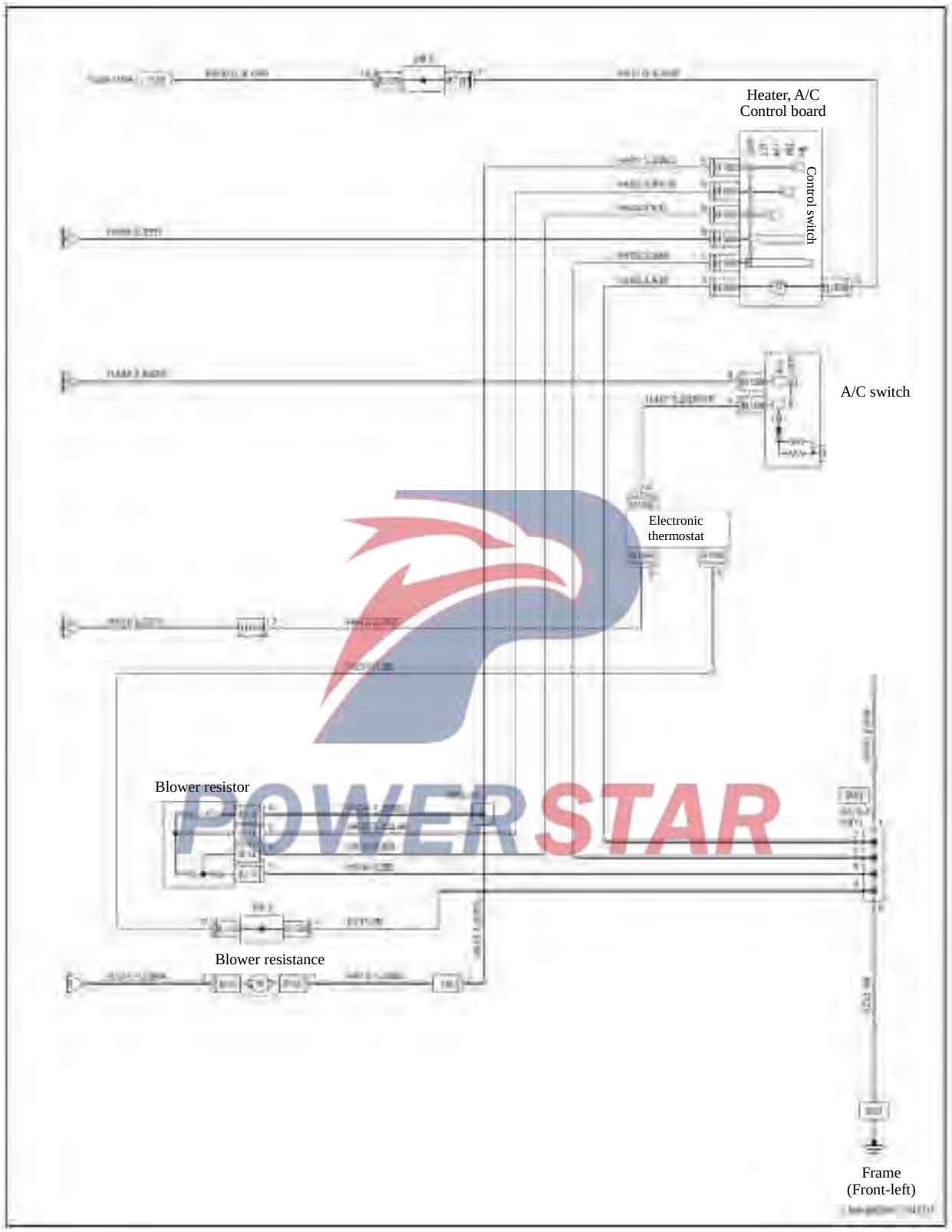
NLR，NMR，NNR，NPR/S，NQR(1/3)



NLR，NMR，NNR，NPR/S，NQR(2/3)



NLR，NMR，NNR，NPR/S，NQR(3/3)



Functional check: heating cycle system

Symptom	Probable causes	Process
Do not cool, otherwise the cooling effect is not good.	Blower motor does not work or fails.	See "Functional Inspection: Fan Switching System."
	Engine coolant temperature is low.	Heat the engine and check the engine coolant temperature. Check the thermostat and replace it if necessary.
	Insufficient engine coolant.	If necessary, add engine coolant.
	Insufficient engine coolant flow.	Check that the water supply hose connected to the heater core is clogged, broken or deformed and correct or replace it if necessary. Check the water pump and thermostat.
	Heater plugged or damaged.	Clean or replace if necessary.
	Air mixing door is defective.	Correct or adjust the control cable of the temperature control connection. Correct or adjust the control cable.
	The pipe connection is damaged or not waterproof.	Correct or replace if necessary.
The command button is working, but the status door does not work.	The cable is locked or dropped badly.	Correct
	Connection unit with defective heating unit or blower assembly.	Correct
Cannot adjust the status gate to the specified mode.	Connection unit with defective heating unit or blower assembly.	Correct
	The control cable is not adjusted correctly.	Adjustment

Functional Check: Fan Switch System

Regardless of the position of the switch, the blower motor will not operate, and prior confirmation and visual inspection.

● Check the battery voltage is normal.

When the battery voltage is abnormal, please charge or replace the battery

● Check if the fuse is normal.

When the fuse is abnormal (abnormal fuse, etc.), check the cause of the fuse (wiring short circuit, etc.) Or fuse check in advance.

● Check if the grounding point is normal.

When the quality point is abnormal (bad installation or obvious dirt), perform maintenance and cleaning.

● Check whether the harness and joint are normal.

It was found that there was no bad wear on the harness connector. When a fault such as a disconnection occurred, the harness formed another circuit in the short circuit for testing.

● Check the electrical effects (wireless devices, lights, etc.).

Turn off or unplug the power plug and check or pay attention to the operation.

Component verification

● Check the blower resistance.

When it is found that the fan resistance is abnormal, the fan resistance should be replaced.

● Check the fan switch.

If you find that the fan switch is abnormal, replace the fan switch.

Check the circuit

● Check the following circuits for open circuit, short circuit (power and ground) and high resistance.

When the circuit is abnormal, repair or replace the circuit in question.

(The number indicates the terminal number of the connector on the chassis harness side.)

- Between fan resistance terminal NO.2 and fan switch NO.6 terminal

Blower motor does not work in position 1 (low level)

Prior confirmation and visual inspection

● Check the battery voltage is normal.

When the battery voltage is abnormal, please charge or replace the battery

● Check if the fuse is normal.

When the fuse is abnormal (abnormal fuse, etc.), check the cause of the fuse (wiring short circuit, etc.) Or fuse check in advance.

● Check if the grounding point is normal.

When the grounding point is abnormal (failure or large area of dirt), repair and clean.

● Check whether the harness and joint are normal.

It was found that there was no bad wear on the harness connector. When a fault such as a disconnection occurred, the harness formed another circuit in the short circuit for testing.

● Check the electrical effects (wireless devices, lights, etc.).

Turn off or unplug the power plug and check or pay attention to the operation.

Component verification

● Check the blower resistance.

Continuously check blower resistance and replace if abnormal.

● Check the fan switch.

Perform fan switch continuity check. If it is abnormal, replace it.

Check the circuit

● Check the following circuits for open circuit, short circuit (power and ground) and high resistance.

When the circuit is abnormal, repair or replace the circuit in question.

(The number indicates the terminal number of the connector on the chassis harness side.)

- Between terminal and mass of fan resistance NO.4

Blower motor in position 2 (medium low, medium low)

Prior confirmation and visual inspection

● Check the battery voltage is normal.

When the battery voltage is abnormal, please charge or replace the battery

● Check if the fuse is normal.

When the fuse is abnormal (an abnormal situation is blown), check the reason for the previous inspection or repair (short-circuit harness, etc.) And replace the fuse.

● Check if the grounding point is normal.

When the grounding point is abnormal (failure or large area of dirt), repair and clean.

● Check whether the harness and joint are normal.

It was found that there was no bad wear on the harness connector. When a fault such as a disconnection occurred, the harness formed another circuit in the short circuit for testing.

● Check the electrical effects (wireless devices, lights, etc.).

Turn off or unplug the power plug and check or pay attention to the operation.

Component verification

● Check the blower resistance.

Continuously check blower resistance and replace if abnormal.

● Check the fan switch.

Perform fan switch continuity check. If it is abnormal, replace it.

Check the circuit

● Check the following circuits for open circuit, short circuit (power and ground) and high resistance.

When the circuit is abnormal, repair or replace the circuit in question.

(The number indicates the terminal number of the connector on the chassis harness side.)

- Between NO.2 fan resistance terminal and N0.6 fan switch terminal

Blower motor does not operate in position 3 (medium height).

Prior confirmation and visual inspection

● Check the battery voltage is normal.

When the battery voltage is abnormal, please charge or replace the battery

● Check if the fuse is normal.

When the fuse is abnormal (an abnormal situation is blown), check the reason for the previous inspection or repair (short-circuit harness, etc.) And replace the fuse.

● Check if the grounding point is normal.

When the grounding point is abnormal (failure or large area of dirt), repair and clean.

● Check whether the harness and joint are normal.

It was found that there was no bad wear on the harness connector. When a fault such as a disconnection occurred, the harness formed another circuit in the short circuit for testing.

● Check the electrical effects (wireless devices, lights, etc.).

Turn off or unplug the power plug and check or pay attention to the operation.

Component verification

● Check the blower resistance.

Continuously check blower resistance and replace if abnormal.

● Check the fan switch.

Perform fan switch continuity check. If it is abnormal, replace it.

Check the circuit

● Check the following circuits for open circuit, short circuit (power and ground) and high resistance.

When the circuit is abnormal, repair or replace the circuit in question.

(The number indicates the terminal number of the connector on the chassis harness side.)

- Between NO.3 fan resistance terminal and N0.5 fan switch terminal

Blower motor does not operate in position 4 (HI high).

Prior confirmation and visual inspection

● Check the battery voltage is normal.

When the battery voltage is abnormal, please charge or replace the battery

● Check if the fuse is normal.

When the fuse is abnormal (an abnormal situation is blown), check the reason for the previous inspection or repair (short-circuit harness, etc.) And replace the fuse.

● Check if the grounding point is normal.

When the grounding point is abnormal (failure or large area of dirt), repair and clean.

● Check whether the harness and joint are normal.

It was found that there was no bad wear on the harness connector. When a fault such as a disconnection occurred, the harness formed another circuit in the short circuit for testing.

● Check the electrical effects (wireless devices, lights, etc.).

Turn off or unplug the power plug and check or pay attention to the operation.

Component verification

● Check the blower resistance.

Continuously check blower resistance and replace if abnormal.

● Check the fan switch.

Perform fan switch continuity check. If it is abnormal, replace it.

Check the circuit

● Check the following circuits for open circuit, short circuit (power and ground) and high resistance.

When the circuit is abnormal, repair or replace the circuit in question.

(The number indicates the terminal number of the connector on the chassis harness side.)

- Between fan motor NO.1 terminal and fan switch terminal N0.4

Blower motor does not stop

Prior confirmation and visual inspection

● Check the battery voltage is normal.

When the battery voltage is abnormal, please charge or replace the battery

● Check if the fuse is normal.

When the fuse is abnormal (an abnormal situation is blown), check the reason for the previous inspection or repair (short-circuit harness, etc.) And replace the fuse.

● Check if the grounding point is normal.

When the grounding point is abnormal (failure or large area of dirt), repair and clean.

● Check whether the harness and joint are normal.

It was found that there was no bad wear on the harness connector. When a fault such as a disconnection occurred, the harness formed another circuit in the short circuit for testing.

● Check the electrical effects (wireless devices, lights, etc.).

Turn off or unplug the power plug and check or pay attention to the operation.

Component verification

● Check the fan switch.

Perform fan switch continuity check. If it is abnormal, replace it.

Check the circuit

● Check for short circuits in the following circuits.

When the circuit is abnormal, repair or replace the circuit in question.

(The number indicates the terminal number of the connector on the chassis harness side.)

- Between the terminals N0.1 and N0.8 of the fan switch (short circuit between lines)

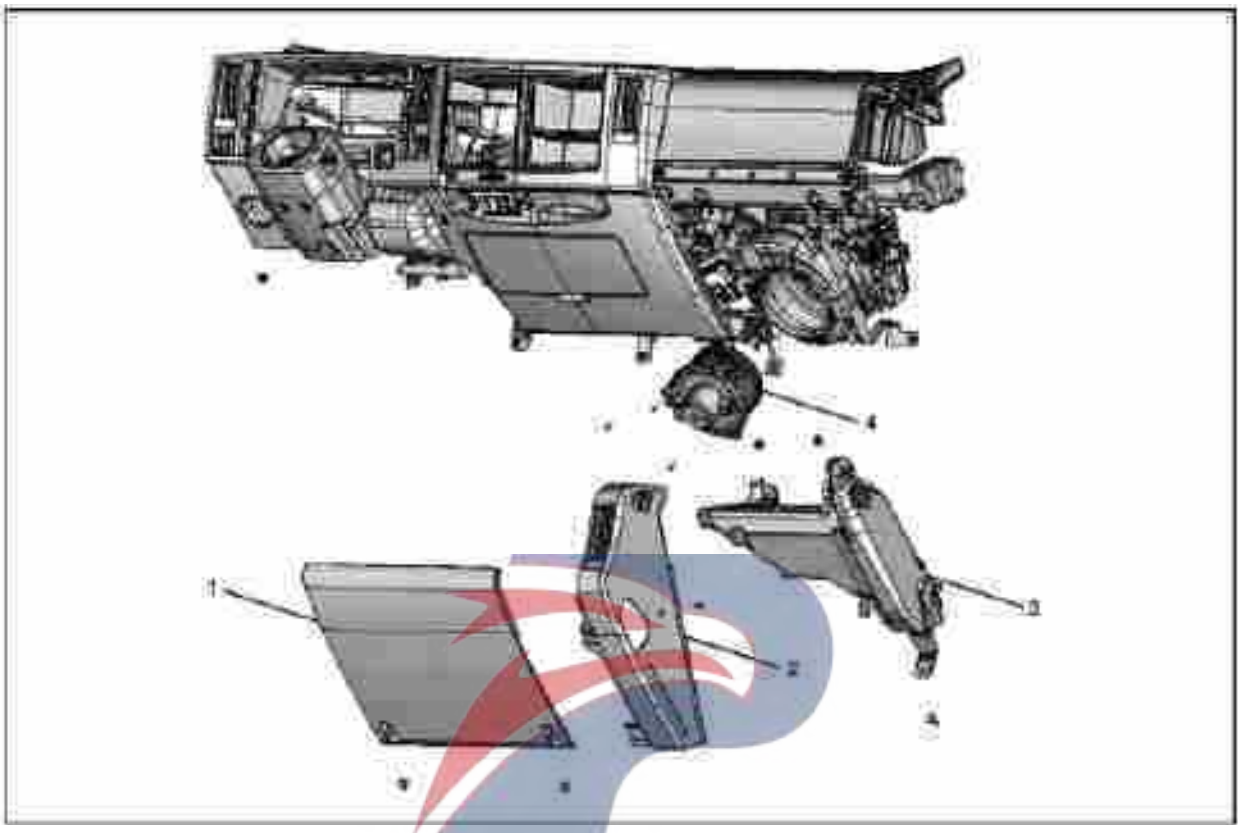
- N0.8 terminal of fan switch and NO.5 terminal of blower relay (short to ground)

Main parameters

Item		Specification parameter
Heater device	Temperature control system	Type of preheated air mixture
	Heat dissipation kw {kcal/hr}	4.8(4100}
	Air volume m3 / h	290
	Fan Motor (Rated Voltage) V	24
Heater core	Type	Airfoil and tube type
	Effective core size mm	284.7×100×27(11.2×3.9×1.1 in)
	Heat dissipation area m^2	About 2.1

Blower motor

Component parts



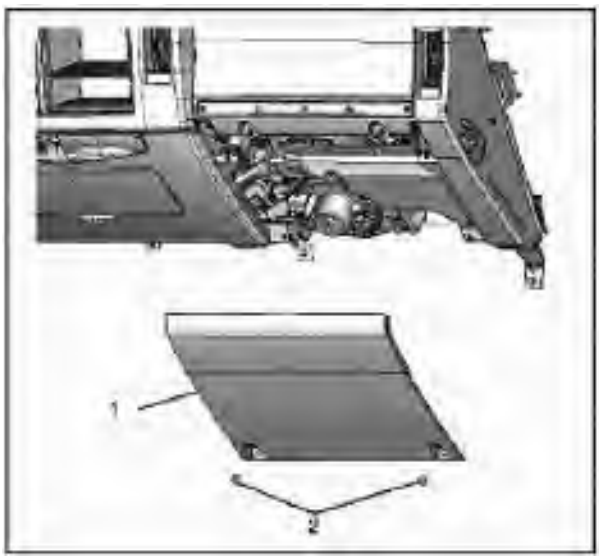
Key

1. Turn deflector (passenger side)
2. Side decorative plate
3. Cleaning tank
4. Blower motor assembly

Disassembly

1. Remove knee baffle (passenger side) (1).

● First remove the resin clip (2) from the bezel (passenger side) (1), then pull the front bezel and release the internal clip.



2. Remove the side trim.

● First remove the resin clip from the side panel, then pull the front panel and release the clip.

3. Remove the cleaning box.

● Remove the cleaning tank's mounting nut and mounting bolts first and then disconnect the connectors.

4. Remove the blower motor assembly.

● Disconnect the blower motor connector.

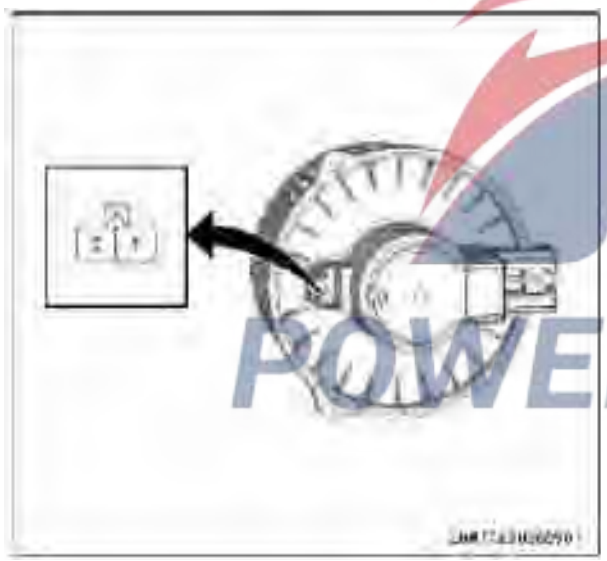
● Remove the screw fixing the blower motor.

Inspection

Blower motor

1. The battery voltage (+) terminal is connected to the blower motor N0.2, and the (-) terminal is connected to the N0.1 terminal.

2. Check if the blower motor is working properly.



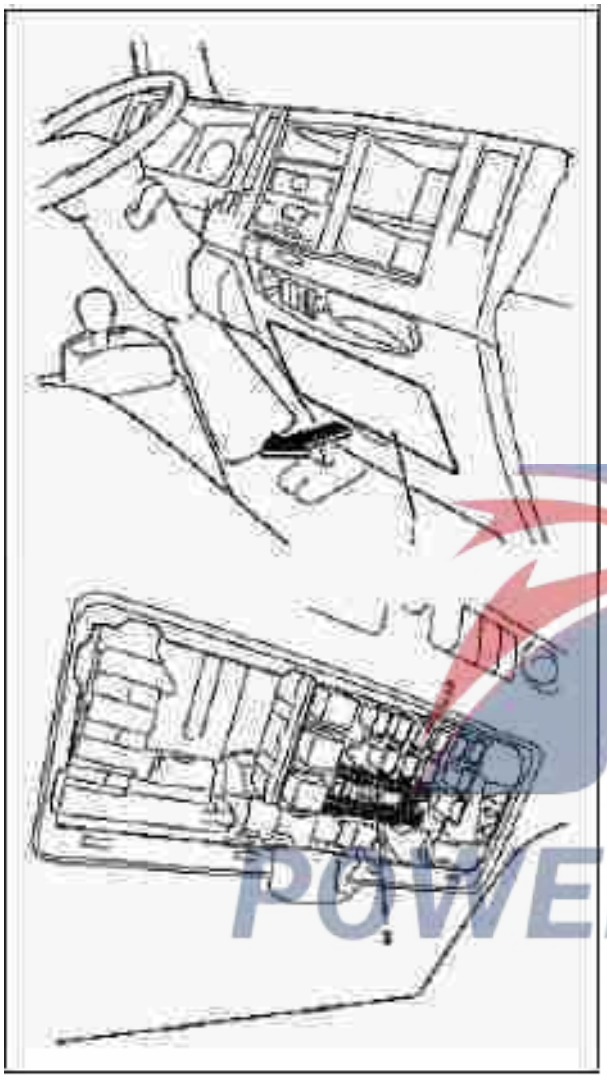
Installation

Install the lamp in the sequence opposite to the removal .

Blower relay

Disassembly

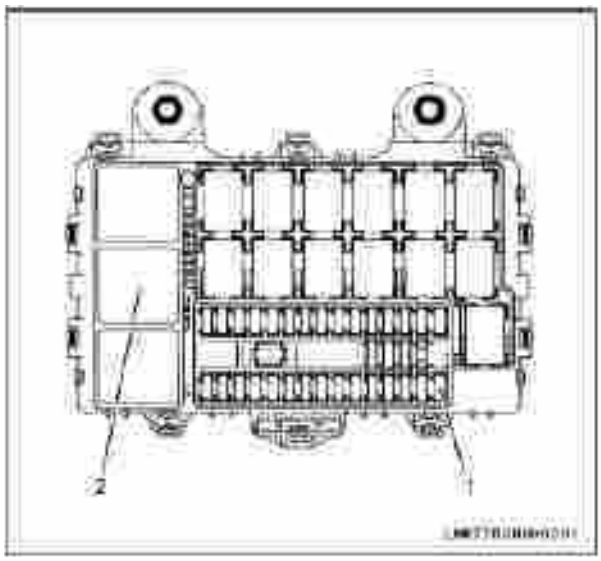
1. Position of fuse box relay box (cab connecting block)



Key

1. Relay box cover
2. Different relays
3. Different fuses

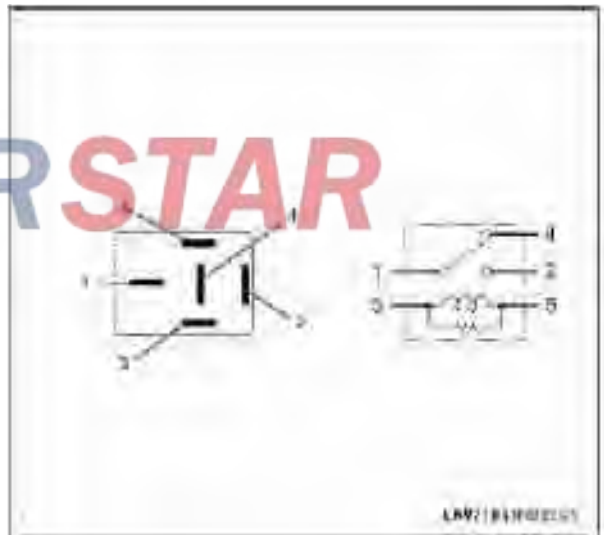
2. Disconnect blower motor relay (2).



Key

1. Blower motor fuse
2. Blower motor relay

3. Perform continuity check between relay-side terminals.



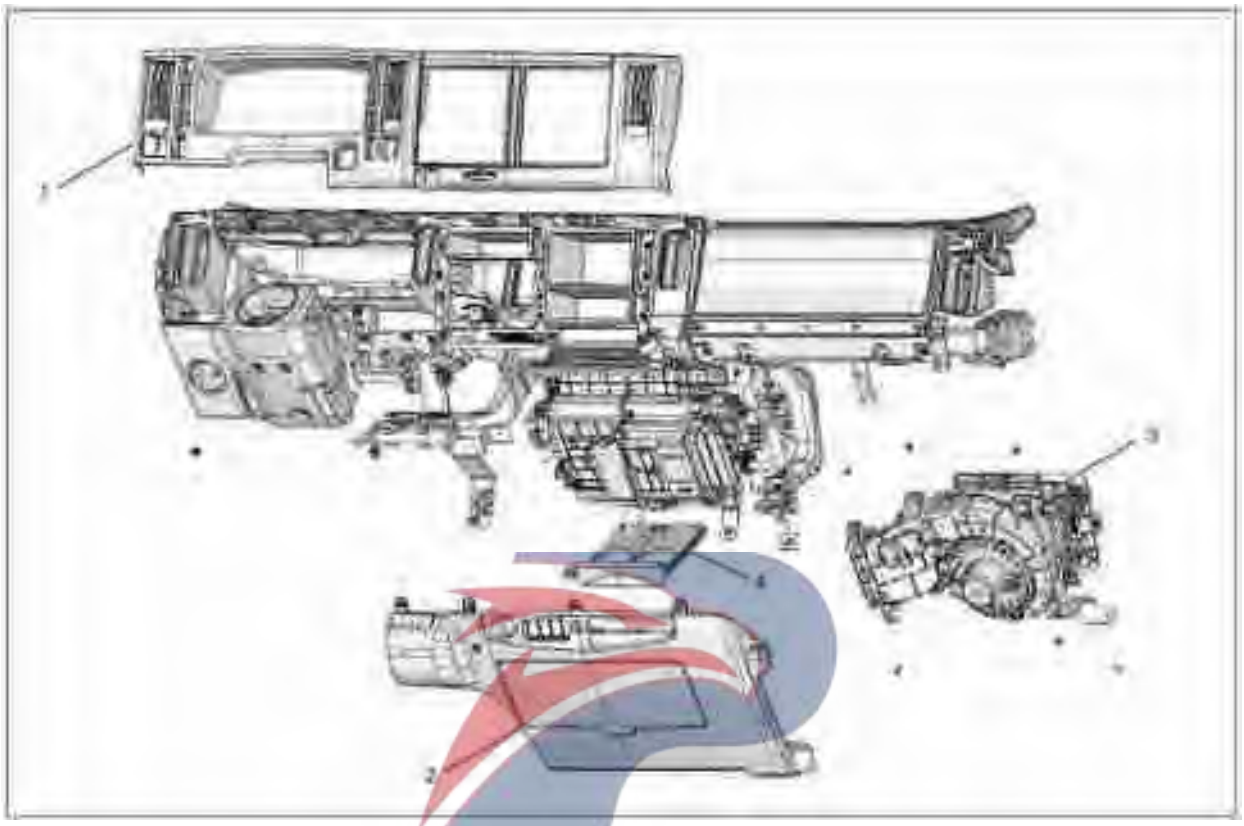
1 - 4---------- Conductivity 1 - 2 ---------- Do not conduct
(When the battery voltage is between 3-5) 1 - 4---------- Conductivity 1 - 2 ---------- Do not conduct

Installation

Install the lamp in the sequence opposite to the removal.

Blower assembly

Component parts



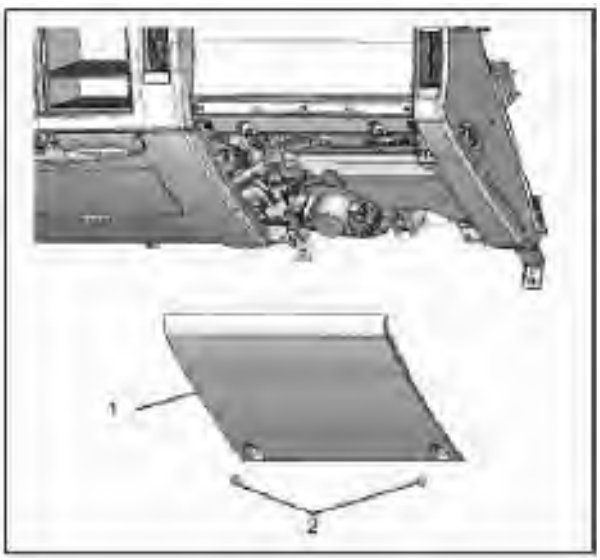
Key

1. Instrument group
2. Knee deflector (driver side)
3. Blower assembly
4. Cup holder

Disassembly

1. Remove the knee baffle (passenger side).

● First remove the resin clip (2) from the bezel (passenger side) (1), then pull the front bezel and release the internal clip.



2. Remove the side trim.

● First remove the resin clip from the side panel, then pull the front panel and release the clip.

3. Remove the cleaning box.

● Remove the cleaning cartridge mounting nuts and mounting bolts first and then loosen the connector connections.

4. Remove the dashboard.

● Place the instrument panel in front of you and release the internal clip.

● Release the connector connection.

5. Remove the knee baffle (driver side).

● First remove the baffle connecting bolt (driver side) and the resin clip, then pull the front bezel and release the internal clip.

6. Remove the air supply control cable.

● Disconnect the air supply control cable from the blower assembly. (Manual A/C)

7. Loosen the blower motor connector connection.

8. Loosen the blower resistor connector.

9. Remove the radiator grille.

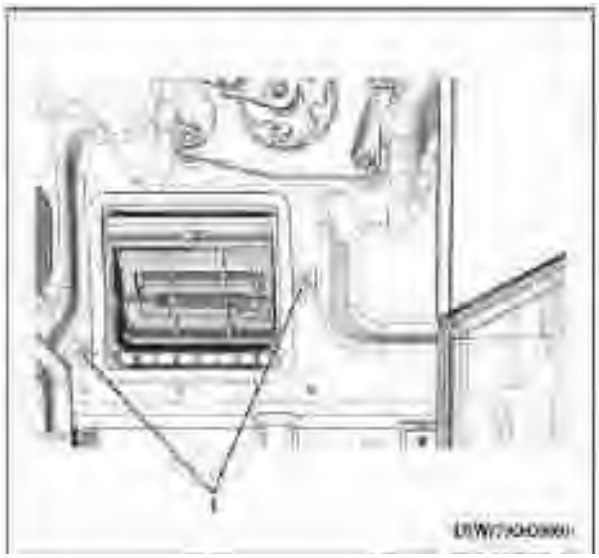
● Refer to Radiator Grille, Dashboard (High Ceiling Cabin, Extended Cabin) in Section 9G.

10. Remove the dashboard. (Height cab/ extension cab)

● Refer to Radiator Grille, Dashboard (High Ceiling Cabin, Extended Cabin) in Section 9G.

11. Remove the bolt(1).

(Height cab/ extension cab)



12. Remove the mounting bolts, nuts, and screws from the side (inside) of the blower.

13. Remove the blower assembly.

● Simultaneously with the installation volume of the ventilation unit (lower left side).

Installation

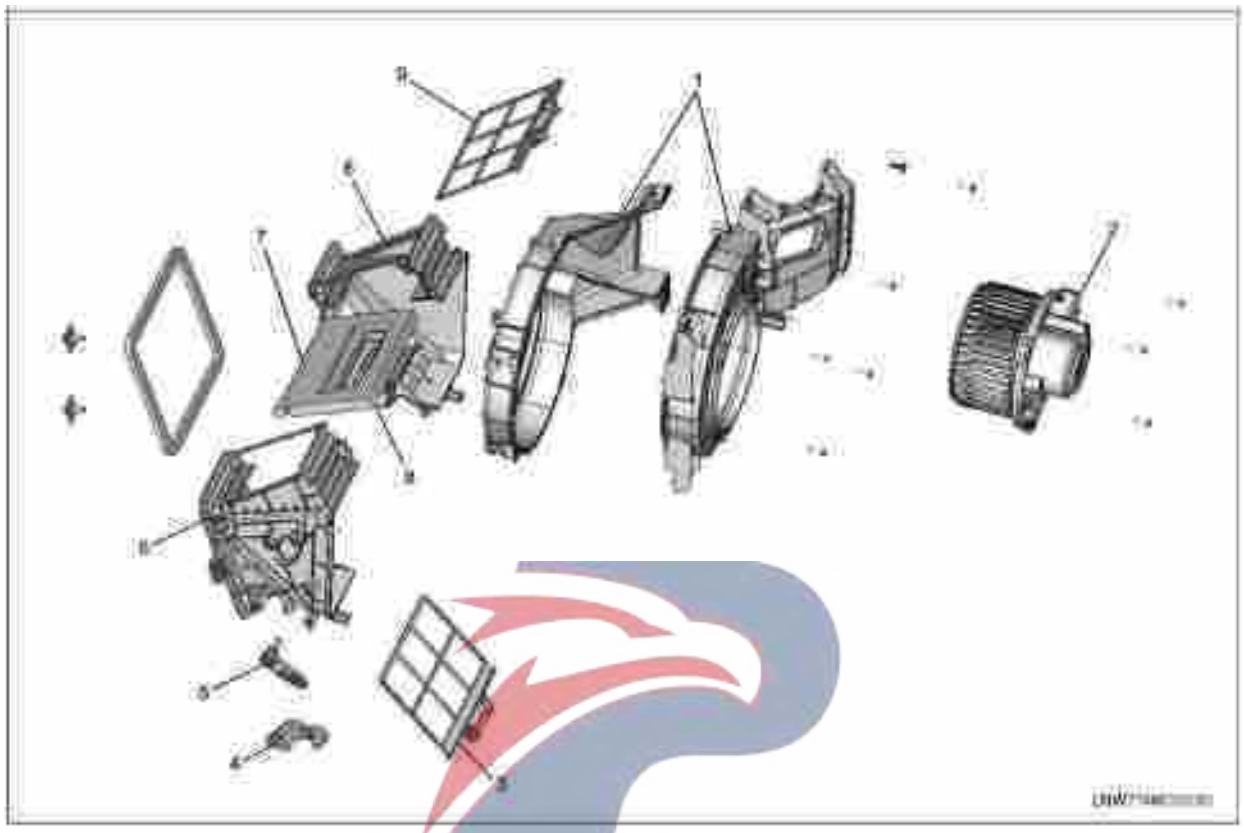
When installing, pay attention to the following points and install them in the reverse order of removal.

1 Adjust the air supply control cable. (A/C manual)

● Refer to the joystick in this chapter.

Blower linkage device and intake valve

Component parts



Key

1. Lower cover
2. Blower motor assembly
3. Outside air filter
4. Intake auxiliary lever
5. Door control rod
6. Upper cover
7. Intake valve
8. Internal air mixture
9. Internal air filter

Use a good example to illustrate

Disassembly

1. Remove the blower assembly.

● See blower parts in this chapter.

2. Remove the outside air filter.

3. Remove the internal air filter.

4. Remove the bottom cover.

Remove the lower cover mounting screw.

5. Remove the air intake assist lever.

● Remove the mounting screws on the air intake assist lever.

6. Remove the lever from the door.

7. Divide the lid into two parts.

● Remove the upper cover mounting screw.

8. Remove the intake valve.

Installation

When installing, pay attention to the following points and install them in the reverse order of removal.

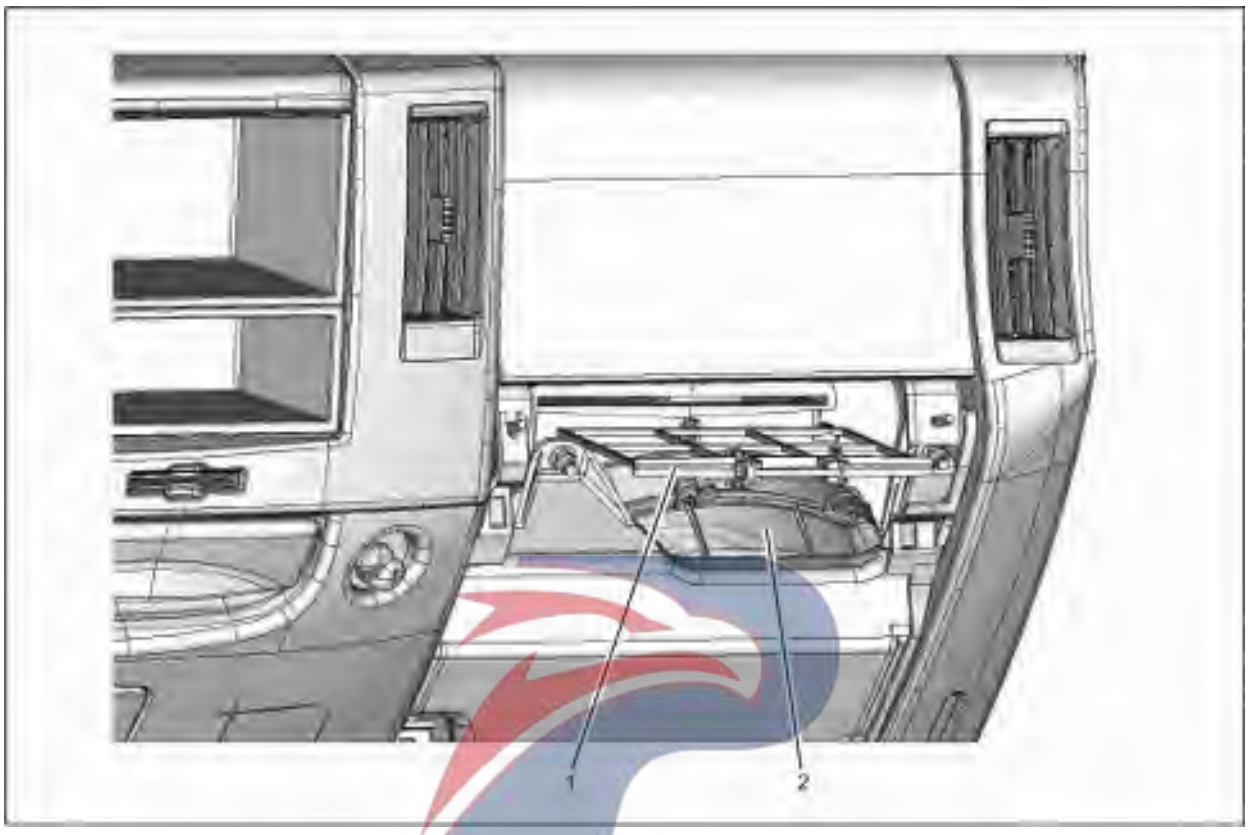
1. First check the intake valve is installed in the normal position, and then tighten the screws on the cover.

2. Apply grease to the sliding surface of each rod.

3. After the installation is complete, check that the intake valve can operate normally.

Internal air filter

Component parts



Key

1. Internal air filter
2. Blower assembly

Disassembly

1. Remove the knee baffle (passenger side).

● First remove the resin clip (2) from the bezel (passenger side) (1), then pull the front bezel and release the internal clip.

2. Remove the internal air filter

● Remove the filter from the upper slot of the blower.

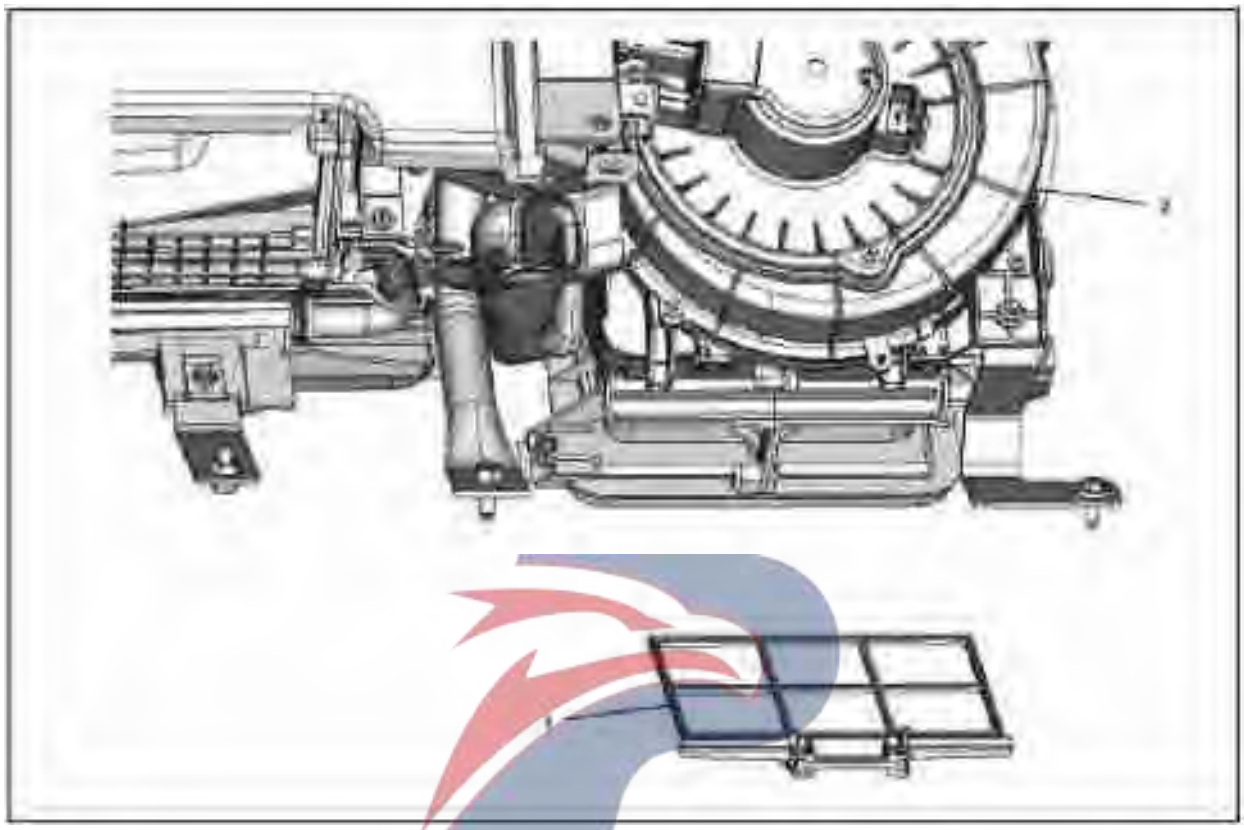
Installation

When installing, pay attention to the following points and install them in the reverse order of removal.

1. Insert the filter into the slot.

Outside air filter

Component parts



Key

1. Outside air filter
2. Blower assembly

Disassembly

1. Remove the outside air filter.

● Remove the filter from the upper slot of the blower.

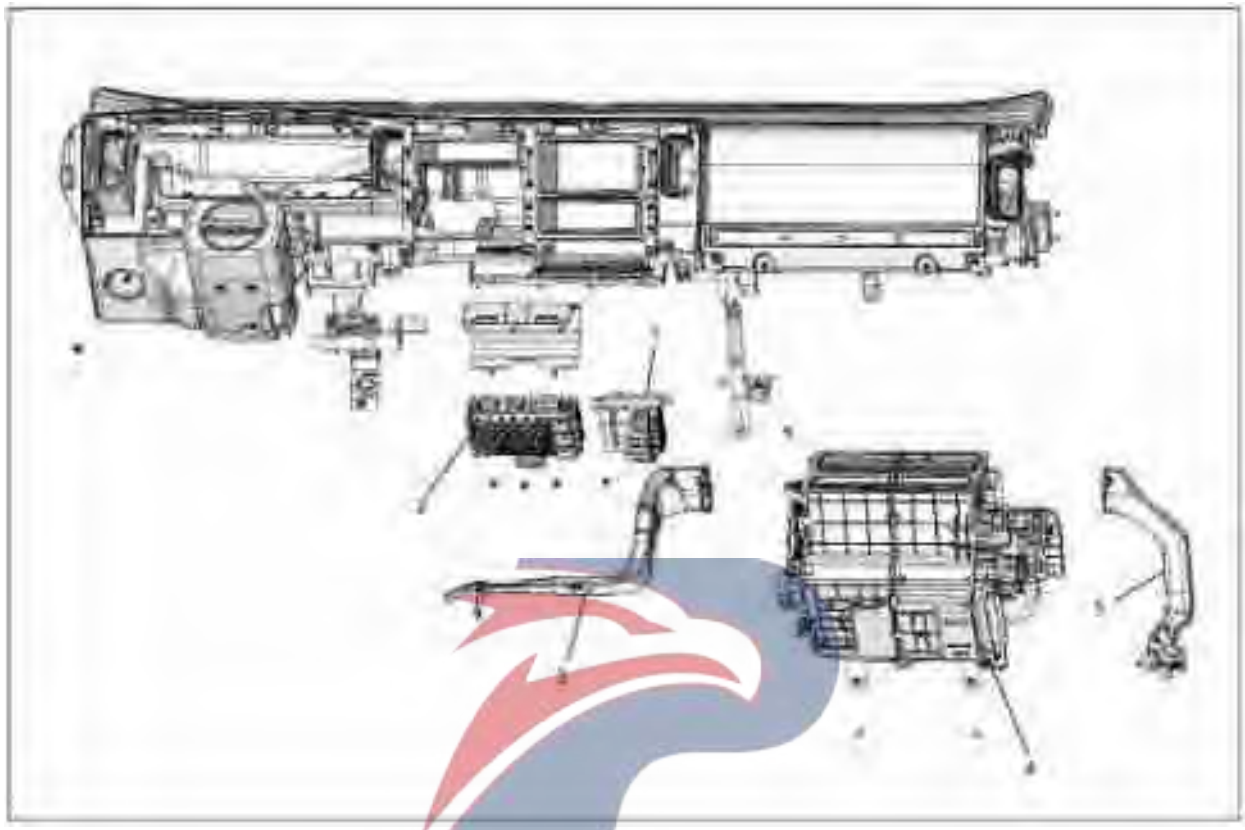
Installation

When installing, pay attention to the following points and install them in the reverse order of removal.

1. Insert the filter completely into the slot.

Heater device (heater and evaporator)

Component parts



Key

1. Connection block
2. Fuse box and relay (cab connecting block)
3. Floor duct (right)
4. Heating and evaporator assembly
5. Floor duct (right)

Disassembly

1. Remove the blower assembly.

● See blower parts in this chapter.

2. Remove the outlet from the floor (left and right).

3. Remove each control cable.

● Loosen the air supply selection and temperature control cables on the heater and evaporator. (Manual A/C)

4. Release the electrical connector.

5. Suspend the connection block on the rib assembly.

● Remove the mounting nut from the terminal box.

6. Leave the fuse and relay box (cab connector block) on the stiffener assembly.

● Remove the fuse and mounting nut from the relay box.

7. Remove engine coolant.

8. Remove the heated hose.

● First remove the hose clamp (3) from the heater hose and then release the heater and evaporator hose.

(Heating block and heater and evaporator tubes to prevent coolant from spraying)

9. Remove the refrigerant A / C.

● Refer to Manual Air Conditioning in Chapter 7B Manual Air Conditioning.

10. Loosen the air conditioning hose connection.

● Remove the connecting nut (1) or bolt (1) from the air conditioning hose.

● Remove the nut (4) from the tracheal clamping lever.

● When loosening the connection of each hose, in order to prevent foreign matter from mixing with the air conditioning circulation, cover the connection with a cover or cover.

11. Remove the heater and evaporator (2) retaining nuts.

(Height cab/ extension cab)

12. Remove the mounting bolts and nuts (inside) from the heater and evaporator.

13. Remove the heater and evaporator assembly.

Installation

When installing, pay attention to the following points and install them in the reverse order of removal.

1. The air-conditioning hose O-ring can no longer be used and a new O-ring must be replaced. (Apply the compressor oil to the O-ring.)

2. Tighten the air conditioning hose connector to the specified torque.

Tightening torque=

(Height cab/ extension cab)

High and low pressure cab 6N • m {0.6kgf • m}

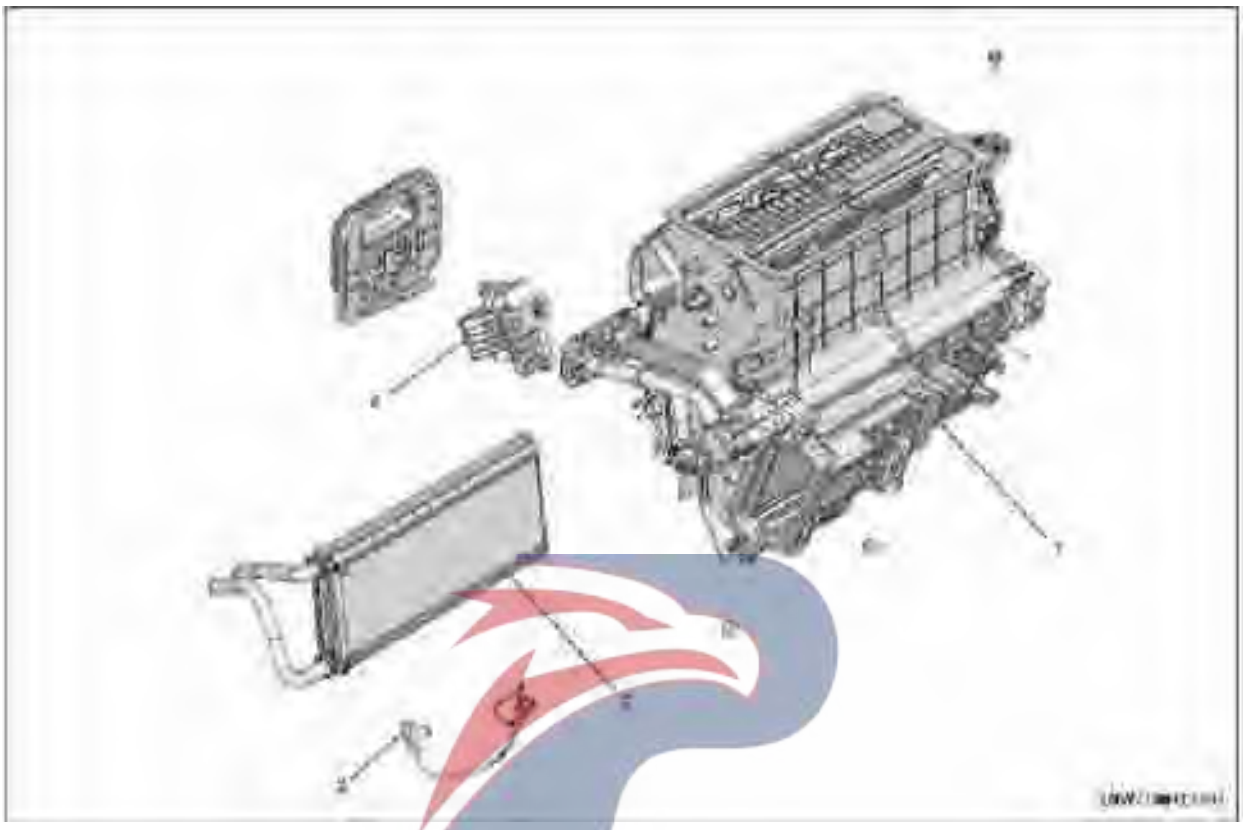
3. Adjust the control cable. (Manual A/C)

● Refer to the joystick in this chapter.

