
Fuel (WD615)

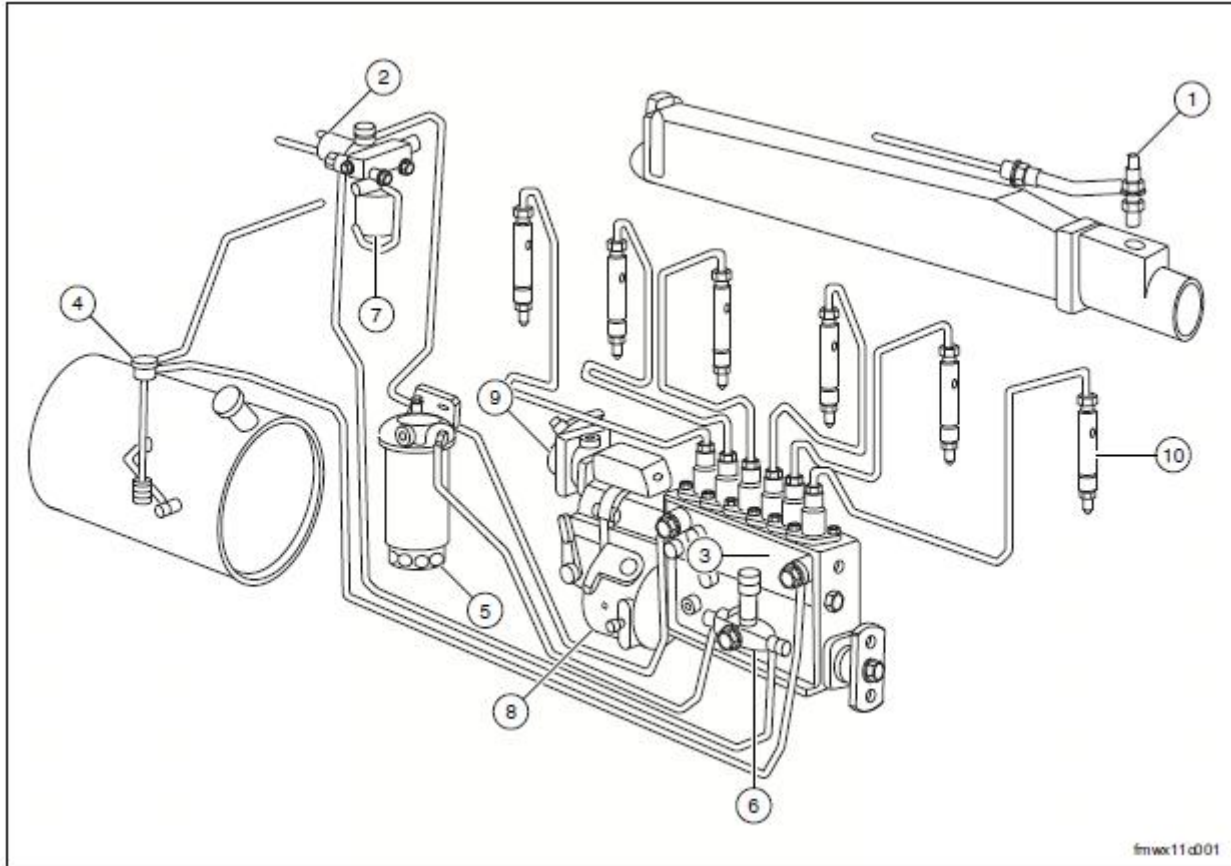
Fuel System	11C-3
General.....	11C-3
Precautions.....	11C-8
Part Drawing.....	11C-9
Testing & Adjustment.....	11C-11
Fuel Tank	11C-26
Replacement.....	11C-26
Cleaning	11C-29
Oil-water Separator	11C-30
Replacement.....	11C-30
Fuel Fine Filter	11C-32
Replacement.....	11C-32
Fuel Injection Pump	11C-34
Replacement.....	11C-34
Fuel Injector	11C-39
Overhaul.....	11C-39
Fuel Injector Sleeve	11C-41
Replacement.....	11C-41

11C

Fuel System

General

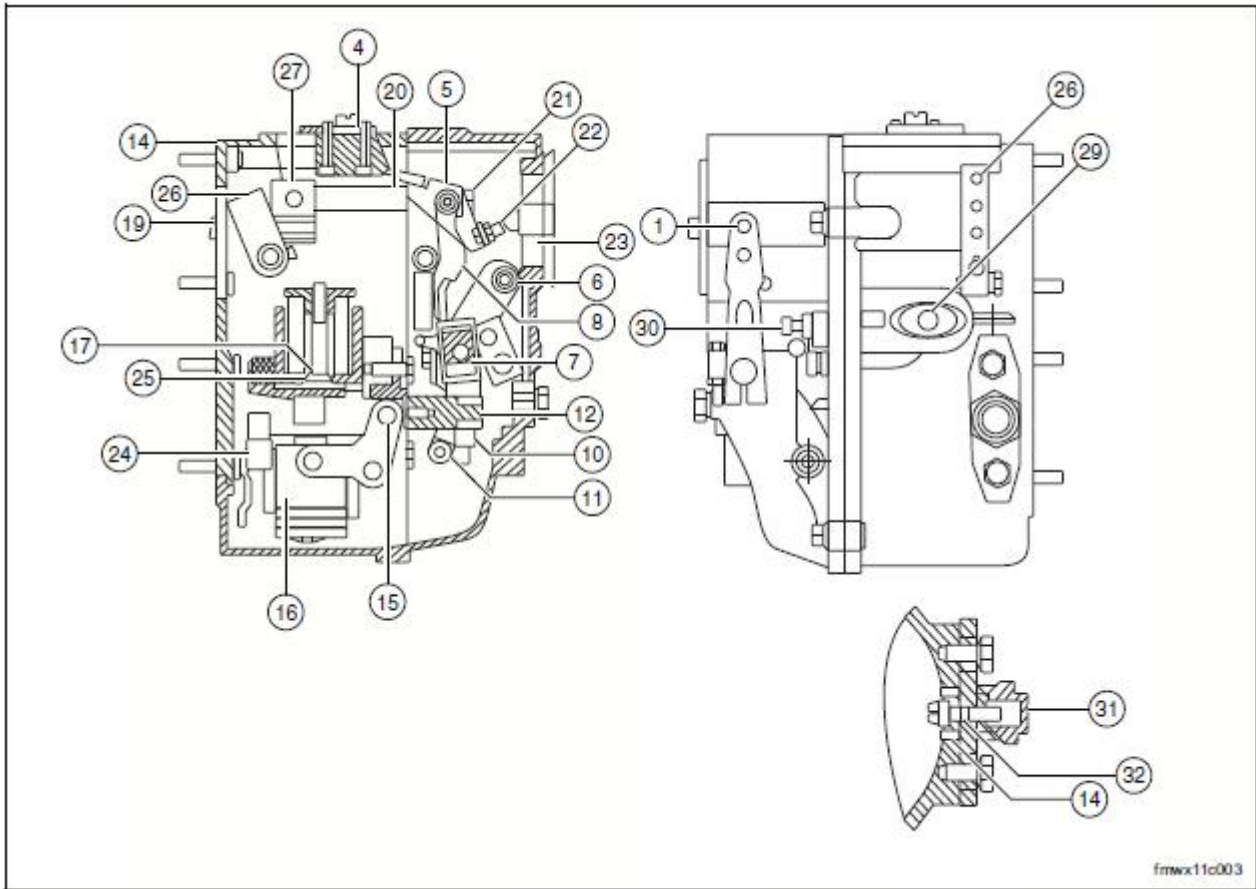
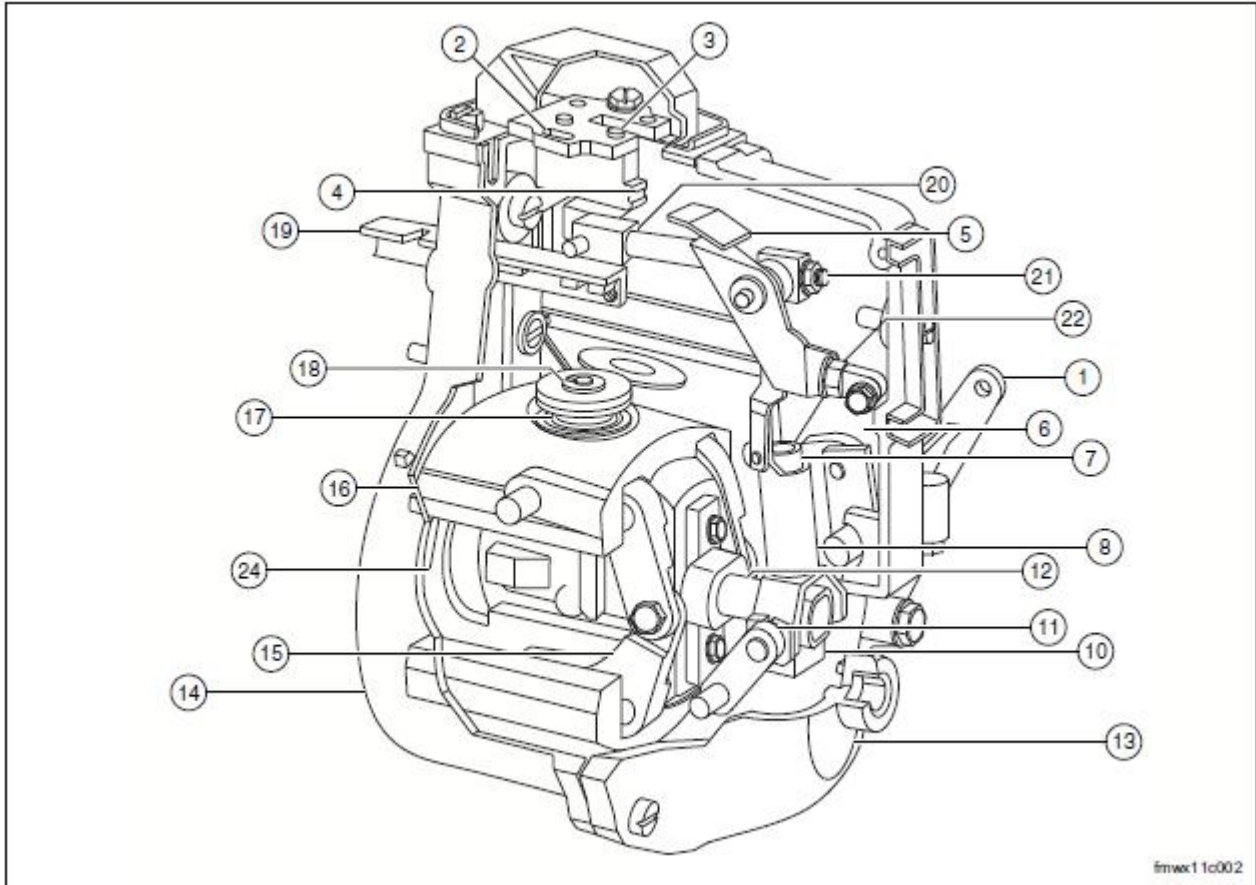
WD615 series diesel engine adopts a typical plunger in-line pump type fuel injection system. The key position of the fuel injection system is a P type intensified fuel injection pump with an RQV or RQV-K type full-range governor and a rear smoke limiter.



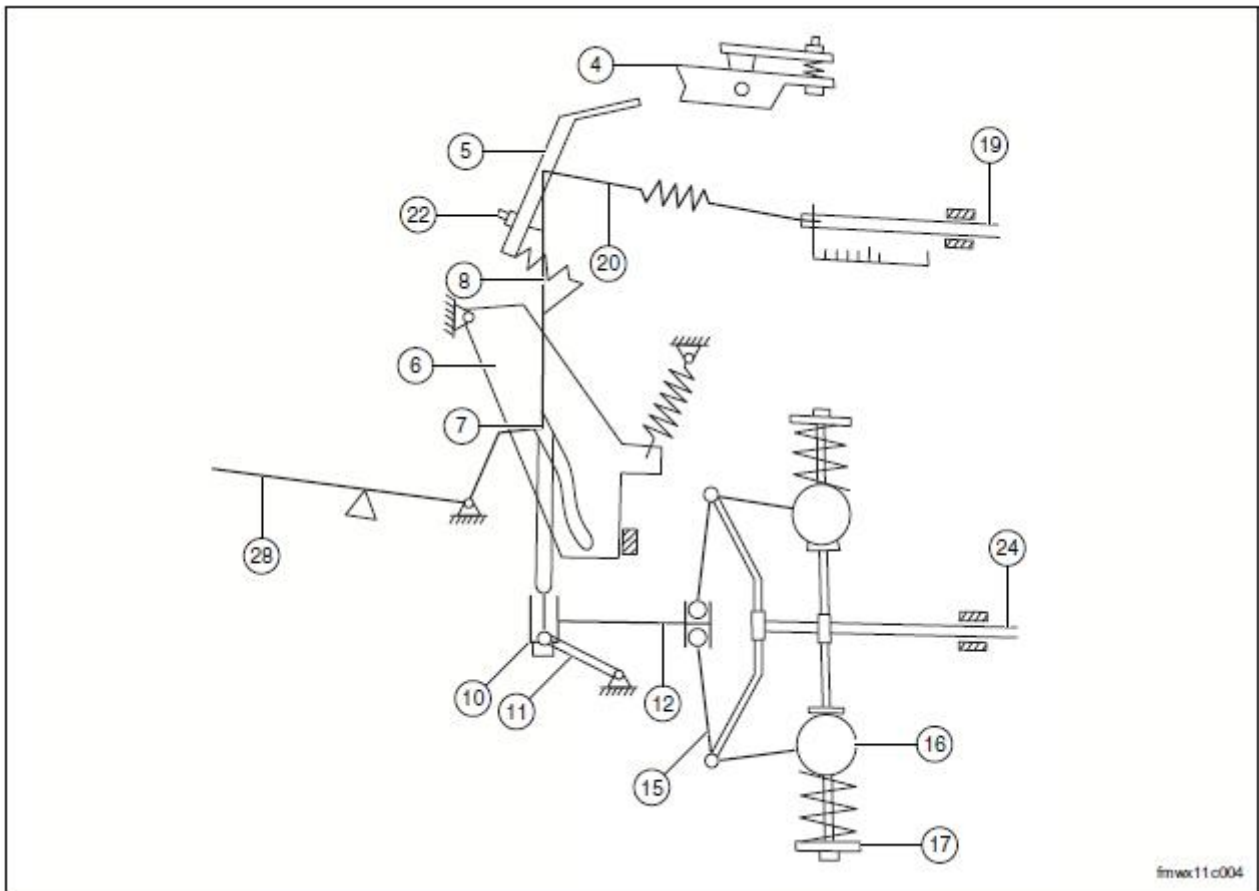
1	Flame Glow Plug
2	Preheating Solenoid Valve
3	P-Type Fuel Injection Pump
4	Fuel Tank
5	Fuel Filter

6	Fuel Feed Pump
7	Preheating Filter
8	Governor
9	RR Smoke Limiter
10	Fuel Injector

Bosch P type pump is a typical intensified pump which is mainly characterized in that the pump body is a tank type fully-enclosed structure. The plunger matching part, outlet valve and valve base are all installed in a flange sleeve, the sleeve is suspended in the pump body, and there is no side window on the pump body, thereby enhancing the rigidity of the pump body. The pump meets the requirement of high-power diesel engine for large fuel injection quantity and high fuel injection pressure, and enables its structure to be particularly compact. For the fine control mode, the pump adopts a link slot, a mechanism meshed with a ball on the fuel quantity control sleeve, to realize reliable fuel quantity control and sensitive speed governing. The pump carries out fuel quantity adjustment by rotating the suspended sleeve, and performs fuel injection timing adjustment by adding or decreasing gaskets to the suspended sleeve, thereby making the adjustment convenient and reliable. The fuel injection pump cam and tappet mechanism is subject to forced lubrication. In the forced lubrication process, oil is supplied through a pipeline connected to the pump body from the secondary oil line of the engine, and then the oil returns to the engine oil pan through the oil return pipe installed at a certain height of the pump body.



