GW4D20 Engines Technical Training of Mechanical Section





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I. Overview of GW4D20Diesel Engines

GW4D20 supercharged diesel engine is an independent 2.0L highperformance engine developed by Great Wall. It adopts inline 4-cylinder, forced water cooling, ω -shaped combustion chamber, 16-valve, DOHC, intake intercooler, electronic control high pressure common rail fuel supply system, variable section turbo supercharging (VGT) and electronic control EGR etc. to allow strong power, good economic efficiency, high reliability, quick cold start, Euro IV and V emission.



Profile of GW4D20 engine





















II. Basic Parameters of GW4D20 Diesel Engines

Item	Technical Parameters
Pattern	Inline 4-cylinder, water cooling, common rail direct injection, 16- valve DOHC, VGT, electronic control EGR valve, intake intercooler
Combustion chamber pattern	Necking ω -shaped
Cylinder bore x stroke	83.1 x 92 (mm)
Compression ratio	16.7:1
Displacement	1.996 (L)
Ignition order	1—3—4—2
Rated power/speed	110/4,000 (kW/r/min)
Maximum torque/speed	310/1,800~2,800 (N⋅m/r/min)



ltem	Technical Parameters
Minimum fuel consumption rate	≤210 (g/kw.h)
Idle speed	750±50(r/min)
Maximum no-load speed	4,400 (r/min)
Compression pressure	3,000±5% kPa (200r/min)
Valve clearance	0 (hydraulic tappet)
Rotation direction (viewed from flywheel)	Counterclockwise
Maximum fuel injection pressure	1,600 (Bar)
Fuel injection control	Electronic control
Lubrication mode	Combination of pressure lubrication and splash lubrication
Oil grade	API CI-4
Oil volume	6(L)



	ltem	Technical Parameters	
Valve timing	Intake valve open (before TDC)	24°	
	Intake valve close (after BDC)	50°	
	Exhaust valve open (before BDC)	86°	
	Exhaust valve close (after TDC)	16°	
Normal operation water temperation open of engine	on water temperature, maximum ure, large and small circulation (with thermostat in water inlet)	Normal water temperature: 80℃-90℃; maximum water temperature: 110℃; thermostat open temperature: 76℃; thermostat full open temperature: 88℃.	
Total weight of steering boosti	engine (including A/C compressor, ng pump, cooling water)	215 kg	
Overall dimens transmission	ions (L $ imes$ W $ imes$ H) without	694x625x829 Mm	
Emission level		Euro IV	



Technical parameters of other GW4D20 parts

	ltem	Technical Parameters	
Starter Voltage Output power	Voltage	12V	
	2 kW		
Ormanatan	Regulating voltage	14.5±0.3 V	
Generator	erator Rated current Specification Variable s	110A	
	Specification	Variable section turbine supercharger (VGT)	
Supercharger	Maximum speed	210,000 r/min	
	Maximum continuous operation temperature	760 ℃	
	Maximum speed	2,800 r/min	
Vacuum pump	Maximum vacuum	-90 kPa	
	Vacuum level achieving time	<5 s(400 r/min) for 50kPa	
Battery	Rated voltage	14V	



III. Mechanical Section of GW4D20

Section 1 Front End Accessories

(1) Composition of front end accessories

GW4D20 engine accessories wheel train mainly includes generator, power boosting steering pump, A/C compressor and accessory idler etc. and the wheel train is driven by belt.



(1) Composition of front end accessories



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(2) Features of front end accessories layout:

- To minimize the bending stress of belt, prolong the service life of belt and allow the compact structure of entire unit, arrange the belt pulley with the smallest effective diameter at the loose side of wheel train and the arrange the tensioner at the loose side of high transmission power accessories;
- Add two idlers to increase the wrap angle of accessory belt pulley and reduce the span of the belt pulley;
- The automatic tensioner allows the belt to achieve better initial tensile force to protect the belt against high impact, slipping and frictional noise due to too low or too high initial tensile force under varying duty and prolong the service life of belt.



- (3) Precautions of generator belt removal and installation
- Removal: rotate the tensioner clockwise with torque wrench by one hand to press the tensioner to the lower limit and push the accessory flat idler belt out by the other hand; then release the tensioner to remove the entire belt;









Installation: fit the belt as shown in Figure 1-7, rotate the tensioner clockwise with torque wrench by one hand to press the tensioner to the lower limit and push belt in the accessory flat idler belt by the other hand; then release the tensioner. Note to ensure the belt chisel teeth and belt pulley wedge slot fit well after installation.