4. After the engine coolant is injected, empty the air and check the amount of water.

Heater core

Component parts



Key

1. Heating and Evaporation Device
2. Heater core
3. Water temperature sensor (automobile air conditioning)
4. Tube shell

Disassembly

1. Remove the blower assembly.

● See blower parts in this chapter.

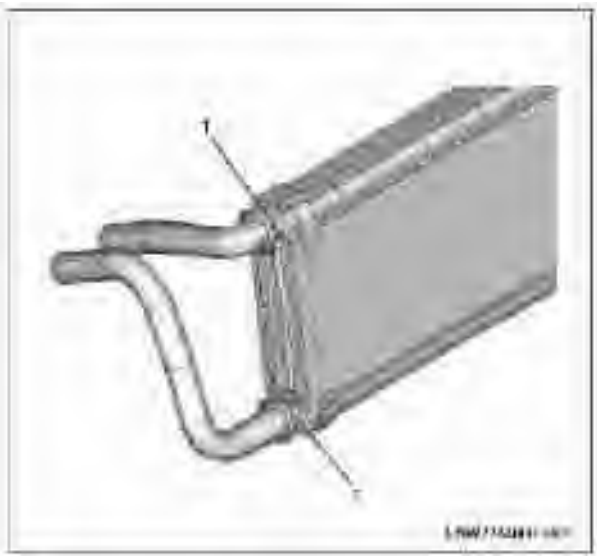
2. Remove the temperature sensor from the water. (automobile air conditioning)

● Remove the temperature sensor clip from the water.

3. Remove the heating tube from the heater core.

(The heater core is no longer available)

● Remove the heating tube from the connector (1) using a flathead screwdriver or the like.



4. Remove the tube shell.

● Remove the mounting screws from the ink cartridges.

5. Remove the heater core.

● Disconnect the heating element from the heater and evaporator.

If you want to reuse the heater core, remove the heater and evaporator first, and then pull the core slowly with a heating tube.

Installation

1. Install the heating core.

● Slowly insert the heater core into the heater and evaporator.

2. Install the heating tube.

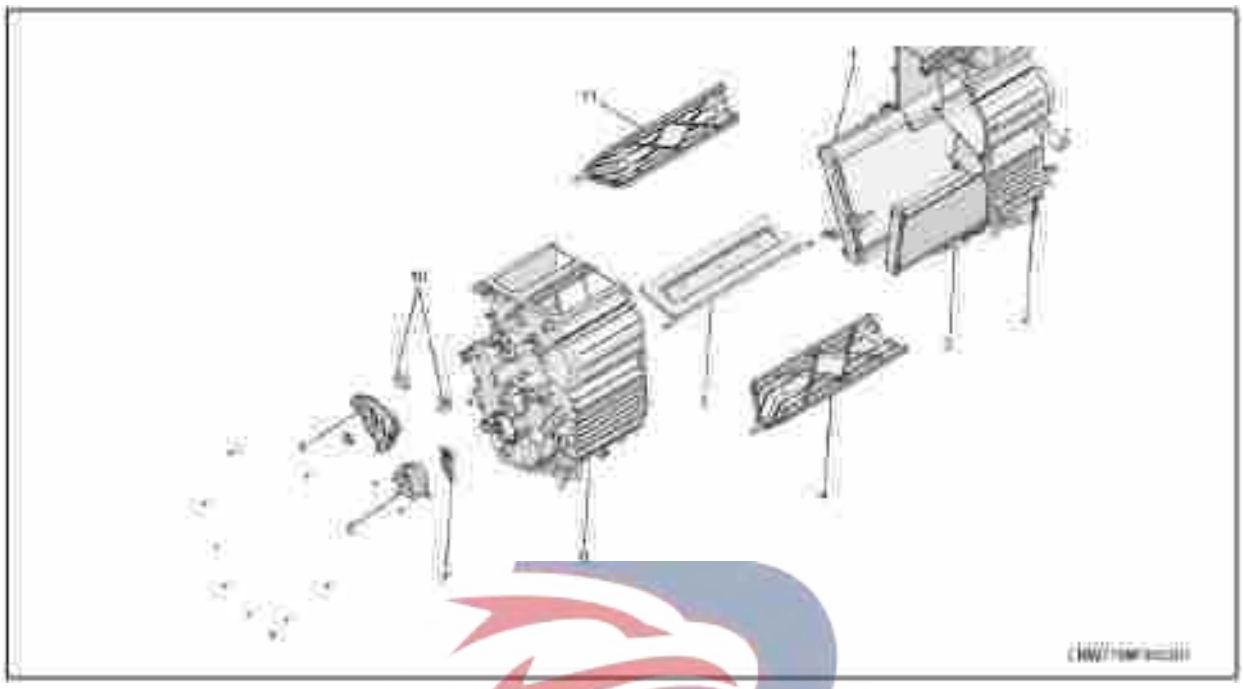
● Insert the pipe into the heater core and secure it with a C-clip.

3. Install the shell.

4. Install the blower assembly.

Air mix door and status door

Component parts



Key

1. Evaporator core
2. Heater and housing from the evaporator(Left).
3. Heater core
4. Status gate (for DEF / FOOT)
5. Air mixture door
6. Heater and evaporator housing (right)
7. Mixing leverage
8. Wing sensor cover
9. Main status control lever
10. Door control rod
11. Status Gate ("face")

Disassembly

1. Remove the heater and evaporator assembly.

● Refer to the heating unit (heater and evaporator) in this chapter.

2. Remove the fin sensor cover and push the sensor connector into the device.

3. Remove the lever connected to the air source and temperature control selection cable.

4. Remove the mixing rod.

5. Remove the main lever from the status.

● Remove the bolt that holds the main pole in place.

6. Remove the lever from the door.

7. Separate the heater and housing from the evaporator.

● Remove the fixing screws from the heater housing and evaporator.

● Separate slowly and do not apply load on the heater core and evaporator core.

● Be careful not to fix the sensor connector in the device.

8. Remove the door.

9. Remove the air mix door.

Installation

When installing, pay attention to the following points and install them in the reverse order of removal.

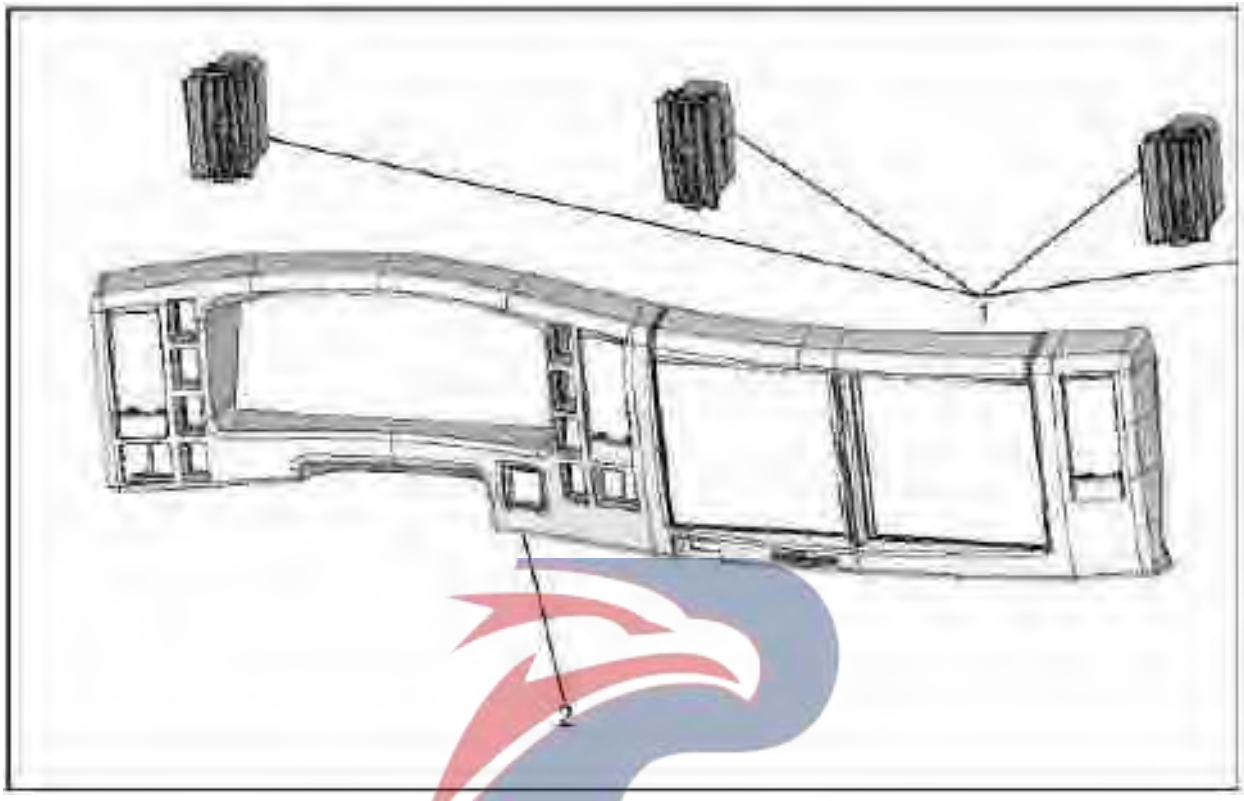
1. Check that the status door and air mix door are properly installed and secured with screws.

2. Apply grease to the sliding surface of each lever.

3. After the installation is complete, check if the status door and the air mix door can operate normally.

Vent grid

Component parts



Key

1. Ventilation grille window
2. Instrument component
3. Side decorative plate

Disassembly

1. Remove the dashboard.

● Place the dashboard in front of you and release the clip inside.

● Release the connector connection.

2. Remove the side trim.

● Remove the resin clip from the side panel, pull the panel to the front, and then release the clip.

3. Remove each window from the ventilation grille.

● Remove the claw (1) from the inside of the combination instrument and remove it

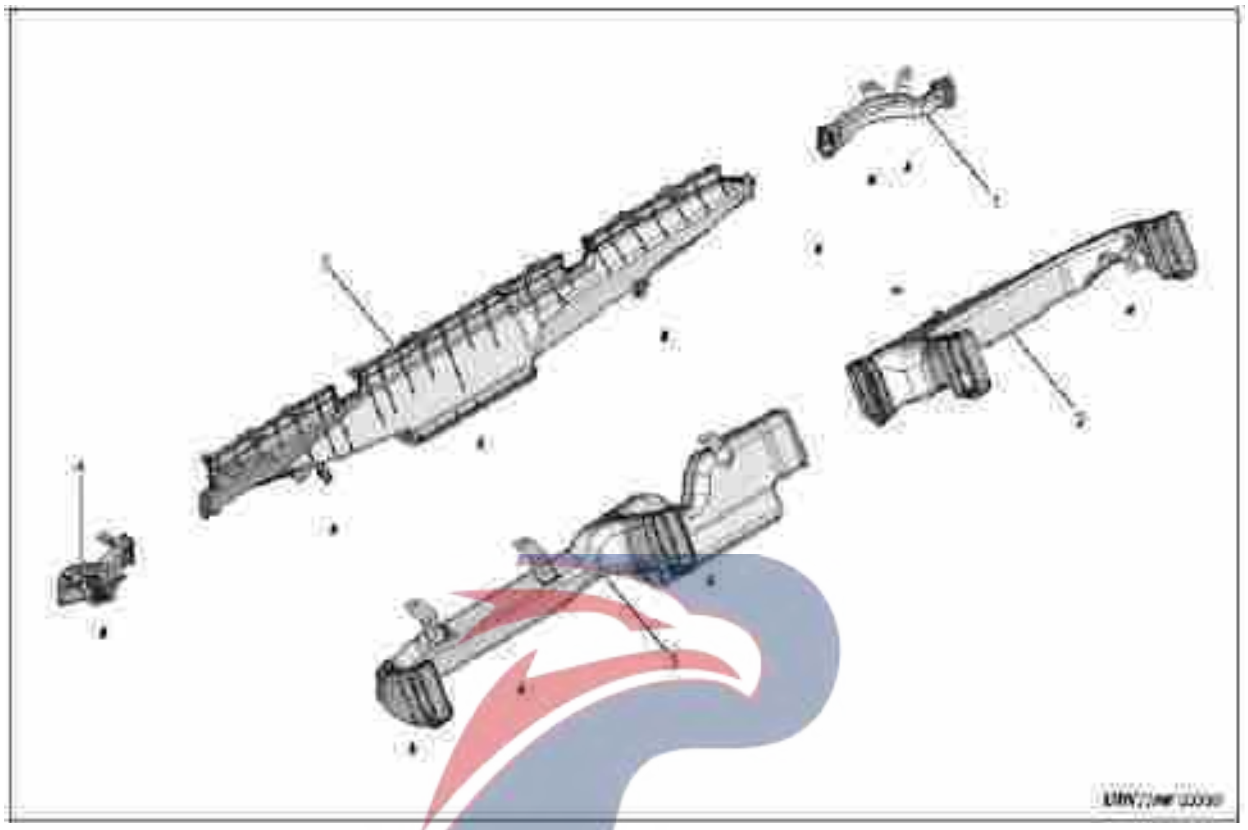
● The grid window on the side trim panel side is also removed in the same way.

Installation

Install the lamp in the sequence opposite to the removal.

Defrost nozzles and vents

Component parts



Key

1. Side defrost nozzle (right)
2. Ventilation tube (right)
3. Ventilation tube (left)
4. Side defrost nozzle (left)
5. Deicing nozzle

Use a good example to illustrate

Disassembly

1. Remove the dashboard assembly.

● Refer to the dashboard in the 9K interior and exterior chapters.

2. Remove the side defrost nozzle (left).

● Remove the set screw (left) from the side defrost nozzle. (Then, remove the mounting screws for each nozzle and pipe one by one.)

3. Remove the side defrost nozzle (right side).

4. Remove the defrost nozzle.

5. Remove the ventilation duct (on the right side).

6. Remove the ventilation duct (left side).

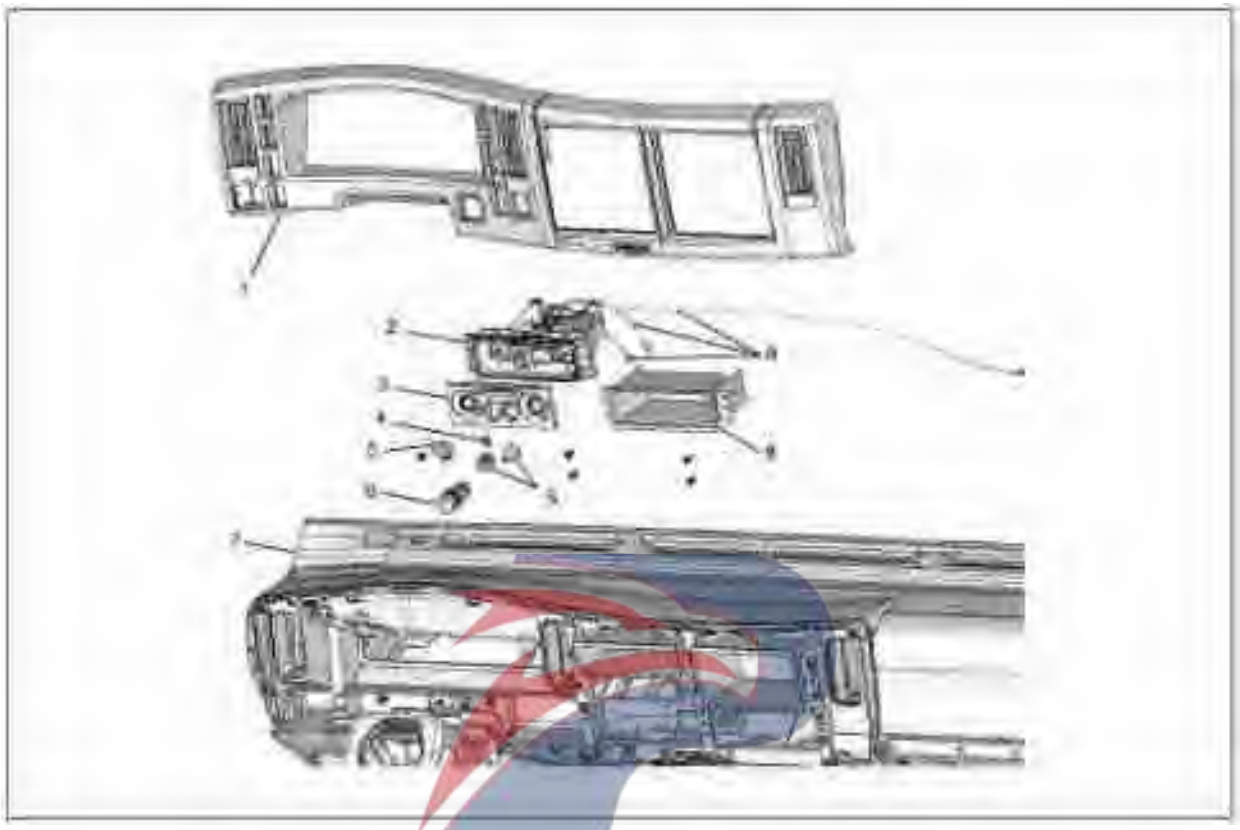
Installation

When installing, pay attention to the following points and install them in the reverse order of removal.

1. When connecting the hose, pay attention to the tight connection between the hose connector and the free space.

Control rod assembly

Component parts



Key

1. Instrument group
2. Control rod assembly
3. Front cover of control panel
4. Control button
5. Each button
6. A/C switch
7. Instrument panel assembly
8. Glove box
9. Each control cable

Disassembly

1. Remove the dashboard.

● Pull the front panel and release the clip.

● Release the connector connection.

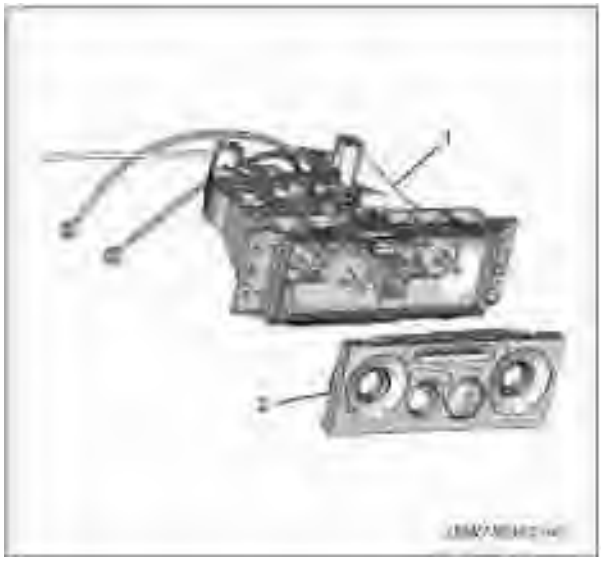
2. Remove the debris box.

● Remove the mounting screws.

3. Remove the joystick button and each button.

4. Remove the front cover of the control panel (2) from the control lever (1).

● Turn up the claws (4 locations) of the front cover (2) of the control panel and remove it together with the air-conditioning switch.



5. Remove each control cable.

● Remove each control cable from the heater and evaporator assembly and remove the connecting rod from the fan assembly.

● Lock release the control cable connection.

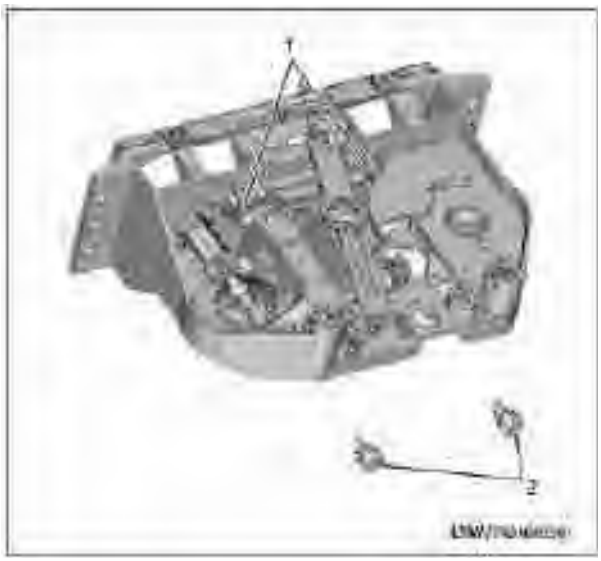
6. Remove the entire control rod.

● First remove the mounting screws, then pull the lever assembly forward, and then release the air conditioning switch connector and fan switch connector.

7. Remove the lever assembly.

8. Remove the light valve from the control panel.

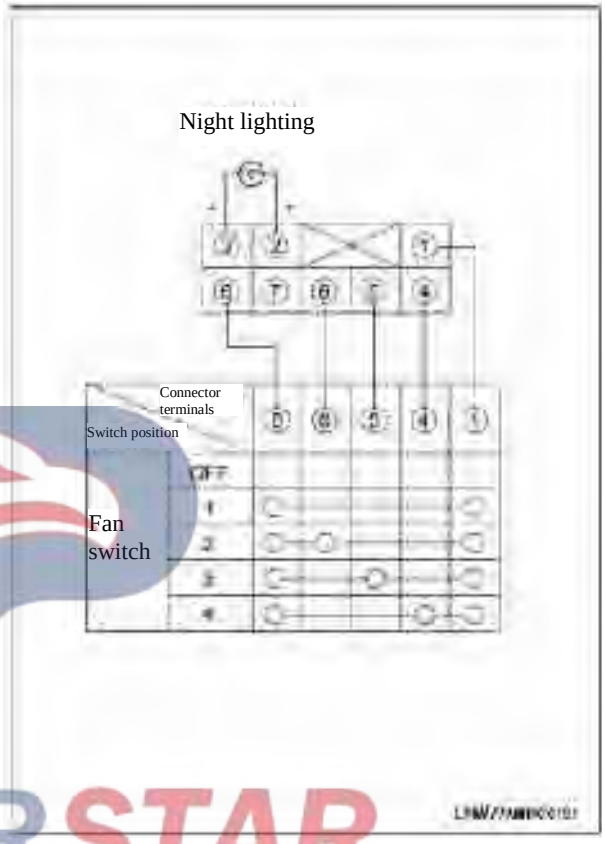
● Turn the light valve (2) from the lever's internal mounting part (1) to the left and remove it.



Inspection

Fan Switch (Air Conditioner with Manual Control)

1. Operate the fan switch according to the following connection diagram and check the continuity between the connector terminals on the switch side.



Installation

During the installation and installation, pay attention to the following points in the reverse order of removal.

1. Adjust the control cable.

● Air source control cable:

- Turn the air selector lever to the LEFT (RECIREC) position.

- Adjust the connection of the fan module (door status) to the (RECYCLE) position, then connect the control cable and connect it to the locking part.

● Temperature control cable:

- Turn the temperature control knob to the left COOL position.

- Adjust the temperature of the heating unit of the position lever (air mixing door) to the (cold) COOL position and connect the control cable to the locking part.

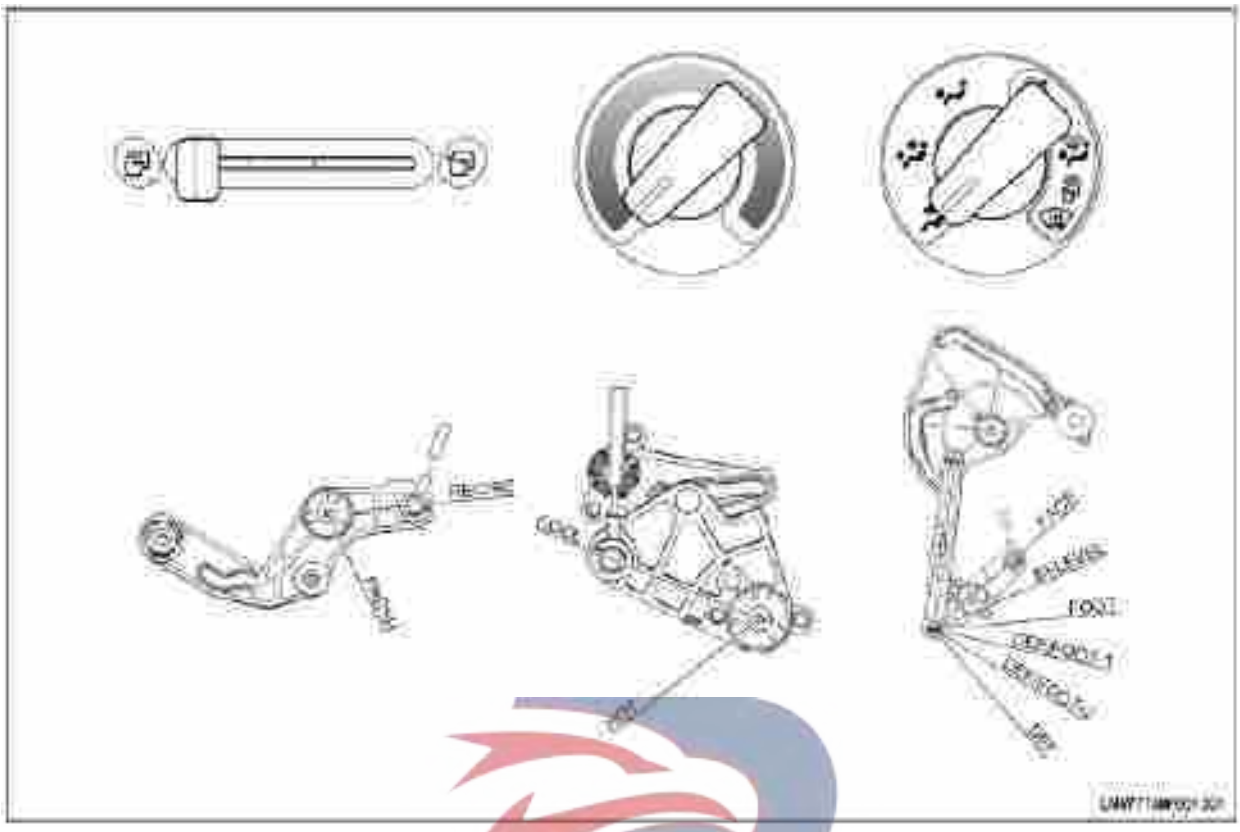
● Air source selection control cable:

- Turn the air selector knob to "Face".

- Set the status bar of the heating unit (status door) to the "front" position and connect the control cable to the lock.

2. Fix the control cable to the original position of the lock.

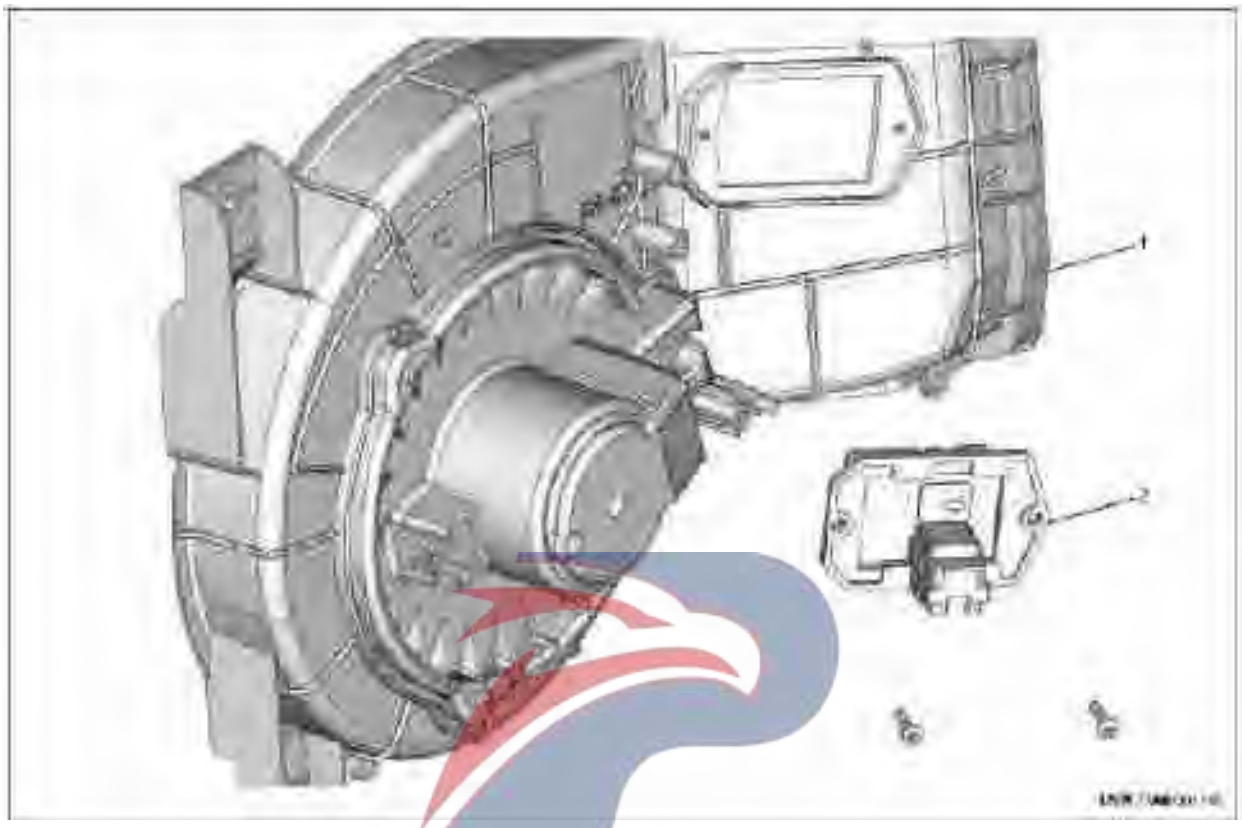
3. After the installation is complete, check that the control rod assembly is working properly.



Use a good example to illustrate

Blower resistance

Component parts



Key

1. Blower assembly
2. Blower resistance

Disassembly

1. Remove knee baffle (passenger side) (1).

● First remove the resin clip (2) from the bezel (passenger side) (1), then pull the front bezel and release the internal clip.

2. Remove the dashboard.

● Place the instrument panel in front of you and release the internal clip.

● Release the connector connection.

3. Remove the knee baffle (driver side).

● Loosen the knee pad (driver side) of the mounting nut and resin clip, and then pull the pliers forward to disengage it.

4. Loosen the fan resistor connector.

Remove the cleaning tank if necessary.

5. Remove the blower resistor.

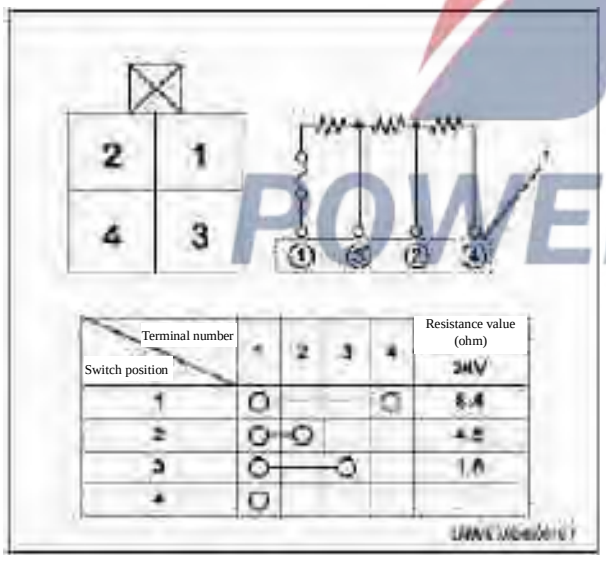
● Remove the screw fixing the blower resistor.

Inspection

Blower resistance (manually controlled air-conditioned vehicle)

1. Loosen the fan resistor connector.

2. Check the island resistance between the blower resistor side terminals according to the following connection plate.



Key

1. Terminal number

Installation

Install the lamp in the sequence opposite to the removal.

Section 7B
Heater, ventilator, air conditioner
Manual air conditioning

Table of Contents

Manual air conditioning system

Precautions during maintenance

Notes on replacing and repairing air-conditioning components

Explain the basic elements, methods and precautions to be observed when servicing air conditioners.

● The working environment must be kept clean.

● Wear safety glasses when working on air conditioning systems.

● In closed spaces or poorly ventilated garages, carbon monoxide and refrigerant gas emissions should be taken into account when starting the engine.

● When replacing or repairing the air conditioning system, remove the negative battery terminal and discharge the refrigerant.

● Use the recovery unit to discharge the refrigerant.

● Pay attention to moisture and dust. Immediately after removing the pipe and refrigerant components, close the opening with a plug or cover. The cover and cover should not be removed before reconnecting, installing hoses and components.

● When removing and reconnecting pipes, use wrenches to support the connections to avoid bending and damaging the pipes.

● Apply new oil to the O-ring before connecting hoses and hoses.

● When removing and replacing parts, if you first need to discharge refrigerant from the climate system, follow the steps below.

1. Drain the refrigerant from the air conditioning system.

2. Remove the defective parts and replace them.

3. Pump down and fill the air conditioning system with the specified amount of refrigerant.

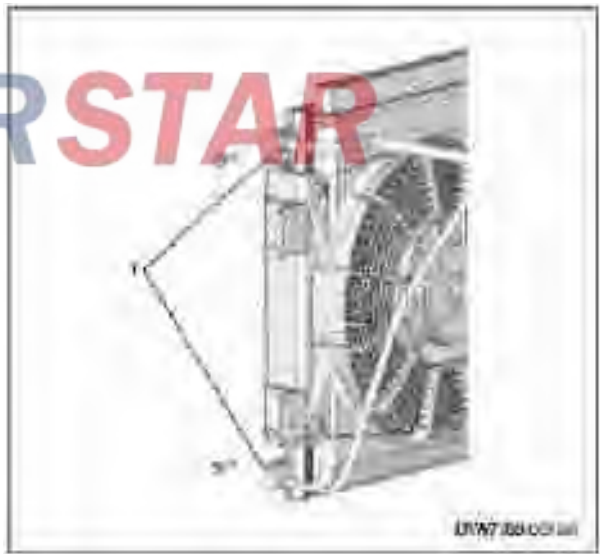
Repair refrigerant leak (refrigerant pipe connection)

When installing a disassembled refrigerant line, a new O-ring must be installed. When removing and connecting the hose, use a hook wrench to prevent twisting and damage to the connection.

Key

1. Support key
2. Torque wrench

When connecting the refrigerant tube to the positioning block connector, insert the protruding part of the connector firmly into the connection hole on the side of the device and fix it with the bolt.

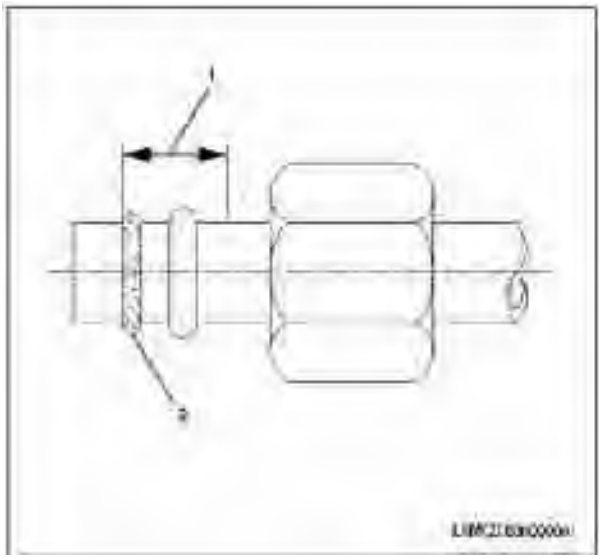


Key

1. Positioning block connector

Before connecting, apply the compressor oil to the O-ring.

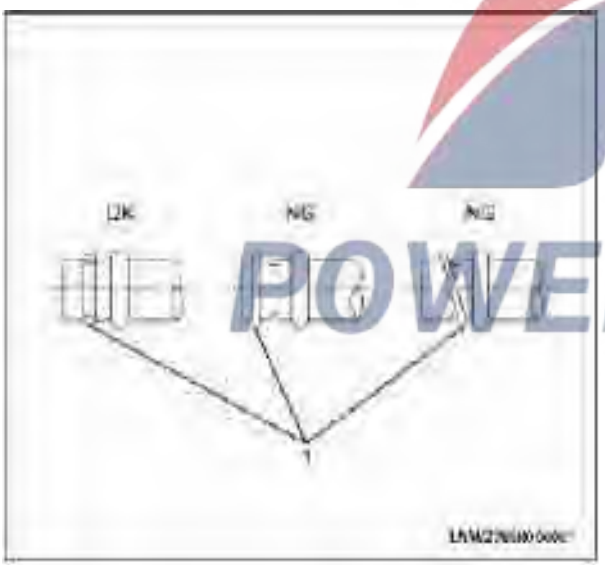
The compressor oil varies depending on the compressor model. Use a compressor oil that matches the compressor.



Key

1. Oil smears the beach
2. O-ring

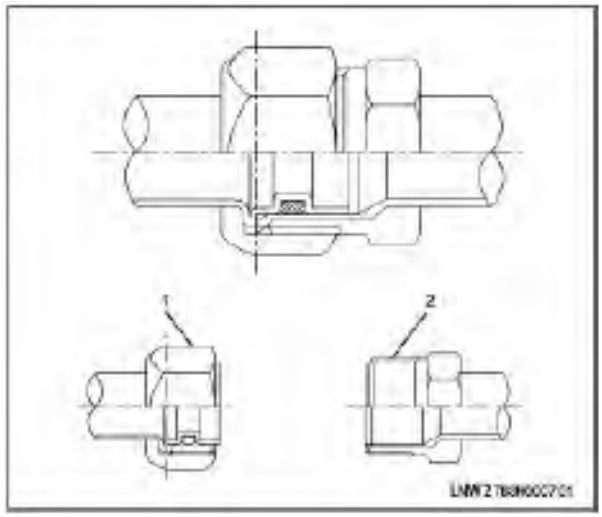
The O-ring must be inserted exactly into the groove of the refrigerant piping.



Key

1. O-ring

Insert the hose into the device. First, try to screw the nut into your hand. Then tighten the nut according to the specified torque.



Key

1. Nuts
2. Joint nut

Refrigerant piping connection leakage

1. Check the torque of the refrigerant tube connector, if loose, tighten it to the specified torque.

● Use a hook wrench to prevent twisting and damaging the hose.

● Do not overstress.

2. Inspect the refrigerant piping connections for leaks.

3. If a leak occurs, empty the air conditioning system refrigerant.

4. Check O-rings and replace if necessary.

● O-rings are not allowed to be reused. It must be replaced with a new O-ring.

● Apply compressor oil to the replacement O-ring before installation.

5. Tighten the refrigerant piping connections to the specified torque.

● Use a hook wrench to prevent twisting and damaging the hose.

6. Vacuum, inject refrigerant, check air conditioning system.

Pipe leak

When refrigerant leakage occurs at the intake or exhaust of the compressor, the entire pipe must be replaced. Cannot shorten hose reconnection.

1. Completely check the location of the refrigerant leak.

2. Discharge the refrigerant.

3. Remove the hose assembly.

● When disconnecting the hose, cover it to prevent foreign matter from entering the air conditioning circuit.

4. Install the new hose into the compressor.

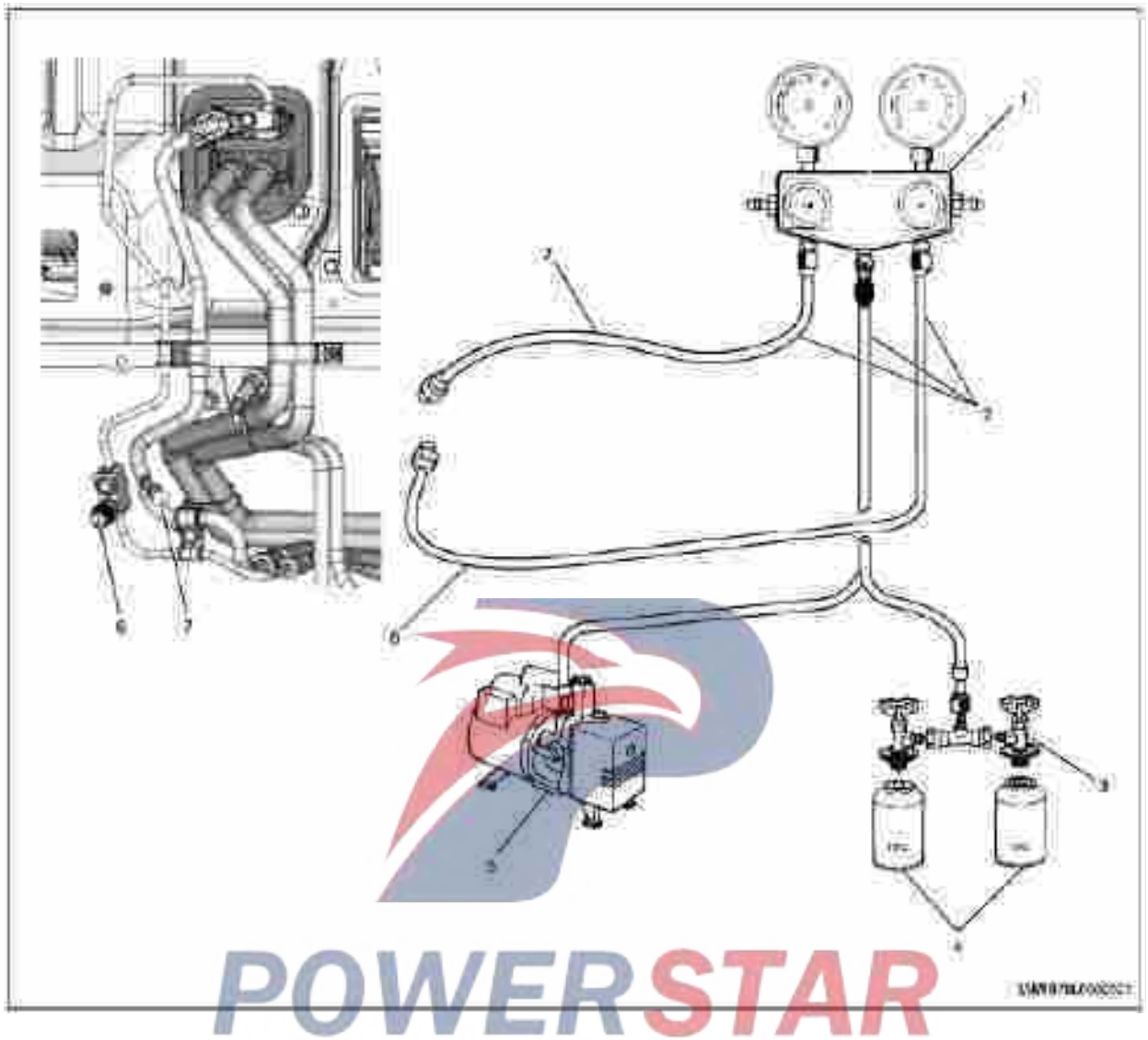
● Tighten the hose connector to the specified torque.

5. Vacuum, inject refrigerant, check air conditioning system.

Compressor leakage

If compressor shaft seal or housing leakage is detected, replace the compressor assembly.

Refrigerant discharge method, suction and filling process



Key

1. Manifold table
2. Fill the pipe
3. Filling valve
4. Replacement box
5. Vacuum pump
6. High pressure side of the condenser (vehicle and hose connection)
7. Low pressure side of the condenser (vehicle and hose connection)

The refrigerant using method

The refrigerant circulates in the air conditioning system. In order to prevent accidents due to misuse, special refrigerants are needed to understand the special operations of chemicals.

● Wear goggles when charging, discharging, and replacing components of the air conditioning system to cover the refrigerant lines and covers.

● Operate in a well-ventilated place. Welding and steam cleaning of air-conditioning ducts and equipment installed in vehicles cannot be performed.

● If refrigerant enters your body, rinse immediately with clean water and seek medical attention.

● When the refrigerant needs to be transferred from a large container to a small container, the small container cannot be overfilled. When the refrigerant expands, care must be taken that there is sufficient free space in the container.

● Keep the temperature of the refrigerant container below 40℃

Refrigerant discharge method

When removing or installing air conditioning components, you must remove the refrigerant from the air conditioning system in advance.

When using a refrigerant, use a recovery unit.

Follow recycling equipment manufacturer's recycling program instructions.

Air Conditioner Vacuum Cleaner

The mixing of air and moisture in the climate cycle can cause a variety of failures in the climate system. Therefore, the air and moisture in the air conditioning system must be completely removed before filling the refrigerant.

1. Connect the center tube of the manifold gauge to the inlet of the vacuum pump.

2. Start the vacuum pump and open the manual valves on both sides of the manifold pressure gauge.

3. When pressing down about 750mmhg, continue to vacuum for more than 5 minutes.

4. Close the manual valves on both sides of the manifold pressure gauge and stop the vacuum pump.

After 5 or 10 minutes, observe if the pressure value changes.

● If the pressure changes, check the system for leaks.

● If a leak occurs, check the connections and parts of the refrigerant lines, reconnect them, and then vacuum again.

6. If there is no leak, vacuum again for more than 20 minutes. After confirming the pressure stability of the manifold pressure gauge after 750 mmhg, close the manual valves on both sides.

7. Stop the vacuum pump and remove the central tube of the vacuum pump.

Refrigerant filling method

(Operation of filling valve when installing a backup tank on a cartridge flowmeter)

1. Before installing the fill valve on the replacement box, turn the handle counterclockwise until the fill valve pin is fully retracted.

2. Turn the nut counterclockwise until it reaches the highest position.

3. Install the fill valve on the reservoir.

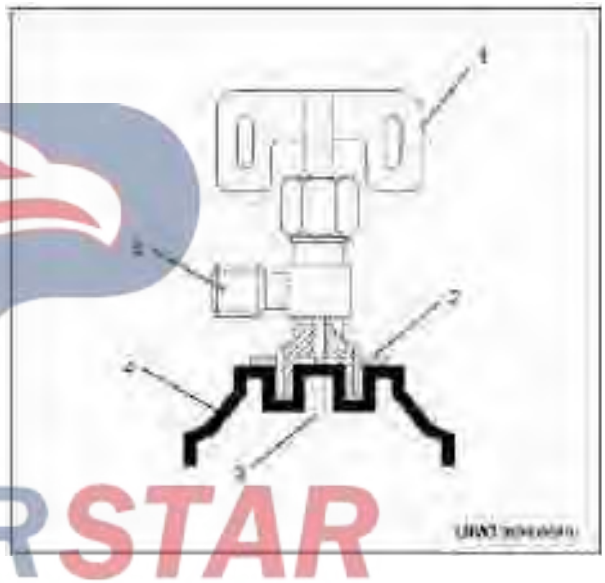
4. Turn the plate nut clockwise to connect the center tube of the manifold pressure gauge to the fill valve.

5. Tighten the nut by hand. Then rotate the fill valve handle clockwise to lower the needle and drill a hole in the reserve tank.

6. Turn the fill valve handle counterclockwise to retract the needle. After opening the valve to collect the instrument, the refrigerant in the tank is filled in the center pipe.

● Do not reuse empty replacement tanks.

● In order to eliminate the trachea in the center, open the pressure side meter to install the low pressure manifold and drain a small amount of refrigerant.



Key

1. Fill valve handle
2. Board nut
3. Needle
4. Replacement box
5. Connection

Filling method

1. Open the manual valve Xin low pressure manifold, fill the low pressure refrigerant to the end of the refrigerant collector pressure gauge to reach 196kpa {2kgf / cm^2}.

● Make sure the high pressure manual valve is closed.

● Do not fill the refrigerant tank.

2. Close the manual low pressure valve on the manifold pressure gauge.

● Check that the pressure value has not changed.

3. Check for refrigerant leaks.

● If a leak occurs, repair the leak and start again from the first suction step.

4. If there is no leakage, open the manual low pressure valve on the manifold pressure gauge and continue to inject the system.

● If the refrigerant does not fill the air conditioning system, start the engine and run the air conditioning to continue charging.

Note: Do not open the high-pressure manual valve when filling the air conditioner. Once the high pressure manual valve opens, the high pressure refrigerant will return, causing the reserve tank to explode.

5. Inject the required amount of refrigerant into the system and close the low pressure manual valve.

The amount of refrigerant is 500±30g (standard cabin, high cabin), 400±30g (increased cabin)

6. Remove the tank from the center pipe and check for no refrigerant leaks.

Check air conditioning system

1. Open all doors, air supply switch button provides “RECIRC” status, fan control switch is at HIGH level when air conditioning operation and temperature adjustment is MAX COOL status (cooler). Hold this state for a few minutes to allow the refrigerant to circulate in the air conditioning circulation system.

2. Use a manifold pressure gauge to detect the pressure on both sides of the refrigerant.

● Normal standard pressure value

Outdoor temperature: about 30~35℃

Low side pressure: about 130 ~ 250kpa {1.3 ~ 25kgf / cm^2}

High side pressure: about 1373 ~ 250kpa {14 ~ 25kgf / cm^2}

● High pressure and low pressure values at both ends of the pressure significantly exceed the standard value. Refer to each function check and check the system in this chapter.

3. While checking the pressure of the refrigerant, check whether the refrigerant is full through the observation window.

● When the refrigerant turns black, the HFC-134a window cannot be correctly determined when the outside air temperature and the high-pressure side pressure are higher than the following values (most of the refrigerant is insufficient. Therefore, in this case, the vehicle shadow is to be moved or Internally, the fan switch is set to "L0 (low)", which reduces the air-conditioning load, makes the outside air temperature and the high-pressure side pressure below this value, and then rechecks.

4. Touch the air outlet with your hand and check that the air temperature of the temperature control dial (dial) is observed.

5. After the system check is complete, remove the fill tube from the fill valve.

High and low pressure pipeline temperature	The high pressure pipe is hot while low pressure pipe is cold (There is a significant temperature difference between the two)	The high pressure pipe is warm and low pressure pipe is cool (The temperature difference between the two is not large)	There is almost no difference in the temperature between the high pressure hose and the low pressure hose	The high pressure hose is hot and the low pressure hose is hot. (There is a temperature difference between the two)
Sight glass state	Almost transparent. Some bubbles are visible but become transparent after starting the engine.	Visible gas bubble flow. Sometimes transparent, sometimes blistering.	The misty flow	Even if you set the fan to HI (the fan runs at maximum speed and the window is fully open) bubbles will not be visible.
				