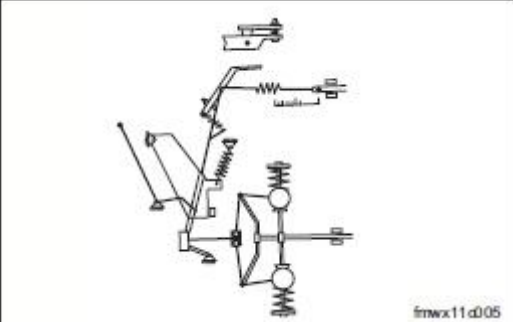
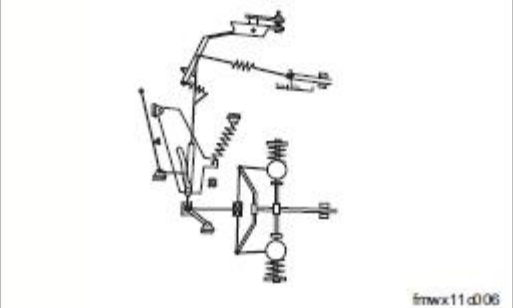
11C



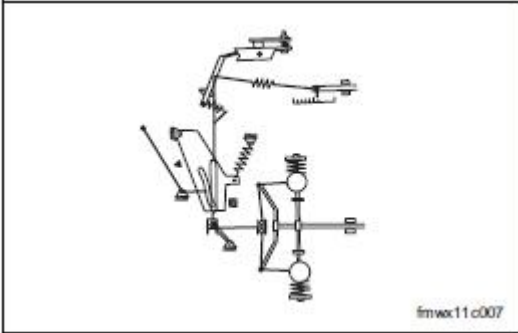
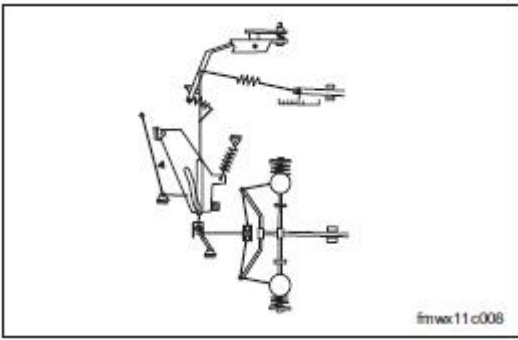
1	Control Lever (Throttle Lever)	17	Speed Governing Spring
2	Fixing Slot Hole of Correction Sliding Block	18	Adjusting Screw of Speed Governing Spring
3	Position Slot of Limiting Block of Smoke Limiter	19	Fuel Supply Gear Rack
4	Correction Sliding Block	20	Connecting Rod
5	Tongue-Shaped Swinging Vane	21	Fuel Quantity Adjusting Screw
6	Curved Guide Plate	22	Tab Adjusting Screw
7	Sliding Block	23	Inspection Window
8	Floating Lever	24	Fuel Injection Pump Camshaft
9	Sliding Block of Shifting Bar	25	Adjusting Gasket
10	Swinging Arm	26	Fuel Cut-Off Lever
11	Shifting Bar	27	Connecting Plate
12	RR Housing of Governor	28	Control Lever (Throttle Lever)
13	FR Cover of Governor	29	Adjusting Window of Speed Governing Spring
14	Angular Lever	30	Rated Speed Limiting Screw
15	Fly Weight	31	Timing Inspection Hole Cover
16	Speed Governing Spring	32	Timing Pin

The lower end of floating lever of governor is supported by the upper end of swinging arm, and it can vertically move along the longitudinal groove of shift sliding block. Therefore, the position of the lower end of floating lever is determined by shifting bar. When the engine stops operating, the fly weight goes closed under the action of the speed governing spring, the angular lever pushes the shifting bar to the leftmost position in the drawing, at the same time, the floating lever is in the lowest position, and the correction tongue-shaped swinging vane is also in the lowest position to be separated from the correction sliding block. If the engine is started at this time, the control lever (throttle lever) of governor will be accordingly pushed to the high-speed limiting screw position, and simultaneously, the floating lever pushes the fuel supply gear rack to the maximum fuel supply position to realize the start enrichment effect.

After the engine is started, the fly weight will immediately overcome the idle spring force and go open. The fly weight pulls the shifting bar to the right side in the drawing through the angular lever, thus the swinging arm is simultaneously pulled to swing clockwise to cause the lower end of floating lever to move upwards, the whole floating lever synchronously move upwards to drive the tongue-shaped swinging vane for correcting fuel supply to move upwards with it and initiate a contact with the correction sliding block, and then, the travel of the fuel supply gear rack regularly changes with the rotation speed in accordance with the end-face shape of the correction sliding block, so that the fuel supply also regularly changes, thereby meeting the requirements of the engine for external characteristics.

 <p style="text-align: right; font-size: small;">fmwx11 d05</p>	<p>Parking and start conditions</p>
 <p style="text-align: right; font-size: small;">fmwx11 d06</p>	<p>Post-start condition</p>

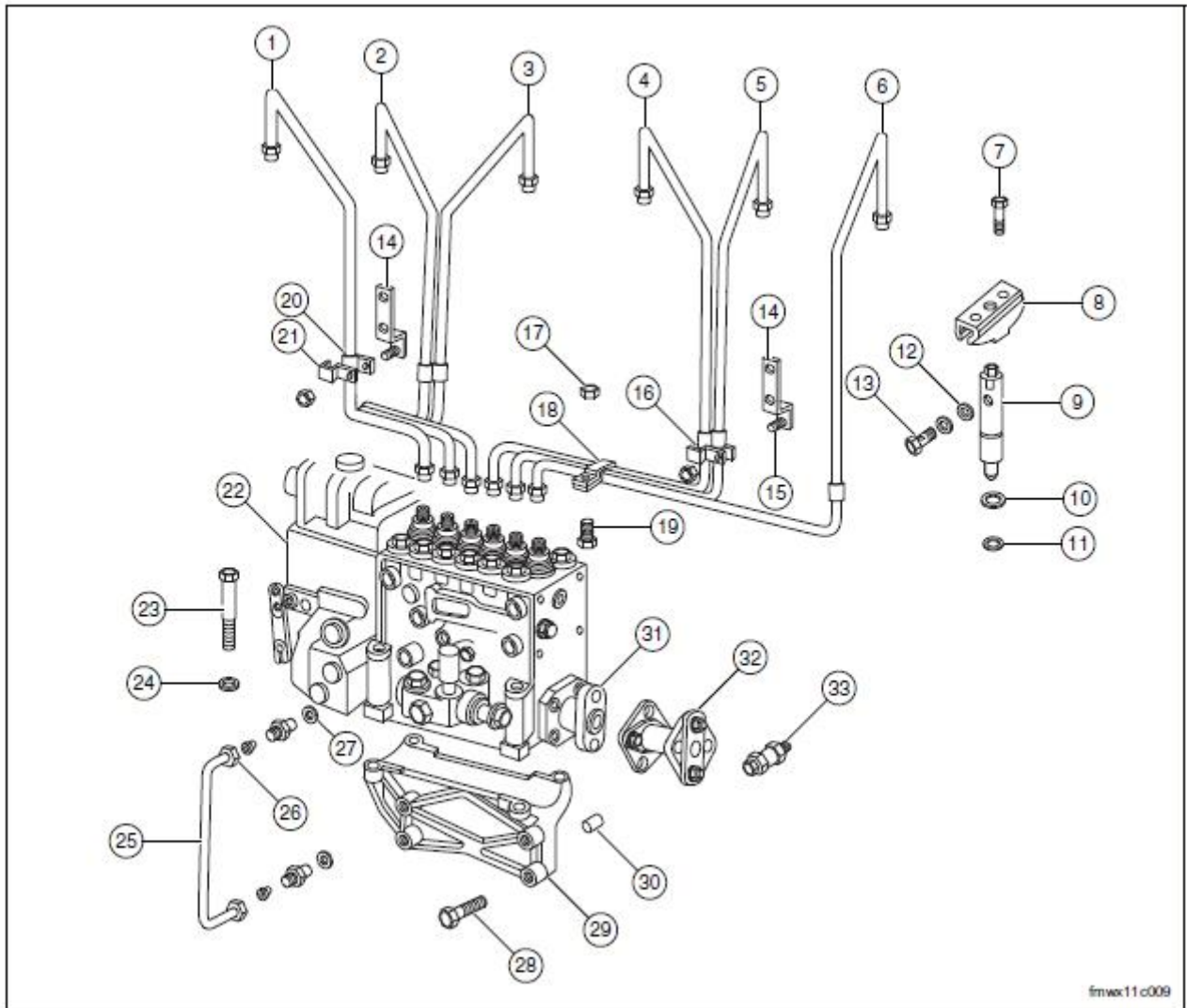
11C

	<p>Intermediate rotation speed condition</p>
	<p>High speed condition</p>

Precautions

1. Before checking and maintaining the fuel system, disconnect the battery negative cable.
2. Because the fuel is an inflammable substance, when the fuel system is operated, keep cigarettes, naked flame, indicating lamps, arc equipment and switches away from the working area, and provide ventilating equipment in the working area to avoid occurrence of personal injury or even death.
3. In order to avoid personal injury, never loosen any fuel pipe joint when the engine runs.
4. Keep the fuel away from rubber or leather components.
5. Manufacture the diesel fuel injection equipment according to very accurate tolerance and clearance. Thus, when the fuel system is operated, absolutely clean working environment is very important. Use special plugs to close all openings.
6. Before disconnecting the fuel system pipeline, check and confirm whether dirt or impurity exists around the fuel pipe joint or not, and clean the dirt or impurity if any, otherwise the dirt or impurity may damage the fuel system or the engine.
7. Do not forcibly bend or twist the fuel system pipeline.
8. Before connecting each pipeline of the fuel system, ensure that each fuel pipe joint is not damaged, and if the fuel pipe joint is damaged or has cracks, replace the fuel pipe assembly and ensure that no dirt exists on the surface of the fuel pipe connecting surface.

Part Drawing

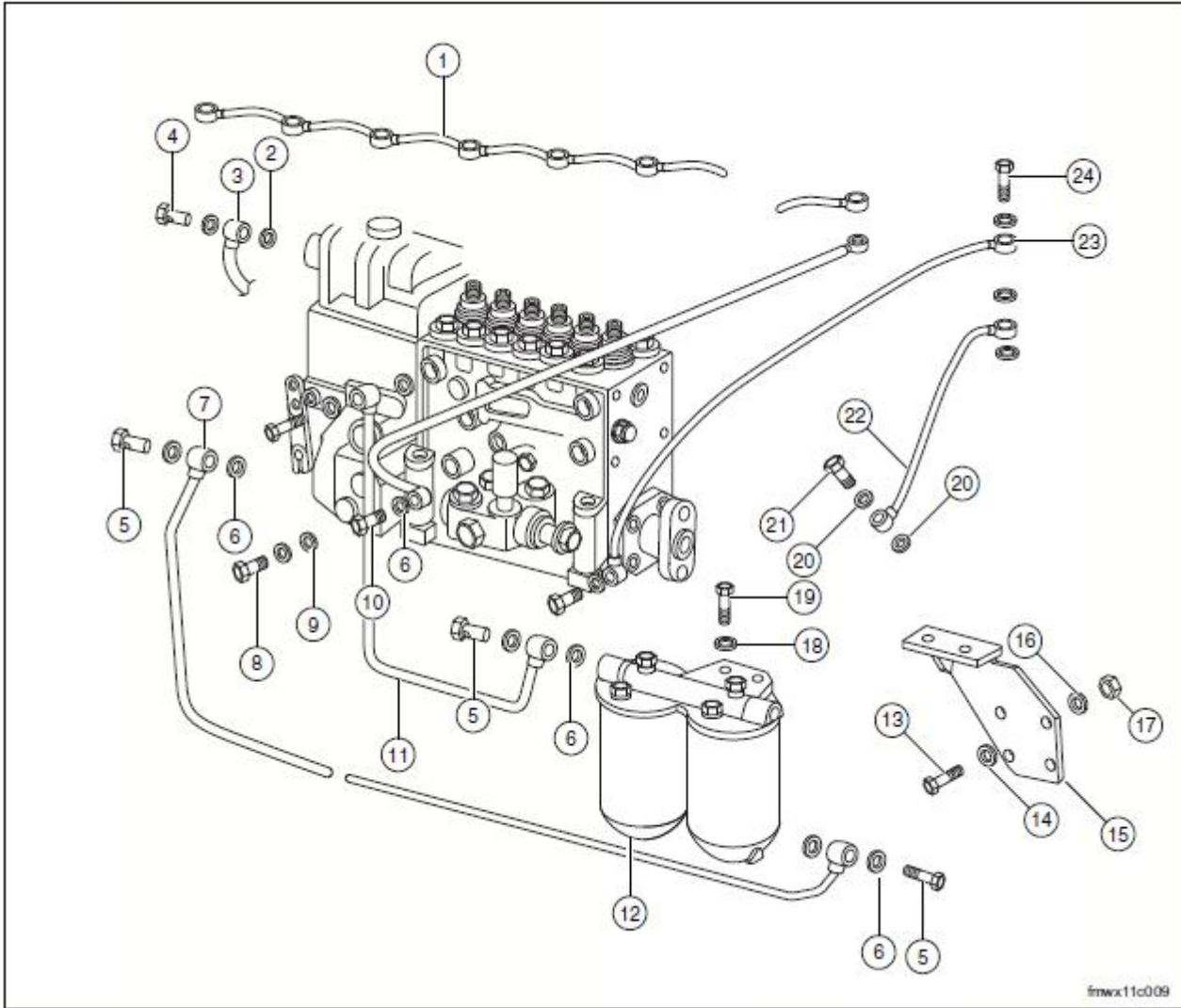


1	6th High-Pressure Oil Pipe Assembly	18	Pipe Clamp
2	5th High-Pressure Oil Pipe Assembly	19	Hex Head Bolt
3	4th High-Pressure Oil Pipe Assembly	20	Lower Plate of Pipe Clamp
4	3rd High-Pressure Oil Pipe Assembly	21	Upper Plate of Pipe Clamp
5	2nd High-Pressure Oil Pipe Assembly	22	Fuel Injection Pump with Full-Range K Type Governor
6	1st High-Pressure Oil Pipe Assembly	23	Hex Socket Cap Head Screw
7	Hex Head Bolt	24	Flat Washer
8	Fastening Pressure Plate	25	Lubricating Oil Return Pipe Assembly
9	Fuel Injector Assembly	26	Lubricating Oil Return Pipe Assembly
10	Sealing Washer	27	Pipe Joint
11	Washer	28	Sealing Washer
12	Sealing Washer	29	Hex Head Bolt

11C

13	Hollow Bolt
14	Support Bracket
15	Hex Head Bolt
16	Pipe Clamp
17	Style 1 Hex Nut

30	Fuel Injection Pump Bracket
31	Cylindrical Pin
32	Flange
33	One-Way Valve



1	Oil Return Pipe Assembly
2	Sealing Washer
3	Air Pipe Assembly
4	Hollow Bolt
5	Hollow Bolt
6	Sealing Washer
7	Fuel Pipe
8	Hollow Bolt

18	Hex Head Bolt
19	Wave Elastic Washer
20	Diesel Filter Bracket Assembly
21	Washer
22	Style 2 All-Metal Hex Locking Nut
23	Wave Elastic Washer
24	Hex Head Bolt
25	Sealing Washer

1	Sealing Washer
2	Hollow Bolt
3	Fuel Pipe
4	Fuel Pipe Filter Assembly

18	Hollow Bolt
19	Lubricating Oil Inlet Pipe Assembly
20	Lubricating Oil Inlet Pipe Assembly
21	Hollow Bolt

Testing & Adjustment

Exhaust of Fuel System

When replacing the coarse filter, reassembling the fuel delivery pipe, or emptying the fuel tank, air will enter the fuel system. If air enters the fuel system, the flow of fuel to the engine will be hindered and can not flow smoothly. To prevent this from happening, the fuel system shall be exhausted.