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Section 2 Timing Mechanism

(1) Composition of timing mechanism

The timing mechanism adopts belt driving and mainly consists of crankshaft timing pulley, water pump belt pulley, camshaft timing belt pulley, high pressure fuel pump belt pulley, timing tensioner, timing idler, timing belt and timing hood etc.





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Timing mechanism



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Features of timing system:

- The timing system has 7 belt pulleys, multi-transmission belt pulleys, large span and high tensioning force;
- To ensure the sufficient tensioning force of timing belt, prevent gear jumping and disengaging and compensate the timing belt growth effectively, the system adopts automatic tensioning design. As the tensioner adopts eccentric shaft bearing design and the tensioner is subjected to high tensioning force during operation, the performance and assembly requirements for the parts are very high;
- The timing belt transmits the moment for the entire timing and the belt must be wear resistant, high temperature resistant and must be protected against slipping and dithering;
- The design of belt pulley wrap angle is subjected to scientific and precise demonstration and avoids the adverse effect on timing due to the belt shock caused by long span largely.







Timing tensioner

Note: the compulsory replacement mileage of timing belt is 80,000km



Timing idler

Timing belt

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- (2) Replace timing belt
- **Precautions of replacing the timing belt:**
- Environment cleaning degree
- ≻Align the timing
- Tightening torque
- Belt fitting direction and sequence
- Verify timing



1. Check and confirm the belt conditions and remove the timing belt

 Check the belt for scuffing, abrasion, tooth absence, oil stain and water trace;

Unscrew the tensioner fixing bolt to remove it and the timing belt.



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 \triangleright

2. Align the timing



Align hole of pulley \geq with hole in engine

> pulley mark with the joint slot of cylinder head and camshaft bearing cap;





arrowhead of oil pump housing

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Align the high pressure fuel pump belt pulley mark with the horizontal rib of water pump housing;



3. Fit the timing belt



Fit the belts to each belt pulley in the sequence shown in Figure 1-7. Ensure the belt and belt pulley couple tight without slack except the tensioner. Belt fitting sequence:

1 Crankshaft timing belt pulley

- 2 Timing idler
- 3 Oil pump belt pulley
- ✤ 4 Water pump belt pulley
- ➡ 5 High pressure oil pump belt wheel
- 6 Camshaft belt pulley
- 7 Timing tensioner

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4. Fit the timing tensioner





When fitting the timing tensioner, clamp the limiting bracket in the cylinder head bowl plug first, slightly tighten (not too tight) the tensioner fastening bolt and then regulate the tensioner pin hole with socket screw wrench until the tensioner arm pointer exceeds the mounting arm notch by $1 \sim 2^{\circ}$. Tighten the fastening bolt to the required torque in the end.

Tightening torque: 24 ± 2 Nm.



5. Verify the timing



Rotate the crankshaft clockwise by two circles to double check whether the timing marks of crankshaft timing belt pulley and camshaft timing belt pulley as the belt meshing are normal. Check whether the automatic tensioner pointer aligns with the notch, whether the tightening torque complies with the requirement and adjust it again if required.

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Section 3 Cylinder Head

(1) Composition of cylinder head

GW4D20 diesel engine cylinder head is made of aluminum alloy cast. The cylinder head is provided with cooling water jacket, intake/ exhaust passage, oil passage, seat bore and plane for the installation of injector, glow plug, valve race, hydraulic tappet, rocker arm and valve chamber hood. The intake and exhaust passages are at different side. The cylinder head is provided with intake and exhaust valve, valve guide, intake and exhaust camshaft assembly, intake and exhaust manifold, roller rocker arm, hydraulic tappet, injector, glow plug and high pressure oil rail etc.









Oil inlet hole



Small circulation return water hole - greater circulation water inlet hole







Camshaft signal panel

- (2) Camshaft and intake / exhaust valve subassembly
- GW4D20 diesel engine adopts DOHC structure, which are respectively intake camshaft and exhaust camshaft. Each camshaft is provided with 8 cams to control the open and close of valve.
- The exhaust camshaft is the driving shaft, which drives the intake camshaft through gear transmission; the intake camshaft front end is equipped with a signal panel, the exhaust camshaft front end is provided with camshaft front oil seal and the rear end is equipped with vacuum pump.