Air conditioning	Normal	Insufficient refrigerant	Almost no refrigerant	Too much refrigerant

* When checking the inspection window, the following conditions must be satisfied.

- Outdoor temperature: below 35℃
- Engine speed: 1500rpm
- Air conditioning switch: ON
- Fan Switch: High
- Temperature setting: MAX COOL (18℃)
- Switch air source: RECIRC (in-vehicle air circulation)

High side pressure: Less than 1667kPa {17kgf/cm^2}

Function and working principle

The manual air conditioning of the vehicle consists of a compressor, an evaporator, a condenser, an air conditioning (A/C) switch and a fan switch.

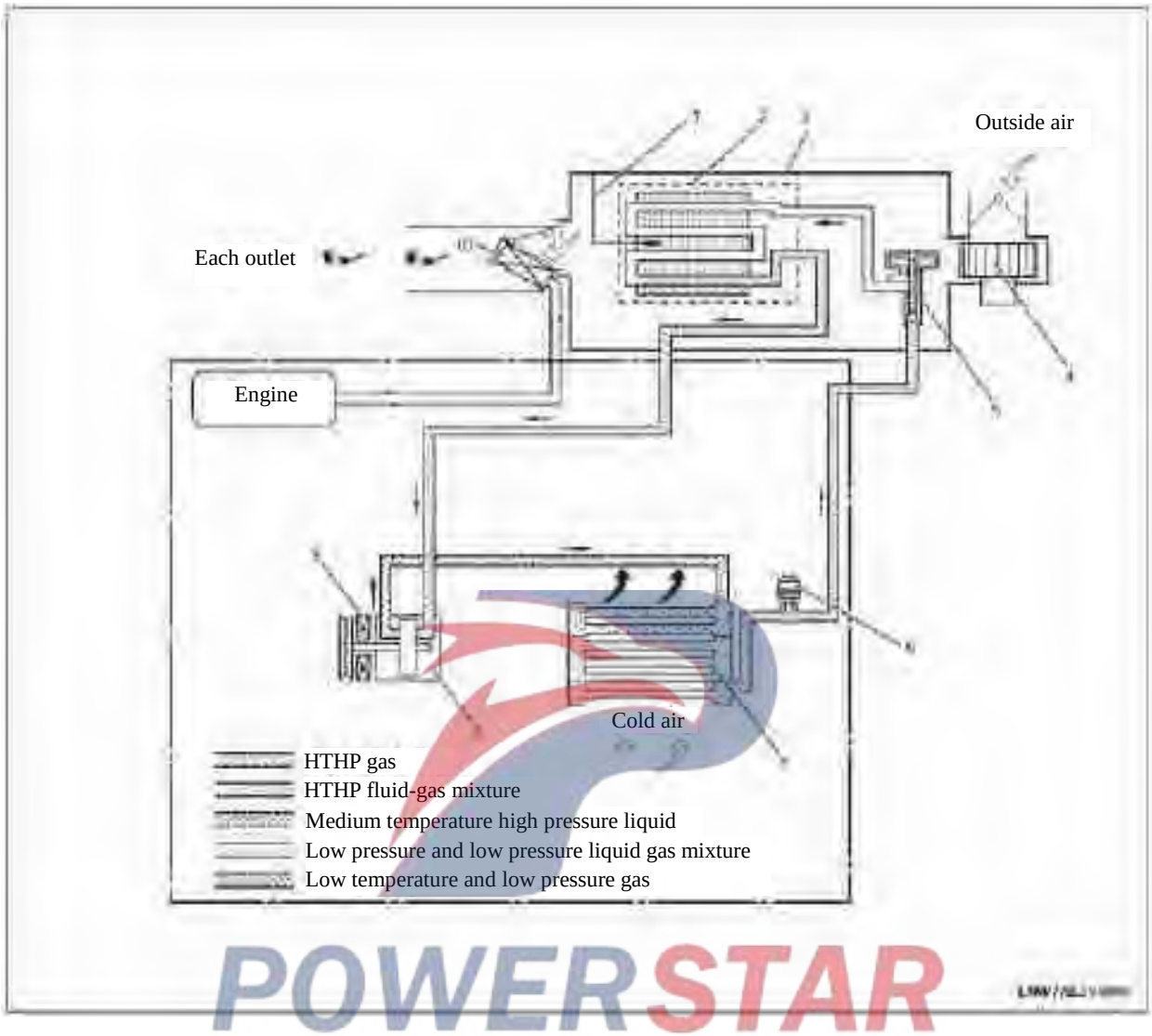
After starting the engine, turn on the air-conditioning switch (A/C) and fan switch to activate the electromagnetic clutch to start the air conditioner. Also, turn off any fan or air conditioning (A/C) switch when it is turned off.

In addition, it also has the following features: The pressure switch detects abnormal refrigerant pressure through the core of the evaporator. The antifreeze thermal switch detects the air temperature, and is set on a part of the thermal model by an (air conditioning cutoff) detection switch. The temperature of the engine water is temporarily cut off by the air conditioning system.

Three pressure switch cycle switches detect the refrigerant pressure in the air conditioning circulation system. Once the pressure exceeds the set point, the condenser fan and condenser are used to improve heat dissipation.

The manual air conditioning section does not describe heater and fan items. See the Heater and Fan section for details.

The structure and function of the air conditioning cycle



Key

1. Shutter sensor
2. Evaporator core
3. Heating and evaporator assembly
4. Blower motor
5. Expansion valve
6. Pressure Switch
7. Condenser (built-in water tank dry box) (enlarged tank)
8. Compressor
9. Electromagnetic clutch
10. Heater core
11. Air mixture door

The four cycles listed below are included in the air conditioning cycle and the refrigerant changes several times through the liquid-gas-liquid.

(1) Evaporation

The refrigerant changes from liquid to gas in the evaporator.

In the evaporator, the atomizing refrigerant is easy to evaporate. The refrigerant absorbs heat from the air around the cooling blades of the evaporator core and quickly evaporates. The refrigerant absorbs heat and lowers the temperature of the air, which is delivered to the vehicle through the fan, which lowers the temperature inside the vehicle. The coolant supplied by the expansion valve and the evaporated refrigerant gas coexist in the evaporator, and the liquid refrigerant is converted into a gaseous refrigerant in the evaporator.

During the transition from the liquid state to the gaseous state, the pressure in the evaporator must be kept low so that the refrigerant can evaporate at a lower temperature. As a result, the gaseous refrigerant flows out of the evaporator and is sucked into the compressor.

(2) Compression

The refrigerant is compressed by the compressor until it is easy to fluidify at ordinary temperature.

The evaporated refrigerant in the evaporator is sucked into the compressor. This process ensures that the refrigerant in the evaporator evaporates easily at low pressure and evaporates again from a low temperature state even near 0℃. The refrigerant that is drawn into the compressor is then compressed in the cylinder and the pressure increases so that it is easily liquefied at normal ambient temperatures.

(3) Condensation

The refrigerant in the condenser is cooled by the outside air and transferred from the gas to the liquid. The air pressurized by the compressor is pressurised and cooled by the outside air and liquefied in the condenser and accumulated in the tank for drying (the storage tank and the condenser are dried in one piece). The amount of light emitted by the refrigerant gas at a high temperature and a high pressure discharged from the compressor to the outside air is referred to as condensation heat. The sum of heat is known from the heat inside the refrigerant passing through the evaporator (evaporative heat) and the work done by the compressor (based on heat).

(4) Expansion

The expansion valve reduces the pressure of the coolant and facilitates evaporation.

Before the liquefaction of the evaporator refrigerant, in order to reduce the pressure during expansion, designated by the evaporator. In addition, the expansion valve can control the refrigerant flow rate. In other words, it is necessary to absorb the evaporated liquid in the evaporator refrigerant evaporation temperature determined by the specific heat (evaporation pressure). Therefore, it is very important to control the refrigerant quantity at a specified value.

Compressor

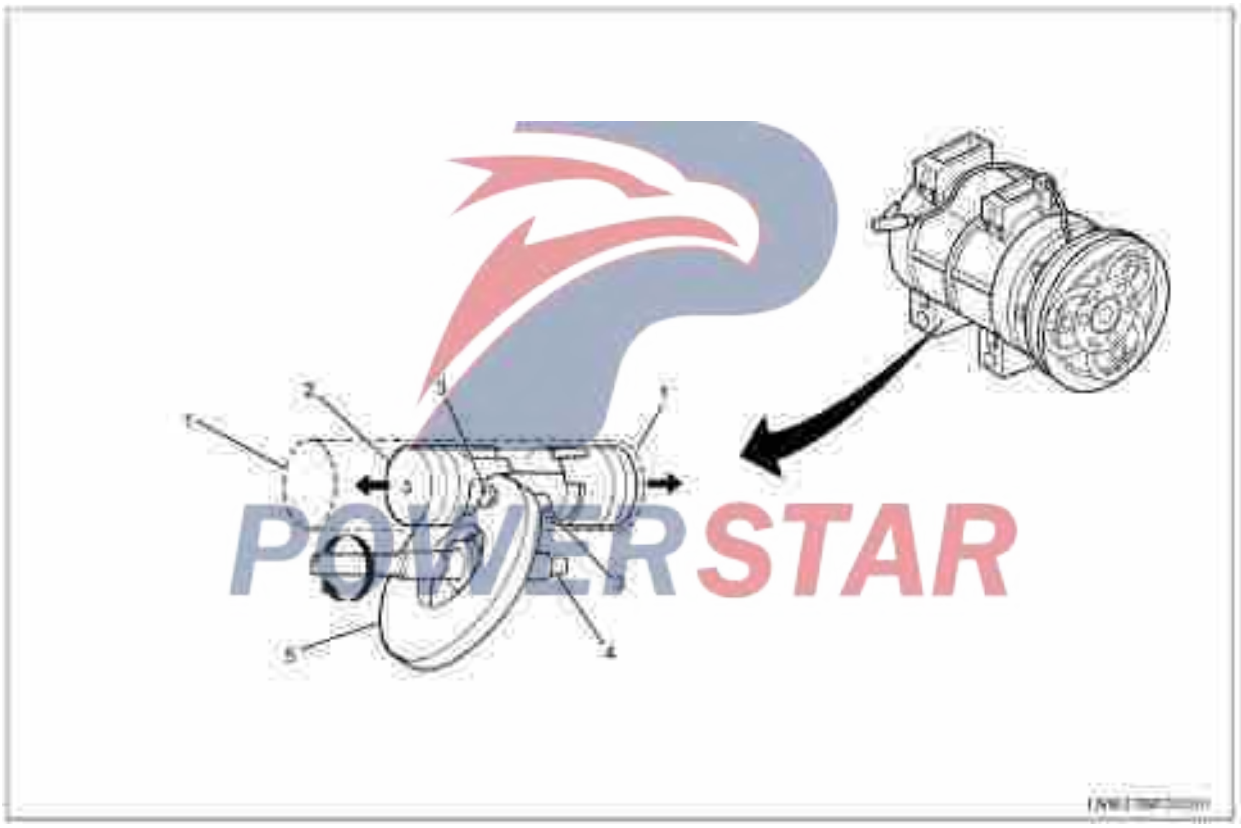
Compressor Refrigerant Temperature Evaporator The refrigerant is sent to the condenser under high temperature and high pressure so that the outside air can be heated more easily.

The model uses dajie, a swash plate type compressor (DKS-15S) from Kessel Automotive Air Conditioning Co., Ltd. A rotary rocking plate including a shaft converts rotational motion of the swash plate into reciprocating motion of the piston through rotation of the shaft to suck in and compress the refrigerant gas.

At both ends of the piston, unloaded refrigerant gas sucked from the valve plate between the shaft and the shaft head is installed to prevent leakage of the refrigerant gas seal (lip seal).

(For maintenance information, refer to the notes in this chapter.)

In addition, the compressor specified 150 cm^3 of oil.

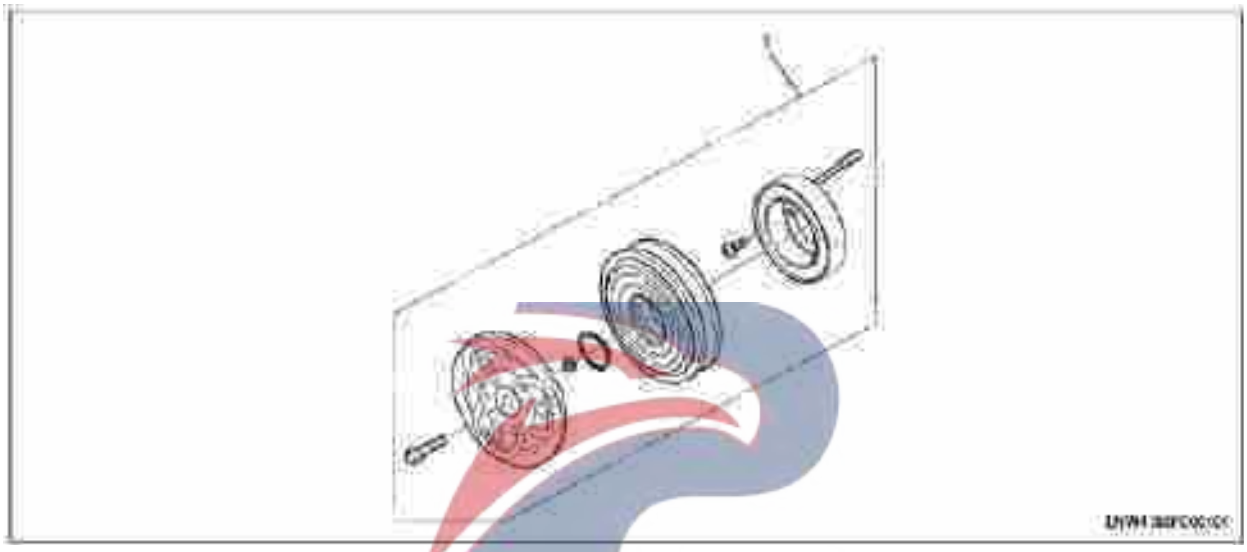


Key

1. Cylinder
2. Piston
3. Rolling ball
4. Axis
5. Swash plate

Electromagnetic clutch

The compressor is driven by the belt of the crankshaft pulley of the engine. If the compressor is driven every time the engine is started, the engine will give a large part of the load. When the engine power reaches the regulated air, the electromagnetic clutch will be transmitted to the compressor and the compressor will operate. If the air conditioner is off, the compressor's engine power will be cut off.



Key

1. Electromagnetic clutch

Condenser

Condenser, high-temperature compressor - high-pressure refrigerant gas cooling force send, liquefaction by outside air. Blockage of condenser and condenser fins leads to blockage of the cooling capacity of the condenser, reduced air flow, increased refrigerant cycle pressure, and increased engine load. When the condenser is operating normally, the condenser of the refrigerant discharge system is generally colder than the intake system.

In order to improve the cooling effect, an electric fan is installed in the condenser. Detecting that the "open" fan "OFF" varies depending on the refrigerant pressure (pressure switch).

Key

1. Condenser assembly (built-in water tank dry box) (enlarged tank)

Liquid tank

The liquid tank has the following effects.

● The amount of circulation of the refrigerant varies depending on the state of the air-conditioning cycle, because in order to accommodate fluctuations in the circulation amount of the refrigerant, normal circulation is ensured, and the container of the container is dried over the stored refrigerant.

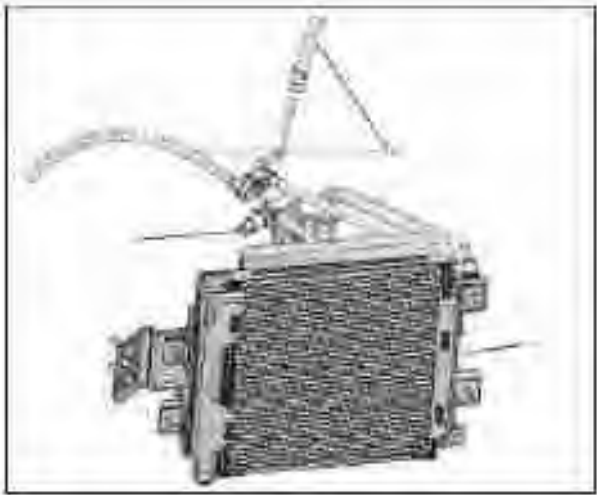
● The output of the liquefied refrigerant condenser is vaporized mixed refrigerant bubbles. If such a bubble cooler is sent to the expansion valve, the cooling capacity will be significantly reduced. Therefore, in order to separate the liquid refrigerant and the air bubbles, only the liquid portion is sent to the expander.

● Dry the tank through filters and tumble dryers to remove any circulating dirt from the refrigerant and water.

Clogging the liquid tank will reduce the air conditioning performance. If the refrigerant pressure increases, the inlet end of the drying tank is blocked, and if the outlet end is clogged, the pressure drops, causing cooling to fail. If the tube at the outlet of the tank drying oven is too cold, clogging occurs.

Pressure Switch

The pressure switch (three pressure switches) is installed at the outlet end of the discharge pipe discharge container. The compressor abnormally detects the high pressure refrigerant pressure (high pressure switch) and prevents the refrigerant leakage (low pressure switch), setting the electromagnetic clutch as required. Go to "Open" and "Closed" positions. In addition, the condenser fan controls the "ON" and "OFF" (pressurized fluid switch) circulation switches.



Key

1. Pressure Switch
2. Refrigerant pipe
3. Liquid storage drying tank

● Low voltage control (low voltage switch)

Compressor

"ON": 225 ± 30 kpa {2.3 ± 0.3 kgf / cm^2}

"OFF": 196 ± 20 kpa {2.0 ± 0.2 kgf / cm^2}

● Medium pressure control (medium pressure switch)

Condenser fan "ON": 1520±98 kPa{15.5±1.0 kgf/cm^2}

“OFF”

1230±98kPa{12.5±1.0kgf/cm^2}

● High pressure control (high voltage switch)

Compressor

"ON (on)": For the OFF value, decompression of 590 ± 196 kpa {6.0 ± 2.0 kgf / cm^2}

"OFF": 3140 ± 196 kpa {32.0 ± 2.0 kgf / cm^2}

Evaporator

The evaporator exchanges heat between the liquid refrigerant at low pressure and at low temperature sent by the expander and the air supplied by the blower motor to convert it into a gaseous refrigerant.

After evaporation of the liquid refrigerant, it turns into gas, absorbs the surrounding heat and cools the evaporator and evaporator core blades. This cools the air sent by the fan.

The humidity of the air is cooled and formed into droplets, which are discharged outside the vehicle to achieve dehumidification.

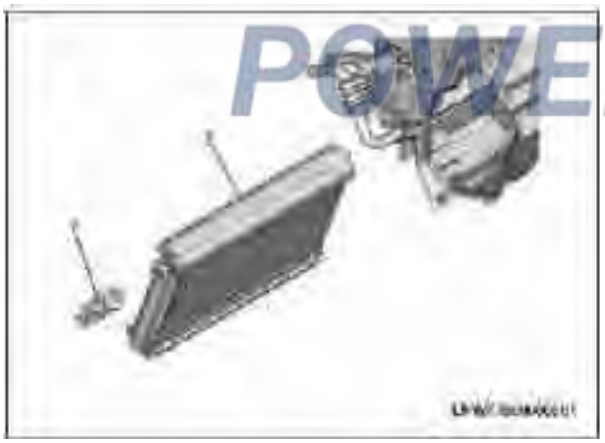
Expansion valve

The expansion valve is balanced in external pressure and is installed on the side of the evaporator inlet.

The high-pressure liquid refrigerant from the liquid storage tank passes through a tiny orifice as it passes through the expansion valve, so that it turns into a mist-type liquid coolant and is sent to the fluid core. The evaporator.

The expansion valve is composed of a thermal sensor, a diaphragm, a ball valve, a spring adjustment screw and the like. The thermal sensor comes in contact with the evaporator outlet pipe, converts the temperature change into pressure and controls the amount of refrigerant by operating the diaphragm.

In addition, the regulator has the function of adjusting the flow of the refrigerant to allow efficient operation of each device of the air conditioning cycle. Thus, once an abnormality occurs in the expansion valve, the pressure at which the liquid is discharged and absorbed becomes low, resulting in insufficient cooling capacity of the evaporator.



Key

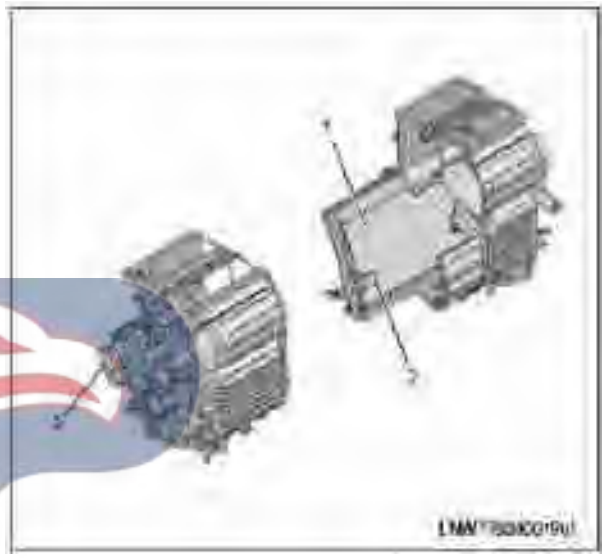
1. Expansion valve
2. Evaporator core

Heat sensitive switch

The thermal switch uses an amplifier (electronic thermostat) and a thermistor (finned sensor) to reduce operating noise.

A finned sensor is mounted at the outlet of the evaporator core and detects the temperature of the air passing through the core of the evaporator.

The OFF value is 1.8℃ and the 0N (on) value is 2.8℃.



Key

1. Evaporation core
2. Shutter sensor
3. Electronic thermostat

Refrigerant pipe

Once the refrigerant pipe is blocked, the following phenomenon occurs.

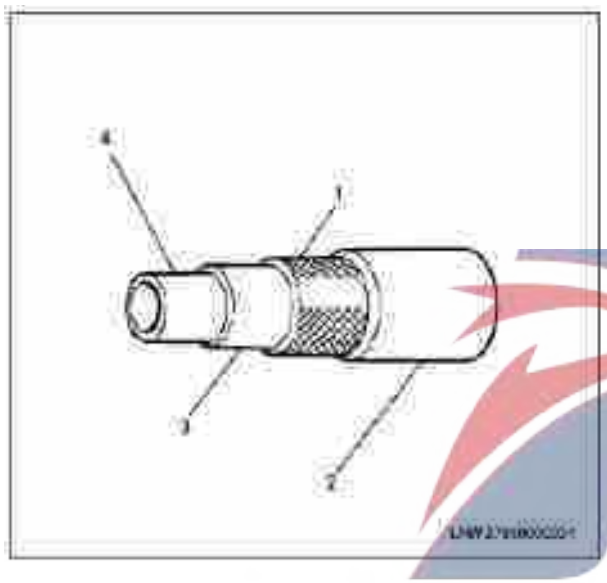
1. Low pressure hose: Once the low pressure hose is blocked, the compressor suction pressure will decrease and the discharge pressure will decrease, resulting in no cooling capacity.

2. High Pressure Hose: Once the high pressure hose is blocked, it will flow out of the system.

3. High pressure hose: Once the high pressure hose is blocked, the discharge end and the suction end become low pressure, resulting in insufficient cooling.

In addition, the high and low pressure hoses use a low permeability pipe with a nylon layer inside the pipe.

The service tool is a quick-connect device to prevent the refrigerant from leaking into the atmosphere during the connection.

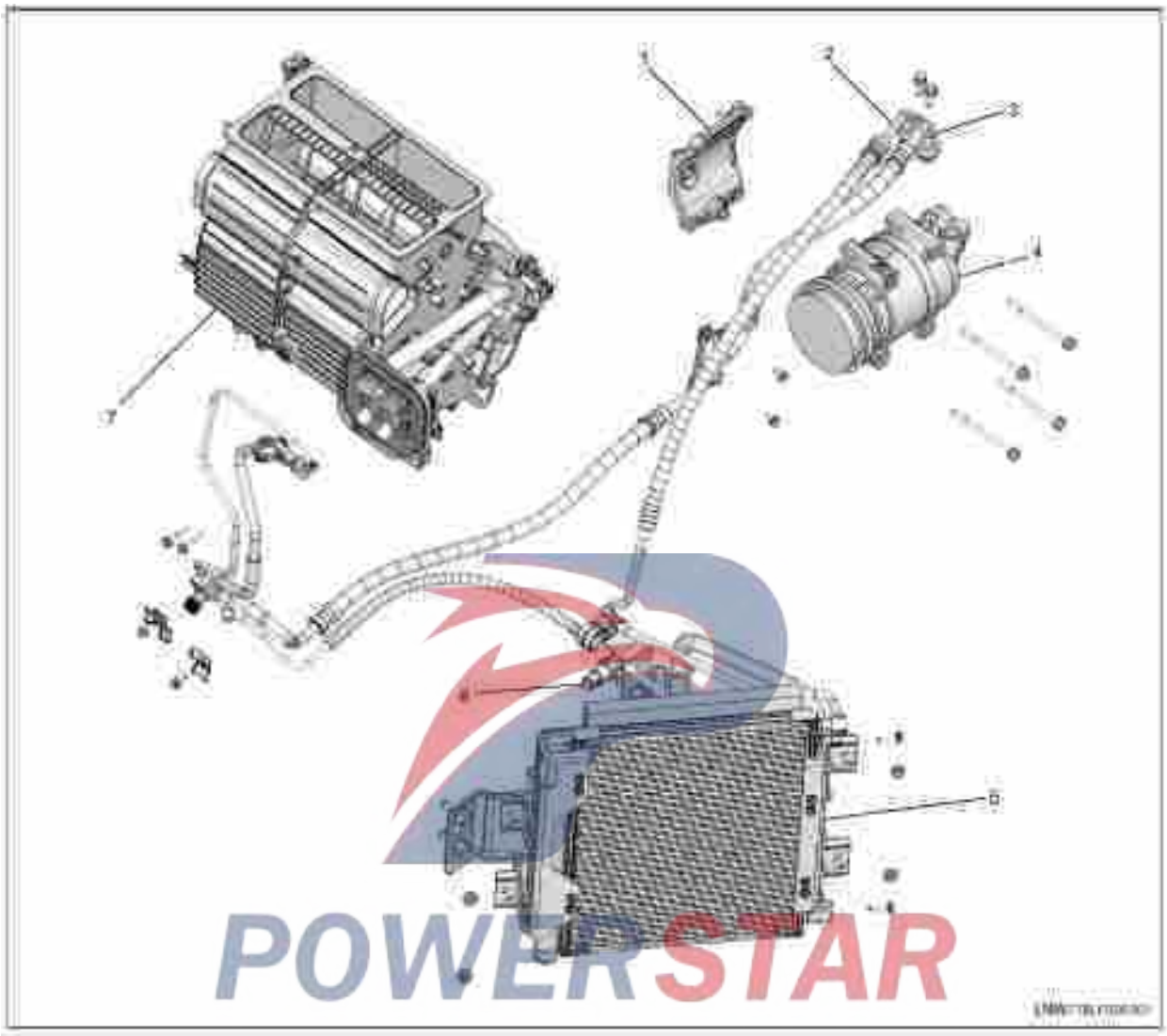


Key

1. Juku (improved layer)
2. External rubber layer
3. Inner rubber layer
4. Nylon layer

Parts configuration diagram

Enlargement of the cabin (high cabin section (connection))



Key

1. Compressor support
2. High pressure tube
3. Low pressure line
4. Compressor
5. Condenser set (built-in dry liquid storage bottle)
6. Pressure Switch
7. Heating and evaporator assembly

Use a good example to illustrate

Circuit diagram

Refer to the heater, section 7A ventilation system, heater, fan

Connector list

Refer to the heater, section 7A ventilation system, heater, fan

Functional check: air conditioning circulation system

Symptom	Probable causes	Process
No cooling air or cooling air Not enough.	The electromagnetic clutch does not work.	Refer to the functional check in this chapter: Electromagnetic clutch system.
	The compressor is not working properly.	Implement the following measures for the compressor to operate normally.
	Drive belt loose or damaged.	Adjust the drive belt to the specified voltage or replace it.
	The surface of the electromagnetic clutch is dirty.	Clean the surface of the electromagnetic clutch or replace it.
	The gap between the drive plate and the electromagnetic clutch pulley is not suitable.	Adjust the gap.
	The compressor oil leaks from the shaft seal or housing.	Replace the compressor.
	Compressor jammed.	Replace the compressor.
	Insufficient or excessive refrigerant.	Check the amount of refrigerant.
	The air conditioning system is leaking refrigerant.	Check the air conditioning and refrigeration system for leaks, retighten or repair.
	The condenser has poor heat dissipation.	Clean the condenser or check the condition of the condenser fan.
	Defective heating temperature control lever.	Repair the connection device.
	Expansion valve failure.	Replace the regulator.
	Electronic thermostat malfunction.	Check the electronic thermostat and replace it if necessary.
Insufficient air conditioning.	Evaporator is clogged or damaged.	Check the evaporator core and clean or replace the core.
	Cooling device or pipe leaking air	Check evaporator and piping connections and repair as needed.
	Blower motor is not working properly.	Refer to the 7A heatsink and check the operation of the fan section: fan changeover system.

Functional check: check air conditioning system with pressure gauge

Condition:

● Temperature: about 30~35℃

● Engine speed: approx. 1500 rpm

● Air conditioning switch: ON

● Fan Switch: High

● Temperature setting: MAX COOL (18℃)

● Switch air source: RECIRC (in-vehicle air circulation)

● Close all doors

Normal pressure: kpa {kgf / cm^2}:

● Low pressure end (1): about 127 {1, 3} ~ 245 {2. 5}

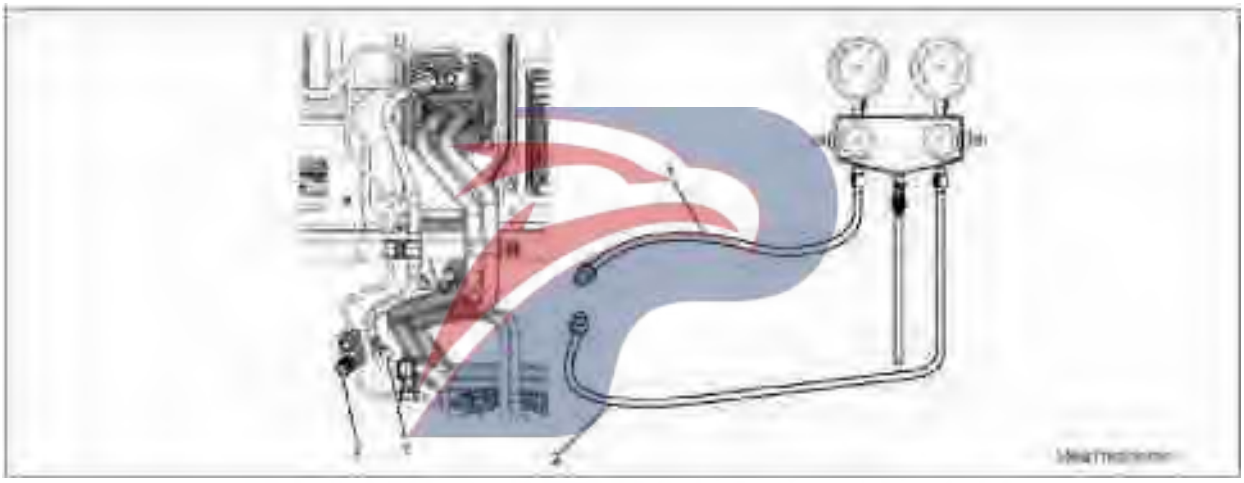
● High-pressure end (2): about 137 3 {14.0} ~ 1667 {17.0}

Collector instrument connection:

● Low pressure hose (low end): Suction end

● High Pressure hose (HIGH): Exhaust end

Since HFC-134a is used in air conditioning systems of vehicles, HFC-134a must be used for air conditioning maintenance tools such as manifold instruments and filling hoses when inspecting air conditioning systems.



Key

1. Low voltage end 2. High pressure end

State (kpa {kgf / cm^2})		Causes	Process
Insufficient cooling	Both sides of the high pressure and low pressure are very low. (Low pressure side = about 49{0. 5}∽98{1.0} high pressure = about 686 {7.0}∽981 {10}) In the inspection window, bubbles can be observed continuously. The temperature did not fall.	The refrigerant quantity due to refrigerant leakage is insufficient.	Check and correct refrigerant leaks. Fill the prescribed amount of refrigerant.
	Both high pressure and low pressure are very high. (Low pressure side = about 245{2.5}∽294{3.0} high pressure = about 2256 {23}∽2452 {25}) Even if the engine speed drops, bubbles are not visible at all in the inspection window. The temperature did not fall.	The refrigerant is too full. Insufficient condenser cooling.	Check the quantity of refrigerant and fill in the required quantity. Clean the condenser. Check and correct the condenser fan.

State (kpa {kgf / cm^2})		Causes	Process
	Both high pressure and low pressure are very high. (Low pressure side = about 245 {2,5} ~ 294 {3,0} high pressure = about 2256 {23} ~ 2452 {25}) The low pressure end tube is not cold. The bubble passes through the inspection window.	Due to the lack of vacuum, the air conditioner mixes in the air conditioning cycle.	Thoroughly blot dry and fill the refrigerant in the specified amount.
	Both high pressure and low pressure are high. (=Low pressure side 294, about 392 to {3,0} {4,0}=approximately 1961 high voltage terminal 20} {25} {~2452), with a low pressure gel at the end of the tube.	Bad expansion valve. (difference in refrigerant flow due to incorrect installation of thermal sensor)	Checking the Thermal Sensor Installation Status If there is no problem, replace the regulator.
Not cooling	The pressure on the low pressure side is high and the pressure on the high pressure side is too low. (Low pressure side = about 392{4.0}∽588{6.0} high pressure = about 686 {7.0}∽1079 {11}) Stop air conditioning and immediately balance high pressure and low pressure.	Poor compression due to compressor damage.	Replace the compressor.
One will be cooling, not cooling for a while.	The pressure on the low pressure side is negative pressure (the pressure on the high pressure side also drops), which is normal. When the air conditioner starts, it can operate normally, but after some time, the pressure on the low pressure side is not negative pressure. (Low-pressure side = negative pressure ~ about 127 {1.3} High pressure side = about 588 {6,0} ~ 1765 {18})	Water is mixed in the air conditioning cycle. (In the regulator, the water freezes and the circulation stops.) After dissolution, it returns to normal.	Replace the regulator. Replace liquid tank and compressor oil. Thoroughly blot dry and fill the refrigerant in the specified amount.
	The pressure on the low pressure side is negative pressure, and the pressure on the high pressure side is also low pressure. (Low pressure side = negative pressure high pressure side = about 490 {5,0} ~ 588 {6,0}) There is frost on the connection between the front and rear pipes of the liquid tank or regulator. (There is a large temperature difference between the IN and OUT terminals of the defective part.)	Traffic was cut off due to freezing of water and clogging of dust. The cycle is off due to an error in the regulator's temperature sensor. (When the pressure is completely blocked, the negative pressure is immediately displayed, and when the pressure is slightly blocked, the negative pressure is slowly displayed.)	When mixing with water, replace the tank dryer and compressor oil and fill the refrigerant to the specified amount. When the thermal sensor fails, replace the regulator.

Functional check: electromagnetic clutch system

Electromagnetic clutch does not work (normally confirmed after fan switching system, please check the following points).

Prior confirmation and visual inspection

● Check the battery voltage is normal.

When the battery voltage is abnormal, please charge or replace the battery

● Check if the fuse is normal.

If the fuse is abnormal (abnormal state is blown off), combine the reason for initial inspection (short-circuit harness, etc.), repair, and replace the fuse.

● Check if the grounding point is normal.

If the particles are not normal (dirty installation, dirty), repair and clean.

● Check if the harness and connector are normal.

Check for bad connections. If there is a defect or abnormal frictional damage, separate from the harness and use another circuit harness to short circuit.

● Check the effects of other electrical components (wireless devices, lights, etc.). Turn off or cut off the power of other electrical components, check and take any measures that do not affect the operation.

Check components

● Check air conditioning fuse (F37).

If the fuse is abnormal (abnormal state is blown off), combine the reason for initial inspection (short-circuit harness, etc.), repair, and replace the fuse.

● Check the compressor relay of the air conditioner.

Check the continuity of the air-conditioning compressor relay and replace it if it is faulty.

● Check the pressure switch.

Check the continuity of the pressure switch. If it is abnormal, replace it.

● Check the air conditioning switch.

Check the continuity of the air conditioning switch. If there is a fault, replace the switch.

● Check the electronic thermostat.

Check the electronic thermostat and replace it if it is abnormal.

● Check the electromagnetic clutch.

Check the electromagnetic clutch. If it is abnormal, replace it.

Check the circuit

● Check the following circuits for open circuit, short circuit (power and ground) and high resistance.

Repair or replace the object circuit if abnormal.

(Each number represents the common terminal on the chassis harness side.)

- Between blower motor relay terminal 1 and air conditioner compressor relay terminal 3

- Between the relay terminal of air-conditioning compressor NO.5 and the terminal of electronic thermostat NO.3

- Between the terminal of the electronic thermostat NO.4 and the terminal NO.4 of the air conditioning switch.

- Between the NO.5 terminal of the air-conditioning switch and the earth

- Between blower motor relay NO.1 terminal and air conditioning switch NO.6 terminal

- Between terminal 2 of the air conditioner compressor relay and terminal 1 of the pressure switch

- Between pressure switch terminal NO.3 and electromagnetic clutch

- Between electronic thermostat terminal NO.5 and ground

Functional check: condenser fan system

The condenser fan does not work (check the following after the air conditioning system outside the condenser fan is normal)

Prior confirmation and visual inspection

● Check the battery voltage is normal.

When the battery voltage is abnormal, please charge or replace the battery

● Check if the fuse is normal.

If the fuse is abnormal (abnormal state is blown off), combine the reason for initial inspection (short-circuit harness, etc.), repair, and replace the fuse.

● Check if the grounding point is normal.

If the particles are not normal (dirty installation, dirty), repair and clean.

● Check if the harness and connector are normal.

Check for bad connections. If there is a defect or abnormal frictional damage, separate from the harness and use another circuit harness to short circuit.

● Check the effects of other electrical components (wireless devices, lights, etc.). Turn off or cut off the power of other electrical components, check and take any measures that do not affect the operation.

Check components

● Check air conditioning fuse (F37).

If the fuse is abnormal (abnormal state is blown off), combine the reason for initial inspection (short-circuit harness, etc.), repair, and replace the fuse.

● Check the condenser fan relay.

Check condenser fan relay continuity, replace if not normal.

● Check the condenser fan motor.

Check the condenser fan motor. If it is abnormal, replace it.

● Check the pressure switch.

Check the continuity of the pressure switch. If it is abnormal, replace it.

Check the circuit

● Check the following circuits for open circuit, short circuit (power and ground) and high resistance.

Repair or replace the object circuit if abnormal.

(Each number represents the common terminal on the chassis harness side.)

- Between the NO.5 terminal of the condenser fan relay and the NO.4 terminal of the pressure switch

- Between the No. 2 terminal of the pressure switch and the mass

- Between the NO.1 terminal of the condenser fan relay and the NO.2 terminal of the condenser fan motor

- Between the terminal 1 of the condenser fan motor and the ground

The fan does not stop (even if you turn off the air conditioner condenser fan does not stop.)

Prior confirmation and visual inspection

● Check the battery voltage is normal.

When the battery voltage is abnormal, please charge or replace the battery

● Check if the fuse is normal.

If the fuse is abnormal (abnormal state is blown off), combine the reason for initial inspection (short-circuit harness, etc.), repair, and replace the fuse.

● Check if the grounding point is normal.

If the particles are not normal (dirty installation, dirty), repair and clean.

● Check if the harness and connector are normal.

Check for bad connections. If there is a defect or abnormal frictional damage, separate from the harness and use another circuit harness to short circuit.

● Check the effects of other electrical components (wireless devices, lights, etc.). Turn off or cut off the power of other electrical components, check and take any measures that do not affect the operation.

Check components

● Check the condenser fan relay.

Check condenser fan relay continuity, replace if not normal.

Check the circuit

● The confirmation circuit between the condenser fan and condenser fan NO.1 NO.2 relay terminal shorts the motor terminals (short circuit power supply). (Each number represents the common terminal on the chassis harness side.)

If the circuit is abnormal, repair or replace it.

The condenser fan does not stop (The condenser fan does not stop when the electromagnetic clutch is turned on during air conditioning operation.)

Prior confirmation and visual inspection

● Check the battery voltage is normal.

When the battery voltage is abnormal, please charge or replace the battery

● Check if the fuse is normal.

If the fuse is abnormal (abnormal state is blown off), combine the reason for initial inspection (short-circuit harness, etc.), repair, and replace the fuse.

● Check if the grounding point is normal.

If the particles are not normal (dirty installation, dirty), repair and clean.

● Check if the harness and connector are normal.

Check for bad connections. If there is a defect or abnormal frictional damage, separate from the harness and use another circuit harness to short circuit.

● Check the effects of other electrical components (wireless devices, lights, etc.). Turn off or cut off the power of other electrical components, check and take any measures that do not affect the operation.

Check components

● Check the pressure switch.

Check the continuity of the pressure switch. If it is abnormal, replace it.

Check the circuit

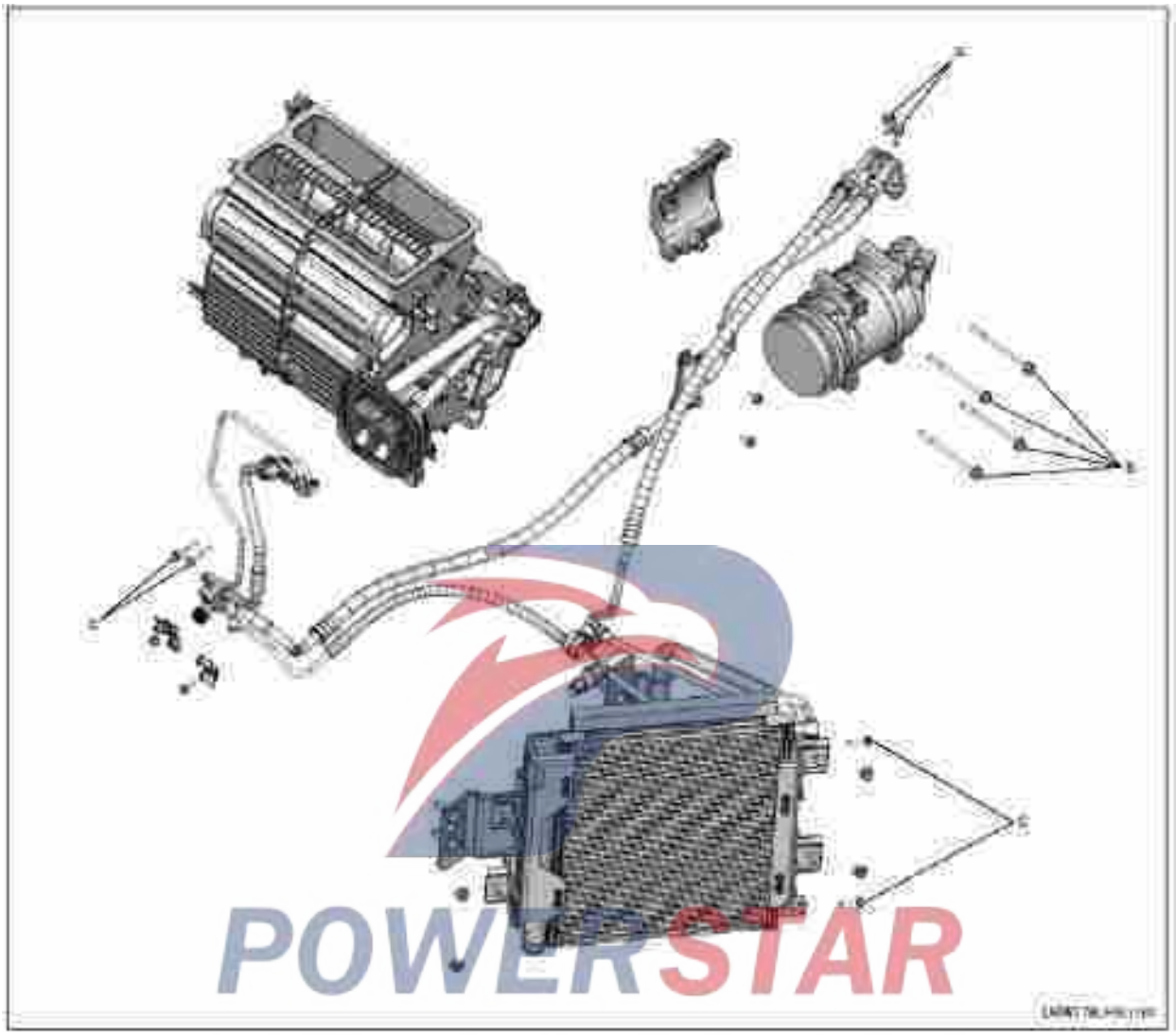
● Check if the circuit between condenser fan relay terminal NO.5 and pressure switch terminal NO.4 is short-circuited (short to ground). (Each number represents the common terminal on the chassis harness side.) If the circuit is abnormal, repair or replace it.

Main parameters

Item		Standard parameter
Evaporator assembly	Refrigeration control method	Steam compression
	Heat dissipation kw {kcal/hr}	4.7 {4040}
	Air volume m^3 / hr	460
Evaporator core	Type	Layered fins
	Effective core size mm	293.1×151×38
Expansion valve	Type	External pressure balance
Heat sensitive switch ※Only can be manually air-conditioned Automatic temperature control is controlled by the control unit based on signals from the blade sensors.	Type	Electronic (electronic thermostat)
	Working temperature 1	OFF:1.8 ON: 2.8
Condenser	Type	MF partial cooling type
	Heat dissipation kw {kcal/hr}	7.2 {6190}(Extended cab)
Liquid tank	Absorbed dose g	Synthetic zeolite 100
	Capacity cm^3	300
Pressure Switch	Working pressure kpa {kgf / cm^2}	Low pressure control ON: 225±30{2.3±0.3} OFF: 196±20{2.0±0.2} Medium pressure control ON: 1520±98{15.5±1.0} OFF: 1230±98{12.5±1.0} High pressure control ON: OFF value is 590±196 {6.0±2.0} Stress reliever OFF: 3140±196{32.0±2.0}
Refrigerant filling	HFC-134ag	400 {30}(Extended cab)
Compressor	Type	DKS - 15D
	Type	Swing plate
	Discharge cm^3	156
	Number of cylinders × inner diameter × stroke mm	10—30.5×21.4
	Maximum speed rpm	7000 (snapshot 8400)
	Shaft seal	Lip type
	Weight kg	4.4
Electromagnetic clutch	Rated voltage V	24
	Power consumption W	45
	Static torque N-m {kgf·M}	49 {5}
	Weight kg	2.0
Specified compressor oil	ZXL100PG cm^3	150

Tightening torque - Overview

Enlargement of the cabin (high cabin section (connection))



Key

(a) 4.5 N • m{1.5 kgf • m}

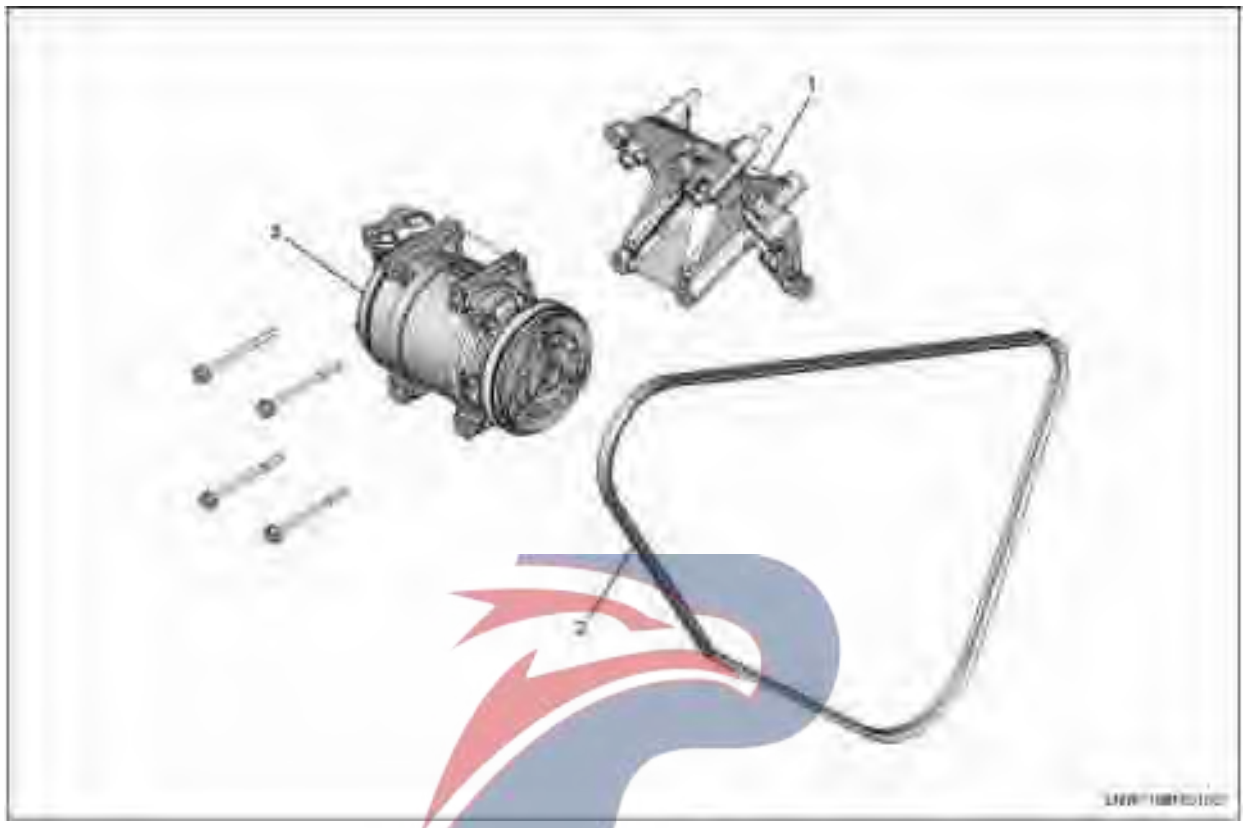
(b) 25 N • m{2.5 kgf • m}

(c) 5. 4 N • m{0. 6 kgf • m}

Use a good example to illustrate

Compressor

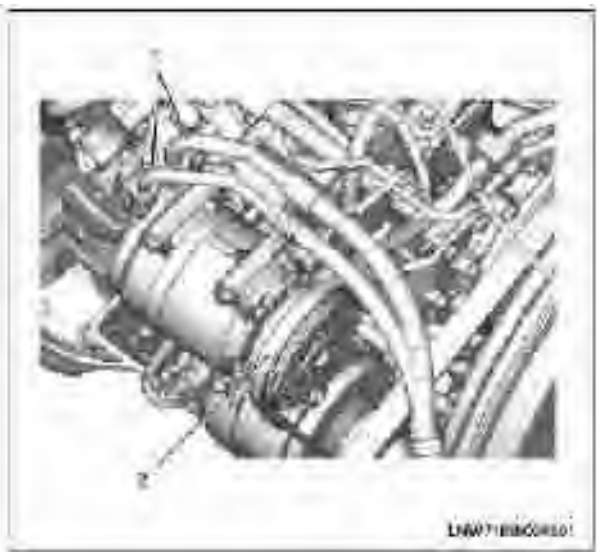
Component parts



Key

1. Compressor support
2. Drive belt
3. Compressor

Disassembly



1. Discharge the refrigerant.
2. Disconnect the electromagnetic clutch harness connector.
3. Disconnect the drive belt (2)

● Loosen the tensioner lock nut, loosen the tensioner adjustment screw, and then remove the belt (2).