The oil return pipe on fuel injection pump can do some exhaust work, i.e. when replacing the fuel filter or the low-pressure oil pipe, the small amount of air in the fuel filter or the low-pressure oil pipe will be discharged by themselves if the replacement is carried out in accordance with the requirements. The oil return pipe of fuel injection pump is positioned at the top of the fuel injection pump, and the small amount of oil bubbles can be discharged through the oil return pipe.

For the fuel injection pump without timing reticle

1. Drive the diesel fuel into the fuel injection pump body with a manual fuel pump, and discharge air in the pump body.
2. Install the observation tube on a fuel outlet joint of the cylinder fuel supply branch pump.
3. Control the throttle at the maximum fuel feed position with hand.
4. Rotate the flywheel to the fuel injection lead angle specified for 1st compression BTDC.
5. Rotate the driving shaft of the fuel injection pump slowly and intermittently in the normal rotation direction of the fuel injection pump, and tighten the driving flange fastening bolt after the diesel in the observation tube starts to rise.

For the fuel injection pump with timing reticle

1. Drive the diesel fuel into the fuel injection pump body with a manual fuel pump, and discharge air in the pump body.
2. Install the observation tube on a fuel outlet joint of the cylinder fuel supply branch pump.
3. Control the throttle at the maximum fuel feed position with hand.
4. Rotate the driving shaft of the fuel injection pump slowly and intermittently in the normal rotation direction of the fuel injection pump, and tighten the driving flange fastening bolt after the diesel in the observation tube starts to rise.

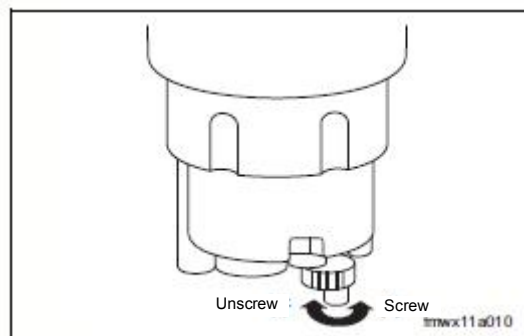
Drain of Water Collector

When the water collector is full, drain the collected water.

Warning:

Because of a risk of icing, the water shall be discharged before icing.

1. Stop the engine

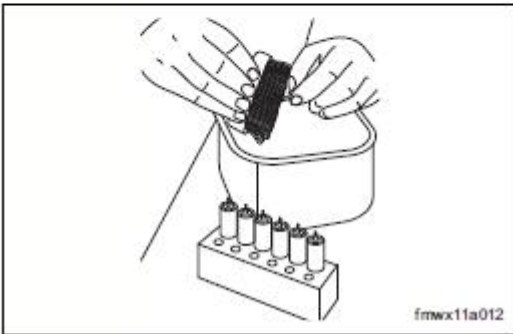


2. Dismantle the drain screw
 - (a). Unscrew the drain screw at the bottom of the water collector to empty water.

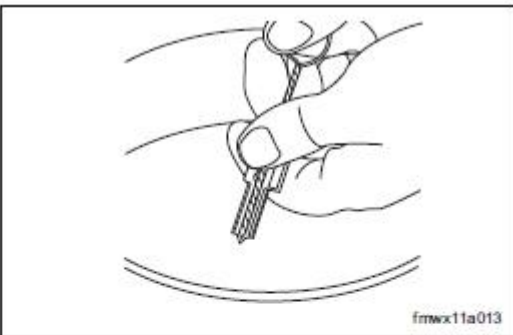
3. Install the drain screw Check and adjustment of fuel injector



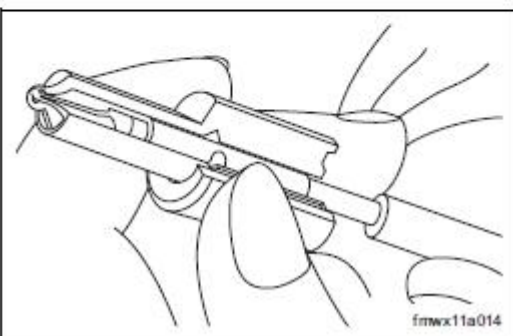
1. Carefully clean the exterior of the fuel injector before disassembling inspection to prevent dirt and impurities from scratching any fine matching surface of the fuel injector in the disassembling and assembling process



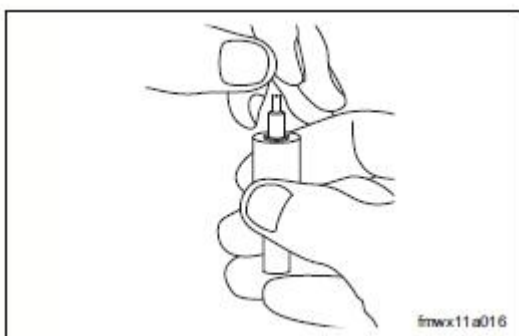
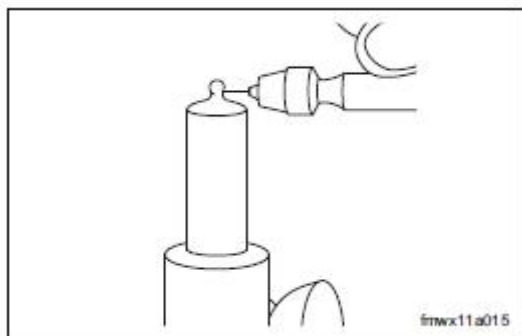
2. Draw the fuel injector needle valve out of the fuel injector, clean the head of the needle valve in kerosene with a brush, and clear carbon deposits at the head of the fuel injector needle valve with a wood piece



3. Clean the needle valve hole in the fuel injector valve base with a special brush



4. Scrape the head of the needle valve hole of the injector valve base with a special scraper to remove carbon deposits, wherein the shank of the special scraper must be in a precision fit with the needle valve hole. Avoid scratching the needle valve hole matching surface in the scraping process.



5. Clean the injection hole of the fuel injector with a clean special cleaning steel needle

- (a). Generally, the diameter of the steel needle is 0.02~0.03 mm smaller than the diameter of the injection hole. In order not to damage the injection hole, firstly clean the injection hole with a thin steel needle, and then gradually increase the diameter of the steel needle.
- (b). During hole cleaning, the steel needle shall be rolled back and forth after being inserted in the injection hole. After cleaning, further clean it with clean kerosene, and blow off dirt in the needle valve hole with compressed air.

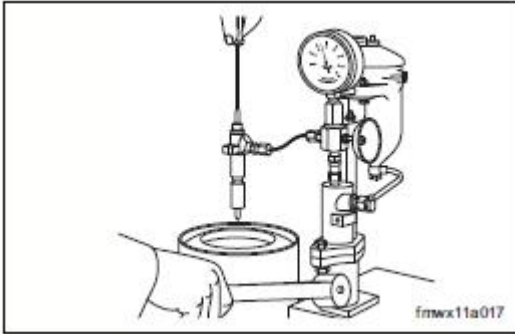
6. Sliding test of fuel injector matching part

- (a). Lubricate the fuel injector in clean light diesel fuel, and roll needle valve to and fro. Erect the fuel injector, pull the needle valve up by 1/3, then release it and check whether the needle valve can smoothly slide into the valve base by the self weight. If the needle valve can not smoothly slide into the valve base, drip a little high-grade low-viscosity lubricating oil in the needle valve and the fuel injector valve hole, then insert the needle valve into the fuel injector hole and roll it to and fro to meet the requirements for slide.
- (b). Check the sealing condition between the needle valve and the conical surface of fuel injection valve base. If wear is not so serious, spread precise alumina abrasive on the conical surface of needle valve, abrade it with the fuel injection valve base, and clean them with clean kerosene after the abrasion is qualified. In the abrading process, do not spread the abrasive on the guide surface for precision fit between needle valve rod and oil injection.
- (c). Check whether the contact surface between the fuel injector seat and the fuel injector body is damaged, whether the fuel injector spring rusts and cracks, whether the needle valve and the fuel injector needle valve hole form eccentric wear, and whether the contact surface between the needle valve and the ejector pin as well as the contact surface between the spring and the ejector pin is seriously worn, and replace them in case of serious damage or wear. Check the wearing condition of the fuel injector locating pin.

Caution:

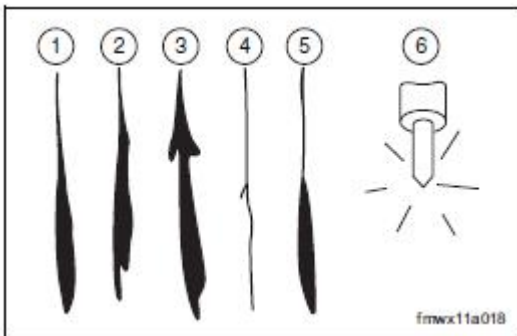
When reassembling the fuel injector assembly, the fuel injection nozzle cap must be tightened in accordance with the specified torque, otherwise bad atomization of fuel injection will be caused.

When replacing with a new fuel injection nozzle matching part, the new fuel injection nozzle matching part shall be cleaned in clean kerosene, and the needle valve shall be rolled to and fro in the needle valve hole of fuel injection nozzle, so that oil enclosed in the fuel injection nozzle can be completely discharged.



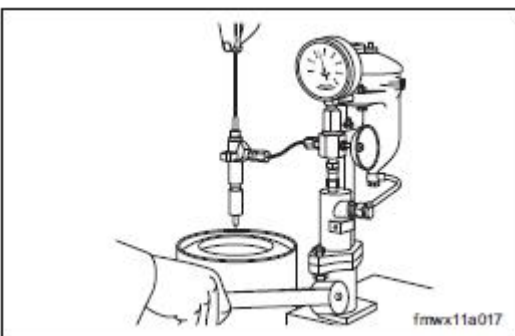
7. Check and adjust fuel injection pressure

- (a). Install the fuel injector on the fuel injector testing stand.
- (b). Press the testing stand handle with hand several times to remove air in the fuel pipe and the fuel injector, and rinse the interior of the fuel injector again.
- (c). Then press the testing stand handle with hand, and observe whether the pressure is 30 MPa when oil injection starts.
- (d). Adjust the fuel injection pressure by using spring gaskets of different thicknesses.
- (e). After the fuel injection pressure is adjusted, tighten the fuel injector locking nut. After the nut is tightened, check the oil injection opening pressure again, and readjust the pressure if it does not meet the standard.



8. Check of atomization state

- (a). On the fuel injector testing stand, repeatedly press the testing stand handle with the maximum stroke at a rate of 40~80 times per min, and observe the atomization state of fuel injection.
 - Fuel injection shall be in the form of uniform mist, the fuel mist shall not contain large fuel particles, and mist beams ejected from all the injection holes shall be even and equal in length, but shall not form continuous fuel columns or be uneven in the concentration.
 - The fuel beams shown as ① through ⑤ do no meet the standard.
 - Obvious noises shall be heard when the injection starts or terminates. After injection, the fuel injector head shall not have fuel dripping or fuel drop suspension phenomenon.



9. Check seal of fuel injector

- (a). Press the fuel injector testing stand handle with hand to slowly increase the pressure to 28~29 MPa (1~2 MPa lower than the fuel injection opening pressure), and hold on for some time (generally, 2~3 S). If there is no oil leakage or obvious pressure reduction, it indicates that the seal is satisfactory.

RQV-K Type Governor

The RQV-K type governor has the following adjustable positions:

1. Fuel quantity adjusting screw

- There is a fuel quantity adjusting screw between the upper end of the floating lever and the connecting rod. The length of the connecting rod can be changed by adjusting the screw. If the connecting rod is lengthened by adjusting the screw, the fuel feed quantity of the fuel injection pump will be integrally increased, and on the contrary, if the connecting rod is shortened by adjusting the screw, the fuel feed quantity of the fuel injection pump will be integrally decreased. Thus, the fuel feed quantity under each working condition can be integrally increased or decreased by adjusting the fuel quantity adjusting screw.
- For some RQV-K type governors, the correction sliding block is fixed on the governor housing by a slot hole, that is to say, the sliding block can be moved forward or backwards for a certain distance relative to the governor housing by unscrewing the fixing screw of correction sliding block. As a result of the movement of the sliding block, the correction tongue-shaped swinging vane abuts on the correction sliding block, the initial position of the floating lever is changed, and the initial position of the fuel feed gear rack is accordingly changed, thereby also achieving the effect of adjusting the overall fuel feed. However, in such adjustment, the tab adjusting screw must be simultaneously adjusted to enable the position for starting correction to meet the original requirements. Because some experience is required for such adjustment, it is not recommended to change the overall fuel feed by changing the position of the correction sliding block, and it is preferred to keep the position of the correction sliding block before leaving factory unchanged.

2. Tab adjusting screw

- The tab adjusting screw is used for adjusting the relative position between the tab and the correction sliding block so as to change the whole fuel feed rule, wherein the change of the fuel feed rule means the change of features of engine. Thus, the screw shall be generally kept in the state before leaving factory, and it needs to be checked and adjusted only if the correction sliding block is reassembled.

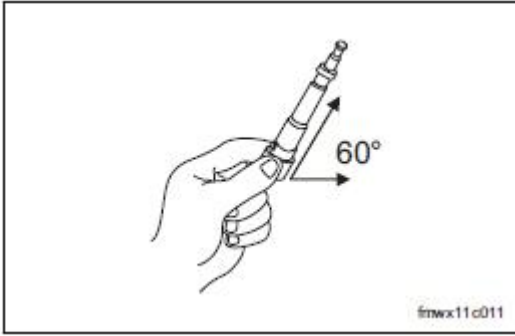
3. Adjusting screw of speed governing spring

- The adjusting screw of speed governing spring is used for adjusting the pretightening force of the speed governing spring. The idle speed and the rated speed can be changed by adjusting the screw.
- In order to match with the charging features of the exhaust-driven turbo charger, the fuel injection pump is provided with a smoke limiter. Because the charging features of the charger, the charging effect of the charger will be sharply enhanced with the increase of rotation speed when the engine is at a speed higher than the intermediate rotation speed. However, when the engine is at a speed lower than the intermediate rotation speed, the charging effect will not be so apparent. Therefore, if the fuel feed can meet the requirements of the engine for maximum torque and rated power when the engine is at an intermediate-low rotation speed, black smoke will be produced as a result of insufficient fuel burning caused by insufficient air intake.

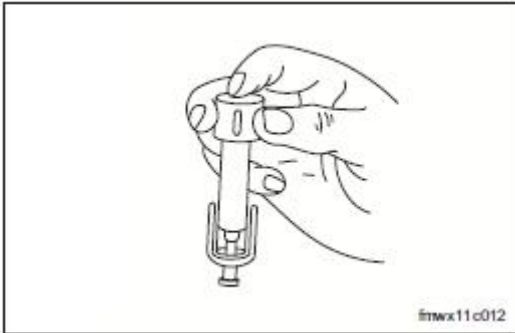
Check and adjustment of fuel injection pump

1. Check of plunger matching part

- (a). The plunger and the plunger bushing are a pair of precise matching parts, and fit clearance between the both is 0.001~0.003 mm. Wear of the precise matching part will postpone the time for starting fuel injection and terminate fuel feed in advance, at the same time, the fuel feed will be decreased, and some faults of diesel engine will be caused, such as power reduction, difficult starting, unsteady idle speed and easy flameout. Beside, the uneven wear of branch pump plungers will cause uneven fuel quantity of each cylinder, and therefore, the wearing condition of the plunger matching part has a direct influence on the power performance of the diesel engine.
- (b). Visual check.
 - Clean the plunger bushing in clean kerosene or light diesel fuel, and observe the matching positions between the plunger and the plunger bushing, especially the guiding part at the upper part of the plunger. If severe change of color on the surface of plunger (wearing position is white), peeling corrosion of spiral flute, straight flute and flute edge of plunger, cracking and deformation of plunger or cracking of plunger bushing, etc. is detected, the plunger matching parts must be replaced in pairs.



- (c). Sliding test of plunger.
- Tilt the plunger matching part that has been immersed in kerosene by 60° , and pull the plunger out of the plunger bushing by $2/3$. After the plunger is released, it shall be capable of completely sliding into the plunger bushing by the self weight. Rotate the plunger to different positions to repeatedly perform the above test. If the plunger is blocked in some positions, spread polishing paste on the plunger, and carry out in-pair abrasion by inserting the plunger into the plunger bushing. In the abrading process, the plunger shall be moved to and fro in the vertical direction and be simultaneously rolled.