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- The intake and exhaust valves are arranged on the cylinder head vertical and control the open and close of valves through the camshaft rotation and hydraulic governor and valve rocker motion. To acquire larger air input, the diameter of intake valve disk is larger than that of exhaust valve disk.
- GW4D20 diesel engine adopts hydraulic clearance regulator to make up the valve clearance automatically. Compared with direct drive valve tappet, the advantage of such structure is to reduce the valve mechanism noise to a certain extent and make the assembly more convenient.









(3) Precautions of cylinder head assembly

1. The cylinder head rear end outlet pipe subassembly and installation parts adopt interference fit. Apply 962T sealant to the pressing-in end of the outlet pipe subassembly. The sealant should be about 3 ~ 5mm and 0.5mm thick. Align the outlet pipe union with the mark on the cylinder head. In addition, apply Loctite 262 sealant to the threads of coolant temperature sensor to prevent water leak during assembly.





- 2. Note the following during the assembly of intake and exhaust camshaft
- Align the marks: align the "●" marks of intake and exhaust camshaft driving gears and make them level with the cylinder head junction plane;
- Fit the plug: apply proper amount of clean oil outside the intake camshaft rear plug, fit it in the plug hole and then assemble the camshaft bearing cap. Note to keep the plug hole clean and place the plug in position to prevent poor sealing and oil leak.



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During the assembly of camshaft front oil seal, as a little sealant at the front oil seal hole may be squeezed out after the camshaft bearing cap is pressed in, wipe the sealant at the oil seal hole off before fitting the seal and then apply clean oil to the top circle of the camshaft front oil seal before pressing the oil seal in the hole with special pressing tool.





- 3. Precautions of camshaft bearing cap sealant application
- Clean the camshaft bearing cap and junction plane of camshaft bearing and cylinder head with carburetor cleaning agent before applying the sealant.
- Apply Loctite 510 anaerobic sealant to the camshaft bearing cap evenly and:
- ① The diameter of sealant application at the outer frame should be 0.8 ~ 1.2mm;
- 2 The diameter of sealant applied in the middle should be 0.4 ~ 0.6mm. Ensure the sealant application is uniform and accurate to prevent the sealant being squeezed into engine internal chamber after assembly;
- ③ The sealant applied within 10mm besides the fifth intake camshaft bore should be flattened evenly; note not to apply the sealant in the shaft bore.
- ④ During sealant application, ensure the camshaft bearing and the edge around it are free of sealant or any impurity; otherwise the camshaft blocking may occur.





No sealant on the camshaft bearing

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4. Tighten the cylinder head



Tighten it in angular way in three steps: tighten it to $50\pm3N.m$ in Step 1; turn the wrench by 90° in Step 2; turn the wrench by 120° in Step 3.



5. Tighten the camshaft bearing cap



Tighten the camshaft bearing cap bolts in the sequence shown in the figure. The tightening torque: $12\pm1N.m$

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Section 4 Cylinder Block

(1) Features of cylinder block

GW4D20 engine cylinder block adopts bisection structure, upper cylinder block and lower cylinder block. The lower cylinder block and main bearing cap form one unit. Compared with flat bottom cylinder block and short skirt cylinder block, this structure design enhances the structure strength a lot and enables sufficient stiffness against high pressure of explosion upon combustion and high torque output of crankshaft.





The cylinder sleeve-free structure design allows compact structure and low cylinder bore deformation. The upper cylinder block is provided with four cooling jets to cool the piston and prevent piston overheating.

Engine number





The starter mounting position is designed on the cylinder block at the engine left side; the engine numbers are stamped at the cylinder block left side and engine left bracket upper end in the following rule:

GW4D20 Model ☆ 2010 10 00001 ☆ Aster Y M SN Aster isk isk

 \triangleright

sleeve-free

passage





- **Oil pump cavity**
- The engine right side is equipped >with oil filter, which is integrated with the cooler. Note to align the cooler positioning notch with the bulge of cooler seat during installation.

Adopting rotor oil pump to integrate \geq the oil pump cavity and cylinder block to make the engine structure more compact.



position

position



(2) Selection of cylinder bore and piston

Cylinder block size (Φ/mm)	Mark	Piston group (Φ/mm)	Mark	Fit clearance (mm)
83.09~83.10	1	83.1 ^{-0.081}	1	0.071~0.09
83.10~83.11	2	83.1 -0.071 -0.080	2	0.071~0.09
83.11~83.12	3	83.1 ^{-0.061} -0.070	3	0.071~0.09

The cylinder bore group mark and piston group mark must correspond during assembly.