4. Remove the high pressure and low pressure hoses (1).

● After unplugging the connecting pipe from the high and low pressure pipes (1), cover or cover the connecting piece to prevent foreign matter from entering the air conditioning circulation pipe.

5. Remove the compressor.

● Remove the compressor fixing screw (4)

Installation

1. Install the compressor.

● Tighten the compressor mounting bolts to the specified torque.

Tightening torque: 25 N • m {2.5 kgf • m}

2. Install high pressure and low pressure hoses.

● Do not reuse O-rings and replace them with new O-rings.

● Before replacing the O-ring, use compressor oil and install it on the pipe.

● Tighten the connecting bolts of the high and low pressure hoses to the specified torque.

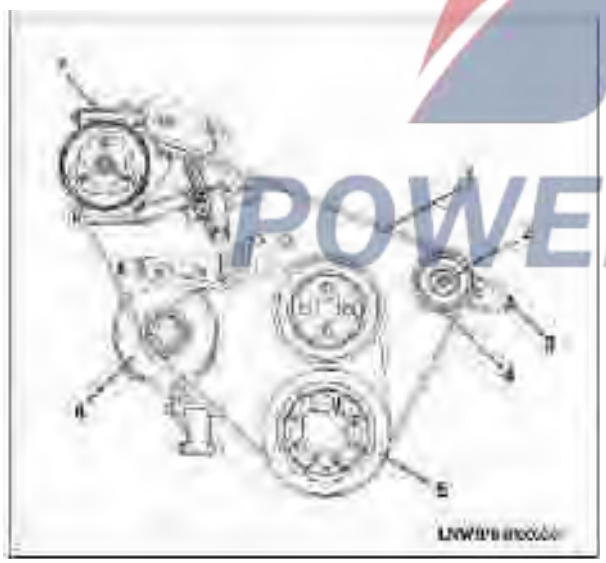
Tightening torque =15N • m {1.5 kgf • m}

3. Install the drive belt.

● Align the drive belt and pulley groove when installing.

4. Adjust the tension of the drive belt.

● Refer to the "Drive Belt" (4HK1) section of the engine.



Key

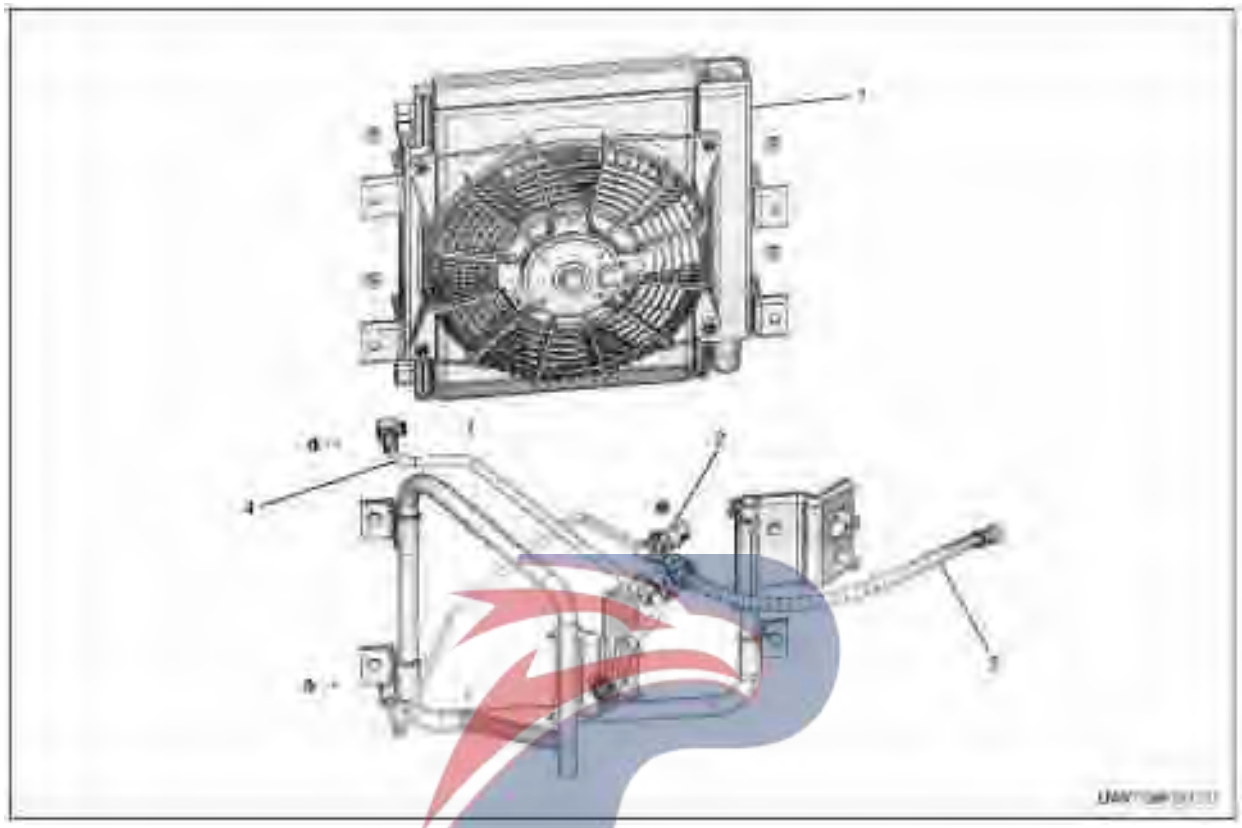
1. Drive belt
2. Tensioner lock nut
3. Tensioner adjustment bolt
4. Tensioning wheel
5. Crankshaft pulley
6. Generator
7. Compressor
8. Tension pulley

5. Connect the electromagnetic clutch harness connector.

6. Add refrigerant.

Condenser assembly

Component parts



Key

1. Condenser set (built-in dry liquid storage bottle)
2. Pressure Switch
3. High pressure hose
4. High pressure tube

For example, the above components show the expansion of the nacelle.

Disassembly

1. Discharge the refrigerant.

2. Remove the mounting clip from the high pressure hose.

3. Remove the high pressure hose.

● Use the support key to open the refrigerant line connection.

● After removing the hose, seal or seal it to prevent foreign matter from entering the air conditioning system.

4. Remove the condenser assembly.

● Remove the condenser fan motor connector.

● Remove the condenser fixing nut.

Installation

Please pay attention to the following points during installation and assemble in the reverse order of removal.

1. When installing a new condenser, fill the compressor oil with 30CID3.

2. It is forbidden to use O-ring repeatedly. It must be replaced with a new O-ring.

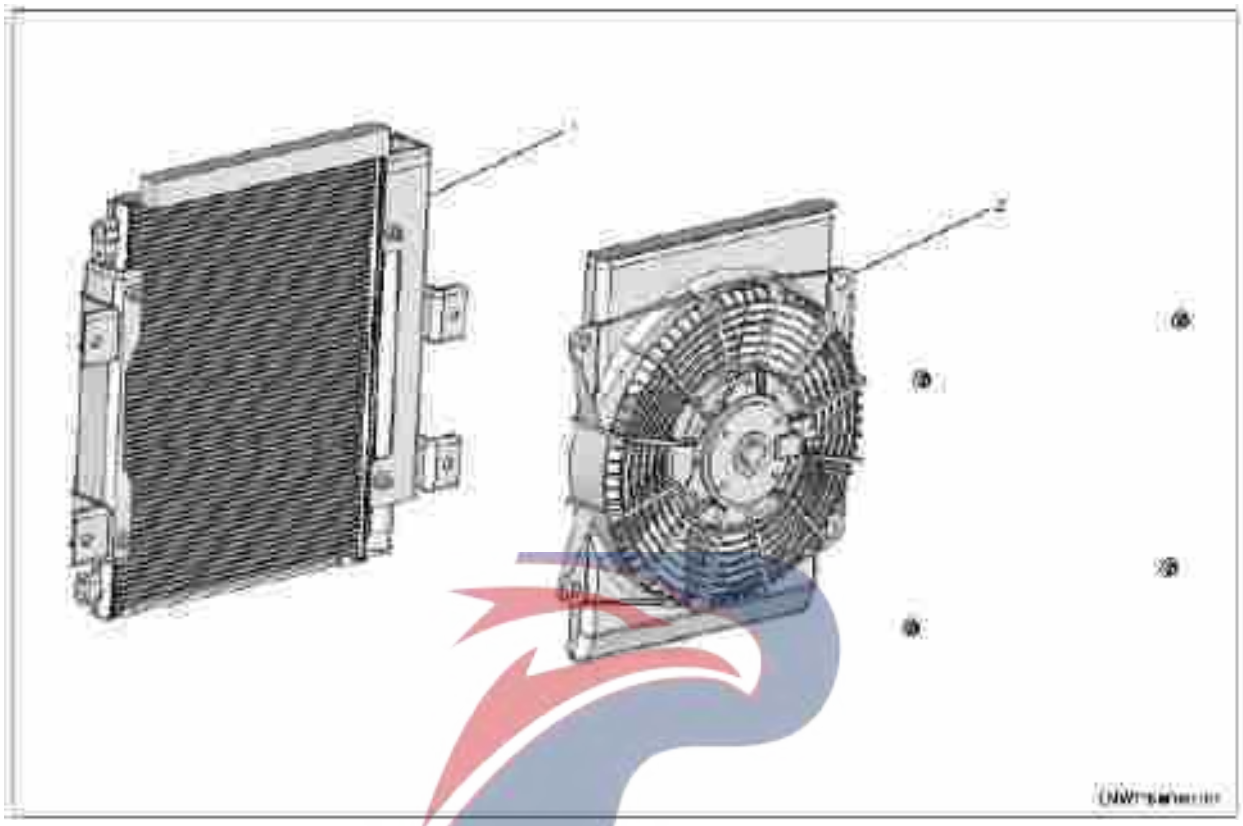
3. Apply compressor oil to the replacement o-ring and connect it to the conduit.

4. Tighten the high pressure hose to the specified torque.

Tightening torque: 5.4 N • m {0.6 kgf • m}

Condenser fan motor

Component parts



Key

1. Condenser (built-in dry liquid storage bottle)
2. Condenser fan assembly

For example, the above components show the expansion of the nacelle.

Disassembly

1. Remove the condenser fan assembly.

● Remove the condenser fan connector.

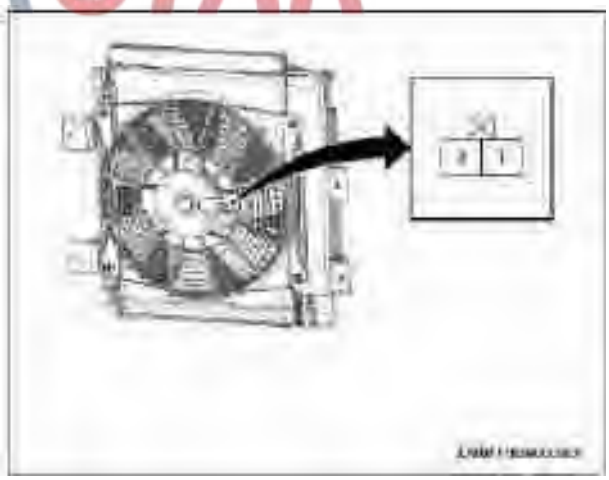
● Remove the condenser fan mounting nut.

Inspection

Condenser fan

1. Connect the (+) battery terminal to the condenser fan No.2 terminal and the (1) terminal to No.1.

2. Check that the condenser fan is working properly.

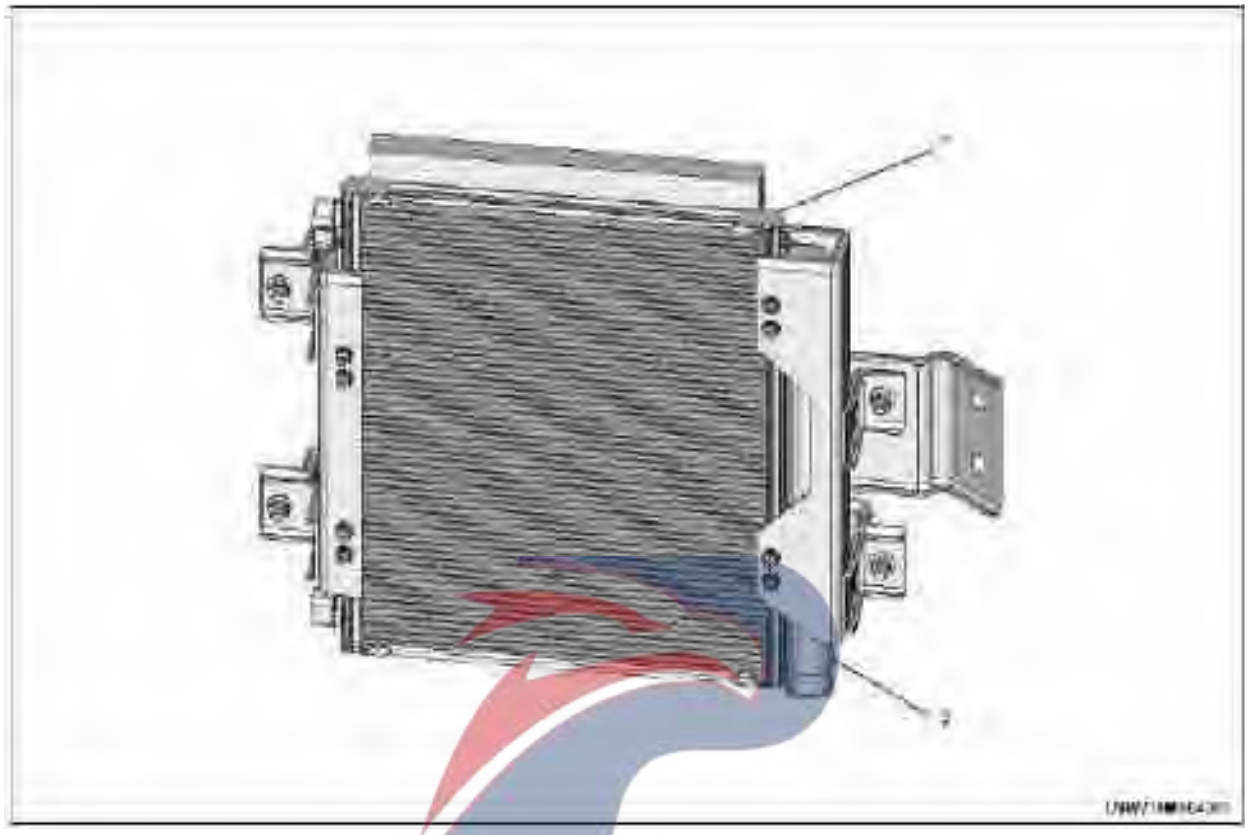


Installation

Assemble in the reverse order.

Liquid tank

Component parts

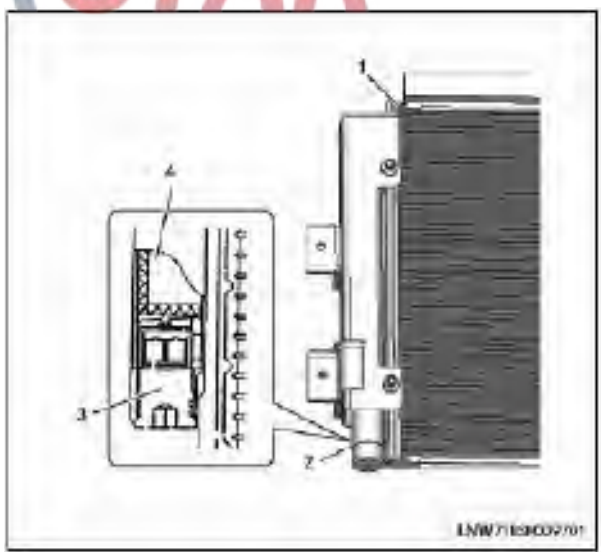


Key

1. Condenser
2. Dry bottle

Disassembly

1. Discharge the refrigerant.
2. Use an Allen wrench to loosen the dry plug of the fuel tank.
3. Remove the liquid drying bottle.

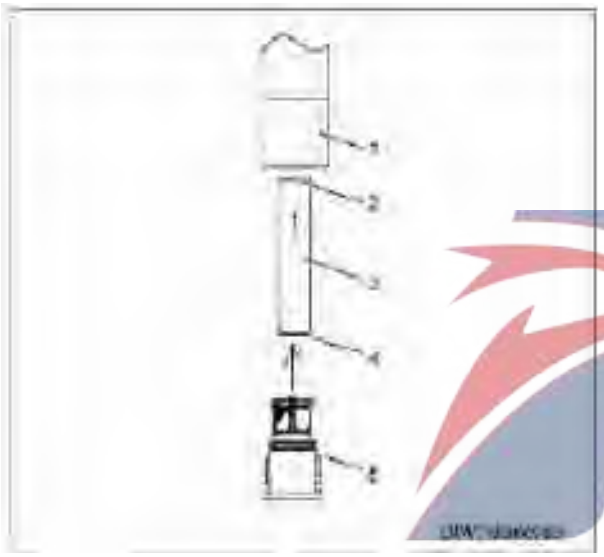


1. Condenser
2. Dry bottle
3. Liquid drying bottle cap
4. Desiccant

Installation

Please pay attention to the following points during installation and assemble in the reverse order of removal.

1. The adhesive part of the drying bottle is lowered during installation.



1. Dry bottle
2. Link website
3. Desiccant
4. Glued part
5. Liquid drying bottle cap

2. It is forbidden to use O-ring repeatedly. It must be replaced with a new O-ring.

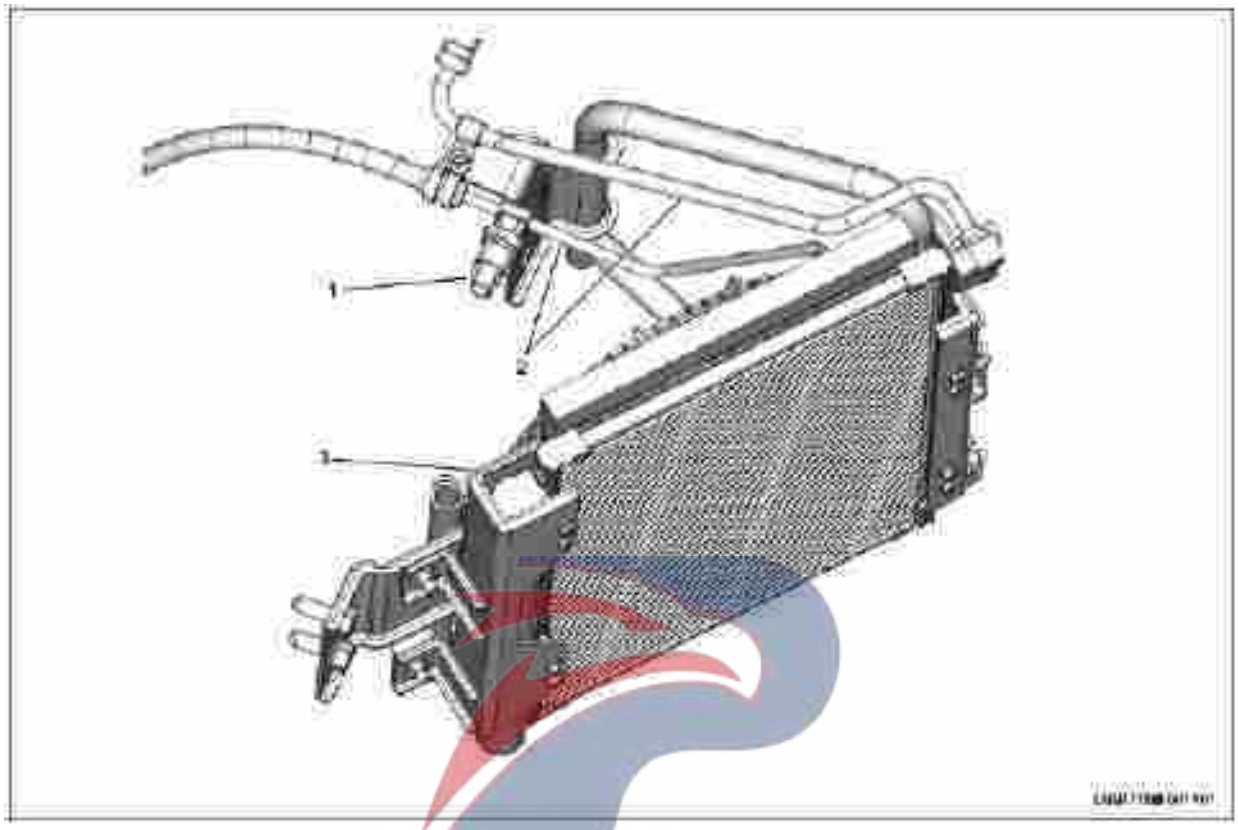
3. Apply compressor oil to the replacement o-ring and connect it to the conduit.

4. Tighten the tube of the reservoir to the specified torque.

Tightening torque = 3N • m {0.3 kgf • M}

Pressure Switch

Component parts



Key

1. Pressure Switch
2. High-voltage lines
3. Condenser set (built-in dry liquid storage bottle)

Disassembly

1. Discharge the refrigerant.

2. Disconnect the pressure switch connector.

3. Remove the pressure switch.

● The support key must be used when removing the pressure switch.

● After removing the pressure switch, cover or cover the connector to prevent foreign matter from entering the air conditioning circulation circuit.

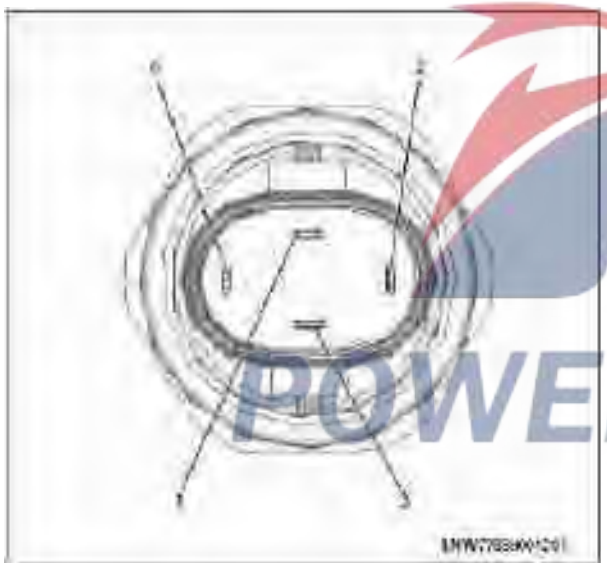
Inspection

Pressure Switch

(When the air conditioner is off (OFF))

1. Disconnect the pressure switch harness connector.

2. Check continuity between pressure switch side connector terminals.



Joint No.	Conductivity	Control
1-3	Conductivity	Compressor on and off
2-4	No conduction	Condensing fan on and off

(When the air conditioner starts)

1. Operate the air conditioner and check that the refrigerant pressure reaches the next set value, and check that the connector #2 to #4 terminals of the chassis harness side are connected and that the condenser fan is operating.

Condenser fan

"ON": 1520 ± 98 kpa {15.5 ± 0.3 kgf / cm^2}

"OFF": 1230 ± 98 kpa {12.5 ± 1 kgf / cm^2}

Installation

Please pay attention to the following points during installation and assemble in the reverse order of removal.

1. It is forbidden to use O-ring repeatedly. It must be replaced with a new O-ring.

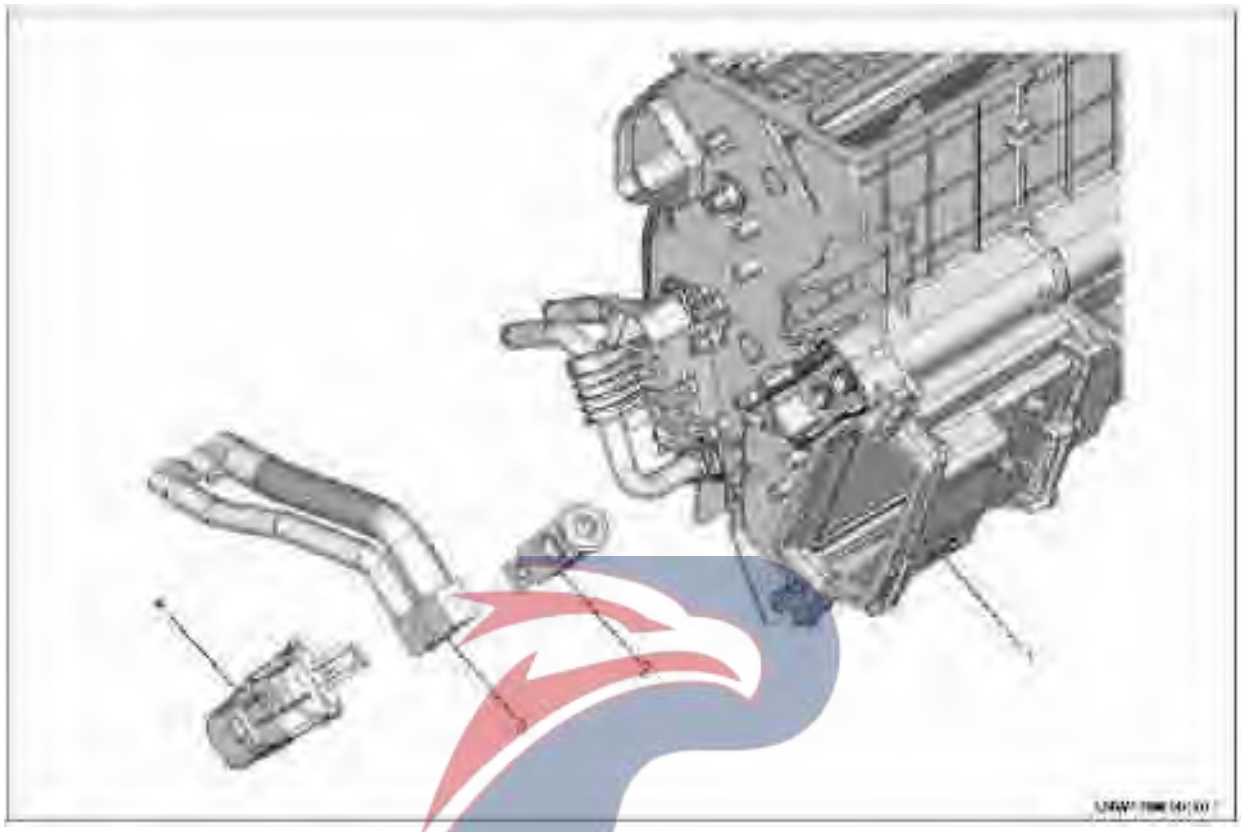
2. Apply compressor oil to the replacement O-ring and connect it to the connector.

3. Tighten the pressure switch to the specified torque.

Tightening torque =10N • m {1.0 kgf • m}

Expansion valve

Component parts



Key

1. Heating and evaporator assembly
2. Expansion valve
3. Pipeline assembly
4. Valve cover

Disassembly

1. Discharge the refrigerant.
2. Remove the heater and evaporator assembly.

● Refer to Section 7A Heaters, Heaters in Fans (Heaters and Evaporators).

3. Remove the valve cover.
4. Remove the hose assembly.

● Remove the fixing screw (2).

5. Remove the regulator.

Installation

Please pay attention to the following points during installation and assemble in the reverse order of removal.

1. Tighten the regulator to the specified torque.

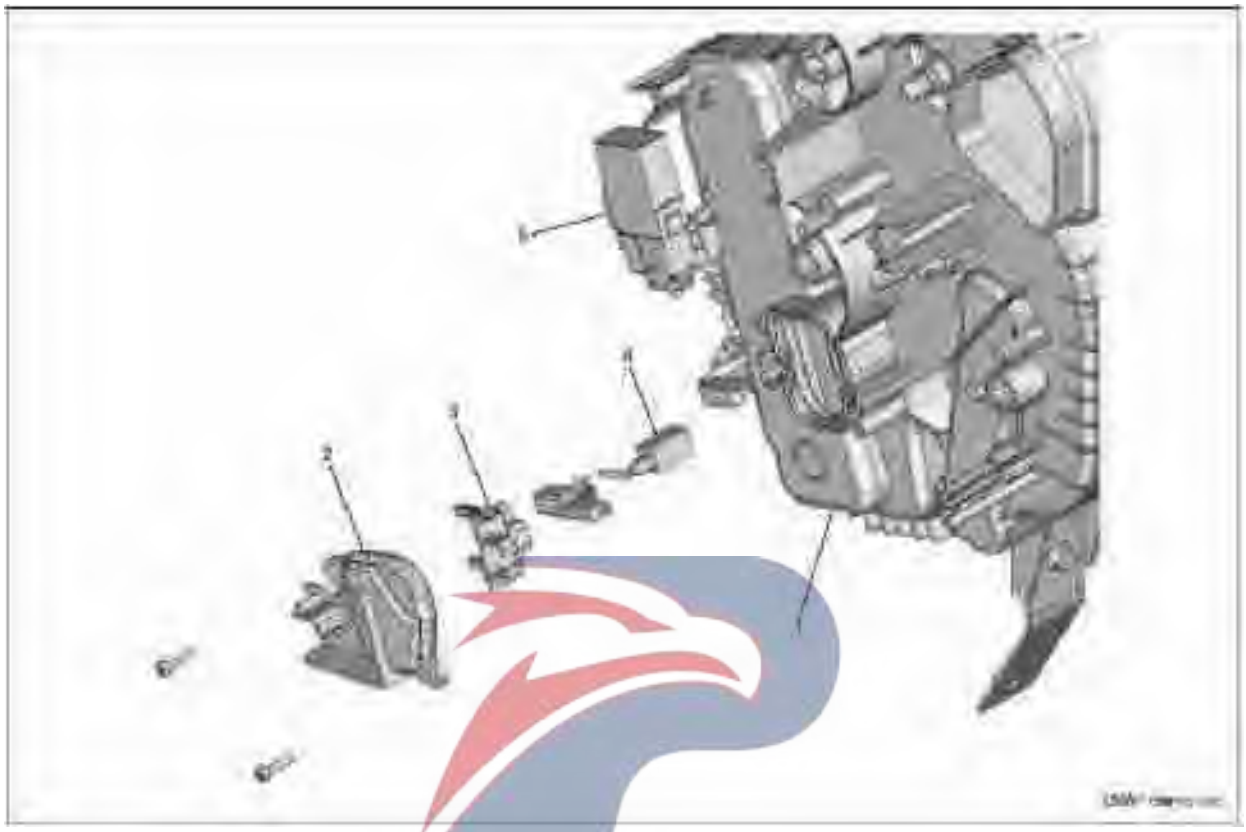
Tightening torque: 5 N • m {0.5 kgf • m}

2. It is forbidden to use O-ring repeatedly. It must be replaced with a new O-ring.

3. Apply compressor oil to the replacement o-ring and connect it to the conduit.

Thermal switch (electronic thermostat and fin sensor)

Component parts



Key

1. Heating and evaporator assembly
2. Sensor cover
3. Sensor clip
4. Shutter sensor (evaporator temperature sensor)
5. Electronic thermostat

Disassembly

1. Disconnect the tag sensor connector.
2. Remove the sensor cover.

● Remove the mounting screws from the sensor cover.

3. Remove the sensor clip.
4. Remove the blade sensor.

● Remove the blade sensor from the center blade.

● When removing, be careful not to damage the ink cartridges.

Inspection

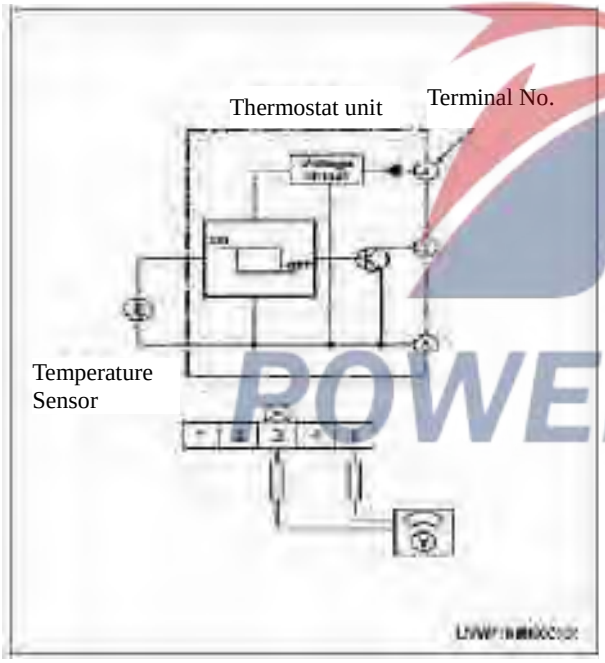
Electronic thermostat

1. The air selector knob is in the "FACE" position and the air source lever is in the "RECIRC" position to activate the air conditioner.

2. When the temperature selector knobs are “MAX COOL” to “MAX HOT”, check the ON/OFF status of the electromagnetic clutch.

3. When the electromagnetic clutch is opened and closed, measure the voltage between the NO.3 and NO.5 terminals on the chassis harness side connector.

Terminal number	Electromagnetic clutch	Voltage
3-5	ON	0V
	OFF	24V



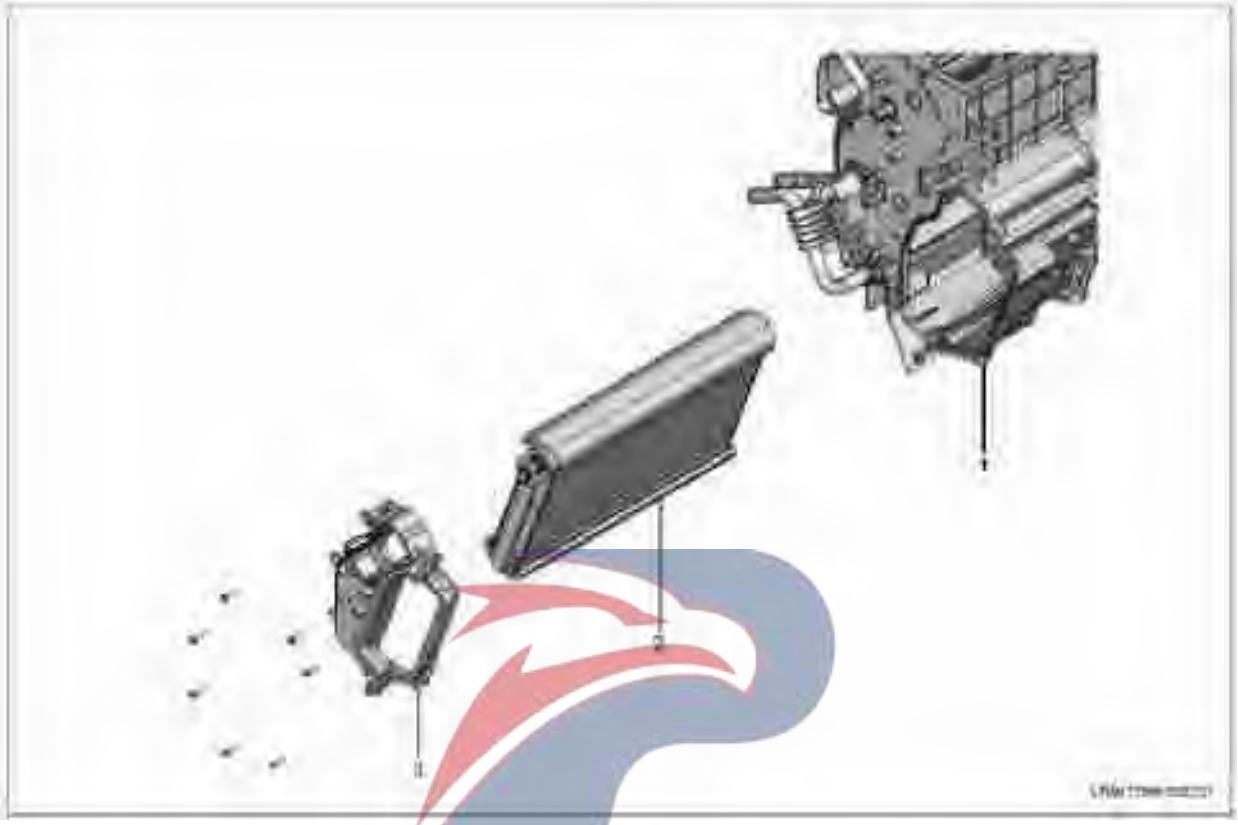
Installation

Please pay attention to the following points during installation and assemble in the reverse order of removal.

1. Accurately mount the blade sensor and sensor clip to their original positions.

Evaporator core

Component parts



Key

1. Heating and evaporator assembly
2. Evaporator core
3. Evaporator cover

Disassembly

1. Discharge the refrigerant.

2. Remove the heater and evaporator assembly.

● Refer to Section 7A Heaters, Heaters in Fans (Heaters and Evaporators).

3. Remove the regulator.

● Refer to the regulators in this chapter.

4. Remove the evaporator cover.

● Remove the screw that holds the evaporator cover.

5. Remove the blade sensor.

● Refer to the thermal switches (electronic thermostats and fin sensors) in this chapter.

6. Remove the evaporator core.

● Remove the evaporator core from the heater and evaporator.

Installation

Please pay attention to the following points during installation and assemble in the reverse order of removal.

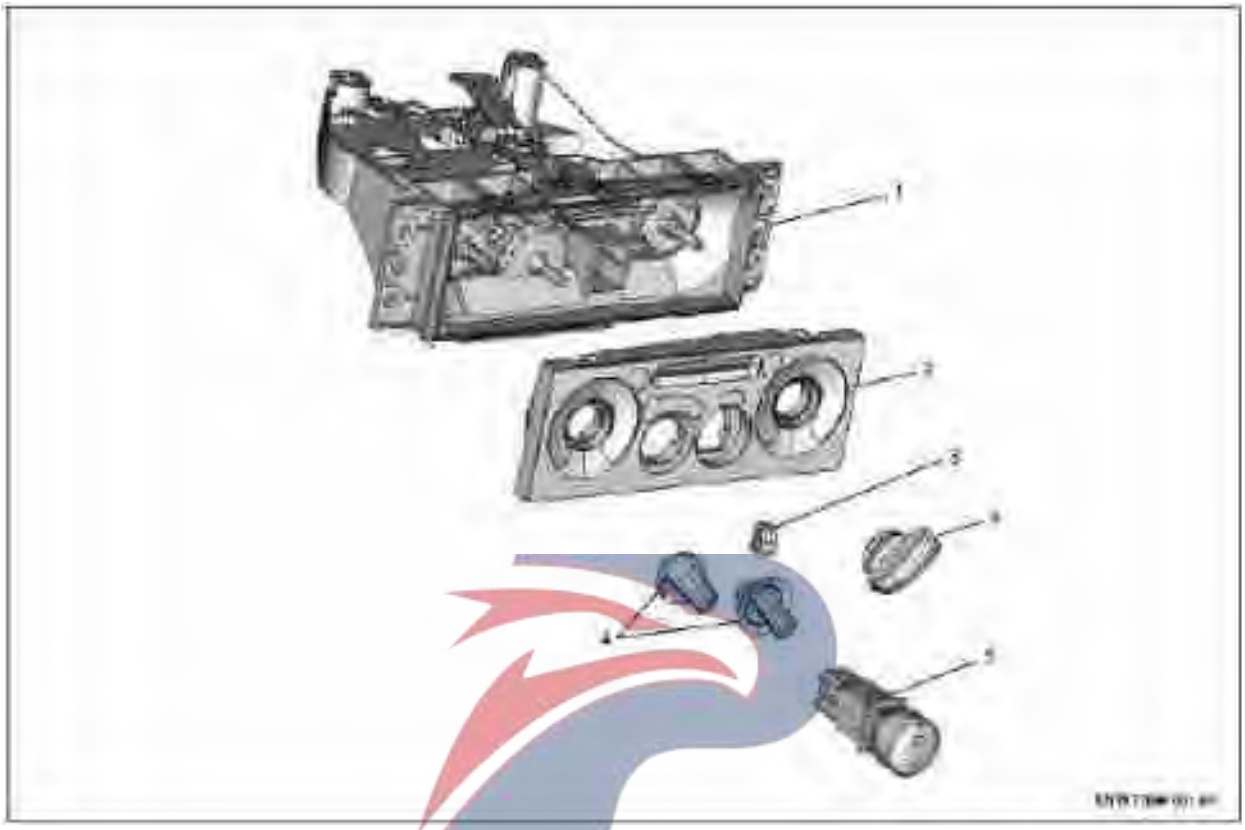
1. When installing a new cartridge, fill the evaporator core with 50 ml of compressor oil.

2. Install the airfoil sensor and collar fully in their original positions.

● Reference thermal switch (electronic thermostat and fin sensor).

A/C switch

Component parts



Key

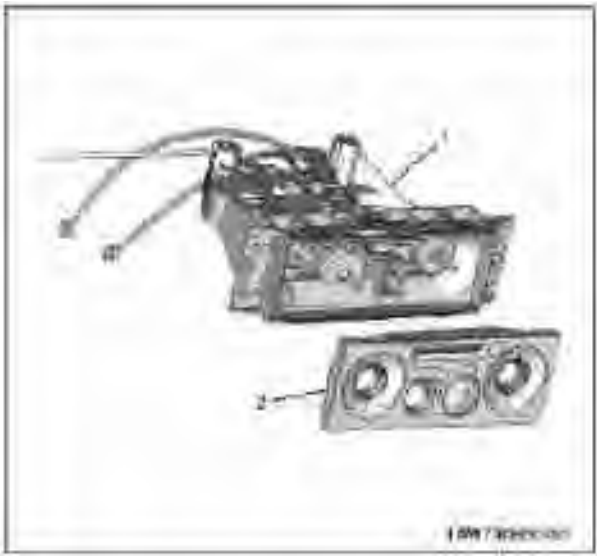
1. Control rod assembly
2. Front cover of control panel
3. Control button
4. Each button
5. A/C switch

Disassembly

1. Remove the front cover of the control panel (2) from the lever (1).

● See heater 7A on the fan section lever assembly.

● Remove it completely with air-conditioning switch.



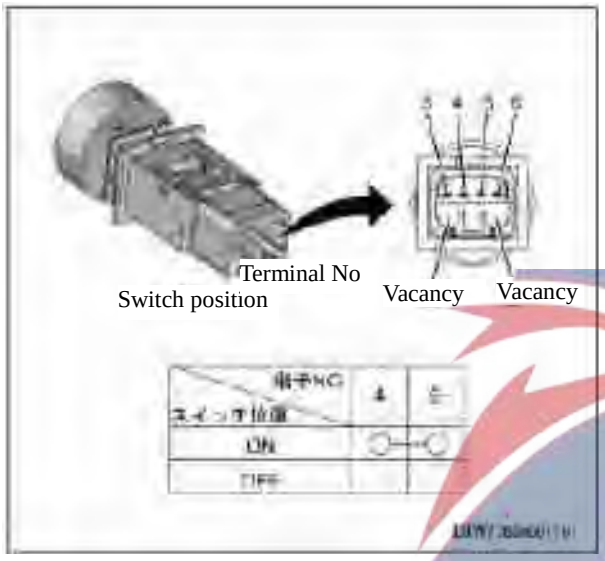
2. Remove the A/C switch

● Press the air-conditioning switch on the back of the front panel of the control panel and pull it toward you to remove it.

Inspection

A/C switch

1. During the switching operation, check the continuity between the terminals on the A/C switch side.



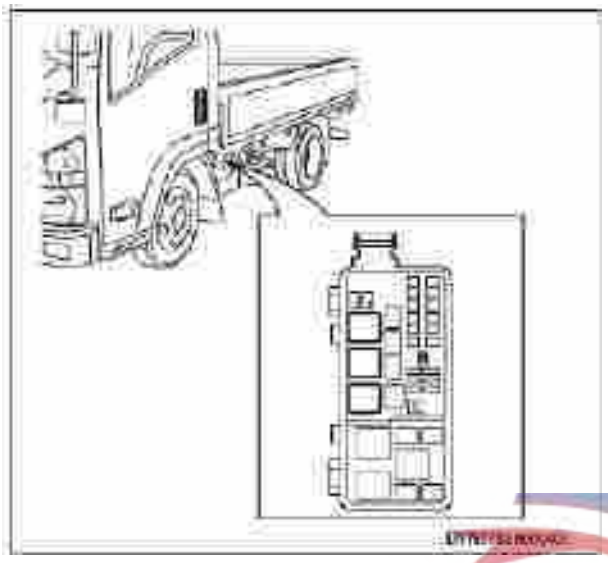
Installation

Assemble in the reverse order of removal.

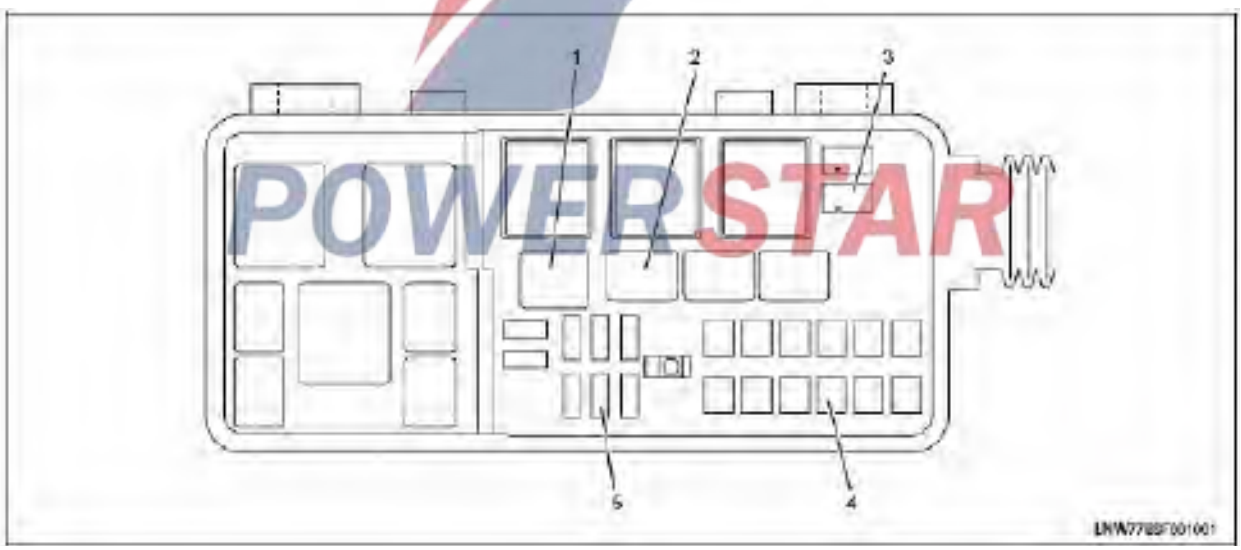
Air Conditioner Compressor Relay and Condenser Fan Relay

Disassembly

1. Location of fuse and relay box (chassis relay box)



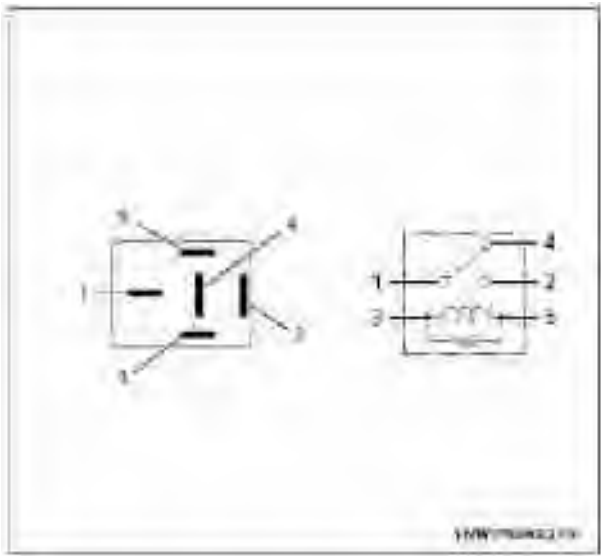
2. Disconnect the air conditioner compressor relay (1) and the condenser fan relay (2).