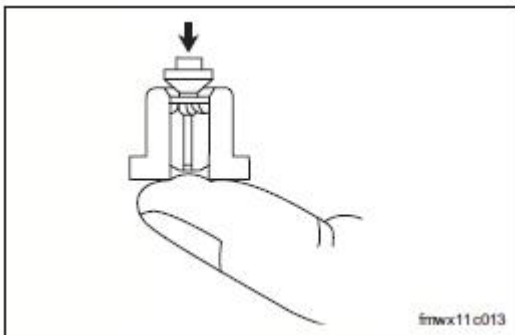
- (d). Leakage test of plunger matching part.
- Cover the upper end of the plunger bushing with forefinger, make the plunger stay at the intermediate or maximum fuel feed position, and pull the plunger down (do not pull the plunger over the fuel inlet hole position of the plunger bushing). At this time, if the forefinger feels a pull of vacuum, and the plunger can still return back to the original position when it is released, it indicates that seal of the plunger is qualified.

2. Check of outlet valve

The outlet valve has two pairs of sealing contact surfaces, namely the precision fit and the seal between the pressure relief ring belt and the valve base hole. When the outlet valve is seriously worn, the pressure relief ring belt or the conical-surface seal will fail, and after burning and fuel dripping phenomena will be accordingly caused, so that burning will be deteriorated to generate white smoke, the power of engine will be reduced, and engine knock will also be caused in serious cases. Thus, check must be carried out on the seal of the outlet valve.

(a). Visual check.

- Clean the outlet valve matching part in clean kerosene or light diesel fuel, and observe the conical surface of outlet valve with naked eyes or a magnifier. If serious wear of pressure relief ring belt (i.e. there are clear wide or deep while wear marks on the conical surface of outlet valve), or obvious longitudinal scratching marks on the pressure relief ring belt are detected, replacement shall be carried out. At the same time, the outlet valve and the valve base shall be observed for crack and corrosion.



(b). Leakage test.

- Slide the outlet valve completely into the valve base, and cover the bottom hole of the outlet valve base with mouth. The lip will be sucked in case of no air leakage, otherwise the outlet valve shall be abraded. When abrading the conical surface of the outlet valve, only spread the abrasive paste on the conical surface of the outlet valve with a thin rod, and do not spread it on the pressure relief ring belt. For the leakage test of the pressure relief ring belt, cover middle finger on the bottom hole of the outlet valve, and press down the outlet valve core. When the outlet valve core is released, the valve core will automatically bounce up, which indicates that the seal of the pressure relief ring belt is qualified, otherwise it shall be replaced with a new one.

(c). Leakage test of outlet valve can also be carried out on a fuel injector tester.

- Pull the outlet valve and the valve base into the special joint (the seat of the joint is provided with an ejector valve base of which the diameter is smaller than that of the outlet valve core,

but the pressure relief ring belt is still in the sealing position in the valve base hole). Connect the joint to the fuel injector tester, unscrew the adjusting screw to slide the valve core completely into the valve base, operate the tester to raise the pressure to 25 MPa, and observe the time for the pressure to drop to 10 MPa, wherein the time shall not be less than 60 s. Use the adjusting screw to lift the outlet valve core by 0.3~0.5 mm, raise the pressure to 25 MPa in a similar way, and observe the time for the pressure to drop to 10 MPa, wherein the time shall not be less than 2 s. In the leakage test, attention shall be paid to the seal of the tester itself, and check shall be firstly carried out on the seal ring of the tester before test.

3. Check of other parts of fuel injection pump

- (a). Check of plunger flange and control sleeve
 - Check the clearance between the plunger flange and the fuel quantity control sleeve groove, wherein the clearance is 0.02~0.08 mm generally. If the clearance is beyond 0.12 mm, replace the control sleeve.
- (b). Check of tappet assembly.
 - Observe the tappet and the roller for wearing and corrosion conditions. Measure the total radial clearance between the tappet roller and the roller bush as well as the total radial clearance between the roller bush and the roller shaft. If the clearance is beyond 0.2 mm, replace the tappet assembly. Check the clearance between the tappet and the pump body, replace the tappet or the pump body.
- (c). Check camshaft.
 - Observe the cam face for wearing, corrosion, cracking and peeling conditions, and carry out stone abrasion or replacement in accordance with the damage. If the wear of cam exceeds 0.2 mm, bending of camshaft is more than 0.15 mm, or height of cam goes beyond the service limit, replace the camshaft.
- (d). Check the plunger spring for crack, corrosion and surface peeling.
 - Check whether the free length of spring meets the standard, wherein the maximum deviation of the center of spring shall not exceed 1.5 mm.
- (e). Check of fuel quantity control mechanism.
 - The travel clearance between the fuel quantity control link (or gear rack) and the fuel quantity control sleeve shall not be more than 0.25~0.30 mm, otherwise the replacement shall be carried out.
- (f). Check resistance of fuel quantity control lever (or gear rack).
 - Measure the sliding resistance of the fuel quantity control lever (or gear rack) in the total travel on the fuel injection pump testing stand, wherein the sliding resistance shall not be more than the standard value.

Pump Speed (r/min)	Sliding Resistance (N)
0	1.3
600	0.5
1000	0.7

Adjustment of fuel injection pump on testing stand

The fuel injection pump is adjusted on the testing stand to enable the fuel injection pump to meet its technical standard, and such adjustment is the basis for the normal work of the fuel injection system.

The adjustment of the fuel injection pump on the testing stand must be carried out under specified conditions. It is preferred to adjust the fuel injection pump by completely simulating working conditions of a diesel engine. However, it is quite difficult to simulate the actual working conditions of each fuel injection system on the testing stand due to great varieties and different types of diesel engine. In order to realize the standardization of test and adjustment and consistency of test data, factors which will have an influence on the test result in the test and adjustment of fuel injection pump of each type are subject to relevant unified specifications which are the test conditions of the fuel injection pump.

Generally, the test conditions for the adjustment of fuel injection pump testing stand contain the following items:

Type of fuel injection nozzle and fuel injector. Under certain circumstances, type of fuel injection nozzle, size and quantity of injection holes and opening pressure of fuel injector have a direct influence on the fuel injection quantity each. Generally, the bigger the diameter of injection hole is and the more the number of injection holes is, the more the fuel injection quantity is. Similarly, the lower the opening pressure of fuel injector is, the less the fuel injection quantity is. In order to eliminate influences of above factors of the fuel injection nozzle and the fuel injector on the test of the fuel injection pump to be tested, the type of the fuel injection nozzle and the fuel injector must be subject to unified specifications during test and adjustment. In order to ensure the test and adjustment accuracy, it is specified that check and adjustment shall be carried out on the fuel injection pressure of a fuel injector which is used on the testing stand for some time, and it is also specified that the fuel injection nozzle must be replaced with a new one after being used several times.

Fuel injection opening pressure. The fuel injection opening pressure of the fuel injector has a strong influence on the fuel injection quantity of the fuel injection pump. Thus, the fuel injection opening pressure standard must be specified in the test. It is to be noted that the fuel injection pressure specified in test conditions does not always conform to the fuel injection pressure required in the actual work.

Fuel supply pressure. The low fuel supply pressure of the fuel injection pump also has a strong influence on the fuel injection quantity of the fuel injection pump. Generally, the higher the fuel supply pressure is, the more the fuel feed of the fuel injection pump is. Thus, the fuel supply pressure must be specified in the test.

Fuel for test and temperature of fuel. The fuel for test and the temperature of fuel determine the viscosity of the test fuel. The viscosity of the test fuel has an indispensable influence on the fuel feed of the fuel injection pump. Generally, the higher the viscosity of the test fuel is, the more the fuel feed of the fuel injection pump is. Thus, the designation and the temperature of test fuel are strictly specified in the test conditions.

Dimensions of high-pressure fuel pipe. The high-pressure fuel pipe for connecting the fuel injection pump with the fuel injector has a certain length, inner diameter and wall thickness, and will generate fuel pipe effect in the impulse type work, that is to say, the fuel pipe will generate elastic expansion in the fuel feed process, and at the same time, the fuel injection of the fuel injector lags behind the fuel feed start time of the fuel injection pump. Thus, high-pressure fuel pipes of different dimensions will have different influences on the fuel injection quantity, and therefore, the dimensions of the high-pressure fuel pipe must be specified in the test.

In order to ensure the accuracy of the test, the test and adjustment of the fuel injection pump must be carried out in accordance with the standard specified in the test conditions. If specified requirements can not be met or test conditions are not available for some items, the test result must be corrected in the test and adjustment.

1. Preparation before test and adjustment

(a). Install the fuel injection pump on the testing stand and connect it with the testing stand driving shaft. Because the smoke limiter is arranged on the fuel injection pump in the turbo-charged diesel engine, the fuel injection pump testing stand must be provided with an air supply device which can regulate the air pressure, so that a specified air pressure value can be input to the smoke limiter when the fuel injection pump is adjusted and tested. Fill clean lubricating oil into the fuel injection pump.

2. Check seal and opening pressure of each cylinder

(a). Raise the pressure of the testing stand pressure regulator valve to 2~3 MPa, and check the outlet valve base of each cylinder for oil leakage. If the leakage is detected, remove the outlet valve and clean it in clean diesel fuel, or replace the outlet valve.

- Connect the high-pressure fuel pipes of each cylinder of the fuel injection pump, sequentially open each overflow pipe of the fuel injector, and check whether the opening pressure of the outlet valve is in the standard range of 1.4~1.8 MPa. If the outlet valve goes beyond the range, it can be adjusted by adding or subtracting the outlet valve gasket. For one fuel injection pump, the difference between the opening pressures of the outlet valves of the cylinders can not be greater than 0.2 MPa.

3. Check and adjustment of "zero" position of fuel feed gear rack

(a). In order to ensure the consistency between the test and adjustment and the specification, a fuel feed gear rack travel meter (or gear rack travel ruler) is generally installed at the front end of the pump in the test. Before adjusting the pump, the "zero" position of the fuel feed gear rack shall be firstly calibrated.

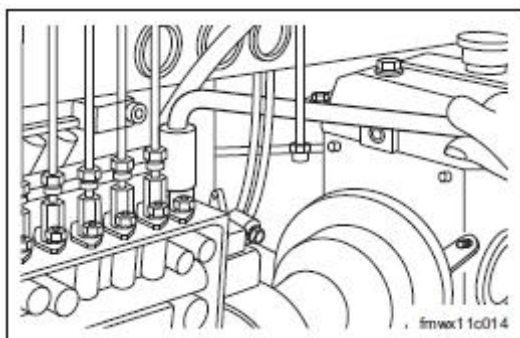
- The "zero" position of the gear rack is preferred to be in the maximum torque speed range of the pump speed (about half the rated-power pump speed). Pull the throttle control lever of governor to the highest limiting screw position, pull the fuel cut-off handle to the limit position, adjust the gear rack travel meter to the "zero" position, and tighten the locking nut.

Caution:

Do not forcibly pull the fuel cut-off lever to the fuel cut-off limit position, which easily causes damage to the governor.

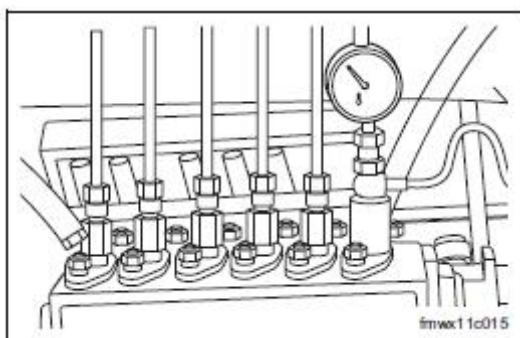
Adjustment of fuel feed timing

1. In order to ensure the accuracy of fuel injection range (fuel injection rule) so that the diesel engine works under the optimum condition, the plunger lift travel, when the branch pumps of the fuel injection pump start to feed fuel (the plunger starts to seal the fuel inlet), are constant, the check and adjustment of the fuel feed timing of the fuel injection pump is the check and adjustment of plunger pretravel. In other words, the proper adjustment of the plunger pretravel ensures that the work area of the cam is within the designed shape of the pump, thereby ensuring that the fuel injection rate is within the design range and ensuring that the fuel feed timing of the fuel injection is accurate. As for the injection timing of the complete machine, as introduced above, must be carried out on the complete machine
2. The plunger pretravel must be measured with a special measurer. There are two kinds of measurers for plunger pretravel: measurer for directly measuring the lift travel of plunger; measurer for measuring lift travel of tappet.

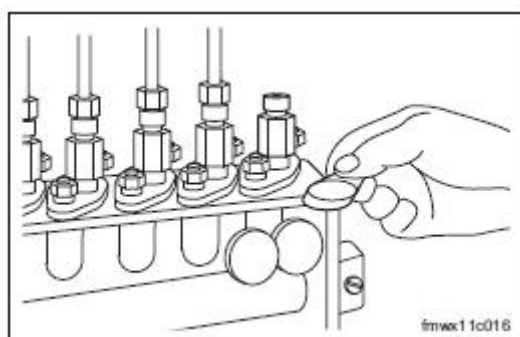


3. Measure pretravel of plunger by overflow method

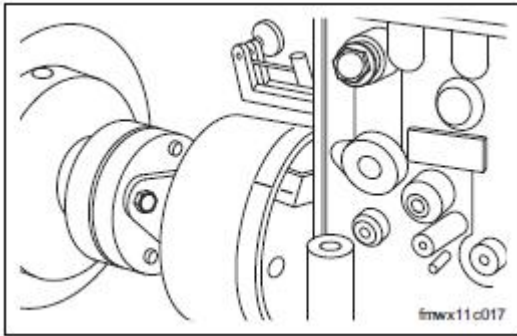
- (a). Dismantle the high-pressure fuel pipe joint of the 1st cylinder branch pump, take out the delivery valve assembly and gasket, and install the measurer on the oil outlet pipe joint of the branch pump. The measurer is composed of a dial indicator and an overflow pipe which are installed on the oil outlet pipe sleeve.



- (b). After installation, make the measuring head of the dial indicator to directly contact the top end of the plunger. Start the low pressure fuel feed duct of the test bed, rotate the camshaft so that the plunger is at the BDC (the BDC position of the plunger can be indicated by the dial indicator), check the pointer of dial indicator to zero, and control the load lever of fuel injection pump so that the fuel injection pump is in the position of maximum fuel feed quantity. At this time, fuel flows out of the overflow pipe. Slowly rotate the camshaft in the working direction of the fuel injection pump. If the measured value does not conform to the standard, adjustment is required.

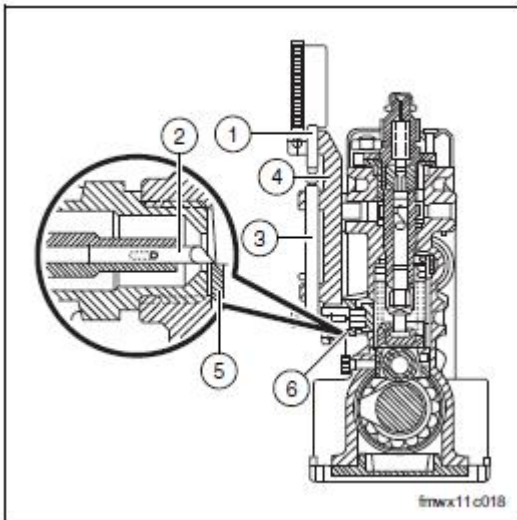


- (c). The adjustment of fuel feed timing is realized by adding or reducing timing gaskets. Remove the branch pump assembly. If the measured value of pretravel of plunger is less than the standard value, it is required to add timing gaskets under the branch pump flange; if the measured value is greater than the standard value, it is required to reduce the timing gaskets. When reinstalling the branch pump, pay special attention to keep the O-ring of the branch pump complete. After the fuel feed timing adjustment of the 1st branch pump, it is required to put the pump in the position where the 1st branch pump starts to feed fuel (i.e. the pretravel position of plunger), and check whether the fuel feed timing reticle of the fuel injection pump is aligned.