(3) Selection of main bearing bush

1. The size of main bearing journal falls into 3 groups, indicated by 1, 2 and 3 and marked at the middle of first crank of the crankshaft. The below figure shows the number of main bearing journal from 1 to 5 from the left to the right.



Note: the first crank is stamped with 3 groups of numbers, that is, the rod journal number, main bearing journal number and crankshaft factory number from top to bottom.



2. The bore diameter of cylinder block main bearing falls into 3 groups, indicated by 1, 2 and 3 and marked at the bottom of lower cylinder block rear left end. The below figure shows the number of main bearing bore diameter from 1 to 5 from the left to the right. See below figure:





3. The crankshaft main bearing bush falls into 3 groups, indicated by the color of yellow, none and blue on the side of bearing bush.



Note: the upper main bearing bush is provided with oil groove and oil hole and mounted to the upper cylinder block; the lower main bearing bush has no oil groove or oil hole and is mounted to the lower cylinder block. These cannot be mounted inversely.

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4. Selection formula of main bearing bush

Main bearing journal size number + cylinder block main bearing bore diameter number	Main bearing bush color	Fit clearance (mm)
=2~3	Yellow	0.020~0.046
=4	None	0.024~0.044
=5~6	Blue	0.022~0.048

Select the corresponding main bearing bush according to the formula. For example: the first main bearing journal size number is 2, the first cylinder block main bearing bore number is 1, 2+1 = 3, then select the main bearing bush with yellow mark.



(4) Selection of connecting rod bearing

1. The size numbers of crankshaft rod journal fall into 3 groups, indicated by 1, 2 and 3 and marked at the upper end of first crank of the crankshaft. The below figure shows the number of rod journal size from 1 to 4 from the left to the right.





2. The big end bore diameter falls into 3 groups, indicated by 1, 2 and 3 and marked at the junction of rod bearing cap, as shown in below figure:





3. The rod bearing bush falls into 3 groups, indicated by the color of yellow, none and blue on the side of bearing bush.



Note: the upper bearing bush is non- smooth face while the lower bearing bush is smooth face, both having no oil hole. Do not mount them inversely.

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4. Selection formula of connecting rod bearing bush

Crankshaft rod journal size number + big end bore diameter number	Main bearing bush color	Fit clearance (mm)
=2~3	Yellow	0.020~0.046
=4	None	0.024~0.044
=5~6	Blue	0.022~0.048

Select the corresponding rod bearing bush according to the formula. For example: the first crankshaft rod journal size number is 2, the first big end bore number is 3, 2+3 = 5, then select the rod bearing bush with blue mark.



(5) Precautions of assembly

- **1. Precautions of connecting rod assembly**
- Select piston of corresponding group according to the group mark of cylinder bore;
- The connecting rod should be assembled according to the forward marks, namely, the piston crown mark, connecting rod shank bulge and big end cap side plane bulge should be in the same side and face the front of the engine;



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During piston ring assembly, the first compression ring is silvery white, the second compression ring is dark gray and these two rings should not be exchanged; the upward mark A TOP of the ring should face the piston crown and the piston ring opening direction should prevent cylinder scuffing in the thrust face direction. In addition, the adjacent piston ring openings should stagger by 180°, as shown in Figure 2;





ylinder block oil passage

- 2. Precautions of lower cylinder block assembly
 - Sealant application: before assembling the lower cylinder block, apply Loctite 510 anaerobic sealant to the junction plane of lower cylinder block in diameter of 0.8 ~ 1.2mm. The sealant application should be uniform and accurate to prevent the sealant being squeezed into the spindle hole after assembly;



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Tightening sequence and torque requirement: the lower cylinder block is fixed by 10 main bearing cap bolts and 11 hexagon flange bolts. Tighten the main bearing cap bolts in angular way in three steps: tighten them to 40±3N.m in Step 1; turn the wrench by 90° in Step 2; turn the wrench by 90° in Step 3. Tightening torque of hexagon flange bolt: 24±2Nm.



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3. Precautions of oil pump assembly

- Cleaning: clean the oil pump junction plane, crankshaft front oil seal hole and the junction plane of cylinder block front end and oil pump;
- Ensure to fit the crankshaft front oil seal and oil pump seal ring in position without deflection, falling out and breakage;
- Sealant application: apply Loctite 587 sealant to the fitting surface of oil pump in a diameter of 2 ~ 3mm along the trace shown in the figure;
- During assembly, fit the oil pump outer rotor in the upper cylinder block pump cavity first with the marked side of rotor facing the inside bottom of pump cavity.





Review of Course

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