Key

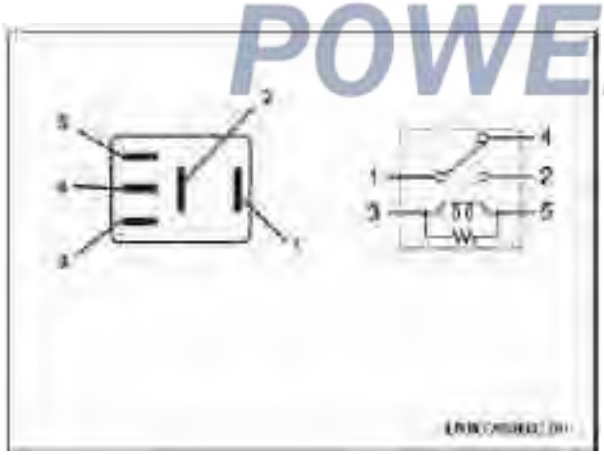
1. A/C compressor relay
2. Condenser fan relay
3. Air conditioning compressor diode
4. Wiper and heater fuses
5. Air conditioning fuse

3. Check the continuity between the air conditioner compressor relay side terminals.



1 - 4———— Conductivity 1 - 2————————No conduction
(between 3 and 5 when applying battery voltage) 1 - 4————————No conduction 1 - 2———— Conductivity

4. Check continuity between condenser fan relay side terminals.



1 - 4— Conductivity 1 - 2—No conduction
Between 3 and 5 thick when battery voltage is applied) 1 - 4—No conduction 1 - 2— Conductivity

Installation

Assemble in the reverse order.

Section 8A

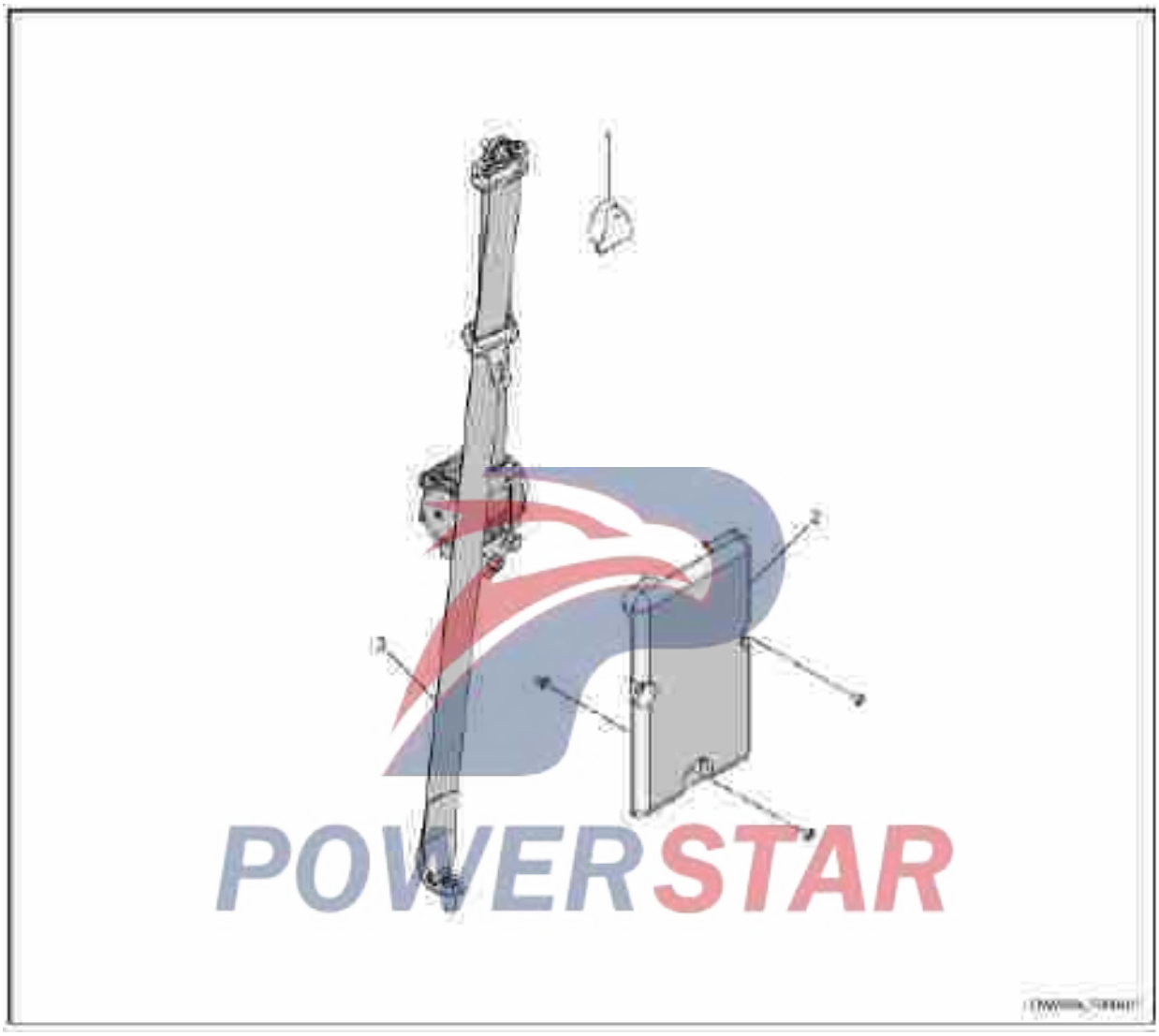
Seat belt

Table of Contents

Side seatbelt buckle

(Bridge Cabin / Single Cab Bicycle Cockpit)

Component parts



Key

1. Bolt cover
2. Decrease the decoration of the rear pillar
3. Seat belt retractor assembly

Disassembly

1. Remove the bottom trim from the rear pillar.

Refer to 9K vehicle interior and exterior trim rear decoration.

2. Remove the bolt decoration.

3. Remove the upper seat belt fixing bolts and the lower fixing bolts.

4. Remove the retractor mounting bolts and remove the retractor from the column.

Installation

1. Tighten the retractor mounting bolts to the specified torque

Tightening torque : 44 N•m {4.5kgf•m}

2. Tighten the upper and lower seat belt attachment bolts to the specified torque.

Tightening torque : 44 N•m {4.5kgf•m}

3. Remove the bolt cover

4. Install the rear pillar lower trim

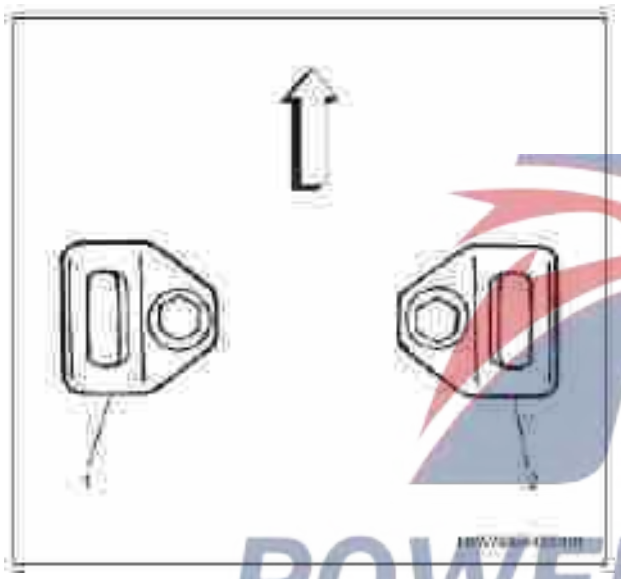
Refer to 9K vehicle interior and exterior trim rear decoration.

5. Install side sill guards.

Refer to rear pillar decoration for interior and exterior parts of 9K vehicles.

Caution:

When installing, do not slide the lower seat belt along the mounting stopper.

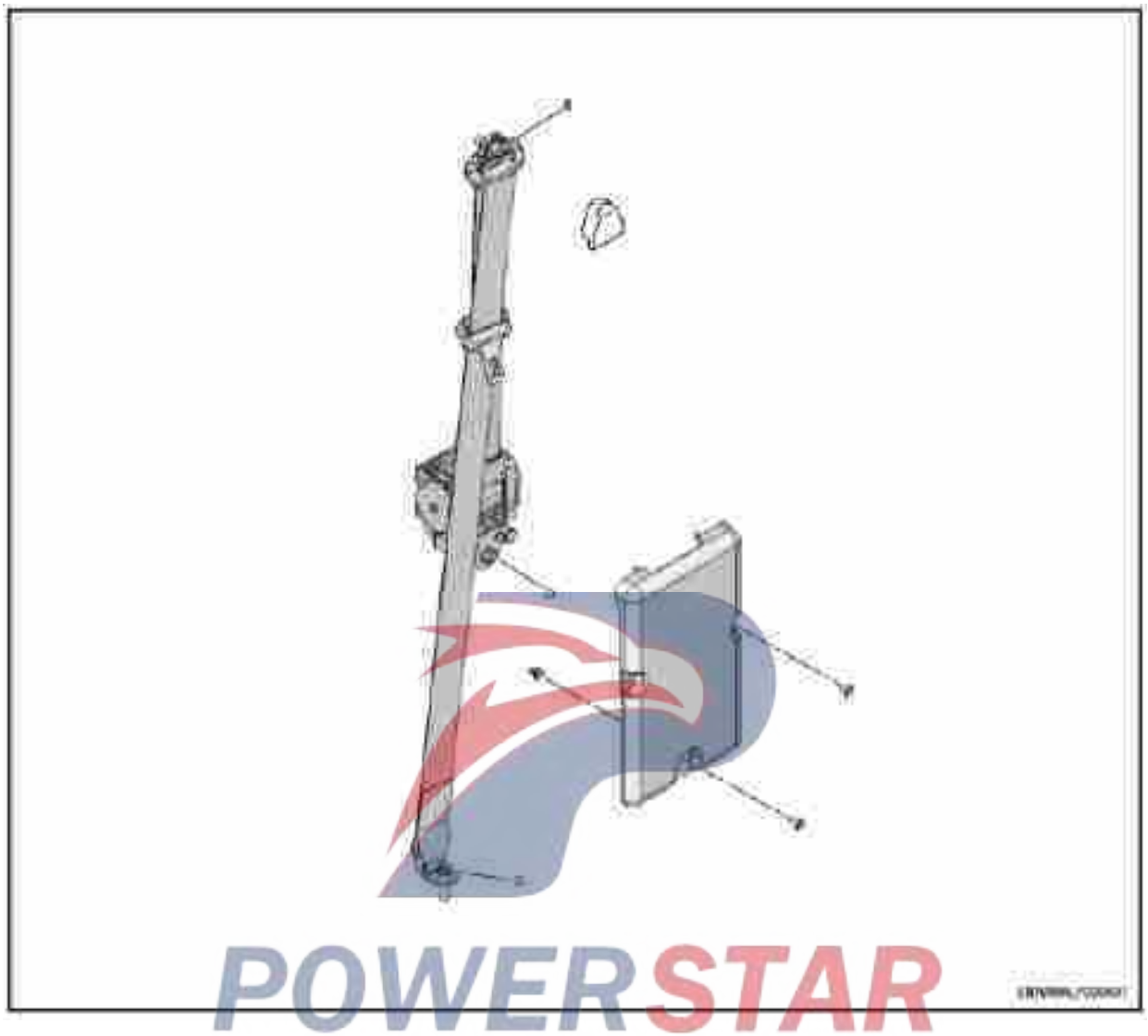


Key

1. Sub driver seat belt lower fixing

2. Reduce the tightness of the driver's seat belt

Tightening torque - Overview



Key

(a) 44 N•m {4.5kgf•m}

(b) 44 N·m {4.5kgf·m}

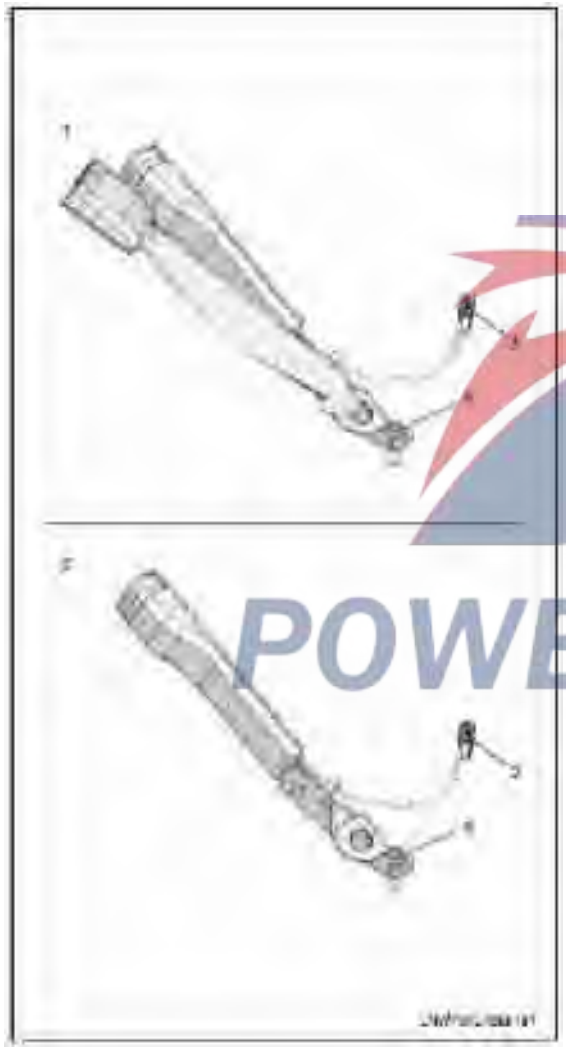
(c) 44 N·m {4.5kgf·m}

Front seat center seat and driver seat side seat belt buckle

Disassembly

1. Disconnect the battery ground cable.
2. Remove the fixing screws (4).
3. Disconnect the alarm interface from the seat belt (3).
4. Remove the driver's seat.
5. Remove the seat belt buckle from the driver's right rear mounting bracket.

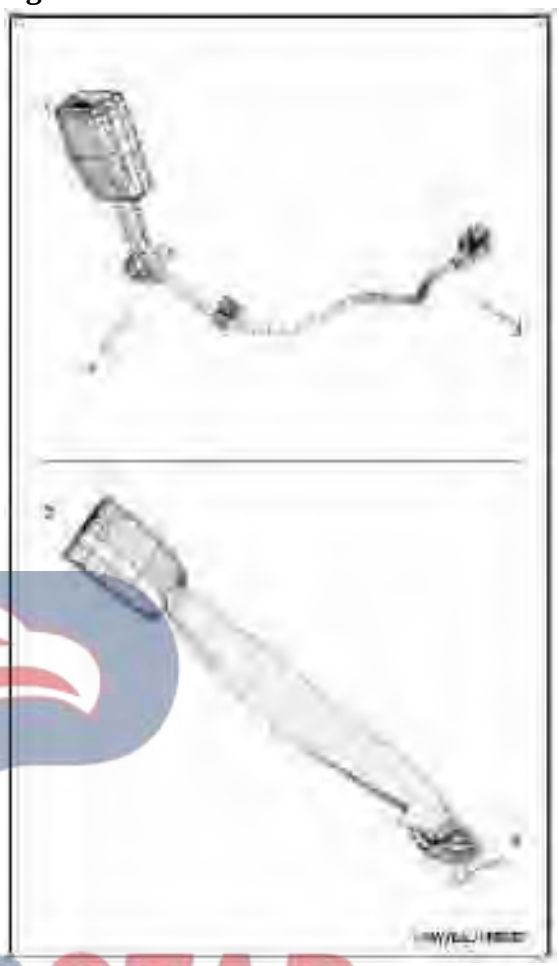
Standard cab



Key

1. Belt buckles for mid-seat vehicles
2. Belt buckles of vehicles without intermediate seats
3. Seat belt alarm interface
4. Fixing bolts

Height cabin/ extension cabin



Key

1. Driver seat belt buckle
2. Intermediate seatbelt buckle
3. Seat belt alarm interface
4. Fixing bolts

Installation

Follow the reverse order of removal and note the following.

1. Attach the lower seat belt buckle connector of the driver's seat belt to the bolt on the right rear seat of the driver's seat, then install the seat assembly and tighten the bolts to the specified torque.

Tightening torque : 44 N•m {4.5kgf•m}

2. Insert the harness on the driver's seat belt buckle into the floor mat and insert the alarm interface (3)
3. Assemble the bolt (4) and install the fastener in the direction indicated Tightening torque = 44 N•M {4,5kgf•M};

4. Lock the middle belt through the strap at the end of the cushion.

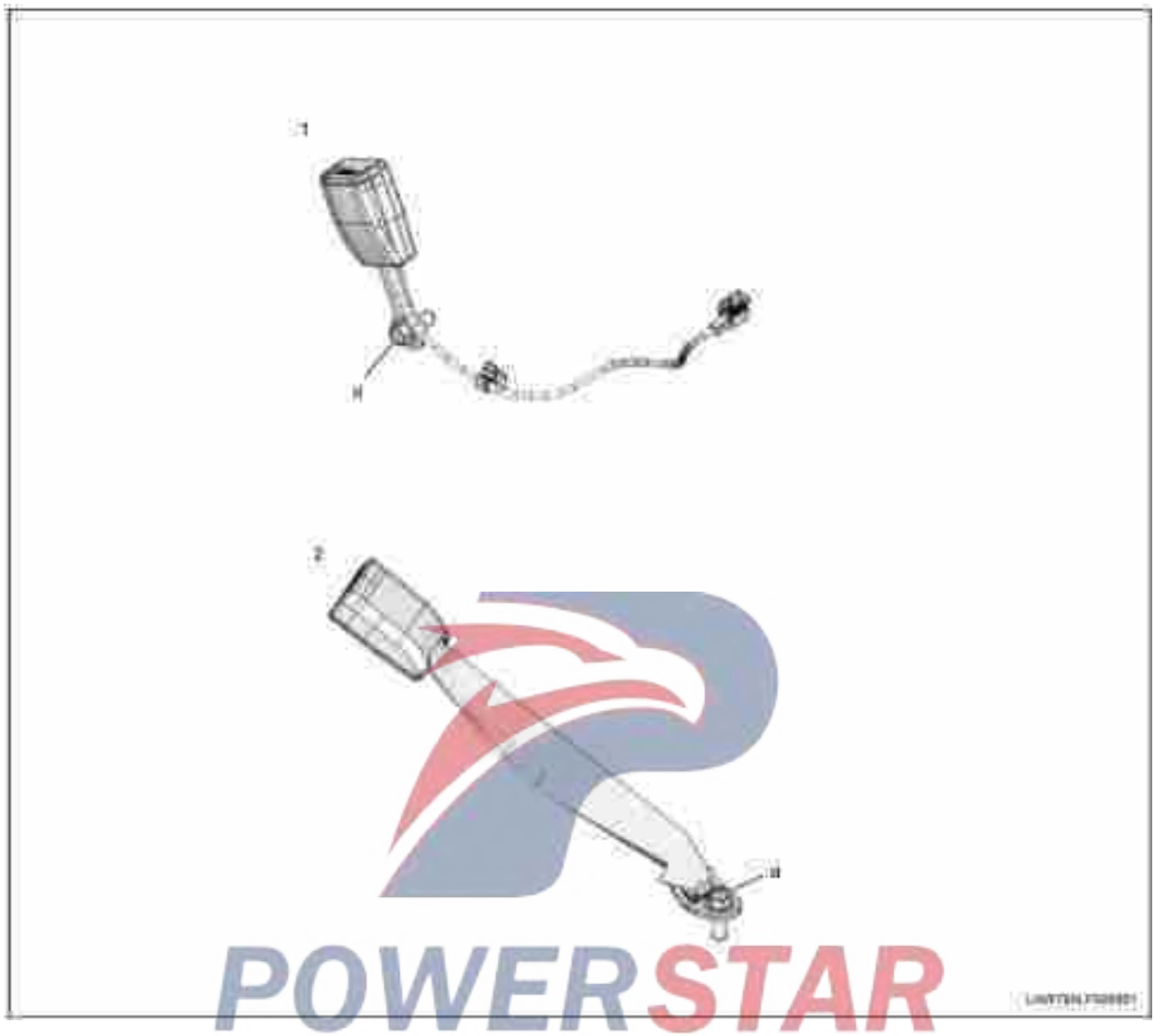
Caution:

When installing, do not slide the lower seat belt along the mounting stopper.

Key

1. Standard cab
2. High ceiling and enlarged cabin (vehicle without engine cover)
3. Widen the cab (vehicle with engine cover)

Tightening torque - Overview



Key

1. Dome cab / widened cab seat
2. From the cabin center to the cabin/seat
(a) 44 N·m {4.5kgf·m}

Front seat belts and driver seat belts

Disassembly

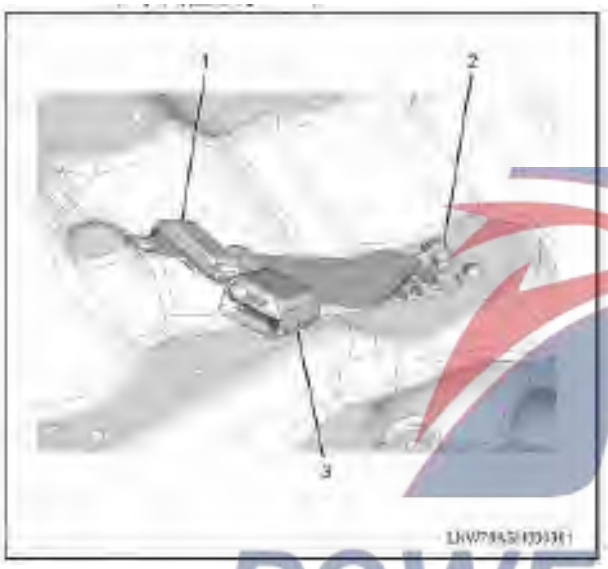
1. Remove the seat on the side of the driver's seat (a vehicle that can accommodate three people).

Please refer to Chapter 9H Headquarters Passenger Seats and Headquarters.

2. Remove the fixing screws (2).

3. Remove the safety belt buckle (3) on the driver seat side.

4. Remove the middle seat belt (1)



Installation

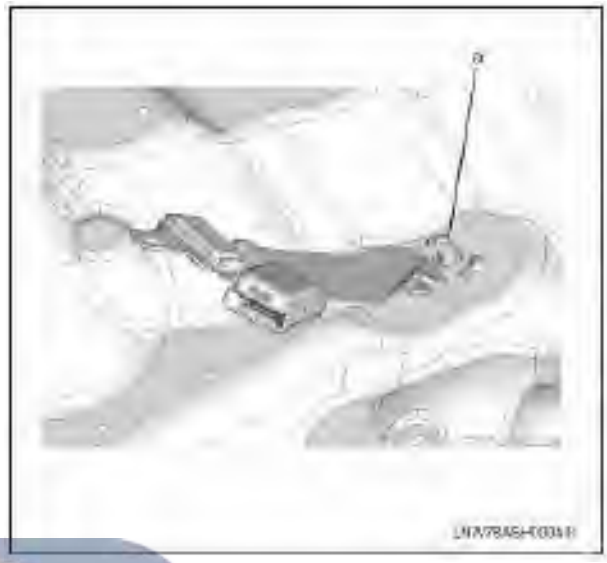
In the reverse order of removal, please pay attention to the followings:

1. Install fasteners in a direction parallel to the vehicle's direction of travel.

2. Tighten the mounting bolts to the specified torque.

Tightening torque : 44 N•m {4.5kgf•m}

Tightening torque - Overview



Key

(a) 44 N·m {4.5kgf·m}

Section 9A

BODY, CAB and ELECTRICAL

Lighting System

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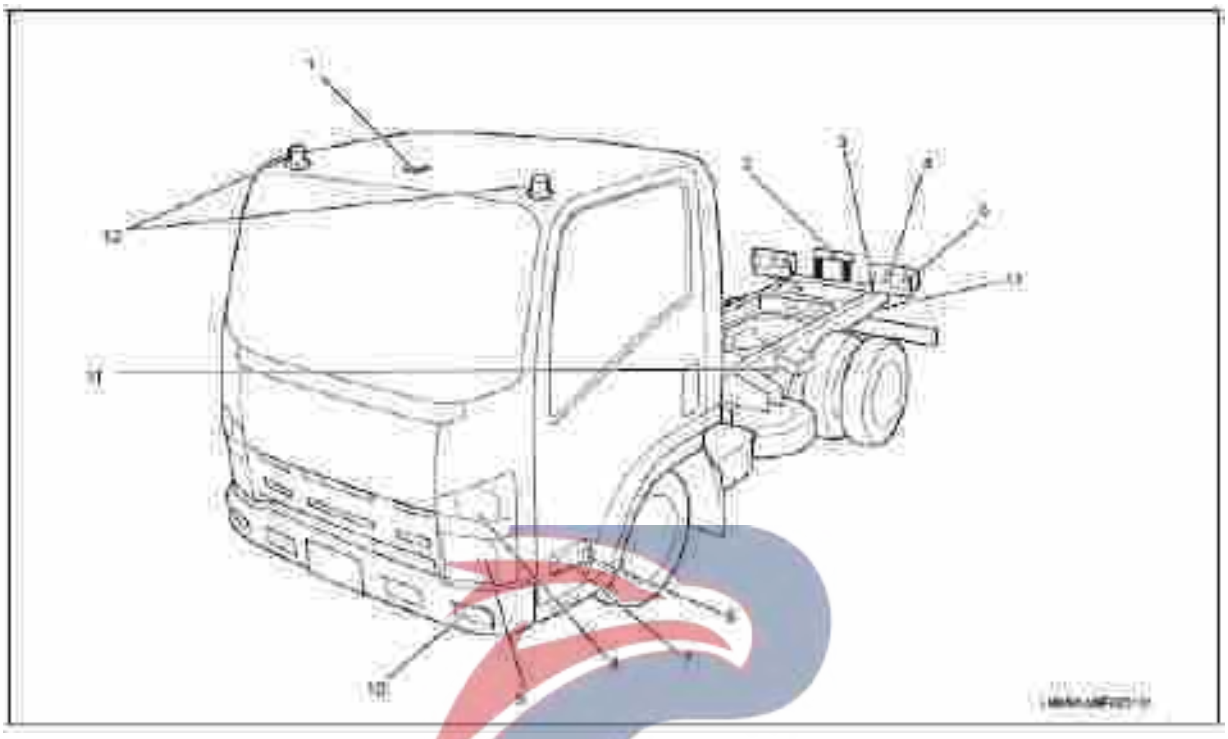
Lighting System

Primary Specifications

Bulb Location Diagram (NLR, NMR, NNR, NPR/S, NQR type)



Legend

1. Dome light
2. License plate light
3. Backup light
4. Stoplight / Taillight
5. Turn signal light
6. Side turn signal light
7. Cornering light (optional)
8. Front turn signal light
9. Headlight / Clearance light
10. Front fog light
11. Side light
12. Roof-mounted clearance light
13. Rear fog light
14. Compartment illuminanting lamp (inside, optional)

Outside of the cab

Light Name	Wattage(NHR/S, NJR/S, NKR/S)	Wattage (LR/S, NMR/S, NNR/S, NPR/S)	Number of Lights	Lens Color
Headlight (halogen) high beam/low beam	75W/70W (H4 type)	75W/70W (H4 type)	2	WHT
Front turn signal light	21W	21W	2	WHT
Cornering light	21W	21W	2	WHT
Clearance light	5W	5W	2	WHT
Front fog light	70W (H3 type)	70W (H4 type)	2	WHT
Rear fog light	—	21W	1	RED

Light Name	Wattage (NHR/S, NJR/S, NKR/S)	Wattage (LR/S, NMR/S, NNR/S, NPR/S)	Number of Lights	Lens Color
Side turn signal light	—	21W	2	WHT (Bulb ORN)
Stoplight / Taillight	21W/5W	21W/5W	2	RE
Rear turn signal light	21W	21W	2	ORN
Backup light	21W	21W	2	WHT
License plate light	10W	10W	1	WHT
Side light	5W	5W	6~8	ORN
Roof-mounted clearance light	5W	5W	2	WHT
Automotive lighting	5W	5W	2	WHT

Inside the cab

Light Name	Wattage	Number of Lights	Lens Color
Room light single cab (crew cab)	10W	1 (2) Without rearview mirror, model 2	WHT

Headlight (Halogen) System

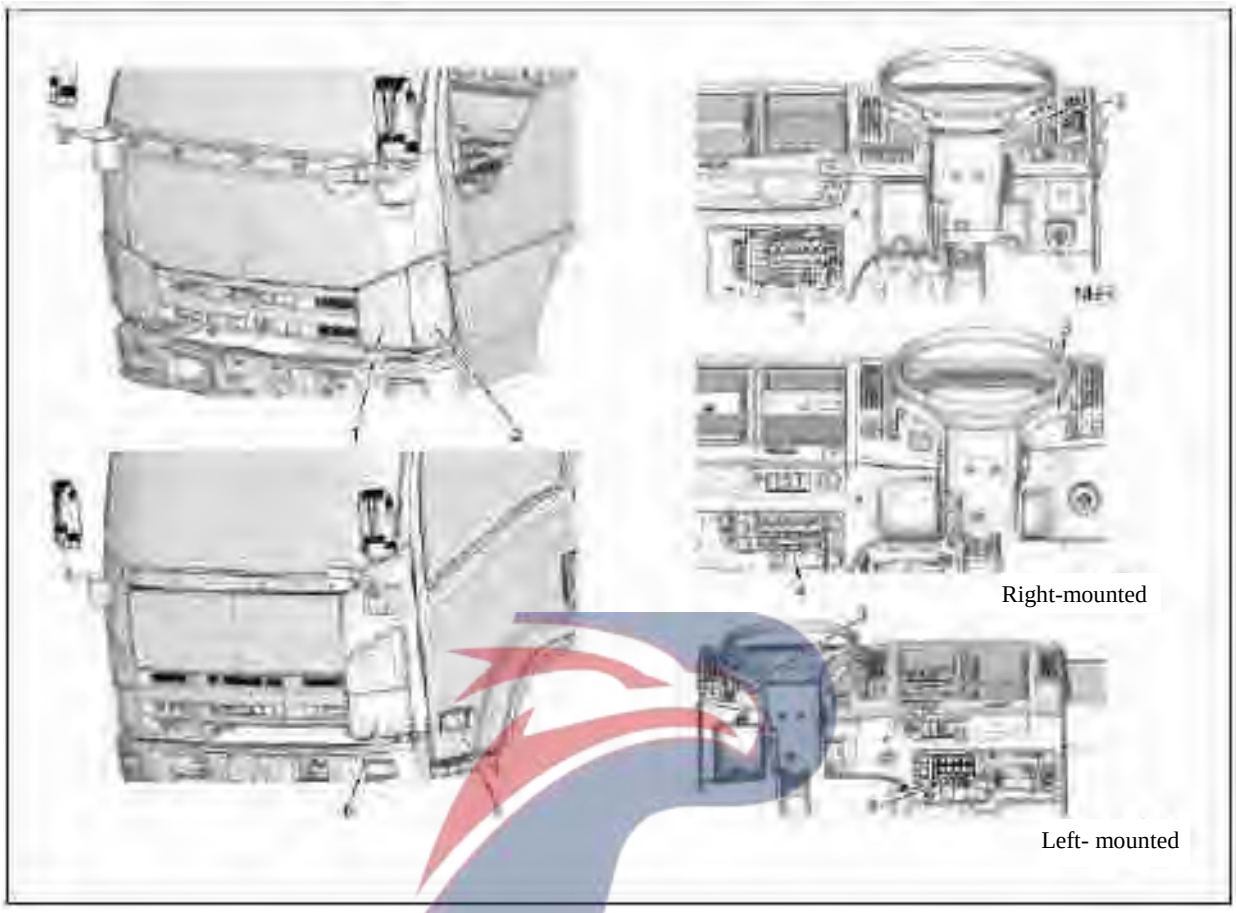
Description of Function and Operation

This circuit comprises headlight, cornering light (optional), ignition switch, combination switch (lighting switch, passing switch), high beam indicator light and relays. When the lighting switch is turned ON at the headlight position, the headlight relay will be activated and the headlight will be illuminated. When the headlight is ON, the optical axis of the headlight can be faced upward and downward alternately using the lighting switch. The passing switch (lighting switch) is not related to the position of the headlight switch. The optical axis will face upward only when the switch lever is being pulled up.

Precautions for bulb replacement of each light

1. HID headlights and halogen lights (headlights and fog lights) become very hot when they are used, so if the bulb surface is stained with grease, the life of the bulb will be shortened. Hold the flange part when replacing the bulb and do not touch the glass part directly by the hands.
2. The pressure inside the glass bulb in HID headlights and halogen lights (headlights and fog lights) is high. If you drop, hit or damage it, broken glass may fly out.
3. If the bulb is removed and left for an extended period of time, dust or moisture may accumulate inside. Prepare a new bulb before replacing the bulb.
4. Be sure to use a bulb with the same wattage for replacement.
5. Improper installation of the socket may cause foggy or misty lens, so firmly install it after replacing the bulb.

Components Location Diagram



Legend

1. Headlight (NHR/S, NJR/S, NKR/S type)
2. Turn light (NHR/S, NJR/S, NKR/S type)
3. Combination switch (lighting switch)
4. Relay box
5. Cornering light (optional)
6. Headlight (NLR, NMR, NNR, NPR/S, NQR type)

Functional Inspection

Operation abnormality of the headlight function

Prior confirmation and visual inspection

• Check that the battery voltage is normal.

If the battery voltage is not normal, charge or replace the battery.

• Check that the fuses are in normal condition.

If a fuse has an abnormality (due to a meltdown, etc.), investigate/repair the cause (harness short circuits, etc.) before replacing the fuse.

• Check that the ground connection is normal.

If the ground connection has an abnormality (due to improper installation or considerable dirt), repair and clean.

• Check that the harness and the connector are in a normal condition.

Check the connector for connection failures and the harness for abnormalities such as friction or bent. Check that the wire inside the harness has not come loose and caused short circuit.

• Check the effect of the post-installed electrical components (radio and lights, etc.).

Turn off or remove the post-installed electrical components, so that they do not affect the inspection or the operation.

Structural components inspection

• Check the slow blow fuse (SBF6, 8).

If SBF has an abnormality (due to a meltdown, etc.), investigate/repair the cause (harness short circuits, etc.) before replacing the fuse.

• Check the lighting switch.

Operate the lighting switch and check that the circuit operates normally in the continuity test. If a problem is found, replace the switch.

• Check the function of the headlight relay (Hi, Lo).

Check the headlight relay for abnormality. Replace it if an abnormality is found.

• Check that the headlight bulbs are normal.

If any abnormality (burnout or improper installation) is found in a bulb, repair or replace it.

Circuit inspection

• Check the following circuits for open circuits, short circuits (power supply and GND), or high resistance.

If an abnormality is discovered, repair or replace the circuit.

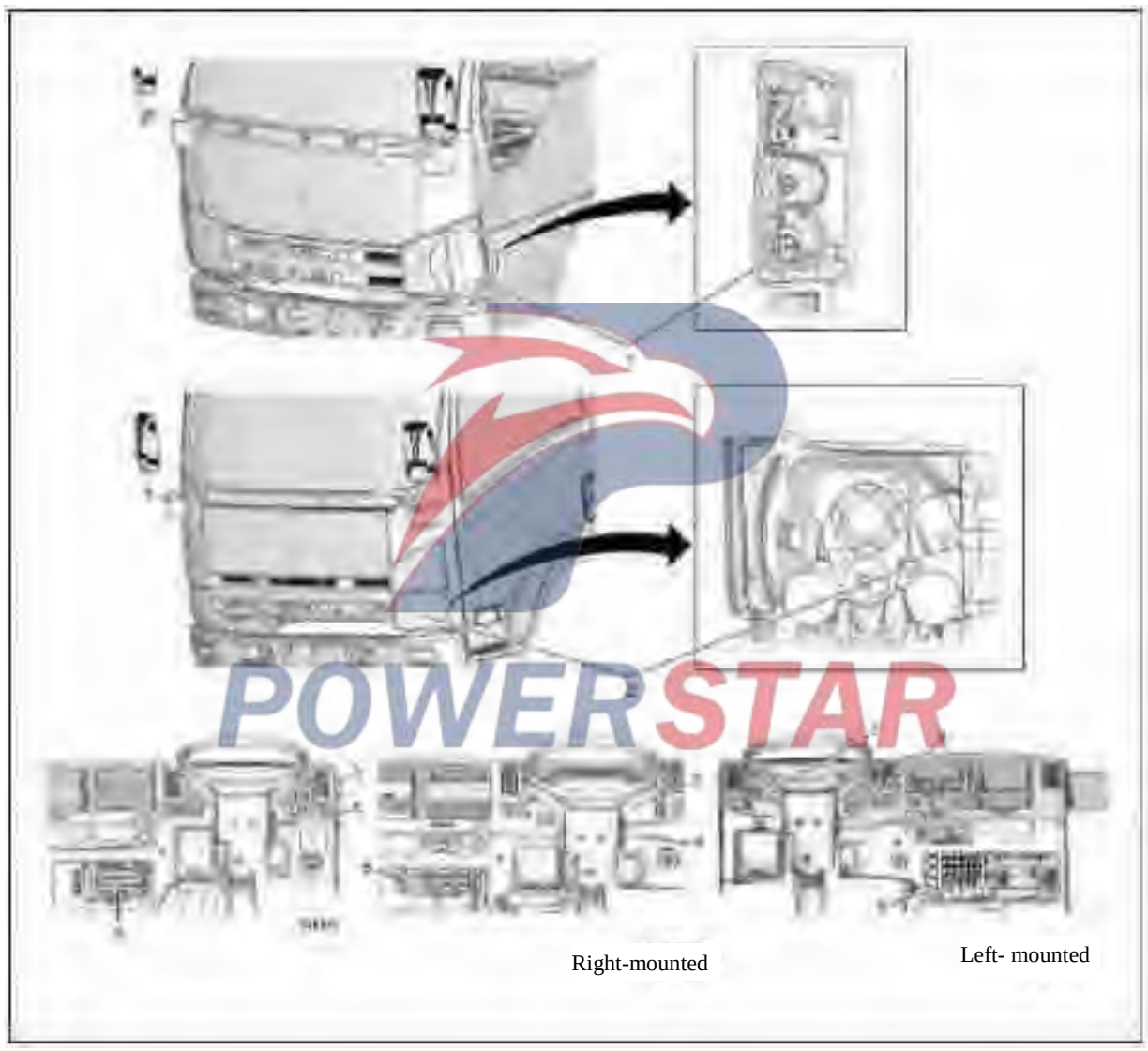
- Between SBF (No.6) and the headlight relay
- Between SBF (No.8) and the headlight relay (Hi, Lo)
- Between SBF and the fuse (No.22)
- Between the fuse (No.22) and the headlight relay (Hi, Lo)
- Between the headlight relay (Lo) and the fuse (No.9, 11)
- Between the headlight relay (Hi) and the fuse (No.14, 15)
- Between the headlight relay (Hi, Lo) and the combination switch (lighting switch)
- Between the fuse (No.9, 11, 14, 15) and the headlight (Hi, Lo)
- Between the headlight (Hi, Lo) and GND

Clearance Light System

Description of Function and Operatio

This circuit comprises a clearance light, ignition switch, combination switch (lighting switch) and relays. When the lighting switch is turned ON at the taillight position, the taillight relay will be activated and the clearance light will be illuminated.

Components Location Diagram



Legend

1. Clearance (NHR/S, NJR/S, NKR/S) combination
2. Clearance (NLR, NMR, NNR, NPR/S, NQR type)
3. Switch (lighting switch)
4. Ignition switch
5. Relay box

Functional Inspection

Operation abnormality of the clearance light function

Prior confirmation and visual inspection

• Check that the battery voltage is normal.

If the battery voltage is not normal, charge or replace the battery.

• Check that the fuses are in normal condition.

If a fuse has an abnormality (due to a meltdown, etc.), investigate/repair the cause (harness short circuits, etc.) before replacing the fuse.

• Check that the ground connection is normal.

If the ground connection has an abnormality (due to improper installation or considerable dirt), repair and clean.

• Check that the harness and the connector are in a normal condition.

Check the connector for connection failures and the harness for abnormalities such as friction or bent. Check that the wire inside the harness has not come loose and caused short circuit.

• Check the effect of the post-installed electrical components (radio and lights, etc.).

Turn off or remove the post-installed electrical components, so that they do not affect the inspection or the operation.

Structural components inspection

• Check the slow blow fuse (SBF8).

If SBF has an abnormality (due to a meltdown, etc.), investigate/repair the cause (harness short circuits, etc.) before replacing the fuse.

• Check the lighting switch.

Operate the lighting switch and check that the circuit operates normally in the continuity test. If a problem is found, replace the switch.

• Check the taillight relay function.

Check the relay for abnormality. Replace it if an abnormality is found.

• Check that the bulbs of the clearance light are normal.

If any abnormality (burnout or improper installation) is found in a bulb, repair or replace it.

Circuit inspection

• Check the following circuits for open circuits, short circuits (power supply and GND), or high resistance.

If an abnormality is discovered, repair or replace the circuit.

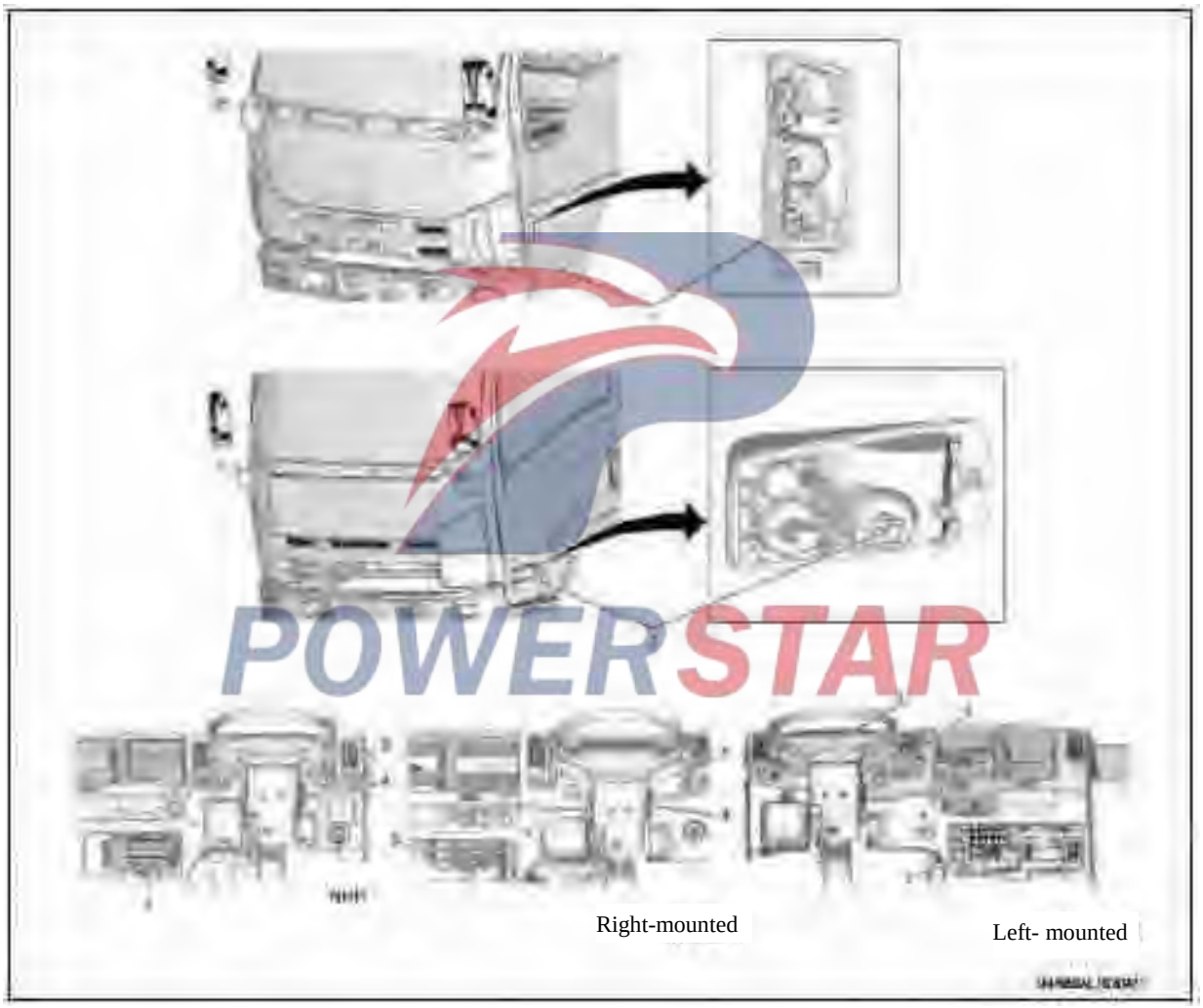
- Between SBF (No.6) and the taillight relay
- Between SBF (No.8) and the taillight relay
- Between the ignition switch and the fuse (No.22)
- Between the fuse (No.22) and the taillight relay
- Between the taillight relay and the lighting switch
- Between the taillight relay and the fuse (No.29)
- Between the fuse (No.29) and the clearance light
- Between the clearance light and GND
- Between the lighting switch and GND

Cornering Light System

Description of Function and Operation

This circuit comprises a cornering light, ignition switch, combination switch (lighting switch, cornering light switch) and relays. When the lighting switch is turned ON at the headlight or the taillight position, the taillight relay will be activated and the cornering light will be illuminated interlocked with the operation of the cornering light switch.

Components Location Diagram



Legend

1. Cornering light (NHR)
2. Cornering light (NLR, NMR, NNR, NPR/S, NQR type)
3. Combination switch (lighting switch)
4. Ignition switch
5. Relay box

Functional Inspection

Operation abnormality of the cornering light function

Prior confirmation and visual inspection

• Check that the battery voltage is normal.

If the battery voltage is not normal, charge or replace the battery.

• Check that the fuses are in normal condition.

If a fuse has an abnormality (due to a meltdown, etc.), investigate/repair the cause (harness short circuits, etc.) before replacing the fuse.

• Check that the ground connection is normal.

If the ground connection has an abnormality (due to improper installation or considerable dirt), repair and clean.

• Check that the harness and the connector are in a normal condition.

Check the connector for connection failures and the harness for abnormalities such as friction or bent. Check that the wire inside the harness has not come loose and caused short circuit.

• Check the effect of the post-installed electrical components (radio and lights, etc.).

Turn off or remove the post-installed electrical components, so that they do not affect the inspection or the operation.

Structural components inspection

• Check the slow blow fuse (SBF6, 8).

If SBF has an abnormality (due to a meltdown, etc.), investigate/repair the cause (harness short circuits, etc.) before replacing the fuse.

• Check the combination switch (lighting switch, cornering light switch).

Operate the combination switch and check that the circuit operates normally in the continuity test. If a problem is found, replace the switch.

• Check the taillight relay function.

Check the relay for abnormality. Replace it if an abnormality is found.

• Check that the bulbs of the cornering light are normal.

If any abnormality (burnout or improper installation) is found in a bulb, repair or replace it.

Circuit inspection

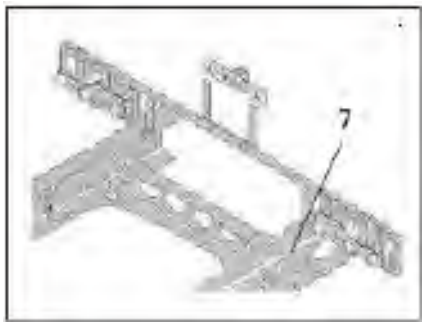
• Check the following circuits for open circuits, short circuits (power supply and GND), or high resistance.

If an abnormality is discovered, repair or replace the circuit.

- Between SBF (No.6) and the taillight relay
- Between SBF (No.8) and the taillight relay
- Between the ignition switch and the fuse (No.22)
- Between the fuse (No.22) and the taillight relay
- Between the taillight relay and the combination switch
- Between the taillight relay and the fuse (No.29)
- Between the fuse (No.29) and the cornering light
- Between the combination switch and GND
- Between the cornering light and GND

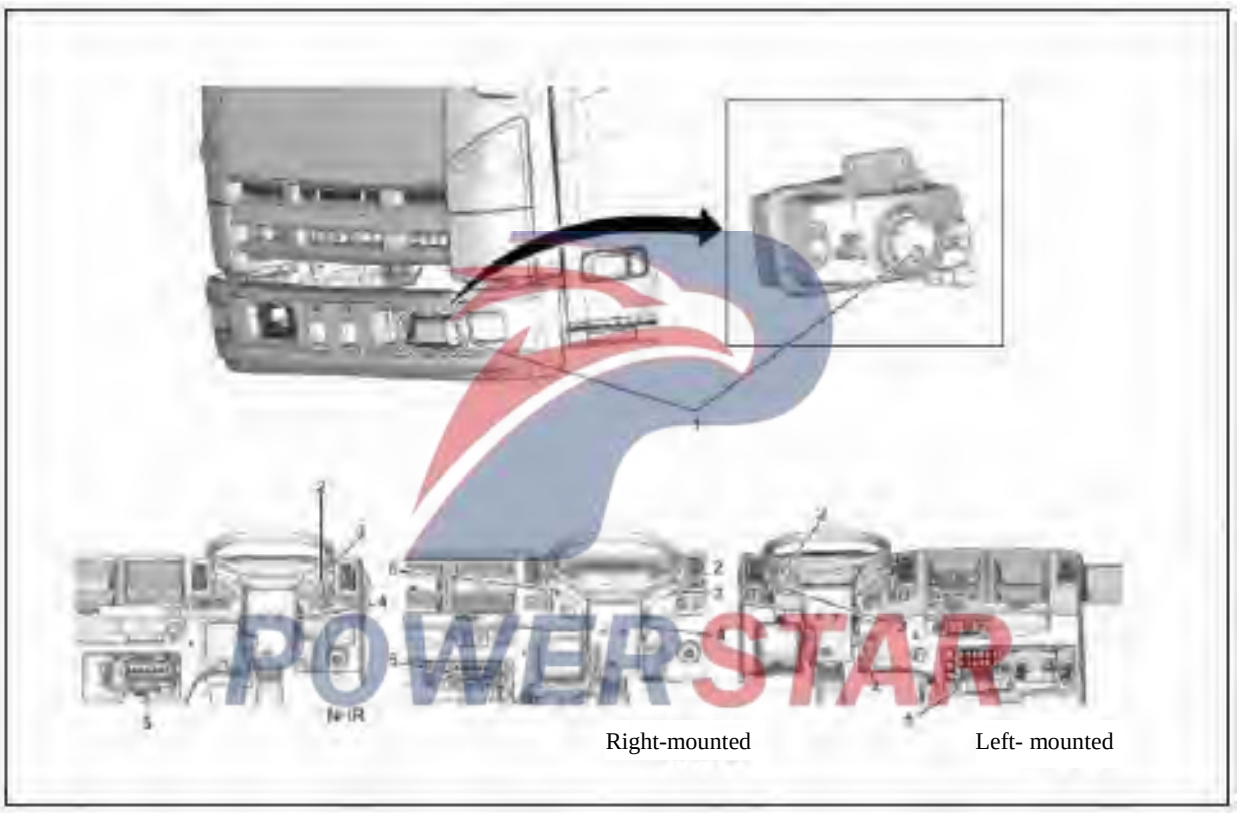
Fog Light System

Description of Function and Operation



This circuit comprises fog light, ignition switch, combination switch (lighting switch, fog light switch) and relays. When the lighting switch is turned ON at the headlight or the taillight position, the taillight relay will be activated and the fog light will be illuminated interlocked with the operation of the fog light switch.