- (d). If the timing reticle is marked in wrong position, it is required to reprint the timing reticle for alignment on the timer and fuel injection pump housing for the check of complete machine and the adjustment of injection timing.

Check and adjust fuel feed angular interval of cylinders



1	Governor housing
2	Adjusting Nut
3	Upper seat

4	Lower seat
5	Correction spring
6	High speed spring

1. By using the same method, check and adjust the fuel feed start points of the branch pumps in the fuel feed sequence of 1-5-3-6-2-4, so that the fuel feed start points are at $60 \pm 0.5^\circ$ cam angle intervals. At this time, the fuel feed timing adjustment of the fuel injection pump is completed.
2. The pretravel of plunger can also be measured with tappet lift travel measurer. Install the measurer on a special measuring hole of the fuel injection pump (the measuring hole is generally in the 1st cylinder tappet position), and put the measuring head on the upper edge of the tappet. Dismantle the delivery valve assembly of the 1st cylinder branch pump, start the test bed to feed fuel for the fuel injection pump (otherwise, it is not necessary to dismantle the delivery valve, but make the fuel feed pressure to reach $2.5 \pm 0.2\text{MPa}$), set the fuel injection pump in the maximum fuel feed position, and at this time, fuel overflows from the branch pump. Rotate the camshaft so that the plunger tappet is in the BDC position, adjust the dial indicator to zero, slowly rotate the camshaft in the normal rotation direction of the pump, and when the branch pump stops feeding fuel (when the plunger starts to seal the fuel inlet), observe whether the plunger lift travel indicated by the dial indicator conforms to the standard value of pretravel. If not, adjust by adding or reducing timing gaskets. Similarly, after finishing adjustment of pretravel of 1st cylinder plunger, adjust the fuel feed timing of other branch pump in the sequence of fuel feed start points, and the fuel feed start points of the branch pumps are at $60 \pm 0.5^\circ$ cam angle intervals.

Check and adjustment of fuel feed gear rack travel at control point, maximum torque point and calibration point

At the control point, the engine speed increases until the smoke limiter no longer operates, and the tongue-shaped swinging vane has already disengaged from the limiting block of the smoke limiter and started to abut against the working molding surface of the correction sliding block. The maximum torque point is the working condition position when the engine is at the maximum torque. The gear rack variation from control point to calibration point via maximum torque point reflects the process of the tongue-shaped swinging vane going on the molding surface of the correction sliding block as the rotating speed rises. In this process, the variation of the gear rack travel (variation of fuel feed quantity) is the variation of the simulating the engine characteristic. Therefore, this adjustment is very important for the engine performance.

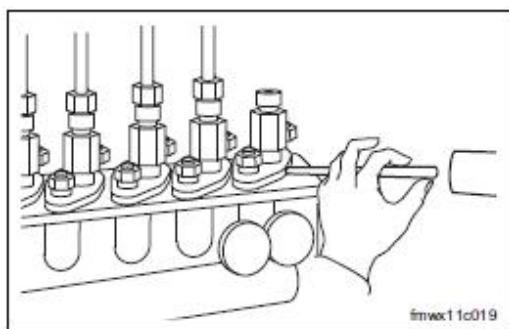
This adjustment is realized by the cooperative adjustment of the fuel quantity adjusting screw and tongue-shaped swinging vane adjusting screw. It aims to realize that the tongue-shaped swinging vane works in the standard molded lines locked by the correction sliding block within the corresponding rotating speed range, so that the actual performance of the engine is more ideal.

1. **Check and adjustment start from the calibration point. Start the test bed, introduce 120kPa air pressure into the smoke limiter (to cancel the operation of the smoke limiter), and push the throttle lever of the governor to the position limited by the high-speed limiting screw. Respectively set the pump speed at calibration point 1100r/min, maximum torque point 750r/min and control point 600r/min, and respectively check whether the gear rack travel is within the standard range of 12.0-12.2mm, 11.8-12.0mm and 11.3-11.5mm.**
2. **4. The adjustment is realized by adjusting the fuel quantity adjusting screw and tongue-shaped swinging vane adjusting screw. The fuel quantity adjusting screw adjusts the total travel of the fuel feed gear rack, i.e. the whole fuel quantity. The tongue-shaped swinging vane adjusting screw adjusts the position of the tongue-shaped swinging vane relative to the correction sliding block, thereby changing the variation rule of the fuel feed gear rack (or fuel feed quantity).**
3. **5. This adjustment is realized by the cooperation of the fuel quantity adjusting screw and the tongue-shaped swinging vane adjusting screw, so that all the gear rack travels at the calibration point, maximum torque point and control point are within the standard range. This adjustment aims to ensure that the engine characteristics conform to the design requirements, so that the engine can exert the maximal efficacy on the premise that the emission is satisfactory.**

Check and adjustment of fuel feed quantity at control point, maximum torque point and calibration point

Once the fuel feed quantity of the fuel feed gear rack is determined under a certain travel, the fuel feed quantities under the other gear rack travels are determined by the working molded lines and precision of the plunger. In the adjustment process, the fuel feed quantity at the maximum torque point or the calibration point of rated power is used as the reference fuel quantity, and the fuel feed quantity standards under other working conditions are only for check during pump correction.

1. **Push the throttle lever of the governor to the position limited by the high-speed limiting screw. Start the test bed, introduce 120kPa air pressure into the smoke limiter, increase the pump speed to 750r/min, and observe whether the fuel quantity is within the range of 37.2-38.4ml when injecting 200 times. If not, it is required to adjust the fuel quantity difference between the cylinders to less than 2.5ml.**



2. **The adjustment of fuel feed quantity is realized by rotating the branch pump plunger sleeve.**
 - (a). Each branch pump plunger sleeve can be rotated by 10° relative to the pump body. This is equivalent to the relative movement travel of 2.5mm of the fuel feed gear rack. When adjusting the fuel feed quantity of the branch pump, firstly loosen the fixing bolt of the branch pump flange, and slightly knock the branch pump flange with screwdriver or any other tool to rotate the branch pump flange. Pay attention to the fuel increase or decrease direction during adjustment.

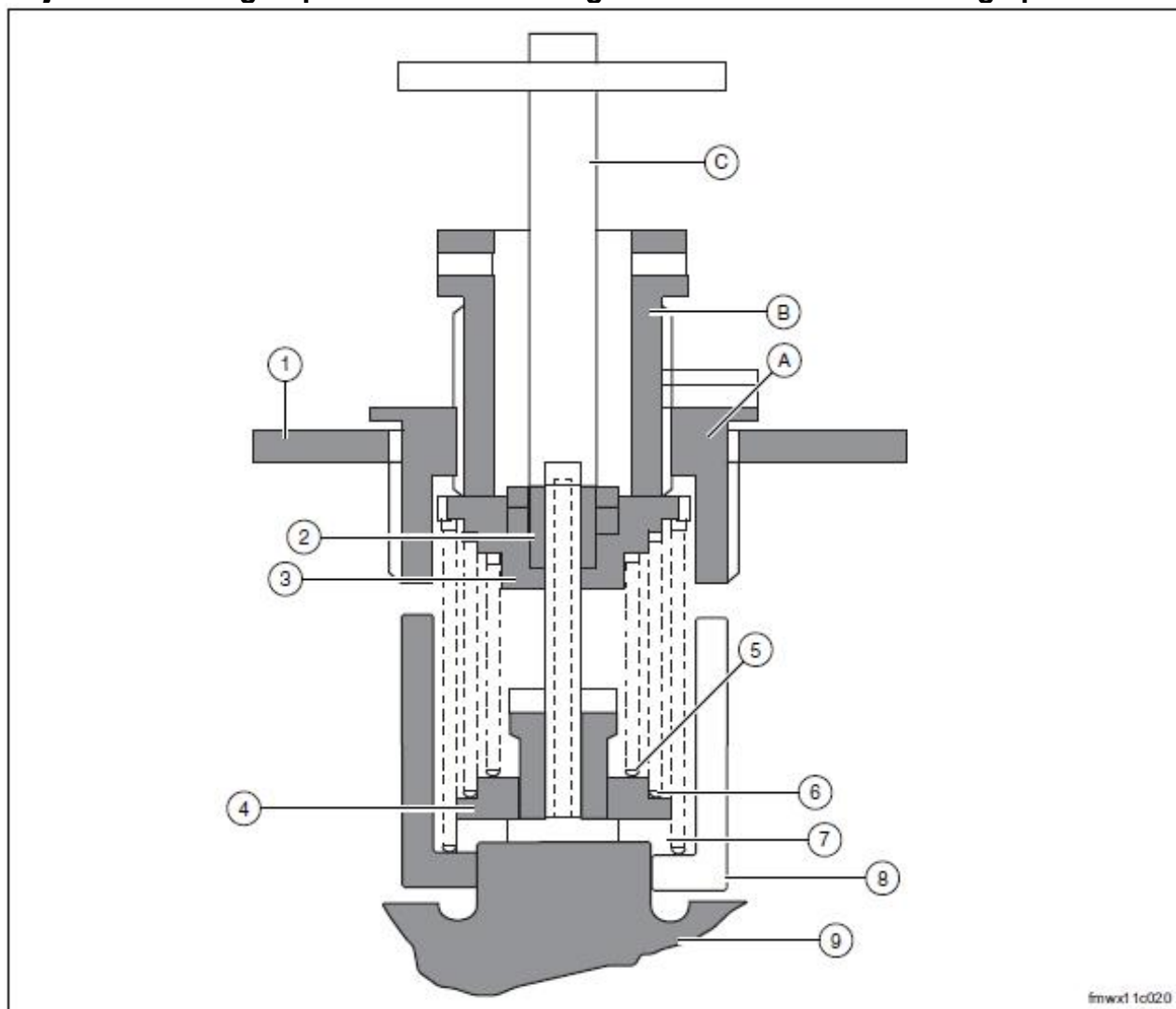
Due to the mismatching tolerance of the plunger, the fuel feed quantity of the fuel injection pump may be satisfactory under the reference working condition, and the difference between the cylinders is also within the allowable range; however, under other working conditions, the fuel feed quantities and fuel feed unevenness between the cylinders may differ a lot. After finishing the adjustment of the fuel feed quantity under the reference working condition, it is also required to check the fuel feed quantity and difference between the fuel feed quantities of branch pumps under other working conditions. If the difference between the fuel feed quantity of a certain branch pump and the fuel feed quantity of any other branch pump is within the limit under the reference working condition, but is great under any other working condition, replace the coupler of the branch pump plunger, to ensure that the fuel feed quantity and difference between cylinders under every working condition are within the limit, thereby ensuring stable operation of diesel engine under various working conditions.

The fuel feed quantity is directly proportional to the gear rack travel, i.e. the greater the gear rack travel is, the greater the fuel feed quantity is. Due to the speed characteristic of constant pressure delivery valve (under the condition of identical gear rack travel, the fuel feed quantity of the delivery valve varies as the speed varies), the fuel feed quantity of the fuel injection pump does not necessarily increase as the gear rack travel increases. Therefore, interchanging the delivery valves may adjust the fuel feed quantity and the uniformity of fuel feed quantities of the cylinders in some cases.

Check of starting fuel quantity

- 1. After checking and adjusting the fuel feed quantity under normal working condition, adjust the pump speed to 100r/min, push the governor control lever to the position of full load high-speed limiting screw (push the throttle push rod to the position of maximum fuel feed quantity), and check whether the starting fuel quantity is greater than 16ml per 100 times.**
- 2. After finishing all adjustment, check the fuel feed quantity under reference working condition again.**
- 3. If the vehicle runs on highland, the fuel feed quantity shall be corrected according to the absolute altitude.**

Adjustment of high-speed start action of governor and cut-off rotating speed



1	Governor housing
2	Adjusting Nut
3	Upper seat
4	Lower seat
5	Correction spring
6	High speed spring

7	Idle speed spring
8	Fly weight
9	Fly weight body
A	-
B	Pressing sleeve
C	Socket wrench

11C

1. Increase the pump speed to 1100r/min, and the governor throttle controls the lever to the limit position limited by the high speed limiting screw.
2. Increase the pump speed to 1120-1140r/min, and make sure that the gear rack keeps still. Continue to increase the pump speed, and the gear rack shall start to move towards the fuel reduction direction. When the pump speed is increased to 1350r/min, the gear rack shall retreat to the travel 0- 1.0mm cut-off position.
3. Press down the adjusting spring outer seat with a special tool tooth socket, and adjust the speed governing nut with a socket wrench.
 - (a). If the special rotation speed for the start action is lower than the standard value, it is required to tighten the nut, else, it is required to loosen the nut.

Caution:

In the adjustment process, the adjusting nuts of the two fly weights shall be adjusted identically, i.e. the spring adjusting nuts of the two fly weights shall be screwed outwards or inwards by the same number of turns. Else, it will accelerate the wear of the governor due to the internal stress generated between the fly weights.

- (b). If the high speed comes into action, the rotation speed is satisfactory, but the adjustment rate is not satisfactory (when the pump speed reaches 1350r/min, the travel of the gear rack is greater than 1.0mm), it is required to replace the high speed spring of the governor.

Adjustment of idle speed control

1. Move the load control lever to the idle speed direction. When the pump speed reaches 300r/min, enable the gear rack to be at the travel 2.8-6.0mm position, and fix the load control lever to this position.
2. Increase the pump speed. Make sure that the travel of the gear rack is less than 2.0mm when the pump speed is 405-445r/min. Make sure that the travel of the gear rack is greater than 7.5mm when the pump completely stops. If the test data does not conform to the standard, the idle speed spring gaskets can be reduced or increased, or the idle speed spring can be replaced.
3. After the idle adjustment, adjust the idle stop screw to just contact the current load control lever limiting block.

Check and adjustment of smoke limiter

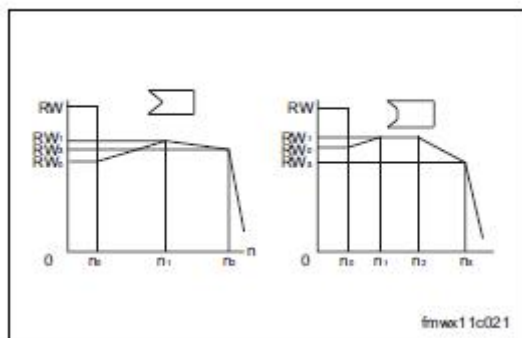
1. Check the gear rack travel and fuel feed quantity at the point of zero supercharging torque
 - (a). Start the test bed, compressed air is not introduced into the smoke limiter, and set the pump speed at 500r/min.
 - (b). Adjust the zero supercharging limiting adjusting screw of the smoke limiter, so that the travel of the gear rack is within the range of 9.4-9.6mm.
 - (c). Check that the fuel feed quantity shall be 29.6-31.0ml when injecting 200 times.
2. Check the start action air pressure and ending action air pressure.
 - (a). When the pump speed is 750r/min, the start action air pressure of the smoke limiter is 70-65kpa, and the ending action air pressure is 25-15kpa.
 - (b). Start the test bed, set the pump speed at 750r/min, and introduce 100kpa air pressure to the smoke limiter. Gradually decrease the air pressure, and observe whether the whether is within the range of 70-65kpa when the gear rack starts to move towards the oil reduction direction.
 - (c). If not conforming to the standard, remove the screw plug at the check hole of the smoke limiter, shift the groove teeth on the adjusting sleeve with a screwdriver, inwardly tighten the adjusting sleeve to reduce the start action air pressure, and outwardly loosen the regulating sleeve to increase the start action air pressure.
 - (d). Continue to reduce the air pressure value, and observe whether the air pressure is within the range of 25-15kpa when the gear rack stops action. If not conforming to the standard, replace the smoke limiter spring.

Check of low-speed torque control

This aims to check whether the smoke limiter is operating smoothly.

1. Start the test bed, introduce 30kPa air pressure into the smoke limiter until the governor throttle lever reaches the limit position of full-load high-speed limiting screws.
2. Check whether the fuel feed gear rack is within the range of 10.2-10.4mm when the pump speed is set at 500r/min. Check whether the fuel feed quantity is within the range of 31.0-32.4ml when injecting 200 times.

Check and adjustment of smoke limiter (no parameter)



1. Introduce 120-150kPa air pressure into the smoke limiter, and push the throttle control lever of the governor to the limit position limited by the full load high-speed limiting screw.
2. Start the test bed. At this time, the pump speed starts to increase from 100r/min. Record the travel value of the fuel feed gear rack every increase of 100r/min.
3. Reduce the input air pressure of the smoke limiter to "0", and push the throttle control lever of the governor to the position limited by the idle stop screw.
4. Start the test bed. At this time, the pump speed starts to increase from 100r/min. Record the travel value of the fuel feed gear rack every increase of 100r/min.
5. Mark the pump speeds under the working conditions with full load and idle speed and the corresponding gear rack travels on the coordinate graph. The horizontal coordinate is pump speed, and the vertical coordinate is gear rack travel. Connect the points into a full-load speed regulation characteristic curve and an idle speed regulation characteristic curve. Use the inflection points of the curves as the calibration points for pump correction.

Fuel Tank

Replacement

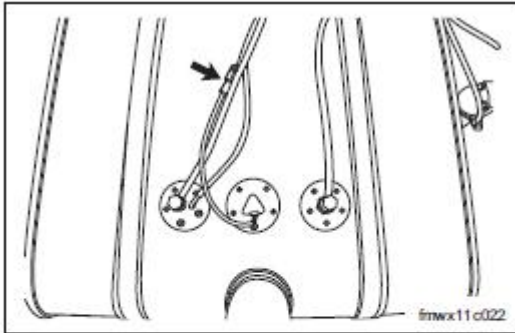
Hint:

Part Drawing, refer to Chapter 11C, Fuel - Fuel Tank, Part Drawing

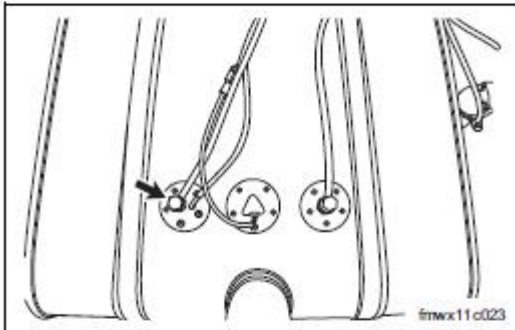
1. **Open cargo box**
2. **Disconnect battery negative cable**
3. **Dismantle guardrail assembly of cargo box, refer to Chapter 77, Interior & Exterior Trim Parts - Cargo Box Guardrail, Replacement**
4. **Release fuel pressure**
 - (a). Insert the key to open the fuel tank lock.
 - (b). Unscrew the fuel tank lock assembly.

Caution:

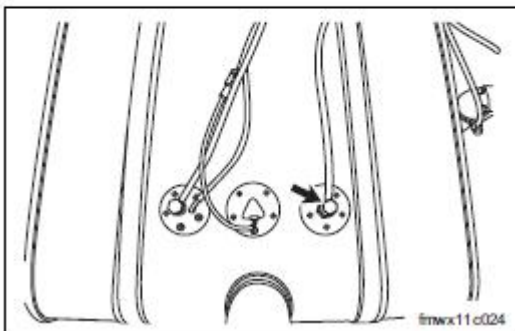
Be sure to use clean, soft cloth to plug the fuel filler.



5. **Disconnect connector of fuel sensor**
 - (a). Disconnect the connector of the fuel sensor.

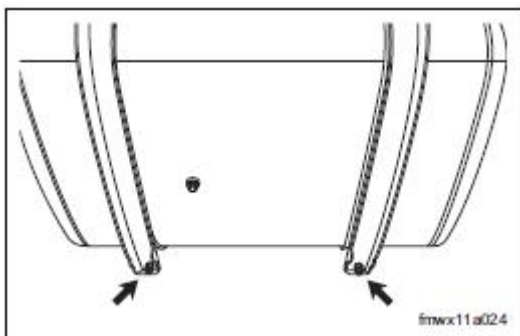


6. **Disconnect outlet pipe of fuel tank**
 - (a). Disconnect the connector nut of the outlet pipe of the fuel tank.



7. **Disconnect fuel return pipe of fuel tank**
 - (a). Disconnect the connector nut of the fuel return pipe of the fuel tank.

11C

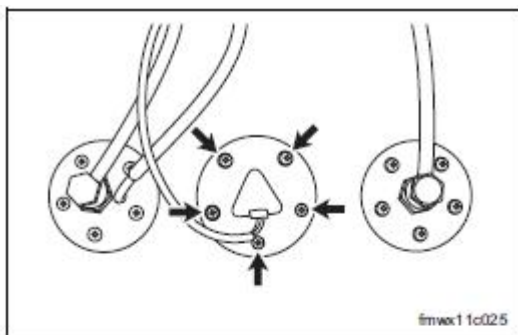


8. Dismantle fuel tank assembly

- (a). Dismantle the fixing nut of the tightening pull strap.
- (b). Take off the tightening pull strap of the fuel tank.
- (c). Dismantle the fuel tank assembly.

Caution:

- Before operation, check and make sure there is no lines, wiring harness or other foreign matters around the fuel tank, and clean up if necessary.
- When lifting the fuel tank, due to large size, use appropriate tools or operate with the help of others if necessary.
- Because the fuel tank is an aluminum alloy workpiece, avoid collision in the process of dismantlement, handling and installation.



9. Dismantle fuel sensor

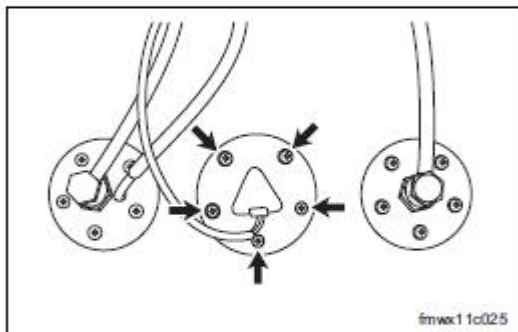
Caution:

- Before operation, check and make sure there is no dirt or other foreign matters around the fuel sensor, and clean up if necessary.
- There is a rubber seal ring in the sealing cover of the fuel sensor. Do not damage the seal ring while dismantling.

10. Install fuel sensor

Caution:

When installing the fuel sensor, insert after rotating to the proper angle, and do not cause warp or deformation.

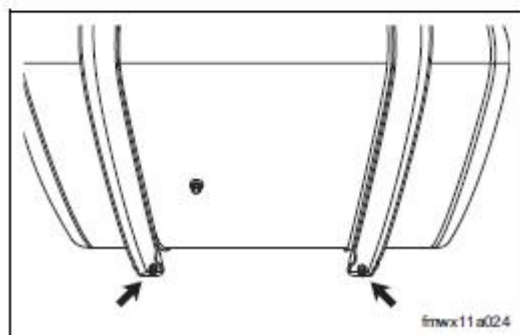


11. Install fuel tank assembly

- (a). Install the fuel tank assembly on the fuel tank bracket and fix to the right position.
- (b). Install the fixing nut of the tightening pull strap of the fuel tank.

Torque: 45±5 N.m(M10)

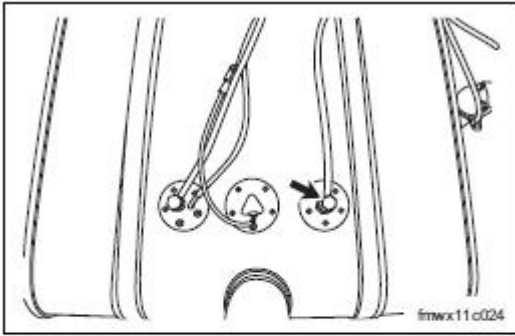
Torque: 81±8 N.m(M12)



Caution:

- The tightening pull strap of the fuel tank and the connecting nut of the fuel tank bracket shall be fastened to the specified torque. Excessive torque will cause deformation of the fuel tank.
- The fuel tank shall be connected firmly and reliably without abnormal vibration.

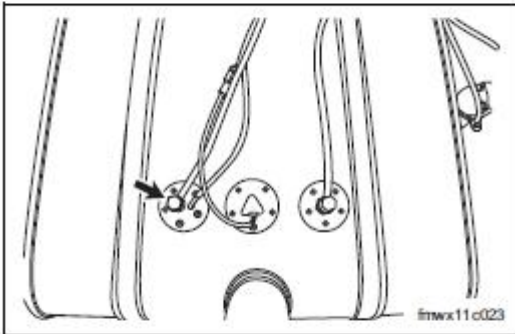
- Each rubber rim strip shall be even and level.



12. Install fuel return pipe of fuel tank

- (a). Install the connector nut of the fuel return pipe of the fuel tank.

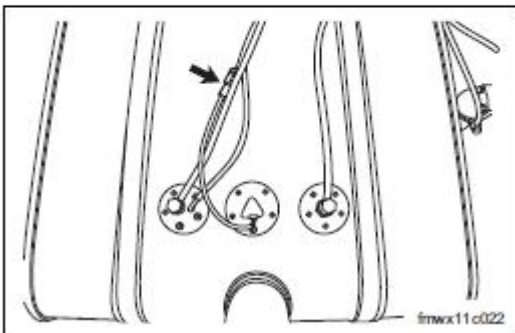
Torque: 46±5N.m



13. Install outlet pipe of fuel tank

- (a). Install the connector nut of the outlet pipe of the fuel tank.

Torque: 46±5N.m



14. Install connector of the fuel sensor

- (a). Install the connector of the fuel sensor.

15. Install fuel tank lock assembly

- (a). Check whether the fuel tank lock and gasket are deformed or damaged. Replace the fuel tank lock assembly if necessary.
- (b). Periodically lubricate the rotating part.

16. Exhaust the fuel system. Refer to Chapter 11C, Fuel - Fuel System, Testing & Adjustment

17. Install battery negative cable

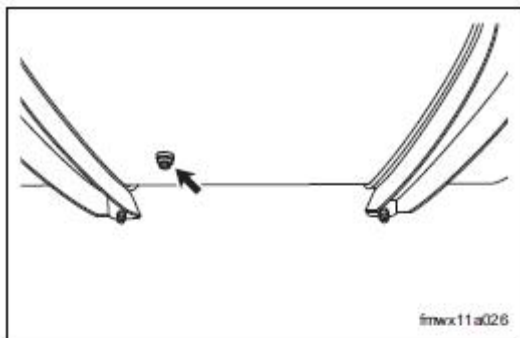
18. Inspect

- (a). After ensuring that the connector assemblies are connected well, open the ignition switch, check whether the fuel gauge of the meter shows normal, start the engine, and check whether there is oil leakage at the fuel pipe joints of the fuel system.

19. Install the guardrail assembly of the cargo box. Refer to Chapter 77, Interior & Exterior Trim Parts - Cargo Box Guardrail, Replacement

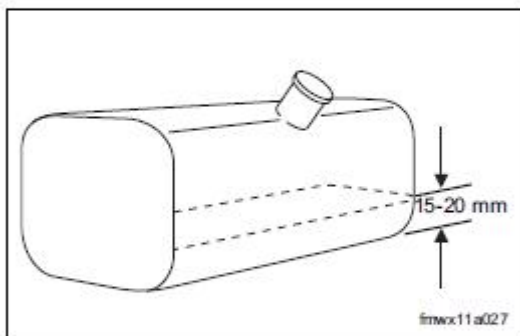
20. Put down cargo box

Clean



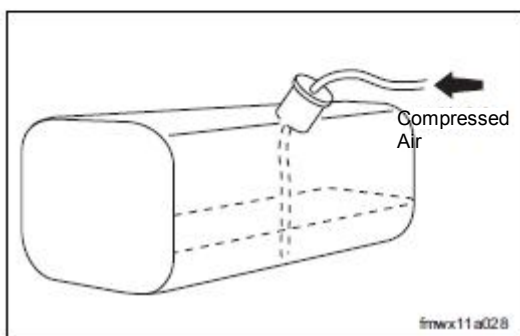
1. Drain fuel

- (a). Open the fuel tank lock assembly, unscrew the drain plug of the fuel tank, after draining the trapped fuel, clean up dirt on the drain plug and then install the drain plug.



2. Fill clean fuel

- (a). Fill up the fuel tank with fuel until the distance from the fuel level to the bottom of the fuel tank is 15-20mm.



3. Clean fuel tank assembly

- (a). Insert a hose with a spraying nozzle into the bottom of the fuel tank.
 (b). Connect the hose with an air duster gun.
 (c). Plug the fuel filler with a clean, soft cloth, and open the switch of the air duster gun for flushing.
- Change the position of the spraying nozzle while flushing so that precipitate and adherent matters are flipped along with fuel.

4. Clean fuel tank assembly for many times

- (a). After flushing the whole fuel tank with the spraying nozzle, unscrew the drain plug to drain the dirty oil, and repeat twice to thrice to clean completely

5. Check fuel tank assembly

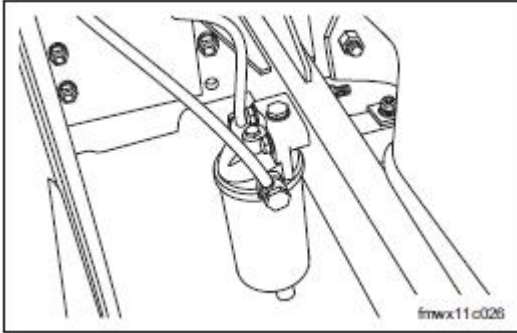
- (a). After cleaning the fuel tank, check whether the fuel tank is damaged, and the damage shall be promptly dealt.

6. Install fuel tank lock assembly

- (a). Check and clean the filter screen of the filler port of the fuel tank.

Oil-water Separator

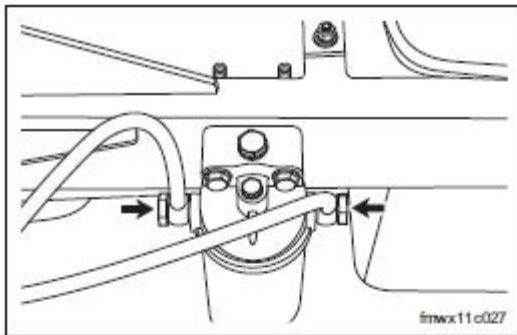
Replacement



1. **Dismantle oil-water separator**

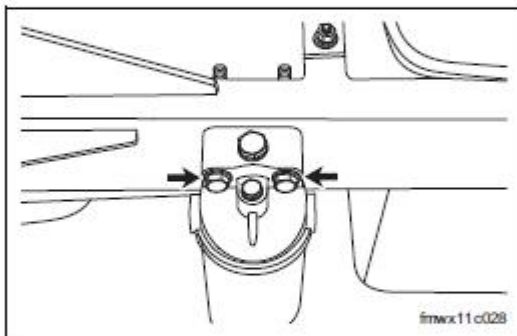
2. **Check oil-water separator seat**

- (a). Check whether the fuel filter seat has defects such as cracks, scratches, obvious damage, etc. Replace with new parts if necessary.

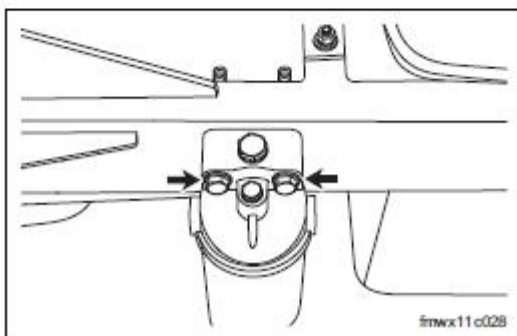


3. **Dismantle oil-water separator seat**

- (a). Dismantle the hinged bolts of the inlet and outlet pipes.



- (b). Dismantle the fixing bolt of the oil-water separator seat.