Components Location Diagram



Legend

1. Front fog light
2. Combination switch (lighting switch)
3. Front fog light switch
4. Ignition switch
5. Relay box
6. Fog lamp switch (Europe)
7. Rear fog light

Functional Inspection

Operation abnormality of the fog light function

Prior confirmation and visual inspection

• Check that the battery voltage is normal.

If the battery voltage is not normal, charge or replace the battery.

• Check that the fuses are in normal condition.

If a fuse has an abnormality (due to a meltdown, etc.), investigate/repair the cause (harness short circuits, etc.) before replacing the fuse.

• Check that the ground connection is normal.

If the ground connection has an abnormality (due to improper installation or considerable dirt), repair and clean.

• Check that the harness and the connector are in a normal condition.

Check the connector for connection failures and the harness for abnormalities such as friction or bent. Check that the wire inside the harness has not come loose and caused short circuit.

• Check the effect of the post-installed electrical components (radio and lights, etc.).

Turn off or remove the post-installed electrical components, so that they do not affect the inspection or the operation.

Structural components inspection

• Check the slow blow fuse (SBF8).

If SBF has an abnormality (due to a meltdown, etc.), investigate/repair the cause (harness short circuits, etc.) before replacing the fuse.

• Check the lighting switch.

Operate the lighting switch and check that the circuit operates normally in the continuity test. If a problem is found, replace the switch.

• Check the taillight relay and the fog light relay function.

Check the relays for abnormality. Replace it if an abnormality is found.

• Check that the bulbs of the fog light are normal.

If any abnormality (burnout or improper installation) is found in a bulb, repair or replace it.

Circuit inspection

• Check the following circuits for open circuits, short circuits (power supply and GND), or high resistance.

If an abnormality is discovered, repair or replace the circuit.

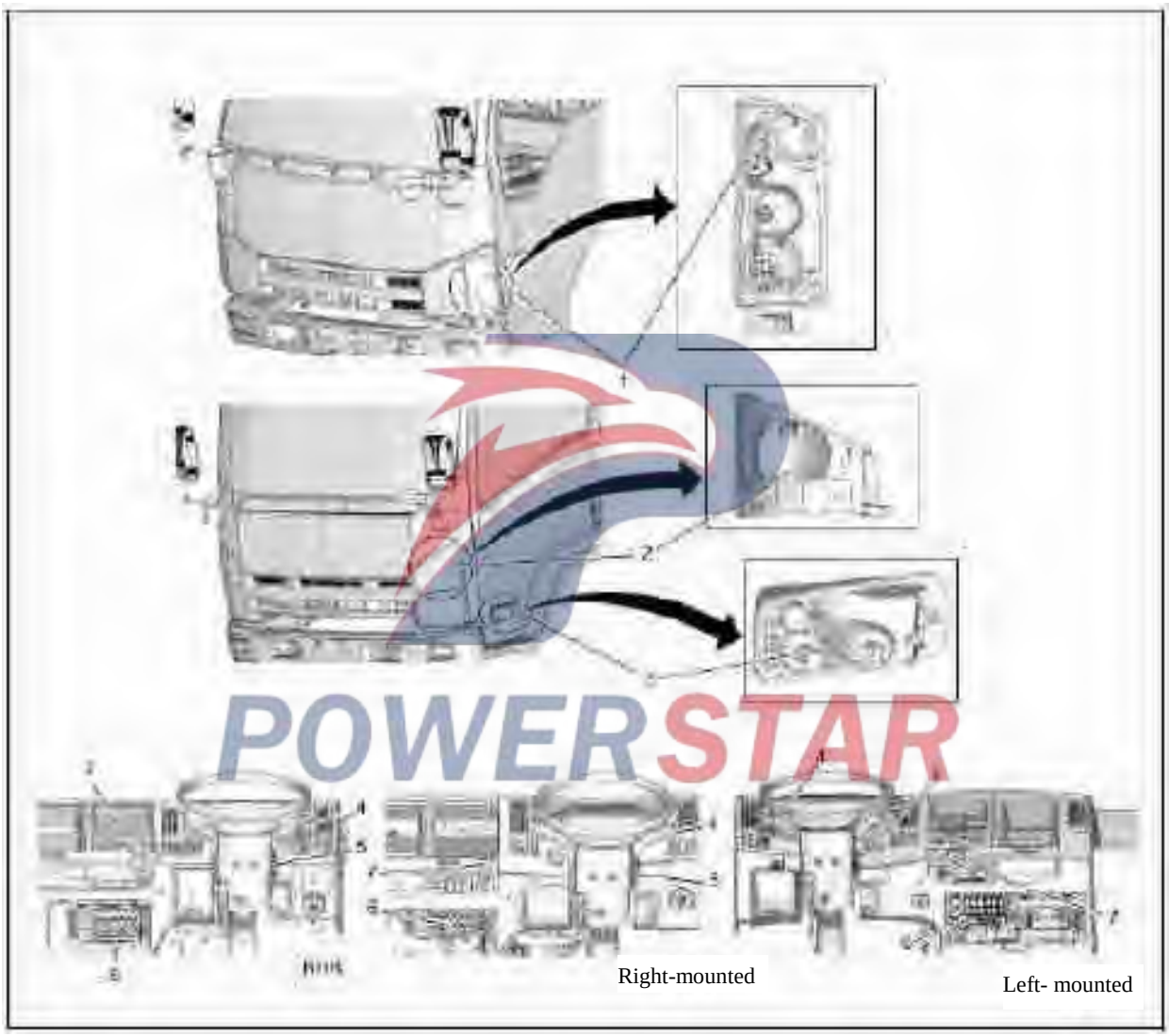
- Between SBF (No.6) and the taillight relay
- Between SBF (No.8) and the taillight relay
- Between SBF (No.12) and the fuse (No.5)
- Between ignition switch and the fuse (No.22)
- Between the taillight relay and the fuse (No.27, 28)
- Between the taillight relay and the lighting switch
- Between the fuse (No.28) and the fog switch
- Between the fuse (No.27) and the fog light relay
- Between the fuse (No.5) and the fog light relay
- Between the fog light relay and the fog light switch
- Between the fog light relay and the fog light
- Between the fog light and GND
- Between the combination switch and GND
- Between the marker relay and GND

Turn Signal / Hazard Warning Flasher Light System

Description of Function and Operation

This circuit comprises turn signal lights, ignition switch, combination switch (turn signal switch), flasher unit, hazard warning switch, etc. When the turn signal switch or the hazard warning switch is turned ON, the flasher unit will be activated and the turn signal light will be illuminated. The turn signal light is also illuminated by the answer-back function of the keyless entry system, etc.

Components Location Diagram



Legend

1. Turn signal light (NHR)
2. Front turn signal light (NLR, NMR, NNR, NPR/S, NQR)
3. Side turn signal light (NLR, NMR, NNR, NPR/S, NQR type)
4. Combination switch (lighting switch)
5. Ignition switch
6. Relay box
7. Hazard warning flasher light switch

Functional Inspection

Operation abnormality of the turn signal light function

Prior confirmation and visual inspection

• Check that the battery voltage is normal.

If the battery voltage is not normal, charge or replace the battery.

• Check that the fuses are in normal condition.

If a fuse has an abnormality (due to a meltdown, etc.), investigate/repair the cause (harness short circuits, etc.) before replacing the fuse.

• Check that the ground connection is normal.

If the ground connection has an abnormality (due to improper installation or considerable dirt), repair and clean.

• Check that the harness and the connector are in a normal condition.

Check the connector for connection failures and the harness for abnormalities such as friction or bent. Check that the wire inside the harness has not come loose and caused short circuit.

• Check the effect of the post-installed electrical components (radio and lights, etc.).

Turn off or remove the post-installed electrical components, so that they do not affect the inspection or the operation.

Structural components inspection

• Check the slow blow fuse (SBF10).

If SBF has an abnormality (due to a meltdown, etc.), investigate/repair the cause (harness short circuits, etc.) before replacing the fuse.

• Check the turn signal switch.

Operate the turn signal switch and check that the circuit operates normally in the continuity test. If a problem is found, replace the switch.

• Check the hazard warning switch.

Operate the hazard warning switch and check that the circuit operates normally in the continuity test. If a problem is found, replace the switch.

• Check the flasher unit.

If no abnormality is discovered in the circuit or the switch, replace the flasher unit.

• Check that the bulbs of the turn signal light are normal.

If any abnormality (burnout or improper installation) is found in a bulb, repair or replace it.

- Front turn signal light
- Side turn signal light
- Rear turn signal light

Circuit inspection

• Check the following circuits for open circuits, short circuits (power supply and GND), or high resistance.

If an abnormality is discovered, repair or replace the circuit.

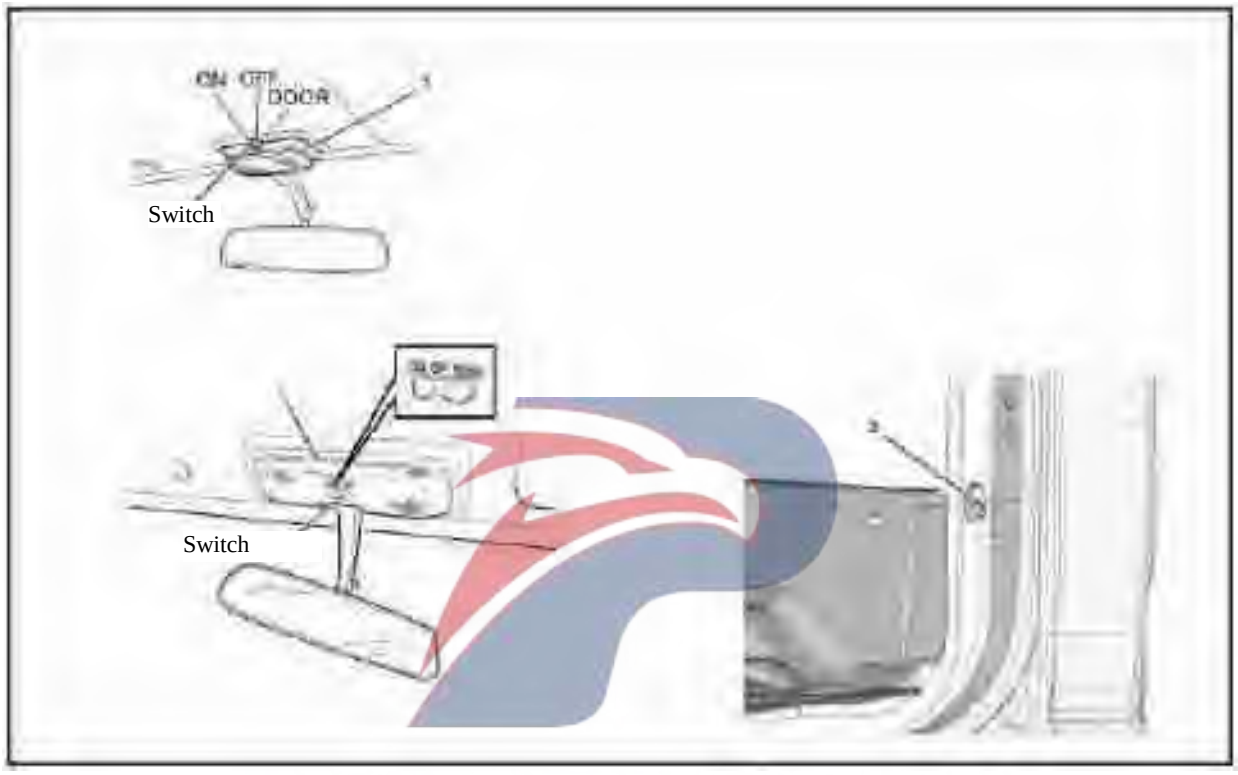
- Between SBF (No.10) and the fuse (No.25)
- Between the fuse (No.25) and the flasher unit
- Between the flasher unit and the turn signal switch
- Between the flasher unit and the hazard warning switch
- Between the turn signal switch and GND
- Between the hazard warning switch and GND
- Between the flasher unit and the turn signal light
- Between the turn signal light and GND

Dome Light System

Description of Function and Operation

This circuit comprises dome light, door switch, etc. When the door switch is ON, the keyless entry control unit will illuminate the dome light.

Components Location Diagram



Legend

1. Dome light (NHR type)
2. Dome light (NLR, NMR, NNR, NPR/S, NQR type)
3. Door switch (NLR, NMR, NNR, NPR/S, NQR type)

Functional Inspection

Operation abnormality of the dome light function

Prior confirmation and visual inspection

• Check that the battery voltage is normal.

If the battery voltage is not normal, charge or replace the battery.

• Check that the fuses are in normal condition.

If a fuse has an abnormality (due to a meltdown, etc.), investigate/repair the cause (harness short circuits, etc.) before replacing the fuse.

• Check that the ground connection is normal.

If the ground connection has an abnormality (due to improper installation or considerable dirt), repair and clean.

• Check that the harness and the connector are in a normal condition.

Check the connector for connection failures and the harness for abnormalities such as friction or bent. Check that the wire inside the harness has not come loose and caused short circuit.

• Check the effect of the post-installed electrical components (radio and lights, etc.).

Turn off or remove the post-installed electrical components, so that they do not affect the inspection or the operation.

Structural components inspection

• Check the slow blow fuse (SBF12).

If SBF has an abnormality (due to a meltdown, etc.), investigate/repair the cause (harness short circuits, etc.) before replacing the fuse.

• Check the dome light switch.

Operate the door switch and check that the circuit operates normally in the continuity test. If a problem is found, replace the switch.

• Check the door switch.

Operate the door switch and check that the circuit operates normally in the continuity test. If a problem is found, replace the switch.

• Check that the bulbs of the dome light are normal.

If any abnormality (burnout or improper installation) is found in a bulb, repair or replace it.

Circuit inspection

• Check the following circuits for open circuits, short circuits (power supply and GND), or high resistance.

If an abnormality is discovered, repair or replace the circuit.

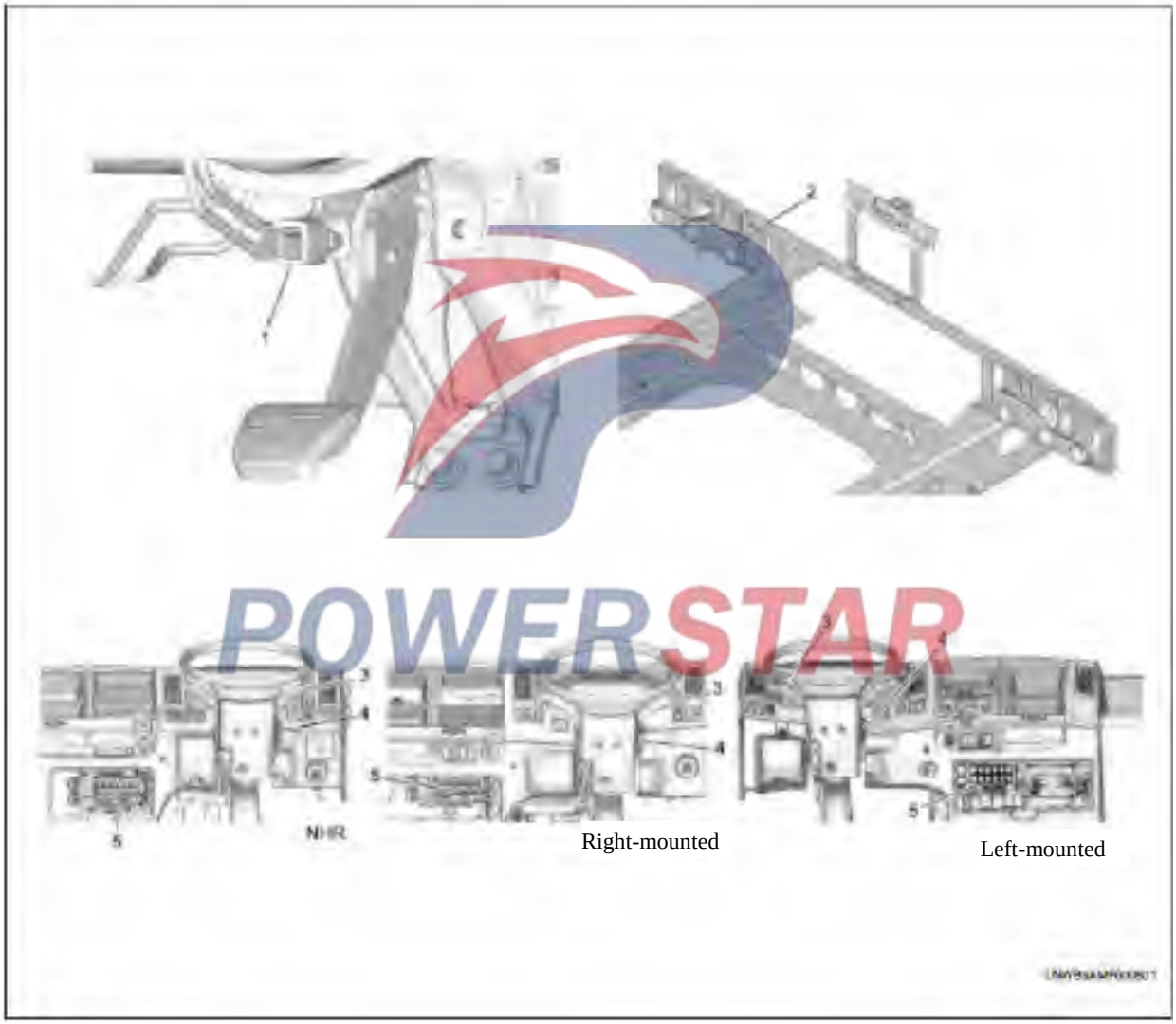
- Between SBF (No.12) and the fuse (No.3)
- Between the fuse (No.3) and the dome light / fluorescent light
- Between the dome light switch and GND
- Between the door switch and GND

Taillight / Stoplight System

Description of Function and Operation

This circuit comprises taillight, stoplight, ignition switch, combination switch (lighting switch), stoplight switch and relays. When the lighting switch is turned ON at the headlight or the taillight position, the taillight relay will be activated and the taillight will be illuminated. The stoplight illuminates according to the operation of the stoplight switch.

Components Location Diagram



Legend

1. Stoplight switch
2. Taillight / Stoplight
3. Combination switch (lighting switch)
4. Ignition switch
5. Relay box

Functional Inspection

Operation abnormality of the taillight / stoplight function

Prior confirmation and visual inspection

• Check that the battery voltage is normal.

If the battery voltage is not normal, charge or replace the battery.

• Check that the fuses are in normal condition.

If a fuse has an abnormality (due to a meltdown, etc.), investigate/repair the cause (harness short circuits, etc.) before replacing the fuse.

• Check that the ground connection is normal.

If the ground connection has an abnormality (due to improper installation or considerable dirt), repair and clean.

• Check that the harness and the connector are in a normal condition.

Check the connector for connection failures and the harness for abnormalities such as friction or bent. Check that the wire inside the harness has not come loose and caused short circuit.

• Check the effect of the post-installed electrical components (radio and lights, etc.).

Turn off or remove the post-installed electrical components, so that they do not affect the inspection or the operation.

Structural components inspection

• Check the slow blow fuse (SBF6, 8).

If SBF has an abnormality (due to a meltdown, etc.), investigate/repair the cause (harness short circuits, etc.) before replacing the fuse.

• Check the lighting switch.

Operate the lighting switch and check that the circuit operates normally in the continuity test. If a problem is found, replace the switch.

• Check the stoplight switch.

Operate the stoplight switch and check that the circuit operates normally in the continuity test. If a problem is found, replace the switch.

• Check the taillight relay and the stoplight relay function.

Check the relays for abnormality. Replace it if an abnormality is found.

• Check that the bulbs of the combination light (taillight, stoplight) are normal.

If any abnormality (burnout or improper installation) is found in a bulb, repair or replace it.

Circuit inspection

• Check the following circuits for open circuits, short circuits (power supply and GND), or high resistance.

If an abnormality is discovered, repair or replace the circuit.

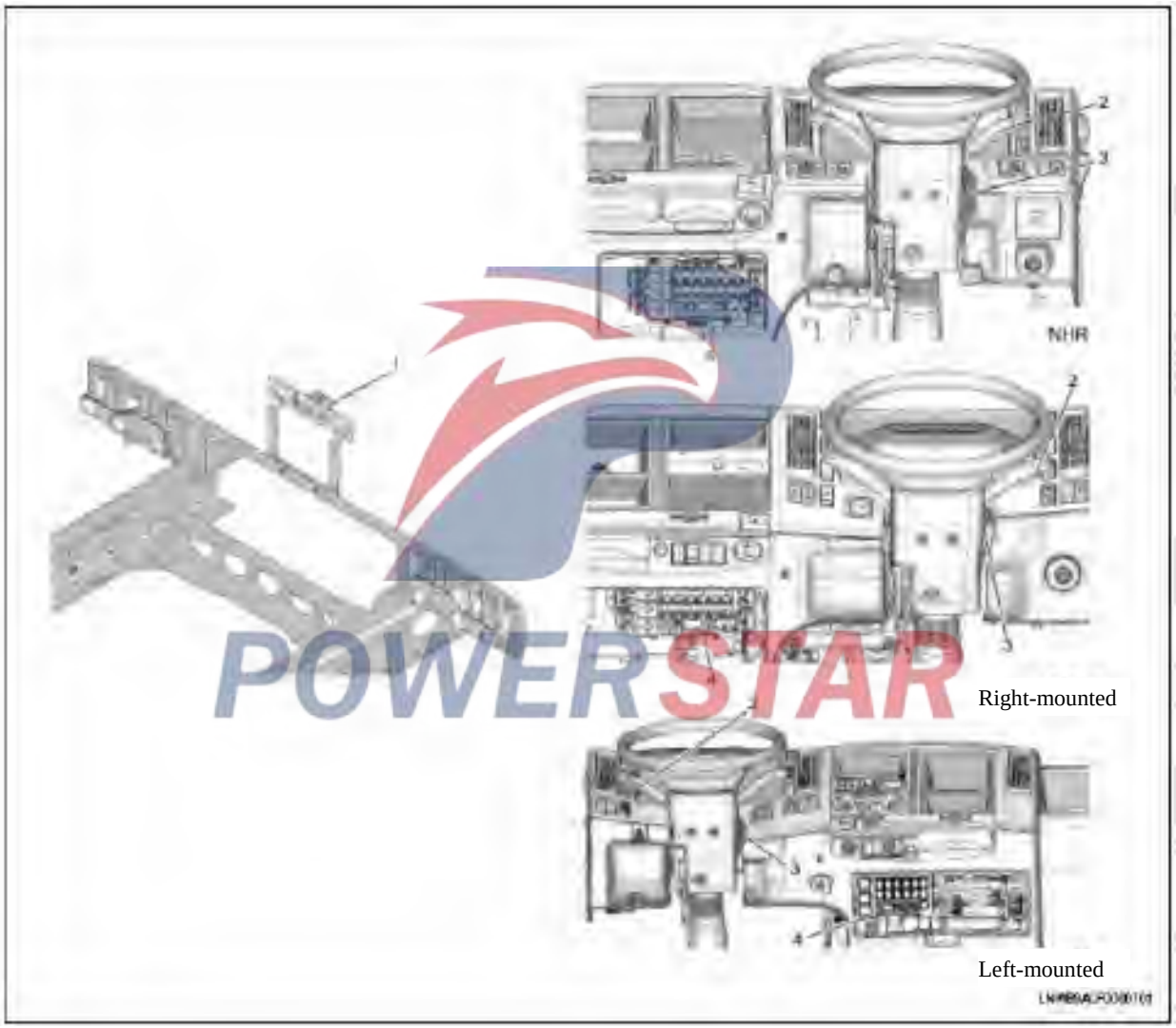
- Between SBF (No.6) and the ignition switch
- Between SBF (No.8) and the taillight relay
- Between SBF (No.8) and the stoplight relay
- Between the ignition switch and the fuse (No.27)
- Between the fuse (No.22) and the taillight relay
- Between the taillight relay and the fuse (No.22)
- Between the taillight relay and the lighting switch
- Between the fuse (No.27) and the taillight
- Between the taillight and GND
- Between the stoplight relay and the stoplight switch
- Between the stoplight switch and GND
- Between the stoplight relay and the stoplight
- Between the stoplight and GND

License Plate Light System

Description of Function and Operation

This circuit comprises a license plate light, ignition switch, combination switch (lighting switch) and relays. When the lighting switch is turned ON at the headlight or the taillight position, the taillight relay will be activated and the license plate light will be illuminated.

Components Location Diagram



Legend

1. License plate light
2. Combination switch (lighting switch)
3. Ignition switch
4. Relay box

Functional Inspection

Operation abnormality of the license plate light function

Prior confirmation and visual inspection

• Check that the battery voltage is normal.

If the battery voltage is not normal, charge or replace the battery.

• Check that the fuses are in normal condition.

If a fuse has an abnormality (due to a meltdown, etc.), investigate/repair the cause (harness short circuits, etc.) before replacing the fuse.

• Check that the ground connection is normal.

If the ground connection has an abnormality (due to improper installation or considerable dirt), repair and clean.

• Check that the harness and the connector are in a normal condition.

Check the connector for connection failures and the harness for abnormalities such as friction or bent. Check that the wire inside the harness has not come loose and caused short circuit.

• Check the effect of the post-installed electrical components (radio and lights, etc.).

Turn off or remove the post-installed electrical components, so that they do not affect the inspection or the operation.

Structural components inspection

• Check the slow blow fuse (SBF8).

If SBF has an abnormality (due to a meltdown, etc.), investigate/repair the cause (harness short circuits, etc.) before replacing the fuse.

• Check the lighting switch.

Operate the lighting switch and check that the circuit operates normally in the continuity test. If a problem is found, replace the switch.

• Check the taillight relay function.

Check the relay for abnormality. Replace it if an abnormality is found.

• Check that the bulbs of the license plate light are normal.

If any abnormality (burnout or improper installation) is found in a bulb, repair or replace it.

Circuit inspection

• Check the following circuits for open circuits, short circuits (power supply and GND), or high resistance.

If an abnormality is discovered, repair or replace the circuit.

- Between SBF (No.6) and the ignition switch
- Between SBF (No.8) and the taillight relay
- Between the ignition switch and the fuse (No.22)
- Between the fuse (No.22) and the taillight relay
- Between the taillight relay and the fuse (No.27)
- Between the taillight relay and the lighting switch
- Between the fuse (No.27) and the license plate light
- Between the license plate light and GND
- Between the lighting switch and GND

Illumination Light System

Description of Function and Operation

This circuit comprises illumination lights, ignition switch, combination switch (lighting switch) and relays. When the lighting switch is turned ON at the headlight or the taillight position, the taillight relay will be activated and the illumination lights will be illuminated.

Lighting

Light Name	Wattage	Number of Lights	Lens Color
Meter	LED		ORN
Danger warning switch	LED	1	RED
Fog light switch	LED	2	Green-yellow working lamp yellow
Dome light switch	LED	2	Orange working lamp yellow
Radio / Audio	LED		ORN
Tachograph	LED		
Radio / Audio	65mA	1	ORN
Air conditioner panel	LED		ORN
Audible alarm disconnecting switch	LED	1	ORN
Warm-up switch	LED	1	Green-yellow

Illumination light

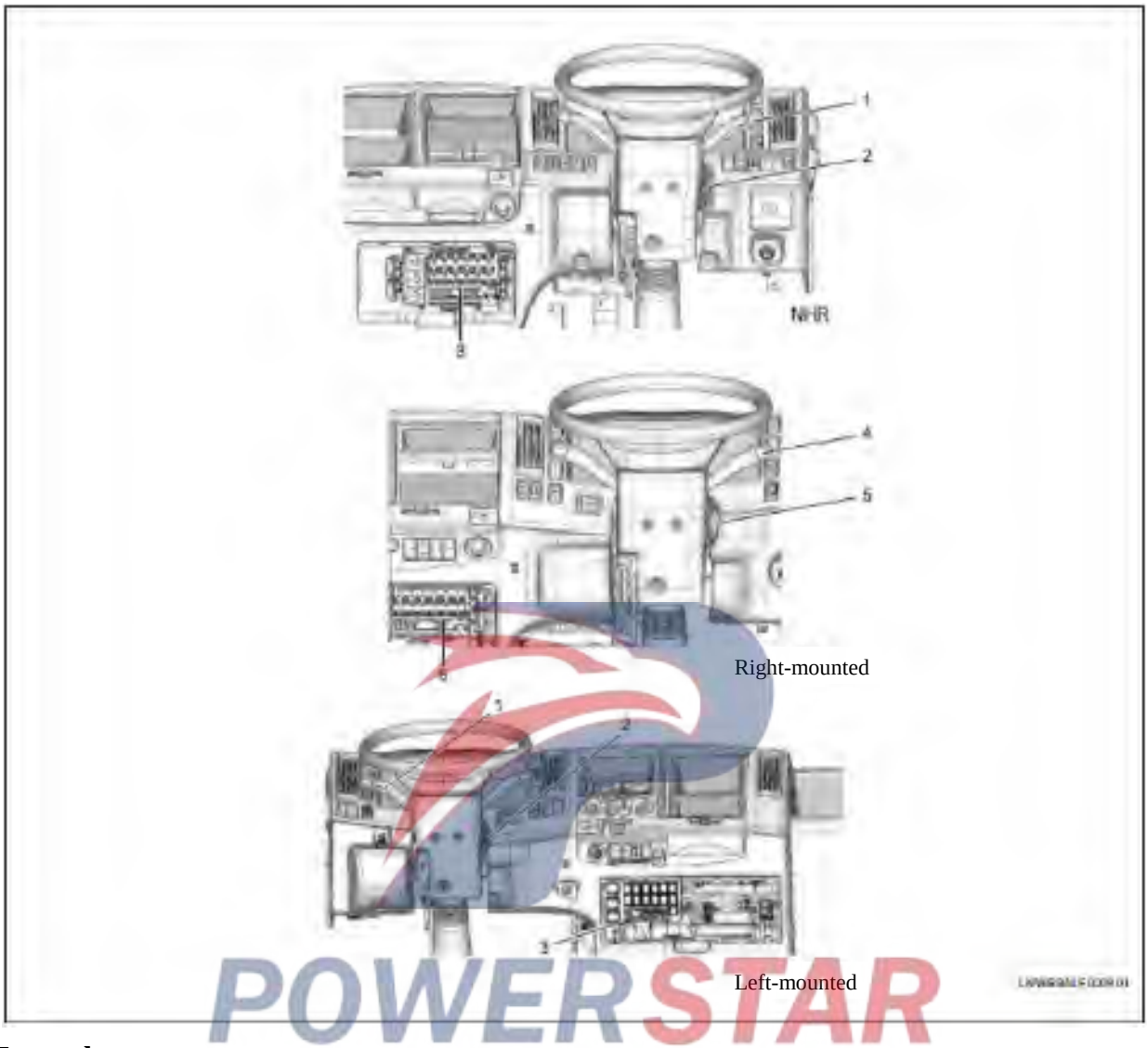
LED type

• Meter
• Air conditioner panel
• Hazard warning flasher light switch
• Fog light switch
• Dome light switch
• Warm-up switch
• Idling stop and starting system master switch
• Audible alarm disconnecting switch

Light (bulb) type, power supply

• Cigarette lighter (light {bulb} type)
• Radio / Audio (power supply)
• Tachograph (power supply)

Components Location Diagram



Legend

1. Combination switch (lighting switch) (NHR)
2. Ignition switch (NHR)
3. Relay box (NHR)
4. Combination switch (lighting switch) (NLR, NMR, NNR, NPR/S, NQR type)
5. Ignition switch (NLR, NMR, NNR, NPR/S, NQR type)
6. Relay box (NLR, NMR, NNR, NPR/S, NQR type)

Functional Inspection

Operation abnormality of the illumination light function

Prior confirmation and visual inspection

• Check that the battery voltage is normal.

If the battery voltage is not normal, charge or replace the battery.

• Check that the fuses are in normal condition.

If a fuse has an abnormality (due to a meltdown, etc.), investigate/repair the cause (harness short circuits, etc.) before replacing the fuse.

• Check that the ground connection is normal.

If the ground connection has an abnormality (due to improper installation or considerable dirt), repair and clean.

• Check that the harness and the connector are in a normal condition.

Check the connector for connection failures and the harness for abnormalities such as friction or bent. Check that the wire inside the harness has not come loose and caused short circuit.

• Check the effect of the post-installed electrical components (radio and lights, etc.).

Turn off or remove the post-installed electrical components, so that they do not affect the inspection or the operation.

Structural components inspection

• Check the slow blow fuse (SBF6, 8).

If SBF has an abnormality (due to a meltdown, etc.), investigate/repair the cause (harness short circuits, etc.) before replacing the fuse.

• Check the lighting switch.

Operate the lighting switch and check that the circuit operates normally in the continuity test. If a problem is found, replace the switch.

• Check the taillight relay function.

Check the relay for abnormality. Replace it if an abnormality is found.

• Check that the bulbs of the illumination light are normal.

If an abnormality (burnout or improper installation) is found in the bulb, repair or replace the bulb or the switch.

Circuit inspection

• Check the following circuits for open circuits, short circuits (power supply and GND), or high resistance.

If an abnormality is discovered, repair or replace the circuit.

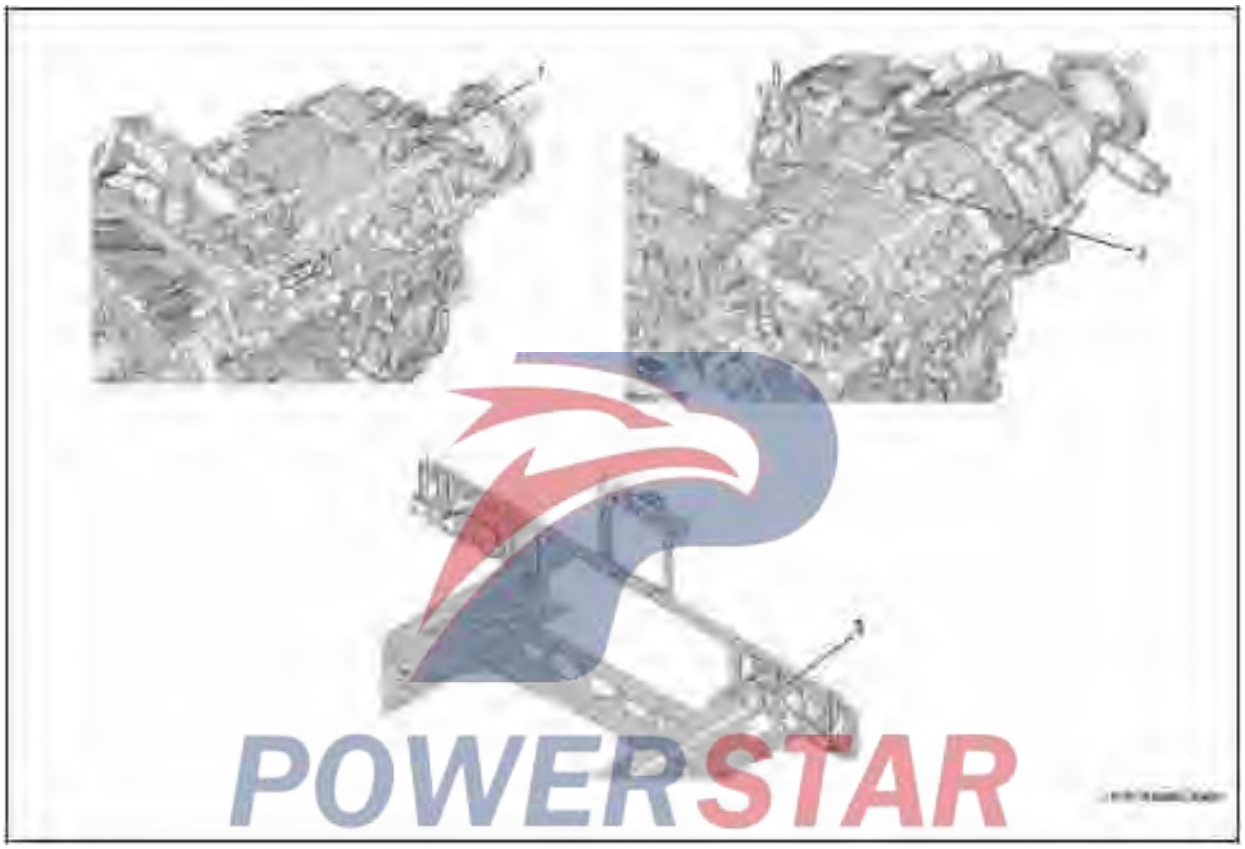
- Between SBF (No.6) and the ignition switch
- Between SBF (No.8) and the taillight relay
- Between the ignition switch and the fuse (No.22)
- Between the fuse (No.22) and the taillight relay
- Between the taillight relay and the fuse (No.28)
- Between the taillight relay and the lighting switch
- Between the fuse (No.28) and the illumination light
- Between the illumination light and GND
- Between the lighting switch and GND

Backup Light System

Description of Function and Operation

This circuit comprises a backup light and backup light switch. When the backup light switch installed to the transmission is turned ON, the backup light will illuminate.

Components Location Diagram



Legend

1. Backup light switch (M/T)
2. Backup light switch (Smoother-Ex)
3. Backup light

Functional Inspection

Operation abnormality of the backup light function

Prior confirmation and visual inspection

• Check that the battery voltage is normal.

If the battery voltage is not normal, charge or replace the battery.

• Check that the fuses are in normal condition.

If a fuse has an abnormality (due to a meltdown, etc.), investigate/repair the cause (harness short circuits, etc.) before replacing the fuse.

• Check that the ground connection is normal.

If the ground connection has an abnormality (due to improper installation or considerable dirt), repair and clean.

• Check that the harness and the connector are in a normal condition.

Check the connector for connection failures and the harness for abnormalities such as friction or bent. Check that the wire inside the harness has not come loose and caused short circuit.

• Check the effect of the post-installed electrical components (radio and lights, etc.).

Turn off or remove the post-installed electrical components, so that they do not affect the inspection or the operation.

Structural components inspection

• Check the slow blow fuse (SBF5).

If SBF has an abnormality (due to a meltdown, etc.), investigate/repair the cause (harness short circuits, etc.) before replacing the fuse.

• Check the backup light switch.

Operate the backup light switch and check that the circuit operates normally in the continuity test. If a problem is found, replace the switch. Also inspect the mechanical parts of the transmission.

• Check that the bulbs of the backup light are normal.

If any abnormality (burnout or improper installation) is found in a bulb, repair or replace it.

Circuit inspection

• Check the following circuits for open circuits, short circuits (power supply and GND), or high resistance.

If an abnormality is discovered, repair or replace the circuit.

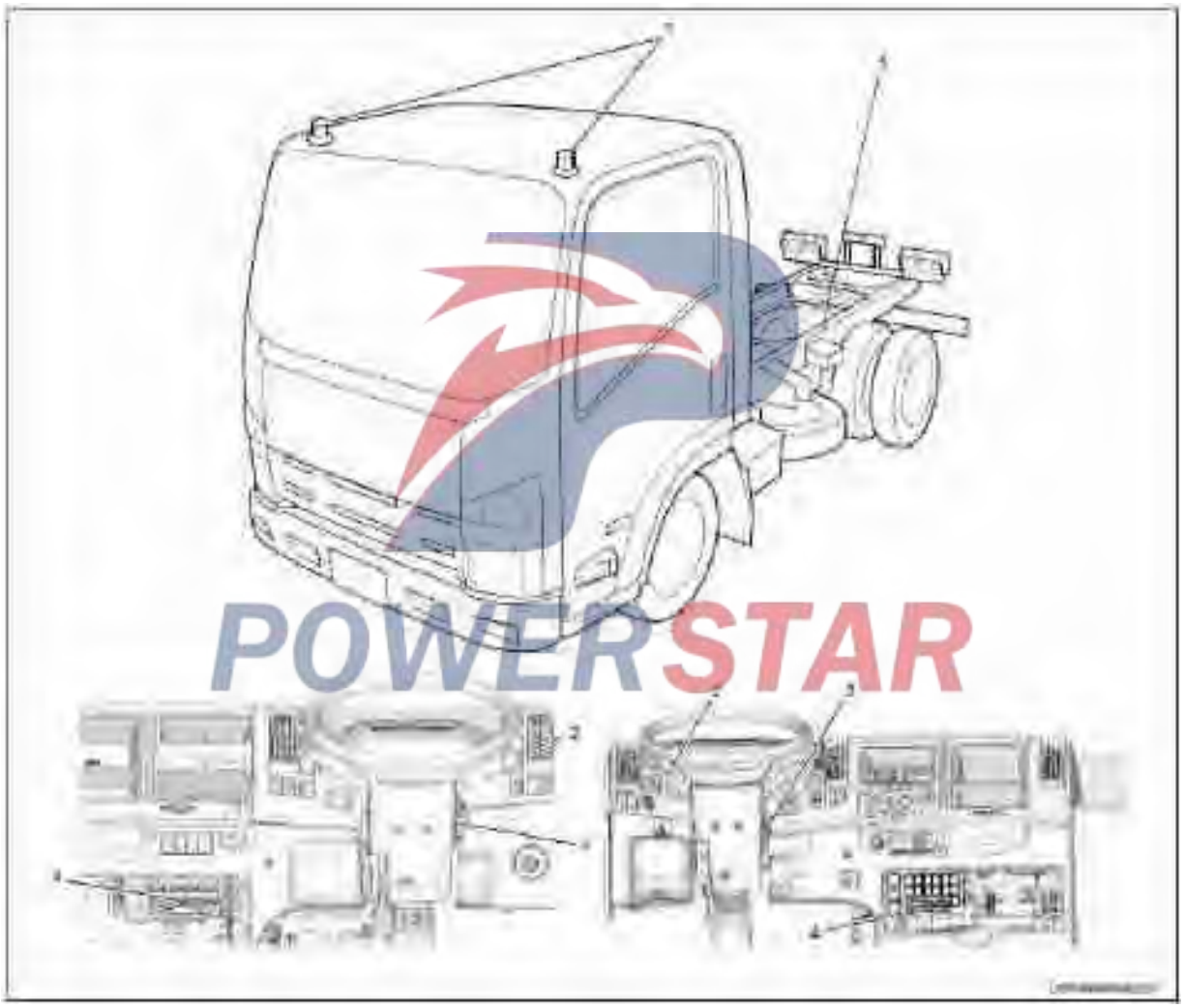
- Between SBF (No.5) and the ignition switch
- Between the ignition switch and the fuse (No.18)
- Between the fuse (No.18) and the backup light switch
- Between the backup light switch and the backup light
- Between the backup light and GND

Roof-Mounted Clearance Light System/Side marker lamp system

Description of Function and Operation

This circuit is comprised of the roof-mounted clearance light/ Side light, ignition switch, combination switch (lighting switch), and relays. When the position of the lighting switch is set to the headlight or taillight, the taillight relay operates, and the roof-mounted clearance lights/ Side light up in conjunction with the taillight, etc.

Components Location Diagram



Legend

1. Roof-mounted clearance light (NLR, NMR, NNR, NPR/S, NQR)
2. Combination switch (lighting switch)
3. Ignition switch
4. Relay box
5. Side light

Functional Inspection

Operation abnormality of the roof-mounted clearance light/ Side light

Prior confirmation and visual inspection

• Check that the battery voltage is normal.

If the battery voltage is not normal, recharge or replace the battery.

• Check that the fuses are normal.

If a fuse is faulty (because it is blown, etc.), check and remove the cause of the fault (such as harness short circuit, etc.) before replacing the fuse.

• Check that the ground connections are normal.

If the ground connection is defective (due to incorrect installation or being considerably dirty), repair and clean.

• Check that the harnesses and connectors are normal.

Check the connector for connection faults and the harness for defect such as abrasion or bends.

Check that the wire inside the harness has not come loose and caused a short-circuit.

• Check the effect of the post-mounted electrical components (radio transceiver and lights etc.).

Turn off or remove the post-mounted electrical components, so that they do not affect the inspection or the operation.

Structural components inspection

• Check the slow blow fuse (SBF5,6,8), fuse F31.

If a fuse is faulty (because it is blown, etc.), check and remove the cause of the fault (such as harness short circuit, etc.) before replacing the fuse.

• Check the lighting switch.

Operate the lighting switch and check that the circuit operates normally in the continuity test. If a problem is found, replace the switch.

• Check the taillight relay function.

Check the relay for abnormality. Replace it if an abnormality is found.

• Check whether the dome lamp/side marker lamp bulbs are normal.

If any abnormality (burnout or defective installation) is found in a bulb, repair or replace it.

Circuit inspection

• Check the following circuits for disconnections, shorts (power supply and GND) or high resistance.

If any defects are found, repair or replace such defected circuit.

- Between SBF (No.5) and the ignition switch
- Between SBF (No.6) and the taillight relay
- Between SBF (No.6) and the fuse (No.22)
- Between fuse (No.22) and the taillight relay
- Between the ignition switch and the fuse (No.22)
- Between the taillight relay and the lighting switch
- Between the lighting switch and GND
- Between the taillight relay and the fuse (No.27)
- Between the fuse (No.27) and clearance lamp relay.
- Between the fuse (No.31) and clearance lamp relay.
- Between the clearance lamp relay and side marker lamp.
- Between the taillight relay and the roof-mounted clearance light
- Between the dome lamp/side marker lamp and GND.

Headlight Bulb (Halogen Type)

Removal

1. Disconnect the battery ground cable.
2. Remove the headlight ASM.

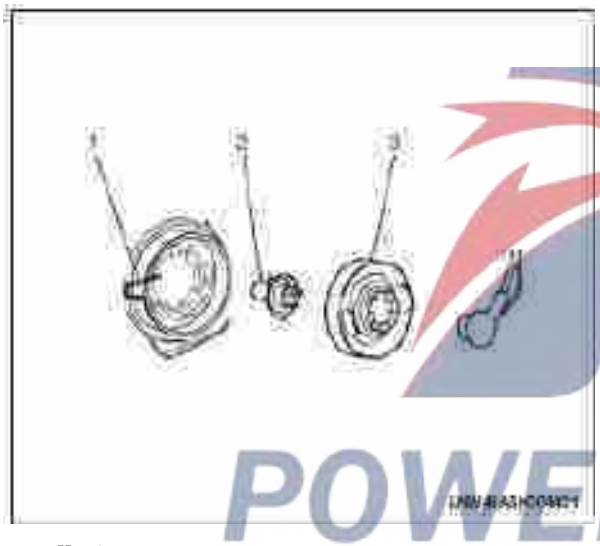
Refer to "Headlight ASM" (NHR/S, NJR/S, NKR/S type) or "Headlight ASM" (NLR/S, NMR/S, NNR/S, NPR/S type) in this section.

3. Remove the headlight bulb.

• Remove the dust cover (3).
• Remove the clip (1).
• Remove the headlight bulb (2).

CAUTION:

Do not touch the glass part of the headlight bulb directly by hand.



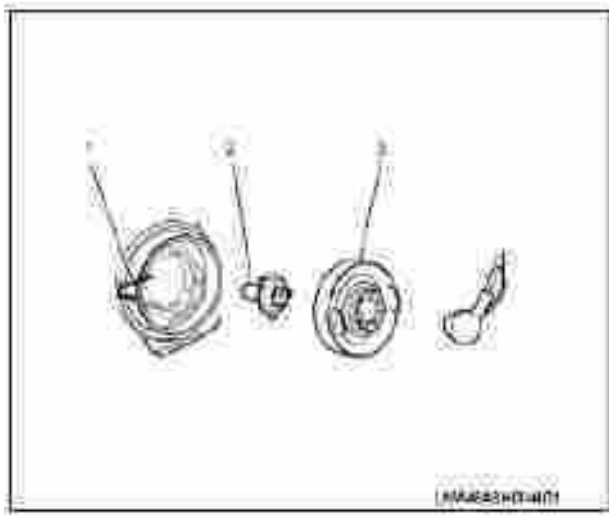
Installation

1. Install the headlight bulb.

• Install the headlight bulb (2).
• Hook the clip (1) and fix the headlight bulb.
• Install the dust cover (3).

CAUTION:

Do not touch the glass part of the headlight bulb directly by hand.



2. Install the headlight ASM.

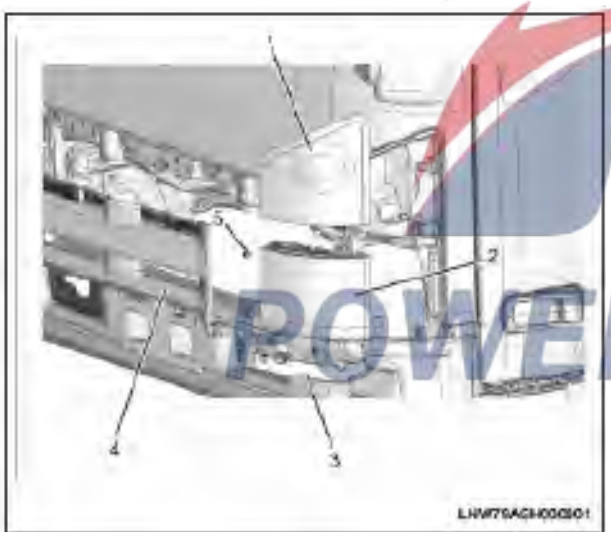
Refer to "Headlight ASM" (NHR/S, NJR/S, NKR/S type) or "Headlight ASM" (NLR, NMR, NNR, NPR/S, NQR type) in this section.