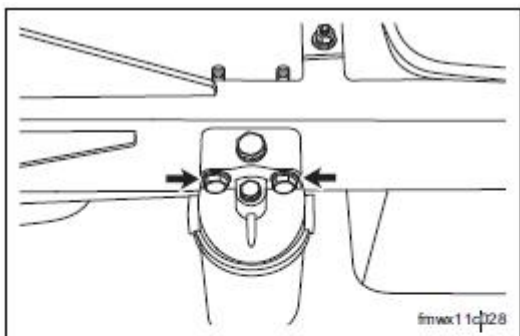


4. **Install oil-water separator seat**

- (a). Install the fixing bolt of the oil-water separator seat.

Torque: 45±5N.m(M10)

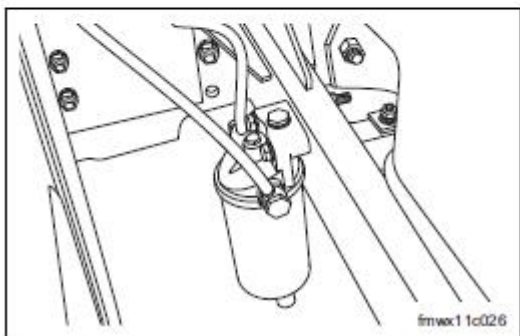
Torque: 81±8N.m(M12)



- (b). Install the hinged bolts of the inlet and outlet pipes.

Caution:

Check the washers of the inlet and outlet pipes, and replace with new parts if necessary.



5. Install oil-water separator

- (a). Apply a small amount of lubricating oil on the seal ring of the oil-water separator.
- (b). Screw on the oil-water separator by hand until the seal ring is combined with the interface.
- (c). Clockwise screw down the oil-water separator with the fuel filter wrench (for about 3/4 turns).

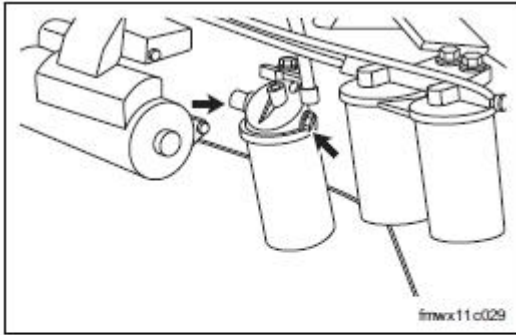
6. Exhaust the fuel system. Refer to Chapter 11C, Fuel - Fuel System, Testing & Adjustment

7. Inspect

- (a). After ensuring that the connector assemblies are connected well, open the ignition switch, check whether the fuel gauge of the meter shows normal, start the engine, and check whether there is oil leakage at the fuel pipe joint of the fuel system.

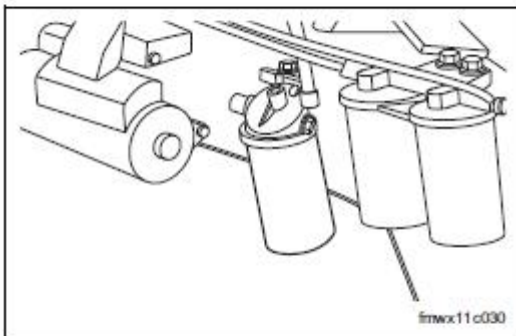
Fuel Fine Filter

Replacement

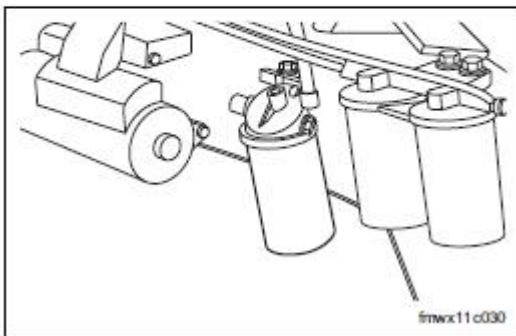


1. Dismantle fuel fine filter

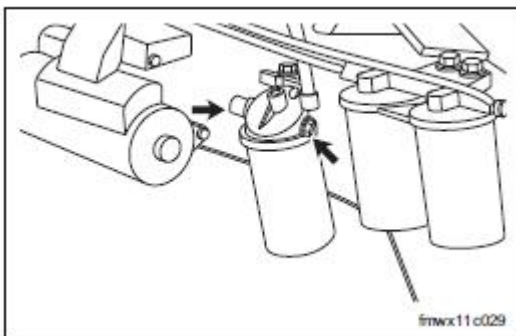
- (a). Dismantle the inlet and outlet pipes of the fuel fine filter.



- (b). Dismantle the fuel fine filter with a fuel filter wrench.

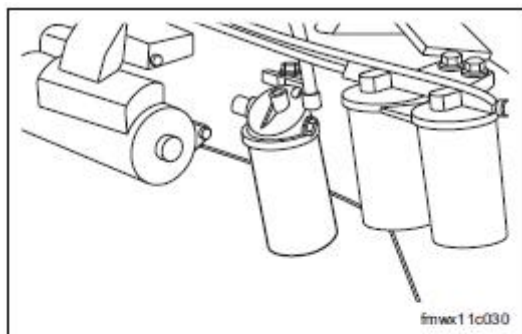


- (c). Dismantle the fuel fine filter seat.

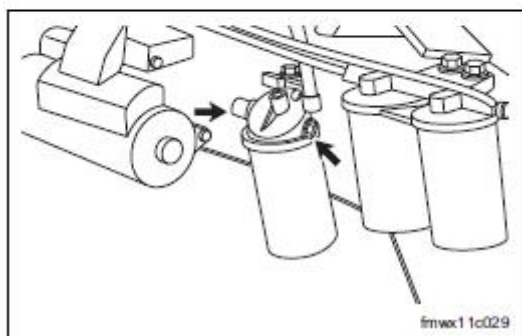


2. Install fuel fine filter

- (a). Install the fuel fine filter seat.



(b). Install the fuel fine filter with a fuel filter wrench.

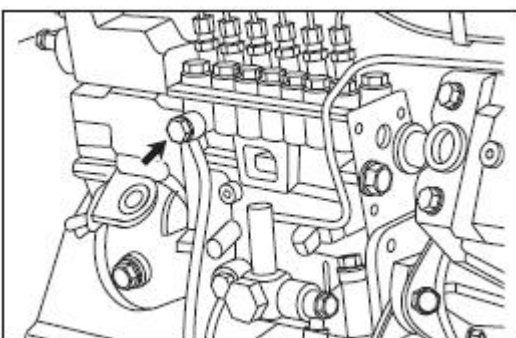
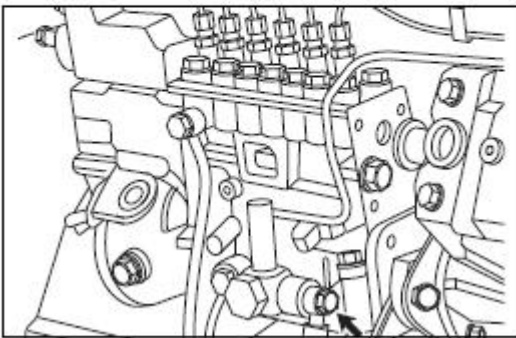
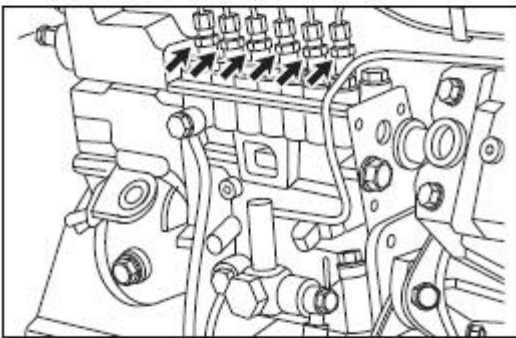
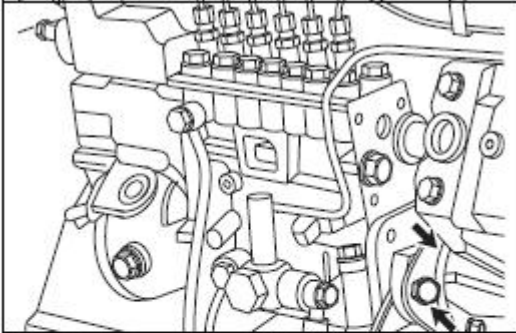


(c). Install the inlet and outlet pipes of the fuel fine filter.

Fuel Injection Pump

Replacement

1. Release the fuel pressure



2. Dismantle the fuel injection pump

- (a). Dismantle the fuel injection pump driving flange.

- (b). Dismantle the high-pressure fuel pipe of the fuel injection pump.

Caution:

When loosening the nut of the high-pressure fuel pipe, the fuel inlet joint of the fuel injection pump must be fixed with another wrench. If the fuel inlet joint is loosened by accident, it can only be repeatedly tightened once, and the fuel inlet joint box gasket must be replaced.

Caution:

Cover the joint caps to prevent pollution.

- (c). Dismantle the low-pressure fuel pipe of the fuel injection pump.

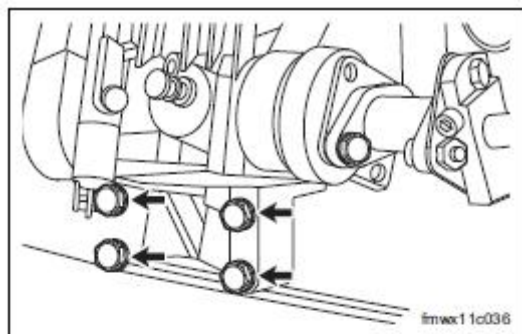
Caution:

Cover the joint caps to prevent pollution.

- (d). Dismantle the oil pipe of the fuel injection pump.

Caution:

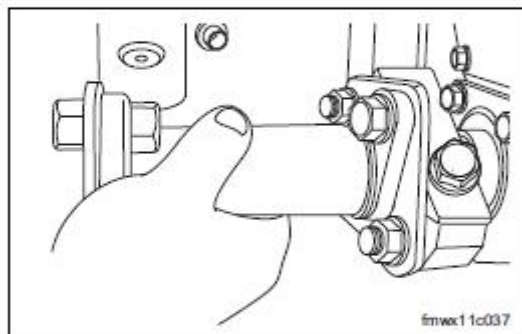
Cover the joint caps to prevent pollution.



(e). Dismantle the fuel injection pump.

Caution:

Cover the joint caps to prevent pollution.

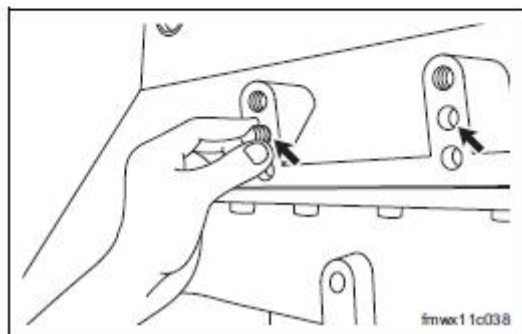


3. Install the fuel injection pump

(a). Install the driving flange and driving sleeve of the fuel injection pump.

Caution:

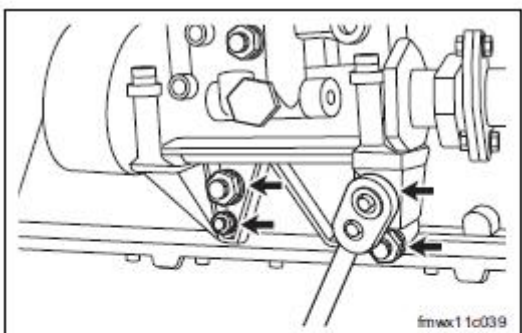
Do not tighten the flange fastening bolt.



(b). Install the locating pin of the fuel injection pump bracket.

Caution:

Cover the joint caps to prevent pollution.

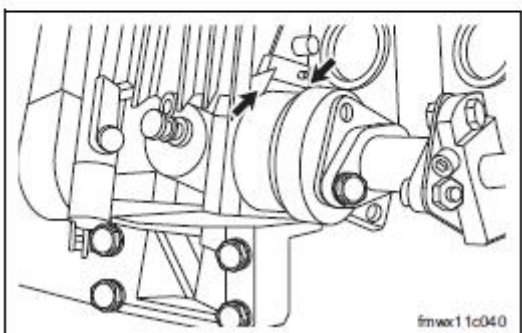


(c). Install the fuel injection pump onto the fuel injection pump bracket.

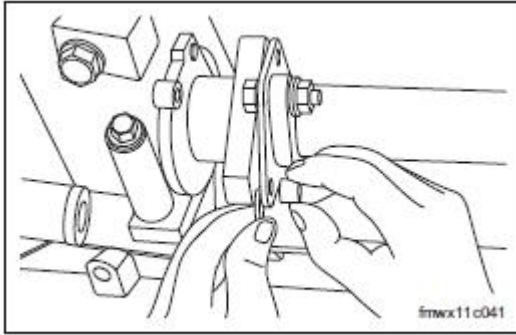
Torque: 32 N.m

(d). Install the fuel injection pump bracket.

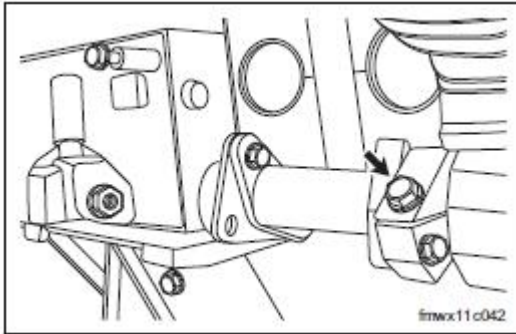
Torque: 80 N.m



(e). Align the timing reticle of the fuel injection pump with the timing reticle on the fuel injection pump driving flange.



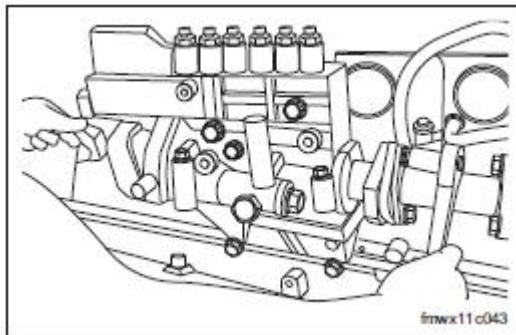
- (f). Make sure that the driving sleeve and fuel injection pump are connected and fastened by connecting bolts.



- (g). Rotate the engine flywheel to the fuel injection lead angle specified at the 1st cylinder compression BTDC, and tighten the driving flange fastening bolt.

Torque: 110N.m

For the fuel injection pump without timing reticle

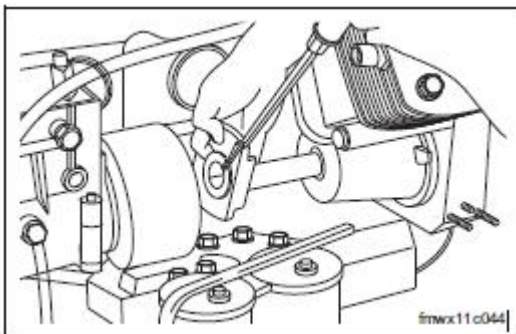


- (a). Drive the diesel fuel into the fuel injection pump body with a manual fuel pump, and discharge air in the pump body.
- (b). Install the observation tube on an fuel outlet joint of the cylinder fuel supply branch pump.
- (c). Control the throttle at the maximum fuel feed position with hand.
- (d). Rotate the flywheel to the fuel injection lead angle specified for 1st compression BTDC.
- (e). Rotate the driving shaft of the fuel injection pump slowly and intermittently in the normal rotation direction of the fuel injection pump, and tighten the driving flange fastening bolt after the diesel in the observation tube starts to rise.

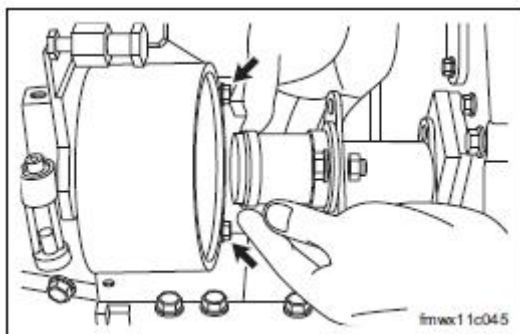
Torque: 110 N.m

Fuel injection pump with timer

When installing the double-cylinder air compressor, the driving shaft of the fuel injection pump and the crankshaft of the air compressor are integrated. When assembling, fix the air compressor onto the timing housing, put the fuel injection pump to the position where the 1st cylinder starts to inject fuel, put the air compressor to the piston TDC position, and finally, install the driving gear of the fuel injection pump and connect the driving shaft of the fuel injection pump with the driving flange.