3. Connect the battery ground cable.
4. Confirm that the light turns on.

Headlight ASM (NLR, NMR, NNR, NPR/S, NQR type)

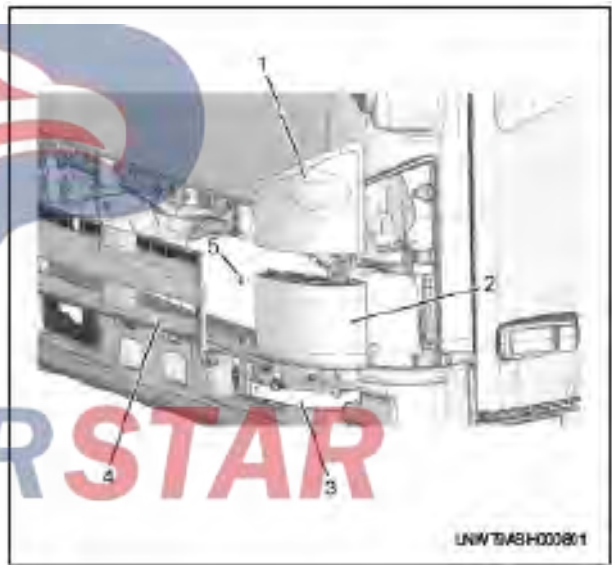
Removal

1. Disconnect the battery ground cable.
2. Remove the headlight grille cover (3).
• Remove the headlight grille cover from the protrusion (at 2 locations) under the headlight.
3. Remove the front grille (4).
Refer to the radiator grid window, front wall panel (the high roof cab and widened cab) in Chapter 9G "Cab".
4. Remove the front turn signal light ASM (1).
Refer to "Front Turn Signal Light ASM" in this section.
5. Remove the headlight ASM (2).
• Remove the 4 bolts (5).
• Remove the clip of the headlight ASM.
• Remove the connector (Halogen vehicle: 2) of the headlight ASM.



Installation

1. Install the headlight ASM (1).
• Install the connector of the headlight ASM.
Fix the headlight ASM with 4 bolts (5).
Tightening torque: 9.8N·m{1.0kgf·m}
2. Install the front turn signal light ASM (1).
Refer to "Front Turn Signal Light ASM (NLR, NMR, NNR, NPR/S, NQR type)" in this section.
3. Install the front grille (4).
Refer to the radiator grid window, front wall panel (the high roof cab and widened cab) in Chapter 9G "Cab".
4. Install the headlight grille cover (3).
• Hook the headlight grille cover to the protrusion (at 2 locations) under the headlight ASM.
5. Connect the battery ground cable.
6. Confirm that the light turns on.

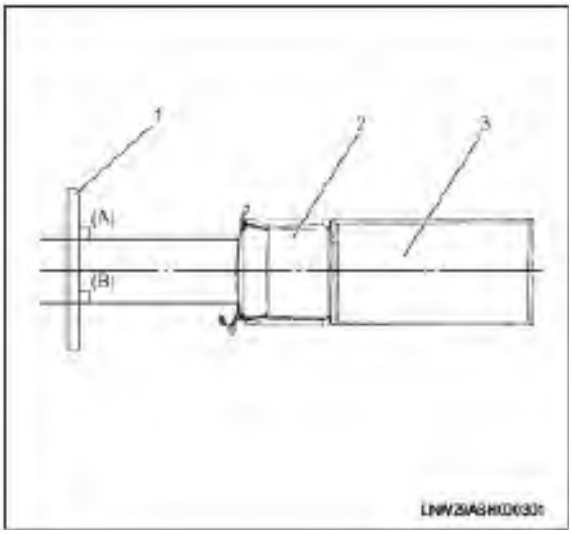


Adjustment

Optical axis adjustment

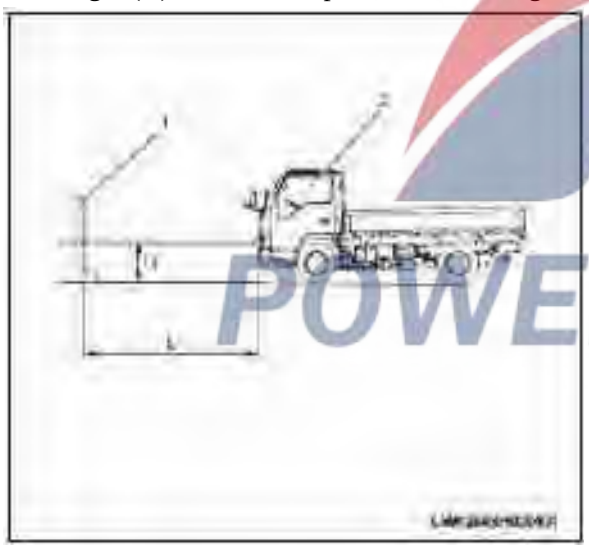
Preparation: Place the empty vehicle (empty condition: full fuel tank, one person on board) on the level floor and inspect the tire air pressure, for any dirt of the lens, and the battery charge status, and then adjust using the screen (1).
1. Place the screen (1) vertically on the level floor.
2. Place the screen (1) so that it will be perpendicular to the center line (3).
3. Align the center of the vehicle (2) with the center line of the floor surface.

4. Project the center points (bulb center mark) (A) and (B) of the left and right headlights on the screen and draw vertical lines.



5. Place the vehicle (2) 3m (L) away from the screen (1).

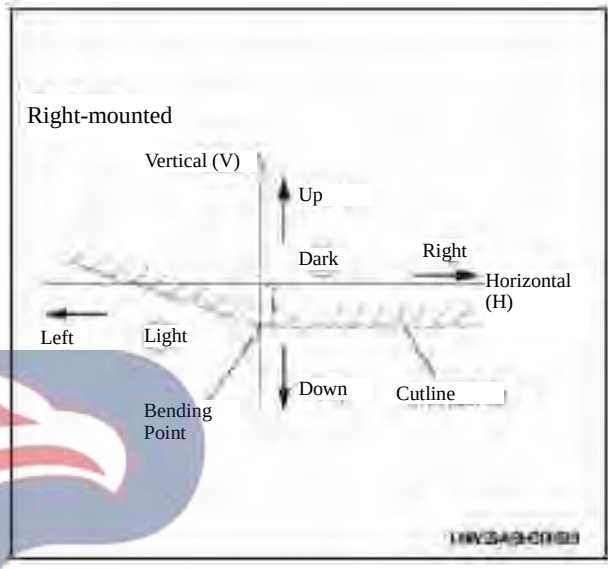
6. Draw a horizontal line on the screen that is at the same height (H) as the center point of the headlight.

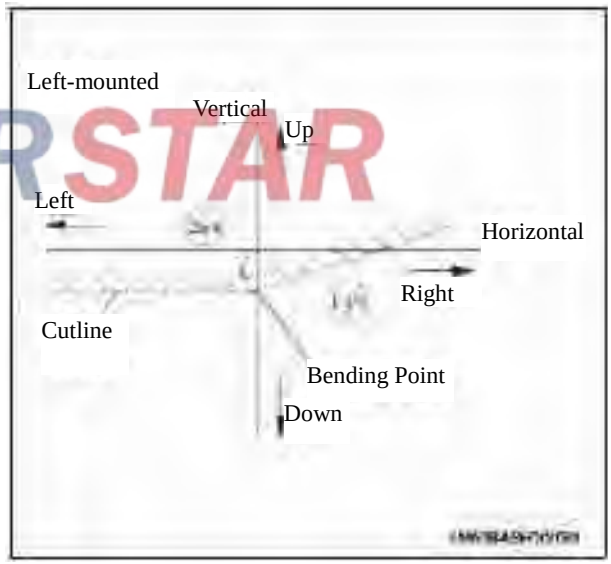


7. Turn on the headlight and set it to low beam.
Cover the other headlight which is not being adjusted with a black cloth, etc.

8. Align with the position of the initial aiming seal attached near the VIN plate.If there is no initial aiming seal, align the bending point with the vertical line (V) in the left and right adjustment. Set the boundary line of the bright part and the dark part to the value (L) in the following table depending on the horizontal line (H).

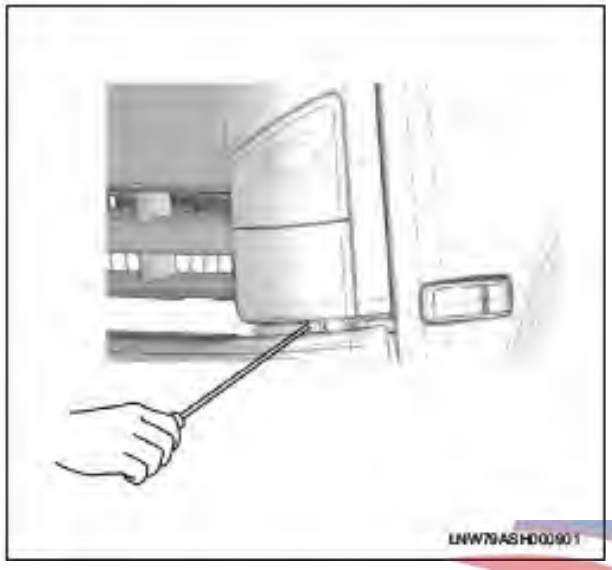
	Downward bending point alignment	Horizontal bending point alignment
Height of the light less than 1m	L=30mm	0
Height of the light more than 1m	L=45mm	0





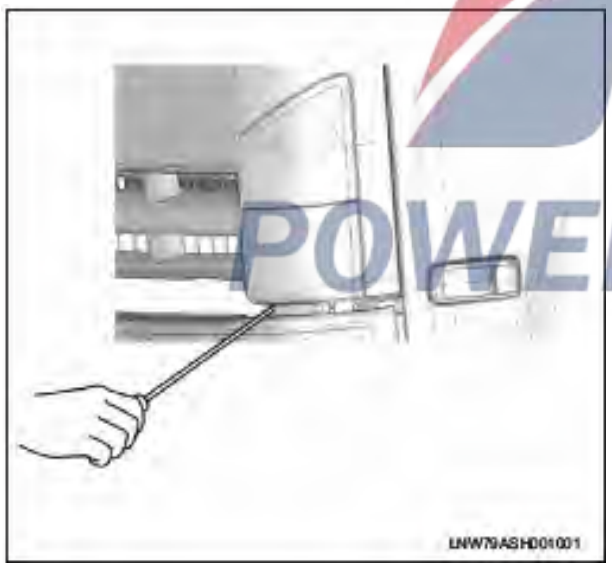
Vertical adjustment

Adjust the vertical direction of the optical axis by rotating the adjusting screw with a screwdriver.



Horizontal adjustment

Adjust the horizontal direction of the optical axis by rotating the adjusting screw with a screwdriver.

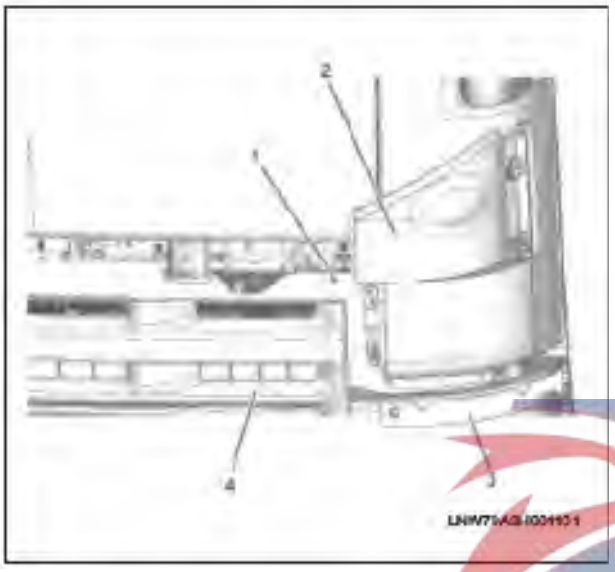


Front Turn Signal Light ASM (NLR, NMR, NNR, NPR/S, NQR)

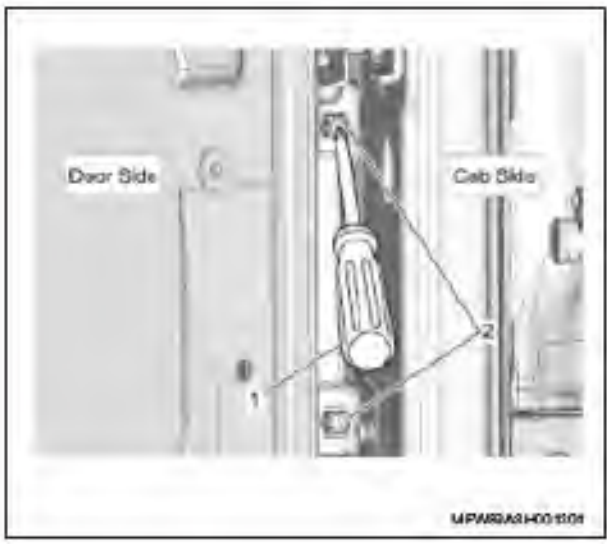
Removal

1. Disconnect the battery ground cable.
2. Remove the headlight grille cover (3).

Remove the headlight grille cover from the protrusion (at 2 locations) under the headlight.



3. Open the door and insert a Phillips head screwdriver (1) in the gap between the cab and the door from inside the door to loosen the screws (2) at the top and the bottom of the turn signal light ASM.
4. Remove 1 installation nut (1) at the front grille (4) side of the front turn signal light ASM (2).
5. Disconnect the connector of the front turn signal light ASM.



Installation

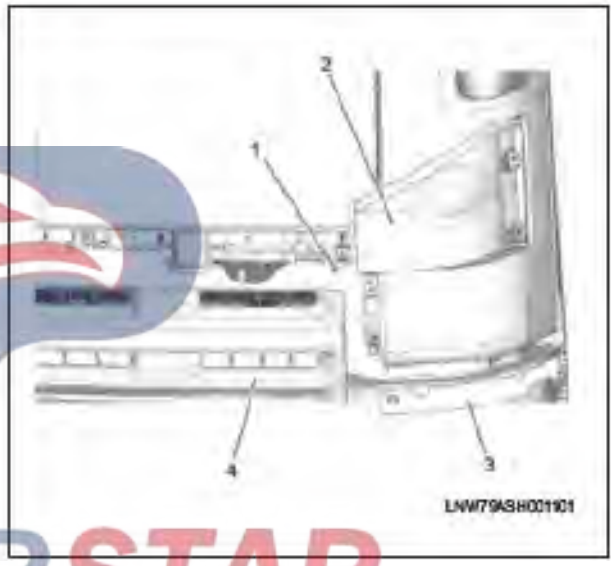
1. Install the front turn signal light ASM.

• Connect the connector of the front turn signal light ASM.
• Insert it into the stud bolt at the front grille (4) side.
• Firmly insert the clips (2 locations) at the outside of the vehicle into the front panel side.

Open the door and tighten the screw from inside.

• Tighten the nut (1) to the front grille (4) side.

Tightening torque:
9.8N·m{1.0kgf·m/7.21b·ft}

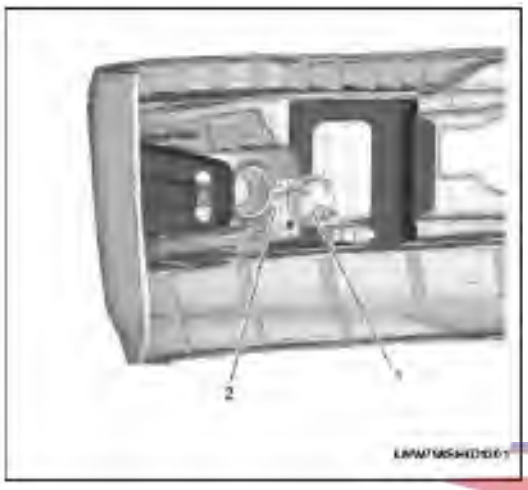


2. Connect the battery ground cable.
3. Confirm that the light turns on.

Fog Light Bulb

Removal

1. Disconnect the battery ground cable.
2. Turn the bulb cover (1) to remove it.
3. Remove the fog light bulb (2).



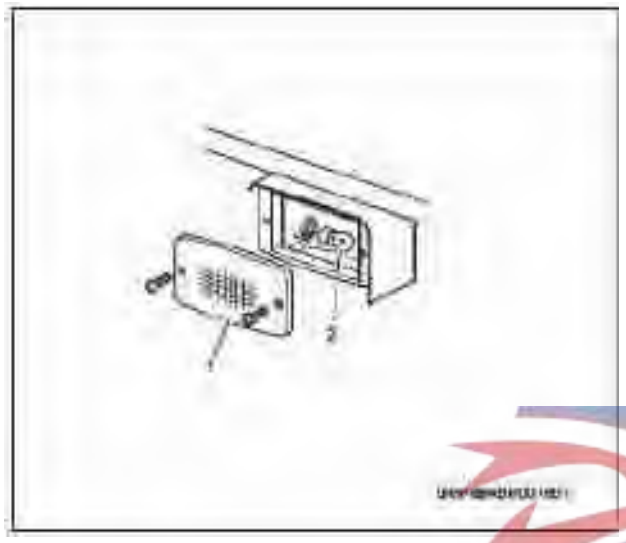
Installation

1. Install the fog light bulb.
2. Turn the bulb cover to attach it.
3. Connect the battery ground cable.
4. Confirm that the light turns on.

Rear Fog Light Bulb

Removal

1. Disconnect the battery ground cable.
2. Loosen the lamp screen (1) screw to remove it.
3. Remove the bulb (2) by turning it to the left while pushing it.



Legend

1. Lens
2. Bulb

Installation

Install it in the reverse order of the removal and confirm that the light turns on.

Clearance Light Bulb

Removal

NHR type

1. Disconnect the battery ground cable.
2. Remove the combination lamp assembly.
Refer to the "Front Combination Lamp Assembly" (NHR) in this chapter.
3. Remove the clearance light bulb.

NLR, NMR, NNR, NPR/S, NQR type

1. Disconnect the battery ground cable.
2. Remove the headlight ASM.
Refer to "Headlight ASM (NLR, NMR, NNR, NPR/S, NQR type)" in this section.
3. Remove the clearance light bulb.

Installation

NHR type

1. Install the clearance light bulb.
2. Install the front combination lamp assembly.
Refer to the "Front Combination Lamp Assembly" (NHR) in this chapter.
3. Connect the battery ground cable.
4. Confirm that the light turns on.

NLR, NMR, NNR, NPR/S, NQR type

1. Install the clearance light bulb.
2. Install the headlight ASM.
Refer to "Headlight ASM (NLR, NMR, NNR, NPR/S, NQR type)" in this section.
3. Connect the battery ground cable.
4. Confirm that the light turns on.

Side marker lamp bulb

Removal

1. Disconnect the battery ground cable.
2. Remove the lamp glass.
• Remove the 2 screws.
3. Take down the bulb by pressing it while rotating leftward.

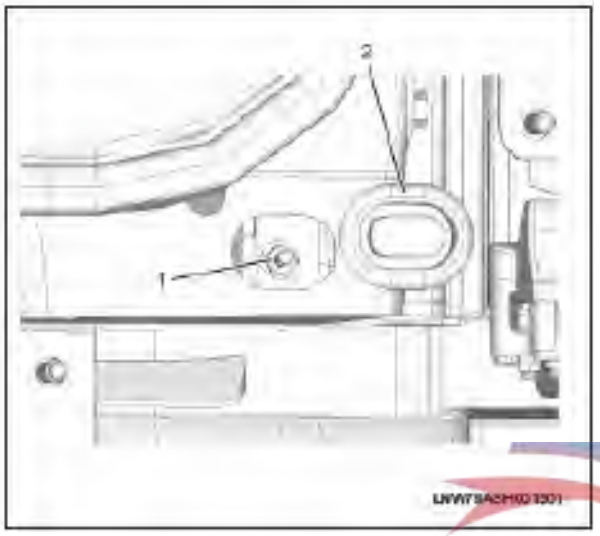
Installation

Install it in the reverse order of the removal and confirm that the light turns on.

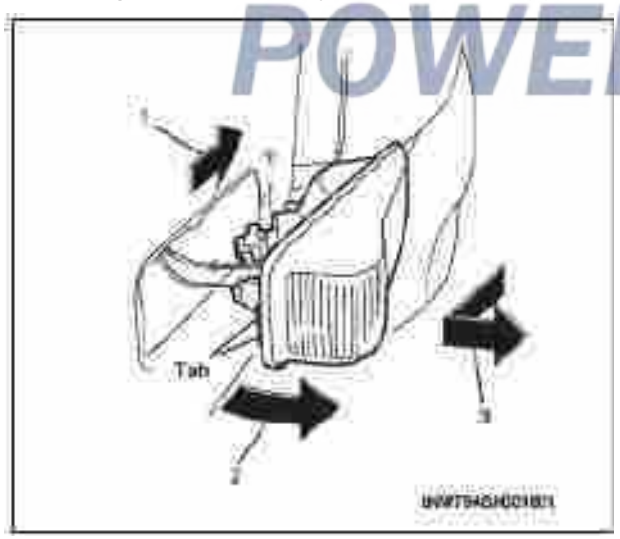
Cornaring Light Bulb

Removal

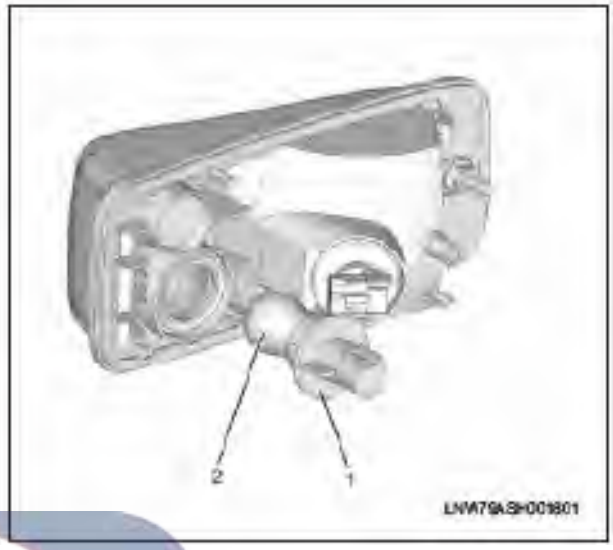
1. Disconnect the battery ground cable.
2. Open the door, remove the hole cover (2), and remove the installation nut (1) of the side light ASM.



3. Slide the side light ASM towards the front of the vehicle (1), and remove the tab at the back of the side light ASM from the door panel.(2)
4. When the tab at the back is removed, slide the side light ASM towards the rear of the vehicle. When the tab at the front of the side light ASM is removed, pull the side light ASM towards you to take it out. (3)



5. Remove the harness connector and remove the side light ASM.
6. Turn the cornering light bulb socket (1) to remove it, and remove the bulb (2) from the socket.



Installation

1) Install the bulb to the socket.
2) Install the harness connector and install the combination light ASM.
3) Install the hole cover.
4) Connect the battery ground cable.
5) Confirm that the light turns on.

Side Turn Signal Light Bulb

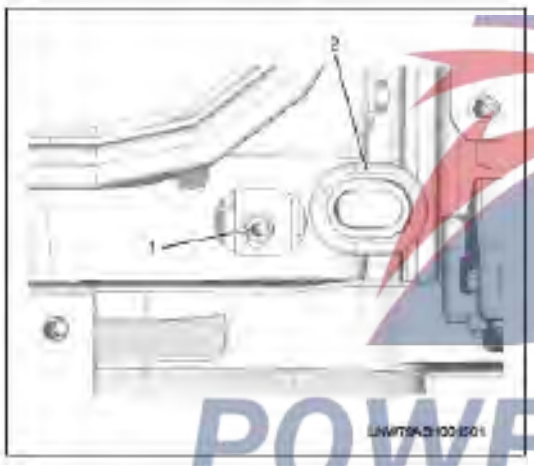
Removal

NHR type

1. Disconnect the battery ground cable.
2. Remove the front combination lamp assembly.
Refer to the "Front Combination Lamp Assembly" (NHR) in this chapter.
3. Remove the side turn light bulb.

NLR, NMR, NNR, NPR/S, NQR type

1. Disconnect the battery ground cable.
2. Open the door, remove the hole cover (2), and remove the installation nut (1) of the side light ASM.
3. Slide the side light ASM towards the front of the vehicle (1), and remove the tab at the back of the side light ASM from the door panel.(2)



4. When the tab at the back is removed, slide the side light ASM towards the rear of the vehicle. When the tab at the front of the side light ASM is removed, pull the side light ASM towards you to take it out. (3)

5. Remove the harness connector and remove the side light ASM.
6. Turn the side turn signal light bulb socket (1) to remove it, and remove the bulb (2) from the socket.

Installation

NHR type

1. Install the side turn light bulb.
2. Install the front combination lamp assembly.
3. Install the hole cover.
4. Confirm that the light turns on.

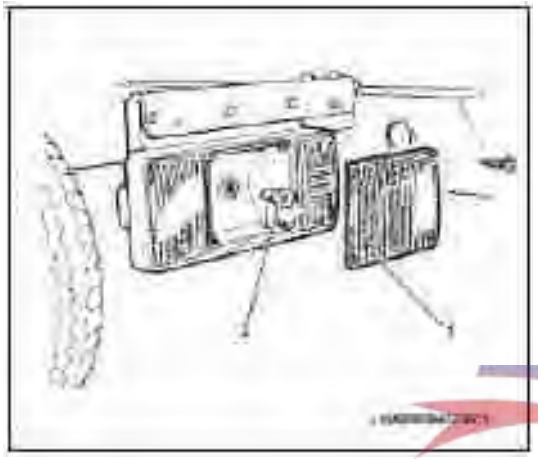
NLR, NMR, NNR, NPR/S, NQR type

1. Install the bulb to the socket.
2. Connect the harness joint and install in the sequence opposite to the removal.
3. Install the hole cover.
4. Connect the battery ground cable.
5. Confirm that the light turns on.

Taillight / Stoplight Bulb

Removal

4. Disconnect the battery ground cable.
5. Remove the lens (1).
• Remove the 4 screws.
6. Remove the bulb (2) by turning it to the left while pushing it.



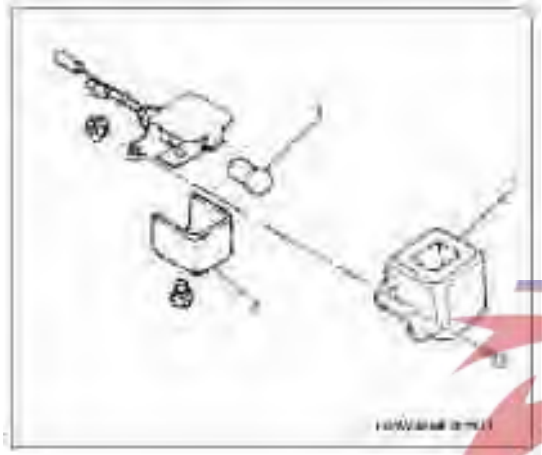
Installation

Install it in the reverse order of the removal and confirm that the light turns on.

License Plate Light Bulb

Removal

1. Disconnect the battery ground cable.
2. Remove the cover (1).
• Remove the 2 screws.
3. Remove the lens (2).
• Remove the 1 screw.
4. Remove the bulb (3) by turning it to the left while pushing it.



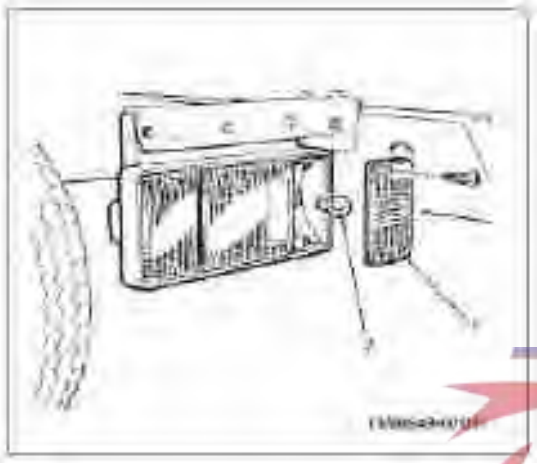
Installation

Install it in the reverse order of the removal and confirm that the light turns on.

Backup Light Bulb

Removal

1. Disconnect the battery ground cable.
2. Remove the lens (1).
• Remove the 2 screws.
3. Remove the bulb (2) by turning it to the left while pushing it.



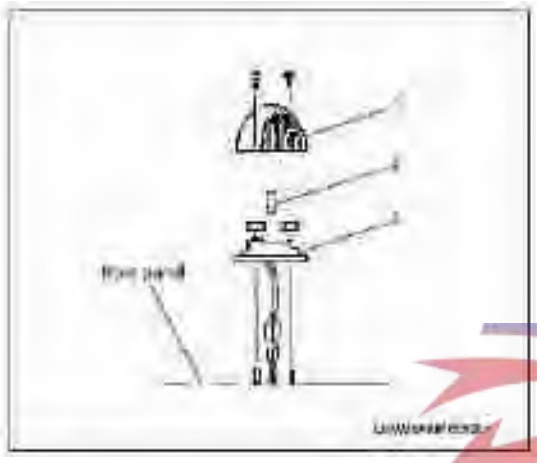
Installation

Install it in the reverse order of the removal and confirm that the light turns on.

Roof-Mounted Clearance Light Bulb

Removal

1. Disconnect the battery ground cable.
2. Loosen the screws from the lens (1), and remove the lens (1).
3. Lift out and remove the bulb (2).
4. Loosen the nuts from the base (3), remove the connector and remove the base.



Legend

1. Lens
2. Bulb
3. Base (With gasket)

Installation

Install it in the reverse order of the removal and confirm that the light turns on.

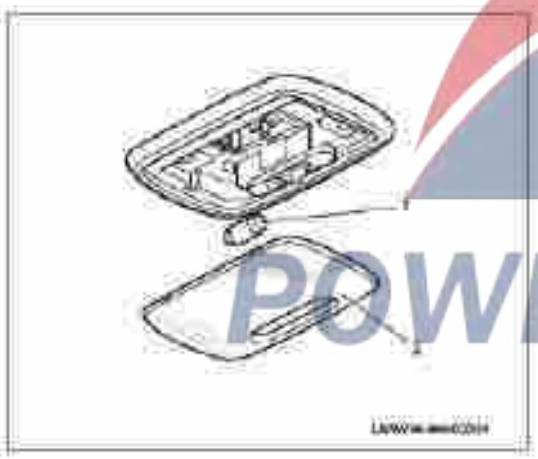
Dome Light Bulb

Removal

1. Disconnect the battery ground cable.
2. Remove the lens (2).
3. Remove the bulb (1).

NHR type

NLR, NMR, NNR, NPR/S, NQR type

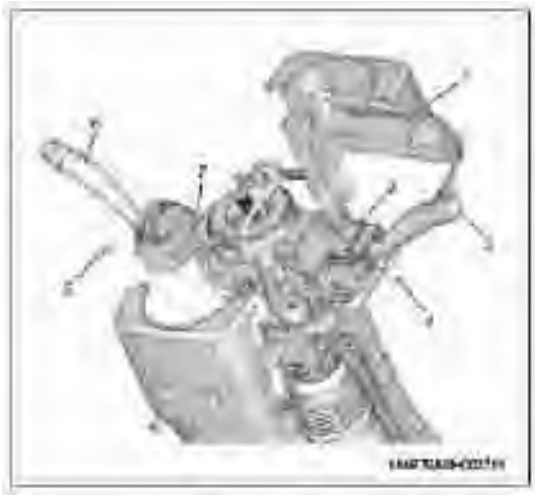


Installation

Install it in the reverse order of the removal and confirm that the light turns on.

Lighting Switch (Combination Switch)

Removal



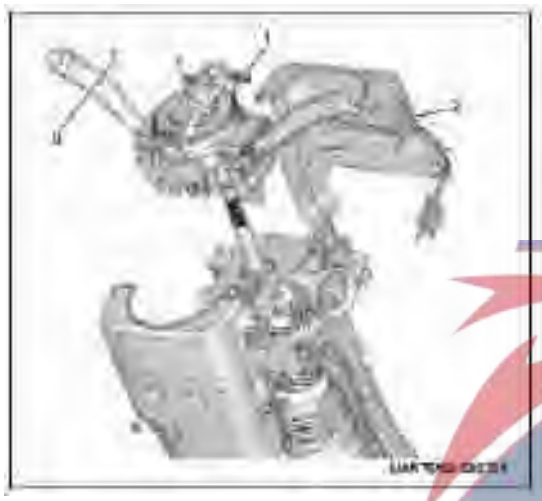
When replacing the whole switch

1. Disconnect the battery ground cable.
2. Remove the steering wheel.

a. Remove the steering cowl (2).

b. Remove the screw (3) and remove the combination switch (1).

Refer to "Power Steering Column and Shaft" in Section 6B Power Steering.



When replacing the lever unit only

1. Disconnect the battery ground cable.
2. Remove the steering wheel.

Remove the steering cowl (1).

Refer to "Power Steering Column and Shaft" in Section 6B Power Steering.

3. Remove the lever unit (turn signal side / wiper side).
4. Turn signal side

a. Remove the screw (4).

b. Remove the snap fit (2).

c. Remove the lever unit (3).

5. Wiper side

a. Remove the screw (5).

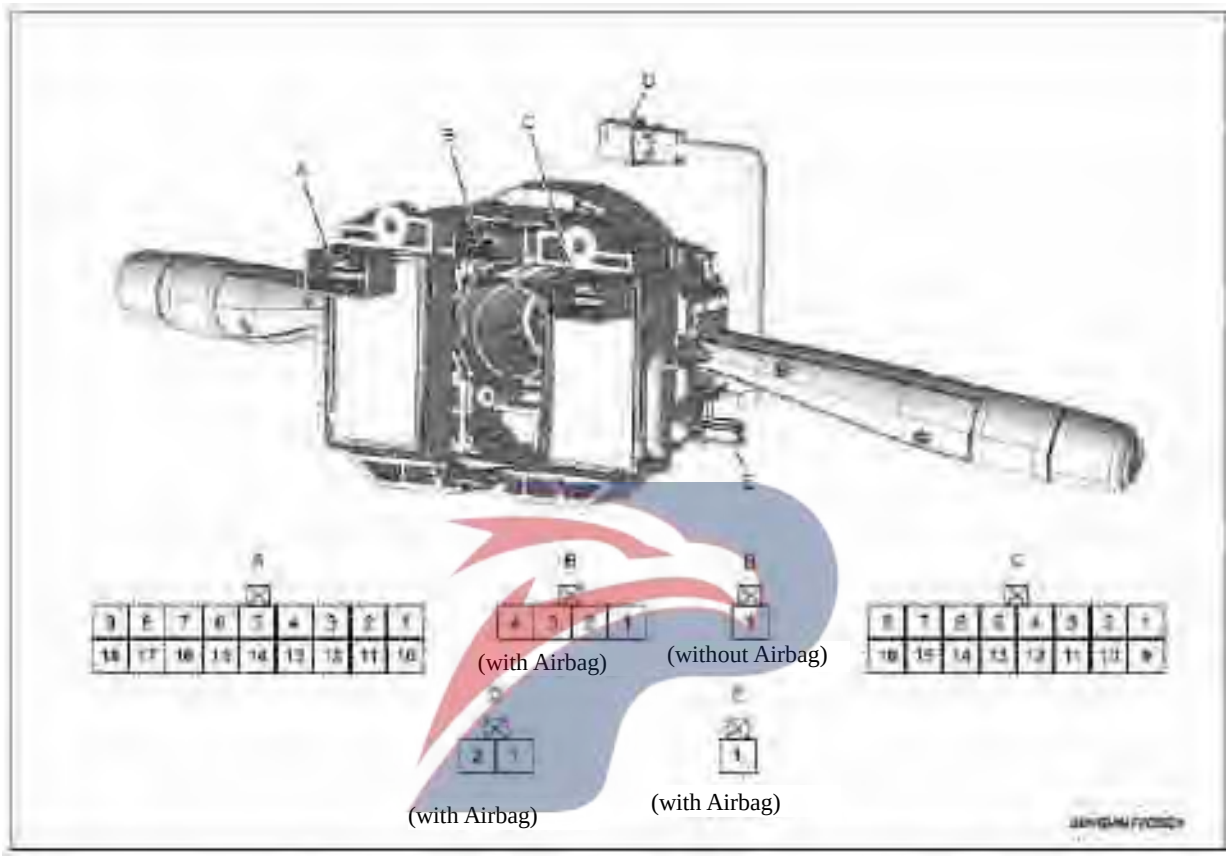
b. Remove the snap fit (7).

c. Remove the lever unit (6).

Inspection

Operate the switch lever to inspect the continuity between the connector terminals.

If any abnormality is found in the inspection results, replace it with a normal one.



Connector A

Wiper/Washer Switch

Position \ Terminal No.	10	9	12	14	16
OFF					
INT		○		○	
LO	○	○			
HI	○	○	○		
WASHER		○			○

Exhaust Brake Switch

Position \ Terminal No.	13	15
OFF		
ON	○	○

Connector C

Flash lamp switch (turn warning)

Position \ Terminal No.	2	1	3	4	10	11	9
L	○			○	○		
L	○						
NEUTRAL							
R		○					
R		○			○		

Lighting Switch

Position \ Terminal No.	17	18	16	17
OFF				
T	○	○		
H	○	○	○	
REAR FOG	○	○	○	○

Position \ Terminal No.	–	18	13	–
UPPER	○	○		
LOWER	○		○	
PASSING		○		○

Installation

Perform installation in the reverse order of the removal.

Dimmer Passing Switch (Combination Switch)

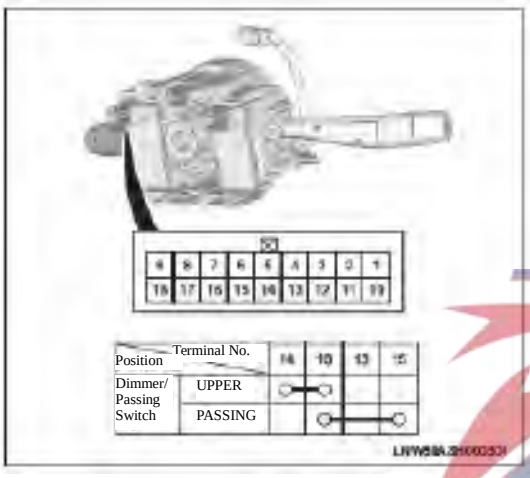
Removal

Refer to "Lighting Switch (Combination Switch)" in this section.

Inspection

Operate the switch lever to inspect the continuity between the connector terminals.

If any abnormality is found in the inspection results, replace it with a normal one.



Installation

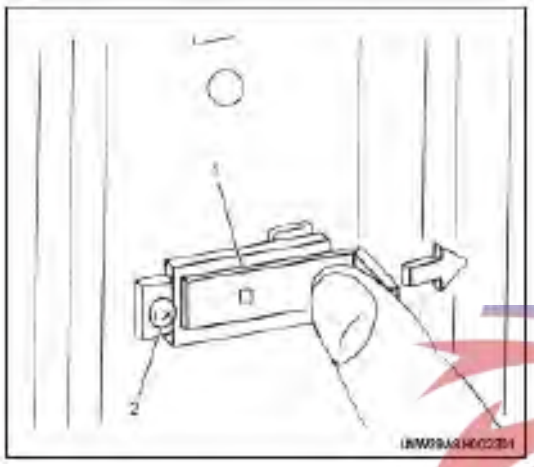
Refer to "Lighting Switch (Combination Switch)" in this section.

Door Switch

Removal

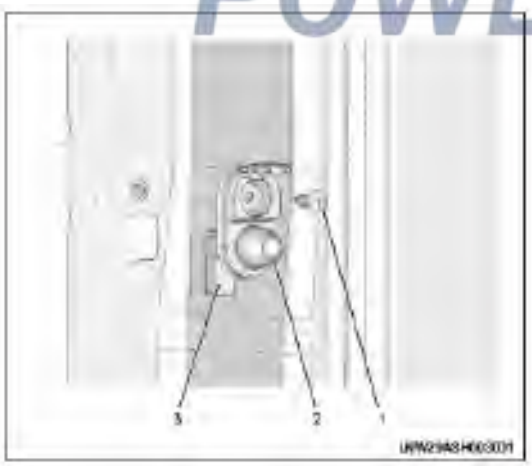
NHR/S, NJR/S, NKR/S type

1. Disconnect the battery ground cable.
2. Remove the door switch (1).
• Press the switch sliding part and remove the screw (2).
• Remove the joint.



NLR, NMR, NNR, NPR/S, NQR type

1. Disconnect the battery ground cable.
2. Open the cover with the slotted head screwdriver and remove the screw (1).
3. Pull out the door switch (2) and remove the harness connector (3).



Inspection

Operate the switch to inspect the continuity between the connector terminals.

If any abnormality is found in the inspection results, replace it with a normal one.

Switch operation	Terminal (1)	Ground
When pressed	-	-
When released	○	○

Installation

Perform installation in the reverse order of the removal.

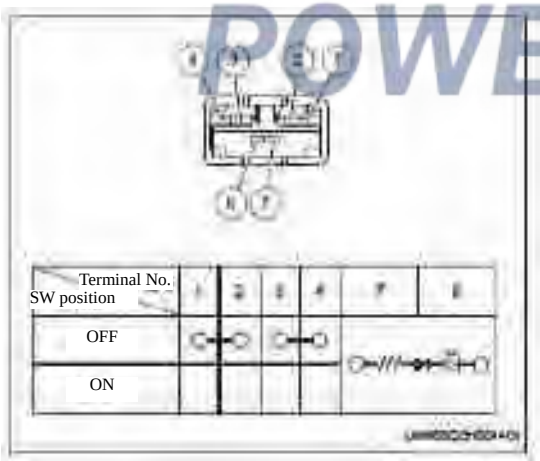
Hazard Warning Flasher Light Switch

Removal

1. Disconnect the battery ground cable.
2. Remove the meter cluster.
Refer to "Instrument Panel" in Section 9K Interior & Exterior Trims. (the high roof cab and widened cab).
3. Remove it while pushing the tab (1) of the hazard warning flasher light switch (2) from the back side of the instrument panel.

Inspection

Operate the switch to inspect the continuity between the connector terminals.
If any abnormality is found in the inspection results, replace it with a normal one.



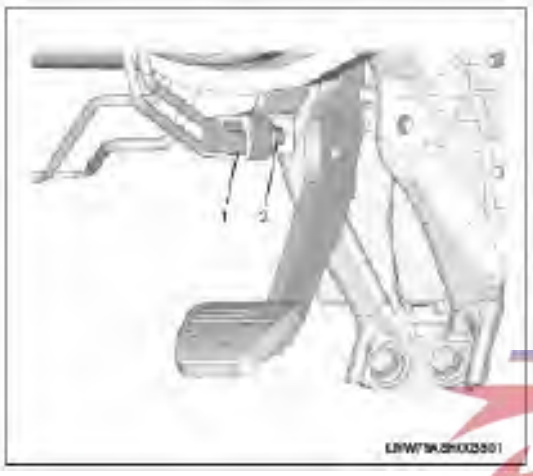
Installation

Perform installation in the reverse order of the removal.

Stoplight Switch

Removal

1. Disconnect the battery ground cable.
2. Remove the stoplight switch (1).
• Disconnect the stop lamp switch joint.
• Loosen the lock nut (2).
• Rotate the switch to take it down from the bracket.



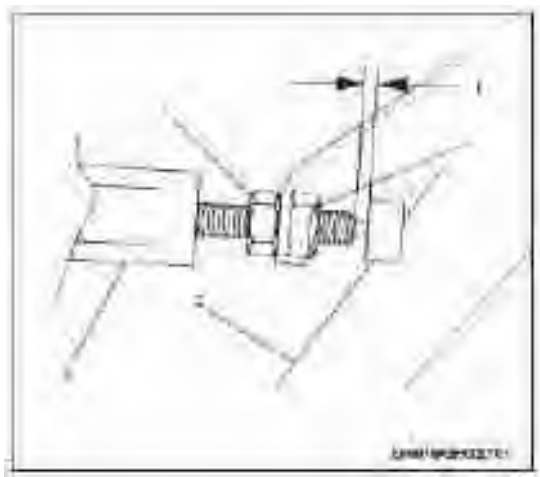
Installation

1. Stoplight switch
• Rotate the stop lamp switch (3) until the switch threads end touches the brake pedal (2).

Note:

Do not allow the switch top end to squeeze the pedal.

2. After the switch touching the pedal, return the switch to make the gap (L) between the pedal and screw top end within 0.5 - 1.0mm and then tighten the lock nut (1).
3. Connect the joint.



Backup Light Switch

Removal

Refer to "Backup light Switch" and "Neutral Switch"
in Section 5C Manual Transmission MLD.

Installation

Refer to "Backup light Switch" and "Neutral Switch"
in Section 5C Manual Transmission MLD.

Turn Signal Light Switch (Combination Switch)

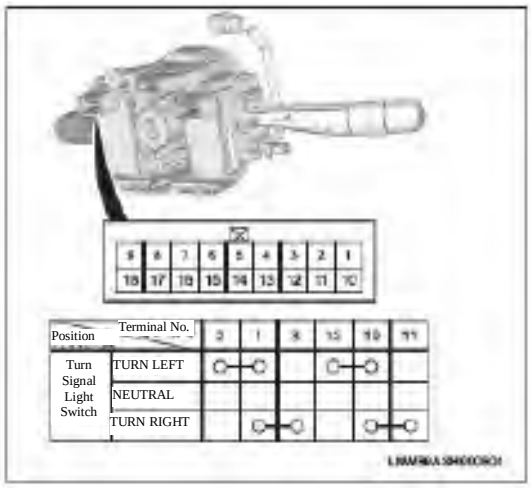
Removal

Refer to "Lighting Switch (Combination Switch)" in this section.

Inspection

Operate the switch lever to inspect the continuity between the connector terminals.

If any abnormality is found in the inspection results, replace it with a normal one



Installation

Refer to "Lighting Switch (Combination Switch)" in this section.

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Fog Light Switch (front fog light)

Removal

1. Disconnect the battery ground cable.
2. Remove the meter cluster.

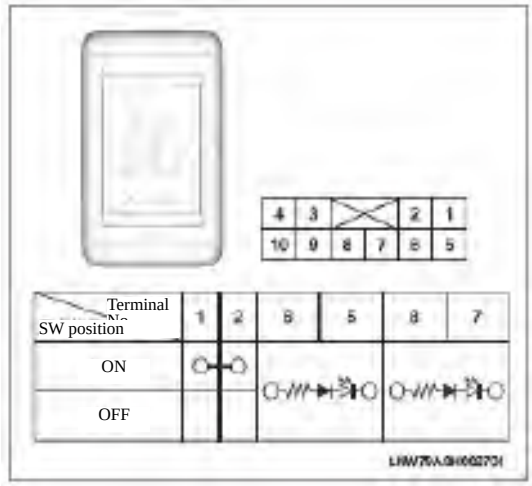
Refer to "Instrument Assembly" in Chapter 9E "Instrument and Driving Information".

3. Disconnect the connector of the dome light switch and push the fog light switch out from the back side of the meter cluster.

Inspection

Operate the switch to inspect the continuity between the connector terminals.

If any abnormality is found in the inspection results, replace it with a normal one.



Installation

Perform installation in the reverse order of the removal

.

Section 9B

BODY, CAB and ELECTRICAL

Wiper/Washer System

TABLE OF CONTENTS

Windshield Wiper and Washer

Description of Function and Operation

The system is activated when the ignition switch is in the "ON" position.

• Wiper & washer switch
• Wiper intermittent relay
• Wiper motor
• Washer motor
• Washer nozzle
• Windshield washer tank
• Wiper arm & blade
• The wiper motor intermittent relay, low speed washer motor and high speed motor are directly controlled by the wiper and washer switch.The intermittent relay detects the wiper and washer running signal.

Windshield washer

When the windshield washer switch is turned ON, the voltage will be supplied to the washer motor.
Intermittent control unit monitors this circuit voltage in order to detect the wiper interlocking request signal. Shortly after it detects the signal, it activates the wiper main relay and drives the wiper motor at low speed.

Wiper intermittent drive (INT)

This drives the wiper intermittently at low speed. When the wiper switch is at the "INT" position, the wiper intermittent control unit activates the wiper main relay only for a fixed time with a fixed interval and drives the wiper motor at low speed.

Wiper low speed drive (LO)

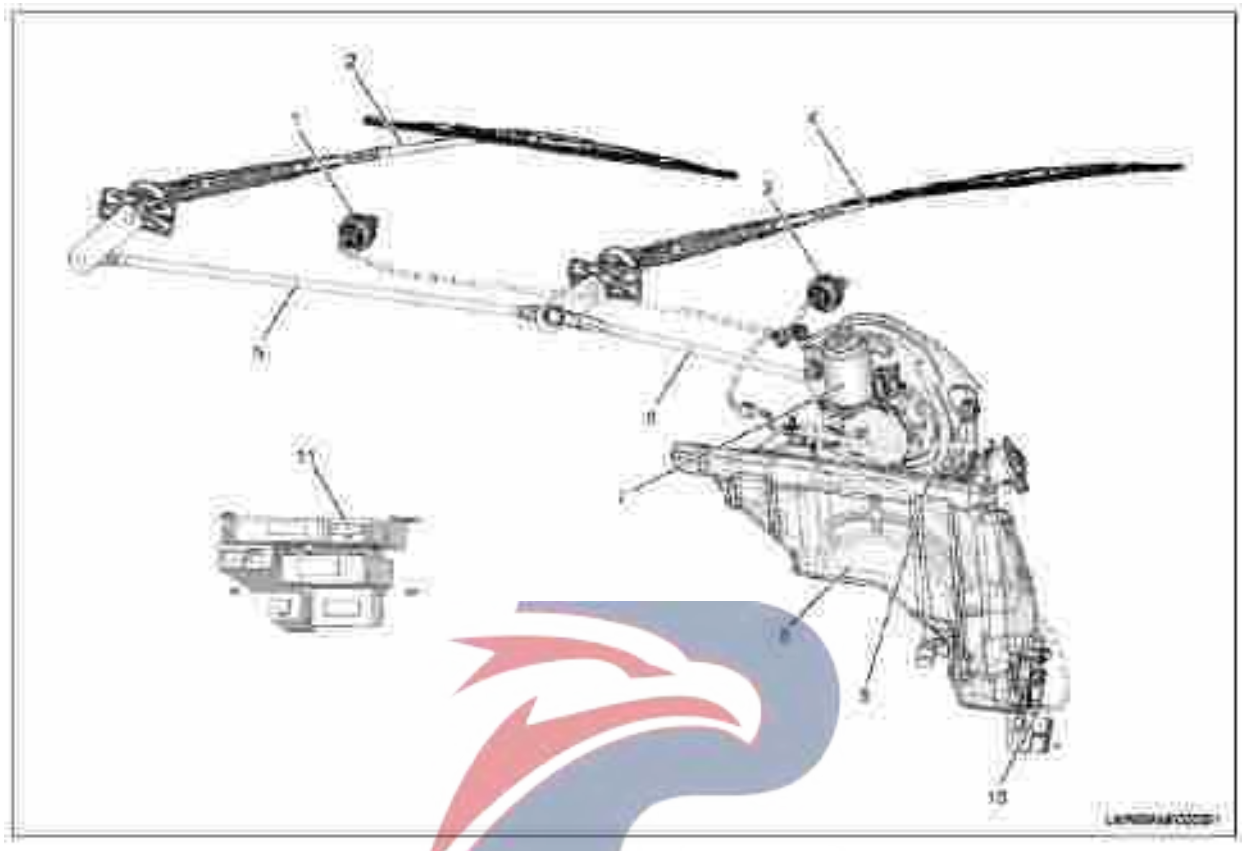
When the wiper switch is at the "LO" position, the wiper main relay is activated to drive the wiper motor at low speed.

Wiper high speed drive (HI)

When the wiper switch is at the "HI" position, the wiper main relay and the wiper high low relay are activated to drive the wiper motor at high speed.

Components

The high roof cab and widened cab



Legend

1. Washer nozzle RH
2. Wiper arm RH
3. Washer nozzle LH
4. Wiper arm LH
5. Link rod LH
6. Link rod RH
7. Wiper motor
8. Windshield washer tank
9. Washer hose
10. Washer motor
11. Intermittent relay

Functional Inspection

The wiper does not operate regardless of the switch position

Prior confirmation and visual inspection

• Check that the battery voltage is normal.

If the battery voltage is not normal, charge or replace the battery.

• Check that the fuses are in normal condition.

If a fuse has an abnormality (due to a meltdown, etc.), investigate/repair the cause (harness short circuit, etc.) before replacing the fuse.

• Check that the ground connection is normal.

If the ground connection has an abnormality (due to improper installation or considerable dirt), repair and clean.

• Check that the harness and the connector are in a normal condition.

Check that the connector for connection failures and the harness for abnormalities such as friction or bent. Check that the wire inside the harness has not come loose and caused short circuit.

• Check the effect of the post-installed electrical components (radio and lights, etc.).

Turn off or remove the post-installed electrical components, so that they do not affect the inspection or the operation.

Structural components inspection

• Check the wiper fuse (F8).

If a fuse has an abnormality (due to a meltdown, etc.), investigate / repair the cause (harness short circuit, etc.) before replacing the fuse.

• Check the key on relay function.

Check the key on relay for abnormality. Replace it if an abnormality is found.

• Check the wiper main relay function.

Check the wiper main relay for abnormality. Replace it if an abnormality is found.

• Check the wiper high low relay function.

Check the wiper high low relay for abnormality. Replace it if an abnormality is found.

• Check the wiper & washer switch.

Operate the wiper & washer switch and check that the circuit operates normally in a continuity test. If a problem is found, replace the switch.

• Check the wiper motor.

Replace the wiper motor if a failure is found.

Circuit inspection

• Check the following circuits for open circuits, short circuits (power supply and GND), or high resistance.

If an abnormality is discovered, repair or replace the circuit.

- Between the cab junction block and the wiper & washer switch.
- Between the cab junction block and the wiper motor.
- Between the wiper & washer switch and GND (cab).

The wiper does not operate at the "INT" position

Prior confirmation and visual inspection

• Check that the battery voltage is normal.

If the battery voltage is not normal, charge or replace the battery.

• Check that the fuses are in normal condition.

If a fuse has an abnormality (due to a meltdown, etc.), investigate/repair the cause (harness short circuit, etc.) before replacing the fuse.

• Check that the ground connection is normal.

If the ground connection has an abnormality (due to improper installation, considerable dirt), repair and clean.

• Check that the harness and the connector are in a normal condition.

Check the connector for connection failures and the harness for abnormalities such as friction or bent. Check the wire inside the harness has not come loose and caused short circuit.

• Check the effect of the post-installed electrical components (radio and lights, etc.).

Turn off or remove the post-installed electrical components, so that they do not affect the inspection or the operation.

Structural components inspection

• Check the wiper & washer switch.

Operate the wiper & washer switch and check that the circuit operates normally in a continuity test. If a problem is found, replace the switch.

• Check the wiper intermittent relay.

Check the DTC and replace the wiper intermittent relay if any abnormality is found.

Circuit inspection

• Check the following circuits for open circuits, short circuits (power supply and GND), or high resistance.

If defects are discovered, repair or replace the circuit.

The wiper does not operate at the "LO" position

Prior confirmation and visual inspection

• Check that the battery voltage is normal.

If the battery voltage is not normal, charge or replace the battery.

• Check that fuses are in normal condition.

If a fuse has an abnormality (due to a meltdown, etc.), investigate/repair the cause (harness short circuit, etc.) before replacing the fuse.

• Check that the ground connection is normal.

If the ground connection has an abnormality (due to improper installation or considerable dirt), repair and clean.

• Check that the harness and the connector are in a normal condition.
Check that the connector for connection failures and the harness for abnormalities such as friction or bent.
Check that the wire inside the harness has not come loose and caused short circuit.
• Check the effect of the post-installed electrical components (radio and lights, etc.).
Turn off or remove the post-installed electrical components, so that they do not affect the inspection or the operation.

Structural components inspection

• Check the wiper & washer switch.
Operate the wiper & washer switch and check that the circuit operates normally in a continuity test. If a problem is found, replace the switch.
• Check the wiper motor.
Replace the wiper motor if it is defective.
• Check the wiper high low relay function.
Check the wiper high low relay for abnormality. Replace it if an abnormality is found.
• Check the wiper main relay function.
Check the wiper main relay for abnormality. Replace it if an abnormality is found.

Circuit inspection

• Check the following circuits for open circuits, short circuits (power supply and GND), or high resistance.
If an abnormality is discovered, repair or replace the circuit.
- Between the cab junction block and the wiper & washer switch.
- Between the cab junction block and the wiper motor.

The wiper does not operate at the "HI" position

Prior confirmation and visual inspection

• Check that the battery voltage is normal.
If the battery voltage is not normal, charge or replace the battery.
• Check that the fuses are in normal condition.
If a fuse has a failure (due to a meltdown, etc.), investigate/repair the cause (harness short circuit, etc.) before replacing the fuse.
• Check that the ground connection is normal.
If the ground connection has an abnormality (due to improper installation or considerable dirt), repair and clean.
• Check that the harness and the connector are in a normal condition.
Check that the connector for connection failures and the harness for abnormalities such as friction or bent.
Check that the wire inside the harness has not come loose and caused short circuit.
• Check the effect of the post-installed electrical components (radio and lights, etc.).
Turn off or remove the post-installed electrical components, so that they do not affect the inspection or the operation.

Structural components inspection

• Check the wiper & washer switch.
Operate the wiper & washer switch and check that the circuit operates normally in a continuity test. If a problem is found, replace the switch.
• Check the wiper motor.
Replace the wiper motor if it is defective.
• Check the wiper high low relay function.
Check the wiper high low relay for abnormality. Replace it if an abnormality is found.

Circuit inspection

• Check the following circuits for open circuits, short circuits (power supply and GND), or high resistance.
If defects are discovered, repair or replace the circuit.
- Between the cab junction block and the wiper & washer switch.
- Between the cab junction block and the wiper motor.

The wiper's auto-stop does not function

Prior confirmation and visual inspection

• Check that the battery voltage is normal.
If the battery voltage is not normal, charge or replace the battery.
• Check that the fuses are in normal condition.
If a fuse has an abnormality (due to a meltdown, etc.), investigate/repair the cause (harness short circuit, etc.) before replacing the fuse.
• Check that the ground connection is normal.
If the ground connection has an abnormality (due to improper installation or considerable dirt), repair and clean.
• Check that the harness and the connector are in a normal condition.
Check that the connector for connection failures and the harness for abnormalities such as friction or bent.
Check that the wire inside the harness has not come loose and caused short circuit.
• Check the effect of the post-installed electrical components (radio and lights, etc.).
Turn off or remove the post-installed electrical components, so that they do not affect the inspection or the operation.

Structural components inspection

• Check the wiper & washer switch.
Operate the wiper & washer switch and check that

the circuit operates normally in a continuity test. If a problem is found, replace the switch.

• Check the wiper motor.

Replace the wiper motor if a failure is found.

The wiper motor does not stop

Prior confirmation and visual inspection

• Check that the battery voltage is normal.

If the battery voltage is not normal, charge or replace the battery.

• Check that the fuses are in normal condition.

If a fuse has an abnormality (due to a meltdown, etc.), investigate/repair the cause (harness short circuit, etc.) before replacing the fuse.

• Check that the ground connection is normal.

If the ground connection has an abnormality (due to improper installation or considerable dirt), repair and clean.

• Check that the harness and the connector are in a normal condition.

Check that the connector for connection failures and the harness for abnormalities such as friction or bent.
Check that the wire inside the harness has not come loose and caused short circuit.

• Check the effect of the post-installed electrical components (radio and lights, etc.).

Turn off or remove the post-installed electrical components, so that they do not affect the inspection or the operation.

Structural components inspection

• Check the wiper & washer switch.

Operate the wiper & washer switch and check that the circuit operates normally in a continuity test. If a problem is found, replace the switch.

• Check the wiper motor.

Replace the wiper motor if a failure is found.

The washer motor does not operate

Prior confirmation and visual inspection

• Check that the battery voltage is normal.

If the battery voltage is not normal, charge or replace the battery.

• Check that the fuses are in normal condition.

If a fuse has an abnormality (due to a meltdown, etc.), investigate/repair the cause (harness short circuit, etc.) before replacing the fuse.

• Check that the ground connection is normal.

If the ground connection has an abnormality (due to improper installation or considerable dirt), repair and clean.

• Check that the harness and the connector are in a normal condition.

Check that the connector for connection failures and the harness for abnormalities such as friction or bent.
Check that the wire inside the harness has not come loose and caused short circuit.

• Check the effect of the post-installed electrical components (radio and lights, etc.).

Turn off or remove the post-installed electrical components, so that they do not affect the inspection or the operation.

Structural components inspection

• Check the wiper fuse (F8).

If a fuse has an abnormality (due to a meltdown, etc.), investigate / repair the cause (harness short circuit, etc.) before replacing the fuse.

• Check the wiper & washer switch.

Operate the wiper & washer switch and check that the circuit operates normally in a continuity test. If a problem is found, replace the switch.

• Check the washer motor.

Replace the washer motor if a failure is found.

Circuit inspection

• Check the following circuits for open circuits, short circuits (power supply and GND), or high resistance.

If an abnormality is discovered, repair or replace the circuit.

- Between the cab junction block and the washer motor.
- Between the washer motor and the wiper & washer switch.
- Between the wiper & washer switch and GND (cab).

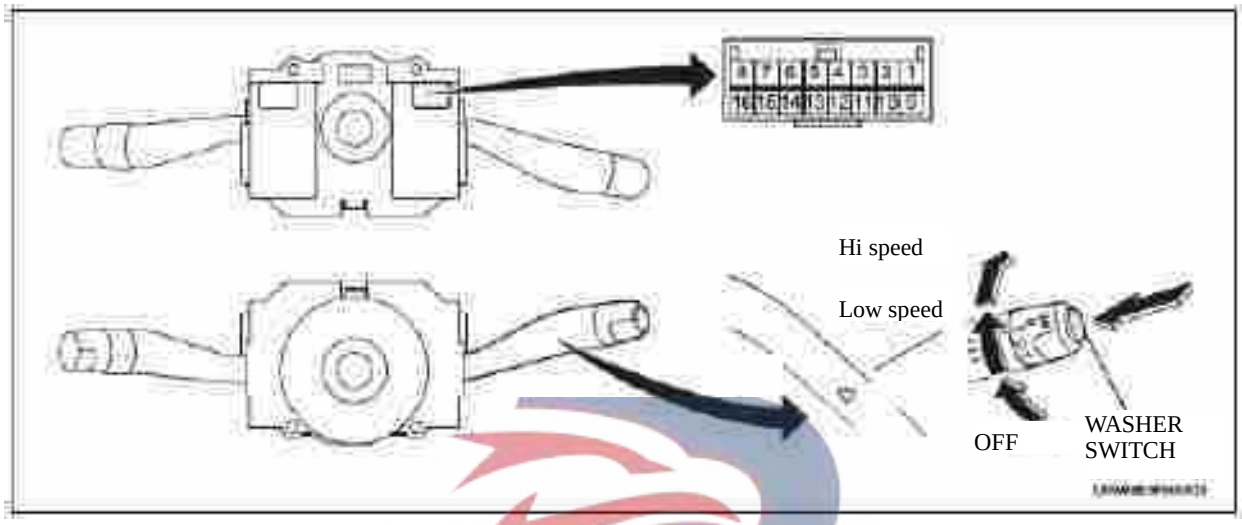
Windshield Wiper and Washer Switch

Removal

Refer to the "Lighting Switch (Combination Switch)" in Section 9A Lighting System.

Inspection

Inspect the continuity at the switch's connector terminals when the switch is operated. If any abnormality is found in the inspection results, repair or replace it with a normal one.



Washer switch	Wiper switch	Terminal No.				
		10	9	12	14	16
OFF	OFF	-	-	-	-	-
	INT	-	○	-	○	-
	LO	○	○	-	-	-
	HI	○	○	○	-	-
ON	OFF, INT, LO, HI	-	○	-	-	○

○: Continuity exists

-: No continuity

Installation

Refer to the "Lighting Switch (Combination Switch)" in Section 9A Lighting System.

Wiper Motor

Removal

High roof cab, widened cab

1. Disconnect the battery ground cable.
2. Remove the radiator grid window and front wall panel.
• Refer to "Radiator Grid Grid Window" and "Front Wall Panel" in Chapter 9G" Cab".
3. Remove the wiper motor (1).
• Remove the spherical joint at the joint of wiper motor crank arm (2) and wiper link mechanism (3).
• Remove the 4 mounting screws.
• Lift the wiper motor and disconnect the harness joint.

Installation

High roof cab, widened cab

CAUTION:

When the crank arm is removed from the wiper motor, tighten the motor shaft nut at the specified torque.

Tightening torque: 18N·m{1.8kgf·m}

1. Install the wiper motor.
• Connect the harness connector.
• Install the motor with 4 screws.
Tightening torque: 8N·m{0.8kgf·m}
• Confirm that the motor is stopped at the autostop position, and then align the ball joint of the crank arm with the coupler at the wiper link's linkage section.
1. Install the radiator grid window and front wall panel.
• Refer to "Radiator Grid Grid Window" and "Front Wall Panel" in Chapter 9G "Cab".
2. Connect the battery ground cable.
3. Confirm the operation.

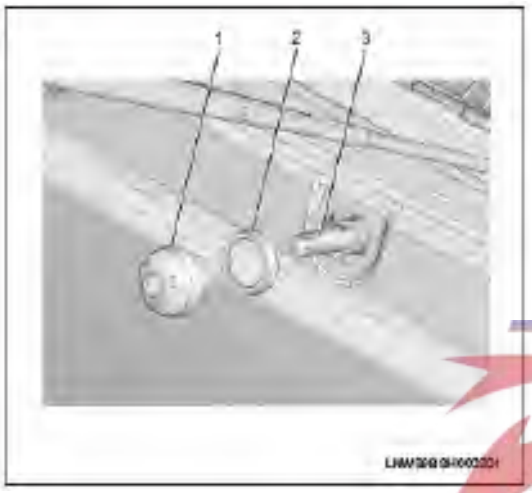
Washer Nozzle

Removal

1. Disconnect the battery ground cable.
2. Rotate the resin nut (1) leftward to remove it and then remove the rubber gasket (2).
3. Rotate the washer nozzle (3) leftward, pull it out and then take down the washer hose.

NOTE:

Prevent the removed washer hose falling into the cab.



Inspection

Inspect that the emission port of the washer nozzle is not clogged.

If any abnormality is found in the inspection results, repair it or replace it with a normal one.

Installation

1. Connect the washer hose to the nozzle.
• Insert it firmly. (8 mm or more)
2. Rotate the washer nozzle rightward by 45° approximately and fix it to the plate.
3. Install the rubber gasket to the resin nut and tighten it rightward.

NOTE:

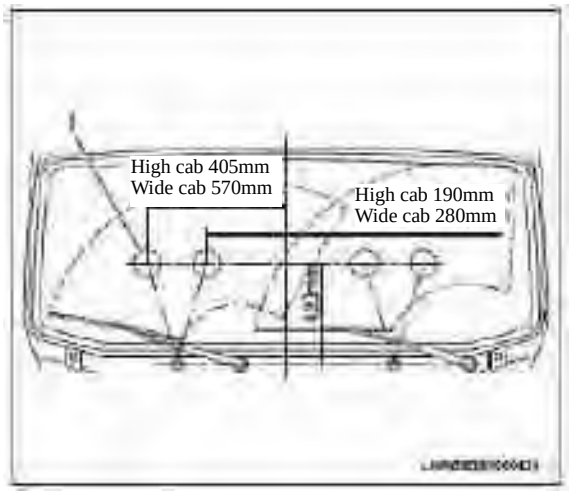
Check the nozzle's installation status for looseness.

4. Connect the battery ground cable.

Adjustment

Adjust the injection direction of the nozzle to make the cleaning solution point to the target position.

Unit: mm



Legend

1. Injection position (high roof cab, widened cab)

Windshield Washer Motor

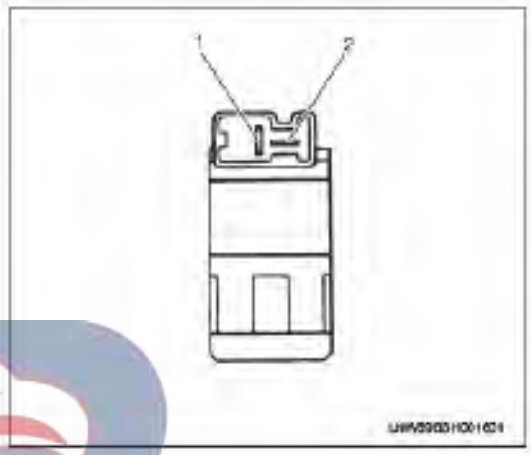
Removal

High roof cab, widened cab

1. Disconnect the battery ground cable.
2. Remove the knee bolster panel. (on the passenger side).
• Refer to "Instrument Panel" in section 9K Exterior & Interior Trim.
3. Remove the side trim panel. (on the passenger side).
• Refer to "Instrument Panel" in section 9K Exterior & Interior Trim.
4. Remove 1 nut and 2 bolts and then remove the cleaning solution tank (2).
• Remove the washer motor connector.
• Disconnect the washer hose.
5. Remove the clip band that fasten the washer motor of the washer tank.
6. Remove the washer motor (1) from the windshield washer tank (2).

Inspection

Inspect whether the cleaning fluid jets out when the battery's positive (+) side is connected to the washer motor's connector terminal (1) and negative (-) side is connected to the terminal (2).
If any abnormality is found in the inspection results, repair it or replace it with a normal one.



Installation

High roof cab, widened cab

1. Assemble the washer motor (1) to the washer tank (2).

• Replace the grommet with a new one and set it to the washer tank side.

• Insert the water supply port of the washer motor into the grommet.

• Fasten the washer motor to the washer tank with a clip band.

2. Fix the cleaning solution tank (2) to the body.

• Insert the washer hose in the washer motor feed water inlet correctly.

• Connect the windshield washer motor connector.

• Fix the cleaning solution tank with 1 nut and 2 bolts.

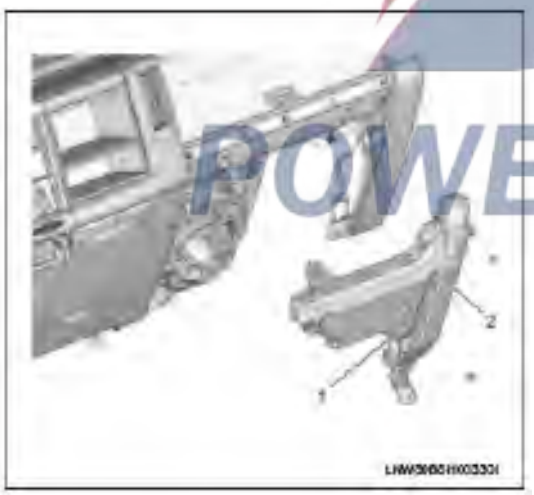
Tightening torque:28N·m {2.8kgf·m}

3. Connect the battery ground cable.

4. Confirm the operation.

5. Assemble the side decorative board and knee cushion in turn (on the passenger side).

• Refer to "Instrument Panel" in section 9K Exterior & Interior Trim.

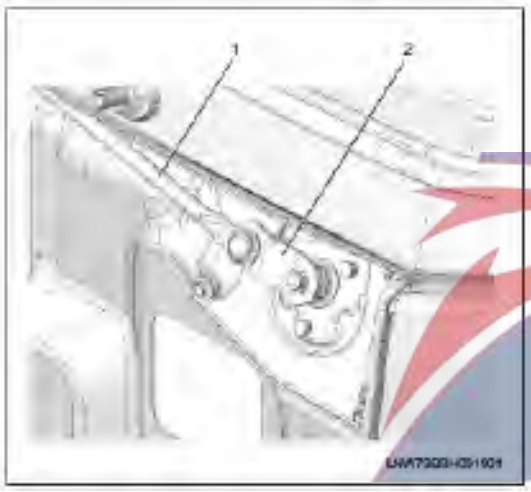


Wiper Link

Removal

High roof cab, widened cab

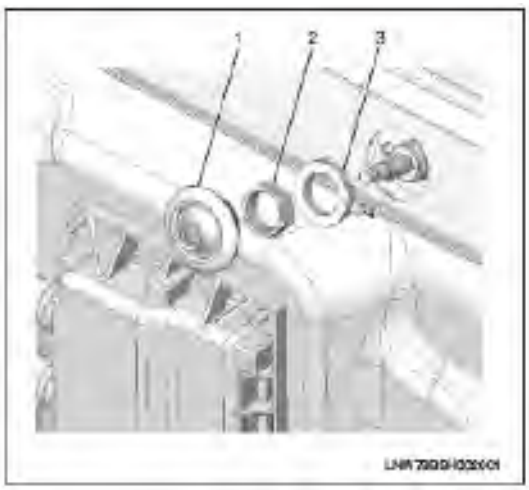
1. Disconnect the battery ground cable.
2. Remove the radiator grid window and front wall panel.
• Refer to "Radiator Grid Grid Window" and "Front Wall Panel" in Chapter 9G "Cab".
3. Remove the wiper arm & blade.
• Refer to "Wiper Arm & Blade" in this section.
4. Remove the coupler at the connection of wiper motor crank arm (2) and wiper link mechanism (1).



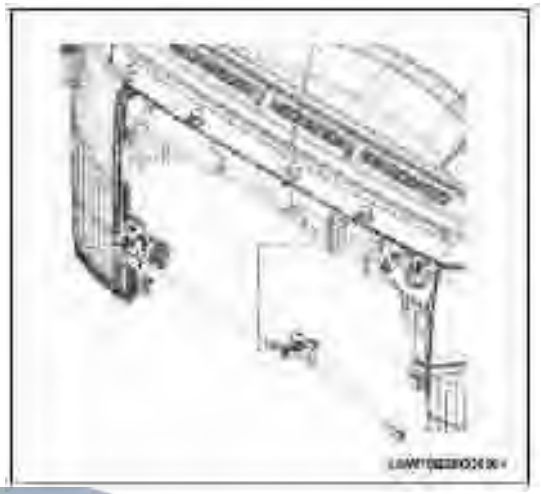
5. After removing the rubber seal cover (1), remove the nut (2) and retainer ring (3) with the long sleeve.

CAUTION:

Remove the nut with the thin type long sleeve of 28mm wide and 55mm long or higher.



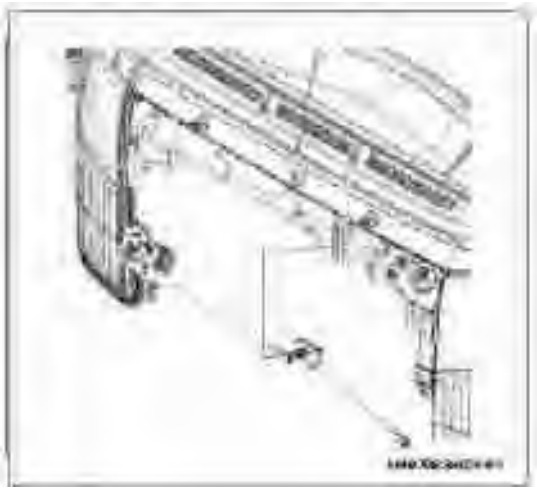
4. Remove the wiper link ASM.



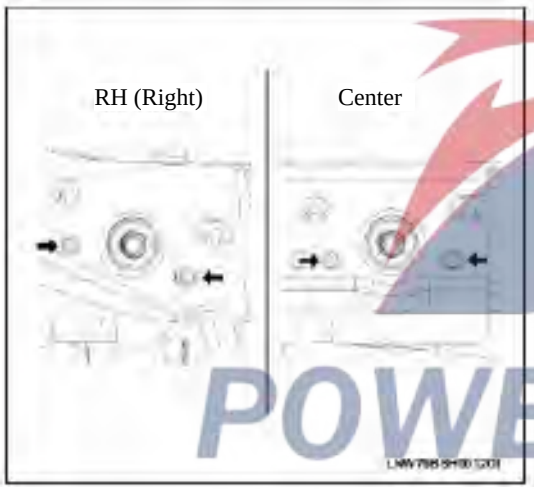
Installation

High roof cab, widened cab

1. Install the wiper link ASM.



• Align the protrusion of the pivot with the positioning hole of the inner panel.

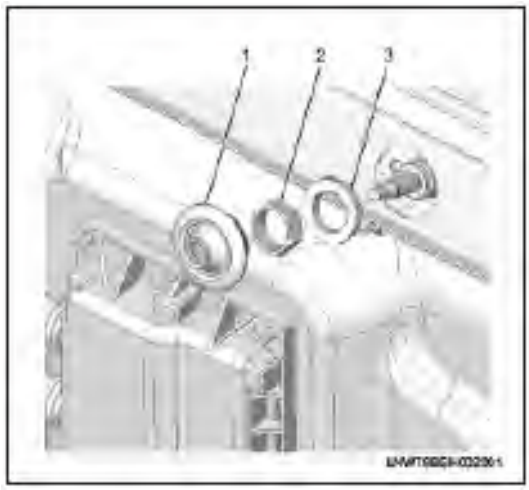


2. Install the retainer ring (3) and tighten the nut (2) with the long sleeve.

Tightening torque:22N·m {2.2kgf·m}

CAUTION:

Tighten the nut with the thin type long sleeve of 28mm wide and 55mm deep or higher.



3. Install the rubber seal cover (1).

4. Install the coupler at the connection of wiper motor crank arm and wiper link.

5. Install the wiper arm & blade.

• Refer to "Wiper Arm & Blade" in this section.

6. Install the radiator grid window and front wall panel.

• Refer to "Radiator Grid Grid Window"and "Front Wall Panel" in Chapter 9G "Cab".

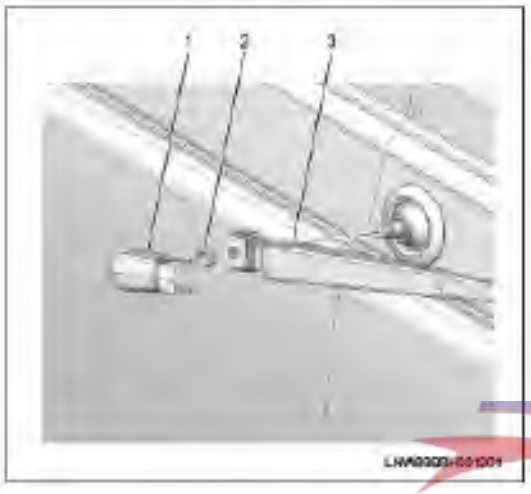
7. Connect the battery ground cable.

8. Confirm the operation.

Wiper Arm & Blade

Removal

1. Disconnect the battery ground cable.
2. Remove the wiper arm cover (1).
3. Remove the nut (2) and remove the wiper arm & blade (3).



Installation

1. Install the wiper arm & blade.

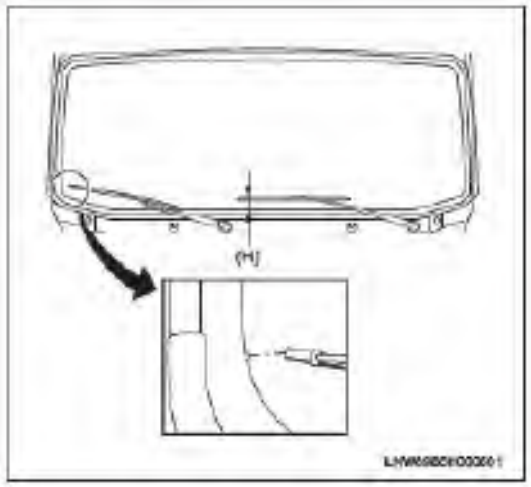
• Confirm that the wiper motor is stopped at the auto-stop position before installing the wiper arm & blade to the shaft.

• Place it so that the distance from the left and right blade tips to the top edge of the windshield molding will be as shown in the diagram.

Align the left side blade of the high cab and the wide cab with the notch of the mounting seat surface of the front windshield glass.

Applicable model	H (mm)
High roof cab, widened cab	70±10

High roof cab, widened cab



2. Tighten the nut.

Tightening torque: 16N·m {1.6kgf·m}

3. Install the wiper arm cover.

Wiper Blade Rubber

Removal

1. Remove the wiper blade (1).

• Push the lock (2) of the wiper blade while pulling the wiper blade in the direction of the arrow.

CAUTION:

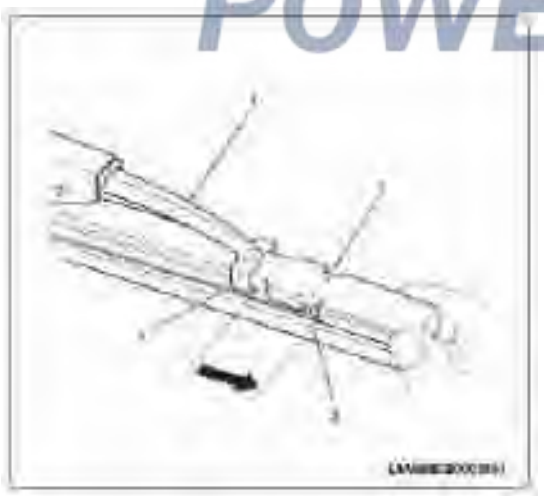
When the wiper blade is removed, cover the tip of the wiper arm with a cloth so that the glass will not be damaged.

2. Remove the wiper blade rubber (2).

• Pull the rubber and remove the groove section (3) of the rubber from the ear (4) of the blade stay (1).

• Pull out the rubber in the direction of the arrow.

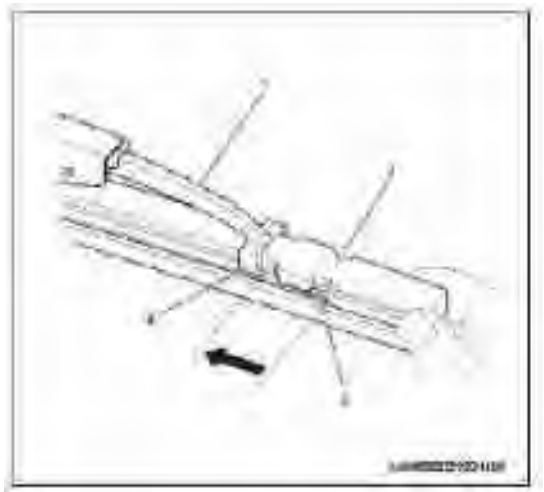
• Remove the 2 support metals.



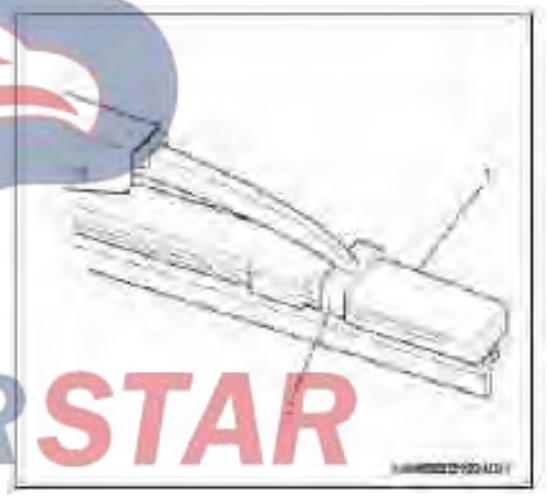
Installation

1. Install the wiper blade rubber (2).

• Assemble the support metal to the new rubber blade, insert the groove (3) at the edge of the rubber into the ear (4) of the blade stay (1) and fasten it by pinching the rubber.



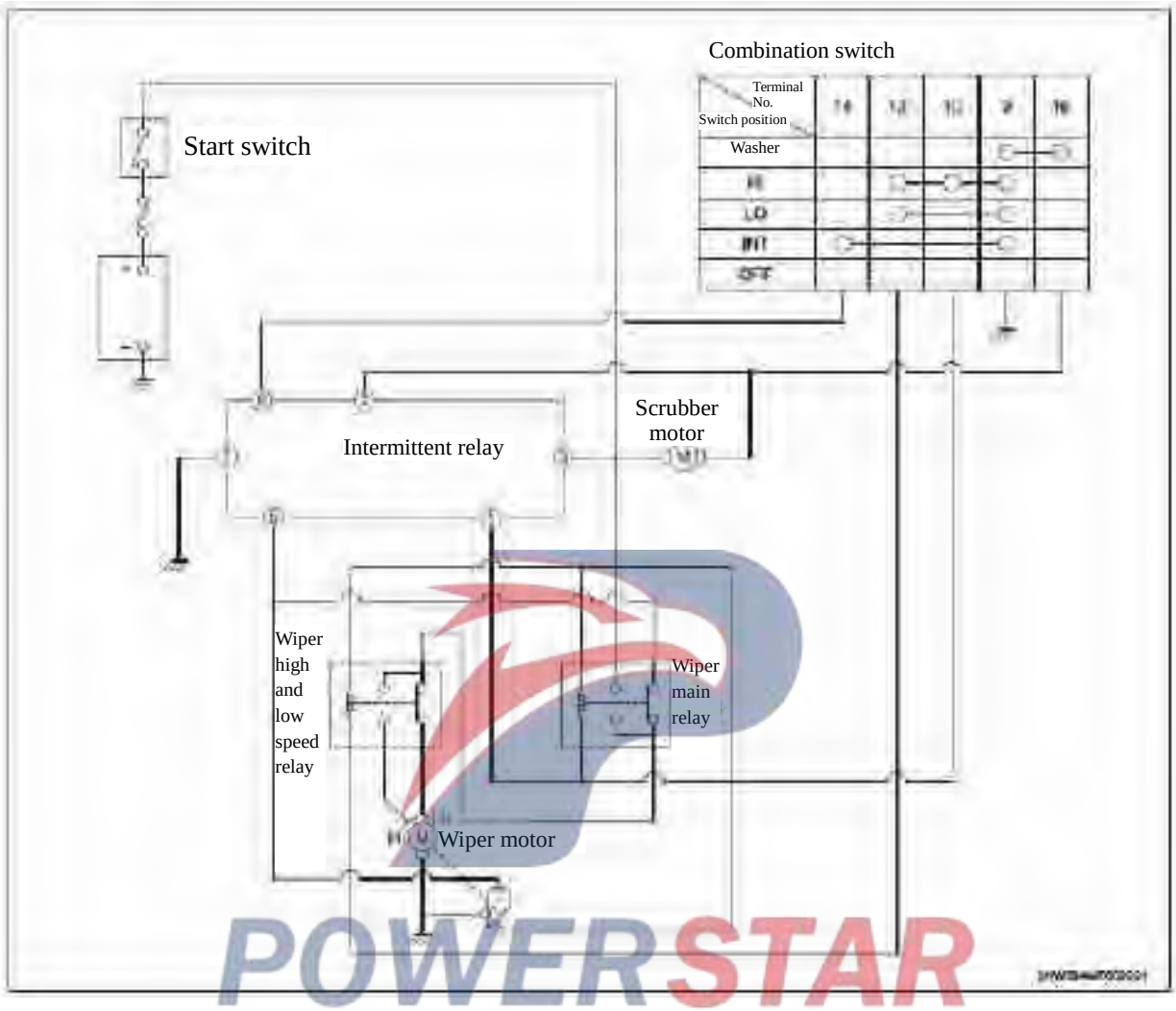
• Check that the ear (2) of the stay firmly bites the rubber (1).



2. Install the wiper blade (1) to the wiper arm (2). Check whether the wiper blade lock engages.

Wiper Intermittent Control Unit

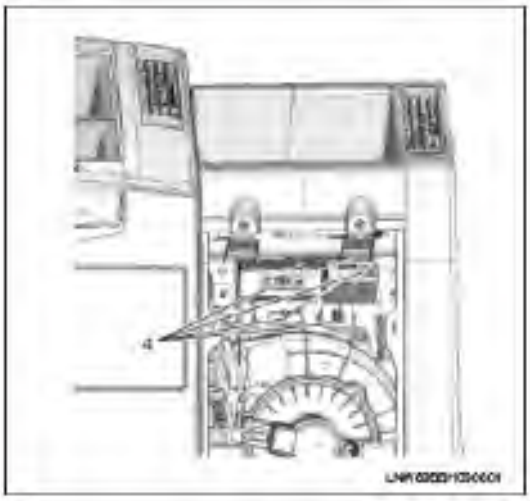
Circuit diagram



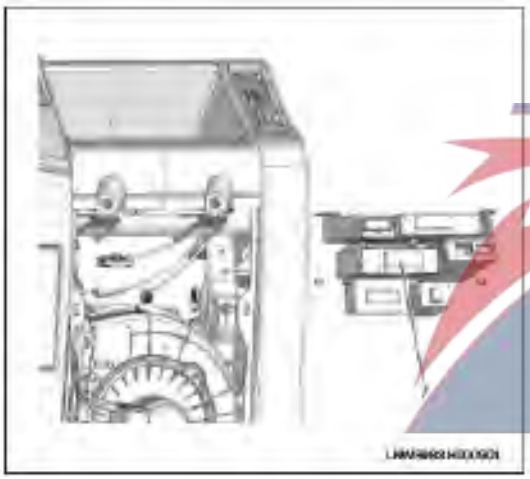
Removal

1. Disconnect the battery ground cable.
2. Remove the knee bolster panel. (on the passenger side).
• Refer to "Instrument Panel" in section 9K Exterior & Interior Trim.
3. Remove the side trim panel. (on the passenger side).
• Refer to "Instrument Panel" in section 9K Exterior & Interior Trim.
4. Remove the windshield washer tank (3). (except NNR, NPR/S, NQR)
• Refer to "Windshield Washer Motor" in section 9B.

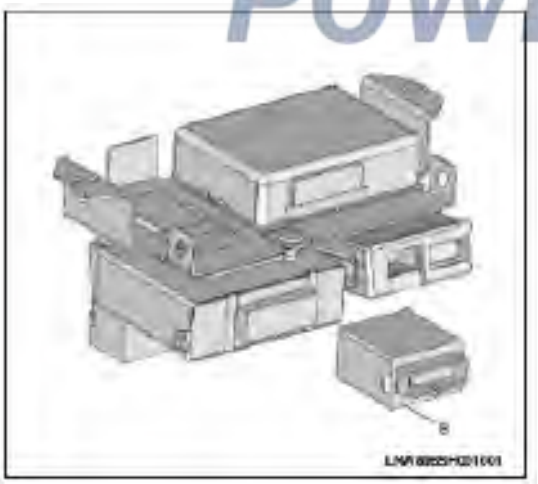
5. Remove the harness joint.
• Remove the intermittent relay and door lock relay harness plug (4).



6. Remove the intermittent relay and door lock relay from the bottom.



7. Remove the intermittent relay (8) from the box.



Installation

Perform installation in the reverse order of the removal

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Section 9C

BODY, CAB and ELECTRICAL

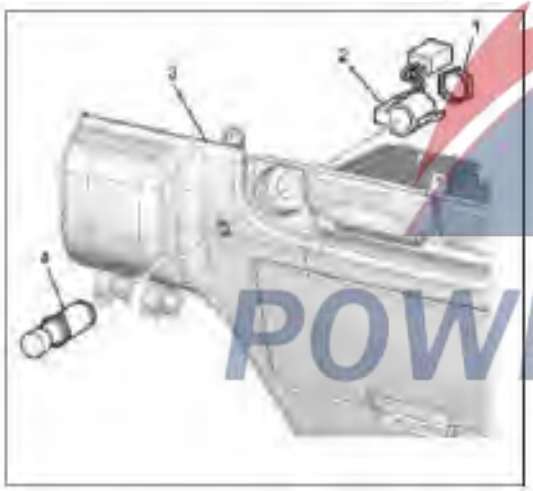
ACCESSORIES

TABLE OF CONTENTS

Cigarette Lighter

Removal

1. Turn OFF the ignition switch.
2. Remove the meter cluster.
• Refer to "Instrument Panel" in Section 9K Interior & Exterior Trims.
3. Remove the knee bolster panel (on the passenger side).
• Refer to "Instrument Panel" in Section 9K Interior & Exterior Trims.
4. Remove the knee bolster panel (on the driver side) (3).
• Refer to "Instrument Panel" in Section 9K Interior & Exterior Trims.
5. Disconnect the harness connector of the cigarette lighter.
6. Remove the nut (1), and remove the cigarette lighter ASM (4) and the outer case (2).



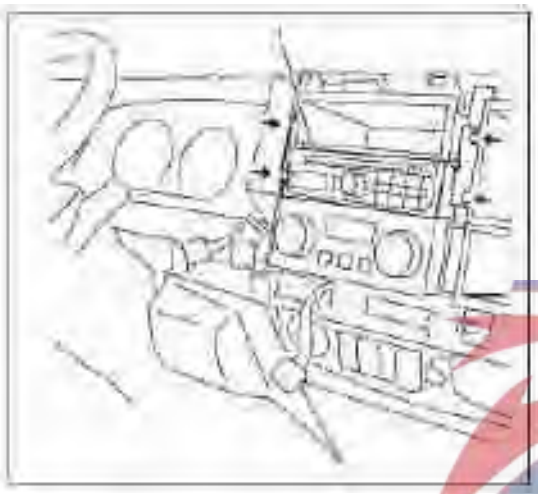
Installation

Perform installation in the reverse order of the removal.

Radio

Removal

1. Disconnect the battery ground cable.
2. Remove the meter cluster.
• Refer to "Instrument Panel" in Section 9K Interior & Exterior Trims.
3. Remove the radio (1).
• Remove 4 radio mounting bolts.
• Disconnect the connector and the feeder plug.



Installation

Perform installation in the reverse order of the removal.

Antenna

Removal

1. Turn OFF the ignition switch.
2. Disconnect the joint connector (5).
3. Remove the bolts (3) at 2 locations on the top and the bottom.
4. Pull out the antenna with antenna feeder (4) from the front pillar (1).

Legend

1. Pull-out direction
2. Antenna base
3. Installation screw
4. Antenna feeder
5. Antenna feeder connecting section
6. To radio

CAUTION:

Tie together the lead wire at the end of the antenna feeder beforehand to make the installation easier.

Inspection

• The metal of (A) section is connected to the pole section (D) at the tip of the antenna through the core wire of the feed line.

• At the metal part of (B) section, the core wire is shielded inside the feed line and ground connected to the body by the screw at the bracket section (C) to prevent noise on the core wire.

• The antenna pole generally has a few sections that expand and contract. If the connecting part of the power receiving metal gets rusted, connectivity will be impaired and so will the sensitivity. Be careful of these sections getting rusted.

Set the circuit tester to resistance X 1 (Ω) range, and measure the following 3 points for the inspection of the antenna.

Between (A) and (B).

• No continuity (the meter gauge needle does not move) → No abnormality.

• Continuity exists → there is a biting in the feeder line. (The core wire is shorted to the ground. The sensitivity will be deteriorated.)

Between (B) and (C).

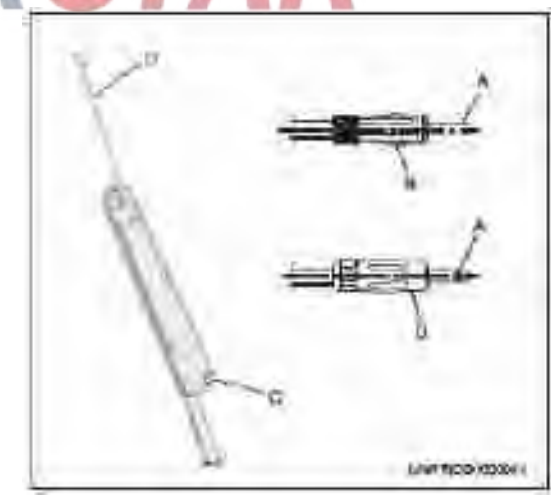
• Continuity exists (the meter indicates 0 (Ω)) → No abnormality.

• No continuity → Open circuits in the shielded part of the core wire or improper body ground at the screw section. (Affected by noise.)

Between (A) and (D).

• Continuity may or may not exist.

→ Some of the antenna feeders and the relay feeders have capacitors in them, so it cannot be inspected by the resistance measurement. Check the sound by temporarily connecting it to a radio.



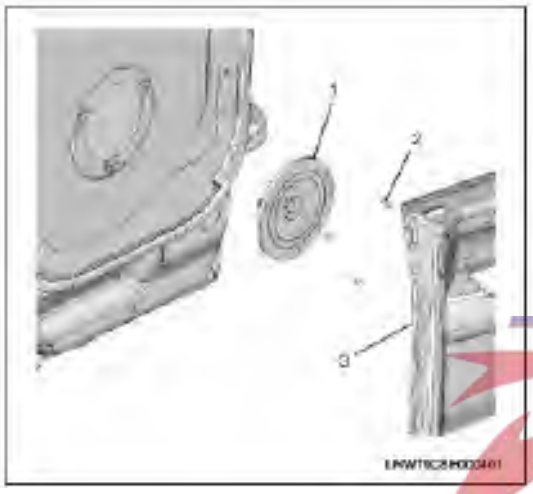
Installation

Perform installation in the reverse order of the removal.

Front Door Speaker

Removal

1. Turn OFF the ignition switch.
2. Remove the door pad (3).
• Refer to "Front Door Decoration Cushion" in Chapter 9K" Interior Trims and Exterior Trims".
3. Remove the 3 screws (2).
4. Remove the speaker (1).



Inspection

Resistance measurement

• Set the circuit tester to resistance X 1 (Ω) range, and connect the probes (red and black) of the tester to the speaker's (+) and (-) terminals respectively.
• When it is normal, it will make a low "ZZZ" sound.
• When it is defective, it will not make a sound.

Distortion or chatter of the sound cannot be inspected here.

Even when it is installed to the vehicle, the same inspection can be performed by disconnecting the connector.

When it does not make a sound, the following failures can be considered.

• The speaker wire is disconnected at the speaker terminals.
• Defective speaker unit.
• The speaker harness at the either side of the vehicle has an open circuit.
• The speaker harness at the vehicle side has a short circuit to the ground (due to biting etc.).

Installation

Perform installation in the reverse order of the removal.

Back Buzzer

Removal

1. Remove the back buzzer (2).

• Take down the reverse buzzer mounting bolt (3) and nut (2).

Inspection

Apply the battery voltage between the harness terminals of the buzzer, and check that the buzzer sounds.

If any abnormality is found in the inspection results, repair it or replace it with a normal one.

Installation

Perform installation in the reverse order of the removal.

Horn

Removal

1. Turn OFF the ignition switch.
2. Remove the front bumper.
• Refer to "Front Bumper" in Section 9G Cab.
3. Remove the horn LOW (1) or HIGH (2).

Inspection

1. Check that the horn sounds when the connector terminal (1) is connected to the (+) power supply, the installation bracket section (2) is connected to (-), and the battery voltage is applied.
If any abnormality is found in the inspection results, repair it or replace it with a normal one.

Installation

Perform installation in the reverse order of the removal.

Horn Switch

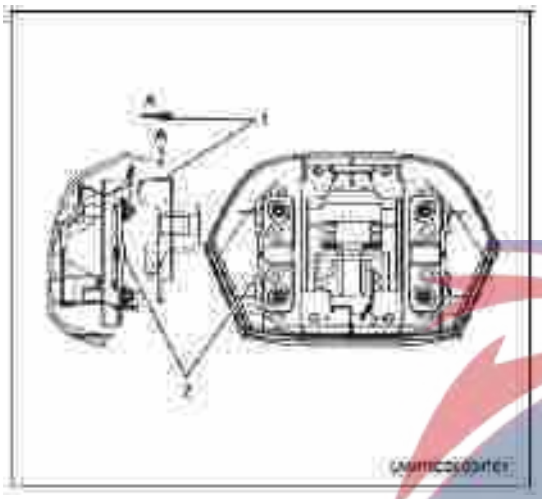
Removal

1. Disconnect the battery ground cable.
2. Disconnect the horn button.

Inspection

Inspect the continuity between the horn switch's connector (1) terminal and the plate (2) that contacts the steering wheel.

If any abnormality is found in the inspection results, repair it or replace it with a normal one.



Installation

Perform installation in the reverse order of the removal.

• Tighten the steering shaft nut at the specified torque.

Tightening torque: 49N·m{5kgf·m}

Starter Switch

Removal

Refer to "Starter Switch" in section 1E Engine Electrical.

Installation

Refer to "Starter Switch" in section 1E Engine Electrical.

Cigarette Lighter Illumination Light Bulb

Removal

1. Turn OFF the key switch.
2. Remove the cigarette lighter ASM.
• Refer to "Cigarette Lighter" in this section.
3. Remove the harness connector (1) and remove the bulb socket (2) from the panel.
4. Remove the bulb from the bulb socket (2).

Installation

Install it in the reverse order of the removal and confirm that the light turns on.