- (a). Sheathe the driving flange on the drive shaft of the fuel injection pump.

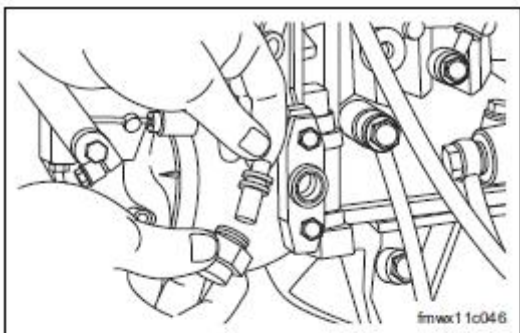


- (b). Connect the drive sleeve with the timer.

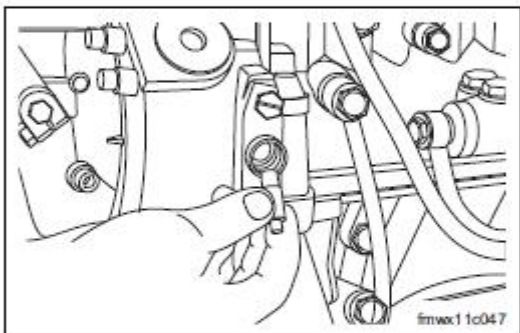
- (c). After connecting the flange and sleeve, rotate the flywheel to the fuel injection lead angle of the 1st cylinder compression BTDC.

PS7100 and PS8500 series fuel injection pumps

This series fuel injection pumps has an injection timing tester on the lateral side of the governor.



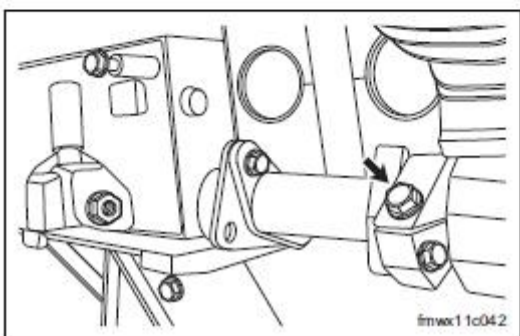
- (a). After installing the fuel injection pump, dismantle the injection timing pin lock cap.



- (b). Take the timing pin out of the inspection hole, invertedly insert the timing pin into the inspection, and rotate the flange connector of the pump. When the timing pin groove is inserted into the locating lug boss, it indicates that the 1st cylinder starts to inject fuel at this moment. At this time, connect the flange connector of the fuel injection pump with the driving shaft flange of the fuel injection pump through connecting steel sheets. Tighten the flange locking nut.

Caution:

After the installation, make sure to pull out the timing pin, invert it, put it in the inspection hole, and finally tighten the lock cap.



- (c). Put the fuel injection pump to a cylinder start fuel injection position.
 (d). Tighten the flange fixing bolt.

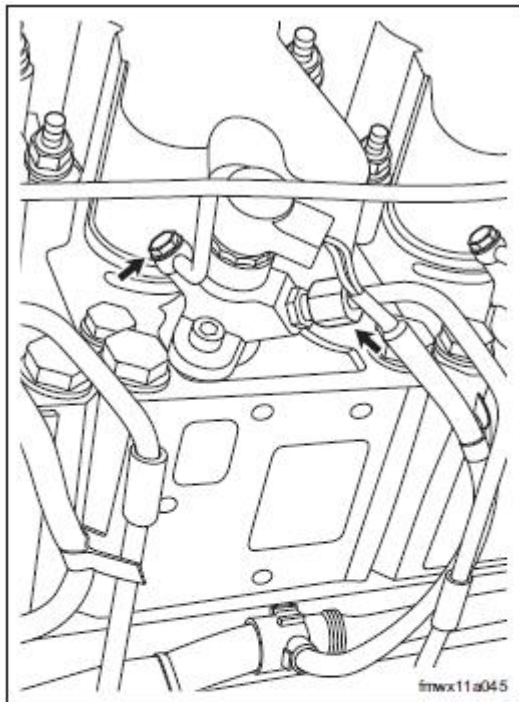
Torque: 110 N.m

4. **Exhaust the low-pressure oil way. Refer to Chapter 11C, Fuel - Fuel System, Testing and Adjustment**
5. **Exhaust the high-pressure oil way**
 - (a). Loosen the first cylinder fuel injector and high-pressure fuel pipe joint, drag the diesel engine to rotate with a starting motor until the joint discharges continuous diesel without bubbles, and tighten the joint nut.

Fuel injector

Overhaul

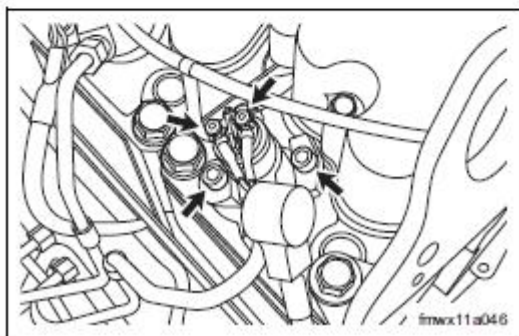
1. Release the fuel pressure
2. Dismantle the intake manifold. Refer to Chapter 16A, Engine Mechanical - Engine Accessories, Replacement



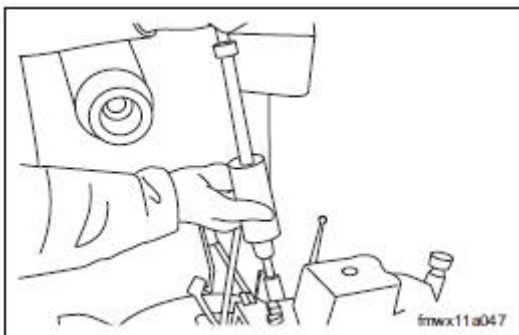
3. Dismantle the fuel injector
 - (a). Dismantle the fuel injector oil inlet pipe.
 - (b). Dismantle the fuel injector oil return pipe.

Caution:

Cover the joint caps to prevent pollution.



- (c). Dismantle the fuel injector wiring harness.
- (d). Dismantle the fuel injector fixing bolts.

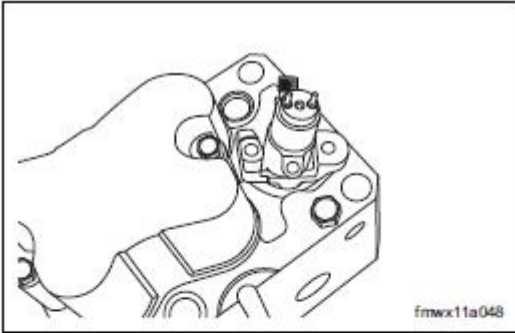


- (e). Dismantle the fuel injector pressure plate.
- (f). Draw out the fuel injector.

Caution:

A special tool is required to dismantle the fuel injector. It is not allowed to apply force on the solenoid valve to pull out the fuel injector.

4. Test the fuel injector. Refer to Chapter 11C, Fuel - Fuel System, Testing & Adjustment



5. Install the fuel injector

- (a). Insert the fuel injector.
- (b). Install the fuel injector pressure plate.

Caution:

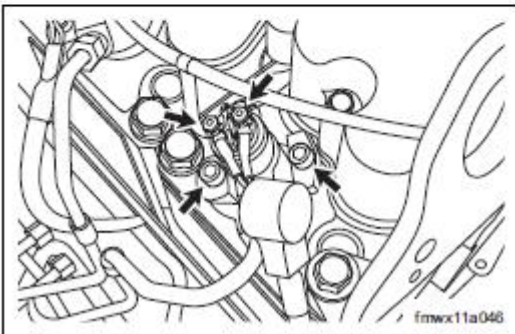
The inner packaging of the fuel injector shall only be opened before installation.

Caution:

Keep the fuel injector body, O-ring and sealing washer clean and complete in the installation process of the fuel injector.

Caution:

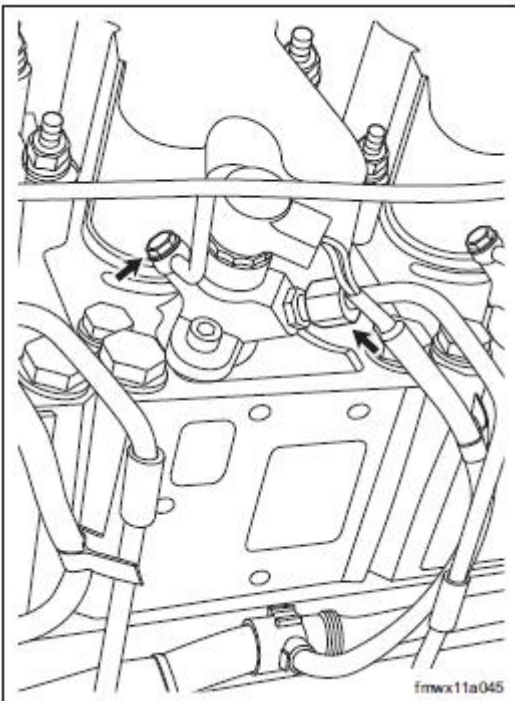
The high pressure joint, O-ring and sealing washer are disposable.



- (c). Install the fuel injector fixing bolts.

Torque: 11 ± 1 N.m. Tighten the bolts symmetrically and make sure that the side clearances are identical.

- (d). Install the fuel injector wiring harness.



- (e). Install the fuel injector oil inlet pipe.

- (f). Install the fuel injector oil return pipe.

Caution:

The protective cap shall only be dismantled before installing the oil pipe.

6. Install the intake manifold. Refer to Chapter 16A, Engine Mechanical - Engine Accessories, Replacement

7. Exhaust the low-pressure oil way. Refer to Chapter 11A, Fuel - Fuel System, Testing and Adjustment

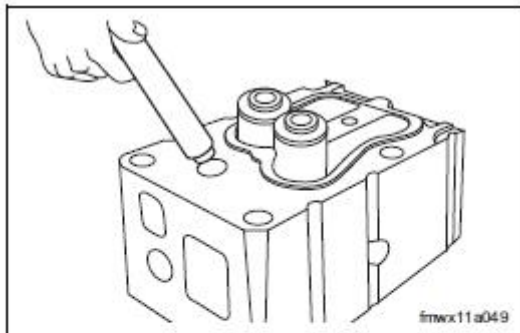
8. Exhaust the high-pressure oil way

- (a). Loosen the first cylinder fuel injector and high-pressure fuel pipe joint, drag the diesel engine to rotate with a starting motor until the joint discharges continuous diesel without bubbles, and tighten the joint nut.

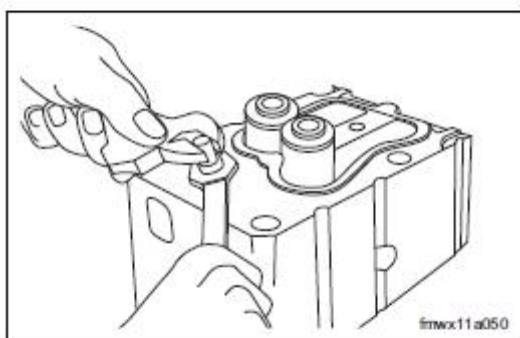
Fuel Injector Sleeve

Replacement

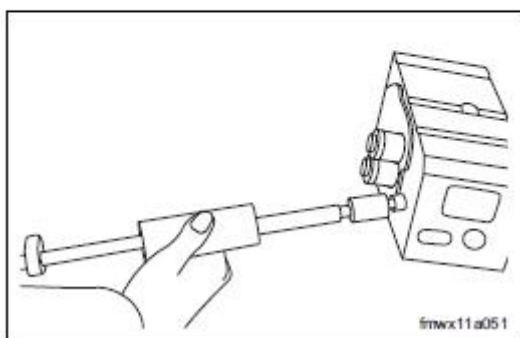
1. Dismantle the fuel injector, refer to Chapter 11C, Fuel - Fuel Injector, Overhaul



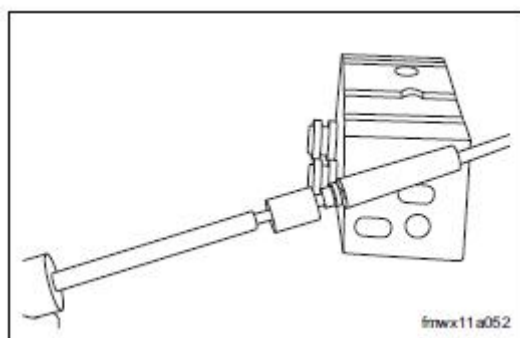
2. Insert shifting block into sleeve



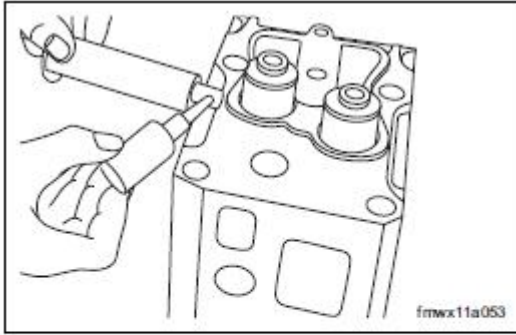
3. Screw down expansion nut of shifting block



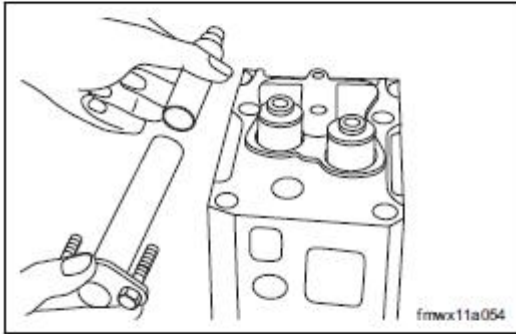
4. Pull old sleeve with puller punch hammer



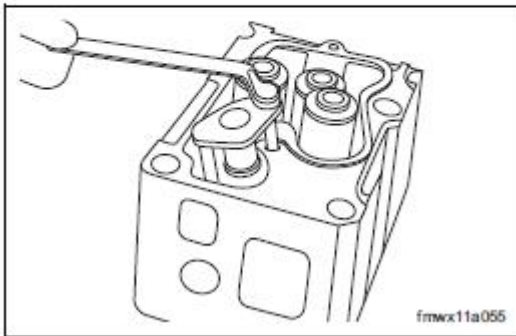
5. Pull out old sleeve



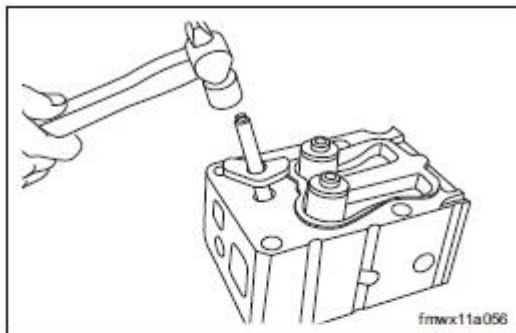
6. Apply 602 sealant at small end of sleeve



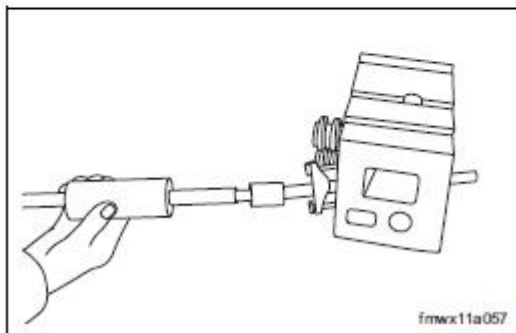
7. Insert new sleeve into pressing sleeve



8. Press pressing sleeve and new sleeve into cylinder head with pressure plate of fuel injector



9. Drive expanding arbor into pressing sleeve



10. Pull out expanding arbor with puller

11C

